

LOCAL STRUCTURE PLAN





URBIS STAFF RESPONSIBLE FOR THIS REPORT WERE:

Regional Director Ray Haeren
Associate Director Megan Gammon
Senior Consultant Stijn Le Large
Consultant Stewart Doran

Job Code PA1023

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Endorsement Page

This Structure Plan is prepared under the provisions of the Shire of Wiluna Local Planning Scheme No. 2.

IT IS CERTIFIED THAT THIS STRUCTURE PLAN WAS APPROVED BY RESOLUTION OF THE WESTERN AUSTRALIAN PLANNING COMMISSION ON: 16 MAY 2017

Signed for and on behalf of	The Western Australian Planning Commiss	sion:
	n duly authorised by the Commission pursu for that purpose, in the presence of:	uant to section 16 of the Plannin
	upalin	Witness
18	6 Mary 2017	Date
16 MAY 2027	Date of Expiry	

Table of Amendments

AMENDMENT NO.	SUMMARY OF THE AMENDMENT	AMENDMENT TYPE	DATE APPROVED BY WAPC

Table of Density Plans

DENSITY PLAN NO.	AREA OF DENSITY PLAN APPLICATION	DATE ENDORSED BY WAPC

Executive Summary

The Wiluna South Structure Plan (the Structure Plan) applies to the area of land directly south of existing Wiluna townsite development, in the Shire of Wiluna. The subject site is 25.32ha hectares in area and consists of the southern part of the town which although now vacant land was previously subdivided and developed during Wiluna's gold rush era of the 1930's. The land has since been converted back to Unallocated Crown Land, with the exception of 1 freehold lot which is currently owned and occupied by a local resident.

The Structure Plan has been prepared to guide and facilitate the subdivision and development of the site for residential and tourist purposes. Although the demand for new land is not immediately apparent it is essential to establish frameworks for growth given a number of potential resource developments which could give rise to townsite development.

The Structure Plan aims to facilitate additional and more diverse residential development in town as well as provide the opportunity to provide temporary forms of accommodation which may convert to permanent accommodation in the future, providing a flexible framework which can respond to market and industry demand. The Structure Plan will also facilitate a new tourist use (caravan park) in town to cater for the visitor population.

Table 1, below, summarises the key components of the Structure Plan:

TABLE 1 - STRUCTURE PLAN SUMMARY TABLE

ITEM	DATA	STRUCTURE PLAN REF (SECTION NO.)
Total area covered by the structure plan	25.32 hectares	Part 2, Section 2.2.3
Area of each land use proposed - Residential - Tourist	- 11.03ha - 0.91ha	Part 2, Section 4.2.1 and 4.2.2
Total estimated lot yield	210 lots	Part 2, Section 4.2.1
Estimated number of dwellings	210 dwellings	Part 2, Section 4.2.1
Estimated residential site density	R10-20	Part 2, Section 4.2.1
Estimated population*	441 people	-
Estimated area and percentage of public open space given over to local parks:	2.9ha (11.61%) – inclusive of drainage.	Part 2, Section 4.3.1

^{*} Assume average household size of 2.1 persons.

As part of the preparation of the Structure Plan, the following technical and supporting documentation has been prepared and is summarised in this report. Full copies of these documents are provided in the technical appendices:

- Environmental Assessment Report (including Geotechnical Investigation and Preliminary Site Investigation) (360 Environmental).
- Engineering Servicing Report (JDSi Consulting Engineers).
- Local Water Management Strategy (360 Environmental).
- European Heritage Assessment (Annabel Wills Architecture and Heritage).

•	Aboriginal Heritage Survey and Assessment (Roina Williams Anthropologist).		

1 Part One – Implementation

1.1 STRUCTURE PLAN AREA

The Wiluna South Local Structure Plan (the Structure Plan), once endorsed, will become the guiding document in the consideration of future subdivision and development for the land contained within the inner edge of the line denoting the structure plan boundary on the Structure Plan Map as shown in **Plan 1**.

1.2 OPERATION

In accordance with sch.2 cl.22(1)(a) and sch2 cl.28(1) of the *Planning and Development (Local Planning Schemes) Regulations 2015*, this Structure Plan shall come into operation when the Structure Plan is granted approval by the Western Australian Planning Commission.

1.3 STAGING

Due to the nature and size of the Structure Plan area and the local context of Wiluna, it is proposed that the development be undertaken within several stages, corresponding to market and industry demand. The staging of the development of the Structure Plan area will be primarily influenced by areas which are located closest to the existing townsite to ensure a consolidated and feasible outcome (from a servicing perspective) and to achieve direct synergies with existing development.

1.4 SUBDIVISION AND DEVELOPMENT REQUIREMENTS

1.4.1 LAND USE AND DEVELOPMENT

- i. Land use and development within the Structure Plan is to be consistent with the prescribed zonings and reservations as detailed on the Structure Plan Map and as defined under the Shire of Wiluna Local Planning Scheme No.2 (LPS 2).
- ii. Land use permissibility is to be in accordance with the relevant zone and the land use permissibility of the Zoning Table of LPS 2.
- iii. In this regard, it is noted that a scheme amendment is currently being progressed by the Shire to introduce the use classes 'workforce accommodation', 'repurposed dwelling' and 'second-hand dwelling' into the Scheme as advertised 'A' uses within the Residential zone. This will enable temporary forms of accommodation to exist within the Structure Plan area at Council's discretion (after advertising), once approved.

1.4.2 RESIDENTIAL DENSITY

i. The residential density for the Structure Plan is R10-20 and R10-30 (refer Plan 2).

1.4.3 PUBLIC OPEN SPACE

- The provision of a minimum of 10 percent public open space (POS) is required to be provided in accordance with the WAPC's operational policy, Liveable Neighbourhoods (2009).
- ii. Public Open Space is to be provided generally in accordance with **Figure X** and **Table 8** of Part 2. An updated public open space schedule is to be provided at the time of subdivision for determination by the WAPC, on the advice of the Shire of Wiluna.

1.5 ADDITIONAL INFORMATION

The following technical information is required to be undertaken at future planning stages.

TABLE 2 – SUBDIVISION AND DEVELOPMENT REQUIERMENTS

ADDITIONAL	PURPOSE	APPROVAL STAGE	CONSULTATION
INFORMATION	PURPOSE	APPROVAL STAGE	REQUIRED
Urban Water Management Plan	To detail drainage construction works, monitoring and maintenance arrangements in accordance with the WAPC's Better Urban Water Management Guidelines. Specifically, it will include: - Details on roadside drains provided in engineering drawings. - Further detail of landscaping design, including POS areas and water requirements and water use sustainability initiatives - Design of the drainage basins and roadside drainage Measures to mitigate mosquito populations	Subdivision	Department of Water Shire of Wiluna
Detailed Site Investigation	To characterise the nature and extent of contamination on site (in addition to asbestos contamination) and to determine if any unacceptable risks to human health or the environment exist in the context of the current and/or future land use	Subdivision	Department of Environment Regulation
Geotechnical Investigations	During detailed design to delineate the thickness of the hardpan layer and provide the final site classification for individual lots.	Subdivision	
Asbestos Management Plan	To detail requirements for the removal of asbestos containing materials from the site.	Prior to development	Department of Environment Regulation
Dust and Air Quality Study	Given proximity to Wiluna Gold Mine	Prior to subdivision	Department of Mines and Petroleum
Road Closure	To close historical portions of road reserve located within the Structure Plan area	Prior to subdivision	Department of Lands
Electricity Feasibility Study	To accurately determine the electrical requirements associated with the development.	Prior to subdivision	Horizon Power
Caravan Park Concept Preparation of a concept plan and business Plan and Business case the caravan park, which will consider the		Concurrently with structure planning	Shire of Wiluna

Case	proposed layout and access/servicing implications	process	
Pedestrian and Cycle Network	Plan showing pedestrian pathway network	Submitted with subdivision application	Shire of Wiluna
Detailed road design	Detailed design of local access roads	Prior to subdivision	Shire of Wiluna



STRUCTURE PLAN - PART ONE: IMPLEMENTATION

WILUNA SOUTHERN RESIDENTIAL DISTRICT

PROJECT NO: PA1023
CLIENT: SHIRE OF WILUNA
DATE: 23/05/2016
DRAWING NO: 01
REV: 1
SCALE: 1:5000@A3
DRAWN: SLL
CHECKED: MG



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2 Planning Background

INTRODUCTION AND PURPOSE 2.1

This Structure Plan has been prepared and lodged by the Shire of Wiluna. The Structure Plan encompasses a 25.32ha site south of existing Wiluna townsite development (refer Figure 1).

The purpose of this Structure Plan is to provide a framework to guide future subdivision, development and use of the land within the Structure Plan area. It is being progressed in order to prepare the site for future development for permanent residential, temporary accommodation and tourist purposes to cater for potential future demand, in the context of enabling a flexible approach to potential resource development demands.

The preparation of the Structure Plan was initiated in response to interest from local mining and industry operators in respect of developing permanent housing or temporary workforce accommodation in town. Having an approved structure plan in place will enable the Shire to facilitate such development in a timely manner.

The Structure Plan will facilitate additional residential development in town as well as provide the opportunity to provide temporary forms of accommodation which may convert to permanent accommodation in the future. To enable this flexibility, a scheme amendment is being progressed concurrently with this amendment, to enable temporary forms of accommodation within Residential zoned areas at Council's discretion. The Structure Plan will also facilitate a new tourist use (caravan park) in town given the current lack of tourist accommodation options in the town resulting in lost visitor stays locally.

The Structure Plan has been prepared based on engagement with local stakeholders and a comprehensive review of relevant planning and technical considerations from an engineering, environmental, heritage, traffic and water management perspective. This document provides all the necessary information and addresses the reporting requirements of the Shire of Wiluna Local Planning Scheme No.2 and the requirements of the Planning and Development (Local Planning Schemes) Regulations 2015, including the WA Planning Commissions Structure Plan Framework (August 2015).

2.2 LAND DESCRIPTION

2.2.1 REGIONAL CONTEXT

The Shire of Wiluna is centrally located within the Mid-West region of Western Australia, on the edge of the Central Desert. It is a remote local government area located over 950km north east of Perth by road, and covers a significant area of some 184,000 square kilometres. The jurisdictional boundary of the Shire of Wiluna once stretched to the boarders of South Australia and Northern Territory making it the largest local government area in the world, until in 1993 when an eastern boundary readjustment was undertaken to create the Shire of Ngaanyatjarraku. The Shire has a population of around 700 people.

The Shire's service and administrative centre (and only town) is Wiluna, which has a resident population of around 300 people. Wiluna is also an important Lore area for Central Desert Aboriginal people, and the town's population can double in size during ceremonies and funerals.

Access to the Shire is via the Goldfields Highway from Meekatharra to the west and Kalgoorlie to the south. The Canning Stock Route (the longest historic stock route in the world) and the Gunbarrel Highway traverse the Shire and converge at Wiluna townsite. Notwithstanding the Shire's location within the Midwest, the town has strong linkages to the Goldfields region and Kalgoorlie is an important regional service centre.

Wiluna is a rich mineral province, with a number of major mining operations within a 150 km radius of the town. The Shire has the potential to become a major contributor to the Mid-West and State GDP. Capturing the benefits of mining development and operation, through stimulation of local industry and

commerce, and delivery of social and essential infrastructure will be important for the long term sustainability of the town.

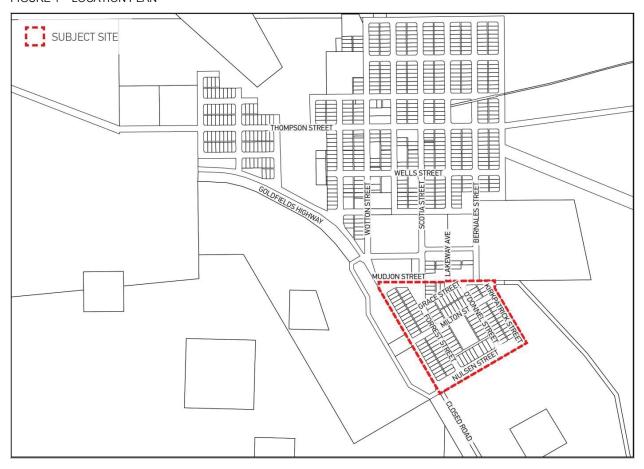
2.2.2 LOCATION

The Structure Plan area is located to the south of the existing Wiluna townsite (however within the existing townsite boundary) and comprises a 25.32ha portion of land over multiple landholdings, a majority of which comprise Unallocated Crown Land (UCL).

The Structure Plan area consists of the southern part of the town which although now vacant land was previously subdivided and developed during Wiluna's gold rush era of the 1930's. The land has since been converted back to UCL, with the exception of 1 freehold lot which is currently owned and occupied by a local resident.

The Structure Plan area is bound by Mudjon Street and vacant land to the immediate north, Nulsen Street to the south, Kirkpatrick Street to the east and Forrest Street to the west. Figure 1, below, illustrates the location of the site in relation to the broader Wiluna townsite.

FIGURE 1 - LOCATION PLAN



2.2.3 AREA AND LAND USE

The site is 25.32ha in size and generally follows a gentle even grade (approximately 1.5%) from east to west. The site comprises predominantly vacant land with the exception of a single residence contained within the south-eastern portion of the area, on Nulsen Street, between Kirpatrick Street and Prior Street (Mary and Len's house). The Structure Plan area contains evidence of previous urban development, such as old house footings/building pads and fireplaces etc.

The surrounding area is characterised by existing townsite development, heritage areas and vacant land. The former Railway Goods Shed which serviced the historical Wiluna to Meekatharra railway line in the gold rush years is located adjacent to the site on Forest Street and is of local heritage significance. The former State Battery is also located to the north-east, also listed on the local heritage register.

The Wiluna Remote Community School and TAFE (Durack Institute of Technology) are located immediately north-west of the site, with vacant land to the east. Directly north of this contains the Shire of Wiluna Offices which are located within the State Heritage listed Old Wiluna Hospital.

2.2.4 LEGAL DESCRIPTION AND OWNERSHIP

The Structure Plan comprises 99 existing lots which were created as freehold lots in the gold rush years as part of a historical subdivision. All lots (with the exception of Lot 402) have since been converted back to Unallocated Crown Land after the population declined.

The detail of the single freehold lot is provided within Table 3 below. It is noted however that the dwelling (and surrounding curtilage) encroaches onto the adjoining Lot 421 (UCL).

TABLE 3 - LOT DETAILS

LOT	NO/STREET	PLAN NO.	LOT AREA	PROPIETER
420	4 Kirkpatrick Street	P204538	1,011sqm	Sullivan, Mary Patricia

The site also contains a number of reserves. The table below indicates the purpose of each and the applicable responsible agency. Consultation with the Department of Lands will be required to confirm the process required to cancel or remove the reserves as part of the future development of the site.

TABLE 4 - RESERVED LOTS

TABLE 4 - NEGETVED LOTO				
RESERVE NO.	LOTS AFFECTED	LAND USE	RESPONSIBLE AGENCY	
20662	Lots 392 and 393	Church Site – Roman Catholic	Department of Planning	
20800	Lot 616	Church of England Church Site	Department of Lands	
21442		Excepted from sale (Government Requirements)	Department of Planning	
21083	Lot 723	Public Utility	Department of Lands	
21109	Lot 896	Excepted from sale (Government Requirements)	Department of Lands	
21043	Lot 721	Excepted from sale (Government Requirements)	Department of Planning	

2.3 PLANNING FRAMEWORK

This section describes the state, regional and local planning context relevant to the Structure Plan area.

STATE PLANNING STRATEGIES AND POLICIES

This following provides a summary of the State planning context and framework which has guided the preparation of this Structure Plan.

TABLE 5 – STATE PLANNING FRAMEWORK ASSESSMENT

DOCUMENT/PURPOSE	RELEVANT PROVISIONS	ASSESSMENT
Liveable Neighbourhoods	Public Open Space - Minimum 10 per cent of gross subdivisible area to be given up free of cost by the subdivider as public open space Movement Network – Provision of 'Access Streets' and shared paths facilitate the pedestrian movement network.	The Structure Plan has been prepared to be consistent with Liveable Neighbourhoods In accordance with Liveable Neighbourhoods, the Structure Plan provides a total of 11.61% open space.
State Planning Policy 2 (SPP 2) – Environment and Natural Resources	 Environment and natural resource management should be integrated with broader land use planning and decision making. Natural environment should be protected, conserved and enhanced. Natural resources should be sustainably used and managed, including water. Soil and land quality should also be maintained. High value and scenic landscapes should be protected. 	A Flora and Fauna Survey (360 Environmental) did not identify any ecological values that would pose a constraint to the future development of the Structure Plan area. The Structure Plan area contains limited remnant vegetation and no threatened species. Further, the site is not located within any environmentally sensitive areas. Notwithstanding, the Structure Plan has however sought to respond to the natural environment and consideration has been given to the retention of natural vegetation where practical, such as within drainage corridors. The preliminary flora assessment identified 1 conservation significant flora species (<i>Eremophila arguta</i>) as 'likely' to occur within the Structure Plan area. The survey was undertaken during the detectable period for this species however it was not recorded on site. The species therefore is not considered to occur on site.
SPP 3 – Urban Growth and Settlement	 Housing should have good access to employment, commercial, recreation and other facilities. Housing options should be diverse to suit various household sizes, ages and 	The Structure Plan aims to deliver a broader diversity of housing and lot sizes in the townsite. Integration with the existing townsite, and specifically Wotton Street and education/community facilities, was a key driver, to ensure a consolidated and

DOCUMENT/PURPOSE	RELEVANT PROVISIONS	ASSESSMENT
	 incomes. Vacant and underutilised land should be utilised for urban growth. Commercial land uses should be clustered. Urban development should foster a sense of identity and community. Higher density development should be close to commercial facilities and near transport options 	integrated outcome, which is further closely linked to the proposed staging of development.
SPP 3.1 – Residential Design Codes	The R-Codes provide a comprehensive basis for the control of residential development throughout Western Australia	A density range of R10-20 is proposed, consistent with the Structure Plan Framework for low density areas. This density range will enable flexibility for the final R-Code to be applied at the subdivision stage, The R10 coding will facilitate development consistent with what is provided in town currently (1,000sqm lots), whereas the R20 coding will allow for smaller (approx. 450sqm) lots, closer to the existing townsite. All residential development within the LSP will be required to satisfy the provisions (or performance criteria) of the R-Codes.
SPP 3.4 – Natural Hazards and Disasters	This Policy deals with planning for natural disasters in order to minimise the adverse impacts of natural disasters on communities, the economy and the environment.	Appropriate measures will be implemented at the detailed planning stage, to manage matters such as bushfire, and flooding. Whilst s minor portion of the Structure Plan area (north-west corner) is mapped as bushfire prone, the presence of an expansive open space area will limit any threat to future development.
SPP 3.5 – Historic Heritage Conservation	This policy sets out the principles of sound and responsible planning for the conservation and protection of Western Australia's historic heritage.	Whilst the Structure Plan area does not include any registered sites of State (or local) heritage significance, it is highly cognisant of the heritage values of the area, being a historical subdivision created within the gold rush years. As such, the existing road network has been retained where possible to continue this historical element. Further the design of the Structure Plan area has been undertaken to respond to external sites of heritage significance, including the

DOCUMENT/PURPOSE	RELEVANT PROVISIONS	ASSESSMENT
		Railway Goods Shed to the west.
SPP 3.7 – Planning in Bushfire Prone Areas	This policy directs how land use should address bushfire risk management. It applies to all land which has been designated as bushfire prone by the Fire and Emergency Services (FES) Commissioner.	A minor portion of the Structure Plan area is designated as bushfire prone, relating to the scrub vegetation on the western side of Goldfields Highway. Based on advice from an accredited bushfire consultant, given the Structure Plan design incorporates an area of maintained POS to the north-west, the hazard level is low and therefore does not warrant further assessment under SPP 3.7.

2.3.2 REGIONAL AND SUB-REGIONAL STRUCTURE PLAN

2.3.2.1 MID WEST REGIONAL PLANNING AND INFRATRSUCTURE FRAMEWORK

Wiluna is located within the Murchison sub-region of the Mid-West region and is classified as a 'Local Centre' under the Mid-West Activity Centres hierarchy, meaning the town offers a level of service that can deal with the daily needs of their service population but with a lower level of choice than regional centres. The town supports the mining and pastoral sectors.

The Framework states the extent to which the Shire can grow its population from activity resulting from resource projects will be largely dependent on influencing a change to the prevalent fly-in, fly-out workforce approach.

The Structure Plan comprises predominately residential development adjacent to the existing townsite. It represents an extension to existing townsite development, enabling appropriate access to existing facilities. Further, the provision of tourism development (caravan park) will aim to provide additional quality accommodation with the town to cater for visitors. This has been identified in the Shire's strategic planning documents as a key constraint to development of the town from a tourist perspective.

2.3.2.2 CENTRAL REGIONS LAND SUPPLY ANALYSIS 2016

This analysis was prepared by the Department of Planning in February 2016 and provides a broad overview of land supply within the Shire of Wiluna. An extract of the townsite is provided at Figure 2 below. As shown, the Structure Plan area is contained within a 'Residential' area as well as an 'Investigation Area' which is cited as being 'capable of substantial further development'.

The development of this Structure Plan for primarily residential purposes is consistent with the intent for the site under this analysis document.

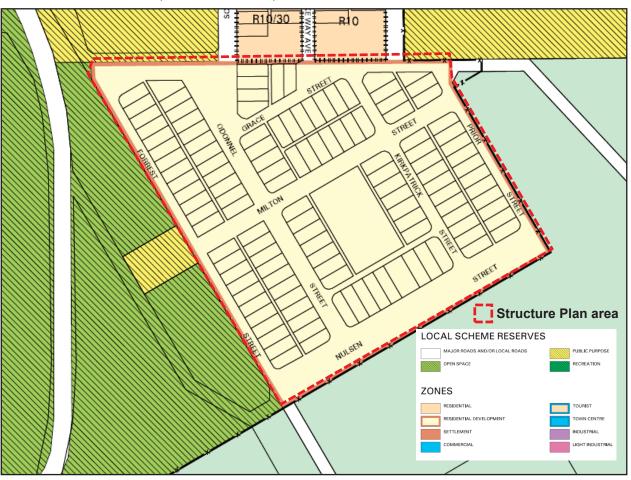
FIGURE 2 – CENTRAL REGIONS LAND SUPPLY ANALYSIS (DEPARTMENT OF PLANNING 2016)



2.3.3 **ZONING AND RESERVATIONS**

The Structure Plan area is currently zoned 'Residential Development' under LPS 2, and accordingly requires the preparation of a structure plan to comprehensively guide subdivision and development. The current zoning of the Structure Plan area is illustrated in Figure 3 below.

FIGURE 3 - ZONING EXTRACT (SOURCE: WAPC 2016)



The objectives of the Residential Development zone are as follows:

'To identify opportunities for the future subdivision and development of land for the purposes of single and group residential purposes together with, if determined necessary by Council, associated community and recreational facilities.

To ensure that subdivision and development of land within the zone is consistent with a structure plan adopted by Council and endorsed by the WA Planning Commission prepared in accordance with (Section) 5.12 of this Scheme'.

In accordance with the above, this Structure Plan sets out a coordinated framework to facilitate the future subdivision of the subject site. The structure plan proposes predominantly residential development (including the provision for temporary accommodation), however also comprises a component of tourism development.

LOCAL PLANNING STRATEGIES AND POLICIES

This section provides a summary of the local planning context and framework which has guided the preparation of the Structure Plan.

TABLE 6 - LOCAL PLANNING CONTEXT

DOCUMENT/PURPOSE	RELEVANT PROVISIONS	COMPLIANCE
Wiluna Shire Council Strategic Plan 2009- 2014 Sets out the 5 year plan for Council to create greater social and economic sustainability for the people of Wiluna.	This Strategic Plan was prepared in 2009 through a series of workshops involving Councillors and staff, the CEO, residents and representatives of local small businesses and community agencies. As a result, a number of goals, strategies and actions were formed to guide the Shire over the next 5 years. The following provides a summary of these outcomes, relevant to this specific project: Lead revitalisation and renewal in Wiluna. Boost tourism planning and initiatives to promote Wiluna as a unique tourist destination.	The proposed LSP satisfies these broad objectives in the provision of both significant residential and tourism development. The location of the tourism elements of the LSP being adjacent to the existing historical Railway Goods Shed, and Former State Battery, in addition to the Red Hill lookout provide a unique tourist offering within the Wiluna townsite. The extent of residential development within the LSP is reflective of the townsites role as a 'local centre',
Sets the planning direction for the sustainable growth and development of the Shire for the next 15 years.	The Shire's Local Planning Strategy as approved in March 2012. The Strategy designates the Structure Plan areas as 'Residential Precinct 4'. The future of this precinct is intended to deliver a significant area of residential development with a mix of open space. The Strategy also highlights the following in relation to the Structure Plan area: - The community's preference is for larger lots however housing at a density of R30 should be provided specifically for the needs of the elderly or where there is demonstrated demand (ie. mining accommodation). - R30 development should only be provided where houses can be appropriately oriented to maximise shading on the western wall, and where a street frontage can be provided for all houses. - Ensure residential densities are appropriate to available servicing options, responds to cultural needs etc.	The Structure Plan been developed in accordance with the 'Residential Precinct 4' and overall objectives of the local planning strategy. The allocation of residential development over a range of residential development coding between R10 to R20 will facilitate increased diversity in housing stock within Wiluna, whilst being cognisant of the regional context. The location and orientation of residential lots has been developed in consideration to the climactic elements affecting the subject site. The proposed tourist facility has been designed to take advantage of public open space and proximity to heritage sites and the Goldfields Highway.

DOCUMENT/PURPOSE	RELEVANT PROVISIONS	COMPLIANCE	
	 There is a critical shortage of both private and public housing in Wiluna, highlighting the need for additional residential land to be brought online in the short to medium term. Current housing stock in Wiluna is considered inappropriate from a 		
	climatic perspective. There are a number of roads within the subject site which are gazetted but not constructed. Through the preparation of the Structure Plan, the historic road layout may be amended, or roads closed to facilitate a more effective subdivision layout.		
	- There is currently a lack of adequate short term and tourist accommodation in town. There is however potential in the town to accommodate additional tourist accommodation, particularly at key gateways.		
	 A portion of the subject site is impacted by gold mineralisation deposits. 		
Tourism Local Policy	·	The Structure Plan includes provision for a tourist site to accommodation a future caravan park. This use will assist in contributing towards the economic development of the town and attract people to the area, in line with the key objectives of this policy.	

2.3.5 OTHER APPROVALS AND DECISIONS

There are no specific approvals or decisions relating to the Structure Plan area. However it is highlighted that a scheme amendment is currently being progressed to allow workers accommodation, as well as repurposed and second-hand dwellings within the Residential zone, all as advertised 'A' uses.

This amendment will introduce flexibility within the Structure Plan area (and broader residential areas), to be able to cater for temporary and transient accommodation as required, which could potentially transition to permanent residential development in the future. This amendment is being progressed concurrently with this Structure Plan.

Site Conditions and Constraints 3

The following section describes the key site conditions and constraints that have informed and impacted on the Structure Plan design.

3 1 BIODIVERSITY AND NATURAL AREA ASSETS

An Environmental Assessment Report was prepared by 360 Environmental in 2014 (refer Appendix A) for the Structure Plan area. In summary, the following key environmental factors were identified, with a more detailed description of the site conditions explaining in subsequent sections:

- There is 1 Beard/Shepherd vegetation unit in the Structure Plan area.
- No Threatened flora species listed under the EPBC Act, or Priority flora listed by the DEC were recorded within the study area.
- No Threatened Ecological Communities or Priority Ecological Communities were recorded within the site.
- A total of 35 Priority taxa were identified as potentially occurring in the Structure Plan area, with only one (Erermophilia arguta) considered likely to occur.
- Vegetation Condition within the Structure Plan area ranges from Completely Degraded to a small pocket of Good vegetation with the southern portion (refer Figure 4).
- Several individuals of the EPBC listed migratory bird species, Rainbow Bee-eater, is considered 'likely' to occur in the project area. Given its large distribution and ample amount of similar habitat in the surrounding area however, the species in not expected to be impacted by the development of the site.

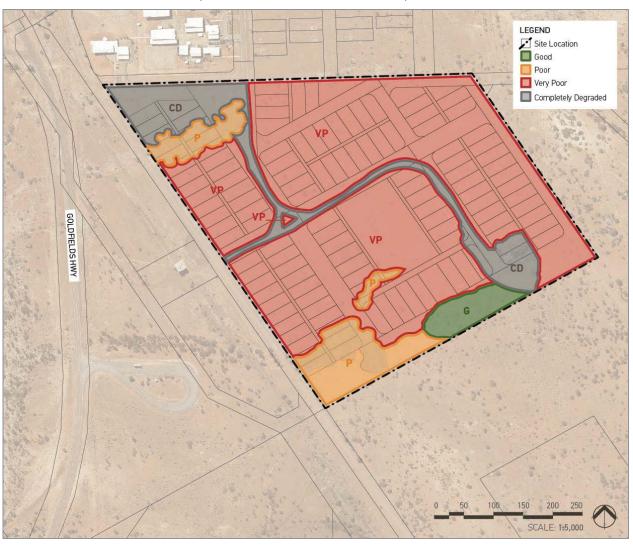
The environmental context of the Structure Plan area is described in further detail below.

3.1.1 VEGETATION

A Level 1 Flora and Vegetation Survey was prepared by 360 Environmental to assess the level and quality of vegetation on-site. The survey confirms that a majority of the site comprises mixed scattered shrubs considered to be in 'very poor' condition. Whilst 1 Beard/Shepherd vegetation unit was identified, it is not considered regionally significant and therefore clearing of this vegetation unit is not considered as having a significant environmental impact.

The Structure Plan area contains a discrete area of open shrubland within the southern boundary of the site which is considered to be in 'good' condition. The vegetation condition of the site is illustrated in Figure 4 below.

FIGURE 4 - VEGETATION CONDITION (SOURCE: 360 ENVIRONMENTAL/URBIS)



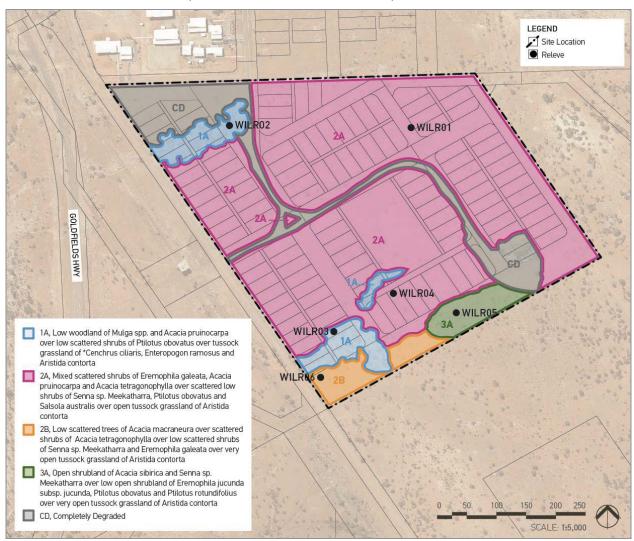
A total of 4 vegetation unit associations are included within the structure plan area as identified below.

- Drainage Line Low woodland.
- Plain Mixed scattered shrubs/low scattered trees.
- Low Rise Open shrubland.

Overall, the condition of these vegetation units are considered to range from 'good' to 'completely degraded', it is noted the majority of vegetation within the Structure Plan area is rated 'very poor' due to the historical clearing associated with the former housing development over the subject area.

The preliminary flora assessment identified 1 conservation significant flora species (*Eremophila arguta*) as 'likely' to occur within the Structure Plan area. The survey was undertaken during the detectable period for this species however it was not recorded on site. The species therefore is not considered to occur on site. The vegetation species contained within the site is illustrated in Figure 5 below.

