Our Projects

This section outlines our applied research projects, how we create capability and deliver economic, environmental, and social benefit for Western Australia.

Through the MRIWA research portfolio, industry, academic and government relationships are activated enabling innovation and research networks to attract investment in high-value research activities.

Highlights for 2022 – 2023

17 Projects Completed[a]

New Projects

- **27** New projects approved[b]
- **$23.6M** Total value new projects approved

- **$48.7M** Total value of CRC/Research Centre projects supported by MRIWA
- **$8.1M** CRC/Research Centre funds managed by MRIWA
- **21** CRC/Research Centre Projects
- Participating in **5** CRCs/Research Centres

- **$25.6M** Total Value of standalone research supported by MRIWA
- **33** Current standalone research projects
- **$16.9M** Third parties' contribution to projects
- **$8.7M** MRIWA's contribution

- **$1.3M** Invested by MRIWA in PhD Scholarships
- **15** Current PhD Scholarship recipients
- **4** New PhD Scholarships awarded
- **3** Scholarships completed

a. Includes PhD Scholarships
b. Includes PhD Scholarships and CRC/Research Centres

Our Focus Areas

MRIWA Focus Areas are campaigns targeting specific areas which seek to stimulate and amplify activities of high value to the State.

Focus Areas may fall in areas specific to parts of the mining value chain or have impact across the entire value chain, with the benefit to be realised in Western Australia.

MRIWA will use these Focus Areas to enable industry, academic and government relationships to activate innovation and research networks and attract investment in high value activities. Calls to action, objectives and anticipated outcomes will vary for each Focus Area.

Areas for focus are selected by the MRIWA Board and informed by government priorities and the Research Priority Plan, with input from the MRIWA College and MRIWA networks.

The following are MRIWA's focus areas:

- Net Zero Emission Mining
- Green Steel
- Critical Minerals
- Exploration Amplification
- Precision and Low Impact Mining
- Alternative Use of Tailings and Waste
- Mineral Carbonation
- Supply Chain Risk (work on this is not yet commenced)

View the full list of projects for each focus area and find out more information on our website.[1]

Net Zero Emission Mining

The Challenge

This strategic focus area aims to reduce the carbon footprint, lower overall energy costs and improve the energy efficiency of the Western Australian mining sector through harnessing collective efforts, enabling decarbonisation to become an opportunity for the sector, not a cost.

The Context

With a global shift towards decarbonisation, the need for mineral resources to support the energy transition places Western Australia at the forefront of a significant economic opportunity.

Western Australia supplies the minerals used for wind and solar energy generation, electric vehicles, and battery storage which will enable the international community to achieve the Paris Agreement goals of net zero emissions by 2050.

With this opportunity also comes a challenge, in ensuring new and increased demand for these resources meets rising environmental, social and governance (ESG) expectations and does not negatively impact on the competitiveness of the mining sector.

Innovation is needed for our mining sector to capture this opportunity, develop new ways of working and transform how energy is generated and used. The lead time to new technology development and deployment means preparations need to start now.

[1] https://www.mriwa.wa.gov.au/minerals-research-advancing-western-australia/focus-areas/

Green Steel

The Challenge

Green Steel – the question is not ‘is it possible’, but rather ‘how to make it possible’.

This MRIWA Focus Area aims to promote further research identified in the green steel study to enable Western Australia to understand and identify magnetite and hematite iron ore resources best suited to supporting the global green steel ambitions, creating new markets and industries for this state.

The Context

Western Australia accounts for 38% of the global supply of iron ore and is the leading Australian state in iron ore production – 934 million tonnes (mt) in 2022 – according to the Australian Government’s Office of the Chief Economist. Brazil, our major competitor, accounted for only 17% of the global supply.

The iron ore industry is the State’s largest and most important industry, providing direct and indirect economic and social contributions which are greater than any other industry to the State. Its contribution is also significant to the national economy.

It is for this reason we are developing opportunities for further testing the iron ore and energy requirements in the identified pathways to green iron in Western Australia. A capability to produce green iron will attract further investment in sustainable processing of iron ores to produce green steel. Work includes a pre-feasibility study for a low emission iron plant. With the steel industry generating more than 7% of global carbon emissions, there is a significant focus on the development of green steel technology.

Western Australian iron ore will have a key role to support the steel industry decarbonise.

Critical Minerals

The Challenge

The critical minerals challenge is to meet the demand for processed metals driven by changing technical requirements and metal types for a low emissions economy.

The Context

The industry recognises critical minerals present a once in a generation opportunity to re-strategise global supply chains. There is a collective demand from countries around the world to democratise the production, transmission, and consumption of energy, which is altering international balances and requirements of minerals.

A new national critical minerals strategy was released by the Federal Critical Minerals Office in June 2023. MRIWA will be working to help align Western Australian research programs led by the state’s universities, industry, and the Western Australia government.

Exploration Amplification

The Challenge

Mineral exploration and discovery represent the foundations of Western Australia's successful mining sector. The future productivity of this key industry will require discovery and characterisation of ore bodies deeper below the surface and hidden from traditional methods of discovery, pushing industry to reduce both the cost and the environmental footprint of exploration technology.

The Context

Investment in exploration innovation is critical for Western Australia to meet the emerging challenges of mineral discovery and maintain the State's position as a preferred supplier of mineral commodities.

Through our Exploration Amplification Focus Area, MRIWA works to define a future vision of productive mineral exploration for Western Australia and to support the areas of priority research and education needed to deliver on this vision.

In striving toward this goal, MRIWA encourages collaboration between the minerals industry, researchers and government to:

- Create and nurture global networks and knowledge leadership in mineral exploration.
- Increase adoption and implementation of exploration research outcomes.
- Maintain strategic foresight regarding research and education needs related to mineral exploration.
- Stimulate partnership opportunities in areas of exploration research initiated by industry.
- Generate awareness of and enthusiasm for career pathways in exploration, and in broader geoscience and technology as they relate to mineral exploration.

Precision and Low Impact Mining

The Challenge

The extractive nature of mining operations creates a variety of impacts on the environment before, during and after mining operations. MRIWA seeks to activate research and innovation for precision and low impact mining, which will lead to a reduction of tailings, waste, and pollution, contributing to social and environmental performance of Western Australia's mining sector.

The Context:

The impact of the mining industry on the environment has been a public concern. Inherent to mining and mineral processing operations is the generation of mine waste.

Over the years, the minerals and mining sector has started to develop a strategy that is more aligned to the UN sustainable development goals (SDGs). Considering the principles of the circular economy and the waste management hierarchy, this focus area aims to contribute to preventing or reducing waste and pollution from mining operations and its potential to cause environmental and social harm.

MRIWA encourages and supports science, technology, and innovation for sustainable, cost-effective mining, particularly from low-grade ores and challenging deposits. This includes efforts to reduce generation of waste and tailings, assess and address social and environmental impacts, and improve safety of operations.

Alternative Use of Tailings and Waste

The Challenge

Mining waste is one of the largest waste streams generated globally, estimated to exceed 100 billion tonnes every year. Our goal is to enable scientific advances and technology development for mining waste valorisation and resource recovery, contributing to environmental protection and creating business and social opportunity for Western Australia.

The Context

Australia produces large volumes of mine waste across a range of commodities, as tailings, waste rock and pyrometallurgical wastes. This is a growing problem with the volume of tailings expected to double by 2035, as the transition to renewable energy increases the demand for critical minerals.

One way to better manage mine waste is repurposing it and turning it into valuable resources. Mine waste can contain concentrations of critical metals and minerals currently in short supply. The value of precious, critical, and strategic metals contained in tailings worldwide is estimated to exceed US$3.4 trillion.

The residual mineral fraction in the tailings can be valorised, for example, upcycled into high-value products such as materials for the construction and ceramic industry, low-carbon geopolymer concrete and mineral fertilisers, or downcycled for backfilling, road construction and carbon capture (mineral carbonation).

Creating a circular economy for mine residues creates cost-effective benefits through offsetting raw material requirements, reducing the carbon footprint associated with obtaining them, and reducing the volumes of waste and related environmental impacts. It also delivers social benefits, boosting job creation, manufacturing self-sufficiency and opportunities for regional growth.

Mineral Carbonation

The Challenge

Increasing the rate of direct air capture and the rate of reaction via mineral carbonation to enable cost effective rapid, large-scale carbon dioxide (CO_2) sequestration.

The widespread, industrial-scale utilisation of mineral carbonation has enormous potential to sequester CO_2 emissions but is inhibited by technological and economic challenges.

The Context

The goal of the 2015 Paris Agreement is to limit global warming to well below 2, preferably to 1.5 degrees Celsius, compared to pre-industrial levels. To achieve this long-term temperature goal will require not only global peaking of greenhouse gas emissions as soon as possible but will also require the removal of CO_2.

Mineral carbonation, one form of carbon capture, use and storage (CCUS), has the potential to be a versatile approach to both remove and permanently store carbon dioxide at the gigatonne scale while also providing strategic economic advantage to quickly transition Western Australia to a low carbon economy supporting global low carbon supply chains.

The best types of materials for mineral carbonation are those rich in the metals calcium, magnesium and iron. Mafic and ultramafic rocks found within Western Australia's prolific greenstone belts are particularly rich in magnesium and calcium-rich minerals, hence are particularly prospective for mineral carbonation.

Calcium, magnesium and iron rich solids which may be suitable for mineral carbonation are also present in many industrial wastes.

Mineral carbonation combined with direct air capture provides added opportunity for Western Australia.

Our Research

The Minerals Research Institute of Western Australia (MRIWA) is focused on the research and development needs of the Western Australian minerals industry to ensure it remains an engine of responsible economic growth and social benefit for Western Australia.

The MRIWA Research Priority Plan[2] identifies the areas where MRIWA may make investment into high-impact research and development. Priorities included in the Plan reflect those issues which industry, the research sector and the MRIWA Board agree present real and significant challenges inhibiting Western Australians from fully benefiting from the minerals sector; and where resolution of these challenges will create opportunities and deliver value.

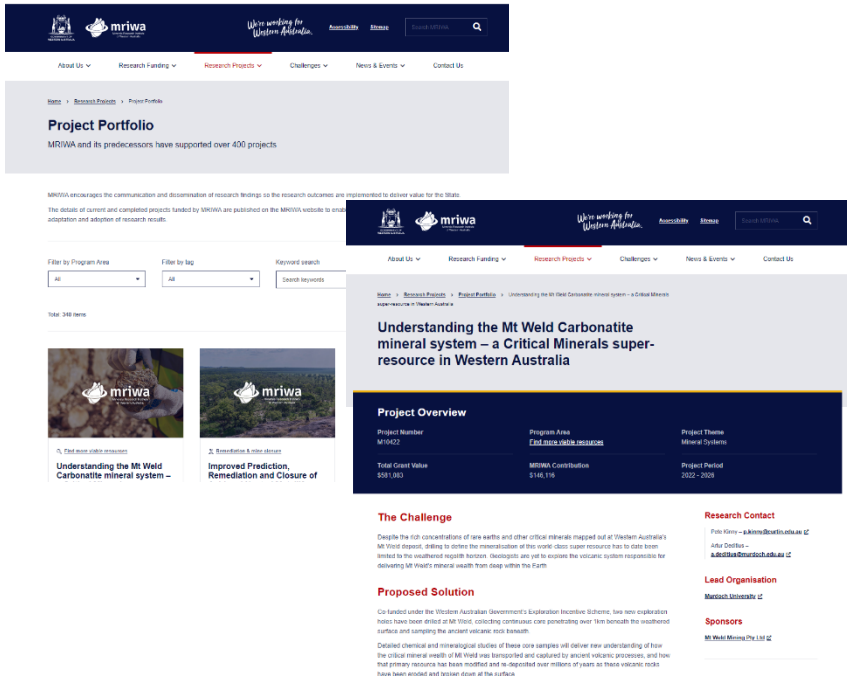
The revised Research Priority Plan was released in February 2020 and describes the medium to long term knowledge and technology needs of the State's minerals industry.

Those seeking to work with MRIWA on our **Impactful Research** program need to demonstrate alignment with the priorities outlined in the Plan, and establish how their proposals would deliver economic, social or environmental benefit for Western Australia.

