BROKEN HILL WATER SUPPLY

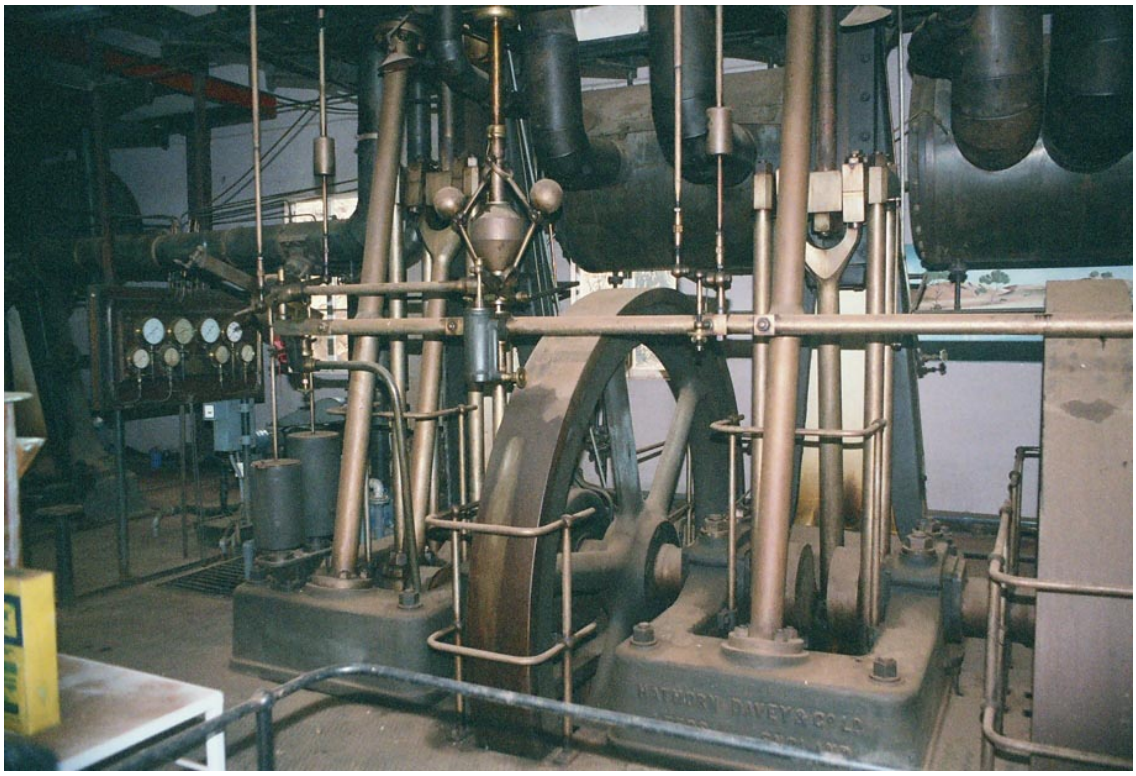
UMBERUMBERKA WATERWORKS

SUBMISSION TO

ENGINEERING HERITAGE AUSTRALIA

for an

HISTORICAL ENGINEERING MARKER



October 2008

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Introduction

Umberumberka Waterworks is an example of a well-engineered and constructed small town water supply scheme built in a very arid area of Australia in the early 20th Century.

Most of the original system is still in place except for the replacement of the original steam pumping engines in the very early years of the project and upgrade of some sections of the delivery pipeline. The steam pumping system was superseded by diesel driven pumps in 1960 however the steam plant was preserved.

The waterworks is still in service however other sources have been added as the water demand in Broken Hill grew over the years.

The Umberumberka Waterworks is nominated for a Historic Engineering Marker because:

a) It is one of the most complete surviving steam-driven water supply systems in Australia
b) It is an important part of the industrial and social development of Broken Hill
c) The major components of the waterworks are open for public inspection and provide a graphic demonstration of how a waterworks in a remote location worked nearly a century ago.

Plaque Nomination Form

NOTE: This form must be signed and submitted by the Chair of the relevant Division Engineering Heritage Group.

Name of work:
Umberumberka Waterworks

The above-mentioned work is nominated for the award of:
Historic Engineering Marker

Location including address and map grid reference if a fixed work:
Unberumberka Creek, 8.2km north of Silverton, Broken Hill WK2080

Owner:
Country Energy, PO Box 718, Queanbeyan, New South Wales, 2620, phone 13 23 56

The owner has been advised of this nomination, and a letter of agreement is attached

Access to site:
Public Access is available during business hours to the heritage parts of the pumping station site and continuous public access to the reservoir viewing area

