ASSET MANAGEMENT OF AUCKLAND'S ROAD STORMWATER NETWORK

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ABSTRACT

Auckland Transport manages the local transport network in the Auckland region including the Hauraki Gulf Islands. The total value of the transport network is approximately $9.2 billion. A significant portion of this includes roads, footpaths, bridges, culverts, retaining walls and seawalls.

In recent years stormwater is increasingly impacting adversely on the road network infrastructure causing flooding, slips and affecting the structural integrity of the road corridor assets.

Auckland Transport and GHD have taken a proactive approach to understand the impact of stormwater and increased urban development on its infrastructure assets. As part of this approach, Auckland Transport has developed a comprehensive Asset Class Management Plan (ACMP) to manage its stormwater asset.

The objectives of the ACMP are good governance and asset stewardship, knowledge of stakeholder requirements, legislative compliance, asset knowledge including condition and performance required to deliver services, knowledge of risks, comprehensive knowledge of what is required to deliver services in a sustainable manner, and allocation of finances and resources.

GHD has conducted the following studies for Auckland Transport and implementation works to meet the objectives of the ACMP:

- Identification of flooding hotspots, stormwater quality issues and development of options,
- Hauraki Gulf Islands Stormwater Management studies to manage the table drainage systems, wetlands, detention basins, structural integrity of road assets, coastal erosion and slope stability,
- Soakage studies to identify condition, capacity, risk and operations and maintenance regimes for Auckland Transport's 2,500 soakholes, and
- Collaboration with other entities in the management of the entire stormwater network including joint discharge consents and agreements on ownership and operational responsibilities of stormwater assets.

To work towards excellence in asset management, Auckland Transport is identifying future threats to its infrastructure assets from stormwater. This paper discusses the asset management planning, the results of studies and future preventative maintenance strategies.

KEYWORDS

Auckland Transport, Road Stormwater Network, Asset Management, Flooding, Preventative Maintenance, Soakage

PRESENTER PROFILE

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John is a Principal Engineer in Infrastructure Asset Management with GHD Limited. He has more than 25 years' experience in civil, construction and local government engineering. John has extensive experience in capital works projects including design, stormwater quality systems, project management, contract administration and team leadership. He has been involved in a number of large infrastructure projects in stormwater and Asset Management over the past 14 years in Auckland City and Councils throughout New Zealand.

John has worked in Construction Management as Senior Site Engineer and Site Agent on large multi-storey buildings in the United Kingdom for 12 years. John has been working closely with Auckland City Transport in drainage design, guidelines, policy and management for the past eight years and is currently project managing for Auckland Transport's road stormwater issues in the Central area and Gulf Islands including the Tetra*Trap* pollutant trap and soakhole filter cages which he developed and its implementation programme.

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Andy is Principal Specialist – Stormwater in Auckland Transport's Project Specialist Team, providing technical advice and design leadership on stormwater management within Auckland Transport.

Andy has thirty years' experience in local authority road engineering, working across the UK for twenty years in capital design, maintenance, road safety and traffic engineering. For five years with North Shore City Council providing liaison between NSCC Transport and Stormwater, and five years with Auckland Transport, Andy has been working to integrate stormwater environmental objectives with transport objectives in the design of stormwater management, and in supporting Asset Management.

1 INTRODUCTION

Auckland Transport manages the local transport network in the Auckland region including the Hauraki Gulf Islands. The total value of the transport network is approximately $9.2 billion. The largest part of the high-use road network is within the urban area of Auckland, where road drainage connects to the Auckland Council (AC) Stormwater network. But Auckland Transport also manages significant lengths of rural roads, and roads in rural settlements without stormwater networks. This includes the Hauraki Gulf Islands.

In recent years stormwater is increasingly impacting adversely on the road network infrastructure causing flooding, slips and affecting the structural integrity of the road corridor assets.