The priorities fall across six broad areas of research (Program areas). The Program areas incorporate priorities specific to parts of the mining value chain, and broader themes applicable across the value chain, with an integrated approach required to achieve the intended outcomes outlined in the Plan.

MRIWA Project Portfolio

The MRIWA website features current and completed MRIWA-funded research projects, the challenges they are seeking to address and the intended benefits the projects will deliver to Western Australia.



[2] See next page for MRIWA's Research Priority Plan Program Summary.

Research Priority Plan Summary

Research Portfolio Summary 2022-2023

No. Projects	17	7	11	3	10	6
MRIWA Contribution[3]	$5.5M	$1.4M	$3.1M	$800K	$3.7M	$464K
Third-Party Contribution	$16M	$2.5M	$7.8M	$2.5M	$25.2M	$5.4M
Total Grant Value	**$21.5M**	**$3.9M**	**$10.9M**	**$3.3M**	**$28.9M**	**$5.8M**

Note: Due to rounding, some totals may not correspond with the sum of the separate figures
Does not include scholarships

[3] Includes the contribution from Department of Jobs Tourism Science and Innovation for the FBI CRC ($500,000) and HILT CRC ($1 million)

CRC/Research Centre Participation

The Cooperative Research Centre for Transformations in Mining Economies (CRC TiME) brings together mining companies, regulators and community participants to deliver coordinated investment into research addressing the challenges underpinning mine closure and relinquishment.

CRC TiME's research mission is structured around four program areas targeting those aspects of the transition from mining to post-mine scenarios to which Australia's economic, environmental and social resilience is most vulnerable.

Over its lifetime, this research centre is intended to deliver practical outcomes empowering and supporting transformational and world-leading change in the Australian mine closure sector.

In 2022-23, six CRC TiME projects were supported by allocation of MRIWA funds.

Commenced operation:	2020
Funding duration:	10 years
Participants:	74 participants including leading mining and METS companies, regional development organisations, government and research partners
Total Project Value:	$130M comprised of $29.5M cash from the CRC Program $30.5M cash from industry and research participants $70M in-kind support
MRIWA contribution: (M0558)	$300,000 over 10 years Additional $460,000 in project funding

ARC Industrial Transformation Training Centre (ITTC) in Transforming Maintenance through Data Science.
This ITTC was established to support the development and implementation of techniques to deliver transformational value in mining industry maintenance through application of innovative Data Science technology, and to support the training of a data-science-savvy future workforce.

MRIWA is supporting the development and research training of two PhD students working within the ITTC.

Commenced operation:	2019
Funding duration:	5 years
Participants:	Partners from mining companies and research
Total Project Value:	$9.10M comprised of $3.95M cash from the ARC ITTC program $3.05M industry cash contributions $1.88M university cash contributions
MRIWA contribution: (M0508)	$240,000 over 5 years

MinEx CRC is delivering coordinated investment in research to develop more productive, safer and more environmentally friendly drilling technologies and workflows to improve the success rate and efficiency of discovering and defining mineral deposits.

Key deliveries from the MinEx CRC will include development of a new style of mineral exploration drilling rig incorporating revolutionary coiled tubing drilling technology, and a suite of new and innovative technologies for collecting data while drilling.

MinEx CRC will operate for three contract phases. Phase 1 of the MinEx research program was completed at the end of December 2021, with phase 2 commencing in January 2022 and due to run until the end of December 2024.

Three phase 2 projects were supported by allocation of MRIWA funds in 2022-23.

Commenced operation:	2018
Funding duration:	10 years
Participants:	Over 40 partners from mining and METS companies, government, and research
Total Project Value:	$219M comprised of $50M cash from the CRC Program $42M cash industry and research participants $52M non-staff in-kind $74M staff in-kind
MRIWA contribution: (M0509)	$1M over 10 years Additional $560,000 in project funding

HILT CRC will enable our heavy industry sector to compete in the low-carbon global economy for carbon-neutral materials such as 'green' iron, alumina, cement and other processed minerals. The Australian Heavy Industries sector will benefit substantially from a carefully considered mix of electrification and hydrogen.

HILT CRC has commenced delivery of the research strategy outlined in 2022. The 16 quickstart projects are nearing completion and have resulted in 12 new stage 2 projects between 1 and 3 years being approved in 2013.

MRIWA has approved 4 projects for in-kind and allocated funding support including Beneficiation of iron ores, Hydrometallurgical treatment of iron ores using brines, green steel market evaluation and China green steel outlook study. The second HILT CRC conference is being held in Perth in October 2023.

Commenced operation:	2021
Funding duration:	10 years
Participants:	Partners from mining and METS companies, government, and research
Total Project Value:	$176M comprised of $39M cash from Dept Industry, Science & Technology $34M cash from the CRC Program $43M cash industry and research participants $29M non-staff in-kind $31M staff in-kind
MRIWA contribution: (M10425)	$1M over 10 years

FUTURE BATTERY INDUSTRIES CRC

The Future Battery Industries Cooperative Research Centre (FBI CRC) is enabling the growth of battery industries to power Australia's future and ensure Australia plays a leading role in the global battery revolution.

The FBI CRC brings together organisations covering the full extent of the battery value chain, including mining, extraction, processing, and refining of battery minerals, metals and materials, as well as downstream uses such as precursor chemical manufacture, battery cell manufacture, battery recycling and battery deployment in defence, electrical utilities, mining, and other mobile and stationary applications.

At the end of 2022-23 MRIWA was actively involved in twelve FBI CRC projects.

Commenced operation:	2019
Funding duration:	6 years
Participants:	73 participants from mining and METS companies, government, and research partners
Total Project Value:	$129.1M comprised of $25M cash from the CRC Program $38.6M cash industry and research participants $32M non-staff in-kind $33.5M staff in-kind
MRIWA contribution: (M0533)	$6M over 6 years ($500,000 contributed by Department of Jobs, Tourism, Science and Innovation)

FBI CRC Research Seminar June 2023

Our Research

PROGRAM 1: Find More Viable Resources

Western Australia's known mineral deposits in the economically viable domain near to the surface are being exploited faster than they are being replenished by new discoveries.

To meet the challenge of finding significant new discoveries and building on the focus of UNCOVER Australia and the Western Australian Government's Exploration Incentive Scheme, the research priority areas in Program 1 are intended to systematically advance knowledge and capability in detection, exploration technology and prediction performance to improve mineral exploration productivity.

In doing so, research under this program will inform the pre-competitive geological, geochemical and geophysical knowledge base and create exploration capability to:

- position Western Australia as a global leader in exploration technology
- facilitate private sector investment in existing and newly-identified Western Australian mineral provinces to develop the State's rich natural resources

Themes

- Mineral Systems
- Detection Technology
- Data Driven Decisions
- Regulatory Tools and Processes
- Safety, Social and Environmental Sustainability
- Workforce of the Future

$5.5M	$21.5M	4	3	14
MRIWA contribution	Total value of research projects	Projects completed	CRC/Research Centre projects	Standalone research projects

Project Case Studies

Coiled tubing drilling for definition of Mineral Deposits: MinEx CRC Project 2

Program 1 – Find More Viable Resources

STATUS: Final Report Published[4] **Project No: M0509a**

THE CHALLENGE

Modern mineral exploration relies on drilling to provide physical samples to test mineralisation potential beneath the surface. Operating current drilling technology in remote landscapes is expensive and resource intensive, and as explorers push deeper in search of new mineral discoveries these costs risk becoming unsustainable.

KEY FINDINGS

This project resulted in development of an advanced prototype lightweight, agile Coiled Tubing (CT) drilling platform (the RoXplorer) and integrated Hydraulic Processing System (HPS) support unit delivering the performance and environmental benefits of CT drilling to a reach of 500m.

BENEFIT TO WA

Cheaper drilling with a lower environmental footprint will be an important enabling technology for future mineral exploration in Western Australia, where many of the most exciting exploration targets are expected to lie below cover in areas where the State's proven and richly-endowed mineral provinces plunge beneath more recent layers of rock.

Sponsors
MinEx CRC

Lead Organisation
MinEx CRC

Research Contact
Soren Soe

Total Grant Value
$2,165,800

MRIWA Contribution
$110,000 [5]

M0509a Coiled tubing drilling for definition of Mineral Deposits: MinEx CRC Project 2, site photo

[4] https://www.mriwa.wa.gov.au/research-projects/project-portfolio/coiled-tubing-drilling-for-definition-of-mineral-deposits-phase-1minex-crc-project-2/
[5] Funds drawn down from MRIWA's contribution to the MinEx CRC

Project Case Studies

Petrophysics for Mineral Discovery during Drilling: MinEx CRC Project 4

Program 1 – Find More Viable Resources

STATUS: Final Report Published[6] **Project No: M0509b**

THE CHALLENGE

Drilling can provide physical samples of rock hidden deep beneath the surface, but with conventional 'blind' drilling it can take many holes for an explorer to develop enough understanding of the buried geology and structures to properly define and test potential mineralisation targets.

KEY FINDINGS

This project delivered a working prototype of a novel sensor for measuring total count gamma radiation in an active drilling environment.

Total gamma count registers the presence of naturally occurring radioactive elements within the sensed volume surrounding a drill hole, providing a real-time proxy for lithology.

The prototype sensor is capable of real-time logging-while-drilling in the RoXplorer Coiled Tubing (CT) drilling system.

BENEFIT TO WA

By improving the accuracy of drill targeting and quality of information returned, this technology could reduce the drilling required to identify and define buried mineralisation. In addition to making exploration cheaper and easier, this efficiency would reduce the environmental impact of exploration in remote and sometimes sensitive areas of Western Australia.

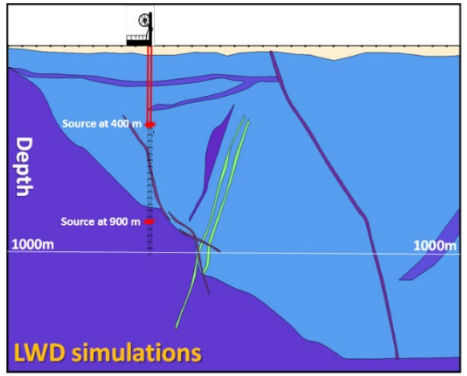
Sponsors
MinEx CRC

Lead Organisation
MinEx CRC

Research Contact
Brett Harris

Total Grant Value
$1,020,700

MRIWA Contribution
$111,700[7]



M0509b Petrophysics for Mineral Discovery during Drilling: MinEx CRC Project 4, LWD simulations model
Image source: final report

[6] https://www.mriwa.wa.gov.au/research-projects/project-portfolio/petrophysics-for-mineral-discovery-during-drilling-phase-2-minex-crc-project-4-2/
[7] Funds drawn down from MRIWA's contribution to the MinEx CRC

Project Case Studies

Seismic in the Drilling Workflow: MinEx CRC Project 5

Program 1 – Find More Viable Resources

STATUS: Final Report Published[8] **Project No: M0509c**

THE CHALLENGE

Modern mineral exploration – particularly beneath cover – is dominated by the use of invasive drilling to access and sample below the surface. By improving technologies for the non-invasive imaging of buried geology, we could reduce the amount of drilling needed to discover and characterise hidden mineral systems.

KEY FINDINGS

- Development of a performance matrix for choosing between optical fibre cable designs for use in low-cost Distributed Acoustic Sensing (DAS) seismic imaging in different mineral exploration environments.
- Development of a seismic exploration workflow for the coal industry, integrating low-cost surface and borehole DAS imaging to define a high-resolution 3D seismic cube.
- Development and validation of a full-waveform inversion (FWI) method providing subsurface models of lithological properties from seismic data.

BENEFIT TO WA

Many of the most exciting exploration targets in Western Australia lie in areas where the richly-endowed geology of proven mineral provinces plunges beneath more recent layers of rock. Lowering the barriers to understanding these buried targets will reduce exploration risk, encouraging investment to underpin the productive future of the State's minerals industry.

