CHAPTER 2
DESCRIPTION OF EXISTING ENVIRONMENT

BIRD IN HAND GOLD PROJECT
MINING LEASE PROPOSAL

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Document Number	File Path	Format	Last Modified
BIHMLP_V2	O:\Technical\Bird In Hand\Regulatory\DSD\ML Application\BIHMLP_V2	PDF	18/6/2019

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Distribution Electronic Copies (Body and Appendices)

Document Number	Issued To	Format	Date
BIHMLP_Draft_V1	DEM	Adobe	18/12/2017
BIHMLP_V2	DEM (45 copies)	PDF	21/6/2019
BIHMLP_V2	DEM (5 copies)	Hard Copy	21/6/2019

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2 DESCRIPTION OF EXISTING ENVIRONMENT

This chapter is provided to give the reader an overview of the existing environment relevant to the construction, development, operation and closure of the Bird in Hand Gold Project ('the Project' or 'BIHGP') and proposed Mining Lease (ML). The existing environment is described in accordance with the Ministerial Determination for the Bird in Hand Gold Project (BIHGP MD). The elements of the existing environment described in this section include static aspects, including the planning framework relevant to the Project, an overview of the local communities and the proximity of the Project to infrastructure and housing and conservation areas, as well as environmental aspects including topography and landscape, climate, and local and regional geology. Further details regarding the existing environmental values are included in the relevant aspects chapters and are supported by the relevant impact assessment (Chapters 7 to 24).

2.1 PLANNING FRAMEWORK

This section provides an overview of the relevant strategies and policies applying to the BIHGP, including the contribution of the proposed ML to the achievement of South Australia's Strategic Plan and Economic Priorities. The requirements for the project associated with the zoning within the Adelaide Hills Council Development Plan is also included.

2.1.1 The 30-Year Plan For Greater Adelaide - 2017 Update

The 30-Year Plan for Greater Adelaide (2017 update) provides a framework for the ongoing growth and development of the State. In 2020, South Australia will have a new planning system which will include a collaborative vision and priorities for the whole state.

South Australia has an established resources industry and is a key mining services hub for Australia and the region. All South Australians have the opportunity to benefit from a strong resources sector.

Mining and energy have been central to the renewal of manufacturing activity and the state has successfully been transformed to one where:

- An established mining goods and services hub serves mines in South Australia and other regions;
- South Australia is renowned for its technological innovation in minerals and energy production and related industries;
- South Australia is renowned for its ability to manage the challenges of a growing mining sector;
- Regional towns are larger, resilient and liveable;
- Minerals and energy projects employ a diverse workforce including local residents, disadvantaged groups, Aboriginal people and women;
- South Australia has a strong reputation for world leadership in safe and sustainable minerals and energy production;
- South Australia is a globally competitive location for minerals and energy development and there is a growing pipeline of resources projects; and
- A Future Fund resulted in all South Australians benefiting through the reinvestment of revenues from mining led growth into projects to further secure South Australia's future.

Terramin are committed to supporting the realisation of the benefits of mining for all, and as such, are committed to working with communities where we operate to maximise the benefits and minimise the impacts resulting from our activities.

Both agriculture and mining are expected to continue to grow significantly over the next thirty years. Deloitte Access Economics forecasts show that the agriculture, forestry and fishing industry will grow by approximately one third in real terms, while the mining industry is forecast to almost double.

The proposed BIHGP is included in the 30-Year Plan for Greater Adelaide (2017 update) as an undeveloped strategic mineral resource with high mineral potential (Map 6).

2.1.2 Policy Directions for South Australia's Resource Sector

Policy directions for South Australia's resource sector were announced by Premier Steven Marshall during 2018 – underpinned by three overarching priorities – to generate new investment, boost exports and create jobs.

The BIHGP will create 600 jobs (Full Time Equivalent (FTE)), and create an impact on the state economy of over $280 million (Gross State Product). Australia is the second highest gold producer in the world, and the BIHGP increases South Australia's contribution to this export by approximately 15% annually (based on 2016 gold production statistics).

The South Australian government are committed to having a dynamic resources sector that's globally competitive and fuels economic development and job creation in a safe and secure destination.

South Australia is in an enviable position with abundant resources, quality geoscience initiatives, a highly skilled workforce and a respected regulatory framework.

The South Australian government remain committed to supporting exploration and development – leveraging the activity generated by mining and energy into new intellectual property, jobs and global business opportunities for mining services companies, while balancing development with protection of the environment, making efficient use of water and energy, as well as providing land access via a shared approach.

2.1.3 Adelaide Hills Council Development Plan

Terramin's property is located within the Adelaide Hills Council (AHC) local government area and is within the Adelaide Hills Council Development Plan's 'Onkaparinga Valley 'Policy Area. The land is zoned Watershed (Primary Production).

The zone's objectives and principles of development control, aim to prevent development that may lead to deterioration in the quality of surface or underground water within the Mount Lofty Ranges Watershed and also maintain land for primary production.

2.1.3.1 OBJECTIVES:

Objective 1: The retention of the existing rural character by ensuring the continuation of farming and horticultural activities and excluding rural living or other uses which would require division of land into smaller holdings.

The project does not propose to divide the Terramin property into smaller holdings. Recommendations for retention of the rural landscape character are discussed within this plan.

The Adelaide Hills Council Development Plan includes specific objectives relating to Council-wide mining activity including:

Objective 58: The continued availability of metallic, industrial and construction minerals by preventing development likely to inhibit their exploitation.

> *"The minerals of greatest significance are those used for building and construction. South Australia has a scarcity of natural timbers for building construction, and is therefore particularly dependent on resources of clay and shale for brick manufacture, and sand and stone for concrete and mortar aggregate. Equally important are materials such as filling sand and quarry products used in road building and general construction. Transport costs of these bulky low-value products rise rapidly as the distance increases between the workings and the point of consumption, with a consequent increase in price to the consumer."*

Gold and silver, being metallic, are acknowledged as being available for extraction in the Mount Lofty Ranges.

Objective 59: The protection of the landscape from undue damage from quarrying and similar extractive and associated manufacturing industries.

> *"New mining operations in the south Mount Lofty Ranges should be confined to areas not readily visible from the Adelaide Plain.*
>
> *It is not in the best interests of the community that land should be left derelict following the extraction of minerals, and wherever possible steps should be taken to reclaim the land and put it to a suitable use."*

Objective 60: The siting and management of quarrying and similar extractive and associated manufacturing industries so that minimum damage is caused to the landscape.

> *"The permanent effect of mining operations on the appearance of the landscape and water front areas should be considered before operations begin, and the suitability of alternative sites investigated.*
>
> *After workings are finished undesirable structures should be removed, quarry faces beautified by landscaping, or the natural cover of the land restored. In some cases the redevelopment of some areas to other uses should be considered."*

The objectives above are considered to apply Council-wide and therefore not limited to land zoned specifically Extractive Industry (EIn).

The project development has taken into account the citing and landscape aspects through the commissioning of a Landscape Amenity Report. Design details are provided in Chapters 3 and 9.

2.1.4 South Australia's Multiple Land Use Framework

The following is taken from South Australia's *Multiple Land Use Framework*, released in 2017 after significant community consultation.

Land use in South Australia is varied and includes recreation, conservation, agriculture, fisheries, aquaculture, forestry, biodiversity, minerals and energy exploration, renewable energy production, housing, defence, tourism, manufacturing and infrastructure, to name just a few. Land ownership, environmental protection, native title and Aboriginal and non-Aboriginal heritage are all important considerations. South Australia has an estimated 76,000 hectares under vine. In 2014–15, the industry produced more than 730,000 tonnes of grapes valued at $470 million. Less than 1% of the State is currently under mineral and petroleum production tenements (SARIG, 2018). Mineral exports accounted for 29% of total State exports for 2015 and production was valued at $5.4 billion. Together, mining and agriculture comprise 74% of South Australia's exports, underscoring the continued importance of supporting our regional communities.

The Framework has been designed to operate within established regulatory and policy frameworks and provides guidance on how best to engage with stakeholders on land use change projects. The Framework is consistent with many of the principles found in State policies, planning documents and Ministerial Guidelines; the Framework does not replace these, nor does it alter existing land rights or override existing legislation.

2.2 OVERVIEW OF LOCAL COMMUNITIES

The entirety of the land covering the proposed ML is zoned rural development, within the AHC boundaries approximately 25km from Adelaide in the Federal District of Mayo and State District of Kavel (see Figure 2-1).

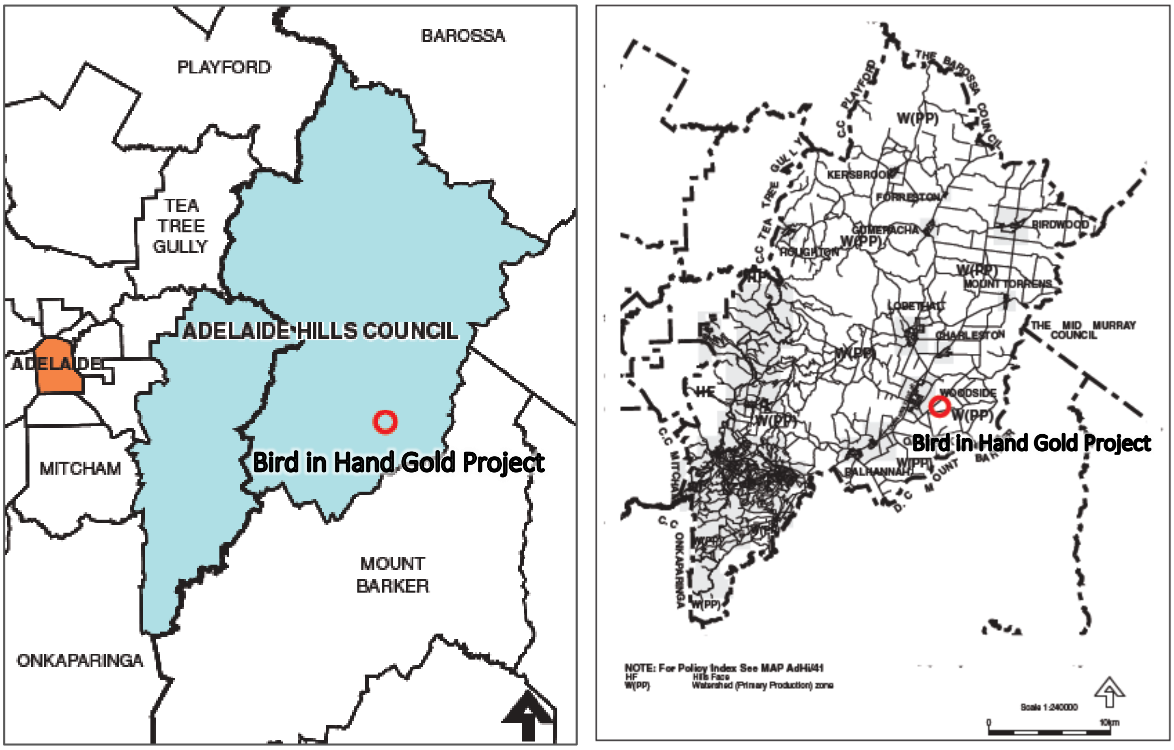

FIGURE 2-1 | LOCATION OF PROJECT WITHIN ADELAIDE HILLS COUNCIL BOUNDARY (ADELAIDE HILLS COUNCIL DEVELOPMENT PLAN)

2.2.1 WOODSIDE AMENITIES

The eastern fringe of the township of Woodside is located approximately 1,200m from the western most point of the ML (see Figure 2-2).

Woodside community amenities include a police station, medical centre, Country Fire Service Station and library, as well as recreational facilities including the local recreation park, which contains a football/soccer oval, netball and tennis courts, bowls club and swimming pool. Woodside hosts various sporting clubs which use these facilities. The main street includes cafes and bakeries, small retail outlets, hair dressers, a supermarket, newsagent, real estate agencies and a range of services including veterinarians, banks, lawyers, accountancies, and a local business centre.

There is a privately owned and operated airstrip opposite the ML.

The Woodside Army Barracks are located approximately 1,500m to the south-west of the ML at Inverbrackie and host the 16th Air Land Regiment.

FIGURE 2-2 | PROPOSED MINING LEASE (MINERAL CLAIM) LOCALE IN RELATION TO WOODSIDE

The amenity of any area is largely subjective, and will mean different things to different people. Community workshops, hosted by the CSIRO, explored the topics related to current attitudes regarding the amenity and wellbeing of the area, and why community members chose to live in the region. Reasons included:

- Quiet, calm, less stress than living in Adelaide;
- Clean air, natural environment (rolling hills), aesthetics;
- Country town but short commute to city;
- Minimal heavy vehicle traffic (farm traffic goes largely unnoticed or is seasonal);
- Long-term family connections;
- Sense of community spirit, welcoming & caring, old fashioned, safe;
- Good mix of business, diversity of options;
- Everything is close i.e. medical, vets, good schools, sport/recreation, work/jobs; and
- Weekend sports and family friendly events (always something on).

The proposed project seeks to expand upon and contribute to these identified topics. It aims to fit in with the existing landscape, working within the existing environmental conditions (for example, dust and noise), safely manage traffic movements between the BIHGP site and the Angas Processing Facility (APF), diversify the local economy and provide opportunities for young professionals to retain these people in our regions, support local services such as the CFS through training and development, and contribute positively to the local community through participation in local events and sponsorships.

The CSIRO Community Workshops to Inform Survey Design Report has been included in Appendix C6.

2.2.2 Demographic Profile

The 2016 census data reflected Woodside, shown in Figure 2-3, (postcode 5244) population data as;

- Permanent population of approximately 2,608, with almost equal proportions of males and females (50.4:49.6);
- The median age of the population is 43, compared to the South Australian average of 40, and the Australian average of 38;
- Aboriginal and Torres Strait Islander Peoples make up 0.4% of the total population;
- Approximately 18% of the population were born overseas, with the largest overseas denomination hailing from England (4.9% of the total population).
- The median weekly income for all persons aged over 15 years is $627 compared to South Australian median of $600 and Australian median of $662.

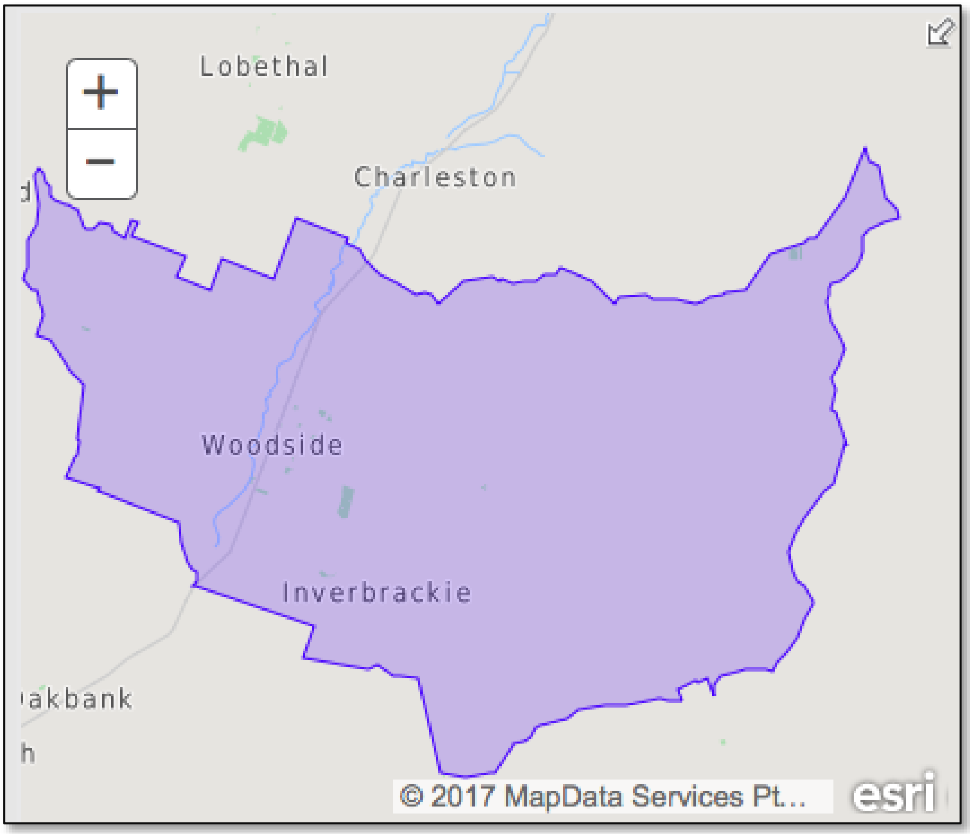

Figure 2-3 | Census (2016) Woodside district

2.2.3 Regional Visitation

According to data available from Tourism SA, approximately one million people visit the Adelaide Hills every year, these visitors contribute an estimated $110 million per annum (Adelaide Hills Tourism Inc., 2015) in direct tourism spend.

95% of visitors to the region were domestic most of whom (64%) were visiting family and friends. 48% of visitors experience dining and cafes in the region and 15% visit wineries (Tourism Research Australia, 2016).

Specific tourism points of interest include the various wineries and cellardoors and the Woodside Heritage Park which includes Melba's Chocolate Factory, Cheesewrights and various arts and crafts.

2.2.4 Land Use

The majority of the surrounding land is currently used for either livestock grazing, agriculture or horticulture (generally planted vineyards). Extensive irrigation in the catchment is predominantly for horticulture and viticulture while less intensive irrigation is associated with dairy farming and grazing (NRM: Adelaide and Mt Lofty Ranges, 2013). Irrigation of orchards, grapevines and pasture increased substantially in the Central Hills region in the preceding 20 years, with the inclusion of apples, strawberries and vineyards in the Inverbrackie Creek sub-catchment. The Western Mount Lofty Ranges Water Allocation Plan regulates all groundwater abstraction within the Inverbrackie Creek sub-catchment.