Auckland Transport was founded in 2010 as a Council Controlled Organisation, as part of the amalgamation of Regional and Distict Councils into Auckland Council. Initial focus was on providing continuity of service while shaping the organisation, its policies and procedures to manage the whole network efficiently and effectively. Much of this has been given effect to in the 2012-2015 Asset Management Plan, which incorporates a number of Guidelines including one for Stormwater and the 2014 Asset Class Management Plan (ACMP).

From the beginning, Auckland Transport and Auckland Council's Stormwater Unit (SW) have collaborated under a Service Level Agreement that sees new maintenance contracts

allowing SW to manage delegated road drainage maintenance budgets within the SW Maintenance contracts. This collaboration is being taken further as Auckland Transport partners with SW to join road and public stormwater assets into a single Auckland Stormwater Network Discharge Consent, recognising the interrelation of surface and piped drainage in the urban areas.

AT supports the Auckland Plan and the goals to become the world's most liveable city and includes the following outcomes for Auckland by 2040:

Safe and Healthy Auckland – addressed through protecting streams and water bodies from contamination from adjoining land uses.

A Green Auckland or Auckland as an Eco-City – addressed through managing streams, contaminants, planting and considering the impact of land users.

A Beautiful Auckland that is Loved by its People – managing flooding, streams and contaminant loads discharged to all receiving environments.

1.1 AUCKLAND ISTHMUS AND HAURAKI GULF ISLANDS

This management area contains extemes of conditions for road drainage. The Isthmus contains the CBD and surrounding suburbs, built upon the site of the original city founded in 1840. Much of the earliest infrastructure depends still on Combined Sewers, managed by Watercare Services Limited, another CCO. The suburbs spread across an area of volcanic actvity that has covered the ground with basalt and tuff, producing drainage basins without stream runoff, and with aquifers discharging towards the sea. This area largely depends on soakage pits, boreholes and natural caverns, giving variable drainage performance and special management challenges.

The Gulf Islands are largely rural and without reticulated drainage. The western end of Waiheke Island, with its ferry linkages to the city centre, is increasing in population. Auckland Transport's road network, with its roadside drains and culverts, is the principal means of providing stormwater management beyond natural land drainage. Increased development is putting pressure on these road drainage assets.

GHD has been working with Auckland Transport over the past 6 years to deliver a substantive renewal programme that aims to have all road-related assets meet the minimum requirements for condition and performance standards. GHD is adding value to the programme by helping Auckland Transport meet its environmental and sustainability goals through a combination of innovative technologies linking to the council's environment strategy.

GHD has been key in taking forward asset management and design drainage activities to fulfill AT Network Asset Management Plan (2012 – 2015) in the following areas:

The challenge set by Auckland Transport for GHD is to create more innovative ways to overcome stormwater issues within the road reserve, implement best practice asset management techniques, develop actions that are linked to strategies, and collaborate with stakeholders to achieve integrated solutions. Outcomes to-date have included:

- Innovations in management and techniques to improve stormwater discharge quality,
- Robust forward works programming (1-, 3-, and 10-year forward works programme),
- Advanced condition and performance assessments of assets,
- Development of workable policies, standards and engineering details,
- Actions on the ground that deliver the Asset Management strategies, and

- A low-cost, easy to retrofit scientifically tested stormwater treatment device, which can be maintained as part of the regular catchpit and soakhole cleaning cycle.

Auckland Transport's stormwater drainage assets within the Auckland region and Hauraki Gulf islands consist of approximately 91,000 catchpits and 2,500 soakholes with the central isthmus totalling 27,500 catchpits. The condition and performance of these structures is critical not only to the city's wider drainage and reticulation system, but also to the efficiency, safety, and reliability of the transportation network.

Auckland Transport and GHD together are striving for excellence in the management and performance of road stormwater drainage assets, particularly with respect to the impact of stormwater on the receiving environment.

The benefits of this programme are potentially wide reaching, as it is not only of value to Auckland Transport and other stakeholders in Auckland who are responsible for the quality of the receiving environment but also to environmentally aware Transport entities anywhere.