FIGURE 5 – VEGETATION SPECIES (SOURCE: 360 ENVIRONMENTAL/URBIS)



FAUNA 3.1.2

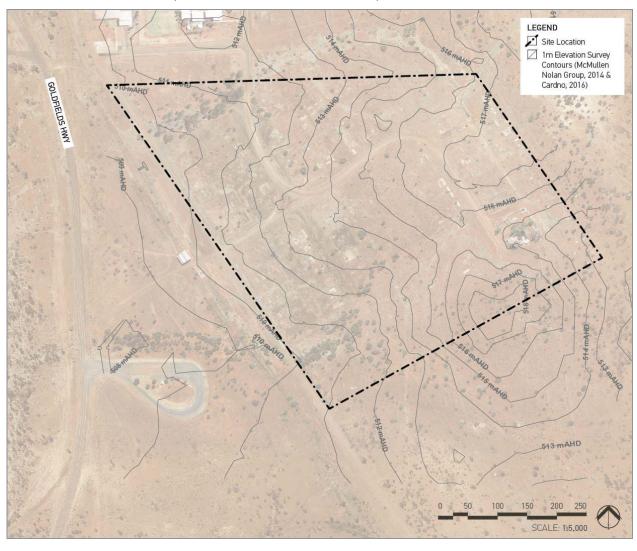
There is 1 conservation significant species likely to occur within the Structure Plan area, identified as the Rainbow Bee-eater and listed as a migratory species under the EPBC Act. However, given the species large distribution and ample amount of similar habitat in the surrounding area, the Rainbow Bee-eater is not expected to be impacted by the development of the Structure Plan area.

3.1.3 LANDFORM AND SOILS

Broad scale topographic mapping suggests that the site is relatively flat ranging from approximately 514m to 519m Australian Height Datum (AHD). Regional soil mapping (Department of Agriculture and Food) indicates that the Structure Plan area falls within the Wiluna System, which is characterised by low greenstone hills with occasional laterite breakaways and broad stony slopes, low saline stony plains and broad drainage tracts. The Wiluna system supports sparse Mulga and other Acacia shrublands with patches of halophytic shrubs.

The Structure Plan area is classified as having an 'extremely low probability' of containing acid sulphate soils.

FIGURE 6 - SITE TOPOGRAPHY (SOURCE: 360 ENVIRONMENTAL/URBIS)



3.1.4 **GROUNDWATER**

Groundwater was not encountered during the geotechnical investigation. Static water level was recorded at 16m below ground level (mbgl) immediately west of the site boundary by Long Neck Creek Holdings in April 2014. Given that the site is relatively flat, it is expected that the depth to groundwater across the site is also approximately 16mbgl which provides sufficient clearance for the proposed development in accordance with Department of Water guidelines.

The groundwater quality is expected to be suitable for irrigation and ex-house uses. Non-potable water is available for irrigation and ex-house uses from the groundwater superficial aquifer. Potable water is assumed to be supplied via an extension of the Water Corporation's town supply scheme from the borefield located 7km to the east of the Structure Plan area.

3.1.5 SURFACE WATER

A majority of stormwater falling on site drains as sheet flow towards 2 shallow depressions to the north and south of the western boundary of the Structure Plan area. A small portion of the site drains to the north-east. Post-development catchments will have to maintain pre-development flow paths.

There are no identified surface water features within the Structure Plan area however there are Department of Water identified watercourses running north-south near the eastern and western boundaries of the site.

The largest creek lies to the west beyond the Goldfields Highway and flows north to south towards Lake Violet. Anecdotal evidence from the Shire suggests that flooding from either creek is not expected to influence the site. The Department of Water has further acknowledged that a flood study has not been performed and advised that the Main Roads WA culverts under the Goldfields Highway to be the critical points for flood management. Therefore no additional flood study is anticipated at this preliminary stage.

Preliminary investigations indicate that off-site post-development flow rates at the Goldfields Highway culverts must be maintained relative to pre-development up to the 100year ARI event. The protection of infrastructure and mitigation from the risk of flooding from stormwater events up to the 100year ARI event will need to be considered as part of the Structure Plan process.

Due to the high rainfall intensities, runoff rates and sporadic rainfall event patterns unique to the region, the conveyance of stormwater is via open drainage systems (swales, road reserve) rather than underground pipe systems.

3.2 **BUSHFIRE HAZARD**

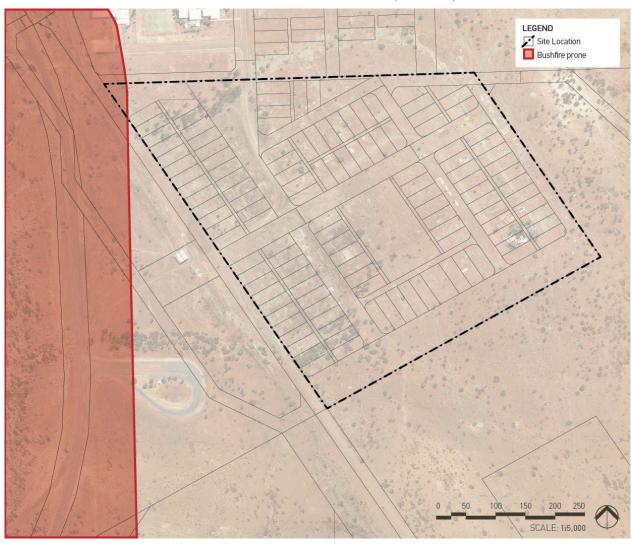
The subject site is not perceived to be at a high risk of bushfire hazard (refer Figure 7). A bushfire prone buffer exists over the area designated as public open space, which will incorporate low-threat vegetation being a maintained public reserve and parkland, and currently is completely degraded. Given the location of the POS, and as reflected in the Guidelines for Planning in Bushfire Prone Areas - Appendix 2 Bushfire Hazard Level Assessment, the site is identified as having a low hazard rating and BAL-Low rating.

Under SPP 3.7 – Planning in Bushfire Prone Areas, Clause 6.2(a) states that the policy measures only apply to land that has or will have:

- A Bushfire Hazard Level (BHL) above low.
- Where a Bushfire Attack Level (BAL) rating is above BAL-LOW.

Therefore, under SPP3.7, it is considered no further action is required.

FIGURE 7 - DEPARTMENT OF FIRE AND EMERGENCY SERVICES MAPPING (DFES 2016)



SURROUNDING LAND USES 3.3

The Wiluna Gold open-cut mine is located approximately 2km to the south of the Structure Plan area, with several tailing ponds located within this separation distance, approximately 1km from the site. According to the EPA's Guidance Statement No.3 (Separation Distances between Industrial and Sensitive Land Uses), a buffer of 1,500m - 3,000m should be achieved between open cut mining (large operations, other than coal) and sensitive land uses. The key impacts associated with this industry include noise, dust and risk impacts.

The provision of a 2km separation distance between the Structure Plan area and the open cut mine is considered consistent with the EPA Guidance Statement. It is further noted that the Structure Plan area has been identified in many State and strategic documents as being suitable for residential development.

3.4 NATIVE TITLE AND HERITAGE

Annabel Wills Architecture Pty Ltd and Human Terrains Anthropological Consultancy were engaged in 2014 to provide preliminary heritage advice on the European and Indigenous heritage factors that may affect the future development of the Structure Plan area. A summary of the key outcomes of these investigations are provided in the following sections.

3.4.1 EUROPEAN HERITAGE

A search of the Heritage Council of WA State Register of Heritage Places confirms there are no sites within the Structure Plan area listed on the State Heritage List. Similarly, there are no sites listed on the Shire of Wiluna local heritage register, however the site is located in close proximity to 2 sites, including:

- Railway Goods Shed (directly adjoining the site to the west).
- Former State Battery (to the north-east).

Given this context, appropriate land use configuration and interface treatments have been considered as part of the final Structure Plan design to appropriately respond to these heritage areas. A copy of the European Heritage Investigation undertaken to inform the Structure Plan is provided at **Appendix B**. Although the site does not contain sites of European significance, it was considered appropriate to undertake this investigation given the history associated with the site and its surrounds.

3.4.2 ABORIGINAL HERITAGE

The Structure Plan area lies solely within the Wiluna People determination area (including Wiluna #2 and #3). This claim group is legally represented by the Central Desert Land Councils with regard to matters of Native Title and heritage concern under the *Native Title Act 1993*. Given the Structure Plan area was previously freehold land and had been reverted back to Crown Land, it will not be subject to Native Title and Future Act proceedings. The Structure Plan area is still however subject to the provisions under the *Aboriginal Heritage Act 1972*.

The Structure Plan area is located within 1 registered Aboriginal heritage site, as detailed in **Table 7** below.

TABLE 7 - REGISTERED ABORIGINAL HERITAGE SITE

SITE ID	NAME	STATUS	TYPE
2182	Tjanapi	Registered	Mythological

It is noted however that the above site covers a majority of the existing Wiluna townsite. There are also a further 2 sites located within a 3km radius of the site (1369 – Women's Ceremonial Site and 1370 – Women's Ceremonial Track).

Given the broader town and Shire is rich in Aboriginal traditional cultural history, an ethnographic survey was undertaken by Human Terrains Anthropological Consultancy from the 11-15th August 2014 over the Structure Plan area (refer **Appendix C**). Specifically, a walkover of the area was undertaken to ascertain the extent of Aboriginal archaeology within or adjacent to the development. Key findings include:

- The area proposed for development is generally clear of ethnographic significance.
- There is significant concern regarding the high potential of subsurface materials within the development area.
- The hill adjacent to the development (known as 'Red Hill') is of ethnographic significance to Aboriginal people, in particular women for secret-sacred 'women's business' and should remain protected.
- Two artefact scatters were located between 25-100m outside of the Structure Plan area along the southern edge.
- A Section 18 ministerial consent is unlikely to be required however if further artefacts or cultural remains are located during the development construction phase, work must stop immediately.

Whilst it is recognised that the broader Wiluna Shire and townsite (including the Structure Plan area) is rich in Aboriginal traditional cultural history, the recommendations provided as a result of the survey conclude that the Structure Plan area is generally clear of ethnographic significance. Accordingly, it is considered that no Section 18 ministerial consent is required on the basis.

The survey however highlighted 2 new places of Aboriginal cultural heritage significance, located within a 25m radius of the Structure Plan area. It was therefore recommended that monitoring by Aboriginal people during the construction phase should be undertaken in the instance that any artefact or important material is discovered.

3.5 OTHER LAND USE CONDITIONS, CONSTRAINTS AND **OPPORTUNITIES**

351 **EXISTING ROAD NETWORK**

The Structure Plan area is bound by existing townsite development and Mudion Street to the north, Nulsen Street to the south-east, Prior Street to the east and Forrest Street to the west. A majority of these roads have been gazetted but are not constructed.

Scotia Street is the main entrance to the subject site from the townsite to the north, which then turns in Milton Street as it extends east and Kirkpatrick Street as it extends south-east. This informal road was gazetted as part of the historical subdivision and street network however is currently unsealed. The unsealed access provides access to the private residence to the south-east of the Structure Plan area. Scotia Street is sealed to the extent of Mudjon Street only.

The Goldfields Highway is located to the west of the Structure Plan area, and is a State Highway under the control of Main Roads WA. The Highway extends almost 800km from south of Kambalda in the Goldfields, to Meekatharra, passing through Wiluna. The Highway is a key transport route which facilitates the development of mines in the Wiluna Shire and is regularly used by heavy haulage trucks.

Goldfields Highway is also a key social linkage between Wiluna and Meekatharra, where there is significant commuting between the town for socio-cultural reasons as well as to access high order retail and services.

3.5.2 CONTAMINATION

A Preliminary Site Investigation (PSI) was undertaken by 360 Environmental in July 2014 to determine the presence and location of hazardous material on site (refer Appendix A). Based on the PSI, 3 areas of potential environmental concern (APEC) have been identified on site, or within influencing distance to the site. These areas include:

- APEC A Widespread use of asbestos containing materials in residential buildings constructed during the Wiluna gold rush eras between 1920 and the 1940's. Asbestos contamination is widespread on the surface of the site with the potential for further contamination of asbestos in the top soil profile.
- APEC B Former railway yard activities located approximately 50m to the west of the site.
- APEC C The former State Battery located approximately 200m north-east of the Structure Plan area is believed to operate from 1904 to 1950. Whilst outside of the Structure Plan area, there could be impacts due to its proximity to drainage lines etc that lead to the Structure Plan area.

Based on the results of the investigation and in the context of the above, it has been recommended that a Detailed Site Investigation, including sampling, is undertaken to characterise the nature and extent of contamination on site (in addition to asbestos contamination) and to determine if any unacceptable risks to human health or the environment exist in the context of the current and/or future land use. This will be undertaken at the subdivision stage.

INFRASTRUCTURE AND UTILITIES 3.5.3

An Engineering Servicing Report (prepared by JDSi Consulting Engineers, May 2016) was prepared to accompany this Structure Plan and is included at Appendix D. This report provides an overview of the existing infrastructure and servicing context of the Structure Plan area, with a summary provided below:

- Water the Water Corporation owns and maintains the water reticulation system in Wiluna. Water is sourced from a bore field approximately 6km east of Wiluna and pumped to 2x 500kL storage tanks located at Tank Hill (approximately 2km north-east of town).
 - Records indicate that the only water main adjacent to the site is a 63mm PE pipe which extends from the southern end of Bernales Street, following a nominal rear lane centrally positioned between Prior Street and Kirkpatrick Street. The water main appears to come to a closed end at Nulsen Street. It is likely this main is a service to the lone residence on Nulsen Street.
- **Sewer** the Water Corporation owns and maintains the town's sewerage reticulation system. Desktop investigations indicate that there is no apparent sewer service in proximity to the Structure Plan area. The nearest sewer service appears to be a private pump main which is located at the corner of Mudjon and Scotia Street.
 - Water Corporation data indicates that gravity connection into existing sewer infrastructure is not feasible for the Structure Plan area.
- **Power** Horizon Power is responsible for the power supply in Wiluna. Electricity supply comprises a remote area power system, with a central 10MW Gas Engine Power Station with back up diesel plant located at Lot 1021-1023 Thompson Street, to the north of the Structure Plan area. Electricity is distributed within the town via a 22kV/415V overhead powerline distribution network.

Within the Structure Plan area, records indicate that overhead powerlines extend from Bernales Street to Prior Street, terminating at the private residence on Nulsen Street. It is likely the power lines has been sized to cater for the one property only and therefore it is unlikely the power line has any additional capacity to cater for the proposed additional power demand.

Records further indicate a second overhead powerline exists adjacent to the Goldfields Highway. Overall, preliminary investigations conclude that the provision of power infrastructure to the Structure Plan area is likely to be at a significant cost, with the final design requirements driven by Horizon Power's standards.

- **Telecommunications** the subject site is serviced by existing telecommunications infrastructure owned and operated by Telstra.
- **Gas** no gas infrastructure is located within the vicinity of the subject site.

4 Design Philosophy, Land Use and Subdivision/ Development Requirements

4.1 DESIGN VISION AND INTENT

The Wiluna South Structure Plan has a number of features that have influenced the design concept. The following sets out the main design principles providing the basis to the design of the Structure Plan. Specifically the Structure Plan responds to the context, opportunities and constraints of the site detailed on the plan provided at **Appendix E**.

- It has been necessary to consider the site context, being within a remote townsite on the fringe of the Great Sandy Dessert and recognising that standard suburban standards are unlikely to be appropriate.
- Residential street blocks have been designed to maintain the historical subdivision design as much as possible and will deliver a variety of dwelling typologies cater for both the permanent and visitor/transient population. Street blocks have generally been oriented either on a north-south or east-west axis to promote climate responsiveness, capturing limited available breezes and reducing the impact of the western afternoon sun.
- The Structure Plan provides a grid-like street pattern which has responded to the existing hydrological conditions and desire for strong permeability through the site and connectivity with the existing townsite to the north. Specifically, the connectivity with Wotton Street is enhanced through continuation and formalisation of Scotia Street, Bernales Street and Lakeway Avenue, providing strong connections and direct linkages.
- The proposed tourist use is appropriately located close to the town centre in a location visible from Goldfields Highway to encourage exposure and visitation. The tourist use is separated by an expansive area of public open space to achieve a level of separation with sensitive uses (primary school and TAFE) to the north.
- The Structure Plan allows for appropriate interface treatments with surrounding land uses, including the primary school and TAFE to the north, through provision of appropriately located public open space and interface treatments.
- Where possible, road frontage has been provided as an edge condition to the vacant land surrounding the site to the south, east and west. This edge treatment is required to ensure a clear delineation between the public and private realm.
- The design sensitively retains the existing residential dwelling located to the south-east of the site, along with an appropriate buffer to future residential lots. This will allow the continuation of this use with minimal disturbance.

4.2 LAND USE

The Structure Plan indicatively demonstrates how subdivision and development may occur on the site, consistent with the *WAPC Structure Plan Framework 2015*. Overall, the proposed Structure Plan proposes the following land uses and areas:

- 11.03ha residential land (approximately 210 lots).
- 0.91ha tourist accommodation.
- 2.91ha public open space.
- 0.23ha drainage.
- 10.24ha roads.

The proposed road network facilitates efficient access to and from the site with direct accessibility to existing local amenities, particularly on Wotton Street. The site is therefore well located for additional residential and tourist development.

4.2.1 RESIDENTIAL

Development proposed with the Structure Plan is primarily for residential purposes, providing housing at a density range of R10-20 and R10-30, in the form of single and grouped dwellings. The R10-20 density is proposed to the east and west of the Structure Plan area, with the R10-30 areas proposed centrally and closest to the existing townsite. The proposed R-Code ranges will enable flexibility for the final R-Code to be determined closer to the subdivision stage. The proposed density ranges are considered appropriate given the regional context and likely demand for lot sizes in this area. It also recognises the Shire's desire to accommodate smaller lots in proximity to existing services.

The R10 coding will allow development consistent with is currently provided in the Wiluna townsite (approximately 1,000sqm) with the R20 and R30 coding allowing for smaller lot sizes (approximately 300 - 450sqm), should this lot product be desired at the subdivision stage. Approximately 210 lots and dwellings will be created (assuming an average density of R20 to R25), with a total of 11.03ha of land occupied for residential purposes.

A scheme amendment is currently being progressed by the Shire to introduce a number of temporary accommodation land use classes (workforce accommodation, repurposed dwelling and second-hand dwelling) into the Scheme and included as advertised 'A' uses. This will allow for temporary dwellings to be located on lots within the Structure Plan area to cater for potential peaks in housing supply associated with surrounding industry.

State Planning Policy 3.1 – Residential Design Codes (R-Codes) provides for development standards to be set out in adopted structure plans and local development plans. All residential development within the Structure Plan area will be required to satisfy the provisions within the R-Codes.

4.2.2 TOURIST ACCOMMODATION

A caravan park facility (0.9ha) is proposed within the north-west portion of the Structure Plan area, with the planning and design of this facility being led by the Shire. This site has been identified due to its close proximity to existing townsite development, including Wotton Street and its high level of visibility from Goldfields Highway.

Tourist accommodation development within the Structure Plan area will assist in growing and supporting Wiluna's tourism market which is currently limited by a lack of quality tourist accommodation and amenities.

4.3 LOCAL RESERVES

4.3.1 PUBLIC OPEN SPACE

The provision of public open space (POS) is distributed throughout the site to provide direct accessibility to residents while responding to the existing drainage lines and the need for appropriate interface treatments. In the case of residential development, a 10 per cent public open space provision is required under the WAPC's Liveable Neighbourhoods.

The Public Open Space plan illustrates that the Structure Plan proposes 2.9ha (11.61%) of land for POS. The north-west portion of open space is an area identified as a dedicated drainage basin and responds to Council's desire to provide an appropriate interface and buffer to the existing Wiluna Remote Community School and Durack Institute of Technology. This area of open space will facilitate direct pedestrian connections between the tourist accommodation site, and town centre. A POS schedule is provided at **Table 8** below.



LEGEND

SUBJECT AREA



PUBLIC OPEN SPACE

(REFER TO LMWS)



DEDICATED DRAINAGE AREAS

POS Schedule		
Gross Area		25.3161 ha
Site Area Less		N/A
Nett Area		25.3161 ha
Deductions		
Dedicated Drainage Areas		0.2312 ha
Gross Subdivisble Area		25.0849 ha
10% POS Requirement		2.5085 ha
Unrestricted POS	P1	1.7033 ha
	P2	0.6959 ha
	P3	0.514 ha
Sub Total		2.9132 ha
Drainage	D1	0.1156 ha
	D2	0.1156 ha
		0.2312 ha

Scale 1:5,000 @ A3



PUBLIC OPEN SPACE PLAN

WILUNA SOUTHERN RESIDENTIAL DISTRICT

PROJECT NO: PA1023
CLIENT: SHIRE OF WILUNA
DATE: 11/05/2016
DRAWING NO: POS-01
REV: 1
SCALE: 1:5000@A3
DRAWN: SLL
CHECKED: MG



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Base data supplied by: PSMA Australia Datum: Geocentric Datum of Australia 1994 (GDA94) Projection: MGA 94 Zone 51 Positional accuracy: +/- 2m



Urbis Pty Ltd ABN 50 105 256 228 Australia . Asia . Middle East



TABLE 8 – PUBLIC OPEN SPACE SCHEDULE

Less ha				
EPA Wetlands to be ceded	0.00			
Protected bushland sites	0.00			
Unrestricted POS sites not included in POS contribution	0.00			
Restricted POS not included in POS contribution	0.00			
Foreshore Reserves to be ceded	0.00			
Total	0.00	0.00		
Net Site Area ha				
			\	
Deductions				
Primary School and High School	0.00			
Town Centres / Commercial (50% of Mixed Use)	0.00			
Dedicated Drainage Reserves	0.23			
Transmission corridors	0.00			
Other (Sewer pump station site)	0.00			
Other (P&R Land)	0.00			
Total Deductions	0.23			
Ouena Culediniailela Aura			25.08	
Gross Subdivisible Area			25.00	
Public Open Space @ 10%			2.51	
Public Open Space Contribution				
May Comprise				
minimum 80% unrestricted POS	2.01			
maximum 20% restricted POS	0.50			
Unrestricted POS sites				
Area 1	1.70			
Area 2	0.70			
Area 3	0.51			
Unrestricted POS Total area	2.91	11.61	percent	
om our otto i our aroa	2.01	77.07	percent	
Restricted Use POS sites (detention/inundation more often than 1:1 yr event, MUW, Buffers etc)				
Restricted POS contribution	0.00	0.00	percent	
Total Restricted Use POS able to contribute to POS (cannot		0.00		
exceed 2% of required 10%)		0.00		
Contributing POS				
Unrestricted POS	2.91			
Restricted POS	0.00			
Total Contributing POS	2.91	11.61	percent	
Total DOS provided				
Total POS provided Surplus unrestricted POS				
Surplus restricted POS				

4.4 INTERFACE TREATMENTS

The Structure Plan is bound by existing townsite development (Wiluna Remote Community School and the Durack Institute of Technology) as well as vacant land to the north, vacant land to the south, vacant land to the east and the Railway Goods Shed and Goldfields Highway further to the west. The Structure Plan has been designed to provide an appropriate interface and buffer to this surrounding development, as described below:

 Railway Goods Shed – The Railway Goods Shed adjoins the Structure Plan area to the west and is listed on the Shire's local heritage register. This intersection provides a clear sense of address for the shed, and the provision of the corner residential development identifies a vista down Milton Street.

The tourist accommodation site is located within close proximity to the north of the shed, encouraging pedestrian movement along Forrest Street and the walkability of the Structure Plan area.

Northern Boundary – The site is surrounded by various community, educational and civic uses
to the north. These elements, which include the Wiluna Remote Community School and Durack
Institute and the Shire of Wiluna Council offices, are predominately separated by an area of POS.

The northern POS elements provide a contrast, and relief from a predominantly built form environment. The POS creates a level of shared amenity between the residential development to the south and community/civic uses to the north.

- Tourist Accommodation Site The tourist accommodation site is located to the north-west of
 the Structure Plan area, adjacent to an area of POS and Forrest Street. The interface to the POS
 provides an opportunity for passive surveillance contributing to a sense of safety and
 identification of the site as tourist accommodation from Goldfields Highway.
- Potential Future Temporary Accommodation and Residential Some transit workforce
 accommodation is proposed as part of the LSP. The provision of transportable dwellings,
 including repurposed dwellings will be appropriately designed with regard to setbacks,
 orientation, landscaping and frontage, in order to integrate with residential development.

4.5 MOVEMENT NETWORK

The proposed roads for the development include linear extensions of existing roads Forrest Street, Scotia Street, Lakeway Avenue and Bernales Street. Of these, only Scotia Street is sealed and is therefore likely to be the primary access for the site. The requirement to upgrade existing roads will likely comprise as a minimum the completion of the western segment of Mudjon Street for the Forrest Street tie-in.

Local Perspective

The Structure Plan area is bound by existing townsite development and Mudjon Street to the north, Nulsen Street to the south-east, Prior Street to the east and Forrest Street to the west. A majority of these roads have been gazetted but are not constructed.

Scotia Street is the main entrance to the subject site from the townsite to the north, which then turns in Milton Street as it extends east and Kirkpatrick Street as it extends south-east. This informal road was gazetted as part of the historical subdivision and street network however is currently unsealed. The unsealed access provides access to the private residence to the south-east of the Structure Plan area. Scotia Street is sealed to the extent of Mudjon Street only.

As part of future stages, it is likely that road closure processes will be required to close historical portions of road reserve within the Structure Plan area.

A Movement Network Plan is provided overleaf.

4.6 WATER MANAGEMENT

This section of the Structure Plan has been informed by a Local Water Management Strategy (LWMS) prepared by 360 Environmental (April 2016 – refer **Appendix F**). The LWMS defines the surface water and ground water management objectives and strategies including water quality management, water conservation and sustainability measures and the requirement for additional work in future planning stages.

The strategies presented in the LWMS will be implemented through the preparation of an Urban Water Management Plan (UWMP) as part of the future subdivision application. A summary of the LWMS is provided below.

4.6.1 WATER CONSERVATION

Significant savings in scheme water are possible through conservations measures provided by Water Corporation. A number of water conservation related elements will be employed. Waste water from the development will be managed through connection to the mains sewerage system at the Wiluna townsite.

4.6.2 STORMWATER MANAGEMENT

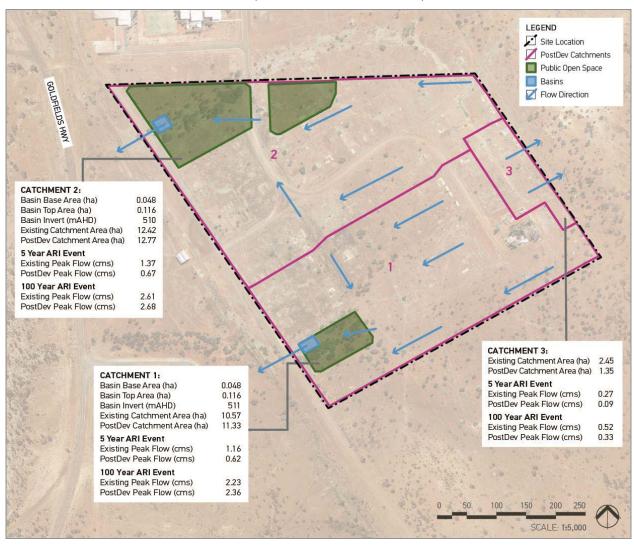
A stormwater management strategy has been prepared in accordance with the guiding principles of the LWMS (refer **Appendix F**). Overall the system will manage catchment runoff to pre-development peak flow rates. The key elements of the drainage strategy can be summarised as follows:

- Maintain the existing catchments and flow paths to the west of the site through earthworks and alignment of road networks. POS areas adjacent to the existing shallow drainages north and south of the site will feature drainage infrastructure.
- No stormwater management system will be designed for catchment 3. The existing drainage to the east will be maintained.
- Adopt a treatment train approach to water quality management and protection of receiving environments, including detaining of frequent events within the site boundaries.
- Due to the high rainfall intensities, runoff rates and sporadic rainfall event patterns unique to the region, conveyance of stormwater is via open drainage systems rather than underground pipe systems
- Frequent events (≤1yr ARI Event) will be detained within lots through the use of rainwater tanks, with runoff from roads via the drainage basins within the POS areas.
- Major events will be discharged offsite at near pre-development peak flow rates. Attenuation of discharge offsite to the unnamed seasonal creek to the west of Site will be achieved with the use of detention basins within the POS.
- No direct groundwater management measures are to be implemented owing to the existing clearance to groundwater.

A major and minor approach to the design of stormwater management systems has been adopted for the site. The minor system consists of roadside drains and kerbs designed to convey runoff up to the 5yr ARI event and ensure serviceability of the road network. The major system consists of roads and a drainage basin within the POS providing protection of the community from extreme flooding events (up to the 100yr ARI event) that exceed the capacity of the minor system.

The conceptual water management plan is provided at **Figure 8**, which illustrates the water management requirements of each of the 3 catchment areas.

FIGURE 8 - CONCEPTUAL STORMWATER PLAN (SOURCE: 360 ENVIRONMENTAL)



4.6.3 GROUNDWATER MANAGEMENT

Based on the groundwater analysis (presented in the LWMS), there is sufficient clearance between the groundwater and the natural surface across the site where lots are proposed. No direct measures, including subsoil drainage or lowering of groundwater are proposed for managing groundwater. Final lot levels and clearance to groundwater will be provided in a Urban Water Management Plan (UWMP) following refinement of the earthwork design.

Where fill is imported, the material should be well graded and have a maximum particle size of 100mm. It must be moisture conditioned and compacted in layers not exceeding 300 mm to achieve an equivalent dry density ratio of approximately 95% based on modified compaction (AS1289). The technical and control requirements for engineered or structural fill, including site observation and compaction testing, are outlined in AS3798-2007: Guidelines on Earthworks for Commercial and Residential Developments (Australian Standard, 2007).

4.7 ENGINEERING REQUIREMENTS

An Engineering Servicing Report has been prepared by JDSi Consulting Engineers (May 2016) and is included at **Appendix C**. A summary of both the internal and external servicing requirements to facilitate the development is provided in the following sections.

4.7.1 **SEWER**

Upgrades to the existing sewer infrastructure will be required to support the proposed development. The upgrades will require further consultation with the Water Corporation with respect to the funding and timing of delivery for the upgrades. A summary of the potential options investigated as part of the Structure Plan are summarised below with further detail provided within the Engineering Servicing Report.

Internal Requirements

Internal sewer reticulation is expected to comprise sewer lines gravity draining to a pump station located at the north-west of the site, in general accordance with the natural topography of the site. Two ridgelines on site have been identified as constraints, which will require consideration to minimise cut and fill requirements.

Sewer reticulation pipework in Wiluna has historically been located in the 5m service laneways at the rear of lots. New sewer design criteria will dictate sewer infrastructure to be located along the front of lots within the sewer alignment of road reserves.

External Requirements

Discussions with the Water Corporation were undertaken as part of the investigations. Based on these discussions, it is apparent that conceptual planning comprises the eventual construction of a new pump station downstream of the existing Type 10 pump station, discharging into the Wiluna Wastewater Treatment Plant via an upgraded pressure main. The pump would then service the Structure Plan area by gravity, and the existing pump station may ultimately be decommissioned and graded out.

The Water Corporation however advised that these works are not in their Capital Investment Program and therefore there is apparent timeframe for delivery of the works. The Water Corporation advised that there are 3 likely options to service the Structure Plan area in the interim (noting the option of utilising the existing school pump station to the north is unlikely). These include:

- Construct a new pump station on site, discharging into the existing Jones Street gravity line via a pressure main.
- Construct a new pump station on site, with the pressure main discharging into the existing pump station.
- Direct injection into the existing pressure main running to the wastewater treatment plan (would require additional hydraulic consultation).

Negotiation with the Water Corporation for inclusion of the new pump station works into their Capital Investment Program is the most economical method of servicing the site (by gravity instead of pump station), however this is subject to the timing for the development.

