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www.smallbridges.com.au
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The Innovative Design of Piled Through Mass Gravity Stone® Strong Wall Homestead Gully Bridge Rehabiliation

Presented by Jeroen Berends
Geoinventions Consulting Services Pty Ltd
27th November 2017

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Content

1. Project Team

Client	Queensland Government Department of Main Roads
Geotechnical Investigations & Principal Designer	GHD
Retaining Wall Designer	GEO INVENTIONS CONSULTING SERVICES
Precast SS Block Supplier	CONCRIB Maximising Land Values
Contractor	RoadTek Main Roads

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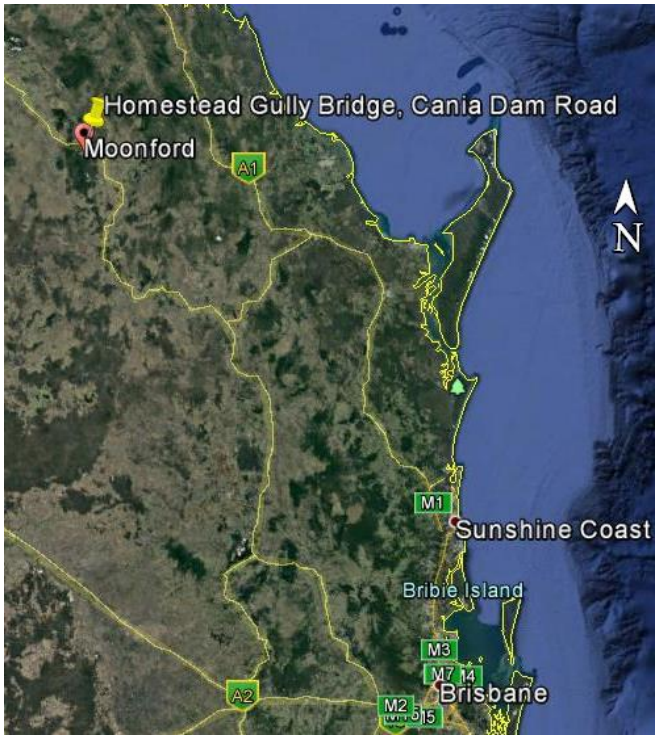
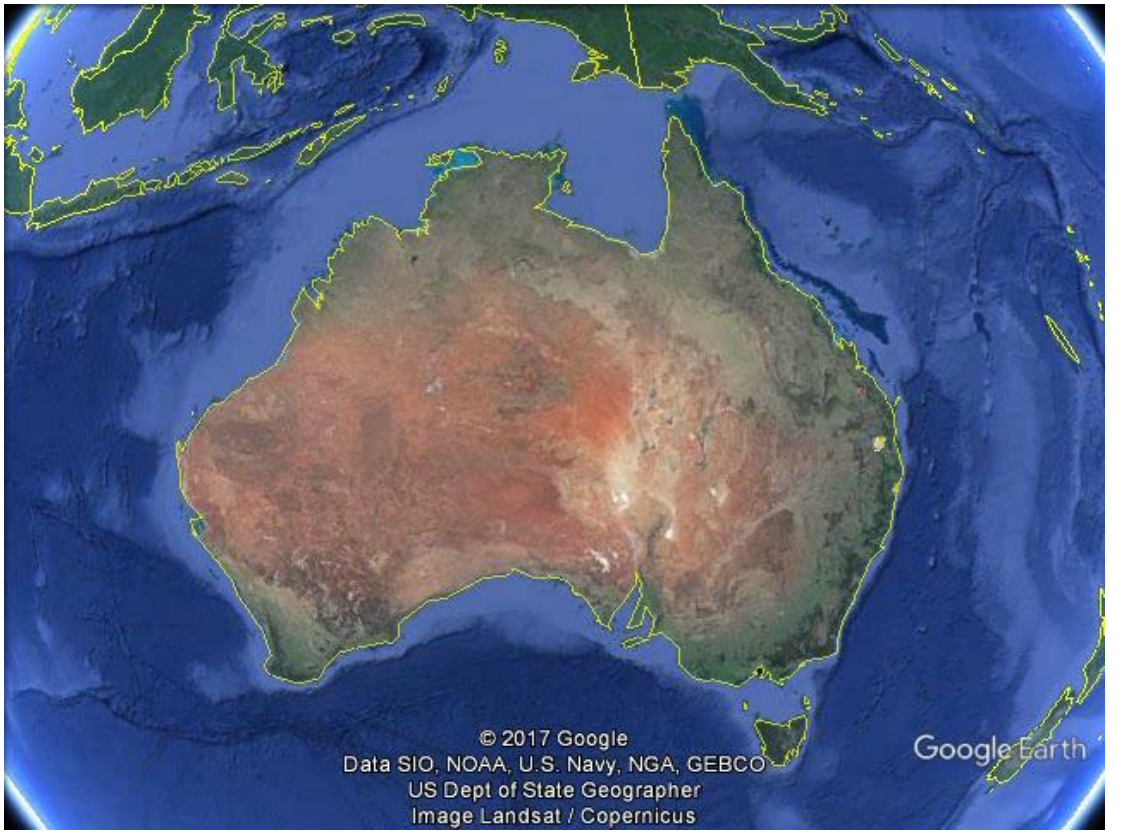
2. General Information

The Location of Homestead Gully Bridge



Approximate 520km North of Brisbane Near Town Of Moonford



Existing Timber Bridge

Three-span bridge supported on driven timber piles, which was constructed in 1960's.

