Paraweb Reinforced Bridge Abutments & MSE Walls – Case Studies

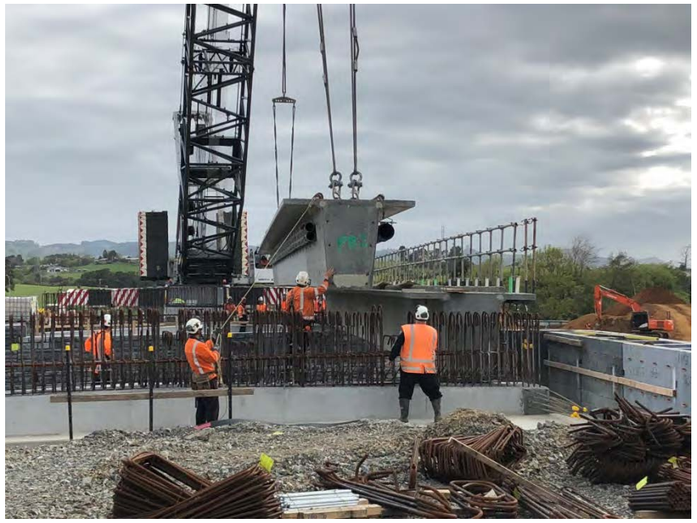
Hitchin Rd
Pokeno, Auckland

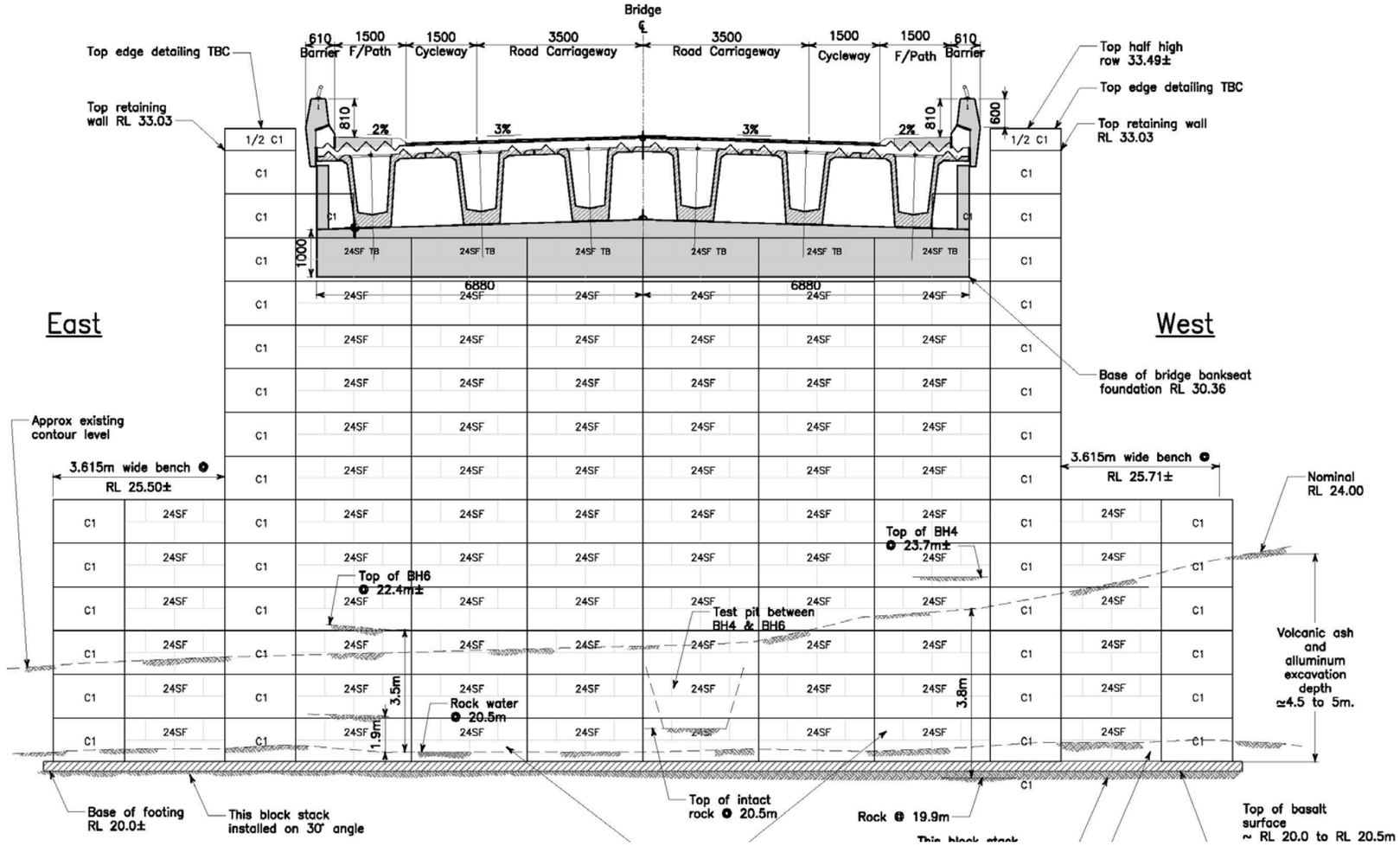
As part of adjacent subdivision development, a new 14m wide rail over bridge was required to improve residential network capacity at Pokeno, some 60km south of Auckland, NZ.
Underlying ground conditions consisted of 2 – 6 metres depth of volcanic ash and alluvium, overlying intact basalt flows. Given underlying competent ground conditions, bridge foundations were designed as bankseat foundations supported on the Paraweb strip reinforcement used to build the approach embankments and abutment walls. Abutments range between 8 & 13.5m high from founding basalt to road centre line levels and are constructed out of compacted GAP65 aggregate reinforced with a mix of Paraweb 2D50 & 2D100 geosynthetic strip reinforcement.