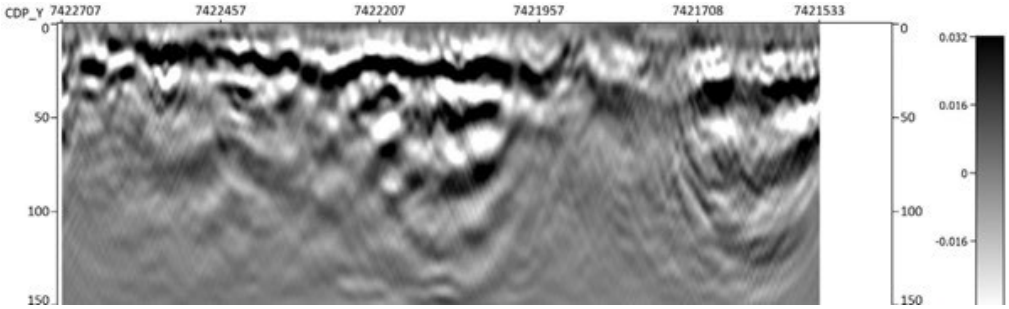
Sponsors
MinEx CRC

Lead Organisation
MinEx CRC

Research Contact
Andrej Bona

Total Grant Value
$1,291,900

MRIWA Contribution
$111,700[9]



M0509c Seismic in the Drilling Workflow: MinEx CRC Project 5
Image source: final report

[8] https://www.mriwa.wa.gov.au/research-projects/project-portfolio/seismic-in-the-drilling-workflow-phase-1-minex-crc-project-5/
[9] Funds drawn down from MRIWA's contribution to the MinEx CRC

Project Case Studies

Centrifuge optimisation for fluid management in Coiled Tubing drilling: MinEx CRC Project 20.1

Program 1 – Find More Viable Resources

STATUS: Final Report Published[10] **Project No: M0509d**

THE CHALLENGE

Current Hydraulic Processing Systems (HPS) cannot recycle the large volumes of fluid required to deliver drilling power and bring rock cuttings to the surface in Coiled Tubing (CT) drilling. This elevates drilling fluid consumption and restricts capacity of the CT system to deliver representative sampling

KEY FINDINGS

This project delivered systematic characterisation of centrifuge performance under the range of flow rates relevant to CT drilling, supporting definition of optimum operating conditions for solid-liquid separation and fluid recycling.

As the basis of guidelines for real-time control of a decanter centrifuge incorporated as an integral component of the integrated Hydraulic Processing System (HPS) developed for the RoXplorer CT drilling platform, these findings represent key enabling knowledge for this innovative drilling technology.

BENEFIT TO WA

Resolution of the fluid management and performance issues identified with CT drilling would help support use of the efficient low-cost RoXplorer CT drilling system in areas of Western Australia where there is a need for deeper exploration with a low environmental footprint.

Sponsors
MinEx CRC

Lead Organisation
MinEx CRC

Research Contact
Masood Mostofi

Total Grant Value
$1,923,125

MRIWA Contribution
$471,875[11]

M0509d Centrifuge optimisation for fluid management in Coiled Tubing drilling: MinEx CRC Project 20.1, site photo

[10] https://www.mriwa.wa.gov.au/research-projects/project-portfolio/centrifuge-optimisation-for-fluid-management-in-coiled-tubing-drilling/
[11] Funds drawn down from MRIWA's contribution to the MinEx CRC

Current Projects/ Contracts Executed

Program 1 – Find More Viable Resources

Project No	Theme	Project Title	Lead Org. and Contact	Sponsors	Duration (yrs)	Total Project Value $	MRIWA Contribution $
M0462a	Detection technology	(Was M556) The paradigm shift for minerals exploration using ultrafine soils and intelligent data integration tools - Extension to M462	Commonwealth Scientific Industrial Research Organisation (CSIRO) Dr Ryan Noble	Anax Metals Limited Condamine Resources De Grey Mining Department of Mines, Industry Regulation and Safety (GSWA) Dreadnought Resources Emmerson Resources Limited Fortescue Metals Group Ltd Geological Survey of New South Wales Geological Survey of Queensland Geological Survey of South Australia Greenmount Resources Pty Ltd Hexagon Energy Materials Limited IGO Limited Kaiross Minerals Kalamazoo Resources Lodestar Minerals Limited MCA Nominees Mining Investments Australia Monger Gold Ltd New Age Exploration Limited Newmont Goldcorp Tanami Pty Ltd Northern Star Resources Limited Northern Territory Geological Survey Ozz Resources Limited Strategic Energy Resources Limited Tojo Minerals Western Gold Resources Limited	3	1,238,249	117,000

Project No	Theme	Project Title	Lead Org. and Contact	Sponsors	Duration (yrs)	Total Project Value $	MRIWA Contribution $
M0470a	Mineral systems	(WAS M555) A multi-scale approach to controls on mineralisation in the Fraser Zone, Western Australia	Curtin University Katy Evans	Curtin University Department of Mines, Industry Regulation and Safety - Geological Survey of Western Australia IGO Limited Legend Mining Limited MG Creasy	3.67	1,023,300	341,300
M0521	Mineral systems	Lithospheric and crustal-scale controls on multi-stage basin evolution: Impacts on Mineralising System	University of Western Australia (CET - Centre for Exploration Targeting) Weronika Gorczyk	Centre for Exploration Targeting (UWA) Department of Mines, Industry Regulation and Safety - Geological Survey of Western Australia First Quantum Minerals Ltd First Quantum Minerals Exploration (Australia) Pty Fortescue Metals Group	4	1,493,737	733,737
M0530	Mineral systems	Yilgarn 2020	University of Western Australia (CET - Centre for Exploration Targeting) Nicolas Thebaud	BHP Billiton Nickel West Bogada Gold Pty Ltd Evolution Mining Limited Gold Fields Australia Gold Road Resources Ltd Newmont Mining Services Pty Ltd Northern Star Resources Ltd Saracen Mineral Holdings Ltd	4.58	2,346,000	796,000
M0543	Detection technology	Field-based XRF for prompt Au analysis	Portable PPB Pty Ltd Simon Bolster	Barrick Gold Corporation Bellevue Gold Mines Ltd Centerra Madencilik A.Ş. Fosterville Gold Mine Pty Ltd Gold Fields St Ives Gold Mining Company Pty Ltd Gold Road Resources Ltd Newcrest Mining Limited Perseus Mining	1	658,000	218,000

Project No	Theme	Project Title	Lead Org. and Contact	Sponsors	Duration (yrs)	Total Project Value $	MRIWA Contribution $
M0551	Mineral systems	Integrated 3G - Geochronology-geochemistry-grain shape: a new toolkit for mineral sands understanding	Curtin University Milo Barham	Curtin University Iluka Resources	4	979,000	345,000
M0554	Mineral systems	Evolution of Proterozoic multistage rift basins – key to mineral systems - ARC Linkage proposal linked to M521	University of Western Australia Mark Jessell	Anglo American Exploration (Australia) Anglo American PLC Australian Research Council BHP Group Operations Pty Ltd IGO Limited Monash University Teck Australia Ptd Ltd	4	2,041,040	540,837
M0557	Mineral systems	Orebody knowledge, landscape history and mineralisation of Martite–Goethite Ores in the Hamersley Province (WA)	Commonwealth Scientific Industrial Research Organisation (CSIRO) Erick Ramanaidou	BHP Billiton Iron Ore Pty Ltd Bureau Veritas Minerals Pty Ltd FMG Resources Pty Ltd Rio Tinto Pilbara Iron Company (Services) Pty Ltd CSIRO Roy Hill Iron Ore Pty Ltd	2	1,552,000	388,000
M10412	Mineral systems	Primary and secondary high-grade gold mineralisation processes in orogenic systems: key to a sustainable mining?	University of Western Australia (CET - Centre for Exploration Targeting) Nicolas Thebaud	Australian Research Council Fosterville Gold Mine Pty Ltd Karora Resources Pty Ltd Monash University Newmont Australia Pty Ltd Northern Star Resources Limited University of Western Australia (CET - Centre for Exploration Targeting)	3	1,942,114	450,417
M10422	Mineral systems	Understanding the Mt Weld Carbonatite mineral system - a Critical Minerals super-resource in Western Australia	Murdoch University Artur Deditius	Curtin University Murdoch University Lynas Corporation Ltd	3.5	581,083	146,116

Project No	Theme	Project Title	Lead Org. and Contact	Sponsors	Duration (yrs)	Total Project Value $	MRIWA Contribution $
M10426	Mineral systems	Indicator Minerals for Nickel Exploration	Commonwealth Scientific Industrial Research Organisation (CSIRO) Louise Schoneveld	Anglo American Technical & Sustainability Services Ltd Ardea Resources Limited Australian Vanadium Ltd BHP Pty Ltd Bryah Resources Estrella Resources IGO Limited St George Mining Limited Western Areas NL	2.17	1,469,677	354,914
M10433	Mineral systems	Distal footprints in the South West Terrane	Commonwealth Scientific Industrial Research Organisation (CSIRO) Ignacio Gonzalez-Alvarez	Anglo American Exploration (Australia) Department of Mines, Industry Regulation and Safety - Geological Survey of Western Australia Ramelius Resources Limited	3.17	1,233,000	308,000
M10444	Detection technology	Coiled Tubing Drilling for definition of Mineral Deposits - Phase 2: MinEx CRC Project 2	University of South Australia Soren Soe	Anglo American Services (UK) Ltd Anglo American Technical & Sustainability Services Ltd BHP Billiton Iron Ore Pty Ltd Department of Regional New South Wales Epiroc LKAB Wassara MinEx CRC South32 Ltd	3	2,833,505	207,561[12]

[12] MRIWA support for M10444 consists of $121,000 drawn down from MRIWA's commitment to the MinEx CRC, and an additional $86,561 cash contribution.

Project No	Theme	Project Title	Lead Org. and Contact	Sponsors	Duration (yrs)	Total Project Value $	MRIWA Contribution $
M10445	Detection technology	Petrophysics for Mineral Discovery during Drilling - Phase 2: MinEx CRC Project 4	Curtin University Brett Harris	Imdex Limited MinEx CRC Rio Tinto Technological Resources Pty Ltd South32	3	816,000	123,000[13]
M10446	Detection technology	Seismic in the Drilling Workflow - Phase 2: MinEx CRC Project 5	Curtin University Andrej Bona	Anglo American Exploration (Australia) Pty Ltd BHP Pty Ltd MinEx CRC Rio Tinto Technological Resources Pty Ltd Sercel	3	940,000	123,000[13]
M10472	Regulatory tools and processes	Amplification of Exploration Education and Research Collaboration	CRU International (Australia) Pty Ltd Allan Trench		0.5	306,758	306,758
M10513	Data driven decisions	A Value Case for Exploration Research: Establishing the ASX Market Value of Minerals Research in the Exploration Sector	University of Western Australia Sistine Sun		0.6	20,000	20,000

M0509c Seismic in the Drilling Workflow: MinEx CRC Project 5, site photo

[13] MRIWA contributions are drawn down from MRIWA's commitment to the MinEx CRC.

PROGRAM 2: Expand the Mining Envelope

A significant proportion of the future Western Australian resource base is likely to reside in deep and complex geotechnical environments. Additionally, most major open-cut and underground operations are known to have extensions to their mineralisation, albeit at possibly lower grade. Mining methods need to adapt to allow continued economic and safe extraction of resources.

The research priority areas in Program 2 are intended to systematically advance knowledge and capability toward solutions for mining more ore from challenging deposits.

In doing so, the research will create engineering capability and demonstrate technical feasibility of mining more selectively and deeper to:

- position Western Australia as a global leader in extraction technologies
- decrease the capital and operating costs associated with mining
- allow for safer and increased productivity from existing mines and for a new generation of deposits to be brought into production

Themes

- Deep and complex extraction systems
- Engineering in highly stressed and complex rock masses
- Mining technology
- Data driven decisions
- Energy utilisation
- Regulatory tools and processes
- Safety, social and environmental sustainability
- Workforce of the future

$1.4M
MRIWA contribution

$3.9M
Total value of research projects

3
Project completed

7
Standalone research projects

Project Case Studies

Rock properties to predict rockburst vulnerability in three dimensions

Program 2 – Expand The Mining Envelope

STATUS: Final Report Published[14]

Project No: M0464

THE CHALLENGE

Unpredictable rockburst and strainburst events create significant safety hazards for mining personnel and operations, however these phenomena are poorly understood.