Nominating Body: **Engineering Heritage South Australia**

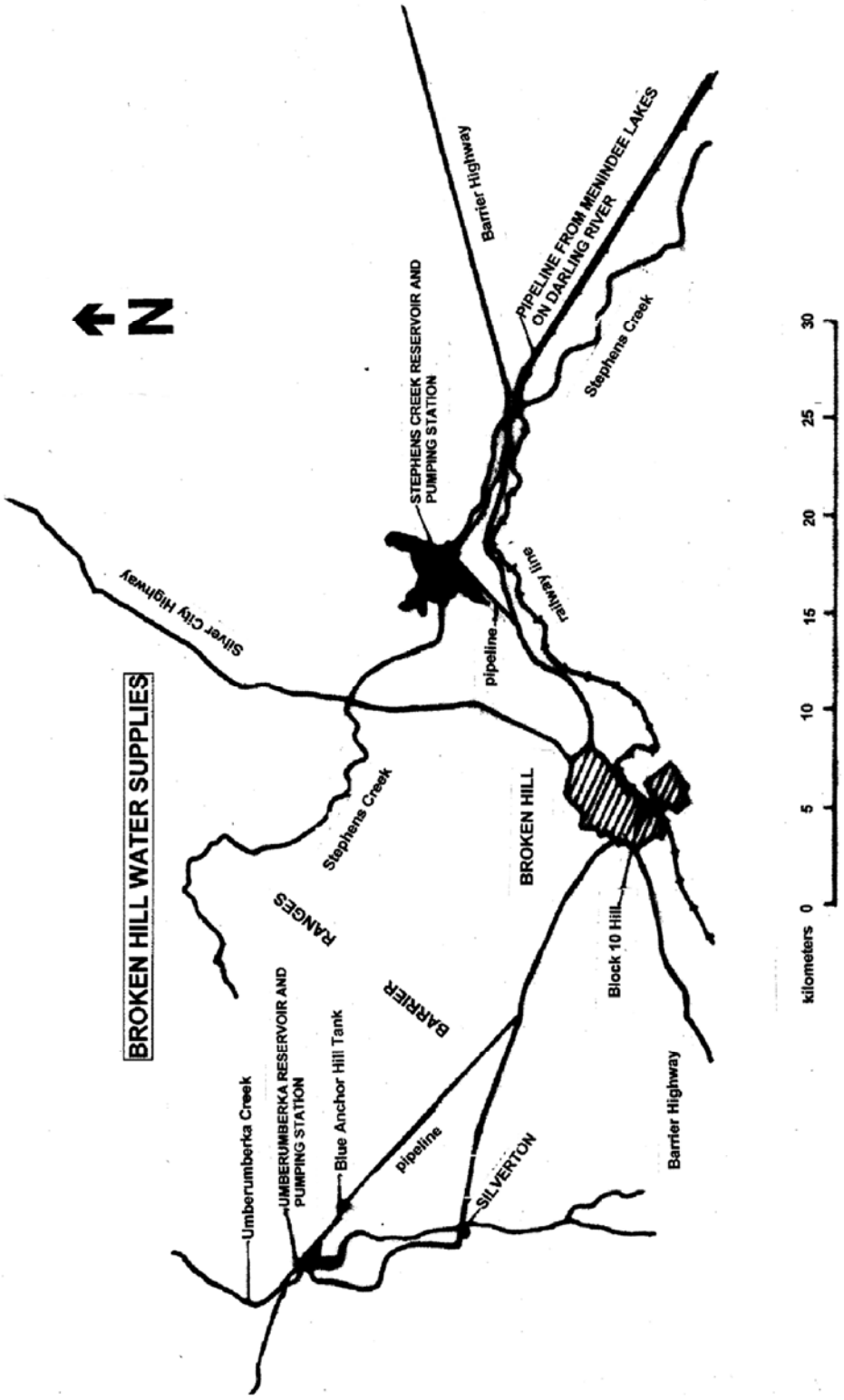
(signed)……..
For Nominating Body

This plaquing nomination is supported and is recommended for approval

(signed)…….
Chair, Engineering Heritage South Australia

After signing, forward to:
The Administrator
Engineering Heritage Australia
Engineers Australia
Engineering House
11 National Circuit
BARTON ACT 2600

Location Map



Engineering Heritage Assessment

A) Basic Data

Item Name

Umberumberka Waterworks consists of Steam Pumping Station, Reservoir including dam, Balance Tank at Blue Anchor Hill, pipeline to Broken Hill and service reservoirs.

Other/Former Names:

Nil.

Location (grid reference if possible)

Far south western area of New South Wales 33km west of Broken Hill.

Umberumberka: 141°12.5' east, 31°48.8' south. Elevation 243 metres
Silverton: 141°13.43' east, 31°53.25' south, Elevation 237 metres
Broken Hill: 141°27.38' east, 31°57.37' south, Elevation 322 metres

AUSLIG Map Reference: Broken Hill WK2080

Address:

Unberumberka Creek, 8.2km north of Silverton

Nearest Town:

Silverton

State:

New South Wales

Local Government Area:

Umberumberka: Unincorporated Far West
Broken Hill town area: Broken Hill City Council

Owner:

Country Energy. On 1 July 2005 Country Energy and Australian Inland merged. Country Energy is a large utility serving most rural areas of New South Wales with electricity, and in some cases, water supply. It is owned by the New South Wales State Government.

Current Use:

Public water supply system principally. Steam pumping engines and boilers are maintained as engineering heritage and are open to the public within the compound of the pumping station which remains in water supply service.

Former Use:

Nil.

Designer:

New South Wales Public Works Department.

Maker/Builder:

Dam builder:	Not known
Manufacturer of initial pumping engines (boilers, engines and pumps)	R. Wolf, Engineers, London with works in Buckau and Salbke, Germany.
Manufacturer of replacement (1921) and additional (1926) pumping engines:	Hathorn, Davey & Co, Leeds, England.
Manufacturer of Boilers for Hathorn Davey engines:	Babcock & Wilcox, England.
Construction contractor:	Not known

Chronology of Events

Failed start (abandoned):	1903
Second start:	1911
Completed and commissioned:	mid 1915
First machine of second generation pumping engines	1921
Second machine of second generation pumping engines	1926

Physical Description:

The Umberumberka Waterworks project was built as a complete supply system consisting of dam and reservoir, steam pumping station, rising main pipeline to a balance tank on Blue Anchor Hill 2.7 km south east of Umberumberka Pumping Station and a gravity main from Blue Anchor Hill to Broken Hill a distance of 25 km delivering to a pair of service reservoirs at Block 10 Hill. Most of the original system is still in place except for the replacement of the original steam pumping engines in the very early years of the project (see Historical Notes below). The steam pumping system was superseded by diesel driven pumps in 1960 however the steam plant was preserved. The waterworks is still in service however other sources have been added as the water demand grew over the years.

The dam (see History Notes below) has remained largely un-altered since construction. In 1955, following a cloud burst, the main wall and the “little wall” (a saddle dam closing a valley 366 metres south of the main wall) were damaged by a surcharge of as much as 0.7 metres. The damage to the main wall consisted of light erosion at the foot of the wall which was repaired in 1958 in accordance with recommendations of the Department of Public Works. The damage to the foundations of the “little wall” was more serious and in 1959 a new wall was built.

The two original pumping engines was supplied by the company R. Wolf, Engineers, London and each had a capacity of 75,000 gallons per hour (some references say 83,000 gallons per hour) against a head of 490 feet. These pumping engines were of the type generally described as a “locomobile” (see **Plate 7**). That is to say the horizontal boiler formed the support structure for the steam engine which was built on top of the boiler. These engines were 250 horsepower each and were fitted with jet condensers, Wadham economiser, and underfeed stokers. They were coal-fired. The pumps were gear driven from the engines and consisted of Gwynne six-stage centrifugal pumps. This plant was not considered satisfactory although its defects are not detailed. The Wolf Company was an establishment of high repute so the failure of these engines is somewhat of a mystery.

The Wolf engines were apparently scrapped after removal. The actual date is unknown. A crankshaft reputed to be a part of one of these engines is located outside a shop called The Coin Carvery at Silverton (see **Plate 6**). Whilst is has not been possible to verify that the claim is correct the crankshaft is from a two cylinder engine and its size is generally consistent with a 250 horsepower engine. The shop owner also suggests that there may be “a few more fragments” at Umberumberka.

The Wolf pumping engines were replaced by a Hathorn Davey vertical inverted triple expansion pumping engine with a capacity of 96,000 gallons per hour in 1921. The engine was supplied through agents Messrs Franks Saunders Ltd, of Sydney. A second (apparently identical) unit was installed in 1926. This plant remained in service until 1960 when the Water Board decided to install diesel powered centrifugal pumps due to the high cost of coal. This plant remains in service whilst the steam pumps have been preserved and are on view to the public.

The Hathorn Davey engines (see **Plates 1,2,3**) are 300 horsepower each, triple expansion, fitted with Corliss valve gear and operated on superheated steam at 175 psi. The cylinder diameters are 16, 28 and 46 inch by 36 inch stroke. The normal operating speed ranged from 13 to 35 rpm. The pumps are located below the engines and are driven from the cross heads by push rods.

The pumps are vertical single acting triplex ram pumps with a diameter of 11 inches and 36 inch stroke. The rated capacity of 96,000 gallons per hour is

achieved against a total dynamic head of 545 feet. Both suction and delivery sides are fitted with air cushion chambers.

The two coal-fired boilers are Babcock & Wilcox 350 horsepower water tube single drum type with superheaters and rotative chain-grate mechanical stokers (see **Plate 5**). The heating surface area is 1650 square feet per boiler and they are rated at 175 psi.

