December 2017

Tamar Estuary River Health Action Plan

Tamar Estuary Management Taskforce

Tasmanian Government

Contents

Executive Summary

Background and Process

The Tamar Estuary Management Taskforce (the Taskforce) was established under the Launceston City Deal with an aim of identifying investments to improve the health of the Tamar Estuary. As part of this work, the Taskforce was charged with delivering a River Health Action Plan (this Plan) by the end of 2017.

Influences including the City's combined sewerage and stormwater system, the inability to flush sediment due to marine tides meeting freshwater rivers, agricultural practices further up in the catchment, historical industrial practices, outflows from multiple waste water treatment plants throughout the Estuary, river floods and man made changes to the flow and channel of the Estuary have all been cited as reasons for the Tamar not meeting modern expectations of health and amenity.

The Taskforce identified improving public health measures of water quality in the Launceston to Legana part of the Estuary as its initial priority. Two Taskforce working groups were subsequently established - one considering best value for money actions in the Estuary's catchments to stop the flow of pathogens into the Tamar (the Catchment Action Working Group) and a second looking at possible actions to mitigate untreated overflows from the City's combined sewerage and stormwater system (the Combined System Overflow Working Group).

The Taskforce conducted a public consultation process calling for submissions regarding the level of service expected from the Estuary and asking for evidence based proposals for improving Estuary health. While the Taskforce had decided its initial work would focus on public health measures in the upper catchment, it was conscious that there may be other views as to what the priorities for the Estuary are and was anxious to capture these.

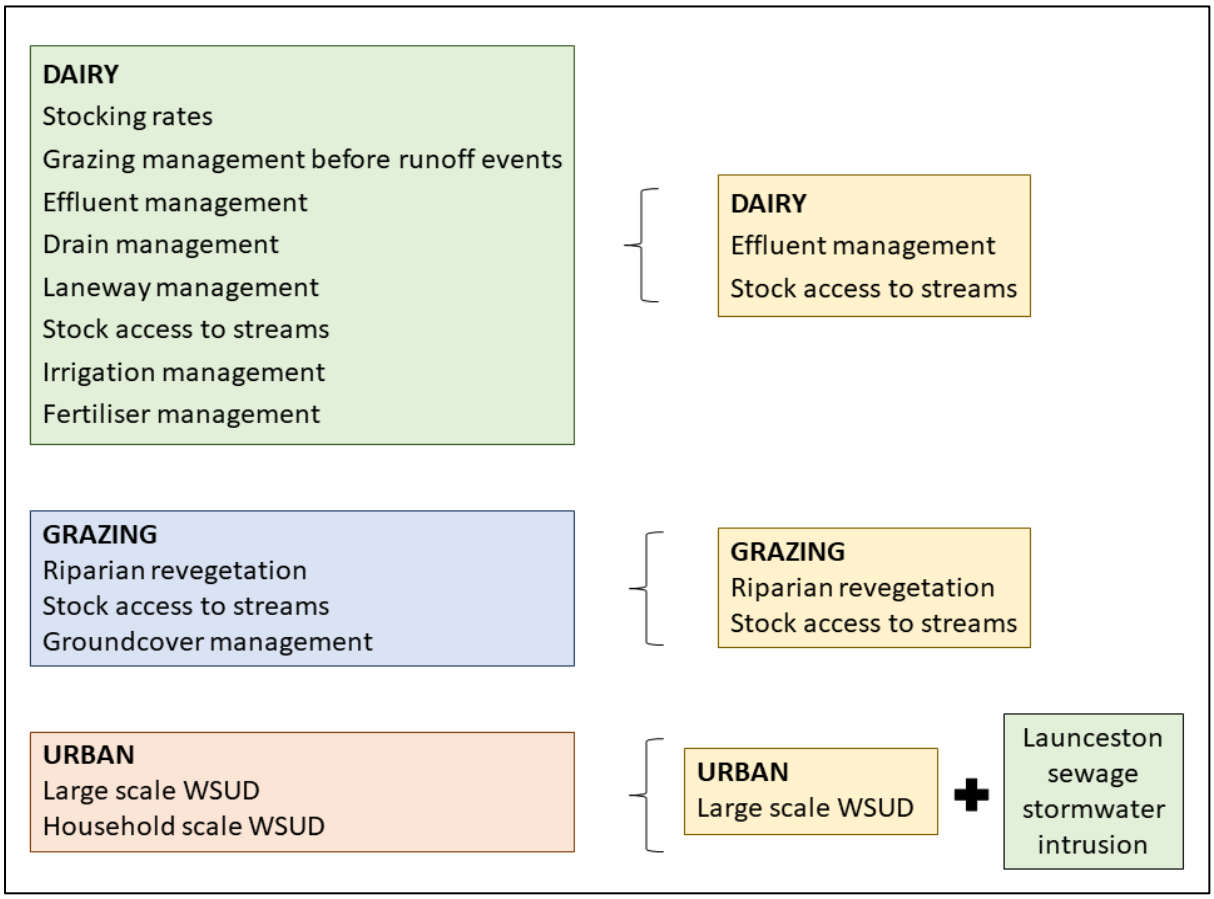
Catchment Action Working Group

The Catchment Action Working Group utilised and extended upon the analysis already completed by the Tamar Estuary and Esk Rivers (TEER) program, but with a narrower focus on the public health actions that had been identified in TEER's Water Quality Improvement Plan 2015 (WQIP).

Actions considered targeted pollutants coming from dairy, grazing and urban areas. These land uses are the three largest contributors to pathogen loads in the greater Estuary catchment and are also major controllable sources of nutrient and sediment loads.

These actions, captured in the green, blue and red boxes in the figure below, were assessed against the following criteria to determine which would provide the best value for money.

- High leverage – actions must have a large relative impact on pollutant loads.
- Adoptable – feedback from key stakeholders must indicate that actions can be adopted at sufficient levels with incentives.
- Measurable – actions need to be able to be accounted for within a planning and investment cycle.

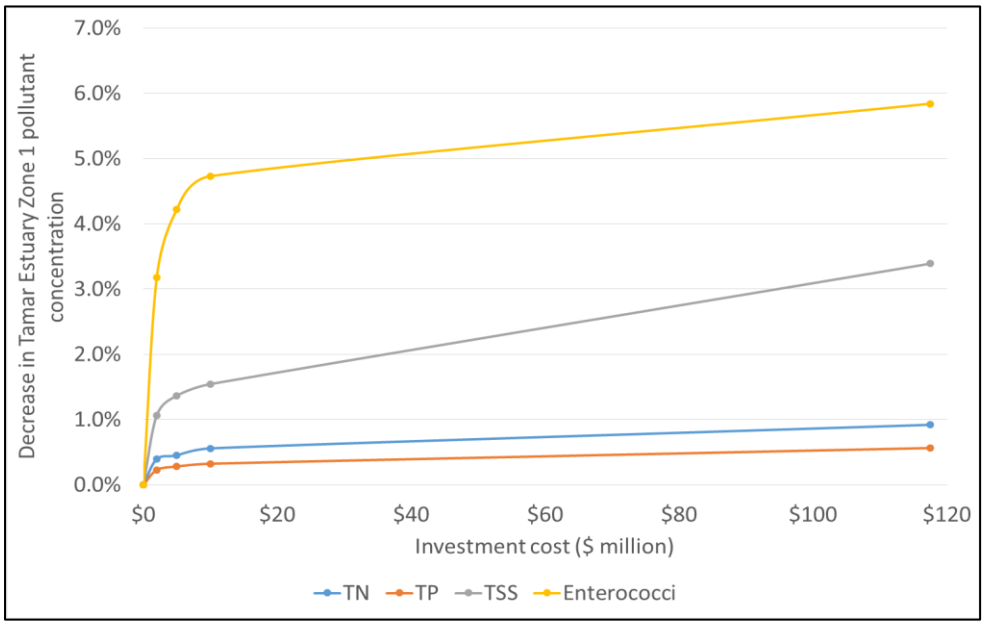


In the dairying and grazing spaces, large benefits were determined available from limiting stock access to streams to minimise input of faecal matter into tributaries, while improved effluent management practices in dairies and the implementation of riparian zones on grazing properties were also assessed to have good potential for pathogen load reduction. The Macquarie and North Esk catchments are the focus of these actions and build on the significant success NRM North have had in addressing these challenges in the Meander catchment.

With respect to the urban catchment actions, the WQIP 2015 had focused on water sensitive urban design (WSUD), but it was found that these actions don't provide great benefit for cost when looking at pathogen load reduction. Instead action options in the urban area turned to focussing on removing cross connections from separated sewerage and stormwater systems, where recent programs by Launceston City Council had been shown to deliver good reductions in sewage load during overflow events.

Three different investment budgets, $2 million, $5 million and $10 million, were considered and a series of actions allocated for each budget amount. The chart below shows the expected reductions in pathogen, nutrient and solids concentrations in the Launceston to Legana zone (Zone 1) at the various investment levels. The far right of the chart includes the benefits possible from a full investment of all the programs initially considered by the Working Group ($117 million).

The findings show that there are significant benefits in reducing Zone 1 pathogens that cause a threat to public health (i.e. enterococci) for relatively small investments. It is the Taskforce's view that a $10 million investment in catchment actions would be preferable and deliver around 80 per cent of what is possible for the full $117 million of initially considered actions.



Combined System Overflow Working Group

The Combined System Overflow Working Group leveraged off work already commenced by the Launceston City Council to build a detailed hydraulic model of the combined system. The model allowed a better understanding of how the network functions in various levels of rainfall event and through this greater detail became known about where the majority of overflows from the system occur. The Group then shortlisted a number of possible mitigation treatments (captured in the table below).