Figure 1: Auckland Transport Stormwater Assets

2 AUCKLAND TRANSPORT ASSET CLASS MANAGEMENT PLAN

Auckland Transport's long-term plan for sustainability includes a goal to reduce the city's environmental footprint and nurture a healthy urban ecosystem. Motor vehicle use has been identified as one of the main sources of contaminants entering the road stormwater system including sediment from construction sites, litter, and hydrocarbons. Auckland Transport's focus includes a proactive approach creating innovative stormwater solutions to manage stormwater quality within the Transport road reserve. This approach included

an asset data capture survey of catchpits, soakholes, manholes and treatment devices over 3 years to collate detailed information of each asset for management and maintenance purposes and update Transport's inventory.

The purpose of conveyance of road stormwater to the Transport drainage system is to prevent flooding/ponding of water within the road reserve and prevent saturation of the pavement layers. Auckland Transport's Levels of Service for carriageway drainage most relevant to that delivery are:

Quality – Assets maintained in good condition, with a service measure that 95% of catchpits and soakholes are maintained to a condition grade 3 or better over the next 10 years.

Responsiveness – improve timelines for network blockages with a service measure for drainage maintenance repair response timeframe of 95%.

Environmental Sustainability – Minimise network stormwater pollution. Eliminate RMA non-compliance with a service measure of compliance with environmental standards for water pollution and percentage coverage of environmentally significant catchments with appropriate treatment.

Figure 2: Gulf Island Bank Erosion, road scabbing, scour and stormwater inlet issues

Auckland Transport has service level commitments for the way in which stormwater is conveyed on road surfaces. It must not adversely affect pedestrians and road users by ponding in the carriageway in a volume and velocity over design levels. It must not affect the integrity of the road surface and it must not flow off the roadway to cause nuisance to other property.

There is also a kerb discharge policy that heavily restricts the peak flow of discharge allowed from private property to prevent overstressing of the city's transport drainage assets. The performance of catchpits, catchpit leads, pipelines, and drainage soakpits is integral to the effectiveness of Auckland's primary drainage and aquifer system. Inadequacies in the network design and maintenance lead to deterioration and possible collapse of roading structures. Blocked assets as a result of environmental and maintenance issues are a principal cause of flooding, and impact on traffic flows around the city.

3 AUCKLAND TRANSPORT LEADING CHANGES IN STORMWATER MANAGEMENT

AT has taken a proactive approach in managing stormwater within its road corridor by embarking on a significant programme of asset data capture, optimisation of its street sweeping and cleaning regimes, and innovation initiatives to substantially reduce pollutants from the road corridor entering the receiving environment. Some of Auckland Transport's innovative projects over recent years as set out in their Network Management Plan include installing Tetra*Traps* in catchpits throughout the region starting with the city centre and installing soakhole filter cages within the central area of Auckland. These projects have exceeded the Level of Service (LOS) (more than met regulatory standards for existing network) to improve stormwater discharge quality. The outcome contributes towards cleaner waters in Auckland's harbours, aquifers, estuaries and streams.

3.1 WORKING WITHIN CONSTRAINTS

Maintenance of the drainage assets is becoming increasingly complex as urbanisation intensifies. Complicating factors include an increase in impervious surfaces, leading to greater stormwater loading on the drainage network; large numbers of trees; multiple utility services (either within or adjacent to footpaths and berms) that restrict installation

of new drainage; and increased on-street parking that makes it difficult to access drainage and associated structures for maintenance programmes.

Figure 3: Congested streets with vehicles parking over catchpits

From a broader environmental perspective, increased stormwater run-off from new housing developments is impacting on stormwater managment. And with climate change predicted to increase occurrences and intensity of rainfall events, greater overland flows are likely with the potential for increased private property flooding. This has implications for controlling peak flows and contaminant discharge to receiving environments, and increases the likelihood of conflict with community expectations.