The challenge for this project was to understand the influence of rock properties on the proneness to strainburst.

KEY FINDINGS

For the first time, this research has enabled direct measurement and understanding of in situ stress, 3D rock properties (static and dynamic), influence of rock fabric and anisotropy, extensional strain in 3D, field observations of bursting, fractography, disking and borehole breakout, and unravelling of support structures around bolts.

The additional measurements can be obtained from oriented drillcore, enabling cost effective development of new strategies to improve design and safety solutions for mining operations.

The process of determining the in situ stress led to development of a 3D extensional strain approach using a fully compliant orthotropic strain matrix that can be used in regular 3D numerical modelling software.

BENEFIT TO WA

This research makes a significant contribution to mine safety, hazard awareness and opportunities for improvements to bolt behaviour.

Sponsors

Agnico Eagle Mines Ltd
AngloGold Ashanti Australia Limited
BHP Nickel West Pty Ltd
BHP Olympic Dam
Glencore Ernest Henry Mining Pty Ltd
Glencore Sudbury Integrated Nickel Operations
Gold Fields Agnew Gold Mining Company Pty Ltd
Gold Fields Australia GSM Mining Company Pty Ltd
Gold Fields Australia Pty Ltd
Gold Fields St Ives Gold Mining Company Pty Ltd
Iamgold Mine Westwood
LKAB Sweden
Newcrest Mining Limited
Northern Star (Kanowna) Pty Ltd
Tritton Resources Limited
University of Western Australia (ACG - Australian Centre for Geomechanics)

Lead Organisation

University of Western Australia (ACG - Australian Centre for Geomechanics)

Research Contact

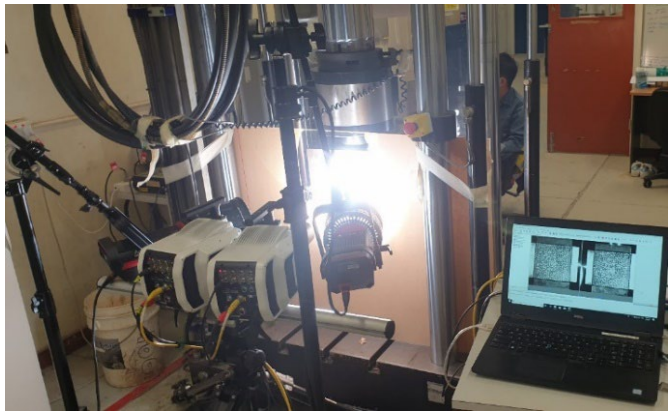
Phil Dight

Total Grant Value

$2,140,000

MRIWA Contribution

$1,100,00



M0464 site photo - Biaxial device in operation, showing cameras, lighting, and camera control. Load frame is controlled by another operator, visible at rear.

[14] https://www.mriwa.wa.gov.au/research-projects/project-portfolio/rock-properties-to-predict-rockburst-vulnerability-in-three-dimensions/

Ground Support Systems Optimisation - Phase 2: Extension to M431

Program 2 – Expand The Mining Envelope

STATUS: Final Report Published[15] **Project No: M0497**

THE CHALLENGE

Ground support is one of the major costs in mining and it is of critical importance to mitigate the risk of rockfalls and maintain the safety of mine workers. As underground mines operate at greater depth, the ground support system design becomes more challenging.

KEY FINDINGS

This project offers several new guidelines and a suite of tools to improve ground support design in very challenging ground conditions, such as squeezing ground and rockburst/strainburst prone environments.

In more common ground conditions, a new understanding of shotcrete support mechanisms can now be applied in the mining environment.

The project has also developed innovative software for the probabilistic design of ground support systems, which is key to optimising support systems to reduce costs and improve safety.

BENEFIT TO WA

Western Australia operates underground mines which are amongst the deepest and highest stress environments in the world. Providing these critical ground support design tools to the industry will enable reduction in ground support costs while improving safety and ensuring the competitiveness of current and future Western Australian mines at depth.

This project is an extension to M0431.

Sponsors

Agnico Eagle Mines Ltd
Dywidag-Systems International Pty Ltd (formerly Fero Strata Systems Pty Ltd T/As DSI Underground)
Dywidag-Systems International Pty Ltd (T/As DSI Underground)
Garock
Gold Fields Agnew Gold Mining Company Pty Ltd
Gold Fields St Ives Gold Mining Company Pty Ltd
Iamgold Mine Westwood
IGO Limited
Jennmar Australia Pty Ltd
New Concept Mining
Newcrest Cadia Holdings Pty Ltd
Sandvik Mining and Rock Technology
University of Western Australia (ACG - Australian Centre for Geomechanics)

Lead Organisation

University of Western Australia (ACG - Australian Centre for Geomechanics)

Research Contact

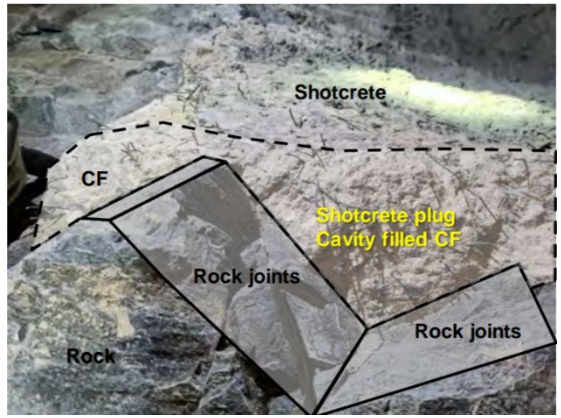
Yves Potvin

Total Grant Value

$1,931,250

MRIWA Contribution

$671,250



M0497 - Upward photograph of a shotcrete plug at the intersection of two joint planes.
Image source: final report

[15] https://www.mriwa.wa.gov.au/research-projects/project-portfolio/ground-support-systems-optimisation-phase-2/

Development of a drilling fluid system for RoXplorer coiled tube drilling

Program 2 – Expand The Mining Envelope

STATUS: Final Report Published[16] **Project No: M0515**

THE CHALLENGE

Innovative Coiled Tubing (CT) drilling is incompatible with conventional drilling fluid processing systems, with at least partial automation of monitoring, cleaning and maintenance of fluid properties required to deliver the high rates of drilling fluid recirculation required by this method.

KEY FINDINGS

Automated fluid loss control together with measurement and maintenance of drilling fluid properties deliver a drilling fluid workflow optimised for CT drilling.

An improved hydrocyclone developed through this project further delivers improved separation of solid materials from recirculated drilling fluid, providing efficient sampling and improved cleaning of the fluid for reuse.

The outcomes of this research pave the way toward automation of drilling fluid handling, and have been incorporated into the work of the MinEx CRC.

BENEFIT TO WA

The drilling fluids and accompanying management systems developed through this research will help support a practical CT drilling system. Widely implemented in the Western Australian mining sector, this new system could reduce the cost and environmental impact of exploration drilling.

Sponsors
Curtin University
Deep Exploration Technologies CRC

Lead Organisation
Curtin University

Research Contact
Masood Mostofi

Total Grant Value
$400,000

MRIWA Contribution
$150,000

M0515 - Collection of drill cutting samples in one of the RoXplorer drilling trials. Image source: final report

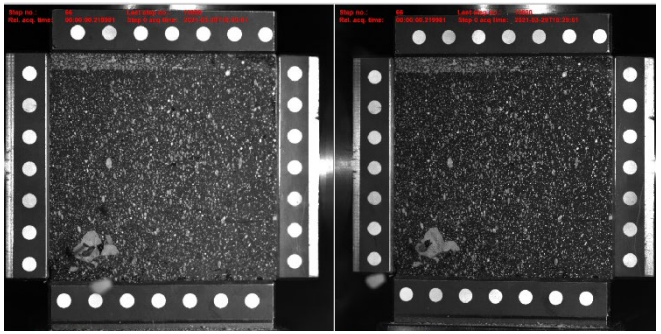
[16] https://www.mriwa.wa.gov.au/research-projects/project-portfolio/development-of-a-drilling-fluid-system-for-roxplorer-coiled-tube-drilling/

Current Projects/ Contracts Executed

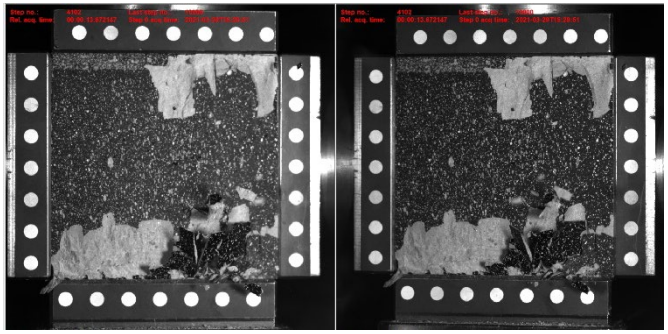
Program 2 – Expand the Mining Envelope

Project No	Theme	Project Title	Lead Org. and Contact	Sponsors	Duration (yrs)	Total Project Value $	MRIWA Contribution $
M0499	Engineering in highly stressed and complex rock masses	Establishing the in situ rock bolt behaviour underground in order to model and design improved rock bolt support systems	CMTE Development Ltd T/As Mining3 Ewan Sellers	Curtin University CMTE Development (trading as Mining3) Peabody Australia	3	1,270,000	400,000
M0510	Mining technology	Safe, sustainable management of filtered tailings	University of Western Australia Prof. Andy Fourie	Alcoa of Australia Ltd Alumina Quality Workshop (Inc) BHP Billiton Group Operations Pty Ltd International Aluminium Institute Rio Tinto Technological Resources Pty Ltd	3	482,500	142,000
M0522	Mining technology	Physics Models for Ore Tracking in Surface Mines	CMTE Development Ltd T/As Mining3 Ewan Sellers	CMTE Development (trading as Mining3) Fortescue Metals Group South32	3.5	760,000	380,000
M0529	Deep and complex extraction systems	Lixiviant access creation in impermeable hard rock mass for the in situ underground leaching of metals from ore	Murdoch University Aleks Nikoloski	CMTE Development (trading as Mining3) Murdoch University	5.54	120,000	30,000
M0544	Deep and complex extraction systems	Towards a mechanistic understanding of electrokinetic in-situ leaching	University of Western Australia Andy Fourie	BHP Pty Ltd Evolution Mining Limited Newcrest Mining Limited Newmont Goldcorp Services Pty Ltd	6	842,605	290,605

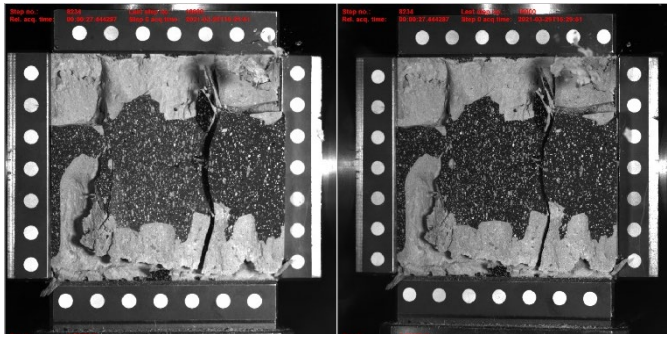
Project No	Theme	Project Title	Lead Org. and Contact	Sponsors	Duration (yrs)	Total Project Value $	MRIWA Contribution $
M0545	Deep and complex extraction systems	Evaluation of in-situ barrier technology for risk mitigation and extraction optimisation for in-situ recovery operations	Curtin University Navdeep Dhami	BHP Pty Ltd CMTE Development (trading as Mining3) Newcrest Mining Limited Orano Mining	3.25	225,000	75,000
M10430	Data driven decisions	Sustainable Optimisation of Mining Complexes through Innovative Algorithms.	Curtin University Dr Waqar Asad	Norton Gold Fields Ltd	3.5	165,000	60,000



M0464 - Early spallation, prior to peak load. A thin lenticular slab breaks up (buckles?) and the fragments eject with rotation and velocity towards the cameras. Image source: final report



M0464 - Buckling-type spallation has occurred at lower left and upper right and is now occurring at lower-right. This image was taken at the peak load. Thin fragments are ejected with rotation and velocity towards the cameras.



