HERITAGE COUNCIL OF WESTERN AUSTRALIA

REGISTER OF HERITAGE PLACES – ASSESSMENT DOCUMENTATION

11. ASSESSMENT OF CULTURAL HERITAGE SIGNIFICANCE

The criteria adopted by the Heritage Council in November 1996 have been used to determine the cultural heritage significance of the place.

PRINCIPAL AUSTRALIAN HISTORIC THEME(S)

- 3.11.5 Establishing water supplies
- 4.2 Supplying urban services (power, transport, fire prevention roads, water, light and sewerage)

HERITAGE COUNCIL OF WESTERN AUSTRALIA THEME(S)

404 Community services and utilities

- 507 Water, power, major transport routes

11. 1 AESTHETIC VALUE*

Victoria Reservoir (fmr) has a simple but elegant curved form and is set within a picturesque valley landscape, surrounded by State Forest. The area in front of the dam wall features a landscaped pond and picnic facilities within an informal bushland garden. (Criterion 1.1)

As the remains of a substantial engineering structure which had a considerable impact on the surrounding natural landscape, *Victoria Reservoir (fmr)* is an important cultural environment, which, since its decommissioning, has become a pleasing and distinct feature of the landscape. (Criterion 1.3)

Victoria Reservoir (fmr) was the first water reservoir in the Darling Range catchment area, and became, until its decommissioning in 1990, an integral component of an important cultural environment that has continuously supplied Perth with water since 1891. (Criterion 1.4)

11. 2. HISTORIC VALUE

Victoria Reservoir (fmr), the first public water supply source in the Darling Range, began as a private enterprise venture, which provided only parts of the City of Perth with reticulated water from 1891, and continued as the first dam in an expanding government-operated public water supply system. (Criterion 2.1)

Victoria Reservoir (fmr) is closely associated with prominent entrepreneur Edward Keane, engineer and manager of the Midland Railway Company, who was the original promoter for the reservoir; with Dr William Traylen, a leading

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* For consistency, all references to architectural style are taken from Apperly, R., Irving, R., Reynolds, P. *A Pictorial Guide to Identifying Australian Architecture. Styles and Terms from 1788 to the Present,* Angus and Roberston, North Ryde, 1989.
For consistency, all references to garden and landscape types and styles are taken from Ramsay, J. *Parks, Gardens and Special Trees: A Classification and Assessment Method for the Register of the National Estate,* Australian Government Publishing Service, Canberra, 1991, with additional reference to Richards, O. *Theoretical Framework for Designed Landscapes in WA*, unpublished report, 1997.

campaigner on public health issues; and with F.W. Lawson, engineer. (Criterion 2.2)

11. 3. SCIENTIFIC VALUE

Victoria Reservoir (fmr) was constructed using rocks and hand-mixed cement to create a concrete gravity-arch dam. The use of concrete for the construction of dam walls utilized building techniques that were innovative and technologically advanced for the time. (Criterion 3.1)

11. 4. SOCIAL VALUE

Victoria Reservoir (fmr) is valued by the local community for its historic associations and for its aesthetic quality in the Munday Brook valley. (Criterion 4.1)

Victoria Reservoir (fmr) is important in contributing to the local community's sense of place and features in published histories of the Kalamunda district. (Criterion 4.2)

Victoria Reservoir (fmr) is valued by bushwalking groups, especially for its historical associations. (Criterion 4.2)

12. DEGREE OF SIGNIFICANCE

12. 1. RARITY

Victoria Reservoir (fmr) is rare as a gravity-arch dam and as a nineteenth century dam constructed of concrete, and is one of only a few large dams constructed of concrete in Western Australia. (Criterion 5.1)

12. 2 REPRESENTATIVENESS

Victoria Reservoir (fmr) is representative of a concrete gravity-arch dam constructed in Western Australia in the late nineteenth century, which uses the weight of a solid mass of concrete in an arched form to retain water. (Criterion 6.1)

Victoria Reservoir (fmr) is representative of the establishment of water storage facilities in the Darling Range in the 1890s to improve the standard of public health by the provision of a safe and adequate potable water supply, which was further consolidated by the launch of the "Hills Scheme" by the Western Australian Premier, Sir James Mitchell, in the 1920's. (Criterion 6.1)

12. 3 CONDITION

Victoria Reservoir (fmr) is in fair condition. Structurally, the concrete in the dam is of poor quality and has a history of leakage. In 1988 the Water Authority decided that the dam did not have acceptable levels of safety under modern design criteria for flood and earthquake loadings. The concrete in the dam was of such poor quality that the dam could not be adequately rehabilitated. Nevertheless the remains of the dam and its surrounding setting are well maintained.

12. 4 INTEGRITY

Victoria Reservoir (fmr) has a low degree of integrity. It functioned as a water reservoir from 1891 until 1991 when it was decommissioned and replaced by the New Victoria Dam. It is no longer used to retain or store water.

12. 5 AUTHENTICITY

Victoria Reservoir (fmr) has a high level of authenticity. A number of modifications were carried out over its lifetime to ensure its continuous use, including changes to the spillways and repairs to the dam walls.

The dam was originally constructed with two small spillways, one on each abutment. In 1939 the right abutment spillway was closed off and the top 1.2 metres of a section of wall on the left abutment was broken off to form a new spillway. In 1988 the spillway was lowered by a further 2 metres. Repairs were carried out to the concrete walls to prevent leakage as early as 1912. In 1966 a reinforced concrete upstream facing was installed to successfully reduce seepage through the wall.