Between the 2000-01 and 2005-06 Agricultural Censuses, the area of agricultural use decreased by 8%, or 2,971Ha. The Adelaide Hills experienced an increase in agricultural land holdings over this period, with a 22% increase of agricultural establishments (Adelaide Hills Council, 2011). This reflects the changing nature of the Adelaide Hills, with an increasing pattern of agricultural land fragmentation, as a result of sub-divisions and urban developments.

2.3 PROXIMITY TO INFRASTRUCTURE AND HOUSING

2.3.1 Housing and Services

Currently, there are four residential houses which are located within the ML, of which three are occupied, and the remaining house is owned by Terramin within the Goldwyn property, identified in Figure 2-5. Detail on the proximity of these houses is located in Chapter 21.

The recently constructed Petaluma Winery and cellar door is within the proposed ML and located approximately 550 m from the proposed operating area. The Bird in Hand (BIH) Winery, vineyard and cellar door, both adjoin the western boundary of the ML. The cellardoor is located approximately 550 m from the proposed operating area. A third cellar door, Artwine, is located approximately 300 m to the water storage dam and 450 m north-east of the proposed operating area within the ML. Pasture both within and surrounding Goldwyn and the ML is used predominantly for beef cattle, as well as medium to large scale viticultural holdings, as shown in Figure 2-4 and Figure 2-5. The property on the north-western side of Bird in Hand Road (Lot 9 and Lot 21) is owned by the Adelaide Polo Club and the land, previously part of a potato growing/dairy has now been converted into sporting fields and associated facilities. Adjoining the Polo club land to the south is a privately owned airstrip used for both fixed and rotary winged aircraft.

The eastern fringe of the township of Woodside is located approximately 1.2km from the western most point of the ML. Woodside amenities include a police station, a CFS station, medical centre, library and a recreation centre which includes a football oval, netball and tennis courts, bowls club and swimming pool. The Woodside army barracks are located approximately 1.5m to the south-west of the ML at Inverbrackie. The location of Woodside is shown in Figure 2-2. Terramin purchased Lot 10, a freehold property between Pfeiffer Road and Bird in Hand Road, known as Goldwyn. Goldwyn is shown in Figure 2-12.

Where residences have been identified as receptors in specific aspect chapters, (e.g. noise, air quality, vibration), they have been described in detail in each specific chapter in the "sensitive receptor" sections.

More detailed information regarding specific infrastructure, proximity and exemption zones (s. 9 of the *Mining Act 1971* (SA) (Mining Act) is included in Chapter 21 – Land Tenure.

FIGURE 2-4 | PROJECT SITE WITHIN ML SHOWING GOLDWYN (YELLOW DASH) AND NEIGHBOURING PROPERTIES

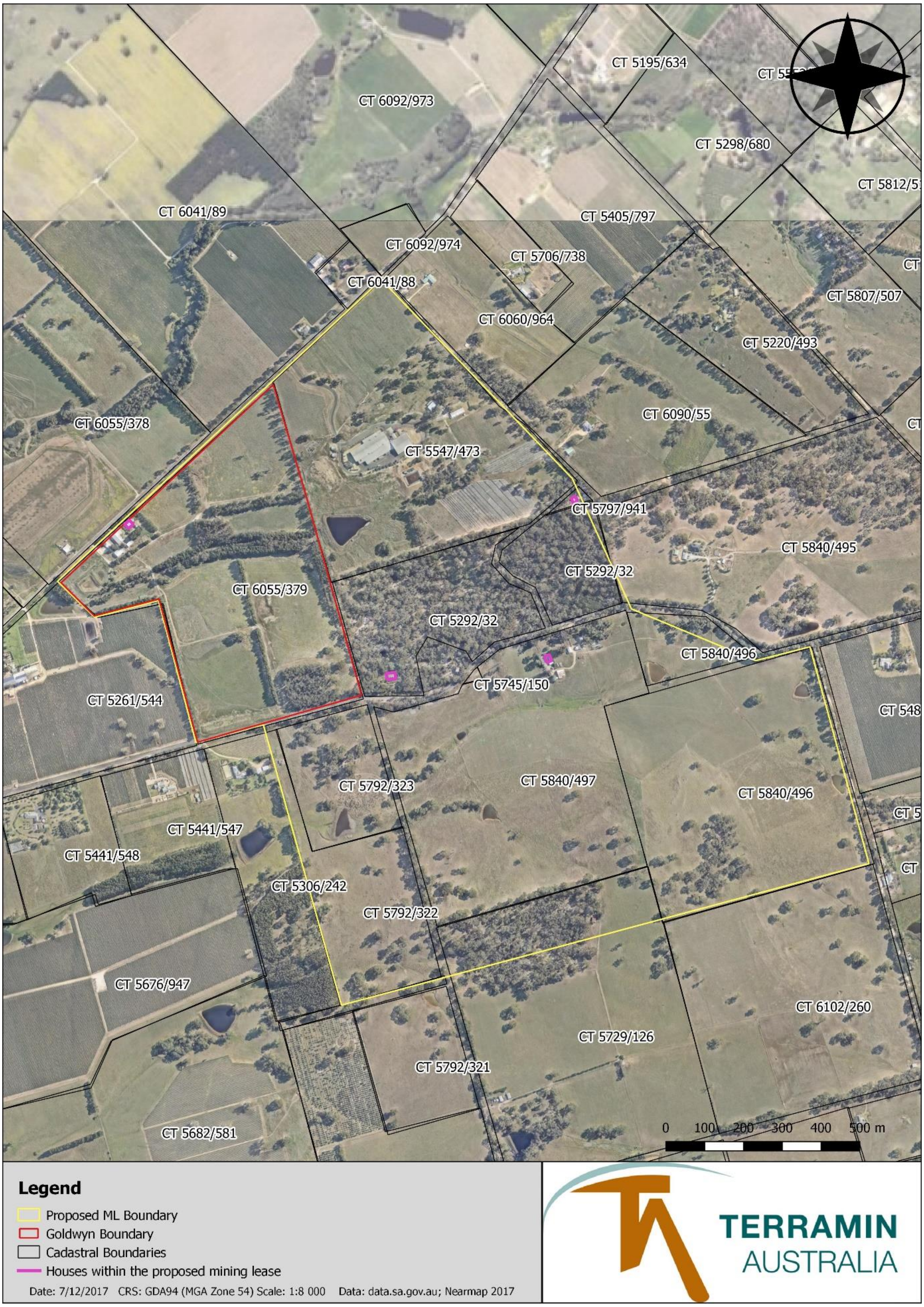

FIGURE 2-5 | HOUSES LOCATION WITH THE PROPOSED ML

FIGURE 2-6 | SITE PLAN OF SURFACE INFRASTRUCTURE PROPOSED ON GOLDWYN

FIGURE 2-7 | OUTLINE OF PROPOSED SURFACE INFRASTRUCTURE WITHIN THE PROPOSED ML

2.3.2 Exempt Land and Waivers of Exemption

The appropriate access forms and waivers (Forms 21, 22 and 23) have been obtained from landholders whose properties are interpreted as exempt under section 9 of the Mining Act for all exploration works undertaken to date. Waivers which will allow continued access and the use of 'declared equipment' (defined by part 1, section 6 of the Mining Act) will be obtained from the necessary landholders and landholders whose properties are interpreted as exempt under the same section of the Act as timing requires.

It is Terramin's intention to negotiate access to all land as defined as exempt under section 9 of the Mining Act prior to the commencement of mining operations. Terramin will discuss and negotiate relevant agreements (such as access and compensation) with each of the land owners individually. These agreements will set out relevant matters including the parties, compensation, access to land (including details of exempt land and the waiving of exempt land), conditions of access, and other matters relevant to the entry and commencement of mining operations.

Terramin has been able to obtain agreements through exploration, and are confident in their ability to obtain agreements with the vast majority of landholder whose properties have the potential to require the negotiation and registration of a waiver of exemption. The vast majority of landholders who are identified to have exempt land which traverses the proposed operating areas have had detailed discussions regarding the operation and waiver negotiations have commenced. These discussions and negotiations are ongoing and an update will be provided to DEM once agreement is reached.

A detailed description of exempt land is detailed in Chapter 21: Land Tenure.

Exempt Land Maps are included in Appendix T3 and a table outlining exempt land based on the boundary of the proposed ML is located in Appendix T4.

2.3.3 Utilities

An 11 kV power transmission line, as well as a mains water supply and telecommunications lines run through the ML parallel with Bird in Hand Road. A sewage main also runs along Bird in Hand Road to the SA Water Treatment facility, recycled water from this facility returns along Bird in Hand Road and branches off along Reefton Road and runs along Pfeiffer Road.

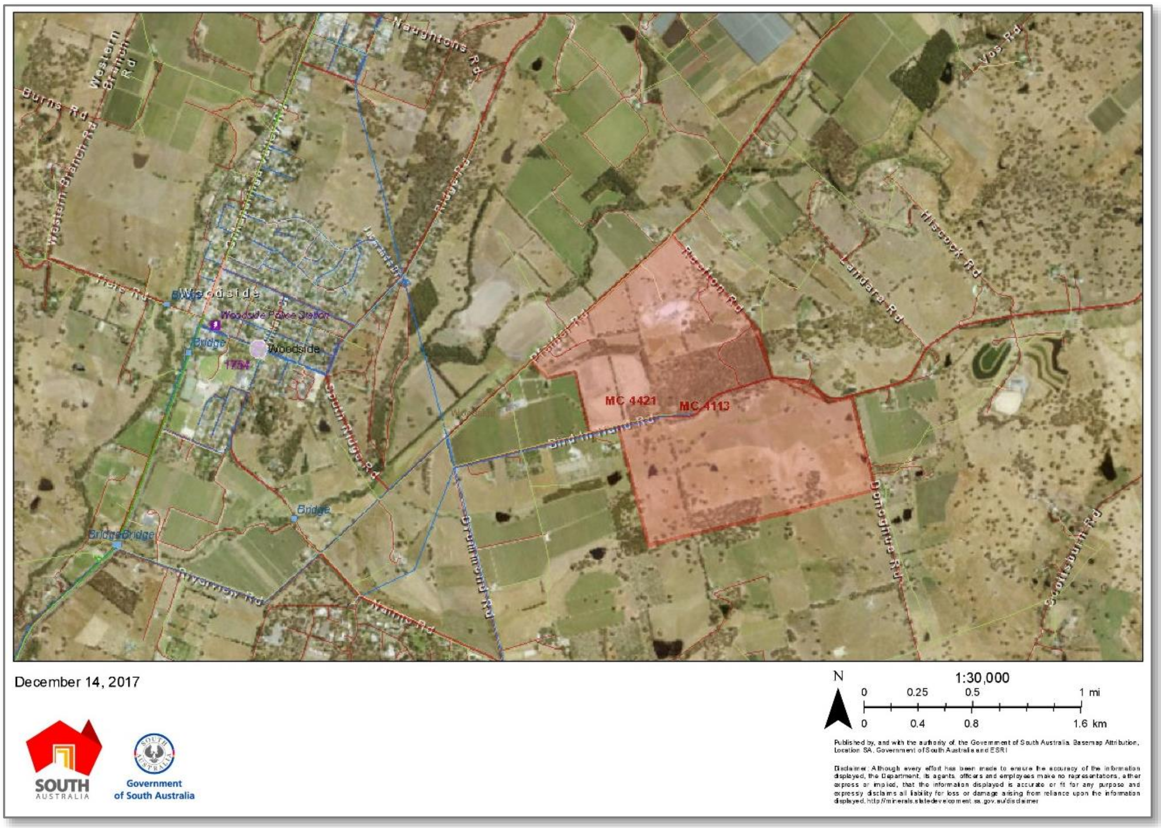

FIGURE 2-8 | UTILITIES (SARIG, 2017)

2.3.4 TRANSPORT

The proposed ML is located approximately 35 km by road from Adelaide, and 4 km by road from Woodside.

The project site is located off Pfeiffer Road, a local road that forms a connection between Nairne Road and Teakles Road. Pfeiffer Road is aligned in a north-east to south-west direction, with a sign posted speed limit of 80km/h, and has a painted centreline that varies between a broken and continuous line due to a number of crests. The road is sealed and consists of a single carriageway with one lane in each direction. There are a number of access points along Pfeiffer Road, including junctions, business and private property driveways. Pfeiffer Road is under the care and control of the AHC.

The Nairne Road is the closest major road, running north to south approximately 2 km west of the proposed ML boundary. Nairne Road connects Woodside to Nairne and consists of a single carriageway with one lane in each direction. Traffic on this road varies with between 3,400 and 6,300 vehicle movements daily, depending on the section. Nairne Road is under the care and control of the Department of Planning, Transport and Infrastructure (DPTI).

A detailed description of the proposed route is provided in Chapter 3 and Chapter 8.

2.4 PROXIMITY TO CONSERVATION AREAS

As described in Chapter 19 – vegetation, weeds and plant pathogens, there is a Native Vegetation Heritage Agreement (NVHA) over 13.8 ha in the centre of the ML, shown in Figure 2-9 and Figure 2-10.

The Charleston Conservation Park is 54 hectares and located 8 km east of Charleston and approximately 5.5 km north-east from the proposed ML boundary. Most of the habitat within the park is woodland with either Manna Gum (*Eucalyptus viminalis* ssp. *viminalis*) or Rough-barked Manna Gum (*E. v.* ssp. *cygnetensis*) over Golden Wattle (*Acacia pycnantha*).

The proposed ML is located approximately 30km from the Baker Inlet, St Kilda, Port Gawler and Buckland Lake, 40km from the Lower Murray Swamps to the east and 40km from the Onkaparinga Estuary to the south-west, and 45km from The Coorong, Lake Alexandrina and Lake Albert, all of which are RAMSAR listed.

Conservation Parks of interest closest to the ML include Cleland CP and Morialta CP, both located approximately 16km to the east.

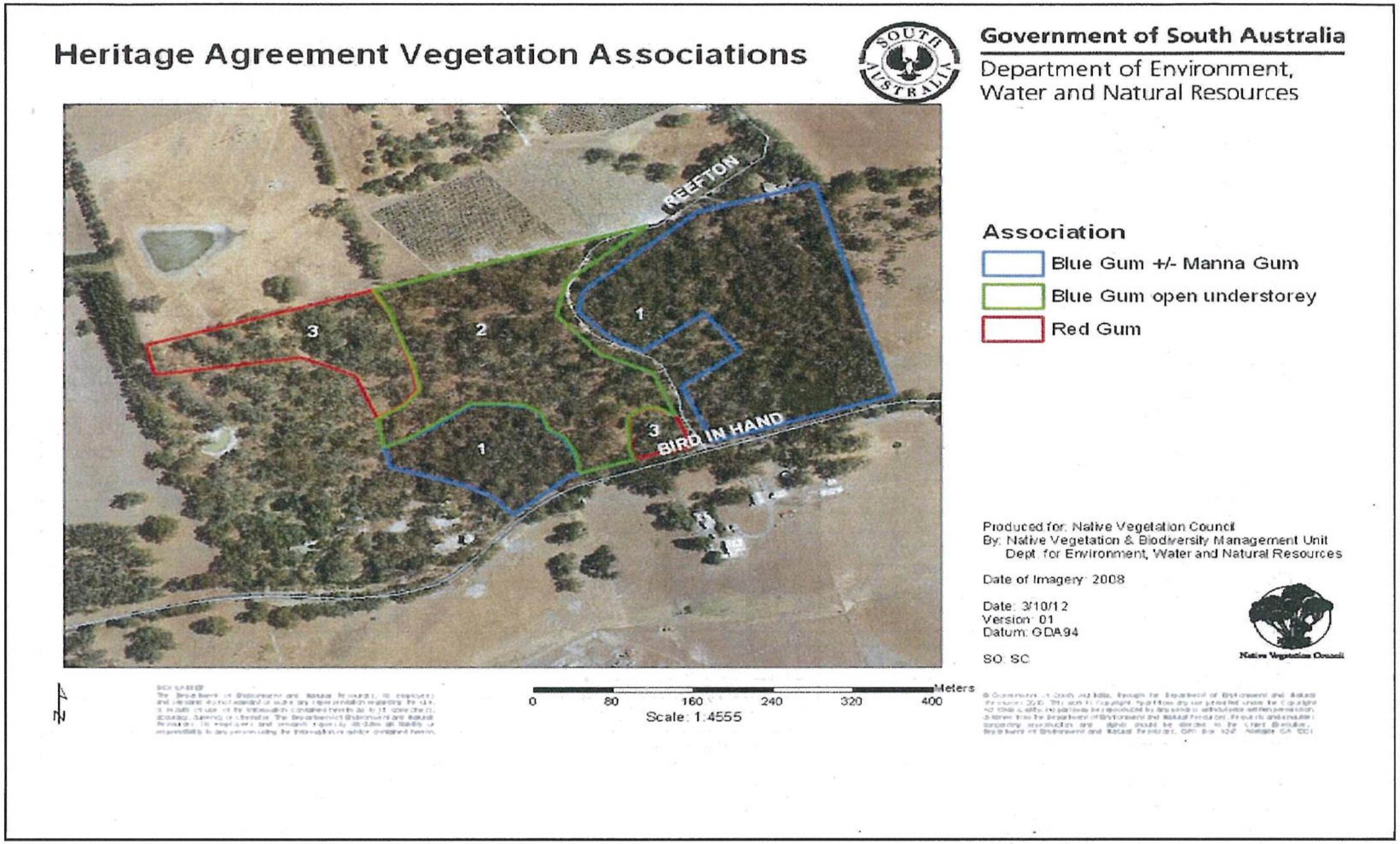

FIGURE 2-9 | HERITAGE AGREEMENT VEGETATION ASSOCIATIONS

FIGURE 2-10 | NVHA AREA AND THE PROPOSED OPERATING FOOTPRINT AND ML

2.5 TOPOGRAPHY AND LANDSCAPE

The ML is located in the Adelaide Hills, specifically the Mount Lofty Ranges subregion. Located approximately 400m above sea level, the topography of the Adelaide Hills generates a wide range of microclimates, however, the region is generally cooler and moister than the plains of Adelaide and the coastal plain.