M0464 - Ultimate spallation and detachment of the free face occurs in the post-peak. Some ejection is visible at upper right; however, the majority of large fragments simply fall by gravity.

PROGRAM 3: Increase Recovered Value Through Processing

More complex and lower-grade orebodies, combined with higher energy costs and the need for a lower environmental footprint, are driving development of advanced methods of processing to transform low value deposits to be economic.

The research priority areas in Program 3 are intended to systematically advance knowledge and capability toward solutions for increasing yield and throughput and optimising the use of raw materials by breaking down operational silos.

In doing so, the research will create mineral processing capability and accelerate the development, testing, piloting, scale-up and other technical de-risking activities associated with new processing technologies to:

- position Western Australia as a global leader in mineral processing
- decrease the capital and operating costs associated with mineral processing
- allow for safer and increased productivity from processes and for a new generation of processing technologies to be deployed

Themes

- Processing Technology
- Data driven decisions
- Energy utilisation
- Regulatory tools and processes
- Safety, social and environmental sustainability
- Workforce of the future
- Interoperability

$3.1M	$10.9M	1	4	7
MRIWA contribution	Total project value	Project completed	CRC/Research Centre projects	Standalone research projects

Geology, Mineralogy and Metallurgy of eMaterials Deposits in WA

Program 3 – Increase Recovered Value Through Processing

STATUS: Final Report Published[17] **Project No: M0532**

THE CHALLENGE

Western Australia is the world's largest producer of lithium, however development of these complex deposits has only recently become economic due to the growth in demand for lithium in battery electric vehicles. Optimising the value of this emerging industry begins with a geometallurgical understanding of each unique orebody.

KEY FINDINGS

Australia's hard-rock lithium resource inventory was emplaced during a narrow window of geological time (2,630-2,640 Myr).

A higher degree of mineralogical and geochemical variability in lithium deposits exists than previously thought, making the ore body knowledge and geometallurgical data critical factors in optimizing the economics of lithium mining operations in Western Australia.

BENEFIT TO WA

Despite over a century of resource development experience in Western Australia, the downstream processing of hard rock lithium deposits is a relatively new industry. This project has shed light on Western Australia lithium deposits, and provides a new geometallurgical framework applicable to mining and processing optimisation.

Sponsors
Department of Mines, Industry Regulation and Safety (GSWA)
Lithium Australia NL
Rio Tinto Exploration Pty Limited

Lead Organisation
Curtin University

Research Contact
Mark Aylmore

Total Grant Value
$525,146

MRIWA Contribution
$175,146

M0532 – Mt Cattlin pegmatite open pit operation. View 1 shows exposure of the pegmatite in the pit wall and View 2 shows the pegmatite/greenstone contact in the southeast corner of the pit.
Image source: final report

[17] https://www.mriwa.wa.gov.au/research-projects/project-portfolio/geology-mineralogy-and-metallurgy-of-ematerials-deposits-in-wa/

Current Projects/ Contracts Executed

Program 3 – Increase Recovered Value Through Processing

Project No	Theme	Project Title	Lead Org. and Contact	Sponsors	Duration (yrs)	Total Project Value $	MRIWA Contribution $
M0508a	Data driven decisions	Unlocking Knowledge from Technical Texts using Deep Active Learning and Entity Typing	University of Western Australia Tyler Bikaun		3.5	120,000	120,000[18]
M0508b	Data driven decisions	Risk-based Inspection Intervals: A Practical Approach	Curtin University Gabriel Gonzalez		3.5	120,000	120,000[18]
M0519	Processing technology	Broadening the opportunity for in-situ recovery of value from mineral deposits	CMTE Development (trading as Mining3) Ewan Sellers	Barrick Gold Corporation CMTE Development Ltd T/As Mining3 Environmental Copper Recovery Pty Ltd Freeport Minerals Corporation Gold Fields St Ives Gold Mining Company Pty Ltd Hatch Heathgate Resources Pty Ltd Mining and Process Solutions Pty Ltd Newcrest Mining Limited Newmont USA Limited Solvay-Cytec Industries Inc. BHP Group Operations Pty Ltd	4.25	960,000	240,000

[18] Projects are supported by funds drawn down from MRIWA's contribution to the Centre for Transforming Maintenance Through Data Science

Project No	Theme	Project Title	Lead Org. and Contact	Sponsors	Duration (yrs)	Total Project Value $	MRIWA Contribution $
M0533f	Processing technology	Hydrometallurgical processing for nickel and cobalt ores, concentrates, tailings, wastes - Stage 2 (FBI CRC)	Curtin University Elsayed Oraby	Ardea Resources Limited BASF Australia Ltd BHP Nickel West Pty Ltd Blackstone Minerals Limited Future Battery Industries CRC Ltd IGO Limited JordProxa Pty Ltd Lycopodium Pty Ltd Mineral Carbonation International Pty Ltd Mining and Process Solutions Pty Ltd Pure Battery Technologies Pty Ltd	3.5	3,607,080	562,500[19]
M0533v	Processing technology	Beneficiation and chemical processing of lithium minerals - Phase 2 (FBI CRC)	Murdoch University Aleks Nikoloski	Allkem Ltd BASF Australia Ltd Calix Limited Department of the Chief Minister and Cabinet (Northern Territory) EV Metals Group PLC Future Battery Industries CRC Ltd IGO Limited JordProxa Pty Ltd Lycopodium Pty Ltd	3.42	3,195,000	673,000[19]
M0537	Processing technology	The effect of water quality on rare earth minerals flotation	Curtin University Bogale Tadesse	Curtin University Lynas Corporation Ltd Mt Weld Mining Pty Ltd	4.25	210,500	70,000
M0541	Processing technology	Organic acid leach system for rare earth extraction technology development	Curtin University Laurence Dyer	Curtin University Department of Industry, Innovation and Science Lynas Corporation Ltd Mt Weld Mining Pty Ltd	5.08	345,160	115,000

[19] Projects M0533f and M05033v MRIWA Contribution drawdown from FBI CRC MRIWA Contribution

Project No	Theme	Project Title	Lead Org. and Contact	Sponsors	Duration (yrs)	Total Project Value $	MRIWA Contribution $
M10475	Safety, social and environmental sustainability	Green Steel Value Chain Model Demonstration Upgrade	GHD Pty Ltd Abhishek Tammina		0.25	45,000	45,000
M10477	Safety, social and environmental sustainability	Advanced electrometallurgy for improved recovery of green metals	University of Sydney Prof. Alejandro Montoya	ECOX Australia PTY LTD	3	1,515,139	378,785
M10480	Processing technology	Flexible pilot plant for low emissions iron making prefeasibility study	Commonwealth Scientific Industrial Research Organisation (CSIRO) Adrien Guiraud		0.83	450,000	450,000
M10481	Processing technology	New Opportunities for the PGM Industry in WA	Acil Allen Pty Limited Mr. Ryan Buckland		0.58	292,678	292,678

M0532 – open pits at Greenbushes pegmatite mine. Views 1 and 2 in the Lithium pit show exposure of the pegmatite.
Image source: final report

PROGRAM 4: Infrastructure and Logistics

Western Australia's export-oriented mining projects place heavy demands on regional infrastructure, requiring long term planning and a high level of capital investment by both government and industry. As the sector moves to adopt automated technologies, greater demand will be placed on network bandwidths.

The research priority areas in Program 4 are intended to systematically advance knowledge and capability to:

- optimise supply chain infrastructure usage, haulage and export logistics
- enable enhanced networks and accurate geo-positioning
- decrease the capital and operating costs associated with getting commodities to market

Themes

- Communications and Positioning Technology
- Data Driven Decisions
- Energy Utilisation
- Safety, Social and Environmental Sustainability

$800K	$3.3M	3	3
MRIWA contribution	Total project value	Projects completed	CRC/Research Centre projects

Project Case Studies

QA4UAV: a standard workflow to quality assure UAV products

Program 4 – Infrastructure and Logistics

STATUS: Final Report Published[20]

Project No: M0507

THE CHALLENGE

Unpiloted Aerial Vehicle (UAV) imagery has become widely applied in the mining industry in recent years, but variable spatial accuracy and lack of traceability in the range of systems used mean that much data gathered in this way is not standardised or fit-for-purpose for advanced scientific analysis.

KEY FINDINGS

This project created operational Minimum Viable Product (MVP) software suitable for undertaking a range of checks required to automate imagery quality assurance, including 11 metadata checks and three photogrammetric checks.

The standardisation provided by this tool is intended to establish a universal framework allowing integration of image data collected from diverse sources, and supporting future development of a broader set of improved aerial imagery analysis products.

BENEFIT TO WA

Application of a standard UAV workflow across the Western Australian mining sector would help the industry operate at the leading edge of technological development globally, and prepare Western Australia mines for future developments in remote analysis and operations.

Sponsors

CRC for Spatial Information

Department of Water, Environment and Regulation

Lead Organisation

CRC SI

Research Contact

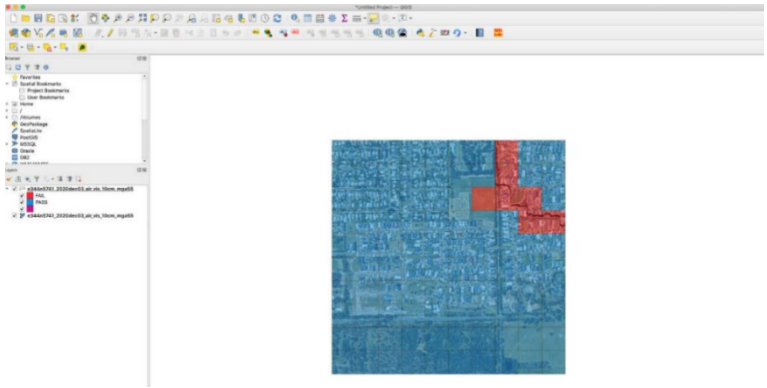
Nathan Quadros

Total Grant Value

$250,000

MRIWA Contribution

$75,000



M0507 – Desktop Application, revies of photogrammetry checks output shapefile.
Image source: final report

[20] https://www.mriwa.wa.gov.au/research-projects/project-portfolio/qa4uav-a-standard-workflow-to-quality-assure-uav-products/

Project Case Studies

Renewable Energy Storage Roadmap

Program 4 – Infrastructure and Logistics

STATUS: Final Report Published[21] **Project No: M10464**

THE CHALLENGE

With variability of renewable energy presenting challenges to reliable energy supply for remote mine sites, there is a need to consider the range of available energy storage technologies and understand the required research and development to support wider implementation within the Western Australian mining sector.

KEY FINDINGS

A significant amount of energy storage will be required to facilitate a net zero future. The Roadmap demonstrates the need for development of a range of energy storage technologies to support the transition to net zero, with recommendations across a range of end use applications.

Storage will be particularly important to support remote or off-grid applications, and/or in industrial processes that will continue to have mid-to-high heat requirements (such as manufacturing, metals and mineral refining). Case study analysis of remote mining and alumina processing applications provide initial insights into lowest cost solutions and recommended next steps for technology development.

BENEFIT TO WA

Energy Utilisation is a priority theme under MRIWA's Net Zero Emission Mining (NZEM) focus area, with energy storage a critical enabler for decarbonisation of Western Australian mining operations through greater integration of renewable energy.

Understanding lowest cost energy storage technologies suited to the unique conditions of remote mining provides greater confidence to support deployment and trial new technologies.