Treatment option	High level description
7. Legislation, regulation and policy improvement	Changes to the legislative and regulatory environment to incentivise continuous improvement of the combined system
8. Community information and education	Ongoing monitoring of river health to facilitate continuous system improvement, education streams and warnings in the event of an overflow
9. Operational improvements and system optimisation	Review existing operational environment of the combined system to ensure existing infrastructure is operating efficiently and effectively (i.e. Margaret Street Detention Basin and weir levels at CSO locations)
10. Green infrastructure (primarily WSUD treatments)	Develop the framework required to transition from "traditional" drainage systems to WSUD drainage systems including detention, wetlands, ponds, bio-filtration systems and infiltration systems to decrease runoff frequency, volume and peak flow. Green infrastructure would also be considered for the immediate mitigation options
11. Screening, preliminary treatment and/or	Installation of screening and chemical treatment facilities at the 3 key CSO locations

Treatment option	High level description
disinfection at CSO locations	
12. Offline storage	Underground storage tanks located at the key CSO locations
13. Live storage	Storage within the existing system, requiring baffles, weirs, actuators at the 3 key CSO locations
14. Separation	Full separation of the combined system and construction of a separated sewer and stormwater network
15. Diversion of separated sewage catchments	Diversion of the West Launceston and South Launceston trunk sewerage mains directly to the Ti Tree Bend STP
16. Diversion of separated stormwater catchments	Construction of required stormwater drainage components to enable direct discharge to the Estuary at Margaret Street
17. System upgrade i.e. additional combined rising main to Ti Tree Bend and reconfiguration of network components	Increase the pump rate to Ti Tree Bend for the key CSO locations
18. Consolidation and movement of discharges further downstream.	Pump combined discharge further downstream to where the Estuary widens and dilution is increased

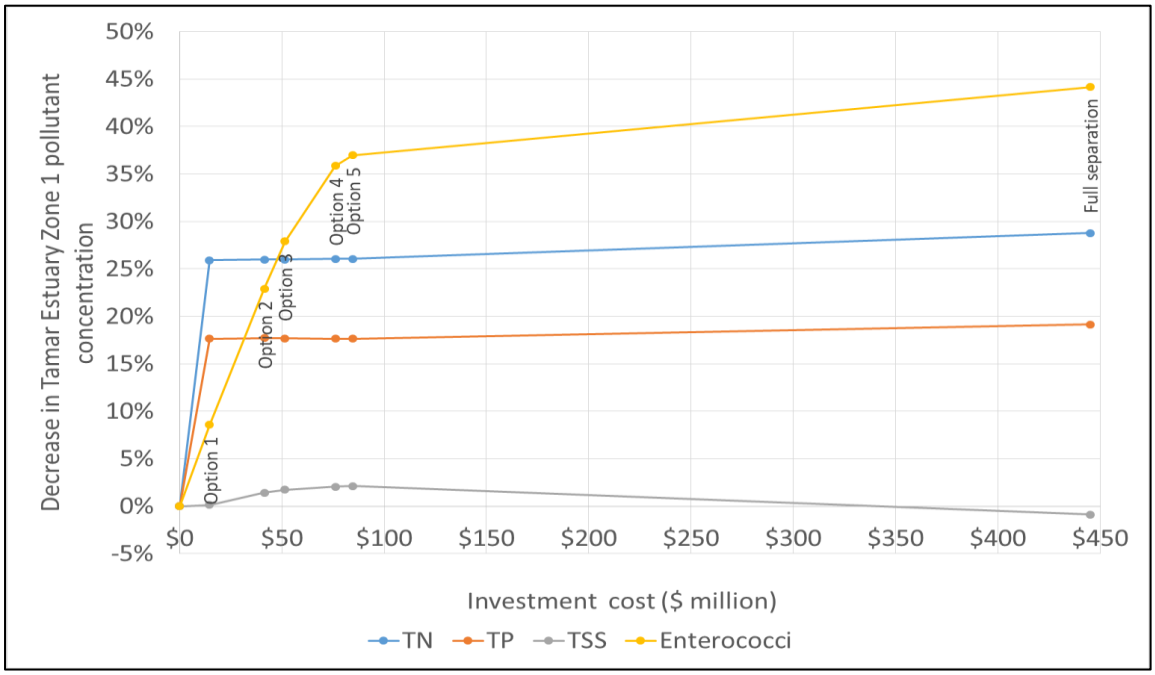
A multi-criteria analysis and preliminary examination of these treatments led to a shortlisting of six "hard" infrastructure projects as being the most feasible in terms of their practical delivery and expected return on investment as measured by reduction of sewage loading to the Estuary.

These projects were:

1. The West Launceston Diversion – a diversion of the separated sewerage catchment that currently joins the combined system at the Margaret Street pump station (and therefore which can then be overflowed to the Estuary in higher rainfall events) and instead extend the trunk main directly to Ti Tree Bend sewerage treatment plant;
2. New Combined Rising Main – a project to upgrade the Margaret Street pump station to allow for greater pumping rates and adding a new combined rising main to Ti Tree Bend to accommodate the increased flows;
3. An offline storage located at New Margaret Street Pump Station – a project to provide a storage to capture the "first flush" sewage that would otherwise spill straight to the Estuary in higher rainfall events, that can then be bled back into the system and receive treatment at Ti Tree Bend;
4. An offline storage located at Forster Street Pump Station – as with project 3;
5. The South Launceston Diversion – similar to project 1, this project would see the separated sewerage catchment that joins the combined system at Shields, Tamar and Willis Streets being redirected to a new pump station and sent straight to Ti Tree Bend; and
6. The offline storage proposed to service the Esplanade – as with projects 3 and 4.

As a number of these projects will increase the flows being received directly by Ti Tree Bend Sewerage Treatment Plant, an analysis of that Plant's performance in higher flow conditions was completed. This showed that while the Plant would continue to perform well in treating enterococci and addressing suspended solids, its performance would be expected to drop off in terms of its nutrient treatment with the additional flows being received. It was the Taskforce's view that while its focus was on improving public health in Zone 1, an outcome where that goal was met, but the ecological health of the Estuary decreased due to a decline in nutrient treatment, would be an unacceptable outcome.

For this reason, the Working Group also included a $10 million project to upgrade nutrient treatment at Ti Tree Bend Plant which is based on preliminary project concepts and costing that TasWater has completed. While it is acknowledged that the Ti Tree Bend project costing is based preliminary estimates and has the potential to be understated by a higher degree than other projects identified, the chart below shows the expected reductions in concentrations in Zone 1 from implementing the six proposed combined system overflow projects and the upgrade of the Ti Tree Bend.



Full separation of the combined system has an estimated cost of $435 million and assumes that this would decrease combined system overflows to the Estuary by 100 per cent. It is clear the proposed mitigation projects provide significant value for money and would reduce enterococci concentrations by more than 35 per cent in Zone 1, or expressed another way, approximately a 70 per cent reduction in combined system sewage load for an estimated $84.6 million total investment. Significant nutrient reduction would also be delivered from these initiatives.

As can be seen, full separation is extremely costly at over 4.5 times the cost of the projects proposed and would require works to be undertaken in up to 7,000 homes to ensure separation of private plumbing infrastructure, not to mention the complexity of works that would occur in commercial parts of the City. This upheaval would be considerable and the total cost may be conservative depending on the level of complexity of rectification works on private pipes, the location of driveways, garages and trees and the for commercial customers the potential loss of trade while works were undertaken.

Recommended Projects and Implementation

The table below outlines the individual and combined value of the projects and actions that the Taskforce believes will yield the best value for money improvements to the Tamar Estuary. The Taskforce is of the view that significant benefits can be delivered to the health of the Tamar Estuary for an investment of under $100 million.

Projects	**Estimated Cost ($ million)**
Catchment Actions	
Brumbys-Lake, Macquarie, Meander & Tamar - Dairy	1.10
North Esk - Grazing	1.33
Upper Tamar – Grazing	1.66
Brumbys-Lake, Meander and South Esk – Grazing	5.41
Launceston sewage stormwater intrusion	0.50
Combined system actions	
Esplanade storage	6.7
Forster St storage	8.4
New Margaret St storage	10.0
South Launceston Diversion	18.1
West Launceston Diversion	4.6
New combined rising main	26.8
Ti Tree Bend plant nutrient removal upgrade	10.0
Total	**94.6**

The catchment actions will need to be implemented in partnership with a number of key organisations. It is expected that grazing and dairy action programs would be implemented by NRM North in partnership with Dairy Tasmania and the Tasmanian Farmers and Graziers Association. Past experience in on-ground investments indicates that a planned investment of $1 million per year is appropriate.

Evidence from similar programs in other Tasmanian catchments reveals that along with early adopters of a such program, momentum is generally created by the relatively large scale investment, with local landholders seeing the benefit of actions on neighbouring farms and the creation of new behavioural norms amongst local farming communities. The program will need to be flexible in terms of the approaches used to ensure ongoing adoption over time (for example the use of market based mechanisms or higher incentive rates for more difficult works may need to be considered).

Works to address sewage intrusion into Launceston's stormwater system would be led by Launceston City Council in partnership with TasWater as required. It is expected that these works could be undertaken over a 2 to 5 year period, depending on the scale of investment.

With respect to the combined system investments, the upgrade to Ti Tree Bend and the West Launceston Diversion would be the most sensible projects to commence first. It is expected that these upgrades could be completed in a two year time frame, but clearly require TasWater's involvement and agreement as asset owner. While these projects are conceptually part of TasWater's Launceston Sewerage Improvement Plan, it is not currently clear how prioritising these works for the benefit of Estuary health would align with TasWater's priorities, nor what funding from TasWater may be appropriate. A negotiation with TasWater will be necessary to understand issues of timing and capacity for delivery.

The South Launceston Diversion is probably a more long term project given the disruption it would cause given its likely route. This project may need three years to undertake and be in the latter tranche of the rollout of projects. The offline storages and the new combined rising main from Margaret Street pump station are more discrete and could be completed in the period between the Ti Tree Bend upgrade /West Launceston Diversion and the South Launceston Diversion.

Other Recommendations

The Taskforce is committed to progressing a number of other recommendations made in the Plan. Firstly, there is need for a comprehensive communications and education plan to be delivered around the proposed recommendations. The Taskforce notes that there is a lack of common understanding amongst the community around how the Estuary operates, both in terms of the natural features and the impact of human interventions. The recommended projects need to be presented in this context. The expected improvements from investment must also be presented in an accessible and tangible form that the community can readily understand. The Taskforce (or its replacement) should develop this content if the recommended projects are funded.

On the issue of funding, Launceston City Council will commit funding to assist delivery of the proposed combined system projects, though Council has not yet approved an amount. Negotiation with TasWater will be required to agree a funding contribution for the recommended combined system projects that are comprised within its Launceston Sewerage Improvement Project. TasWater's timing for these projects may not align with the Taskforce's intended schedule and as such some negotiation may be required to bring the works forward. Funding of the proposed dairy and some of the grazing catchment action initiatives could be funded from the allocation provided to the Taskforce by the Department of Energy and Environment and it is recommended that this source of funds be allocated for that purpose.