Soil depth is variable due to topography, which ranges from steep slopes to undulating hills, resulting in shallow stony soils on the top of hills and deep peat-like clays at the bottom of hills.

The ML is distinctly divided into two sub-catchments, one located on the southern side of Bird in Hand Road, the other to the north of Bird in Hand Road. The drainage line on the northern section of the ML continues under Pfeiffer Road and fuses with Inverbrackie Creek approximately 300m east of the ML.

The Interim Biogeographic Regionalisation of Australia (IBRA) establishes a hierarchy of ecosystem classification for which physical, climatic and biological characteristics are described (Department for Environment and Heritage 2009). The Project site falls within the Kanmantoo IBRA Bioregion, Fleurieu IBRA Sub-region and Eden Valley IBRA Association. More discussion on IBRA association characteristics is provided in Chapter 19: Vegetation and weeds.

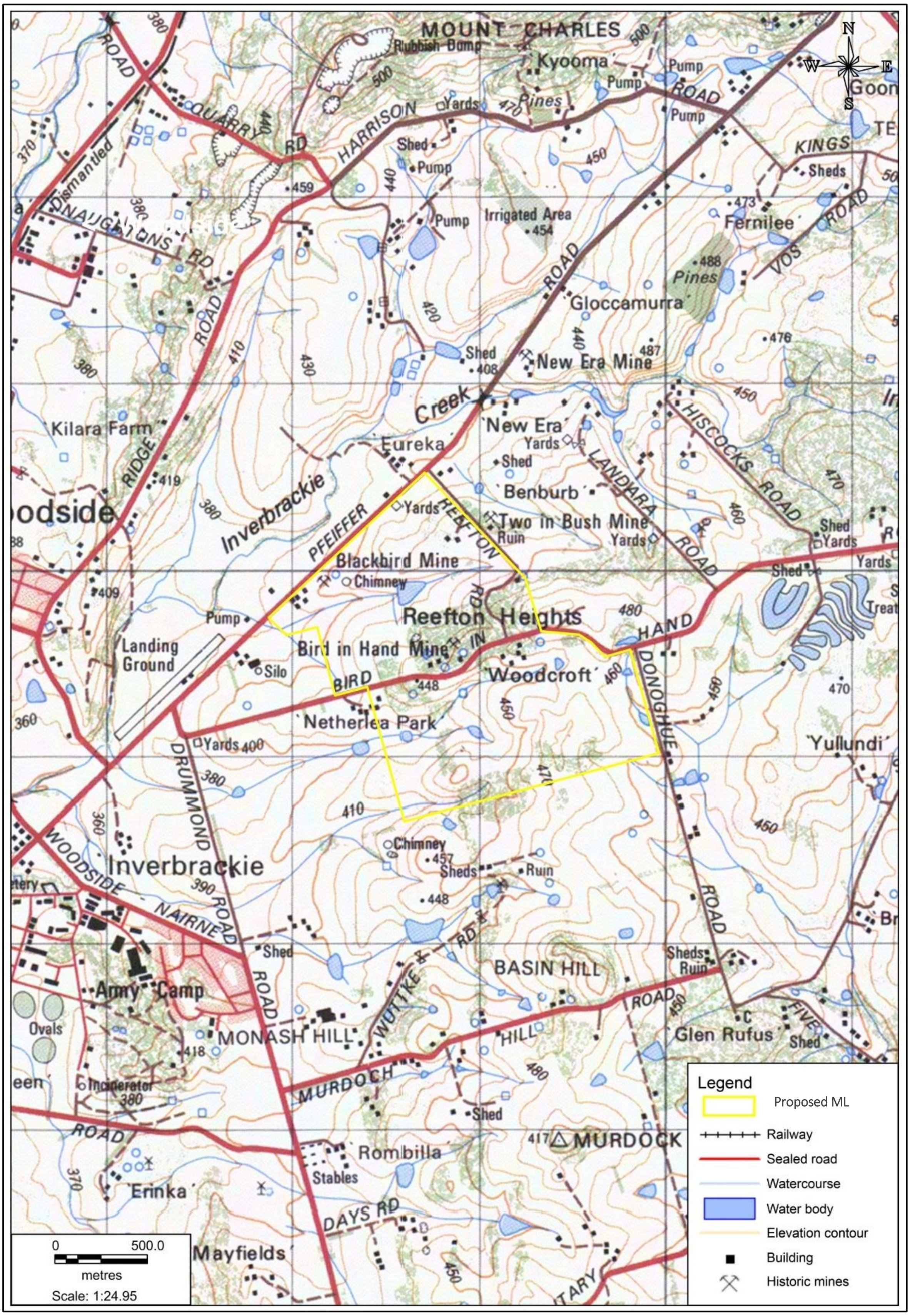

FIGURE 2-11 | ML4113 TOPOGRAPHIC AND LANDSCAPE FEATURES

2.5.1 Goldwyn Topography

The Goldwyn property sits within the proposed ML shown in Figure 2-11. The proposed Project infrastructure sits predominantly within the 36 Ha property. The BIHGP has an elevation of approximately 385 to 440m AHD. The eastern portion (Southern creek catchment) shown in Figure 2-12, drains directly into the creek, while the western portion (Western site catchment) currently drains into the adjacent property. The highest land point is located with the south-eastern corner of the site, with an elevation of approximately 440m AHD.

A ridge line passes through the section of the property to the north of the creek. This divides this region into the Pfeiffer Road catchment that drains northward towards Pfeiffer Road, and the Northern creek catchment, which drains southward into the ephemeral creek that passes through the site.

The existing ephemeral creek traverses the northern portion of the site from the east to the west at approximate elevations of 405 to 385 mAHD. Within Project site the creek is bounded by established vegetation, with only two discrete cleared areas where crossings have been formed. At the upstream end, beyond the eastern property boundary of the site, the watercourse is interrupted by an existing on-stream water storage (farm dam) located on the Petaluma property. The watercourse continues under Pfeiffer Road and ultimately discharges into Inverbrackie Creek, located west of the subject site.

There are two catchments upstream from the proposed Project site. The largest of these and the main contributing catchment (Upstream creek catchment) is shown in Figure 2-12 and drains into the creek that passes through the site. On the site’s eastern boundary there is an existing channel that directs runoff from the adjacent Petaluma winery site into the creek. The smaller catchment (Bird in Hand Road catchment) drains through the south western corner of the site and then passes through the adjacent property.

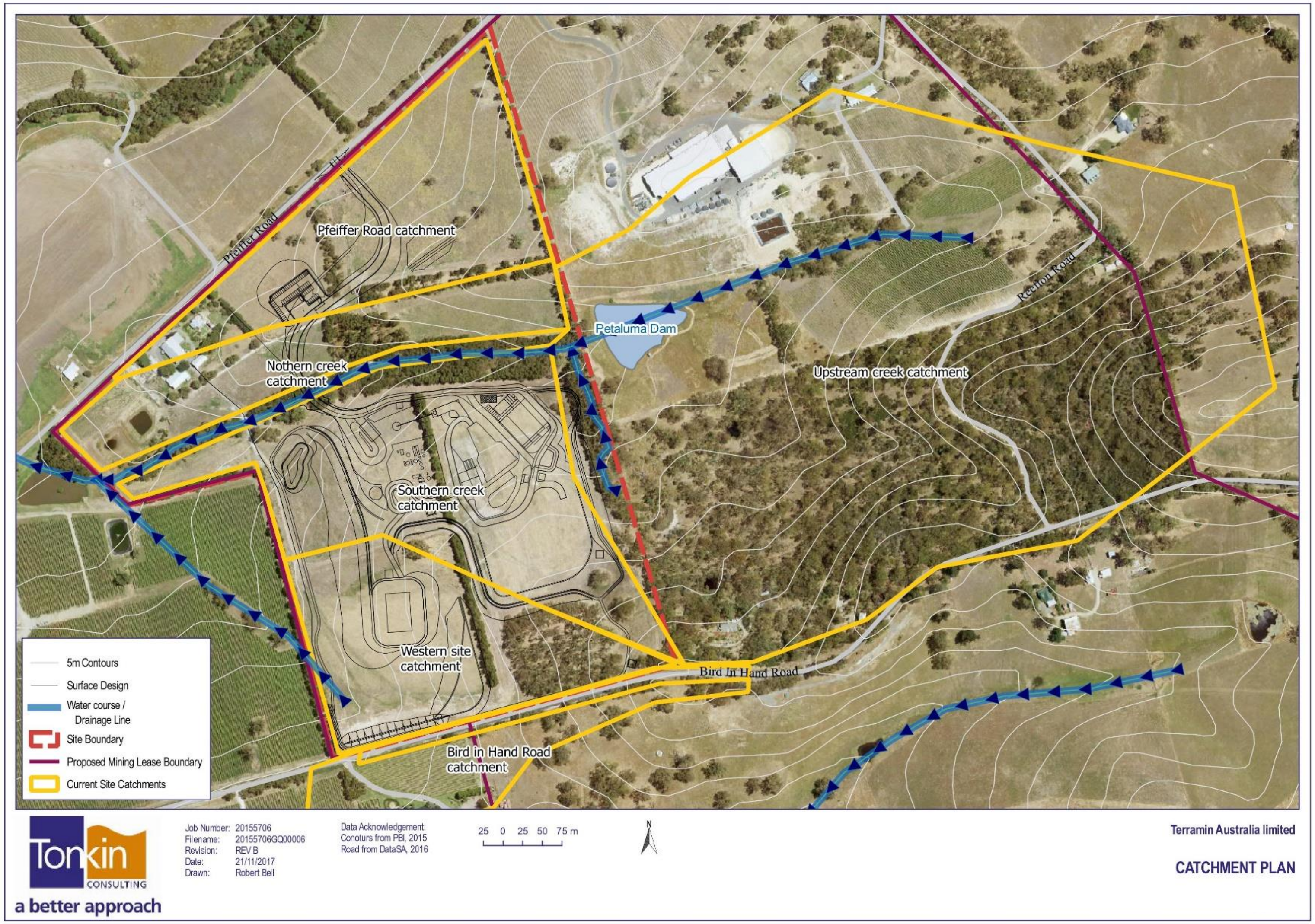

FIGURE 2-12 | CATCHMENTS IN AND SURROUNDING GOLDWYN

2.5.2 REMAINDER OF PROPOSED ML

Topography within the north-east corner of the ML, where Petaluma Winery is situated, includes surface run off which reports to the upstream creek catchment, which then reports to either the Goldwyn Creek, or drainage onto Pfeiffer Road from the northern paddocks/vineyards, as shown in Figure 2-11 and Figure 2-12.

The southern side of Bird in Hand Road includes a prominent valley, located between two ridges, with a peak elevation 455 mAHD near Bird in Hand Road, and the valley dipping to between 420 mAHD and 405m AHD, before rising again further south to between 475 mAHD in the east, and 430 mAHD in the west – shown in Figure 2-11. This valley creates two distinct ephemeral drainage lines which join within the ML before continuing west and joining the Inverbrackie Creek approximately 1.7 km further west of the proposed ML.

Within the ML, the southern side of Bird in Hand Road is entirely used for beef cattle grazing, including the riparian areas. This includes four stock dams, most of which are within the drainage line to maximise run off potential.

Two other small catchment zones exist, a small portion of the ML drains to the south west of the ML, to another ephemeral drainage line, which also joins the Inverbrackie Creek to the west of the ML, and a small portion to the south east of the ML which drains to another ephemeral drainage line, which ultimately joins the Dawesley Creek further south. None of Terramin's proposed activities have the potential to impact either of these two smaller catchment zones.

2.6 CLIMATE

According to the Koeppen system of measuring climate, which is based on temperature and rainfall according to vegetation in the area, the site is located within the Adelaide Hills region and has a temperate or Mediterranean climate, characterised by warm to hot summers and mild to cool, wet winters in the area (Peel MC, 2007). The combination of relatively high rainfall and hilly topography results in most of the rainfall occurring in winter. Local characteristics of the climate are summarised below.

Rainfall data was collected from the Woodside Post Office (Bureau of Meteorology station number: 023829) between 1884 and January 2017.

The Woodside weather station does not collect evaporation data for the region, monthly evaporation data presented in this overview has been sourced from the Lenswood Research Centre (BOM Station number: 023801), approximately 7 km from Woodside, thus it is considered to be appropriate for use in this overview. The data provides an average for each month collected between 1973 and 1999 using a Class A pan evaporimeter.

All other climatic data was obtained between 1926 and 2012 from Mount Barker (BOM Station number: 023733) 14km from Woodside, as this was considered the closest, most reliable and most complete set of data. The data has been collected from 1926 to 2012.

Terramin have installed an onsite weather station to provide site specific data in regard to wind direction, speed, temperature and rainfall. The results from this weather station will be used to inform the MLP application and associated PEPR.

2.6.1 Rainfall and Evaporation

Woodside has an average annual rainfall of 814 mm. Most of the rain falls in the winter months, at around 42% of the total average annual precipitation.

Monthly annual rainfall data were analysed for the period 1884 to 2018.

Figure 2-13 presents average monthly rainfall data for Woodside and monthly evaporation data for Lenswood. The Lenswood BOM station recorded evaporation data from 1973 to 1999. Points to note about rainfall and evaporation are as follows:

- Average monthly evaporation is greater than the average monthly rainfall for January, February, March, April, October, November and December;
- Average monthly rainfall is greater than the average monthly evaporation in May, June, July, August and September;
- The greatest deficit (rainfall minus evaporation) occurs in summer (December, January and February), with a deficit between 137.5, 163.5 and 136.3mm;
- The greatest surplus (rainfall minus evaporation) occurs from May through to September, with a surplus of up to 84mm/month in July;
- The highest rainfall on record was 110.7mm, which occurred in 18th April 1938;
- The lowest rainfall on record is 0mm, and commonly occurs in the months of January, February, March, November and December.

Figure 2-14 presents basic rainfall characteristics for Woodside, including the cumulative deviation from the annual rainfall mean, as required by the BIHGP MD.

The plot indicates positive cumulative deviation or wetter than average periods from 1905 to 1925, 1945 to 1955 and 1970 to 1975 and negative cumulative deviation or dryer than average periods from 1895 to 1905, 1930 to 1945 and 1975 to 2007.