Sponsors

APA Group
Australian Renewable Energy Agency
BHP Billiton Iron Ore Pty Ltd
Commonwealth Scientific Industrial Research Organisation (CSIRO)
CSIRO - Australian Solar Thermal Research Institute
Department of Industry, Science, Energy and Resources
Department of Jobs Tourism Science and Innovation
Energy Policy WA
GHD Pty Ltd
NSW Dept of Planning and Environment
Woodside Energy Ltd

Lead Organisation

Commonwealth Scientific Industrial Research Organisation (CSIRO)

Research Contact

Vivek Srinivasan

Total Grant Value

$590,000

MRIWA Contribution

$25,000

M10464 – Renewable Energy Storage Roadmap official document
Image source: final report

[21] https://www.mriwa.wa.gov.au/research-projects/project-portfolio/renewable-energy-storage-roadmap/

Mining in a low emissions economy

Program 4 – Infrastructure and Logistics

STATUS: Final Report Published[22] **Project No: M10468**

THE CHALLENGE

Western Australia's mining and resources sector has a critical role to play in the transition to net zero emissions by 2050. The potential is enormous, as are the benefits. But where are the opportunities? What should be prioritised? And how do we turn ambition into action?

KEY FINDINGS

The three-part report series seeks to build an understanding across the mining sector about what is possible today and provide practical steps to deliver on the emissions reduction targets being set across industry.

The reports demonstrate how analysis of technology driven decarbonisation pathways to form a roadmap provides a structured approach for decision makers to group and evaluate relevant technologies, while accounting for unique decarbonisation goals, budgets, risks, and other site-related constraints.

BENEFIT TO WA

The demand for low-emissions energy minerals and the decarbonisation of mining presents the greatest opportunity in a generation to diversify and grow the resources sector. Western Australia's mineral commodities are critical enablers to global decarbonisation efforts and this report series provides a practical guide to support junior to mid-tier mining companies to deliver on this demand whilst navigating the complexities of their own decarbonisation journey.

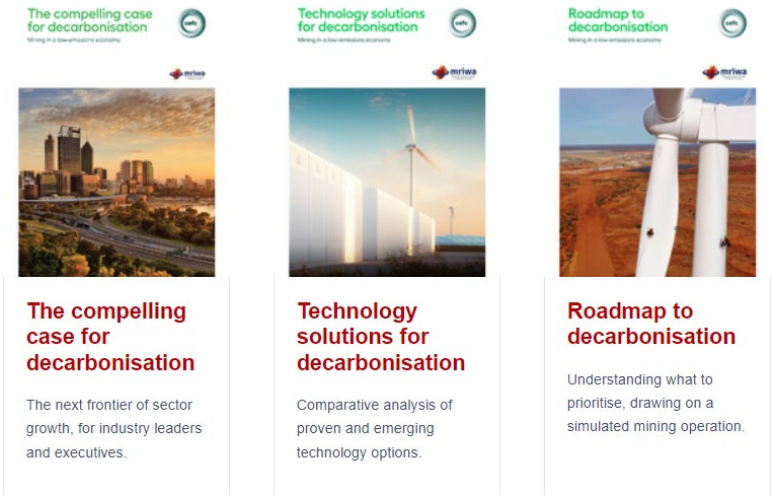
Sponsors
Clean Energy Finance Corporation

Lead Organisation
Engie Impact Australia Pty Ltd

Research Contact
Joshua Martin

Total Grant Value
$105,223

MRIWA Contribution
$52,611



M10468 – three-part report series downloadable on NZEM resources webpage*

[22] *https://www.mriwa.wa.gov.au/minerals-research-advancing-western-australia/focus-areas/net-zero-emission-mining/nzem-resources/

Current Projects/ Contracts Executed

Program 4 – Infrastructure and Logistics

Project No	Theme	Project Title	Lead Org. and Contact	Sponsors	Duration (yrs)	Total Project Value $	MRIWA Contribution $
M0533u	Data driven decisions	Assessment, design and operation of battery-supported electric mining vehicles and machinery (FBI CRC No. 028)	University of Adelaide Ali Pourmousavi Kani	BHP Nickel West Pty Ltd Department for Energy and Mining (SA) Department of Energy and Public Works Energetics Pty Ltd Future Battery Industries CRC Ltd IGO Limited Multicom Resources Limited Galaxy Resources Limited - now Allkem Limited	3.5	1,160,000	300,000*[23]
M10443	Energy utilisation	Stationary Mine Electrification (FBI CRC No. 039)	University of Western Australia Tyrone Fernando	Energetics Pty Ltd Future Battery Industries CRC Ltd Lycopodium Pty Ltd Magellan Powertronics Pty Ltd Ultra Power Systems Pty Ltd	2.5	1,112,000	300,000*
M10451	Energy utilisation	Development of Vanadium Electrolytes (FBI CRC Project Number 038)	Murdoch University Aleks Nikoloski	Department of Energy and Public Works Department of the Chief Minister and Cabinet (Northern Territory) Future Battery Industries CRC Ltd King River Resources Limited Lycopodium Pty Ltd Lynas Corporation Technology Metals Australia Limited Ultra Power Systems Pty Ltd	3	1,073,000	200,000*

[23]*Projects M0533u, M10443 and M10451 MRIWA Contribution drawdown from FBI CRC MRIWA Contribution

PROGRAM 5: New Products and Markets

Rapid adoption of new high-tech products and manufacturing processes is changing the demand for high-value, low-volume minerals and creating opportunities for the re-use and recycling of by-products and waste.

Increasing emphasis is being placed on those critical minerals which are subject to high risks of supply but represent irreplaceable inputs for important technological and industrial innovations, especially renewable energy systems, electric vehicles, rechargeable batteries, consumer electronics, telecommunications, specialty alloys, and defence technologies.

Given Western Australia is well-positioned with significant reserves of a broad variety of minerals now required globally, the research priority areas in Program 5 are intended to systematically advance knowledge and capability which will:

- create new industries
- result in increased demand for one or more minerals found in this State
- develop and demonstrate ethical and sustainable production of minerals, metals and chemicals
- create premium products which can be marketed and sold to new generations of customers

In doing so, the research will create new niche markets for minerals and position Western Australia as a global supplier of critical minerals while also creating opportunities for progressive downstream processing activity in the State.

Themes

- Strategic Foresight
- Downstream Processing Technology
- Data Driven Decisions
- Energy Utilisation
- Regulatory Tools and Processes
- Safety, Social and Environmental Sustainability
- Workforce of the future

$3.7M	$28.9M	2	7	3
MRIWA contribution	Total project value	Projects completed	CRC/Research Centre projects	Standalone research projects

Project Case Studies

State of Play Critical Minerals Report 2022

Program 5 – New Products and Markets

STATUS: Final Report Published[24]

Project No: M10470

THE CHALLENGE

New demand for metals including rapidly changing technical requirements for: digital equipment; renewable energy builds; chemical processing advancements; electrification of industry. How can the mining industry accelerate the supply of critical minerals to meet increasing metals demand from new technologies?

KEY FINDINGS

Need to promote Australia as a low risk critical mineral supplier: Engagement from Australian businesses, senior government officials, trade delegations and NGOs with foreign investors.

Pursue cooperative arrangements with foreign investors: The creation of alliances, forging of cooperative arrangements or trade agreements should be pursued with those foreign investors

(FIRB) process: Reform targeted at streamlining the critical mineral investment review processes and increasing the flexibility of investment thresholds should be considered.

Provide direct project finance: Continue and increase the provision of government-backed grants, incentives, and debt facilities to catalyse private co-investment.

Establish waste processing hubs: Support the construction of centralised waste processing facilities.

BENEFIT TO WA

The overview given from the survey responses in the study will be an enabler for potential Critical Minerals projects. It identifies the needs of building technical knowledge, targeting resources and looking at customers for investment in Western Australia. The consideration of multiple technology solutions could also support a range of strategic investments in R&D to benefit Western Australia.

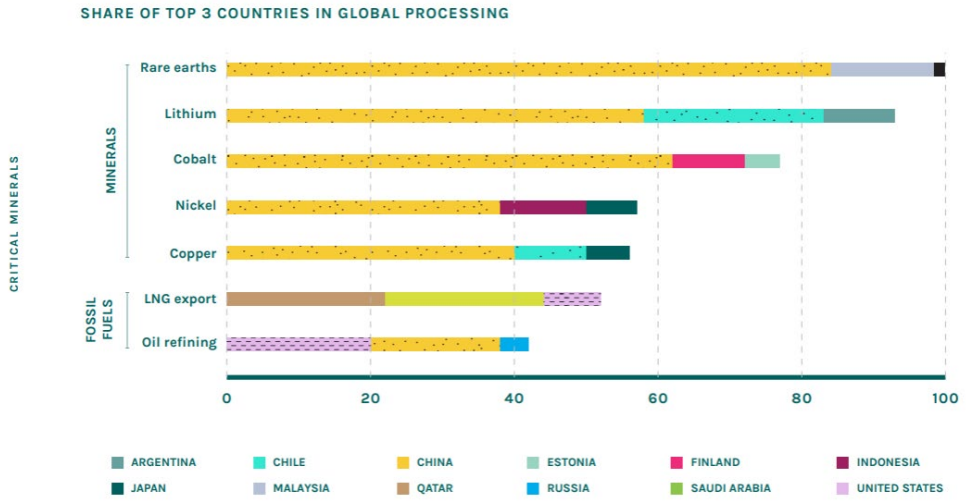
Sponsors
METS Ignited

Lead Organisation
State of Play (Slate Advisory Pty Ltd)

Research Contact
Madi Ratcliffe

Total Grant Value
$135,000

MRIWA Contribution
$45,000



M10470 – share of top 3 countries in global processing graph from state of play critical minerals report 2022.

[24] https://www.mriwa.wa.gov.au/research-projects/project-portfolio/state-of-play-critical-minerals-report-2022/

Project Case Studies

Green Steel Value Chain Assessment

Program 5 – New Products and Markets

STATUS: Final Report Published[25] **Project No: M10471**

THE CHALLENGE

Understanding the pathways to enable Western Australia to maximise use of its hematite and magnetite iron ore resources, and to maximise emerging hydrogen and renewable energy potential to support global green steel ambitions and create new markets for Western Australian iron ores.

KEY FINDINGS

The Western Australian Green Steel Opportunities report provides important insights into the iron ore to steel making markets and what is going to be needed for the global steel industry to decarbonise. The steel industry is an important customer to Western Australia, and it is important to understand the significant challenges they are facing to reduce emissions in their operations.

The MRIWA assessment of the green steel opportunity has examined low emission scenarios around magnetite and hematite iron ores including a range of energy costs and qualities.

The key findings increase the understanding of the size and scale of the capital requirements and infrastructure needed, both energy and water, the land requirements and the energy price point at which it becomes economic to produce green iron ore, green pellets, green iron and potentially green steel in the State.

BENEFIT TO WA

Future low emission steelmaking will demand a different mixture of iron ore types and grades. With the variety of ore types in Western Australia and our natural advantages in the supply of renewable energy solutions, we are well positioned to supply new iron feedstock products into the market in addition to our existing exports. Further processing of Western Australia iron ore to green steel, or the inputs to enable green steel, is seen as a significant opportunity.

