Australian Capital Territory

Heritage (Decision about Registration for Canberra's Main Outfall Sewer, Weston, Weston Creek and Yarralumla) Notice 2011

Notifiable Instrument NI 2011 -496

made under the

***Heritage Act 2004* section 42 Notice of Decision about Registration**

1. **Revocation**
   This instrument replaces NI 2011-107
2. **Name of instrument**
   This instrument is the Heritage (Decision about Registration for Canberra's Main Outfall Sewer, Weston, Weston Creek and Yarralumla) Notice 2011 -
3. **Registration details of the place**
   Registration details of the place are at Attachment A: Register entry for Canberra's Main Outfall Sewer, Weston, Weston Creek and Yarralumla.
4. **Reason for decision**
   The ACT Heritage Council has decided that Canberra's Main Outfall Sewer, Weston, Weston Creek and Yarralumla meets one or more of the heritage significance criteria at s 10 of the *Heritage Act 2004*. The register entry is at Attachment A.
5. **Date of Registration**
   25 August 2011

Jennifer O'Connell
Acting Secretary
ACT Heritage Council
25 August 2011

ACT Heritage Council	**AUSTRALIAN CAPITAL TERRITORY** **HERITAGE REGISTER** **(Registration Details)** **Place No:**

For the purposes of s. 41 of the *Heritage Act 2004*, an entry to the heritage register has been prepared by the ACT Heritage Council for the following place:

Canberra Main Outfall Sewer, Cotter Road, Weston; Lady Denman Drive, Weston Creek; Dunrossil Drive, Yarralumla; and Coronation Drive, Yarralumla

(part) Block 17, Section 83 Weston, Weston Creek
(part) Block 2, Section 119, Yarralumla, Canberra Central
(part) Block 4, Section 22, (part) Block 3 Section 128, (part) Block 2, Section 128, and (part) Block 8 Section 128, Yarralumla, Canberra Central
(part) Block 664, District of Weston Creek
(part) Block 1163, District of Weston Creek

DATE OF REGISTRATION

Notified: 25 August 2011 Notifiable Instrument: 2011-496

Copies of the Register Entry are available for inspection at the ACT Heritage Unit. For further information please contact:

The Secretary
ACT Heritage Council
GPO Box 158, Canberra, ACT 2601

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IDENTIFICATION OF THE PLACE

Canberra Main Outfall sewer – nine features

- Ventilator Shaft # 4 Cotter Road, (part) Block 17, Section 83 Weston, Weston Creek
- Ventilator Shaft # 22 Westbourne Woods (part) Block 2, Section 119, Yarralumla, Canberra Central
- Ventilator Shaft # 36
- Access chamber # 35
- Access chamber # 37
- Access chamber # 38
- Access chamber # 40
- Access chamber # 41
  Ventilator Shaft #36 and the five access chambers are all located in Stirling Park – Alexandrina Drive, (part) Block 4, Section 22, (part) Block 3 Section 128, (part) Block 2, Section 128, and (part) Block 8 Section 128, Yarralumla, Canberra Central
- Tunnel Crossing at Yarralumla Creek, Cotter Road (part) Blocks 664 and 1163, District of Weston Creek

n.b: see also separate Registrations –

- *Westbourne Woods*
- *Canberra's Garbage Incinerator*
- *Button Wrinklewort Habitat*

STATEMENT OF HERITAGE SIGNIFICANCE

This statement refers to the Heritage Significance of the place as required in s12(d) of the *Heritage Act 2004*.

The nine above-ground features of Canberra's Main Outfall Sewer which form this registration are of heritage significance as important evidence of a distinctive design and function of exceptional interest; for their association with a development within the history of the ACT; and as rare examples of their kind.

The Main Outfall Sewer, completed in 1924, is important as evidence and has a special association with the development of Canberra as the Nation's Capital in the 1920s. The Main Outfall Sewer formed a critical component in the original infrastructure associated with the early development of Canberra, without which the transfer of Parliament from Melbourne to Canberra would never have been possible. The Main Outfall Sewer allowed healthy conditions to be retained as the population expanded.

The features comprising this registration are some of few remaining examples of built evidence of Canberra's early sewerage treatment system, including
Canberra Main Outfall sewer – nine features

- Ventilator Shaft # 4
- Ventilator Shaft # 22
- Ventilator Shaft # 36
- Access chamber # 35
- Access chamber # 37
- Access chamber # 38
- Access chamber # 40
- Access chamber # 41
- Tunnel Crossing at Yarralumla Creek

Other related registrations

The former Sewerage Attendant's Cottage (Weston Creek) is thematically related to this registration as the only remaining example of the Weston Creek Sewerage Treatment Works. It is entered separately in the ACT Heritage Register under the district of Weston Creek.

One ventilation shaft (feature #22) is located in Westbourne Woods. The broader Westbourne Woods forms a separate citation in the ACT Heritage Register.

Canberra's Garbage Incinerator is also located in Westbourne Woods, and adjacent to the ventilation shaft (feature # 22). The incinerator forms a separate citation in the ACT Heritage Register.

One ventilation shaft (feature #36) and the five access chambers are located in Stirling Park. Stirling Park is also the location of the Button Wrinklewort Habitat which forms a separate citation in the ACT Heritage Register.

FEATURES INTRINSIC TO THE HERITAGE SIGNIFICANCE OF THE PLACE

The attributes listed below are assessed as features intrinsic to the heritage significance of the place:

- Three brick ventilator shafts at Stirling Park, Westbourne Woods and Weston Creek;
- An exposed section of tunnel where the sewer crosses Yarralumla Creek near the Yarralumla Woolshed; and
- Five access chambers in close proximity to the ventilator shaft in Stirling Park.