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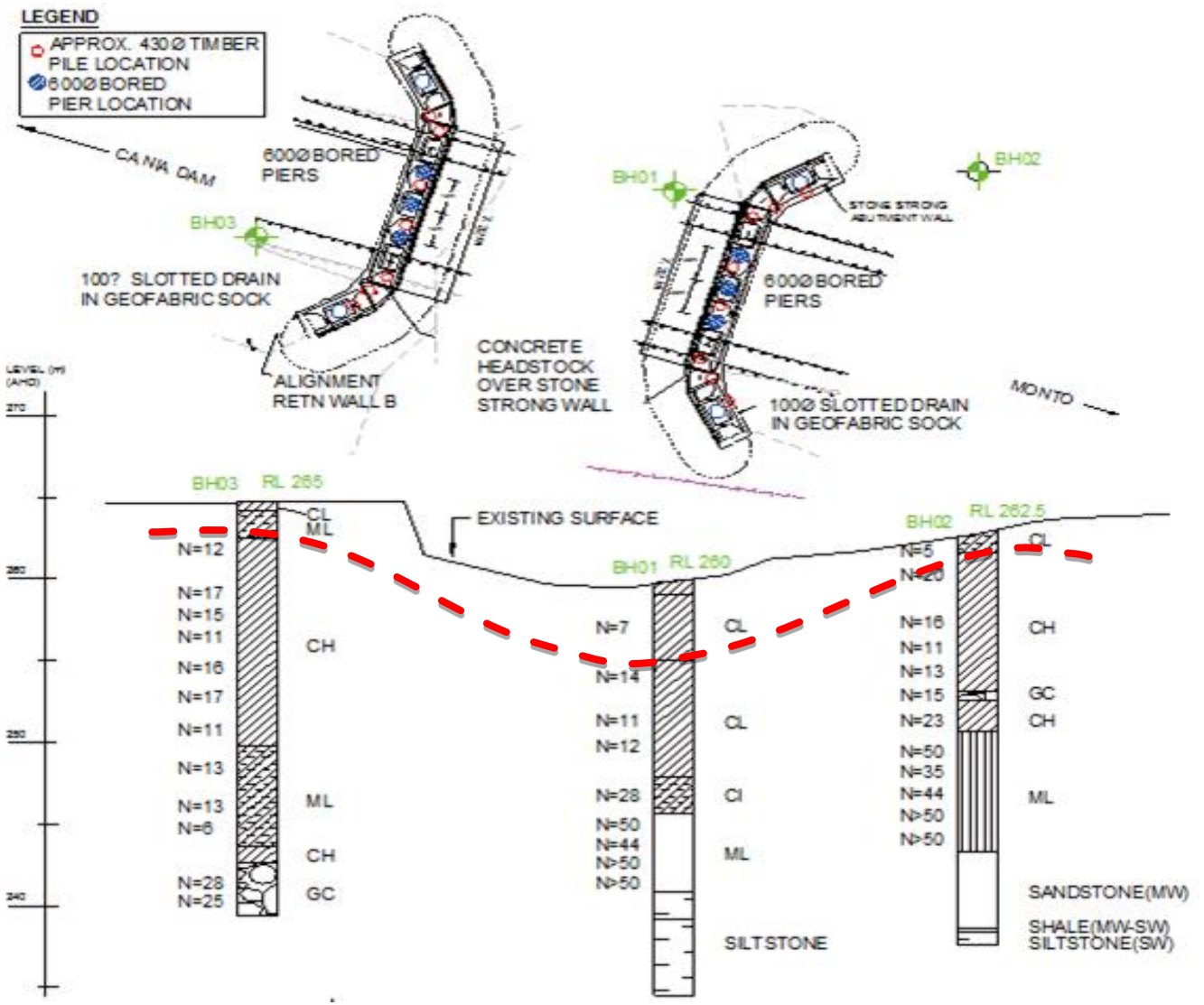
Many timber bridges which were constructed have come to the end of their design lives and requires replacement OR upgrades

These bridges do not conform to current design standards & safety requirements

3. Geological and Geotechnical Information



The Critical Borehole (BH01)

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3. Geological and Geotechnical Information

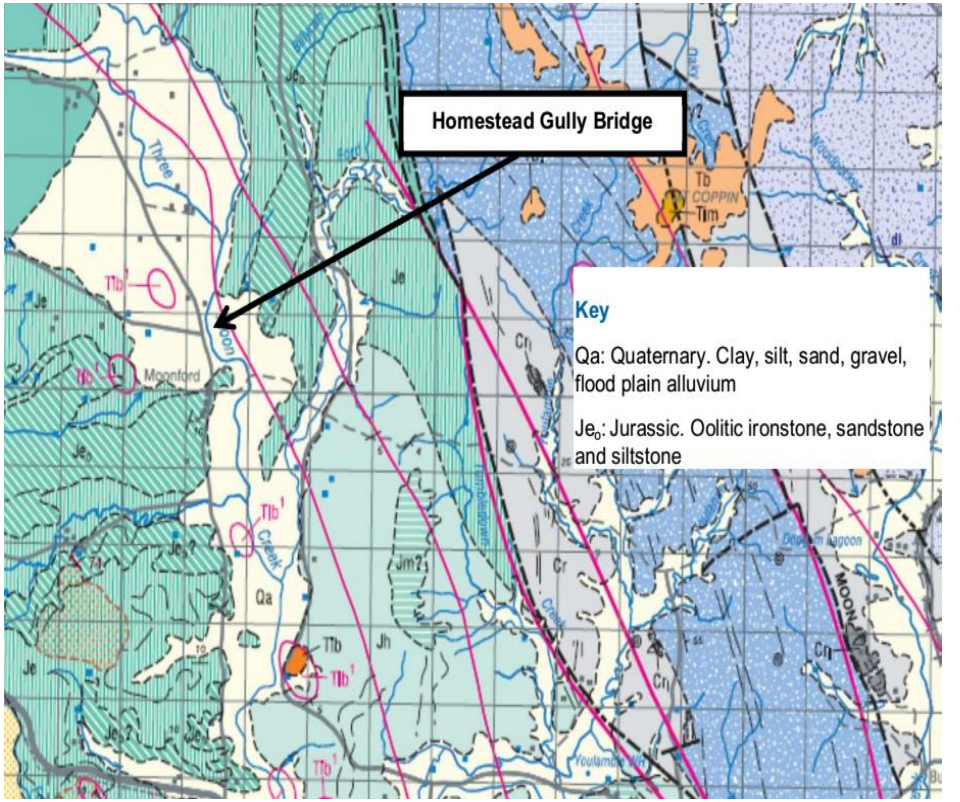
Geology:

Quaternary Flood Plain (Qa)

- Alluvium - Clay, Silt and Gravel
- Rocks of the Jurassic Evergreen - Ironstone, Sandstone, and Siltstone.

Geotechnical Profile(BH01):

- 0.0-5.0m firm to stiff Sandy CLAY (alluvium)
- 5.0-14.0m very stiff
- CLAY / Silty CLAY (alluvium)
- 14.0-19.0m residual soil;
- 19.0-21.0m moderately weathered,
- low strength Argillaceous SANDSTONE.



