A DAY IN THE LIFE OF AN EARTHQUAKE SEWER RECOVERY OPERATION

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Abstract

This paper examines the unique collaborative response to restore and maintain service to the sewer network following the 22nd February Christchurch Earthquake. The response bought together people from council staff, consultants and contractors from all over the country to work with the Council's maintenance contractor.

The combined approach and shared knowledge and experience enabled rational and systematic responses to pro-actively identifying the service condition of the network while responding to customer service issues. This paper examines some of the challenging conditions encountered and the organisational approaches used to overcome these difficulties.

The condition of the wastewater network was well beyond what contractors and engineers had previously experienced, and a key role of the operational recovery team was to assist each other identifying the cause of the problems and liaise with both public and private contractors to ensure an efficient restoration of service to the public.

The interface between public and private drainage pipes was a particularly frustrating aspect for operations recovery staff, private drain layers and the public. Collaboration between private drain layers, council and EQC greatly assisted the resolution of these issues.

Key Words

Wastewater Network, Liquefaction, Earthquake, Recovery Operation

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Introduction

This paper examines the wastewater recovery operational response following the 2011 Christchurch earthquakes to identify the service status and restore the operation of the sewer network.

Initial Response

After 22nd February, the Council's maintenance contractor, City Care soon had over fifty jetting crews and associated suction trucks from all over the country clearing liquefaction from the sewer mains. These crews were assigned sub-catchments to clear silt and restore service to the sewer mains. The entire wastewater sewer network was divided in to just over 200 sub-catchments. These areas formed the basis of the wastewater recovery operations and have remained as a key management tool for City Care as well as being used by Council and now SCIRT for network investigations such as CCTV inspections and modelling/flow studies.

The City Care Depot at the Bromley wastewater treatment plant was used as base to spearhead the recovery of the water, wastewater and the stormwater networks with engineers from Council and City Care assisted by additional resources from around the country.

Structure of Recovery Team

From early March, the city was divided in to 10 zones, each with 3-6 staff from City Care, Council or other engineers under a zone manager for each zone to assess the network operation, respond to service complaints, and

target the response according to requirements. This was later reduced to six, then three zones as the network was stabilised and the requirements reduced

The division of the network into separate zones enabled people to take responsibility for manageable areas without being overwhelmed by the extent of the task at hand.

Separate groups were also formed for other roles including;

- Deployment of Chemical Toilets
- Installation of Chemical toilet waste holding tanks
- Deployment of Portaloos (Civil Defence)
- Major/Complex Repairs (requiring design component or extended durations to restore service)
- Minor Repairs (less than two weeks to complete)
- GIS mapping to track a variety of response work and outcomes

Communications

Initially communications were very limited without a networked computer system and the primary communication consisted of daily meetings. These were held with City Care management & Council staff each morning to cover issues arising, system status, and sharing of experiences and observations in different parts of the network.

The morning meetings included City Care Health and Safety and traffic control staff, who took an active part in the meetings. As time passed the health and safety and traffic control requirements reverted to pre-earthquake systems with approved generic and site specific plans and procedures with regular audits by both the traffic and health and safety staff. This transition back to 'normality' was greatly assisted by the positive attitude and willingness to normalise by the contractors involved.

These meetings largely remained the principal means of communication for over six months, as days were fully occupied keeping in contact with contractors and organising responses to issues arising.

Inspections

Although the initial response was with deploying contractors directly to reported problem areas, it soon emerged that the extent of the problem required more judicious deployment of resources requiring defining the extent and causes of the problems. These roles were undertaken under the direction of catchment teams with manhole inspections and CCTV inspections. While the CCTV inspections were essential for determining the source of the silt ingress and causes of blockages, the initial operations were almost solely directed by the catchment teams collating and investigating public complaints, catchment based manhole inspections and jetting operations.

GIS

A GIS team was established by City Care to assist with collating information and initially producing plans from stand-alone computers and printers. The GIS team was used to collate the network service status and other details for the whole city. A simplified colour coded description of the operational status of the sewer network was developed to communicate the basic problem areas of the sewer network:

Red = No Service - High sewer levels or overflows, flows not draining from street

Orange = Low Service – limited capacity or surcharged levels in sewer, flows draining from the street slowly

Green = Full service – normal water levels and operation. Flows at low level and draining away freely from street

This enabled operations to be quickly focused on the important areas, provided a quick reference to other operations such as the call centre, Council staff, portaloo or chemical toilet distribution and provided direction to drain layers working on laterals. This plan was updated every week for distribution and formed a key tool to describe the condition of the sewer network and plan responses.

