Engineers Australia

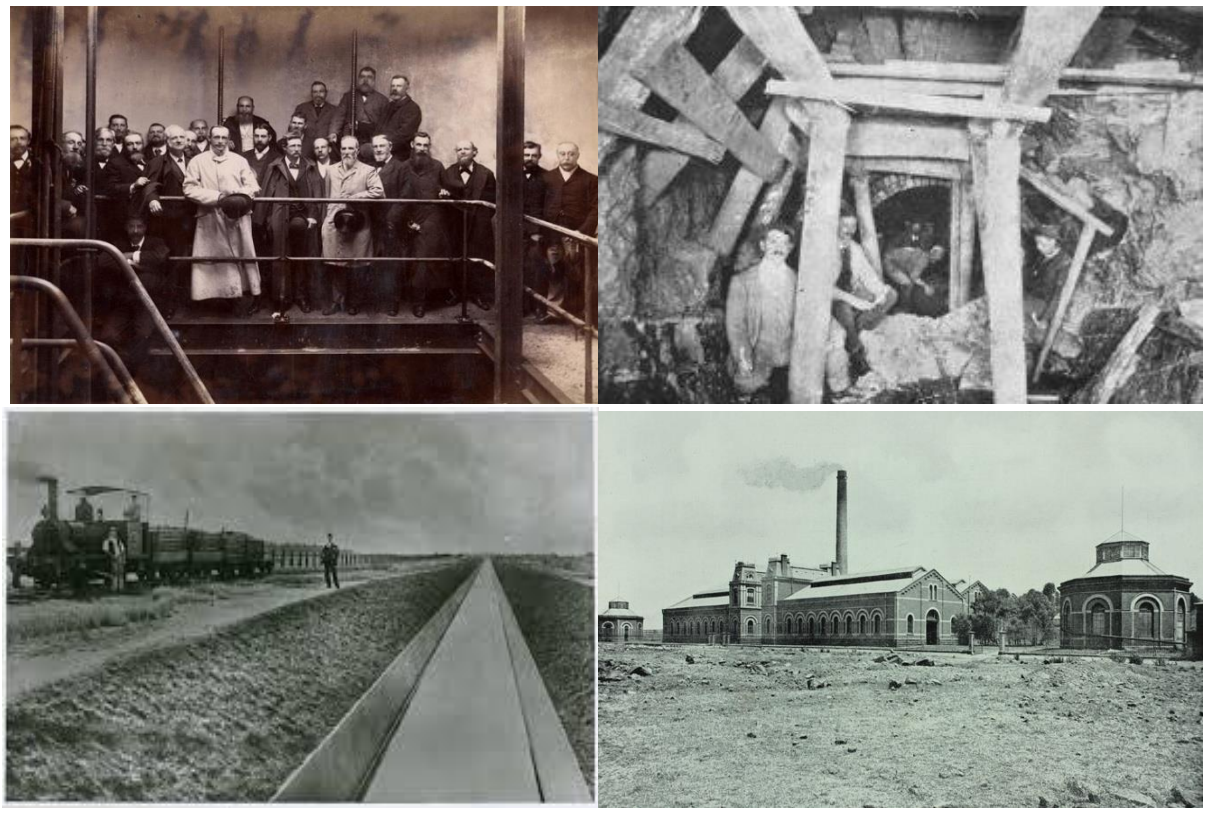
Engineering Heritage Victoria

Nomination for the

Engineering Heritage Australia Heritage Recognition Program

MELBOURNE SEWERAGE SYSTEM

Nineteenth Century Scheme



July 2014

Front Cover Photograph Captions

Top Left: **Lord Hopetoun inspecting Spotswood Pumping Station, 1895.**
Image: Public Records Office Victoria

Top Right: **Tunnelling excavation of the North Yarra Main Sewer.**
Image: Water Services Association of Australia

Bottom Left: **Main Outfall Sewer.**
Image: Culture Victoria

Bottom Right: **Spotswood Pumping Station shortly after it was constructed.**
Image: Museum Victoria

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1 Introduction

Summary of the System

Melbourne's Sewerage System collects, transports, treats and disposes of the sewage generated within a large portion of the Melbourne metropolitan area. Melbourne's sewerage system was developed in a single mammoth effort in the 1890s. However, before it was built there had been 60 years of complaint, make do, inadequate alternative proposals, and ad-hoc attempts at disposing of human and other waste. Until 1897, the city did not have the facility for disposing of its waste, apart from the services of the night cart, and despite Melbourne's well developed infrastructure, civic and commercial buildings and robust economy, it was known as "Marvellous Smellbourne", to a great extent because of the raw sewage which lay in drains and cesspits due to inadequate collection and treatment facilities.

Provision of sewerage systems was a great challenge facing Australian cities in the 19th century. Melbourne was slow to come up with a scheme to implement sewerage however when it did start the project in the 1890s it did so in a professional and comprehensive way delivering a remarkable engineering achievement. The system began operation in 1897, five years after the initial plans were produced. The work included up to 2400 miles (3840 km) of underground sewers, a large steam powered pumping station, a 16 mile (25.6 km) gravitational Main Outfall Sewer and the Werribee Sewage Farm.

Perhaps most importantly, it provided protection of public health at a time when typhoid was epidemic and causing an alarming death rate.

Post the Second World War, Melbourne expanded rapidly to the east. In the 1960s a second sewerage system, to service the eastern suburbs was built with a treatment plant at Carrum Downs (now called the Eastern Treatment Plant at Bangholme) and an ocean outfall near Cape Schanck to the east of Port Phillip Bay. This system is not covered by this nomination.

As detailed in this submission, the sewerage scheme exhibits many features of engineering heritage significance. Based on the evaluation of these, it is recommended that it be awarded an Engineering Heritage award.

It should be noted that the Spotswood Pumping Station, which is an element of this nomination, has already been recognised with a Historic Engineering Marker in 1994.

Drivers for this Nomination

This project commenced with a declaration by the Heritage Recognition Committee in about 2009 that the level of recognition of the Spotswood Pumping Station should be reviewed. Engineering Heritage Victoria was invited to submit a nomination so that the site could be considered for an upgrade to a National Engineering Landmark, the national award terminology at the time.

On investigating what might need to be done to achieve this objective Engineering Heritage Victoria discovered that the original nomination document could not be found. An extensive search by EHV and EHA failed to recover the document and it remains "missing in action" to this day.

Engineering Heritage Victoria then reconsidered a number of aspects of the project and concluded that it would be more appropriate to leave the current recognition of the Spotswood Pumping Station as it stands and to prepare a new nomination for the whole of the Melbourne Sewerage System with a strong emphasis on its building during the 1890s and its early development and extension immediately after commissioning in 1897.

It was further decided to make this nomination a project within the Victoria University and Engineers Australia joint project to provide Work Experience, by the researching and writing of heritage recognition nominations, to engineering students at Victoria University (VU).

The project was initiated in the 2011/2012 VU project and three students commenced work. By early 2012 all three students had been forced to retire from the project for various personal reasons. However during this time German Osuna had produced a first draft of the nomination.

This draft was subsequently used as a basis to develop the next stage of the document.

In 2012 Gary Vines of Biosis Pty Ltd was commissioned to undertake an extensive Melbourne Sewerage Heritage Study by Melbourne Water. EHV had been working closely with Paul Balassone, Melbourne Water's Heritage Services Coordinator, Asset Planning to progress the project and it was agreed that Gary Vines, who is a highly respected heritage consultant would carry out further drafting of the nomination in the light of his work on the Melbourne Sewerage Heritage Study. This work was completed in mid-2013.

During the 2013 Open Day at the Western Treatment Plant Paul Balassone and I decided that 2014 was the year to complete our recognition of the Melbourne Sewerage System. It was subsequently placed into the 2014 EHV Heritage Recognition Program.

Owen Peake commenced work on finalising the nomination in January 2014. Prior to this time the document lacked the necessary appendices and an Interpretation Plan.

It is hoped to be able to hold a Heritage Recognition Ceremony at the Western Treatment Plant later in 2014.

It is very appropriate to hold the ceremony at the Western Treatment Plant as this plant remains one of the key facilities of the Melbourne Sewerage system 117 years after the initial scheme was started up. It was a far-sighted project when it was built so competently by engineer William Thwaites. The Melbourne & Metropolitan Board of Works and more recently Melbourne Water have diligently expanded the original Thwaites scheme and added a new Eastern Suburbs scheme during the late 20th century.

Melbourne has been well served by its sewerage systems and these systems were, and remain, world class.

It is a privilege to work on the heritage recognition of this extraordinary enterprise which has helped Melbourne to be one of the most liveable cities[1] on the planet.

[1] Wikipedia, Most Livable Cities, Version dated 26 December 2013, downloaded 9 January 2014.

2 Heritage Award Nomination Letter

The Administrator
Engineering Heritage Australia
Engineers Australia
Engineering House
11 National Circuit
BARTON ACT 2600

Dear Sir

Name of work: **Melbourne Sewerage System – Nineteenth Century Scheme**

The above-mentioned work is nominated for an award under the Heritage Recognition Program.

Location: Melbourne Metropolitan Area including Western Treatment Plant at Werribee, south-west of Melbourne.

Current Owner: Melbourne Water Corporation
990 La Trobe Street
DOCKLANDS VICTORIA 3008

The owner has been advised of this nomination and a letter of agreement is attached at Appendix 6.

Access to sites: Access to sites is highly variable. Most sewers are in public streets; pumping stations are controlled sites; Western Treatment Plant is a controlled site and Spotswood Pumping Station is incorporated in Museum Victoria Scienceworks and is accessible to the public during museum open hours.

Nominating Body: **Engineering Heritage Victoria**

Yours sincerely

Owen Peake
Chair
Engineering Heritage Victoria

Date: 11 July 2014

3 HERITAGE ASSESSMENT

3.1 Basic Data for Melbourne Sewerage System

3.1.1 Basic Data: Spotswood Pumping Station

Item Name:	Spotswood Pumping Station.
Other/Former Names:	NIL
Location:	S 37°49'53.23", E 144°53'42.63"
Address:	2 Booker Street, Spotswood Victoria 3015.
Suburb/Nearest Town:	Spotswood.
State:	Victoria.
Local Govt. Area:	Hobson Bay City.
Owner:	State Government (Managed by Scienceworks, Museum Victoria).
Current Use:	Exhibition at the Scienceworks Museum.
Former Use:	Designed to pump the gravitated sewage collected from Melbourne City and suburbs from the North Yarra Main Sewer and Hobsons Bay Main Sewer through a Rising Main to Brooklyn where it discharged into the Main Outfall Sewer which then conveyed the sewage to the Metropolitan Treatment Plant at Werribee, where it was purified by land treatment.
Designer:	First drawings: James Mansergh Chief Engineer, Final Design: William Thwaites Architect/Designer: Christian Kussmaul
Maker/Builder:	Contractor AG Shaw
Year Started:	*Construction:* 1893[2] *Use:* 1897
Year Completed:	*Construction:* 1897[3]

[2] Withers M. The Spotswood Pumping Station. April 1984.
[3] Withers M. The Spotswood Pumping Station. April 1984.

Use: 1965[4]

Physical Description:

The pumping station comprises two mirror image pump houses and associated boiler houses and coal bunker buildings.

There are two polygonal straining well houses at the north and south ends of the pump house buildings. The Trunk sewers terminate beneath these.

Associated structures include a valve house on the Rising Main, a two-storey, brick managing engineer's residence built in 1898, two substations to supply electric pumps (one for 25 Hz, and one for 50 Hz supply), and three WWII air raid shelters.

Within each engine house are six elliptical pump wells extending from ground level to the depths of the sewers. A unique collection of steam engine driven pumps, electric motor driven pumps and control equipment as well as tools, furniture and other objects, remain at the station.

The steam pumping machinery included ten triple expansion condensing steam engines driving vertical direct acting plunger pumps. The engines were supplied with steam at 150 psi (1 MPa) from ten internally fired, marine, tubular, manually stoked boilers made by Thompsons of Castlemaine of which one remains in position.

The first group of four engines were manufactured by Thompsons of Castlemaine and were of the non-rotating type. Two were located in each pump house.

It was soon realised that rotative engines were likely to be more efficient and two engines of this type were obtained. One was based on an American design built locally by the Austral Otis Engineering Company of Melbourne. The second was made by the famed British pump builder Hathorn Davey & Company of Leeds, England in 1901. This was one of the most advanced pumping engines in the world at that

[4] Year closed down.

time and possibly the oldest extant engine of its type in Australia or Britain.

The final group of four engines were also made locally by Austral Otis but were close copies of the single Hathorn Davey engine.[5] These engines performed well and along with the single Hathorn Davey engine remained in service until the end of the steam engine era in the 1940s.

From the engine houses the sewage was pumped beneath the yard in the centre of the complex into a wrought iron rising main which delivered the sewage to the Main Outfall Sewer at Brooklyn, 4 km to the west, from where it gravitated to the Werribee Sewage Farm.

The pumping station is architecturally very decorative in a mixture of red and cream bricks.

Spotswood ceased operation in 1965, although sewage still flows under the site. The site is now part of the Museum of Victoria Scienceworks museum complex.

Physical Condition:

The buildings, and the remaining unique collection of steam and electrical pumping equipment comprising four Austral Otis triple expansion rotative seam engines, and one Hathorn Davey triple expansion rotative steam engine, a coal fired boiler, electric pumping equipment, recording gauges, control systems, tools, furniture and other objects all are in a very well preserved condition**.**

One engine has been restored to operation, driven by compressed air, and is demonstrated to museum visitors regularly.

Timeline and Modifications:

Refer Appendix 7

[5] Hobsons Bay Heritage Study citation.

3.1.2 Basic Data: Werribee Sewage Farm

Item Name:	Werribee Sewage Farm
Other/Former Names:	Current name: Western Treatment Plant.
Location:	S 38°00', E 144°34'
Address:	Point Wilson Victoria 3212.
Suburb/Nearest Town:	Cocoroc.
State:	Victoria.
Local Govt. Area:	Wyndham City.
Owner:	Melbourne Water.
Current Use:	Sewage Treatment Plant.
Former Use:	Sewage Treatment Plant.
Designer:	Chief Engineer: William Thwaites
Maker/Builder:	MMBW now Melbourne Water
Year Started:	*Use:* 1897
Year Completed:	*Use*: Still in Use
Physical Description:	Werribee Sewage Farm is about 10,852 hectares located to the west of the Werribee River. Initially the grass filtration method of treatment was used whereby the raw sewage was flood-irrigated onto paddocks and then allowed to filter through the grass. Animals were grazed on the farm. Today after numerous improvements the plant has 10 lagoons used as oxidation ponds to treat the sewage. Remnants of the former grass filtration beds are still evident, along with the concrete and earth channel distribution network.
Physical Condition:	Excellent**.** After different modern improvements the plant is ranked as a world leader in technical and environmental innovation.
Timeline and Modifications:	See Appendix 7.

3.1.3 Basic Data: Main Outfall Sewer

Item Name:	Main Outfall Sewer.
Other/Former Names:	NIL
Location:	Commencing near the present Brooklyn Pumping Station and terminated at Werribee Sewage Farm. See map page 19.
Address:	Beginning on the west side of Millers Road Brooklyn between Cypress Avenue and Primula Avenue and continuing to the south side of the Princes Highway then from the north side of the Princes Highway to the east side of Little Boundary Road then from the west side of Little Boundary Road to the east side of the Western Ring Road then from the west side of the Western Ring Road to the north side of Doherty's Road Laverton North then from the south side of Doherty's Road to the east side of Fitzgerald Road then from the west side of Fitzgerald Road to the north side of Leakes Road then from the south side of Leakes Road to the north side of Sayers Road then from the south side of Sayers Road Laverton to the east side of Forsyth Road then from the west side of Forsyth Road Truganina to the north side of Old Geelong Road Hoppers Crossing then from the south side of Old Geelong Road to the north side of the Melbourne to Geelong Railway then from the south side of the Princes Highway alongside the Princes Freeway (Maltby By-pass). It crosses the Werribee River then turns south crossing the Princes Freeway and continues into the Werribee Sewage Farm (Western treatment Plant) [6].
Suburb/Nearest Town:	Brooklyn, Laverton North, Truganina, Hoppers Crossing, Werribee.
State:	Victoria.

