

6 WEEKS WORK IN 4 DAYS – THE JERVOIS QUAY EMERGENCY WORKS

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ABSTRACT

In February of 2021, a sink hole found on Jervois Quay brought Wellington's CBD to a standstill. A partial closure of Jervois Quay created widespread congestion across Wellington's road network, immediately garnering national media attention.

Urgent investigations discovered the sink hole was caused by a void formed above an aging stormwater pipeline. What was also apparent were several other damaged sections which could potentially cause additional voids. Immediately, the emergency response pivoted from a simple patch repair to a complete renewal of a stormwater main located beneath Wellington City's busiest road.

After efforts to line the pipe were unsuccessful, an open-cut solution was viewed as the only option which would deliver a robust and long-term solution. The project team's focus now shifted to considering how an upgrade could be completed while minimising disruption to the people of Wellington. This paper documents how 40m of stormwater pipe, spanning across a six-lane road servicing 14,000 cars daily, was completed in only four days.

The project was successfully delivered through the combined effort and collaboration of all affected parties. Coordination of the road network, water infrastructure, consenting requirements, public notification and design were completed and the works were constructed in a fraction of the time a project of this size would normally take.

An innovative approach was required to streamline project delivery. Extensive environmental control measures and monitoring near Wellington's Harbour, large scale dewatering around high-risk structures and military-like coordination of multiple contractor teams all contributed to the success. Wellington Water's collaborative whānau delivery model and the advantages of their longstanding relationships with consultants and contractors significantly contributed to the rapid emergency response, whilst maintaining a holistic view of the long-term service goals of the catchment.

This paper will detail how the emergency response and its learnings can be used as a blueprint for future emergency works, especially for critical assets located in highly sensitive locations. As water networks continue to age, more and more cases like Jervois Quay are likely to arise.

KEYWORDS

Asset Management, Stormwater Infrastructure, Emergency Responses, Ageing infrastructure, project delivery efficiencies, pipe renew, case study.

PRESENTER PROFILE

James Matthews is a water engineer with four years' experience, split between Wellington and Christchurch. In that time he has been lucky enough to be involved in several emergency works including the 2021 Jervois Quay stormwater renewal.

Paul Langedijk is a senior water engineer with ten years' experience in the water sector, both in London and Wellington. In the two years since arriving in New Zealand Paul has been involved in a handful of emergency-style projects, each with technical and stakeholder complexities.

INTRODUCTION

JERVOIS QUAY IS SINKING

In February of 2021 a small depression was discovered along Jervois Quay, a main road located in Wellington's CBD. The discovery required the closure of two south-bound lanes, causing widespread congestion throughout Wellington's traffic network.

Further investigation into the depression discovered a void beneath the road surface. The void had been created by a damaged stormwater pipe which had been scouring material away from beneath the road surface. The 450mm earthenware (EW) pipe was located 2.2m below the road surface.

Figure 1: Location of the void and view from within the damaged 450mm EW pipe



CCTV of the stormwater pipe found a section beneath the void had collapsed and blocked the pipe. Additionally, the full 40m pipe length was in very poor condition. Contractors closed the road and excavated the collapsed section, clearing debris to unblock the main.

ROAD CLOSURE AND MEDIA COVERAGE

Jervois Quay is a six-lane arterial road conveying 14,000 cars every day. The road passes through Wellington's CBD and is often used as an alternative route to State Highway 1. Upon closing two south-bound lanes on Jervois Quay, traffic began to back up for 10km causing traffic jams at the Ngauranga Gorge.

All of Wellington's major media outlets ran stories documenting the sinkhole on Jervois Quay:

Photograph 1: Traffic congestion on State Highway 1 (Credit: Stuff / Kevin Stent)



- RNZ - Sinkhole in central Wellington under investigation (<https://www.rnz.co.nz/news/national/435744/sinkhole-in-central-wellington-under-investigation>)
- Stuff - 'Significant delays' expected for Thursday morning commuters due to sinkhole repairs in Wellington (<https://www.stuff.co.nz/dominion-post/news/wellington/124135361/significant-delays-expected-for-thursday-morning-commuters-due-to-sinkhole-repairs-in-wellington>)
- NZ Herald - 'Significant delays': Wellington sinkhole sparks rush hour commuter warning (<https://www.nzherald.co.nz/nz/significant-delays-wellington-sinkhole-sparks-rush-hour-commuter-warning/BYKRC7CUOY7S4LQS3QXPIR32WY/>)

Coverage and public interest were immense. Instantly the pressure to have Jervois Quay re-opened and functioning as soon as possible rose.