In 1989 when the decision was made to replace *Victoria Reservoir (fmr)* with a new larger dam further upstream, sufficient of the original wall was demolished, using explosives, to allow free passage of flood overflow from the New Victoria Dam. Although a large section of the wall has been removed, the original form is still evident, and the opening has revealed an informative cross-section through the wall.

13. SUPPORTING EVIDENCE

The documentation for this place is based on the heritage assessment completed by by Wayne Moredoundt, Historian, and Palassis Architects in January 2004, with amendments and/or additions by HCWA staff and the Register Committee.

13. 1 DOCUMENTARY EVIDENCE

Victoria Reservoir (fmr), located in a valley in Carmel on the Munday Brook, comprises a random rubble concrete gravity-arch dam wall with mortar render, formerly used as a water storage reservoir with a capacity of 9.08 Gigalitres (Gl), completed in 1891, and forming Perth's first permanent public water supply.

The first stimulus for settlement in the area that is now the Shire of Kalamunda, of which the locality of Carmel forms part, was provided by the rich jarrah forests of the Darling Range. In 1864, Benjamin Mason acquired a license to cut timber over an area of 260 hectares in what is now the locality of Carmel. By 1871, Mason's timber concession had expanded to 40,000 hectares, subject to the construction of a tramway from the Darling Range to the Cannington Landing on the Canning River. In partnership with Francis Bird, Mason had the tramway completed by January 1872, but there were, from the outset, problems with the reliability of the system. These difficulties combined with strong competition from other mills in the Range to bring about the closure of Mason's Mill in 1882.[1]

By this time, two other settlers had established properties in this part of the Darling Range, having moved out from Guildford in search of cheap, fertile land. In 1873, William Mead acquired a 16-hectare lot in the south-east corner of what is now the locality of Gooseberry Hill. In addition to a small orchard, Mead also grazed sheep on his land. In 1881, the Stirk family moved onto a 4-hectare allotment at the top of the scarp. Situated on the track from the old timber mill down to Guildford (now Kalamunda Road) this was fertile land, well suited for market gardening.[2]

While Stirk, Mead and others had realized the agricultural potential of this part of the Darling Range, the problem of access and communication continued to impede the further development of the Kalamunda District. By the mid-1880s, however, new rail lines connected outlying parts of Perth to the capital and its port. With the opening of the Guildford-Perth-Fremantle line in 1886, suburban settlements were established around railway stations along the route. Soon afterwards, the railway network was extended to York via Chidlow Wells.[3]

A beneficiary of this improvement in the transport of goods and people was the timber industry, which grew rapidly now that the railway provided a more efficient link from mills to the seaports. To take advantage of this situation, Edward Keane, engineer and manager of the Midland Railway Company, proposed the construction of a rail line down the escarpment, linking the abandoned Mason-Bird Mill to Midland (and on to Fremantle). The State Government approved Keane's proposal for exclusive rights to cut timber over the previous Mason-Bird concession, subject to the construction of a railway. As part of the arrangement with the State Government, Keane's zig-zag railway was to carry the public and the general freight of the area. This agreement continued until the end of 1899, at which time the Government had the right to purchase the line.[4]

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1 Philip J. Bonser, 'Kalamunda: The Evolution of a Suburban Settlement', M. Arch. Thesis, University of Western Australia, 1980, p. 17.

2 *Western Mail*, 8 October 1931.

3 Bonser, 'Kalmunda', pp. 19-20.

4 Bonser, 'Kalmunda', pp. 20-21.

By the end of July 1891, the railway was completed. The course of the line was through Bushmead to the foot of the Hills at Maida Vale, then up the escarpment in three zig-zag stages to Gooseberry Hill. From there, it ran to Stirk's Landing, Guppy's Siding, Twelve Mile Siding, Heidelburg, Green's Landing, Monument Hill and Pickering Brook to Canning Mills. Although Canning Mills, with a population of around 400, was the centre of activity in this part of the Range, each of the sidings and landings represented settled landholdings.[5]

From these stop-over points and population centres, settlers took up land, particularly for orchards, and so the population within the Kalamunda area gradually increased. The large growth in the State's population between the mid-1890s and the middle of the first decade of the twentieth century also provided an impetus for the expansion of Kalamunda. Population increase created a high demand for agricultural produce and so a greater incentive for settlement in the Darling Range, an area now known for its productive soil.[6]

Prior to the late 1880s, the State Government had minimal involvement in the supply of fresh water for the general population. It provided wells at intervals on main roads and stock routes as these became necessary, and water supplies for shipping were provided at ports such as Fremantle, Albany and Geraldton, but supply for the general population was the responsibility of the individual householder and business or property owner.[7]

One of the major users of water was the railway, where good quality water was required for the steam locomotives. After the completion of the second section of the Eastern Railway between Guildford and 'Chidlow's Well' in 1884, the issue of water supply came to the fore when water had to be carried long distances during the summer to service the route. As a result, the first railway dam was built at Clackline in 1887, to catch water from the Clackline Gully and enable the service on the Eastern Railway extension to Toodyay.[8]

Water supply for the population of Perth and suburbs was usually met by the use of rainwater tanks or wells, but the former were often unable to provide sufficient water during Perth's long, dry summer, while the latter were susceptible to contamination by septic systems and other pollutants. Concern about a safe supply of potable water for the residents of Perth led to the appointment of a Parliamentary Commission, appointed by the Governor on 7 November 1884 to 'inquire into and report on the sanitary conditions of the City of Perth and the Town of Fremantle, especially with regard to the question of water supply and the disposal of sewage'.[9]

After the Parliamentary Commission issued their report, attempts were made to implement the recommendations contained therein; namely that a Central Board of Health be appointed; that Perth, Fremantle and Guildford required separate consideration in the short-term; and that schemes for a Darling Range-based water supply be developed. The Government was to commission designs for a water catchment dam and associated works, on which interested private parties could submit proposals.[10]

In June 1887, two local consulting engineers, Saunders and Barrat, who were also Perth City Councillors, submitted a detailed proposal for a water supply for

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5 Bonser, 'Kalmunda', p. 21.