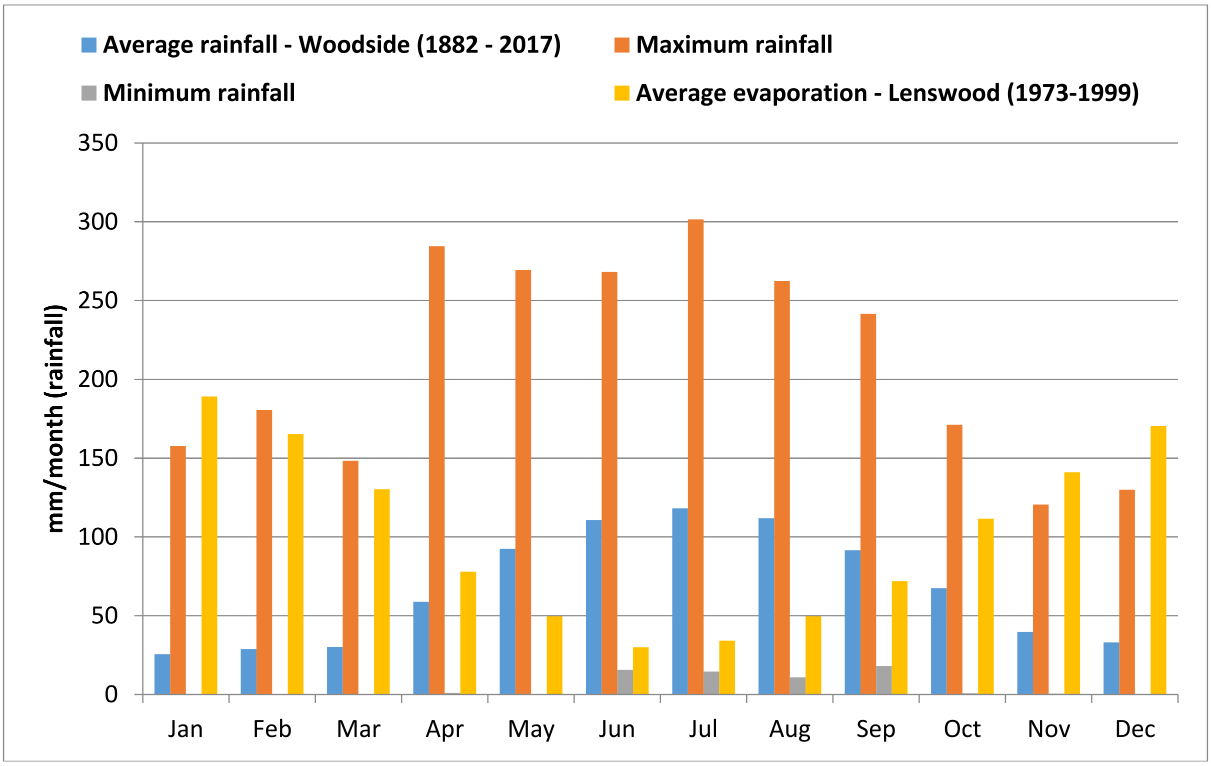

FIGURE 2-13 | AVERAGE MONTHLY RAINFALL AND EVAPORATION

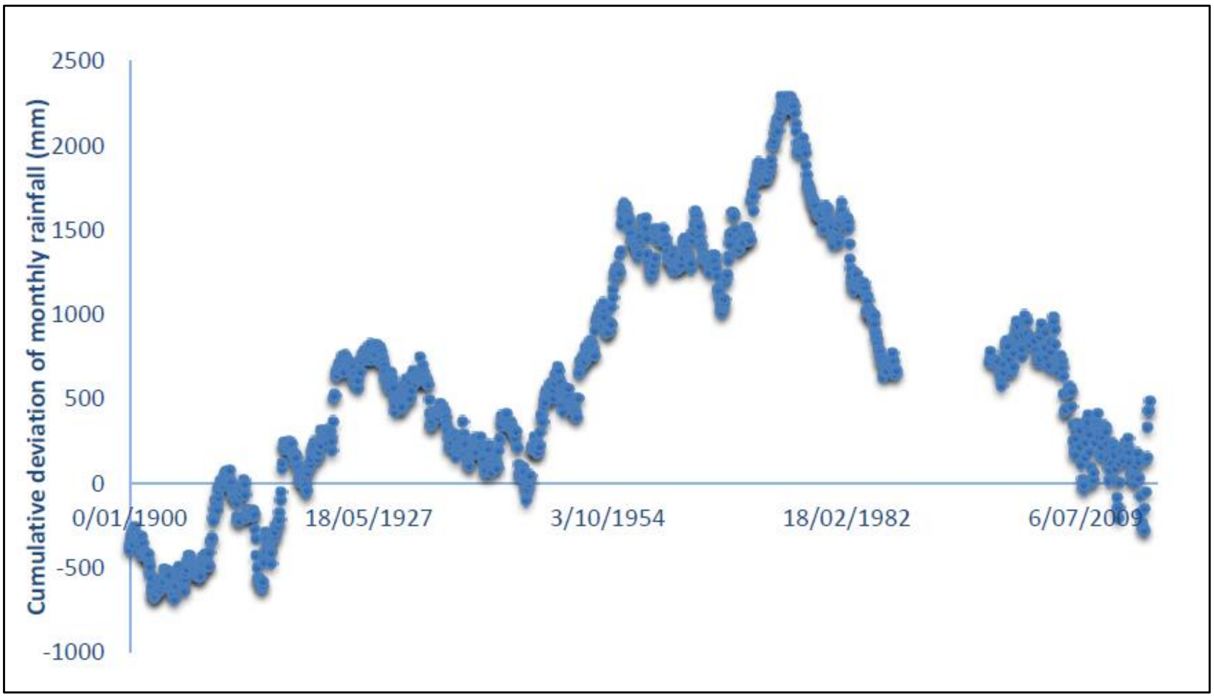

FIGURE 2-14 | CUMULATIVE DEVIATION FROM THE MEAN RAINFALL (BOM STATION: 023829)

2.6.1.1 MAXIMUM AVERAGE RECCURRENCE INTERVAL (ARI)

The two key industry standard aspects related to flood management are:

- Ensure that all development is kept out of the 100-yr ARI flood extents; and
- Ensure that peak flows leaving the site are no higher than pre-development rates.

The 100-yr ARI flood extents for the main creek that passes through the site have been determined through the creation of a HEC-RAS model, with work being undertaken by Tonkin Consulting Pty Ltd (Tonkin) in 2016 (see Appendix I3). The model is based on representative sections of the watercourse that passes through the site. The upstream catchment leading to the site is approximately 45 hectares in size, as shown in Figure 2-12. A peak flow rate for the 100-yr ARI flow of 2.5 m^3/s has been derived based on a Rational Method using the following parameters:

- 0.28 runoff coefficient; and
- 30 minute time of concentration comprised of 25 minutes of sheet flow and 5 minutes of channel flow resulting in a rainfall intensity of 71mm/hr.

The flood extents are contained within the well-defined valley that the creek passes through. The width of the flood plain typically ranges between 10 and 15 m wide, as shown in Figure 2-12. The extents of the 100-yr ARI floodplain are shown on Figure 2-15. All development, other than the access road which crosses the creek, has been kept at least 40-50m away from the flood extents.

The HEC-RAS model output is contained in Appendix A of the Stormwater Management Report, located in Appendix I3.

Access to the site will require crossing the creek. To ensure uninterrupted access to the site the culvert has been sized for the predicted 100-yr ARI flow of 2.5 m^3/s. This will require a 1.5 m wide by 0.7 m high box culvert, based on inlet control conditions.

FIGURE 2-15 | 100-YR ARI FLOODPLAIN

2.6.2 Temperature

The topography of the Adelaide Hills has a significant influence over the average temperature over the year.

During winter, the average daily maximum temperatures vary between 12°C and 14°C in Woodside, while the temperature rises to a maximum of between 24°C and 27°C on average in summer. Mean daily temperatures for the year are provided in Figure 2-16.

Average daily minimum temperatures in the winter vary from 4°C to 6°C. In summer, the average minimum temperatures vary between 10°C and 12°C. Frosts are common in winter.

Daily temperature data were available for the years 1926 to 2016 and were used to calculate the mean monthly maximum and minimum temperatures. Points to note include the following:

- The highest mean monthly temperatures occur in January and February, after which they gradually decline until a minimum is reached in July. After July, temperatures rise again through Spring into Summer;
- The highest mean monthly maximum temperature (27°C) occurs in January;
- The lowest mean monthly maximum temperature (12.8°C) occurs in July;
- The highest mean monthly minimum temperature (12°C) occurs in February;
- The lowest mean monthly minimum temperature (4.7°C) occurs in July.

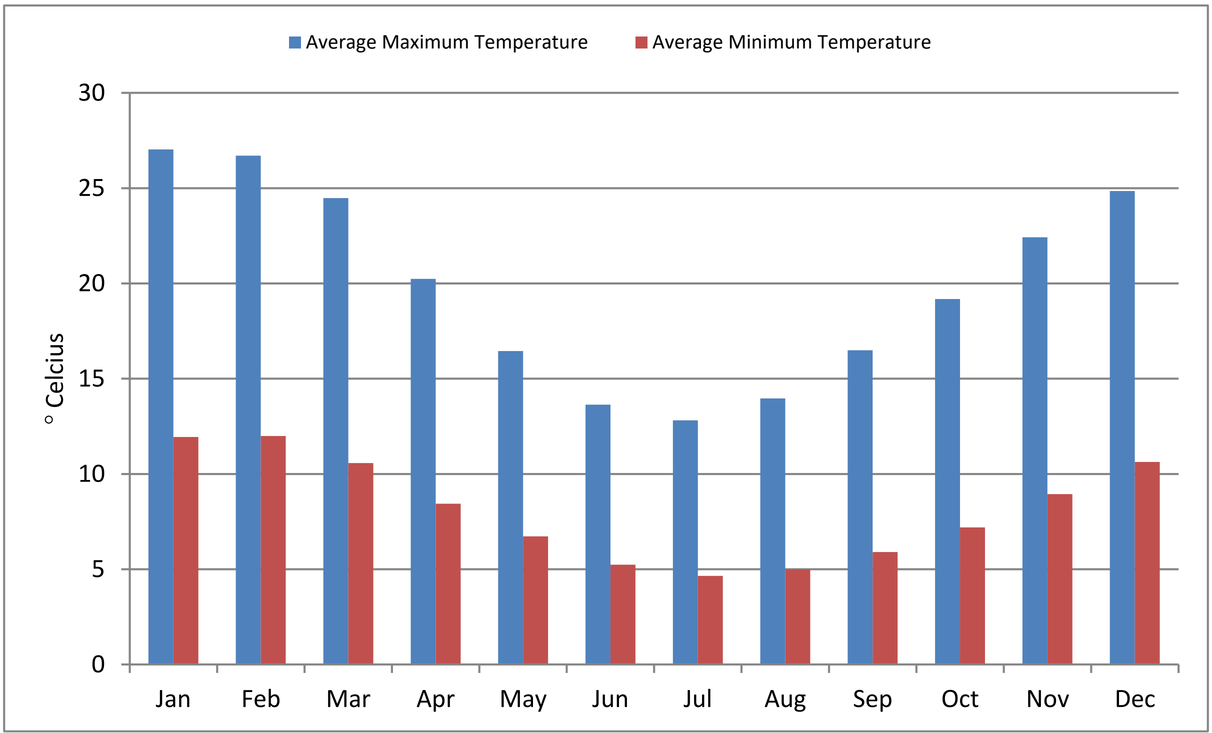

FIGURE 2-16 | WOODSIDE (MOUNT BARKER) AVERAGE MAXIMUM AND MINIMUM TEMPERATURE 1926 - 2016

2.6.3 Cloud Cover

Data recorded at Mount Barker weather station included details of conditions such as the mean number of clear, cloudy each month from 1957 to 2010 and mean number of rain days each month from 1861 to 2016. Clear days refer to days when the sky is clear from cloud, fog, mist or dust haze. A day is defined as cloudy when there is predominantly more cloud cover than clear sky. For example, during a cloudy day the sun would be obscured by cloud for substantial periods of time. Rain days occur when at least 0.2mm of precipitation is recorded. These data are presented in Figure 2-17. Points to note include the following:

- The highest mean number of clear days occurs in January, with an average of 11.2 days;
- The lowest mean number of clear days occurs in June with an average of 4.4 days;
- The highest mean number of cloudy days occurs in May with an average of 15.3 days;
- The lowest mean number of cloudy days occurs in February with an average of 7.8 days;
- The highest mean number of rain days occurs in August with an average of 17.5 days;
- The lowest mean number of rain days occurs in February with an average of 5 days.

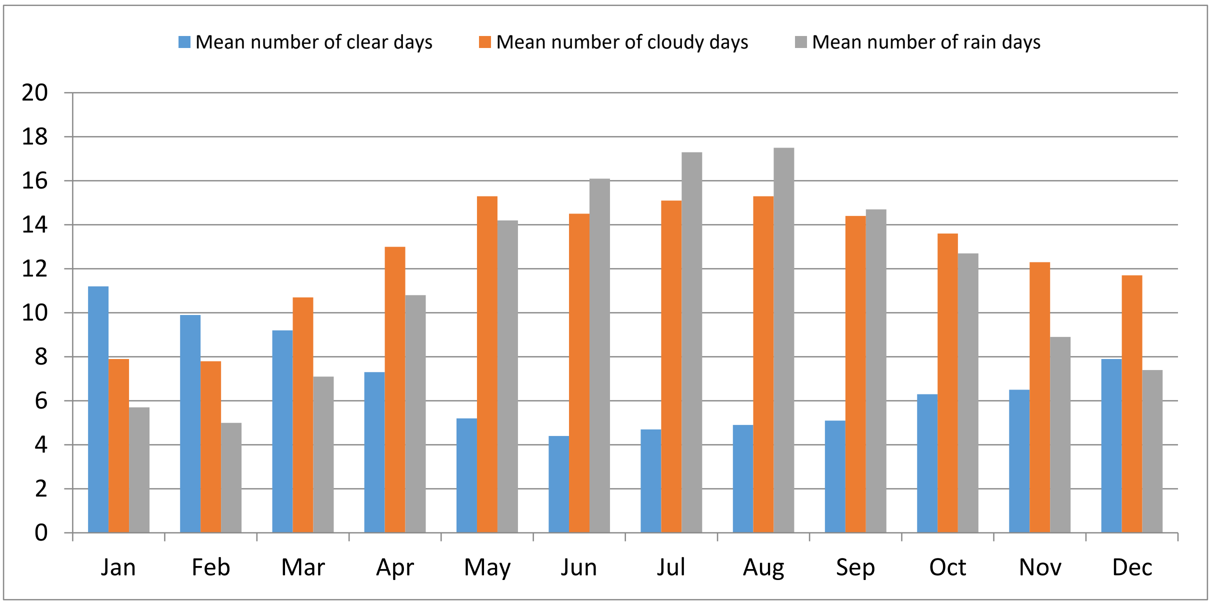

FIGURE 2-17 | WOODSIDE (MOUNT BARKER) AVERAGE CLEAR, CLOUD AND RAIN DAYS PER MONTH 1957 – 2010

2.6.4 WIND SPEED AND DIRECTION

Wind roses with wind frequency analysis generated by the Bureau of Meteorology using the data from the Mount Barker weather station are shown below in Figure 2-18, Figure 2-19 and Figure 2-20. The wind roses provide a visual indication of the wind speeds and frequencies recorded in the period 1957 – 2010, and can be considered to be representative of future wind speeds and frequencies likely to occur at the ML. The following points summarise the wind conditions at Woodside on a seasonal basis:

- The 3pm wind speeds are generally greater than the 9am wind speeds;
- In the summer months, 9am wind speed generally tends come from the easterly, south-easterly, or southerly directions. Between 6% and 14% of the observations recorded in this period are classified as calm, with the most frequent wind speed category being between 1 and 10km/hr. The 3pm wind data indicates that wind blows more commonly from the south-easterly or southerly directions. Most speeds recorded for the 3pm summer wind still fall into the 1-10km/hr category, however, only 2% of the observations are classified as calm.

- Wind conditions for March are similar to the summer wind trends, however, wind direction in April tends to come slightly from the westerly or north-westerly direction at 9am, and from the westerly, south-westerly, southerly or south-easterly direction by 3pm. This pattern becomes more prevalent in May, where 9am wind direction tends to come from the westerly and north-westerly direction, with this becoming more prevalent in the 3pm observations. The 9am readings for autumn observed calm conditions between 15% and 20% of the time, while only between 3% and 6% of the time observed calm at 3pm. The most frequently recorded wind speed categories are 1-10km/hr for both the 9am and 3pm readings.
- Winter winds tend to be largely from the south-westerly, westerly, north-westerly or northerly direction at both 9am and 3pm. 9am tends to be calmer in June (23% of the time), with this reducing to only 11% of the time by August. 3pm is considerably calmer in winter, with calm observed between 3% and 7% of the time. The majority of the time wind speeds are between 1 and 10km/hr.
- September wind direction at 9am and 3pm tends to follow the same pattern as winter, while 9am readings for October and November come from the westerly or easterly direction respectively. By 3pm, the wind direction tends to come from the westerly, south-westerly or southerly direction. Spring tends to be calmer than the seasons, with calm observed between 2% and 7% day round. Wind speeds are generally between 1 and 10km/hr