APPLICABLE HERITAGE GUIDELINES

The Heritage Guidelines adopted under s27 of the *Heritage Act* 2004 are applicable to the conservation of Canberra's Main Outfall Sewer.

The guiding conservation objective is that the above ground features of the Canberra Main Outfall Sewer shall be conserved and appropriately managed in a manner respecting its heritage significance and the features intrinsic to that heritage significance, and consistent with a sympathetic and viable use or uses. Any works that have a potential impact on significant fabric (and / or other heritage values) shall be guided by a professionally documented assessment and conservation policy relevant to that area or component (i.e. a Statement of Heritage Effects – SHE).

REASON FOR PROVISIONAL REGISTRATION

Canberra's Main Outfall Sewer has been assessed against the heritage significance criteria and has been found to have heritage significance when assessed against four criteria under the ACT *Heritage Act 2004*.

ASSESSMENT AGAINST THE HERITAGE SIGNIFICANCE CRITERIA

Pursuant to s.10 of the *Heritage Act 2004,* a place or object has heritage significance if it satisfies one or more of the following criteria. Significance has been determined by research as accessed in the references below. Future research may alter the findings of this assessment.

(a) it demonstrates a high degree of technical or creative achievement (or both), by showing qualities of innovation, discovery, invention or an exceptionally fine level of application of existing techniques or approaches;
The place is assessed as not meeting this criterion.

(b) it exhibits outstanding design or aesthetic qualities valued by the community or a cultural group;
The place is assessed as not meeting this criterion.

(c) it is important as evidence of a distinctive way of life, taste, tradition, religion, land use, custom, process, design or function that is no longer practised, is in danger of being lost or is of exceptional interest;

The above ground elements of the Main Outfall Sewer are important as evidence of a distinctive design and function of exceptional interest - the early planning and development of Canberra as the nation's capital, where the construction of the sewer was a critical component in the transfer of Parliament from Melbourne to Canberra in time for its opening in 1927. It would not have been possible to transfer public servants from the newly sanitised city of Melbourne to a city without comparable services.

Canberra's Main Outfall Sewer meets this criterion.

(d) it is highly valued by the community or a cultural group for reasons of strong or special religious, spiritual, cultural, educational or social associations;
The place is assessed as not meeting this criterion.

(e) it is significant to the ACT because of its importance as part of local Aboriginal tradition
This criterion is not applicable.

(f) it is a rare or unique example of its kind, or is rare or unique in its comparative intactness

Canberra's Main Outfall Sewer is a rare example of its kind – twentieth century sewerage schemes and is the only example of this kind in the ACT. The above ground elements demonstrate this kind of place. Another component of the sewerage system, the former Sewerage Attendant's Cottage at Weston Creek, is entered separately in the ACT Heritage Register.

The three ventilation shafts comprising this registration have a high level of integrity and intactness.

Canberra's Main Outfall Sewer meets this criterion.

(g) it is a notable example of a kind of place or object and demonstrates the main characteristics of that kind

Canberra's Main Outfall Sewer is a notable example of a kind of place, being twentieth century sewerage schemes. It is notable as one of very few schemes built from scratch in a new city, prior to the development of the city, implementing the best technology at the time. Other twentieth century sewerage schemes in Australia and elsewhere incorporated older elements of pre-existing sewerage schemes in already established towns and cities.

Canberra's Main Outfall Sewer meets this criterion.

(h) it has strong or special associations with a person, group, event, development or cultural phase in local or national history

Canberra's Main Outfall Sewer has a strong association with a development in the history of the ACT – that of the development of Canberra as the national capital. The sewerage system enabled the increase in population to occur with the transfer of parliament and the public service to Canberra while avoiding the health risks associated with typhoid and other diseases which were common in unsewered areas of population.

The feasibility of this essential piece of engineering infrastructure was considered, along with water, electricity and roads, in the selection of the site for Canberra.

Canberra's Main Outfall Sewer meets this criterion.

(i) it is significant for understanding the evolution of natural landscapes, including significant geological features, landforms, biota or natural processes
This criterion is not applicable.

(j) it has provided, or is likely to provide, information that will contribute significantly to a wider understanding of the natural or cultural history of the ACT because of its use or potential use as a research site or object, teaching site or object, type locality or benchmark site
The place is assessed as not meeting this criterion.

(k) for a place—it exhibits unusual richness, diversity or significant transitions of flora, fauna or natural landscapes and their elements
This criterion is not applicable.

(l) for a place—it is a significant ecological community, habitat or locality for any of the following:
(i) the life cycle of native species;
(ii) rare, threatened or uncommon species;
(iii) species at the limits of their natural range;
(iv) distinct occurrences of species.
This criterion is not applicable.

The place is assessed as not being significant in relation to the following criteria: a, b, d, e, g, I, j, k, and l.

SUMMARY OF THE PLACE
HISTORY AND PHYSICAL DESCRIPTION

HISTORY

The separated sewage that the world now uses was first developed in Britain and Europe in the 1700s and 1800s.

Prior to the introduction of underground sewer systems, the majority of waste from homes across Australia (including kitchen, bathroom and laundry wastes, along with the contents of chamber pots) were emptied into open drains that flowed into street channels and on to local rivers and creeks. Cholera and dysentery outbreaks were common. A more hygienic solution was needed.

Across Australian cities from the 1880s there was much debate about possible solutions. The answer soon came as the construction of a sewerage system – a system of pipes, sewers and drains built underground to carry sewage from homes and factories to a sewerage treatment farm.

Adelaide was the first Australian capital to be connected to a water-borne sewage treatment in 1881. Sydney's first sewerage scheme began in 1886. In 1889 an English engineer, Mr James Mansergh, was employed to draw up plans for Melbourne's sewerage system. Construction began in May 1892, and the

first Melbourne homes were connected to the sewerage system in 1897. Brisbane's sewerage treatment system was constructed in the early twentieth century. In Hobart, modern sewage treatments were installed in the early 1900s.

