



Welcome to the opening of Wellington's Arras Tunnel



Prime Minister William Massey addressing soldiers of the New Zealand Tunnelling Company at Arras, with Sir Joseph Ward to his left, 2 July 1918. Source: Alexander Turnbull Library. Ref: ATL: 1/2-013354-G. Photograph Henry Armytage Sanders.



**BRAVERY OF WWI MINERS
RECOGNISED IN WELLINGTON
TUNNEL NAME**

Arras Tunnel

The NZ Tunnelling Company and the Arras Tunnels in France

The tunnel through Wellington's memorial precinct opens to traffic on Monday 29 September and is named Arras Tunnel for the wartime efforts of New Zealand miners in the French town of the same name. Pukeahu National War Memorial Park will be built on top of the tunnel as the Government's key project to commemorate the centenary of the First World War.

During the First World War, miners from New Zealand coal and gold mines extended underground quarries at Arras, France, to create a tactical advantage for Allied forces. The tunnels were intended to house Allied troops massing for the 1917 Arras Offensive in complete safety and totally unknown to the Germans.

About 300 New Zealand tunnellers, aided at various times by British and Canadian tunnelling companies, British and New Zealand infantry and the New Zealand Pioneer Battalion, began work on the tunnels in November 1916.

Two vast quarry and tunnel networks were completed over the following five months. They ran from the centre of Arras almost as far as the German front lines. The tunnel systems could accommodate up to 25,000 men and were outfitted with running water, electric



New Zealand Tunnelling Company miners below the ground at La Fosse Farm, 5 December 1917. Source: Alexander Turnbull Library. Ref: ATL: 1/2-012990-G. Photograph Henry Armytage Sanders.

lights, kitchens, latrines, a light rail system and a fully equipped hospital.

The tunnellers dug 4,300m of tunnels. The record for metres of tunnel in a single day was set on 16 December 1916 when they dug 100m of tunnel. Tunnelling was carried out seven days a week, 24 hours a day, with individual tunnellers carrying out eight-hour shifts followed by 24 hours rest.

The quarries were not rediscovered until the 1990s. La Carrière Wellington, a museum providing access to the tunnels, was opened in Arras in 2008.

Apart from graves and memorials, the quarries are one of the very few physical traces left behind by the New Zealanders on the Western Front.

Did you know?

- By the end of the First World War, 1308 men had served in the New Zealand Tunnelling Company, of whom 41 died and 151 were injured.
- They were the first unit of the New Zealand Expeditionary Force to arrive on the Western Front, arriving in France at midnight on 9 March 1916
- The first New Zealand Expeditionary Force soldier to die on the Western Front was 4/1639 Sapper Michael Tobin of the New Zealand Tunnelling Company. He died of bronchial pneumonia on 15 April 1916 at the British 42nd Casualty Clearing Station at Luchaux.
- The New Zealand Tunnelling Company was also the last New Zealand Expeditionary Force unit to return to New Zealand - on 24 April 1919.
- With an average age of 32, approximately half the men were experienced mining and public works engineers, quarrymen, miners from the

Hauraki goldfields or other mines, or labourers from the Railways and Public Works Departments. Recruits were obtained from all over New Zealand, with Auckland, Waihi, Huntly and Thames in the North Island and Millerton, Reefton and Blackball in the South Island providing the largest contingents. They were "experts in the class of work for which they were called up for....mature men, hard of muscle, hand and face".

- While mustered at Avondale Racecourse in Auckland for training prior to embarkation, they quickly earned the nickname of "The Red Feds" because of the high number of union activists among their ranks. It was reported that "such men did not take kindly to drill and were later famed throughout the Expeditionary Force as being the toughest and roughest company".
- The New Zealand Tunnelling Company formed one of 25 British and 7 Dominion

Tunnelling Companies totalling 25,000 men. Their primary task was to undertake the difficult and dangerous task of underground mining and countermining against the German Army on the Western Front.