3.2 OPTIMISING PERFORMANCE AND DATA

Meeting these service levels not only means making sure that the condition, design and performance of catchpits, soakpits and culverts within the network is adequate, but also that the asset life-cycle is managed over time to optimise performance and cost. Determining the probability and consequence of the structure failing is key, so the accuracy, consistency and completeness of data with respect to the age, condition and performance of each and every structure is vital to the integrity of the programme. This is a complex and logistically challenging task.

3.3 STAKEHOLDER CONSULTATION

GHD's broader involvement with Auckland Transport and its stakeholders on resolution of stormwater issues occurs through onsite meetings with property owners, Auckland Transport internal stakeholders and operations teams on solutions to manage road corridor stormwater flows and minimising the impact on private properties where a limited reticulation system exists. It also requires coordination of works across Auckland Council operations to manage overlaps and conflicts.

GHD also coordinates investigations with Auckland Council to set Transport policy and standards, and its breadth of relationship with Auckland Council, and wider role within the transportation and water sectors, underpins the value of the programme.

Flooding "hotspots" identified, mapped, and managed by GHD are of significant interest to other utility and transportation stakeholders within the city. The outcome is an integrated plan showing the location of these "hotspots" and their connection to asset locations, flood hazard areas, geographical attributes, roading renewal programmes and catchpit cleaning and maintenance programmes.

Figure 4: Carriageway Flooding

4 SOAKAGE MANAGEMENT

Stormwater runoff from a third of the Central Auckland area (former Auckland City) is discharged through ground soakage into the Auckland aquifer system. Private properties in the soakage areas also discharge to private soakholes and in some cases public soakholes, whilst road stormwater is discharged via catchpits and pipe leads to Auckland Transport's soakholes within the road reserve. Auckland Transport owns and manages 2,500 soakholes in the Auckland region.

As part of Auckland Transport's asset management processes, risk assessments were undertaken by GHD to determine those soakhole assets at high risk of failure resulting in increased maintenance and renewal costs, posing a high risk to the community, property, stakeholders and the environment. Risk issues considered included location of soakholes in flood prone areas, blockage of soakholes, future increase in impervious areas, contamination of the aquifer system, property overland flows contributing to soakholes and Health & Safety around maintenance of soakholes by Contractors.

The risk study on 2,500 soakholes indicated that approximately 478 soakholes were identified in the risk category 3-5 (medium to high) where further assessment was required to confirm their condition and performance.

The public soakage system is nominally designed to cater for the 1 in 10 year design storms, however the capacity of the soakage system is largely dependent on regular maintenance to remove litter and sediments. In many cases, litter and sediments significantly reduce capacity; often requiring new bores to be drilled or existing bores redrilled. It is paramount that these important Auckland Transport stormwater assets valued at approximately $45 million are maintained at a high level of service with cleaning at 3 cleans per annum to ensure road safety is not compromised through flooding; reducing callout costs for blockage and the asset can function at optimum performance level.

A sustainable solution to the maintenance and performance of the soakholes developed by GHD for Auckland Transport has included the development of soakhole filter cages installed over bores with access flip lids to protect against blockage, safety in cleaning with no Contractor entry required and reduce aquifer contaminant build-up. In addition, the installation of Tetra*Traps* in catchpits within areas of significant litter and sediment build-up has reduced pollutant loading on soakholes.

Figure 5: Soakhole with GHD Filter cage

Figure 6: Gross Pollutants in Soakhole

Auckland Transport is building on this work to develop improved asset data records, including borehole capacity field test records, to enable discharge management, cyclic maintenance and asset renewal to improve the reliability of service in design storms and maximise cost effectiveness

An additional challenge is to protect the groundwater resource from contamination. Auckland Transport is working with Auckland Council SW Unit and Natural Resources (regulatory) Teams to develop standard design solutions that discharge effluent within acceptable parameters.

4.1 DOMINION ROAD SOAKAGE STUDY

GHD have completed a preliminary design study of a major central Auckland arterial road widening along Dominion Road to determine condition, performance, and connectivity of Auckland Transport's drainage system including soakholes over a 4.5km length.