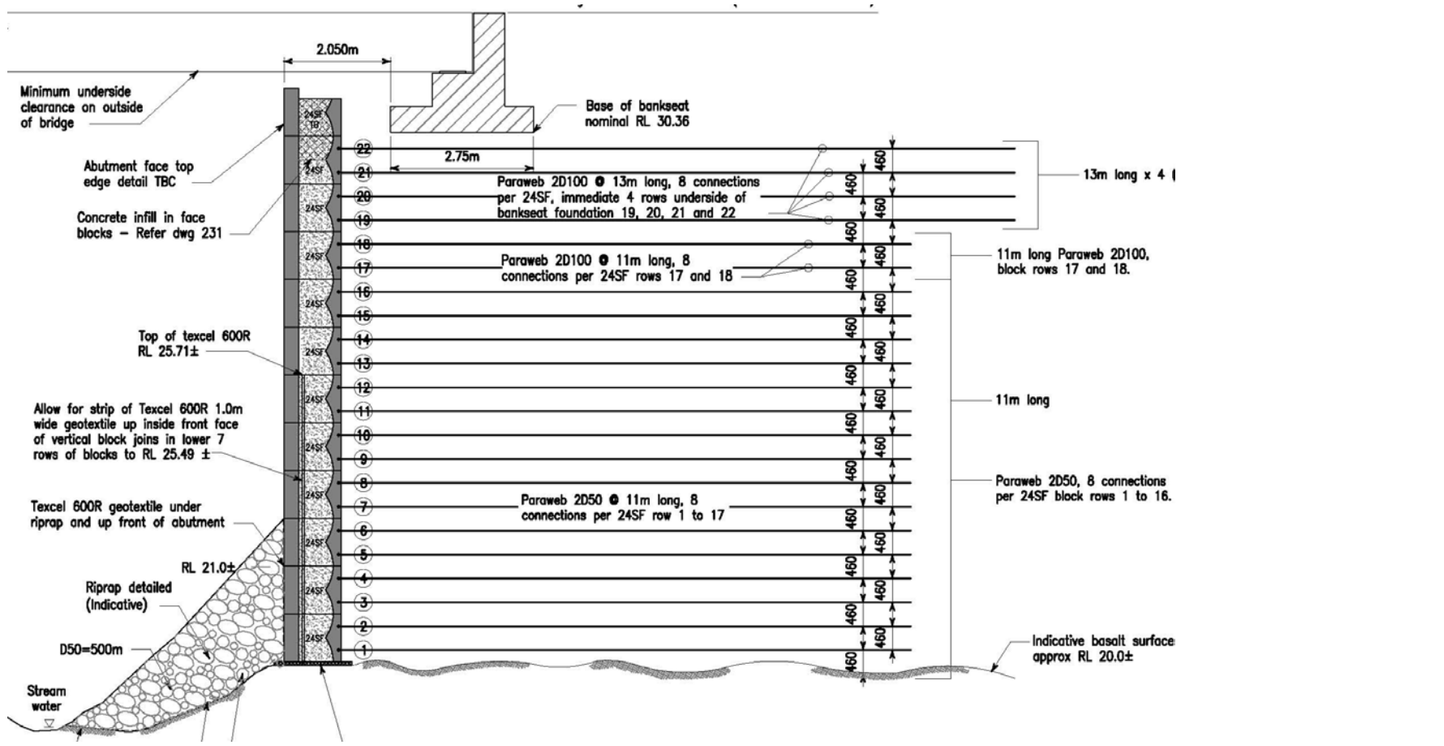
Innovation

- 100% positive Paraweb block connections using GFRP pins and patented block fittings
- 13.5m high bridge abutment founded on basalt
- Circular corner blocks – allowing for abutment corners from 70 to 120 degrees
- Shallow bankseat foundations – 600 tonnes of bridge deck carried directly on Paraweb reinforced GAP65 aggregate
- 2000kn railway impact beam built directly into eastern abutment block facing using modified 24-62 blocks
- 1800mm storm water line under rear of western abutment, minimum 1.2m of permanent groundwater in abutment toe and designed for 4m of unbalanced flood drawdown forces during 1:100 storm events
- 550 tonne crane lifting 66 tonne, 35m long bridge beams off MSE bridge abutment
- Seismic ULS 0.29g SLS 0.1g

Circular corner blocks (above right); Impact beam (below)




Bridge
Top edge detailing TBC
Top retaining wall RL 33.03
610 Barrier
1500 F/Path
1500 Cycleway
3500 Road Carriageway
3500 Road Carriageway
1500 Cycleway
1500 F/Path
610 Barrier
Top half high row 33.49±
Top edge detailing TBC
Top retaining wall RL 33.03
810
600
2%
3%
3%
2%
1/2 C1
C1
1000
24SF TB
6880
24SF
East
West
Base of bridge bankseat foundation RL 30.36
Approx existing contour level
3.615m wide bench
RL 25.50±
3.615m wide bench
RL 25.71±
Nominal RL 24.00
Top of BH4 23.7m±
Top of BH6 22.4m±
Test pit between BH4 & BH6
3.5m
1.9m
3.8m
Rock water 20.5m
Volcanic ash and alluminum excavation depth ≅4.5 to 5m.