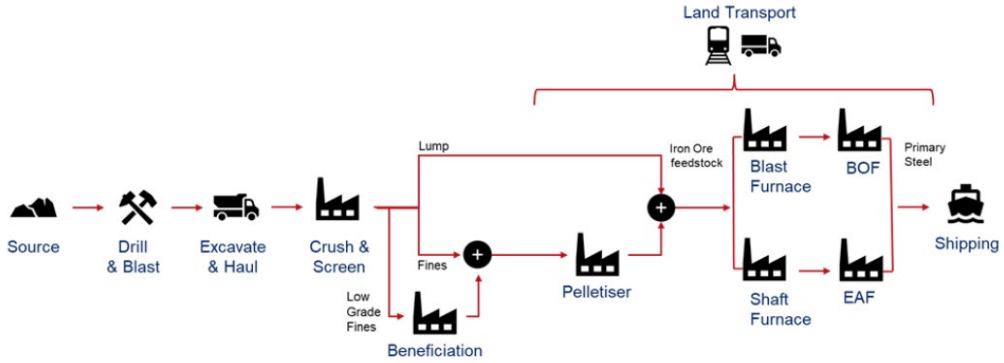
Sponsors

Lead Organisation
GHD Pty Ltd

Research Contact
Kenneth Leong

Total Grant Value
$598,908

MRIWA Contribution
$598,908



M10471 – Green steel value chain model.
Image source: mriwa green steel resources webpage

[25] https://www.mriwa.wa.gov.au/minerals-research-advancing-western-australia/focus-areas/green-steel/green-steel-resources/

Current Projects/ Contracts Executed

Program 5 – New Products and Markets

Project No	Theme	Project Title	Lead Org. and Contact	Sponsors	Duration (yrs)	Total Project Value $	MRIWA Contribution $
M0533d	Downstream processing technology	Process Legacy - Stage 2 (FBI CRC)	Curtin University Arie van Riessen	Anax Metals Limited Australasian Pozzolan Association ChemCentre Department of the Chief Minister and Cabinet (Northern Territory) EV Metals Group PLC Future Battery Industries CRC Ltd FYI Resources Limited IGO Limited	3.5	2,957,386	589,500[26]
M0533h	Downstream processing technology	Cathode precursor production pilot plant in Western Australia - Stage 2 (FBI CRC)	Curtin University Alireza Rabieh	Alpha HPA Limited Ardea Resources Limited BASF Australia Ltd BHP Nickel West Pty Ltd Blackstone Minerals Limited Calix Limited ChemX Materials Ltd Cobalt Blue Holdings Limited EV Metals Group PLC Future Battery Industries CRC Ltd IGO Limited JordProxa Pty Ltd King River Resources Limited Lycopodium Pty Ltd Mn Energy Limited Pure Battery Technologies Pty Ltd	3	5,916,300	879,750[26]

[26] MRIWA contributions are drawn down from MRIWA's commitment to the FBI CRC and include Department of Jobs Tourism Science and Innovation (JTSI) funds.

Project No	Theme	Project Title	Lead Org. and Contact	Sponsors	Duration (yrs)	Total Project Value $	MRIWA Contribution $
M0533j	Data driven decisions	Establishment of the National Battery Testing Centre	Queensland University of Technology Joshua Watts	Australian Vanadium Ltd BASF Corporation USA BHP Nickel West Pty Ltd Calix Limited Defence Science and Technology Department of the Chief Minister and Cabinet (Northern Territory) ESS Asia Pacific Pty Ltd Future Battery Industries CRC Ltd Lava Blue Ltd Magellan Powertronics Pty Ltd Multicom Resources Limited Sunrise Energy Metals Limited Syrah Resources Ltd Ultra Power Systems Pty Ltd	4	7,145,342	200,000[27]
M0533k	Downstream processing technology	Super Anode (FBI CRC)	University of Melbourne Amanda Ellis	AnteoTech LTD Calix Limited EcoGraf Limited Future Battery Industries CRC Ltd Koppers Carbon Minerals and Chemicals Pty Ltd Syrah Resources Ltd Talga Group Ltd	4	4,200,000	200,000[27]

[27] MRIWA contributions are drawn down from MRIWA's commitment to the FBI CRC and include Department of Jobs Tourism Science and Innovation (JTSI) funds.

Project No	Theme	Project Title	Lead Org. and Contact	Sponsors	Duration (yrs)	Total Project Value $	MRIWA Contribution $
M0533m	Data driven decisions	Electrochemical testing of Li-ion Battery materials in standard cell formats (FBI CRC)	Queensland University of Technology Michael Horn	Alpha HPA Limited Ardea Resources Limited BASF Australia Ltd BHP Nickel West Pty Ltd Calix Limited ChemX Materials Ltd Cobalt Blue Holdings Limited EV Metals Group PLC Future Battery Industries CRC Ltd FYI Resources Limited IGO Limited Koppers Carbon Minerals and Chemicals Pty Ltd Lava Blue Ltd Pure Battery Technologies Pty Ltd Sicona Battery Technologies Pty Ltd Sunrise Energy Metals Limited Talga Group Ltd	4	4,210,396	500,000[28]
M0533q	Data driven decisions	Development of a trusted supply chain for Australian battery minerals and products (FBI CRC)	Curtin University Prokopiy Vasilyev	Ardea Resources Limited Australasian Pozzolan Association BASF Australia Ltd EV Metals Group PLC Everledger Australia Pty Ltd Future Battery Industries CRC Ltd Source Certain International Pty Ltd	3	1,688,550	500,000[28]

[28] MRIWA contributions are drawn down from MRIWA's commitment to the FBI CRC and include Department of Jobs Tourism Science and Innovation (JTSI) funds.

Project No	Theme	Project Title	Lead Org. and Contact	Sponsors	Duration (yrs)	Total Project Value $	MRIWA Contribution $
M0533r	Data driven decisions	Battery materials for a circular economy (FBI CRC)	University of Technology Sydney Damien Giurco	Ardea Resources Limited Australasian Pozzolan Association BASF Australia Ltd BHP Nickel West Pty Ltd Energetics Pty Ltd Future Battery Industries CRC Ltd IGO Limited Multicom Resources Limited Galaxy Resources Limited - now Allkem Limited	4.5	1,587,000	400,000[29]
M10462	Strategic foresight	Roadmap to Decarbonise WA Through Integrated Mineral Carbonation	Curtin University Michael Hitch		0.58	250,000	250,000
M10482	Safety, social and environmental sustainability	Circular Economy Assessment and Strategy	GHD Pty Ltd Huia Adkins		0.5	150,000	150,000
M10488	Safety, social and environmental sustainability	Alternative Use of Tailings and Waste - Stakeholder Engagement Workshops	Curtin University Fran Ackerman		0.92	26,000	26,000

[29] MRIWA contributions are drawn down from MRIWA's commitment to the FBI CRC and include Department of Jobs Tourism Science and Innovation (JTSI) funds.

PROGRAM 6: Remediation and Mine Closure

An increasing number of Western Australian mining operations are approaching scheduled mine closure with a lack of certainty in the process for relinquishment of rehabilitated land to the State and the potential for trailing liabilities.

To meet the challenge of mine closure and to support the Western Australian Biodiversity Science Institute's Research Priorities and other work happening across government, the research priority areas in Program 6 are intended to systematically advance knowledge and capability toward developing new technologies and approaches for mine remediation and alternative land use, while filling knowledge gaps to ensure a sustainable positive legacy for the industry and surrounding communities.

In doing so, the research will:

- position Western Australia as a global leader in mine closure
- decrease the capital and operating costs associated with remediation and mine closure
- support evidence-based decision making

Themes

- Acid Mine drainage and treatment of tailings
- Sustainable land use post-mining
- Data driven decisions
- Regulatory tools and processes
- Safety, social and environmental stability

$464K	$5.8M	1	4	2
MRIWA contribution	Total project value	Project completed	CRC/Research Centre projects	Standalone research projects

Project Case Studies

Mine pit lakes – Their characterisation, assessment, management and value as potential lead indicators for in-situ metal recovery opportunities

Program 6 – Remediation and Mine Closure

STATUS: Final Report Published[30]

Project No: M0478

THE CHALLENGE

Mine closure requires assessment and management of the pit lakes that can form in open pit mines after mining ceases. Understanding of the long-term environmental risk posed by these lakes is incomplete, which often hampers the realisation of post-mining reuse opportunities.

KEY FINDINGS

Mine pit lake waters continue to evolve for many years after mine closure, posing a significant challenge to the regulation and management of mining legacy sites.

Groundwater chemistry represents the primary control on pit lake water quality at equilibrium, particularly in regards to major ion content, pH, and water salinity.

pH represents a significant influence on metal solubility in lake waters, with mine pit lakes in some sites reaching concentrations compatible with in-situ metal recovery.

BENEFIT TO WA

This research will help address the environmental legacy of mining in Western Australia and support better planning of, and a reduced environmental footprint for future Western Australia mines. The data generated will assist government and industry in better defining the residual risks of existing pit lakes, and identify opportunities for beneficial post-closure uses.

Sponsors

CRC for Contamination Assessment and Remediation of the Environment (CRC CARE)

Lead Organisation

ChemCentre

Research Contact

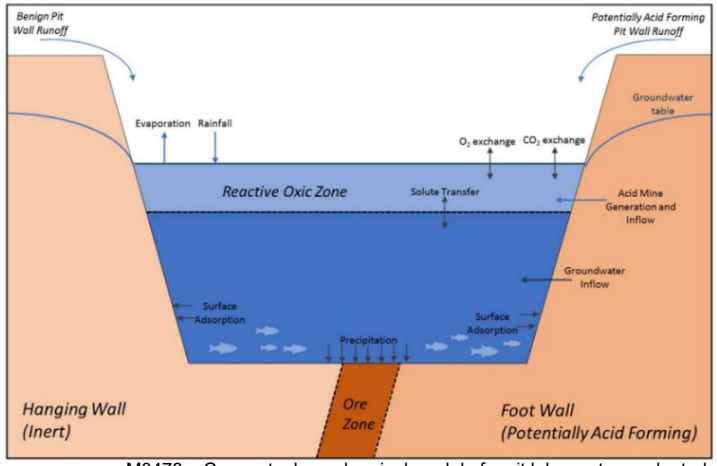
Kathryn Linge

Total Grant Value

$550,000

MRIWA Contribution

$220,000



M0478 – Conceptual geochemical model of a pit lake system, adapted from Castendyk et al. (2015)
Image source: final report.

[30] https://www.mriwa.wa.gov.au/research-projects/project-portfolio/mine-pit-lakes-their-characterisation-assessment-management-and-value-as-potential-lead-indicators-for-in-situ-metal-recovery-opportunities/

Current Projects/Contracts Executed

Program 6 – Remediation and Mine Closure

Project No	Theme	Project Title	Lead Org. and Contact	Sponsors	Duration (yrs)	Total Project Value $	MRIWA Contribution $
M0513	Regulatory tools and processes	Validation and standardisation of sequential leaching tools to better predict the impact of iron ore mining on ground and surface water quality – Phase 2	ChemCentre John Moursounidis	BHP Billiton Iron Ore Pty Ltd CRC for Contamination Assessment and Remediation of the Environment (CRC CARE) Fortescue Metals Group Ltd Rio Tinto Limited (Iron Ore)	2.92	525,000	216,000
M10409	Acid mine drainage and treatment of tailings	How can CRC TiME help industry, government and communities prevent closure related acid and metalliferous drainage (AMD) impacts?	University of Western Australia Carolyn Oldham	CRC Transitions in Mining Economies	0.67	100,000	15,000[31]
M10413	Sustainable land use post- mining	Post Mining Land Use – Practice Mapping Options	University of South Australia Andrew Beer	CRC for Transitions in Mining Economies (CRC TiME)	1	149,459	15,000[31]

[31] MRIWA contributions are drawn down from MRIWA's commitment to the CRC TiME.

Project No	Theme	Project Title	Lead Org. and Contact	Sponsors	Duration (yrs)	Total Project Value $	MRIWA Contribution $
M10442	Acid mine drainage and treatment of tailings	Improved Prediction, Remediation and Closure of Acid and Neutral Metalliferous Drainage (AMD/NMD) Sites	Flinders University Sarah Harmer	Australian Genome Research Facility Limited Australian Research Council BHP Group Operations Pty Ltd CRC for Transitions in Mining Economies (CRC TiME) Fortescue Metals Group Ltd MMG Australia Ltd Newmont Mining Services Pty Ltd Rio Tinto Services Limited Teck Resources Limited	5	4,558,586	125,000[32]
M10476	Safety, social and environmental sustainability	Opportunities for Growth in Australia's Mine Closure Solutions Industry (CRC TiME Project Number 3.17)	Commonwealth Scientific Industrial Research Organisation (CSIRO) Dominic Banfield	CRC TiME	0.5	410,350	50,000
M10447	Acid mine drainage and treatment of tailings	Wetland in a Box (EnphytoBox®) - a smart water treatment system to support the decarbonisation of water in mining	Syrinx Environmental PL Kathy Meney	Syrinx Environmental PL	0.83	86,600	43,300

[32] MRIWA contributions are drawn down from MRIWA's commitment to the CRC TiME.

