



2018 Review of the Woomera Prohibited Area Coexistence Framework

Submission from the South Australian Government
September 2018

Executive Summary

Mining, primary industries and Defence industries are critical foundations of South Australia's economic success, fuelling the prosperity and well-being of communities across the State, particularly the development of regional centres, rural towns and rail, road and coastal infrastructure. The Woomera Prohibited Area (WPA) is significant to all these three industries, and to traditional owners who use the WPA for cultural and traditional activities.

The WPA is an important region for generating economic opportunities to assist South Australian Government achieve its commitment of creating more jobs and increasing exports especially for the Far North outback region. The convergence of three major industries in the WPA provides significant opportunities for regional economic growth, employment, skills training and capacity development, and investment in regional infrastructure.

The South Australian Government recognises the WPA is a significant national security asset, and the WPA Coexistence Framework, implemented in 2011, must maintain the primacy of Defence use and the protection of Australia's national security, whilst balancing the needs of other land users. This submission supports the intent of the 2018 Review of the WPA Coexistence Framework (2018 WPA Review) to deliver a contemporary coexistence framework that recognises and manages varied land uses and interests including those of Defence, mineral exploration and mining, pastoral operations, traditional land ownership, and other national security and economic interests.

The current WPA coexistence framework has operated well and is an example of a model based on multiple land use principles. The current framework operated during a period of reduced resource exploration and mining activity due to the 2014 global commodity downturn and related investment repercussions from the global financial crisis. The 2018 WPA Review is an opportunity to consider additional improvements to ensure the coexistence framework continues to balance Defence and non-Defence uses and interests including accommodating increased future activity in the WPA.

South Australia has mineral resources of national and global significance. Securing ongoing access to the WPA is of vital importance to the future development of Australia's resource sector and mineral wealth security. The WPA encompasses the mineral-rich Gawler Craton and Stuart Shelf where three major mines are located – all established prior to the WPA coexistence framework. The Prominent Hill copper gold, the Challenger gold and Cairn Hill iron ore mines have delivered more than \$140 million in royalties and 1,500 jobs in the region since the *WPA Rule 2014* came into operation.

A review by the Geological Survey of South Australia shows there are more than 260 mineral occurrences recognised within the WPA area. Geological models clearly indicate a correlation between the deposits within the WPA and highly prospective IOCG (Iron Ore, Copper, Gold) deposits east of the WPA, such as Carrapateena and Olympic Dam. Further work is required to define specific exploration targets and enhance the understanding of precise IOCG targets within the WPA. There are important leadership and investment roles for the Australian and South Australian Government in this regard.

The WPA is of strategic mineral significance. It is prospective for highly sought after globally critical minerals such as, but not limited to, copper, cobalt and rare earths that will form the foundation of Australia's future economy. Some of these minerals are critical to Australia's

national security and that of our major allies, including the United States of America. A group of 35 minerals, including cobalt and lithium, were identified as essential to the economic and national security of the United States of America (see Annex A). The establishment of new, secure supplies of critical minerals and the development of a local critical mineral processing sector will support the Australian and South Australian Governments to achieve multiple Defence, national security, resources and economic policy goals. To succeed, this potential requires appropriately flexible access arrangements in the WPA that enable profitable mining projects to be established.

Exploration is vital to identify the commercially viable resources necessary to enable mining operations and production to occur. Companies and explorers continue to acquire mineral tenements within the WPA. More than 280 new mineral exploration licences were granted since the WPA coexistence framework was implemented in 2011. From 2011-2017, mineral exploration expenditure in the WPA totalled more than \$250 million.

The WPA Coexistence Framework must be modernised to assist more exploration activities successfully transition to the development of profitable mining projects. Without corporate confidence in the ability to successfully transition from exploration to mining within the WPA there is potential for reduced investment and capital raising opportunities for exploration and mining companies alike. This negatively affects Australia's ability to benefit economically from WPA's mineral wealth.

There is scope to enhance the WPA coexistence framework. The South Australian Government submits the following recommendations to better balance national security and economic interests in the WPA and aimed at forging stronger South Australian - Australian Government partnership towards sustainable regional growth and development and future economic growth:

1. The South Australian Government recommends development of a more flexible timeshare and access zone model to ensure ongoing access for resource exploration and commercially viable mining.
 - It is recognised Defence is investing in upgrading the Woomera Range Complex in anticipation of an increased requirement to test new capabilities. South Australia is anticipating higher utilisation of the WPA, both in terms of test area size and the number and duration of trials. This, combined with an upturn in the global commodity market, will test the coexistence framework. A more flexible and granular zone management plan would benefit Defence and non-Defence WPA users.
2. The South Australian Government recommends increased support for Government-led scientific research and geoscientific surveys to deliver a more detailed knowledge and understanding of the mineral, energy and natural resources potential of the entire WPA.
 - A more detailed understanding of the mineral prospectivity of the WPA will be an invaluable input into the development of a more flexible timeshare and access model. Such a program would occur over a few years. This timeframe would enable a longer strategic planning period for both Australian and South Australian Governments and the Defence industry. This planning period would enable considered planning and responses to possible changes in global competition and security around mineral supply, and also the consideration of the WPA's longer term use by interested stakeholders.

3. The South Australian Government recommends developing clear and prescriptive guidelines surrounding foreign investment in the WPA.
 - Capital-intensive industries in Australia such as mining are dependent (at least in part) on access to foreign investment to fund the development of new projects. Transparency of decisions about foreign investment is critical to not only supporting the future economic development of the WPA but also to Australia's reputation as a low risk investment destination. Pursuant to Australian Government's policy on foreign investment, the development and publication of a clear set of guidelines for potential investors in the WPA is recommended. Such guidance will assist to provide better commercial and investment planning for possible foreign investors, reducing uncertainty and enabling better planning around project investment structures, project development and market signals for project developers.
4. The South Australian Government recommends review of administrative processes for business and systems improvement pursuant to a more streamlined regulatory access management framework in the WPA.
 - Drawing on four years of operational experience there are some systems and administrative processes that can be improved to more efficiently meet the needs and requirements of Defence and non-Defence users today and in the future.
5. The South Australian Government recommends a contemporary coexistence framework that leads the way for partnerships with the different Aboriginal groups that access the WPA for cultural heritage and traditional land uses.
 - Members of the Aboriginal communities in the WPA have gained skills training and employment through participation in the resources sector, pastoral enterprises and Defence activities. With the projected increase in Defence, resources sector and pastoral activities, the coexistence framework should lead the way in promoting and supporting further economic development opportunities for members of the Aboriginal communities in and around the WPA.
6. The South Australian Government recommends amending the *WPA Rule 2014* (WPA Rule) to formalise South Australia's role in the governance and management of the regulatory access management framework through the WPA Coordination Office (WPACO), WPA Advisory Board and a Stakeholder Reference Group ensuring the coexistence principles are embedded in the regulatory access framework.
 - After the WPA Rule came into operation in 2014, the Board did not meet for more than two years from June 2015 to June 2017, which meant there was no formal mechanism available to discuss potential issues in the lead-up to decisions made under the WPA Rule such as refusal of access permits. Formalising the partnership between the Australian Government and South Australian Government can provide the mechanism to consider issues in the implementation of the WPA Rule. It would also allow discussion on other issues including collaborative geoscientific surveys, future use of emerging

technologies including drones, remote sensors etc., and mutually beneficial infrastructure development including road, rail, water and power supplies.