Base of footing RL 20.0±
This block stack installed on 30° angle
Top of intact rock 20.5m
Rock 19.9m
Top of basalt surface ~ RL 20.0 to RL 20.5m


2.050m
Minimum underside clearance on outside of bridge
Base of bankseat nominal RL 30.36
2.75m
Abutment face top edge detail TBC
Concrete infill in face blocks – Refer dwg 231
Paraweb 2D100 13m long, 8 connections per 24SF, immediate 4 rows underside of bankseat foundation 19, 20, 21 and 22
13m long x 4
Paraweb 2D100 11m long, 8 connections per 24SF rows 17 and 18
11m long Paraweb 2D100, block rows 17 and 18.
Top of texcel 600R RL 25.71±
Allow for strip of Texcel 600R 1.0m wide geotextile up inside front face of vertical block joins in lower 7 rows of blocks to RL 25.49 ±
11m long
Paraweb 2D50, 8 connections per 24SF block rows 1 to 16.
Texcel 600R geotextile under riprap and up front of abutment
Paraweb 2D50 11m long, 8 connections per 24SF row 1 to 17
RL 21.0±
Riprap detailed (Indicative)
D50=500m
Indicative basalt surface approx RL 20.0±
Stream water
460
24SF

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Taramakau River Bridge Replacement Project, Westland

The Taramakau Bridge replacement project was undertaken in 2017 / 2018 and entailed building a new two lane bridge to replace the single lane bridge shared with the Hokitika Branch Railway Line as well as construction of a highly skewed rail over bridge some 300m south of the Taramakau River.