4.7.2 WATER SUPPLY

<u>Internal Requirements</u>

Internal water reticulation within the Structure Plan area is expected to comprise a conventional DN100 network, serving lots from the front instead of the rear. Accordingly, it will be necessary to decommission and remove the existing DN63 reticulation main running through the site which is located along the rear of lots.

External Requirements

Scheme water is currently sourced from 3 production bored to the east of town. The capacity of the bore mains, the collector main and the supply main out of the tank have been assessed by Water Corporation as being adequate to cater for long term system demands.

Water treatment capacity at the Wiluna tank is only 172kL/day, which was assessed by the Water Corporation as being insufficient to cater for average day peak week demands of the scheme. Upgrades are also required to the treatment plant to deal with source water quality issues. A capital project has been activated to replace the existing treatment plant. The new 240kL/day plant will allow for longer term growth.

4.7.3 POWER SUPPLY

Electricity supply to the Wiluna townsite comprises a remote area power system wholly owned and operated by Horizon Power. Its central generation facility is a 10MW Gas Engine Power Station with back up diesel plant located at Lot 1021-1023 Thompson Street.

Electricity is distributed within the town via a 22kV/415V overhead powerline distribution network. The power station is connected to the town centre overhead network via a high voltage underground cable system. Parts of the township's low voltage distribution system have been converted to aerial bundled conductor. In addition the combined Matilda and Wiluna Gold Project synergies include a private 12MW Gas Engine Power Station generation capability with diesel back up.

The proposed residential subdivision ultimately provides for up to approximately 244 lots, given the residential area and assuming R20 density. Forecast Electrical Load per Dwelling is currently available from the Horizon Power Information – Electrical Design for Distribution Networks: After Diversity Maximum Demand (ADMD) - Standard No: HPC-3DC-07-0001-2012. An electrical loading of 6kVA per residential dwelling in Wiluna is recommended consistent with the Horizon Power information.

This suggests an ultimate electrical loading for the proposed subdivision in the order of 1.5MVA. Whilst current and detailed electrical load data for the Wiluna townsite is not readily available, it could be assumed this increase would be accommodated within the current generation capacity with some associated network augmentation cost.

It is recommended that Horizon Power is commissioned to undertake a feasibility study for the proposed development. This represents the only avenue to accurately determine the electrical requirements associated with the development.

4.7.4 TELECOMMUNICATIONS

The NBN rollout database indicates Wiluna is not part of any immediate rollout. Therefore, telecommunications for the site would need to be provided by Telstra. No assets from other telecommunications service providers have been identified near the study area.

The existing Telstra cables within the site boundary would likely need to be decommissioned as part of the proposed development works, as they appear to be direct buried and not located in proposed road reserve alignments. External connection options for the site appear to be the existing pit at Forrest Street, the existing pit at Scotia Street, and potentially the above ground cable joint at Grace Street.

4.7.5 EARTHWORKS

Due to the existing topography of the Structure Plan area, earthworks will be required to prepare the site for residential development and will need to be undertaken in accordance with the recommendations of the geotechnical report and the relevant Australian Standards.

Fill has been identified to likely be required in the south-western quadrant and south-eastern corner of the development, as indicated in the Servicing Report, primarily to facilitate sewer reticulation. The locations shown however are indicative and detailed design would be required to ascertain earthwork requirements.

Consideration will also need to be given to the proposed stormwater management strategy and the impact on fill levels. Lots will require to be graded towards the front of the lot to provide for drainage towards the road reserve for subsequent flow conveyance.

4.8 MOVEMENT NETWORK

This section describes the movement network proposed by the Structure Plan, as described in the Engineering Servicing Report (prepared by JDSi Consulting) at Appendix C.

ROAD CLASSIFICATION

The Structure Plan adopts the street classification defined in Liveable Neighbourhoods (Table 3 and 4). An indicative road hierarchy based on Liveable Neighbourhoods road classifications is shown on the Movement Network Map. As shown, all roads are identified as local roads. The road layout is indicative only and is subject to detailed planning at the time of subdivision and development.

INTERNAL ACCESS ROADS 4.8.2

Pursuant to Liveable Neighbourhoods requirements, the Structure Plan provides a permeable, connective and accessible road network. The proposed local roads for the development include linear extensions of existing roads including Forrest Street, Scotia Street, Lakeway Avenue and Bernales Street. Of these, only Scotia Street is sealed and therefore is likely to be the primary access for the site.

Local road reserve widths have generally been retained as they current exist, ranging between 20-30m, with the Nulsen Street road reserve a larger 55m road reserve width. The requirement to upgrade existing roads will need to be confirmed by the Shire as part of the detailed design however will likely comprise as a minimum the completion of the western segment of Mudjon Street for the Forrest Street tie in.

Road pavements will need to be designed in consideration of the bearing strength of the in-situ subgrade material. It is noted from the geotechnical investigation undertaken that the surficial material has been classified as clay of intermediate plasticity. It is recommended that the proposed roads are kerbed and sealed.

4.8.3 PEDESTRIANS AND CYCLISTS

There will need to be provision for the safe and convenient cross flow of residents between each cell of the Structure Plan area, as well as from the tourist site to existing townsite development (including Wotton Street). A network of footpaths and cycleways will also be built within the Structure Plan area to provide for safe pedestrian and cyclist movement, and will be investigated as part of the detailed design stage.

Access across Goldfields Highway is not required given all townsite development is located to the north of the Structure Plan area.

49 LANDSCAPE TREATMENTS

Providing opportunities for the public to engage with the natural landscape is important to human health and well-being. Opportunities for soft landscape treatments will be investigated as part of the detailed planning stage, through preparation of a Landscape Management Plan.

DEVELOPMENT STAGING 4.10

The development will be staged according to demand for development within the town. As a general principle however, development will be staged to deliver development in closest proximity to existing townsite development to ensure a level of townsite consolidation. The tourist facility will also be pursued by the Shire in the initial stages of the development.



MOVEMENT NETWORK PLAN

WILUNA SOUTHERN RESIDENTIAL DISTRICT

PROJECT NO: PA1023 CLIENT: SHIRE OF WILUNA DATE: 01/02/2016 DRAWING NO: MNP-01 REV: -SCALE: 1:5000@A3 DRAWN: SLL

CHECKED: MG



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Base data supplied by: PSMA Australia Datum: Geocentric Datum of Australia 1994 (GDA94) Projection: MGA 94 Zone 51 Positional accuracy: +/- 2m



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Technical Appendices 5

A number of technical reports were undertaken to support the Structure Plan. The table below provides an overview of all technical appendices included with this Structure Plan. In addition, pre-lodgement consultation was undertaken with a range of Government and community stakeholders, as detailed in Appendix G.

TABLE 9 - TECHNICAL APPENDICES

APPENDIX NO.	DOCUMENT TITLE	NATURE OF DOCUMENT	REFERRAL/APPROVAL AGENCY	SUMMARY OF DOCUMENT MODIFICATIONS
A	Environmental Assessment Report, containing:	Supporting document only	Department of Planning	
A	Level One Flora and Fauna Survey	Subject to separate formal approval by DEC	Department of Environment	
A	Preliminary Site Investigation	Supporting document only	Department of Environment	
В	European Heritage Survey	Supporting document only	Shire of Wiluna	
С	Aboriginal Heritage Survey	Supporting document only	Shire of Wiluna	
D	Engineering Servicing Report	Supporting document only	Shire of Wiluna	
F	Local Water Management Strategy	Subject to separate formal approval by the Department of Water	Department of Water	

Appendix A

Environmental Assessment Report (360 Environmental 2014



Wiluna South Structure Plan

Environmental Assessment Report

Prepared for:

Shire of Wiluna

September 2014

people
 planet
 professional

Document	Revision	Prepared	Reviewed	Submitted to Client	
Reference	nevision	by	by	Copies	Date
LD485AB	A INTERNAL DRAFT	СТ	LR	1. Electronic	25.09.14
LD485AB	B. CLIENT DRAFT	СТ	LR	1. Electronic	25.09.14

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Executive Summary

360 Environmental Pty Ltd was commissioned by Urbis to prepare an Environmental Assessment Report (EAR) assessment for the Wiluna South precinct. In total, the site occupies an area approximately 25 hectares (ha). The purpose of this report is to outline the key environmental features, and proposed management measures to support the submission of a Local Structure Plan for residential and tourism purposes within the southern portion of Wiluna town.

The scope of work for the EAR consisted of a desktop assessment for key environmental features and a historical aerial photo review. This study also included a site visits by 360 Environmental scientists to verify the findings of the desktop assessment including a Level 1 Fauna Survey and a Level 1 Flora and Vegetation Survey. A summary of the findings of the EAR is given below:

- Geology: Regional soil mapping by The Department of Agriculture and Food Western Australia (DAFWA) dataset indicates that the entire site falls within the Wiluna System (DAFWA, 2012) (Figure 3). A geotechnical investigation was undertaken by CMW in 2014 (CMW Geosciences Pty Ltd 2014). The geological units encountered during the assessment were Alluvium comprising sandy clay and gravel overlying a siliceous hardpan. The depth to the hardpan ranged from 0.35m to 1.2m with excavation beyond the hardpan not possible. The low permeability nature of this geology may lead to pooling of surface water and localised erosion.
- Contamination and Acid Sulphate Soils (ASS): A search of the ASRIS database indicated that there is very low probability of the occurrence of Acid Sulfate Soils on the site (CSIRO 2011) (Figure 4). The Contaminated Sites Database (DER 2014) indicates that no known contaminated sites are registered within the vicinity of the site. The Preliminary Site Investigation undertaken by 360 Environmental in July 2014 identified surface soil contamination caused from the widespread use of asbestos in former residential developments on the site. Potentially contaminating land uses were also identified adjacent to the site. It is recommended that a detailed site investigation be undertaken prior to any disturbance of the site in order to identify human health risks associated with contamination.
- Surface Hydrology and Wetlands: Broad hydrology mapping by the Department of Water (DoW) (2010) did not identify any wetlands or watercourses within the site. However two minor drainage lines were eveident during the site visits by 360 Environmental Scientists. Any necessary surface water management measures will be identified and outlined in the Local Water Management Strategy (LWMS) being prepared by 360 Environmental.
- Ground Water: Static water level was recorded at 16 meters below ground level (mbgl) immediately west of the site boundary by Long Neck Creek Holdings in



April 2014. Given that the site is relatively flat, it is expected that the depth to groundwater across the site is also approximately 16 mbgl which provides sufficient clearance for the proposed development in accordance with the DoW's guideline Better Urban Water Management (2008).

- Public Drinking Water Source Areas: The site is not located within or in close proximity to any surface or groundwater protection areas (DoW, 2012). The closest Public Drinking Water Source Area is Wiluna Water Reseve located approximately 6 km to the east of the site (DoW, 2012).
- Flora, Vegetation and Fauna: One Beard/ Shepherd vegetation association has been mapped within the site, 28 (a1Lr) − Open low woodland: mulga. This vegetation type exceeds the 30% threshold for remaining pre-European vegetation and therefore is not considered to be regionally significant.

The preliminary flora assessment undertaken by 360 Environmental identified one conservation significant flora species, *Eremophila arguta* (P1) as 'Likely' to occur within the survey area based on regional habitat mapping. The flora survey was undertaken during the detectable period for this species however, and it was not recorded. The species therefore is not considered to occur on the site.

The project area is considered to contain potential habitat for one conservation significant species, the Rainbow Bee-eater. However given its large distribution and ample amount of similar habitat in the surrounding area, this species is not expected to be significantly impacted by the development of the project area.

- Threatened and Priority Ecological Communities. The flora and vegetation survey conducted by 360 Environmental did not identify any vegetation within the site which is floristically similar to any Threatened or Priority ecological communities (TECs, PECs). Therefore no TECs or PECs are likely to be impacted by the proposed development.
- Conservation Areas: A search of WA Atlas (Landgate, 2014) identified that the site does not fall within any Environmentally Sensitve Areas (ESAs) (DEC, 2013b) or DEC (now DPaW) Managed Lands (DEC, 2013c).



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Appendix A: 360 Environmental Flora, Vegetaiton and Fauna Assessment 2014

Appendix B: 360 Environmental Preliminary Site Investigation 2014

Appendix C: CMW Geotechnical Assessment 2014



1 Introduction

1.1 Background

360 Environmental Pty Ltd (360 Environmental) was commissioned by Urbis on behalf of the Shire of Wiluna to prepare this Environmental Assessment Report (EAR) for the Wiluna South precinct ('the site') (Figure 1). This EAR has been prepared to support a Local Structure Plan (LSP) submission for a residential and tourism devlopment. 360 Environmental were also commissioned to undertake a Level 1 Fauna, Flora and Vegetation Assessment (360 Environmental 2014a, Appendix A) as well as a Preliminary Site Investigation (PSI) (360 Environmental 2014b, Appendix B) to supplement the preparation of this report. CMW Geosciense Pty Ltd (CMW) were also commissioned to undertake a geotechnical investigation for the site (CMW Geosciences Pty Ltd 2014) (Appendix C), the results of which are summarised within this report.

1.2 Scope

The following scope was undertaken for the preparation of this EAR:

- Literature review of relevant documents;
- Summary of the 360 Environmental Flora, Fauna and PSI Survey results;
- Desktop assessment of conservation areas, that may exist on or nearby to the site, including Bush Forever sites, Regional Parks and Environmentally Sensitive Areas (ESA's);
- Desktop assessment of mapped wetlands in the area and their conservation status and buffers;
- Summary of the Geotechnical Survey results;
- Desktop review of the geology, surface hydrology and groundwater information using available databases and digital mapping to identify;
- Identification of environmental constraints and opportunities associated with the proposed development and the development of management actions in consultation with the client; and
- Formulation of this report detailing the results of the above investigations.



2 Site Description and Assessment

2.1 Property and Zoning Information

The site represents an area of vacant, subdivided land created from an original subdivision during the gold rush in the 1930's, which has now been converted back to Unallocated Crown Land (Figure 1). The site is located within the remote local government area of the Shire of Wiluna and is currently zoned as 'Residential Development' under the Shire's Local Planning Scheme No.2. The site is earmarked as 'Residential Precinct 4' in the Local Planning Strategy, which is identified as having potential for a mix of open space and residential development.

2.2 Topography

Broad scale topographic mapping suggests that the site is relatively flat ranging from approximately 514m to 519m Australian Height Datum (AHD) (Google Earth Pro, 2014) (Figure 2), however this mapping is inherently coarse. Any implications of localised topographical variation on water management will be addressed in the future Local Water Management Strategy (LWMS) to be prepared by 360 Environmental.

2.3 Regional Geology and Soils

Regional soil mapping by The Department of Agriculture and Food Western Australia (DAFWA) dataset indicates that the entire site falls within the Wiluna System (DAFWA, 2012) (Figure 3). This soil sub-system is characterised by low greenstone hills with occasional lateritic breakaways and broad stony slopes, lower saline stony plains and broad drainage tracts. The Wiluna system supports sparse Mulga and other *Acaicia* shrublands with patches of halophytic shrubs.

The geotechnical assessment undertaken by CMW concluded that the geological characteristics of the site were generally consistant with published geological information for the area. The geological units encountered during the assessment were Alluvium comprising sandy clay and gravel overlying a siliceous hardpan. The depth to the hardpan ranged from 0.35m to 1.2m with excavation beyond the hardpan not possible.

The geotechnical limitations of the site have been identified in greater detail within the accompanying geotechnical report prepared by CMW along with recommendations for overcoming any restraints. These recommendations are outlined in Section 3 of this report.

2.4 Acid Sulfate Soils

The DER has not identified any areas of Acid Sulfate Soil (ASS) risk within the site boundaries or within the vicinity of the site. A search of the ASRIS database indicated that there is very low probability of the occurrence of Acid Sulfate Soils on the site (CSIRO 2011) (Figure 4).



2.5 Contamination

2.5.1 Historical Land Use

A desktop review of historical imagery and a Preliminary Site Investigation (Appendix B) were undertaken by 360 Environmental in July 2014. The survey identified that the site was historically used for residential land uses with the majority of development on the land occurring between 1920 and 1940. The widespread use of asbestos in former residential developments on the site presents is evident through asbestos containing material fragments identified in surface soil contamination and potentially presents a health risk to future residents of the site.

In addition, potentially contaminating land uses were identified adjacent to the site and represent an unquantified environmental risk to future land users. These additional areas of potential environmental concern include the former state battery, and railway storage yard and above ground fuel storage area.

2.5.2 Contaminated Sites Database Search

The Department of Environment Regulation (DER) online Contaminated Sites Database was searched in July 2014 for known contaminated sites at both the site and in close proximity to the site. No known contaminated sites are registered within the vicinity of the site (DER 2014) (Figure 5). The nearest registered contaminated site is believed to be located approximately 10 km north of the site, classified as contaminated due to a spill of approximately 250,000 litres of diesel into surrounding soils. The site is not considered to be within influencing distance of the site for soil or groundwater contamination and therefore is not expected to impact the development of the site.

2.6 Surface Hydrology and Wetlands

A search of the Department of Water's (DoW) hydrology mapping did not identify any surface water features within the site (DoW, 2010) (Figure 6). However two minor drainage lines were eveident during the site visits by 360 Environmental Scientists.

The geotechnical assessment concluded that low infiltration rates are expected due to the poor permeability of the clayey soils, moderately cemented gravels and the hardpan found throughout the site. This is likely to lead to ponding of surface water in the lower lying areas during periods of intense rainfall and significant overland flow, which could also lead to erosion of the thin soil profile (CMW 2014).

Any necessary requirements for the management of water on site will be identified and outlined in the LWMS being prepared by 360 Environmental, and will accompany the LSP.

2.7 Groundwater

Regional groundwater data recorded between 1971 and 1985 was obtained for several WIN bores within a 5km radius of the site (DoW 2014) (Figure 2). This data indicates



that groundwater levels in the vicinity of the site ranged between 3.01 and 18.3 meters below ground level(mbgl). Static water level was recorded at 16 mbgl immediately west of the site boundary by Long Neck Creek Holdings in April 2014. Given that the site is relatively flat, it is expected that the depth to groundwater across the site is also approximately 16 mbgl. As anticipated, the geotechnical investigation undertaken by CMW did not encounter any groundwater (CMW 2014), although it is recognised in some areas the test pits were unable to penetrate deep into the soil due to the hardpan surface.

As separation to groundwater greater than 1.2 m complys with the requirements of the Department of Water's Better Urban Water Management Guidelines (2008) which states 'where the level is at or less than 1.2 m of the surface, the importation of clean fill and/or the provision of sub-surface drainage will be required to ensure that adequate separation of building floor slabs from groundwater is achieved.' Water management measures will be outlined in the LWMS prepared by 360 Environmental.

2.8 Public Drinking Water Source Areas

The site is not located within or in close proximity to any surface or groundwater protection areas (DoW, 2012). The closest Public Drinking Water Source Area is Wiluna Water Reseve located approximately 6 km to the east of the site (DoW, 2012) (Figure 7).

2.9 Vegetation

2.9.1 Broad Vegetation Associations

Mapping of the vegetation of the Murchison region of Western Australia was completed on a broad scale (1:1,000,000) by Beard (1976). These vegetation units were reassessed by Shepherd et al. (2001) to account for clearing in the intensive land use zone, dividing some larger vegetation units into smaller units.

There is only one Beard / Shepherd vegetation unit in the project area (Figure 8a). The Shepherd et al. (2001) vegetation type (corresponding Beard [1976] type in brackets) is described below, and it's representation in the project area, subregion, region and state is shown in Table 1:

28 (a1Lr) – Open low woodland: mulga.

Table 1: Broad vegetation types in the Project Area their State and Regional Representation (Government of Western Australia 2013).

VEGETATION TYPE	PRE-EUROPEAN AREA (HA)			CURRENT EXTENT % IN IUCN CLASS I-IV RESERVES
Vegetation Ty	/pes (Beard 1976	; Shepherd et al. :	2001) in WA	
28 (a1Lr)	395,895	392,172	99%	-



Vegetation Types (Beard 1976; Shepherd et al. 2001) in the Murchison Bioregion					
28 (a1Lr) 224,292 220,584 98% -					
Vegetation Types (Beard 1976; Shepherd <i>et al.</i> 2001) in the East Murchison Subregion					
28 (a1Lr) 141,411 137,703 97% -					

Broad vegetation associations which have less than or equal to 30% of their pre-European extent remaining may be considered as regionally significant and may be formally assessed. Given that Beard / Shepherd vegetation association 28 (a1Lr) has over 95% remaining in each of the above regions, the clearing of this vegetation would not be considered as having a significant environmental impact.

2.9.2 Vegetation Associations

A total of four vegetation units were described for the project area over three major landforms (Table 2)(Figure 8b).

Table 2. Vegetation Units in the Project Area

LANDFORM	CODE	VEGETATION UNIT	Area (ha)
Drainage line	1a	Low woodland of Mulga spp. and Acacia pruinocarpa over low scattered shrubs of Ptilotus obovatus over tussock grassland of *Cenchrus ciliaris, Enteropogon ramosus and Aristida contorta	1.59
Plain	2a	Mixed scattered shrubs of Eremophila galeata, Acacia pruinocarpa and Acacia tetragonophylla over scattered low shrubs of Senna sp. Meekatharra, Ptilotus obovatus and Salsola australis over open tussock grassland of Aristida contorta	18.03
	2b	Low scattered trees of Acacia macraneura over scattered shrubs of Acacia tetragonophylla over low scattered shrubs of Senna sp. Meekatharra and Eremophila galeata over very open tussock grassland of Aristida contorta	0.87
Low Rise	За	Open shrubland of Acacia sibirica and Senna sp. Meekatharra over low open shrubland of Eremophila jucunda subsp. jucunda, Ptilotus obovatus and Ptilotus rotundifolius over very open tussock grassland of Aristida contorta	0.75

2.9.3 Vegetation Condition

Vegetation condition was for the project area ranged from Completely Degraded to Good (Figure 8c). The majority of the site was considered to be in Very Poor condition Table 3). The project was formerly a housing development and is heavily disturbed with



historical clearing, former building footprints and ground disturbance evident. Weed species were also noted in the project area with *Cenchrus ciliaris at moderate densities in the shallow drainage lines. A small rise in the eastern boundary was considered to be in Good condition and contained fewer disturbances than the remainder of the project area.

Table 3: Vegetation Condition and Extent in the Project Area.

VEGETATION CONDITION	AREA (HA)
Good	0.75
Poor	2.46
Very Poor	18.03
Completely Degraded	2.97

2.9.4 Threatened and Priority Flora

No threatened species pursuant to the EPBC Act or to the WC Act were recorded in the project area during the 2014 field survey by 360 Environmental or identified as potentially occurring during the desktop survey.

No Priority flora (as listed by the Department of Parks and Wildlife (DPaW)) was recorded during the survey. A total of 35 Priority taxa from database searches were identified as potentially occurring in the project area. Of these 35 taxa, only *Eremophila arguta* (P1), is considered likely to occur. The remaining 34 taxa were considered either possible (six taxa) or unlikely (29 taxa) to occur in the project area. *Eremophila arguta* may be present in the minor drainage line of the project area however was not recorded during the field survey despite searches of the shallow drainage lines. Given that it is a perennial shrub it would have been present at the time of the survey and as such is not considered to occur in the project area.

As a result, it is considered unlikely that any Threatened or Priority taxa will be impacted by the proposed development of the site.

2.10 Fauna

Searches of the EPBC Protected Matters Search Tool, DPaW's threatened fauna database and NatureMap were undertaken to identify fauna species of conservation significance potentially occurring within a 40 km radius of the site (DotE 2014; DPaW 2014a).

A total of 27 conservation significant species (including Priority species) were identified during the desktop review of database searches (Table 4). These comprised one reptile, 21 birds and five mammals. Twenty one of the 27 species are considered as 'Unlikely' to occur in the project area, five species are considered as 'Possible' and one species is considered 'Likely' to occur in the project area.

The conservation significant species considered likely to occur within the project site is the Rainbow Bee-eater (*Merops ornatus*) which is lised as a migratory species under the EPBC Act. This species is one of the most common and widespread birds in Australia



with a distribution that covers the majority of Australia (Barrett et al. 2003). In Western Australia this bird can occur as a 'resident, breeding visitor, postnuptial nomad, passage migrant and winter visitor' (Johnstone & Storr 1998). Given its large distribution and ample amount of similar habitat in the surrounding area the Rainbow Bee-eater is not expected to impacted by the development of the project area.

Table 4: Conservation Significant Fauna Potentially Occurring in the Project Area

Table 4: Conservation Significant Fauna Potentially Occ TAXA	CONSERVATION STATUS ¹	LIKELIHOOD	
	STATUS		
Reptiles			
Great Desert Skink (<i>Liopholis kintorei</i>)	Vu,S1	Unlikely	
Birds	·		
Fork-tailed Swift (Apus pacificus)	Ma, Mi	Possible	
Great Egret (Ardea alba/modesta)	Mi, Ma	Unlikely	
Bush Stone-curlew (Burhinus grallarius)	P4	Possible	
Pacific Golden Plover (<i>Pluvialis fulva</i>)	Ma, Mi	Unlikely	
Oriental Plover (Charadrius veredus)	Ma, Mi	Unlikely	
Grey Falcon (Falco hypoleucos)	S1	Possible	
Peregrine Falcon (Falco peregrinus)	S4	Possible	
Oriental Pratincole (Glareola maldivarum)	Ma, Mi	Unlikely	
Malleefowl (Leipoa ocellata)	Vu, S1	Unlikely	
Rainbow Bee-eater (Merops ornatus)	Ma, Mi	Likely	
Australian Bustard (Ardeotis australis)	P4	Possible	
Princess Parrot (Polytelis alexandrae)	Vu, S1	Unlikely	
Common Sandpiper (Actitis hypoleucos)	Ma, Mi	Unlikely	
Sanderling (Calidris alba)	Ma, Mi	Unlikely	
Sharp-tailed Sandpiper (Calidris acuminata)	Ma, Mi	Unlikely	
Pectoral Sandpiper (Calidris melanotos)	Ma, Mi	Unlikely	
Red-necked Stint (Calidris ruficollis)	Ma, Mi	Unlikely	
Long-toed Stint (Calidris subminuta)	Ma, Mi	Unlikely	
Wood Sandpiper (<i>Tringa glareola</i>)	Ma, Mi	Unlikely	
Common Greenshank (<i>Tringa nebularia</i>)	Ma, Mi	Unlikely	
Glossy Ibis (Plegadis falcinellus)	Ma, Mi	Unlikely	
Mammals			
Brush-tailed Mulgara (Dasycercus blythi)	P4	Unlikely	
Long-tailed Dunnart (Sminthopsis longicaudata)	P4	Unlikely	
Northern Marsupial Mole (Notoryctes caurinus)	En, S1	Unlikely	
Burrowing Bettong (Bettongia lesueur subsp. graii)	Ex	Unlikely	
Bilby (Macrotis lagotis)	Vu, S1	Unlikely	

¹ En Listed as Endangered under the EBPC Act Vu Listed as Vulnerable under the EBPC Act Mi Listed as Migratory under the EBPC Act S Scheduled under the WC Act P Listed as Priority by the DPaW



The proposed development is unlikely to significant impact the fauna of the project area as the majority of fauna retrieved from the database searches are generally common and widespread throughout the region and are not dependent upon habitat in the project area. Extensive areas of similar habitat also occur in the surrounding area with 3,022 ha of the Shepherd/Beard unit 28 (a1Lr) remaining in the Shire of Wiluna (Government of Western Australia 2013).

2.11 Threatened and Priority Ecological Communities

A search of the DPaW Threatened Ecological Community (TEC) and Priority Ecological Community (PEC) database identified six PECs and no TECs within 50 km of the project area (DPaW 2014b) (Figure 9). No TECs or PECs were recorded within the site. Five of the six PECs identified in the searches are associated with calcrete groundwater assemblages. Neither calcrete or groundwater were encountered during the geotechnical investigation by CMW. In addition, the Long Neck Creek Holdings 37m deep log for the bore located adjacent to the western boundary of the site did not encounter calcrete. Given that the depth to groundwater is likely to be approximately 16m bgl, and minimal interference of groundwater from the proposed development is expect, these communities are not likely to be impacted. Generally mining acitivities are listed as the threat to these calcrete groundwater communities (DEC 2013a), however provided deep servicing or unexpected high groundwater is encountered, these communities are unlikely to be impacted by housing development. In the event of significant groundwater abstraction or dewatering, consideration should be given to the potential occurance of these communities in the vicinity of the site.

The remaining PEC, Wiluna West BIF occurs on banded ironstone formations and given the absence of this landform from the project area this PEC is not expected to occur.

None of the described broad vegetation association for the project area appear to be analogous with any other listed TECs or PECs and therefore no conservation significant communities are considered to be impacted by the proposed development.

2.12 Conservation Areas

A search of WA Atlas (Landgate, 2014) identified that the site does not fall within any Environmentally Sensitve Areas (ESAs) (DEC, 2013b) or DEC (now DPaW) managed lands (DEC, 2013c) (Figure 10). It is therefore considered that the development of the site for residential purposes will not impact on any conservation areas.

2.13 Conflicting Land Uses

Potentially conflicting land uses exist to the south of the site in the form of open cut gold mining operations and Toro Energy's proposed Uranium mining operations to the southeast of the site. Toro's Wiluna Uranium Project is set to become Western Australia's first ever uranium mine following final environment approvals granted in April 2013.



The EPA guidance statement Seperation Distances Between Industrial and Sensitve Land Uses No. 3, recommends a setback distance of 1500-3000 meters from open cut mining industries other than coal, in the absence of site specific data. The existing gold mine is located approximately 1.8 km south of the site. The EPA indicate that potential risks associated with such operations are mostly related to noise and dust emissions. Additional health impacts may be associated with the radiological nature of the proposed uranium mine.

It is considered that the proponents of these mines would have been liable to consider such impacts as part of the approvals process. However, consultation with existing and future mining facilities is recommended to ensure that adequate management measures are in place to mitigate the potential impacts on future residents of the residential development.





3 Impacts and Management

Any potential environmental impacts that may result from development of the site are discussed below, along with management measures intended to mitigate any possible impacts of the development on the environment.

3.1 Hydrogeology and Soils

Low infiltration rates are expected due to the shallow hardpan and poor permeability of the clayey soils, moderately cemented gravels and the hardpan found throughout the site (CMW 2014). This is likely to lead to ponding of surface water in the lower lying areas during periods of intense rainfall and significant overland flow, which could also lead to erosion of the thin soil profile.

The following management measures have been recommended by CMW to ensure appropriate geotechnical characteristics of the site for development.

3.1.1 Management measures

Excavation and Fill Recommendations:

- Where present below design subgrade levels, any fill, topsoil or otherwise unsuitable material must be removed and cut to waste or reworked and re-used under engineering supervision
- At the completion of any excavation to design levels, including foundation excavations, the upper 300 mm of the exposed subgrade must be moisture conditioned to within ±3% of optimum moisture content (OMC) and compacted;
- Any fill should comprise material with grain size of <100 mm. It must be moisture conditioned as above and compacted in layers not exceeding 300 mm;
- A preliminary site classification of Class "S" to AS2870 is considered suitable

Surface and Groundwater Management

Surface and groundwater management measures will be outlined in the seperate Local Water Management Strategy prepared by 360 Environmental.

3.2 Contamination

During the Preliminary Site Investigation, the presence of asbestos was identified. All types of asbestos fibers are known to cause serious health hazards in humans. In addition, potentially contaminating land uses were identified adjacent to the site and represent an unquantified environmental risk to future land users.

3.2.1 Management measures

Based upon the results of the investigation and in the context of the conclusions outlined in Section 2.5, 360 Environmental recommend that a detailed site investigation, including



intrusive soil and groundwater sampling as outlined in the site specific Sampling and Analysis Quality Plan (SAQP), is recommended to be undertaken to characterise the nature and extent of contamination at the site (if any) and to determine if any unacceptable risks to human health or the environment exist in the context of the current and/or future land use.