7. The South Australian Government recommends the WPA Rule include a provision for a Stakeholder Engagement Plan, which would also formalise the role of the WPA Advisory Board and a Stakeholder Reference Group in the management of a contemporary coexistence access management framework for WPA.
 - The Stakeholder Reference Group will provide the necessary mechanism to keep the dialogue open and ongoing between Defence and non-Defence WPA user groups such as the pastoralists, traditional landowners and Aboriginal groups with native title rights, and exploration and mining operators and inform the WPA Advisory Board.
8. The South Australian Government recommends a contemporary WPA coexistence framework that would provide a mechanism for considering future infrastructure demands in the WPA.
 - Long term infrastructure planning and development of the WPA and adjacent regions, including existing and potential future road and rail transport routes, communication and power supply options, modern automation and remote sensing can address the potential for shared use of infrastructure and any possible hazards or impact on related infrastructure.

Multiple Users in the WPA: Balancing National Security and Economic Interests

The South Australian Government works collaboratively with the Australian Government to implement the current coexistence management scheme in the access and use of the WPA for national security and economic interests. After seven years in operation, South Australia acknowledges the current framework is generally working well. The coexistence framework has increased positive interactions amongst the various stakeholders in the WPA and increased awareness and understanding of the many interests, rights, requirements and concerns of Defence, the South Australian Government, the minerals and energy resources sector, Aboriginal groups and traditional landowners, pastoralists, railway operators and other non-Defence users.

Defence use and interests

The WPA plays an important role in the nation's ability to respond to today's challenging and complex strategic environment. It forms part of Australian Government's policy to align Australia's Defence strategy with capabilities and resourcing, to grow the nation's international Defence partnerships to support shared security interests, and to invest in the partnership with Australian Defence industry to develop innovative technologies and deliver essential capabilities (2016 Defence White Paper).

As the Defence State, South Australia is preparing for a jobs boom associated with significant Defence projects announced including the Future Frigates, Submarines and offshore patrol vessels and increasingly the Intelligence, Surveillance, Reconnaissance, Electronic Warfare (ISREW) and Cyber capabilities. Underpinning these critical capabilities including the P8 Poseidon, TRITON UAS, F35 Joint Strike Fighter, Electronic Warfare platforms and unmanned systems are the Research, Development and Test and Evaluation (T&E) capabilities essential to supporting the introduction of these new platforms. To ensure this, Defence is investing heavily in the Defence Science and Technology (DST) capabilities and the T&E capabilities at the Air Warfare Centre at Edinburgh. Enabling the training and testing activities is guaranteed access to large, available test and training areas and the WPA is recognised as the largest, most electronically quiet and accessible testing range in the Western world.

In January 2015, the WPA became part of the Woomera Range Complex (the Range) comprising the RAAF Woomera Test Range (WTR), the RAAF Base Woomera and associated facilities within the complex, the Nurrungar Test Range, and the restricted airspace over the WPA. In recognition of the importance of the Range, Defence is currently completing a \$300 million upgrade to the Range systems including facilities, communications systems and advanced tracking and control sensors. This is providing significant opportunities to South Australian companies from construction and communications companies, through advanced systems integrators and Defence industry companies supporting the upgrade.

To support the Range upgrade, Defence is planning to significantly improve the support facilities at the Woomera village, airfield and local infrastructure including water and power supplies. Work is scheduled to commence around 2021 and current budget estimates include approximately \$700 million in funding to complete the upgrades. This will provide significant benefits to South Australian companies and workforce during the upgrade and supporting ongoing range activities as Defence testing increases to support newly acquired capabilities, research and development (R&D) with DST including hypersonic rocket trials, advanced weapons including electronic and laser capabilities, and integration of multiple weapon systems in a live and virtual training environment.

The South Australian Defence strategy is focused on increasing the number and value of direct and associate Defence jobs in South Australia with a strong focus on systems and cyber. Defence science and research and supporting development of new technologies to support the Defence export industry. Continued access to testing and training ranges is critical to maintaining the Defence industry eco system and R&D activities as part of South Australia's competitive edge in the Defence industry market. The development of South Australia as an ISREW Hub will add up to 400 additional Defence positions to the 6000 already part of the Edinburgh Defence precinct with consequent flow down to other jobs supporting increased Defence presence. South Australia recognises the critical role the WPA and the Range in the development and testing of the next generation Australian Defence Force.

Minerals and Energy Resources Sector

The WPA overlaps a major part of South Australia's significant minerals and energy resources potential, covering over 30 per cent of the Gawler Craton, one of the world's major mineral domains, and the Arckaringa, Officer and Eromanga Basins that contain conventional and unconventional hydrocarbons and coal. Geoscience Australia previously estimated that 62 per cent of Australia's known copper resources, as well as 78 per cent of the country's known uranium resources are located within the WPA and its immediate surrounds. A global deficit in copper is predicted by 2020, posing significant implications for technology and future industries. In addition, battery, technological and strategic minerals are increasingly in demand from jurisdictions with stable geopolitical environments, responsible manufacturing and mining cultures and low financial and social risk profiles.

In addition, the Coober Pedy Proclaimed Precious Stones field covers about 5,000 square kilometres, about 48 per cent of which falls within the WPA.

Mineral Production Activities

There are four mines located in the WPA: the Prominent Hill copper-gold mine, Challenger gold mine, Cairn Hill magnetite iron ore mine, and Peculiar Knob iron ore mine. In excess of \$1 billion of capital expenditure was invested in these four mines prior to the commencement of the current coexistence framework. Since 2011, an additional \$220 million of capital expenditure was spent to expand operations as more resources were found and defined. These mines have created more than 2,000 full time jobs in the region and in the local economy. Mine royalties

from 2011-2017 have contributed more than \$170 million to the State, accounting for almost a quarter of total mineral royalty payments received for the same period.

During the 2011-2016 global commodity downturn, copper and gold remained in demand commodities. South Australia has significant copper and gold resources and two related mines are located in the WPA. The Prominent Hill copper-gold mine, a medium-sized, high quality copper-gold mine owned and operated by OZ Minerals, commenced operations in 2010 and has produced more than half a million tonnes of copper and more than 600,000 oz of gold for the period 2012 – 2017 (WPA Advisory Board Annual Reports). The Prominent Hill mine life is expected to be until 2029 with an upgraded underground ore reserve and a plant operating at full capacity to 2023. The Challenger gold mine has produced in excess of 1 million ounces of gold. During 2012 to 2017, opal mining in the WPA produced almost \$5.5 million worth of opals.

Resource Exploration Activities

More than 280 new mineral exploration licences were granted since the coexistence framework was implemented in 2011. As at 30 June 2018, there were 143 mineral exploration licences active in the WPA held by junior explorers, and major mining companies BHP, OZ Minerals and FMG Resources. From 2011 to 2017, mineral exploration expenditure in the WPA totalled more than \$250 million. Exploration and resource evaluation activities undertaken during this time included ground and airborne geophysical surveys, geochemical surveys, environmental and cultural surveys, 595,000 metres of drilling, and drill site rehabilitation. These activities were searching for a range of mineral commodities including copper, gold, iron, nickel, heavy mineral sands, uranium, lead and zinc.

In 2013, the South Australian Government undertook a major geoscientific data acquisition program in collaboration with Geoscience Australia resulting in the release of highly detailed and accurate new WPA gravity data. This data assists mineral explorers to refine their mineral and drilling targets, and the State estimate mineral reserves in the area. In 2018, the South Australian Government, together with Geoscience Australia, is undertaking the world's largest high-resolution airborne geophysical and terrain imaging program, the Gawler Craton Airborne Survey, which aims to set the foundations for the next generation of resource industry growth and job creation in the services, supply and manufacturing sectors in South Australia.

The WPA also holds 10 Petroleum Exploration Licences granted under the *Petroleum and Geothermal Energy Act 2000* held by six tenement holders, with 19 applications pending. One Gas Storage Exploration Licence is current while 21 applications are still pending. Exploration activities undertaken over the past ten years included data evaluation, seismic acquisition and drilling with an expenditure of about \$11.7 million.