All the steam pumping plant ceased operation in 1960 but is complete. Water Board employees have recognised the heritage value of the plant and have preserved it since it was closed down.

Physical Condition

The dam is still in service and has been maintained however there is now significant siltation of the reservoir resulting in a much reduced storage capacity.

The steam pumping plant consisting of the two Hathorn Davey steam engines and the two Babcock & Wilcox boilers are preserved. The engines are in a substantial steel-framed shed whilst the boilers are in the open. The original Wolf pumping engines has long since been removed and are not thought to have survived.

The pipeline is still in service and is maintained in operating condition although some sections have been replaced over the years.

The steel balance tank on Blue Anchor Hill is still in service.

Modifications and Dates

- Stephens Creek Dam commissioned This was the first formal water supply to Broken Hill) 1892
- Umberumberka Dam built 1912-1915
- Umberumberka Dam initial commissioning: mid 1915
- Replacement of Wolf pumping engine with first Hathorn Davey pumping engine: 1921
- Added second Hathorn Davey pumping engine: 1926
- Repairs to main dam wall after surcharge events: 1958
- Replacement of “little wall”: 1959
- Diesel-driven pumps installed and steam plant shut down but preserved: 1960

Historical Notes

Broken Hill is a remote mining town in the far west of New South Wales 1160 kilometres west of Sydney and 410 kilometres from Adelaide (Adelaide and Broken Hill both use Central Standard Time (CST). Broken Hill is only 45 kilometres from the South Australian border, has always had a closer association with South Australia

than with New South Wales and many locals consider that they are South Australians. A range of mining equipment, steam winders and stationary engines for the BHP mine were manufactured at Gawler in South Australia by May Brothers and James Martin foundries, establishing long term commercial and technical relationships between South Australia and Broken Hill.

The area is semi-desert and the town has struggled since mining commenced in 1883 to provide itself with water. The mines were a major world source of silver, lead and zinc and the town was the first enterprise of the Broken Hill Proprietary Company (BHP). BHP has held a legendary place in Australian development, being Australia's major steel producer as well as miner for much of the 20th century. The company is now part of the huge international company BHP Billiton Limited with world-wide interests. Mining continues at Broken Hill to this day by Perilya Broken Hill Ltd.

Like many of the towns in the arid Outback of Australia the story of water supply to Broken Hill is interesting and punctuated by problems and disasters. When mining started small dams, waterholes and wells were used as water sources but these soon became inadequate. In 1892 a private water company, the Broken Hill Water Supply Company Limited was formed and built the Stephens Creek Reservoir, 15 kilometres north east of Broken Hill, which continues in use today. This company continued to supply water until 1916 when the water supply was taken over by the New South Wales Department of Public Works. The Broken Hill Water Board was constituted in December 1938 and took over water supply services in 1939. The Broken Hill Water Board continued to be responsible for water supply & sewerage services in the town until 2000 when it was amalgamated with Australian inland Energy to form Australian Inland Energy and Water. Australian Inland Energy and Water was amalgamated with Country Energy in 2005.

Stephens Creek had insufficient capacity and by 1901 public protest led to the first proposal for a dam on the Umberumberka Creek, 33 kilometres north west of Broken Hill. The Department of Public Works prepared estimates for a dam of 690 million gallons which was sufficient for two years supply at the time. There was some delay in commencing the dam due to government scepticism that the mines would continue. Construction commenced in June 1903 during a period of severe drought however in August 1903 flood waters swept away the diversion works and the partially completed dam. The project was abandoned.

In 1907 the "Umberumberka Water Trust" prepared plans for a dam at a different site on Umberumberka Creek. The mines were to provide finance but commencement was delayed again by a downturn in metal prices. Following further public protest in 1908 the Department of Public Works took over the responsibility for financing and constructing the project.

Work commenced in 1912 and by 1914 the dam was storing water. By mid 1915 the works were completed including the dam, steam pumping station, 19 miles (30.4 km) of pipeline and a steel balance tank on Blue Anchor Hill in Broken Hill.
The concrete gravity dam (see **Plates 9 & 10**) is 85 feet high and extends 50 feet below the creek bed into bedrock. The dam is 680 feet long at the crest with a

spillway located 610 metres south of the main dam in a saddle. A smaller dam 3.6 metres high closes a saddle 366 metres south of the main dam.

The original capacity of the dam was 13.2 Megalitres but siltation had reduced this to 7.8 Megalitres by 1974. In fact by 1985 the silt against the back of the main wall had reached RL 14.1 metres compared to a Top Water Level of RL23.4 metres leaving a water depth of only 9.3 metres when the dam was full.

The delivery system consisted of a rising main steel pipeline to a steel balance tank on Blue Anchor Hill 2.7km from the Umberumberka Pumping Station. The balance tank is 20 feet in diameter and 40 feet high with a capacity of 75,000 gallons. The balance tank is at an elevation of approximately 360m (1181feet) and from this point water gravitates to Broken Hill. The total head difference between the pumping station and Blue Anchor Hill tank is about 120m (394feet) and under test the total head (including friction losses) averaged 510 feet (155m). The pipeline from Blue Anchor Hill to Broken Hill consisted primarily of wooden stave pipe 18 inches in diameter. In some places, where the pressure exceeded 350 feet of head (approximately 150 psi), steel pipe was used. These sections totalled 3.25 miles (5.2 km).

The wooden stave pipe construction was used extensively in the early days of water supply pipelines where wood was available. The pipe consisted of a number of wooden planks running parallel to the centre line of the pipe and wrapped with a continuous steel wire binding to contain the pressure. The joints in the wood were offset and water proofing was achieved by careful fitting and the liberal use of pitch coating. The pipes were usually run above ground or in a large open trench on concrete or brick support stools to avoid contact with surrounding backfill soil and subsequent rotting of the timber. The wood stave pipelines were of relatively low water pressure capability and were inherently high maintenance.

The head difference between Blue Anchor Hill and Broken Hill was 96 feet. In a test carried out in 1915 a flow rate of 91,000 gallons per hour was measured. Quite high rates of leakage from the wood stave pipeline was reported to be around one gallon per minute per mile. It was reported that this was “improving” with time.

An early reference (Victories of the Engineer, Archibald Williams, Thomas Nelson & Sons, after 1907) states that wood stave pipes were not used where the internal pressure exceeded 90 pounds per square inch.

Samples of the original pipe are on display at the Umberumberka Pumping Station (see **Plate 8**).

At the Broken Hill end of this pipeline there were two service reservoirs at Block 10 Hill (1km south west of the town centre between the present Wills Street and South Road), which was close to the railway goods sheds. These were built of gravity section cyclopean concrete walls, 18 feet deep. The “town” reservoir was 100 feet diameter giving a capacity of 1 million gallons whilst the “mines” reservoir was 77.5 feet diameter with a capacity of 0.5 million gallons. The tanks were roofed with galvanised iron.

A bank of four Candy pressure filters was built adjacent to the service reservoirs configured so that the “town” water was filtered but the “mines” water was not.