[6] Victorian Heritage Database , *Heritage Victoria, Main Outfall Sewer*, File number: No H1932.

Local Govt. Area:	Brimbank City, Hobsons Bay City, Wyndham City.
Owner:	Melbourne Water.
Current Use:	Much of the structure has been converted to a Bike Trail.
Former Use:	Designed to transport the sewage from Brooklyn to the Western Treatment Plant by gravity.
Designer:	Chief Engineer: William Thwaites
Maker/Builder:	Seven different local contractors
Year Started:	*Use:* 1897
Year Completed:	*Use*: 1993
Physical Description:	The Main Outfall sewer is a 15.53 mile (25 km) long sewer that was built to carry sewage from the Brooklyn outlet of the three Rising Mains which pump from Spotswood, to the Werribee Sewage Farm (Western Treatment Plant). This sewer operates by gravity on a grade of 2 feet per mile (379 mm/km), with a combined 9.32 miles (15 km) of semi-circular cross section open sewer, along with covered portions with a diameter of 11ft (3.36 m), and three major brick aqueducts over Skeleton Creek, Kororoit Creek and the Werribee River, to finally end in the northern section of the Werribee Sewage Farm (Western Treatment Plant).
Physical Condition:	The Main Outfall Sewer is no longer in use and all the structures are currently abandoned but preserved, including the aqueducts.
Timeline & Modifications:	See Appendix 7.

3.1.4 Basic Data: Sewerage Reticulation System

Item Name:	Sewerage Reticulation System.
Other/Former Names:	NIL

Location:	Extends upstream from Spotswood Pumping Station along Hobsons Bay Main and North Yarra Main, with many branch mains
Address:	Throughout inner Melbourne suburbs
Suburb/Nearest Town:	Greater Melbourne Area
State:	Victoria.
Local Govt. Area:	Inner and middle ring suburbs
Owner:	Melbourne Water
Current Use:	Most of original system is still used for its original purpose – Gravity sewers deliver to Brooklyn Pumping Station
Former Use:	Designed to transport the sewage from residential and commercial properties to Spotswood Pumping Station by gravity
Designer:	Chief Engineer: William Thwaites
Maker/Builder:	Seven different local contractors on mains, numerous contractors and MMBW day labour for reticulation sewers.
Year Started:	Construction: 1893 Use: 1897
Year Completed:	Initial construction: 1897 Use: still being used and extended
Physical Description:	The Sewage reticulation and main trunk network is a vast engineering structure which is almost entirely hidden underground. Hundreds of kilometres of brick lined tunnels large enough to stand upright in, or row a boat through. At each vent, change or direction or junction, a manhole gives access to a brick or concrete lined chamber up to six feet (1.83 m) diameter and 26 feet (7.93 m) deep.
Physical Condition:	The sewer is still in use for its intended purpose, apart from some few sections including the Hobson's Bay Main Tunnel under the Yarra River and the Stony Creek Siphon, which have been replaced.

Timeline & Modifications: See Appendix 7

3.1.5 Historical Notes - System History [7]

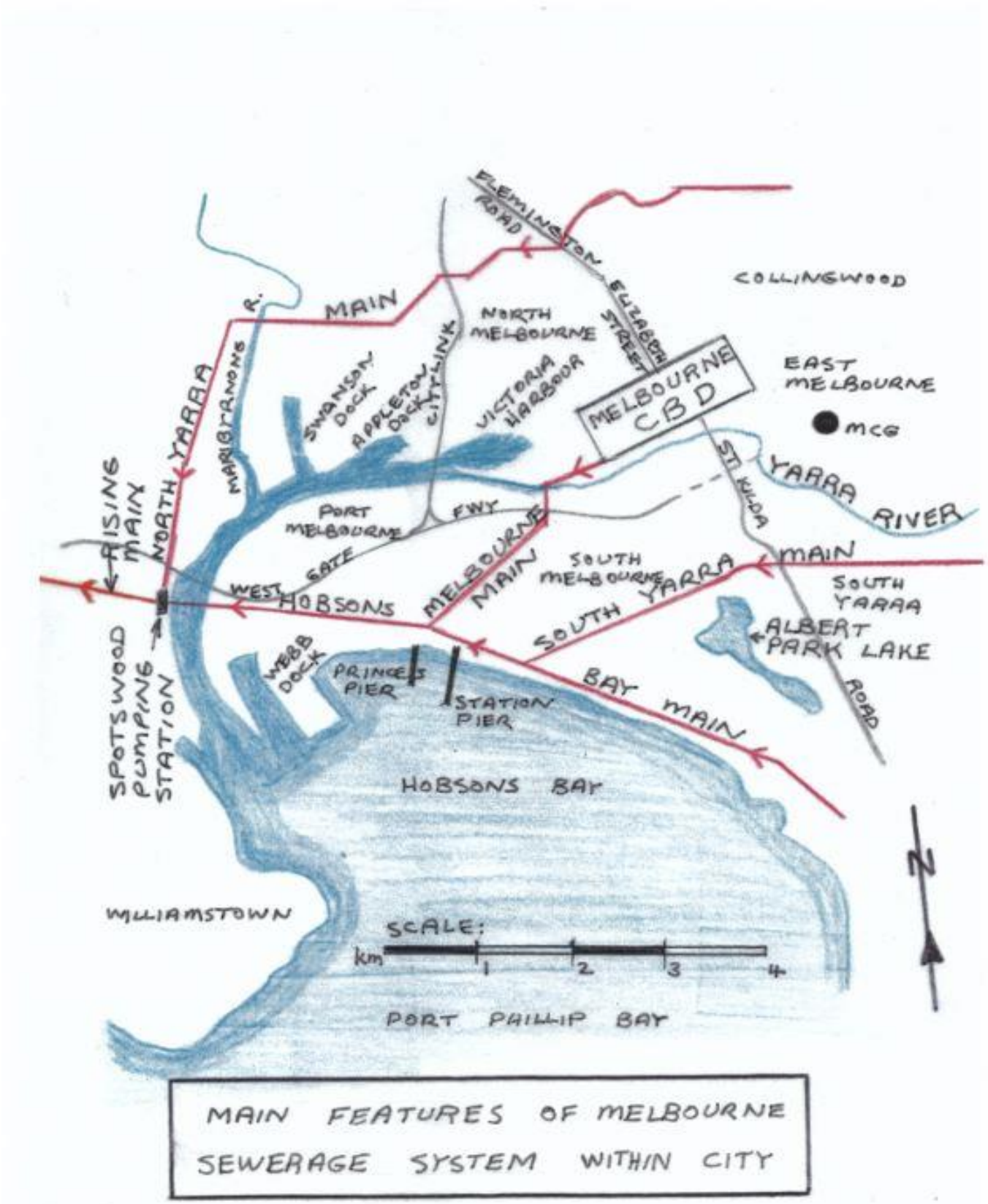
The construction of the main sewers was commenced in 1893, generally using deep tunnelling methods, although some sections, such as the Hobsons Bay Main along Beach Road, used open cut methods where possible. The Hobsons Bay Main was constructed in five sections, generally following the Beach Road and running through the undeveloped Fishermens Bend, with the final section crossing the Yarra at Spotswood. It was completed in 1896, but not fully operational until 1898.[8]

The North Yarra Main ran through Footscray, crossing the Maribyrnong River and tracing the northern edge of the inner suburbs. It included eight separate contracts with final completion in 1900. The South Yarra Main commenced in 1894, branching off the Hobsons Bay Main to the eastern suburbs and was completed in 1897, while the Melbourne Main branched at Port Melbourne to the Central Business District.

Unfortunately the works experienced a serious industrial accident when on Good Friday, 9 March 1895. While tunnelling works were progressing on the Hobsons Bay Main, where it crossed under the Yarra River at Spotswood a section of tunnel collapsed, killing six workers. Rescue attempts were made, but flooding prevented rescuers reaching the site of the accident for some time.[9]

See sketch map of the main features of the Melbourne Sewerage System within the city on the following page.

[7] Refer to maps on pages 16 and 19 for locations of sewerage system features.
[8] Unknown. The Hobson's Bay Sewer. *The Sydney Morning Herald* (NSW: 1842 - 1954). 22 July 1896. p7. Retrieved May 9, 2012, from http://nla.gov.au/nla.news-article14059338
[9] Unknown. Appalling Accident, Collapse of a sewer. The Argus (Melbourne) 13 April 1895. p7. Retrieved March 29, 2012, from http://nla.gov.au/nla.news-article9353948


FLEMINGTON ROAD
COLLINGWOOD
MAIN
R.
NORTH MELBOURNE
ELIZABETH STREET
EAST MELBOURNE
MCG
MELBOURNE CBD
SWANSON DOCK
APPLETON DOCK
CITYLINK
VICTORIA HARBOUR
MARIBYRNONG
YARRA
RISING MAIN NORTH
PORT MELBOURNE
FWY
ST KILDA
YARRA RIVER
GATE
WEST
HOBSONS
MELBOURNE MAIN
SOUTH MELBOURNE
SOUTH YARRA MAIN
SOUTH YARRA
ALBERT PARK LAKE
WEBB DOCK
PRINCES PIER
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PORT PHILLIP BAY
MAIN FEATURES OF MELBOURNE SEWERAGE SYSTEM WITHIN CITY
OWEN PEAKE 6/6/2014

Spotswood Pumping Station

Built by the Melbourne & Metropolitan Board of Works (MMBW) between 1894 and 1897, the Spotswood Pumping Station was a key part of Melbourne's first centralised sewerage system. The purpose of the pumping station was to raise raw sewage collected through a network of underground sewers and pump it up to the start of the Main Outfall Sewer at Brooklyn, from where it flowed by gravity to the Werribee Sewage Farm.

The construction of the Melbourne Sewerage System represented the largest single public infrastructure project in Victoria at the time. With an overall cost of £3.5 million, the project provided a much needed boost to local industry and employment at a time when Victoria was gripped by a major economic recession.

Construction of the pumping station began in March 1894 with the excavation of a large 25 metre deep hole, much of which was blasted out of solid basalt. The twelve oval-shaped pump wells were formed from unreinforced concrete thick enough to carry the weight of the buildings and heavy machinery.

The original equipment consisted of four large steam pumping engines powered by steam from coal-fired boilers. By 1914, ten steam engines were in operation at Spotswood [10]. The first electric powered pumps were installed in 1921, and by 1925 most of the daily flows were pumped by electricity.

In 1938, the Harbour Trust requested that the Hobsons Bay Main be lowered to allow dredging and deepening of the Yarra River shipping channel, and to avoid the risk of grounding or anchors snagging. This put in train a sequence of events which ultimately saw the replacement of both the Spotswood Pumping Station and the river crossing, but this took until the 1970s to achieve.[11]

The rapid growth of Melbourne after the Second World War meant that by the 1960s, the Spotswood Pumping Station's capacity had been exceeded. Corrosion of the wrought iron Rising Mains from Spotswood to the Main Outfall Sewer led to a decision to build a new pumping station at Brooklyn. The Spotswood Pumping Station ceased operation in September 1965, but sewage still flows under the site today on its way to Brooklyn and the Western Treatment Plant at Werribee.

Following the end of its pumping operations, the Spotswood Pumping Station site continued to be used as an engineering maintenance workshop and deep sewer maintenance depot by the Board of Works until the 1980s.

In March 1989, the Museum of Victoria took over the Spotswood Pumping Station site to develop Scienceworks - an interactive Science and Technology Centre, which opened in February 1992. The North Yarra and Hobsons Bay sewer mains, converge at the Spotswood Pumping Station, from where the sewage was pumped upwards over 107 feet (30 m)

[10] Refer to Appendix 7 for more details of the dates of various pumping engines.
[11] Dingle & Rasmussan, *Vital Connections: Melbourne and its Board of Works, 1891 -1991,* McPhee Gribble. 1991. p291.

through the three wrought iron rising mains, to the Main Outfall Sewer, at a point at Brooklyn where it could flow by gravity to the Werribee Sewage Farm.

The first two Austral Otis pumping engines in the northern engine room (No.7 & 8) recently celebrated their centenary since coming into service in 1911. Museum Victoria celebrated this event and published two articles on their web page. As these article have since been taken down copies are included in Appendix 4.

Further details of the steam pumping engines at Spotswood Pumping station are given at Appendix 4.

Rising Mains

The Rising Mains from Spotswood to Brooklyn consisted of three wrought iron riveted pipes laid through the suburban and industrial areas over a distance of about 4 km. The land height at Brooklyn was sufficiently high to allow flow in the Main Outfall Sewer from there to Werribee by gravity. The total height which the sewage was raised from the pump wells at Spotswood to the Main Outfall Sewer at Brooklyn was about 30 m.

Main Outfall Sewer

The Main Outfall Sewer involved considerable earthworks to ensure the uniform but very gentle fall required to deliver the rated throughput without overtopping whilst conserving head as the sewer traversed quite flat country. The sewer crosses a number of small waterways and aqueducts were built to cross these shallow valleys.

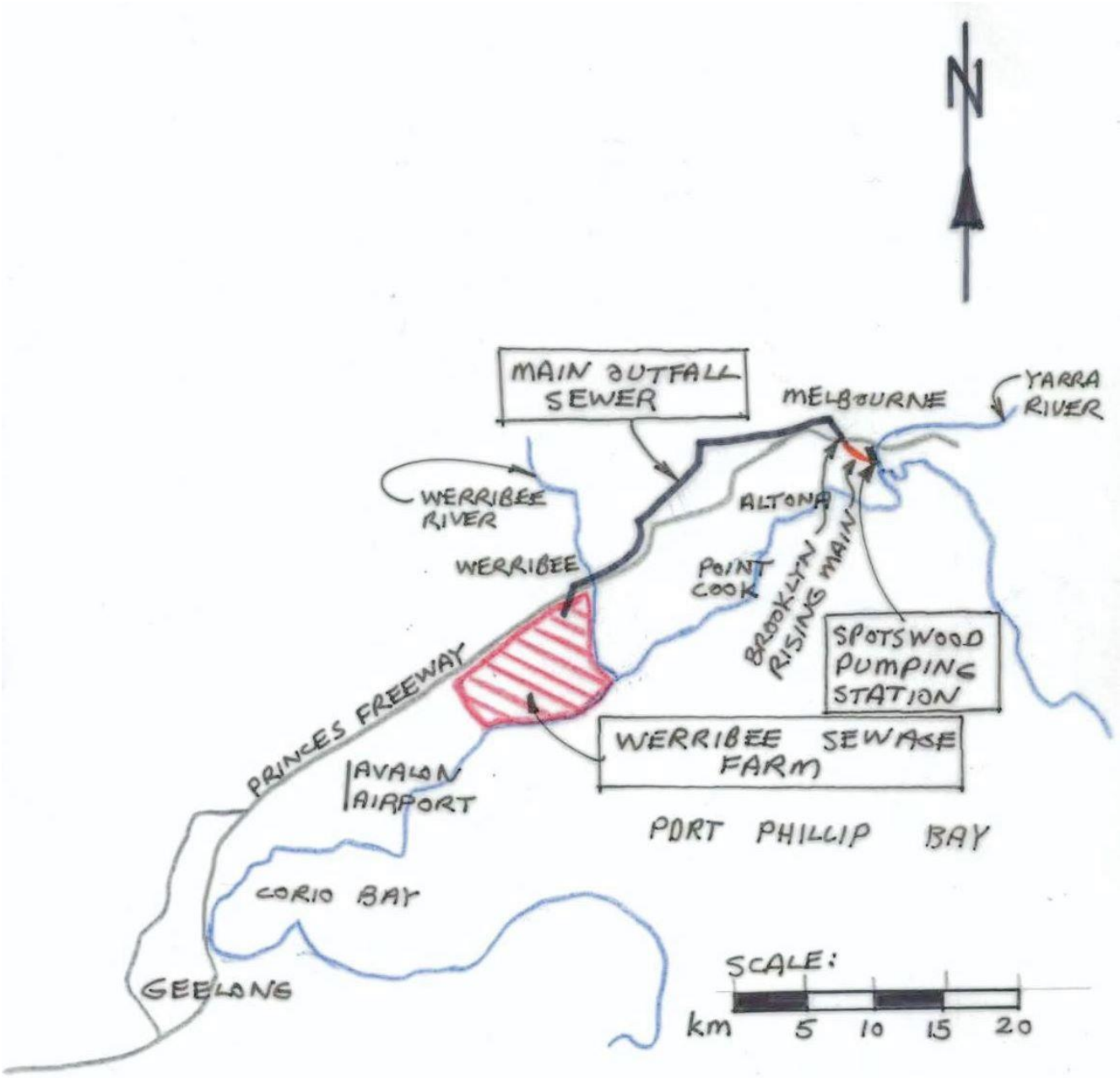
Much of the Main Outfall Sewer is a semi-circular brick structure open to atmosphere. Sections were covered either to traverse higher ground or to reduce odour where the structure ran close to settlements.

