PRIORITISING TO DELIVER SAFE WATERWAYS AND HARBOURS, CATCHPIT BY CATCHPIT

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ABSTRACT (500 WORDS MAXIMUM)

Auckland Transport (AT) is responsible for the management of 7,500 km of roads and associated infrastructure throughout Auckland, including over 92,000 road catchpits. Stormwater runoff contaminants and gross pollutants are being discharged from their road corridors into Auckland's waterways and harbours.

GHD Limited is assisting AT to develop and implement a programme for improving the water quality from road catchpits. The objective of AT's City-wide catchpit prioritisation and intervention programme is to reduce the impact of road runoff discharges in an innovative, sustainable, integrated and cost effective manner. Through the targeted installation of stormwater treatment devices in road catchpits in priority areas, this programme will provide improved operations and reduce pollutant loads entering our waterways.

AT has allocated funding over the next ten years in the 2018-2028 LTP, with a total investment of capex $9 M for stormwater treatment and improved cleaning programmes. A systematic and collaborative approach is required to determine how to utilise this funding to provide best value for money, the desired environmental outcomes and manage risks.

The guideline for prioritising treatment areas were to assess where high levels of contaminants and litter are generated, and the associated impacts across a range of criteria such as public health, water quality, flood prevention and preventative maintenance.

Based on these guidelines, GHD identified a number of priority areas to be targeted for treatment. These include:

- **AT PT Facilities** - Park and ride, bus stations and rail stations where high litter and contaminant generation is evident.
- **Amenity Areas** - Road corridor drainage systems that discharge directly to beaches, waterways, or other high-use receiving environments eg. marinas.
- **Critical Soakpits** - Catchpits discharging to critical soakpits at risk of blockage.
- **High Sedimentation in Runoff** - Catchpits that receive high levels of sediment and litter from upstream overland flows (from parks, highly vegetative areas) and which may impact on downstream infrastructure (pipes and treatment devices such as stormwater ponds).
- **Flooding due to Blocked Catchpits** - Catchpits where blockage will lead to significant flooding which impacts on the integrity of the road pavement, affect private

properties and road users, create safety issues and require multiple maintenance call outs.

- **Town Centres** - Town centres with high gross pollutant loads in catchpits.
- **Sensitive Receiving Environments** - Sub-catchments with sensitive receiving environments eg streams with high ecological value.
- **High Use Arterial Roads** - High-use roads in sub-catchments with sensitive and high-use receiving environments.
- **Areas covered by Auckland Council's Safeswim programme** - Areas that are continually assessed as contaminated and unsafe to swim.

Priority catchments are identified using mapping tools which analyse a range of geospatial data, including asset data, traffic volumes, land use, recreational areas, hydrology, and flood hazards.

Based on the maps and workshops with AT and Auckland Council stakeholders, a prioritisation tool has been developed for the Auckland region. This will be the road map for implementing a robust treatment programme over the next ten years.

KEYWORDS

Asset management, prioritisation, road runoff, water quality, stormwater, catchpits

PRESENTER PROFILE

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1 INTRODUCTION

Auckland Transport (AT) is responsible for the management of 7,500 km of roads and associated infrastructure throughout Auckland, including over 92,000 road catchpits. Its infrastructure represents approximately 25% of the city's impervious surface areas, so AT understands the pivotal role it must play in protecting the downstream marine environment from stormwater road run-off contaminants and gross pollutants. Improving receiving environment water quality can lead to a range of follow-on benefits including improved ecosystem health, increased recreational opportunities, influencing the development of Auckland's waterfront, increasing tourism and driving the growth and prosperity of the city.

Providing at-source treatment within road catchpits, and improving maintenance and cleaning regimes of these assets, has been identified by AT as an 'easy win' for reducing contaminants and gross pollutants in road run-off.

The objective of AT's 'City-wide catchpit prioritisation and intervention programme' is to provide improved operations and reduce pollutant loads entering our waterways through the targeted installation of stormwater treatment devices in road catchpits in priority areas.