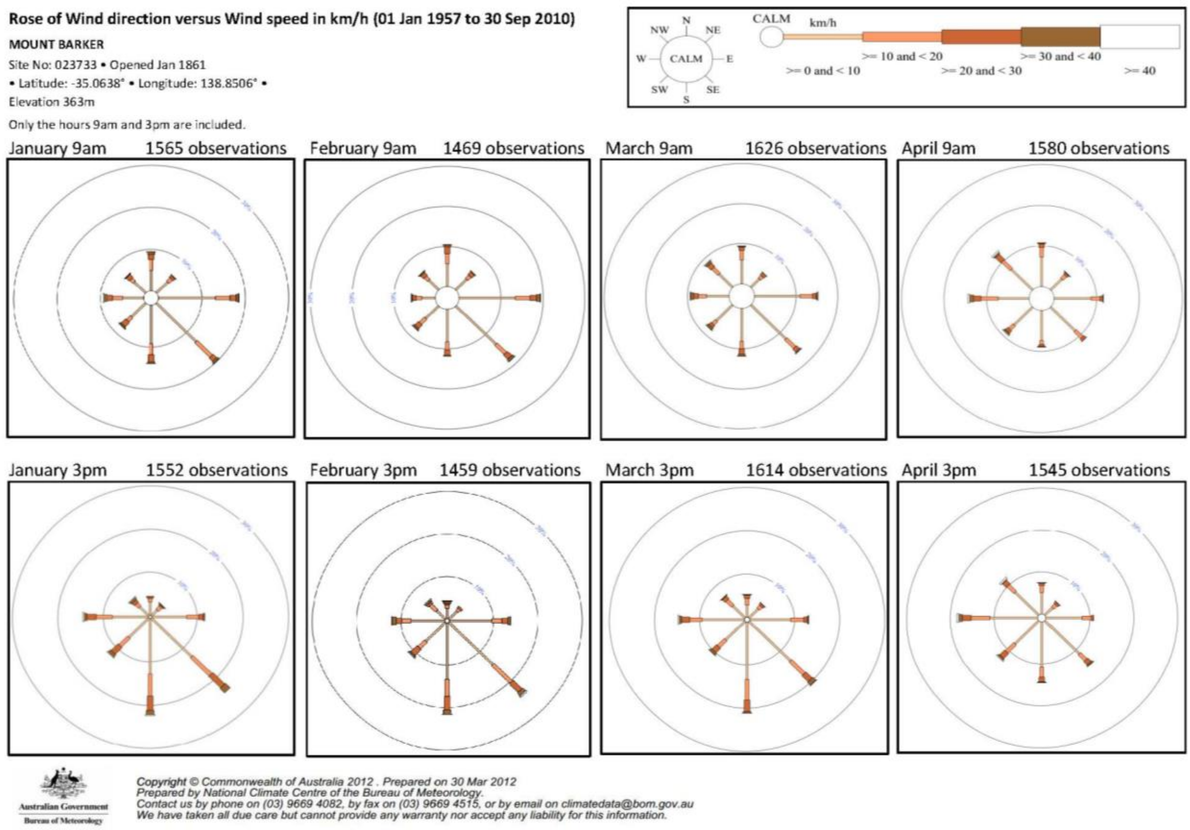

FIGURE 2-18 | WIND ROSES JANUARY – APRIL 1957-2010

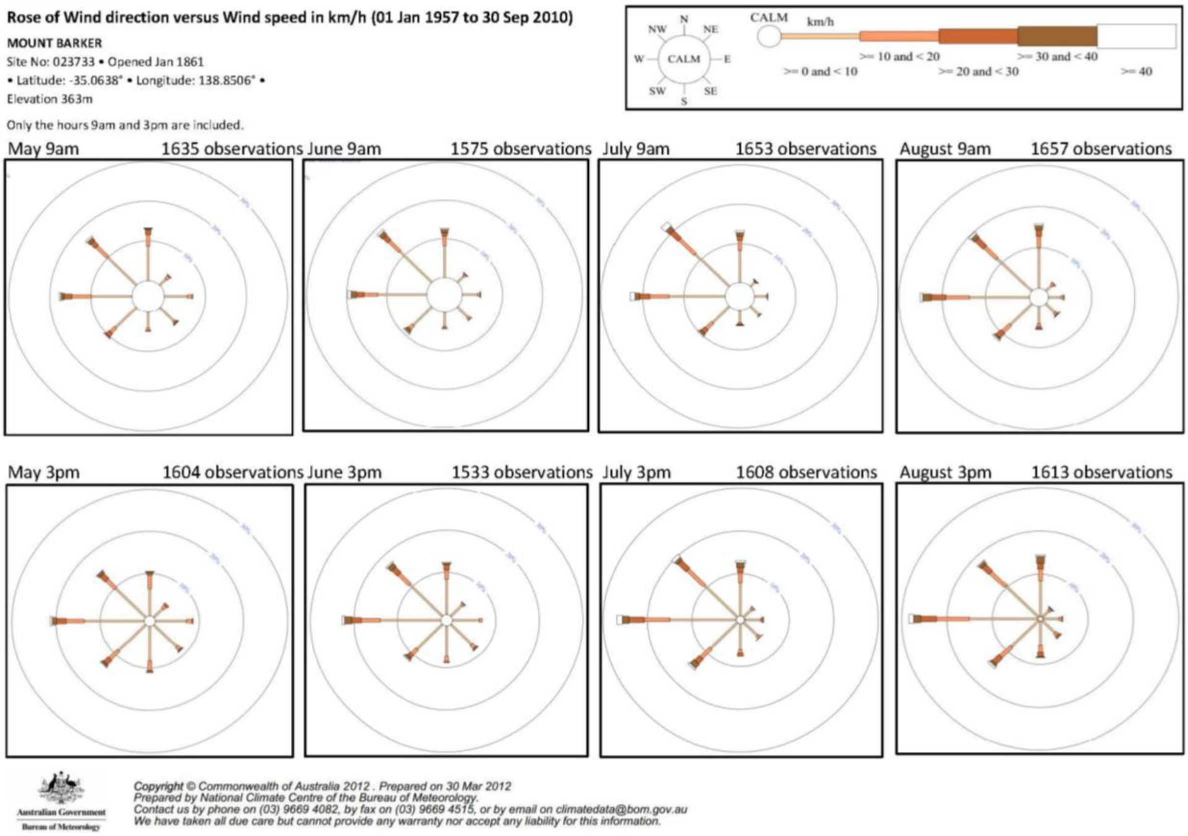

FIGURE 2-19 | WIND ROSES MAY – AUGUST 1957-2010

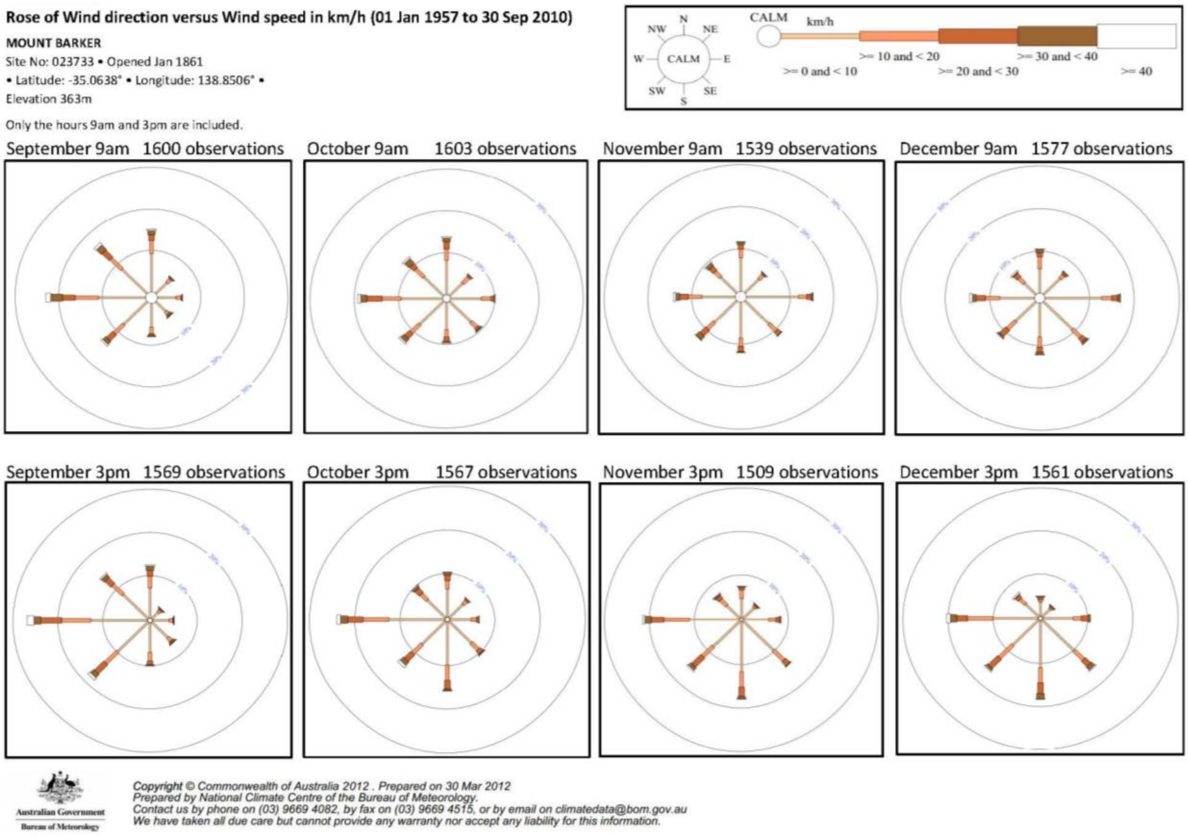

FIGURE 2-20 | WIND ROSES SEPTEMBER – DECEMBER 1957-2010

2.6.5 Climate Change

The Intergovernmental Panel on Climate Change's (IPCC) fifth assessment (2013) forecasts a warming of the Earth's average surface temperatures of 0.3°C to 4.8°C by 2100. Relative to the average global temperatures from 1850 to 1900, global surface temperature change by the end of this century is forecast to likely exceed 1.5°C. The IPCC project that it is "*virtually* certain that there will be more frequent hot and fewer cold temperature extremes over most land area on daily and seasonal timescales, as global mean temperatures increase" (Figure 2-21) (IPCC, 2013). The South Australian Government released a strategy in 2007, *Tackling Climate Change*, which is a framework for South Australian community, industry, energy, transport, development and natural resource sectors. Each section outlines a goal, which associated strategies, objectives and action, which together, provide means to achieve the goal. Terramin accept that the industry sector is a significant emitter of greenhouse gases and will continue to review policy documents published by the Australian and South Australian Governments, as well as further reports published by the IPCC and accepted academics within the climate change sector in order to make informed decisions regarding how Terramin can reduce their climate impact.

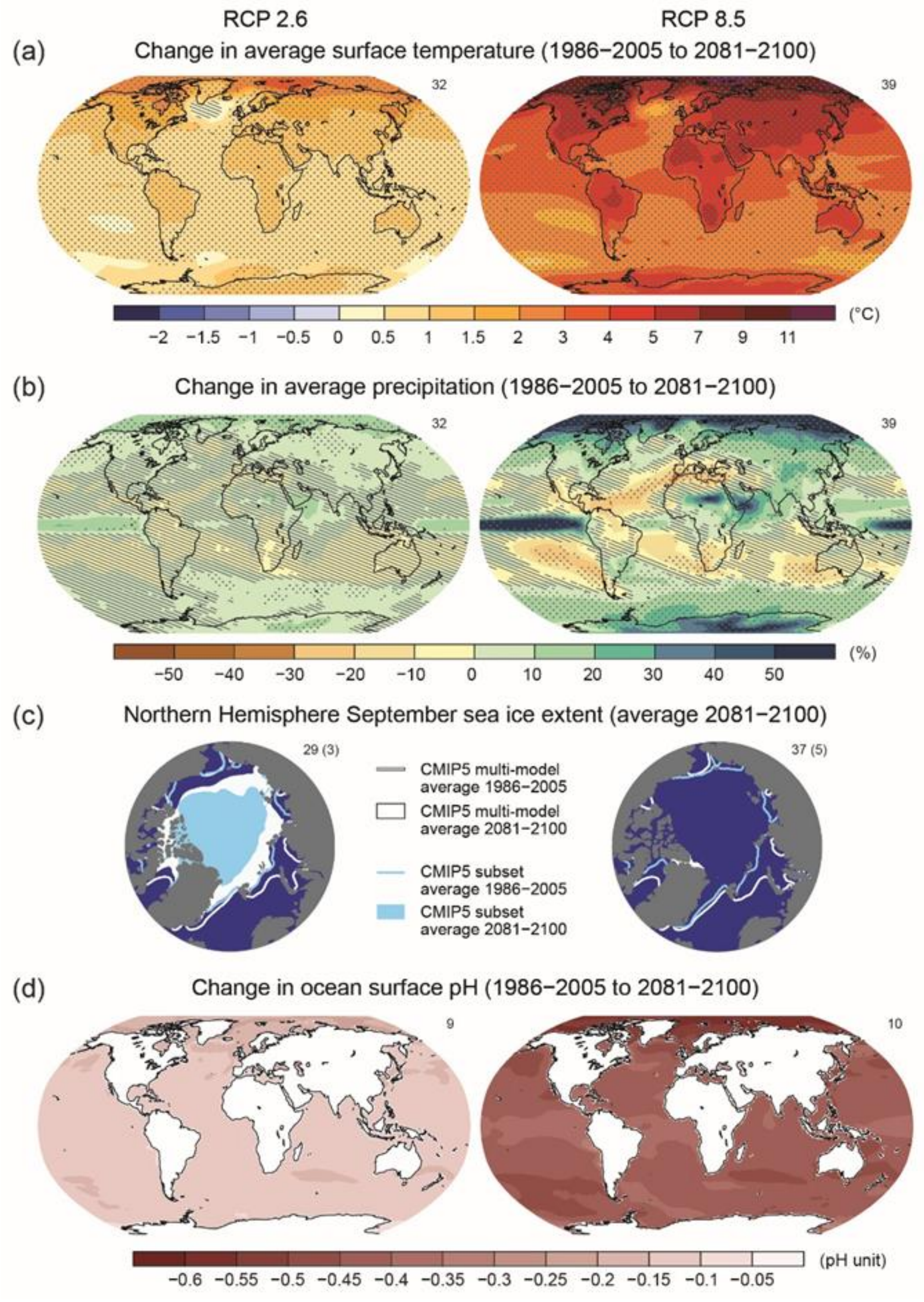

FIGURE 2-21 | IPCC GLOBAL FORECAST

2.6.6 Natural Hazards

Bushfire is a natural part of the South Australian landscape. South Australians should be alert to the possibility of bushfire, particularly during the summer months and on days with high temperatures, wind and low humidity.

The Adelaide Hills is contained within the Mount Lofty Ranges Fire Ban District. This is Area 1 as defined by the South Australian Country Fire Service. Region 1 covers an area of 10 000 square kilometres of the Adelaide Hills, Fleurieu Peninsula and Kangaroo Island.

Region 1 has over 3 000 dedicated and highly trained volunteers who staff 83 Fire Brigades and respond to thousands of incidents across the Region each year. Whilst Region 1 has the smallest geographic area, it has the most volunteers and responds to the largest number of incidents.

During the Fire Danger Season, generally from 15 November to 30 April, there are strict conditions for lighting any fires. On Total Fire Ban Days all fires are banned (Bushfire Management Plan Committee, 2016).

The Goldwyn property is located within a "medium" fire risk area, as defined by the Adelaide and Mount Lofty Ranges Bushfire Management Plan (Bushfire Management Plan Committee, 2016).

Research undertaken indicates that South Australia can expect serious fires somewhere in the State in 6 or 7 years out of every 10 (R. H. Luke, 1978).

Table 2-1 | Significant bushfires within the Mount Lofty Ranges area (Bushfire Management Plan Committee, 2016)

Year	Location	Notes
1938-1939	Adelaide Hills	£650 000, 90 houses
1943-1944	Adelaide Hills	
1948-1949	Bridgewater, Mount barker	
1950	Mount Lofty	
1951	Adelaide Hills, Woodside, Stirling, Lenswood	
1955	Adelaide Hills	Black Sunday - 40,000ha, 2 firefighters, $4,000,000
1980	Adelaide Hills	Ash Wednesday I - 3,770ha, 50 homes
1983	Adelaide Hills	Ash Wednesday II - 12 deaths, 120 homes, historic buildings.
1985	Adelaide Hills	
1987	Morialta	300 Ha
1988	Kersbrook	400 Ha
1995	Heathfield	450 Ha
2000	Brownhill Creek	1000 Ha
2001	Hillbank	350 Ha
2003	Morphett Vale	300 Ha
2005	Mount Osmond	120 ha, 3 buildings, 4 vehicles, 4 km fencing.
2007	Mount Bold	2,000ha, numerous sheds, livestock and equipment fire damaged.
2014	Eden Valley	25,000ha, 4 houses, multiple sheds, livestock, native fauna, 100s x km fencing

Year	Location	Notes
2015	Sampson Flat	12,600ha, 24 houses, 103 sheds, 62 firefighter injuries, $13 million.

2.7 GEOLOGY

2.7.1 OVERVIEW

The BIHGP deposit lies within Exploration Licence (EL) 5469 and is located approximately 30 km north of Terramin's APF, Figure 2-22.

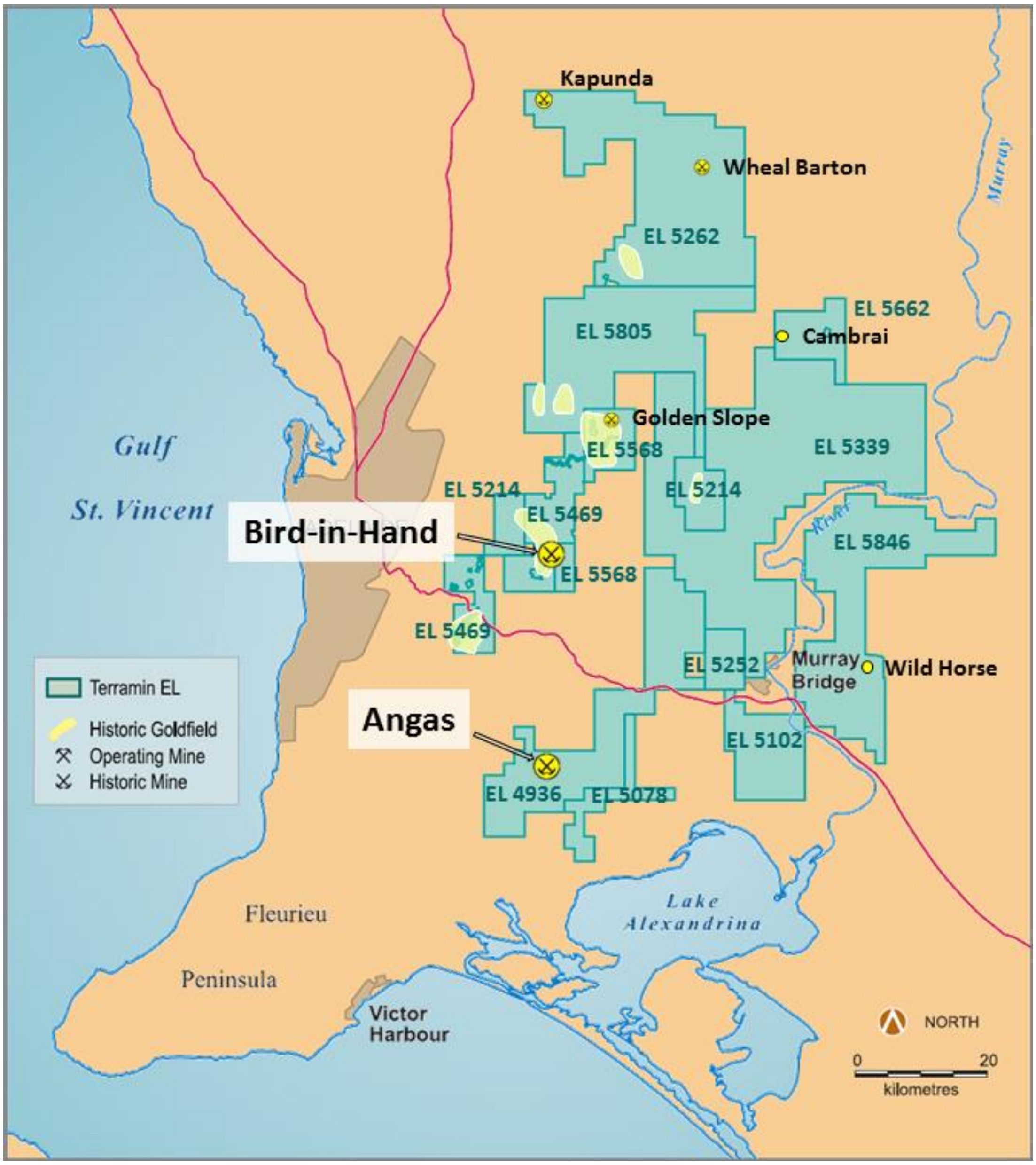

FIGURE 2-22 | ADELAIDE HILLS TENEMENT PACKAGE

The Woodside goldfield is situated 1km east of Woodside and about 30 km east of Adelaide in the Adelaide Fold Belt. The goldfield covers an area extending about 4 km from north to south and 2 km from east to west (Figure 2-23). The Adelaide Fold Belt is the oldest metalliferous mining region in

Australia. Mining of lead and silver at Wheal Gawler commenced in 1841 at Glen Osmond (Brown, 1908), in what is now an eastern suburb of Adelaide.