3.3 Priority Ecological Communities

A search of the DPaW TEC and PEC database identified six PECs and no TECs within 50 km of the project area (DPaW 2014b) (Figure 9). The PECs identified were associated with Priority one ecological communities. These are poorly-known ecological communities that are only known from very few occurrences with a very restricted distribution (generally ≤ 5 occurrences or a total area of ≤ 100 ha) (DEC 2010). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.

3.3.1 Management measures

Five of the six PECs identified in the searches are associated with calcrete groundwater assemblages. In the unlikely event that both groundwater and calcrete are encountered during construction, site works will cease pending further investigation into the presence of calcrete/groundwater dwelling invertebrates.



4 Limitations

This report is produced strictly in accordance with the scope of services set out in the contract or otherwise agreed in accordance with the contract. 360 Environmental makes no representations or warranties in relation to the nature and quality of soil and water other than the visual observation and analytical data in this report.

In the preparation of this report, 360 Environmental has relied upon documents, information, data and analyses ("client's information") provided by the client and other individuals and entities. In most cases where client's information has been relied upon, such reliance has been indicated in this report. Unless expressly set out in this report, 360 Environmental has not verified that the client's information is accurate, exhaustive or current and the validity and accuracy of any aspect of the report including, or based upon, any part of the client's information is contingent upon the accuracy, exhaustiveness and currency of the client's information. 360 Environmental shall not be liable to the client or any other person in connection with any invalid or inaccurate aspect of this report where that invalidity or inaccuracy arose because the client's information was not accurate, exhaustive and current or arose because of any information or condition that was concealed, withheld, misrepresented, or otherwise not fully disclosed or available to 360 Environmental.

Aspects of this report, including the opinions, conclusions and recommendations it contains, are based on the results of the investigation, sampling and testing set out in the contract and otherwise in accordance with normal practices and standards. The investigation, sampling and testing are designed to produce results that represent a reasonable interpretation of the general conditions of the site that is the subject of this report. However, due to the characteristics of the site, including natural variations in site conditions, the results of the investigation, sampling and testing may not accurately represent the actual state of the whole site at all points.

It is important to recognise that site conditions, including the extent and concentration of contaminants, can change with time. This is particularly relevant if this report, including the data, opinions, conclusions and recommendations it contains, are to be used a considerable time after it was prepared. In these circumstances, further investigation of the site may be necessary.

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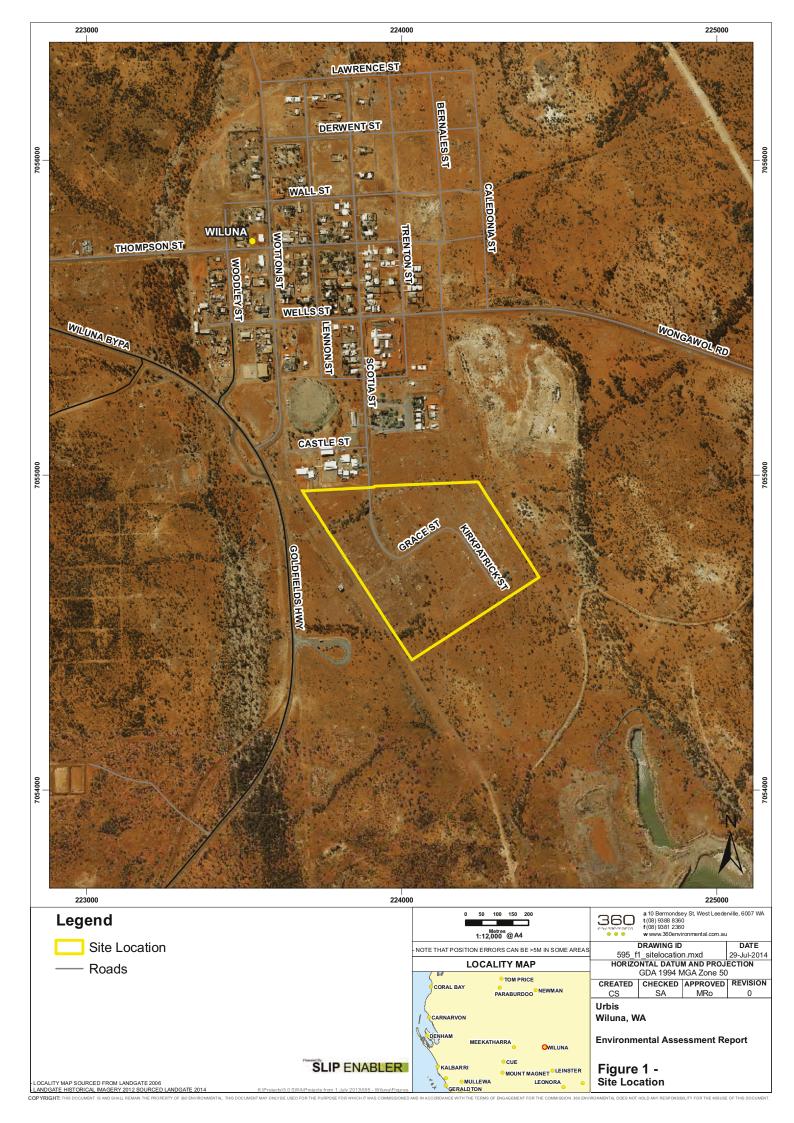
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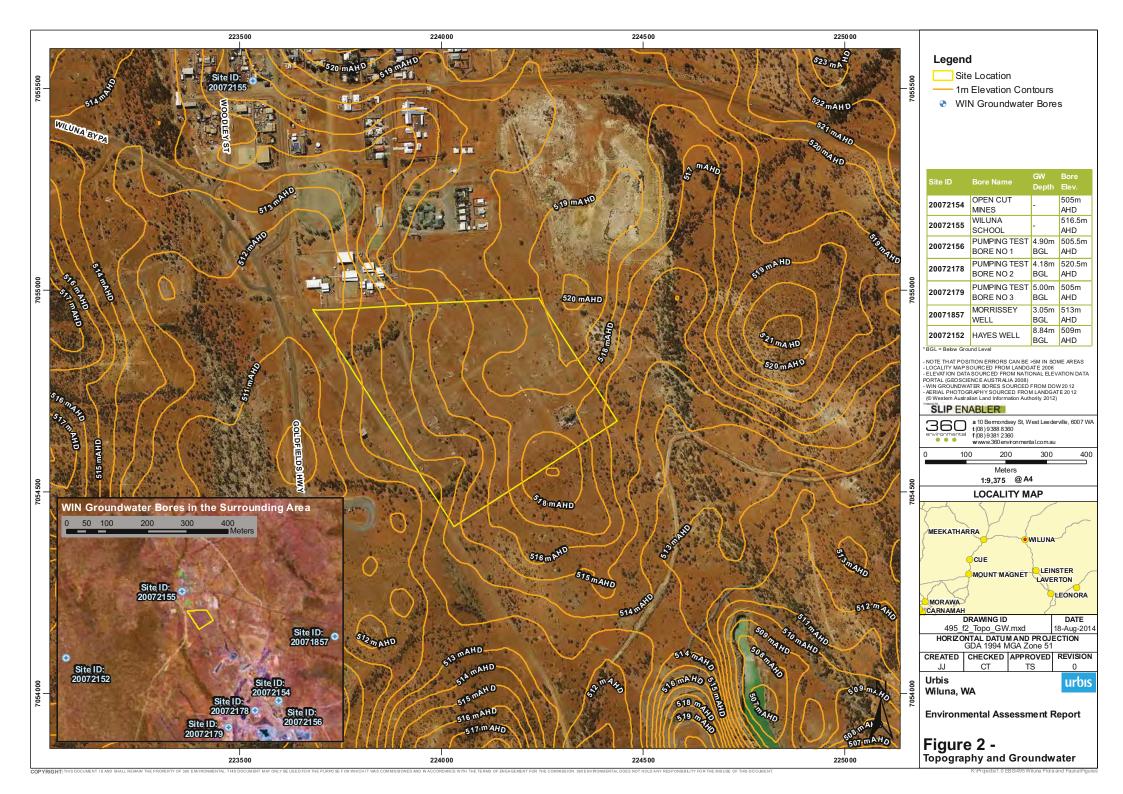


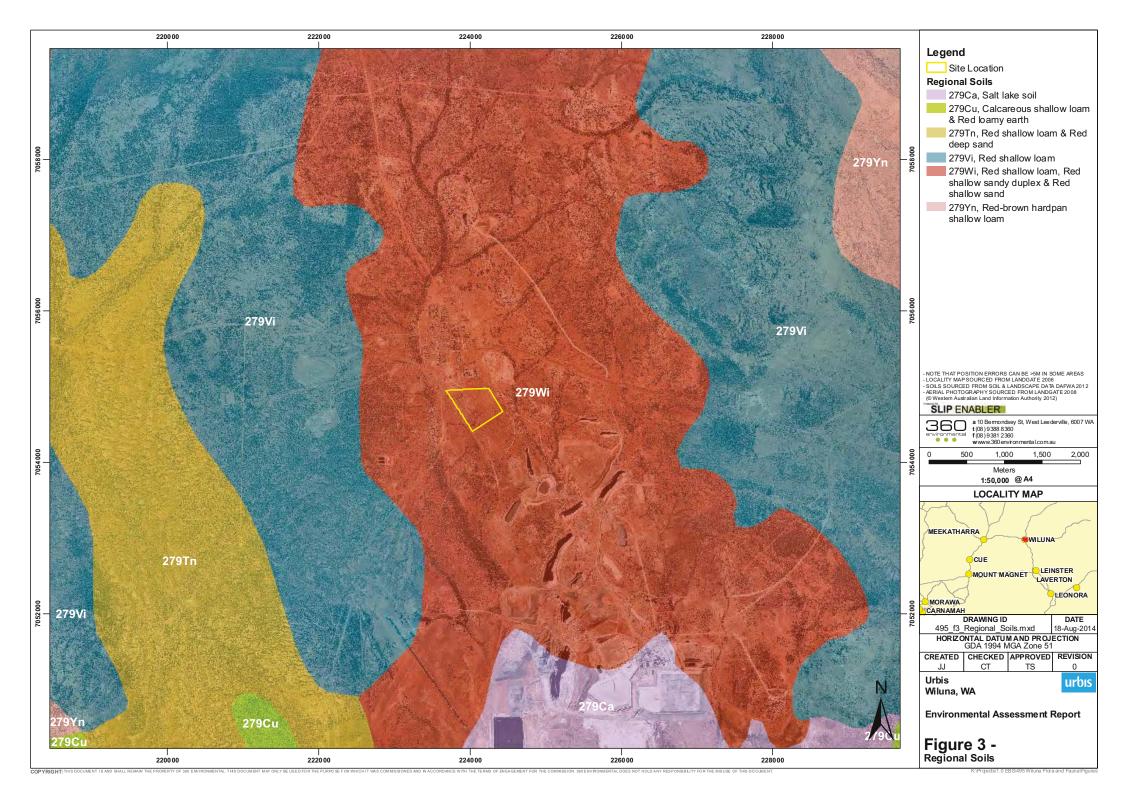
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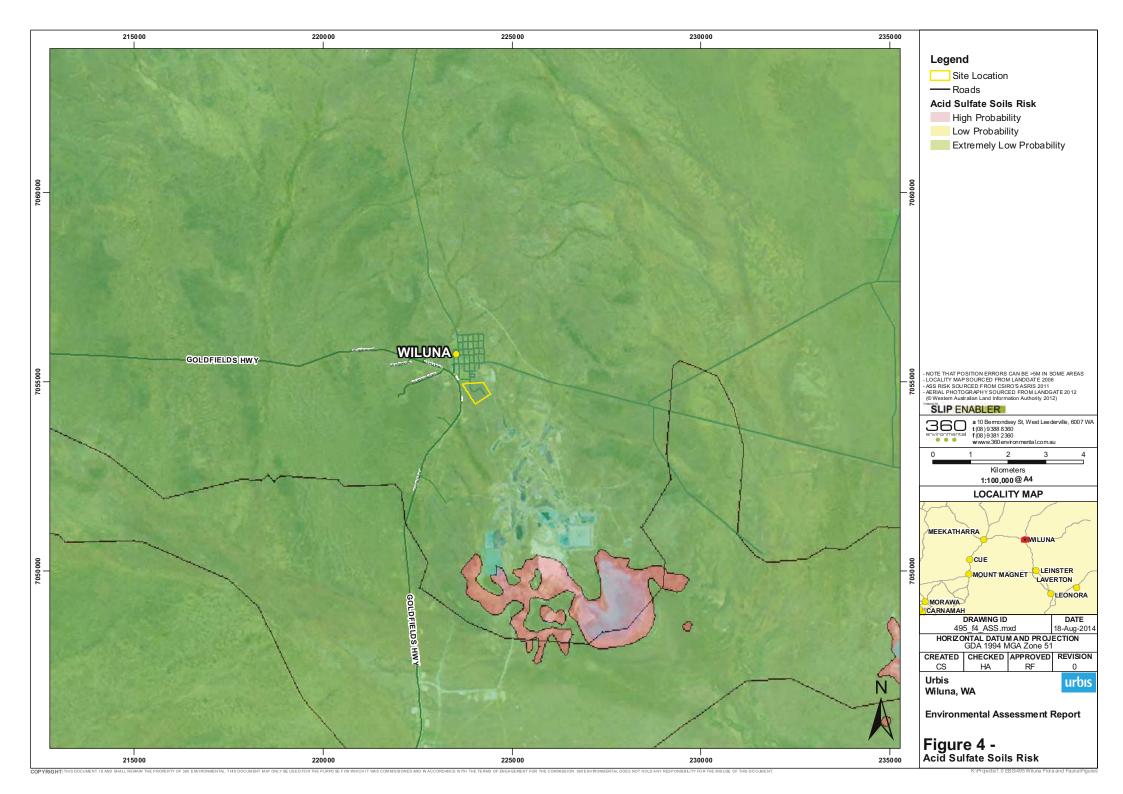