FIXING THE VOID IN RECORD TIME

Four months after the original void was discovered beneath Jervois Quay, the road was completely shut over Queen's Birthday weekend. The closure spanned four days, with no access for public vehicles throughout. In that time, contractors laid 40m of 750mm marine grade rubber ring joint reinforced concrete (RRJRC) pipe at a depth of 3m. All while crossing a key bulk water supply for Wellington, a strategic gas main, a host of other services and working in reclaimed land just 100m from Wellington's Harbour. The project delivery was so successful the road

was ready to be opened 12 hours early. Staggering considering a job of this size and location would typically take six weeks to construct if a standard business as usual (BAU) approach was taken.

Photograph 2: Trenching works during the four-day shutdown (Credit: Mark Tantrum Photography, Mark Tantrum)



Not only was the construction delivered in an aggressively condensed programme, response from public and stakeholders was enormously positive. Wellington City Council (WCC) noted the delivery model would be implemented for future emergency works which demand similar constraints to the Jervois Quay works.

So, how was the Jervois Quay stormwater upgrade delivered so quickly and effectively? What were the key lessons learned and conditions which facilitated the completion of six weeks' work in four days; and how can these contributing factors be condensed down into a framework that future councils can use if they find themselves in a similar situation?

This paper discusses the key learnings which enabled the successful delivery of Jervois Quay - what went well, and what did not. These learnings have been outlined in a framework which can be applied by water entities if they find themselves in future emergency situations.

THE EMERGENCY RESPONSE

ASSEMBLING THE TEAM

Panel Structure

Wellington Water, like many other water entities in New Zealand, operate a consultancy panel. The majority of capital projects are procured through the panel, providing stable workload, fostering strong relationships, encouraging knowledge and resource sharing and creating expectations for quality and delivery between parties. During emergency situations like Jervois Quay, Wellington Water can approach the panel leads to form a team to quickly define scope and project plan, with the understanding that the panel members will follow Wellington Water's processes and deliver quality work. When necessary, panel members can also work together on projects.

Wellington Water also has a contracting panel which utilises a very similar engagement approach to the consultancy panel. A highly visible programme forecast for construction works allows contractors to be involved in projects they are set to construct from preliminary design. This allows contractors to provide valuable constructability and costing insight throughout a project's lifecycle and build strong relationships with the consultancy panel.

Emergency Application

The same day Wellington Water's operations staff discovered the depression on Jervois Quay, Wellington Water approached their contractors and consultants panels. E Carson & Sons Limited (ECS) were allocated as the lead contractor, and GHD Limited (GHD) as designers to oversee the work. By the time the Operations team began undertaking the necessary investigative works and had a good understanding of the scale of the issues, ECS and GHD were on site discussing the next steps. Allocation required Wellington Water to elevate Jervois Quay's importance, allowing ECS and GHD to pull resource from other Wellington Water projects to enable delivery; something only possible due to the number of workers already assigned to Wellington Water projects from both organisations.

Throughout the works the power of the panels was used to facilitate delivery. GHD utilised panel partners WSP and Stantec for surveyors, archaeologists and attained potholing results from previous designs. ECS' unique delivery approach (to be discussed later in this paper) would not have been feasible without E.N. Ramsbottom Limited and GP Friel Limited, all contractor panel partners, providing the necessary resource to complete six weeks' work in four days. All of this was only possible due to the relationships fostered and encouraged by Wellington Water through their panel arrangements.

EMERGENCY SOLUTION

When ECS first established on site following the Jervois Quay void discovery, they excavated to the collapsed section of the stormwater main and inserted a 375mm

PVC pipe section. The temporary fix would minimise further scouring of material from beneath the road. The excavation was covered and Jervois Quay was reopened to the public with a temporary speed reduction.

