

ENGINEERS AUSTRALIA
Sydney Division



ENGINEERS
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NOMINATION OF

JUNCTION REEFS DAM

FOR AN

ENGINEERING HERITAGE AUSTRALIA
ENGINEERING HERITAGE RECOGNITION AWARD



Junction Reefs Dam, October 2010

PREPARED BY NORM HIMSLEY

August 2016

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Cover image courtesy of NSW Dams Safety Committee.

1. INTRODUCTION

Gold was discovered in 1870 by Martin Sheahan where the Mandurama Ponds creek meets the Belubula River some 7km northwest of Lyndhurst in NSW. Mining companies were formed soon after and the very fine nature of the gold tested all their ingenuity in its separation from the parent rock. It was necessary to grind the ore to a very fine state which required a great amount of power which was initially supplied by wood fired steam engines at great expense.

However, Lyndhurst Goldfields Ltd consolidated various gold mining claims at Junction Reefs and made use of the special features of the site, namely a good dam site and a large drop in the river height, to set up a dam and hydropower scheme as a power source for their crushers and mills. They employed (Carl) Oscar Schulze to design and implement this hydropower scheme.

2. STATEMENT OF SIGNIFICANCE

The construction of Junction Reefs Dam was highly significant, from a civil engineering point of view, as the first multi-arched dam built in Australia and for its predominantly hand-made brick work construction. It has the potential to reveal research information about dam building techniques and the utilisation of hydro power.

From a mining engineering aspect, it is historically significant as a pioneering place where hydro power was converted to mechanical power to enable the processing of gold ore and forms part of the classic history of development and advancement in mining engineering technology in the area and for all Australia.

The dam is unique to NSW and is aesthetically significant because of its graceful design utilising multiple arches and curved brick buttresses. Although the water body is substantially silted up, the dam wall is in excellent condition, some 120 years after construction and there are still remains of associated mining machinery in the area

The designer, Oscar Schulze, was a visionary who appreciated the value of alternative energy sources and was strong willed enough to proceed with his ideas even though criticised by his fellow engineers. He had a substantial input to various major engineering structures during his working life in NSW including the first railway bridge crossing of the Hawkesbury River.



Junction Reefs Dam during recent flooding. *Image: NSW Dams Safety Committee.*

3. LOCATION

The location of Junction Reefs Dam on the Belubula River, 7km north-west of Lyndhurst, in NSW is shown on the following satellite images (Figures 1 & 2).



Figure 1. Satellite image of NSW showing location of Junction Reefs. Image: Google Earth.



Figure 2. Local satellite image of Junction Reefs Dam location. Image: Google Earth.

4. HERITAGE RECOGNITION NOMINATION FORM

Learned Society Advisor
Engineering Heritage Australia
Engineers Australia
Engineering House
11 National Circuit
BARTON ACT 2600

Name of Work: Junction Reefs Dam

The above-mentioned work is nominated to be awarded a

Engineering Heritage National Marker

Location, including address and map grid reference

This nomination refers to the Junction Reefs dam located on the Belubula River, 7km north-west of Lyndhurst in NSW (see Section 3)

Latitude: 33° 37' 9.41" S


Longitude: 148° 59' 47.83" E

Owner (name and address): NSW Department of Primary Industries, 437 Hunter St, Newcastle NSW 2300. **The owner has been advised of this nomination and a letter of agreement is attached (to be done).**

Access to site: The dam is accessible by dirt road and foot. However public access is not permitted.

Nominating Body: Engineering Heritage Sydney.

Yours faithfully


PP **GLENN RIGDEN** S.A. WILTSCHER
Chair
Engineering Heritage Sydney

August ~~2016~~ 2017

5. OWNER'S LETTER OF AGREEMENT

Need to contact:

Guy Russell,

Manager Assets & Climate Change,

Department of Primary Industries, NSW

437 Hunter St, Newcastle NSW 2300

(02)49254148

guy.russell@crowland.nsw.gov.au

6. HISTORICAL SUMMARY

The history of this dam began in 1895 when Lyndhurst Goldfields Ltd, an English company, consolidated various gold mining claims at Junction Reefs. They financed the significant infrastructure to enable fine crushing of the gold ore from the site and extraction of gold from the ore using the recently developed cyanide leaching system.