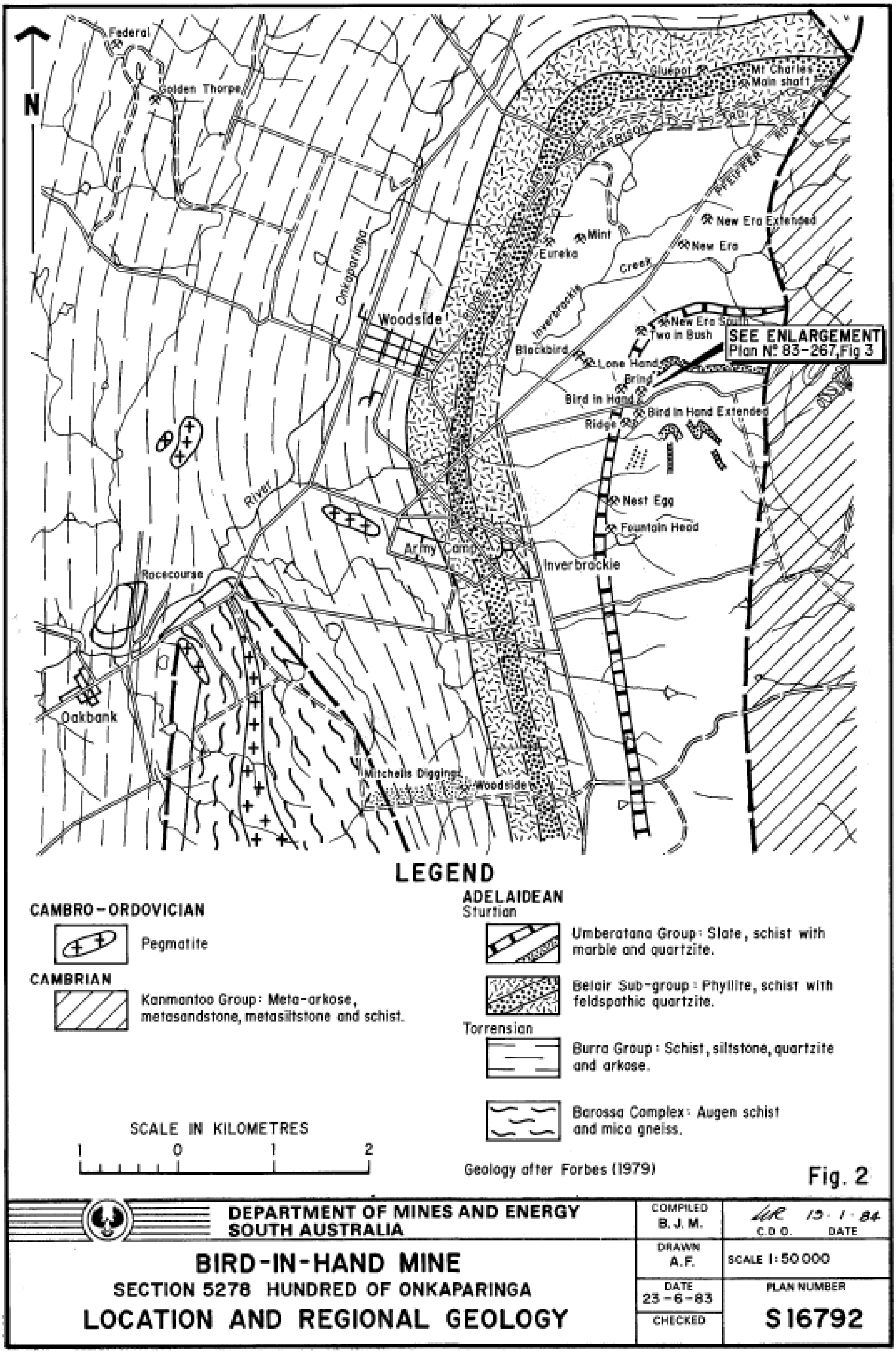

FIGURE 2-23 | WOODSIDE GOLDFIELD REGIONAL GEOLOGY (DSD PLAN S16792).

The first gold mine in South Australia, the Victoria, opened at Montacute, north-east of Adelaide in 1845, making it the first gold mine on mainland Australian (Brown, 1908; Drew, 2004). Recorded production from this mine was only 24 oz. of gold, but it drew the attention of gold prospectors to the Adelaide

Fold Belt. In 1851, the South Australian government offered a reward of £1,000 for new gold discoveries in the colony (DSD, 2001). The first major discovery was the Echunga goldfield in 1852, the largest gold producer to date in the Adelaide Fold Belt with a production of more than 130,000 oz. Gold was mainly extracted from Tertiary and Quaternary alluvial sediments, from which a few gem quality diamonds were also recovered. Numerous small gold bearing quartz-ironstone veins were mined too, but they contributed very little to the total gold output of the field (Brown, 1908; Drew, 2004).

By the mid 1860's the rush at Echunga was over, the Victorian gold rush which began in 1854 led to the withdrawal of many prospectors and it took until 1868 for the next major discovery to be made in the Adelaide Fold Belt, which was the alluvial Barossa goldfield (100,000 ounces). At about the same time the first deposits in the Nackara Arc were discovered, the alluvial Ulooloo and the Waukaringa goldfields. The latter one proved to be the largest gold producer from primary mineralisation in the Adelaide Fold Belt to date, with a production of about 50,000 oz. (Drew, 2004).

Alluvial gold was found in the Onkaparinga River and its tributaries near Balhannah as early as 1849 (Drew, 2004). In 1879, A. Mitchell discovered alluvial gold on his property near Woodside with yields of up to 3 oz. per ton of washdirt. In 1881 primary gold mineralisation was found on the property on which the Woodside Mine was developed with the sinking of Mitchell's Shaft and Mitchells Underlie Shaft. The gold bearing quartz reef produced rich specimens of gold the largest weighing 14oz. The BIH reef was also discovered in 1881 with the initial crushing of 12 tons yielding 22 oz. of gold.

Two years later, the giant Pb-Zn-Ag orebody at Broken Hill in New South Wales was discovered. This caused the withdrawal of capital and skilled workers from the South Australian mining sector just as the Victorian gold rush did three decades before. During the 1890's, only a few mines produced gold such as the Kitticoola Au-Cu mine in the Mount Lofty Ranges, but reworking of tailings from closed batteries with cyanide produced some 1,000 oz. during those years.

The last two important discoveries in the Adelaide Fold Belt were made in 1909 at Deloraine in the Mt. Lofty Ranges with a total production of approximately 30,000 oz. and Mongolata near Burra in the Nackara Arc with a total production of 11,129 oz. (Plimer, 1997; DSD, 2001; Drew, 2004). In the second half of the 20th century, gold production in the Adelaide Fold Belt was restricted to small scale reworking of historical goldfields and their tailings.

Total gold production in the Adelaide Fold Belt is more than 525,000 oz. to date. Gold is still being produced as a by-product from the Kanmantoo copper mine near Callington. The Kanmantoo copper resource contains approximately 100,000 ounces of gold.

2.7.2 Regional Geology

Primary gold mineralisation at Woodside is located within a synclinal structure in Adelaidean strata (Figure 2-23) at the transition between the Warrina and Heysen Supergroup with the fold axis is plunging at an angle of about 45° to the east. The syncline is cut on the eastern side by a major north-south-striking, east-dipping Nairne Fault, along which younger Cambrian metasediments of the Kanmantoo Trough were thrust over older Adelaidean Strata. The majority of gold was mined from vein structures hosted by the lower Umberatana Group. This group unconformably overlies clastic metasediments of the Burra Group, which forms the upper part of the Warrina Supergroup, Figure 2-23. The Burra Group contains only minor mineralisation in the Woodside area.

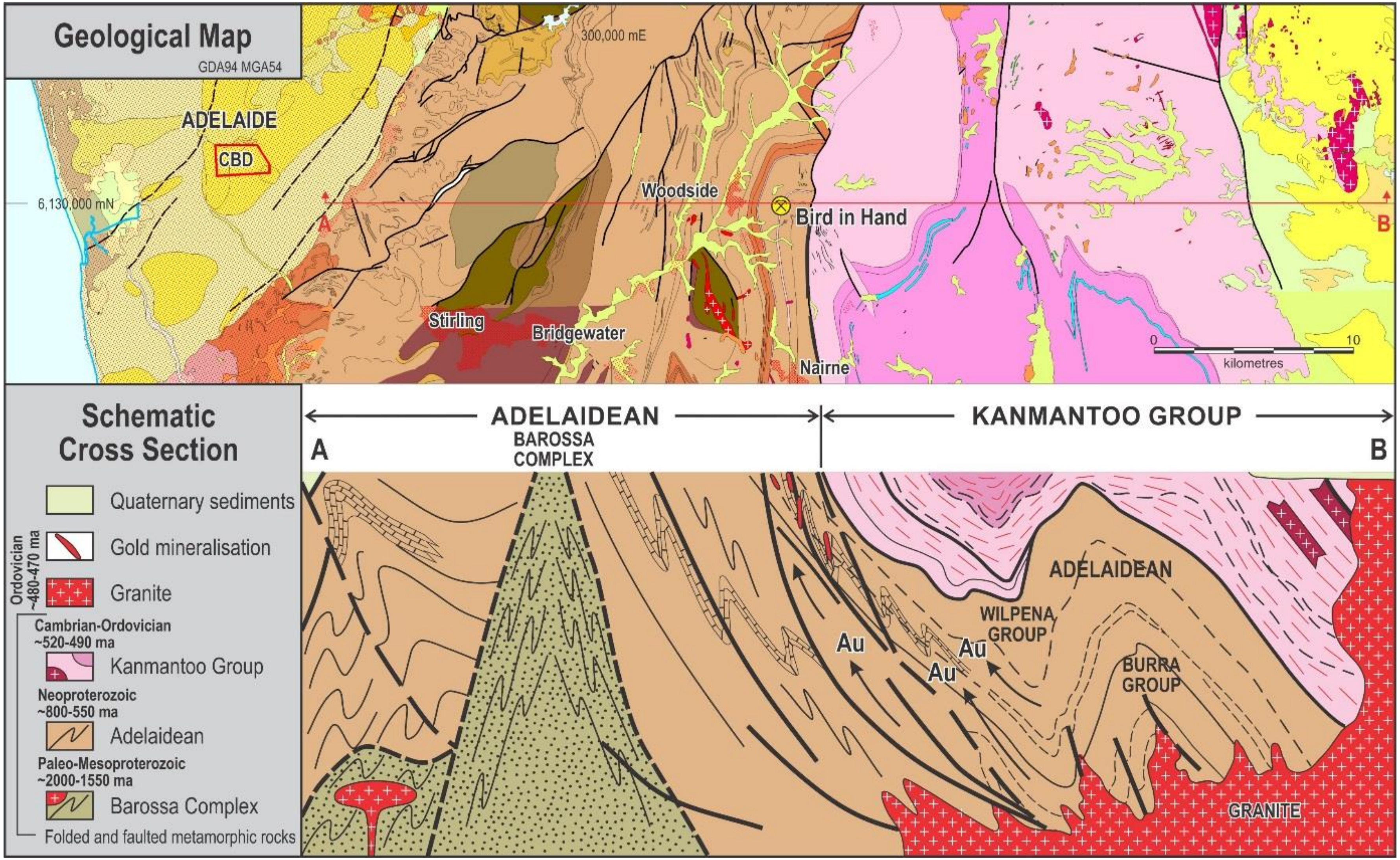

FIGURE 2-24 | REGIONAL GEOLOGICAL MAP OF THE BIHGP SITE

Umberatana Group stratigraphy from west to east (stratigraphically upwards) comprises the Apilla Tillite, the Tapley Hill Formation, the Brighton Limestone and finally the Tarcowie Siltstone. The Apilla Tillite is a fine grained, dark tillitic shale unit. The Tapley Hill Formation consists of dark grey to blue, carbonaceous, pyritic, sandy to dolomitic siltstones.

The Brighton Limestone is a grey to white pyrite-bearing marble containing silt- and sand-rich beds. The Tarcowie Siltstone is a grey to beige siltstone unit containing sandstone beds thought to be equivalent to the Cox Sandstone Member in the Tarcowie Siltstone of the Umberatana Group in the Nackara Arc region.

The core of the syncline in the Woodside area is formed by Brachina Formation siltstones, the basal unit of the Wilpena Group. The sedimentary strata on both sites of the Nairne Fault are cut by steeply dipping, northwest-southeast trending dolerite dykes, called the Woodside Dolerites.

The three largest zones of mineralisation of the goldfield are each hosted in different units of the Umberatana Group; BIH is within the Brighton Limestone, New Era is hosted by the Tapley Hill Formation and Eureka is located within the Apilla Tillite,

The less significant Ridge mineralisation is hosted within the Tarcowie Siltstone. There are a larger number of smaller mines which produced further gold from structures in the aforementioned units. Some gold was also mined from structures within the upper Burra Group below the Umberatana Group, but this did not contribute significantly to the known historical production of the field, which is approximately 30,000 oz. (Drew, 2004). There is no significant mineralisation known within the Cambrian strata east of the Nairne Fault in the Woodside area.

Historical gold mining at BIH progressed to a vertical depth of approximately 110m. Drilling by Maximus Resources Ltd from 2006 to 2008 proved mineralisation to a depth of at least 400m and this is open to depth. Mineralisation hosted by the Brighton Limestone, dips at about 45° to the southeast in the mine area. Brown (Brown, 1908) described three lodes with widths of 1 ft. to 8 ft. (0.3m to 2.5m) striking approximately north-south at 010° and dipping east at 40°. Drilling by Maximus Resources Ltd below the historical mine workings showed two mineralised structures: the so called White Reef and the Red Reef. The White Reef located a few meters above the Red Reef can be followed to a vertical depth of about 300m. The Woodside Dolerite dykes were intersected in various drill cores and show alteration and veining in the vicinity of the mineralised structures.

The smaller Ridge Mine south of BIH is centred on three veins that strike 010° and dip 40° to the east within the Tarcowie Siltstone. The veins range in thickness from 0.3m to 5.0m. Mining reached a depth of approximately 45m (Brown, 1908).

2.7.3 Project Geology and Petrography

The youngest lithology intersected in drill core is the Tarcowie Siltstone of the Umberatana Group (Figure 2-25 and Figure 2-26) which is characterised by fine grained interbedded metasandstones and metasiltstones. These rock types display varying quantities of biotite resulting in a banded appearance. Three discrete coarse grained, clean and mature sandstone units are intersected within the Tarcowie Siltstone which are very uniform and can be correlated between drillholes. In places where they have decomposed and become unconsolidated they can cause difficulties during drilling, often resulting in the need to case off with HQ rods and continue with NQ sized drilling. It is interpreted that these sandstones are broadly equivalent to the more regionally extensive Cox Sandstone member of the Tarcowie Siltstone.

The Brighton Limestone is stratigraphically beneath the Tarcowie Siltstone and is typically characterised by upper and lower coarse-grained and recrystallised marble units with fine grained calcareous siltstones. The Brighton Limestone is the host to BIH quartz reef gold mineralisation.

The blue-grey Tapley Hill Formation which underlies the Brighton Limestone is a partly dolomitic siltstone often is finely laminated, cross-bedded or shows sedimentary features. Regionally the Tapley Hill Formation can be rich in pyrite and organic matter but these units have not as yet been identified in drilling at BIH. Many of the major goldfields in the Mt. Lofty Ranges are partly hosted by the Tapley Hill Formation or in close stratigraphic units.

All information regarding the existing environment for geochemistry and geohazards is included in Chapter 13.