The reticulation to the town and mines was carried out with “Mannesmann” steel pipes ranging in diameter from 22 inches to 3 inches. There were a total of 62 miles of mains laid. Total consumption of water in 1915 was estimated at 12.5 million gallons per week or about 1.8 million gallons per day which was approximately 82% of the capacity of the Umberumberka supply system.

There was further augmentation of Broken Hill water supply in 1952 when a pipeline was commissioned to deliver water from the Menindee Lakes, adjacent to the Darling River, 104 kilometres to the south east of Broken Hill. This pipeline ends at the old Stephens Creek Reservoir from where it is delivered to the town. Prior to this pipeline being completed water was delivered from Menindee by train. At present supply is taken both from Stephens Creek (which is in turn supplied from Menindee) and from Umberumberka. Pumping costs from Umberumberka are higher however the water quality is good which saves on water treatment costs.

Heritage Listing:

Not listed by NSW Heritage Council

Existing Plaques:

There is a brass plaque mounted in the reservoir precinct which states “This tablet is erected to the memory of George Sidney Mullen assistant engineer Dept Public Works NSW under whose supervision these works for the supply of water to Broken Hill were constructed in 1912-15 and who was accidentally drowned in Sydney Harbour in the latter year”

B) Assessment of Significance

Historic Phase:

Mining commenced in Broken Hill in 1883 and the silver, lead and zinc source in the Barrier Range proved to be world class.

Water was a problem from the start both for supply to the mines and the local community. The Stephens Creek Reservoir, completed in 1892, provided the first permanent water supply scheme. However this was not enough to meet demand and, after long delays, Umberumberka Reservoir was commissioned in 1915. This improved the situation but later water was brought from the Menindee Lakes on the Darling River to the east and pumped into Stephens Creek for on-forwarding to Broken Hill.

The Umberumberka supply was reinforced with a change in pumping engine technology in 1921 and a second engine was added in 1926.

The Umberumberka system remains in service although its capacity has been reduced by siltation of the reservoir. The 1921/1926 steam pumping engines have been preserved since they were retired in 1960.

Historic Individuals of Association:

Charles Rasp (1846-1907)

Charles Rasp discovered the Broken Hill "Line of Lode" and was the principal player in the establishment of the Broken Hill Proprietary Company (BHP). He was born in Stuttgart, Germany on 7 October 1846 as Hieronymous Salvator Lopez von Pereira. He started work as a clerk in a large chemical firm and later trained as an edible-oil technologist. He was delicate and in the winter of 1868 contracted a serious lung disease. He left Germany to find a warmer climate and arrived in Melbourne in 1869. He moved around finding work on rural properties for some time and eventually took a job as a boundary rider on Mount Gipps Station near Silverton, NSW. His work took him to the vicinity of the 'hill' which he thought contained mineralisation although he had no geology training. On 5 September 1883 he pegged the first claim on the 'Broken Hill' which he thought was a mountain of tin.

A 'syndicate of seven', including Rasp, formed the unregistered Broken Hill Mining Company and they commenced a disappointing search for tin. In 1885 they realised that the ore was silver and formed the Broken Hill Proprietary Company (BHP). The company then grew rapidly as it developed the 7.5km by 2.5m ore body. Within five years Rasp had made a fortune.

BHP left Broken Hill in 1939 but other companies took over the operation which peaked in 1952 employing 6500 people and continues today.

Rasp married Agnes Maria Louise Klevesahl in Adelaide in 1886. Later Rasp had mining interests in Western Australia. He died suddenly of a heart attack in 1907 and is buried in the North Road Cemetery, Adelaide.

George Sidney Mullen (---- -1915)

Mullen was an assistant engineer for the Public Works Department of New South Wales. He supervised the building of the Umberumberka Waterworks during the period 1912-15. He was accidentally drowned in Sydney Harbour in 1915.

Creative or Technical Achievement:

The civil work and pumping plant installed were current good engineering practice at the time of installation but contained no unique design features.

One important design feature which was somewhat unusual (but not unique) in Australia was the use of wood stave pipeline construction for the gravity delivery section from Blue Anchor Hill to Broken Hill.

The installation of such competent plant in such a remote location and in the service of a mining town was notable. This ensured long service for the scheme.

Research Potential:

Much detail of the Umberumberka scheme and its associations remains to be discovered. Although we are fortunate that the majority of the physical evidence has remained intact the story of the Umberumberka scheme is far from complete.

One aspect which requires further research is the fuel efficiency of the pumping plant. The original Woolf pumping engine was a compound engine whilst the later Hathorn, Davey engines were triple expansion. The use of these two types in the same installation and providing the same duty presents an opportunity to demonstrate the real efficiency differences between the two types if convincing recorded data can be found. It should however, be kept in mind that the Wolf engines drove their pumps using gears which may have contributed to them having had a lower efficiency that the Hathorn Davey engines which where the pumps were direct-coupled to the engines and operated at the same speed.

The completeness of the fabric of the scheme enhances the research potential. Few schemes anywhere remain in such a complete state.

Social:

<u>The Key Role of Water</u>

Umberumberka Waterworks provided the thriving mining town of Broken Hill with a long term, well engineered solution to its water supply problem. Mining towns in the Australian arid areas often developed, or failed, based on the solutions to their water supply needs. Even today mining operations in arid areas are often limited by water supply considerations. Mineral processing can require prodigious quantities of water, in addition to the domestic needs of the populations of the mining towns which grow up around the mines. The present quest for water to supply the proposed expansion of the huge Olympic Dam copper and uranium mine in northern South Australia is a further example of the problem of mining in arid areas. In this instance BHP Billiton (the descendent of the company which developed Broken Hill) proposes to desalinate seawater and pump it to the mine more than 220km from the ocean.

<u>Water Famine</u>

In 1892 there was a serious breakdown of water supply in the town. This was reported by The “Illustrated Australian News” amongst others. “The water famine is becoming more serious every day. Many of the wells in and around the town, from which the poorer classes of the community and stock have been getting water, are showing signs of failing. As a rule they are not springs

but merely drainages from surrounding rocks, and produce only a meagre supply…. "

"Broken Hill is now practically dependent for its domestic supply on the water trains which are run daily by the South Australian Government under arrangement with the New South Wales authorities. The arrival of the train at the station, and the rush of the water carts for the supply…. At the outset the facilities for emptying the trucks were very poor and owing to the slow way in which this work was carried out it was only possible to send one train of 10 trucks daily instead of two…."

"The weather continues very hot, and half the town is absolutely without water. The poorer classes who live furthest from the heart of the town, are suffering worst, owing to the carters being bribed to sell the loads when on the way to the distant parts. So eager are the purchasers that in many cases they bribe the carters to let them have water already sold by offering 30s. to £2 per 100 gallons. In the meantime water is being sold for domestic purposes from abandoned shafts, wells, old cattle tanks from which the remaining water is scooped up from amongst dead rabbits, the droppings of stock and other impurities. So impure is much of the supply that a serious epidemic is almost certain to ensue, especially as the inhabitants are reduced to living on about 4 pints each per day, which necessarily means that cleanliness cannot be observed".