In addition to the hard infrastructure projects and catchment actions, the Taskforce also recommends that the Department of Primary Industries, Parks, Water and Environment develops a discussion paper that overviews the current regulatory arrangements for the combined system, with a view to a more detailed review by EPA Tasmania that canvasses the options and potential costs and benefits of a more formal regulatory framework for the combined system. Despite local community concerns, combined systems operate successfully around the world and the common approach appears to be to set up a regulatory arrangement that requires best practice management and continuous improvement of the network. The intention is for the recommended discussion paper to be prepared and released before the end of the first quarter of 2018, with feedback to be sought from stakeholders regarding whether a detailed review and possible reform is supported.

An increased monitoring and analysis program is considered necessary by the Taskforce to accompany the proposed actions and investments. This will ensure that progress against the target improvements can be tracked and reported on and any learnings captured to aid future management decision making or to improve on actions and investments yet to be undertaken. An extended monitoring regime that would provide measurable data to assess the success of actions proposed by the Taskforce is likely to cost in the order of $250,000 per annum.

Two other pieces of work are still being progressed by the Taskforce with an intention to deliver findings by the end of the first quarter of 2018. The first of these is a recommendation for an ongoing governance structure for the Estuary, while the second will respond to the submissions received through consultation that seek an approach to improving the visual and recreational amenity associated with the process of sedimentation. Specialist advice is being sought on each of these issues.

Recommendations

The Taskforce makes the following recommendations:

1. Catchment actions to the value of $10 million be implemented across dairy, grazing and urban areas. These actions will seek to exclude stock from streams, rehabilitate riparian vegetation buffers on grazing properties, ensure better effluent management on dairy farms and remove sewage intrusion into separated stormwater system in urban Launceston. These actions are expected to reduce pathogen concentrations in the Launceston to Legana zone of the Estuary by more than 4 per cent.
2. Priority projects to the value of $84.6 million are implemented within the combined system. The projects include improved pumping rates and transmission capacity to take greater volumes of combined system flows to Ti Tree Bend sewerage treatment plant, implementing a series of off line storages to capture the "first flush" of combined system sewage which would otherwise overflow into the Estuary and diverting separated sewerage catchments straight to Ti Tree Bend instead of them joining the combined system at Margaret Street and the Esplanade. These projects are expected to reduce pathogen concentrations in the Launceston to Legana zone of the Estuary by more than 35 per cent.

Projects	**Estimated Cost ($ million)**
Catchment Actions	
Brumbys-Lake, Macquarie, Meander & Tamar - Dairy	1.10
North Esk - Grazing	1.33
Upper Tamar – Grazing	1.66
Brumbys-Lake, Meander and South Esk – Grazing	5.41
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West Launceston Diversion	4.6
New combined rising main	26.8
Ti Tree Bend plant nutrient removal upgrade	10.0
Total	**94.6**

3. A discussion paper is prepared by the Department of Primary Industries, Parks, Water and Environment of the regulatory arrangements surrounding the combined system in consultation with relevant stakeholders. The paper would then form the basis of a review to be undertaken by EPA Tasmania on potential changes to the existing regulatory framework to recognise and regulate combined systems consistent with best practice frameworks elsewhere.
4. An increased monitoring and analysis program in the Estuary to accompany the proposed actions and investments. This will ensure that progress against the expected improvements can be tracked and reported on and any learnings captured to aid future management decision making or to improve on actions and investments yet to be undertaken.

5. The Taskforce continue work to determine appropriate ongoing governance arrangements for the Estuary and what actions may be taken to improve amenity values associated with sedimentation.

1. The kanamaluka/Tamar Estuary, its catchment and the Launceston Combined System

At 70 kilometres long, the Tamar is one of the longest estuaries in Australia. The catchment that feeds the Estuary is around 10,000km2 in area and it encompasses a number of uses such as grazing, dairying, forestry, mining, residential and industrial activities.

As can be seen, what happens as far away as Tunbridge, Fingal and Deloraine can impact on the Estuary's health at Launceston or George Town. Key tributaries include the North Esk, South Esk, Macquarie and Meander Rivers.

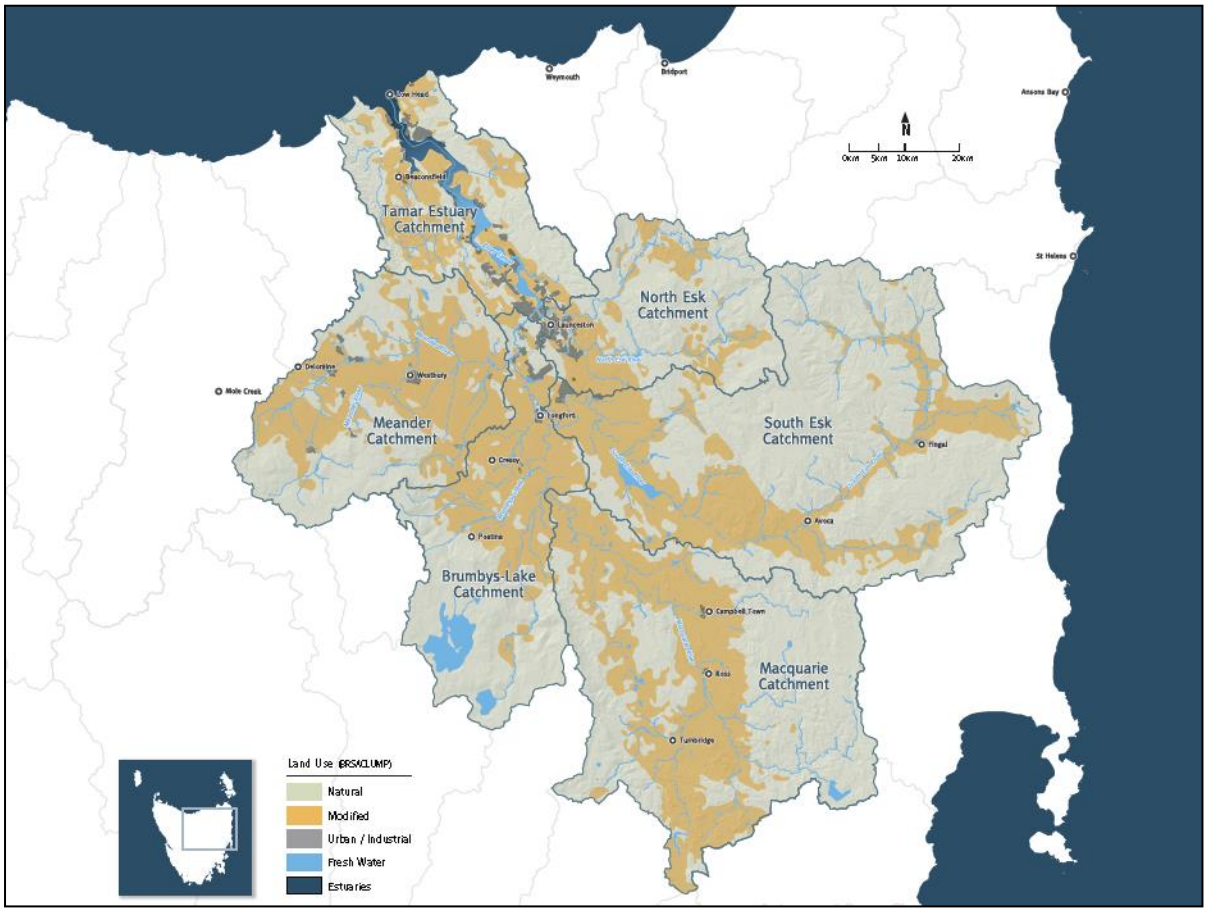

Figure 1. The Tamar Catchments

There is a long held desire by the Launceston community to improve the health of the Estuary, particularly the area around the Yacht Basin at the confluence of the North Esk, South Esk and Tamar Rivers. Many of Launceston's older residents recall a beach at Royal Park (which was in fact man made from sand imported from George Town) and there is a view amongst much of the community that primary contact with the water (e.g.

swimming) should be the norm, not the exception. However, the health of the Estuary is influenced by many factors, some inherent in nature, some as a consequence of the social and economic history of the region.

Influences including the City's combined sewerage and stormwater system, the inability to flush sediment due to marine tides meeting freshwater rivers, agricultural practices further up in the catchment, historical industrial practices, outflows from multiple waste water treatment plants throughout the catchment, river floods and man made changes to the flow and channel of the Estuary have all been cited as reasons for the Tamar not meeting modern expectations of public amenity.

It is worth highlighting that Launceston's combined system is somewhat unique to Australia. It is the only major city that still has part of its stormwater and sewerage system utilising the same system of pipes. While it may be unique in Australia, combined systems are still prevalent in many major cities around the globe, including London and Paris. Their network of pipes are designed to carry the larger stormwater flows and thus are much bigger than that of a separated sewerage network and have a number of benefits. For example, run off from roads such as motor oils, contaminants washed down from the catchment and dog faeces, receive treatment in Launceston, which isn't the case in the rest of the State.

Historically combined systems were seldom designed to accommodate all rainfall events as this was often not possible or economically/technically feasible. This led to the systems having dedicated overflow points where any stormwater and sewage in the pipe at the time of a large rainfall event would also overflow. In the case of Launceston, there are 62 overflow points in the system, with around 15 that can overflow with sewage and these overflows ultimately end in the upper reaches of the Tamar.

Previous research into the system suggested that the most frequently overflowing points in the system were spilling, on average, more than once weekly or in rainfall events of 4-5 mm. However, there was little consensus on the scope and scale of the issues created by the combined system as there was not a significant analysis of the historical body of detailed water quality monitoring, under varying weather conditions, to understand just what impact these overflows have and how long they last.

The data available shows that relative to pathogen levels as recently as the early 1990s, there has been significant improvement in the public health measures in the upper Estuary.

