Scenic Highway, Statue Bay
Cyclone Marcia Reconstruction Project

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Abstract:

In February 2015, Severe Tropical Cyclone Marcia crossed the Queensland coast north of Yeppoon in Central Queensland, causing extensive damage to infrastructure and the community. The singularly most significant damage to infrastructure in the Shire was the undermining of the coastal Scenic Highway at Statue Bay and the concurrent failure of the steep cliff-face above.

The reconstruction of the road and the cliff-face has been the most challenging infrastructure project ever undertaken by the Livingstone Shire Council, and has involved

- the construction of a mechanically stabilised ocean protection wall;
- reconstruction of the road; and
- the stabilisation of the cliff-face with soil nails and shotcrete surfacing.

The project was largely funded by the Natural Disaster Relief and Recovery Arrangements (NDRRA) funding under the administration of the Queensland Reconstruction Authority (QRA).

The major issues encountered and dealt with on the project were:

- environmental approvals for construction in a coastal marine and tidal environment;
- detailed geotechnical investigations and design for two adjacent but very different engineering problems;
- the protrusion of the soil nails into private property, requiring the acquisition of volumetric easements, within very constrained timeframes;
- the logistics and challenges of constructing the two separate components of the restoration works on a constrained site;
- impractical deadlines imposed by NDRRA funding agreements;
- the poor and variable geology below the wall foundations;
- community expectations and displeasure at the diversion of significant volumes of traffic through residential areas;
- dust and noise nuisance to adjacent residents from the drilling and construction processes; and
- termination of the construction contract and completion of the works by Council, to ensure completion within NDRRA timeframes.

This paper outlines the reconstruction of the Scenic Highway at Statue Bay after Cyclone Marcia, from the initial damage caused by the cyclone, through the approval processes and design of the restoration solution, to the construction of the approved scope of work; highlighting the challenges of managing a complex infrastructure project in conjunction with community expectations and NDRRA guidelines.
INTRODUCTION

On 20th February 2015, Severe Tropical Cyclone Marcia crossed the Queensland coast north west of Yeppoon in Central Queensland as a Category 5 cyclone, causing extensive damage to the coastal township and its infrastructure.

The ferocious seas inflicted the most severe damage on an exposed section of the coastal Scenic Highway at Statue Bay, 7 kms to the south of Yeppoon. A 600 m section of the Scenic Highway was severely eroded and undermined by pounding waves, and a number of slip failures occurred on the steep cliff-face above the damaged road.

This paper describes the damage, remediation options, funding arrangements, design and construction of the final solution, which transformed a narrow, substandard, potentially dangerous section of road into a safe, multi-user carriageway, capable of withstanding future severe storm events.

EMERGENCY RESPONSE

Immediately after the cyclone had subsided, the Scenic Highway was determined as unsafe for road users and was closed to traffic. Fortunately, an alternate route was available as a detour; however, the route passed through residential areas.

Council commissioned a geotechnical consultant to investigate the stability of the cliff-face and the road to determine if the road could safely be re-opened to road users. A number of recommendations eventuated that saw the cliff face de-scaled, safety barriers installed to protect traffic and the road re-opened to a single lane of one-way (southbound) traffic. Council’s primary concern was the safety of road users.

REMEDIATION SOLUTION AND FUNDING APPROVAL

Council engaged specialist consulting engineers to undertake further detailed geotechnical investigations and determine long term remediation solutions for both upslope and downslope failures. The solutions were proposed to the Queensland Reconstruction Authority (QRA) in support of an application for Natural Disaster Relief and Recovery Arrangements (NDRRA) funding for the project.

Options Investigation

Upslope

Options investigated included:

- Re-grading of batter slope;
- Installation of draped mesh and rock fall fences;
- Installation of soil nails and shotcrete; and
- Pile wall.
Downslope

Options investigated included:

- Reconstruction of the road embankment and batter stabilisation with large rock armour (500 – 1,000 mm);
- Gravity block revetment wall with stabilised embankment; and
- Bridge / viaduct structure.

Options Assessment

The above options were assessed utilising a multi-criteria analysis, including constructability, capital cost, ongoing maintenance costs, increased safety for road users and improved alignment.

Scope of Work

The best options were determined as:

Upslope:

- installation of soil nails with shotcrete surfacing to stabilise the higher risk areas of the cliff face;
- including sub-horizontal and strip drainage.

Downslope:

- construction of a gravity block ocean protection revetment wall with mechanically stabilised earth (MSE) embankment;
- reconstruction of the road with increased formation width to facilitate a previously unattainable off-road pathway.

The sketch below shows the scope of the work proposed.