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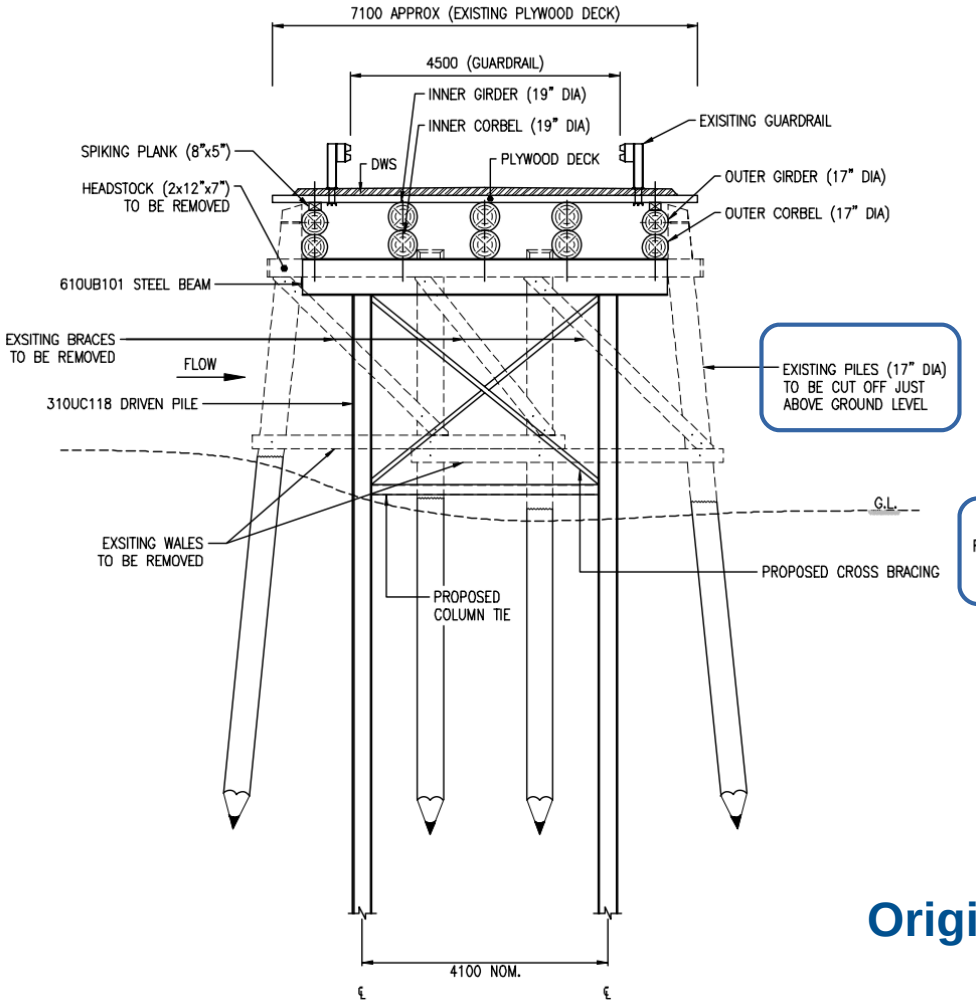
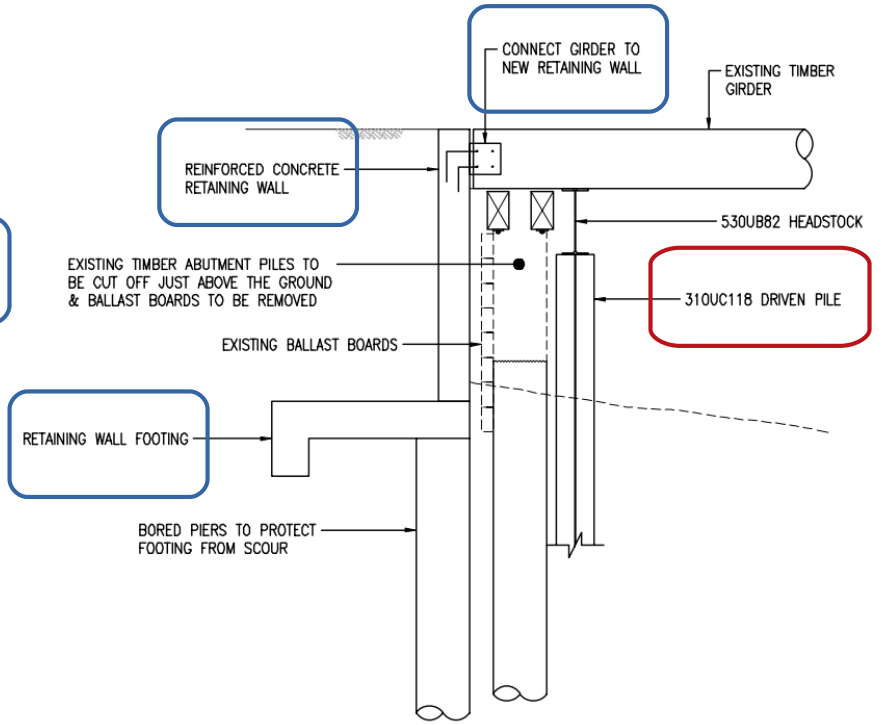
4. Challenges - Design & Construction