Pastoralist WPA Users

The WPA is home to 26 pastoral stations comprising of 39 pastoral leases under the *Pastoral Land Management and Conservation Act 1989* (SA) ('Pastoral Act'). Most are operated as commercial enterprises for cattle grazing. Defence has established good relations with the pastoral groups and informal arrangements relating to evacuations and access management are reported to have worked well. Eight pastoral leases within the WPA have changed hands

since 2010 – Wintinna, Mount Eba, Mable Creek, Ingomar, Coondambo, Parakylia South, Lake Wirrida and Anna Creek.

Generally, any development that occurs as part of pastoral operations include fencing, stockyards and shedding. Wind farms are currently permitted under the Pastoral Act but large scale solar developments are not considered a compatible activity, as they require the exclusion of stock, which is against the primary purpose of a pastoral lease. Use of solar panels to power shedding and housing would be considered ancillary to the primary purpose of pastoral activities and therefore have been allowed in recent times.

In 2017, WPACO issued a Pastoral Leaseholder Permission booklet to all pastoralists in the WPA to formalise the access requirements of Defence under the Defence Force Regulations to ensure safety and security within the WPA.

Indigenous WPA Users

The WPA is the traditional land of a number of Aboriginal groups - two Aboriginal groups (Maralinga Tjarutja and Anangu Pitjantjatjara Yankunytjatjara) with freehold land ownership over a significant portion of the WPA and four native title holders (Antakirinja Matu-Yankunytjatjara, Arabana People, Gawler Ranges People and Kokatha People). Generally, Aboriginal groups access the WPA for their traditional ceremonies, hunting, heritage site protection, and cultural activities. Like pastoralists, they are exempt from the WPA Rule, their occupation implicitly authorised under the Defence Force Regulations.

During previous WPA Rule consultations, the Maralinga Tjarutja ('MT') objected to the site of the British nuclear testing on their land – 'Section 400' – being included in the WPA. The MT runs a tourist business at the site, and the need for individual tourist permissions from Defence strongly impacted planning and profitability. Due to this, Section 400 was excised from the WPA and the land was handed back to the Maraling Tjarutja people on 5 November 2014.

WPACO has conducted one-on-one meetings to develop working level agreements to better structure relationships between Aboriginal groups and Defence.

General WPA Users

Main road, rail and State Government users have standing permissions to access the WPA and do not require permits, but must still observe access zones and exclusion periods. Others need a permit. Tourists must apply for access at least 10 days before entering. Commercial and private tourists access the WPA for 4WD activity and access to the Tallaringa Conservation Park. On average, almost a thousand tourists a year accessed the WPA since the WPA rule came into operation. The University of Adelaide and Australian National University were also issued with an access permit under the WPA Rule for research purposes.

The 5,400 km dog fence also traverses the WPA. This dog fence protects sheep graziers and their livestock from wild dogs and dingoes on the southern side of the fence. It is the longest continuous fence in the world. The Dog Fence Board established under the *Dog Fence Act 1946* (SA) is the governing body that manages the approximately 2,150 km long South Australian section of the dog fence.

Update on the mineral resource prospectivity of the WPA

Note: Annex B contains the Geological Survey of South Australia's (GSSA) review of the mineralisation and mineral potential of the WPA.

The WPA includes one of the most prospective regions for hosting world-class mineral deposits. The most well-known is the area referred to as the Olympic Domain, which corresponds to the eastern margin of the Gawler Craton and extends through the eastern parts of the WPA. Elsewhere the Olympic Domain hosts world-class iron oxide – copper – gold (IOCG) plus uranium (IOCG+U) mineral deposits such as BHP's Olympic Dam, OZ Minerals' Carrapateena and the historic copper mines of the northern Yorke Peninsula. Within the WPA the Olympic Domain is closely associated with the mineral deposits at Prominent Hill, Peculiar Knob and Cairn Hill mines as well as numerous high quality mineral exploration prospects and targets with potential to evolve into future mineral discoveries. The WPA also hosts geological units known to be highly prospective for gold, nickel, platinum group elements (PGEs), lead, zinc, iron ore, uranium and heavy minerals, many of which are of high value as strategic resources internationally and for technological applications.

The vital pre-competitive geoscience data acquisition required to support mineral exploration has largely focussed on techniques that map out the physical characteristics¹ of buried rocks. Recent higher resolution and better integration of different data strands has greatly improved knowledge of the area. The age of different rocks and minerals (geochronology) has assisted understanding of the important geological processes for forming mineral systems, including IOCG+U deposits. There have also been significant improvements in constraining and mapping the depths of cover that overlie prospective rock units.

Depth of cover mapping is critical because it is essential in defining drilling costs to access mineralisation targets and in turn the expenses and feasibility of mining. The depth of cover is a key element in defining what mineral explorers consider to be the "economic search space". Although some parts of the WPA have deep cover, recent depth to cover mapping show many parts to have more shallow cover than previously thought, and therefore larger areas that are well within the "economic search space" for viable exploration and mining. The WPA continues to show significant potential for in demand copper, battery and technology minerals.

Despite the improved knowledge and high prospectivity of the region, there is a sparsity of drill holes and related samples, most especially within the "continuous use" area in the southeast. Future pre-competitive and exploration analysis and geoscience programs are required to establish even greater confidence in existing interpretations of buried geology and prospectivity. One example of this would be the significant value of a regional programs and compilation of existing data, such as proposed by the National Drilling Initiative (NDI) within the MinEx CRC of which GSSA and Geoscience Australia are both major participants.

¹ The physical characteristics of buried rocks include geophysical properties, such as gravity and magnetic fields, radiometrics and more recently magnetotelluric data.

Contemporary Coexistence Framework in the WPA: Recommendations for Stronger South Australian Government – Australian Government Partnership towards Sustainable Regional Growth and Development

The Existing Coexistence Framework

The existing WPA Coexistence Framework includes the following key components:

- The **WPA Advisory Board** (the Board) monitors and reports on the balance of national security and economic interests in the WPA, and oversees implementation of the Coexistence Framework. It is supported by membership from relevant Commonwealth and State Government senior officials.
- A Commonwealth-South Australia jointly operated **WPA Coordination Office** (WPACO) to support the Board and to administer the WPA Rule. The Department for Energy and Mining (DEM) and Defence SA sit as remote members of WPACO representing State Government interests.
- Implementation of discreet access zones each with pre-defined exclusion periods. The **access zones (Green, Amber 1 and 2, and Red) and timeshare model²** have existed since 2012 offering different levels of access to non-Defence users. Each access zone has exclusion periods during which Defence may undertake testing activities and access for non-Defence use is not permitted. The Red Zone is for continuous Defence use only.
- The **WPA Rule 2014** (WPA Rule) is a legislative instrument specifying the conditions upon which non-Defence users may access the WPA. Access permits are issued WPACO subject to a set of general conditions. Permits are issued for resource production and exploration, opal mining and precious stone prospecting, tourists, researchers, environmentalists and other purpose. Permits are granted for between one day and 10 years. A presumption of access applies in the Green Zone and permits can be renewed perpetually subject to any compliance issues.

The existing WPA coexistence framework is an example of a system based on multiple land use principles. An increased awareness and understanding of the various issues, concerns, and challenges facing the multiple users of the WPA resulted from the consultation and stakeholder engagement activities undertaken during the first review process up until the new regulatory access regime came into operation in August 2014. The establishment of WPACO with virtual representation from South Australian Government to manage non-Defence use and access created a central coordinating office to respond to the access requirements of non-Defence user groups and provides a level of certainty and transparency that supported investment and commercial planning.

² Please refer to Attachment 1: Map of the WPA Access Zones with Exclusion Periods.

