

## Keith Berry

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Principal Hydrogeologist

**Education**

BSc Geology - Auckland University, 1984

MSc Geology - Auckland University, 1986 - Geology, Geophysics, Engineering Geology

**Courses**

- CSIRO - Groundwater Flow Modelling
- Jacob Bear - Solute Transport
- Tim Wilson - Air-Photo Geological Mapping
- Brian McKenzie - Mineral Economics Analysis
- ANU - G.I.S. Applications in Hydrology
- ESRI - Advanced G.I.S., ARCVIEW Applications for Geoscientists
- ICEWARM - River and Floodplain Modelling

**SUMMARY OF MINE WATER EXPERIENCE WATER EXPERIENCE**

- **COMMODITIES** - Coal, gold, nickel, copper, uranium, phosphate, mineral sands, talc, iron
- **COUNTRIES** - Australia, New Zealand, Canada, USA, Uzbekistan, Finland, Chile, Colombia
- **GEOLOGY** - Mapping, remote sensing, drilling
- **GEOPHYSICS** - Gravity, EM, magnetics, seismic, downhole, NMR
- **GEOCHEMISTRY** - Exploration and Contaminant investigations. Field program and Lab. test specification, leaching and transport models, plume measure and recovery, ARD.
- **DEWATERING** - Shaft sinking, underground mine and open pit dewatering, depressurisation, pit slope hydrology, pit hydrology, pit lake modelling
- **HYDROLOGY** - Meteorology, flood forecasting, rainfall/runoff, flood plain modelling, drain/diversion design
- **GEOTECHNICAL** - Tailings and evap. ponds - hydrology and seepage, design, investigation and management
- **CIVIL** - Well design, pipeline hydraulic analysis, pipe system optimisation
- **WATER SUPPLY** - Exploration, well/wellfield design, construction, resource evaluation, modelling, management
- **ENVIRONMENTAL** - Approvals documentation, baseline studies, impacts and risk assessment, monitoring systems, contaminated sites assessment, remediation, auditing, post closure studies and submissions
- **CLOSURE** - Demolition, waste and residue storage facility cover design, erosion analysis, closure scheduling/planning/cost estimate
- **PROCESSING** - CIP, flotation, PAL, smelting, refining, heap leaching, desalination, ocean outfall
- **DATABASE** - Design, implementation, management of spatial and time series data systems
- **SOFTWARE** - Modflow, Arcview, Surfer, Viewlog, Datamine (DHE), HEC/RAS
- **COMMERCIAL** - Tenement, and JV management. Acquisition due diligence
- **STRATEGIC** - Industry position papers, policy/law reform review. Water accounting system design/review
- **IPR/AUDIT** - Water supply/mine development projects, water/environment management systems

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**PROFESSIONAL WORK HISTORY 1992-2014**

1992 - 2001 SENIOR HYDROGEOLOGIST, WMC RESOURCES, EXPLORATION DIVISION, PERTH, WA

2001 - 2005 PRINCIPAL HYDROGEOLOGIST, WMC RESOURCES, GROUP PROJECTS, PERTH, WA

2005 - 2014 ENGINEERING DISCIPLINE LEADER – HYDROLOGY, BHP BILLITON NICKEL WEST, PERTH, WA

**MINE DEWATERING****Hydrogeological/Geotechnical**

- Kambalda Nickel Operations, Mariners Nickel Mine. Investigation of water bearing structures arising from hanging wall failure. Implementation of dewatering and grout sealing.
- Kambalda Nickel Operations, St Ives Gold Mines. Investigation and remediation of leaky shaft liners at Mittel and Junction Mines.
- Perseverance Deeps Underground Nickel Project WA. Investigation of shaft and mine dewatering requirements.
- Cliffs Underground Nickel Mine, WA . Development and operation hydrogeological investigations
- Mt Keith and Leinster Open Pits. Pit slope drainage and depressurisation design for geotechnical design specification.