6 Bonser, 'Kalmunda', p. 21.

7 J. S. H. LePage, *Building a State: the Story of the Public Works Department of Western Australia, 1829-1985*, WAWA, Perth, 1989, p. 263.

8 LePage, *Building a State*, pp. 263-264.

9 *Parliamentary Paper (Western Australian Parliament)*, 1885, # 20.

10 LePage, *Building a State*, p. 158.

both Perth and Fremantle, based on a source at Munday Brook in the Darling Range, south of the old Mason and Bird timber mill, in Carmel. Perth supported the scheme, but Fremantle, with its own scheme under way, rejected it.[11] The Saunders and Barratt scheme was referred to the Legislative Council in August 1887, but no immediate action was forthcoming. Following Perth City Council elections in November 1888, Dr Edward Scott, who had campaigned largely on the issue of a water supply, was elected Mayor. In February 1889, he gained Council's support to conduct a referendum of ratepayers on the matter. This was held on 13 March 1889, and majority support for the water supply proposal was recorded.[12]

An attempt to enlist Government financial assistance in August 1889 was unsuccessful, leaving Council with the alternatives of proceeding with the scheme itself, or negotiating with a private entrepreneur. Deciding on the latter course, the Council rejected an offer from Watson and Co. but accepted a scheme submitted by Edward Keane, representing the Melbourne-based Neil McNeil and Co., which had purchased the amended Saunders and Barratt scheme. An agreement was signed on 21 October 1889 for construction over the next two years.[13]

The *Water Works Act 1889,* 'An Act to enable Municipal Council to construct Water Works, or to Contract for a Water Supply', was given Royal Assent on 4 December 1889, and provided the legal framework for the scheme. Construction of the reservoir began in February 1890. The works included the reservoir itself, 17 miles of 12 inch trunk main to a 784,000 gallon service reservoir at Mount Eliza, and a reticulated supply to consumers.[14]

In building the reservoir, 21,000 casks of Portland cement, each weighing around sixty kilograms, and the mains and distribution pipe work was imported from England. The cement and other materials were transported from Perth up to the site by horse and dray, using the original Mason track running alongside the wooden tramway still standing in the bushland.[15]

The wall of the reservoir was built by manual labour, utilizing rocks from the site, with hand-mixed cement used for the final surface. *Victoria Reservoir (fmr)* was designed as a fully arched gravity wall construction with the substantial mass of the wall holding back the weight of water behind. The dam wall was 60 feet (18m) high, 48 feet (14.5m) wide at the base, tapering to 3 feet 6 inches (1.06m) at the top. The dam had a capacity of 240 million gallons (1,091 million litres) and covered 40 acres when full. A pipeline was built to the Mount Eliza Reservoir, in Kings Park, from where water was supplied to the houses and businesses of the City.[16]

Victoria Reservoir (fmr) was officially opened at the beginning of October 1891, with a party of almost 200 guests in attendance. Among those present was Alexander Forrest; the Mayor of Perth and Manager of the Midland Railway Company, Edward Keane; former Premier, George Leake; Sir Winthrop Hackett; and other leading figures of the day. Notably absent was the Premier, John Forrest, who was laid low by a case of influenza.[17]

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11 In 1887, dual, partly underground reservoirs were constructed within the Fremantle Prison and supplied to houses in Fremantle. LePage, *Building a State*, pp. 156-157.

12 LePage, *Building a State*, pp. 158-159.

13 LePage, *Building a State*, pp. 159-160.

14 LePage, *Building a State*, pp. 159-160.

15 Slee, *Cala Munnda*, p. 58.

16 Slee, *Cala Munnda*, pp. 58-59.

17 *Western Mail*, 3 October 1891.

Guests had boarded a train at the Perth Railway Station, stopping at Guildford to take on more passengers and proceeding via Midland and the Zig-Zag Railway, which had been completed some three months previously. The guests arrived finally at a spot some 7 km from the dam site. According to the *Western Mail*:

> The spot where the party alighted is situated some four and a half miles from Mr Keane's mill and nearly three miles from the old and dismantled timber mill of Mason and Bird of some years back. At the place where the passengers disembarked a number of [horse-drawn] vehicles provided by the contractor were in waiting. They proved however insufficient to convey the whole of the passengers at once and therefore they were appropriated to the ladies' use, and most of the men set out to walk to the reservoir, which they were assured … was not more than a mile and a half distant. Unfortunately there are miles and miles- geographical miles and kangaroo miles- and the pedestrians found by experience that the distance they had to journey was composed of the latter. However, about an hour after landing at the fifteen mile [point] all the passengers reached their destination, and proceeded to inspect the reservoir.[18]