The Board has been effective in its role as an 'honest broker' and has been instrumental in building trust and confidence between key stakeholders and non-Defence users in the WPA. It has provided a formal forum for both Defence and non-Defence user groups to raise their issues and concerns. It has laid a strong foundation for relationship-building between and among key stakeholders in the WPA, having conducted one-one-one meetings with pastoralists, opal miners, exploration and mining companies, resource industry associations, environment groups, Aboriginal freehold landholders and native title claimant groups, railway owners and operators, and tourism operators. Through the stakeholders' interactions with the Board significant outcomes were achieved including Defence's decision to excise Section 400 from the WPA in 2014 and maintaining the existing user status of pastoralists, Aboriginal groups and railway owners and operators in the regulatory access regime.

Furthermore, through the Board, Defence raised a concern with the South Australian Government about the lack of formal notifications of sales and changes of control of pastoral leases in the WPA. South Australia responded by amending the Property Interest Report (PIR) that is issued by the State's Land Titles Office for any pastoral lease located within the WPA to include reference to the WPA and the need for Defence permission under the 'Additional Information' section of PIRs. The South Australian Government will continue to investigate the transfer of pastoral lease ownership process in the WPA, including legislative amendment as part of any future reviews of the Pastoral Act.

There is increased transparency and certainty of access for non-Defence users through publicly available and accessible information and communication in relation to permit conditions, application requirements, application timeframes, forms and access permit processes. Importantly, during the 2016 interim review of the WPA Rule, staff at WPACO and Woomera Test Range were commended for being helpful and readily available for general enquiries, assistance and urgent personnel access permit applications.

Despite the many positive outcomes, the 2018 WPA Review provides a significant opportunity to enhance the current coexistence framework by considering increasing and evolving use and interests of Defence, resources sector and other non-Defence WPA users to better balance and respond to national security and economic interests in the WPA.

Recommendations for a Contemporary Coexistence Framework

The South Australian Government submits the following recommendations for the development of a contemporary WPA coexistence framework that supports stronger South Australian Government – Australian Government partnership towards sustainable regional growth and development and future economic growth.

a. A contemporary access management framework that deepens its commitment to coexistence by enabling the growth of South Australia’s resource exports, future industries and jobs in the resources sector, and associated services and value chain industries and jobs.

- 1) *The South Australian Government recommends development of a more flexible timeshare and access zone model to ensure ongoing access for resource exploration and commercially viable mining.*

The South Australian Government recommends the current timeshare and access zones model should be reviewed to ensure it is more adaptable to the changing needs and requirements defence and non-Defence users. The current timeshare and access zones model does not allow exclusion of any part of the Green Zone during an exclusion period. The whole Green Zone is excluded from non-Defence use when an exclusion period is operational even though Defence testing may only be requiring a portion of it. A more granular zone model would potentially benefit both Defence and non-Defence users.

There is a growing perception amongst industry that under the current WPA Rule any resource exploration investment in Amber Zones 1 and 2 carries significant high risks that regardless of the size of any mineral discovery it will be difficult to get an access approval for mining operation. Mining operations are a high capital investment activity that require sufficient time and scope for operation to ensure financial returns are balanced with the significant expenditure to discover the resource and establish a mine. There are examples of delays in progressing some major exploration projects with clearly defined resources due to the inability of companies to gain ongoing access in the Amber zones. These projects include Acropolis (IOCG), Hawks Nest (iron ore), Golf Bore and Golf Bore North (gold), and Lake Phillipson (coal).

The South Australian Government recognises that Defence is investing in upgrading the Range in anticipation of an increased requirement to test new capabilities including longer-range weapons, multiple weapons and systems, electronic systems and conduct sensitive research and development. Although details will remain classified, the South Australian Government is anticipating a higher utilisation of the WPA, both in terms of size of test areas and number and duration of trials. This, combined with an upturn in the global commodity market, will test the coexistence framework and where a more flexible and granular zone management plan would be useful and benefit Defence and non-Defence WPA users.

The South Australian Government therefore recommends investigation and development of an enhanced flexible timeshare and access zones model. The South Australian Government further recommends a joint South Australian Government - Australian Government commissioned independent study to investigate and explore a flexible timeshare and access zones model that would:

- increase granularity of the Green Zone by dividing it into smaller sub-blocks based on Defence use and requirements;
- identify zones where it is possible to build a central minerals processing infrastructure that would support growth in mining operations and be able to operate for commercially viable time periods; and
- allow increased access in areas of high mineral prospectivity such as the eastern half of the WPA.

2) *The South Australian Government recommends increased support for Government-led scientific research and geoscientific surveys to ensure detailed knowledge and understanding of the mineral, energy and natural resources potential of the entire WPA.*

The WPA region contains globally significant deposits of key minerals and the State has 68 percent of Australia's potential copper resources. Discovery is key to the ability to mine copper and other mineral deposits. South Australia contains highly prospective geology and valuable groundwater resources that in many parts are still either poorly understood or else provide scope for the discovery of new mineral provinces and groundwater and hydrocarbon basins.

Pursuant to reviewing and developing a more flexible timeshare and access zones model to maximise the use of the WPA for resource exploration and mining, the South Australian Government recommends a more thorough assessment is undertaken of the resource potential of the WPA in addition to the ongoing Gawler Craton Airborne Survey and data analysis.

A more detailed knowledge and understanding of the mineral, energy and natural resources potential of the entire WPA, through Australian Government-supported scientific research and geoscientific surveys, would assist:

- identify areas of less prospectivity, which would likely be of less interest to private industry explorers,
- identify highly prospective areas in key technological, strategic or Defence industry related minerals, and
- allow a more detailed understanding of the WPA's resources potential to develop without relying on the private sector for access to the WPA.

A more detailed knowledge and understanding of the mineral prospectivity of WPA will be a valuable input in the State's recommendation for a flexible timeshare and access model (as discussed above). It is likely such a program would be undertaken over a few years, which would enable longer term strategic planning for Governments and the Defence industry to respond to possible changes in global competition and security around mineral supply, and consider potential use of WPA in a longer timeframe by interested stakeholders.

On a broader scale, it is recommended the Australian Government launch a national geoscience initiative equivalent to the Exploring for the Future program for southern Australia to complement the existing northern Australia program. A challenge for better discovering the full potential of these is not only the widespread depth cover sequences (e.g. as identified in UNCOVER), but also the coexistence of exploration with pastoral activities and other land access challenges. Such initiatives also align with recommendations within the National Mineral Exploration Strategy, which was developed by Geoscience Working Group

of the COAG Energy Council. **A South Australian program would over-arch and help further support drilling programs, including MinexCRC's National Drilling Initiative.**

In South Australia, this would specifically provide support for Geoscience Australia to be a collaborative partner with the proposed 10-year regional program extending across the margins of major geological domains and major infrastructure corridors particularly in the WPA.

3) The South Australian Government recommends developing clear and prescriptive guidelines surrounding foreign investment in the WPA.

The South Australian Government recognises that activities and access to the WPA must balance national security considerations and commercial interests particularly involving foreign investment.

Capital intensive industries in Australia such as mining are dependent (at least in part) on access to foreign investment to fund the development of new projects. Transparency of decisions in regard to foreign investment is critical to not only supporting the future economic development of the WPA but also to Australia's reputation as a low risk investment destination.

Pursuant to Australian Government's policy on foreign investment, the South Australian Government recommends development and publication of a clear set of guidelines for possible foreign investors in the WPA, which could include a matrix of risk profile and mitigation strategies for each zone (and possibly sub-zones) in the WPA. This guidance material will greatly assist the pastoralists, and exploration and mining operators in the WPA in their forward commercial and investment planning and strategies for growth and expansion supporting jobs and economic growth in the region.

4) The South Australian Government recommends review of administrative processes for business and systems improvement pursuant to a more streamlined regulatory access management framework in the WPA.