Education Program

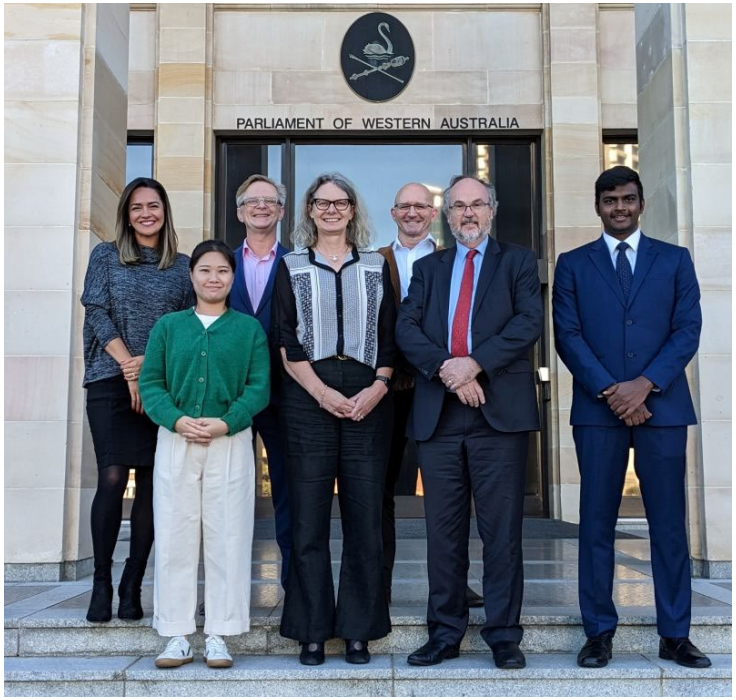
MRIWA provides a program of scholarships and education opportunities to shape and empower future mining industry thought leaders.

The MRIWA Education Program supports the development of exceptional talent to help meet the future needs of the Western Australian mining industry through:

- Attracting domestic and international applicants of exceptional academic capability to the Western Australian research community.
- Effectively marketing MRIWA and the participating universities and research institutions.
- Expanding the diversity of research supported by MRIWA.
- Producing highly skilled graduates aligned to the needs of the Western Australia mining sector.

Education program components

- A minimum of three prestigious MRIWA scholarships available each year to support post-graduate research students at Western Australian universities.
- Tailored professional and communication skills training for research students accepted into the MRIWA program.
- Outreach and mentoring to encourage students of exceptional ability to consider careers in the mining industry.
- Sponsorship of the work of Australian Earth Science Education[33] (formerly Earth Science Western Australia) supporting earth science teaching in Western Australian schools.



Pictured (L-R) MRIWA RPM Laura Machuca Suarez, MRIWA PhD Scholar Hyunjin Na, MRIWA RPM Geoff Batt, MRIWA CEO Nicole Roocke, MRIWA PhD Scholar Alex Eves, the Hon. Bill Johnston MLA, Minister for Mines and Petroleum, and MRIWA PhD Scholar Nilan Jayasiri Mudiyanselage at the 2023 MRIWA Scholarship Induction event, Parliament House 19 April 2023

[33] https://ausearthed.com.au/wa/

MRIWA Scholarships

MRIWA Scholarships are awarded through a competitive application process to students undertaking research aligned to MRIWA's Research Priority Plan at any university in Western Australia.

The MRIWA scholarship program currently supports the studies and professional development of a cohort of 15 students undertaking PhD degrees at three different Western Australian universities. Four students supported under the program successfully completed their studies in 2022-23.

This scholarship program delivers on MRIWA's mission for applied research to create capability and deliver economic and social benefit for Western Australia by supporting the development of professionals prepared for the future workforce needs of the minerals industry.

On an annual basis, subject to availability of funds and receipt of suitable applications, MRIWA may award:

- 1 MRIWA Directors' PhD Scholarship valued at no less than $45,000 per year
- 3 Postgraduate research scholarships valued at no less than $44,216 per year
    - MRIWA Odwyn Jones PhD Scholarship
    - MRIWA PhD Scholarship for Women
    - MRIWA Indigenous Postgraduate Scholarship

MRIWA's support for scholarships directed at groups traditionally under-represented in mining industry leadership positions contributes to a diverse and innovative minerals industry delivering value to all Western Australians.

MRIWA also funds the scholarships of two students undertaking PhD research within the ARC Centre for Transforming Maintenance through Data Science, and indirectly supports a further 57 PhD students and 8 students completing other higher degrees by research through scholarships funded under individual projects in the research portfolio summarised in the previous section.

Scholarship Overview

$1.29M	3	57	2	15
Value of PhD Scholarships directly funded by MRIWA	Projects completed	PhD Scholarships funded through Research Projects	MRIWA-Funded ARC ITTC PhD Scholarships	Current PhD Scholarships directly funded by MRIWA

2023 MRIWA Scholarship Recipients

Hyunjin Na – MRIWA PhD Scholarship for Women

Project Title
Development of cementation-magnetic separation method for sulfide mineral processing and AMD prevention

Host University	University of Western Australia	**MRIWA Contribution**
Project Number	M10485	$143,735 over 3.25 years
Status	Commenced	

A graduate of the Korea Maritime and Ocean University with a Master's degree in Engineering, Hyunjin was awarded the 2023 MRIWA PhD Scholarship for Women to support her PhD studies at Curtin University's WA School of Mines: Mechanical, Electrical and Chemical Engineering (WASM: MECE).

Hyunjin's research into simple, flexible technologies for separating sulfide minerals has potential application on mine sites throughout Western Australia, increasing mineral recovery and improving environmental outcomes by removing sulfide compounds from the tailings left behind after mining.

Alex Eves – MRIWA Odwyn Jones PhD Scholarship

Project Title
Petrogenesis and metallogenic significance of the Speewah V-Ti Deposit

Host University	University of Western Australia	**MRIWA Contribution**
Project Number	M10484	$48,361 over 2.92 years
Status	Commenced	

Alex is a graduate of the University of Western Australia with a first-class honours degree in Geology, and has over a decade of career experience in Western Australia minerals exploration.

He was awarded the 2023 MRIWA Odwyn Jones PhD Scholarship as a top-up to an Australian Research Training Program (RTP) award supporting his PhD studies under the supervision of Professors Marco Fiorentini and Tony Kemp at UWA's Centre for Exploration Targeting.

Alex is working to understand the formation of the Speewah Vanadium-Titanium (V-Ti) Deposit in the East Kimberley region of Western Australia, delivering new exploration models and insights to help geologists locate new economic mineralisation across the State.

Nilan Jayasiri – MRIWA PhD Scholarship

Project Title
Accelerating Consolidation of Mine Tailings using Electro-osmosis Dewatering Technology

Host University	University of Western Australia	**MRIWA Contribution**
Project Number	M10487	$58,034 over 3.5 years
Status	Commenced	

Nilan holds Bachelor's and Master's degrees in Engineering and Geotechnical and Earth Resources Engineering from the Asian Institute of Technology in Sri Lanka.

He was awarded a MRIWA PhD Scholarship to support his PhD studies under Professor Andy Fourie at UWA's Australian Centre for Geomechanics.

By contributing to new approaches for improving the strength and stability of mine tailings. Nilan's research could help increase the safety of tailings storage facilities at mines throughout Western Australia.

Daniel Goldstein – MRIWA PhD Scholarship

Project Title
Ore Body Characterisation using Machine Learning and Measure-While-Drilling Data

Host University	Curtin University	**MRIWA Contribution**
Project Number	M10486	$45,598 over 2.9 years
Status	Commenced	

Daniel is a graduate of Colgate University (USA) with a Bachelor of Arts in Biochemistry, the University of Wollongong with a Bachelor of Science in Geology, and the University of New South Wales with a Master's degree in Mining Engineering.

A previous winner of the Dr Baden Clegg award from the Australian Geomechanics Society and the 2022 Curtinnovation Student Prize, Daniel was awarded a MRIWA PhD Scholarship to support his ongoing PhD studies at WASM: MECE.

Daniel's research is connecting datasets to deliver accurate real-time models of subsurface geology and rock properties during mining. This technology will support operational decision-making and optimisation of mine performance, improving safety, and enhancing sustainability outcomes to help keep the Western Australian minerals sector at the forefront of global performance and practice.

MRIWA Directors' PhD Scholarship

The MRIWA Directors' PhD Scholarship is funded by some members of the MRIWA Board foregoing their sitting fees. This scholarship is awarded at the discretion of the MRIWA Board and is not guaranteed to be offered every year. A total of four Directors' Scholarships have been awarded since 2014.

Current recipients

Project No	Scholarship Recipient	Project Title	Host University	Duration (yrs)	Status	MRIWA Contribution $
M0501	Yihao Fu	Characterisation of ore and bulk solid systems by use of multivariate image analysis and deep learning neural networks	Curtin University	3.5	Commenced	104,006

MRIWA PhD Scholarship

MRIWA PhD Scholarships are awarded through a competitive application process to students undertaking research aligned to MRIWA's Research Priority Plan at any university in Western Australia. One or more MRIWA PhD Scholarships may be awarded annually at the discretion of the MRIWA Board.

Project No	Scholarship Recipient	Project Title	Host University	Duration (yrs)	Status	MRIWA Contribution $
M10408	Alexandra Halliday	Integrating field monitoring and numerical modelling to better quantify the stability of tailings storage facilities	University of Western Australia	3.5	Commenced	52,973

MRIWA PhD Scholarship for Women

The MRIWA PhD Scholarship for Women is awarded annually. It was first awarded in 2018 and aims to promote opportunities for women in higher-degree research in the minerals sector.

Current recipients

Project No	Scholarship Recipient	Project Title	Host University	Duration (yrs)	Status	MRIWA Contribution $
M0524	Kudzai Angeline Mchibwa	Innovative processes for leach liquor purification and production of battery grade LiOH from Li mineral resources	Murdoch University	4	Commenced	120,000
M0547	Polyanna Moro	Geodynamics and basin evolution of the Paterson Orogen from the Paleoproterozoic to Neoproterozoic based on 3D geophysical modelling and data inversion	University of Western Australia	4	Commenced	76,200
M0563	Alicja Polewacz	Processes at the interface between fluids and lithium minerals	Murdoch University	3.5	Commenced	140,000
M10407	Devika Bhatia	Taxation of Australian Mining Firms	University of Western Australia	2.67	Commenced	107,627
M10452	Bishenka Mahaulpatha	Feasibility of effective metal recovery from tailings material via electrokinetic in-situ leaching	University of Western Australia	3.5	Commenced	144,228

MRIWA Odwyn Jones PhD Scholarship

The MRIWA Odwyn Jones PhD Scholarship is awarded annually. This prestigious scholarship is named for Emeritus Professor Odwyn Jones AO, in recognition of his outstanding contribution to education in support of the mining industry in Western Australia.

Current recipients

Project No	Scholarship Recipient	Project Title	Host University	Duration (yrs)	Status	MRIWA Contribution $
M0548	Xingjie Chen	Investigating the underground support provided by shotcrete using tailings and waste rock	University of Western Australia	3.5	Commenced	105,000
M0561	John Grigson	Giant rare-metal pegmatite deposits of the East Pilbara Terrane, Western Australia: mineral systems analysis and criteria for terrane-scale exploration	University of Western Australia	3.5	Commenced	52,500
M10406	Liz Wall	Evaluating the mining industry's view of their success in delivering a positive legacy for host communities at the time of mine closure	University of Western Australia	3.5	Commenced	52,972
M10453	Kylie Ward	Beneficiation of Gold Telluride Ores	Curtin University	2.67	Commenced	41,208

2023 Completed MRIWA PhD's

Project No	Scholarship Recipient	Project Title	Host University	Duration (yrs)	Status	MRIWA Contribution $
M0502	Zela Ichlas	Development of an industrially applicable electrostatic solvent extraction column for process metallurgy	Curtin University	3.5	Completed	105,000
M0523	Keith Giglia	Monitoring and control of hydrocyclones by use of convolutional neural networks and deep reinforcement learning	Curtin University	3.5	Completed	106,050
M10454	Martin Ralph	Removal of naturally occurring radioactive materials (NORM) deposited in corrosion scale in mineral processing circuits	Edith Cowan University	2.4	Completed	47,801