The prioritisation and intervention programme assists in meeting AT's level of service requirements and addresses a key issue of the greater public awareness and stakeholder expectations for sustainability, stormwater quality and environmental impacts, particularly from road run-off.

AT supports the Auckland Plan goals and outcomes by 2040 being:

- Safe & Healthy Auckland, protecting streams and water bodies from contamination
- A green Auckland, managing streams and contaminants
- A beautiful Auckland, managing flooding, streams and contaminant loads.

Guidelines that indicate how the goals are to be implemented include:

- Working together with AC
- Plan for sustainability
- Reduce adverse environmental effects from Auckland Transport system
- Make the best of every dollar spent, applying prudent asset management practices.

GHD is assisting AT to develop and implement a programme to meet these objectives. AT has allocated funding over the next ten years in the 2018-2028 LTP, with a total investment of capex $9 M for catchpit stormwater treatment devices and improved cleaning programmes.

A systematic and collaborative approach is required to determine how to utilise this funding to provide best value for money, the desired environmental outcomes and manage risks. This will be the road map for implementing a robust treatment programme over the next ten years.

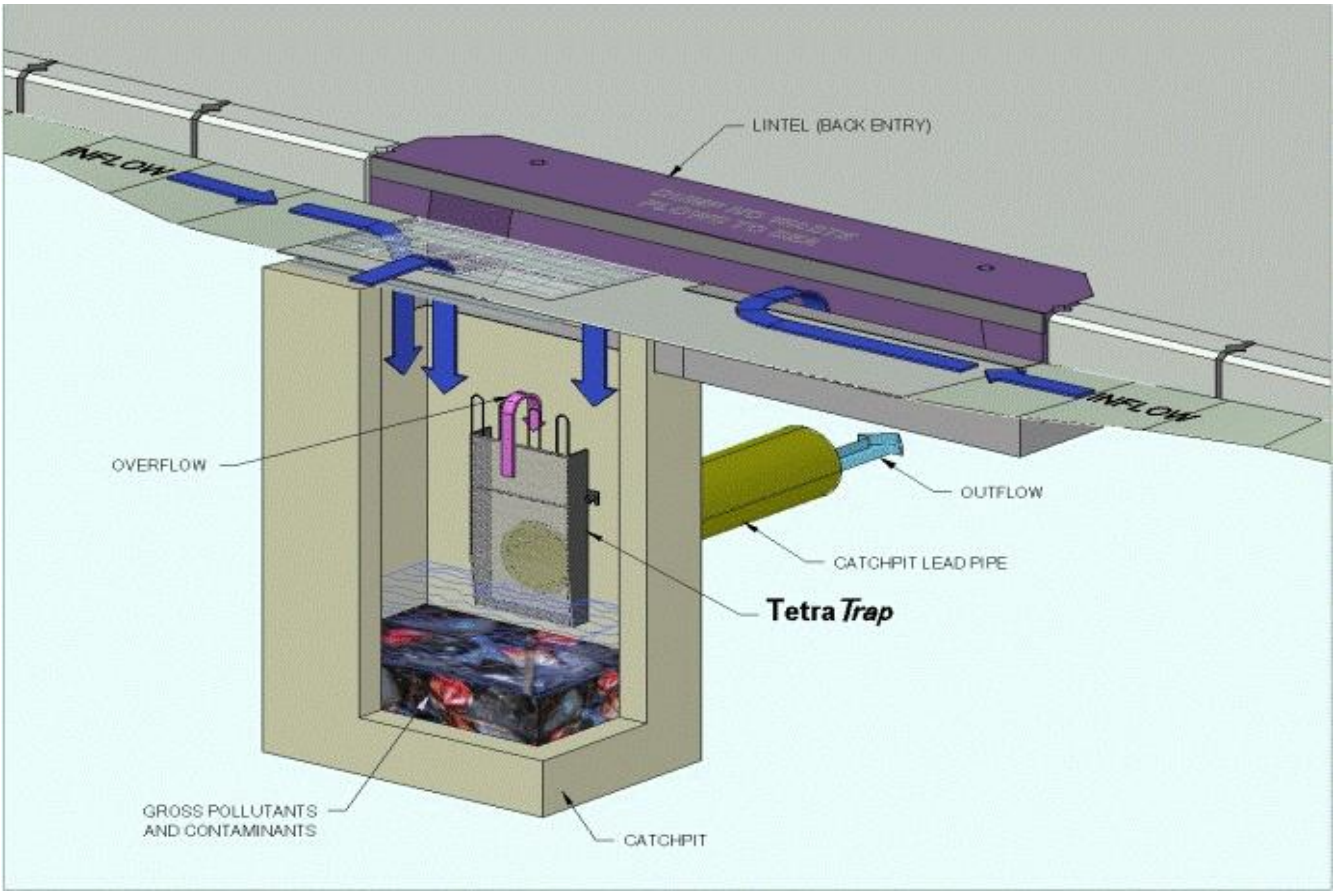
2 DISCUSSION

2.1 TREATMENT DEVICES

Since 2008, GHD and Auckland Transport have worked in partnership to develop and test the Tetra*Trap*, a cost-effective and easy to maintain catchpit treatment device.

The Tetra*Trap* is a stainless steel device that can be easily retrofitted in roadside catchpits and utilises the catchpit redundant space and hydraulic capacity to form a simple but effective barrier. There are 6 versions of Tetra*Trap* devices currently available to suit different catchpit types and sizes. Each device collects gross pollutants and contaminants such as litter, plastic bottles, bags and heavy metals, prior to stormwater discharging to the receiving environment. Tetra*Traps* can also be fitted with a fine mesh bag to collect fine sediments from construction sites and high sediment-generating upstream catchments. They are also 100% recyclable and have a 30 year design life.

Figure 1 Schematic of TetraTrap in operation



Catchpit treatment is considered a low-cost and easy-to-implement first step in improving water quality, particularly from road corridor assets. To date, approximately 3,000 Tetra*Traps* have been installed throughout the Auckland Central region, removing tonnes of refuse every year.