Being one of Auckland longest roads, Dominion Road is vital to public transport, carrying 2.2 million bus passengers per year.

Flow testing and CCTV survey of pipelines was conducted to determine asset condition and performance of soakholes through porosity testing. Soakholes generally rockbores in this catchment, required cleaning and retesting due to excess litter and sediment build-up.

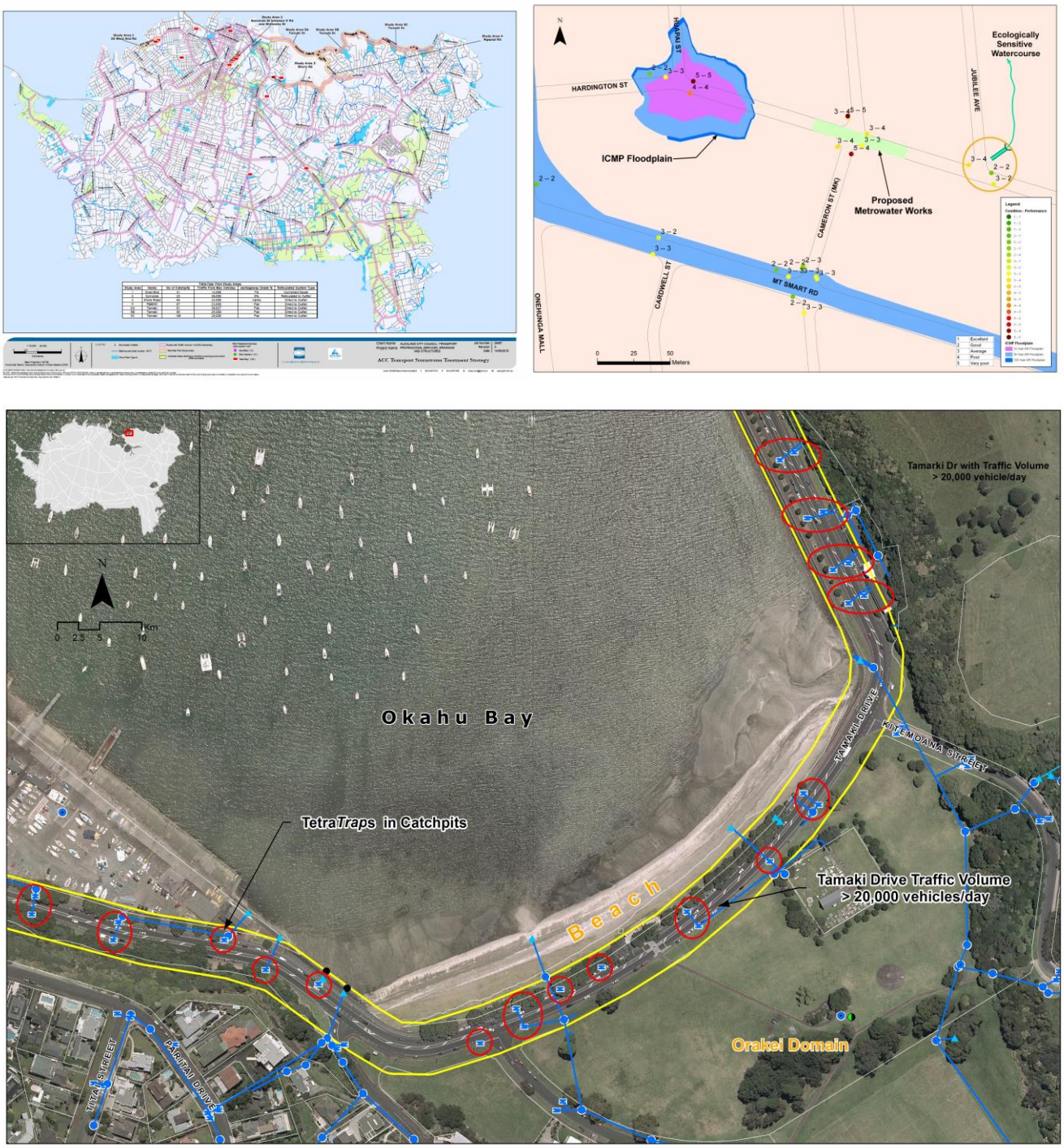
The majority of the soakholes tested performed poorly with clogged bores and fissures due to constant sediment and litter loading. The study recommended re-drilling of existing blocked bores, following cleaning and retesting where results were low, installation of Tetra*Traps* in catchpits to mitigate against conveyance of excess pollutants to the soakholes and an optimised cleaning and maintenance regime with a minimum of three regular cleans per year and five cleans for critical soakholes and catchpits where the risk to carriageway flooding and safety is high.