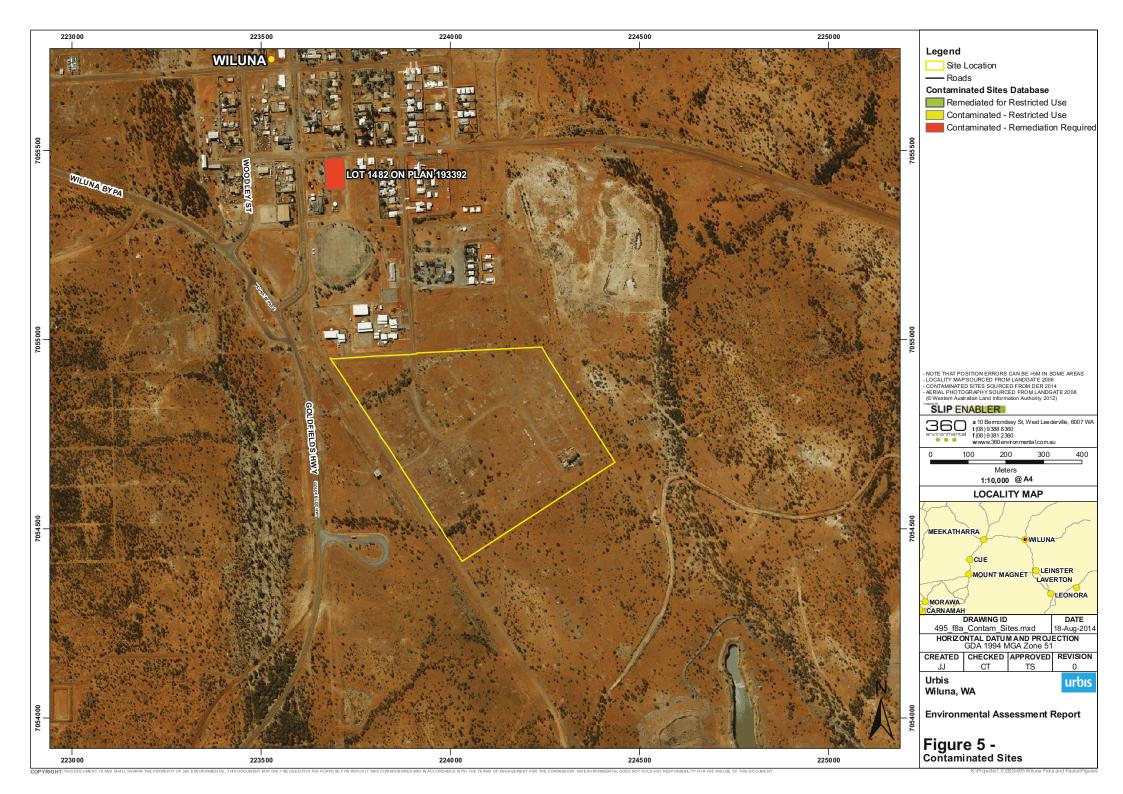


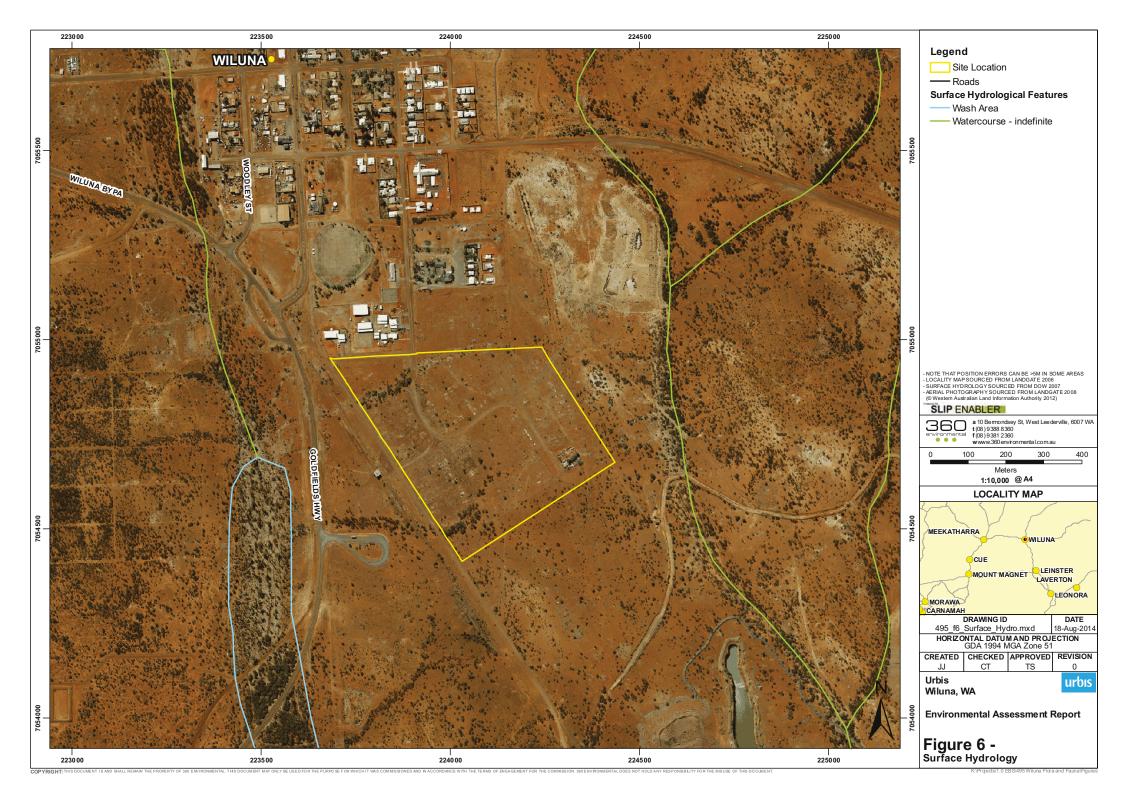


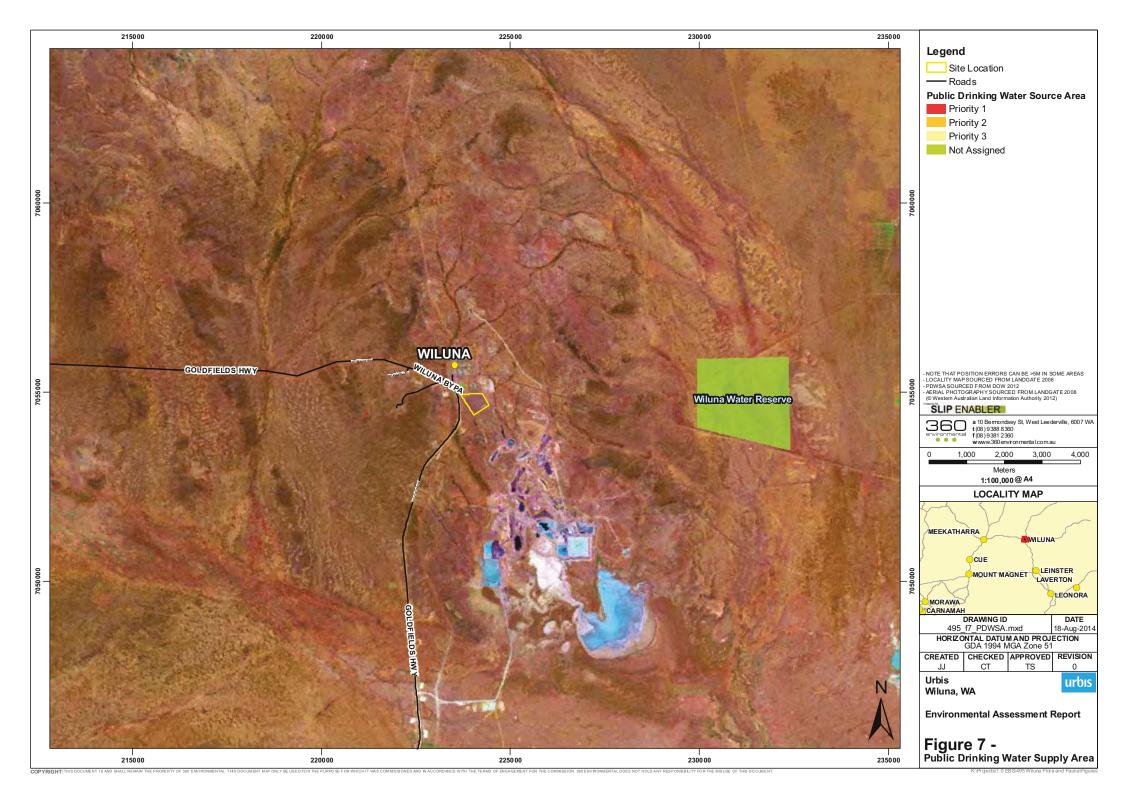


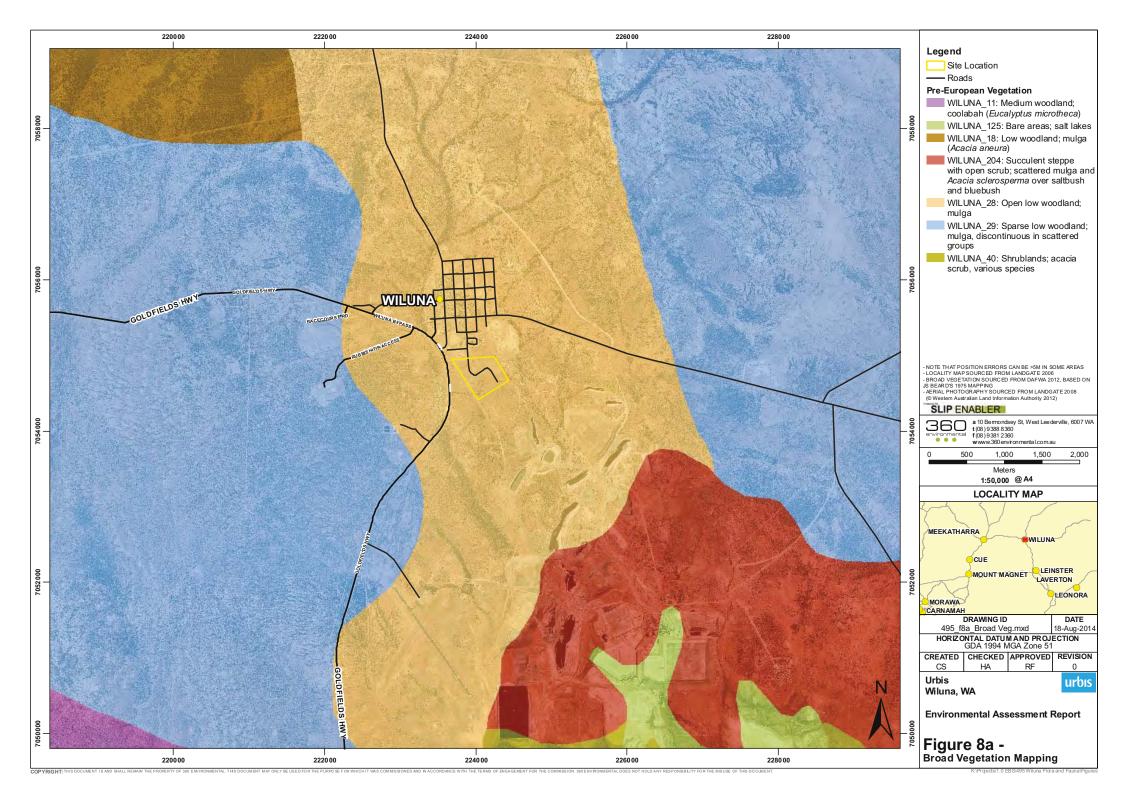


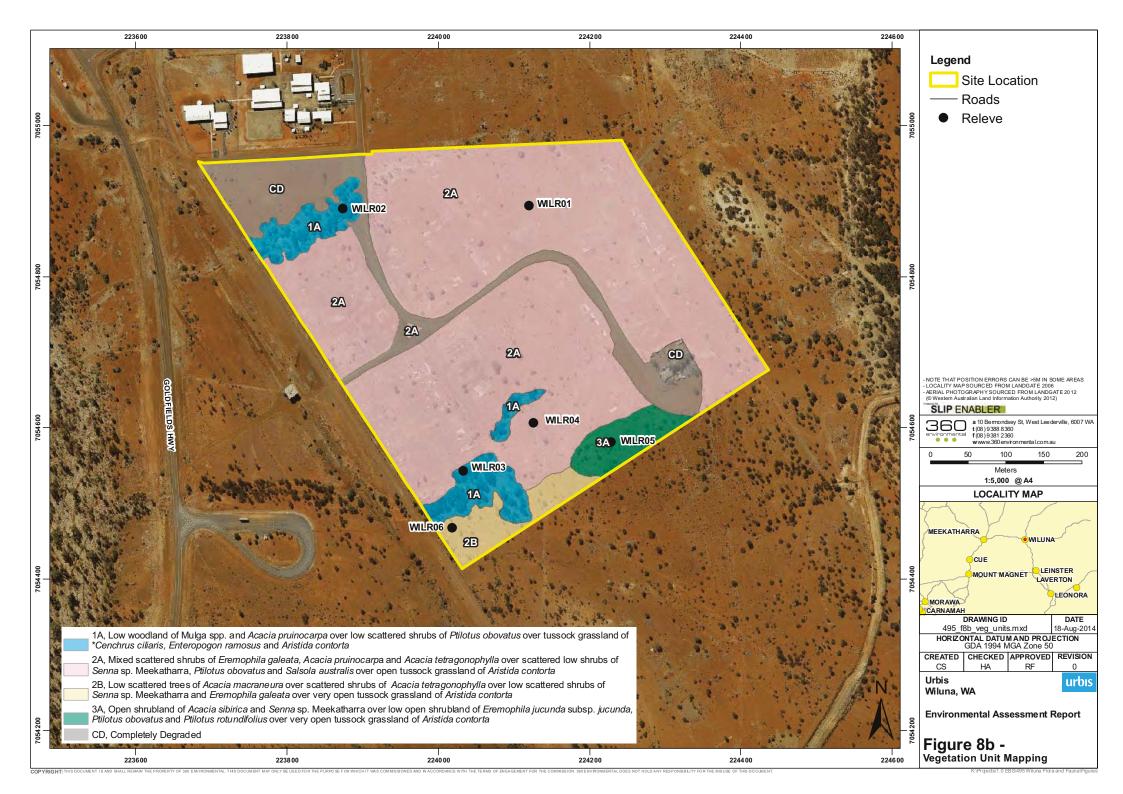


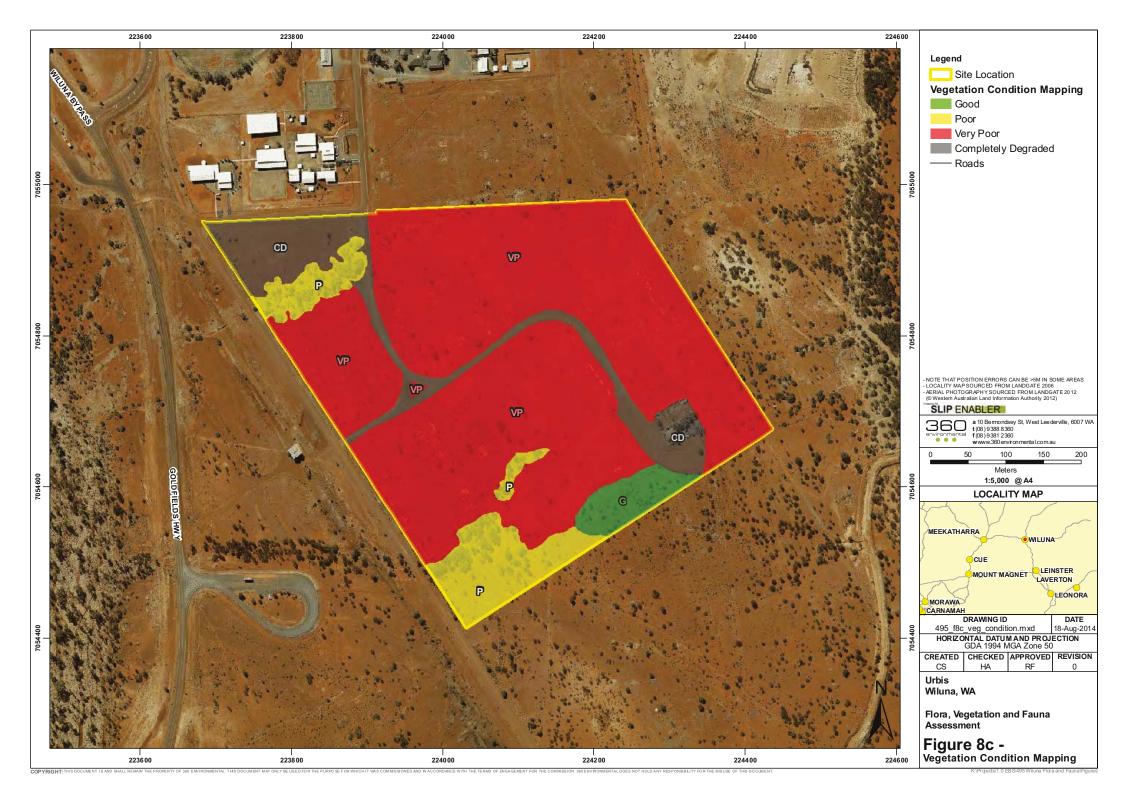


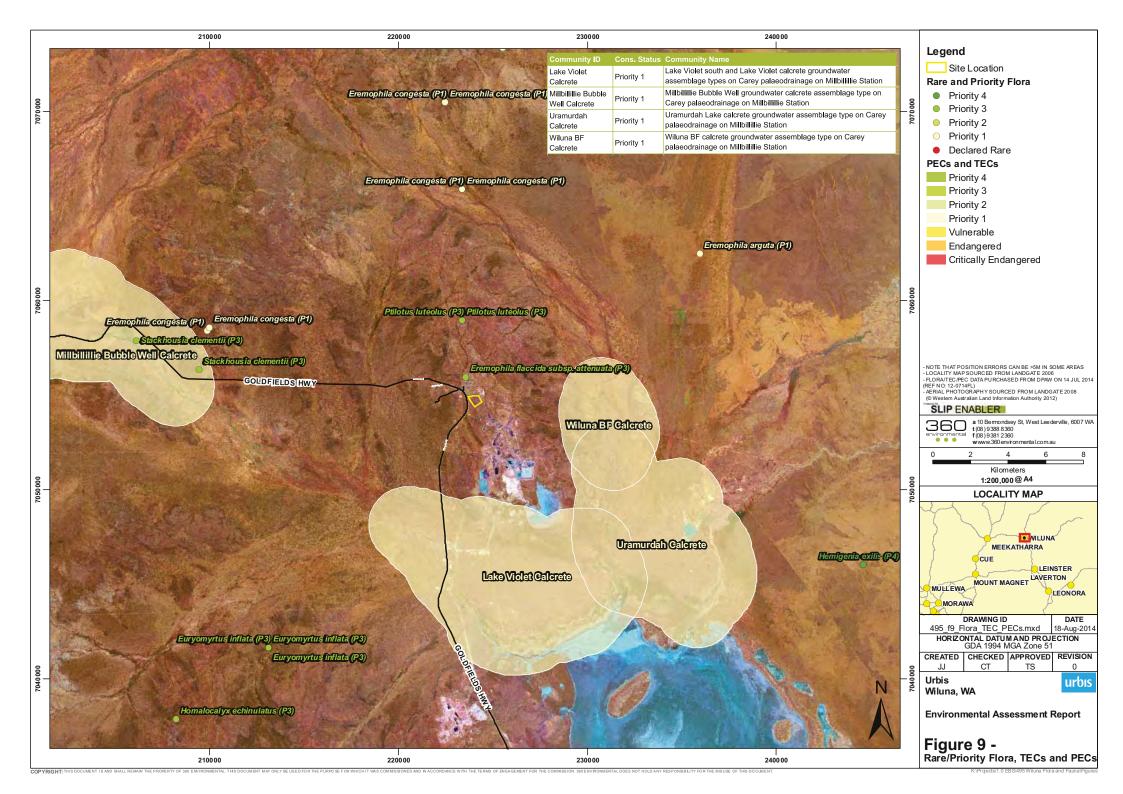


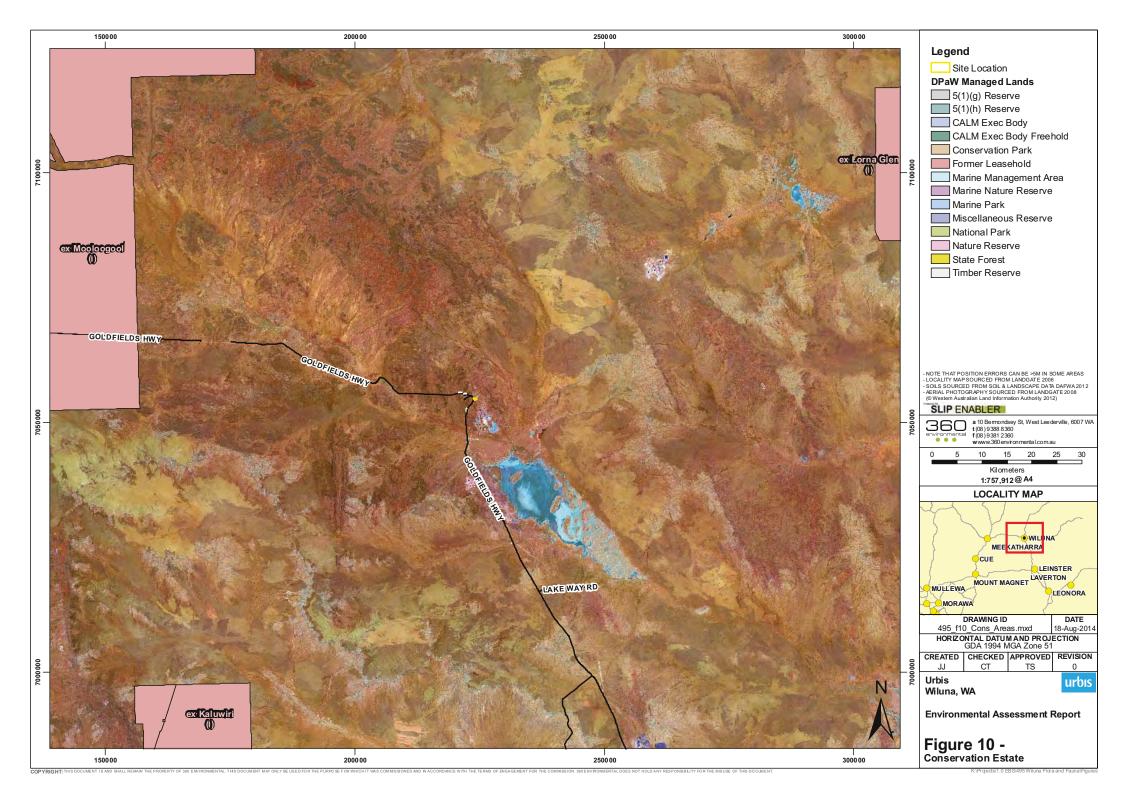




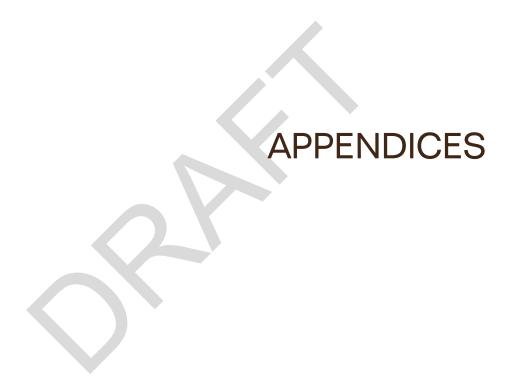












APPENDIX A

360 Environmental Flora, Vegetation and Fauna Assessment 2014

APPENDIX B

360 Environmental Preliminary Site Investigation 2014



Wiluna South, Western Australia

Preliminary Site
Investigation and
Sampling and
Analysis Quality Plan

Prepared for:
Shire of Wiluna

August 2014

peopleplanetprofessional

Document	Revision	Prepared by	Reviewed	Submitted to Client	
Reference			by	Copies	Date
595-AA	A Client Draft	DR	MR	1 Electronic (email)	1-09-2014

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Executive Summary

Background

360 Environmental Pty Ltd was commissioned by the Shire of Wiluna to undertake a Preliminary Site Investigation (PSI) for potential contamination at a 25 hectare (ha) landholding located in the southern portion of Wiluna town. The PSI has been prepared in order to support a structure plan for the redevelopment of the land.

It is understood that that the site has historically been used predominantly for residential land uses, but a number of potentially contaminating activities and industries occurred in close proximity to the site including mining operations, fuel storage and railway activities. This PSI report has been prepared with reference to the Department of Environment Regulation (DER)'s Contaminated Sites Management Series (2001-2010).

Objectives

The objectives of the PSI were as follows:

- Identify the potential for contamination to be present on the site based on an assessment of past and present land uses.
- Identify potential pathways for contamination (if any) to migrate from sources to receptors (human and environmental).
- Identify sensitive receptors that may be impacted by contaminants (if any).
- Determine an appropriate scope for subsequent phases of work (if required).

Scope of Work

In accordance with guidelines outlined in the DER's Contaminated Sites Management Series (2001-2010) the following scope of work was undertaken:

- A detailed site inspection was completed by an environmental scientist.
- Review of historical land uses using historical aerial photography and interviews with persons knowledgeable of past land use activities, in order to determine if there are any potentially contaminating historical or current land uses at the site.
- Review of previous reports and supporting documentation relevant to the site.
- A search of DER databases and a Freedom of Information (FOI) search through the Department of Mines and Petroleum database for licences pertaining to the storage of dangerous goods, including fuels and chemicals.
- Development of a conceptual site model (CSM) including sources, pathways and receptors to gain an understanding of the fate and transport of chemicals of potential concern at the site.



Conclusions

Based on the results of the PSI, 360 Environmental make the following conclusions:

- The site was historically used for residential properties from the 1920s to the 1940s.
- The proposed future land use for the site is residential and forms the Wiluna south structure plan.
- Several areas of concern have been identified at site or within influencing distance to the site and include the following:
 - Remnant fragments of asbestos containing materials (ACM) as a result of demolished residential buildings constructed during Wiluna gold rush years of 1920-1940s. ACM is widespread on the surface of the site with the potential for further contamination of asbestos ion topsoil
 - Former State Battery located approximately 200 metres north east of site and believed to operate from 1904-1950 presenting potential soil and groundwater impacts.
 - Former railway yard activities located approximately 50 metres to the west of the site presenting potential soil and groundwater impacts.
 - Bunded tank storage area to the north-west of the site presenting potential groundwater contamination impacts.
 - Wiluna Gold Mine potentially generating dust.

Recommendations

Based upon the conclusions of the investigation, 360 Environmental recommend that, in accordance with the DER's *Contaminated Sites Management Series* that a Detailed Site Investigation (DSI) is undertaken to characterise the nature and extent of contamination at the site and to determine if any unacceptable risks to human health or the environment exist in the context of the current and/or future land use. As such a SAQP for the site has been prepared.

In addition, 360 Environmental recommend that an Asbestos Management Plan is prepared in order to detail requirements for the removal of ACM from the site. We note that Shire of Wiluna is obligated to report asbestos contamination at the site to DER.

A dust and air quality study should also be undertaken for the site due to its proximity as close as 600 m to the operational Wiluna Gold Mine.



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Appendix H Existing Production Well Borelogs

Appendix I Conceptual Site Model





1 Introduction

1.1 Overview

360 Environmental Pty Ltd was commissioned by the Shire of Wiluna to undertake a Preliminary Site Investigation (PSI) for potential contamination at a 25 hectare (ha) landholding located in the southern portion of Wiluna town. The PSI has been prepared in order to support a structure plan for the redevelopment of the land.

It is understood that that the site has historically been used predominantly for residential land uses, but a number of potentially contaminating activities and industries occurred in close proximity to the site including mining operations, fuel storage and railway activities. This PSI report has been prepared with reference to the Department of Environment Regulation (DER)'s *Contaminated Sites Management Series* (2001-2010).

1.2 Objectives

The objectives of the PSI were as follows:

- Identify the potential for contamination to be present on the site based on an assessment of past and present land uses.
- Identify potential pathways for contamination (if any) to migrate from sources to receptors (human and environmental).
- Identify sensitive receptors that may be impacted by contaminants (if any).
- Determine an appropriate scope for subsequent phases of work (if required).

1.3 Scope of Work

In accordance with guidelines outlined in the DER's Contaminated Sites Management Series (2001-2010) the following scope of work was undertaken:

- A detailed site inspection was completed by an environmental scientist.
- Review of historical land uses using title information, historical aerial photography and interviews with persons knowledgeable of past land use activities, in order to determine if there are any potentially contaminating historical or current land uses at the site.
- Review of previous reports and supporting documentation relevant to the site.
- A search of DER databases and a Freedom of Information (FOI) search through the Department of Mines and Petroleum database for licences pertaining to the storage of dangerous goods, including fuels and chemicals.
- Development of a conceptual site model (CSM) including sources, pathways and receptors to gain an understanding of the fate and transport of chemicals of potential concern at the site.



1.4 Site Identification and Zoning

The site location is presented in Figure 1. The site comprises 123 lots and forms the southern portion of the Wiluna town site and is bordered by Grace Street and Mudjon Street to the north, Prior Street to the east by Forrest Street to the west and Nulsen Street to the south. The site is located within the Shire of Wiluna and is presently zoned residential under the Shire of Wiluna Local Planning Scheme Number 2. Lots within the site are unallocated crown land apart from Lots 394, 395, 404, 420 and 421. Site identification details are summarised in Table A.

Table A: Site Identification

SITE IDENTIFICATION			
Street Address	Multiple		
Location	Wiluna Town site South		
Local Government	Shire of Wiluna		
Common Name	Not applicable		
Lot/Diagram	Multiple		
Volume/Folio	Multiple		
Registered Proprietor	Multiple		
Memorial on Title	Not Applicable		
Site Zoning	Residential		
	Corner Easting Northing		
Boundary Coordinates	NW: 223675 7054952		
(MGA 94, Zone 50)	SW: 223968 7054484		
(IVIGA 94, Zulie 30)	SE: 224349 7054752		
	NE: 224173 7054914		



2 Site History

Historical site activities were investigated in the following manner:

- A review of available historical aerial photographs from 1955 to present. Figures 2a-2c present a selection of significant aerial photographs.
- A search of the DER's Contaminated Sites Database (Appendix A) and Department of Water (DoW) Water Information Network (WIN) database (Appendix B) for previous site contamination assessments and groundwater characteristics, including bore uses in the vicinity of the site.
- A search through the Department of Aboriginal Affairs (DAA) and the Heritage Council of WA databases (Appendix C).
- A review of State Heritage Records
- A freedom of information (FOI) search for a dangerous goods license through the Department of Mines and Petroleum (DMP) (Appendix D).

The outcomes of the investigation are discussed in the following sections.

2.1 Historical Aerial Photographs

Viewing of selected historical aerial photographs dating back to 1955 was undertaken to assess land use, and environment and developmental changes over time. The site history, which includes a summary of aerial photography review and information, is summarised in Table B. Historical aerials are included as Figures 3a – 3c.

Table B: Historical Aerial Photograph Review

YEAR	FIGURE	Notes
1955	-	No structures could be observed within the site. The aerial photograph viewed from 1955 was not of adequate quality for the purpose of this investigation and could not accurately be reviewed.
		Site: The site infrastructure appears to be demolished with building pads remaining within the development area.
1983 3a	North: The town is developed and is serviced by unsealed roads. To the north east, significant staining or soil disturbance appears to occur in the approximate vicinity of the former State Battery operation.	
	3a	East: Minor staining or soil disturbance is identified to the immediate east of the site. A series of small unsealed tracks are visible in the approximate location of the staining or soil disturbance area. A seasonal river or drainage culvert is identified by the vegetation distribution and is located approximately 200 m to the east of the site.
		South: To the immediate south of the site a series of unsealed tracks and remnant vegetation is visible in what appears to be predominantly cleared land. Approximately 500 m south east of the site a number of buildings and building remains can be observed.



YEAR	FIGURE	Notes
		West: To the immediate west of the site, the railway station is visible. The location of the former railway track area can be identified but the infrastructure appears to have been removed prior to the photo being taken. Further to the east, Goldfields Highway is visible in its present day alignment and is unsealed. Site: Site infrastructure is predominantly demolished with building pads remaining. A residential property is visible in Lots 420 and 421 (See figure 1). Milton Street, Kirkpatrick Street and O'Donnell Street appear to be sealed.
		North: The town is developed and serviced by a sealed road. Approximately 200 metres to the north east, significant staining or soil disturbance appears to occur in the approximate vicinity of the former state battery.
2001	3b	East: An area of minor soil disturbance is identified to the east of the site along with a network of unsealed roads.
		South: To the immediate south of the site a series of unsealed tracks and remnant vegetation is visible in what appears to be predominantly cleared land.
		West: To the immediate west of the site, the railway station is visible. The location of the former railway track area can be identified but the infrastructure appears to have been removed prior to the photo being taken. Further to the east, Goldfields Highway is visible and appears to be a sealed road.
		Site: The site is predominantly demolished with building pads remaining. A residential property is visible in lots 420 and 421. Milton Street, Kirkpatrick Street and O'Donnell Street are no longer sealed.
		North: The town is developed and serviced by a sealed road. To the north east, significant staining or soil disturbance appears to occur in the approximate vicinity of the former state battery. Footprints of former buildings are visible.
2012	Зс	East: An area of minor soil disturbance is identified to the east of the site along with a network of unsealed roads.
		South: To the immediate south of the site a series of unsealed tracks and remnant vegetation is visible in what appears to be predominantly cleared land.
		West: To the immediate west of the site, the railway station is visible. The location of the former railway track area can be identified but the infrastructure appears to have been removed prior to the photo being taken. Further to the east, Goldfields Highway is visible and appears to be a sealed road.

2.2 Contaminated Sites Database Search

The DER online Contaminated Sites Database was searched in July 2014 for known contaminated sites at both the site and in close proximity to the site. The Contaminated Sites Database indicates that no known contaminated sites are registered within the vicinity of the site. The nearest registered contaminated site is believed to be located approximately 10 km north of the site, classified as contaminated due to a spill of approximately 250,000 litres of diesel into surrounding soils. The site is not considered to be within influencing distance of the site for soil or groundwater contamination.



2.3 DoW WIN Database Search

The DoW's WIN (Water Information Network) Groundwater Well Dataset (2014) has identified no groundwater wells within the boundaries of the site (Figure 3 and Appendix B). One groundwater well is located within 1 km of the site. The well is located at the Wiluna School approximately 500 m north west of the site boundary (well id 20072155). No static water level or purpose of the well is provided.

Fifteen groundwater wells are identified between 1 km and 5 km from the site. All wells are listed as having 'no current owner'. Only four of the wells are listed as 'operating'. Six of the wells are listed as being for observation or investigation. One well (well id 20071965) is listed as being for the purpose of investigation/production. This well is not listed as operating and is located approximately 4 km east of the site.

Static water level is provided for a limited selection of groundwater bores in the WIN database with static water levels ranging from 3.05 meters below ground level (mbgl) (well id 20071857) (approximately 4 km east of site) to 18.3 mbgl (well id 20072150) (approximately 3 km north of site.

Salinity measured as Total Dissolved Solids (TDS) ranges from 640 mg/L to 6170 mg/L indicating groundwater conditions are brackish within the town site and surrounds.

2.4 Heritage

2.4.1 Aboriginal Heritage

The Aboriginal Heritage Act 1972 is the Western Australian legislation in place to protect places and objects customarily used by or traditional to, the original inhabitants of Australia. Such places and objects are maintained in a register under the Act; however, all sites are protected under the Act whether or not they have been registered.

According to the DAA Aboriginal Heritage Inquiry System, one Aboriginal Heritage records were reported within the site and an additional Aboriginal Heritage site was identified approximately 500 metres south of the site boundary. The search results are included in Appendix C (DAA, 2014).

The heritage area identified within the site is site 2182 and listed due to mythological value and covers the entire Wiluna town site. The heritage area listed 500 metres south of the site is 2014 and listed due to artefacts, scatter and rock shelter heritage significance.

2.4.2 State Heritage

The Government of Western Australia's State Heritage office identified no known State Heritage sites the immediate vicinity of the site. The closest known heritage site was the Mine Manager House located 2 km south of the site and identified by state heritage number 5507 (Government of Western Australia, 2014).



2.5 Dangerous Goods Licence Search

A FOI search for a dangerous goods license was undertaken on 26 June 2014 through the DMP, to determine if any licenses for the storage of dangerous goods have ever been issued for the site. Under Section 26 of the *Freedom of Information Act 1992* access to documents was refused, that is, based on the information provided, a search of records failed to locate any documentation falling within the scope of request (Appendix D).

2.6 Council Records

The Shire of Wiluna was contacted on 11 July 2014 to obtain any relevant information regarding the site. The chief executive officer Ms Andrea Nunan noted they had no particular information on the site besides what can be found through a general desktop analysis.

2.7 Consultations with Knowledgeable Persons

Ms Andrea Nunan, the Chief Executive Officer of the Shire of Wiluna was contacted on 11 July 2014 to discuss operations of the site over the site's history. Ms Nunan detailed that the site was predominantly developed in the 1930s for residential purposes to support the influx of residents to the town during the Wiluna Gold rush years. Ms Nunan was not aware of any storage of fuels or chemicals on site and believed that the majority, if not all lots within the site were historically residential lots. Ms Nunan was not aware of any significant spills or environmental remediation within the site or immediate surrounds of the site.

Mr Rod Liversidge, the Manager of Technical Services at the Shire of Wiluna provided information on the site during the site visits on 21 July 2014 and 22 July 2014. Mr Liversidge provided details of former mining operations and processing facilities located in close proximity the site. This included information on the State Battery located to the north-east of the site and details on the railway station. Mr Liversidge was not aware of any significant spills or environmental remediation with the site or immediate surrounds of the site.

Site conditions and infrastructure are detailed further in Section 3.1.

2.8 Previous Environmental Reports

360 Environmental and the Shire of Wiluna are not aware of previous environmental investigations relating to the site.

2.9 Town Historical Records

The State Heritage office provided information in respect to historical records relating to the site.



On 2 February, 1904 the State Battery was opened. The Battery was a government owned and run ore-crushing facility. It was located adjacent to the east boundary of the early town site. The Battery located approximately 200 metres north east of the site boundary received much use from the time it was constructed until the late 1940s when the Wiluna Gold Mine closed treating 102,849 tons of ore. From 1915 to 1930, when the Battery also had a ball mill and cyanide vats, 82,979 tons of ore were treated (State Heritage Office, 2014).





3 Site Conditions and Surrounding Environment

3.1 Detailed Site Inspection

The site was inspected by an Environmental Scientist on 21 July 2014 and 22 July 2014 to examine for indicators of potential contamination. Site conditions are discussed in Table E with site photographs provided in Appendix E.

Table C: Site Conditions

FEATURE	CONDITIONS		
Access	Access to the majority of the site was observed to be unrestricted with vehicle access available to the north of the site through O'Donnell Street. Lots 420 and 421 were observed to be fenced with limited access and occupied by a residential property.		
Structures and hardstands	Two structures were identified within the lots which form the site. A standalone house observed covering Lots 420 and 421 is currently occupied and suspected to contain ACM Remnant concrete pads were identified in the majority of lots within the site boundary (approximately 75 concrete pads identified) and were surrounded by general scattered demolition waste including wood and asbestos containing material (ACM) on soil surface consistent with what would be expected to be contained in the original buildings at site developed during the 1930s and 1940s. ACM cladding was widespread across the surface soils of the site and confirmed to contain asbestos by laboratory analysis with certificates of analysis provided in (Appendix F. ACM is not anticipated to have entered the sub surface soils however this could not be confirmed by the site inspection. A number of waste disposal pits across the site were identified and appear to contain waste from the demolition of residential buildings within the site boundaries. These waste disposal pits are likely to contain ACM. Used tyres and rusted machinery was identified across the site with a tractor or truck engine observed in the southern portion of site.		
Flora and Fauna	A level 1 flora investigation was completed on site on 21 July 2014. Scattered vegetation regrowth has occurred on site including a mixture of native and introduced species. Site vegetation is not considered to contain significant habitat.		

3.2 Surrounding Environment and Land Uses

The surrounding environment and land use is summarised in Table F. The DEC (2004) Potentially Contaminating Activities, Industries and Landuses guideline lists railway yards and mining and extractive industries as potential sources of contamination to site soil and groundwater. In addition to these potential sources of contamination, residential development on the site occurred during a time period when asbestos use was widespread and contamination is considered likely at site.



Table D: Surrounding Environment and Land Uses

DIRECTION	ENVIRONMENT CONDITIONS		
North	Wiluna Town site (residential). An above ground tank was present approximately 100 metres to the north east of site; however, it looked aged, rusted and appeared to have not been in use for a significant time period.		
East	Former refinery facility approximately 300 metres to the north east (State Battery) and seasonal creek line.		
South	Former residential area and Wiluna Gold Mine (600m to 4.5 km south-east of the site)		
West	Former railway station, goods shed, tank storage, concrete bund elevated railway track and Goldfields Highway. An existing groundwater well is installed in the vicinity of the former railway station with construction logs provided in appendix H and location displayed in Figure 4.		

3.3 Underground Services

A Dial Before You Dig search request for all underground services located on and in the immediate vicinity of the site was submitted through the Dial Before You Dig website on 8 July 2014. Results of this search are summarised below:

- Telstra Underground services were identified on the site along the site western boundary.
- Water Corporation A water main is identified running parallel to Kirkpatrick Street to the east.
- Horizon Power A wire segment LV route is detailed in the south east of the site and connects Lots 420 and 421 with Wiluna town. (Above ground)

3.4 Topography

A site survey was conducted by McMullen Nolan Group on 1 August 2014 (Appendix G). The site elevation ranges from 510 mAHD to 518 m AHD. Interpreted gradients from the survey points indicate that site gradient falls gradually towards the north-west corner with the exception of the south-east of site which drains to the south east.

3.5 Surface Hydrology and Wetlands

Surface runoff of the site is expected to follow the topography contours of the site and progress predominantly towards the south western boundary of the site with select portions of the site draining to the eastern area of site as outlined in Section 3.5Surface water from the west of site is expected and passing through a series of culverts beneath the former railway line and Goldfields Way to an unnamed seasonal creek to the west of site and eventually connect into Lake Violet approximately 6 km to the south of site. Surface water in the eastern portion of the site is predicted to flow off-site towards the east following natural groundwater contours and potentially joining with a seasonal creek line to the north of site.



No permanent surface water features were identified within the site or within close proximity to the site. The closest surface water features to the site are a series of tailings dams located approximately 1 km south of the site with Lake Violet located approximately 6 km south of the site. It is not known if Lake Violet contains any environmental significance but it is not considered to be within influencing distance of the site.

The site does not lie within the 100 year average recurrence flood interval and would be unlikely to become flooded with heavy rainfall events (Landgate, 2014).

3.6 Regional Geology and Soils

Regional soil mapping by The Department of Agriculture and Food Western Australia (DAFWA) dataset indicates that the entire site falls within the Wiluna System (DAFWA, 2012). This soil sub-system is characterised by low greenstone hills with occasional lateritic breakaways and broad stony slopes, lower saline stony plains and broad drainage tracts.

Geological mapping of the site shows the bedrock geology of the site as belong to Granite and Gneiss bedrock of the Archaean period (Department of Mines and Petroleum, 2014). Drilling logs supplied by the Shire of Wiluna (Appendix F for a recent irrigation bore install detail the surface soil lithology as a red loam/broken rock top soil underlain by coffee rock and weathered granite.

There is no known imported fill at the site.

3.7 Acid Sulfate Soils

The DER has not identified any areas of Acid Sulfate Soil (ASS) risk within the site boundaries or within the vicinity of the site. A search of the ASRIS database indicated that there is very low probability of the occurrence of Acid Sulfate Soils on the site.

3.8 Hydrogeology

Wiluna is situated on the north eastern bloc of the Archaean Yilgarn Block. The town wellfield draws groundwater from the East Wiluna aquifer that occupies the lower portions of the Negrara and Kukabudda Creek drainage systems.

The East Wiluna aquifer in the vicinity of the town well field comprises lateritic alluvium and massive calcrete overlaying weathered Archaean greenstone and granite. The calcrete aquifer extends over 25 km² between the wellfield and Lake Violet to the south.

The calcrete stratum exploited by the town water supply bores at Wiluna appears to behave as an unconfined aquifer. Hydraulic properties for the bores have not been derived although it is believed that the calcrete operates as a relatively high permeability secondary flow dominated aquifer.

Recharge to the aquifer is believed to result from periodic direct rainfall onto the calcrete and through indirect recharge resulting from periodic flow within the Negrara and



Kukabubba creeks drainage system with groundwater flow to the south. (Water Corporation, 2004).

Based a review of the site's location with the catchment and a review elevation contours it is anticipated that groundwater flow within the site is likely to be in a southerly direction.

3.9 Public Drinking Water Source Areas

The site is not located within any surface or groundwater protection areas. The closest Public Drinking Water Source Area (PDWSA) is the Wiluna Water Reserve located approximately 6 km east of the site (Water Corporation, 2004).

3.10 Community Consultation

A community consultation program was not conducted as part of this phase of works as the primary aim of the PSI was to gather information on the potential for contamination existing onsite and offsite. Following results of this PSI and in accordance with the staged approach to site investigations endorsed by the DER, 360 Environmental recommend appropriate community consultation is undertaken to meet the requirements of the DEC (2006) Contaminated Sites Management Series: Community Consultation Guideline and Ministerial Statement 669 during any future stages of assessment.



4 Conceptual Site Model

Based on results of the PSI, including desktop assessment and site visit, a conceptual site model (CSM) was developed for the site. The CSM summarises potential contaminant linkages (source-pathway-receptor) and is discussed in the sections below.

4.1 Potential Sources of Environmental Concern

Widespread evidence of impacts from contamination (particularly ACM) were observed during the site inspections, activities undertaken across the site are recognised under the DEC (2004) Potentially Contaminating Activities, Industries and Landuses guideline as being of potential environmental concern. Further assessment, including soil and groundwater sampling, is recommended to delineate the lateral and vertical extent of the contamination status of the soil and groundwater across the site.

Several potential contamination sources can be identified for the site:

- Widespread use of ACM in residential buildings constructed during Wiluna gold rush years of 1920-1940s. Asbestos contamination is widespread on the surface of the site with the potential for further contamination of asbestos in top soil profile.
- Former State Battery located approximately 300 metres north-east of site which operate from 1904 to 1950.
- Former railway yard activities located approximately 50 metres to the west of the site.
- Former Fuel Storage Tanks located north-west of the site.
- Wiluna Gold Mine potentially generating dust.

4.2 Potential Contaminants

Contaminants that may be associated with the potential contamination sources are summarised in Table G below.

Table E: Potential Contaminants and Areas of Association

CONTAMINANT	RATIONAL	MATRIX
Heavy metals (including arsenic, lead, zinc, cadmium, chromium, copper, mercury)	Associated with former off-site facilities including railway yards and state battery and groundwater application through irrigation from off-site production bore and current land use.	Soil and groundwater
Copper and arsenic	Potential pesticide treatment of house foundations and wood. It is noted that organochlorine pesticides were not in use at the time housing was present within the site.	Soil and groundwater



Cyanide	Associated with State Battery processing facility off-site	Soil and
Cyanide	(Cyanide Vats).	groundwater
	Associated with former off-site fuel storage areas to the	
Petroleum hydrocarbons	north-west of the site and surrounding mining	Groundwater
	operations.	
Asbestos	Associated with demolished residential buildings on site.	Soil
Air particulates (pm10)	Potential for dust generation from the Wiluna Mine Site	Air

4.3 Receptors

Potential receptors for the soil or groundwater contamination at the site may comprise the following:

- Current or future users of groundwater on and offsite hydraulically down-gradient (south)
- Future occupants of the site (residential)
- Current and future occupants of surrounding residential housing
- Future recreational site users
- Current and future contractors and employees working on the site
- Environmental Receptors located off-site.

4.4 Risk Assessment

Table H summarises the sources of potential environmental concern, pathways, receptors and risks.

DBYD searches have indicated that there are service trenches across the site which may provide a preferential pathway for the migration of contaminants across the site; if additional services are installed, these may provide additional preferential pathway for groundwater contaminant migration.



Table F: Sources of Potential Environmental Concern, Pathways and Receptors.

SOURCE	PATHWAY	RECEPTOR	POTENTIAL RISK
Surface soil impacted by ACM	Direct contact, ingestion of soil, inhalation of	Current or future site users	High where surface asbestos fragments remain and no cap is present or proposed
	particulates	Occupants of adjacent areas	Low
		Construction phase workers during any site works	High where surface soils remain and no cap is present or proposed, with no requirement for workers to wear asbestos PPE
Surface soil potentially impacted by off- site mining and	Direct contact, ingestion of soil, inhalation of particulates	Current or future site users	Moderate where surface soils remain and no cap present or proposed Low when concrete capping present or proposed
soil activities due to potential termite		Occupants of adjacent areas	Low (unless occupying former contamination source areas)
treatment, former Railway Storage Yard		Construction phase workers during any site works	Moderate
		Ecological receptors	Low. No significant ecological receptors in proximity to site
Subsurface soils potentially	Direct contact, ingestion of excavated	Current or future site users	Moderate where no cap present
impacted by potential termite treatment,	soil, inhalation of particulates/vapours	Construction phase workers during excavation works	Moderate
former Railway Storage Yard	Leaching into groundwater then migration offsite to hydraulically down gradient receptors	Ecological receptors	Low. No significant ecological receptors in proximity to site
Groundwater potentially	Direct contact and ingestion, dermal	Current and regional groundwater users	Low
impacted by potential termite treatment,	contact with abstracted water, inhalation of vapours.	Occupants on site and of adjacent areas.	Moderate where site groundwater is used for irrigation purposes
former Railway Storage Yard and State Battery Facility	Migration offsite	Construction phase workers during site works	Low if groundwater is not used on site
y		Ecological receptors	Low. No significant ecological receptors in proximity to site



5 Fate and Transport of Chemicals of Potential Concern

Primary fate and transport mechanisms for contaminants potentially present at the site have been identified as including the following:

- Transport of chemicals with groundwater flow
- Degradation of chemicals in soil and groundwater
- Volatilisation of chemicals from soil and groundwater
- Erosion of particulate-bound chemicals from soil
- Leaching from soil with infiltrating water

These mechanisms affect the distribution and migration of potential contaminants of concern across the site.