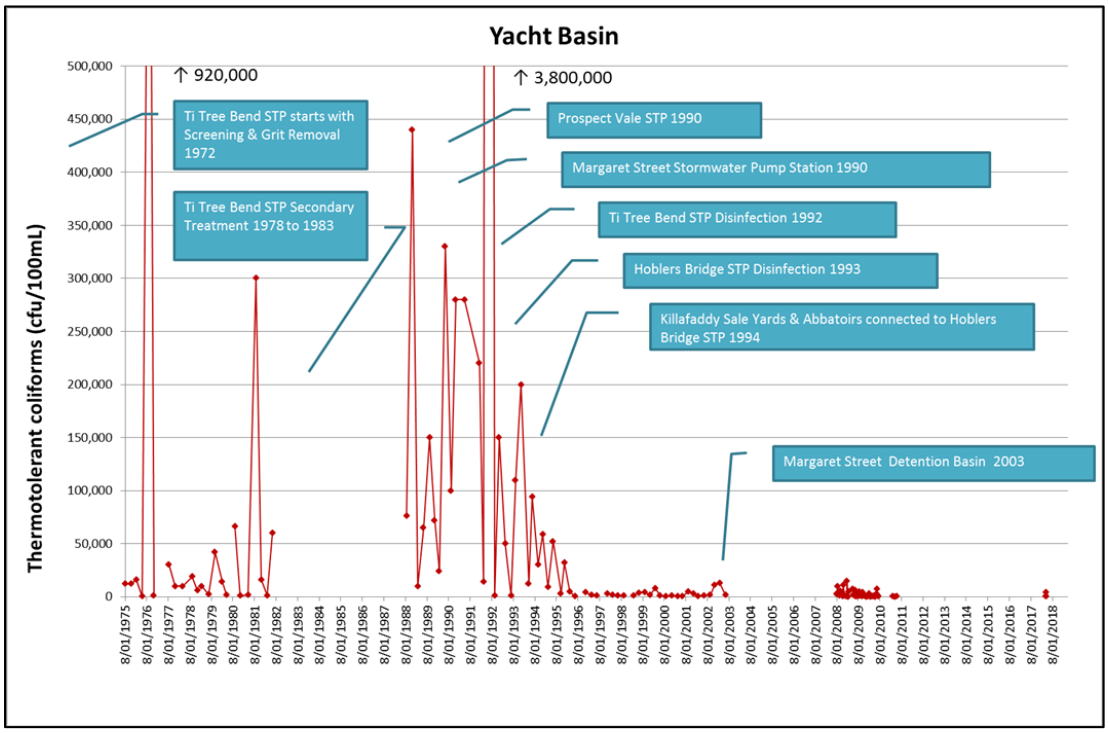

Figure 2. Historical pathogen concentrations in the Upper Tamar (colony forming units per 100ml)

Past proposals for improving water quality have not been short in supply, but there has been no consensus as to the actions that will yield the best value for money improvements across public health, ecology and amenity values. While a complete separation of the combined system may be preferable, it would be extremely costly, potentially technically infeasible in part and would require upheaval across the city for a significant period. It would also not address all the diffuse sources of pollution entering the Estuary from further up in the catchment.

2. Tamar Estuary Management Taskforce

2.1 Launceston City Deal

The Launceston City Deal is a five-year plan (from 2017 to 2022) to position Launceston as one of Australia's most liveable and innovative regional cities. The Commonwealth Government, Tasmanian Government and City of Launceston are working together with local partners to achieve this shared vision for Launceston.

The City Deal commitments aim to maximise Launceston's potential through targeted investment to deliver:

- jobs and skills growth;
- business, industry and population growth;
- a vibrant, liveable city;
- innovation and industry engagement; and
- a healthy Tamar Estuary.

With respect to the last of the aims, the City Deal noted...

"The fragmented governance and management of the Tamar Estuary and its catchments is a barrier to improving river health. Responsibility falls across various government departments, agencies, local government authorities and private land holders with competing priorities that cannot be easily resolved. There is a lack of clear authority, responsibility and accountability for identifying and investing in priority actions and policies to improve water quality standards."

It is in this context that the Tamar Estuary Management Taskforce was established under the City Deal.

2.2 Membership of the Taskforce and its governance

Appointed by invitation of the Treasurer, the Hon Peter Gutwein, the Taskforce is Chaired by Allan Garcia, Chief Executive Officer of Infrastructure Tasmania, and includes representation from councils surrounding the Estuary, a State Government agency and other stakeholders with key technical expertise relating to the Estuary.

The full membership comprises.

- Allan Garcia, CEO Infrastructure Tasmania (Chair)
- Mayor Christine Holmdahl, West Tamar Council
- Mayor Craig Perkins, Meander Valley Council
- Councillor Leisa Gordon, Northern Midlands Council
- Mayor Bridget Archer, George Town Council
- Shane Eberhardt, Launceston City Council
- Andrew Fullard, General Manager, Launceston Flood Authority

- Rosanna Coombes, CEO NRM North
- Rolph Vos, Chair of Tamar Estuary and Esk Rivers
- Martin Read, Department of Primary Industry, Parks, Water and Environment

The Taskforce reports to the Launceston City Deal Executive Board which comprises:

- Commonwealth Department of the Prime Minister and Cabinet (co-Chair)
- Tasmanian Government Office of the Coordinator General (co-Chair)
- Commonwealth Department of Education and Training
- The City of Launceston
- The University of Tasmania

The Board met twice in its first year (2017), then will meet annually, to monitor progress in implementing the Deal's commitments. The Taskforce is to deliver annual reports to the Launceston City Deal Executive Board on progress towards the targets it sets.

2.3 Taskforce Terms of Reference

The Taskforce met for the first time on 3 August 2017 and agreed a terms of reference for its work. Key amongst its scope and as set out in the City Deal, the Taskforce was charged with developing a River Health Action Plan by the end of 2017 (this Plan). The Taskforce agreed that the Plan should include:

- recommendations for priority government investments and policy actions;
- preferred options for mitigating the effect on the Tamar Estuary of the combined sewerage and stormwater system;
- arrangements for the long-term oversight and ongoing governance of the health of the Tamar Estuary and its catchments; and
- measurable targets and accountability for meeting them over the life of the City Deal and the longer term.

In commencing its work, the Taskforce acknowledged the significant work of the Tamar Estuary and Esk Rivers (TEER) partnership led by NRM North, including its 2015 Water Quality Improvement Plan and agreed that where appropriate this work would be built upon. It also acknowledged that there have been many past reports and investigations into the issues pertaining to Tamar Estuary health and did not have any intent to duplicate what has come before.

2.4 Initial priorities agreed by the Taskforce

To reach agreement on what its work program should be, the Taskforce first gained a common understanding of the measures of Estuary health.

To some, "Estuary health" relates to measures of public health (e.g. faecal contamination from human and animal sources as measured by enterococci levels in the water) which present the most immediate risk to the public. To others, it is the ecological health in the Estuary (e.g. the impacts of nutrients like nitrogen and phosphorous on the diversity of Estuary flora and fauna) and for some it is less about health measures and more about amenity

measures (e.g. the level of sedimentation in the yacht basin impacting on the ability to use pleasure craft or the visual amenity of less water flowing down the South Esk due to use for hydroelectricity generation).

Given the potential for a very broad scope, the Taskforce resolved that, based on the guidance within the City Deal and on the membership's collective view as to the key risk of poor Estuary health, its initial focus would be on looking at actions to improve public health measures. In essence, this is the risk to the population of primary contact with the Estuary, and the Taskforce decided to focus specifically on what TEER had already defined as "Zone 1", between Launceston and Legana.

This is not to say that the other measures of health and amenity are not important, nor are the other zones of the Estuary not important, but this narrowing of focus allowed this Action Plan to be developed by the end of 2017 and allowed the Taskforce to consult with the community about which of the other measures were seen as of most importance and which could be part of a future work program.

This led the Taskforce to focus on mitigating pathogens entering the Estuary from the combined sewerage and stormwater system and looking at other sources of pathogens coming down the catchment.

2.5 Establishment and scope of working groups

The Taskforce resolved to establish two Working Groups to support its efforts, particularly to provide specialist input and advice. The working groups were directed to focus on:

The Launceston Combined System Overflows

The working group's scope was to build on the Launceston City Council's hydraulic modelling of the combined system, agree a set of priority solutions to mitigate overflow events which could be tested through the hydraulic model, understand the impact of these solutions on public health outcomes in the Estuary and then cost priority works.

Catchment Actions

This working group sought to build upon the TEER Water Quality Improvement Plan 2015 and aimed to identify the most cost effective and beneficial investment scenarios to achieve outcomes for water quality improvement in Zone 1 with a focus on reducing pathogen loads from catchment diffuse and urban sources.

As necessary, other stakeholders were consulted by the Working Groups.

2.6 Initial funding for Taskforce activities

The Taskforce was provided with $2 million for priority actions to reduce pollution from urban and rural land uses and address pollution from the combined sewerage and stormwater system. The Australian Government, through the Department of Energy and Environment, allocated $1.5m ($500,000 per annum for three years), while the Tasmanian State Government provided $500,000.

A proportion of these initial funds have been utilised to support the Taskforce's Working Groups, with the Australian Government funding expected to largely be utilised for ongoing programs recommended by the Catchment Action working group.

Given any major infrastructure solutions would likely cost significantly above the initial funding allocations, the City Deal also required the Taskforce to explore funding and financing options for upgrades to the Launceston's combined sewerage and stormwater system, including through bodies such as the Clean Energy Finance Corporation.

3. Process and consultation

3.1 Tamar Facts paper and public consultation

In acknowledging that the Taskforce had narrowed its scope for the delivery of this initial Plan, it was felt that broader community should still be consulted regarding the aspects of Estuary health important to them. The Taskforce was of the view that as there has been such a history of diverse views on the problems, causes and solutions for Tamar health, these should be consolidated as part of this process to ensure all parties were given a voice.

The consultation period opened on 16 September 2017, with an advertisement placed in The Examiner, and concluded on 20 October 2017.

To assist this process, a short paper, Tamar Facts, was prepared by the Taskforce and released on the Infrastructure Tasmania website (see Appendix 1). The intent of the paper was to present some of what the Taskforce considered to be the key agreed facts relating to the Estuary, but to also prompt respondents into answering key questions like "what expectations does the community have for use of the Estuary?" and "what level of service do they desire?". Feedback was also sought on which form of Estuary health was seen as most important and what priority actions, informed by a sound scientific evidence base, should be implemented.

The Taskforce was of the view that if there was strong feedback on issues of Estuary health outside of public health, it would either encompass these into the existing working group efforts, or set up additional work streams.

3.2 Specialist input

Through the course of the Taskforce's meetings, specialist input was sought from a number of organisations.

TasWater and LSIP

TasWater was invited to present on its Launceston Sewerage Improvement Program (LSIP), which provided the Taskforce with an understanding of the expected benefits of LSIP and the timing of the key works.

LSIP is a two stage program, with the first being a rationalisation of the six wastewater treatment plants around Greater Launceston to a new treatment facility at Ti Tree Bend, with a second phase that would upgrade the existing treatment plant at Ti Tree Bend (which receives the flows from the combined system). Collectively this program totals around $370 million and, while it will have benefits for public health measures, it will primarily reduce nutrients loads from wastewater treatment plant outfalls.