Werribee Sewage Farm

The concept of sewage treatment was quite new at the time of construction of the Melbourne system. Most large systems which had been built in the decades before discharged to the sea or rivers without treatment. The London system, also influenced by Mansergh, discharged to the River Thames from pumping stations on the north and south banks downstream of most urban development. Sewage was retained in large ponds during incoming and slack tides and discharged during the outgoing part of the tidal cycle to the river to be carried out to sea.

The adoption of the grass filtration system at Werribee and combining this with an intensive farming activity placed it in the vanguard of sewerage developments. The work was labour-intensive but in the late nineteenth century public utilities were prepared to invest heavily in employment and training to achieve higher performance for the communities which they served. This was particularly true at the time with Thwaites in charge of the MMBW as he was a man of particularly high ethical standards.

See sketch map of the main features of the Melbourne Sewerage System downstream from Spotswood on the following page.



MAIN FEATURES OF MELBOURNE SEWERAGE SYSTEM BEYOND SPOTSWOOD PUMPING STATION

OWEN PEAKE 6/6/2014

3.1.6 Heritage Listings

The Melbourne Sewerage System as a whole system is not listed or registered however some of its components are registered in the Victorian Heritage Register, and by the National Trust of Australia (Victoria) as follows:

Name	Register	Registration Number
Sewerage Pumping Station	**Victorian Heritage Register**	**H1555**
Pumping Station -Spotswood	**National Trust**	**B3704**
Main Outfall Sewer	**Victorian Heritage Register**	**H1932**

3.2 ASSESSMENT OF SIGNIFICANCE

3.2.1 Historical Significance

The remaining early structures, buildings, works and landscapes of Melbourne's Sewerage System are of historical significance for their role as the principal elements in the first major metropolitan sewerage system constructed in Victoria, developed in the 1890s under the auspices of the Melbourne and Metropolitan Board of Works. The system is significant for its critical historical role in the development of Melbourne, leading to dramatic improvements of hygiene, health, urban character and quality of life in the city at the end of the nineteenth century and throughout the twentieth. It led directly to a substantial reduction in death and illness from typhoid and other infectious diseases.

The system was designed by the Board's Engineer-in-Chief, William Thwaites and represented a modified version of the system recommended by British engineer, James Mansergh. The construction of the system was one of the most significant single infrastructure projects ever undertaken in the history of the colony and was a major achievement in terms of surveying, engineering and construction work. The completion of the system represented a major advance in public health and led to a reduction in disease amongst residents of the metropolitan area.

While some small elements of the original system have been replaced or modified, a significant portion of the layout survives intact to demonstrate the original function and layout of the works. The surviving components include the underground sewers, Spotswood Pumping Station, Main Outfall Sewer and the Werribee Sewage Farm.

It is also of historical significance as the earliest sewerage system and treatment plant in the state and for its continuous operation from its commissioning in 1897 until the present day.

Melbourne's sewerage system is of technological significance for the demonstration of the substantial engineering works, which required a high level of survey skill and accuracy, integrated hydrological control, both through the vast construction of the underground sewers, with all their connections, access shafts, pumps, valves, penstocks and venting structures, and the outstanding collection of steam and electric powered pumping engines at Spotswood Pumping Station. There is also technical significance in the engineered channels and earthworks of the Main Outfall Sewer and Werribee Sewage Farm. Features at the Werribee Sewage Farm include the original layout of finely graded paddocks, roads, windbreak plantings and large-scale reticulation/irrigation systems, the latter specifically designed for the land filtration method of processing sewage.

It is one of the few still operating, large turn-of-the-century filtration sewage systems in the world and one of the earliest to be established in Australia. It is by far the earliest sewage treatment plant still in operation in Victoria and retains much of its original layout.

The design of Melbourne's sewerage system was based on similar systems in England. As constructed, the system comprised a system of gravity sewers coming from the various suburban areas and converging at Spotswood, where the pumping station raised the sewage and transferred it to a 16 mile (24 kilometre) long Main Outfall Sewer along which it gravitated the to the Werribee Sewage Farm.

Melbourne's sewerage system has aspects of aesthetic or architectural significance including the Spotswood Pumping Station, some engineering structures and 20th century office buildings. The farming landscape overlain with the grid of channels and drains of the Werribee Sewage Farm creates a unique aesthetic quality.

Melbourne's sewerage system is of local social importance as one of the most essential services in a modern healthy city. It is of wider social significance for its continuing role in maintaining the health and amenity of a large part of Melbourne's population.

3.2.2 Historic Individuals or Associations

Refer to Appendix 2 for additional biographical details.

Melbourne Sewerage scheme was made possible thanks to the significant engineering knowledge of several individuals. In 1888, a Royal Commission was appointed to analyse and solve the biggest problem of Melbourne by that time, the sanitary conditions of Melbourne and its suburbs. It should be pointed out that this coincided with an investment boom and arguably one of the most prosperous decades in the history of Victoria.[12] The Royal Commission reported to the government in 1889.

James Mansergh, an important British sanitary engineer, was invited to visit Melbourne and report the best solution to drain Melbourne's sewage. Mansergh presented his report in 1890, in which he proposed eight different sewerage schemes. Scheme M, was recommended. This involved the construction of two independent sewerage networks, one to drain the eastern and the other to drain the western parts of the city.

In December 1890 the Victorian parliament authorise the creation of the Melbourne and Metropolitan Board of Works, formed by 39 members elected by the 24 Municipal councils of Melbourne. By 1891 the board appointed William Thwaites as the Engineer-in-Chief.

William Thwaites as the first Engineer-in-Chief of the Board, analysed the schemes that Mansergh submitted in his report, and proposed to the Board a simpler and more economical scheme that was very similar to the one proposed by Mansergh as Scheme M.

Thwaites was able to ensure the integrity of the system as a whole. He was also responsible for all the detailed designs, his team was in charge of the meticulous designs and drawings that were later signed by Thwaites for different standards of connections to domestic and commercial properties.

Finally, Christian Kussmaul, Designing Engineer of the MMBW, was put in charge of designing the key component in the whole system, including Spotswood Pumping Station.

3.2.3 Creative or Technical Achievement

In general, Melbourne's sewerage scheme was one of Victoria's most important engineering achievements of the century, from all points-of-view, including civil engineering with the major challenge of the Main Outfall Sewer with its structure and aqueducts, and all the underground sewerage network, including the Yarra River crossings.

[12] Wikipedia, Economic History of Australia, downloaded 5 January 2014.

From the mechanical engineering point-of-view the opportunity of building the pumping engines for Spotswood created a boost in the development of steam technology in Australia.

3.2.4 Research Potential

The Melbourne Sewerage Scheme has been well documented both historically and as a consequence of recent research.

3.2.5 Social

The Melbourne Sewerage System had a significant social importance and impact in Melbourne. Despite being one of the richest cities in the world by the 1880s and the largest city in Australia, with advanced infrastructure, Melbourne had gained the un-attractive name of “Marvellous Smellbourne” due to its city’s unsanitary waste disposal methods after decades of unplanned growth. The sewage was emptied into open drains that flowed into street channels and out into the bay via the rivers and creeks, which brought to Melbourne not just the characteristic smell of raw sewage, but an increase in the death rate from water-borne infectious diseases such as cholera and typhoid.

The construction of the sewerage system provided Melbourne with a planned system to cope with population growth well into the future. It also brought about a significant improvement of public health.

Today, parts of the sewerage scheme no longer in active service are being used for recreational and educational purposes.

Werribee Sewage Farm (now termed Western Treatment Plant) is still in use. Melbourne Water currently has several education programs for the community in order to educate them about the treatment process and its history.

Spotswood Pumping Station, a major community landmark in Melbourne, is part of Scienceworks, a part of Museum Victoria. Guided tours of the pumping station are provided.

A large proportion of the Main Outfall Sewer is being used for recreation as a bicycle trail route for community use.

3.2.6 Rarity

The Melbourne sewerage scheme was one of the earliest to treat sewage before discharge to receiving waters - in this case Port Phillip Bay. It was probably the second sewerage scheme in Australia which treated the effluent before discharge after the Adelaide system.

The surviving Hathorn Davey pumping engine is a very early example of this configuration of engine. Vertical inverted triple expansion engines with reciprocating pumps driven from the engine crossheads significantly increased the efficiency of steam pumping plant in the years leading up to the introduction of electrically-driven centrifugal pumps. This configuration of steam pumping engine became very popular with Hathorn Davey being a prolific manufacturer of the type up to the end of the steam era. The use of this type of engine allowed the Australian steam engine manufacturing industry (Austral Otis of Melbourne in this case) to enter this market sector.

The architecture of the Spotswood Pumping Station is very aesthetic although not rare.

3.2.7 Representativeness

Melbourne Sewerage System is an exceptional example of advanced design and technology, with some of its components being amongst the largest challenges of Australian engineering in the 19th century. In this regard the Main Outfall Sewer and the Spotswood Pumping Station are of particular significance. This work was representative of the best sewerage schemes worldwide during the late Victorian Era.

Besides the representativeness of the system itself, the Melbourne sewerage system (and especially Spotswood Pumping Station) created examples to be followed around Australia in the construction of water supply and sewerage systems. For example at Broken Hill Water Supply, Umberumberka Waterworks [13], the same configuration of inverted vertical triple expansion steam pumping engines were used as found at Spotswood Pumping Station.

3.2.8 Integrity/Intactness

Sections of the Scheme are still in use today for the purpose for which they were designed. Major items no longer in active service in the sewerage system are now used for recreation and educational purposes. This has ensured a high degree of intactness of the whole system.

3.2.9 Comparison with other systems

This section investigates the sewerage systems in some Australian capital cities, regional cities and overseas cities. The emphasis is on what happened in Sydney and Adelaide which could be expected to have highly developed systems at about the same time that Melbourne had come to the conclusion that it was time to 'bite the bullet' and build a city-wide sewerage system.

A comparison with London is instructive as the expertise which was initially used to determine the direction for the Melbourne Sewerage system came from London.

Many cities started with systems of sewers which collected sewage from properties but simply deposited it into the nearest available waterway. This quickly became a problematic methodology as the waterways became polluted and odour problems proliferated.

The following table places a number of cities in the chronological order in which they completed comprehensive integrated sewerage schemes. In this context 'comprehensive' means that the bulk of the urban area of the city at the time was serviced by a sewerage system. 'Integrated' means that the service is a 'top to bottom' sewerage system incorporating the following components:

- Collection of sewerage from premises
- System of minor and main sewers
- Trunk Sewers
- Pumping Stations
- Outfall Sewers
- Treatment Plants
- Treated effluent disposal

[13] The two Umberumberka engines are somewhat smaller than the Spotswood machines.

City	Limited system of deep sewers to nearest waterway with no treatment			Comprehensive integrated system including treatment		
	Decision made	Work started	Work complete	Decision made	Work started	Work complete
London	-	-	-	1858	1859	1865 ■
Adelaide	-	-	-	▲	▲	1885
Christchurch	-	-	-	▲	▲	1889 ●
Melbourne	-	-	-	1889	1892	1897
Sydney	▲	1854	1859	▲	1889	1904
Newcastle	▲	1888	▲	1926	1929	1936
Dunedin	▲	▲	1889 ●	▲	▲	▲

Legend:
- Details of possible limited system not available
■ Only limited treatment incorporated initially but later upgraded
▲ Date not known
● Status at the time of the Melbourne Inquiry in 1889
Listing in chronological order of completion of comprehensive system

Table 1 - Comparison of Sewerage Systems by Completion Date [14]

Melbourne:

Melbourne had the earliest major city fully integrated sewerage system in Australia. A system of reticulated sewers serving all households and industries, connecting all premises, in all streets, to gravity feed mains that passed under the Yarra River to the large Pumping Station at Spotswood, then major rising mains to the large sewer aqueduct to the treatment farm at Werribee. The scheme involved a fully integrated, fully planned, whole of city approach which required a whole of Melbourne Land Survey – all properties, all titles, fully contoured. The Melbourne & Metropolitan Board of Works (MMBW) was given full control of designing and specifying all fittings, and connections over the entire system. Major technical innovations included the use of compressed air in tunnelling. Like all major sewerage systems, this had a major impact on the health and liveability of the whole of Melbourne, reducing disease, removing smells, and progressively dealing with industrial wastes.

Planning for the system started in 1889, construction commenced in 1892 and the first customers were connected to the operational system in 1897.

Adelaide:

The first integrated system with deep sewers and treatment system in Australia was completed in 1885. It was a simple gravity system. Problems with lack of ventilation of deep

[14] Data for Table 1 could not be found for Brisbane.

sewers were an issue with this system. Householders were totally responsible for the house connection and for the sewer from their house and connection in the street [15].

The deep drainage system diverted all sewage from the River Torrens and other inappropriate outfalls to a single treatment farm, about 4½ miles from the centre of the city. There was adequate fall from the city to the farm for a gravity system. The farm was 480 acres and initially dealt with sewage from a population of about 70,000 people. The soil types in the farm were generally suitable for absorption of the sewage effluent [16].

Sydney:

The system was developed in two phases. Firstly, a system of deep sewers that drained to the Harbour. This work commenced as early as 1854. A Board of Inquiry was appointed in 1875. A later scheme was developed to intercept these sewers and divert the sewage to an ocean outfall at Bondi. This work was commenced in 1889. Offensive industries were located away from the city and were difficult, or impossible to service [17].

A second scheme was developed termed the southern scheme of deep sewers leading to a 'farm' treatment plant at Botany Bay, over the Cook River [18,19].

More detail is provided in the following quote from Sydney Water:

> "In 1859 Sydney had a rudimentary system of five sewers which serviced an area just beyond today's central business district and drained directly into the Harbour.
>
> By 1889, the system had grown to some 10 km of main sewers and 130 km of subsidiary sewers, serving the city and the suburbs of Darlington, Paddington and Redfern. This amplified system continued to discharge into the Harbour, posing a serious threat to public health, as the Harbour was the centre of Sydney's activities at the time.
>
> In 1889, two major projects were commissioned (built by the Government and subsequently transferred to the Board of Water Supply and Sewerage). These were: (i) an ocean outfall sewer discharging to the ocean near Bondi; and (ii) a main southern sewer, draining to a sewage farm near Botany. These two sewers intercepted most of the discharges to the Harbour and were a major advance for

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[15] Notes provided by Ken McInnes, May 2014.
[16] Victorian Parliament, Parliamentary Papers, 1889 No27.
"Royal Commission to Inquire and Report upon the Sanitary Condition of Melbourne. Progress Report".
Summary pp xii-xiii,
<http://www.parliament.vic.gov.au/papers/govpub/VPARL1889No27Pi-xliv.pdf>
Evidence pp37-77
<http://www.parliament.vic.gov.au/papers/govpub/VPARL1889No27P1-50.pdf> and
<http://www.parliament.vic.gov.au/papers/govpub/VPARL1889No27P51-100.pdf>
[17] Notes provided by Ken McInnes, May 2014.
[18] *Victorian Parliament, Parliamentary Papers, 1889 No27. "Royal Commission to Inquire and Report upon the Sanitary Condition of Melbourne. Progress Report". Summary pp xiii-xiv, Evidence pp94-144.*
[19] Henry FJJ & New South Wales Metropolitan Water Sewerage and Drainage Board. *The water supply and sewerage of Sydney* Halstead Press Sydney. 1939.

Sydney. These gravitational sewers were unable to take in areas below their own level, thus leaving some localities still discharging into the Harbour.

To cope with this problem, the government constructed pumping stations at various locations to lift waste to the gravitational sewer before going to the outfalls. The first pumping station to be connected to the Bondi system was the Double Bay Ejector in 1898. Power was provided from the Rushcutters Bay Tramway Power House. The total project was completed by the Public Works Department and handed over to the Board in 1904, with more pumping stations subsequently built and connected to the system" [20].