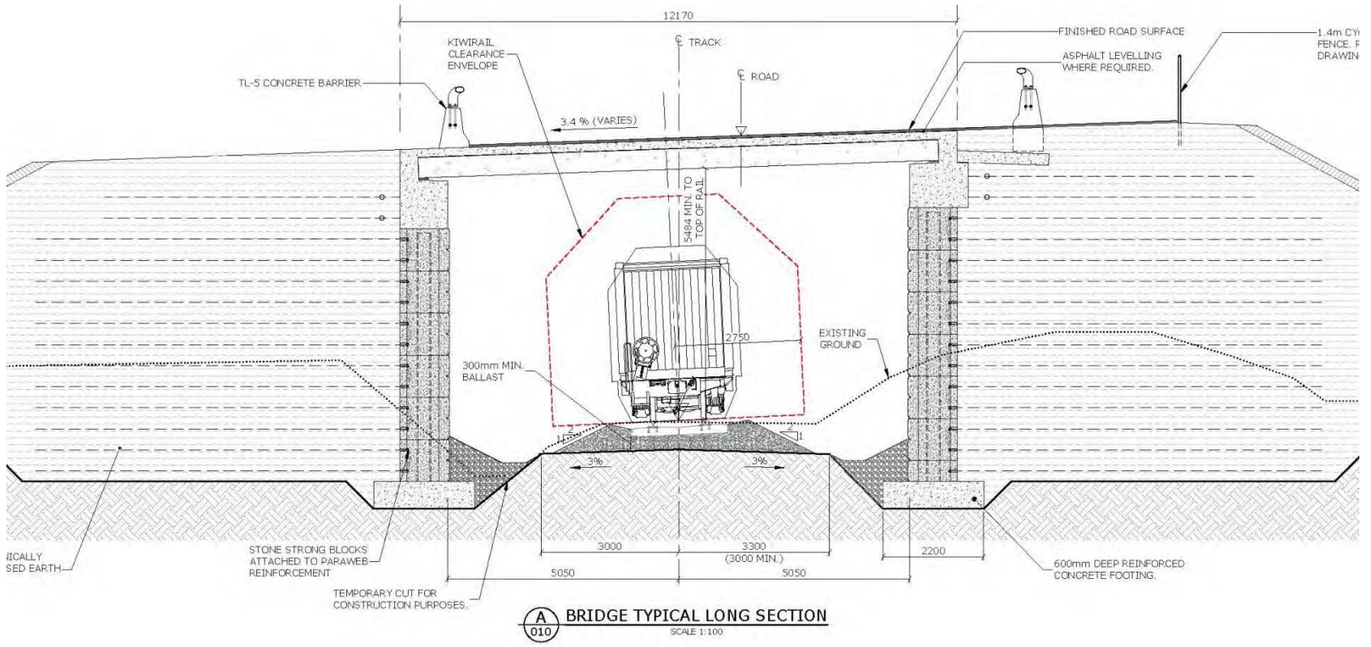
Stonestrong MSE abutments using Paraweb strap reinforcement were used on the rail bridge with abutment loads being carried on shallow pier cap foundations and block voids used for precast shuttering of vertical reinforcement columns

Paraweb detail showing GFRP pin cast into pier caps

Innovation

- 100% positive Paraweb block connections using GFRP pins and patented block fittings
- Paraweb concreted directly into pier caps – HDPE sheath allows for high alkaline conditions
- Shallow bridge foundations founded on compacted river gravels / intact siltstone.
- Stonestrong blocks used for both MSE retaining walls as well as insitu formwork for bridge abutment reinforcement.
- High seismic demand design – 0.86g ULS for intense shaking within 30km of site (M 8.3)
- Paraweb reinforcement operating well within creep limits to provide maximum stiffness performance under seismic shaking
- MSE walls offset from rail centre line to avoid impact beam requirements from train derailments
- Highly skewed span (70 degrees) requiring some 60m of hollow core bridge deck for two traffic lanes
- Significant groundwater drainage in build, abutment design has minimum 1.0m of permanent groundwater in design