The first phase of the program is nominally scheduled for TasWater's fourth regulatory pricing period (2021 - 2024), but requires regulatory approval for the spending, which wouldn't be considered by the Tasmanian Economic Regulator until 2020. In anticipation of this, TasWater is currently reviewing the LSIP Strategy to ensure that it meets the prudency and efficiency tests required by the Regulator. As a result the scope and timing of "Stage 1" and "Stage 2" may change.

With this program largely aiming to reduce nutrient loads and thereby assisting to improve ecological health in the Estuary, the Taskforce was comforted that its initial focus on public health was sensible. This said, only 20 per cent of nitrogen loads are a result of poorly performing wastewater treatment plants, while this figure is approximately 35 per cent for phosphorous. As such it was noted that the issue of ecological health may still need further action and would be influenced by consultation feedback.

Hydro Tasmania and impact of flow in the South Esk

The CEO of Hydro Tasmania attended the October 2017 meeting of the Taskforce and presented on Hydro's understanding of the impact of environmental flows through the Cataract Gorge on siltation in the Tamar and, in turn, public health measures.

Currently, a constant flow of 2.5 cumecs (2.5 cubic metres of water per second) is released to flow through Cataract Gorge for amenity reasons. It was noted that silt raking at 2.5 cumecs is barely effective in dispersing sediment and much greater releases are required to have a tangible impact. For example there was an early 2017 release for white-water kayaking of 18 cumecs for three days and this was combined with silt raking, which had significant short term impact. This is the reason that raking activities are currently coordinated with large rainfall events.

While it is Hydro's view that significant environmental flow release has little impact on improving public health measures, it was agreed that the Taskforce would work with Hydro Tasmania during its summer releases of 2017-18 for kayaking to establish the effects of large intermittent flows.

There has previously been discussion about recommissioning Duck Reach power station downstream of the Trevallyn Dam to offset potentially greater flow releases to the Gorge by Hydro, it was noted that the Trevallyn power station produces electricity 3 to 4 times more efficiently than Duck Reach could and as such the generation capacity of Duck Reach would not be sufficient to offset the loss of electricity production. The Trevallyn power station produces enough energy to power 80,000-90,000 homes and therefore any foregone production has an opportunity cost in terms of domestic supply or revenue generation into the National Electricity Market. In addition, the levels in the Dam, particularly over the summer are generally not sufficient to support the level and frequency of release required to have a material impact on sedimentation if electricity production is to be unaffected.

The Taskforce formed the view that there appears little benefit at this time in pursuing greater Hydro releases to aid the improvement of public health measures in the upper reaches, but will seek evidence through the summer period, noting the case would need to be compelling given the importance of the Trevallyn Power Station to electricity generation. However, there are demonstrable benefits to greater flows from a sedimentation removal viewpoint.

3.3 Submissions received and key themes

Eight submissions were received through the public consultation process and each of these is available on the Infrastructure Tasmania website (https://www.stategrowth.tas.gov.au/infrastructure_tasmania/tamar_estuary_management_taskforce).

While many of those received agreed with the Taskforce's initial assessment that improving the public health measures in upper Estuary is a priority, in almost every submission the issue of sedimentation was raised.

Variously, submissions linked sedimentation build up to poor public health outcomes, poor ecological health and a lack of recreational amenity. However, the amenity issues seem to be a key priority for the community.

Proposals to deal with sedimentation have included:

- Making changes to Estuary bathymetries;
- Moving the Tailrace discharge to Yacht Basin;
- Returning higher flows from Trevallyn Dam to the South Esk;
- Changing the configuration of North Esk entry at the confluence of the Upper Tamar;
- Upstream detention basins;
- Alternatives to silt raking;
- Establishing a barrage; and
- Implementing speed limits on boats to stop riverbank erosion.

On the basis of the strength of support in submissions for improving sediment based amenity issues, the Taskforce determined that it would be appropriate to seek appropriate technical advice to peer review proposals put forward. The process for this work is documented in section 10.

4. Catchment Action Working Group

4.1 Membership

The Taskforce Catchment Action Working Group consisted of members from Dairy Tasmania (Jono Price and Rachel Brown), the Tasmanian Farmers and Graziers Association (Peter Skillern, Brigid Morrison and Nick Steel), the Environment Protection Agency (Martin Read and Glen Napthali), the Meander Valley Council (Martin Gill), the West Tamar Council (Rolph Vos) and NRM North (Rosanna Coombes), with technical and scientific modelling support provided by isNRM (Dr Rebecca Kelly).

However, the Group's Technical Report and the proposed Investment Plan (see Appendix 2) also benefited from review by the TEER Scientific and Technical Committee and Partnerships Committee.

4.2 Previous work available and updates completed

The Catchment Action Working Group's efforts build on the work previously undertaken in development of the TEER Water Quality Improvement Plan 2015 (WQIP) by NRM North for the catchment. The Technical Report and Investment Plan are a considerable step forward in the WQIP implementation for the Zone 1 area.

The WQIP and Investment Plan consider the impact of investment actions on four major pollutants: Total Nitrogen (TN); Total Phosphorus (TP); Total Suspended Sediments (TSS); and enterococci. TN and TP are nutrients. Elevated nutrient levels can feed the growth of nuisance algal growth in streams, dams and estuaries. This algae can increase turbidity and can smother and replace native plant and animal species. It can also make water dangerous for recreation and drinking.

High levels of TSS make water turbid and dirty looking and can smother and replace native plant and animal species, decreasing the health of waterways. Sediment exports from the freshwater system to the Estuary can also contribute to sediment accumulation in the Upper Estuary.

Enterococci is a bacteria used as an indicator of pathogen pollution. Pathogens come from animal or human faeces and when elevated can make people sick if they drink or recreate in water.

The Tamar Facts document (Appendix 1) and the Catchment Action Working Group Technical Report and Investment Plan (Appendix 2) both provide a more detailed discussion and breakdown of the specific sources of these pollutants within the Tamar catchment, but the following figure summarises the catchment by land use and the contribution of those land uses to catchment flow and pollutants.

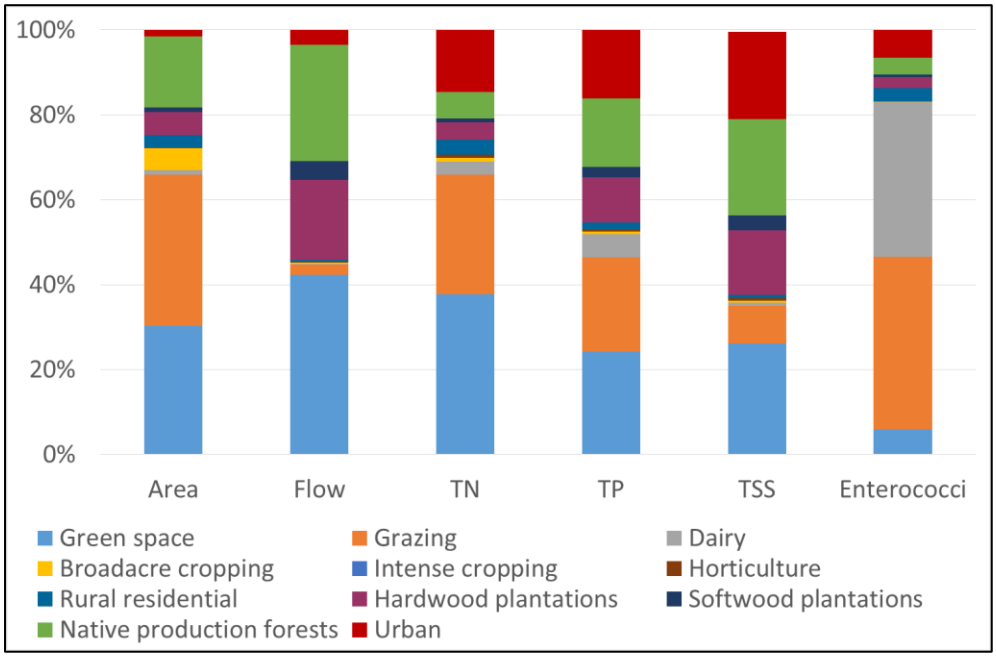

Figure 3. Relative contribution of different land uses to Greater TEER catchment loads, flows and area

As can be seen, dairy and grazing represent the largest contributors of enterococci and hence are the focus of the Group's proposed Investment Plan, though contributions from urban areas too are not insignificant.

4.3 Criteria for investment plan

The Catchment Action Investment Plan considers the range of actions evaluated and recommended in the TEER WQIP 2015. From these, a smaller group of actions were selected for consideration using the following criteria:

- High leverage – actions must have a large relative impact on pollutant loads
- Adoptable – feedback from key stakeholders must indicate that actions can be adopted at sufficient levels with incentives
- Measurable – actions in the Investment Plan need to be able to be accounted for within a planning and investment cycle

Actions considered target pollutants coming from dairy, grazing and urban areas. These land uses are the three largest contributors to pathogen loads in the greater TEER catchment and are major controllable sources of nutrient and sediment loads (i.e. loads that are able to be reduced through improved management actions as opposed to loads that are largely driven by uncontrollable factors such as rainfall and high slope).

4.4 Actions considered

The figure below shows the range of actions for each land use considered in the WQIP and the actions selected using the above criteria for assessment in this Investment Plan.