Oscar Schulze, a German born engineer, was retained to design a 2,000 mega litre dam on the Belubula River and an associated hydropower system. This involved a low pressure steel pipeline running along the contour for about 1.4km downstream of the dam to a point, at which, four 375mm diameter penstocks were run about 60m down the hillside to drive Pelton turbines. The three largest turbines were 1.8m, 1.2m and 0.9m in diameter and drove the following equipment:

- 35 stamp batteries;
- Mills
- Air compressor for rock drills; and
- Vanners (a type of shaking table) and cyanide mixing equipment.

The fourth small turbine was used to generate electricity for lighting and other equipment.

The dam, Schulze designed and constructed, was a multi-arch buttress dam. It was completed in the short period of nine months and included approximately 4,600m³ of concrete, for the foundations and side walls, and over half a million bricks for the six buttresses and five contained arches. All the bricks were hand made on the site from local materials.

It is an amazing structure, listed on the NSW State Heritage Register as being of high state significance that has survived siltation, weathering and overtopping floods for around 120 years and remains in excellent condition after some remedial works in 2006.

7. BASIC DATA

Project Name:	Junction Reefs Dam (alternate name is Belubula Dam)
Owner:	NSW Department of Primary Industries
Location:	On the Belubula River some 7km northwest of Lyndhurst NSW
	Latitude: 33 ⁰ 37' 9.41" S Longitude: 148 ⁰ 59' 47.83" E
State:	New South Wales
Local Government Area:	Blayney
Designer:	Carl Oscar Schulze
Year commenced:	1895
Year completed:	1897
Constructor:	Carl Oscar Schulze for Lyndhurst Goldfields Ltd

Physical Description:

The dam is a concrete-brick multiple arch buttress dam which is 131m long and has a maximum height of 18.3m. There are five elliptical arches with an 8.5m span each and a 60⁰ lean supported by six arch shaped buttresses. The dam foundations and outside walls are made of concrete while the arches and buttresses are made of locally fired clay bricks. The original storage capacity was around 2,500ML but is now substantially silted. The dam was equipped with a large scour outlet system and a pipe outlet to supply the Pelton turbines some 1.5km downstream. The main spillway in the left abutment is an unlined rock stepped cascade which was originally gated but today is ungated.

Physical Condition: Good

Heritage Listings: NSW State Heritage Listing

8. DESCRIPTION OF PROJECT

Junction Reefs Dam is a multiple arch buttress dam which whose construction was completed in 1897 to provide water through an outlet pipe to provide hydropower for downstream gold ore processing facilities. Its length, including its bye wash on the left (eastern) abutment, is 131m and it is straight in plan. Its height to its deepest foundation is 18.3m with a maximum brickwork height of 11.2m.

There are six brick buttresses 8.53m apart at their centrelines, founded on concrete foundations, 3.6m wide at their crest, and forming a sextant of a circle 11m radius. These buttresses support five brick arches 1.2m thick at their bases tapering down to 0.5m thick at their crests and leaning at 60⁰ to the vertical. On each side of this central arch buttress section of the dam the wall was continued up into the hillsides to firm rock faces as concrete masonry.

The 20m wide bywash was originally divided into five sluice openings and a wingwall was built on rock foundations to lead stream flow clear of the dam. Allowance was also made for extreme flood flows to overtop the arch buttress section. There was a 1.5m race built in the foundation for diversion flows during construction which was closed with a wooden “cap” some 300mm thick after construction. The service outlet was carried through the main wall by a 600mm cast iron pipe.

The dam was constructed in the remarkable short period of nine months and contains some 4,500m³ of concrete in the foundations and side walls and around 500,000 bricks in the arches and buttresses. The bricks were produced on-site from local clays and around 5,000 casks of cement were used overall in the dam’s construction. The comparatively small amount of cement used is accounted for by the use of large boulders placed in the concrete pours wherever practicable. The total cost of the dam was less than 9,000 pounds.