The 'Royal Commission to Inquire and Report upon the Sanitary Condition of Melbourne' visited Sydney and were impressed by the sewage farm at Botany. The sewage farm at Botany was of 1000 acres and designed to serve a population of 50,000 people. It is clear from their comments that they considered this methodology to be fit for purpose and that it would be appropriate to use a similar system in Melbourne [21].

An interesting side issue raged in Sydney, in particular during the period of indecision about implementing a comprehensive and integrated system between the 1860s and about the turn of the 20th century. There were arguments between proponents of centralised water-borne sewerage systems and more localised "back yard" treatment alternatives. Some people wanted dry disposal of sewage whilst others advocated "septic tank" methods. This debate was called the 'Water-carriage debate'.

In many people's minds the provision of sewerage systems equated to rampant water pollution and endless odour problems [22].

The City Fathers of Sydney did very little to allay these concerns as they repeatedly failed to come to terms with the proper development of the sewerage system over a period approaching 40 years.

Fortunately the engineers in the industry, who were dedicated to seeing sewerage systems which provided comprehensive implementation of fully integrated engineered systems and the pursuit of better technologies to enhanced sewage treatment, won the day.

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[20] Sydney Water Heritage. Other details of source not known.

[21] Victorian Parliament, Parliamentary Papers, 1889 No27.
"Royal Commission to Inquire and Report upon the Sanitary Condition of Melbourne. Progress Report".
Summary pp xiii-xiv,
<http://www.parliament.vic.gov.au/papers/govpub/VPARL1889No27Pi-xliv.pdf>
Evidence pp94-144.
<http://www.parliament.vic.gov.au/papers/govpub/VPARL1889No27P51-100.pdf> and
<http://www.parliament.vic.gov.au/papers/govpub/VPARL1889No27P101-149.pdf>

[22] Beder Sharon. Early Environmentalists and the Battle Against Sewers in Sydney. *Royal Australian Historical Society Journal, vol 76, no.1.*June 1990. pp27-44.

Newcastle (New South Wales): [23]

"Completion of the Walka water supply scheme in 1885 had meant a continuity of water supply in dry spells and caused a basic improvement in domestic cleanliness where people made use of the service. Newcastle City Council began construction of a pipe drainage system to dispose of storm water in 1888 and eventually laid more than 12 miles of sewers at an estimated cost of £18,000. Shortly afterwards the Council made the dubious decision to permit human sewage to be carried away in the drains, which discharged into the harbour at nine locations between Telford and Union Streets and into the Pacific Ocean at Newcastle Beach" [24].

The Hunter District Water Supply and Sewerage Board was established in 1892 and saw one of its most urgent responsibilities as the provision of proper sewerage facilities. "Implementation of the Board's sewerage powers was to be delayed until 1907 because of the need for detailed surveys, the City Council's unwillingness to be included in a new sewerage scheme, financial limitations in the 1890s and the period taken to construct the scheme" [25].

By the turn of the 20th century the mortality rate from diseases linked to inadequate sewerage systems was high. There were also many towns in the region which were not sewered at all and the Newcastle system required extension and diversion of existing sewers from the harbour to more appropriate treatment/outfall locations.

A Parliamentary Standing Committee on Public works approved the Newcastle and Suburbs Sewerage Amplification Scheme and the provision of sewerage services in Carrington in 1926 [26]. The scheme was passed by parliament in 1928 and work commenced in 1929. This scheme incorporated an intercepting sewer 4½ miles (7.2 km) long. This sewer was of variable diameter from 18 inches (460 mm) to 6 feet (1830 mm) and involved considerable tunnelling. The scheme also involved a pumping station at Merewether, a one mile (1.6 km) long rising main sewer from the pumping station to the Intercepting Sewer and a treatment plant at Murdering Gully and outfall to the Pacific Ocean. These works were completed in 1936.

Christchurch New Zealand:

The 'Royal Commission to Inquire and Report upon the Sanitary Condition of Melbourne' received a report on the progress of sewerage works in Christchurch. "At Christchurch, a satisfactory scheme of deep drainage has been carried out. The separate system has been adopted, and the sewage is pumped on to a sewage farm, and so purified" [27].

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[23] Armstrong John W. Chapter 12, Sewerage. *Pipelines & People – A history of the Hunter Valley District Water Board, Newcastle, New South Wales*. Publisher and date not known.
[24] Ibid. page 153
[25] Ibid. page 152.
[26]Ibid. page 165.
[27] Victorian Parliament, Parliamentary Papers, 1889 No27.
"Royal Commission to Inquire and Report upon the Sanitary Condition of Melbourne. Progress Report". Page xiv.

Dunedin New Zealand:

The 'Royal Commission to Inquire and Report upon the Sanitary Condition of Melbourne' received a report on the progress of sewerage works in Dunedin. "At Dunedin, a scheme has been proposed for carrying the sewage to the ocean, but has not yet been agreed to. A partial scheme of underground drainage has been carried out, and 750 of 5,000 houses have water closets and are connected to the sewers, which discharge the sewage into the harbour without purification" [28].

London:

Interception sewers were built on both sides of the Thames, forming the embankments, collecting sewage from a diversity of drainage systems, gravity feeding to two pumping stations with two separate treatment systems [29,30]. Effluent, after primary treatment [31], was discharged into the river on the outgoing tide.

During the early 19th century the River Thames was an open sewer, with disastrous consequences for public health in London, including cholera epidemics. These were caused by enterotoxin-producing strains of the bacterium *Vibrio cholerae*. Proposals to modernise the sewerage system had been made during 1856, but were neglected due to lack of funds. However, after the Great Stink of 1858, Parliament realised the urgency of the problem and resolved to create a modern sewerage system.

Joseph Bazalgette, a civil engineer and Chief Engineer of the Metropolitan Board of Works, was given responsibility for the work. He designed an extensive underground sewerage system that diverted waste to the Thames Estuary, downstream of the main centre of population. Six main interceptor sewers, totalling almost 100 miles (160 km) in length, were constructed, some incorporating stretches of London's 'lost' rivers. Three of these sewers were north of the river, the southernmost, low-level one being incorporated in the Thames Embankment. The Embankment also allowed new roads, new public gardens, and the Circle Line of the London Underground.

The intercepting sewers, constructed between 1859 and 1865, were fed by 450 miles (720 km) of main sewers that, in turn, conveyed the contents of some 13,000 miles (21,000 km) of smaller local sewers. Construction of the interceptor system required 318 million bricks, 2.7 million cubic metres of excavated earth and 670,000 cubic metres of concrete.

Gravity allows the sewage to flow eastwards, but in places such as Chelsea, Deptford and Abbey Mills, pumping stations were built to raise the water and provide sufficient flow. Sewers north of the Thames feed into the Northern Outfall Sewer, which fed into a major treatment works at Beckton. South of the river, the Southern Outfall Sewer extended to a similar facility at Crossness.

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[28] Victorian Parliament, Parliamentary Papers, 1889 No27.
"Royal Commission to Inquire and Report upon the Sanitary Condition of Melbourne. Progress Report". Page xiv.
[29] Notes provided by Ken McInnes, May 2014.
[30] One system on the North Bank and one on the south Bank.
[31] Primary treatment usually consists of screening for the removal of solids.

During the 20th century, major improvements were made to the sewerage system and to the sewerage treatment provision to substantially reduce pollution of the Thames Estuary and the North Sea.

4 STATEMENT OF SIGNIFICANCE

The Melbourne Sewerage System is highly significant for its historic, aesthetic and social value for Melbourne and its habitants between 1897 and the present day.

The Melbourne Sewerage System was the first reticulated sewerage system in Melbourne, constructed in the 1890s, and the majority of its underground networking still in use today. The construction of the system marks a significant improvement in technology and manufacturing capability in Australia.

The system was the solution of one of the biggest problems of early Melbourne, the raw sewage smell in the street and the typhoid epidemic and high death rate that was afflicting Melbourne.

The Melbourne Sewerage System was not the first comprehensive integrated sewerage system in Australia. That distinction is held by Adelaide which commissioned its system in 1885. The Melbourne system, when first commissioned, was much larger than the systems in other Australian cities, planned for a population of 1.5 million people. It was, however, the engineering excellence incorporated in the scheme and the high level of management and control exercised over it by the Melbourne and Metropolitan Board of Works which made the Melbourne system a national and perhaps international leader.

The project was made possible thanks to the work of Mr William Thwaites, Engineer-in-Chief of the Melbourne and Metropolitan Board of Works, in charge of the redesign of the original scheme devised by James Mansergh. Thwaites signed every drawing of the system to make sure that it was in perfect condition and completely functional.

The whole system contains four items of high importance: 1) the system of minor and trunk collecting sewers; 2) the Spotswood Pumping Station which was the key element of the system, capable of moving millions of gallons of sewage per day; 3) the Main Outfall Sewer, designed to transport sewage, by gravity, the 16 miles (25.6 km) from Brooklyn to Werribee and; 4) the Werribee Sewage Farm (now termed Western Treatment Plant), initially designed to treat the whole of Melbourne's sewage. Today the Western Treatment Plant still treats approximately 50% of Melbourne's sewage.

4.1 Area of Significance

The Melbourne sewerage system is of national significance. This conclusion is based not on the Melbourne system being the first comprehensive and fully integrated sewerage system in Australia, nor on its great size, but on the engineering excellence incorporated in the scheme and the high level of management and control exercised over the system by the Melbourne and Metropolitan Board of Works.

5 INTERPRETATION PLAN

5.1 Interpretation Strategy

The strategy for interpretation of the Engineering Heritage Works is laid out in the latest, 2012 version of EHA's "Guide to the Engineering Heritage Recognition Program". The interpretation will consist of an appropriate level of heritage marker; a public ceremony to unveil that marker and an interpretation panel which summarises the heritage and significant features of the works for the public.

This plan provides a summary of the proposals for design, content, location, manufacture and funding of the proposed interpretation.

5.2 Date for the Event

The ceremony is planned for **Thursday 11 September 2014** at 10:30 am. The ceremony will form a lead-up to the Open Day for the Western Treatment Plant on Sunday 12 October 2014.

5.3 The Interpretation Panels

It is anticipated that there will be a primary panel located at the Western Treatment Plant and secondary panels located at Scienceworks, Spotswood and at an agreed location along the decommissioned Main Outfall Sewer.

The primary panel will be located at the heart of the Western Treatment Plant at the site of the historic workers township of Cocoroc which today is managed as a heritage precinct. Whilst this site is central to the original Scheme it is acknowledged that the site is not accessible to the general public at all times as it is within the security perimeter of an operational facility. Nevertheless the location of the panel is ideally located and consistent with Melbourne Water's Heritage Master Plan currently being developed for the precinct.

At Scienceworks it is proposed to locate the secondary panel within the grounds adjacent to the Spotswood Pumping Station. Ideally the location should be above the main sewers which lead from Spotswood to the Brooklyn Pumping Station. The panel design would be somewhat different to the panel illustrated below to allow it to relate to its particular site.

Similarly, the secondary panel earmarked for the Main Outfall Sewer will be located at a location to be agreed with Melbourne Water along the route of the Main Outfall Sewer.

The secondary panels will be added later and are not part of the immediate nomination for implementation in 2014.

Negotiations with Museum Victoria and Melbourne Water have not yet taken place regarding the location of panels at Scienceworks and the Main Outfall Sewer. Therefore the secondary panels are subject to these negotiations.

Other sites are available if the Scienceworks location proves not to be practical.

The following will be incorporated into the design of the primary panel:

1) A title: **“Melbourne Sewerage Scheme”.**
2) A subtitle: **“Putting an end to Smell-bourne”.**
3) Logos of Engineers Australia and Melbourne Water.
4) A small scale representation of the EHA marker plate.
5) The date and other details of the marking ceremony.
6) A web site reference to the availability of the full nomination on the EHA web page.
7) A QR code to the above reference.
8) Text for main text panels should be 30 point Arial Bold.
9) Minimum text size should be 24 point Arial Bold.
10) A map showing the extent of the system will be required on this panel.
11) Historic and/or current photographs will be used to illustrate the panel. Many historic photographs exist. Brief captions for each photograph and source references to be used with each photograph.
12) Original drawings exist and copies may be incorporated into the panel.

The interpretation panel will technically be constructed and erected as follows:

1) Size to be nominally 1200 mm wide by 600 mm high.
2) The panel to be constructed of vitreous enamel-on-steel plate with flanges as per drawing at Appendix 5.
3) The panel to be mounted on a steel free-standing frame as per Appendix 5.
4) The EHA marker (Engineering Heritage National Marker) to be mounted below the interpretation panel as shown in Appendix 5.

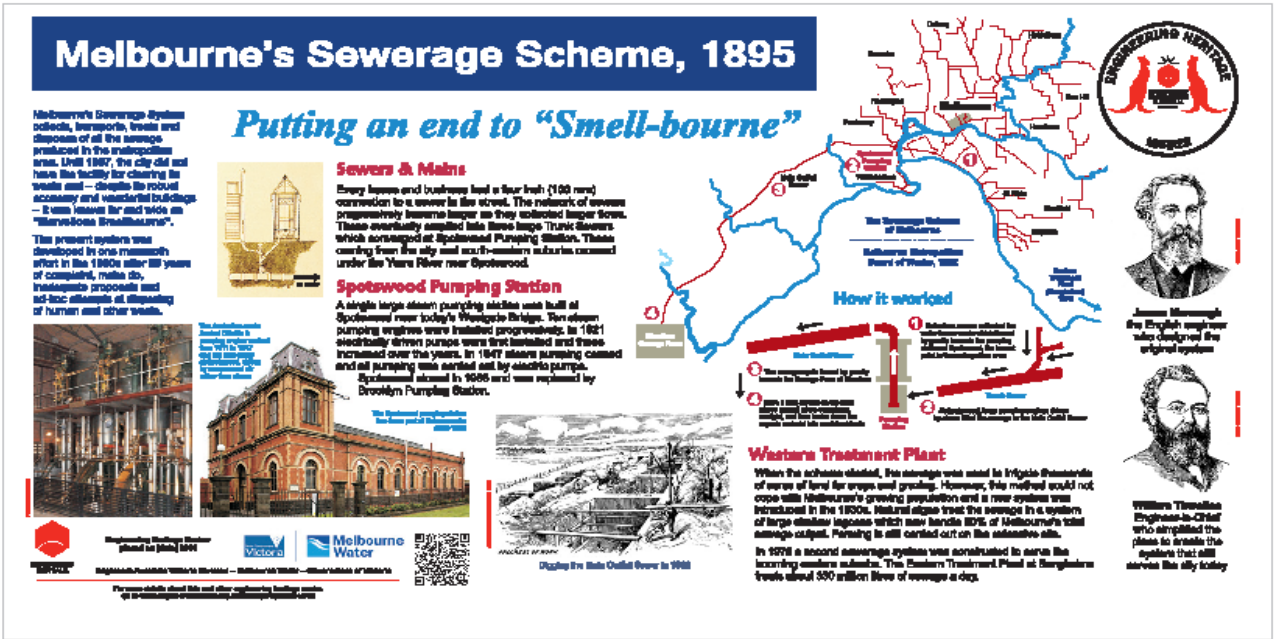
The exact location of the interpretation panel has not yet been agreed with Melbourne Water, owner of the land on which it is to be erected, however it is likely to be placed within the old township of Cocoroc probably in the vicinity of the elevated water tank and swimming pool.

5.4 Design Process for the Panel Content

The nomination will be reviewed during its development by the following parties:

1) The 11 members of the committee of Engineering Heritage Victoria.
2) Mr Richard Venus, who has been selected as the graphic designer for the project.
3) Mr Paul Balissone of Melbourne Water.

The design of the interpretation panel has been developed by Richard Venus and is shown below.



The nomination and panel design will then be submitted to the Heritage Recognition Committee.

Manufacture will then be carried out by Glass Metal Industries, subject to availability of sufficient funding with the fall-back position being manufacture using vinyl film on aluminium by Advanced Group, Melbourne.