Figure 2 TetraTrap pollutant capture (dry and wet conditions)

It is recognised, of course, that catchpit treatment is just one step in a larger, interconnected treatment train. Over time, as road corridors and urban areas are re-developed, AT will look to install other treatment devices such as stormwater ponds, constructed wetlands and rain gardens so that additional treatment processes will be utilised to further treat road run-off.

Tetra*Traps* are portable and can be re-installed elsewhere, so they can be re-deployed if additional end-of-line treatment devices are installed in the catchment in the future.

Catchpit treatment devices are just one part of the overall solution, but it is something that can be easily implemented to give immediate results. Therefore, the prioritisation of catchpit treatment devices is the main focus of this paper.

2.2 PRIORITISATION PROCESS

2.2.1 TARGETED CATCHMENT AREAS

The guideline for prioritising treatment areas were to assess where high levels of contaminants and litter are generated, and the associated impacts across a range of criteria such as public health, water quality, flood prevention and preventative maintenance.

Firstly, GHD collated and analysed an array of geospatial information using ArcGIS to understand AT's catchpit assets in relation to high use roads and receiving environments.

Data was sourced from Auckland Transport and NZTA, including RAMM asset information, road hierarchy, traffic volumes, known operational and maintenance issues.

Further information was gathered from Auckland Council, for example, the Auckland Unitary Plan land use zones, stormwater network, catchment hydrology, flood hazard risks and SafeSwim monitoring locations.

Collaboration between Auckland Transport and Auckland Council on asset data recording and sharing is improving the quality of information available for planned management in all areas. It is important for both organisations to have the most relevant information possible to drive asset management and renewal decisions.

Using a combination of spatial analysis and manual reviews, we identified specific areas that could be targeted for treatment. In total, we identified 108 priority stormwater catchments. These catchments included priority areas such as:

AT Public Transportation Facilities – Areas where large numbers of commuters meet, such as park and ride facilities, bus and rail stations, have high litter and contaminant generation potential.