"Much blame has been cast on the New South Wales authorities for neglecting to provide against such a contingency by establishing a permanent supply. From the reports of the officers attached to his department, as well as from information derived from private sources, Mr Slattery, Minister for Mines, says the water difficulty at Broken Hill does not appear to be so serious as is represented in some quarters…. Premier Dibbs intends to make arrangements for rain producing experiments at Broken Hill by means of explosives. The experiments will be carried out under the supervision of government officials".

Broken Hill's Community Resolve

The Broken Hill community has revolved around mining for more than 120 years and continues to see itself as a mining community. This community has dealt with the cost in lives and effort from working in the deep mines. It is attuned to the influences of corporate greed and government indifference on its continued survival. It is well aware that it is part of the rich industrial history of this country and that the mines below it provided the early growth to a mining company which came to not only dominate Australian mining but to dominate the mining world – the immense BHP Billiton.

This community has fought and won some of the great issues in the development of Australian society. It was a cradle of the Australian industrial relations system and more than a century later it is still very much a "union town" in a world where organised labour has become less popular. This community has struggled to obtain reasonable services in The Outback and

has placed high value on the educational, health and other services for which it has fought. Broken Hill was in the vanguard when the Royal Flying Doctor Service and the School of the Air were fighting for recognition as relevant ways to use new technology to address the tyranny of distance.

This community is well aware of its vulnerabilities and is well aware of the frailties of its water supply and the key role this supply plays in the success or otherwise of the mining operations as well as the community. Umberumberka Waterworks (together with the other water supply systems which supply the town) is therefore seen as a key part of the town's infrastructure, a part of the glue that holds the community together and a critical part of the town's survival. Mining communities like Broken Hill, which have had to fight hard for the survival of their communities are jealous of the key elements which help them to support their community. In Broken Hill the simple ability to turn on a tap and have clean flow from it is not taken lightly.

Rarity:

The plant which forms the Umberumberka Waterworks is not rare in global context but is quite rare in Australian terms. The engineering design principles which were used had been well developed in the late 19th Century in the United Kingdom as populations migrated from the country to towns and cities due to the pressures of the Industrial Revolution and started to demand more sophisticated public services. Clean reticulated water was the first need which had to be met followed by sewerage, paved roads, schools, hospitals and later reticulated gas and electricity supplies.

These needs soon spread throughout a rapidly industrialising world and then to the colonies of the great European powers including New South Wales.

The New South Wales Department of Public Works designed and built quite sophisticated water supply systems from the last two decades of the 19th Century, well into the 20th Century. They were typical of plants built in the United Kingdom and in other colonies. These plants were built with substantial civil engineering structures which have survived, in many cases, well over a century of service, and specified the best quality machinery from manufacturers of high repute. Much of the design was conservative which provided a bonus to future generations who pushed the old systems well beyond their original design parameters, particularly during times of national emergency such as during the two World Wars.

The machinery at Umberumberka Waterworks (as it currently stands) came from two manufacturers of high international reputation – Hathorn Davey (pumping engines) and Babcock & Wilcox (boilers). The standard, well-proven, reliable, highly maintainable products of these companies became well known throughout the world and were often copied.

Australia has been particularly careless with the preservation of this class of industrial heritage and there are only a very few such installations remaining. Only one other example of a well preserved colonial-era small-town water

supply system remains in Australia and that is the Appleby beam engine and its buildings and associated engineering works at Goulburn in New South Wales. Another significant survivor, although not in such good condition as Umberumberka or Goulburn, is the pair of Hathorn Davey pumping engines on the Burdekin River near Charters Towers in Queensland fitted with the remarkable Davey Differential System of control. Fragments of some other systems remain.

What is becoming increasingly rare, anywhere in the world, is to find so many elements of a complete waterworks scheme still intact after such a long time. All the key elements in this scheme are still present:

- Reservoir
- Steam Pumping Engines
- Steam Boilers
- Rising Main
- Balance tank on Blue Anchor Hill
- Gravity main to Broken Hill

This greatly increases the heritage value of the remaining infrastructure.

Furthermore the reservoir site still contains remnants of the flying fox used in the construction of the dam, 1912 cement mixers and cement barrels used to build the dam. These remnants may be unique in Australia.

Representativeness:

This installation is highly representative of public water supply systems built in the late Victorian era and early in the 20th century before reticulated electricity became widely available. The use of steam pumping equipment would have been usual in this era although this installation was a little unusual in that the fuel used was coal which had to be imported from South Australia by rail and from Silverton by road. Inland remote sites were more usually wood-fired.

This system has strong parallels with the much larger sewerage pumping station at Spotswood in Melbourne. The same pumping engine configuration was employed in both cases and they were both coal-fired and both had very long service lives. The pumping engines were derived from the same manufacturer – Hathorn Davey. At Umberumberka the two engines were manufactured by the company whilst at Spotswood one was manufactured by Hathorn Davey whilst the remaining four were copies manufactured by a Melbourne company, Austral Otis Elevator & Engineering Company Ltd.

This system has some parallels with the very large mine dewatering pumping installation at Beaconsfield in Tasmania. Force pumps (reciprocating, single acting) were employed in each case and the engine manufacturer, Hathorn, Davey & Company was common to both sites.

This system also has some parallels to the Goulburn water supply pumping system although Goulburn is somewhat older (1889) and employs a beam

pumping engine. Nevertheless both are steam powered, coal-fired and installed to exploit a local water source for the benefit of the local town. These systems were very much a part of the towns they served.

This system has some parallels to the Charters Towers water supply system in Queensland. Although the Charters Towers system pumped from a run-of-the-river situation (no dam) and was wood-fired the steam engine manufacturer was Hathorn, Davey & Co in both cases and there are strong resemblances between the delivery systems to towns some considerable distance away. In both these cases there were two pumping engines installed to share the duty. The Charters Towers system is also somewhat older than Umberumberka (1887).

Integrity/Intactness:

Much of the fabric of the scheme remains in place and some of it is still in service.

B) Statement of Significance:

Statement

The Umberumberka Waterworks is significant for:

- the constant battle to provide sufficient water of reasonable quality for a vigorous world-class mining operation in a very remote and arid area;
- the use of pumping equipment from two well regarded and influential manufacturers;
- the importance of the development of Broken Hill and its iconic owner, the Broken Hill Proprietary Company (BHP) to the industrial development of the nation;
- the retention and public display of the reservoir, the Hathorn, Davey pumping engines and the Babcock & Wilcox boilers;
- the completeness of the Umberumberka Waterworks fabric after more that 90 years of service to Broken Hill.

Assessed Significance: State

Draft Citation for Plaque:

Umberumberka Waterworks

Mining for silver, lead and zinc commenced at Broken Hill in 1883. Water supply was critical for the town from the earliest times. A water supply system was built at Stephens Creek north east of Broken Hill in 1892 and as the town expanded more water was required. After much delay the Umberumberka project was commissioned in 1915 and continues in operation today. Broken Hill is still threatened by water shortages as supply from the Darling River is affected by a changing environment.