It was in this context that planning for Canberra began in the early twentieth century. In keeping with sewage treatment and the installation of sewerage schemes in other capital cities across Australia at this time, the disposal of waste water and water borne waste was one of the early matters for resolution in the early planning of Canberra.

In this sense, the sewerage scheme of Canberra differs to that of Australia's capital cities, in that it was incorporated in the early planning for the city, rather than as a later addition.

The sewage collection system was considered in the selection of Canberra as the site for the national capital in 1909 by L A B Wade, Chief Engineer (Irrigation and Drainage) Department of Public Works NSW, and Charles Scrivener, District Surveyor, Department of Home Affairs. The planning for the system occurred during the period of rapid development in Australian urban areas (1890s-1920s) and was influenced by the serious crisis in the water supply and sewerage in country towns, and in urban morbidity and child mortality.

The sewage collection system was planned as a whole for the Canberra city area in 1914 by Thomas Hill, Chief Engineer (Sewerage and Water Supply) Department of Home Affairs.

In considering sewage treatment for the nation's capital, the main issues were:

- to protect the health of the residents of the city;
- to avoid polluting the Molonglo and Murrumbidgee Rivers which flow into Burrinjuck dam; and
- to avoid objectionable odours while containing costs to a reasonable level.

Thomas Hill performed a detailed design of the Main Outfall Sewer. His successor in what was by then the Department of Works and Railways, Henry Connell, designed the Main Intercepting Sewer and subsequent works following his repatriation from Canberra in 1917. Sewerage design work was performed from Melbourne, and both engineers were under the general supervision of Colonel Percy Owen, Director-General of Works from 1904 to 1924. Owen was then appointed Chief Engineer of the newly formed Federal Capital Commission (FCC), from which he retired in 1929, ending a career in which he was intimately involved with the engineering services of Canberra from site selection through to well beyond the transfer of Parliament. Ernest de Burgh, Chief Engineer for Water Supply and Sewerage with the Public Works Department of New South Wales was also involved in advising on engineering services over an extended period and with Owen, was a member of the Federal Capital Advisory Committee (FCAC).

Walter Burley Griffin, who had been excluded from the Department of Home Affairs' design process for engineering services, argued for a series of small distributed septic systems which he claimed would be at lower cost, would be odourless and would discharge innocuous effluent into the ornamental lake system. Other evidence from state government engineering practitioners generally supported the departmental proposal, but with an option for a reduced length of outfall to Yarralumla Creek.

In the face of conflicting opinions about the reliability and potentially offensive nature of Griffin's proposal, and uncertainty about population growth, the committee supported the departmental position. They concluded with a strong recommendation that investigations should continue in order to obtain the most up-to-date treatment system before that part proceeded.

Canberra's sewage collection system proceeded in two major stages, with the initial main from Yarralumla to Western Creek known as the Main Outfall Sewer, and the subsequent stage from Parkes to Yarralumla known as the Main Intercepting Sewer. Yarralumla was regarded as the boundary of the city in Griffin's design. Western Creek (later changed to Weston Creek in the 1970s when the suburban area

was named in honour of Thomas Weston) was a suitable area to which sewage could be gravitated and treated before discharging effluent into the Molonglo River downstream of the ornamental lake system. The destination of the Main Outfall Sewer was also described at various times as Twelve-mile Creek and Stony Creek, but there is no evidence that different locations were intended.

Two other branch sewers were planned as part of the overall system. The Southern Intercepting Sewer was to collect sewage on the southern side of the Molonglo form the Powerhouse area at Eastlake (Kingston) and through the Parliamentary zone. The Northern Main Sewer was to collect sewerage from the Civic Centre and inner north-east through to the Royal Military College. Levels were designed so that the collection system could operate entirely by gravity, with an inverted siphon under the Molonglo River east of Commonwealth Avenue Bridge, and both branches feeding into the Main Intercepting Sewer at a junction in Commonwealth Avenue opposite the Hostel (Hyatt Hotel).

Some construction work on the Main Outfall Sewer commenced prior to the Parliamentary Works Committee hearing of 1915. Thomas Hill showed four trial shafts on his drawing dated July 1914 and he indicated in evidence to the commission in January 1915 that the first ten shafts were down and being opened out. Work continued until 1917, and resumed in 1922 with some deterioration of unfinished sections occurring in the intervening time.

The Royal Commission into Federal Capital Administration in 1917 questioned the efficiency of the work being undertaken in a number of areas including sewerage, and as a result Parliament called a halt to the works. Commissioner Blacket was strongly critical of Owen and Hill for their lack of attention to treatment aspects, and lack of investigation of the suitability of the soil at Western Creek for sewage disposal. He sided with Griffin and Calder Oliver, Engineer in Chief of the Melbourne and Metropolitan Board of Works, who presented a distributed scheme of underground Emscher tanks, similar to that earlier proposed by Griffin to the Parliamentary Works Committee. Blacket stated that “I am of the opinion that this main sewer should not be completed, and I have to regard the whole amount spent upon it by the Commonwealth as money lost”.

Owen and Hill appear to have treated this as a setback in their battle with Griffin, but not sufficient reason to abandon their design even if construction was halted. Ernest de Burgh, Chief Engineer for Water Supply and Sewerage with the Public Works Department of New South Wales re-entered the picture through the Federal Capital Advisory Committee, and took an active role in developing the design involving the outfall sewer to Weston Creek. An independent expert, Colonel F F Longley from the International Health Board of the Rockefeller Foundation was also consulted, and the departmental proposal for treatment of the sewage on land at Western Creek was abandoned in favour of the use of sedimentation and trickling filters.