5.5 Funding for Panel

Funding for the interpretation panel is expected to be required as follows:

Item	Fund Source	Amount
Graphic Design including purchase of photographic rights	EHA National Budget	$500
Manufacture of panel by Glass Metal Industries	To be arranged but notionally Melbourne Water	$1400
Manufacture of Steel Stand	To be arranged but notionally Melbourne Water	$1000
Installation of panel stand and panel	To be arranged but notionally Melbourne Water	$500
Supply from stock of markers by EHA	EHA National Budget	$400
	TOTAL	**$3800**

5.6 Draft Interpretation themes for Interpretation Panels

In accordance with good interpretation practice the content of the panel is divided into three themes for ease of understanding by the public. In this case one of the themes has been split into several sub-themes. The following themes have been incorporated in the interpretation panel:

a) Putting an end to “Smell-bourne” (78 words)
b) The Sewerage System described in three parts:
- Sewers & Mains
- Spotswood Pumping Station
- Main Outfall Sewer
- Werribee Sewerage Farm (215 words)

c) Associated Individuals:
- James Mansergh
- William Thwaites (27 words)

Total text is 320 words excluding headings.

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- Unknown. Happy Birthday No.8! Museum Victoria website:
  www.museumvictoria.com.au/scienceworks/discoverycentre/pumpingstation . Downloaded 10 December 2011.
- Unknown. Melbourne Water, *Wikipedia last updated 29 August 2013, downloaded 6 Jan 2014.*

[32] This reference list is laid out in accordance with the Vancouver System as described in the Commonwealth of Australia Style Guide, pp 190-1.
[33] Museum Victoria
[34] Fitzgibbon was the first chairman of the MMBW.
[35] Thwaites was the first Engineer-in-Chief of the MMBW.

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Prepared by:

First Version (original Victoria University Work Experience Project)
German A Osuna S
30 December 2011

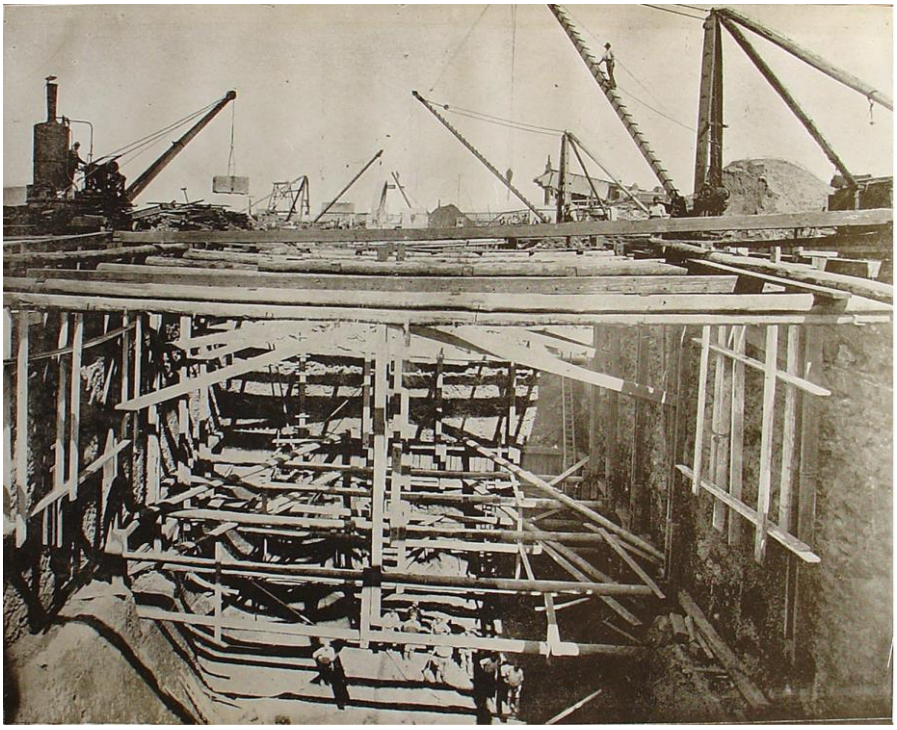
Second Version (addition of material from Melbourne Sewerage System Heritage Study)
Gary Vines
Biosis Research Pty Ltd
38 Bertie Street, Port Melbourne, Vic 3207
30 June 2013

Third Version (editing for Heritage Recognition Program use)
Owen Peake
Chair
Engineering Heritage Victoria
4 July 2014

APPENDIX 1

IMAGES AND CAPTIONS

A1.1 Historic Images



Construction of pump pits at Spotswood Pumping Station. ***Image: Source unknown***

Lord Hopetoun inspecting Spotswood Pumping Station, 1895.
Image: Public Records Office Victoria

Spotswood Pumping Station shortly after it was constructed. ***Image: Museum Victoria***

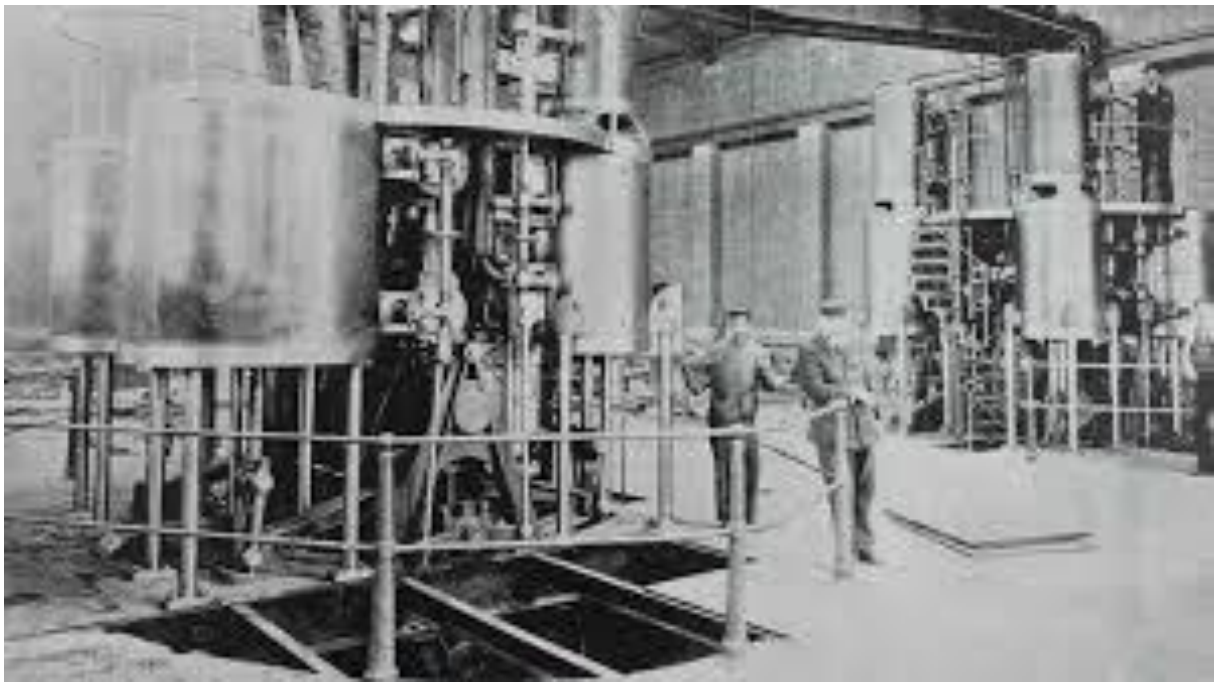
Main Outfall Sewer. ***Image: Culture Victoria***

Menu from Engineering Branch Banquet, 11 August 1894, showing William Thwaites with the weight of the Metropolitan Drainage System on his back and his assistants in attendance.
Image: Culture Victoria

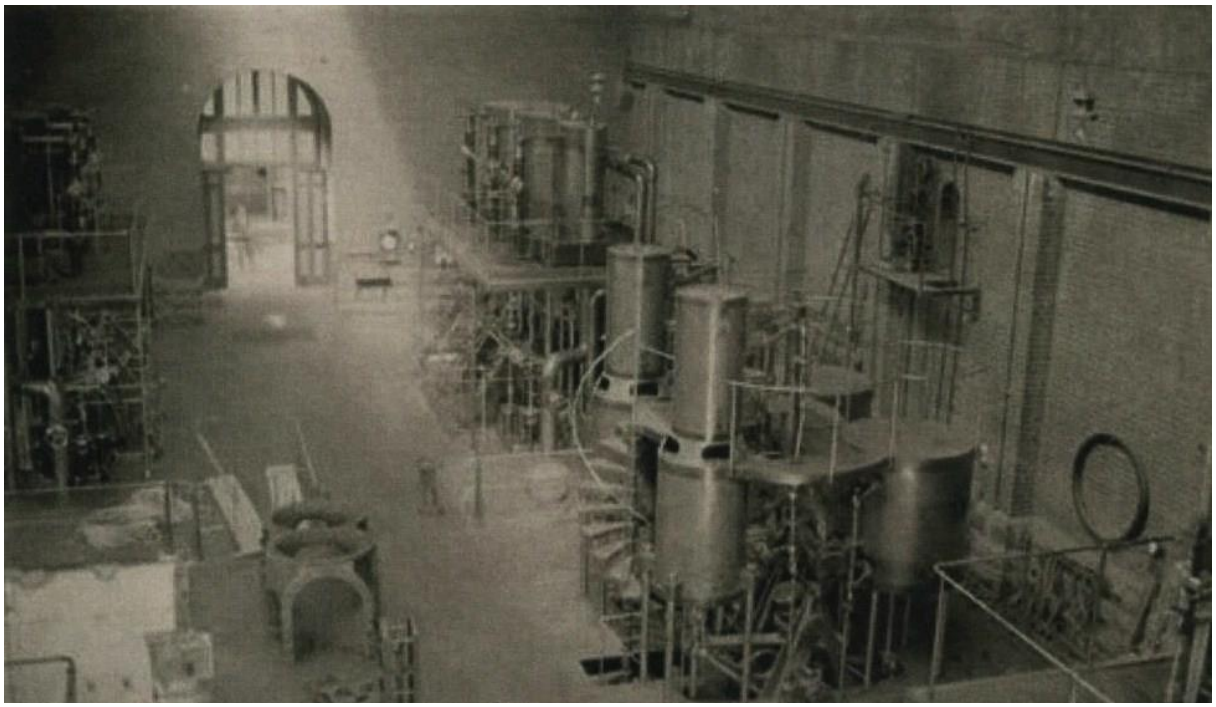
Inspection of the rising main from Spotswood to Brooklyn where the Main Outfall Sewer started. It was ultimately corrosion in this main which led to the closure of Spotswood Pumping Station.
Image: source unknown

Kororoit Creek aqueduct for the Main Outfall Sewer. ***Image: source unknown***

Tunnelling excavation of the North Yarra Main Sewer. ***Image: Water Services Association of Australia***



Two of the four Thompson of Castlemaine non-rotative triple expansion pumping engines at Spotswood Pumping Station. These were the first pumping engines supplied.
Image: Colour Chorus

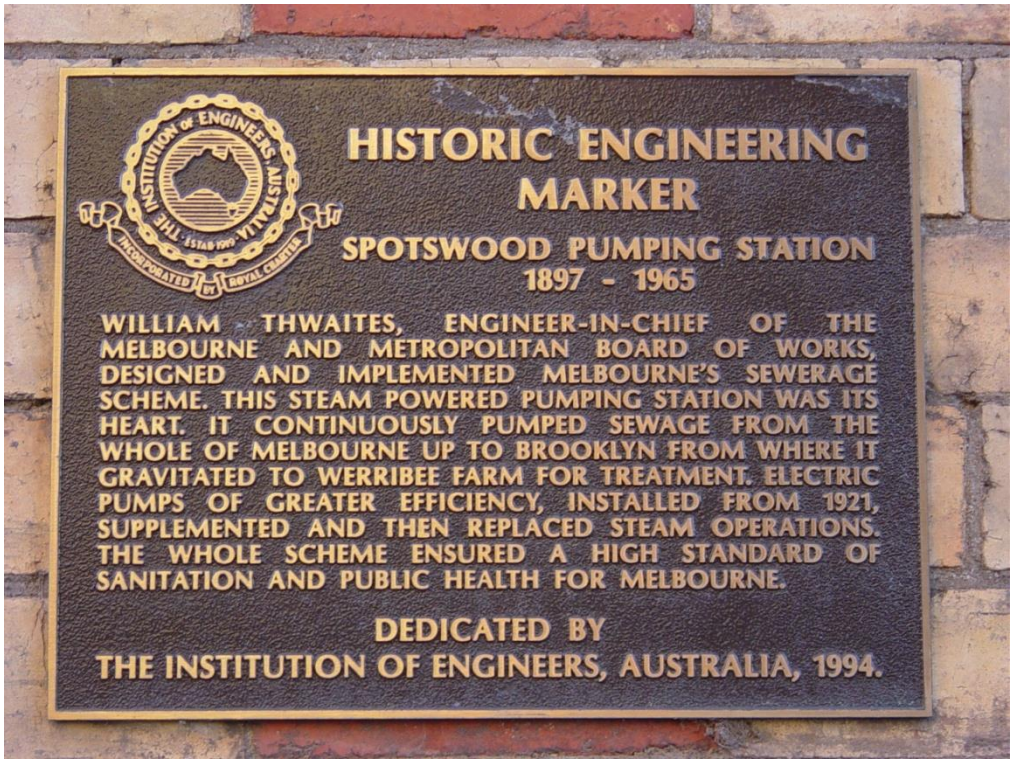


Three generations of steam pumping engines in the South Engine House at Spotswood. At right is one of the original Thompson engines with the single Hathorn Davey behind it at centre. The single Austral Otis engine to an E P Ellis design is at the left. This engine was supplied before the arrival of the Hathorn Davey engine. Austral Otis subsequent successfully copied the Hathorn Davey engine, building the four extant engines in the North Engine House.
Image: Museum Victoria

A1.2 Recent Images

Spotswood Pumping Station from the river bank, 2011. ***Image: Owen Peake***

Sections of tunnel from the Yarra River crossing at Spotswood Pumping Station. ***Image: Owen Peake***

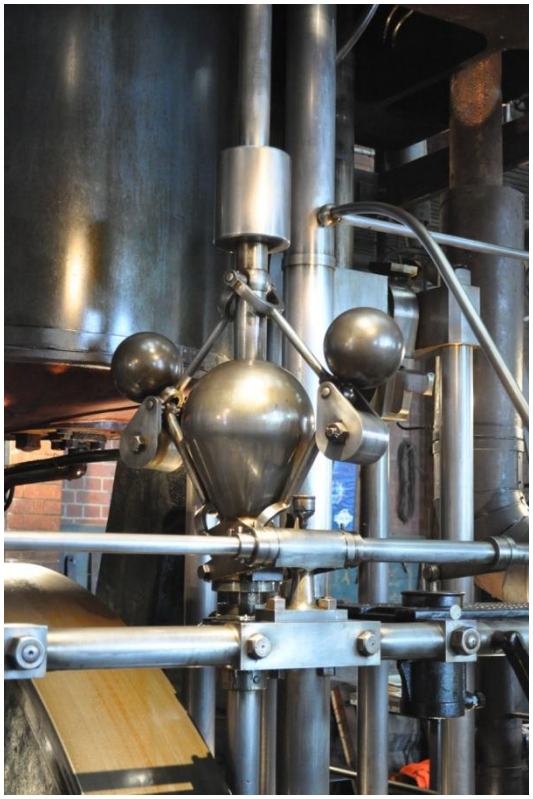


Engineering Heritage Australia Bronze Historic Engineering Marker. ***Image: Owen Peake***

National Trust Marker at Spotswood. ***Image: Owen Peake***

Hathorn Davey steam pumping engine at Spotswood. ***Image: Miles Pierce***

Austral Otis pumping engine No.8 at Spotswood. ***Image: Owen Peake***



Mechanical flyball governor of Austral Otis No.8 steam engine. The governor controls the rotational speed of the engine.

This engine is fully restored and is run daily on compressed air. The workmanship of this locally made engine is every bit as good as the Hathorn Davey engine from which it was copied.

Image: Owen Peake

One of the Main Crossheads of the Austral Otis No.8 steam engine. The four vertical rods below the crosshead are the pump drive rods driving the reciprocating pump far below the engine.

This engine is fully restored and is run daily on compressed air. The workmanship of this locally made engine is superb.