Original Design - RC Retaining Wall

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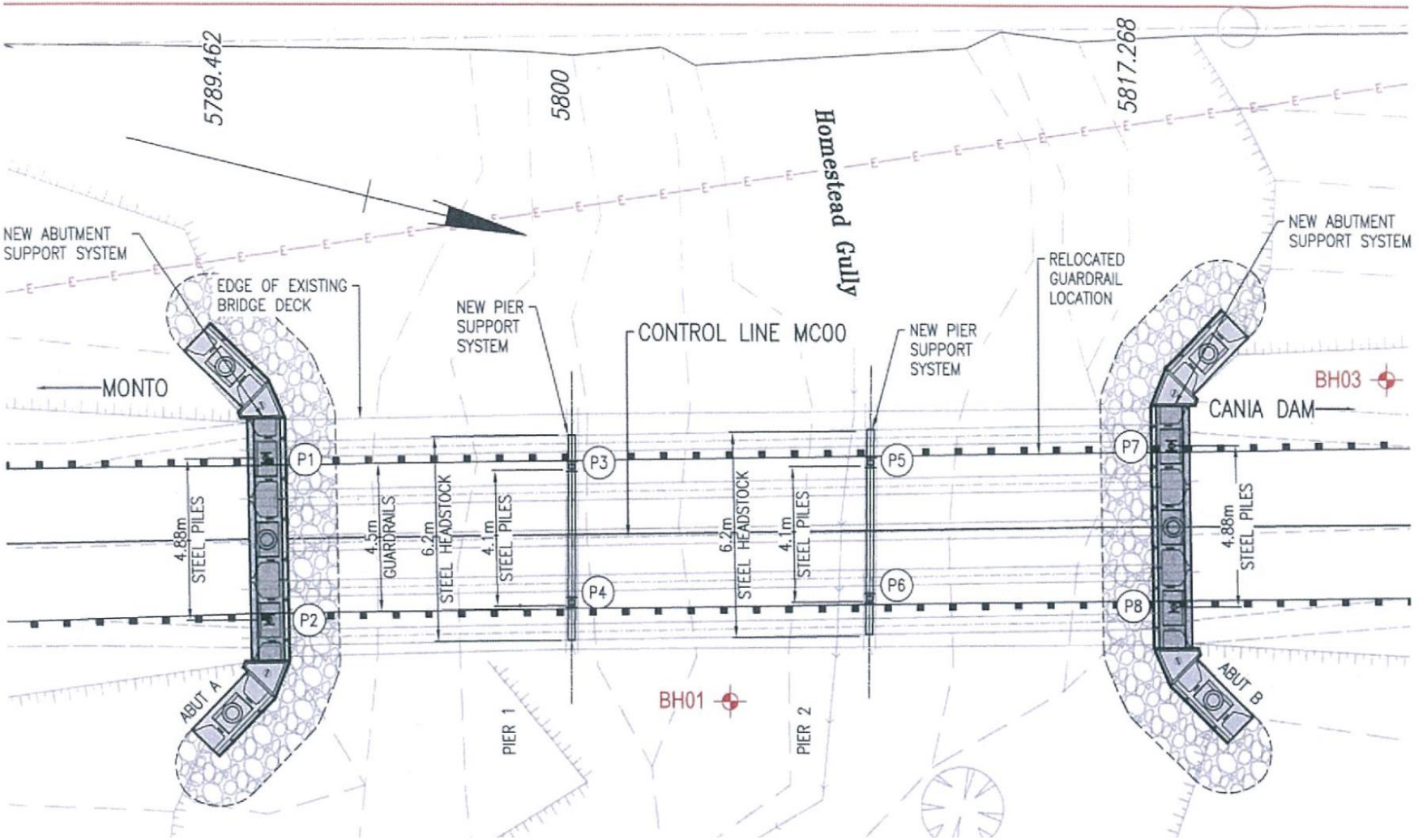
New Plan Layout



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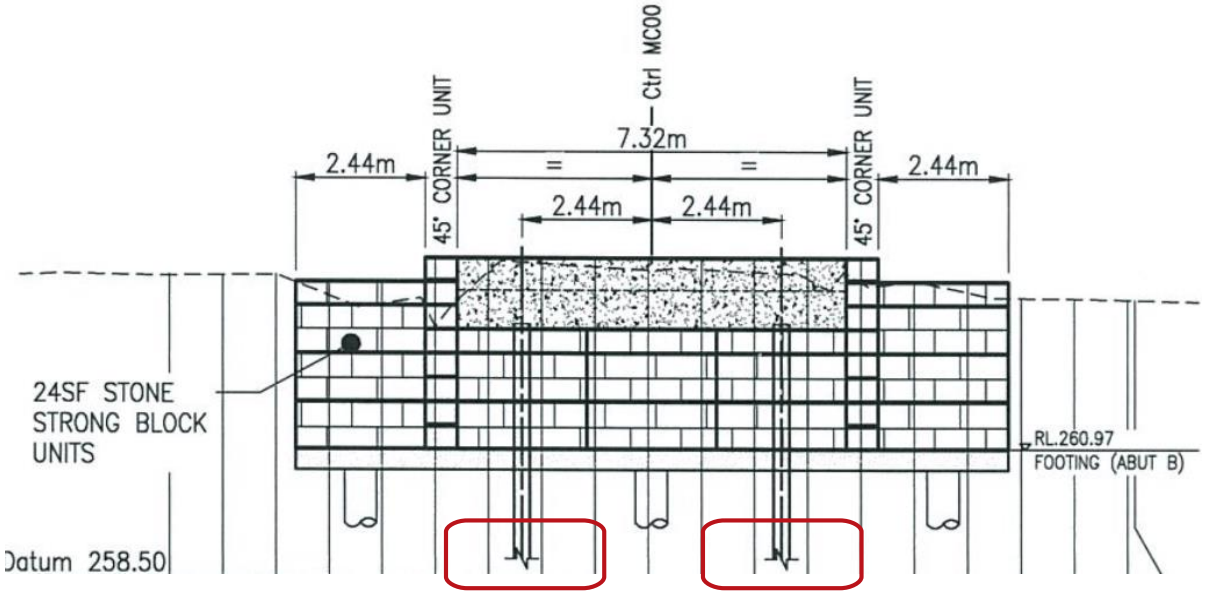

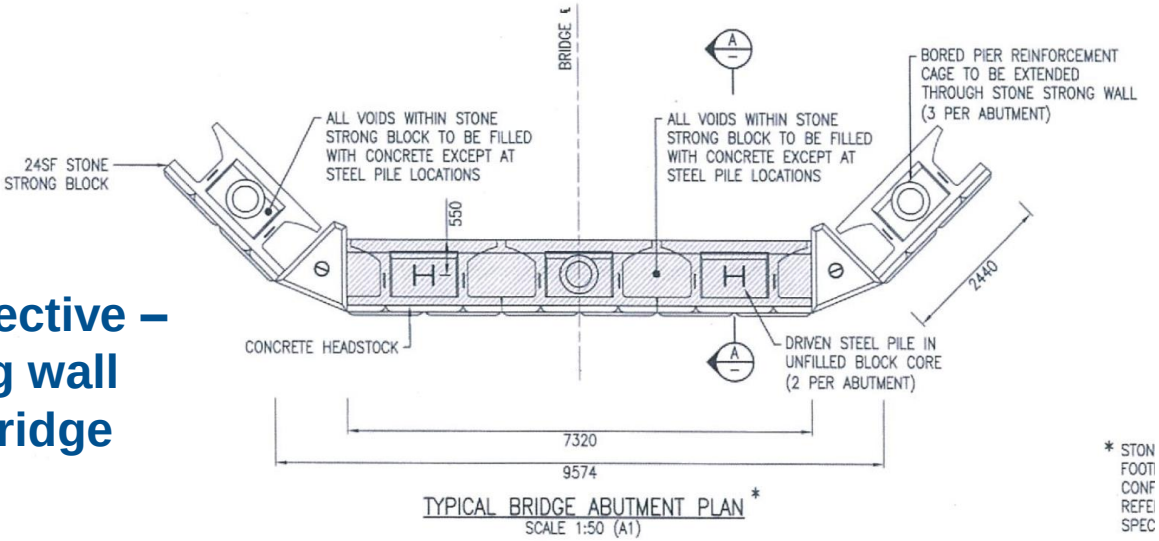

GCS Alternative Design & Objective – Stone Strong precast retaining wall which was isolated from the bridge