In 1922 the Parliamentary Standing Committee on Public Works considered the construction of a Main Intercepting Sewer, in order that sewerage works could be completed by the time that Parliament was expected to meet in Canberra. Colonel Owen pointed out that the Outfall sewer had not been completed, as the direction to cease work had not been rescinded. The approval that was obtained following this hearing was really to complete the first stage outfall sewer and continue with a second stage to near the city centre on the south side of the Molonglo. Consideration was given in the hearing as to whether the earlier form of an *in situ* concrete lined tunnel should be continued or whether a brick lining with a concrete invert, or precast pipes would be more economical. Continuation of the present design was recommended, with a requirement that a further referral be made of the treatment works.

Subsequent committee hearings in 1924 and 1925 enabled work to proceed on the collection system north and south of the river, and treatment works to be constructed at Western Creek. The initial population to be catered for was 5000, with a design capacity of the outfall sewer of 125,000 expected to take many years to be reached.

The Main Outfall Sewer is largely unchanged since 1926. It has had manhole tops rebuilt in the 1980s and supplementary ventilators added to some manholes following a report in 1987.

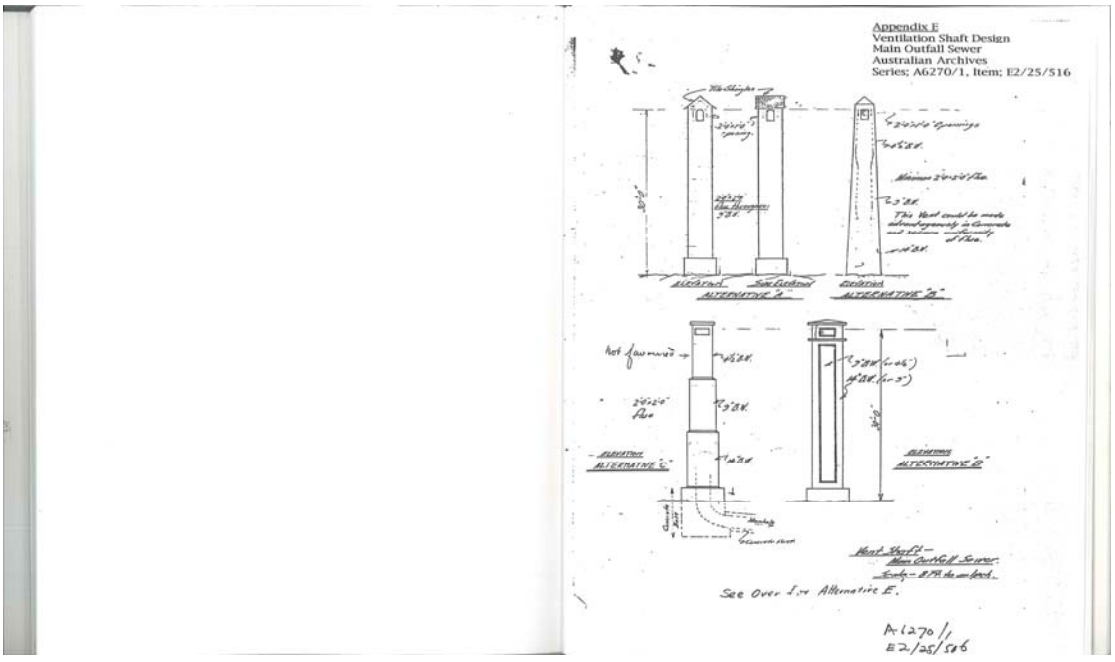
While the Main Outfall Sewer continues its original function the volume of sewerage carried is considerably greater than originally intended because the suburban areas to the north and south of the Molonglo have expanded considerably. It copes with the increased load by having the flow regulated through storage in areas such as Fyshwick, so that sewerage is released during the times of day when the sewer tunnel can handle it.

With the construction of the Lower Molonglo Water Quality Control Centre (LMWQCC) in 1978 the newer suburbs of Belconnen and Tuggeranong were able to be connected to the treatment works for the whole of Canberra without requiring that their sewage be carried by the Main Outfall Sewer. This also allowed the decommissioning of the Weston Creek Sewerage Treatment Plant, and the diversion of sewerage to the LMWQCC through the Molonglo Interceptor Sewer.

Ventilation shafts

'Due to the material that passes through sewers, and the enclosed space of such tunnels, there is a natural build up of noxious fumes. These gases are not only toxic, but they can cause enormous pressure to build up if there is no means of release' (Hore, 1994:5). Ventilation shafts allow the gases to escape, reducing the risk of explosion.

The design of the ventilation shafts is credited to W.S Brownless, en engineer working on the Main Outfall Sewer. In a letter dated March 1923, he wrote to the Chief Engineer, T. Hill, on the subject of the ventilation shaft design, submitting five drawings with his letter, detailing his ideas. The three ventilation shafts today bear a remarkable resemblance to Brownless' design D, with only minor modification, possibly by J.S Murdoch, Director of General Works (Hore, 1994: 20).



Brownless' Design for the Main Outfall Sewer Ventilation Shafts
Credit: Hore, 1994

DESCRIPTION

The Main Outfall Sewer follows the Griffin street layout along what had been proposed to be Arboretum Way Westlake (now a shorter Brown Street Yarralumla), before turning to run under the Royal Canberra Golf Course, past the Yarralumla Woolshed, under the Tuggeranong Parkway, and Cotter Road.

What is now known as the Main Outfall Sewer tunnel is 7.9 km (5 miles) long, running from the east side of Commonwealth Avenue in Parkes, opposite the Hyatt Hotel and Croquet Club, through to Weston Creek, north of the Cotter Road near Streeton Drive. The starting point, in terms of the direction of flow, is access chamber feature # 45 in Commonwealth Avenue, and the original tunnel finishes at access chamber feature # 1 which is the most easterly of a concentrated group of manholes and concrete junction structures near Weston Creek at the Cotter Road. The main sewer was built in two distinct sections, at the time referred to as the Main Outfall Sewer (3 miles long) from the city boundary at Yarralumla to Western Creek, and the Main Intercepting Sewer (2 miles long) from Commonwealth Avenue to connect with the Main Outfall Sewer.