Figure 1 – Schematic of Scope of Work
Approved Funding

After substantial negotiations with the *Queensland Reconstruction Authority*, the above scope was agreed and funding approved as below, based on concept level cost estimates:

### Table 1 – NDRRA Funding Approval

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>NDRRA Restoration (Category B)</td>
<td>$9.67 M</td>
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<tr>
<td>NDRRA Betterment (Category D) – capped</td>
<td>$2.00 M</td>
</tr>
<tr>
<td>LSC contribution (Category D + Complementary)</td>
<td>$4.80 M</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$16.47 M</strong></td>
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NDRRA funding is provided on the basis that the eligible actual cost of reconstructing the asset is reimbursed, based on the agreed scope of work. The funding conditions mandated that the work had to be completed within two (2) years after the (financial) year in which the event occurred, i.e., in the case of Cyclone Marcia, by 30th June 2017.

After detailed design was completed and construction contracts awarded and commenced, a review of the construction cost estimates and category funding with QRA resulted in revised funding approvals as below:

### Table 2 – Revised NDRRA Funding Approval

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
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</thead>
<tbody>
<tr>
<td>NDRRA Restoration (Category B)</td>
<td>$14.76 M</td>
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<td>NDRRA Betterment (Category D) – capped</td>
<td>$3.15 M</td>
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<tr>
<td>LSC contribution (Category D + Complementary)</td>
<td>$2.41 M</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$20.32 M</strong></td>
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**PROJECT DELIVERY**

**Volumetric Easements**

Critical to the timing of the project was the design of the upslope soil nail solution. The lengthy soil nails meant intrusion into private property below ground level which necessitated a requirement for volumetric easements. The easement acquisition path (either through resumption by agreement or compulsory acquisition) was a complex and time-consuming process, and had the potential to extend the project towards the critical deadline of 30th June 2017.

Before approaching individual property owners, Council wanted to be certain about which properties were going to be affected by easements so as not to create unnecessary anxiety and distress. The final design resulted in five properties being affected by volumetric easements, which were located about 3.0 – 4.0 m below the surface, and had little material impact on the host property.
Ultimately, the easement acquisition process took around five (5) months to complete and were all acquired by agreement with the property owners.

**Detailed Design**

A consulting engineer was engaged to undertake the detailed design and documentation for the downslope and upslope works in December 2015.

![Figure 2 - Extent of Revetment Wall and Upslope Areas to be Stabilised](image)

**Downslope**

The ocean protection wall was designed as a gravity block and mechanically stabilised earth revetment wall using locally produced Keppel blocks (1.4 m wide x 850 mm deep x 500 mm high weighing 1.1 tonnes each), physically tied to horizontal reinforcing layers of geogrid throughout the earth embankment behind the wall. The MSE material was akin to a railway ballast to ensure good drainage through the material. The geogrid is connected to the Keppel blocks via a friction grip between the vertical block layers.

![Figure 3 – Typical Cross-Section of Revetment Wall and MSE Embankment](image)
Upslope

The upslope stabilisation design included:

- Approximately 1,300 soil nails between 12-15 m long at a declination angle of 15-25 degrees, at 1-2 m horizontal and vertical centres;
- Sub-horizontal drainage between soil nails; and
- Almost 5,300 m² of shotcrete in 2 layers – 1st layer 50 mm min thickness with F82 mesh / 2nd layer 150 mm min thick coloured with F81 mesh.

Construction

Combined Contract

Council initially offered the work as a single construction contract to ensure the risk of the interface between the upslope and downslope components rested with, and was managed by, the one contractor, and to make the package sizeable enough to attract Tier 1 or Tier 2 contractors. This was done as a two stage tender process, consisting of an Expression of Interest (EOI) from contractors, followed by an Invitation to Tender (ITT) offered to the contractors shortlisted in the EOI phase.

As it would not be prudent to award a contract involving the installation of the soil nails without firstly having secured easements (or at least legal access for their placement), tender award was governed by the volumetric easement timing.

Unfortunately, the volumetric easement negotiations with residents were delayed by the protracted upslope design, and the critical decision was made to expedite the downslope design and tender the downslope works as a separate contract. This would allow the downslope work to be constructed while the volumetric easements were being secured, and enable the upslope work to be tendered and constructed after the completion of the downslope work.
**Downslope Contract**

The downslope contract was procured through a two stage tender process. One tenderer offered an alternative Design and Construct (D&C) tender with a significant saving, involving their own similar design utilising a larger prefabricated concrete block (3.0 m long x 1.0 m high x 0.5 m deep weighing 3.5 tonnes each) and Tensar grid reinforcement.

Unfortunately, after award of the contract in September 2016, there was delay in producing the design and at the Contractor’s request, Council extracted and undertook the design for the Contractor’s alternate wall. Delays were exacerbated by the foundation conditions, and this resulted in the downslope work not being completed by the time the volumetric easements were resolved and the upslope work was ready to be commenced.