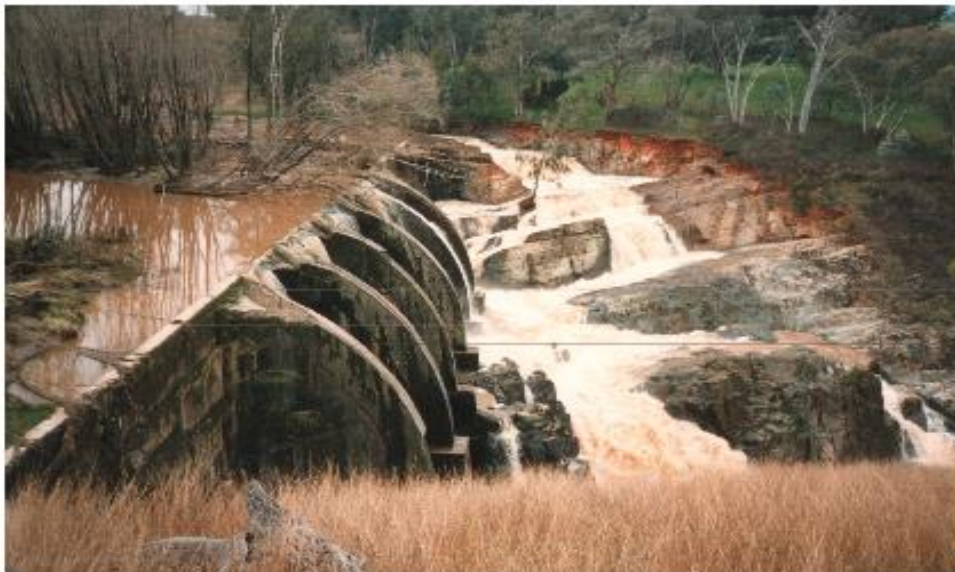


Figure 3. Junction Reefs Dam in current state. Image: NSW Dams Safety Committee.

9. EMINENT PERSON ASSOCIATED WITH THE PROJECT

Carl Oscar Schulze, or Oscar Schulze as he preferred to be known, was born on 1 August 1848 at Leipzig Germany. After living in Switzerland from 1865 to 1869, where he studied engineering, he moved to the United States where he lived from 1869 to 1876 where he had an interest in the construction of large wooden grain elevators in St Louis and other places.

He returned to Leipzig for a short time to construct the first Continental bulk grain store with elevator and cleansing machinery before moving to Sydney, arriving on 1 September 1879. He worked in the Blue Mountains area designing and operating equipment (eg cable ways) for the shale mines in the area. In 1886 he was appointed the resident consultant engineer for the Union Bridge Company of Pennsylvania for the construction of the world renowned first Railway Bridge crossing of the Hawkesbury River which was completed in 1889. He then continued his career as an engineering consultant based in NSW until his death in 1919.

Oscar Schulze's standing as a respected Sydney engineer is demonstrated by his presence at, and input into, the 1891 Royal Commission into the City and Suburban Railways.

His most noteworthy achievement was for his design and construction of the Junction Reefs Dam in 1895-97, which is recognised internationally as one of the earliest dams of this type and the first multi-arch dam in Australia.

10. HERITAGE ASSESSMENT

Historical Significance

The construction of Junction Reefs Dam was highly significant, from a civil engineering point of view, as the first multi-arched dam built in Australia and for its predominantly hand-made brick work construction. From a mining engineering aspect, it is historically significant as a pioneering place where hydro power was converted to mechanical power to enable the processing of gold ore.

Technical Achievement

Considering the remoteness of the site, limited transport and infrastructure, the construction of the Junction Reefs Dam and associated infrastructure in a nine month period was a significant technical achievement incorporating the substantial use of local materials (ie clay bricks).

Rarity

The dam is unique to NSW and was the first of its type built in Australia.

Representativeness

The dam forms part of the classic history of development and advancement in mining engineering technology in the area and for all Australia.

Research Potential

It has the potential to reveal research information about dam building techniques and the utilisation of hydro power.

Aesthetic Significance

The dam is aesthetically significant because of its graceful design utilising multiple arches and curved brick buttresses.

Integrity / Intactness

Although the water body is substantially silted up, the dam wall is in excellent condition, some 120 years after construction and there are still remains of associated mining machinery in the area

Social Significance

The designer, Oscar Schulze, was a visionary who appreciated the value of alternative energy sources and was strong willed enough to proceed with his ideas even though criticised by his fellow engineers. He had a substantial input to various major engineering structures during his working life in NSW including the first railway bridge crossing of the Hawkesbury River.

11. INTERPRETATION PLAN

It is understood that the site is currently closed to the public and fenced off with warning signs forbidding access.

Under these circumstances Engineering Heritage Australia policy would suggest that this site should be recommended for **Virtual Interpretation**.