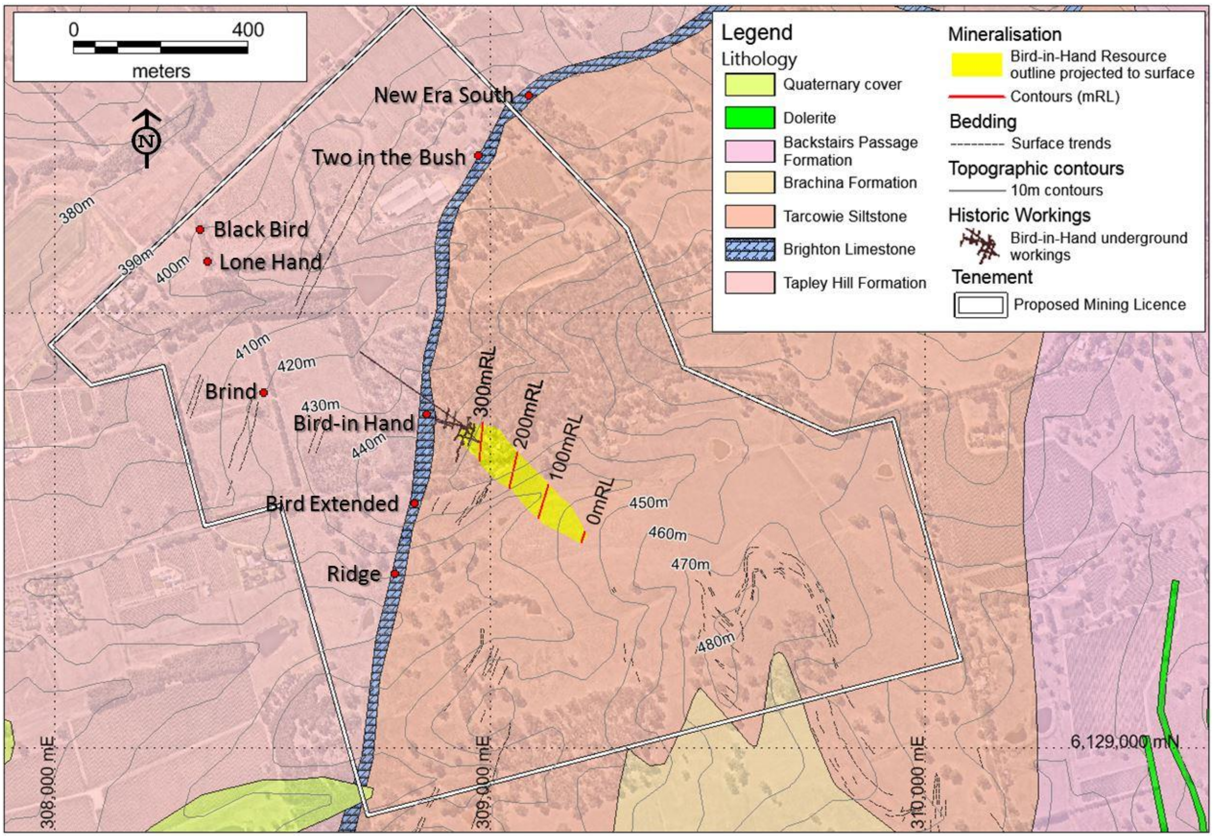

FIGURE 2-25 | SURFACE GEOLOGY WITH THE BIRD IN HAND RESOURCE PROJECTED TO SURFACE

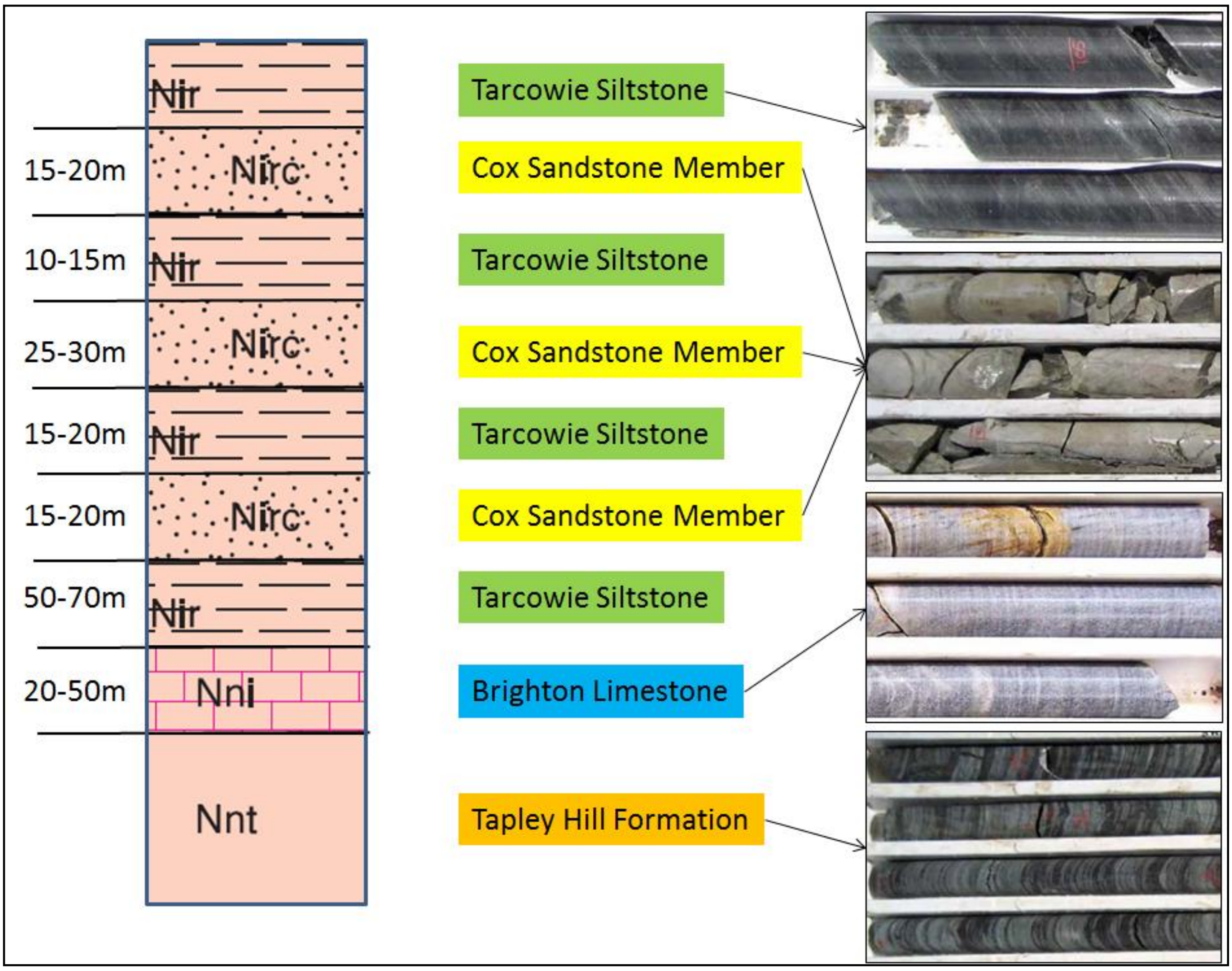

FIGURE 2-26 | BIH STRATIGRAPHIC COLUMN (TONKIN, 2017)

2.7.4 MINERALISATION

BIHGP gold mineralisation primarily occurs within the lower north-south orientated Red Reef. Mineralisation also occurs in two sub parallel quartz veins; White Reef and Orange Reef which converge with the Red Reef to the south. The Red Reef has a strike of approximately 100m, dips 53° to 090 and plunges 41° to 133 and has been intercepted at 15mRL which gives it a known down plunge length of 400m. The Red Reef has an average true thickness of approximately 5.4m and appears to be relatively continuous over the entire deposit. The White Reef varies in true thickness from 1.1 to 2.6m. It is relatively continuous in the upper parts of the deposit (above 240m RL) but becomes more discontinuous with depth. Higher grades are encountered in the Red Reef; the names "Red" and "White" reflect the level of oxidized pyrite present in the quartz veining seen in the upper part of the orebody.

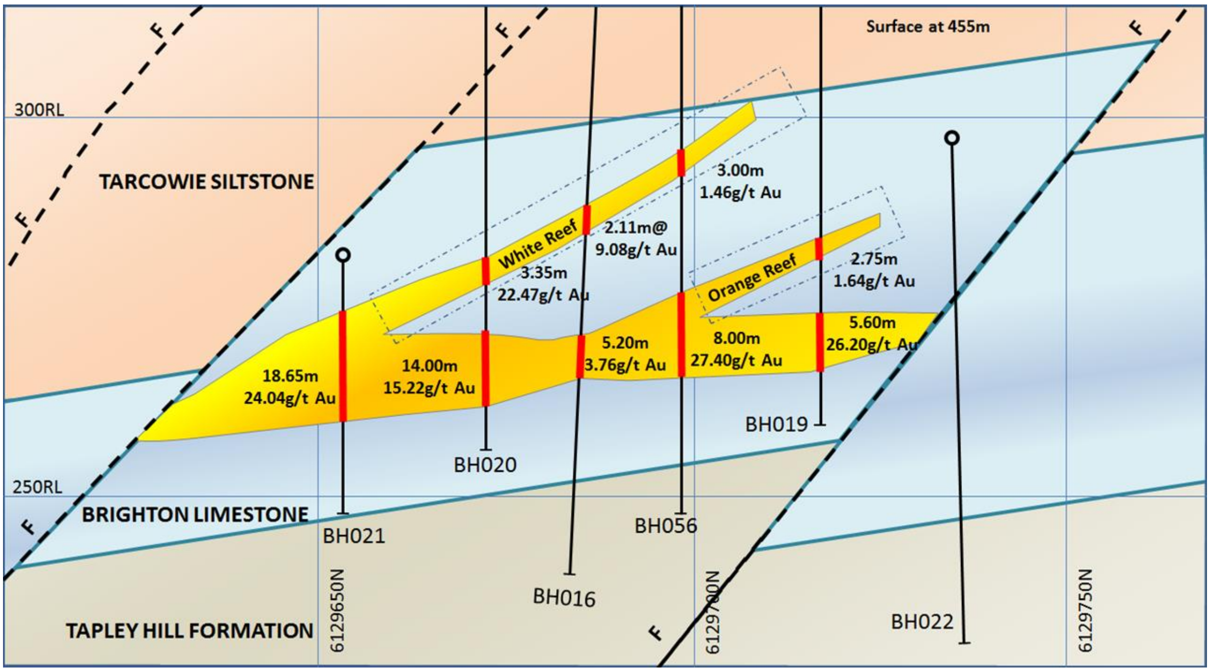

FIGURE 2-27 | CROSS SECTION 309000E (10M WINDOW; TRUE WIDTHS ARE APPROX. 75% OF THE DOWNHOLE WIDTHS).

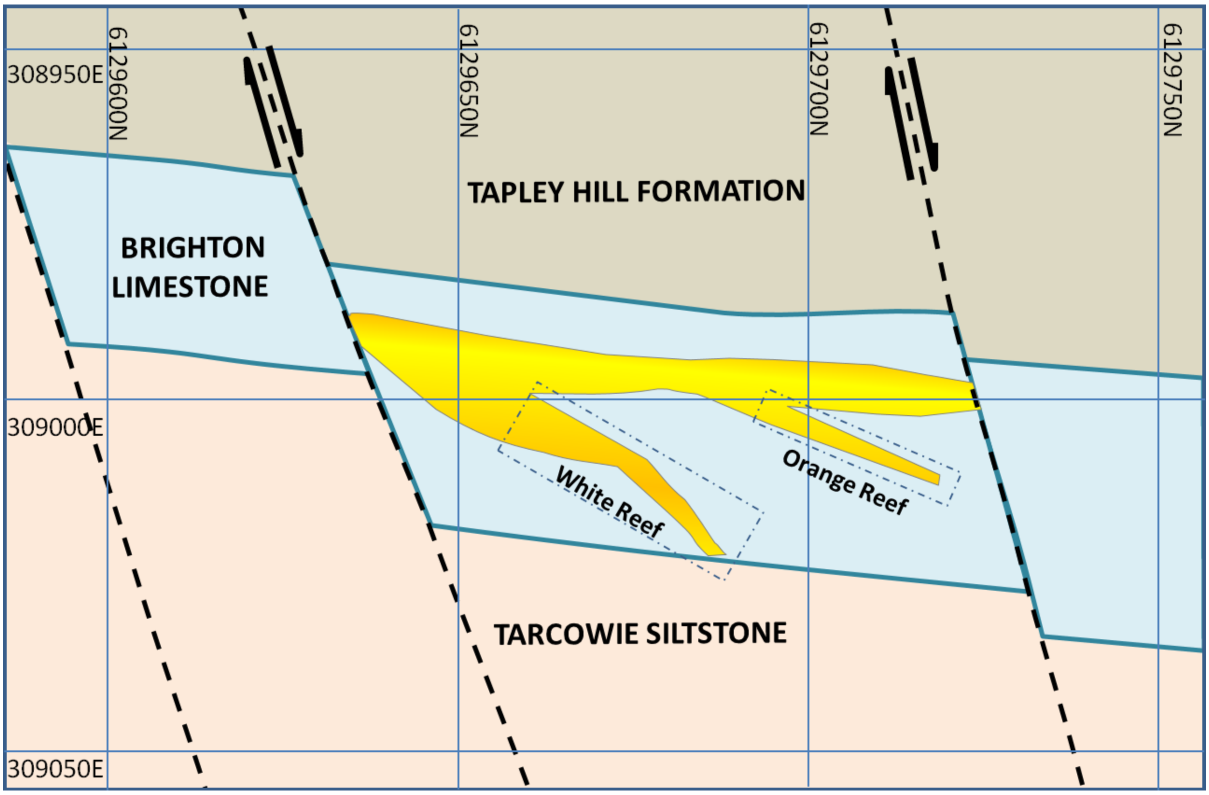

FIGURE 2-28 | LEVEL PLAN AT THE 275M RL

In some instances, as seen in drillhole BH021 (Figure 2-27), there is consistent mineralisation between the Red and White Reefs effectively forming one continuous zone. The gold is very fine grained with very rare examples of visible gold seen in the drill core. It is typically associated with variably fresh to highly oxidized zones of pyrite ± base metal mineralisation (Figure 2-29).

The mineralisation at BIHGP is characterised by a quartz-sulphide assemblage. Quartz is the dominant gangue phase with carbonate (siderite and calcite) being minor. Regarding the ore minerals, the primary mineralisation can be subdivided into a pyrite-dominated gold only mineralisation (Figure 2-29) and a mineralogically more complex Au-Pb-Zn-Cu-Cd-Ag mineralisation (Figure 2-30) (Griessmann, 2011). Both sulphide styles are irregularly oxidized with the transition to fresh sulphide mineralisation extending in depth to several hundred metres. Figure 2-31 shows both weathering products (iron oxides and native copper) at 210.3m and primary sulphide minerals (galena, pyrite, chalcopyrite and sphalerite) at 212.8m.

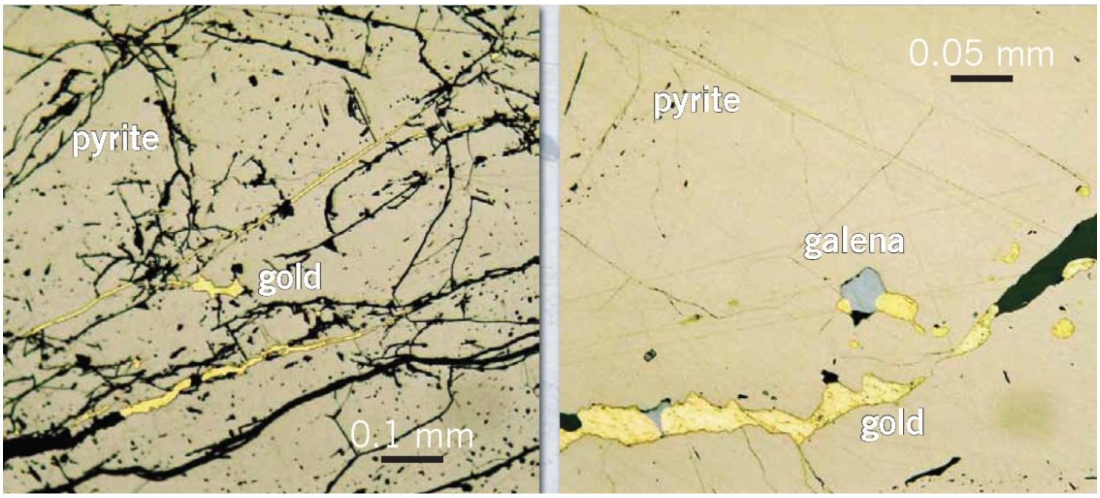

FIGURE 2-29 | MICROPHOTOGRAPHS OF GOLD WITHIN PYRITE FRACTURES) FROM 3.8M ZONE AT 160 METRES ASSAYING 47G/T AU, 108G/T AG, 11% PB, 9% ZN, 0.8%CU.