Although all six lanes of Jervois Quay were open, several issues remained:

- The under capacity 450mm stormwater pipe was further constrained by the 375mm PVC slip lining
- CCTV footage showed the remaining sections of the pipe were in very poor condition and required repair. Any solution needed to address the full pipe length beneath Jervois Quay
- The damaged pipe was located beneath an 800mm steel bulk water supply. Damage and disruption to this service would have significant and potentially catastrophic consequences
- Jervois Quay would remain at a reduced speed limit until the collapsed road section could be correctly reinstated. Reinstatement of the road required a 200mm thick concrete subbase cast beneath the asphalt. Casting the 200mm thick base would not allow access to the slip line pipe, which was required to allow for removal and facilitate a more permanent solution

Once Jervois Quay was reopened following the temporary slip lining, optioneering for a more permanent solution begun. The three key assessment criteria were cost, public disruption and delivery. While options were being developed, the stormwater pipe was monitored using CCTV and GPR surveys every week to assess the potential for further collapse.

Discussions between Wellington Water, GHD, ECS and suppliers determined the following options for addressing the damaged stormwater main:

- Construct a new pump station at the Hunter Street – Jervois Quay intersection. The existing stormwater main would be slip lined and used as a rising main
- Line the pipe using a Smart Lock stainless steel sleeve lining methodology
- Open trench online and upgrade the existing stormwater pipe

Pipe bursting, an often favourable trenchless renewal methodology which reduces traffic closures and provides a new, slightly larger pipe, was considered unfeasible due to the existing 450mm pipe's poor condition.

After deliberation of the potential options it was decided to line the main using the Smart Lock system. The system is pulled into place using pullies and expands a stainless-steel sleeve when in place. The benefits of the methodology included:

- The Smart Lock system was considered suitable by suppliers regardless of the pipes deteriorating condition

- Installation could be completed in two weeks of night works with only access to the upstream and downstream manholes required. Both were located outside the carriageway and did not require any lane closures
- The option was significantly cheaper than open cutting or the installation of a Hunter Street pump station

Eight weeks after the initial void was discovered, the Smart Lock lining system was commissioned. This did not go particularly well. The pressure imposed during the expansion of the stainless-steel sleeves caused further sections to collapse. Additionally, with the dragging of the Smart Lock system using pulleys, the liners got caught on the pipe joints and damaged the invert.

GPR survey of the road following the lining found it had created additional voids. Further complications were added to the job:

- More material was now being scoured from beneath Jervois Quay due to the additional broken sections. All six lanes were covered with steel plates and temporary speed limits were enforced
- Damaged sections were being washed down the pipe into the downstream manhole. The inserted steel packing pipe offered little structural capacity as it was largely disjointed. The pipe rapidly grew weaker and weaker as the days went on

The lead times for a pump station construction were too excessive given the time constraints to address the deteriorating pipe. The stormwater main now required an open trench solution.

Lesson Learned

The decision to undertake the lining was suitable given the cost and time saving to undertake the work. However, the attempted lining of the 450mm EW pipe illustrated the limitations of the technology when a pipe is significantly damaged. Future works on similarly deteriorating pipes will avoid the use of the technology given the results at Jervois Quay.

DESIGN AND PREPARATION

DESIGN AND MATERIAL PROCUREMENT

The Jervois Quay works were split into four stages:

- Stage 1 was completed as enabling works in preparation for the Queen's Birthday weekend
- Stage 2 would be completed during the Queen's Birthday weekend shutdown
- Stage 3 was outside the carriageway and would be completed in the weeks following the Queen's Birthday shutdown

- Stage 4 included the renewal of a length of 450mm pipe upstream of Jervois Quay. This section was in good condition but was still causing flooding issues upstream

Figure 2: Staged delivery of the construction works



Sizing the new stormwater main for each stage was a relatively straightforward process. It was largely influenced by what size pipe could be installed between the host of services. However, material procurement was not so simple. ECS had eight weeks to procure materials and construct Stage 1 prior to the Queen’s Birthday shutdown. The 20m upgrade required the following:

- 20m of 1200mm Class 2 RRJRC marine grade pipe
- One 3m deep 2550mm manhole
- One 3m deep 2300mm manhole

Sourcing materials was difficult since supply chains were impacted by COVID-19, with lead times for similar size projects spanning months. ECS were only able to source the required materials through leftovers from previous jobs and through other contractors on the contractor panel.

Similar issues were present for Stage 2. ECS had only 8 weeks to source the following materials:

- 40m of 750mm Class 4 RRJRC marine grade pipe
- One 2.5m deep 1200mm manhole
- One 2.5m deep 2050mm manhole

ECS were able to source 750mm Class 4 RRJRC marine grade pipe due to their long standing relationship with Hynds who prioritised their order. Manhole risers were difficult to source, again, relying on the contractor panel to supply them with the needed materials. The 1200mm manhole was upsized to a 1500mm as this was the only size of manhole riser available at the time. The manhole risers installed were either excess from previous jobs or to be installed on current Wellington Water projects.