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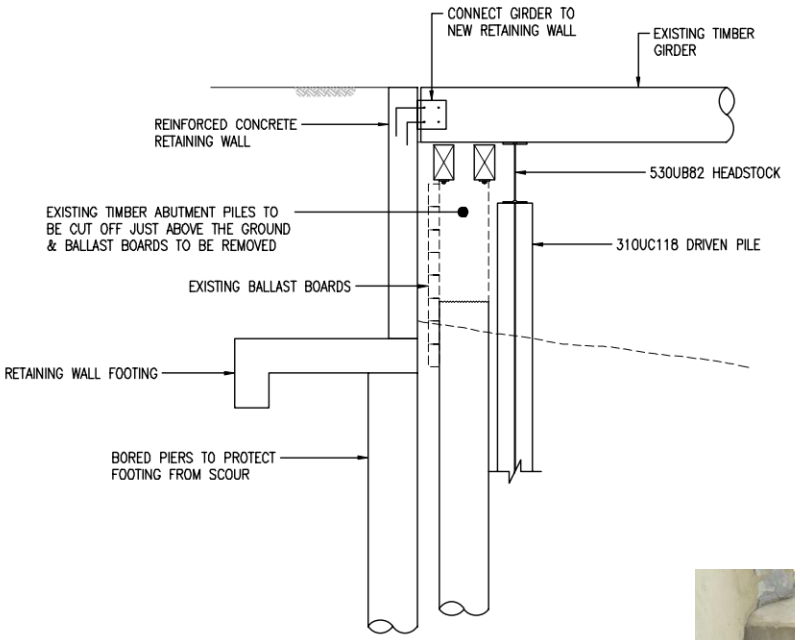
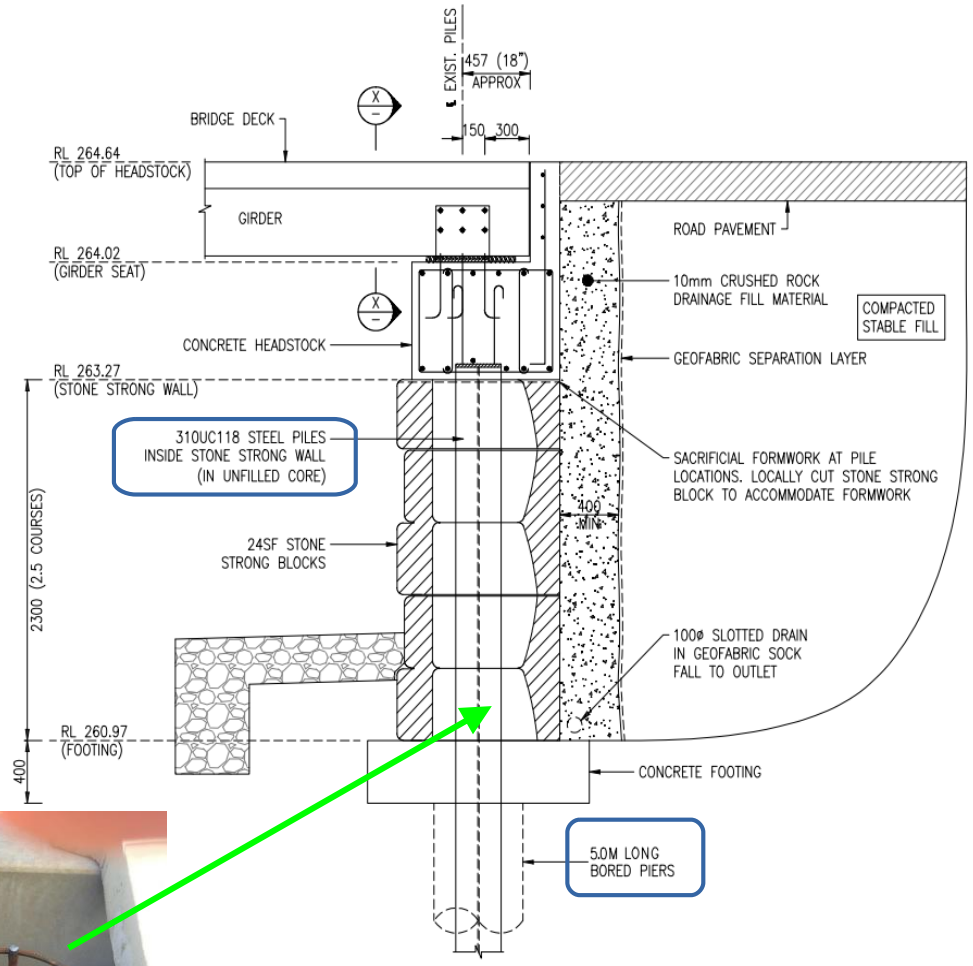