A small part of the tunnel is now under Lake Burley Griffin near the YMCA Sailing Club, but all access openings are on land above the level of the lake.

Local sewage is fed in at various access chambers along the route. The sewer carries solid and liquid waste from toilets, which is diluted with flushing water as well as waste from kitchen sinks, laundries, bathrooms and a small quantity of industrial waste. Water from roofs and surface run-off is carried by a separate storm water system and is excluded as far as possible from the sewer system. The egg shaped section allows more depth under low flow conditions than a circular cross section would allow, thus washing solids through and causing less residual odour problems. The sewage is generally liquefied by the time it passes through the outfall sewer, without chemical decomposition occurring.

The above ground features mark the route of Canberra's first main sewer, and provide a visual reference in the landscape of the existence and route of the underground sewerage tunnel.

Ventilator shafts

Ventilation is necessary to allow free flow in the sewer, avoiding the build up of poisonous or explosive gases, and preventing excessive condensation of acidic liquids which would cause corrosion to the internal lining.

The ventilator shafts in Melbourne and Sydney sewerage works were of galvanised iron vent pipe. This same material was also proposed for Canberra's ventilation shafts. However, at some stage in the construction of Canberra's main outfall sewer, plans were changed and brick shafts were substituted for the metal piping. It is expected that this decision was influenced by the availability of the nearby Canberra Brickworks at Yarralumla. Seventeen ventilators were proposed in the initial plans, though only three were constructed.

These three brick ventilator shafts remain as part of the original Main Outfall Sewer; one in Stirling Park, one in Westbourne Woods, and one off Cotter Road near the intersection with Tuggeranong Parkway. The shafts are 6m (20 ft) high and square in section. They are 1300mm (4ft 3 in) square at the base and 1060mm (3 ft 6 in) above, with a flat concrete capped top. Ventilation has been augmented in recent years by the addition of low metallic vents with hoods at other selected access chambers along the route.

- Stirling Park

There is some evidence of early construction work, including a broken concrete slab and machinery bases near the ventilator shaft. Some small mullock heaps remain from spoil which was apparently not of sufficient quality for removal for road making and was not fully spread at completion of the works. A small heap of river washed gravel within 10m of the ventilator shaft appears to have been surplus from concrete making.

- Westbourne Woods

The ventilator shaft in Westbourne Woods is in close proximity to Canberra's Garbage Incinerator, built between 1938 and 1941 (see separate citation). Two concrete pits share an earth mound about the height of the brick base of the ventilator shaft. One has a two part rectangular concrete cover while the other has a rectangular cast iron cover that appears to have more recently been fitted to an earlier circular top. Their purpose and significance is not known, but it is unlikely that they are original features. The two concrete pits do not form part of this registration.

- Weston Creek

The area around the Weston Creek ventilator shaft has mounds of fairly large sharp-edged rock which would have been blasted from the tunnel. A rough concrete structure about 1m wide and a similar height shows evidence of a pipe having been cast into the top. This was probably the anchor point for a winch for raising the spoil from the shaft.

Yarralumla Creek

The sewer crosses Yarralumla Creek above natural ground level, at a location to the east of Yarralumla Woolshed, at the northern corner of the Equestrian Park. The concrete structure containing the egg shaped sewer forms a weir with a short spillway as it crosses the creek. The top is about 3m above the natural surface and about 50m long. It is 2.5m thick at the base and narrower at the top.

Access Chambers or Manholes

Forty-five concrete chambers exist along the outfall sewer. Five of these are included in this registration as representative examples, located adjacent to the Stirling Park ventilator shaft, and within Stirling Park.

The chambers are generally cylindrical in form with an offset conical top to which is attached a concrete ring containing a manhole cover. The offset top on the chamber allows a ladder to run straight down one side from the manhole opening. Some manholes in the Main Interceptor section have drop pipes with a sweeping bend at the bottom cast in to the side opposite the ladder to allow local sewerage reticulation to be connected to the tunnel. Provision was also made closer to the surface on most manholes for the future connection of ventilators.

At certain points in the sewer line a different form of manhole chamber has been employed containing a control device known as a penstock. These chambers are cylindrical the full height and have a circular concrete top of 7 ft diameter, compared with the 3ft 6in that most chambers are reduced to at ground level.

The original covers have been replaced with modern tight fitting 'gatic' type covers to avoid vandalism and exclude stormwater.

The access chambers are each fitted with a painted wrought iron ladder. Cast iron devices known as penstocks are fitted in some access chambers at intervals along the sewer. They can be lowered to cut off the flow for maintenance purposes. The penstock control wheel and position indicator are made of cast iron and are mounted on a landing part-way down the access chamber. Penstock controls are similar to those that were employed earlier on the Cotter Dam for controlling the release of water into the intake tower.

SITE BOUNDARIES

The site plan (below) provides a visual portrayal of the location of each feature comprising this registration.
The Stirling Park Ventilator Shaft (feature # 36) is located at GDA 94 E692064 N6091372
The Westbourne Woods Ventilator Shaft (feature # 22) is located at GDA 94 E689744 N6091430
The Weston Creek Ventilator Shaft (feature # 4) is located at GDA 94 E687306 N6089341

Each ventilator shaft has a boundary of 10 metres surrounding it. This boundary reflects the height to space ratio of the structures and the immediate visual setting for them.