Material Stockpiling

Wellington Water and ECS, thanks to the contractor panel, effectively had access to other contractor's material stockpiles. Without this, construction would not have been possible in the required timeframe. Holding large quantities of large diameter stormwater pipe or similar is not economic nor feasible due to the amount of storage required for even a short section of pipe. However, leveraging a water entity's contractor relationships does provide a stopgap in situations where material procurement may lead to significant delays in an emergency response.

CONSENTING AND APPROVALS

The Jervois Quay emergency works fell under the provisions of the Resource Management Act 1991 (RMA) for dewatering and marine discharge. Technically there were no new resource consents required due to the existing "global dewatering" resource consent that Wellington Water held. Unfortunately, the conditions for that consent could not be fulfilled in advance and the works were forced to rely on the emergency provisions of the RMA, following as much of process in the existing consent as possible.

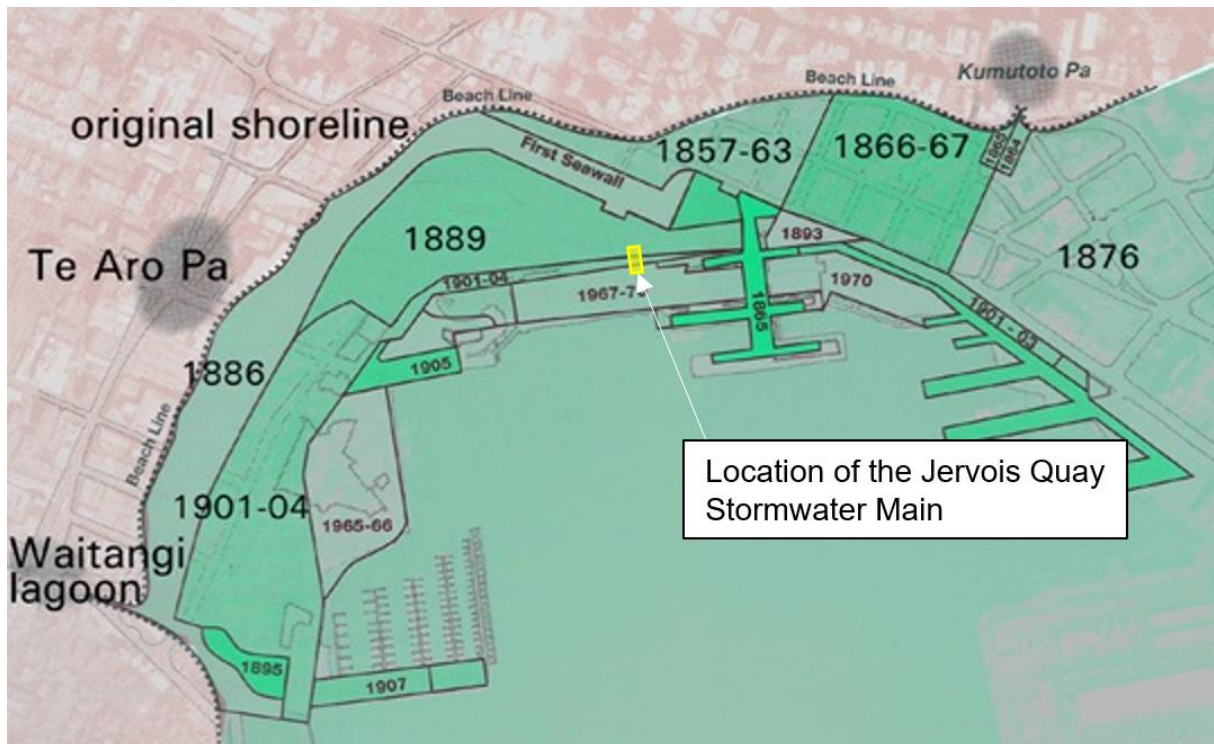
In place of a standard consenting process, GHD employed a partnership approach with Greater Wellington Regional Council (GWRC); the consent authority responsible for ensuring Wellington Water met their usual global dewatering consent requirements. Once established on site, GHD, ECS and GWRC completed a walkover to discuss the best methods to manage environmental considerations without compromising the delivery of the emergency works. The two major considerations were dewatering (a significant amount was seawater versus groundwater), and its discharge to Wellington Harbour. If the dewatering works or marine discharge were found to have long lasting environmental effects, GWRC would require GHD to apply for a retrospective consent on behalf of Wellington Water.