Original Design
RC Retaining Wall



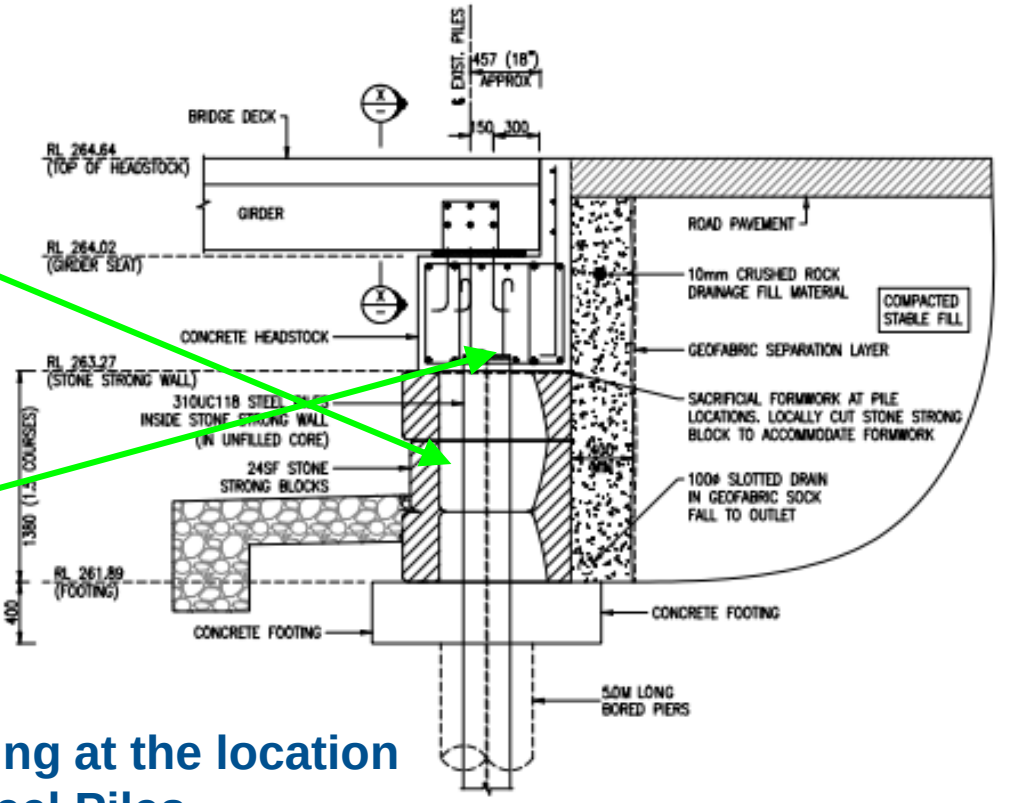
GCS Alternative Design
Pile Through Stone
Strong Wall

5. The Innovative Solution

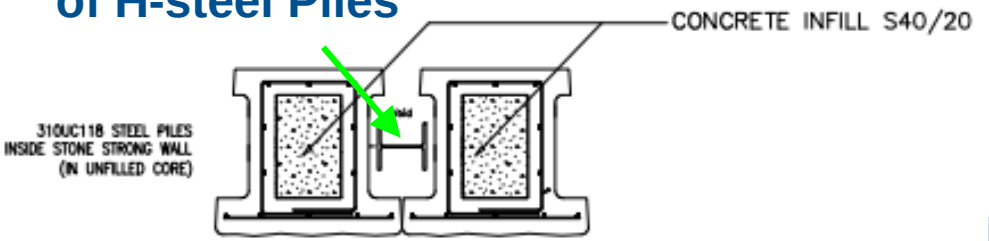
Typical Stone® Strong Block for Backfill Retaining

H-Steel Pile for Bridge Support

Two Separate Structures were combined into Piled Through Stone® Strong System

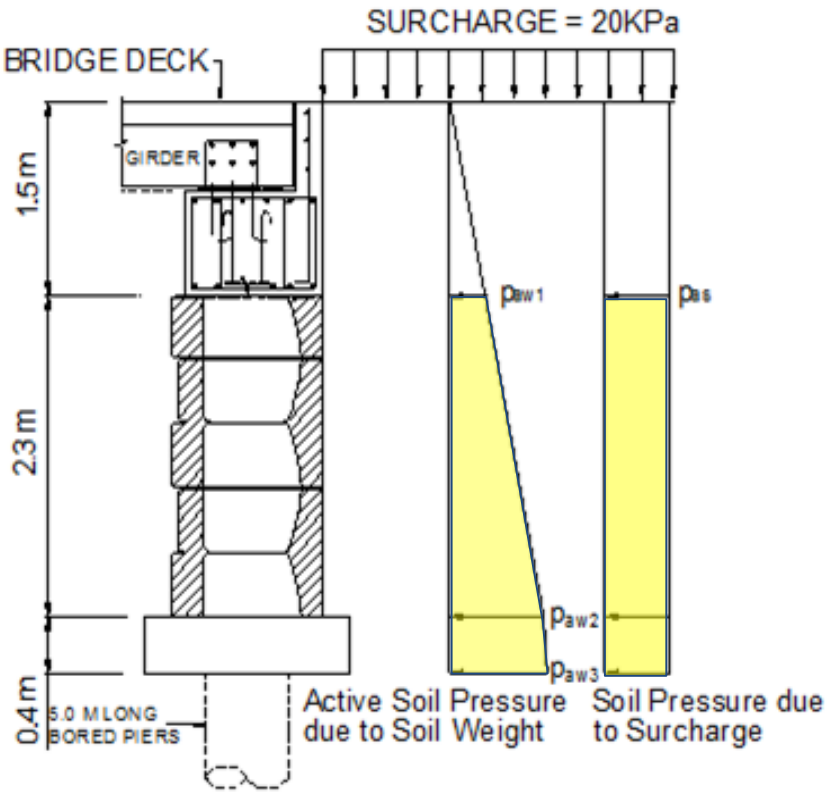


No Filling at the location of H-steel Piles



6. ULS and SLS Check

Ultimate Limit State(ULS)



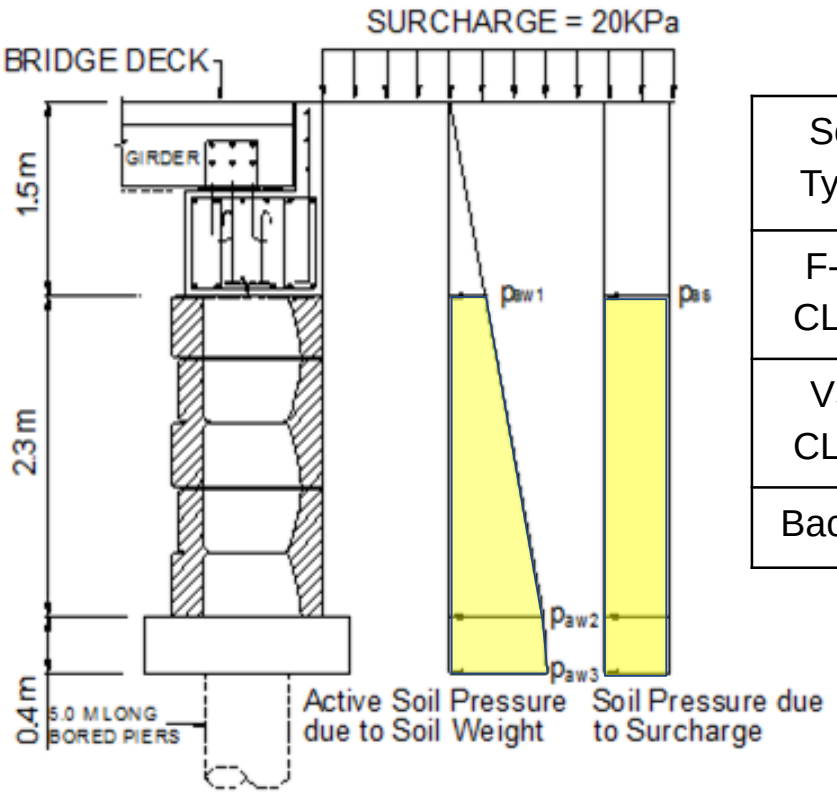
Earth Pressure Behind The Retaining Wall