5.1 Fate and Transport Mechanisms

5.1.1 Volatilisation

Volatilisation can significantly affect the distribution of a chemical in the environment. In soils, the result is a decrease in the amount of a chemical in the soil as the chemical volatilises to soil gas and ultimately discharges to the atmosphere. The end result is a reduction in chemical concentration in soil over time. Volatilisation reactions are most significant in surface soils that are in direct (or near-direct) contact with the atmosphere.

Chemical volatility is typically quantified by a chemical's Henry's constant. Henry's constant may be calculated from the chemical's vapour pressure, molecular weight, and solubility. The lower the Henry's constant, the less volatile the chemical.

The majority of the potential contaminants are characterized by low Henry's constants (i.e., < 0.01), and thus volatilization is not anticipated to substantially influence the fate of these analytes at the site. Notable exceptions include all BTEX compounds with Henry's constants, orders of magnitude higher. Similarly, it would be anticipated that shorter and longer chained total petroleum hydrocarbons would also be fairly volatile. It is considered likely that volatilisation would deplete BTEX and TRH, particularly in surface soils.

5.1.2 Degradation

Numerous chemicals in the environment are subject to naturally occurring biotic (biologically based) and abiotic (non-biologically based) transformation reactions that result in the degradation of the chemical. Many organic compounds are subject to biodegradation reactions under aerobic (in the presence of oxygen) and anaerobic (in the absence of oxygen) conditions. During biodegradation, naturally occurring microorganisms in the subsurface transform a chemical to another state as a direct or



indirect consequence of their metabolic processes. Biodegradation reactions often break down organic chemicals to less toxic forms.

Several naturally occurring abiotic reactions can significantly affect the fate of chemicals in the environment. Common abiotic reactions include photodegradation and hydrolysis. Photodegradation is the process of decomposition of a chemical upon exposure to radiant energy such as the action of light, and is most significant to chemicals in surface soil that are in direct contact with sunlight. Hydrolysis is the degradation reaction of the chemical with components of water (e.g., hydroxyl and hydronium ions) and is thus most important in saturated environments.

Degradative processes may substantially influence the concentrations of the chemicals of concern identified in the CSM, including heavy metals, BTEX, MBTE, TRH and nutrients. However, petroleum hydrocarbons (particularly shorter chain length species) are known to be biodegraded, particularly under aerobic conditions. It is anticipated that biodegradation processes would be acting to reduce petroleum concentrations in soils at the site.

5.1.3 Leaching

Chemicals in soils have the potential to migrate to greater depths with infiltrating water. As rainwater infiltrates, chemicals may be leached from the soil and carried to greater depths and potentially to groundwater. The degree to which a chemical is leached is strongly influenced by the chemical's tendency to partition to the solid or aqueous phases, which is largely a function of the chemical's solubility and particle affinity. As the majority of the site is uncapped with a red loam/brown rock surface, there is a significant potential for rainwater to infiltrate to greater depths through the soil.

5.1.4 Solubility

Water solubility describes the amount of a chemical that will dissolve in a given quantity of water, and thus is a primary determinant in the transport of a chemical in the environment. Highly soluble chemicals can often readily dissolve in water and are thus susceptible to being mobilised from the soil matrix with infiltrating water and migrate to groundwater.

The solubility of organic chemicals is typically a function of the hydrophobic nature of the chemical. Many organic chemicals are non-polar and thus do not dissolve readily into water; a polar solution. Strongly non-polar compounds have low water solubility and therefore are rarely present in water. The solubility of inorganic chemicals is typically a function of the tendency of the chemical to form mineral phases and the relative abundance of the chemical ingredients required to form the mineral phase.

5.1.5 Adsorption

The aqueous concentration of chemicals in soil systems can be substantially influenced by adsorption reactions to the soil matrix. Adsorption is the ability of a substance to bind to the surface of soil particles as a result of reactions that occur between the chemical



and the soil particle surface. The tendency for a chemical to be adsorbed is a function of the nature of the chemical and the site-specific soil properties, and is typically quantified by a distribution partitioning coefficient (K_d). K_d is a measure of the ratio of chemical mass that partitions to the solid and liquid phases under equilibrium conditions. Inorganic compounds are commonly bound to soil particles as a result of electrostatic interactions.

Organic compounds are frequently non-polar and thus tend to interact with organic matter commonly associated with the soil matrix. The general tendency of an organic chemical to be adsorbed by soils may be assessed by the chemical's organic carbon partition coefficient (K_{oc}), which describes the tendency of the chemical to partition from water to organic carbon. The site-specific K_d for organic chemicals can be estimated as the product of the fraction of organic carbon (f_{oc}) in the soil matrix and the chemical's K_{oc} . The K_d values for the contaminants of concern are relatively low suggesting that these chemicals are unlikely to be readily absorbed by soils.

5.1.6 Erosion

Erosion processes can substantially affect the distribution of soil-bound particulates in the environment and thus influence the distribution of soil contaminants. High winds can scour fine particles from the soil surface and redistribute these particles downwind. This, plus surface runoff often represent the primary mechanism for transport of otherwise immobile chemicals such as heavy metals. Wind erosion plays part in mobilizing contaminants from surface soils. As a result, water erosion has the potential to redistribute contaminants in surface soils on a localised basis and offsite. Fate and Transport of contaminants at the Site

The assessment of chemical fate and transport in soil and groundwater focuses on the distribution, historical trends, and subsurface migration of contaminants. Contaminants in groundwater may be transported hydraulically down gradient of the site. The rate of migration of contaminants in groundwater is largely dictated by the groundwater flow rate, interstitial pore velocity, and the chemical-specific attenuation.

Chemical migration rates are often slowed relative to groundwater flow due to attenuation reactions that occur in the subsurface. As discussed earlier in this section, two common attenuation mechanisms are adsorption and degradation reactions—both of which are highly dependent on subsurface conditions. The effect of adsorption reactions on chemical migration rates is typically quantified through the use of a retardation factor (R), which may be estimated from the chemical-specific partition coefficient (K_d) and soil bulk density (ρ b) and porosity (ρ) as per the following equation:

$$R = 1 + (\rho b/n) \times K_d$$
.

The velocity of contaminant migration (vc) can then be estimated from the interstitial velocity (v) as:

$$vc = v/R$$



5.1.7 Heavy Metals

The relative proportion of heavy metals between the dissolved and particulate phases is controlled by a complex combination of precipitation and sorption reactions. In addition, heavy metals in solution may exist as "free" ions or complexed with other dissolved inorganic or organic compounds. Water solubility is a primary determinant in the transport of a chemical in the environment. The solubility of heavy metals is highly dependent on geochemical conditions at the site, and is controlled by precipitation and adsorption reactions, which are likely to be the most significant factors affecting heavy metals migration.

Arsenic is typically present in groundwater as its trivalent state (as the anion H_2AsO_3 - or as H_3AsO_3) under reduced conditions and its pentavalent state (as the anions H_2AsO_4 $^-$ or $HAsO_4$ 2) under oxidized conditions. The trivalent forms are generally more poorly sorbed, and thus more mobile than the pentavalent forms. Overall, arsenic is moderately soluble and is readily transported in groundwater.

Chromium typically exists in groundwater in its trivalent or hexavalent oxidation state. Cr^{3+} is much less soluble in groundwater than Cr^{6+} . Copper is strongly bound to inorganic and organic materials both in soil and groundwater. Mercury is typically present as a free cation (Hg^{2+}) in most natural water systems.

5.1.8 BTEX and TPH

Upon release to soil, BTEX and shorter chained TRH compounds are usually subject to rapid volatilization near the surface. That which does not evaporate, is generally highly to very highly mobile in soil and may leach to groundwater. The compounds may be subject to biodegradation both in soils and in shallow, aerobic groundwater. Longer chained TRH may undergo some volatilization, but the remainder is likely to adsorb moderately well to the soils.

5.1.9 MTBE

Methyl tertiary-butyl ether (MTBE) is the most common oxygenated fuel additive used in reformulated unleaded petroleum. Even at low concentrations MTBE can be detected by taste which causes even low concentrations of contaminants to leave samples non-potable. The higher water solubility and persistence of MTBE cause it to travel faster and farther than many other components of gasoline when released into an aquifer.

MTBE is biodegraded by the action of bacteria, this can occur rapidly and economically removed from water to undetectable levels.

5.1.10 Asbestos

Asbestos has been used as a reinforcing agent in cement sheeting for walls and roofs, in cement building products such as tiles, cold water tanks, pipes and gutters, and in



insulating board used as wall partitions, fire doors, ceiling tiles and electrical switchboards (Department of Health and Aging (DoHA, 2005). The manufacture of asbestos cement sheeting and high- pressure piping was phased out in the 1980s, with the last asbestos product, Pressure Pipe, ceasing in 1987. Accordingly, houses built since then are considered unlikely to contain asbestos (DoHA, 2005). DoHA provides a list of common trade names for asbestos cement products and the last year of production for each product.

Site history investigations have indicated the majority of the surrounding housing and site infrastructure, was constructed prior to the mid to late 1980s. No ACM was observed across the site during the detailed site inspection; however, on the basis of the information provided by the site history study in relation to the ages of the site and surrounding buildings, asbestos is considered a potential contaminant of concern at the site.



6 Conclusions and Recommendations of the Preliminary Site Investigation

Based on the results of the PSI, 360 Environmental make the following conclusions:

- The site was historically used for residential properties from the 1920s to the 1940s.
- The proposed future land use for the site is residential and forms the Wiluna south structure plan.
- Several areas of concern have been identified at site or within influencing distance to the site and include the following:
 - Remnant fragments of asbestos containing materials (ACM) as a result of demolished residential buildings constructed during Wiluna gold rush years of 1920-1940s. ACM is widespread on the surface of the site with the potential for further contamination of asbestos ion topsoil
 - Former State Battery located approximately 200 metres north east of site and believed to operate from 1904-1950 presenting potential soil and groundwater impacts.
 - Former railway yard activities located approximately 50 metres to the west of the site presenting potential soil and groundwater impacts.
 - Bunded tank storage area to the north-west of the site presenting potential groundwater contamination impacts.
 - Wiluna Gold Mine potentially generating dust.

Based upon the conclusions of the investigation, 360 Environmental recommend that, in accordance with the DER's *Contaminated Sites Management Series* that a Detailed Site Investigation (DSI) is undertaken to characterise the nature and extent of contamination at the site and to determine if any unacceptable risks to human health or the environment exist in the context of the current and/or future land use. As such a SAQP for the site has been prepared.

In addition, 360 Environmental recommend that an Asbestos Management Plan is prepared in order to detail requirements for the removal of ACM from the site. We note that Shire of Wiluna is obligated to report asbestos contamination at the site to DER.

A dust and air quality study should also be undertaken for the site due to its proximity as close as 600 m to the operational Wiluna Gold Mine.



7 Sampling and Analysis Quality Plan

7.1 Site Data Quality Objectives

The following data quality objectives (DQOs) are suggested as being appropriate for the site, are consistent with the processes set out in AS4482.1 (2005) *Guide to the investigation and sampling of sites with potentially contaminated soil - Non-volatile and semi-volatile compounds* and have been incorporated into this SAQP as discussed throughout the remainder of this document.

7.1.1 The Problem

The general premise of the SAQP is as follows:

- To determine whether soil and groundwater across the site have been contaminated by historical activities undertaken at the site and at the site surrounds.
- To determine if contaminants at the site present an unacceptable risk to the environment or human health.

7.1.2 Outcomes

The outcomes of the SAQP and subsequent Detailed Site Investigation (DSI) are to:

- Identify the potential for contamination to be present on the site based on an assessment of past and present land uses.
- Determine an appropriate scope for subsequent stages of work.

7.1.3 Decision Inputs Affecting Outcomes

There are a number of parameters that are considered to be likely to influence the outcomes of the investigation. These parameters are considered to be:

- Type and distribution of contamination within soil and groundwater at the site.
- Toxicity of the chemicals of potential concern and their persistence.
- The rate of flow of groundwater from the site and the location of potential receptors.
- The identification of potential receptors and the location of sensitive environments.
- The assessment of the exposure period for the potential receptors of concern.
- DER endorsed criteria for each medium.

Table I identifies the media identified as requiring assessment.



Table G: Media Requiring Assessment

MEDIA	YES	NO	JUSTIFICATION
Soil	Х		Further assessment of the soil conditions beneath the site is required.
Air		х	The risk of hazardous volatilisation of contaminants is considered very low.
Dust		х	The risk of hazardous dust transfer of contaminants is considered moderate with the potential for asbestos fibres to become airborne during earthworks.
Surface Water		Х	No surface water bodies identified on site.
Groundwater	х		Further assessment of the groundwater conditions beneath the site is required.
Sediments		Х	There are no water bodies on site.
Biota		x	Significant Biota was not identified during the level 1 Flora and Fauna survey.

The decision rules for the project will be based on an analysis of land and groundwater uses and potential receptors, which will in turn lead to the selection of Tier 1 screening criteria for the site.

For subsequent stages of work, assessment levels will initially be selected taking into account the proposed land use for residential redevelopment, applicable soil and groundwater beneficial uses and will be consistent with relevant published guidelines, including the following:

- National Environment Protection (Assessment of Site Contamination) Amendment Measure (NEPM), (1999) Schedule B(1) – Guideline on Investigation Levels for Soil and Groundwater Contamination.
- DoH (2009) Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia.



7.1.4 Decision Errors

The DQOs define how the quality of data collected through the various phases of investigation is to be assessed. These criteria are summarised in Table J.

Table H: Evaluation Criteria of Each Aspect of the Investigation

DATA QUALITY OBJECTIVE	EVALUATION CRITERIA								
Documentation and	Site conditions accurately described.								
data completeness	 Sampling locations accurately described. 								
	 Completion of field notes, calibration certificates, chain-of-custody documentation and laboratory test certificates. 								
	 Samples collected from all areas of potential environmental concern. 								
	 Samples are scheduled for analysis of all identified contaminants. 								
Data comparability	 Use of appropriate techniques for sampling, storage and transport of samples. 								
	 Use of National Association of Testing Authorities (NATA) accredited primary and secondary laboratories 								
Data representativeness	 Collection of representative samples from each sampling location and across the site. 								
·	 Use of appropriate techniques for sampling, storage and transport of samples. 								
Precision for	Use of properly trained and qualified personnel.								
sampling and analysis	Use of duplicate and triplicate samples collected at a minimum rate of 1 in 20 (i.e. 5%).								
	 Assessment of the relative percentage difference (RPD) between primary, duplicate and triplicate samples. 								
	Acceptable recovery of laboratory matrix spikes.								
	Acceptable quality of rinsate blanks.								

7.1.5 Optimal Design

The sample locations outlined in the SAQP are aimed to target the potential source areas and therefore suspected hot spots. Specifically, samples will be collected within each area of concern identified by the findings from the site history study and the detailed site inspection.



7.2 Areas of Assessment

Table K summarises the proposed field investigations that will be undertaken across the site based on potential contamination sources identified by the PSI.

Table I: Summary of Proposed Field Investigation

Area	DESCRIPTION	MATRIX	NUMBER OF SAMPLING LOCATIONS	CONTAMINANTS		
Sub-Surface Soils of Site	Potential presence of Asbestos in Subsurface Soils	Soil	20 test pits to be sampled to depth of 0.3 metres across the site using a grid based approach to test for presence of asbestos in subsurface soils.	ACM fragments, and asbestos fibres in soil.		
Soils and Groundwater, north east of site	State Battery	Groundwater and Soil	One groundwater well to be installed down gradient of state battery on the sites north eastern boundary. Three soil samples to be collected from north east corner of the site boundary.	Cyanide, PAH, Heavy metals (arsenic, copper, iron, mercury), TRH, BTEX		
Soils and groundwater, western portion of site	Railway Yard Storage Shed	Groundwater and Soil	Groundwater will be investigated from existing groundwater well. Five soil boreholes will target potential for soil contamination on the western boundary of the site	Heavy metals (arsenic, lead, zinc, cadmium, chromium), phenols, OCPs, TPH, BTEX, Phenols and OCPs.		
Groundwater, north western portion of site	Fuel Tank to north-west of the site	Groundwater	Groundwater will be sampled from existing production groundwater bore on site	Heavy metals, TRH, BTEX, Phenols,		

Proposed sampling locations are presented on Figure 4.



7.3 Soil

Soil samples are to be collected from the soil boreholes in accordance with the following Australian Standards:

- AS4482.1:2005 Guide to the Investigation and Sampling of Sites with Potentially Contaminated Soil Part I Non Volatile and Semi Volatile Compounds.
- AS 4482.2:1999 Guide to the Investigation and Sampling of Sites with Potentially Contaminated Soil Part 2 Volatile Compounds.

7.3.1 Sampling Locations

The density of sampling locations at the site has been determined with reference to DER (2001-2010) Contaminated Sites Management Guideline Series, particularly the Development of Sampling and Analysis Programs (DEP 2001) and are displayed in Table K. As several potential contaminants have been identified at the site, each with different contaminants and land uses and risk, it is proposed that grid based sampling and targeted sampling are undertaken to assess the potential for contamination across the site.

The sampling methodology employed by 360 Environmental is comprised of targeted and grid based sampling with a total of 28 soil sample locations advanced across the site to a depth of 0.3 mbgl; unless signs of potential contamination are evident, in which case samples will be drilled until visually and olfactory clean soil is encountered. The figure of 20 ACM specific soil samples is based on an assessment of site soils designed at characterising the potential for asbestos contamination to exist within the soils. The targeted

Soil sampling locations have been determined to target historical potential contaminants as outlined from the site inspection carried out by 360 Environmental Soil Sampling Methodology

7.3.2 Soil Sampling Methodology

Recovery of soil samples will be undertaken by a combination of manual excavation techniques (test pitting) and continuous core sampling using environmental drilling techniques to collect samples. In order to determine the vertical extent of additional environmental contaminants outlined in Table K, soil samples are to be collected at multiple depths and each targeted sampling location. Samples are to be collected from the surface (0.0-0.15 mbgl) with three additional samples collected within the first metre of drilling. Additional samples will be collected at each metre until change of lithology is observed or end of borehole is reached. All samples are to be stored on ice within an esky, prior to submission to the laboratory for analysis. All soil samples are to be accompanied to Perth and couriered to the laboratory at the conclusion of the field work,



with adequate packing and ice to ensure that they arrived intact and at the appropriate temperature to ensure sample preservation.

7.3.3 Asbestos Sampling Methodology

An approximate systematic grid pattern will be used to assess for the presence/concentration of ACM in sub-surface soils. Sampling densities will not conform to the DoH guidelines which adopt the DER Contaminated Sites Management Series document 'Development of Sampling and Analysis Programs' (DEP, 2001) providing minimum densities for grid sampling patterns. The purpose of this sampling is to establish the potential for asbestos contamination in sub-surface soils and not strictly characterise the contamination status of the soil. The purpose of the investigation is not to assess ACM at the site's surface as a significant amount of ACM has been observed at the surface. It is recommended that ACM at the surface is removed in accordance with an Asbestos Management Plan prior to further assessment of surface soils.

Sub-surface soil sampling for asbestos will occur to a depth of 0.3 m as it is not considered likely to have the potential to be found at greater depths. A new pair of nitrile, disposable gloves is to be used for each sampling location. The test pit sampling methodology will include:

- 1 Test pits will be dug to 0.3 mbgl.
- 2 One 10 L sample collected from 0 0.3 mbgl will be collected.
- 3 The 10 L soil sample will be screened manually through a \leq 7mm sieve.
- 4 Sieved material will be spread out for inspection (for asbestos fines).
- Suspected ACM caught in the sieve will be weighed (if found), photographed and placed in a sample bag. Any unidentifiable fragments will be assumed to be potential ACM (PACM).
- Where PACM is identified in the 10 L sample, a 500 mL sample of soil will be collected in a sample bag to be analysed for asbestos fibres.
- 7 Collected PACM and soil will be sent to a laboratory for analysis.
- Where PACM is identified in the 0 0.3 m sample, an additional 10 L sample from 0.3 0.6 mbgl will be collected following steps 3 to 7.

PACM sample weights along with laboratory results will be used to determine asbestos w/w % concentrations in soil as per DoH *Guidelines for the Assessment, Remediation and Management of Asbestos Contaminated Sites* in Western Australia, 2009. The soil lithology is to be recorded on a 360 Environmental soil bore log sheet. The soil bore logs should also record any indications of the presence of contamination, including odour and sheen, the presence of any foreign material or objects, the unique sample identifiers, any QA/QC sample details, and the GPS coordinates at the borehole/test pit location.



7.4 Groundwater

7.4.1 Sampling Locations

Groundwater sampling locations have been determined to target potential contamination sources. An existing production groundwater well is suitably located to target the potential for contamination from the railway yard. Two groundwater monitoring wells will be advanced to a depth of approximately 2 m below the water table interface (approximately 18 mbgl) to allow for seasonal fluctuations. A well will be placed to the north-east of site to assess potential contamination associated with the historical State Battery located hydraulically up-gradient of the site (MW02). Another well will be placed on the north-western boundary of site to characterise potential contamination on site from the former fuel storage area and allow for calculation of groundwater flow (MW03). The locations of the proposed groundwater monitoring wells are provided in Figure 4.

7.4.2 Well construction and development methodology

Groundwater monitoring wells will be installed in accordance with Contaminated Sites Management Series: Development of Sampling and Analysis Programs (Department of Environmental Protection, 2001), Water Quality Protection Note 30 – Groundwater Monitoring Bores (DoW, 2006) and Minimum Construction Requirements for Water Bores in Australia (National Uniform Drillers Licensing Committee, 2012).

Two groundwater monitoring well will be advanced using environmental drilling techniques and the constructed bores cased with Class 18 machine-threaded 50 mm PVC casing. The bore annulus surrounding the screened interval is then filled with washed, graded (0.8 to 1.2 mm) gravel pack. The annulus above the filter pack will be sealed with bentonite granules and grouted to the surface. The bores will be capped with an envirocap and cased with a flush mounted gatic cover.

The constructed groundwater wells will be developed following installation to remove excess fine sediments from the filter pack and surrounding formation. Approximately 100 litres of water will be pumped from each well until it is clear in appearance. Following installation, the wells will be surveyed to Australian Height Datum (AHD).

7.4.3 Sampling Methodology

Groundwater samples will be collected from the groundwater wells in accordance with the following Australian Standards:

- AS/NZS 5667.1:1998 Water Quality Sampling. Part I Guidance on the Design of Sampling Programs, Sampling Techniques and the Preservation and Handling of Samples; and
- AS/NZS 5667.11:1998 Water Quality Sampling. Part II Guidance on the Sampling of Groundwater.



After development, wells shall be left for a period until bore water chemistry can be demonstrated to have stabilised (generally between 24 hours and seven days) before samples are collected (ASC NEPM 1999).

Recovery of groundwater samples is to be undertaken utilising standard environmental groundwater sampling techniques. New, low-density, polyethylene tubing, polyethylene bladder and nitrile, disposable gloves are to be used at each monitoring location.

Representative samples for laboratory analysis will be recovered after stabilisation of groundwater physio-chemical parameters is achieved. Measurements of these parameters, including temperature, pH, electrical conductivity, redox potential and dissolved oxygen, are to be taken every three to five minutes using appropriately calibrated equipment.

Stabilisation of groundwater parameters is considered to be achieved when there is less than 10% variation in physiochemical parameters between three successive readings. The groundwater stabilisation measurements are to be recorded on a 360 Environmental groundwater field data sheet. The field data sheet should also record physical observations such as colour and turbidity of the purged water, any indications of the presence of contamination, including odour and sheen, the presence of any foreign material or objects, the unique sample identifiers, any QA/QC sampling and the GPS coordinates.

Groundwater samples are to be collected directly from the low-flow pump into appropriately preserved and labelled, laboratory supplied bottles and filled to zero headspace. Samples that required field filtering are to be collected using an in-line, single-use, 0.45 μ m filter, connected directly to the discharge tube once all other samples have been collected.

All samples are to be stored on ice within an esky, prior to submission to the laboratory for analysis. All groundwater samples will be couriered to the laboratory at the conclusion of the field work, with adequate packing and ice to ensure that they arrive intact and at the appropriate temperature to ensure sample preservation.

Sampling will occur in a progression, with the up-gradient wells sampled before downgradient wells, to reduce the risk of cross-contamination.

7.4.4 Calibration

All equipment is to be calibrated prior to sampling, to known standards in accordance with manufacturers' recommended procedures for each instrument. A YSI Professional Plus will be used to measure the groundwater physio-chemical parameters.



7.5 Laboratory Analysis

7.5.1 Soil

Soil samples scheduled for analysis will be analysed for a range of parameters dependent upon the contaminants identified in Table I. Laboratory results are to be assessed upon their receipt, so if any samples require speciation as a result of exceeding the adopted guidelines, the analysis can be carried out within holding times for the relevant parameters.

7.5.2 Groundwater

The groundwater samples will be analysed for a range of parameters dependent upon the contaminants identified in Table K. A total of three primary samples from across the site will be analysed.

7.6 Quality Assurance and Quality Control

7.6.1 Quality Control Samples

QA/QC measures will be adopted during soil and groundwater sampling in accordance with the DEP (2001) Development of Sampling and Analysis Programs and Australian Standard AS4482.1 (2005) Guide to the investigation and sampling of sites with potentially contaminated soil - Non-volatile and semi-volatile compounds and AS5667.1 (1998) Water Quality - Sampling. QA/QC samples are necessary to ensure the precision, accuracy, representativeness, comparability and completeness of the data.

Precision: Precision measures the reproducibility of measurements under a given set of conditions. Precision is expressed in terms of relative percent differences (RPDs). RPD is calculated as follows:

Accuracy: Accuracy is a measure of the bias or error in a measurement. Examples of bias include contamination and errors made in sample collection, preservation, handling and analysis. Accuracy will be assessed by the collection of field/trip blanks and trip spikes, and in the laboratory by the use of known and unknown QC samples and matrix spikes. Accuracy will be measured by the percent recovery based on matrix spikes or surrogate recoveries. Percent recovery is calculated as follows:

Where: SSR = Spike Sample Result



SR = Sample (unspiked) Result

A = Spike Added

Representativeness: Representativeness is the degree to which the sample data accurately and precisely represent an environmental condition. Ensuring that sampling locations are selected properly and an adequate number of samples are collected, as developed in the SAQP, will satisfy representativeness.

Completeness: Completeness is the percent of measurements that are judged to be valid. The completeness of the data means that all the required samples have been taken and requisite analyses performed to generate an adequate database to successfully complete the remedial design studies.

Comparability: Comparability expresses the confidence with which one data set can be compared with another. To this end, the SAQP specifies the sampling method employed, the chain-of-custody methods responsible for the transfer of the samples to the analytical laboratories, and the analytical techniques implemented at the laboratories.

Work will be carried out by an experienced environmental scientist in accordance with accepted industry standards. Prior to commencement of field investigations, all soil and groundwater sampling equipment will be cleaned with water and phosphate-free detergent and rinsed with deionised water.

7.6.2 Field Quality Control Samples

Field quality control samples including soil duplicate/triplicate samples (1 per 20 primary samples), rinsate samples and transport blanks will be collected. The purpose of these samples is to ensure quality and reproducibility of all sampling methods used at the site. These samples provide information which discounts any errors due to possible sources of cross-contamination, inconsistencies in sampling and checks on the analytical techniques used.

Duplicates and triplicates will be analysed in order to identify the variation in analyte concentration between samples collected from the same sampling point and/or also the repeatability of the laboratory's analysis. Triplicate samples taken will be analysed at a secondary NATA accredited laboratory to ensure the primary laboratory data is within data quality limits.

One rinsate sample will be taken for each sampling event. Rinsate samples are undertaken to provide confirmation that there has been no cross contamination of substances from the sampling equipment used. The sample consists of deionised water prepared by the laboratory that is used to rinse the sampling equipment between the decontamination and sampling steps.

One transport blank sample will be analysed per sampling event. Transport blanks are used to estimate the amount of contamination introduced during the transport and storage of samples from the time of sampling until the time of analysis.



7.6.3 Evaluation of Quality Control Sample Results

The analytical results and quality control data are evaluated for accuracy, precision and representativeness of the data and compiled into a QA/QC report.

Laboratory data is checked for any analytical errors, such as contamination identified in rinsates and laboratory blanks, which may indicate cross contamination of samples. The RPD results and actual concentrations will be reviewed to determine the acceptability of the data.

Consideration to the homogeneity of the samples collected should be given when determining whether RPDs are acceptable. In the case of duplicate and triplicate samples being non-representative of the primary sample, samples should be scheduled to be reanalysed.

7.6.4 Laboratory QA/QC

All laboratory analysis will undertake by NATA-registered laboratories MGT and MPL using NATA-accredited methods of analysis. 360 Environmental requires that laboratories have a QA/QC Program that is endorsed by NATA. Both laboratories have a comprehensive QA/QC program to monitor and control every aspect of the laboratory process. MGT has an internal QA/QC process which includes laboratory control samples (LCS), method blanks, matrix spikes (MS), laboratory duplicates and surrogates (for target organics), at frequencies at or above that detailed in the ASC NEPM (1999) NEPM guidelines.

All soil and groundwater samples will be transported under 360 Environmental chain-of-custody procedures. This process details the links in the transfer of samples between the time of collection and arrival at the laboratory. The Chain of Custody documentation includes the name of the person transferring the samples, name of the person receiving laboratory samples, time and date the samples are taken, time and date samples are received at the laboratory, name and contact details of the client, analytes to be determined, details of the sample matrix and any other specific instructions in the handling of the samples during the analysis (e.g. special safety precautions).

7.6.5 Data Usability

An assessment of the usability of the laboratory data will be made by considering field and laboratory procedures and comparing against pre-determined qualitative criteria.

7.7 Assessment Criteria

7.7.1 Soil Investigation Criteria

Assessment of site contamination in Western Australia is based on the Contaminated Sites Act 2003, the DEC (2001-2010) Contaminated Sites Management Guideline Series and the ASC NEPM (1999) Schedule B(1) – Guideline on Investigation Levels for Soil and Groundwater Contamination. The guidelines include health based soil



criteria for various exposure settings. The soil analysis results for this investigation will be compared with the following criteria:

- ASC NEPM (1999) Health Screening Level Residential (HSL-A)
- ASC NEPM (1999) Soil Vapour Screening Levels (HSL-A)
- DoH (2009) Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia.

HSL-A are considered the most appropriate criteria as the site will be developed into medium density residential housing.

7.7.2 Groundwater Assessment Criteria

Groundwater contamination assessment in Western Australia considers the potential beneficial uses of groundwater. The site's groundwater may potentially be utilised for residential bore use on site, and by down-gradient, off-site groundwater users including local businesses or commercial purposes. Groundwater analysis results are to be compared to the following documents and guidelines based on future beneficial use of groundwater on and off-site.

- ASC NEPM (1999) Groundwater HSL A/B for vapour intrusion (low-high density residential).
- ASC NEPM (1999) Groundwater Investigation Level Drinking Water (GIL-DW)
- DEC (2010) Long-Term Irrigation (LTI) guidelines
- DEC (2010) Domestic Non-Potable (DNP) guidelines

The above guidelines recommend contaminant levels which, based on present knowledge, will not result in any significant risk to the health of landusers over a lifetime. Contaminant levels below the (DEC 2010) Domestic Non-potable Groundwater Use guideline confer no risk to human health via the non-potable use of groundwater. The use of (DEC 2010) Long-Term Irrigation guidelines provide values that should protect plant growth and provide long-term protection against toxicity from contaminant accumulation.