The Institution of Engineers Australia
Country Energy

83 words – central text

Additional Information

1) Summary of Large Steam Pumping Installations in Australia

Location	Umberumberka, New South Wales	Stephen's Creek, New South Wales	Dights Falls, Victoria	Spotswood, Victoria	Beaconsfield, Tasmania	Charters Towers, Queensland
Maker	Hathorn Davey	Austral Otis■ (Worthington type)	Austral Otis■ (Worthington type) ▼	Austral Otis (4 units)■ and Hathorn Davey (1 unit)	Hathorn Davey	Hathorn Davey
Year commissioned	1921 and 1926	1892	1891	1900-1914	1905-06	1887 and 1890
Number of units installed and status	2 ▲ preserved	2 none survive	1 none survive	5 ▲ preserved	3▲ none survive	2 survive, not restored
Type of engine	Inverted vertical triple expansion	Duplex horizontal triple expansion	Duplex horizontal triple expansion direct-acting	Inverted vertical triple expansion	2 cylinder horizontal compound with Davey differential control	2 cylinder vertical compound with Davey differential control
Piston diameter (in)	16,28,46	9,12,21	11,18.5,29	20,36,54	50,108	21,37
Piston stroke (in)	36	15	21	42	120	66
Pump rate (each unit)	96,000 GPH	26,000 GPH	120,000GPH	8 MGPD (333,333 GPH)	2.16 MGPD (90,000 GPH)	20,000 GPH
Head (ft)	545	450	Not known	Not known	1500	Not known
Function	Public Water Supply	Public Water Supply	Irrigation Water Supply	Sewerage Main Outfall Lift	Mine Drainage	Public Water Supply
Engine Efficiency Steam consumption/ PHP/hour (pounds)	Test #1 = 10.58 Test #2 = 10.65				Specified to not exceed 16.5	

■ Austral Otis was a replicator with works in Melbourne

▲Earlier equipment which does not survive was installed at this site

▼A 240 horsepower Bellis & Morcom steam engine was installed in this pumping station in 1912 and an 80 horsepower Blackstone oil engine in 1927. These pumps operated occasionally until 1957.

2) Stephens Creek Reservoir and Pumping Station

The following information is taken from a short article in The Engineer of 6 May 1892, page 381.

In 1890 there were two rival schemes for the supply of water to Broken Hill. After considerable difficulty, and loss of time, the Broken Hill Water Supply, Limited obtained an Act of Parliament in New South Wales, to construct its scheme at Stephen's Creek. This scheme was developed by Mr George Gordon M. Inst. C.E. and was designed to supply 1,500,000 gallons per day from a dam to be constructed at Stephen's Creel 11 miles [north east] from Broken Hill. The reservoir to be formed would have a capacity to store two years supply after making allowance for evaporation. Water was to be supplied to a service reservoir in Broken Hill through riveted steel pipes of 14in., 16in. and 18in. diameter.

The pumping equipment was supplied and erected by Austral Otis Engineering Company, Limited of South Melbourne who designed and constructed the pumping engines.

The pumping station had two pumping engines of a design resembling Worthington. The engines were horizontal duplex direct-acting non-rotative with triple expansion steam cylinders of 9in., 12in. and 21in. diameter and a 15in. stroke. The order of cylinders from the pump (drive) end is intermediate pressure, low pressure and high pressure. The engines are designed to be usually worked at 110 feet per minute piston speed. The intermediate and low pressure cylinders are steam jacketed and supplied with live steam. The drains from the jackets are taken to the hot well. All cylinders are lagged with asbestos and cedar wood. The jet condensers and air pumps are driven from the tail rods of the high pressure cylinders.

Steam is supplied at 120 pounds per square inch by two Babcock and Wilcox water-tube boilers.

The pump plungers are 8½ in. diameter giving a capacity of 625,000 gallons per day for each pump against a total head of 450feet. The pump plungers are of gunmetal, externally packed. The pump valves have gunmetal seats and faces and are each 4in. diameter.

These pumping engines and associated plant have been scrapped however the date of their removal is not known.

3) Specific Outstanding Questions to be Answered

A number of specific questions have not been answered during the collection of material for this paper. The following is a list of key questions still to be answered:

- What was the reason for the failure of the Wolf pumping engines at Umberumberka Pumping Station to perform?
- What happened to the Wolf pumping engines when they were taken out of service at Umberumberka?
- When was the wood stave pipeline between Blue Anchor Hill and Broken Hill replaced by steel pipe?
- What happened to the Austral Otis pumping engines when they were taken out of service at Stephen's Creek?
- Who was the contractor for the construction of the Umberumberka Dam?
- Who was the contractor for the Umberumberka Pumping Station?
- Who was the design engineer for the Umberumberka scheme?
- What is the current status of the service reservoirs at Block 10 Hill?

Appendices:

A) Owners Permission Letter:

Copy not attached to this version

B) References

- Broken Hill Water Board, Umberumberka Dam – A Brief History, dated not known.
- The Engineer, The Water Supply of Broken Hill, Australia, May 6, 1892, pages 381and 386.
- The Commonwealth Engineer, Broken Hill Mines and Town Supply, July 1, 1915, pages 418/9.
- The Commonwealth Engineer, Broken Hill Water Supply, July 1, 1923, page 453.
- The Commonwealth Engineer, The Water Supply of Broken Hill, N.S.W, October 1, 1925, page 87.
- Archibald Williams, Victories of the Engineer, Second Edition, about 1907, pages 293-299.
- Graeme Inson and Russel Ward, The Glorious Years, 1971, pages 54-55.
- Catalogue, R.Wolf Engineers London, Patent Superheated Steam Locomobiles, about 1910.
- Victorian Historical Journal Vol 67, No.1, April 1996.