**Dewatering/Depressurisation Systems**

- St Ives Gold Mines Revenge, North Orchin, Africa, Argo Pits and Revenge Underground Mine. Archaean rock and Tertiary sediments, host rocks.
- Hill 50 -Gold Mines. Star underground mine dewatering system.
- Leinster Nickel Operations, 11 Mile Pit. Evaluation of dewatering and long term environmental impacts of a mine connected to a substantial fresh water aquifer system
- Olympic Dam Operations, Junction Gold Mine, Cliffs Nickel Mine. Grouting and drainage systems for leaky service shafts to underground mines
- Whaleback Mine – Acting Hydrogeology Superintendent. Mine dewatering plan and infrastructure optimisation.

**Water Hazard Assessment**

- Surface and groundwater hazard assessment for Leinster Nickel Operations, Kambalda Nickel Operations and St Ives Gold Mines. Mine water control plan documentation.

**Hydrology**

- Stormwater hydrology and hydrogeology for water inrush hazard evaluation for mines at Kambalda and Leinster
- Final void catchment hydrology for mines at Leinster
- Mine stormwater drainage design for mines at Leinster
- Evaluation of rainfall-runoff relationships for catchment yield to dams and artificial storage and recovery systems at Phosphate Hill, Qld
- Yakabindie Nickel Project, WA. Jones Creek Diversion design
- Cerro Matoso Nickel Mine - Colombia – Pit hydrology, drainage, pumping and discharge system design

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**WATER SUPPLY****Mt Keith Nickel Operations - Western Australia**

- 30 ML/d Supply. Yilgarn Tertiary Palaeochannel Source. Directed geological and geophysical exploration programmes. Designed wellfields. Numerical modelling for conceptual design and resource assessment
- Expansion Study. 30 ML/d ongoing. Directed exploration programs. Designed wellfields, scope of work for feasibility study

**Olympic Dam Operations - South Australia**

- Wellfield B 33 ML/d. Great Artesian Basin Mesozoic Basin Source. Background geological and geophysical studies. Conceptual borefield design, numerical flow model, environmental impacts assessment, consultation with regulatory authorities, bore designs, contract management, project supervision. Operations phase reporting and advisory role.
- Expansion Concept Study. 60 ML/d. Economic, social, environmental assessment of range of potential water supply expansion options. Murray river, seawater desalination, Great Artesian Basin groundwater, local groundwater and process water recycling options. Scoping and implementation of field investigations for groundwater studies.
- Expansion Pre-Feasibility Study. 70 ML/d. Great Artesian Basin Source – mapping basin architecture- seismic and gravity surveys, integrated structural interpretation. Deep basin drilling contract, targeting, contract management, consultant management. Reservoir modelling, environmental impacts assessment. Stuart Shelf Source – exploration methodologies, drill program management. Arckaringa Basin Source – Concept development, desktop studies, investigation methodologies, program management
- Water Studies Reviewer - Desalination studies, water recycling studies, mine dewatering studies

**Escondida - Chile**

- IPR groundwater resource review for water supply expansion project. Cenozoic inter-montane volcanoclastic basins. Geology, geophysics, hydrology, modelling and related commercial/tenure aspects.

**Phosphate Hill Operations - Queensland**

- 19 ML/d Cambrian Graben Source. Water supply/dewatering model.

**Zarmitan Gold Project - Uzbekistan**

- Feasibility Study, Cenozoic Intermontane Basin. Regional data evaluation. Liaison with local authorities and local technical specialists.

**Escondida Water Supply Expansion Study -Chile**

- IPR for evaluation of water supply expansion options

**Operational Water Supply - General**

- Western Australian Operations - Fractured Rock and Palaeochannel Sources. Hill 50 Gold Operations, Leinster Nickel Operations, Agnew Gold Operations. St Ives Gold Operations. Central Norseman Gold Operations. Routine consulting, supply upgrades, reporting.