8 Limitations

This report is produced strictly in accordance with the scope of services set out in the contract or otherwise agreed in accordance with the contract. 360 Environmental makes no representations or warranties in relation to the nature and quality of soil and water other than the visual observation and analytical data in this report.

In the preparation of this report, 360 Environmental has relied upon documents, information, data and analyses ("client's information") provided by the client and other individuals and entities. In most cases where client's information has been relied upon, such reliance has been indicated in this report. Unless expressly set out in this report, 360 Environmental has not verified that the client's information is accurate, exhaustive or current and the validity and accuracy of any aspect of the report including, or based upon, any part of the client's information is contingent upon the accuracy, exhaustiveness and currency of the client's information. 360 Environmental shall not be liable to the client or any other person in connection with any invalid or inaccurate aspect of this report where that invalidity or inaccuracy arose because the client's information was not accurate, exhaustive and current or arose because of any information or condition that was concealed, withheld, misrepresented, or otherwise not fully disclosed or available to 360 Environmental.

Aspects of this report, including the opinions, conclusions and recommendations it contains, are based on the results of the investigation, sampling and testing set out in the contract and otherwise in accordance with normal practices and standards. The investigation, sampling and testing are designed to produce results that represent a reasonable interpretation of the general conditions of the site that is the subject of this report. However, due to the characteristics of the site, including natural variations in site conditions, the results of the investigation, sampling and testing may not accurately represent the actual state of the whole site at all points.

It is important to recognise that site conditions, including the extent and concentration of contaminants, can change with time. This is particularly relevant if this report, including the data, opinions, conclusions and recommendations it contains, are to be used a considerable time after it was prepared. In these circumstances, further investigation of the site may be necessary.

Subject to the terms of the contract between the Client and 360 Environmental Pty Ltd, copying, reproducing, disclosing or disseminating parts of this report is prohibited (except to the extent required by law) unless the report is produced in its entirety including this page, without the prior written consent of 360 Environmental Pty Ltd.



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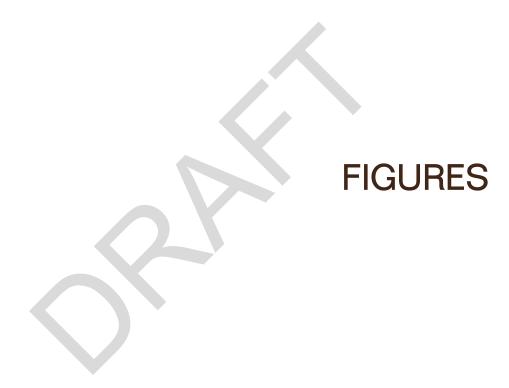
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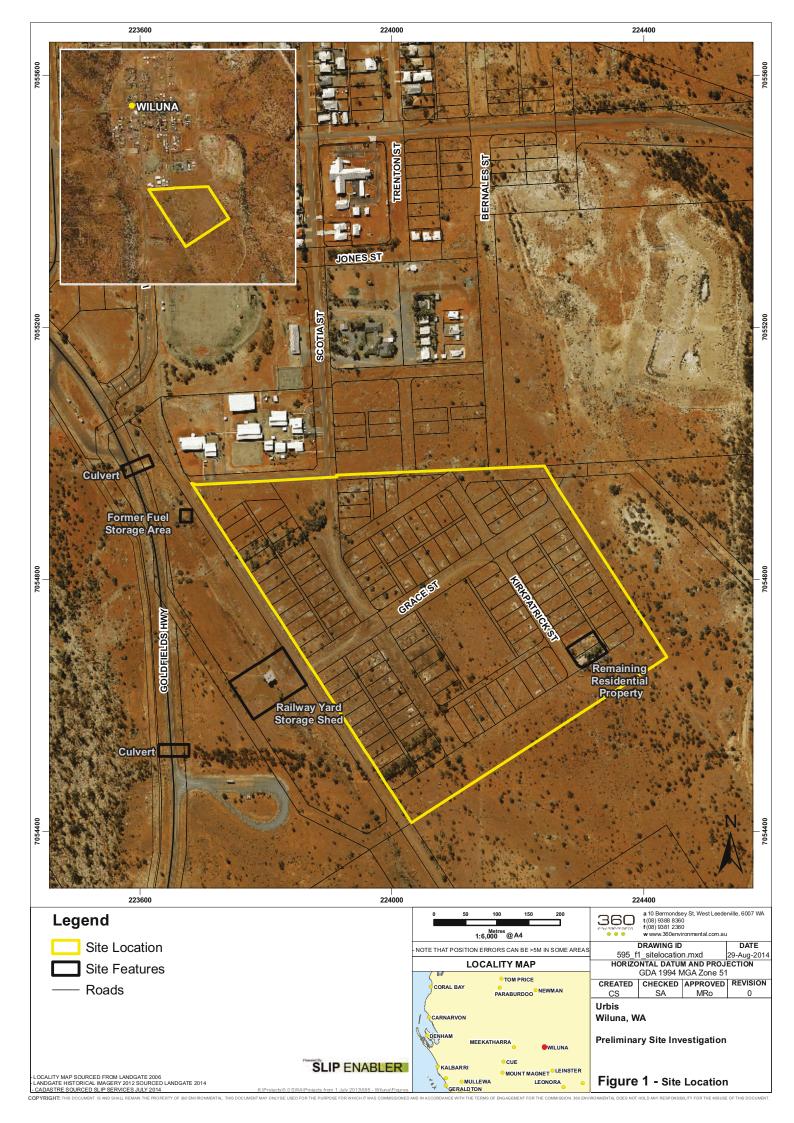
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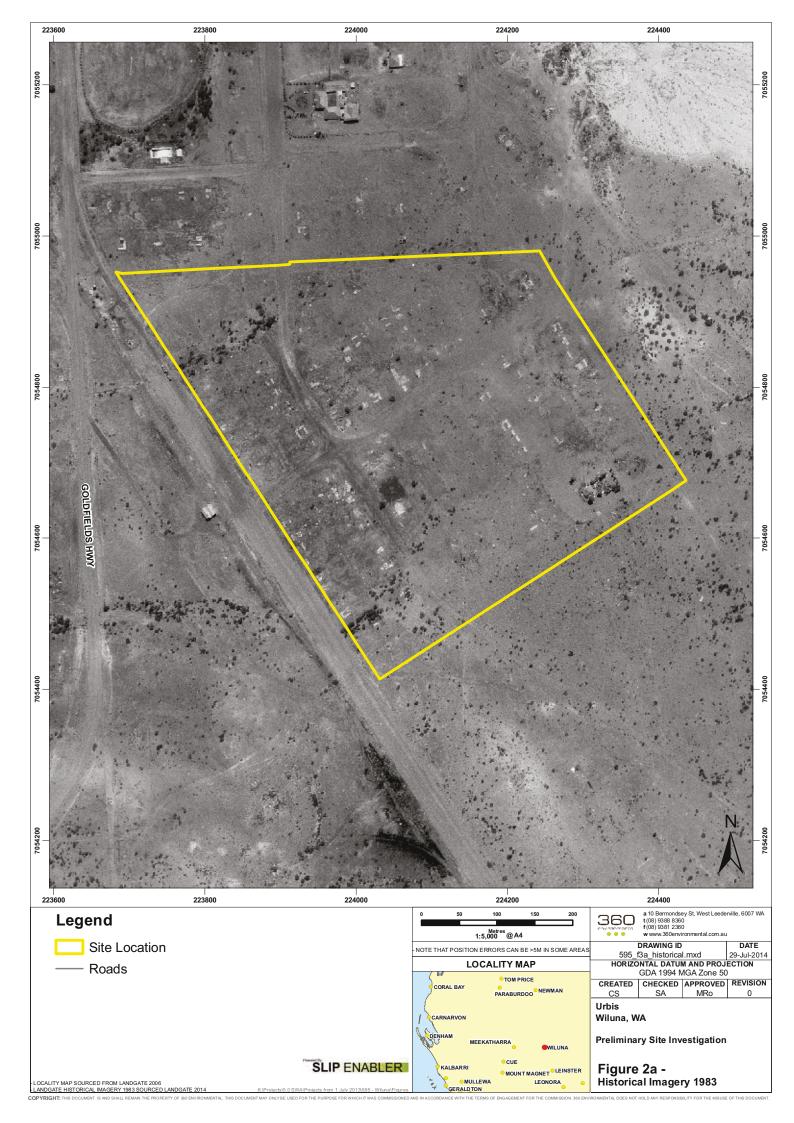
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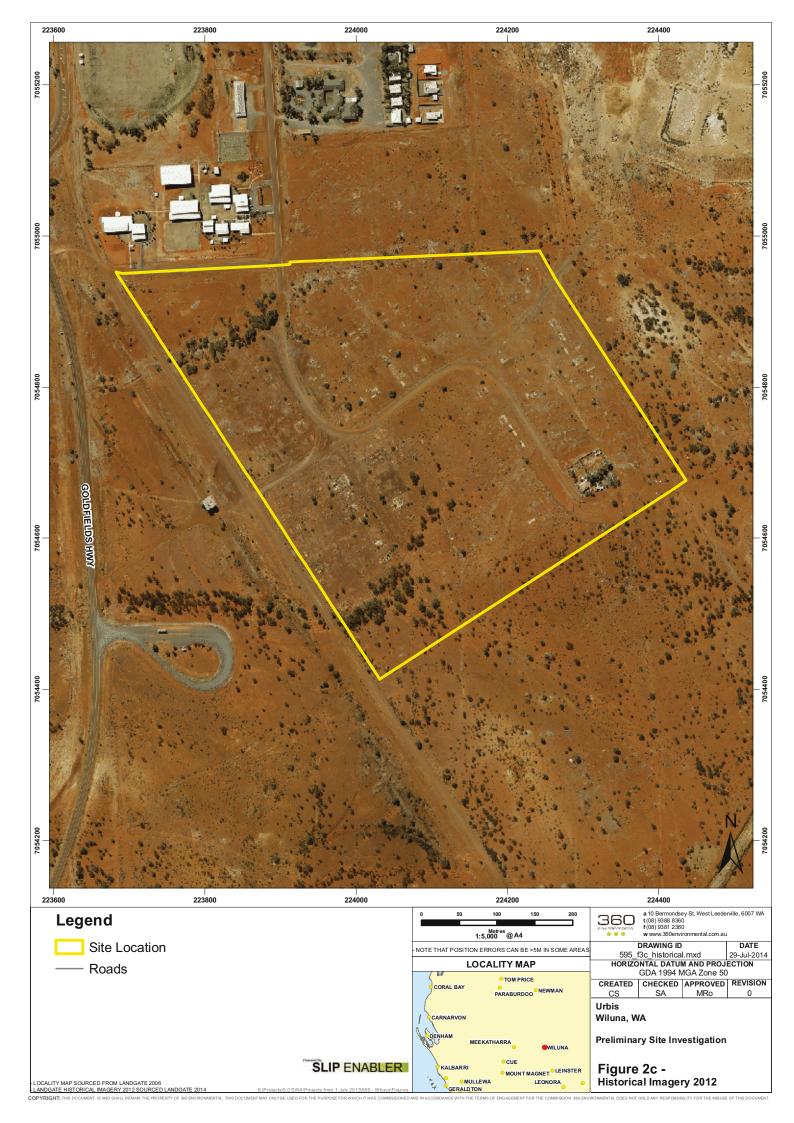


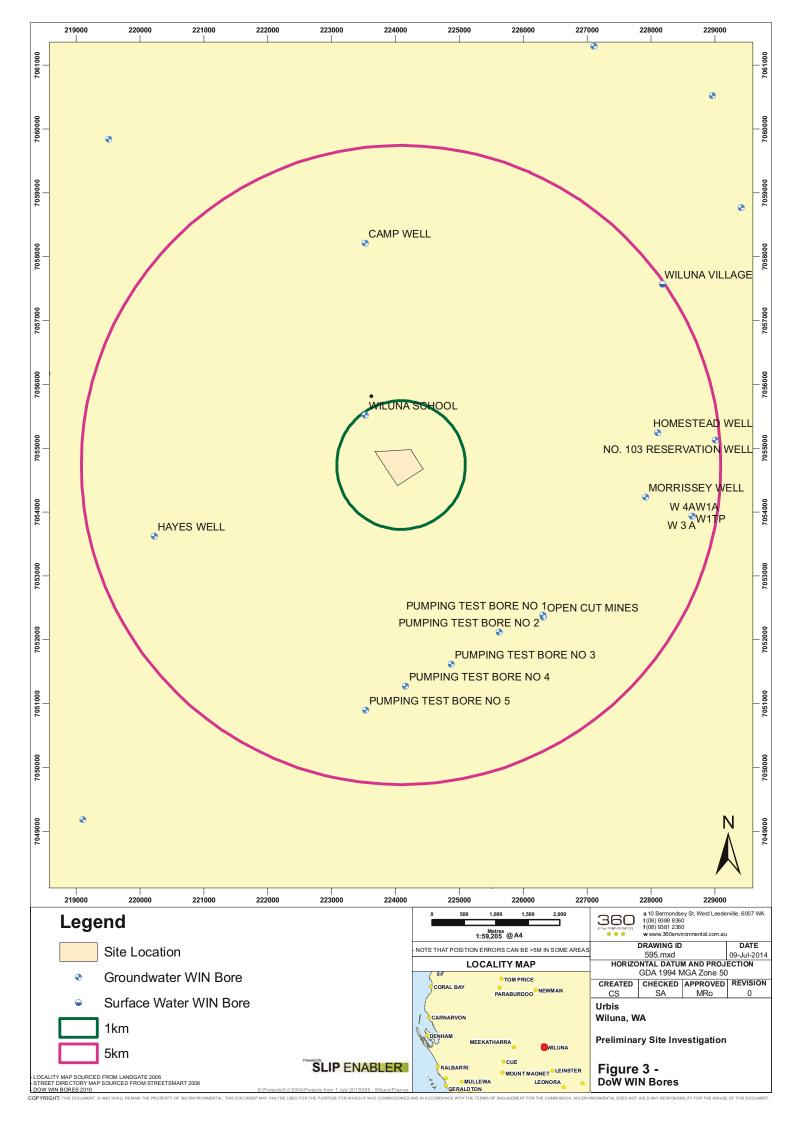


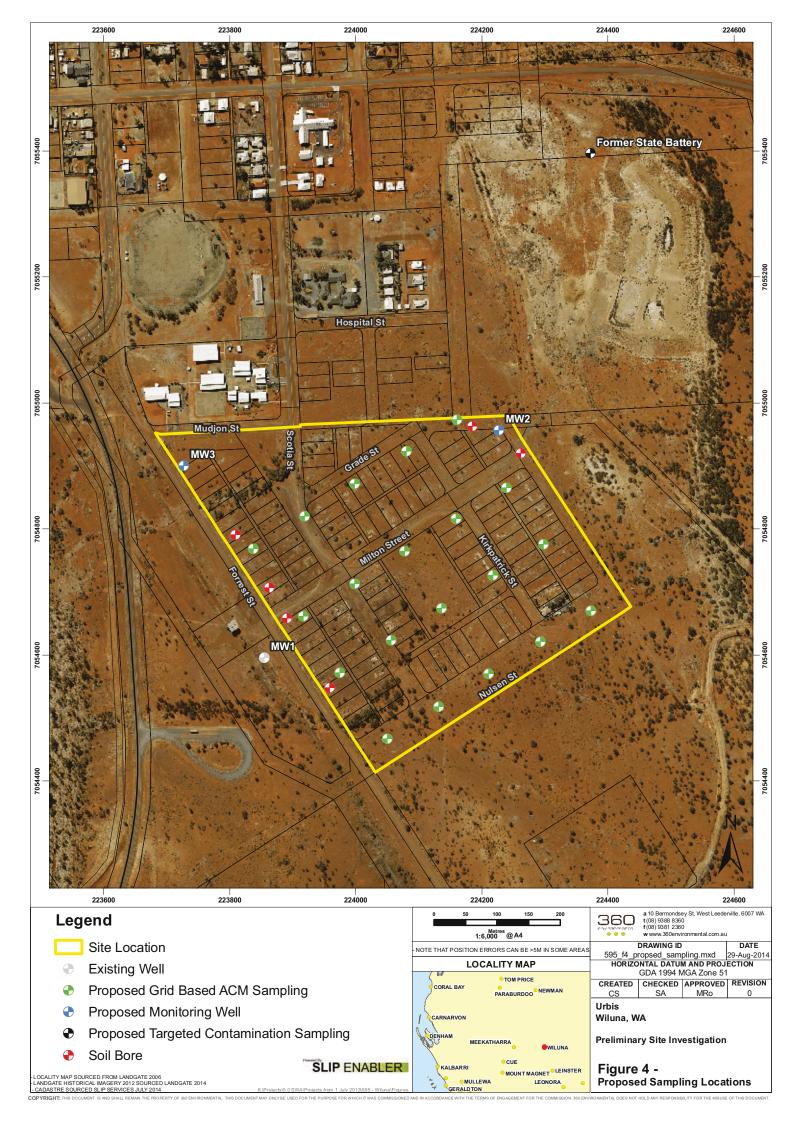














APPENDIX A

Contaminated Sites Database

Contaminated Sites Act 2003 Basic Summary of Records Search Response

Report Generated at: 11:31:54AM, 08/07/2014

Search Results

This response relates to a search request received for:

Lot 34 On Plan 238590 Wiluna WA 6646

This parcel belongs to a site that contains 3 parcel(s).

According to Department of Environment Regulation records, this land has been reported as a known or suspected contaminated site.

Address

Lot 34 On Plan 238590 Wiluna WA 6646

Lot on Plan Address

Lot 34 On Plan 238590

Parcel Status

Classification: 09/06/2010 - Contaminated - remediation required

Nature and Extent of Contamination:

Hydrocarbons (such as from diesel or oil) are present in soil at the site.

Restrictions on Use:

Please refer to Reasons for Classification for further information on the contamination present at the site.

Reason for Classification:

This site was reported to the Department of Environment and Conservation (DEC) as per reporting obligations under section 11 of the 'Contaminated Sites Act 2003', which commenced on 1 December 2006. The site classification is based on information submitted to DEC by 31 May 2007.

The site was historically a pastoral lease and is now used as a gold mine including bulk fuel storage facilities. These are land uses that have the potential to cause contamination as per the guideline "Potentially Contaminating Activities, Industries and Land Uses" (Department of Environment, October 2004).

The site was reported following an infrastructure failure in June 2003 which resulted in approximately 250,000L of diesel being lost into soil at the site, in several locations. Prior to the discovery of the infrastructure failure in June 2003, a site investigation was carried out in March-April 2003, following earlier indications of hydrocarbon (such as from diesel or oil) contamination at four locations on the site.

Disclaimer

This Summary of Records has been prepared by Department of Environment Regulation (DER) as a requirement of the *Contaminated Sites Act 2003*. DER makes every effort to ensure the accuracy, currency and reliability of this information at the time it was prepared, however advises that due to the ability of contamination to potentially change in nature and extent over time, circumstances may have changed since the information was originally provided. Users must exercise their own skill and care when interpreting the information contained within this Summary of Records and, where applicable, obtain independent professional advice appropriate to their circumstances. In no event will DER, its agents or employees be held responsible for any loss or damage arising from any use of or reliance on this information. Additionally, the Summary of Records must not be reproduced or supplied to third parties except in full and unabridged form.

Contaminated Sites Act 2003 Basic Summary of Records Search Response

Report Generated at: 11:31:54AM, 08/07/2014

The investigation identified hydrocarbons (such as from diesel or oil) at concentrations exceeding Health Investigation Levels for Commercial/Industrial landuses and Ecological Investigation Levels (EIL's) as published in the guideline "Assessment Levels for Soil, Sediment and Water" (Department of Environment, draft November 2003). Groundwater investigations have not been carried out, and the quality of groundwater beneath the site is unknown.

As the site is known to be contaminated but has not been the subject of any remediation or risk management measures to reduce the risk to human health, the environment or any environmental value to acceptable levels, the site is classified as "contaminated - remediation required".

When the results of further soil and groundwater investigations are submitted to DEC, these will be reviewed, and the site may be re-classified.

DEC, in consultation with the Department of Health, has classified this site based on the information available at the time of classification. It is acknowledged that the contamination status may have changed since this time, and as such the usefulness of this information may be limited.

In accordance with Department of Health advice if groundwater is being, or is proposed to be, abstracted DEC recommends that analytical testing should be carried out to determine whether the groundwater is suitable for its intended use.

Under the Contaminated sites Act 2003, this site has been classified as "Contaminated - remediation required". An instrument affecting land which comprises all, or part of, this site will not be registered or accepted for registration, unless the CEO of the Department of Environment & Conservation consents to the registration in writing. For further information on the contamination status of this site, or this restriction, please contact the Contaminated Sites section of the Department of Environment & Conservation.

Type of Regulatory Notice: Nil

Date Issued: Nil

No other information relating to this parcel.

Certificate of Title Memorial

Current Regulatory

Caparal

Disclaimer

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APPENDIX B

Department of Water WIN Database

	_,														
SITE_ID SITE_T	PE SITE_SUBTY	AWRC_REF_AWRC_NAME	AQWAB_NAME	ZONE	EASTING NORTHING	BASIN	PURPOSE_CU	STATUS_CUR	DATE_DRILL	BORE_INLET	SUMMARY	LITHOLOGY	WATER_SUPP	WATER_LEVE	TDS_COND
15124 Surfac	Water Supply - Sampling Po	0244012 WILUNA VILLAGE		51.0000000000	228184.0000000000 7057577.00000000000	024 - Salt Lake Basin		Operating			No	No			Cond uncomp (lab) 1960.000 uS/cm on 08-12-1992
20072150 Grouni	Borehole or Well	02411199 CAMP WELL	CAMP WELL	51.0000000000	223530.0000000000 7058214.0000000000	024 - Salt Lake Basin		Operating			No	No	Borehole water supply 22.730 m3/day on 01-01-1000	Static water level 18.290 m from Ground level on 01-01-1000	
20072154 Grouni	Unknown	02414707 OPEN CUT MINES	OPEN CUT MINES	51.0000000000	226322.0000000000 7052356.0000000000	024 - Salt Lake Basin					No	No			
20072155 Grouni	Unknown		WILUNA SCHOOL	51.0000000000	223532.0000000000 7055520.0000000000	024 - Salt Lake Basin			01-01-1000 - Unknown		No	No	Borehole water supply 15.000 m3/day on 01-01-1000		
20072156 Grouni	Borehole or Well	02411203 PUMPING TEST BORE NO 1	PUMPING TEST BORE NO 1	51.0000000000	226309.0000000000 7052388.0000000000	024 - Salt Lake Basin	Investigation		10-12-1985 - Known day		Yes	Yes	Borehole water supply 810.000 m3/day on 10-12-1985	Static water level 4.900 m from Ground level on 10-12-1985	TDSolids (in situ) 4395.000 mg/L on 10-12-1985
20071856 Grouni	Borehole or Well	02411049 HOMESTEAD WELL	HOMESTEAD WELL	51.0000000000	228108.0000000000 7055246.0000000000	024 - Salt Lake Basin		Operating	01-01-1000 - Unknown		No	No	Borehole water supply 9.092 m3/day on 01-01-1000	Static water level 4.570 m from Ground level on 01-01-1000	TDSolids (in situ) 900.000 mg/L on 02-01-1000
23011785 Meteo	olog Rainfall			51.0000000000	223624.5500000000 7055822.2400000000	024 - Salt Lake Basin		Operating			No	No			
20071966 Grouni	Borehole or Well	02411088 W 3 A	W 3 A	51.0000000000	228652.0000000000 7053945.0000000000	024 - Salt Lake Basin	Observation		04-07-1979 - Known day	Top of top inlet =5m, E	3 Yes	Yes		Static water level 5.140 m from Ground level on 04-07-1979	TDSolids (in situ) 575.000 mg/L on 04-07-1979
20071964 Grouni	Borehole or Well	02411086 W1A	W1A	51.0000000000	228652.0000000000 7053945.0000000000	024 - Salt Lake Basin	Observation		30-06-1979 - Known year		Yes	Yes	Borehole water supply 113.000 m3/day on 30-06-1979	Static water level 4.050 m from Ground level on 30-06-1979	TDSolids (in situ) 670.000 mg/L on 30-06-1979
20072178 Grouni	Borehole or Well	02411221 PUMPING TEST BORE NO 2	PUMPING TEST BORE NO 2	51.0000000000	225626.0000000000 7052125.0000000000	024 - Salt Lake Basin	Investigation		11-12-1985 - Known day	Top of top inlet =4.5m	Yes	Yes		Static water level 4.180 m from Ground level on 11-12-1985	TDSolids (in situ) 4620.000 mg/L on 11-12-1985
20072179 Grouni	Borehole or Well	02411222 PUMPING TEST BORE NO 3	PUMPING TEST BORE NO 3	51.0000000000	224877.0000000000 7051619.0000000000	024 - Salt Lake Basin	Investigation		15-12-1985 - Known day	Top of top inlet =4m, E	3 Yes	Yes	Borehole water supply 1000.000 m3/day on 15-12-1985	Static water level 5.000 m from Ground level on 15-12-1985	TDSolids (in situ) 3430.000 mg/L on 15-12-1985
20071965 Grouni	Borehole or Well	02411087 W1TP	W1TP	51.0000000000	228652.0000000000 7053945.0000000000	024 - Salt Lake Basin	Investigation/Production		11-07-1979 - Known day	Top of top inlet =9m, E	3 Yes	Yes	Borehole water supply 82.000 m3/day on 11-07-1979	Static water level 4.170 m from Ground level on 11-07-1979	TDSolids (in situ) 670.000 mg/L on 11-07-1979
20071857 Grouni	Borehole or Well	02411050 MORRISSEY WELL	MORRISSEY WELL	51.0000000000	227918.0000000000 7054234.0000000000	024 - Salt Lake Basin		Operating	01-01-1000 - Unknown		No	No	Borehole water supply 9.092 m3/day on 01-01-1000	Static water level 3.050 m from Ground level on 01-01-1000	
20072152 Grouni	Borehole or Well	02411201 HAYES WELL	HAYES WELL	51.0000000000	220228.0000000000 7053626.0000000000	024 - Salt Lake Basin		Operating	01-01-1000 - Unknown		No	No	Borehole water supply 6.819 m3/day on 01-01-1000	Static water level 8.840 m from Ground level on 30-06-1971	TDSolids (in situ) 1060.000 mg/L on 30-06-1971
20072181 Grouni	Borehole or Well	02411224 PUMPING TEST BORE NO 5	PUMPING TEST BORE NO 5	51.0000000000	223539.0000000000 7050895.0000000000	024 - Salt Lake Basin	Investigation		13-12-1985 - Known day	Top of top inlet =4m, E	3 Yes	Yes	Borehole water supply 765.000 m3/day on 13-12-1985	Static water level 4.470 m from Ground level on 13-12-1985	TDSolids (in situ) 6170.000 mg/L on 13-12-1985
20071872 Grouni	Borehole or Well	02411051 NO. 103 RESERVATION WELL	NO. 103 RESERVATION WELL	51.0000000000	229011.0000000000 7055132.0000000000	024 - Salt Lake Basin			01-01-1000 - Unknown		Yes	Yes			TDSolids (in situ) 640.000 mg/L on 01-01-1000
20071967 Grouni	Borehole or Well	02411089 W 4A	W 4A	51.0000000000	228652.0000000000 7053945.0000000000	024 - Salt Lake Basin			04-07-1979 - Known day	Top of top inlet =4m, E	3 Yes	Yes		Static water level 3.760 m from Ground level on 04-07-1979	TDSolids (in situ) 650.000 mg/L on 04-07-1979
20072180 Grouni	Borehole or Well	02411223 PUMPING TEST BORE NO 4	PUMPING TEST BORE NO 4	51.0000000000	224163.0000000000 7051272.0000000000	024 - Salt Lake Basin				Top of top inlet =4m, E		Yes	Borehole water supply 780.000 m3/day on 13-12-1985	Static water level 4.600 m from Ground level on 13-12-1985	TDSolids (in situ) 4215.000 mg/L on 13-12-1985





APPENDIX C

Aboriginal and European Heritage

Government of Western Australia Department of Aboriginal Affairs

Aboriginal Heritage Inquiry System

Aboriginal Sites Database

Search Criteria

2 Registered Aboriginal Sites in Custom search area; 222684.48mE, 7053530.05mN (zone 51): 224898.53mE, 7055797.71mN (zone 51)

Disclaimer

The Aboriginal Heritage Act 1972 preserves all Aboriginal sites in Western Australia whether or not they are registered. Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist.

The information provided is made available in good faith and is predominately based on the information provided to the Department of Aboriginal Affairs by third parties. The information is provided solely on the basis that readers will be responsible for making their own assessment as to the accuracy of the information. If you find any errors or omissions in our records, including our maps, it would be appreciated if you email the details to the Department at HeritageEnquiries@daa.wa.gov.au and we will make every effort to rectify it as soon as possible.

Copyright

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Coordinate Accuracy

Accuracy is shown as a code in brackets following the coordinates.

© Government of Western Australia Report created: 08/07/2014 15:22:25 by: Public User Identifier: 112953 Page: 1

overnment of Western Australia epartment of Aboriginal Affairs

Aboriginal Heritage Inquiry System

Aboriginal Sites Database

nology (NB that some terminology has varied over the life of the legislation)

D/Site ID: This a unique ID assigned by the Department of Aboriginal Affairs to the place

- o Registered Site: The place has been assessed as meeting Section 5 of the Aboriginal Heritage Act 1972
- o Other Heritage Place which includes:
 - Stored Data / Not a Site: The place has been assessed as not meeting Section 5 of the Aboriginal Heritage Act 1972
 - **Lodged:** Information has been received in relation to the place, but an assessment has not been completed at this stage to determine if it meets Section 5 of the *Aboriginal Heritage Act 1972*

and Restrictions:

- File Restricted = No: Availability of information (other than boundary) that the Department of Aboriginal Affairs holds in relation to the place is not restricted
 in any way.
- o **File Restricted = Yes:** Some of the information that the Department of Aboriginal Affairs holds in relation to the place is restricted if it is considered culturally sensitive. This information will only be made available if the Department of Aboriginal Affairs receives written approval from the informants who provided the information. Download the Request to Access Restricted Information letter and form.
- Boundary Restricted = No: place location is shown as accurately as the information lodged with the Registrar allows.
- Boundary Restricted = Yes: To preserve confidentiality the exact location and extent of the place is not displayed on the map. However, the shaded region (generally with an area of at least 4km²) provides a general indication of where the place is located. If you are a landowner and wish to find out more about the exact location of the place, please contact DAA.
- Restrictions:
 - No Restrictions: Anyone can view the information.
 - Male Access Only: Only males can view restricted information.
 - Female Access Only: Only females can view restricted information

ID: This is the former unique number that the former Department of Aboriginal Sites assigned to the place. This has been replaced by the Place ID / Site ID.

Aboriginal Heritage Inquiry System

Aboriginal Sites Database

List of Registered Aboriginal Sites with Map

D	Site Name		Boundary Restricted	Restrictions	Status	Site Type	Knowledge Holders	Coordinates	Legacy ID
14	RED HILL.	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Rockshelter	*Registered Knowledge Holder names available from DAA	224051mE 7053694mN Zone 51 [Unreliable]	W01156
32	TJANAPI	Yes	Yes	No Gender Restrictions	Registered Site		*Registered Knowledge Holder names available from DAA	Not available when Place location is restricted	W01054

Aboriginal Heritage Inquiry System

Aboriginal Sites Database



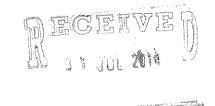




Freedom of Information



Government of **Western Australia** Department of **Mines and Petroleum** Resources Safety



Your Ref:

Our Ref: Enquiries: FOI NO: 14/15-3 A1340/201401

s: Doris Marenko Ph: (08) 9358 8145 doris.marenko@dmp.wa.gov.au

Email: <u>doris.mar</u> Facsimile: 9358 800

Michael Robinson 360 Environmental 10 Bermondsey Street WEST LEEDERVILLE WA 6007

Dear Mr Robinson

NOTICE OF DECISION UNDER \$30 FREEDOM OF INFORMATION ACT 1992 (the Act)

Scope

Your application under the Act sought access to Dangerous Goods Storage (DGS) licence and any additional information for South Wiluna at:

- Milton Street;
- Grace Street;
- Kirkpatrick Street;
- Nulsen Street;
- Forrest Street;
- Prior Street; and
- O'Donnel Street, Wiluna WA 6646 (site located on map provided).