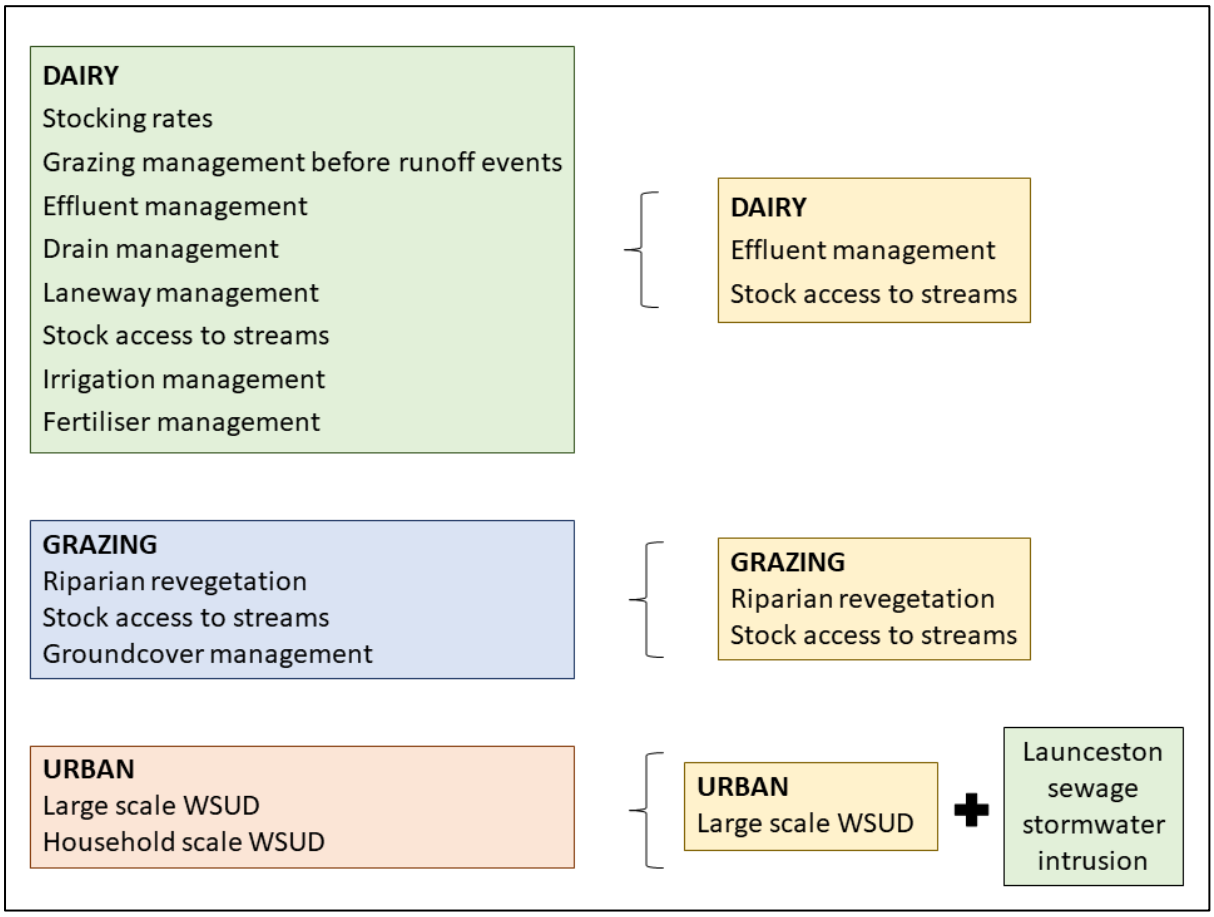

Figure 4. Catchment actions considered to target Estuary enterococci levels

In dairying, improved effluent management has great potential. While a Code of Practice established under the Dairy Industry Act 1994 currently guides the size of the holding pond required for effluent, there are further management measures associated with treatment and spreading that could be improved.

In the case of both dairying and grazing, there is much that can be done in limiting stock access to streams through fencing and provision of off-stream water as well as through addressing issues with stock crossings. Incorporation of a 5m wide vegetated riparian buffer within this fencing will also be of much benefit in grazing.

With respect to the actions in urban settings, large scale water sensitive urban design such as wetlands, swales and bioretention systems focused on treating urban runoff to remove pollutants as well as reducing runoff volumes can be more widely utilised.

In addition, fixing issues with sewage intrusion into Launceston's separated stormwater system also has merit. This action was not identified in the 2015 WQIP but was included in the analysis for the Working Group's Investment Plan following the success of a recent program run by the Launceston City Council. This program found sewage intrusion into the separated stormwater system in parts of Launceston is causing elevated pathogen

levels in stormwater that is directly discharged into Tamar Estuary Zone 1. Works have recently been undertaken in the Kings Meadows Rivulet catchment to resolve these issues resulting in significant and measurable improvements in pathogen levels observed. It is considered that continuing these works to address issues in Trevallyn and Waverley/Ravenswood stormwater systems would have material benefits.

4.5 Findings

The full cost of implementing the actions considered by the Working Group across the catchment was estimated at $117 million. Three different investment budgets were then considered: $2 million; $5 million; and, $10 million[1] and analysis completed to see what the best value for money mix of actions would be at those investment budgets.

These budgets were allocated to the individual land uses one at a time to allow comparison of the cost effectiveness of various investments. The location of investments was prioritised by the criteria above, with grazing and urban action focused first in the North Esk and Upper Tamar foreshore catchments before investments above Trevallyn Dam were considered.

It was found that all dairy actions considered could be implemented catchment wide for $1.1 million, less than the lowest budget considered. Addressing issues with the separated stormwater system was also costed at $500,000 for both Trevallyn and Waverley/Ravenswood systems and so would be fully implemented for 25 per cent of the lowest budget considered.

The analysis shows very clear differences between the cost effectiveness of the different actions in reducing greater TEER catchment loads[2] and to a lesser extent Tamar Estuary Zone 1 concentrations[3].

Dairy management was by far the most cost-effective action in reducing greater TEER catchment pathogen loads, accounting for more than 50 per cent of the potential load reduction possible from all considered actions at under 1 per cent of the full cost (see Figure 5).

Investments in dairy management also had similar impacts on nutrient and sediment loads as a $5 million investment in grazing management, for around only a fifth of the cost.

Investments in water sensitive urban design (WSUD) are very cost ineffective for reducing greater TEER catchment loads with significantly smaller proportions of load reduction versus relative costs.

Addressing issues with sewage intrusion to Launceston's separated stormwater system (SS) is cost effective for enterococci but has no impact on nutrient or sediment loads. This option has a small overall impact on Greater TEER catchment loads but this impact compares favourably with an even smaller relative cost.

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[1] Note that with the exception of works to fix sewage intrusion into Launceston's separated stormwater system, investment options assume a 15 per cent overhead to cover costs associated with program implementation such as extension staff.

[2] Load is estimated in the model as the average concentration of pathogens, measured in colony forming units (cfu) across the catchment, multiplied by volume entering the catchment.

[3] Concentration is the number of cfu per 100 millilitres of water at a specific point in the Estuary.

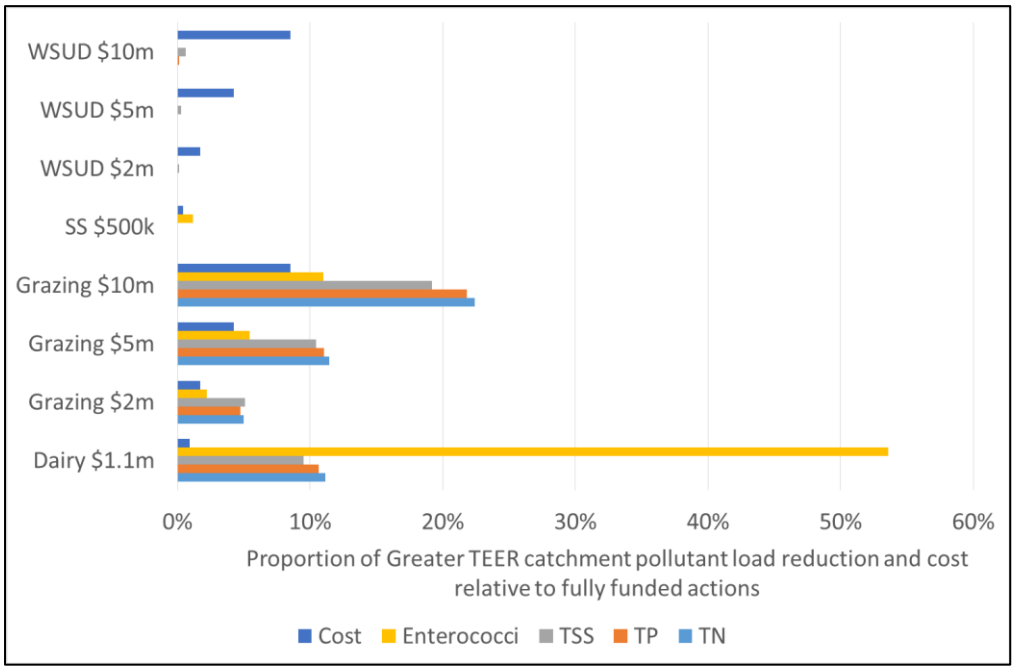

Figure 5. Proportion of Greater TEER catchment Diffuse load reductions and costs relative to fully funded actions Met with investment Options

Differences between grazing and dairy management are less evident when their impact on Tamar Estuary Zone 1 concentrations is considered (see Figure 6). In this case it is modelled that all levels of investment in grazing management achieve greater decreases in Tamar Estuary Zone 1 concentrations for all pollutants than dairy management does. However dairy management impacts on enterococci concentrations are still high and compare very favourably to grazing, particularly given the smaller relative budget.

Addressing issues with sewage intrusion into Greater Launceston's separated stormwater system (SS) is a very cost-effective way of reducing pathogen concentrations in Tamar Estuary Zone 1, although this action has no benefits in terms of nutrient or sediment concentrations. This action achieves a greater reduction in pathogen concentration relative to cost than both dairy and grazing management. Water sensitive urban design (WSUD) is shown to be cost ineffective for addressing pathogen concentrations in Tamar Estuary Zone 1. Its greatest relative benefit is in addressing sediment concentrations which are not a focus in this Investment Plan. Even for sediments it is less cost effective than investment in either dairy or grazing management.

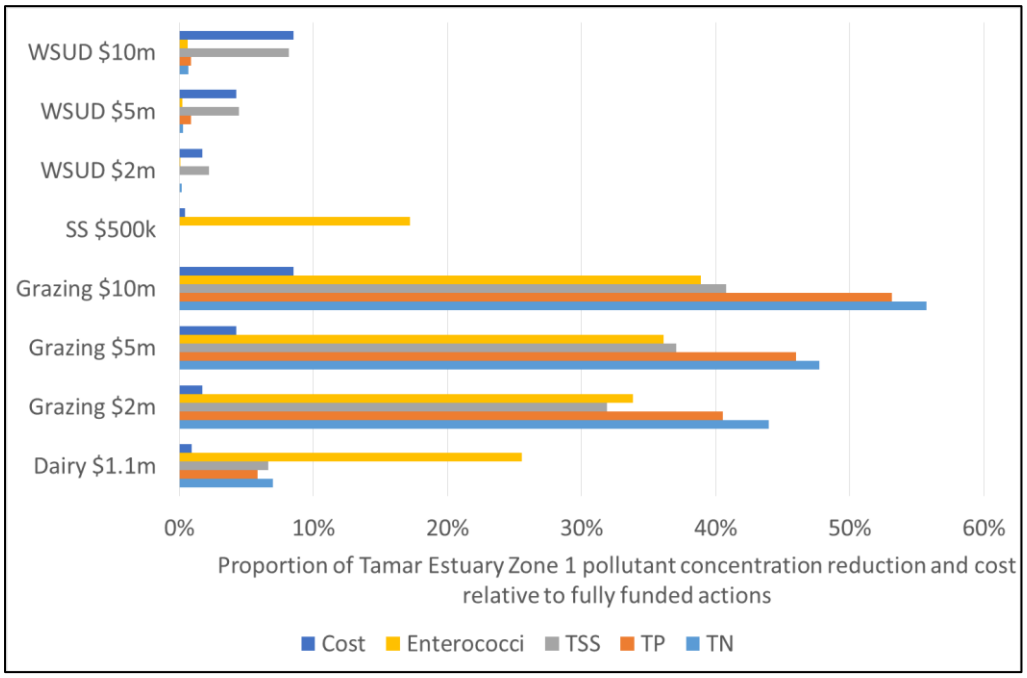

Figure 6. Proportion of Tamar Estuary Zone 1 Concentration reductions and costs relative to fully funded actions met with investment options

4.6 Recommendations and expected benefits

Balanced investment options

Based on the above analysis, a set of balanced investment options has been developed, using a mix of investment in the different land uses with different levels of investment to maximise public health outcomes at those budget levels. These options include a mix of dairy management, grazing management and investments in reducing sewage intrusion into Launceston's separated stormwater system. No investment in water sensitive urban design is included given it was found not to be cost effective for reducing pathogen concentrations in in Tamar Estuary Zone 1.