**ENVIRONMENTAL WATER MANAGEMENT****Mine/Plant Water Retaining Structures**

- Investigations, regulatory submissions, operation and remediation projects for tailings storage facilities, evaporation ponds and heap leach pads at Mt Keith Nickel Operations, Leinster Nickel Operations, Agnew Gold Operations, St Ives Gold Mines, Hill 50 Gold Mines, Phosphate Hill Operations Olympic Dam Operations, Ravensthorpe Nickel Operations, Escondida Mine, Carson Hill Gold Mine.
- Baseline hydrological, hydrogeological and geophysical studies. Monitoring system design. Ongoing monitoring data appraisal, risk assessment, reporting.

**Baseline Environmental Studies**

- Yakabindie Nickel Project, WA. Jones Creek catchment hydrology, soils, geochemistry. Subterranean fauna studies.
- Meliadine Gold Project, North West Territories, Canada. Programme Review, Data Management Systems.
- Zarmitan Gold Project, Uzbekistan. Design of Water Components of Environmental Baseline Study.
- Yeelirrie Project. WA. Groundwater modelling for water balance and environmental assessment Young Project. Saskatchewan, Canada. Due diligence on baseline groundwater studies for land acquisition, drilling, hydrogeology, modelling

**Environmental Reporting**

- Statutory reporting for ground and surface water monitoring systems for operations: St Ives Gold Mines, Olympic Dam Operations, Kambalda Nickel Operations, Mt Keith Operations, Leinster Nickel Operations, Ravensthorpe Nickel Operations.
- Surface and groundwater components of notices of intent, public environmental review and environmental impact statement.

**Special Environmental Projects**

- Olympic Dam Operations Wellfield A. Remediation of ground springs flow by groundwater re-injection.
- Kambalda Nickel Operations, Mariners Nickel Mine. Excess mine water disposal system, water treatment and groundwater re-injection systems, Liaison with DEP and WRC.
- Pit closure studies, St Ives Gold Mines. Case studies for WRC compilation of hydrological and hydrogeological issues of pit closure.
- Kalgoorlie Nickel Smelter. Soil geochemistry study. Extensive sampling and integration with regional soil geochemistry data sets.
- Mondo Minerals Talc Operations, Finland. Review of due diligence studies of mines, processing plants and TSF's. Issues including acid rock drainage from waste dumps and TSF, water treatment and discharge systems.
- Carson Hill Gold Mine, California, USA. Mine and leach pad post-closure submissions.
- HiFert Operations. Auditing of environmental water management of bulk fertiliser import, storage, modification, blending and distribution network in S.A. Vic and NSW.
- Leinster and Mt Keith Nickel Operations. Tailings seepage risks and impacts assessment for revision of environmental groundwater monitoring programmes
- Kwinana Nickel Refinery. Re-evaluation of contaminant plume mass and flux, revision of pump and treat remediation and monitoring systems.

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- Phosphate Hill Operations. Evaluation of impacts of 5GL/a mine dewatering discharge to Kolar Creek

## **PROFESSIONAL WORK HISTORY 1990-1992**

**PROJECT HYDROGEOLOGIST, WATER RESOURCES BRANCH, P.A.W.A., ALICE SPRINGS, NT.**

### **BOREFIELD ASSESSMENT INVESTIGATIONS**

- Revision of geological mapping, hydrogeology, monitoring requirements, bore performance, pumping schedules and infrastructure planning for communities at Yuendumu, Santa Teresa and Finke.

### **GROUNDWATER EXPLORATION**

- Exploration programmes for small supplies in Hatches Creek Group, Georgina and Amadeus Basins and Arunta Complex Environments.

### **ENVIRONMENTAL**

- Water and salt balance study of Alice Springs Town Basin, including study of major ion and isotope chemistry of surface and groundwater.