Dewatering

Dewatering was considered one of the larger risks in delivering the Jervois Quay works. The site is located inside the 1904-09 sea wall and is positioned only 100m from Wellington's Harbour. The elevation, location and site ground conditions meant the dewatering rates were expected to be significant. Wellington Water holds a global dewatering consent with GWRC. This requires further assessment

work and dewatering to meet certified geotechnical and contaminated land protocols, based on mapped risk levels for areas within Wellington Water's permit. Conditions of the global dewatering consent also identify maximum pumping rates and a Dewatering Construction Management Plan (DCMP) is to be submitted to GWRC for approval prior to dewatering commencing.

Figure 3: Wellington Reclamation Map (Credit: Wellington City Council, Wellington Reclamation)



Without a comprehensive DCMP in place, GHD and GWRC collectively determined a dewatering monitoring regime which could be implemented quickly and was suitable given the high-risk nature of the works. This included several boreholes adjacent to the site for groundwater monitoring, dewatering rate supervision and settlement monitoring of the surrounding buildings.

Figure 4: Borehole and settlement monitoring locations

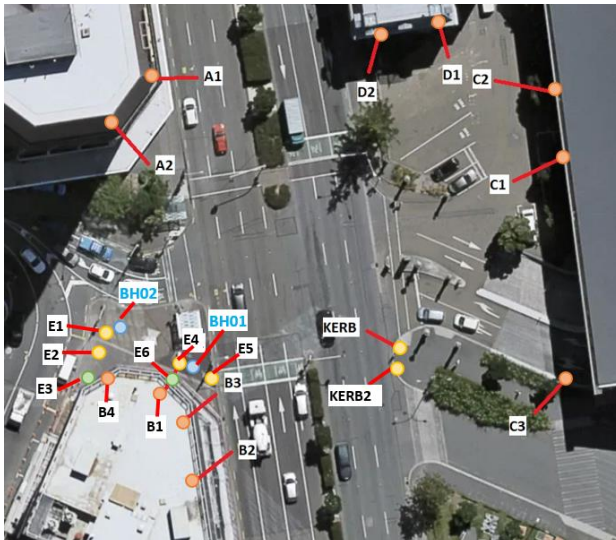
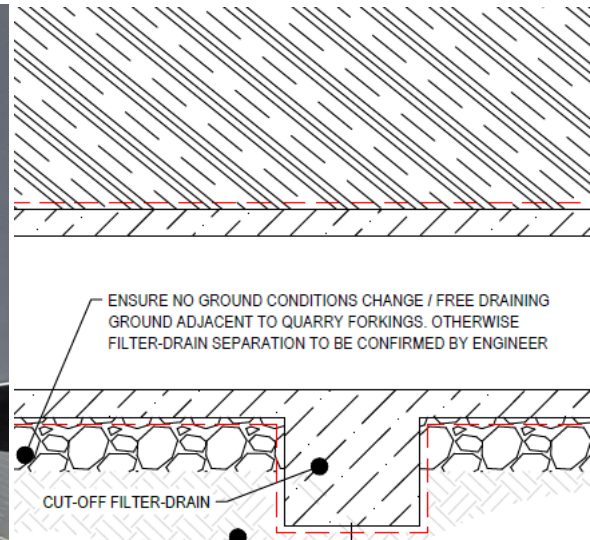


Figure 5: Trench detail to allow for dewatering without sheet piling



To enable dewatering in deep excavations with high infiltration rates and ground water tables, typically sheet piling would be utilised. The number of services spread across Jervois Quay, and the four-day construction installation period, did not allow for sheet piling. Instead, ECS and GHD developed a reinstatement detail that included laying quarry forkings (large rocks) at the base of the excavation. This allowed ECS to pump ground water from within the layer of quarry forkings, maintaining a dry excavation base.

Discharge to the Harbour

The stormwater outlet discharges to the Wellington Harbour, adjacent to one of the busiest sections of the city's waterfront walkway. An agreed approach was undertaken to utilise flocculation tanks and water quality monitoring at boreholes and the discharge point. A marine boom at the discharge point reduced any sediment plumes visible from within the harbour.