5 SUSTAINABLE SOLUTIONS

From the analysis and development work detailed in Section 4, GHD have created and maintained a stormwater asset inventory for Auckland Transport in RAMM that can be used as a basis for Forward Works Programming.

GHD have developed a stormwater treatment strategy plan for Auckland Transport identifying and prioritising locations in the Auckland central area where catchpits discharge directly or via a stormwater outlet pipe to primary receiving environments.

Figure 7: Stormwater Treatment Strategy



The treatment strategy plan implementation assists Auckland Transport in meeting its level of service requirements and address a key issue of "greater public awareness and stakeholder expectation for sustainability of stormwater quality particularly road run-off and environmental impacts".

Underpinning these plans is a body of data already collected and mapped to identify critical assets, map flooding "hotspots", and prioritise maintenance and renewal programmes. As data capture and asset assessment and work programmes develop, a multi-criteria analysis tool is applied to evaluate social, cultural, environmental, and economic factors to enhance decision-making on asset renewal and repair works and increase the likelihood of long-term sustainable outcomes.

Figure 8: Catchpit Pollutant Trap installed in Catchpits

5.1 GULF ISLANDS STORMWATER SOLUTIONS

Auckland Transport currently own and manage stormwater assets on the Gulf Islands.

The current discharge of wider catchment stormwater to roadside ditches and culverts requires management to prevent increased pavement deterioration, which is a specific area of concern on the Hauraki Gulf Islands. As there is no formal stormwater system for the wider catchment with primarily an ad-hoc drainage system of culverts, catchpits, table drains and lined channels, a greater knowledge of the existing reticulation is needed. The focus is, therefore, on collecting more accurate data on the condition and performance of pipelines, culverts, catchpits, and manholes. This will also lead to an improved maintenance regime, as the system is currently cleaned on an as required basis.

Existing flood hazard mapping studies are being used to determine the impact of storm events on pavement deterioration. GHD has undertaking a study of wider catchment stormwater flows that impact on the Gulf Islands drainage network and ultimately pavement deterioration. Issues visually assessed as part of the study have included slope stability, erosion, carriageway deterioration, flooding, and drainage asset defects.

There are significant road corridor stormwater preventative maintenance issues evident on the Gulf Islands affecting the carriageway, adjacent slopes, and the harbour.

The islands have many primary roads along steep slopes and aligned along the coastline. Any erosion or failure of banks and shoreline structures could have a major impact on the roading infrastructure, particularly where there is little or no room to relocate the road corridor.

Increased development particulary on Waiheke Island with land use and zoning changes in rural areas has accounted for increased pressure for Auckland Transport to manage its

stormwater flows within the road reserve and invest in infrastructure upgrades to ensure stormwater flows from the carriageway do not affect private property owners.