Further information and sources:

Neill, J C, The New Zealand Tunnelling Company 1915-1919 (Auckland: Whitcombe & Tombs Limited, 1922)

The New Zealand Engineers Tunnelling Company, www.nzetc.co.nz

New Zealand History - The Arras Tunnels, www.nzhistory.net.nz/war/arras-tunnels

The New Zealand Tunnellers, www.nztunnellers.com



Tunnellers on bunks underground. Source: National Army Museum.

Building Wellington's Arras Tunnel



Panoramic image of the Memorial Park project site (note the fishbowl effect of the imaging process). Source: Memorial Park Alliance. Photograph: Stephen Patience 2012.



Archaeologists at work in the military drill hall site near the corner of Buckle St and Taranaki St. Source: Memorial Park Alliance. Photograph: Stephen Patience 2012.

- 1 Buckle St in 2012
- 2 Tunnel site
- 3 Buckle St Diversion under construction
- 4 Mount Cook School
- 5 Former Mount Cook Police Barracks
- 6 Former Defence General Headquarters
- 7 Gun pit for training - once held an 1880s 8-inch retractable Armstrong Gun
- 8 Foundations of military drill hall annexe

In August 2012, the Government announced its key project to commemorate the centenary of the First World War. Pukeahu National War Memorial Park would be built on Wellington's Mount Cook hill in time for Anzac Day, 25 April 2015 - 100 years since the landings at Gallipoli, New Zealand's first major battle. Pukeahu is the Māori name for the hill.

For the park to happen, Buckle Street (State Highway 1) which runs in front of the National War Memorial had to be placed underground. Special legislation was passed with consents and rules to make it possible to meet a strict deadline of two and a half years.

During that time, the tunnel and park were to be designed and built to the highest quality while still respecting the area's neighbours and its military history.

The challenge was to develop a project at pace in a busy central Wellington area where a memorial, school, university, naval base, businesses and residential apartments are right beside an often-noisy site and where vehicle and foot traffic is heavy.

Clearing the site

Before construction could begin, a complex network of underground pipes had to be diverted out of the way, without disrupting

the city's services. A diversion road was built and archaeologists conducted a dig. As the surface of the ground was stripped off, Wellington history was revealed in military artefacts from the 1800s and early 1900s when the street was a major military base.

The Memorial Park Alliance of government, construction and design companies - NZ Transport Agency, Downer NZ, HEB Construction, Tonkin & Taylor and URS - rose to the challenge and is opening the tunnel to traffic one month ahead of schedule on Monday 29 September 2014.

Digging the trench

The tunnel was designed as a “cut and cover” trench. Retaining walls of steel king posts and timber lagging were installed as excavation progressed to protect the people working inside and maintain stability of the ground outside.

The excavation interrupted the natural flow of groundwater downhill so recharge wells were sunk on the northern side and topped up as necessary. These will no longer be needed as groundwater will flow through gravel down the sides of the tunnel and under the site.

A 90-metre long wall of interlocking steel sheet piles was installed to protect the foundations of the historic Mount Cook Police Barracks building and the nearby

Tasman Gardens Apartments. The soil here is sensitive to rapidly losing groundwater pressure and the wall slows the rate of drainage.

Dirty water from the site was filtered through two sediment tanks before being discharged into the city’s stormwater system. The Alliance developed an innovative way of cleaning concrete-tainted water by pumping CO2 into the tanks through a leaky hose.

Two historic sewers – still in use – run through the site and have been protected from damage, one being a 100-year-old brick sewer running from Tory Street to Sussex Street.

A directional drill was used to burrow underneath the state highway to install a stormwater pipe from the trench down to Cambridge Terrace. This meant traffic was not disrupted.

The Alliance tested the strength of various reinforced concrete tension piles to see how they coped with the soil structure. Piles with a bell shape at the bottom performed the best and 94 were poured to hold the tunnel fast in a 1-in-2500 year earthquake.

By November 2013, the site was ready for construction of the tunnel to begin.