Photograph 3: Marine sediment boom (Credit: ECS / Peter Mumm)



Response and Learnings

Following the completion of the project, GWRC provided positive feedback regarding the open and proactive communication, including praise for not

exceeding dewatering settlement trigger levels at any time during the works. The partnership approach meant GWRC were well informed of what was occurring on site and had confidence that the environmental management of the emergency works was undertaken appropriately.

The collaborative approach undertaken is applicable to any emergency project. Although the typical consenting protocol was not undertaken, the bar was not lowered. No retrospective consents were required for either the discharge or dewatering at Jervois Quay. Any water entity finding themselves in an emergency situation needs to collaborate with their consenting authority as soon as the issue is uncovered. This delivers outcomes best for the project, without compromising the environment.

COMMUNICATIONS AND ROAD CLOSURES

After the initial void discovery, failed lining attempt and general inspections, sections of Jervois Quay had been opened and closed for several weeks. Wellingtonians were beginning to grow tired of the constant disruptions. Installing the new 750mm stormwater pipe using a typical trench and lay methodology would require periodic lane closures over a six-week period. Wellington City Council (WCC) and their Roding team, along with ECS and GHD, were well aware of the growing frustration from public and media. It was this that drove the team to propose completely closing Jervois Quay for a short period to maximize construction productivity and reduce the time traffic would be affected.

WCC Roding had been considering the methodology for some time. Their upcoming Let's get Welly Moving project required significant upgrade works along some of the Wellington CBD's busiest streets, and they had been waiting for the right project to trial the methodology. It was agreed that ECS could shut all six

Figure 6: WCC Communications Map Illustrating the Planned Closure (Credit: Wellington City Council, Closures and detours, Jervois Quay this Queen's Birthday weekend)



lanes of Jervois Quay over the Queen's Birthday weekend. This allowed the team four days to upgrade the 40m section during one of Wellington's quieter periods.

Effective communication leads to successful traffic management. This was perhaps the biggest takeaway from successfully closing Jervois Quay for four days. The Jervois Quay communications plan achieved two things: it was far reaching and well received, and successfully changed the public's behavioral response to traffic management. Communications gained buy-in from public by communicating several key messages:

- A full closure was the key to stopping any further closures of Jervois Quay
- A 'rip the Band-Aid' approach rather than dragging out disruptions
- Communications told the story of how contractors would be completing six weeks' work in four days, and the sacrifice needed to deliver

Wellington Water and WCC were very aware of the reputational risk associated with the planned approach. The communications plan utilised a 'saturation coverage' approach, which used every outlet at their disposal to inform the Wellington public weeks in advance. This included:

- TV and radio advertisements
- News stories
- Social media and websites
- Direct approach to affected parties – sports clubs, petrol stations and haulage companies
- The biggest deployment of VMS traffic boards in Wellington's history

The project exposure allowed the public to plan their Queen's Birthday weekend around the closure, instead of being surprised as they tried to leave Wellington to go on holiday. Rather than a typical public response to project communications of annoyance and frustration, the public understood the importance of the project and were thankful of the sacrifice the team were making to deliver the upgrade in such a short period of time.

Data collected by WCC over the weekend showed just how successful this engagement was. Traffic flow measurements showed average traffic speeds reduced by only 5km/h through the inner-city roads at peak times. The Terrace Tunnel of State Highway 1, an alternative route to Jervois Quay, saw average speeds barely reduced at all. No reduction in speed means very limited congestion was witnessed compared to a typical weekend. Astonishing when you consider 14,000 cars typically travel on Jervois Quay every day, and which, in theory, would need to be accommodated on these other roads.

Furthermore, banking data showed that despite the arterial road closure, business was still booming. Total spend reduced by just 4% compared to the same weekend in 2019, with a notable reduction in accommodation being balanced in part by department stores and leisure.

The small impact of closing such an important road in Wellington indicates a change in the behavioral pattern for people moving and shopping around the city, which can only be explained by successful engagement and communications.

Photograph 5: Jervois Quay during the four-day Shutdown (Credit: Mark Tantrum Photography, Mark Tantrum)



Communication is key

Traffic management is only as good as the communications that accompany them. Jervois Quay showed that main roads can be completely shut if managed and communicated correctly. As Wellington's water networks continue to age, issues like Jervois Quay are likely to arise more frequently. The trial closure has given WCC valuable insight for future water projects and the Let's Get Welly Moving project, with the required communications to deliver them with minimal impact.