Image: Owen Peake

Kororoit Creek aqueduct on the original Main Outfall Sewer. This sewer is now out of service and the aqueduct has been converted to a cycle path. ***Image: Owen Peake***

Oxidation ponds at Western Treatment Plant. ***Image: Melbourne Water***

APPENDIX 2

HISTORIC INDIVIDUALS OR ASSOCIATIONS

A3.1 William Thwaites (1853 - 1907) [36]

William Thwaites, MCE. ***Image: Heritage Australia Magazine***

William Thwaites, civil engineer and public servant, was born on 13 August 1853 in Melbourne, son of Thomas Thwaites, cabinetmaker, and his wife Eliza, née Raven, both English born. Educated at the Victorian Grammar School, Collins Street, and the Model School, Spring Street, he passed the civil service examination in 1868, but went to the University of Melbourne (Certificate of Engineering, 1873; B.A., 1874; M.A., 1876; M.C.E., 1901). An outstanding student, he won numerous prizes and scholarships.

Commencing his professional career as a pupil-draftsman with the Victorian Department of Railways in 1874, he transferred in 1876 to the South Australian department as an assistant draftsman. In 1879 he returned to the Victorian Department of Public Works and completed engineering surveys for Sir John Coode's reports on Portland Harbour, Lakes Entrance and the Sale navigation, as well as a survey for defence purposes of Swan Island in Port Phillip Bay.

[36] Dingle Tony. *Australian Dictionary of Biography, Volume 12.* Melbourne University Press, 1990. accessed 6 January 2014.

Transferring to the water supply branch, he designed the Toorourrong Reservoir, the Essendon and Caulfield service reservoirs, and other facilities. Thwaites was appointed engineer of roads, bridges and reclamation works in 1883. Here he made his mark on Melbourne's landscape through the Dight's Falls scheme (which directed salt-free water to the lakes in the Botanic Gardens and in Albert Park), and by draining Elwood swamp and Port Melbourne lagoon. He also began drainage works at the Condah, Moe and Koo-wee-rup swamps.

Elected a member of the Victorian Institute of Engineers (1881) and a councillor of the Institute of Surveyors (1887), Thwaites became a member of the Institution of Civil Engineers, London, in 1889, and Australasian representative on its council in 1899-1901. He was appointed co-examiner in engineering at the University of Melbourne and in 1890 was elected to the university council. In 1889 he gave evidence before the Royal Commission into Melbourne's sanitary conditions and provided the most detailed and comprehensive scheme for underground sewers put before the commission. Next year he became engineer in charge of the water supply branch. In 1891 he was appointed engineer-in-chief of the Melbourne and Metropolitan Board of Works which had been established to build the sewerage system urgently recommended by the Royal Commission. There were a few critics of his appointment, but Melbourne's engineers held a banquet to honour the local achievement.

While James Mansergh is commonly regarded as the architect of Melbourne's sewerage system, Thwaites deserves credit both for its design and construction. He modified Mansergh's preferred scheme so that what was built owed more to the plans Thwaites had earlier put before the Royal Commission. Construction began in 1892. It was by far the largest building project in Melbourne during the depression, providing work for several thousand men and contracts for local businesses. An innovative administrator, Thwaites managed all aspects of the work, making use of the recently introduced telephone to check on progress. He worked well with contractors who trusted him and respected his expertise. Despite problems in raising loan finance, difficulties in tunnelling, and accidents, the sewerage system quickly became operational: house connexions were made during 1897. Thwaites personally answered the many criticisms of the M.M.B.W. and of his work, appearing before parliamentary committees of inquiry in 1896 and 1900, at public meetings and in print. He gave evidence before Royal Commissions on tariffs and on technical education, and also maintained a massive output of memoranda and reports. Robust in build and seemingly inexhaustible, he had few interests outside his work.

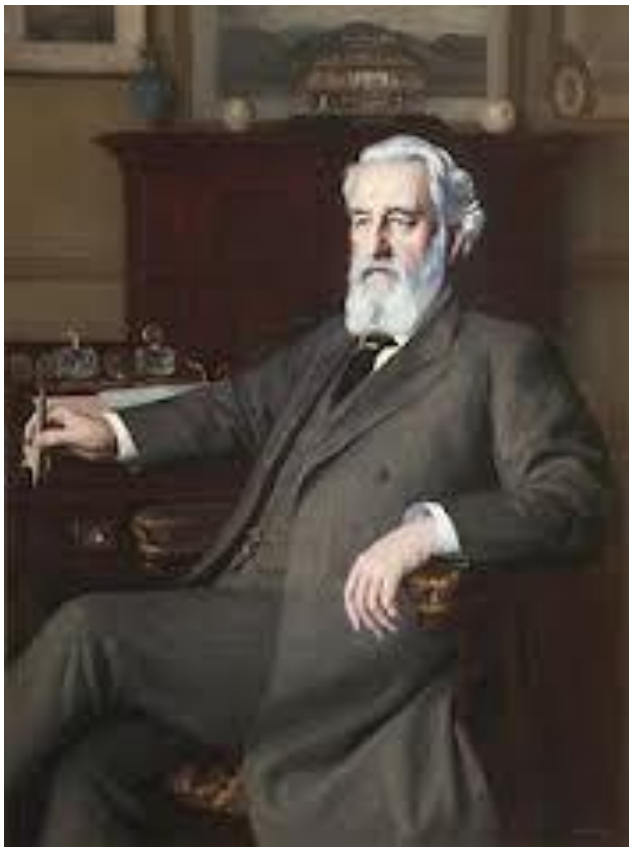
Although he never travelled abroad, Thwaites had one of the best engineering libraries in Victoria and was well informed on overseas engineering practice. His knowledge of the physical and climatic characteristics of the metropolitan area amazed his colleagues. He 'had a genius for statistics' and carried out most of the M.M.B.W.'s statistical projections, in the engineering area and in relation to finance. Behind his schemes lay a firm belief in the ability of the engineer to improve the natural world for the benefit of humanity. One of his more interesting proposals was for fuller use of the Yarra River to provide water, electricity and recreational areas.

Thwaites was twice married, with Congregational forms: on 18 October 1879 in Melbourne to Elizabeth Ferres (d.1905), daughter of the government printer; on 16 December 1905 at Balwyn to Margaret Barton. There were no children. He died of uraemia and pneumonia on 19 November 1907 at San Remo. Survived by his wife, he was buried in Melbourne general cemetery.

Select Bibliography

- *Melbourne and Metropolitan Board of Works Sewerage Scheme* (Melb, 1900)
- J. Smith (ed), *Cyclopedia of Victoria*, vol 1 (Melb, 1903)
- *Parliamentary Papers* (Legislative Assembly, Victoria), 1895-96, 2, (3), p 351, 1901, 2, (7), p 361
- *Building and Engineering Journal*, 25 July 1891
- *Age* (Melbourne), 30, 31 Jan, 20 Nov 1907
- *Argus* (Melbourne), 20 Nov 1907.

A3.2 James Mansergh (1834 - 1905) [37]



James Mansergh. ***Image: en.wikipedia.org***

[37] Mellor Suzanne G. *Australian Dictionary of Biography, Volume 5*. Melbourne University Press. 1974. accessed 7 January 2014.

James Mansergh, civil engineer, was born on 29 April 1834 at Lancaster, England, second son of John Burkitt Mansergh, draper. Educated locally and at Preston, in 1847 he entered Queenwood College, Hampshire, an advanced institution reputed for mathematics. He was first apprenticed to McKie & Lawson in 1849 and by 1866 was in partnership with his brother-in-law, John Lawson, after whose death he practised alone until his sons joined him. His first works were railways, particularly in Wales and Brazil, and he then specialized in waterworks and sewerage. He designed the scheme which cost £6,000,000 and was to supply Birmingham with over 100,000,000 gallons (454,609,000 litres) of water a day. He also designed and constructed water supply and sewerage plans for other major English cities and was a consultant on hundreds of parliamentary and municipal committees. He was president of the Institution of Civil Engineers, a councillor of the Institution of Mechanical Engineers and a fellow of the Royal Society.

In 1889 after the appalling reports of the Royal Commission on Melbourne's sanitary conditions and a vigorous press campaign with public protest demanding reform, Mansergh was invited to advise on a deep-sewerage scheme for Greater Melbourne. He arrived with his son Ernest as assistant on 18 October and left on 13 December. The contour plans of the whole area which he had requested did not arrive in England until April 1890. His figures were provided by H H Hayter, government statistician, who from the population of 427,200 in 1889 estimated a total over 1,680,000 by 1934. This growth seemed reasonable to Mansergh and induced him to propose the high figure of seventy-five gallons (341 litres) of water a head each day for sewerage and domestic use because of 'the almost universal and very free use of baths'.

Mansergh found the level of pollution in Melbourne disgraceful. 'Open gutters conveying chamber slops and other foul liquids in the open' into the Yarra and Hobsons Bay were standard. Heavy rain often overflowed from gutters into low-lying houses and yards, while the subsoil was 'permanently besodden and stinking' from this overflow and from disused cesspits. He was also disgusted by industrial waste from tanneries and other factories and by the disposal methods for domestic refuse. His aim was 'to remove all human refuse from the proximity of human habitations without the assistance of human labour': all cesspits and pails were to be replaced by water closets which were to drain into underground channels; street gutters were to carry only rain water to the rivers and all other water was to be carried by pipes to two land treatment plants to be installed at Werribee and Mordialloc. These plans, submitted in August 1890, were to cost over £7,000,000. The press attacked his high estimates and the plan was modified but as implemented was 'substantially his', though at a greatly reduced estimate and without the Mordialloc plant.

Mansergh's later projects included waterworks for Toronto and sewerage schemes for Colombo and the Lower Thames valley. He married twice: first, in July 1859 to Mary, daughter of Robert Lawson of Skerton, Lancashire, by whom he had two sons and two daughters; and second, in September 1898 to Harriet, née Branford, widow of Nelson Irons of Tunbridge Wells. He died in Hampstead on 15 June 1905.

Select Bibliography

- G. Serle, *The Rush to be Rich* (Melb, 1971)
- *Votes and Proceedings* (Legislative Assembly, Victoria), 1890, 4 (182)
- *Age* (Melbourne), 17 June 1905.

A3.3 Christian Kussmaul (1851 - 1916)

ICE Obituary [38]

"Christian Kussmaul, born on the 9th January, 1851, died at Melbourne, Australia, on the 30th July, 1916. After gaining experience on railways in Germany, he went out to Australia in 1886 and joined the staff of the Victorian Railways. In 1891 he entered the service of the Melbourne and Metropolitan Board of Works, and subsequently was promoted to be Designing Engineer, latterly acting as deputy to the Engineer-in-Chief. He took a large part in the design of the Melbourne Sewerage System, retiring in 1915. He was elected an Associate Member on the 6th December 1898, and was transferred to the class of Members on the 24th February, 1903".

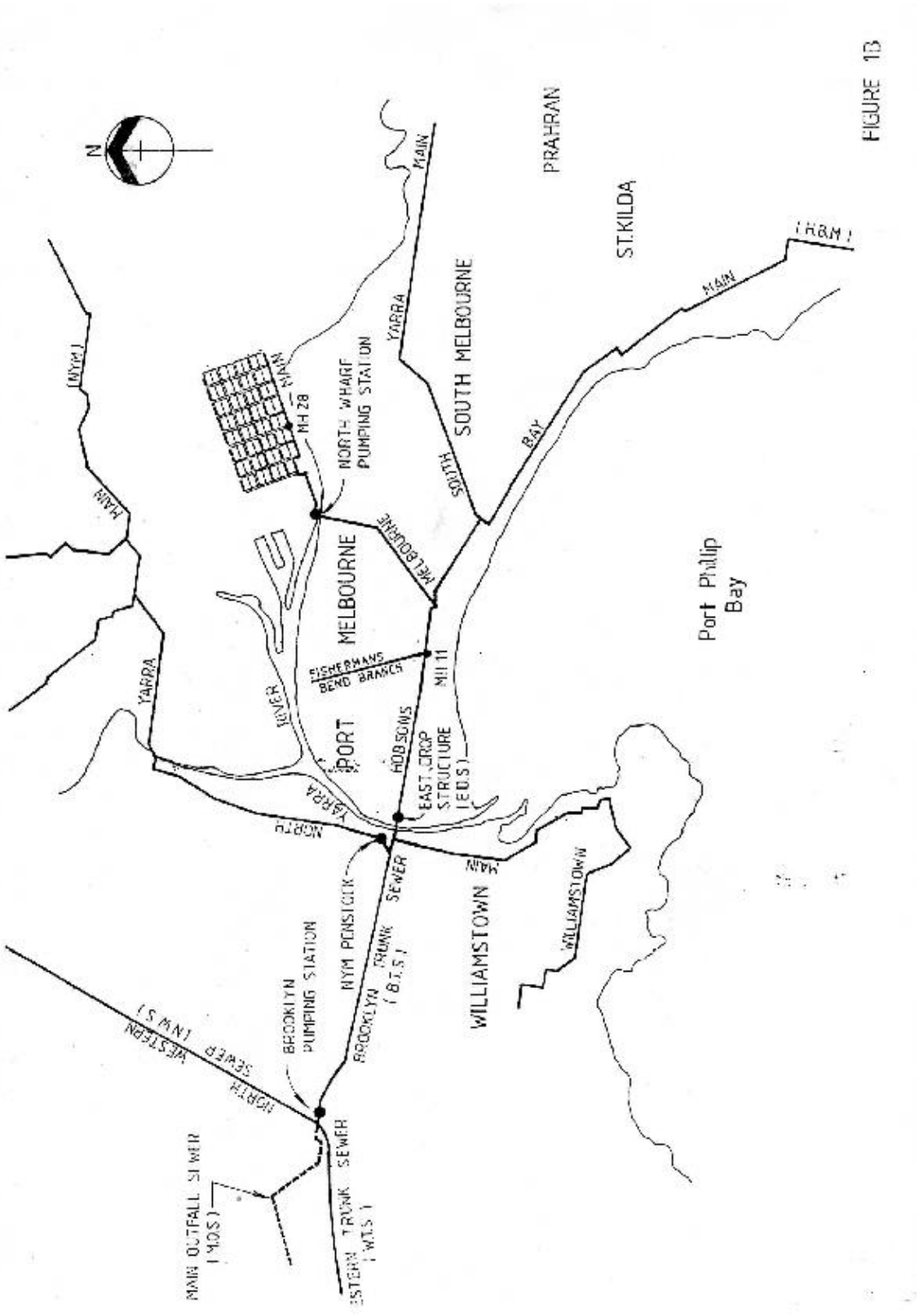
Kussmaul is credited with the design of the Spotswood Pumping Station including the buildings [39].

There was controversy concerning his dismissal or retirement due to his German background at the beginning of the First World War. The Board lacked the intestinal fortitude to stand behind him as a loyal and skilled engineer who had served the MMBW very well. Kussmaul was not accused of showing any signs of sympathy with Germany and its war-mongering prosecution of the First World War [40].