The South Australian Government recommends a review of WPACO's and the Woomera Test Range's administrative processes to streamline them and make them more fit-for-purpose as well as future proofing them to meet the needs and requirements of Defence and non-Defence users today and in the future.

After four years in operation, the South Australian Government recommends the WPA Rule and its administrative processes should be reviewed to:

- enable cross-accreditation of Approved Person status,
- enable extension of the term of Approved Person status to five years,
- enable notification of cancellation of exclusion periods in the Amber Zones 1 & 2 at least 28 days before the start of exclusion period,
- enable an 8-week gap in between exclusion periods in Amber Zones 1 & 2 between March to November when weather is most suitable to undertake advance resource exploration programs,
- ensure continued appropriate resourcing of WPACO and WTR,
- avoid exclusion of access to Central Australian railway line and Stuart Highway for longer than 24 hours to provide certainty in freight services, and

- consider the use of online application options to streamline the application, assessment and notification processes.
- b. A contemporary coexistence framework that leads the way for partnerships with the different Aboriginal groups that access the WPA for cultural heritage and traditional land uses.**

5) The South Australian Government recommends a contemporary coexistence framework that leads the way for partnerships with the different Aboriginal groups that access the WPA for cultural heritage and traditional land uses.

The South Australian Government recognises the current coexistence framework led to opportunities to engage and build relationships with a range of stakeholders, particularly with the traditional owners and Aboriginal groups with Native Title rights and interests over the WPA. Members of the Aboriginal communities in the WPA have gained skills training and employment through participation in the resources sector, pastoral enterprises and Defence activities.

Traditional landowners and Native Title holders have shown willingness and interest to explore increased participation in the resources sector, in pastoral enterprises, and in Defence activities. Maralinga Tjarutja (MT) now operates a growing tourism operation showcasing visits to former nuclear sites in MT Lands. Kokatha People have formed an industry-leading partnership with OZ Minerals in the development of the Carrapateena copper-gold mine located 62 km east of Woomera. Over the years, members of Aboriginal groups have also participated in heritage surveys and rehabilitation works for the exploration and mining operators in the WPA.

Aboriginal groups including Antakirinja Matuntjara Yankunytjatjara and Kokatha peoples own and manage pastoral stations in the WPA and run them as commercial enterprises. Antakirinja Matuntjara Yankunytjatjara people, together with the State Department for Environment and Water, have also developed a new management plan for the Tallaringa Conservation Park that is located within the WPA. This new management plan will protect significant archaeological and Aboriginal cultural sites, and protect and restore the environment for the benefit of the Antakirinja Matuntjara Yankunytjatjara people.

Defence continues to promote its Air Force Reserve Compliance Team Officer program with Aboriginal groups in the WPA. Six Aboriginal members have successfully completed the program and are now part of the Range's Compliance Monitoring Team, supporting the team's operations and engagement activities in the WPA.

With projected increase in Defence, resources sector and pastoral activities, a contemporary coexistence framework should lead the way for partnerships with the different WPA Aboriginal groups promoting and supporting further economic development opportunities for members of the Aboriginal communities in and around the WPA.

- c. A contemporary coexistence framework that formalises the role of South Australian Government in the governance and management of the regulatory access regime.**

6) The South Australian Government recommends amending the WPA Rule to formalise South Australia's role in the governance and management of the regulatory access management framework through the WPA Coordination Office, WPA Advisory Board and

a Stakeholder Reference Group ensuring the coexistence principles are embedded in the regulatory access framework.

- 7) *The South Australian Government recommends the WPA Rule include a provision for a Stakeholder Engagement Plan, which would also formalise the role of the WPA Advisory Board and a Stakeholder Reference Group in the management of a contemporary coexistence access management framework for WPA.*

The State's formal representation in the governance and management structures in the WPA coexistence framework is absent due to failure to implement all of the WPA Review 2011 recommendations.

There is no signed Memorandum of Understanding (MoU) between the Commonwealth and South Australia (Recommendation #6 WPA Review Report 2011), which is intended to articulate principles of coexistence for the WPA and outlines consultative mechanisms and management protocols. **The South Australian Government recommends the MoU is finalised and signed as part of 2018 WPA Review's key recommendations.**

After the WPA Rule came into operation in 2014, the Board did not meet for more than two years from June 2015 to June 2017. Without the Board, South Australia lost the only mechanism available to it to have a frank and honest conversation about some decisions made under the WPA Rule such as refusal of access permits to some of the State's exploration and mining tenement holders.

The WPA Review 2011 also recommended establishment of a Reference Group (Recommendation #37 WPA Review Final Report 2011) as a source of advice to the Board and to WPACO on the practicalities and appropriateness of coexistence, and includes representatives from stakeholders with a recognised interest in the WPA.

Failure to establish the recommended Reference Group has limited the interaction of non-Defence user groups with existing presence in the WPA such as the pastoralists, traditional landowners and Aboriginal groups with native title rights, and exploration and mining operators with the Board.

To address these shortcomings, **the South Australia Government recommends amendment of the WPA Rule to formalise South Australia's role in the administration of non-Defence access through the South Australian Government – Australian Government jointly operated WPACO.** This would mean amending the WPA Rule to formalise WPACO's role as administrator of non-Defence access in the WPA through inclusion of an additional Part that could be referred to as the '*Access Management and Stakeholder Engagement*' provisions. These provisions would define the role, functions and operations of WPACO as a jointly operated office by the two governments. The proposed additional Part would also include stakeholder engagement provisions to formalise the roles and functions of the WPA Advisory Board and a Stakeholder Reference Group underpinned by a Stakeholder Engagement Plan. More importantly, **the South Australian Government recommends that this additional Part would include a provision to review the WPA coexistence framework every seven years** to ensure that it continues to be innovative and to adapt to evolving needs and interests of Defence and non-Defence users in the WPA.

The South Australian Government recommends the Stakeholder Engagement Plan (the Plan) be developed by WPACO together with the Board and a Stakeholder Reference

Group. The Stakeholder Engagement Plan, to form part as an additional Schedule of the WPA Rule, will underpin the workings of the Board and the Stakeholder Reference Group, and will provide the necessary mechanism to keep the dialogue open and ongoing between Defence and non-Defence WPA users. It could include, amongst other matters:

- Information sharing and communication strategies including, but not limited to, a Woomera Stakeholders' Day, a regular newsletter and regular industry meetings;
- Engagement activities for any development proposals – mining, exploration, pastoral activities, railway operations, Defence activities etc.;
- Joint undertakings such as compliance and regulatory activities – between Defence and other State agencies; and
- Provision to review the Plan every seven years as part of the overall review of the WPA coexistence framework.

Refining the role and function of the Board provides the framework to deliver ongoing support to the WPA coexistence framework. Formalising the partnership between the Australian Government and South Australian Government can provide the mechanism to consider issues in the implementation of the WPA Rule, including the untested demerit points system and compensation scheme. It would also allow further discussion on issues including collaborative geoscientific surveys, future use of emerging technologies including drones, remote sensors etc., and mutually beneficial infrastructure development including road, rail, water and power supplies.

d. A contemporary coexistence framework that promotes and supports sustainable regional growth and infrastructure development.

8) The South Australian Government recommends a contemporary WPA coexistence framework that would provide a mechanism for considering future infrastructure demands in the WPA.

Long term infrastructure planning and development is essential to supporting future activity not just within the WPA, but also in adjacent regions. The projected expansion and development of resource exploration, mining, pastoral and tourism activities within the WPA and nearby areas will require consideration of supporting infrastructure including existing and potential future road and rail transport routes, communication and power supply options.