Mrs Lila Keane turned the valve to supply Perth with its first reticulated water, while Edward Keane delivered a short speech in which he informed the crowd that the Company had already spent £160,000 on the scheme, a sum substantially in excess of the expected cost, and 'were not going to throw it away'.[19]

In fact, the parties had negotiated an agreement under which the Company had the right to operate a water supply within the City for a period of twenty-five years. Provision was made in the deed for the Council to purchase the enterprise as a running concern, after ten years of operation, at a valuation determined from the paid-up capital of the Company, plus a premium of one third for 'goodwill'. For its part, the Company was to provide a minimum domestic water service or a metered service to a prescribed part of the City.[20]

Within two weeks of the water supply to the City commencing, ratepayers, angry with the large connection charges which the Company was levying on consumers, forced a public meeting to resolve the conflict. So it was that, within two months of the water supply commencing, a further agreement was concluded between the City of Perth Waterworks Company and the Perth City Council. As part of this agreement, the paid-up capital of the Company was acknowledged as £150,000, and the revised purchase price, inclusive of 'goodwill', was £200,000, the increased latter figure an acknowledgement of the Company's cost over-run.[21]

Not only were there problems with charges levied by the Company, the quality of the water in the Mount Eliza reservoir was also of concern to the Council. It was shown that *Victoria Reservoir (fmr)* had been polluted from the activities taking place at Keane's timber mill on adjacent ground. Not only was drainage from the camp entering *Victoria Reservoir (fmr)*, but there was evidence of typhoid being present in the camp.[22] An outcome of these concerns was the passing of the *Water Supply Preservation Act* (1892), which had the effect of placing the catchment basins and reservoirs of water supply areas under the jurisdiction and control of the Local Board of Health.[23]

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18 *Western Mail*, 3 October 1891.

19 *Western Mail*, 3 October 1891.

20 H.E. Hunt, *Perth's Early Water Supplies*, WA Division Institute of Engineers Australia, Perth, 1984, pp. 7-8.

21 Hunt, Perth's Early Water Supplies, p. 9.

22 *West Australian*, 21 December 1892, p. 6, 18 February 1893, p. 2.

23 Hunt, *Perth's Early Water Supplies,* p. 9.

Although Perth City Council opened negotiations to purchase the assets of the City of Perth Waterworks Company no agreement was reached.[24] Meanwhile, the situation for householders continued to deteriorate further. Some had no water at all, and others had little more than one or two hours a week of supply. Two private member's Bills in 1894 sought unsuccessfully to take over the Company, and by the summer of 1895-96 the water situation was more desperate than ever. In December 1895, the Perth City Council served a writ on the Company for not providing sufficient water. The Company retaliated by threatening to cut off the water supply completely. Low water pressures, water turned off at night, and other hardships provoked further public meetings which urged the Council to approach the State Government about purchasing the scheme.[25]

During the 1890s, the strains placed on an already inadequate water supply by an increase in population drawn by gold discoveries in the State proved almost unbearable. There were large tent settlements established in North Perth, East Perth and Subiaco, together with an increased number of people living in shanties and lodging houses. Finally, a severe outbreak of typhoid in June and July 1896 impelled the State Government to take over the scheme from the City of Perth Waterworks Company, with agreement reached in September 1896.[26]

The *Metropolitan Water Works Act* (1896), which received Royal Assent on 8 October 1896, appointed a Board to manage, maintain and improve the Perth water supply. The members of the Board appointed by the Government were Edward Keane, as Chairman; engineer, T.W. Hardwick; and architect, J.J. Talbot Hobbs. The fourth, an ex officio appointment, was the Mayor of Perth, in this case, Henry John Saunders, one of the engineers responsible for the design and planning of the original scheme. The Board's first financial responsibility was to repay to the Colonial Treasurer the £220,000 paid by the Government for the purchase of the scheme.[27]

Unfortunately, the Board had no time to make improvements to the water supply before the summer of 1896-97. To compound their problems, Perth experienced a cycle of drier than average weather; from 1891 to 1899 the average annual rainfall was reached only once. At the same time, water-borne typhoid was causing increasing problems, with 89 deaths in 1896 and 134 in 1897.[28]

Nonetheless, the Board took a number of steps to alleviate these problems in a timely manner. Pipes were ordered to increase the supply of water from *Victoria Reservoir (fmr)* to Mount Eliza six-fold, and to construct a further 36 miles of reticulation, but these pipes were not available for the summer of 1896-97. In addition, the Public Works department was undertaking a programme to drill for artesian water in the metropolitan area, with some success. A bore had been established at Midland Junction in January 1895, which delivered 266,000 gallons a day and an earthen dam was constructed to store 11,000,000 gallons of water. A bore was also sunk in the Perth Station Yard (near present Milligan Street) for the use of the railway. This supplied 400,000 gallons a day when completed in October 1896. The most successful bore was sunk at Guildford, where 1,000,000 gallons a day was delivered.[29]

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24 For details on the progress of negotiations: *West Australian* 14 July1893, 17 July 1893, 19 August 1893, 20 September 1893.

25 *West Australian*, 7 January 1896, p. 4.

26 *West Australian*, 31 July 1896; 3 August 1896, p. 2; LePage, *Building a State*, pp. 258-259.

27 *West Australian*, 3 August 1896; LePage, *Building a State*, p. 259.

28 *West Australian*, 13 January 1897, p. 5; 16 March 1897, p. 5.