The tunnel crossing Yarralumla Creek is located at GDA 94 E688758 N6090528. Its boundaries are defined by the polygon map below, and reflect its height to space ration, and its immediate visual setting.

The five access chambers, all located within Stirling Park, are located at GDA 94:

- (feature # 35) GDA 94 E691885 N6091357
- (feature # 37) GDA 94 E692192 N6091385
- (feature # 38) GDA 94 E692473 N6091422
- (feature # 40) GDA 94 E692702 N6091438
- (feature # 41) GDA 94 E692841 N6091503

Each access chamber has a boundary of 1 metre surrounding it, reflecting their size and scale.

REFERENCES

National Archives of Australia files:

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CP664/1, Bundle 1/22, Main Sewer Construction
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A414, 19, Sewerage
A6270/1, E2/25/516, Main Outfall Sewer
A6270/1, E2/27/2765, Construction of Main Intercepting Sewer, Canberra
A199, FCW1914/1156, Construction of Main Sewer

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Report, together with Minutes of Evidence on the Question of the Proposed Construction of a Main Intercepting Sewer from the Centre of the City of Canberra to Connect with the Main Outfall Sewer. 29 June 1922
Report, together with Minutes of Evidence in regard to Construction of Southern Intercepting Sewer, Nnberra. 2 September 1924
Report, together with Minutes of Evidence relating to the proposed Construction of Northern Main Sewer, Canberra. 24 June 1925
Report, together with Minutes of Evidence relating to the proposed Construction of Sewerage Treatment Works, Federal Capital, 24 June 1925

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September 17, 1926, p1, “Industrial trouble breaks out again on city sewer”
September 24, 1926, “Sewer workers trouble settled”
November 29, 1997, Panorama section, p7, “Adventures in the sewers”

Quarterly Bulletin of the Institution of Engineers Australia, 30 April 1928, *Establishment of Enabling Services at Canberra, FCT*, Address by the Chairman to the Engineering Conference, Canberra FCT on 4 February 1928, by Colonel P T Owen CBE, MIEAust.

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Ann Gugler, 1994, *The Builders of Canberra 1909-1929, Part One –Temporary Camps and Settlements.*

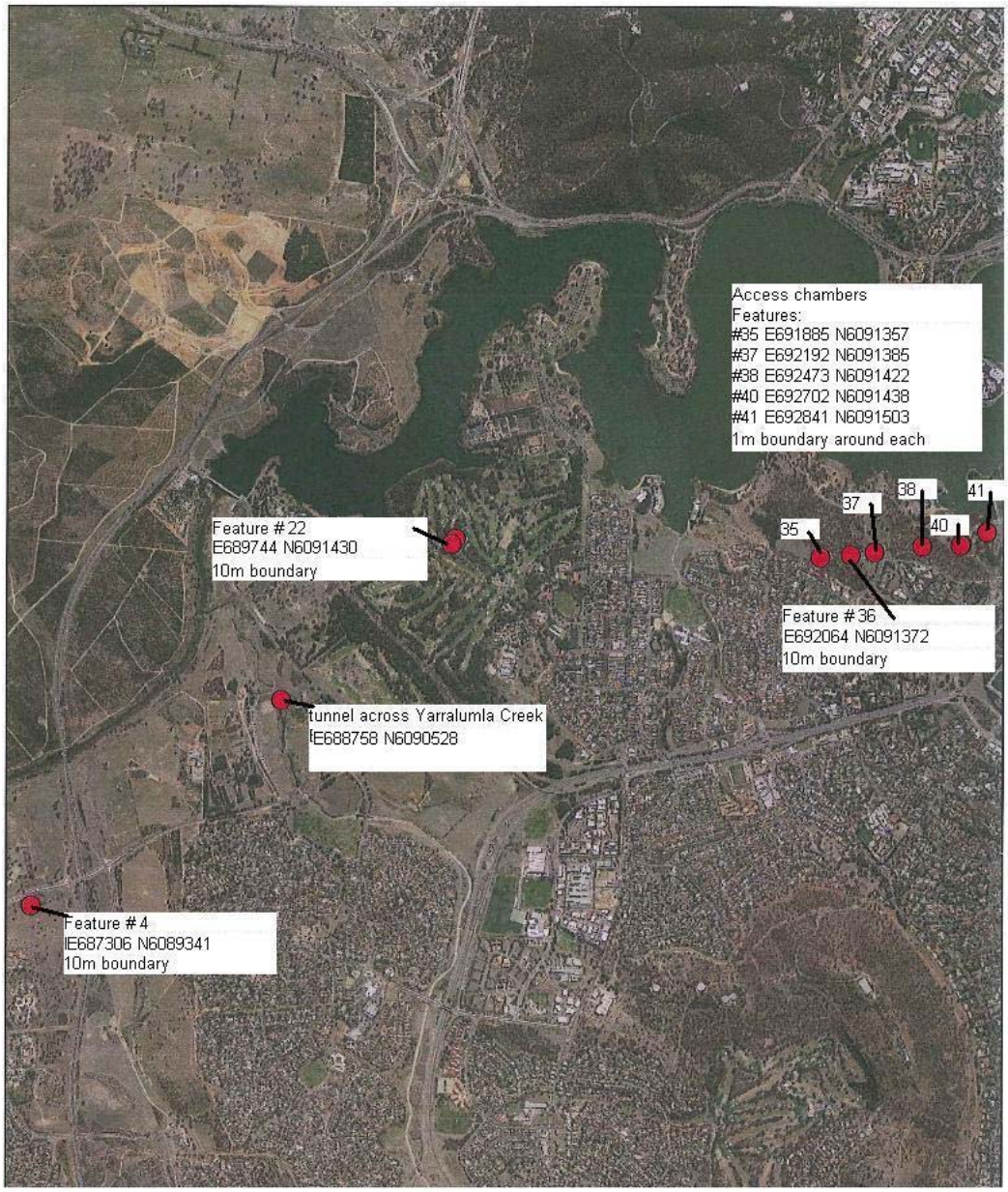
Freeman Collett and Partners Pty Ltd, October 1992, Westbourne Woods Incinerator Conservation Plan.