Amenity Areas - Road corridors that discharge directly to beaches, waterways, or other high-use receiving environments like marinas. The public amenity and aesthetics of these areas can be improved significantly if the litter load into the stormwater system was captured rather than discharged.

Critical Soakpits - Catchpits discharging to critical soakpits which are at risk of blockage. These soakpits need to be kept clean in order to maintain high performance.

High Sedimentation in Runoff - Catchpits that receive high levels of sediment and litter from upstream overland flows (from parks or highly vegetative areas) and which may impact on downstream infrastructure (pipes and treatment devices such as stormwater ponds).

Flooding due to Blocked Catchpits - Catchpits where blockage will lead to significant flooding which impacts on the integrity of the road pavement, affect private properties and road users, and create safety issues and require multiple maintenance call outs. These problem areas were identified through a combination of flood maps and understanding the number and location of maintenance call-outs.

Town Centres - Town centres and busy urban areas where there are likely to be high gross pollutant loads in catchpits.

Sensitive Receiving Environments - Sub-catchments with sensitive receiving environments such as streams within significant ecological areas or conservation areas.

High Use Arterial Roads - High-use roads in sub-catchments with sensitive and high-use receiving environments.

Areas covered by Auckland Council's Safeswim programme - Areas discharging to beaches that are continually assessed as contaminated and unsafe to swim.

The next step was to prioritise these stormwater catchments to develop a 10-year programme of works for catchpit treatment device installation and improvements.

2.2.2 PRIORITISATION MATRIX

A prioritisation matrix was developed to rank each catchment based on a number of health and safety and environmental, social and cultural, economic, political and land use criteria.

For each criterion, the probability and consequence of specific impacts were considered to give an overall 'opportunity' score. The higher the opportunity score, the higher the catchment was prioritised.

CONSEQUENCES

The impacts within each criteria and related consequences are described below.

Health and safety and environment

- Public health. This criteria considers the improvement to public health where road stormwater discharges directly to beaches, watercourses, streams etc. for swimming and water sports. Ratings were from 1 (no improvement) to 4 (major improvement which significantly reduces times when receiving marine environment is closed for public use)

- Ecology and sensitive receiving environments. This criteria considers the improvement to ecology and water quality in receiving environments. Ratings were from 1 (low improvement) to 4 (major improvement which significantly increases safe swimming and thriving ecologies).

- Road flooding, road integrity and property nuisance. This criteria considers the reduction in flooding, blocked soakpits or road integrity issues on AT assets and private property nuisance flooding. Ratings were from 1 (no reduction) to 4 (major reduction).

Social and cultural

- Existing recreational areas. This criteria considers whether the downstream environment is of interest for swimming, recreational use, tourism etc. and if improvements in catchment would improve recreational amenity. Ratings were from 1 (insignificant interest) to 4 (significant interest ie. high profile, high-use public recreation space)

- New recreational areas. This criteria considers whether water quality improvements in the catchment has the potential to create new areas for swimming, recreation and community activities. Ratings were from 1 (no impact) to 4 (significant impact)

- Community interest and public awareness. This criteria considers whether the downstream environment is of interest to the community (eg. Iwi,, Forest & Bird, community interest groups etc.) for business, cultural and liveability reasons, and if improvements in the catchment would improve sense of community. Ratings were from 1 (insignificant interest) to 4 (significant interest).

Economic

- Infrastructure and operational costs. This criteria considers the reduction in infrastructure replacement, maintenance and operational costs due to improved road integrity, less flooding call-outs etc. Ratings were from 1 (no reduction) to 4 (major reduction).

- Tourism potential. This criteria considers the potential increase in tourism in/around the receiving environment due to improvements in the catchment. Ratings were from 1 (no increase) to 4 (significant increase).

Political

- Media visibility. This criteria considers the level of media interest, either if poor water quality continues ('bad news story'), or water quality is significantly improved due to improvements in targeted catchment ('good news story'). Ratings were from 1 (no media interest) to 4 (front page visibility on national media).