C) Illustrations

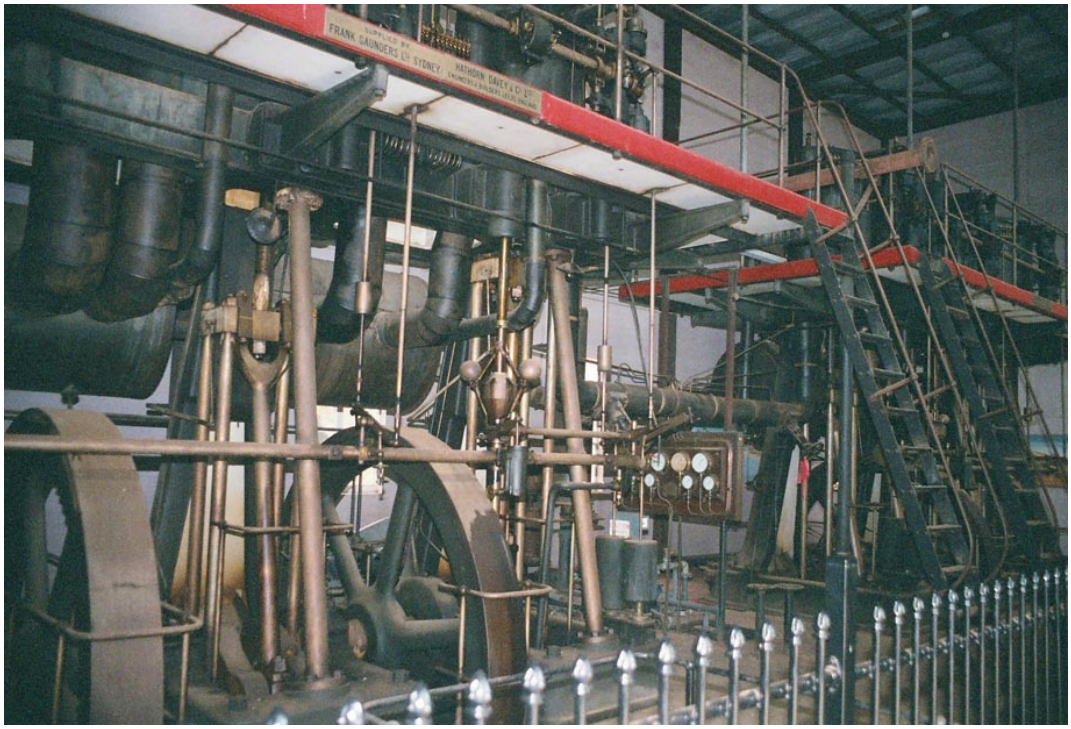


Plate 1. Umberumberka Pumping Station. The two Hathorn Davey triple expansion vertical inverted steam pumping engines.

Plate 2. Umberumberka Pumping Station. The two Hathorn Davey triple expansion vertical inverted steam pumping engines.

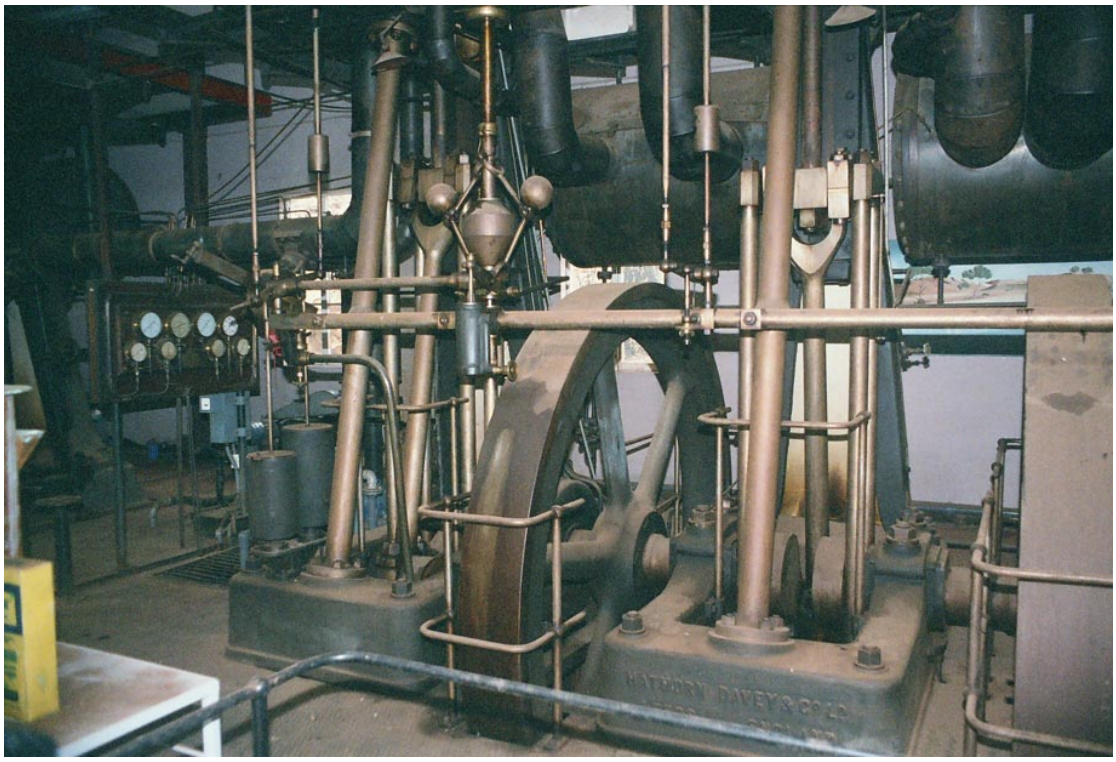


Plate 3. Umberumberka Pumping Station. Flywheels and connecting rods of one of the Hathorn Davey triple expansion vertical inverted steam pumping engines. The pumps are below the floor and are driven by the four parallel rods passing down close to the crankshaft from the crosshead. There were three pumps driven by each engine – one for each steam cylinder.

Plate 4. Umberumberka Pumping Station. Flue and Chimney Base behind boilers. The chimney was placed on the escarpment to increase its effective height.

Plate 5. Umberumberka Pumping Station. Two Babcock and Wilcox water tube boilers which supplied steam to the Hathorn Davey pumping engines.

Plate 6. Crankshaft believed to be from one of the Wolf pumping engines originally installed at Umberumberka Pumping Station in 1915. The crankshaft is located in front of a shop in Silverton township a few kilometers from the pumping station. This may be all that remains of the original engines.

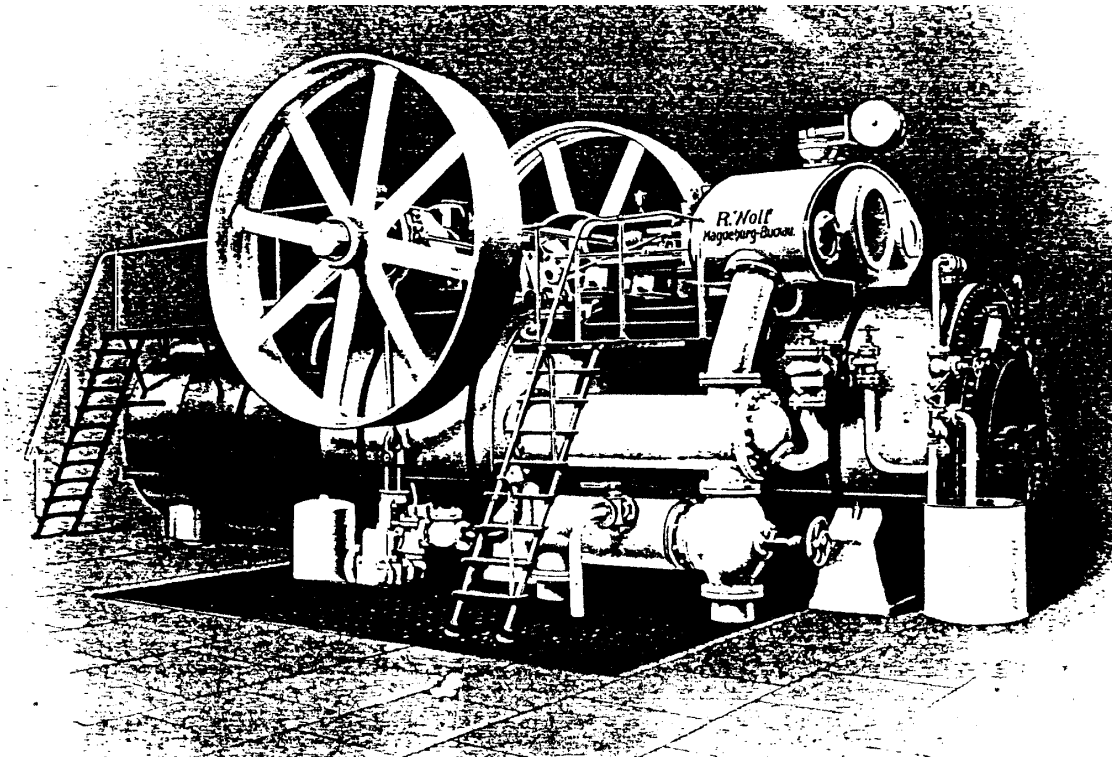


Plate 7. Wolf Locomobile 250 horsepower “overtype” steam engine of the type originally installed in the Umberumberka Pumping Station in 1915. The exact engine type is not known. This illustration is of a Wolf Class SL engine.