Performance Tracking

Figure 1 shows the rate of progress in restoring service to the network. After February, it took almost a month to mobilise resources and quantify the extent of the network that was not operational. Based on the sewers that were cleaned immediately following 22nd February, it is estimated in excess of 450-500km of sewer main was out of service following 22nd February. This was reduced from approximately 160 km of sewer main on 16th March to 9km of sewer main on the morning of 13 June. Following the aftershocks on 13 June, over 160 km of sewer main was again out of service. However, this time it took only 3 days to determine the extent of the network out of service (160+ km) as the organisation and catchment knowledge was in place. The response from catchment staff and contractors alike was impressive as operations were quickly mobilised to restore service without consideration to the previous months of efforts that had been extinguished in a matter of seconds with the June aftershocks.

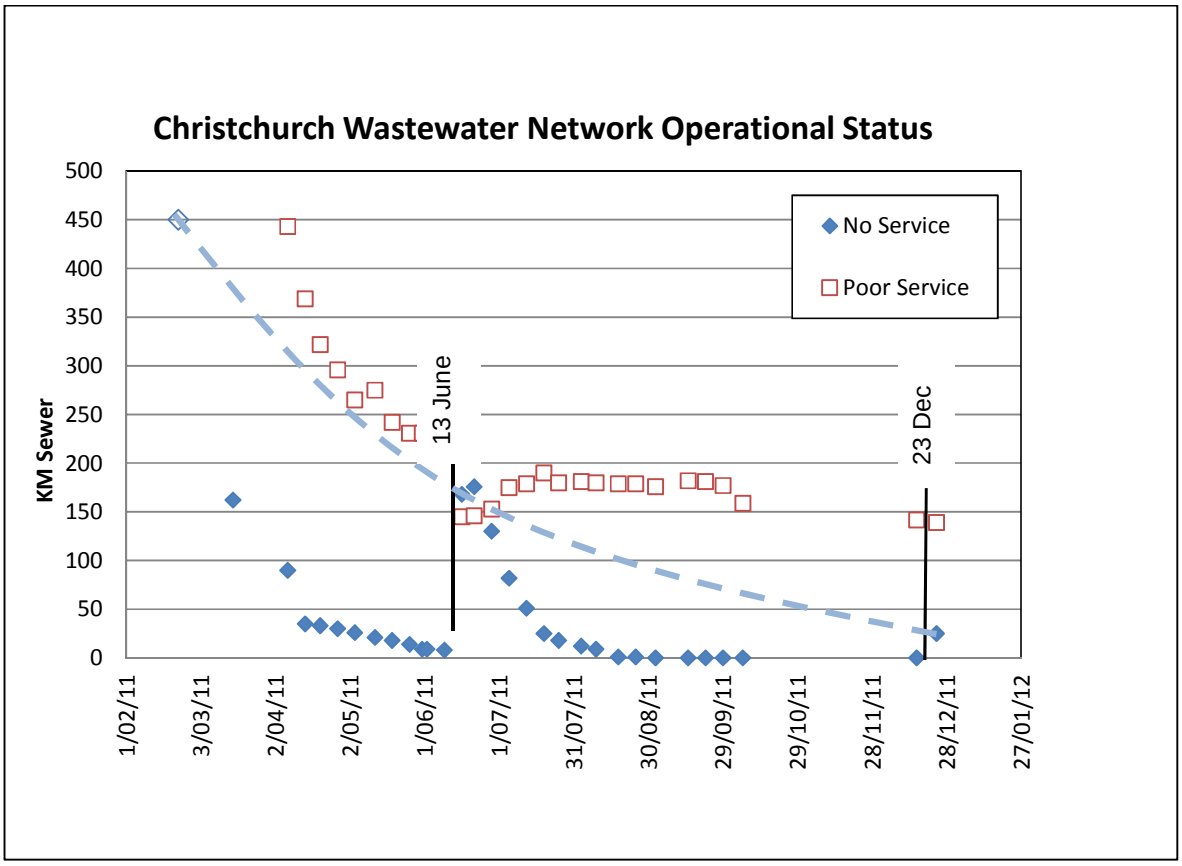

Figure 1 Christchurch Wastewater Network Service Status

The regular monitoring of network status enabled short and long term targets to be set to return the network back to service. Two particular targets set by the City Council were:

- service restored to all properties by the end of July,
- all overflows to waterways ceased by the end of September.

After the June aftershocks, there was certain amount of scepticism whether these targets would be achieved, but motivation and resources were provided to meet these targets. This was a significant achievement

and testament to the performance and leadership of the operation.

Cleaning

Typically sewers were cleaned of silt at least two or three times after the February earthquake even before a camera could be used to determine the sewer condition and the causes of the blockages and silt ingress identified. Each clean allowed more liquefaction from laterals or breaks in the pipes to fall into the main and cause further blockages.

Jetter crews from throughout Australasia were used in the recovery operation. The assistance of crews with larger equipment from Auckland and Australia was particularly beneficial in cleaning the heavily silted and large sewers.