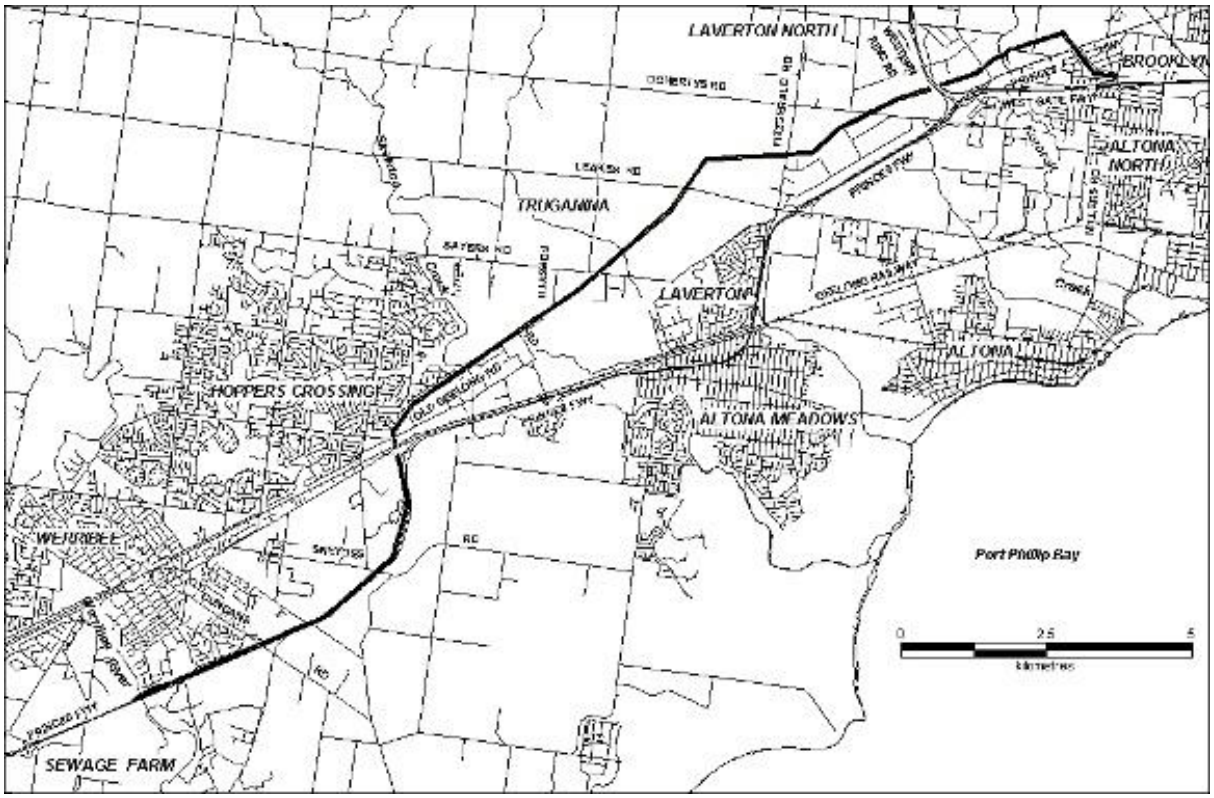
[38] Unknown. Obituary, Christian Kussmaul,1851-1916. *Minutes of the Proceedings Vol 202, Issue 1916.* 01 January 1916. p 442. Accessed via the Institution of Civil Engineers (ICE), Virtual Library.
[39] Owen Peake, 15 January 2014, unsubstantiated opinion.
[40] Trove contains references to a large list of newspaper articles relating to this matter at the following link: *trove.nla.gov.au/ndp/del/tag?allTags=1&name=**Christian**+**Kussmaul**...*

APPENDIX 3
MAPS

Map of Melbourne showing extent of the sewerage system completed or under construction (coloured areas) in 1897. Note that the map is signed by William Thwaites.
Image: Culture Victoria



Main and Trunk Sewers in Melbourne since the installation of Brooklyn Pumping Station. Note that Spotswood Pumping Station is at the point where the Hobsons Bay Main crosses the Yarra River.
Image: Source unknown



Route of the Main Outfall Sewer from Brooklyn to Werribee.
Image: source unknown

APPENDIX 4
FURTHER MATERIAL ON THE STEAM PUMPING ENGINES AT SPOTSWOOD PUMPING STATION

4.1 Museum Victoria article on the centenary of engine No.8 [41]

Steam Pumping Engine - Austral Otis, No.8 Pumping Engine, MMBW Spotswood Sewerage Pumping Station, 1911 Reg. No: ST 038266

Summary:

In 1902 the Melbourne & Metropolitan Board of Works began operating a new steam pumping engine at the Spotswood sewerage pumping station. It was built by Hathorn Davey & Co. of Leeds, UK. This engine was an inverted vertical rotative direct-acting triple-expansion surface-condensing design; it featured fully steam-jacketed cylinders and inter-cylinder steam receivers. This engine proved to be 70% more efficient than the four locally-built Thompson & Co Worthington type triple-expansion engines installed at Spotswood between 1895 and 1897 and 28% more efficient than the single Austral Otis Engineering Co pumping engine installed in No. 6 pumping well in 1901.

When the MMBW required additional pumping engines in 1909, Austral Otis were asked to prepare plans for four new engines, this time based largely on the successful Hathorn Davey design, with a few minor modifications. The first two new Austral Otis engines

[41] Extract from Museum Victoria Web Site 4 July 2014.

were commissioned in June and July 1911, followed by the remaining two in mid-1914. Four additional boilers, again supplied by Thompson & Co. of Castlemaine, were installed in 1909 in preparation for these engines. This brought the plant at the pumping station to a total of ten manually-stoked coal-fired boilers and ten steam pumping engines, each of about 300 horsepower, with a combined pumping capacity of 80 million gallons per day (363 ML/day).

This engine is located in the No. 8 pumping well at the southern end of the North Engine Room. It was installed in July 1911. Since 1992 this engine has been operated on compressed air and is regularly demonstrated to Scienceworks visitors.

Acquisition Information:

Donation from Melbourne Water, 1989.

4.2 Museum Victoria article on the centenary of engines No. 7 & 8 [42].

Centenary of the Austral Otis Steam Pumping Engines Nos. 7 & 8

No.8 Austral Otis Pumping Engine, Spotswood Pumping Station, 1982
Source: Museum Victoria

[42] Extract from Museum Victoria Web Site 10 December 2011.

The year 2011 marks the centenary of the two oldest surviving Australian-built steam engines at the former **Spotswood Pumping Station.** Manufactured by the Austral Otis Engineering Company Limited, of South Melbourne, the engines were installed in Wells Number 7 & 8 in the North Engine House and were coincidently the 7th & 8th pumping engines installed at Spotswood.

Rated at 300 nominal horsepower, the engines are of a type described as inverted vertical rotative triple-expansion direct-acting surface-condensing steam pumping engines, and were each capable of pumping 9 million gallons (40 million litres) of sewerage a day against a head of 125 feet (38.1 metres). They were amongst the most sophisticated reciprocating steam engines ever made in Australia and have advanced design features such as semi-rotary Corliss valves on all cylinders and improved Craig trip gear for steam cut-off.

In March 1909, the Melbourne & Metropolitan Board of Works advertised tenders for the *"Manufacture (within the state of Victoria), Supply, Delivery, and Erection, in the Northern Engine House, at the Pumping Station, Spotswood, of two Pumping Engines, complete."* Tenders closed on 25th May 1909, and on 15th June the tender of the Austral Otis Company was accepted at a cost of £19,830/17/8.

Although Austral Otis had supplied an earlier steam engine for the Spotswood Pumping Station in 1902, the design of Engines No.7 & 8 was based on Engine No.5, in the South Engine Room, which had been built by Hathorn Davey & Co Limited, of Leeds, in 1900 and had proved to be the most efficient of the first six engines installed. The Board of Works had obtained a full set of working drawings with the Hathorn Davey engine, but Austral Otis began its contract by preparing a new set of drawings, incorporating a number of modifications to the original design probably made as a result of the experience gained in installing and running the earlier engine. Amongst the changes made was the use of a massive single-piece bedplate casting for rigidity, additional crankshaft bearings and a modified governor controlling the steam cut-off on all three cylinders, rather than just the high-pressure cylinder.

Erection of the engines commenced in late 1910, with the installation of large beams 35 feet (10.7 metres) below ground to support the cast-iron pump casings and steam condenser, followed by the assembly of the engines themselves at ground level.

Engine No.7 was first run under steam on Monday, 8th May 1911, and after a month of further testing and adjustments was handed over to the Board of Works to begin its official 12-month warranty period on 6th June 1911.

Engine No.8 was first run on steam on Thursday, 28th September 1911, and was handed over to the Board of Works to begin its official 12-month warranty period on 12th October 1911.

When official duty trials of both engines were undertaken in July 1912 they performed admirably, both recording figures over 180 million ft-lbs per 1,120 lbs steam consumed - equivalent to 20% over manufacturer's guarantee and 6% better than the original Hathorn Davey engine. The completion of the engines was a triumph for Victoria's local engineering industry, however, after a glowing account of the duty trials was published in the British journal *Engineering*, it is interesting to note that in the following issue a letter from the manager of Hathorn Davey & Co's Sun Foundry, Leeds, was published politely pointing out that the plant described *'corresponds almost exactly'*

with *'a sewerage pumping plant designed and constructed by ourselves for the Melbourne and Metropolitan Board of Works in 1900'* and further commenting that:

'During the twelve years that have elapsed since we designed the Melbourne engine considerable progress has been made. Superheated steam is now generally adopted, with a consequent economy in fuel, and so many mechanical details have been simplified or improved as to materially improve the durability and efficiency of the whole.'
'As an instance of this improvement we may mention the four engines designed and constructed for the Rand Water Board in 1906 ... [which] *showed a duty ... of 210 millions, compared with the 184.8 in your report.'*

Pumping Engines Nos.7 & 8 continued to operate at the Spotswood Pumping Station until 1947, although most of their work was done prior to the installation of the first generation of electric pumps in 1921-23. During these years the use of the engines peaked at around 40-68% of the total number of hours in a year. After they were retired, the engines sat quietly in the southern corners of the North Engine House silently gathering dust, but were given an occasional polish by the pumping station staff.

In 1982, Engine No.8 was modified by the Board of Works engineering staff to operate on compressed air for demonstration purposes and it continues to be run on a daily basis as a feature of guided tours through the Pumping Station. In March 1989, Museum Victoria took over the management of the former Spotswood Pumping Station and the Austral Otis steam engines.

4.3 Museum Victoria article on the centenary of engine No. 8 [43].

Happy birthday No.8!

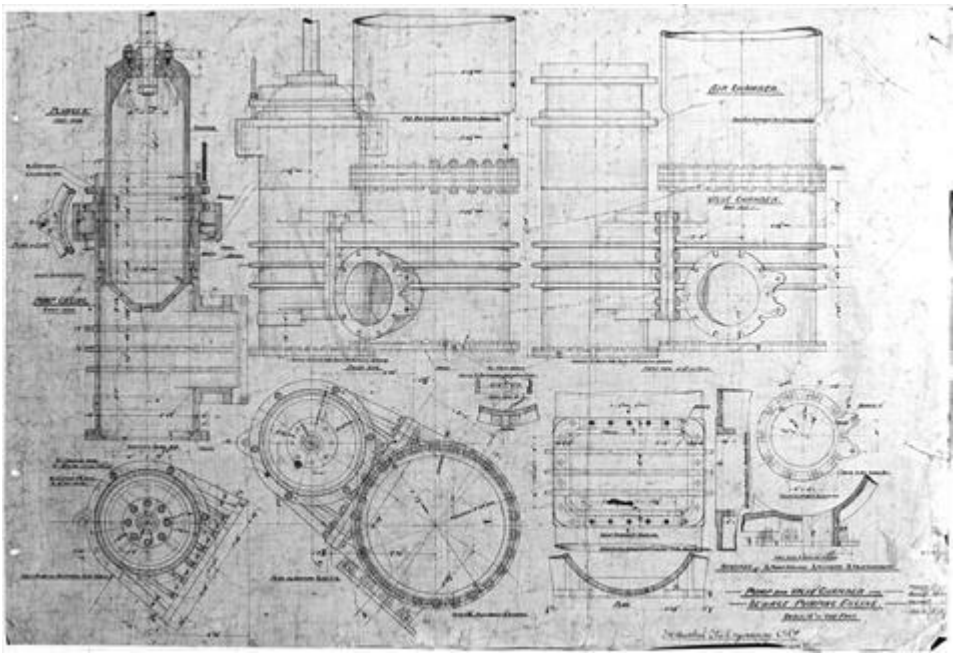
At 2pm today it was exactly 100 years ago, on 28 September 1911, that the No.8 Steam Pumping Engine n the Spotswood Pumping Station was fired up for the first time [44]. You can still see it in motion in the Engine Room but these days it runs in demonstration mode, powered by compressed air.

Steam Pumping Engine - Austral Otis, No.8 Pumping Engine, MMBW Spotswood Sewerage Pumping Station, 1911 (ST 038266). Source: Museum Victoria

Built by local company Austral Otis, the No. 8 Engine was a modified copy of the earlier Hathorn Davey engine. It is one of five surviving engines at the Pumping Station which remain some of the most sophisticated steam engines ever built in Australia. It took four men to run the No. 8 Engine: an engine driver, a greaser, a pump attendant and a fireman. It was one of the engines that moved sewerage from Melbourne to Werribee following the welcome introduction of Melbourne's sewerage system in the 1890s.

[43] Extract from Museum Victoria Web site 10 December 2011.

[44] http://museumvictoria.com.au/collections/items/398791/steam-pumping-engine-austral-otis-no-8-pumping-engine-mmbw-spotswood-sewerage-pumping-station-1911



Original blueprint for an Austral Otis Steam Pumping Engine.
Image: Austral Otis
Source: Museum Victoria

Of the bank of engines, one or two were run continuously with additional machines brought on to handle peak sewerage flow. The Pumping Station log books show that from 1912, the No. 8 Engine was used heavily for the first decade of its life. In the 1920s and 30s the old steam engines were progressively replaced by electric engines which were cheaper to run. No. 8 was used less often, but was still important for managing peak periods.

There was a regular flow pattern coinciding with the daily cranking up of industrial and domestic activities. Curator Matthew Churchward describes a peak on Mondays when many women did the week's laundry. The superintendent would also keep a close eye on the weather and impending rainfall, and counted raindrops to predict how many staff would be needed to manage the stormwater that would be on its way to Spotswood within a couple of hours. During big storms, all the engines might be running to prevent sewerage from entering the Yarra River.

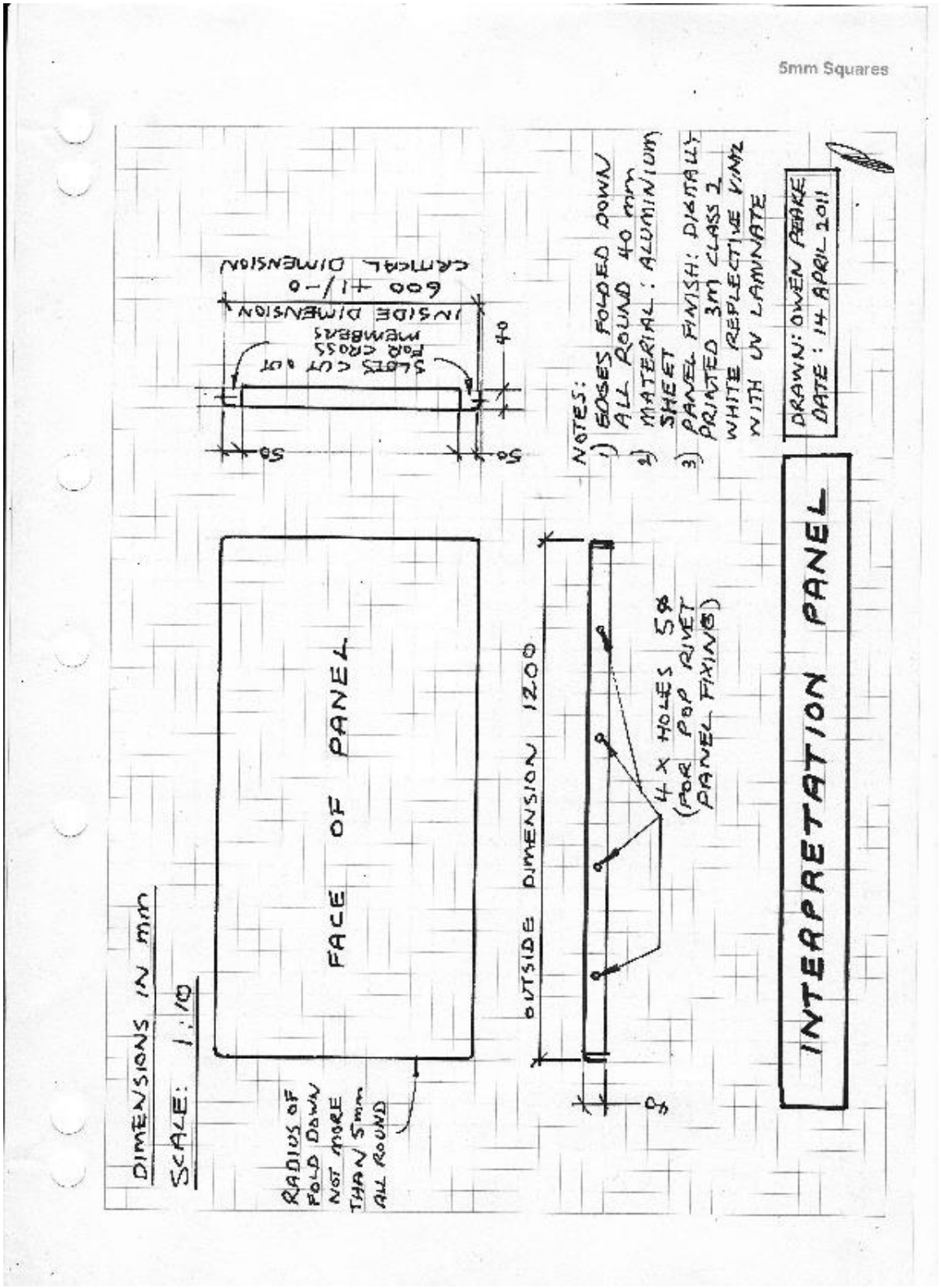
During its working life from 1911 to 1947, the No. 8 Engine pumped the equivalent of four billion toilet flushes out of the city. It was a filthy job but vital to the health and quality of life of 20th century Melbourne. If you're at Scienceworks today, be sure to wish this gleaming hulk of pistons, valves, cranks and pipes a happy birthday!