Another consideration for the WPA and Defence relates to the technology applications for not just modern business but related infrastructure. There is increasing use of automation, remote sensing, communication and remote operation technologies. Such applications could have significant impacts to Defence activities. It is recommended these matters should be considered carefully to provide clearer future direction on the planning, related hazards and ultimately WPA guidance on such technologies and the infrastructure limitations or opportunities for both defence and other stakeholders.

Incorporating future infrastructure planning and consideration into the access management framework for the WPA will enable a better understanding of the potential infrastructure needs of Defence and non-Defence users. It would also identify potential opportunities for shared use of infrastructure, and any possible hazards or guidance related to application of digital technologies.

Further information

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Annex A

Final List of 35 Minerals Deemed Critical to U.S. National Security and the Economy³

- Aluminum (bauxite), used in almost all sectors of the economy
- Antimony, used in batteries and flame retardants
- Arsenic, used in lumber preservatives, pesticides, and semi-conductors
- Barite, used in cement and petroleum industries
- Beryllium, used as an alloying agent in aerospace and defense industries
- Bismuth, used in medical and atomic research
- Cesium, used in research and development
- Chromium, used primarily in stainless steel and other alloys
- Cobalt, used in rechargeable batteries and superalloys
- Fluorspar, used in the manufacture of aluminum, gasoline, and uranium fuel
- Gallium, used for integrated circuits and optical devices like LEDs
- Germanium, used for fiber optics and night vision applications
- Graphite (natural), used for lubricants, batteries, and fuel cells
- Hafnium, used for nuclear control rods, alloys, and high-temperature ceramics
- Helium, used for MRIs, lifting agent, and research
- Indium, mostly used in LCD screens
- Lithium, used primarily for batteries
- Magnesium, used in furnace linings for manufacturing steel and ceramics
- Manganese, used in steelmaking
- Niobium, used mostly in steel alloys
- Platinum group metals, used for catalytic agents
- Potash, primarily used as a fertilizer
- Rare earth elements group, primarily used in batteries and electronics
- Rhenium, used for lead-free gasoline and superalloys
- Rubidium, used for research and development in electronics
- Scandium, used for alloys and fuel cells
- Strontium, used for pyrotechnics and ceramic magnets
- Tantalum, used in electronic components, mostly capacitors
- Tellurium, used in steelmaking and solar cells
- Tin, used as protective coatings and alloys for steel
- Titanium, overwhelmingly used as a white pigment or metal alloys
- Tungsten, primarily used to make wear-resistant metals
- Uranium, mostly used for nuclear fuel
- Vanadium, primarily used for titanium alloys
- Zirconium, used in the high-temperature ceramics industries

³ US Department of the Interior, 18 May 2018, "Interior Releases 2018's Final List of 35 Minerals Deemed Critical to U.S. National Security and the Economy", <https://www.usgs.gov/news/interior-releases-2018-s-final-list-35-minerals-deemed-critical-us-national-security-and>

Annex B

Review of the mineralisation and mineral potential of the WPA

By the Geological Survey of South Australia

This 2018 submission provides a summary of the key geoscience work programs completed over the WPA region and updates of resource prospectivity. Reference to a figure plan number in the following discussion is found on Attachment 2: *The South Australian Atlas of Geoscience and Mineral Exploration Data – Woomera Prohibited Area within the Gawler Craton, Second Edition 2018* Department for Energy and Mining Report Book 2018/00018 (Government of South Australia, June 2018).

New Geoscience data acquisition

The second edition of the South Australian Atlas of Geoscience and Mineral Exploration Data - Woomera Prohibited Area within the Gawler Craton is a compilation of currently available open file spatial information including administrative, geological, geophysical and remotely sensed data. State government geoscience initiatives have been undertaken since the release of the first edition in 2013, including PACE Frontiers and PACE Copper. These captured a range of important geophysical and geological data, adding to the richness and complexity of geoscientific data and information covering this important geological region within South Australia.

The new and significantly updated datasets include:

- Geological Domains: Geological “domains” have been used informally for decades to delineate areas of linked geology that can typically have implications as metallogenic regions. The currently accepted domain boundaries in and around the WPA help set the scene for geological associations and the mineral potential of the region.
- Cover thickness: The Geological Survey of South Australia have developed a regularly updated data package generating depth to crystalline basement and cover thickness from a range of input data including drill hole, surface geology, seismic and airborne EM. This dataset helps define the economically viable search space for mineral exploration in South Australia and evolves as additional informational data are acquired.
- Gravity: The WPA gravity survey captured over 34,000 ground gravity stations at 1 km and 2 km spacing, which have been processed with other open-file gravity data to produce a new generation of state-wide gravity products, including residual gravity and gradient strings.
- Reprocessed Total Magnetic Intensity (TMI): Existing open-file company and government airborne magnetic data have been reprocessed from first principles and merged to generate a new series of state-wide magnetic products with the WPA and Gawler Craton being the main area of focus. These new magnetic products have also been enhanced, delivering a suite of TMI products to aid geological interpretation and exploration targeting. Among the new TMI products routinely being produced for South Australia and included in the atlas are Tilt of TMI and Pseudo Gravity.

- Radiometrics: Existing open-file radiometric data have been updated and merged using the most up-to-date techniques, providing almost complete coverage of the WPA.
- Airborne magnetic, radiometric and DEM survey: The Gawler Craton Airborne Survey is currently in progress and will capture 1.67 million line kilometres of TMI, radiometric and elevation data with 200 m line spacing at 60 m acquisition height, covering almost 300,000 km² of the Gawler Craton, including 85% of the WPA. These new data provide new benchmarks for airborne geophysical data capture in Australia.
- Magnetotellurics: Magnetotelluric data provides three dimensional lithospheric-scale conductivity information that correlates closely with known mineral occurrences and deposits, suggesting that lithospheric-scale conductivity features are directly linked with mineral endowment and fertility. The AusLAMP program has captured magnetotelluric data over most of South Australia and is currently available for over 90 % of the WPA.
- Solid Geology: The reprocessed and recently acquired geophysical data enable new interpretations of basement geology and structure to be produced. The “East Central Gawler Craton solid geology map” is an example of this.

Economic Geology / Mineral Deposits

Review of current deposits (in 2008 report) and comment on future potential - include strategic minerals (cobalt, lithium etc.). A comparison of resource inventory of key commodities since the last review is tabulated below.

Commodity			2008 status	2017 status	Production 2008-2017	Change to Resource inventory (net of production)
GOLD	No. deposits		3	8		167%
	No. Mines		1	2		100%
	Total JORC resources (oz.)	Total¹	8,636,834	1,142,870	1,948,679	-38%
			<i>Carrapatenna²</i>	2,600,000	<i>In development</i>	<i>n/a</i>
COPPER	No. deposits		1	1		0%
	No. Mines		1	1		0%
	Total JORC resources (t.Cu).	Total	2,500,000	1,620,000	943,134	4%
			<i>Carrapatenna</i>	2,000,000	<i>In development</i>	
FE ORE	No. deposits		6	8		33%
	No. Mines		0	2		200%
	Total JORC resources (t. Fe).	Total	305,000,000	640,000,000	7,000,000	115%

Table 1: Status and inventories of key mineral commodities within the WPA, 2008 – 2017.

¹ Gold resource base is inclusive of changes and write downs of resources at one deposit (Prominent Hill, ~3Moz write down)

² Carrapateena resources are included for reference as it is located adjacent to the WPA and is hosted in the same geological domain that continues into the WPA and is a new resource since the last review.

Although there has been a decrease in the reported gold resources within the WPA, a large proportion of this decrease is attributable to a changed interpretation and reporting at one deposit (Prominent Hill), which required a write down in attributable gold resources. Gold inventories (net of production) otherwise increased by ~9%. Over this period the total number of defined gold deposits increased and there remains a sustained level of exploration for gold by companies.