Hypothesis:

- Norminal surcharge of 20kPa adopted in the retaining wall deisgn and was assumed to be at the top of the embankment;
- Retaining wall designed to account for active soil pressure behind wall only
- Soil pressure behind the bridge headstock is not transferred to the retaining walls;
- Passive soil resistance is not considered according to Clause 13.3.1 of AS5100.3 – 2004.
- All bending moments are transferred to the bored piers beneath the concrete footing;
- Bore piers have spacing of 2.44m.

6. ULS and SLS Check

Ultimate Limit State(ULS)



Adopted Soil Parameters

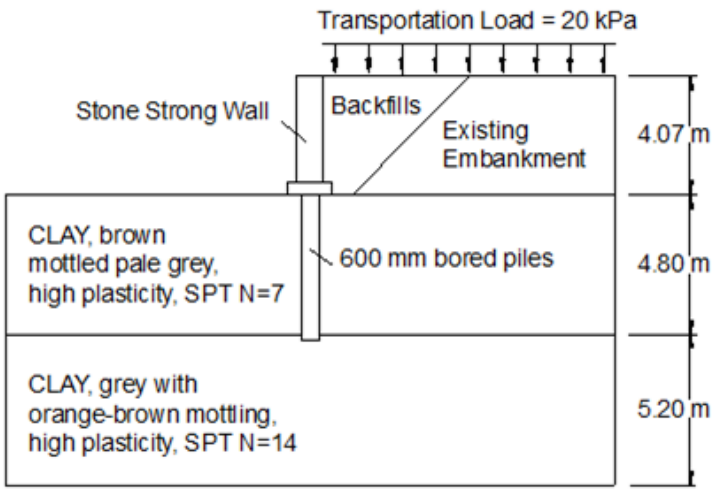
Soil Type	γ (kN/m^3)	E (MPa)	Poisson's Ratio	c' (kPa)	φ' (°)	c_u (kPa)
F-St CLAY	18	10	0.4	3	25	66
VSt CLAY	19	20	0.3	5	27	96
Backfill	20	30	0.3	0	30	-

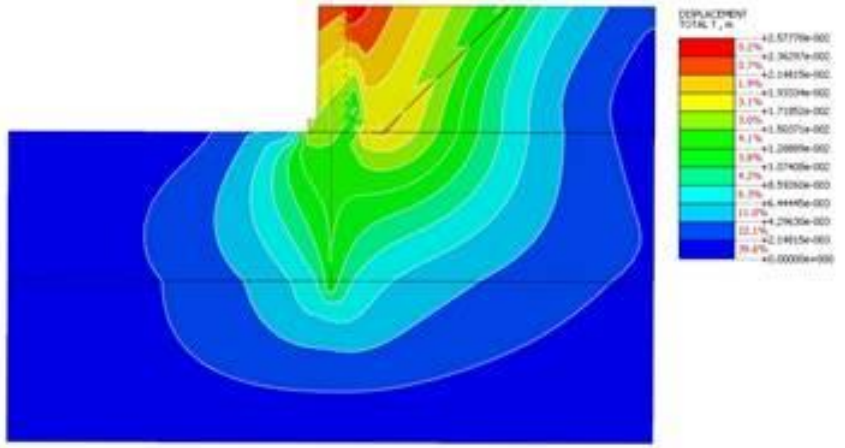
Load transferred to each bored pile:
F_V=175.0kN; F_H= 111.0kN; M=179.0kNm
Based On 2.44m Bored Pile Spacing

6. ULS and SLS Check

Serviceability Limit State(SLS)