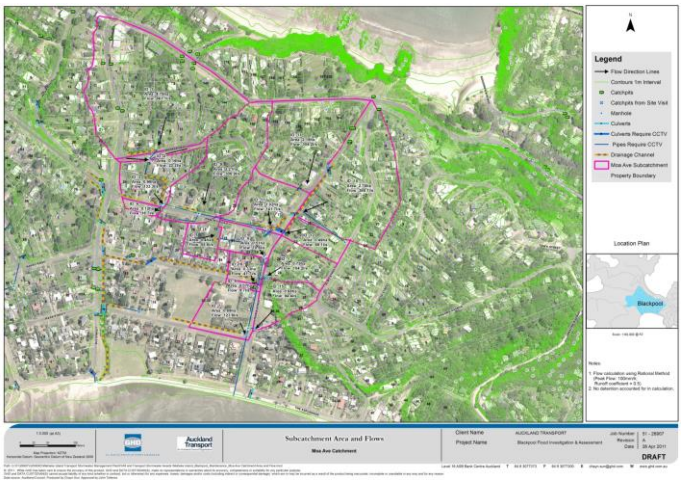
This issue has triggered catchment studies to better understand flow conveyance in rural catchments and its roading network which acts as the conduit for stormwater flows.

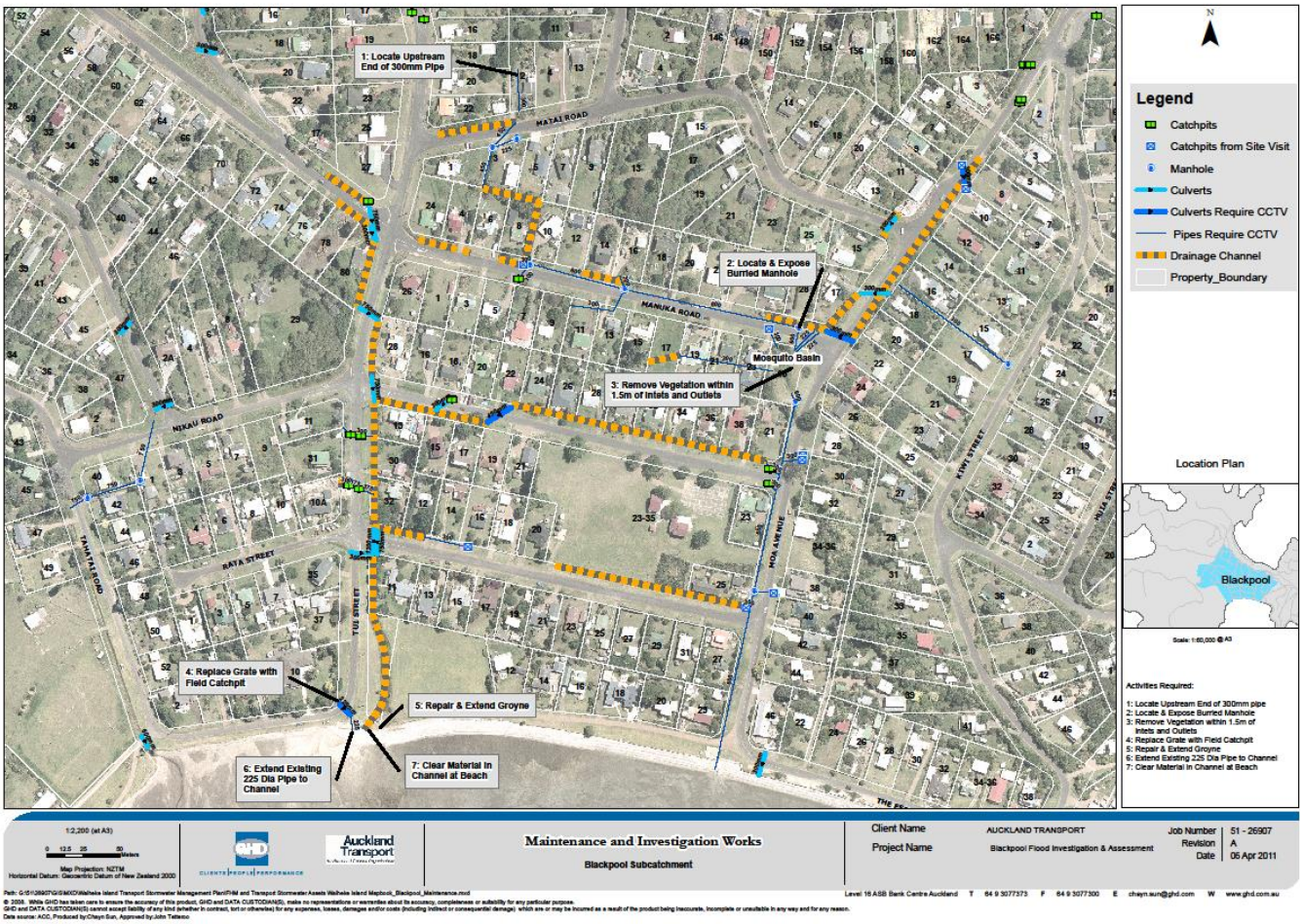
GHD is currently assessing rural subcatchments on Waiheke Island to identify critical locations, culverts, and overland flows onto private properties and priority upgrades required. This has included the design of new systems, stormwater treatment and the use of energy dissipating structures due to steep topography to ensure reduced environmental impacts, community input, approvals and a sustainable solution when discharging to sensitive environments.