Personal information is not required.

Decision

For the reasons set out below, it was decided on **22 July 2014** by Liz Haddon-Cave, FOI Co-ordinator, Business Development, (delegated decision maker by a general directive provided under s.100 (1) (b) of the Act), to deny access to the documents under s.26 of the Act.

The Facts

On the information you provided, a search of our records has failed to locate any
documentation containing the information you seek. Under s26 of the Act, the
failure of the Department to locate any documents after a diligent search is deemed
as a refusal to grant access.

The Facts (cont'd)

- 2. Location descriptors provided by applicants may not always match site location details in our database and we ask if possible applicants provide the DGS Licence number of the site of interest to them. We recognise this is not always possible and do all we reasonably can to search for the site from the information provided.
- 3. The lack of information held by the Department in relation to this property does not necessarily mean the property is not or has ever been a dangerous goods storage site. Accordingly, if you have any reason to suspect the property is or may have been the subject of a DGS licence or dangerous goods may have been stored there, you may need to consider carrying out additional site inspection investigations.

Review Process

If you wish to contest the decision to refuse access, you have a right to have the decision reviewed. Details of the review process are set out in the attached notes.

Please do not hesitate to contact Doris on telephone 9358 8145 if you require any further information concerning this matter.

Yours sincerely

22 4

Liz Haddon-Cave Freedom of Information Coordinator BUSINESS DEVELOPMENT

22 July 2014

Enc.

Receipt for \$30 Application Fee; and Review & Appeal Process Notes





Site Photographs





Plate 1. Former tank storage area with earth bund



Plate 2. Concrete bund





Plate 3. Former State Battery located to the north east of the site.



Plate 4. Widespread asbestos contamination on the surface soils of the site. Photograph is of sample location S1 in the north-west of the site.





Plate 5: Example of concrete pad likely associated with former residential building



Plate 6: Example of concrete pad potentially associated with light industrial landuse





Plate 7: Railway goods shed

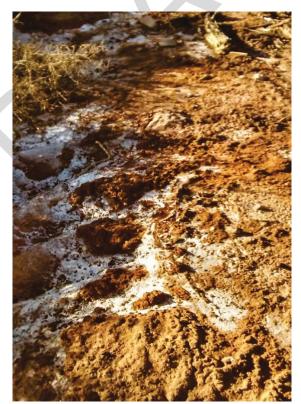


Plate 8: Salt staining in vicinity of former battery storage area



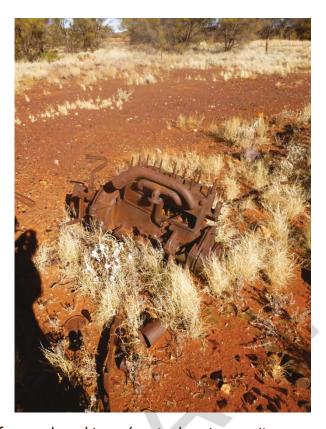


Plate 9: Example of general machinery/waste dumping on site



Plate 10: Off- site drainage culvert beneath former railway line





Plate 11: Off-site drainage to Goldfields Highway



APPENDIX F

Certificates of Laboratory Analysis



Chain of Custody Record

Send samples to:						Chain o	of custody numb	er:	220720	14	NOTES: C						
Laboratory i	name:		urofin							are likely to contain					1		
Laboratory a					gston Town Close Oakleigh Victoria 3166				Samples from:					Asbestos.			
Laboratory (contact number:	(0	3)95	9564 7055					360 Environmental Pty Ltd								
Sample deli	very method:	C	ourie					10 Bermondsey Street									
Laboratory (quotation reference:								West Leederville WA					Marian			
				15/	Name												
Send elect	ronic results to:			S	samp	olers:				Project	reference deta	ils:					
labresults@	2360environmenta	al.cor	n.au	1 0	David	Richards				Project n	ame:	Wiluna So	outh PSI				
	rds@360environm														_		=
davidificita	us@socenvironini	Cilia	1.001	II.d	Samp	le details	verified by								_		
Address co	rrespondence to:				sign)		vermed by			Project n	umber:	595					
davidricha	rds@360environm	ental	Lcor	n a	U	•											
davidiloria	43(3,333311111311111	01110		Ī									Sample	e analysis			
			atrix														
		101	auix	-													
				1	ا ۾						Asbestos ID only						Hold
Laboratory			ŧ	1	Collection					2000							
sample		Nater	Sediment	Other	et el					Depth							
reference	Sample Number	Wat	_		ŏΣ	Time	Date	Com	ments	(m)							4
	S1		\rightarrow	X			21/07/2014				X						
	S2		\rightarrow	X	_		21/07/2014			-							X
	S3			X	_		21/07/2014			-	X						
	S4	-	_	X	_		21/07/2014			-							×
	S5	-	4	X	-		22/07/2014				X			_		_	
			4	-	-		7							_	-		
		-	4	+	-												
		\vdash	+	+	-												
			+	-	-					1							
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	David Richards		Sig	natu	re:	Ilmi	, w	Time:	10:00	name):	, (P	E	Flmat	Signature:	0-	ime: S	317 3.34 au
			3			-		Date:			thu (print		1		С	ate:	
Relinquished	by David Richards		Sic	matu	ro:			Time:		Received	by (print			Signature:		ime:	

PLEASE OUTPUT TO ESDAT

426339



Liability & Risk Management Consulting

LRM Global Pty Ltd 65 Stubbs Street Kensington VIC 3031

ABN:

Fax: (03) 9371 3499
Email: enquiries@Irmglobal.com.au
Web: www.Irmglobal.com.au
Telephone: (03) 9371 3400

34 116 540 277

Eurofins/Mgt 2-5 Kingston Town Close Oakleigh Victoria 3164

Client Ref: 426339

Job Number: 14234.000 Batch Number: B11453 Received Date: July 28, 2014 Analysed Date: July 28, 2014

No of Samples: 3

Dear Natalie Krasselt,

This report presents the analytical results of samples forwarded by Eurofins/Mgt for asbestos analysis.

Methodology:

The samples were examined under a Stereo Microscope and selected fibres were analysed by Polarized Light Microscopy in conjunction with Dispersion Staining Method. (LRM Global ID Method 1)

Analytical Results:

Sample No.	Sample Description	Result
M14- JL22020	The sample consisted of fibre cement sheet Sample Dimensions: 15.0cm X 10.0cm X 0.5cm	Chrysotile Asbestos Detected
M14 - JL22021	The sample consisted of fibre cement sheet Sample Dimensions: 10.0cm X 4.0cm X 0.5cm	Chrysotile Asbestos Detected
M14 - JL22022	The sample consisted of fibre cement sheet Sample Dimensions: 6.0cm X 5.0cm X 0.5cm	Chrysotile Asbestos Detected



Approved Identifier Karu Jayasundara

CAMP.

Report Issued by Karu Jayasundara



This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025. The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.



ABN - 50 005 085 521

e.mail: EnviroSales@eurofins.com.au

web: www.eurofins.com.au

Melbourne 3-5 Kingston Town Close Oakleigh Vic 3166 Phone: +61 3 8564 5000 NATA # 1261 Site # 1254 & 14271 Sydney Unit F6, Building F 16 Mars Road Lane Cove West NSW 2066 Phone: +61 2 9900 8400 NATA # 1261 Site # 18217

Brisbane 1/21 Smallwood Place Murarrie QLD 4172 Phone : +61 7 3902 4600 NATA # 1261 Site # 20794

Sample Receipt Advice

Company name: 360 Environmental

Contact name: David Richards

Client job number: WILUNA SOUTH PSI 595

COC number: 22072014 Turn around time: 5 Day

Date/Time received: Jul 25, 2014 8:34 AM

Eurofins | mgt reference: 426339

Sample information

- ☑ A detailed list of analytes logged into our LIMS, is included in the attached summary table.
- All samples have been received as described on the above COC.
- COC has been completed correctly.
- Attempt to chill was evident.
- Appropriately preserved sample containers have been used.
- ✓ All samples were received in good condition.
- Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.
- Organic samples had Teflon liners.
- ✓ Some samples have been subcontracted.
- N/A Custody Seals intact (if used).

Contact notes

If you have any questions with respect to these samples please contact:

Natalie Krasselt on Phone : (+61) (3) 8564 5000 or by e.mail: NatalieKrasselt@eurofins.com.au

Results will be delivered electronically via e.mail to David Richards - davidrichards@360environmental.com.au.

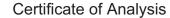
Eurofins | mgt Sample Receipt







360 Environmental 10 Bermondsey St West Leederville WA 6007





NATA Accredited Accreditation Number 1261 Site Number 1254

Accredited for compliance with ISO/IEC 17025. The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Attention: David Richards

Report 426339-S

Client Reference WILUNA SOUTH PSI 595

Received Date Jul 25, 2014

Client Sample ID Sample Matrix Eurofins mgt Sample No. Date Sampled Test/Reference	LOR	Unit	S1 Solid M14-JI22020 Jul 21, 2014	S3 Solid M14-JI22021 Jul 21, 2014	S5 Solid M14-JI22022 Jul 22, 2014
Asbestos Identification in Soil Sample (Non Quantitative - identification only)			see attached	see attached	see attached



Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.

A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description Testing Site Extracted Holding Time





Melbourne

3-5 Kingston Town Close Oakleigh VIC 3166 Phone: +61 3 8564 5000 NATA # 1261 Site # 1254 & 14271

Sydney
Unit F6, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone: +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane 1/21 Smallwood Place Murarrie QLD 4172 Phone: +61 7 3902 4600 NATA # 1261 Site # 20794

ABN - 50 005 085 521 e.mail : EnviroSales@eurofins.com.au

HOLD

Asbestos Identificati (Non Quantitative - i

web: www.eurofins.com.au

Company Name: 360 Environmental Address: 10 Bermondsey St

West Leederville

WA 6007

Client Job No.: WILUNA SOUTH PSI 595 Order No.:

Report #: 426339

Phone: 08 9388 8360

08 9381 2360 Fax:

Received: Jul 25, 2014 8:34 AM

Due: Aug 1, 2014 **Priority:** 5 Day

Contact Name: David Richards

Eurofins | mgt Client Manager: Natalie Krasselt

		Sample Detail			ation in Soil Sample - identification only)		
Laboratory who	ere analysis is co	onducted]
Melbourne Laboratory - NATA Site # 1254 & 14271							
Sydney Laboratory - NATA Site # 18217							
Brisbane Labo	ratory - NATA Si	te # 20794					
External Labor	atory				X		
Sample ID	Sample Date	Sampling Time	Matrix	LAB ID			
S1	Jul 21, 2014		Solid	M14-JI22020	X		
S3	Jul 21, 2014		Solid	M14-JI22021	X		
S5	Jul 22, 2014		Solid	M14-JI22022	Х		
S2	Jul 21, 2014		Solid	M14-JI22023		Х	
S4	Jul 21, 2014		Solid	M14-JI22024		Х	

Report Number: 426339-S



Eurofins | mgt Internal Quality Control Review and Glossary

General

- Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
- 2. All soil results are reported on a dry basis, unless otherwise stated
- 3. Actual PQLs are matrix dependant. Quoted PQLs may be raised where sample extracts are diluted due to interferences
- 4. Results are uncorrected for matrix spikes or surrogate recoveries.
- 5. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
- 6. Samples were analysed on an 'as received' basis. 7. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the Sample Receipt Acknowledgment.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

**NOTE: pH duplicates are reported as a range NOT as RPD

UNITS

mg/kg: milligrams per Kilogram
mg/l: milligrams per litre
ug/l: micrograms per litre
ppm: Parts per million
ppb: Parts per billion
%: Percentage
org/100ml: Organisms per 100 millilitres
NTU: Units

MPN/100mL: Most Probable Number of organisms per 100 millilitres

TERMS

Dry Where a moisture has been determined on a solid sample the result is expressed on a dry basis.

LOR Limit of Reporting.

SPIKE Addition of the analyte to the sample and reported as percentage recovery.

RPD Relative Percent Difference between two Duplicate pieces of analysis.

Laboratory Control Sample - reported as percent recovery

CRM Certified Reference Material - reported as percent recovery

Method Blank In the case of solid samples these are performed on laboratory certified clean sands.

In the case of water samples these are performed on de-ionised water.

Surr - Surrogate The addition of a like compound to the analyte target and reported as percentage recovery.

DuplicateA second piece of analysis from the same sample and reported in the same units as the result to show comparison.

Batch Duplicate A second piece of analysis from a sample outside of the clients batch of samples but run within the laboratory batch of analysis.

Batch SPIKE Spike recovery reported on a sample from outside of the clients batch of samples but run within the laboratory batch of analysis.

USEPA United States Environmental Protection Agency

APHA American Public Health Association

ASLP Australian Standard Leaching Procedure (AS4439.3)

TCLP Toxicity Characteristic Leaching Procedure

COC Chain of Custody

SRA Sample Receipt Advice

CP Client Parent - QC was performed on samples pertaining to this report

NCP Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within

TEQ Toxic Equivalency Quotient

QC - ACCEPTANCE CRITERIA

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50% $\,$

Results >20 times the LOR: RPD must lie between 0-30%

Surrogate Recoveries : Recoveries must lie between 50-150% - Phenols 20-130%.

QC DATA GENERAL COMMENTS

- 1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
- 2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
- 3. Organochlorine Pesticide analysis where reporting LCS data, Toxophene & Chlordane are not added to the LCS.
- 4. Organochlorine Pesticide analysis where reporting Spike data, Toxophene is not added to the Spike.
- Total Recoverable Hydrocarbons where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported
 in the C10-C14 cell of the Report.
- 6. pH and Free Chlorine analysed in the laboratory Analysis on this test must begin within 30 minutes of sampling. Therefore laboratory analysis is unlikely to be completed within holding time.

 Analysis will begin as soon as possible after sample receipt.
- 7. Recovery Data (Spikes & Surrogates) where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
- 8. Polychlorinated Biphenyls are spiked only using Arochlor 1260 in Matrix Spikes and LCS's.
- 9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
- 10. Duplicate RPD's are calculated from raw analytical data thus it is possible to have two sets of data.

Report Number: 426339-S



Comments

NB: Asbestos analysis subcontracted to LRM Global, reference number 14234.000, NATA accreditation number 15684.

Sample Integrity

	· ·	
Custody	Seals Intact (if used)	N/A
Attempt	to Chill was evident	Yes
Sample	correctly preserved	Yes
Organic	samples had Teflon liners	Yes
Sample	containers for volatile analysis received with minimal headspace	Yes
Samples	received within HoldingTime	Yes
Some sa	imples have been subcontracted	Yes

Authorised By

Natalie Krasselt

Contraction of the second

Glenn Jackson

Laboratory Manager

Final report - this Report replaces any previously issued Report

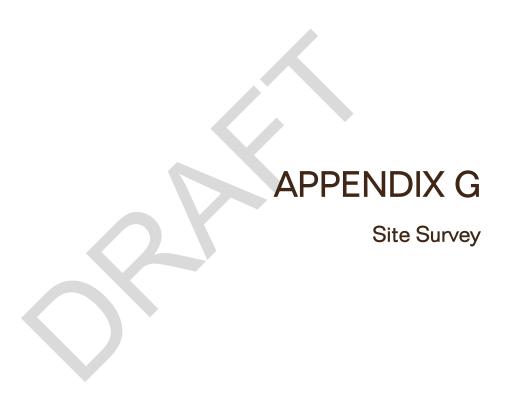
- Indicates Not Requested
- * Indicates NATA accreditation does not cover the performance of this service

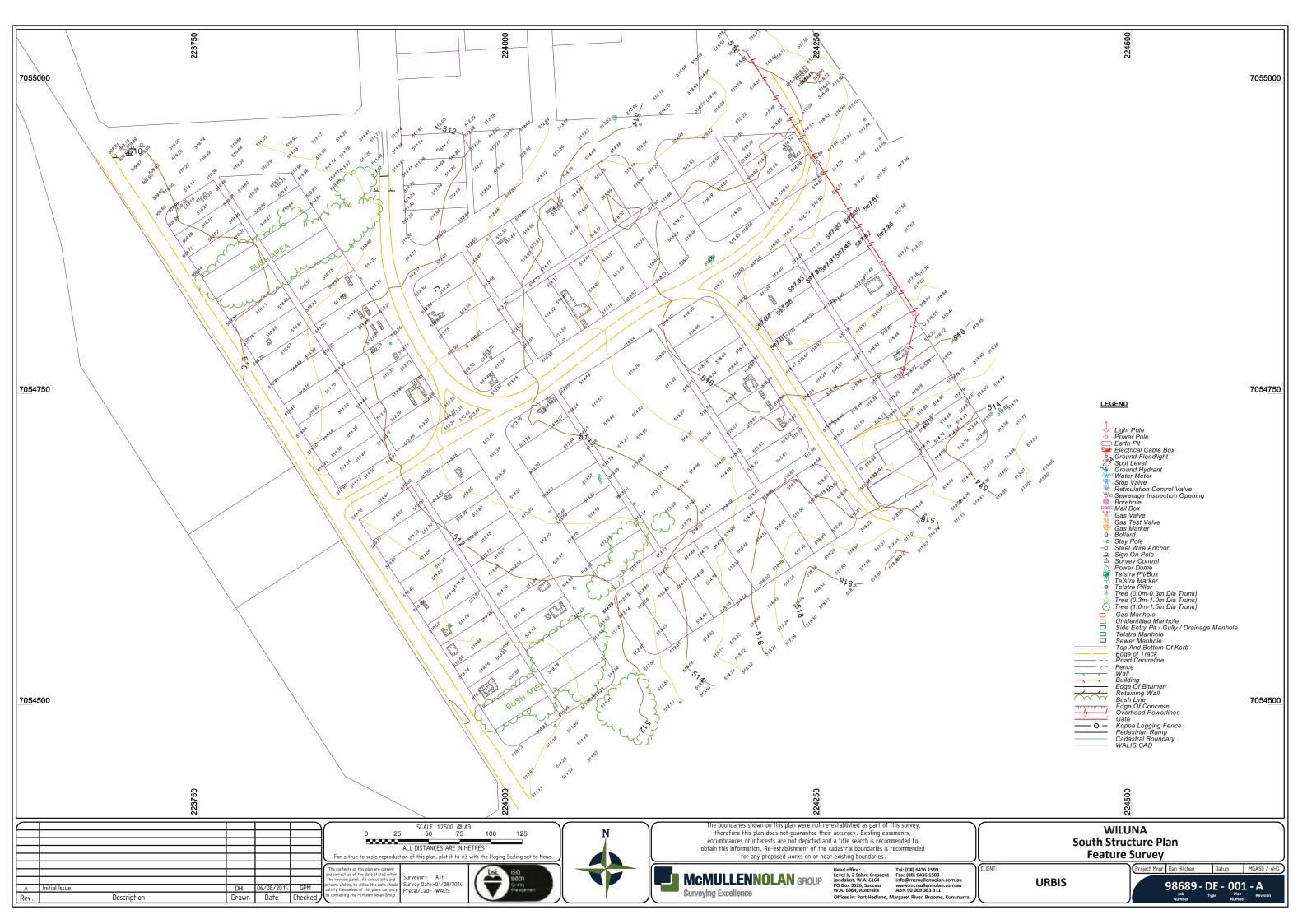
Client Services

Uncertainty data is available on request

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APPENDIX H

Existing Production Well Borelogs

LONG NECK CREEK

PH 0428 381 341 FAX 08 9923 3356

HOLDINGS ABN 13 248 614 820

DRILLERS LOG 0201

CLIENT: SHIRE OF WILLIAM
CONTACT: ROS LIVER SIDE
LOCATION: WILLUNA.
PHONE: 6429 817010
DATE: 1- 4- 14
DRILLER: IAN PINE
COMPLETION DATE: -4-14

-	SIZE	No.
HAMMER	7"	81
CLAY BLADE		
HARD BLADE		
TRI CONE		-
PRO LINE		
REAMER		

RU	NNING COSTS
FUEL	
REPAIRS	
OIL	
COOLANT	
SUNDRIES	

<u> </u>	1			
DEPTH		SOI	TYPE	
0-1	RED LOAM	n/ Barowani	Nota	
1-3	COFFEE	hoch		
3-6	WETHERED		Ę	
6-9	v	v		
9-12	n '	'n		
12-15	BROWEN	ROCK /	WETHERED	GROWITE
15-18	Brown	Nocn 1	QUANT	"Moist."
18-21	l?	n '	r	" WET"
21-24	· 1/1	n	v	
24-27	11	7 '	<i>/</i> ~	
27-30	n	n	n	
30-33) į	<i>ķ1</i>	.) (
33-36	11	ы	ş1	
36 - 37	HAN K	EK. CA	ANITÉ.	
W				
				,

MUD	AMOUNT

CASIN	IG AND PACKING
5" PLAIN	25m class 9 Puc
5" SLOTTED	12m class 9PUC
4" PLAIN	
4" SLOTTED	
GRAVEL	PARK TO SURFACE
EXTRAS	END CAF

COMMENTS	
16 M STOTIC WATER LOVER	
37 M 7070L 10 297H	
2800 C/HOUR AIR LIFTING	
WATER SOMS ELESH	
at a	

Drillers Signature



APPENDIX C

CMW Geotechnical Investigation 2014



20 August 2014

PROPOSED LAND REZONING FORREST STREET, WILUNA, WA GEOTECHNICAL INVESTIGATION REPORT

360 Environmental Pty Ltd Ref. 2014-0379AC Rev 0

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FIGURES

Figure 01 – Site Location Plan

Figure 02 – Site Plan

PLATES

Plates 1 to 14 – Test Pit photographs

Plates 15 to 17 – Other photographs

APPENDICES

Appendix A – Hand Auger Borehole Logs

1 EXECUTIVE SUMMARY

This report presents the results of a geotechnical site investigation carried out for the proposed rezoning of approximately 21 ha of Unallocated Crown Land (UCL) to residential land in the south of the town Wiluna, WA.

Based on the investigation results, the site is underlain by a thin layer of sandy clay overlying moderately cemented gravel and a siliceous hardpan layer.

Geohazards and risks identified included existing structures, subsurface drainage and the excavatability of the hardpan layer.

The site is considered suitable for the proposed rezoning subject to the recommendations provided herein, which are summarised as follows:

- Where present below design subgrade levels, any fill, topsoil or otherwise unsuitable material must be removed and cut to waste or reworked and re-used under engineering supervision;
- At the completion of any excavation to design levels, including foundation excavations, the upper 300 mm of the exposed subgrade must be moisture conditioned to within ±3% of optimum moisture content (OMC) and compacted;
- Any fill should comprise material with grain size of <100 mm. It must be moisture conditioned as above and compacted in layers not exceeding 300 mm;
- A preliminary site classification of Class "S" to AS2870 is considered suitable.

2 INTRODUCTION

CMW Geosciences Pty Ltd (CMW) was authorised by Luke Rogers of 360 Environmental Pty Ltd on behalf of the Shire of Wiluna to carry out the required work in our signed terms and conditions dated 3 July 2014. The scope of work and associated terms and conditions of our engagement are detailed in our proposal letter referenced 2014-0379AB, dated 17 April 2014.

It is understood that a package of land, located south of Wiluna town is currently zoned as Unallocated Crown Land (UCL) by the Shire of Wiluna District Planning Structure Plan. It has been proposed by the Shire that the UCL be rezoned as land to be used for residential and tourism purposes.

The purpose of this report is to describe the investigation completed, the ground conditions encountered and to provide recommendations with respect to geotechnical aspects of the proposed rezoning including the identification of any geohazards, and provision of site and subsoil classification including earthworks and construction considerations.

3 SITE DESCRIPTION

The site is a pentagonal shaped area of land approximately 21 ha in size, which is proposed for rezoning from Unallocated Crown Land (UCL) to residential land and land for tourism purposes. A private property located within the study area was excluded from our investigation at the request of Rod Liversidge, Executive Manager Works & Services, Shire of Wiluna.

The site is generally level and located in the south of the town of Wiluna, WA (refer attached Site Location Plan – Figure No. 01), over 950 km northeast of Perth. It represents an area of vacant, subdivided land created as a result of the original 1930's residential development, but has since been converted back to UCL. It is bound by Forrest Street, an unsealed gravel road to the west and undeveloped scrub land on all other boundaries. Several other roads, gazetted but not formally constructed, cross the site. Evidence of the original 1930's subdivision was present in the form of foundation slabs and partially collapsed walls. Areas of sparse vegetation comprising shrubs and trees are also present. A recent feature survey has not been provided.

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4 FIELD INVESTIGATION

Fieldwork was carried out on 28 July 2014 following a dial before you dig search. All fieldwork was completed under the direction of CMW in general accordance with AS1726 (1993), Geotechnical Site Investigations. The scope of fieldwork was as follows:

- The excavation of 5 machine excavated test pits to depths of between 0.35 m and 1.2 m using a 30T excavator to determine the underlying soil and rock conditions. All test pits met with refusal.
- The completion of 4 Dynamic Cone Penetrometer (DCP) tests undertaken adjacent to the test pits to a maximum depth of 1.05 m to determine a soil density profile.

The approximate test locations are shown on the attached Site Investigation Plan (Figure No. 02). It should be noted that a handheld GPS with an accuracy of ±3 m has been used to determine coordinates for test locations. Engineering logs of the test pits with corresponding DCP results are provided in Appendix A.

5 GROUND MODEL

5.1 Published Geological Information

Published geological information for the area suggest that shallow clayey sand soils overlie ultrabasic and basic igneous rocks. Soils tend to be leached and there is a widespread occurrence of siliceous hardpan or silcrete. It is not anticipated that groundwater will be encountered during the investigation.

5.2 Subsurface Conditions

The ground conditions encountered were generally consistent with published geological information for the area. Based on the findings of this investigation the geological units mapped on site include Alluvium comprising sandy clay and gravel, overlying a siliceous hardpan. The depth to the hardpan ranged from 0.35 m in TP04 to 1.2 m in TP01, but was generally at a depth of less than 0.5 m from existing ground levels. It was not possible to excavate beyond the hardpan, therefore the thickness of this layer is unknown. In addition, an outcropping dolerite dyke up to 100 mm wide was observed within a few metres of TP05.

The two soil units that were identified during our investigation are described as follows:

- Sandy CLAY (CI), medium plasticity, red brown, fine to medium grained sand with fine to coarse grained gravel (Alluvium).
- GRAVEL (GP), fine to coarse grained, pale grey to cream and dark green with red brown surface staining, fine to coarse grained sand, trace fines and cobbles, moderately cemented (Alluvium).

A typical ground model for the site is outlined in Table 1 below.

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Table 1: Typical Ground Model						
Unit	Depth to base of unit (m bgl)	Thickness of unit (m)	Consistency / Estimated Relative Density			
Sandy CLAY (CI)	0.05 – 0.5 (0.15)	0.05 – 0.5 (0.15)	Very Stiff			
GRAVEL (GP)	0.35 – 1.2 (0.57)	0.3 - 0.7 (0.42)	Dense – Very Dense			

Notes:

- 1. Estimated relative density from DCP
- 2. Average representative values are shown in brackets

5.3 Groundwater

As anticipated, groundwater was not encountered during our investigation.

6 GEOHAZARDS AND RISKS

The following geohazards and risks have been identified following our investigation and are described below.

6.1 Existing Structures

Foundation pads and structures from the original 1930's subdivision are present over a large portion of the site. Foundation pad thicknesses of up to 0.35 m are currently exposed above existing ground levels. Surficial rubble and rubbish including old car bodies, metal, glass and wood chippings were also present. Some of these materials could be used provided that appropriate sorting and crushing is carried out to ensure materials comply with the fill specifications outlined in Section 8.1.

6.2 Low Infiltration Rates

Low infiltration rates are expected due to the poor permeability of the clayey soils, moderately cemented gravels and the hardpan found throughout the site. This is likely to lead to ponding of surface water in the lower lying areas during periods of intense rainfall and significant overland flow, which could also lead to erosion of the thin soil profile.

6.3 Shallow Hardpan

During our investigation we were unable to excavate below the hardpan with a 30T excavator (Komatsu PC300), which will be an issue during any future excavation works.

7 ALLOWABLE BEARING PRESSURE

Shallow pad or strip foundations supported by the materials identified in our test pits are expected to be suitable for low rise residential buildings. Foundations should be designed in accordance with AS2870 and must be subject to undertaking the preparations in accordance with the recommendations outlined in Section 8.1 and 8.3.

8 GEOTECHNICAL ASSESSMENT AND RECOMMENDATIONS

8.1 Earthworks

Site preparation and earthwork recommendations are summarised as follows:

- Any topsoil or otherwise unsuitable material including domestic rubbish, organic material and car
 bodies must be cut to waste from all proposed cut and fill areas and the root bulbs of trees must
 be removed and completely grubbed out. Existing structures should be cleared from the site prior
 to works. Rubble from the demolition of existing foundations may be used as backfill in public
 open spaces;
- Based on the penetration of our test pits using a 30T excavator, the rippability of the ground will be extremely hard and hydraulic breaking is likely to be required. Best estimates from published literature suggest that a Caterpillar DL10 (700 HP, 522 kW) may be able to rip through the hardpan at a productivity of around 380 BCM/hr. It is expected that the materials encountered on site may be excavated to the required levels using standard mechanical plant with provision made for a rock breaker if excavation through the hardpan layer is required (refer Section 6.3). Most of the material excavated can be disposed of off-site, used in public open spaces or reworked and reused under engineering supervision. If excavated, the hardpan may be used as fill material, however, it must be crushed and blended in accordance with the recommendations provided below:
- At the completion of any excavation to design levels, including foundation excavations, the upper 300 mm of the exposed subgrade must be moisture conditioned with a water cart to within ±3% of optimum moisture content (OMC) and compacted with a suitable roller to achieve an equivalent dry density ratio of approximately 95% based on Modified compaction (AS1289 5.2.1). Any soft, loose, weak, or organic materials observed must be removed and replaced with compacted fill;
- Any fill material should be well graded and have a maximum particle size of 100 mm. It must be
 moisture conditioned and compacted in layers not exceeding 300 mm to achieve an equivalent
 dry density ratio of approximately 95% based on Modified compaction (AS1289 5.2.1).

The technical and control requirements for Engineered or Structural Fill, including site observation and compaction testing, are outlined in AS3798. We recommend that this work is completed under the direction and control of a suitably experienced Geotechnical Engineer familiar with the contents of this report. CMW would be pleased to perform this function if required.

8.2 Drainage

Due to the anticipated low permeability of *in-situ* materials, in-ground soakage systems are not considered suitable for the site.

8.3 Preliminary Site Classification

Based on our assessment of the sand soils beneath the site and within the depth investigated, as reported in AS2870, the classification for this site is Class "S" referring to a site containing clay soil with vertical surface movements of less than 20 mm.

Final site classification should be undertaken by a suitably qualified person for each lot once the development works are completed.

It should be noted that AS2870 may not apply to all the structures proposed for this development.

8.4 Further Investigations

Following clarification of the final development proposal details, it is recommended that consideration be given to undertaking further geotechnical investigation. The requirements of the investigation may include the following:

- Determination of the thickness of the hardpan layer.
- Final site classification for individual lots on completion of the subdivision.

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9 LIMITATIONS

The findings contained within this report are the result of limited discrete investigations conducted in accordance with normal practices and standards. To the best of our knowledge, they represent a reasonable interpretation of the general condition of the site. Under no circumstances, can it be considered that these findings represent the actual state of the ground conditions outside of our investigation locations.

For and on behalf of CMW Geosciences Pty Ltd

Compiled by:

Stuart Archer

Engineering Geologist

Approved by:

Phil Chapman

Managing Director

Figures