29 LePage, *Building a State*, pp. 260-61.

While these measures were positive, the problem of pollution of *Victoria Reservoir (fmr)* continued. The prime source of pollution was from the camp at Canning Mills, still owned by Keane, also the Chairman of the Water Board. When a sample of the water from *Victoria Reservoir (fmr)* was tested in Melbourne in March 1897, it was found to contain typhoid bacillus and other disease organisms.[30] To counter this problem, the offending stream was diverted away from the *Victoria Reservoir (fmr)*, at an expense of £4,000 for the Board.

After a Select Parliamentary Committee, chaired by Premier Forrest, investigated Perth's water supply from August 1898, the existing Board resigned and a new Board was appointed, headed by public health campaigner, Dr William Traylen. The new Board introduced an unpopular increase in the price of water, began an aeration process to improve water quality, sunk more bores, and increased the capacity of *Victoria Reservoir (fmr)*. These measures resulted in deaths from typhoid decreasing from 134 in 1897 to 19 in 1899.[31]

In the 1899-1900 financial year, the Board requested the Public Works Department to construct an additional reservoir at Mount Eliza. The capacity was 2,400,000 gallons, and the £10,000 provided for this and associated works included a system of filtering. In the following year, the Public Works Department prepared a comprehensive scheme for supplying water to all municipalities from Midland Junction to Fremantle. The Department also began test drilling of a proposed dam site on the Canning River, which it had first surveyed in 1897. It not would be until 1940 that the Canning Dam was completed.[32]

In the first decade of the twentieth century, continuing problems with the quality and quantity of Perth's water supply led to a number of proposals for improvement. These included: the construction of a dam on the Helena or Canning Rivers, the drilling of more artesian bores, and the drawing of surplus water from the Mundaring Weir. The drilling of further bores to supplement the supply from *Victoria Reservoir (fmr)* was the scheme that was actually adopted during this period.[33]

In 1912, a single organisation was established to deal with the provision of drinking water and sewerage to Perth, with F.W. Lawson, an engineer from Sydney, appointed as its head. From the beginning, he set about establishing a foundation to cope with projected urban growth. The requirement for the provision of good quality water at Fremantle for shipping and railways was met by conveying water from *Victoria Reservoir (fmr)*, via a south of the river main and by joining to the Perth system the separate systems that had grown up around Fremantle and other parts of Perth Later, Armadale, Guildford and Midland Junction were added to a system of artesian wells, distributing mains and modern service reservoir equipment. Even at a time of disruption during and after the First World War, the number of people serviced by the scheme doubled to 178,000 in 1925 from 1912. There was also considerably more water available per consumer.[34]

The continuing weakness in the system was the insufficiency of storage in the Darling Range, and in 1912, bore water still constituted seventy per cent of Perth consumption. In 1920, Premier James Mitchell, consulting with his Victorian political counterparts rather than his Western Australian engineering advisors, arranged for E.G. Ritchie, an engineer of the Melbourne and Metropolitan Board

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30 *West Australian*, 16 March 1897, p. 5.

31 LePage, *Building a State*, p. 262.

32 LePage, *Building a State*, pp. 262-263.

33 Hunt, *Perth's Early Water Supplies*, pp. 20-24.

34 Hunt, *Perth's Early Water Supplies*, p. 25.

of Works to undertake a review of the various options available to increase and safeguard Perth's water supply. Ritchie's proposal for a rock and earth-fill dam on a tributary of the Canning River was not acted upon at that time.[35]

This inaction on the part of the State Government led to water restrictions in the summer of 1920-21. In 1921, supplies from the relatively small Upper and Lower Bickley Dams added to the water resources available to Perth, (though due to low pressure and poor water quality they were removed from the scheme in 1936) but by the summer of 1922-23, serious water shortages still emerged. The Press was forceful in condemning Government inaction. Under the headline, 'The Responsible Person Should Forthwith be Dismissed', the *Daily News* reported:

> Last night practically the whole city was without water, and the sorry spectacle was witnessed, even in Hay Street West, of mothers taking their pitchers to those who possessed wells, to obtain water to wash their children before putting them to bed.[36]

Premier Mitchell's attempt to placate the public with promises of an imminent announcement of a permanent end to water shortages was scorned by the newspaper:

> A decent water service is essential, but it has been an urgent matter for years … The Government knew [that a shortage] would occur this year, but ... sat back and trusted to luck … Now that Sir James Mitchell has made a definite promise that he will announce a new scheme at an early date, he should be constantly reminded of the fact, and be given no possible loophole through which he might avoid the obligation.[37]

In order to deal with these criticisms of his Government, Premier Mitchell announced a public meeting to be held in North Perth, at which he would deliver his plan for Perth's water supply. Subsequently, an audience of 2,000 heard the Premier announce his 'Hills scheme': a dam was to be built at Churchman's Brook, to be completed in two years, which would deliver two million gallons of water a day; a dam would be built at Wungong Brook, to be completed in four years, which would supply eight million gallons of water a day; and a large dam was to be built on the Canning River holding sixteen thousand, nine hundred million gallons of water, capable of supplying twenty-five million gallons a day, which would take about six years to complete.[38]

Work commenced on the 'Hills Scheme' with a pipe-head diversion structure at the Churchman site linked to Perth on 25 November 1925, while by the end of the following February, the Wungong and Canning pipe-heads were contributing to the Perth supply. Aided by a number of wetter than average years, these new sources extinguished any likelihood of harsh water restrictions. During the 1925-26 summer consumption exceed 18 million gallons in a day and, in the following year, more than ninety per cent of the City's water supply came from a Hills source, with half of it from the Canning and Wungong Rivers.[39]