The net copper inventory has not materially changed over the review period, although a significant Cu-Au deposit has been defined since the last review immediately south of the WPA, hosted within the same geological domain that continues beneath the WPA. There remain strong levels of activity directed towards copper exploration by companies. A new exploration model for Cu-Au deposits (the iron sulphide copper gold style) has been recognised in recent times with technical success for this exploration model proven within the WPA (Mt Woods Inlier).

Iron ore resources have more than doubled with a 33% increase in the number of deposits and two mines commencing operation over the review period.

Parts of the WPA are considered as being prospective for 'newly' recognised commodities such as cobalt, with this potential being further pursued by the exploration sector.

At the time of the last review the GSSA mineral deposit database recorded ~150 mineral occurrences across over 30 commodities within the WPA. Systematic review of historical records over the review period has resulted in ~260 mineral occurrences recognised within the WPA area, which is an increase of over 70%. Figure 1 (plan number 205068-058) illustrates known mineral deposits and occurrences within the WPA region.

Key parameters for geological prospectivity and new discovery

The burial of mineral deposits and mineral exploration targets beneath a barren cover of younger geological units has previously proven to be a major impediment that has effectively concealed mineral deposits from mineral explorers. This challenge has been recently defined and addressed as part of the Australian Academy of Science's UNCOVER program, which has since developed an industry-government – research sector Roadmap via AMIRA. A geoscience foundation for this recognises four key parameters for the search for covered mineral deposits.

These include:

- Characterising the Cover;
- Lithospheric Architecture;
- 4-dimensional geodynamic and metallogenic evolution; and,
- The assembly and expression of mineral systems.

These key parameters form the basis of the following account.

Characterising the Cover

There have been three main updates to our understanding of the materials that cover basement geology hosting mineral exploration targets in the WPA, since publication of the last report in 2013. Primarily, the cover thickness map update (Figure 2 plan number 205068-067) has revealed significantly less sedimentary thickness in the mineral exploration search space in the WPA. This has implications for reducing drilling costs, and mitigating risk for explorers, as less cover means more drill holes can be planned. The potential for

buried mineralisation to be expressed a nearer the land surface is increased as depth to basement decreases.

A significant amount of research has been done since 2015 to present by Deep Exploration Technologies Cooperative Research Centre (DET CRC) to characterise the sedimentary and weathered cover and associated mineral system signatures. DET CRC's focus on understanding the development of geochemical signatures in weathered rocks, and their dispersion processes has produced a large body of work that has the potential to assist mineral explorers to "vector" towards prospective sites in and through the cover. Numerous PhD theses have been completed (Johnson, Normington, van der Hoek, Dietman and Rollison), conference posters presented (Baudet *et al.*, 2017a; Baudet *et al.*, 2017b) and journal articles published (Forbes *et al.*, 2015, Forbes *et al.*, 2016). The thesis by Normington, which discusses the development of geochemical systems Permian Arckaringa Basin highlights how these sediments host geochemical signatures that can be used to search for potential buried mineralisation, such as Prominent Hill.

The hydrogeochemistry of South Australia: Data Release: Accompanying Notes (Gray and Bardwell, 2016) is another body of work that has contributed to the ongoing development of geological knowledge and resource potential for the WPA. The data release is part of the "Continental Scale Hydrogeochemistry" initiative, and is also being reviewed by CSIRO to be re-released in 2018. The preliminary results from the data review is that there are many anomalous groundwater results within the WPA, that require further investigation to determine their origins (such as basement-derived, anthropogenic inputs, buried mineralisation contributions) in areas that have not previously been investigated by mineral explorers.

Lithospheric Architecture

In 2018, the Australian Lithospheric Architecture Magnetotelluric Project (AusLAMP) completed acquisition of South Australia including the WPA (station locations in Figure 3 plan number 205068-058). Furthermore, new broadband magnetotelluric (MT) data across the Olympic Dam IOCG-U deposit along the eastern margin of the WPA, as well as the Gawler-Officer-Musgrave-Amadeus seismic and MT line (GOMA) along the N-S railway corridor exist.

The in-house developed 3D electrical resistivity models of the state reveal new understanding of the prospectivity of the WPA (Figure 3 plan number 205068-058). The models clearly indicate a correlation between location of the highly prospective IOCG deposits, such as Carrapateena and Olympic Dam, east of the WPA and deposits within the WPA, such as Prominent Hill, Peculiar Knob and Cairn Hill. All of the deposits occur along margins of low resistivity zones in the mid to lower crust. This will potentially focus the search space for future exploration within the WPA.

New integration of data sets high light the fertile nature of the crust and mantle beneath the WPA (Thiel and Heinson, 2013; Skirrow *et al.*, 2018). Recent studies have shown that these can be mapped as part of large mineral system footprints using a combination of MT and re-

processed deep seismic data (Heinson *et al.*, 2018); refer to Figure 3 plan number 205068-058.

4D Geodynamic and Metallogenic Evolution

Updated Geology of the WPA

The recent studies and the 2015 update to the solid geology of the eastern WPA (GDP00034, available from SARIG) have implications for the prospectivity for IOCG-U deposits (and other deposit styles):

1. An increase in the area of recognised metasedimentary successions of low metamorphic grade, identified as a key ingredient in the formation of IOCG-U deposits (Reid and Fabris; 2015) provides a boost for prospectivity through the eastern WPA.
2. The Gawler Range Volcanics, another key component in IOCG-U formation, and a 1590 Ma palaeosurface indicator, and a geological unit prospective in its own right for epithermal mineralization, has also hosted major advances in geoscientific knowledge.
3. Thermochronological results (Reid, Jourdan and Jagodzinski; 2017) in the poorly constrained region between Olympic Dam and Prominent Hill mines show the alteration footprint associated with the 1590 Ma mineralization event has affected wide regions with previously unknown prospectivity.

Figure 4 plan number 205068-057 illustrates the geological domains comprising the Gawler Craton which encompasses the WPA area.

Mineral Systems

Iron-oxide-copper-gold (IOCG) Mineral Systems

The geochemical and alteration mineral footprints of IOCG deposits were investigated to identify combinations of trace elements that reflect proximal and distal effects of hydrothermal fluids (Fabris *et al.* 2013). Related geochemical patterns were also identified in basal sedimentary units that overlie the hydrothermally altered bedrock.

Patterns of white mica, chlorite and feldspar alteration mineralogy were mapped in a HyLogger spectral study on Olympic Dam drill core, in collaboration with BHP and the University of Adelaide. In a 14 km drill section, a broad pattern of mineral alteration was established that extends for approximately 5 km either side of the orebody (Mauger *et al.* 2016).

These studies were extended in an industry collaboration on the footprints of skarn-style copper-gold mineralisation in the Punt Hill region. Geochemical and mineralogical characteristics were determined that can be used to assess the relative degrees of prograde and retrograde mineral alteration. The patterns of alteration are used to identify the source areas of the hydrothermal fluids and regions where conditions were conducive to sulphide mineral precipitation. The results were incorporated with physical measurements on drill core

and used to refine strategies to map skarn alteration patterns using regional magnetic and gravity data (Fabris *et al.* 2018).

These recent developments in understanding IOCG mineral system footprints provide additional tools to add value to data already collected over the WPA and for improvement in interpretation of results from future mineral exploration drilling for copper deposits buried by thick cover sediments.

Uranium Mineral Systems

A 3D model of the Cariewerloo Basin (42,500 km²) was constructed and the pattern of sediment fill determined as precursors to interpreting basin history and fluid circulation. The data package was released in June 2012 (Wilson *et al.* 2012). The timing of fluid flow and fluid pathways were established and interpreted in terms of potential to mobilise and concentrate uranium to form unconformity-related uranium deposits, within the basin sediments and the underlying crystalline bedrock. The results indicate that interaction of basin fluids with reactive basement rocks was confined largely to the eastern and northern margins, where more permeable middle and upper sedimentary sequences on-lapped crystalline basement (Keeling *et al.* 2015).