35,000 cubic metres
of soil removed – **2700**
truck and trailer loads

600 metres of
retaining walls,
up to **12m high**

Trench is
300 metres long,
18 metres wide and
up to **12 metres** at
its **deepest point**

558 13m long ground
anchors drilled
through the **walls**

16,000 bags of
cement **bind** the
anchors in place

More than **6.95 kilometres** of **pipes laid** to
divert watermain, stormwater, wastewater,
electricity and telecommunications services

- 1 Historic Newtown sewer protected
- 2 70 tonne crane – “Cranosaurus” named by Mount Cook School pupils
- 3 Sediment tanks
- 4 Jack for testing tension piles
- 5 100 tonne crane – “Mt Cranea” named by Mount Cook School pupils
- 6 35,000 cubic metres of soil removed
- 7 Steel king posts and timber retaining wall

- 8 90 metre sheet steel retaining wall
- 9 Historic Tory St brick sewer protected
- 10 Machine screwing in ground anchors

Source: Memorial Park Alliance.
Photograph Stephen Patience 2013.





2,598 tonnes of steel reinforcing tied in for the floor, walls and roof

7,500 cubic metres of concrete poured for the floor, walls and roof

130 precast concrete panels line the Sussex St entrance and Taranaki St exit

Up to 220 workers on site at peak of construction

60 designers, construction managers and support staff

637,000 hours worked by mid September 2014

- ① First floor slab in place
- ② Reinforcing for the next floor slab
- ③ Wall reinforcing being tied in place
- ④ Boxing being prepared
- ⑤ Area where stormwater pipe lies below concrete
- ⑥ Tunnel roof takes shape
- ⑦ Gap between concrete walls and retaining walls to be filled with gravel

Constructing the tunnel

Before construction began, three symbolic stones were laid at the tunnel exit to impart cultural and spiritual protection for the tunnel and travellers. They were blessed by Te Atiawa iwi representing the Taranaki iwi who migrated to Wellington in the 1830s.

The 130-metre tunnel - and the trench leading in and out of it - took shape in stages with the floors, walls and roof all made from reinforced concrete 800 millimetres thick. The concrete was poured into steel reinforcing that ties the roof, walls and floor together. The benefit of pouring the roof slab, rather than placing pre-formed slabs across the gap, is that the strength of the underpass tunnel can be increased to withstand a high magnitude, 1-in-2500 year earthquake.

The tunnel and trench were primarily made with expert handwork by skilled workers. An uncompromising attitude toward safety and excellence was essential given that, at the peak of construction, up to 220 people were working above and below the surface of a site that was only the size of three rugby fields.



The Arras Tunnel opens



The Arras Tunnel prior to lane-marking. Source: Memorial Park Alliance. Photograph: Colin McLellan 2014.



Arras Tunnel is a one-way route carrying State Highway 1 traffic west on three lanes from the Basin Reserve to Taranaki St and the Terrace Tunnel, passing underground in front of the National War Memorial.

The tunnel contains sophisticated information technology with 24/7 monitoring, safety and traffic management systems, including barrier arms to control traffic in an emergency. The Alliance team avoided any last minute snags by building and testing a live replica of the systems at Wellington's Transport Operations Centre and at the Alliance office in the year prior to installing the equipment in the tunnel.

Source: Ministry for Culture and Heritage.
Image Stantiall Studio 2013.

The top layer of the three layers of asphalt on the road consists of polymer-bound 14-millimetre aggregate including steel slag stone to create a strong skid-resistant surface. Expansion joints of bitumen and stone at the entrance and exit allow the road to stretch as the concrete below matures and shrinks over time.

The walls are lined with 273 decorative red poppies symbolising the 2721 New Zealand fatalities in the Anzac campaign at Gallipoli and are a reminder that Pukeahu National War Memorial Park is being built on top of the tunnel.

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Absolutely Positively
Wellington City Council
Me Heke Ki Poneke



ALLIANCE MEMBERS