CONSTRUCTION AND RESOLUTION

CONDENSING PROGRAMME AND DELIVERY

With the date set, and only four days to complete the upgrade works, ECS needed to figure out how to deliver it. As discussed, materials were sourced through relationships, but they still required additional resource to complete the works. ECS called in contractor panel partners E.N. Ramsbottom and GP Friel to sub-contract for the works. Each knew how the others operated and had previous experience working together.

A plan was hatched to complete the work in three eight-hour shifts each day, working all four days. Six weeks work in four days would not have been possible without WCC Roding and NZTA's accommodating approach to the emergency. ECS were allowed to complete a large amount of service locating and surface removal prior to the four-day shutdown of Jervois Quay. Leading up to the works, the 200mm thick concrete subbase was removed and reinstated with a temporary seal. Excavation and service location were completed during single lane closures in the early mornings prior to the closure. ECS confirmed GHD's design alignment prior to the four-day shutdown, confirming no undocumented services or unexpected contaminated material were present before construction began.

With everything in place, Jervois Quay was closed at 7pm Thursday night. The three contracting crews worked seamlessly to close the road, start excavation and begin installing the new 750mm stormwater pipe. With the depth and location of all services understood, the contractors' main consideration was maintaining the eight six-inch pumps required to draw down groundwater. The construction works were carried out without any significant issues. Jervois Quay was even opened early due to the pace at which the contracting teams were working.

Condensing a Programme

The combination of WCC Roding's accommodating approach, Wellington Water's contracting panel relationships and the aggressive yet efficient construction plan enabled the closure to be successful. Any necessary enabling works were completed in advance of the shutdown. Although simple, small factors can be overlooked during emergency works planning. These factors can then have large timing implications if found once on site. Reviewing the construction plan from start to finish can enable project teams to pick up any minor details and allow for more efficient delivery and fewer surprises.

UNDERSTANDING THE LONG-TERM NETWORK PLAN

When the Jervois Quay upgrade works were in design, the staged approach included the upgrade of the Hunter Street 450mm concrete pipe upstream of Jervois Quay, known as Stage 4 of the works. The pipe was in good condition, however it, along with the Jervois Quay pipe, created a bottleneck in the system. For Stage 4 to be constructed together with Stage 1 to 3 of the Jervois Quay emergency works, it required a full consenting process, as it did not qualify under the RMA's emergency provision. The required consents weren't applied for during the eight week lead up period to Queen's Birthday for two main reasons:

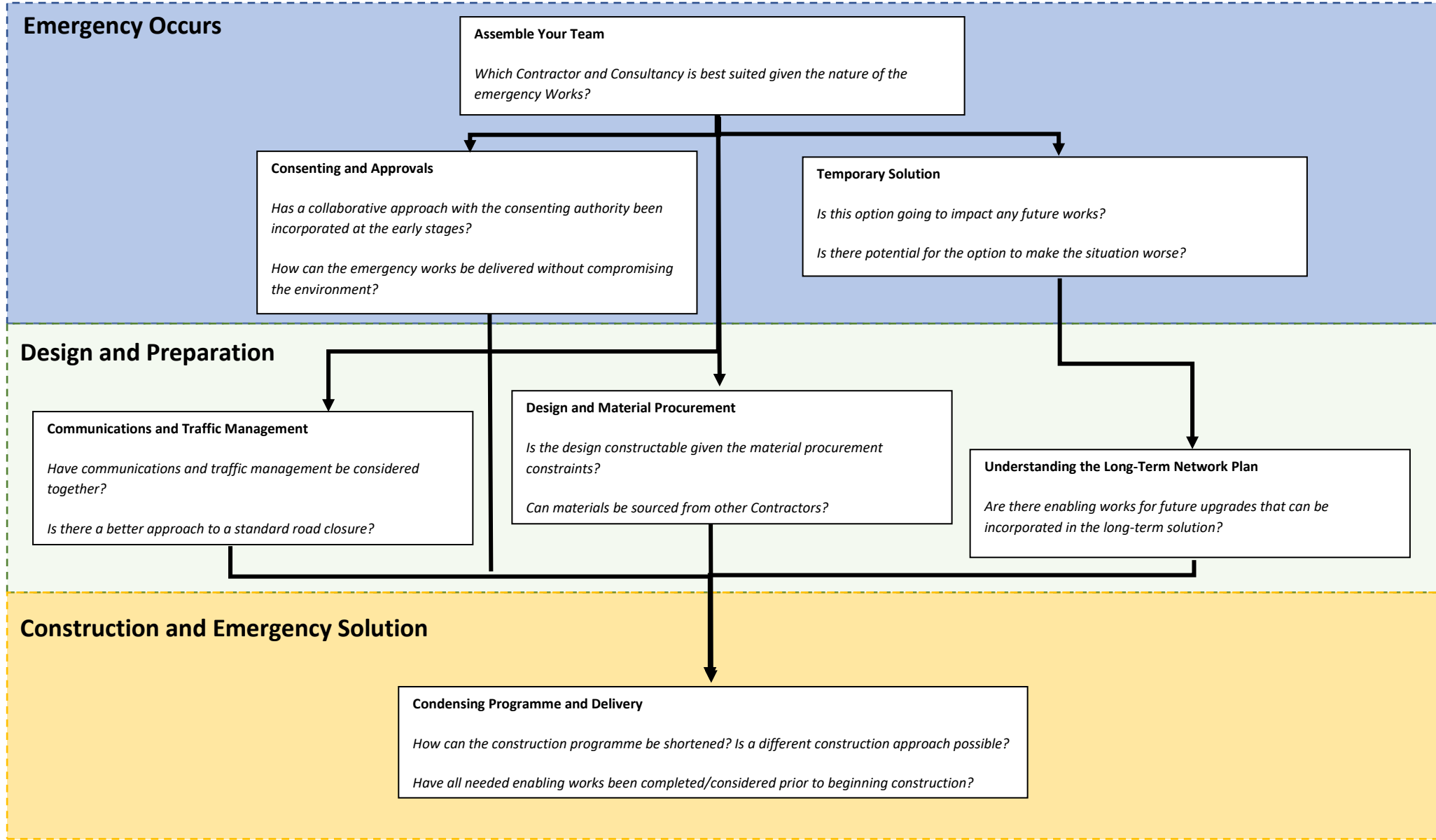
- A long-term plan for Wellington CBD's stormwater network was not fully established. The Stage 4 works would have increased capacity, however spending approximately \$5million on the works would not have been wise if 10 years later a Hunter Street pump station was installed
- Overall budgeting concerns; construction works had already exceeded \$5million for the emergency response and Stage 1 to 3 construction

With so many factors to consider in the lead up to the Queen's Birthday closure, GHD and WWL were not able to refine the long-term Wellington CBD stormwater plan enough to determine if the Stage 4 works were a sound investment. This is a sentiment that is easy to acknowledge post-construction when time is more readily available, however it was raised as a lesson learned for the project team.

Future emergency works should look holistically at the network's long-term plan. This will provide the project team with context on how their planned works may help or hamper any long-term efforts.

A FRAMEWORK FOR FUTURE EMERGENCY'S

As national water networks continue to age, more and more emergency works like Jervois Quay are likely to occur in highly trafficked areas. The lessons learned during the Jervois Quay works can be broken down into a framework for water entities to use to enable a similar response in an emergency. The flow chart below outlines the key considerations that should be reviewed at an emergency works inception, design and construction stage.



CONCLUSION

When a significantly damaged stormwater pipe was discovered to be causing Jervois Quay to sink, Wellington looked to be plagued by road closures and traffic jams for months. A typical renewal of the 450mm pipe would require periodic lane closures for six weeks.

Prior to the works, intentionally shutting down one of Wellington's main roads for a renewal job would have been considered as a last resort. However, the public disruption observed during Jervois Quays initial lanes closure drove the design team and stakeholders to undertake an unorthodox approach to address the emergency works.

The project successfully upgraded one of Wellington CBD's most troubled stormwater assets in four days. This required juggling of many factors including design, communications, supply chains, stakeholder management and an aggressively condensed construction programme. The delivery approach was made easier by stakeholders who understood the impact of the works, and genuinely wanted to see the issue resolved.

Resoundingly positive feedback from stakeholders and public for the delivery model undertaken will likely guide how similar emergency works are completed in Wellington's CBD. This is massively important given the aging infrastructure beneath some of Wellington's most trafficked streets.

ACKNOWLEDGEMENTS

The success of this project would not have been possible without the significant contributions from many organisations including Wellington Water, Wellington City Council, NZTA, Greater Wellington Regional Council and numerous contractors and consultants.

E. Carson and Sons managed the condensed programme and coordinated construction with military-like precision. It was their hard work and dedication that was key to resolving the site issues while producing a quality product in very trying circumstances.

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