The data provide evidence of a more expansive basin along the eastern margin that was removed by later erosion. This is supported by recent studies that identified remnants of basin sediments (Pandurra Formation sandstone) in the breccia at the Olympic Dam orebody (the world's largest uranium deposit) and indicates a connection with fluids circulating in the overlying Cariewerloo Basin (Cherry *et al.* 2017). Dating of uranium minerals confirm significant mobilisation and recrystallisation of uranium in the Olympic Dam deposit at ~1200 Ma, consistent with the timing of mobilisation of basin fluids. The results enhance the prospectivity for unconformity-related uranium along the eastern margin of the Cariewerloo Basin, including large tracts of the south eastern area of the WPA.

Future geoscience considerations

The WPA region remains one of the regions of most significant mineral potential in South Australia, that has had the least amount of post-1990s geological mapping. For example, the COOPER PEDY and TALLARINGA 1:250k map sheets were completed in 1983 and 1992 respectively, and since this time have not hosted new generations of geological mapping, such as has occurred in many parts of Australia.

The quality of our regional geological maps and therefore our understanding of the geological units of the WPA must be recognised as still being at the level they were at in the 1980s and 1990s.

Significant advances in geological and geophysical techniques since the 1990s mean that the WPA and the central Gawler Craton more broadly is a region that is in need of a renewed geoscientific effort. For example, our ability to characterize a rock or rock package in terms of the bulk geochemical characteristics and age has improved to such an extent that analyses that

formerly cost hundreds or even thousands of dollars in the 1990s are now routine and a fraction of the cost. Likewise, new imaging of the Earth's crust, such as utilising passive electrical techniques such as magnetotellurics as in the AusLAMP program, are now able to detect potentially significant anomalies at the scale of the entire crust.

Our ability to image and understand the geology of the WPA region is therefore now entering a new phase. This means that the Geological Survey of South Australia views the WPA as a region of both significant mineral potential, and a region where the application of new techniques will assist in realizing some of the predicted mineral potential for this region.

This new effort is being focused into a planned geoscience initiative within GSSA that extends across the WPA. This initiative will broadly follow the major infrastructure corridor centered on the east-west and north-south railway lines that meet at Tarcoola.

The initiative will incorporate regional geological mapping, geochemical and geophysical surveys over the next 3-5 years. These surveys will build towards a major new drilling campaign facilitated by the MinEx Cooperative Research Centre and to be incorporated as part of its National Drilling Initiative. The MinEx CRC program will utilise many new technologies to make drilling for subsurface samples more efficient and environmentally more benign, while at the same time providing important insights into the geology of the subsurface. This is significant because the mineral endowment of the WPA region is likely to be realised not by remapping exposed crystalline basement, but by investigating those regions buried beneath the shallow veneer of sedimentary cover, the sand dunes and flats that dominate the landscape of this region of central South Australia.

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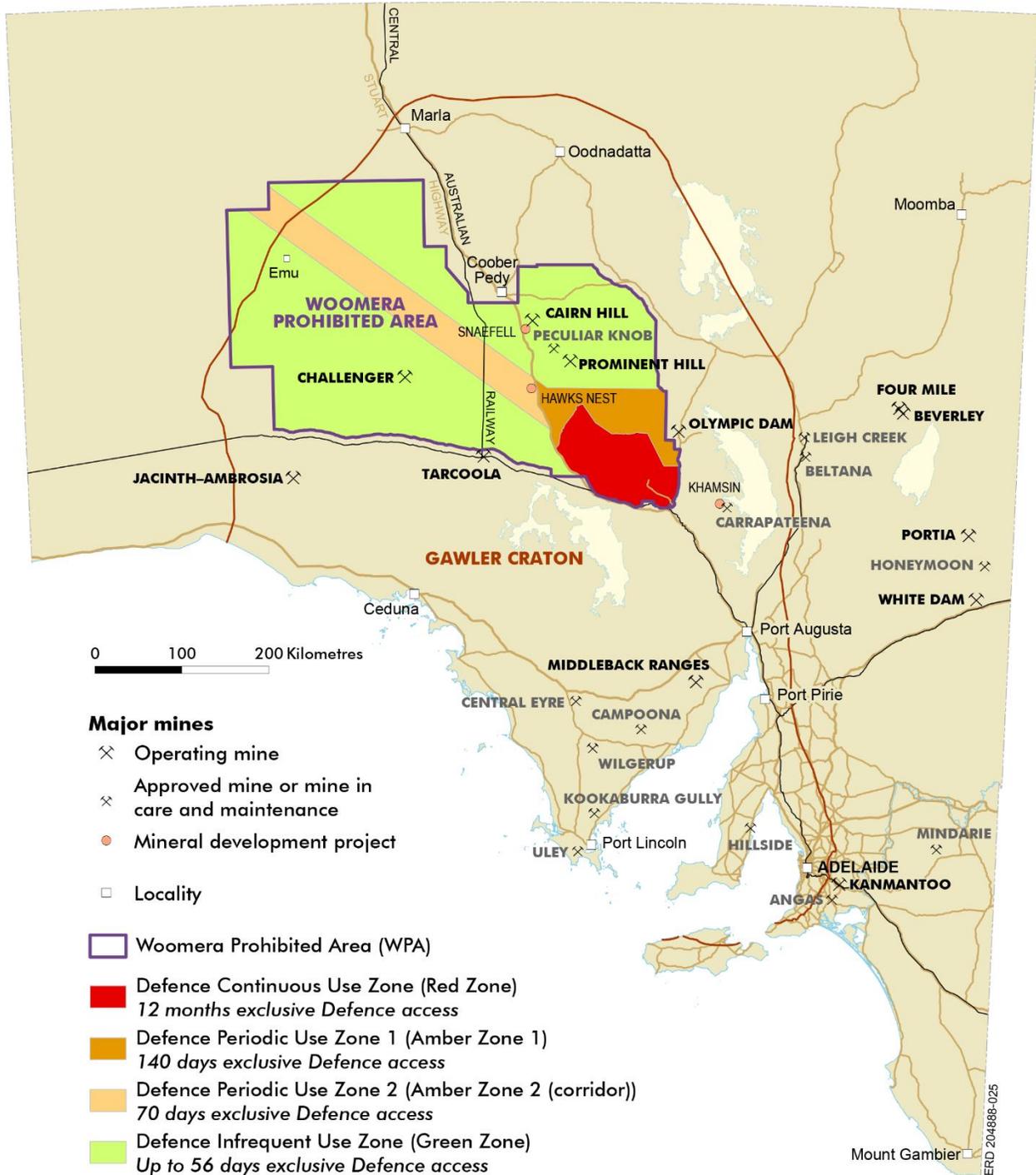
<https://sariqbasis.pir.sa.gov.au/WebtopEw/ws/samref/sariq1/image/DDD/GDP00005.pdf>

Attachments

- 1) Map of the WPA Access Zones with Exclusion Periods
- 2) *The South Australian Atlas of Geoscience and Mineral Exploration Data – Woomera Prohibited Area within the Gawler Craton, Second Edition 2018* Department for Energy and Mining Report Book 2018/00018 (Government of South Australia, June 2018)

Attachment 1

Map of the WPA Access Zones with Exclusion Periods



Attachment 2

The South Australian Atlas of Geoscience and Mineral Exploration Data – Woomera Prohibited Area within the Gawler Craton, Second Edition 2018 Department for Energy and Mining Report Book 2018/00018 (Government of South Australia, June 2018)

Note: This publication is available online and can be downloaded via the South Australian Resources Information Gateway found here - <https://map.sarig.sa.gov.au/>.