It was important to keep in contact with the jetter operators to determine the most appropriate response to be implemented to restore service and maintain continuity of operation. A variety of actions were taken depending on the nature of the problem.

These responses included;

- On-going cleaning if the source of silt appeared to be from outside the main
- Limiting cleaning if the silt appeared to be sourced from faults in the main that would cause on-going problems
- traffic management for depressions or sinkholes on the road
- Issuing of chemical toilets if restoration was not anticipated in the short term
- CCTV inspection to identify pipe damage
- Spot repairs
- Re-laying mains from manhole to manhole
- Trenchless repairs and linings
- Alternative systems such as installing holding tanks or pumps for individual houses
- Installation of over pumps to by-pass collapsed pipes or broken down pumping station

The amount of silt that entered into the system was phenomenal, and special measures were required to dispose of the material as the impact on the wastewater treatment system was so great.

A disposal lagoon was constructed to accept the silt near the closed landfill site in the Bottle Lake forest on the North East of the city. The proximity of the disposal site to the most badly damaged area of town meant that the turnaround times for the sucker trucks was short and maximised the use of the trucks.

Over-Pumping

Where service was not able to be restored either through failure of a pumping station or collapsed pipes, up to 90 diesel driven pump sets were used extensively to maintain service and prevent overflows to private property. Along with cleaning operations, this was a key ‘first response’ tool to restoring ‘service’ and preventing sewage overflows to private properties.

Over pumping operations often required assistance with traffic control and liaison with the adjacent residents to explain what was happening (as well as selecting, locating and positioning the pump to minimise noise impacts). These operations were carried out with liaison and co-operation from both the City Council and Environment Canterbury, where there were no immediate alternatives but to pump to storm-water in the short term. This co-operation and trust of the regulatory bodies was particularly beneficial in being able to implement decisions and eliminate overflows to private properties quickly.

The over pumping operations included a number of pumping station catchments where the pumping station or rising main were broken for extended periods of time. This resulted in surcharged mains, which were prone to blockages and difficult to clean and were required to be continuously attended to.

Chemical Toilets

As the extent of the devastation to the council sewer network became obvious and a looming public health situation became an increasing distinct risk, over 38,000 chemical

toilets like the ones used for camping were bought into the country and most of them distributed over a 10 week period to the eastern suburbs with instructions and the chemicals required for their use. Five hundred and fifty, 2,000 litre chemical toilet waste tanks were procured and installed in the berms outside properties at even intervals around the chemical toilet delivery area. An assistance programme was set up for the frail or elderly to take the chemical toilets to the waste tanks. Many of the chemical toilet waste tanks in the most damaged areas are still in place today as a precaution for further large aftershocks. In addition there were 2900 portable toilets distributed throughout the eastern suburbs. As of 25th March 2012 the number has dropped to 250.

CCTV

Repairs were positively identified with CCTV to restore and maintain service as road damage and service status did not always co-relate. The CCTV assessment was undertaken by a dedicated group of experienced reviewers.

Sewers with dips and excess infiltration through damaged pipes were particularly problematic to inspect to identify the infiltration source. Even once a camera was able to be used, it was usually required to be used in conjunction with plugging flows from upstream, by-pass pumping and use of a jetter unit to remove silt or excess water in the line.

Repairs

Owing to the logistics of managing and tracking the repair crews, repairs were managed by a separate group within City Care operations, with the catchment teams providing assistance where required.

Prioritisation of the severity of the repairs to the available resources was an on-going role of the catchment managers with the repairs team.

Major repairs that took significant resources or required design components or such as to pumping stations or trunk sewers were assigned back through Council to major contractors to complete.

Laterals

Perhaps the greatest source of disruption to the public was due to damage to service laterals between the main in the street and the house. These issues were not able to identified and dealt with until the main in the street was restored to service.

The first 2-3 months after the February earthquake was mainly focused on clearing and restoring service to the mains. The service status in the street was also often uncertain or changeable due to excessive infiltration, on-going silt ingress or pipe failures. Many streets where revisited on many occasions after it was thought the pipelines were clear. This caused frustrations to residents, drain layers, call centre, council and recovery operations staff as the status of the network was always changing.

Damaged sewers in areas of high groundwater or adjacent to the estuary, rivers and streams resulted in the sewers surcharging nearly to surface level with groundwater. This invariably lead to blockages in the house laterals connected to these sewers. In these cases, it was necessary to determine if the sewers in the street were blocked or just full so resources could be deployed efficiently. This was not an easy task when both the lateral and the main were not able to be easily inspected.