## **PROFESSIONAL WORK HISTORY 1987 - 1990**

**HYDROGEOLOGIST ROCKWATER PTY LTD, PERTH, WA.**

### **GROUNDWATER EXPLORATION AND DEVELOPMENT IN SEDIMENTARY BASINS**

- Supervision of drilling, testing and rehabilitation of deep bores (to 700m) at Eneabba, WA. Supervision of exploration programmes at Bald Hill, Leinster and Coolgardie, WA, Supervision of drilling and testing at Katherine, NT. Computer simulation of aquifer response to borefield pumping.

### **GROUNDWATER EXPLORATION AND DEVELOPMENT IN CRYSTALLINE ROCK TERRAINS**

- Supervision of exploration programmes at Bottle Creek, New Celebration, Bald Hill (WA), Pajingo (QLD) and Moline (NT). Supervision of installation and testing of production bores at Transvaal, Telfer and Goongarrie (WA), Tarcoola (SA), Mt Todd (NT). Computer simulation of aquifer response to borefield pumping.

### **DEWATERING STUDIES**

- Supervision of drilling and testing programmes at Telfer, Eneabba, Jangardup, Cue - WA and Moline NT. Computer simulation of aquifer systems and assessment of dewatering requirements, operation of numerical models, including data analysis, conceptual model set-up, calibration and simulation.

### **GROUNDWATER ENGINEERING**

- Assessment of urbanization effects of residential developments. Modelling of proposed stormwater discharge systems. Slug and Packer tests for permeability in hard and soft rock.

### **ENVIRONMENTAL STUDIES**

- Computer simulation of a plume of contaminated groundwater from a tailings dam at Harbour Lights. Computer simulation of salt water encroachment into the shallow sedimentary aquifer at Mandurah due to a proposed canal development.

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**GROUNDWATER RESOURCE EVALUATION**

- Computer simulation of aquifer systems for borefield design and prediction of borefield performance, mine water supplies of up to 5,000 NI/yr, in Western Australia, Northern Territory and Queensland. Assessment of borefield monitoring data. Desk study of prospective resources in Tennant Creek area.

**GEOPHYSICAL LOGGING**

- Operation of Gearhart Owen and SIE equipment.

**PROFESSIONAL WORK HISTORY 1986-87**

**HYDROGEOLOGIST WORLEY CONSULTANTS, AUCKLAND, NZ.**

**OHINEWAI COAL PROSPECT**

- Dewatering study in Quaternary fluvial sediments. Pumping test monitoring, analysis of test data and assessment of hydrogeology. Simulation of pumping test data using numerical models. Involvement with calibration of dewatering model undertaken by Rheinbraun Consulting, Germany.

**PROPOSED WAINUI ROAD GOLD MILL SITE, MATATOKI**

- Simulation of leachate movement from tailings and sulphide concentrate disposal site, using computer based solute transport and groundwater flow models.

**PAPAKURA CITY COUNCIL**

- Evaluation of a computer based method to be used for geological mapping.

**PROFESSIONAL WORK HISTORY 1980-85**

**RESEARCH STUDENT AUCKLAND REGIONAL AUTHORITY WATER RESOURCES DIVISION, AUCKLAND UNIVERSITY, NZ.**

- MSc Thesis "Stratigraphic, Structural and Geophysical Studies of Neogene Sediments of the Manakau Lowlands". Thesis research was sponsored by the Auckland Regional Authority, to develop a structural and palaeogeographic model of the Pliocene Kaawa Shellbed aquifer.

**1983 - 1984 FIELD GEOLOGIST NEW ZEALAND GOLDFIELDS, PAEROA, NZ.**

- Surface and underground mapping and sampling, core logging and drafting, for an epithermal gold prospect.

**1980 ASSISTANT TO DISTRICT TECHNICIAN NEW ZEALAND FOREST SERV**

- Collection, reduction and summary of field data, mapping and financial estimates.