Personal Communications:
Garry Rolfe, Resource Planner (Sewerage and Storm Water), Actew
Ann Gugler

Maps:
ACT Planning Series, 1:10,000: sheet 200-594,
ACT Planning Series, 1:2,500: sheet 2020-5985, June 1982

Aerial Photographs:
National Library Box B I55 Map 685 Canberra Run 2 (872-895) 16 December 1944 (153.4mm 17,000’)

SITE PLAN AND MAPS



SITE PLAN
Canberra's Main Outfall Sewer - location of features

The Weston Creek Ventilator Shaft (feature # 4) is located at GDA 94 E687306 N6089341
A 10 metre boundary surrounds this GDA reference.

The Westbourne Woods Ventilator Shaft (feature # 22) is located at GDA 94 E689744 N6091430
A 10 metre boundary surrounds this GDA reference.

The Stirling Park Ventilator Shaft (feature # 36) is located at GDA 94 E692064 N6091372
A 10 metre boundary surrounds this GDA reference.

The tunnel crossing Yarralumla Creek is located at GDA 94 E688758 N6090528
The boundary surrounding this GDA point is shown above in red.

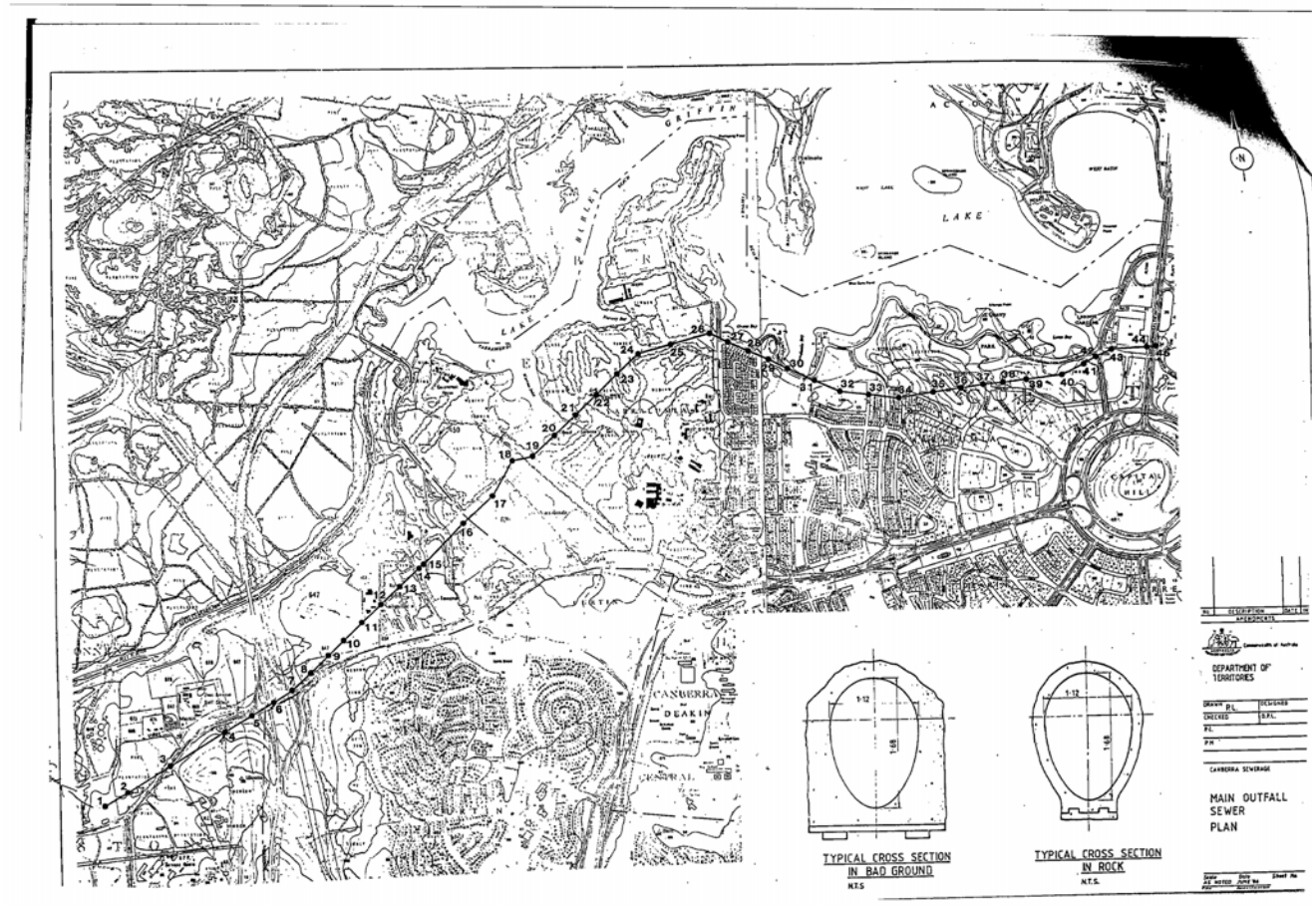
(feature # 35) GDA 94 E691885 N6091357
A 1 metre boundary surrounds this GDA reference.

(feature # 37) GDA 94 E692192 N6091385
A 1 metre boundary surrounds this GDA ref.

(feature # 38) GDA 94 E692473 N6091422
A 1 metre boundary surrounds this GDA reference.

(feature # 40) GDA 94 E692702 N6091438
A 1 metre boundary surrounds this GDA ref.