Paraweb & block fittings (top) abutment foundation (above), looking south between both abutment walls (below)



A 010 BRIDGE TYPICAL LONG SECTION
SCALE 1:100

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Cowie Street Level Crossing, Auckland

Cowie Street Bridge is a replacement road over rail bridge for a closed level crossing some 150m further south along the Newmarket branch line in Auckland, NZ. Underlying ground conditions are local residual clayey sands and silts sitting on less weathered weak sandstones & siltstones at moderately shallow depths. Bridge foundations are 1m diameter piles socketed into the underlying rock mass; these required installation from top of abutment level to stay clear of live (25kV) overhead traction lines.
Stonestrong pile through blocks (Octablocks) were built into the front abutment face with Tee panels used to adjust for pile centres. Octablocks were installed with the Paraweb strapping preloaded with wall backfilling following block placement

Innovation

- 1700mm internal diameter Stonestrong Octablocks used for pile through bridge abutments.
- Piles installed from top of the abutment - drilled down through the wall under live / operating rail conditions.
- Conventional pile installation before abutment construction would not have been possible due to overhead line (OHLE) conflicts with work limited to 4 hourly overnight time windows; Octablocks took 3 months off construction program.
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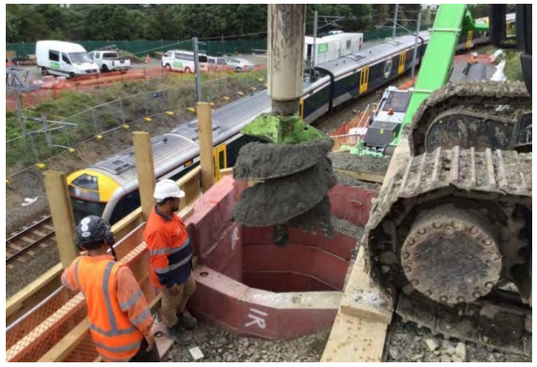

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Cowie Street Level Crossing, Auckland Hybrid MSE/Gravity/Piles