If this arrangement is approved there will be no requirement for an unveiling ceremony or an interpretation panel. Information about the site will be available from the Engineering Heritage Australia web page, Heritage Register which can be found at:

<https://www.engineersaustralia.org.au/portal/heritage/search>

12. ACKNOWLEDGEMENTS

The author wishes to thank the following for their assistance in preparing this nomination:

NSW Dams Safety Committee.

13. REFERENCES

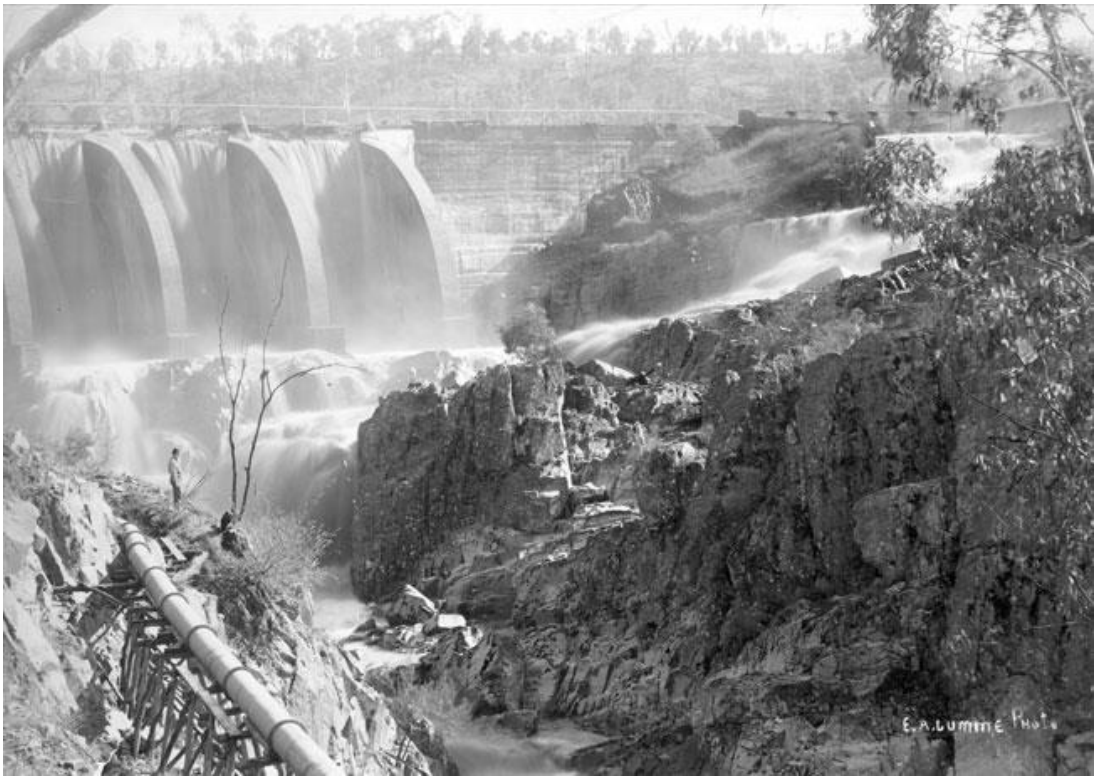
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14. AUTHOR

Norm Himsley

Member of the NSW Dams Safety Committee and private dams safety management consultant

APPENDIX 1 - PHOTOGRAPHS



Junction Reefs Dam with penstock in foreground. Date unknown but probably during period of operation of mine. *Image: E A Lumme.*



Junction Reefs Dam shortly after construction. *Image: E A Lumme.*



Junction Reefs Dam, September 2009. *Image: Source unknown.*



Junction Reefs Dam, early 2016. *Image: Miles Pierce*



Junction Reefs Dam from downstream, early 2016. Note remnants of penstock at left. *Image: Miles Pierce*



Junction Reefs Dam from upstream looking at the dam wall, early 2016. *Image: Miles Pierce*



Junction Reefs Dam outlet channel from the top of the dam wall, early 2016. Image: Miles Pierce



Junction Reefs Dam outlet channel from below the dam wall, early 2016.
Image: Miles Pierce

CHANGE CONTROL

VERSION 1 3 AUGUST 2016 INITIAL DRAFT

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