(feature # 41) GDA 94 E692841 N6091503
A 1 metre boundary surrounds this GDA reference.



Main Outfall Sewer Plan, Department of Territories, Commonwealth of Australia
Features # 4, 22, 35, 36, 37, 38, 40 and 41 comprise this registration, as well as an unmarked feature between # 15 and 16 (the tunnel across Yarralumla Creek).
Features # 4, 22 and 36 are the brick chimney vents.
Access chamber #39 could not be located.

Ventilation Shaft (feature # 4)

Ventilation shaft (feature # 22)

Ventilation shaft (feature # 36)

tunnel at Yarralumla Creek
(sewerage tunnel forms part of the weir)

Access Chamber (feature # 37) in Stirling Park.

NON-STATUTORY BACKGROUND INFORMATION

- Construction history

Work on Canberra's Main Outfall Sewer was conducted by direct government employees, with site supervision provided by Henry Connell as Resident Engineer and James Brilliant as Clerk of Works. Both were involved with the construction of the Cotter Dam. Connell returned to Melbourne after the Royal Commission and concentrated on design work. Supervision of later construction work on the sewer was by William Brownless, Engineer for Water Supply and Sewerage with the Federal Capital Commission.

The Main Intercepting Sewer stage was intended to be performed by contract. When tenders were called none were received, and on re-advertising the project, it was decided that it could be performed more economically by wages employees. A range of detailed drawings exist for this latter stage, as would be expected for tendering and the control of contractors. By contrast, the drawings that have been discovered for the earlier stage give the route and levels, but little detail otherwise. This suggests that as is common for directly controlled work, the details may have been determined on site as the job progressed.

The quality of the workforce was apparently high and management was reluctant to see the job stop and start with funds being obtained progressively, as the skilled workforce would disperse. Miners were used but there was a reluctance to classify the work as mining because of the relative industrial conditions. Several strikes held up the work as pressure mounted for its completion.

Work on the tunnel was by the traditional mining method of pot and drive. Explosives were used, but there would have been little mechanisation of the excavation in the initial stage on the Main Outfall Sewer. Electricity from Kingston Power House was reticulated to the major shafts during the second stage on the Main Intercepting Sewer, enabling electrically driven compressors to power pneumatic drills, and allowing the use of electric hoists to raise spoil from the shafts and lower workmen, tools, shoring timber and concrete to the workface. Electric pumps were also available for de-watering sites.

The tunnel was excavated in an egg shape with a flat floor where geological conditions permitted, but would have been larger and less regular where the soil, shale or decomposed rock was not self supporting. Concrete lining was performed by firstly pouring a concrete base with the invert at the required level and fall. Curved sides were then formed with timber in lengths and concrete poured behind the formwork. The arch of the tunnel was then formed in shorter sections and stiffer concrete was rammed between the formwork and the excavated ceiling. After removal of formwork, the tunnel had a further thin coating of concrete applied to the inside to waterproof any joints and to provide a smooth steel trowelled invert to aid flow.

- Camps and site works

Several hundred workmen were employed on tunnelling works and the concrete installation. No 1 Sewer Camp, also known as the Outfall Camp was set up towards Western Creek, while No 2 Sewer Camp was near the Yarralumla Woolshed. It was common for married men to be provided galvanised iron cubicles, while single men camped in tents. The tent area for No 2 Sewer camp is reported to have been further north-east in Yarralumla near Westbourne Woods. Both of these camps operated from 1915 to 1917 when work was stopped and cubicles were dismantled. They were re-established in 1923 along with No 3 Sewer Camp at Westlake (Stirling Park).

DESCRIPTION

Additional and associated features which do not form part of the registration

- Tunnel

At Canberra Avenue the Main Outfall Sewer tunnel is about 15m (50 ft) below ground and ranges in depth from 44m (145 ft) where it passes under Stirling Park overlooking the lake near Canberra Yacht Club, to 7 ft (2m) above the surface where it crosses Yarralumla Creek.

The sewer is egg shaped, of internal dimensions 1.68m by 1.12m (5ft 6in by 3ft 8in), the wider part being towards the top. It has a poured concrete invert (base channel), with formed concrete sides and arch. Concrete is of a minimum thickness of about 150mm (6 inches) where the tunnel was cut through rock, and is several times as thick where softer or less stable ground was encountered. It was plastered or rendered internally to give a smooth surface to minimise friction. It has a constant fall of 0.57m per km (3 feet per mile) and was originally fed from the Northern Main Sewer bringing sewerage from the Civic Centre, and the Southern Intercepting Sewer bringing sewerage from Kingston (Eastlake) and Parliament House in 600mm (24 inch) pipes.

The main change regarding the tunnel itself is the connection to it of further main sewers such as the Woden Trunk Sewer which now connects into it at Manhole 15, north of Curtin. It also accepts sewerage from the North west Intercepting Sewer which passes through an inverted siphon from Acton Peninsula, and feeds in at a junction at manhole 42.

- Weston Creek sewerage treatment plant

The former sewerage treatment works are some hundred metres north of the end of the Main Outfall Sewer. Everything has been removed above ground, and the main area is enclosed by a security fence which has been breached in several locations. A concrete lined lagoon toward the Molonglo River is comparatively recent as it cannot be identified in the 1944 aerial photograph, but the concrete lined channel for the diversion of Weston Creek is an early feature, as is the former operator's cottage across the creek. The sites of the original Imhoff tanks and trickling filter beds have been covered with introduced rough fill, but the deteriorating underground humus tank to the north is probably original. The entry road and slab from the former office and laboratory correspond with the 1955 drawing. An area exists outside the fence to the east of the cycle path with a substantial grid of decaying precast concrete panels forming what may have been drying beds or sand filters. The area is abandoned and is likely to be redeveloped in the future.