1038m of tunnel

Removing 850m^3 of material

In order to keep the tunnel fluid pressure to a minimum, the drilling rig was relocated to the top platform. Fluid recycling was undertaken at the bottom site, before the cleaned fluid was pumped back to the drill rig at the top site and reused in the tunnel.

The pilot hole needed to be enlarged to over 1 meter diameter and this was achieved with three reamer passes. Reaming of the first past went without difficulty for 800 meters until a sudden tunnel blockage caused the pressure in the tunnel to spike. This caused a tunnel fluid break through at “Tunnel Gully” resulting in a six week delay to the project while environmental preventive measures were established.

Reaming recommenced. Break out fluid was collected at tunnel gully and pumped to the low platform for cleaning before being pumped back to the top platform for bentinite dressing and then pumped back down the tunnel.

This new operation made progress very slow. Three sites working together to manage fluid in a calculated manner, ensuring the pump in the bush was not overwhelmed with fluid exiting the tunnel and therefore contaminating the environment with an overflow. The abrasive nature of the tunnel cuttings caused the pump impellers to wear very quickly requiring replacement every second day.

▲Tunnel cuttings removed from the fluid with 3 shaker screens and 16 hydro cyclones

▲1050mm diameter tunnel requiring three reamer passes

▲Butt fusion welding of the 850 OD, SDR12 PE pipe.

▲Maneuvering 200 ton of pipe required plenty of grunt

1.2 million rotations

As the reaming progressed, the 15m long pipes were delivered to the Water filter station where they were welded into two 520 metre strings. Each pipe string weighted almost 100 tons and manuvioring the pipe up a windy metal track proved very difficult. To add to the difficulties there was a requirement to keep the track open to small vehicles in case emergency works were required at the dam head.
On completion of the welding the two pipe strings were pressure tested and inspected.

During reaming, the reamer came to a slow but complete stop under “Tunnel Gully”. (Coincidently this is right beside the jammed pilot tools). Several things were tried such as increase/decrease carriage pressure, increase fluid volume and pressures, and rotate cutting face with plenty of fluid for about 25 minutes without any progress forward. The only remaining option was to trip out and check the reamer. The reamer was found completely packed with sand however was otherwise in good condition. The reamer was cleaned and tripped back to the face. 50m further on and the reamer again came to stop. Again the reamer was tripped back out the hole and found to be packed with sand. It was cleaned out and pulled back up to the face. After clearing tunnel gully the reamer progressed without event.

The ground conditions under Tunnel Gully presented an unacceptable risk to the project so on completion of the reaming, six swabbing passes were undertaken giving particular attention to “tunnel gully”.

200 ton of pipe

Into one long hole

The drill was now moved to the bottom platform in order to pull the pipe downhill. The 1.5 ton nose cone was fitted to the pipe and connected to the drill string. One bulldozer winch applying 40 tons of push on a double purchase was set up at the top platform and two winch trucks assisted the pipe as it snaked down the track. When the pulling/pushing forces started to climb water ballast was systematically added into the pipe to manage the pipe/tunnel roof friction. The water volume was carefully monitored because if the pipe was over filled, the water would become dead weight in the empty part of the tunnel. The pipe was installed over a five day period, this included stopping at the midway point to weld the two pipe strings together. The force required to install the pipeline didn’t exceed half of the drills capability.