Plate 8. Sections of woodstave pipeline removed from the Umberumberka to Broken Hill gravity pipeline installed in 1915. The wires wrapped around the timber section contain the internal pressure.

Plate 9. Umberumberka Reservoir from the public viewing point looking at the upstream side of the dam wall. This photograph was taken in September 2002 when the water level was quite low and not far above the silt level.

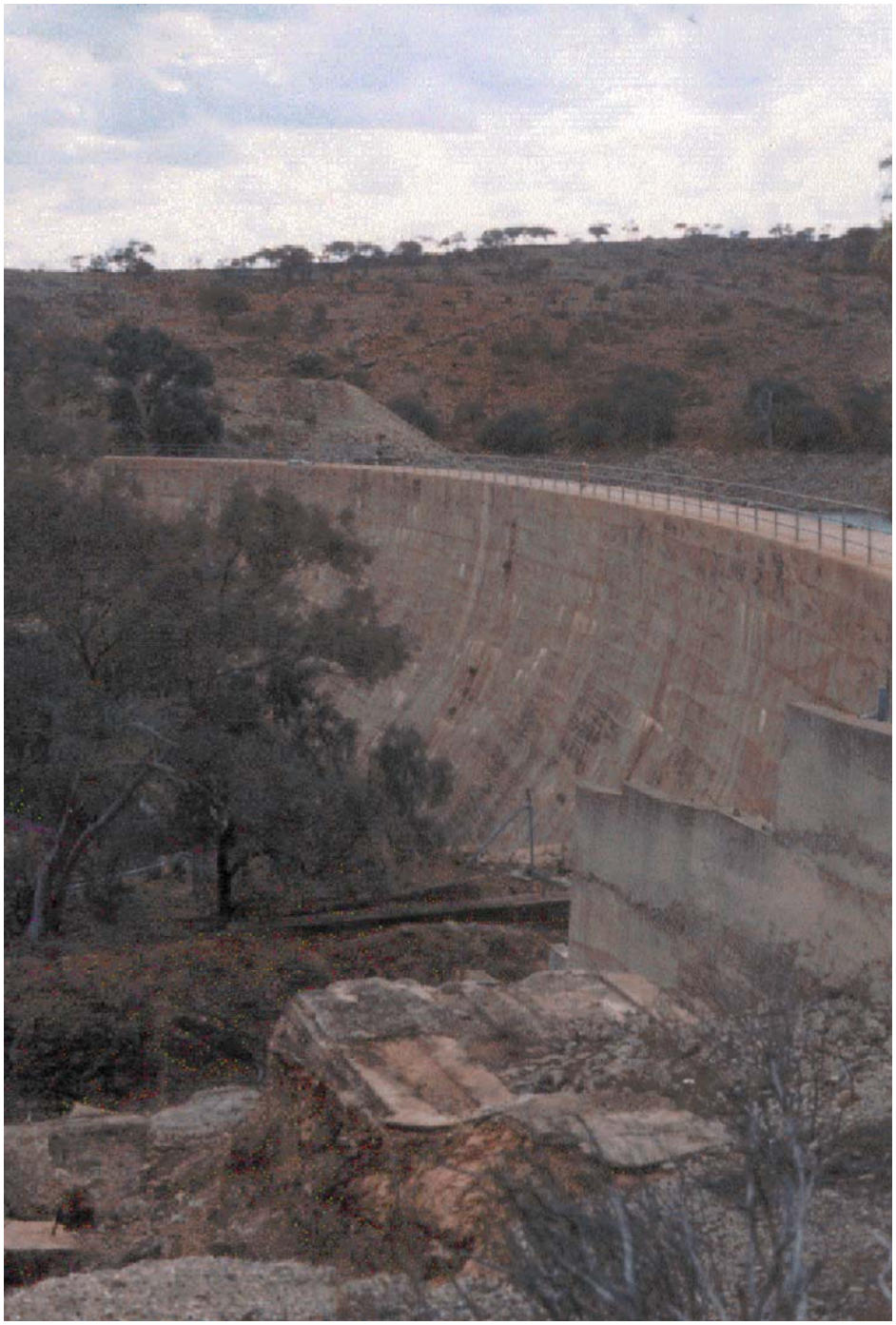


Plate 10. Umberumberka Reservoir from the public viewing point looking at the downstream side of the dam wall. This photograph was taken in September 2002.

D) Evolution of Citation

Original draft by Owen Peake 2006

Umberumberka Waterworks

Mining for silver, lead and zinc commenced at Broken Hill in 1883. Water supply was critical for the town from the earliest times. A water supply system was built at Stephens Creek north east of Broken Hill in 1892 and as the town expanded more water was required. After much delay the Umberumberka project was commissioned in 1915 and continues in operation today. Broken Hill is still threatened by water shortages as supply from the Darling River is affected by a changing environment.

The Institution of Engineers Australia
Country Energy

Analysis by Bruce Cole 16 June 2009

I feel that Owen's wording dwells too much on aspects other than Umberumberka itself, i.e. previous and post water supplies. There is not enough space on the marker to put the scheme fully in context.
A citation should say what it is, who did it and why it is important.

What is it?
It is a water supply for Broken Hill mine and towns.
Its main components are a reservoir on Umberumberka Creek, a steam pumping station and a pipeline to the town. It supplemented the earlier Stephens Creek scheme.

Who did it?
The NSW Public Works Department designed the scheme. Asst Engineer George Mullins supervised its construction in 1915.

Why is it important?
It was essential for the continued development of Broken Hill mining.
The steam plant operated until 1960.
Most of the machinery remains on display.
The current scheme remains in operation today.

Citation draft 2 by Bruce Cole 16 June 2009

ENGINEERING HERITAGE MARKER

Umberumberka Waterworks

Designed by the NSW Public Works Department to augment the supply to Broken Hill mining and township, the waterworks consists of a reservoir, steam pumping station, rising main and 25 km pipeline. Assistant Engineer George Mullins supervised its construction in 1915. The scheme was critical for the continued development of rich silver, lead and zinc mining. The dam and most of the early machinery remains, and the scheme with new equipment continues in operation today.

The Institution of Engineers Australia
Country Energy 2009

OWEN PEAKE FRMIT FIEAust CPEng
International Stationary Steam Engine Society (ISSES),
Australian Representative
Engineering Heritage Australia, Executive Member

7 November 2006