Lateral Repairs Programme

The Christchurch City Council's wastewater lateral policy is that the owner of the property is responsible for the lateral from the building served to the boundary and from the boundary to the main it is the council's responsibility. In normal times, this policy creates minimal issues, but due to the scale of the damage after February, property owners were facing up to 6 to 8 week waiting lists just to get drain layers in to make a first attempt to evaluate the damage to their lateral. After the drain layer had been to site the damage had to be fixed under the EQC banner or by the council depending on where the damage was reported. Where damage to the house laterals existed on both sides of the property boundary, sometimes separate drain layers were attending to the public section and private sections of the laterals at

different times and service wasn't gained until both were completed.

In response to this, the City Water and Wastewater Unit Manager sought and gained agreement from EQC that City Care would be the lead contractor in the evaluation and repair of laterals both on and off property to speed the process of repair and service. The properties in the eastern suburbs with chemical toilets were the first properties to get the benefit of this process. Each week as service was restored to the mains, residents were notified that the mains were cleared and they were to advise the Council if they were still having problems. There was considerable pressure put on the zone managers to keep freeing up areas to allow the laterals to be targeted.

This process was not without problems as increased flows in the mains sometimes caused downstream blockages as pipes collapsed or additional silt ingress into the mains. On-going monitoring and response was required. In total there were 2500 laterals repaired in this programme.

Future of the Recovery Operations

Although the network is in a more stable state, the recovery operation team is still operational in a scaled down form and is still maintaining service to the public of Christchurch and involved in responding to blockages and collapsed pipes, carrying out repairs as issues emerge.

The maintenance of service to damaged sewers in the abandoned red zone areas is on-going until people move out and requires a fine balance between repairs and on-going cleaning maintenance costs to ensure people continue to be provided with basic sanitary services. Most of these areas have on-going high infiltration and silt ingress along with on-going pipe collapses.

Over 100 kms of sewer remain in a limited operational condition, and over 400km of sewer main is expected to be replaced over the next five years.

Summary Conclusions

The 2011 earthquakes caused many kilometres of damage to the Christchurch wastewater network and service has been restored without any public health outbreaks.

A key aspect of the recovery operations has not necessarily been the availability of resources as the extent of the problem has not always been clearly defined owing to the scale of the problems. The management and communications structures have proved vital to facilitate efficient and cost effective decisions to re-store sanitary services to the public.

The division of the wastewater network into manageable areas enabled individuals and contractors to take ownership of achievable tasks to restore service to the public.

The use of GIS enabled the status of the network and progress as a whole to be monitored, communicated and activities targeted.

This enabled challenging targets to be set to restore service to the network. These targets were largely achieved despite the June earthquakes.

It was often necessary to decide on the appropriate response to the service condition often in advance of the full extent of the problem being identified. The introduction of Council and other engineers assisted with this and enabled City Care and other contractors to focus on their specialist skills and expertise with repairs and maintenance operations.

The response included a variety of organisations working together to achieve restoration of service to the sewer system including;

- City Care facilitating the introduction of Council and other engineers to assist formation of the recovery team working within City Care's operations.
- Council staff sourcing and distributing chemical toilets

- Sewer cleaning crews from throughout Australasia
- Traffic management staff
- Pump hire contractors
- Drainage construction contractors from throughout the country to repair the mains and laterals
- Environment Canterbury
- Assistance and liaison with private drain layers.
- A collaborative approach between Council and EQC enabled issues to be resolved that lie at the interface between the public and private parts of the sewer network.

While, the recovery operation has stabilised the sewer network, reactive response work will be on-going until the network is restored.

Acknowledgements

There are too many people involved in the operation to mention individual names, but the efforts of the following groups are acknowledged in the recovery efforts

The patience and resilience of the people of Christchurch needs to be acknowledged. Their acceptance of the extent of the problem (in most cases ahead of our own appreciation of the extent of the problem) greatly assisted our role with minimal aggravation, when it was very understandable to occur.

City Care management and staff for allowing the integration of outside staff into their operation to assist with the recovery efforts.

The jetting, CCTV and construction contractors from throughout Australasia that assisted with restoring service to the network. Without exception, their enthusiasm and willingness to ensure service is restored to the public as quickly as possible remained steadfast despite long hours and difficult and frustrating working conditions.

Finally to the colleagues and to the friendships formed during 2011 to restore service to the Christchurch sewer network, which is on-going today.

Biography

Bill Noell
Bill was seconded to assist 'on the ground' with Christchurch City Council and City Care restore and maintain service to the network after the 22 February earthquake. He has over 20 years' experience with assessment, upgrading and construction sewer systems in New Zealand UK and Ireland with Local Government and Engineering Consultancy's.

Bill is currently working as design engineer with the Stronger Christchurch Infrastructure Recovery Team

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Rob Meek
Rob is the Reticulation Maintenance Team Leader for Christchurch City Council and manages the Water and Wastewater Network Maintenance Contracts.

Rob has worked for Christchurch City Council in different roles for 16 years and his first response after the September Earthquake has been quoted as "No, not on my watch"

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