**Upslope Contract**

The upslope contract was also procured through a two stage tender process. The contractor undertaking the downslope contract was the lowest tenderer, and they were awarded the upslope contract as well, for the following primary reasons:

- competitively priced tender;
- the constrained overall site area would have made it very difficult for two separate upslope and downslope contractors to operate side by side; and
- the looming funding deadline would not allow both contracts to be undertaken sequentially.

**QUEENSLAND RECONSTRUCTION AUTHORITY (QRA)**

Due to the value and complexity of this project, QRA was closely involved in the project throughout. QRA representatives were regularly kept abreast of progress and problems as they arose. They were of great assistance to Council's project team in identifying eligible activities and works, providing advice on the NDRRA process and providing support throughout the project.

**CHALLENGES**

**NDRRA Deadlines**

The original completion date for funding purposes was 30th June 2017 and all eligible work not completed by the designated date would have to be fully funded by Council. As Council had been advised that a request for an extension of time (EoT) was unlikely to be successful, a substantial amount of ratepayers’ money was at risk for Council if the eligible work was not completed by the due date.

As it became evident that the works were unlikely to be completed by the 30th June deadline, an EoT until 31st December 2017 was applied for in November 2016. However, a decision on the success of the EoT application would not be known until May 2017. Ultimately this EoT was granted.
Despite the deadline being extended to the end of 2017, the works were still unable to be completed within the extended timeframe. In November 2017, Council once again applied for an EoT until 30\textsuperscript{th} June 2018, which was ultimately granted in May 2018.

**Community Engagement**

This was a high profile project from the outset, as it involved the closure of one of the coast’s major transport links, and diversion of a significant amount of traffic through residential areas. Traffic control measures were installed on the detour and were quite successful in controlling vehicle speeds in particular. Comment on social media was regular and prolific, and often from the same contributors.

The major issue that had to be managed was the dust generated from the soil nail drilling process as the designers had precluded the use of wet drilling. This made it difficult to control dust emanating from the drilling rigs, and many of the residents in the vicinity were affected by the regular intrusion of dust. This was dealt with by offering affected residents a comprehensive internal and external cleaning of their properties.

Council established a database of interested residents and regularly issued community update reports via this distribution list. These reports, along with regular drone flyover footage, were posted on Council’s website.

**Termination**

In early March 2018, the prospect that the works would not be completed prior to the expiration of the non-negotiable funding deadline became very real.

On 14\textsuperscript{th} March 2018, Council made the difficult decision to terminate both contracts and take over the remaining works.

**Completion of the Works by Council**

Council then proceeded to install a Project Manager and Construction Manager, and work through the process of engaging the staff, subcontractors and suppliers previously engaged by the contractor. This process was done expeditiously and successfully to the point where productive work recommenced on-site within one week of termination of the contractor. Almost all previous staff, subcontractors and suppliers were re-engaged.

From a position of being faced with multi-million dollar cost of non-reimbursable work, Council completed all but a minor amount of eligible work by 30\textsuperscript{th} June, and opened the Statue Bay link to traffic on 26\textsuperscript{th} July 2018.

**CONCLUSION**

The reconstruction of the Statue Bay road link has been the most complex and challenging infrastructure project ever undertaken by the Livingstone Shire Council. While the NDRRA funding deadlines initially appeared adequate, it became evident throughout this project as the different challenges arose, that the looming funding deadline precipitated many critical decisions that may not
have been made otherwise. Had these critical decisions not been made, the consequences of the loss of eligible funding on Council’s Budget would have been dire.

The final cost of the project has been determined at $24.83 million, with the funding distribution shown in the table below:

<table>
<thead>
<tr>
<th>Table 3 – Final Project Cost</th>
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<tbody>
<tr>
<td>NDRRA Restoration (Category B)</td>
</tr>
<tr>
<td>NDRRA Betterment (Category D) – capped</td>
</tr>
<tr>
<td>TMR Contribution (Category D)</td>
</tr>
<tr>
<td>LSC Contribution (Category D + Complementary)</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
</tr>
</tbody>
</table>

Notwithstanding the prolonged reconstruction timeframe, the final outcome of the project has resulted in a significantly enhanced and resilient section of the coastal highway which will serve the community for many decades to come.

Generally, the community was very patient and accepting of the protracted design and construction period. Some adjacent residents were long-suffering and Council is very grateful for their patience and understanding.

Aerial vision of the construction and completed project can be viewed on Livingstone Shire Council’s Facebook page at

https://www.facebook.com/livingstoneshirecouncil/app/349313058487732/

**Acknowledgements**

The Author would like to acknowledge the contributions of the following people to the success of this project:

- Council’s Project Team
- Livingstone Shire Council’s Chief Executive Officer and Executive Director, Infrastructure
- QRA Representatives
- Council’s construction team involved in completing the construction
- The local residents directly impacted by the project