The budget for planned investment for activities by land use for the three balanced investment options is given below.

Catchment Action	$2 million	$5 million	$10 million
Dairy			
Brumbys-Lake, Macquarie, Meander & Tamar	$550,000	$825,000	$1,100,000
Grazing			
North Esk	$1,250,000	$1,330,000	$1,330,000
Upper Tamar	$0	$1,660,000	$1,660,000
Brumbys-Lake, Meander & South Esk	$0	$685,000	$5,410,000
Urban			
Launceston sewage stormwater intrusion	$200,000	$500,000	$500,000

Table 1. Investment in Land uses by major subcatchments under balanced options

Some of the benefits that can be expected from these investments include:

- Immediately after actions are undertaken
- Reduced stock trampling of the river and consequent turbidity and stream health impacts.
- Reduced pathogens in the rivers and estuary from direct manure inputs to streams and effluent runoff from dairy farms.
- Pathogens are very rapidly reduced by fixing intrusion of sewage into Launceston's separated stormwater system.

Medium term

- Riparian vegetation grows providing streambank stability and reduced streambank erosion.
- Riparian vegetation increases river shading and reduces stream temperatures, improving instream habitat.
- Riparian vegetation provides corridors for the movement of flora and fauna increasing the connectivity of populations and their resilience to change.
- Further improvements in water quality are experienced as riparian vegetation provides a filter for runoff from grazing properties and improved effluent management reduces overloading of nutrients in soils on dairy farms and reduces losses through runoff and infiltration.

Long term

- The landscape becomes more resilient to change. Fencing and off-stream water ensures increasing numbers of stock (through intensification and/or conversion of grazing into dairy) are unable to access the stream. Riparian buffers filter increased pollutant exports off paddocks caused by intensification of land use.
- Flora and fauna corridors provided by riparian vegetation allow for species retreat under climate change and variability, increasing the resilience of flora and fauna populations to these changes.

Impact of investments on greater Estuary pollutant loads

Figure 7 shows the relative cost-benefit of the balanced investment options in terms of reduced Greater TEER catchment loads. The balanced investment options are very cost effective for reducing all pollutant loads, but particularly effective for reducing enterococci loads.

The low end $2 million investment option can be expected to achieve roughly a 9 per cent decrease in enterococci loads for the Greater TEER catchment, equivalent to 25 per cent of the potential decrease in enterococci from fully funding all actions considered ($117 million), but for only 1.7 per cent of the budget. Relative benefits for other pollutants are smaller but still represent a greater relative benefit than cost, with roughly 9 per cent of the potential benefit for nutrient and sediment loads achieved for only 1.7 per cent of the fully funded budget.

While the marginal benefit of further investment decreases with subsequent investment, investment of $10 million is still shown to be very cost effective with 25 to 30 per cent of the potential decrease in nutrients and sediment and over 60 per cent of the potential decrease in enterococci loads achieved for only 8.5 per cent of the cost of fully funding potential actions. This represents a very good return on investment. It should be noted that benefits in terms of reduced sediment loads are likely to be significantly underestimated. This is because the benefits for increased streambank stability and reduced streambank erosion through exclusion of stock and riparian revegetation are not included in the modelling. Using very conservative estimates of the benefits of these actions for streambank erosion the reduction in tonnes of sediment is likely to be at least twice what is estimated using the CAPER DSS model[4], and potentially a lot higher.

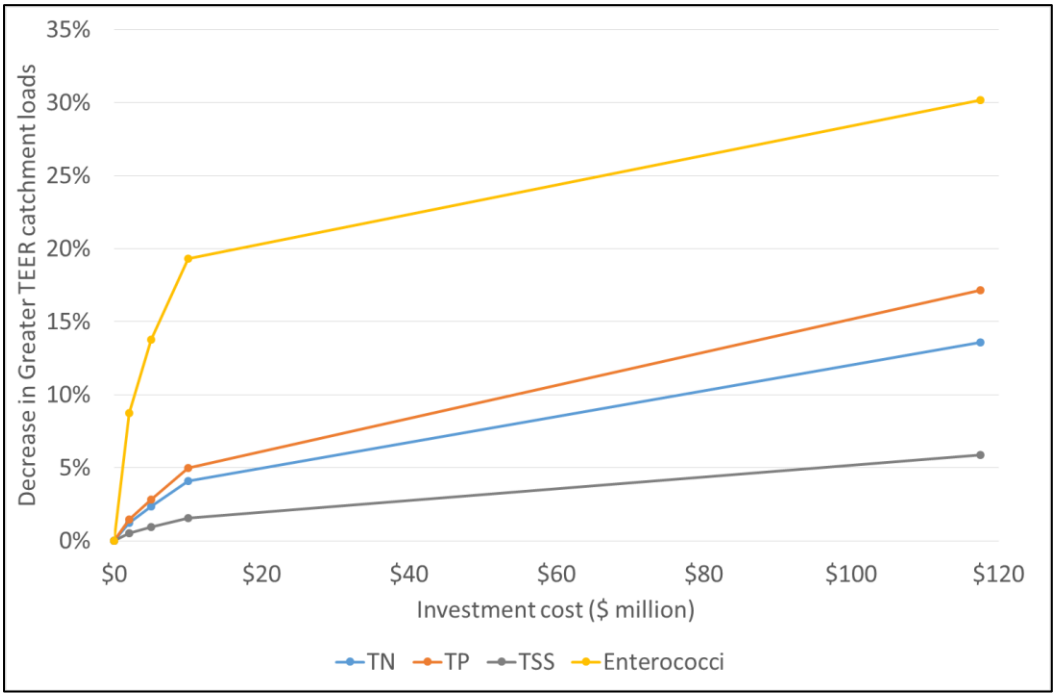

Figure 7. Decrease in pollutant loads in Greater TEER catchment from balanced investment option

On the basis of this analysis, the Taskforce recommends a $10 million investment in catchment actions. While significant benefit is expected to be realised from the first $2 million investment, an almost 20 per cent reduction in enterococci loads in the catchment is thought possible if the upper budget is allocated. This is almost two-thirds of the benefit thought possible if the full $117 million of actions initially considered were implemented.

[4] For example – for a $10 million investment in the balanced option, the CAPER DSS estimates a decrease of 1560 tonnes of sediment as a result of the management actions. This action includes roughly 390km of streams with stock excluded, including 50km on dairy properties with a single wire fence and 340km on grazing properties with both stock exclusion and a 5m vegetated riparian buffer. If this reduces streambank erosion by 1cm per year on the affected streambanks, assuming a uniform streambank height of 1m then 6650 tonnes of sediment export through streambank erosion is avoided. This is over 4 times more than the reduction in sediment load estimated by the CAPER DSS. Similar calculations for the $2 million and $5 million investment find reduced sediment exports through avoided streambank erosion of 2.5 and 3.4 times respectively.

5. Combined System Overflows Working Group

5.1 Membership and specialist advice

The Combined System Overflows Working Group included Launceston City Council (Shane Eberhardt, Kathryn Pugh, Michael Newby and Randall Langdon), TasWater (Andrew Truscott, Cameron Jessup), Infrastructure Tasmania (Stewart Sharples), independent consulting expertise from local engineering firms JMG (Geoff Brayford) and GHD (Ray Dodson), international experience in combined systems management provided by GHD (particularly Richard Roll from Buffalo, New York State) and integrated catchment assessment by isNRM (Dr Rebecca Kelly).

5.2 Previous work available

While there is a history of reports and studies relating to the issues of the in Tamar's river health, the Work Group's investigations extends the detail looking at the combined system impacts and possible mitigations.

In 2015, through funding provided by the Australian Department of Energy and Environment, TasWater (who is the asset owner of the Launceston combined system) engaged consultant Beca to prepare a long term strategy for the combined system based on an understanding of the frequency, extent and environmental impact of the overflow events on the receiving environment. In April 2016, Beca delivered a report entitled Launceston Combined Drainage System Investigation Interim Options and Strategy Report.

The Beca report set out a number of potential options for dealing with combined system overflows, but importantly noted that "the results and potential solutions are predicated on the results of an out-dated hydraulic model that requires calibration and refinement" and further, that this model be improved "as a matter of urgency". While Beca's report made progress in understanding how the combined system functions, the Working Group has built on the work undertaken and extended it.

5.3 Hydraulic modelling and scenarios considered

Prior to the commencement of the Taskforce's efforts, the Launceston City Council (as the authority required to provide stormwater drainage in the City) had commenced progressing the recommendations of Beca in relation to improving the hydraulic modelling relating to the combined system.

When the Taskforce was formed and the Combined System Overflows Working Group set up, it made sense to build upon Council's work and help to expedite the completion and validation of the model. Crucial to the validation was information provided to the working group by TasWater, which allowed validation against actual pump run data in rainfall events. This gave sufficient confidence to the working group that the model was ready to run the mitigation scenarios.

The combined system hydraulic model estimates the sewage flows generated by residential, commercial and industrial premises and the stormwater flows generated by rainfall. The model also routes these modelled flows via a one dimensional network to the point of discharge (i.e. either the sewage treatment plant or the Estuary). The model is then able to estimate the content of sewage within the combined flow discharged to the Estuary.