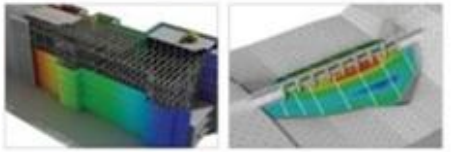
The Allowable Displacement: 70mm



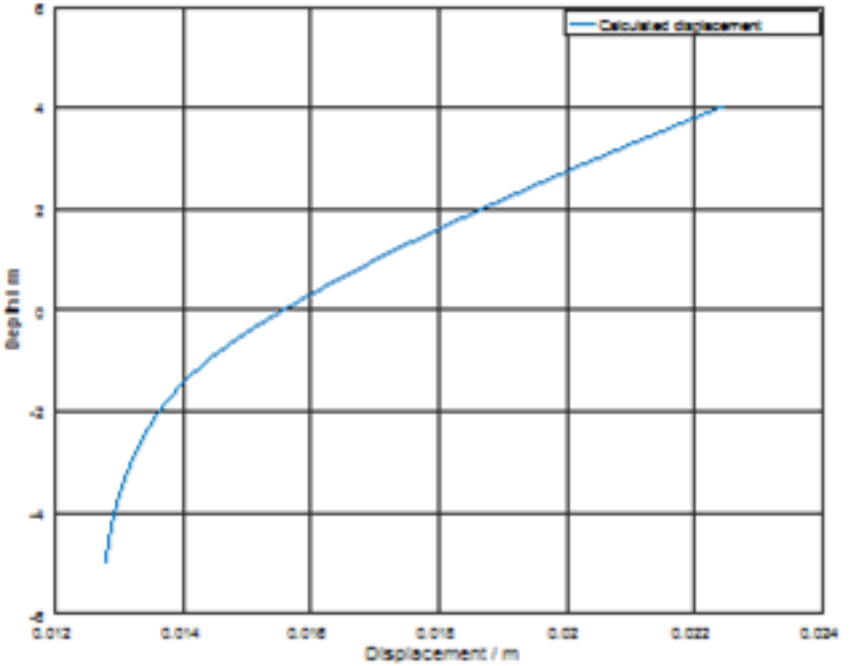


GTS NX

Geo-Technical analysis System New eXperience



Maximum Displacement = 26mm



7. Construction Methodology

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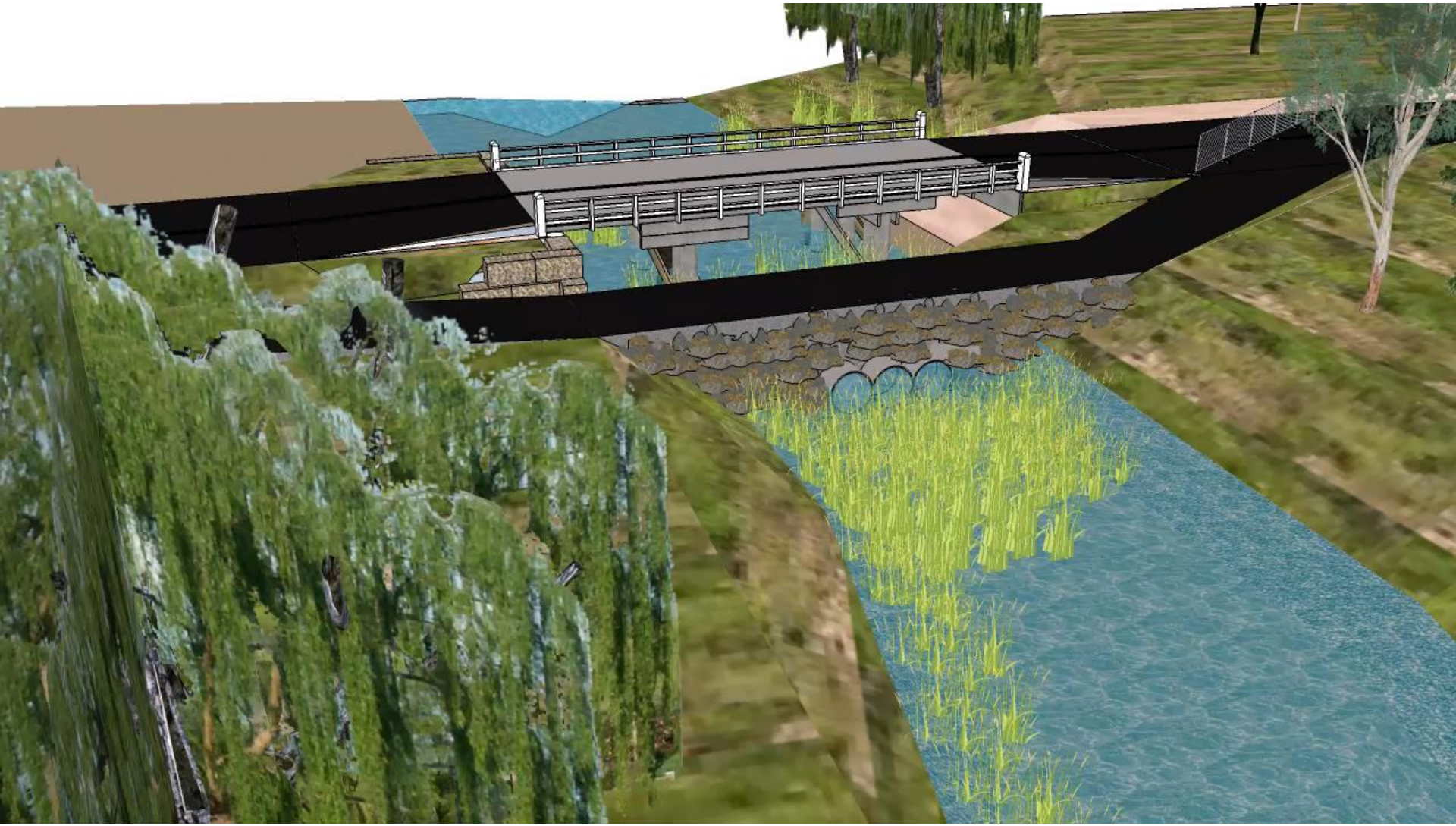

dynamic engineering through innovation

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Boring Of 5.0m Deep Bored Piers At Precise Locations

Installation Of Steel Liners At Bored Pier Locations

Installation Of Reinforcing For Bored Piers - 8N20 Bars

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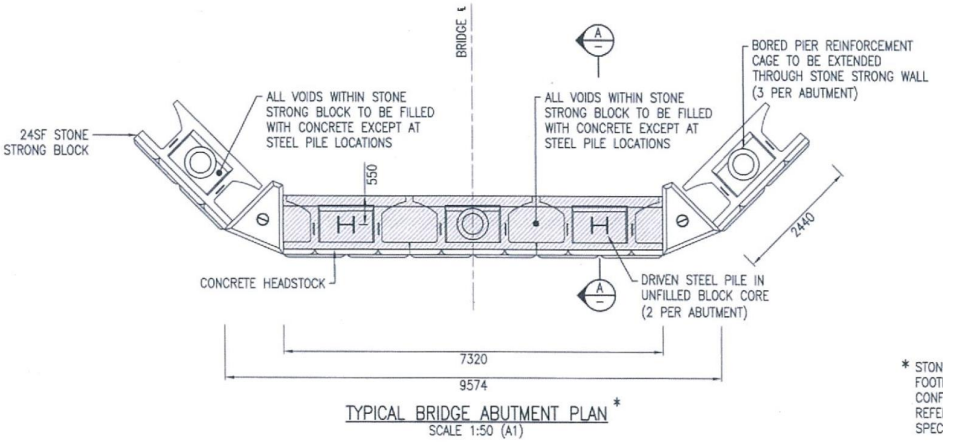

Delivery Of Stone Strong Blocks – 24SF, 6SF and Corner Blocks

Reinforcement Cage Through 400mm Concrete Footing and Stone Strong Block

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Reinforcement Cage & H Steel Pile Through Stone Strong Block

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Completed Rehabilitated Bridge

8. The Advantages & Limitations

Advantages

- Stone Strong System provides degree of flexibility to accommodate hybrid solutions
- Minimise the space required for abutments to achieve the optimum cost
- A better option compared to conventional spill through wall
- Accelerated construction program with large precast blocks
- Aesthetic chisel sandstone facade

Limitations

- Fixed spacing at 2.44m or 1.22m for piled foudation
- Required accurate pile position & verticality control to sleeve through the blocks

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If you can't reduce a difficult engineering problem to just one 8 ½ x 11-inch sheet of paper, you will probably never understand it

Ralph B. Peck

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