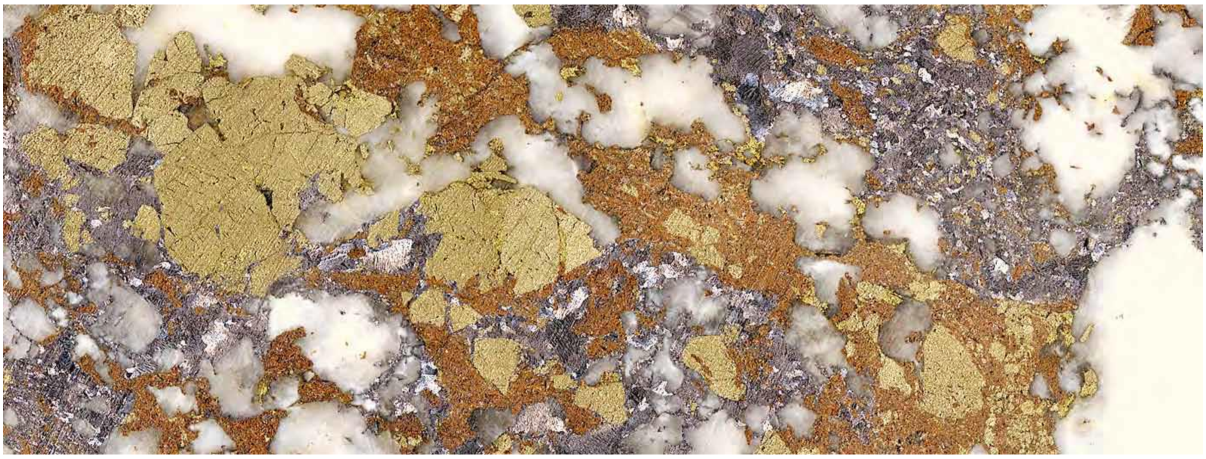

FIGURE 2-30 | BASE METAL SULPHIDE RICH SECTION FROM MINERALISED INTERVAL IN DRILLHOLE BH017. (BROWN – ZINC SULPHIDE, GREY – LEAD SULPHIDE, YELLOW – IRON SULPHIDES, WHITE – QUARTZ

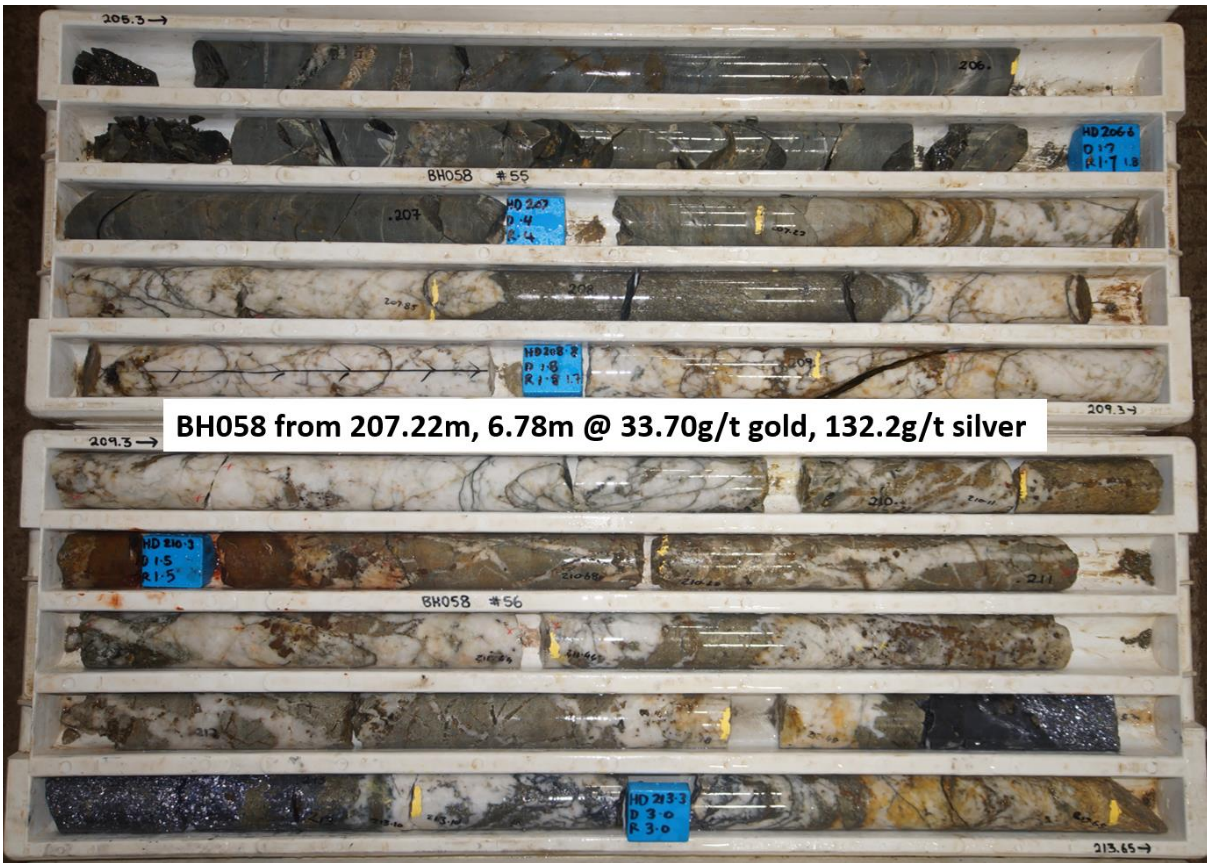

FIGURE 2-31 | INTERSECTION OF RED REEF INBH058, FROM 207.22M, 6.78M @ 33.70G/T GOLD AND 132.2G/T SILVER

WEATHERING

Metamorphic rocks (and minerals) such as those found at BIHGP form at high temperatures and pressures and are therefore at equilibrium with the high temperature and pressure environments. When metamorphic rocks are exposed to Earth's surface, their equilibrium is disturbed, and their minerals react and experience transformation so as to adjust to lower temperature, pressure and water conditions. The transformation process whereby rocks on exposure to near surface conditions change in character, decay and finally crumble into soil is known as weathering.

In South Australia during the Tertiary when the climate was warm and wet, deep weathering took place and under the right conditions in the host lithologies to depths of hundreds of metres. Regionally where the regolith profile is still intact the results of this weathering can be seen now in the form of a red, oxidised upper zone that grades via a mottled zone into the pallid zone (a bleached clay zone). At BIHGP the Tertiary regolith profile has been stripped of the red, oxidised upper zone and the mottled zone and only the parts of the bleached clay zone remain where the conditions for chemical weathering was optimal.

Drilling in the area has shown that in the immediate vicinity of the BIH orebody the host metasediments the bleached clay zone down to a depth in excess of 100 metres.

The mineralogy, location and shape of the alteration indicates that bleached clay zone is the result of acid sulphate leaching of the Tarcowie Siltstone and the Tapley Hill Formation. Acid sulphate leaching is typically characterized by the assemblage kaolinite + quartz + alunite + /– pyrite and results from base leaching by fluids concentrated in H_2SO_4. Requisite amounts of H_2SO_4 can be generated by different mechanisms but at BIH the most likely source of the H_2SO_4 is the atmospheric oxidation of sulphide minerals associated with the gold mineralisation in the supergene environment.

The deepest and most intense clay alteration is immediately adjacent to the BIH orebody but differential weathering has resulted in the acid sulphate alteration halo being asymmetrical. The dolomitic siltstones of the Tapley Hill Formation were more susceptible to the acid leaching clay alteration than the siltstones and of the Tarcowie. The acid sulphate leaching alteration is seen to extend into the Tapley Hill Formation up to 200 metres to the east of the BIHGP mineralisation where the alteration appears to be limited to around 100 metres into the Tarcowie Siltstone.

As well as the difference in chemistry of the Tapley Hill Formation and the Tarcowie Siltstone the asymmetry in the depth of the weathering may also be the result of the plunge of the sulphide bearing BIH orebody. During the Tertiary, prior to the erosion of the red, oxidised upper zone and the mottled zone the BIH mineralisation would have overlain the area where the Tapley Hill Formation would outcrop if not covered by Quaternary soil.

The projected outcrop of the BIH mineralisation, Cox Sandstone, Brighton Limestone, and the extent of the known clay alteration are shown on Figure 2-32. Also shown are the depths of the bleached clay from five representative holes which are from west to east; BH049, BH048, BH050, BH054 and BH046. Core from the upper sections of these five holes are shown in Appendix B6.

FIGURE 2-32| DRILLHOLES USED AS EXAMPLES, LABELLED WITH DEPTH OF CLAY DEVELOPMENT

2.7.5 CAVES

Caves are known to have developed in the marble of the Brighton Limestone, host rock to the BIHGP gold bearing quartz reefs. Caves are typically formed in limestone and marble by acidic solutions that have preferentially dissolved rock along the joints, bedding planes and fractures. Most caves are formed by acids such as carbonic acid H_2CO_3 that formed from rainwater dissolving carbon dioxide (CO_2) from the air and humic acid that formed by water percolating through humic soils.

However, at BIHGP the interaction between Brighton Limestone and oxidizing sulphide minerals associated with the gold mineralisation would have played (and still is playing) an important role in the formation of the caves. The exposure of sulphide minerals, such as pyrite (FeS2), to atmospheric oxygen and water results in the acid generation. The oxidation of pyrite can be represented by the following overall reaction:

$FeS_2 + {}^{15}/_4\ O_2 + {}^{7}/_2\ H_2O \rightarrow Fe(OH)_3 + 2H_2SO_4$

As the acid interacts with the calcite (CaCO3) in the marble the following reaction takes place:

$H_2SO_4 + CaCO_3 \rightarrow CaSO_4 + CO_2\ (gas) + H_2O$

As the reaction proceeds, siderite ($FeCO_3$) and dolomite ($CaMg(CO_3)_2$) formation occurs progressively, with gypsum ($CaSO_4$-$2H_2O$) becoming saturated later in the reaction.

Resource drillholes have intersected several small caves (Figure 2-33), the largest possibly up to 3.15m in width intersected in drillhole BH051 but that width may in part be due to core loss owing to the soft friable nature of decomposed marble. The average width assigned to caves intersected in drilling is 1.25m.

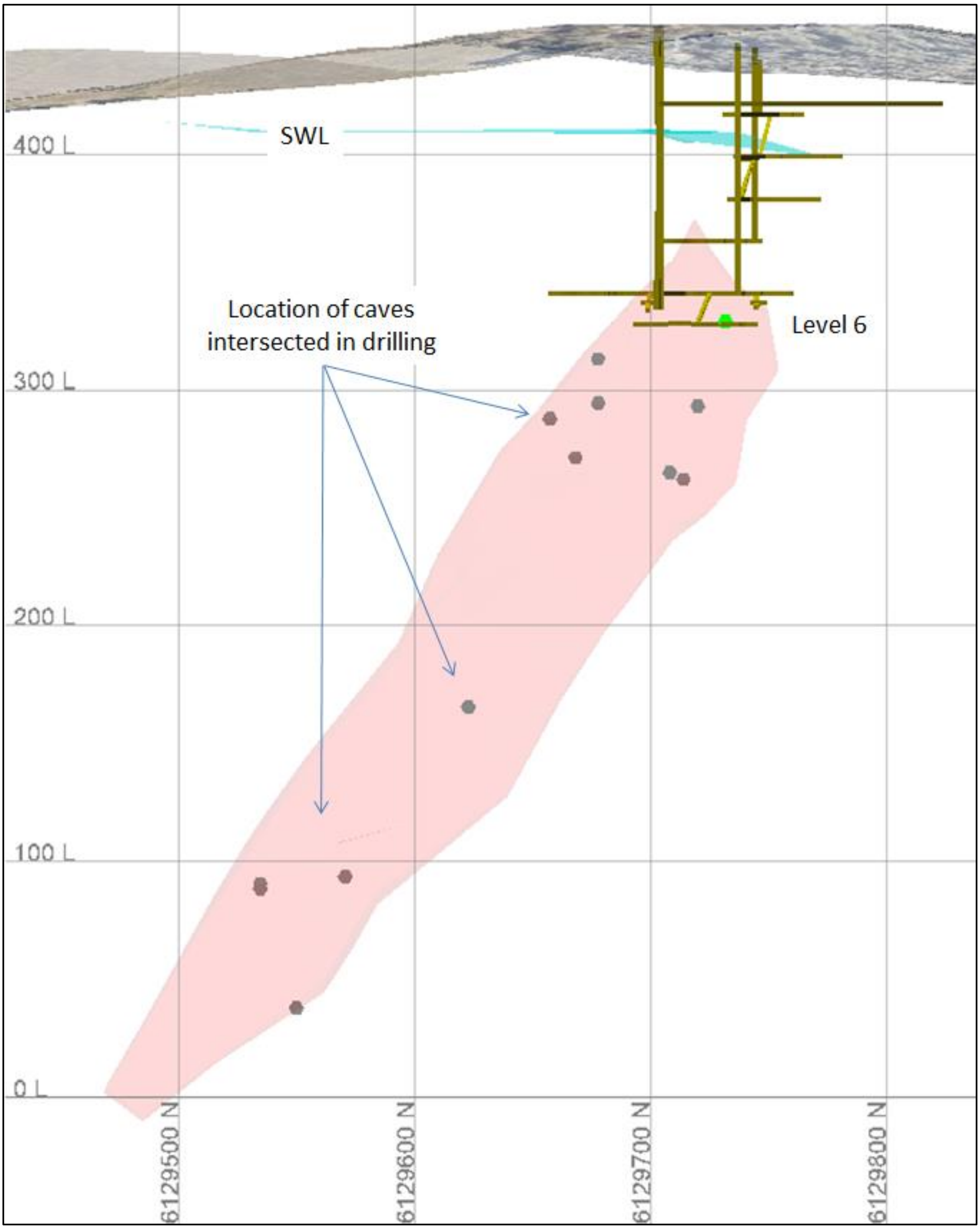

FIGURE 2-33 | SECTION LOOKING WEST SHOWING LOCATION OF CAVES INTERSECTED IN DRILLING (GREY) AND AS MAPPED ON PLAN N0328 (GREEN).

A cave (vugh) was recorded on the No. 6 Level of the historic BIH underground workings (DEM plan N0328, 1935). At a depth of 125m beneath surface, 80 metres beneath the groundwater standing water level this is the shallowest cave recorded. Drillholes above this level are not recorded as having intersected caves. Historic mining records do not record the presence of marble and instead record the host of the quartz veins as being decomposed schists (Brown, 1908). There is the possibility that the marble has undergone complete dissolution and the bleached clay has collapsed to fill the higher caves.

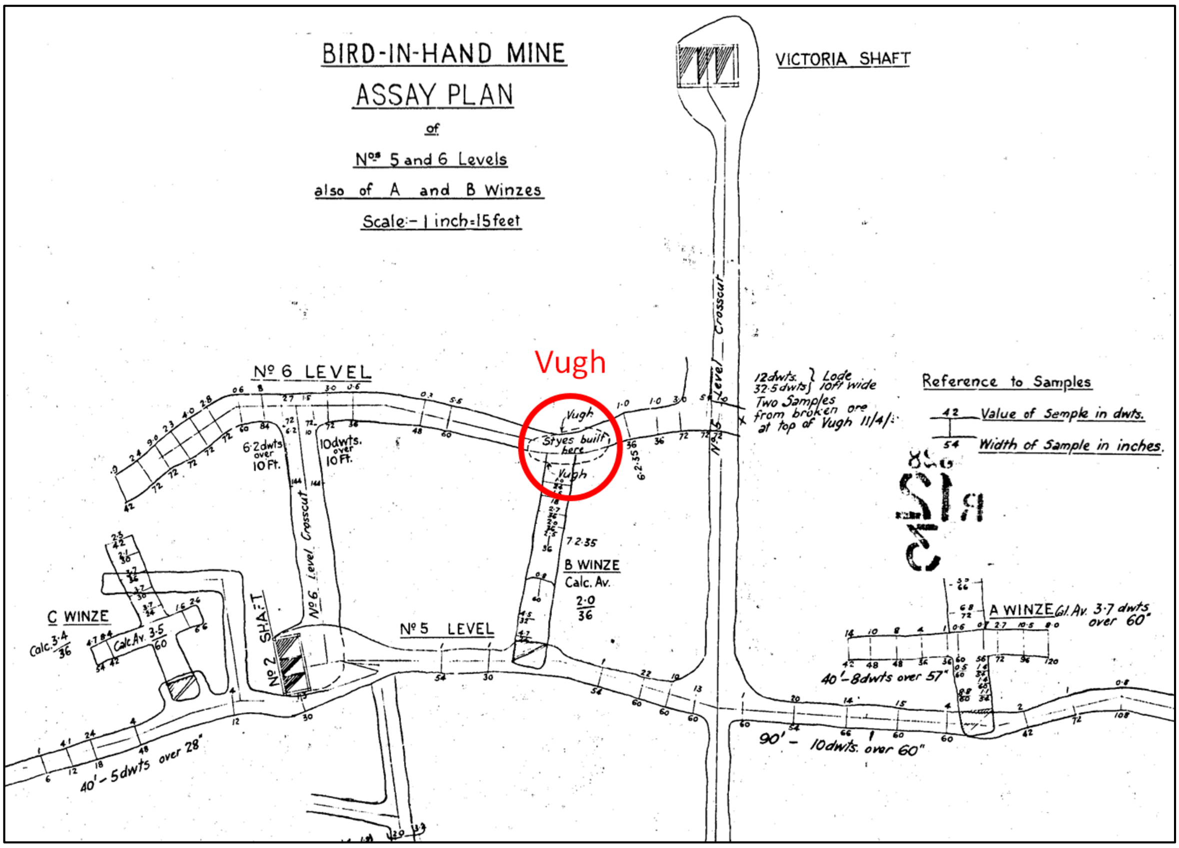

FIGURE 2-34 | VUGH SHOWING ON BIRD IN HAND MINE ASSAY PLAN (DEM PLAN N0328, 1935)

Near surface caves were intercepted in BHMB002A and BHMB002B which were abandoned after intersecting caves within sandy limestones at depths of around 30 metres. No other caves have been located at surface within the Mineral Claim area, nor have caves been identified in in the geotechnical drilling or test pits.

Caves and fractures will be identified as part of the probe hole and grouting process as described in Chapter 3.

Groundwater sampling studies undertaken by Terramin in 2016 (see Appendix Q3), following the recommendations of COOE Pty Ltd (see Appendix Q2) have shown that no stygofauna have been found within the proposed ML boundaries and hence are unlikely to be present in these caves as described in Chapter 18. The conditions of the bores at BIHGP suggest that they are not conducive to the presence of Stygofauna. More information on the potential for stygofauna is included in Chapter 18.