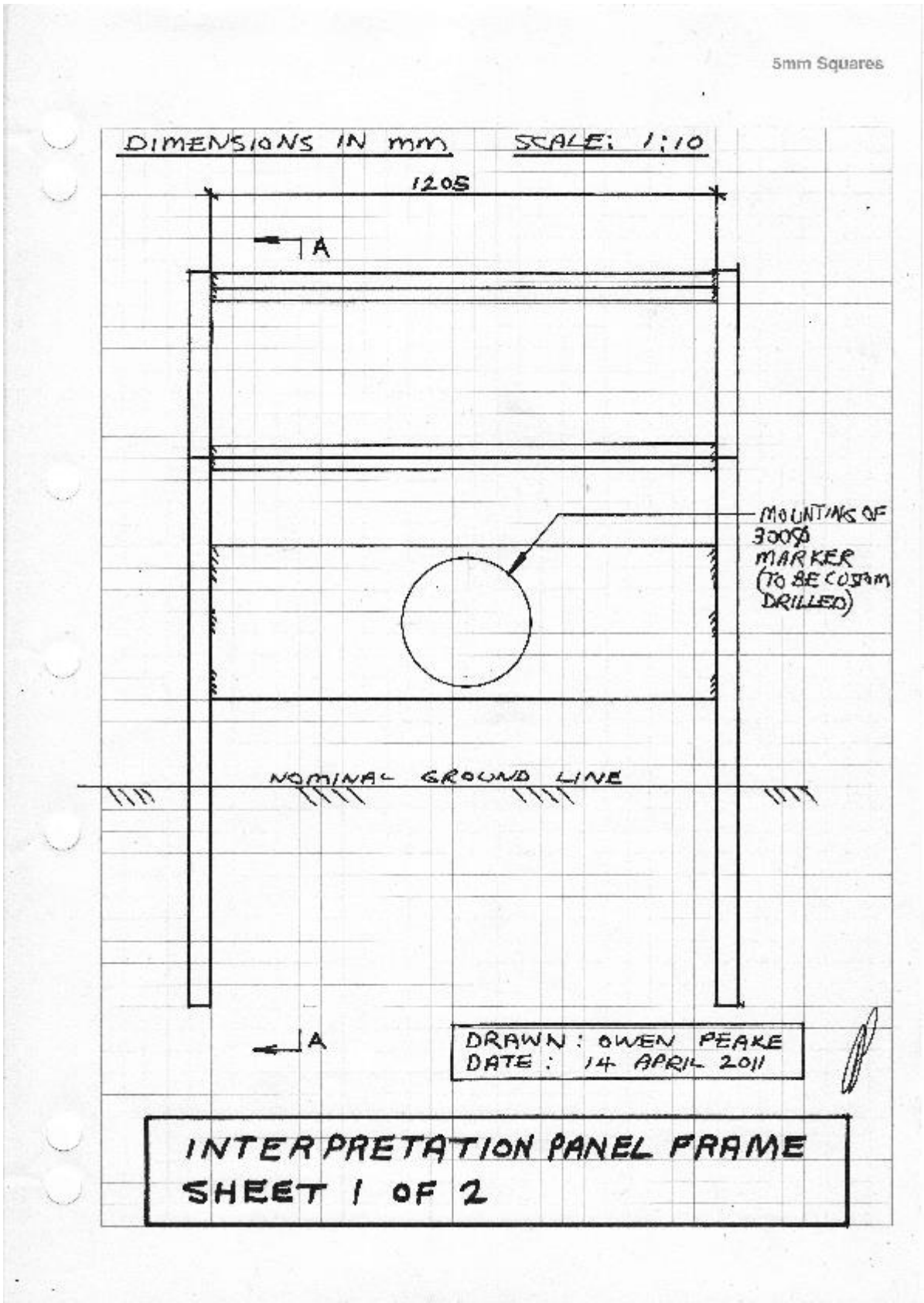
Workshop volunteer and casual engine driver Graeme Kerrs running a pumping engine demonstration in front of the No. 8 Engine.
Image: James Geer Source: Museum Victoria

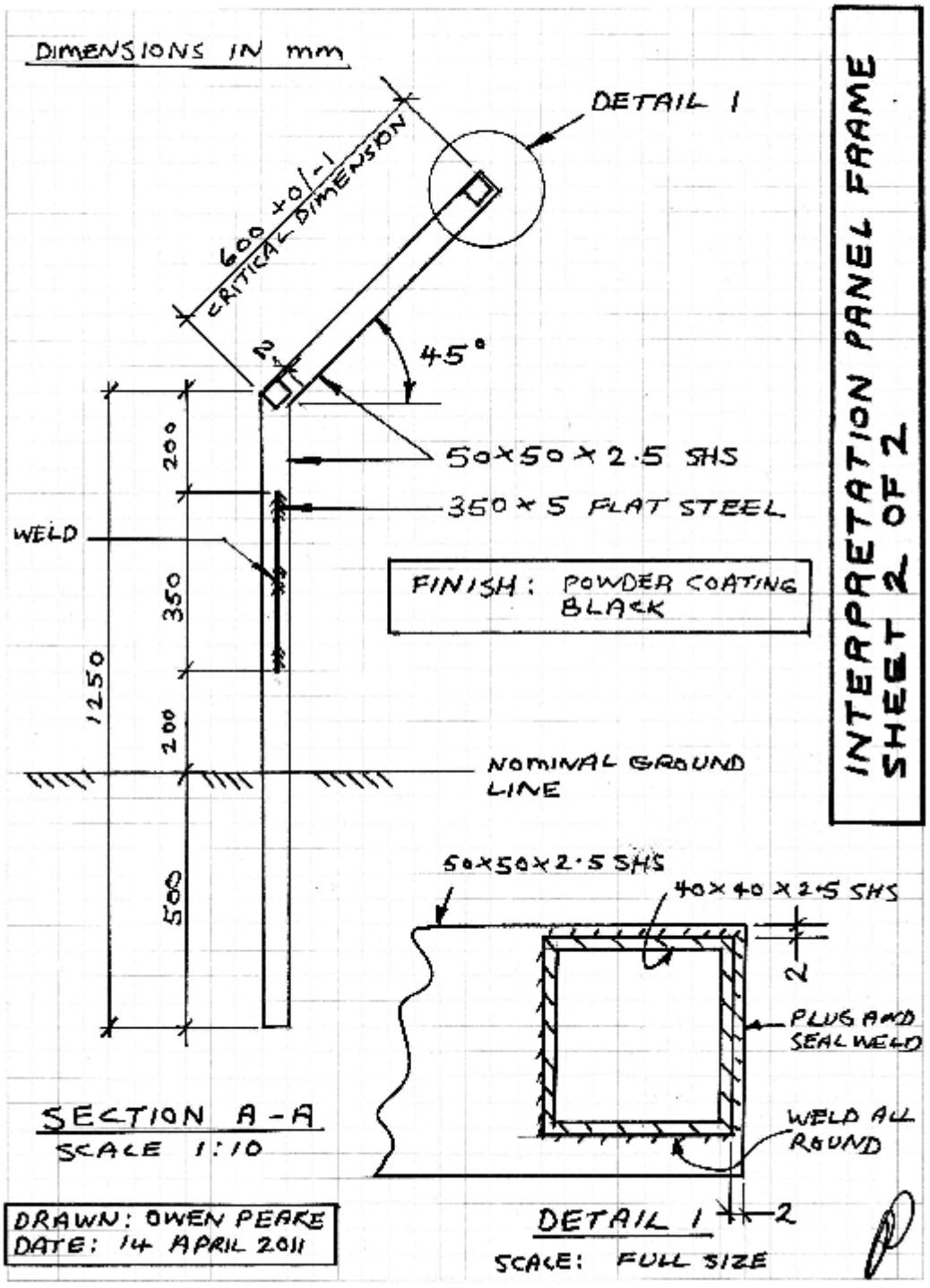
4.4 Article from International Stationary Steam Engine Society (ISSES) Bulletin IB13.1 – A Short Technical History of Spotswood Pumping Station, Melbourne Victoria.

Article to be sourced

APPENDIX 5
DRAWINGS OF INTERPRETATION PANEL & MOUNTING STAND




5mm Squares
DIMENSIONS IN mm
SCALE: 1:10
1205
A
MOUNTING OF
300Ø
MARKER
(TO BE CORAM
DRILLED)
NOMINAL GROUND LINE
A
DRAWN: OWEN PEAKE
DATE: 14 APRIL 2011
INTERPRETATION PANEL FRAME
SHEET 1 OF 2


5mm Squares
DIMENSIONS IN mm
DETAIL 1
600 +0/-1
CRITICAL DIMENSION
45°
50×50×2.5 SHS
350×5 FLAT STEEL
WELD
FINISH: POWDER COATING BLACK
INTERPRETATION PANEL FRAME
SHEET 2 OF 2
200
350
200
1250
500
NOMINAL GROUND LINE
SECTION A-A
SCALE 1:10
DRAWN: OWEN PEAKE
DATE: 14 APRIL 2011
50×50×2.5 SHS
40×40×2.5 SHS
2
PLUG AND SEAL WELD
WELD ALL ROUND
2
DETAIL 1
SCALE: FULL SIZE

APPENDIX 6
LETTER OF APPROVAL FROM MELBOURNE WATER

Melbourne Water

29 January 2014

Mr Owen Peake
c/o Engineering Heritage Australia (Vic)
4 Islington Street
COLLINGWOOD VIC 3066

Dear Owen

MELBOURNE SEWERAGE - HERITAGE RECOGNITION NOMINATION

I refer to the abovementioned and wish to confirm Melbourne Water's support for the proposed nomination of the Sewerage System. To this end, our support extends to assisting your organisation in planning an appropriate ceremony, which tentatively is planned for some time later this year.

We are excited by the opportunity to finally have recognition bestowed upon the Sewerage System, which is long overdue. The Western Treatment Plant (WTP) is the idyllic location to mark the occasion and indeed to bear an interpretive marker, which is in keeping with Melbourne Water's Heritage Master Plan currently being developed for the WTP.

Melbourne Water is happy to discuss further the logistics regarding the timing and nature of the ceremony and importantly, details of interpretive signage.

We look forward to developing this proposal further.

Yours sincerely

PAUL BALASSONE
ACTING TEAM LEADER, LAND AND HERITAGE

Melbourne Water
990 La Trobe Street Docklands VIC 3008
PO Box 4342 Melbourne VIC 3001 Australia
T 131 722 F 61 3 9679 7099

APPENDIX 7
TIMELINES FOR MELBOURNE SEWERAGE SYSTEM

1) Spotswood Pumping Station

1894 Spotswood Pumping Station contractor began work.

1897 Four Thompson steam pumping engines were installed, two in the north engine room and two in the south engine room. Pumping station began operation.

1902 Two further steam pumping engines were installed, both in the south engine room. One was an imported Hathorn Davey machine and the other was an Austral Otis machine made in Melbourne but based on a design by the American company E P Allis. The Hathorn Davey engine has been preserved.

1911 Two steam pumping engines built in Melbourne by Austral Otis were installed in the north pump house. These machines were based on the single imported Hathorn Davey machine purchased earlier. These two engines have been preserved.

1914 Two further (more or less identical) steam pumping engines built in Melbourne by Austral Otis were installed in the north pump house. These machines were based on the single imported Hathorn Davey machine purchased earlier. These two engines have been preserved.

1921 The first two electrically driven centrifugal pumps were installed in the south engine house. These pumps were manufactured by Australian manufacturer George Weymouth Pty Ltd.

1923 The Austral Otis (E P Allis design) engine in the south pump house was scrapped. Two of the original Thompson steam pumping engines in the south pump house were scrapped. Additional electric pumps were installed in the spaces made by scrapping the three steam engines.

1938 The final two of the original four Thompson steam pumping engines in the north pump house were scrapped. Additional electric pumps were installed in the spaces made by scrapping the two steam engines.

1942 The electric pumps installed in 1838 were dismantled and transferred to Watsonia Army Barracks for safe keeping during World War Two.

1950 Two of the centrifugal pumps installed in 1923 were replaced with more efficient pumps but remained driven by the original electric motors.

1951 The centrifugal pumps installed in 1921 and the remaining pump from 1923 were replaced with more efficient pumps but remained driven by the original electric motors.

1954 Electric starting gear for the electric motors installed in 1921 was replaced.

1965 Spotswood Pumping Station ceases operation and it was replaced by Brooklyn Pumping Station.

2) Werribee Sewage Farm

1892 Werribee Farm started operation with Land Filtration used as the method of sewage treatment.
1897 The sewerage system completed and connected to Werribee Farm to treat all of Melbourne's sewage.
1930 Grass Filtration adopted as the main treatment method during winter.
1936 First treatment lagoon constructed.
2004 The plant stopped using Land and Grass Filtration methods and moved entirely to lagoon treatment.
2005 Major upgrade to reduce the amount of nitrogen in the treated water that is discharged to Port Phillip Bay.

3) Main Outfall Sewer

1891 Design sketches of the Main Outfall Sewer were made.
1892 Construction of the system Main Outfall Sewer began.
1897 Main Outfall Sewer connected and functional.
1996 Main Outfall Sewer replaced by a larger, fully underground structure.

4) Sewerage Reticulation System

1891 Design sketches of the Melbourne Sewerage System were made.
1892 Construction of the Sewerage System began.
1897 Melbourne Sewerage System connected and functional.
1996 Ongoing replacement and upgrading of individual components.

CHANGE CONTROL

VERSION 1	**30 DEC 2011**	**GERMAN OSUNA**	
VERSION 2	**JAN 2012**	**GERMAN OSUNA**	
VERSION 3	**30 JUNE 2013**	**GARY VINES**	
VERSION 4	**5 JAN 2014**	**START EDITING BY OP**	
VERSION 5	**6 JAN 2014**	**ADDED IMAGES OP**	
VERSION 6	**7 JAN 2014**	**ADDED INTERPRETATION PLAN & APPENDICES OP**	
VERSION 7	**8 JAN 2014**	**8497 WORDS**	**FURTHER EDITING OP**
VERSION 8	**15 JAN 2014**	**8556 WORDS**	**COMPLETED FIRST CHECK READ**
VERSION 9	**4 FEB 2014**	**8968 WORDS**	**INCORPORATED PB COMMENTS**
VERSION 10	**7 FEB 2014**	**8913 WORDS**	**INCORPORATED MP COMMENTS**
VERSION 11	**12 FEB 2014**	**8913 WORDS**	**INCORPORATED MELB WATER APPROVAL**
VERSION 12	**11 MAR 2014**	**9230 WORDS**	**CORRECVTIONS FROM BEN JOHNSTON**
VERSION B1	**17 MAY 2014**	**9230 WORDS**	**TRANSFERRED TO NEW DOCUMENT**
VERSION B2	**30 JUNE 2014**	**10077 WORDS**	**FURTHER DRAFTING & REFINEMENT**
VERSION B3	**2 JULY 2014**	**12536 WORDS**	**ADDED 3.2.9. COMPARISON WITH OTHER CITIES**
VERSION B4	**4 JULY 2014**	**12783 WORDS**	**CHECK READ COMPLETED**
VERSION B5	**4 JULY 2014**	**14600 WORDS**	**ADDED 3 MUSEUM VICTORIA ARTICLES TO APPENDIX 4**
VERSION B6	**11 JULY 2014**	**14592 WORDS**	**ADDED PROOF READING CHANGES**
VERSION B7	**18 JULY 2014**	**14576 WORDS**	**REVIEWED MAPS PAGE 16 +19 FOR CLARITY**