Contributing catchment land use

- Traffic volumes. This criteria considers the types of roads and traffic volumes within the catchment. Ratings were from 1 (access road volume) to 5 (regional road volume).

- Land use type. This criteria considers the predominant land use in the catchment and the impacts that water quality improvements would achieve. Ratings were from 1 (low impact - rural / reserve) to 4 (significant impact - residential, commercial, light industrial)

PROBABILITY

For each criterion, a probability score was given to qualitatively assess how likely the consequences would be realised, as defined in Table 1.

Table 1 Probability rating

Rating	Likelihood
1	Rare – Low probability of consequence being realised within 10 years
2	Unlike – Probability of consequence being realised within 5 to 10 years
3	Possible – Probability of consequence being realised within 2 to 5 years
4	Probable – Probability of consequence being realised within 1 to 2 years
5	Almost Certain – Probability of consequence being realised within 12 months

For the contributing catchment land use criteria, the probability score was set as the same as the consequence score as there are no probabilities related to these criteria.

OPPORTUNITY SCORE

The consequence and probability ratings for each criteria were then multiplied to give an 'opportunity score'. This score identified the priority (low to high) for targeted catchment treatment for that specific criteria. The opportunity score ranged from 1 to 25, as defined in Table 2.

Table 2 Opportunity score definitions

Score	Criticality	Explanation	Priority
1-3	N Non-Critical	Failure to install the device is **not critical** to managing the discharge of litter, sediments and contaminants to the receiving environment and impacts on public users.	Low
4-8	L Low y	Failure to install the device **has minor consequences** to managing the discharge of litter, sediments and contaminants to the receiving environment and impacts on public users.	Low
9-12	M Medium	Failure to install the device **has moderate consequences** to managing the discharge of litter, sediments and contaminants to the receiving environment and impacts on public users.	Medium
13-16	H High	Failure to install the device **has major consequences** to managing the discharge of litter, sediments and contaminants to the receiving environment and impacts on public users.	High
17-25	E Extreme	Failure to install the device **has severe consequences** to managing the discharge of litter, sediments and contaminants to the receiving environment and impacts on public users.	High

An opportunity score was calculated for each of the 11 criteria, for every targeted stormwater catchment.

The scores for each criterion were then given weightings and totaled. The weightings, shown in Table 3, were developed in collaboration with Auckland Transport through workshops and meetings. The weightings reflect the relative importance of each criteria in achieving the programme objectives and the drivers for catchment improvements.

Table 3 Weightings for prioritisation criteria

Criteria	Total weighting of prioritisation criteria
Health and safety and environment	37.5%
Social and cultural	31.25%
Economic	12.5%
Political	6.25%
Contributing catchment land use	12.5%

2.2.3 PRIORITISATION RESULTS WORKSHOP

Once the prioritisation matrix was applied to all stormwater catchments within the 4 regions (north, south, east and west Auckland), the catchments were ranked to identify the top priorities in each region. These catchment rankings were discussed with AT operations and asset management teams to verify the prioritisation process.

The workshops were also useful in gaining a more detailed understanding of each priority catchment, so that critical interception points could be better identified. These are the optimum points where Tetra*Traps* should be installed to provide maximum benefit. It is anticipated that further investigations and consultations will be undertaken in the future to confirm the catchment prioritisation and critical catchpit locations.

2.3 IMPLEMENTATION

The prioritisation and catchpit identification work to date has fed into the development of a high-level capital expenditure programme for the next 10 years.

Implementation of year 1 of the capex programme is now underway. The initial focus is currently on the Auckland North region, specifically in high ranked priority areas discharging directly to our harbours and sensitive waterways. There are approximately 367 catchpits being investigated for installation in this Stage 1, Northern area.