Churchman Brook Dam was completed in 1929, while the Wungong Brook pipe-head dam was completed four years earlier. Despite its small size, the Wungong Brook pipe-head dam supplied more water to the metropolitan area than either Churchman Brook Reservoir or *Victoria Reservoir (fmr)*. In a good winter it could supply as much as 32,000 cubic metres a day. Although plans for a larger dam on the site were prepared, these were put aside when it was decided instead to build the major Canning Dam in the 1930s. It was not until the 1970s that

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35 Hunt, *Perth's Early Water Supplies*, pp. 27-28.

36 *Daily News*, 14 March 1923, p. 4.

37 *Daily News*, 14 March 1923, p. 4.

38 *West Australian*, 23 March 1923.

39 Hunt, *Perth's Early Water Supplies*, p. 32.

attention once again focused on the water resource potential of the Wungong River. Work on the current dam began in 1975 and was completed in 1979.[40]

On 6 September 1940, the Canning Dam was officially opened, although due to wartime conditions, the number of invited guests was restricted. In a speech later in the day at the local community hall, Premier J.C. Wilcock stated that:

> Today we are celebrating the completion of Western Australia's second really big water scheme. [The first being the Mundaring – Goldfields Scheme.] The Canning Dam with a storage capacity nearly five times that of Mundaring primarily will serve … those living in the metropolitan area. It will meet the water needs for Perth, for its industries, the health of its people and for the beautification of its surroundings … [41]

During the course of the 20th century, *Victoria Reservoir (fmr)* continued to supply a diminishing proportion of Perth's water supply, although it needed periodic maintenance to avoid structural failure. In 1939, the right spillway (originally there was a left and right side spillway on each abutment of the dam wall) was closed off and the top portion of a section of wall on the left abutment was broken off to form a new spillway. In addition, leakage through the dam wall was leaching lime and forming voids, thus reducing the strength of the concrete structure. While repairs to this leakage were carried out as early as 1912, a major renovation of the dam wall was carried out in 1966. At that time, a 460mm concrete skin was installed on the upstream face of *Victoria Reservoir (fmr)*, a new inlet tower constructed and wall drainage installed.[42]

Later, in 1983, a safety review of both *Victoria Reservoir (fmr)* and the Lower Bickley Dam was undertaken as part of an ongoing safety and surveillance programme. It found that both dams had an inadequate margin of safety under 'worst-case' conditions for flooding and earthquakes. With post-tensioning and buttressing Bickley was repairable. However, due to the extremely poor condition of the concrete in *Victoria Reservoir (fmr)* this process was not considered feasible. It was decided to replace the dam wall as soon as was possible, rather than waiting until 2005-2010, as had been originally planned. In 1989, after a decision was made to replace the original *Victoria Reservoir (fmr)* dam wall, a section of the original wall was demolished with explosives to allow free passage of flood overflow from the planned new Victoria dam some 500 metres upstream.[43]

In order to carry out necessary renovations, *Victoria Reservoir (fmr)* was taken out of service on 3 April 1990. At the same time it was decided to bring the Lower Bickley Dam back into service, after a break of fifty-five years, and have it pump back into the new Victoria Dam.[44] *Victoria Reservoir (fmr)* (dam wall construction) was no longer used to store water, although the upstream valley formation of *Victoria Reservoir (fmr)* was incorporated into the new Victoria Dam

Compared to the 908ML capacity of the original Victoria Reservoir, the new Victoria Dam had a capacity of 9,300ML of water storage; while the height of the old dam wall was 22 metres, the new wall was 50 metres high; whereas the old dam had a base width of 9 metres and a crest width of 1 metre, the new dam had a base width of 37 metres and a crest width of 9 metres; and where the original dam supplied water from a 305mm cast iron pipe (1890) and 460mm pipe (1896), the new dam used 1200mm steel pipe instead.[45]

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40 Information from the Water Corporation web site: www.watercorporation.com.au.

41 *West Australian*, 7 September 1940.

42 Water Corporation, Victoria Dam, Interpretative Display, undated.

43 Water Corporation, Victoria Dam, Interpretative Display, undated

44 Water Corporation, Victoria Dam, Interpretative Display, undated.

45 Water Corporation, *Brief History of the Victoria-Bickley Dam Scheme,* undated.

The first water was stored in the new Victoria Dam during the 1991 winter, the system coming 'on-line' in November 1991. A plaque on the site records an official opening by the Minister for Water Resources, Ernie Bridge, MLA, on 22 November 1991. Also in attendance was Victoria Williams, the great-great-grand-daughter of Lila Keane, who performed the original opening ceremony in 1891.

In recent years, the area has been promoted for bush walking by various groups, with an emphasis placed on its historical significance.[46]

At the end of 2003, the original *Victoria Reservoir (fmr)*, downstream from the new Victoria Dam, is no longer used for water storage.

13. 2 PHYSICAL EVIDENCE

Victoria Reservoir (fmr) comprises a random rubble concrete gravity-arch dam wall with mortar render, formerly used as a water storage reservoir with a capacity of 9.08 Gigalitres (200,000,000 gallons), completed in 1891, and forming Perth's first permanent public water supply.