GHD, Auckland Transport and Auckland Council SW have been proactive in managing the Gulf Island issues through improved inlet/outlet protection, installed structures to minimise erosion at outlets and maintain flow conveyance, installation of low cost treatment devices to manage pollutants and blocked catchpits, instigating cleaning and maintenance regimes for detention basins and open channels to remove litter and excess sediments, trimming vegetation and grasses and maintaining capacity including scour protection.

Figure 9: Detention Basin clearing and inlet/outlet protection

Figure 10: Blackpool Maintenance and Remediation Works plan, Mosquito Basin





6 WIDER AUCKALND TRANSPORT ASSET MANAGEMENT INITIATIVES

New maintenance contracts for both Auckland Transport and Auckland Council SW have been written to provide improved data logging and performance reporting. First reports from the South Area contract are being analysed. This will allow the optimisation of catchpit cleaning to maximise sediment capture and removal while minimising cost, and prioritising high-risk sites.

Collaboration between Auckland Transport and Auckland Council SW on asset data recording and sharing is improving the quality of information available for planned management in all areas.

Pavement management is taking more account of the effect of moisture on road pavement performance. Both surface and subsurface drainage defects are responsible for a high proportion of early pavement failure, and systematic improvement of drainage can extend pavement life. This is particularly significant where localised failures require extensive pavement rehabilitation. The use of flood hotspot mapping, in conjunction with subsoil drain information, can allow planned deficiency improvement to extend pavement life.

7 CONCLUSIONS

Auckland Transport is steering a substantive drainage renewal programme that aims to have all road related drainage assets meet the minimum requirements for condition and performance standards, and has level of service commitments for the way in which stormwater is conveyed on road surfaces.

There are significant challenges in retrofitting urban catchments with stormwater treatment devices, aiming to improve stormwater discharges to the environment. This initiative shows there are opportunities to significantly improve the stormwater discharge quality by focussing on asset management and the operation and maintenance regimes of the road drainage network.

The opportunities can be realised through challenging past practises and investing in research and development of innovative ideas.

Auckland Transport has incorporated the catchpit pollutant devices and soakhole filter cages into its management of road stormwater contaminants based on this initiative, and is currently installing the devices at prioritised locations (such as environmentally sensitive areas, roads with greater than 20,000 vehicles per day, and in locations of combined sewer overflows) to maximise the benefits.

Key actions are collecting and validating asset data, analysing effects on receiving environments to identify which improvements should be prioritised, and allowing innovation to produce cost-effective improvements. These work projects show how co-ordinating design detailing and maintenance practices through asset information management can be targeted to achieve value for money management related to environmental and service-level objectives.

The successful outcome of this initiative can be replicated in any city in the world impacting positively on the receiving environment.

ACKNOWLEDGEMENTS

Auckland Transport for allowing the use of information from the report "Central Area Soakage Assets Risk Assessment" report.

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