The process for the investigation and installation of catchpit treatment devices in these areas will include:

1. Review of all available data on the catchpits including age, location, type, ownership (Auckland Council, Auckland Transport or private). The location for catchpit treatment devices will be refined at this stage to produce a list of catchpits for retrofitting with Tetra*Traps*.
2. Contractors will be engaged to undertake site investigations for each catchpit, measuring the dimensions of catchpit and outlet pipe, depth, orientation, wall materials etc.
3. Based on the collected data, GHD can identify the type of Tetra*Trap* to be installed.
4. Contractors will manufacture and install the Tetra*Trap* device in the catchpit.
5. Quality control inspections will be completed to ensure devices have been installed correctly.
6. As-built data will be recorded in AT's RAMM database and also transferred to the AC GIS and asset database.
7. Monitoring and maintenance requirements for the catchpits will be updated in the AC/AT's asset maintenance database.

The implementation process can be rolled out across multiple catchments at the same time dependent on priority ranking for each catchment.

The catchment prioritisation work can also be used for the identification and prioritisation of other stormwater treatment devices. For example, the criteria and weightings could be adapted in the future to identify the best areas for targeted road corridor re-development and construction of new treatment devices.

In this way, we have developed a multi-purpose, multi-criteria analysis tool that can enhance overall decision-making on asset management and increases the likelihood of long-term sustainable outcomes.

2.4 CLEANING AND MAINTENANCE REGIME

Catchpit cleaning and maintenance is an important aspect that needs to be considered as part of a holistic programme for improving the performance of catchpits. Maintenance of drainage assets is becoming increasingly complex as urbanisation intensifies. Complicating factors include: an increase in impervious surfaces, leading to greater stormwater loading and gross pollutants; large numbers of trees; multiple utility services that restrict installation of drainage systems; and increased on-street parking that make it difficult to access drainage structures.

Due to these difficulties, the development of at source treatment in catchpits has been designed to make cleaning and maintenance as simple as possible. The cleaning process is the same as for routine catchpit cleaning, with no specialist equipment required. Debris can be easily removed by vacuuming through a sucker truck and high-pressure water jetting. If debris gets caught between the Tetra*Trap* and the catchpit wall, the Tetra*Trap* unit can be lifted out of its mount manually so the debris can be removed.

As part of the city-wide catchpit prioritisation and intervention programme, GHD is working with Auckland Council and Auckland Transport to optimise the road sweeping and catchpit cleaning programme. For example, by identifying the critical catchment areas and critical catchpit locations, we can assess whether the cleaning programme is sufficient or if more frequent cleaning is required to manage operational risks to the network. We can also identify catchpit locations that are susceptible to causing flooding and implement pro-active, preventative cleaning and maintenance at those locations.

A pro-active and optimised cleaning and maintenance regime will ensure that AT and AC can get the most benefit out of its existing assets, optimising their return on investment and utilising what it already installed in the ground to give better environmental outcomes.

3 CONCLUSIONS

Auckland Transport is steering a significant city-wide catchpit prioritisation and intervention programme that aims to improve the quality of road runoff going into the receiving environment.

Our streams, waterways and harbours are important from an environmental, social and cultural perspective and are of major economic value to Auckland. The cost of improving receiving water quality and reducing pollutant discharges within Auckland Transport's infrastructure is an investment in the prosperity of the region.

There are significant challenges in retrofitting urban catchments with stormwater treatment devices. The city-wide catchpit prioritisation and intervention programme shows that there are opportunities to significantly improve road runoff discharge quality in the short term; by focusing on prioritising sensitive areas, installing catchpit treatment devices and improving the operation and maintenance regimes of the road drainage network.

Auckland Transport is now in their implementation phase for three high priority catchments, with the design and installation of catchpit treatment devices due to continue throughout 2019 and beyond.

The data mapping and multi-criteria analysis process that has been developed has provided Auckland Transport with a decision-making tool to prioritise capex spending in a way that takes into account health and safety, social, cultural, economic and political factors. By considering all of these criteria across all the catchments in the Auckland region, we can

identify the best opportunities for long-term sustainable outcomes while managing the risks to the network holistically and getting the best value for money.

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REFERENCES

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