Victoria Reservoir (fmr) is located in Carmel, approximately six kilometres south of Kalamunda and twenty-five kilometres southeast of Perth. The site is located in a valley, which is fed by Munday Brook as part of the Darling Range catchment area, and is surrounded on all sides by State Forest. Access to the site is via a two kilometre long access road off Masonmill Road. The Weston Grave (1876) is located at 20 Masonmill Road, part of the *Victoria Reservoir (fmr)* catchment, and comprises an infant's grave, with a simple timber headstone, surrounded by a timber paling fence, positioned only metres from the road's edge. The visitor's carpark is located on the access road off Masonmill Road, approximately 600m north of *Victoria Reservoir (fmr).* The Ranger's house is located on the east side of the approach road. The New Victoria Dam is located approximately 500m upstream (south) of *Victoria Reservoir (fmr)* and comprises a Roller Compacted Concrete dam with a water storage capacity of 93 Gigalitres (Gl). A simple timber visitor's shelter is located at the eastern end of the New Victoria Dam wall where the access road terminates, while a timber lookout is located on the eastern slope. A Pump Station is located northwest of *Victoria Reservoir (fmr)* and comprises a single-volume shed structure, clad with corrugated iron and featuring a distinct barrel roof, and is surrounded by a number of small outbuildings associated with the station.

Victoria Reservoir (fmr) is set within an informal bushland garden that includes a large landscaped pond to the southeast of the dam wall, with rocks and a range of native trees and shrubs at its edges. A concrete path winds its way around the edges of the pond and also connects the garden area with the upper roadway. South of the pond is a grassed picnic area which contains a timber-framed picnic shelter. Mature trees of various native species are located on either side of the grassed area and there are a number of large garden beds. The grassed area eventually connects to a concrete overflow pool and the New Victoria Dam, which can be seen in the immediate distance (to the south). To the west of *Victoria Reservoir (fmr)*, and directly abutting its western face, is a natural rock outcrop, which extends towards the southeast end of the dam wall and north towards the channel. The channel is constructed of concrete and stone and was built to direct floodwater down the valley, and past the Pump Station. A flat area of concrete forms a crossing between the channel and the landscaped pond, and allows views north to the Pump Station and south to the New Victoria Dam.

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46 For example, *West Australian*, 27 September 2002, 'Liftout', p. 5; Perth Bushwalkers Club (Inc) at web-site: www.perthbushwalkers.asn.au

Victoria Reservoir (fmr) comprises a concrete gravity-arch dam wall, constructed in 1891 using rocks and hand-mixed cement, and featuring concrete abutments on its western face and a curved arc form that tapers at the outer ends. The dam wall has a 30ft (9m) wide base with a crest 3ft 6in (1m) wide, formed by the battering of the western face. The height from the base to the crest is 72ft (22m) and the overall length of the wall is 720ft (220m). A spillway is located at the southernmost end of the wall, approximately 20m high and 30m in length.

An opening has been made through the dam wall, approximately 75m wide, to allow free passage of flood overflow from the New Victoria Dam upstream. The concrete floodway channel and the access road to the Pump Station pass through the opening, which reveals a cross-section through the dam wall and divides it into two sections. The north wall section is approximately 55m long with a 30m long abutment that extends to the west. The south section is approximately 90m long, with the spillway at its southernmost end and a concrete abutment that extends to the west. A steel-pipe railing forms a balustrade across the tops of both sections of the wall, although access to the upper ledge is not readily available. A fixed steel-framed awning has been attached to the eastern face of the south section of wall, protecting a simple interpretative display, also attached to the wall. Nearby is a section of the original 21-inch mains pipe, mounted on concrete supports and forming part of the display.

Victoria Reservoir (fmr), as it remains, is in fair condition. Structurally, the random rubble concrete and mortar render is of poor quality and has a history of leakage. Areas of the wall are discoloured from years of water seepage, and non-structural cracks are evident in the concrete surface, especially on the western face where plants have taken root. Nevertheless, the place appears to be regularly maintained and the remains of the dam wall are not deteriorating.

13. 3 COMPARATIVE INFORMATION

Victoria Reservoir (fmr) comprises a random rubble concrete, and mortar render, gravity-arch dam wall constructed in 1891 using rocks and hand-mixed cement, and formerly used as a water storage reservoir with a capacity of 9.08 Gigalitres (200,000,000 gallons). *Victoria Reservoir (fmr)* is rare as a gravity-arch dam, which relies on a combination of arching and gravity for its stability and is the only known dam of this kind in Western Australia.

Victoria Reservoir (fmr) may be compared to a number of other dams in the State of similar function, age and construction material, a number of which are also included on the HCWA database.