◀Manufacturing the towing head

Connecting the towing head to the swivel ▶

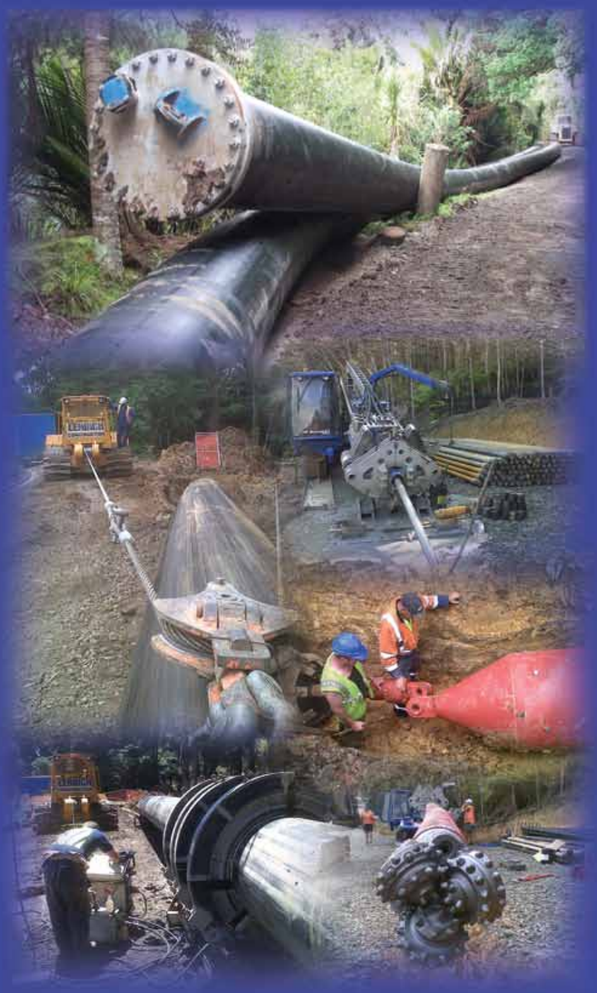
◀Ancher block construction

This was an extremely tough project in a sensitive ecological environment. Millions of litres of fluid were used to remove near a thousand cubic metres of tunnel material and protecting the environment was always a high priority. This project required a high level of skill and commitment and all though this project proved very tough, perseverance won in the end.

Story & Photos by Neil Vanner ©

DIGGING DEEP

to complete NZ’s toughest HDD project



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Slips, rust & fatigue

A new pipeline was needed to replace a failing cast iron watermain laid during World War 2, which traverses some of the most rugged topography and dense bush imaginable.

The existing cast iron watermain mostly mimicked the topography of the route and was left exposed in many locations. Ground movement and erosion led to high maintenance of the cast iron pipeline constructed in 3m long sections.

The proposed new pipeline was a siphon with a height difference between ends of 40m and a low point 80m below the high point. The pipeline would cross under five streams, pass beneath bluffs by up to 40m deep, intersect conglomerate gravel beds and pass through sections of faulted ground.

On completion the pipeline would offer a smooth straight alignment with an increased capacity, improved efficiency and near nil ongoing maintenance issues.

▲ Universal HDD Rig (100 ton pull back)

Going bush

With 8 metres visibility

A mud motor with a Digitrak magnetic steering tool was chosen for the pilot hole drilling. The pilot drilling progressed on plan from the low end unit passing under the third stream near the 600m mark. At this location drilling fluid started exiting in a wide area in and around the stream in this gully. This gully was later named “Tunnel Gully” due to its close proximity to the tunnel used for the cast iron pipeline built back in the 1940s. Progressing the pilot hole under this gully led to the drill string becoming jammed.

A heli drill rig was dropped into the bush and two ground investigation bore holes were drilled revealing substantially weak beds of barely cemented sands.

It was suspected that sand falling into the pilot hole had packing behind the mud motor caused the tool to jam.

New down hole equipment was ordered from overseas and UUL went about salvaging as much of the drill string from the hole as possible. An explosive charge was feed down the drill string and 350m of rods were eventually recovered.

Grout injection was undertaken in tunnel gully to help stabilise the formation.

▲ Mud motor with electronic compass steering system

▲ Exploded drill rod to recover drill string

▲ Heli rig used for grout injection and additional ground investiqation

▲ All equipment lifted in and out of tunnel gully by helichopter

When the new equipment arrived it was straight back into drilling the pilot hole.

Pilot drilling progressed 900m before a hard turn upwards under the last stream was required to meet the exit target 140m away and 40m vertical. However the mud motor failed to achieve the targeted vertical gains and the exit location was going to be over shot. Drilling on may have resulted in drilling into the existing cast iron watermain or exiting under the floor of the filter station building.

UUL conceived utilising a small drill rig to drill down the steep embankment and intersect the existing pilot hole nine metres below the stream and 40 metres below the small drill rig platform. The difficulty of this manoeuvre was no small feat. The small drill had to land its drill string into a 260mm diameter pilot hole like landing an aeroplane. Simply drilling straight to the existing pilot hole would not work. The steep and densely vegetated embankment and depth of the drilling made the operation very tricky. The drill string had to achieve a depth of 18 metres before arriving under the stream on line and grade. Every longitudinal metre had a different grade to achieve as it bent around to eventually match the target grade. A survey and computer bore plan was undertaken for the shot and recalculated every 15m.

The extremely skilled drill operator “Tim Mitchell” and supporting crew successfully landed the drill string into the existing pilot hole creating a 1km path through the job for the first time.

◀ Ditchwitch 30/20 drill rig utilised to drill down to and intercept the existing pilot hole

Site two

Water Filter Station

Site one

Hilary Estate

Site three

Tunnel Gully