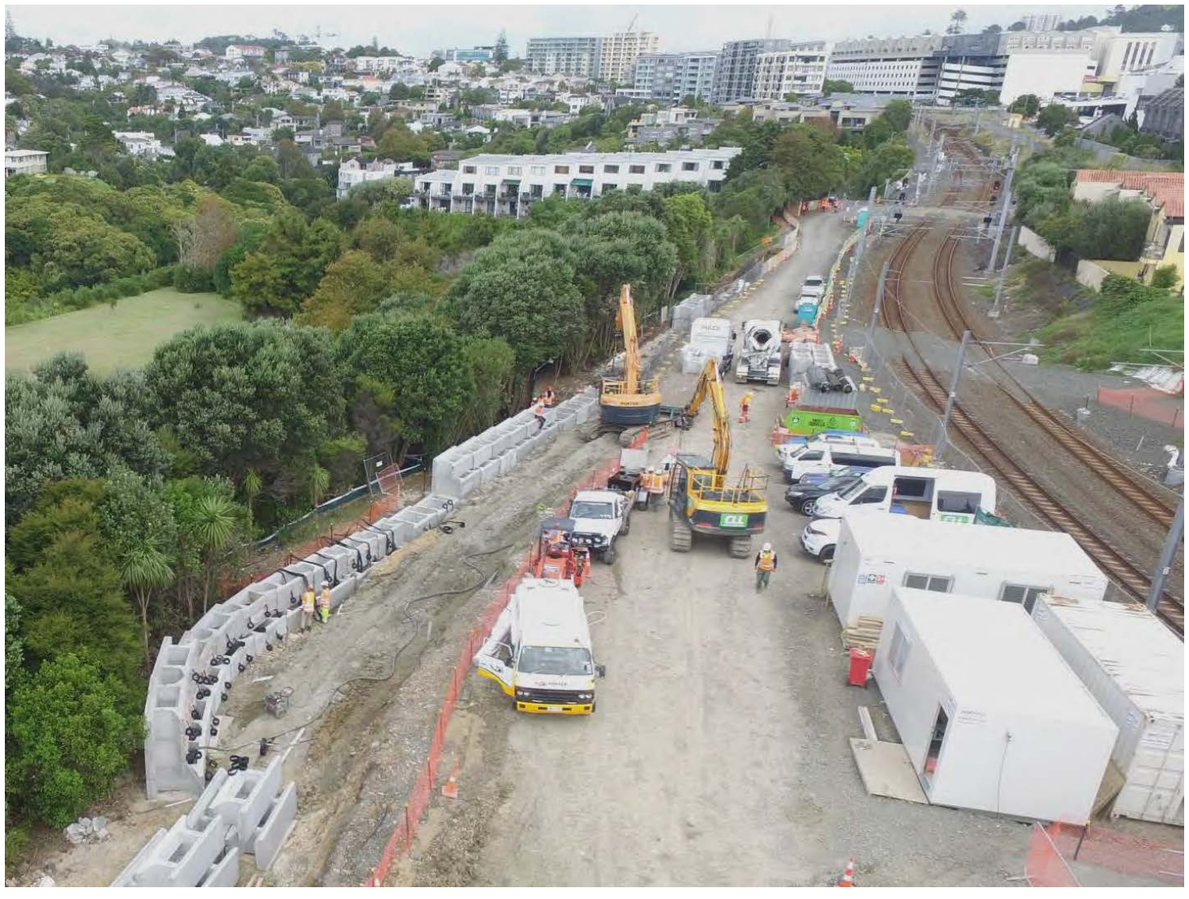
A second road approach wall was required as part of bridge construction.
This was piled due to an adjacent steep slope and built is staggered stack bond to accommodate various grade change issues within the carriageway on top.

Block stacks were installed with nominally 60 – 100mm offset per block step with cast insitu capping edge to meet adjacent footpath/ road cross fall.

Wall is a mixture of piled, gravity and Paraweb MSE retaining elements.

Innovation

- Hybrid retaining wall – piled bases for slope stability, MSE walls reinforced with 2D50 Paraweb on higher wall sections, gravity blocks otherwise.
- Paraweb preinstalled on blocks, backfilled after block placement (different subcontractor crews)



Paraweb Reinforced Bridge Abutments & MSE – Case Studies

Mingha Bluff, SH73 Arthurs Pass

Mingha Bluff deviation comprised some 6km of road deviation on SH73 just south of Arthurs Pass in the central South Island of NZ. The original road was built in the 1860s along a series of bluffs above the flood plain of the adjacent Bealey River; Railway construction in the 1920s built flood protection and land reclamation works and the road was relocated next to this as part of the project.

Some 3200m2 of Stonestrong walls were used in the project including a mix of MSE, rock anchored and gravity walls as well as walls structurally reinforced for TL4 traffic barrier loads and the use of Stonestrong Corbel blocks to carry the carriageway out over the adjacent railway envelope where required.

Walls built with exposed aggregate finish, designed to blend in with surrounding terrain.

Innovation

- Stonestrong blocks used for both MSE retaining walls as well as insitu formwork for corbel abutment / rock anchor connection reinforcement.
- High seismic demand design – 1.03g ULS for intense shaking within 20km of site (M 8.3)
- Concrete footings, GAP65 aggregate screened and crushed from adjacent riverbed materials, large earthworks construction equipment.
- Corbel blocks above railway envelope on wall One
- Wall One built to follow curved road alignment above – wall curves horizontally, vertically with the start point 5m lower than finish point to follow railway gradient
- Wall Two anchored to slope behind; multiple other walls installed with TL4 traffic barriers adjacent to railway track.
- Several walls constructed with F2 traffic barrier shape on front face.