Of the 74 dams in Western Australia listed on the Water Corporation's website, only eight are identified as concrete and two as part concrete dams, seven of which are in the greater metropolitan area. These seven are Bickley, Canning, Conjurup Pipehead, Lower Helena, Mundaring, Serpentine Pipehead and *Victoria Reservoir (fmr)*. Aside from the two large dams in the Northwest (Argyle and Harding dams, both of which are rockfill construction) most of the non-concrete dams are very small, many with a capacity of less than 50 megalitres.[47]

There are 250 reservoirs and dams listed on the HCWA database, of which 11 are Registered and 26 are in the Current Assessment Program. The 250 include a large number of relatively small agricultural area dams and railway dams, and some private dams that make up part of farming complexes. Thirty-nine of the dams listed are constructed using concrete, of which five (including *Victoria Reservoir (fmr)*) are Registered places: P01557 *Niagara Dam* (1898), P4611 *Kent Street Weir* (1926) P10954 Station Creek Reservoir (Registered as part of

47 Water Corporation website, www.watercorporation.com.au, December 2003.

P10520 *Leonora-Gwalia Water Supply Group* (1903)) and P03830 Canning Dam (1933-40) (Registered as part of P3709 *Canning Contour Channel (fmr)*). Ten concrete dams are in the Current Assessment Program: P03660 Toorak Hill Goldfields Water Supply Reservoir (1903), P03935 Boondi Catchment and Dam (1899), P04898 Toapin Weir (1912), P05977 Koorarawalyee Tank (unknown date), P06344 Wellington Dam (1933), P08538 Mundaring Weir, Gardens & Village Precinct (1898-1903), P09585 Ord River Diversion Dam (1960-1963)[48], P10128 Pioneer Dam Norseman (1910), P10376 Mundy's Brook Diversion Channel Pickering Brook (1897), and P12613 Dingo Rock Dam Beening (1951).

Descriptions of the large dams in this list follows:

P01557 *Niagara Dam,* Kookynie, comprises a concrete gravity wall dam on a natural basin, built in 1898 and having a capacity of approximately 0.18 Gigalitres (40,000,000 gallons). As with *Victoria Reservoir (fmr)*, Niagara Dam is constructed using the solid mass of concrete to retain water. It is similar to *Victoria Reservoir (fmr)* in terms of condition and authenticity, but, because it still functions as a water storage reservoir, has a higher degree of integrity.

P10954 Station Creek Reservoir, Leonora, is a concrete gravity wall over 100 metres long, which continues to be used for water catchment. There is a pipe-rail balustrade along the east side of the top of the wall.

P03830 Canning Dam, Roleystone, comprises a concrete dam first constructed in 1933 and officially opened in 1940, with an approximate capacity of 90 Gigalitres. As with *Victoria Reservoir (fmr)*, Canning Dam was designed to supply water to the metropolitan area.

P06344 Wellington Dam Precinct comprises Wellington Dam, a solid concrete gravity dam constructed in 1933, and enlarged in 1945 and 1960, No. 1 Pumping Station and associated Chlorine Store and Chlorinator (1953, 1963), 2Kw Hydro-Electric Station (1956), Caretaker's Quarters & Kiosk (1966), landscaped Quarry, and roads, landscaping and facilities for public use and recreation.

P08538 Mundaring Weir comprises a concrete dam constructed in 1898-1903 as part of the Goldfields water supply scheme and is part of a complex that includes eight large steam-driven pumping stations positioned along 557km of steel pipeline. Mundaring Weir has an approximate capacity of 64 Gigalitres making it a much larger water storage reservoir than *Victoria Reservoir (fmr)*.

P09585 Ord River Diversion Dam was built as part of the Stage I of the Ord River Project to allow water to be diverted and regulated from the Ord River into the Ord Irrigation area. The dam consists of 20 radial gates mounted within a concrete framework and a wide spillway structure. The water is gravity fed into channels to service the area to the north of the town and is pumped into the Packsaddle Plains area to the south. It is creates the State's largest reservoir, Lake Argyle.

Forty-six of the dams included in the HCWA database were constructed in the nineteenth century. Only six of these include concrete construction. Five are already noted above; the sixth is P04272 Kellerberrin Railway Dam (1893).

Victoria Reservoir (fmr) is therefore rare as one of only a few large dams constructed of concrete in Western Australia, and as a concrete dam from the nineteenth century.

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48 Note that while the HCWA database lists this dam as being concrete construction, an assessment has not been completed to confirm this information, and the Water Corporation website lists the dam as rockfill construction.

Victoria Reservoir (fmr) may also be compared to Wungong Dam (1925), Churchman Brook Dam (1929), and 4174 Serpentine Dam (1957, 1961), which were all constructed to increase the storage capacity of Darling Range.

Wungong Dam comprises a small concrete pipehead dam, constructed in 1925 as part of the 'Hills Scheme' – involving the construction of three reservoirs and three pipehead dams to increase the storage capacity of the Darling Range. This scheme also included Churchman Brook Dam. Wungong Dam is a rockfill embankment dam with an approximate capacity of 60 Gigalitres. Churchman Brook Dam was constructed in 1929 and comprises an earthfill embankment dam with an approximate capacity of 2.16 Gigalitres. Neither Wungong Dam nor Churchman Brook Dam has any heritage listings.

Serpentine Dam comprises two dams, the Pipehead Dam (1957) and the Serpentine Main Dam (1961), both built on the Serpentine River to increase storage capacity in the Darling Scarp during the rapid industrial growth in the late 1950s. The Pipehead Dam comprises a concrete gravity plus earthfill embankment dam with an approximate capacity of 3.14 Gigalitres. The Main Dam comprises an earthfill embankment dam with an approximate capacity of 138 Gigalitres. These construction methods use a combination of earth and rock fill instead of solid concrete, typical of newer dams. Serpentine Dam is in the Current Assessment Program.

Victoria Reservoir (fmr) is representative of the establishment of water storage facilities in the Darling Range in the 1890s, further consolidated by the launch of the "Hills Scheme" by the Premier, Sir James Mitchell, in the 1920's.

13. 4 KEY REFERENCES

No key references.

13. 5 FURTHER RESEARCH