The model showed that while there are 15 possible combined stormwater and sewage overflow points, three distinct sites were identified that contribute around 95 per cent of combined overflows to the Estuary:

- New + Old Margaret Street Pump Station located in Royal Park off Paterson Street;
- The Esplanade (including the Shields Street, Tamar Street and Willis Street Pump Stations); and
- Forster Street Pump Station.

During periods of dry weather, pump stations associated with these locations transfer sewage to the Ti Tree Bend Sewage Treatment Plant. During wet weather events when combined flows exceed the sewage pumping capacity of the stations, excess combined flows are discharged to the Estuary to mitigate flooding behind the levee, either by gravity weir or rising mains attached to pumps. These sites became the focus of the risk management scenarios, or treatment options.

Treatment option	**High level description**
1. Legislation, regulation and policy improvement	Changes to the legislative and regulatory environment to incentivise continuous improvement of the combined system
2. Community information and education	Ongoing monitoring of river health to facilitate continuous system improvement, education streams and warnings in the event of an overflow
3. Operational improvements and system optimisation	Review existing operational environment of the combined system to ensure existing infrastructure is operating efficiently and effectively (i.e. Margaret Street Detention Basin and weir levels at CSO locations)
4. Green infrastructure (primarily WSUD treatments)	Develop the framework required to transition from "traditional" drainage systems to WSUD drainage systems including detention, wetlands, ponds, bio-filtration systems and infiltration systems to decrease runoff frequency, volume and peak flow. Green infrastructure would also be considered for the immediate mitigation options
5. Screening, preliminary treatment and/or disinfection at CSO locations	Installation of screening and chemical treatment facilities at the 3 key CSO locations
6. Offline storage	Underground storage tanks located at the key CSO locations
7. Live storage	Storage within the existing system, requiring baffles, weirs, actuators at the 3 key CSO locations
8. Separation	Full separation of the combined system and construction of a separated sewer and stormwater network

9. Diversion of separated sewage catchments	Diversion of the West Launceston and South Launceston trunk sewerage mains directly to the Ti Tree Bend STP
10. Diversion of separated stormwater catchments	Construction of required stormwater drainage components to enable direct discharge to the Estuary at Margaret Street
11. System upgrade i.e. additional combined rising main to Ti Tree Bend and reconfiguration of network components	Increase the pump rate to Ti Tree Bend for the key CSO locations
12. Consolidation and movement of discharges further downstream.	Pump combined discharge further downstream to where the Estuary widens and dilution is increased

Table 2. Combined system overflow – grouped treatment options

The risk management scenarios were initially grouped into the twelve categories listed in Table 2 and were then shortlisted using multi-criteria analysis and preliminary investigation.

The Working Group's Investment Plan can be found at Appendix 3, which provides detailed information on the processes of model validation and calibration, the options considered and the process of shortlisting.

5.4 Water quality

Water quality parameters have been monitored in the Tamar Estuary and the North and South Esk rivers since the 1970s, with historical data predating the Ti Tree Bend and Hoblers Bridge sewerage treatment plants. Thermotolerant coliforms in the North Esk River at Hoblers Bridge and in the Estuary at the yacht basin were observed to be present in the millions of cells/100mL in the 1970s, with the highest count peaking at 8.8 million cells/100mL at Hoblers Bridge in June 1991.

Mirroring the trend observed globally, there is a strong trend of significantly improved water quality following the construction of wastewater treatment plants. While pathogens in the Estuary are demonstrably much lower than in previous decades, they are still observed to peak, particularly during times of rainfall, rendering the water in Zone 1 unsuitable for primary recreational contact some of the time.

A monitoring program implemented by the Launceston City Council in 2016 collected water quality data from a number of waterways upstream of inputs from Launceston, stormwater sites and downstream sites in the lower North Esk River and within Zone 1 of the Estuary. The data show a strong relationship between rain events and elevated Enterococci levels in the waterways. Rainfall causes a statistically significant increase in pathogens at sites in the lower North Esk River and upper Tamar Estuary. This relationship is evident when rainfall in the catchment exceeds 1mm in a 24-hour period. On average, Launceston experiences 89 days per year where rainfall exceeds 1 mm. At sites upstream of Launceston's urban discharges (e.g. the North Esk River at St Leonards), the water quality meets the recreational guidelines most of the time, but fails to meet the guidelines after rain.

Samples collected on 5 consecutive days in September 2017 captured data from 11 sites in waterways in Launceston, including four sites in Zone 1 in the Estuary. A total of 11 mm of rain fell during the second day of sampling, causing the New Margaret Street pump station to discharge untreated effluent to the estuary. The rainfall event (and associated combined system overflow) resulted in elevated turbidity and Enterococci, with

levels particularly high at St Leonards and the yacht basin. High sediment and pathogen load at the upstream site at St Leonards is largely catchment driven, with livestock the likely source of most of the pathogens. By day 4, Enterococci counts at most sites had returned to baseline levels, with the exception of North Esk River at Inveresk and the yacht basin, and the Tamar Estuary at T2 Kings Bridge. It's likely that these sites remained elevated as the pulse of water from the North Esk catchment made its way downstream and into the upper estuary. By day 5, all sites had returned to baseline (pre-rain) levels.

While only based on one event, this detailed event monitoring data appears to confirm what was previously thought likely. That is, that a first flush of pathogens occurs in large rainfall events and the Upper Tamar soon returns to pre rainfall pathogen levels.

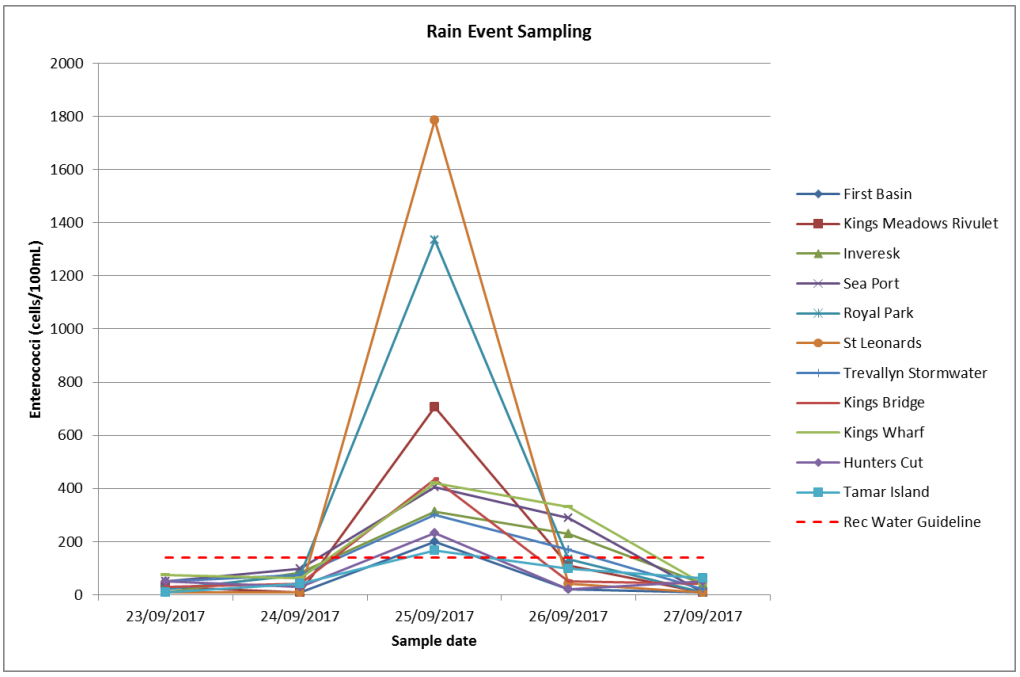

Figure 8. Event monitoring data, September 2017

5.5 Peer review

Richard Roll, Environmental Engineer with GHD in Buffalo, New York State, spent a week in Launceston providing specialist oversight of the treatment options considered. Richard has extensive experience directing technical services for the City of Niagara Falls which has a combined drainage system and which has completed a long term control plan to comply with combined system overflow reduction requirements (administered by the US Environment Protection Agency).

Richard was able to bring a perspective of the regulatory environment in the USA, which provides the principal driver for overflow reduction and environmental improvement. Specific improvement projects for specific municipalities are determined by mandated water quality goals for their respective receiving waters. Typically, municipal programs are composed of mixed measures such as runoff reduction, better collection system maintenance practices, wet weather storage, conveyance enhancement, and treatment facility capacity improvements. There are a myriad of combined sewer collection systems in the USA that are being brought into

water quality compliance without the need for extensive separation programs, and with no plans to separate in the future.

A frequent control measure in the USA involves constructing a deep tunnel system for active storage of excessive wet weather flows while also transporting the stored volumes toward treatment facilities. It may also be possible to reduce the number of outfalls and pumping stations depending upon tunnel routing. Exploring this possibility with Launceston City Council's environmental scientists and engineers led to a consensus that local soils, particularly between the North Esk River and the treatment facility, are problematic and would discourage such a measure. The scale of such projects also tend to make them rather expensive choices.

After considering Launceston's service area, sewer collection system, treatment abilities and improvement goals, Richard expressed his opinion that a well-planned scheme of additional wet weather storage, improved conveyance to the Ti Tree Bend facility, and vigilant sewer maintenance practices presents a very good approach to achieving the desired waterway impact(s). Extensive sewer separation, or a constellation of new wet weather treatment facilities at remote locations, were not expected to be comparably efficacious solutions.

It is the Taskforce's view that bringing an international perspective to investigations relating to the combined system was very useful. It should be made clear that combined systems are accepted infrastructure in major cities around the world. While separation of the two systems would be preferable, most cities have confronted the fact that this is often extremely expensive, but of equal concern, requires complete upheaval to the foundations of a city and also requires thousands of household front or back yards to be excavated to ensure pipes leaving those properties are also separated.

For this reason, regulatory frameworks have often been established to ensure that there are moves to best practice management and a driver for continual consideration of capital upgrade, noting that the United States is just one country that has faced this problem and there are other countries, Europe in particular, that would be worth exploring further.

5.6 Hard Infrastructure Findings

The multi-criteria analysis and preliminary examination led to a shortlisting of six "hard" infrastructure projects as being the most feasible in terms of their practical delivery and expected return on investment as measured by reduction of sewage loading to the Estuary.

These were the actions contained at points 6, 9 and 11 in Table 2 and include:

1. The West Launceston Diversion;
2. New Combined Rising Main;
3. The offline storage located at New Margaret Street Pump Station;
4. The offline storage located at Forster Street Pump Station;
5. The South Launceston Diversion; and
6. The offline storage proposed to service the Esplanade.

Each of these proposed projects are examined in detail below, including their expected cost and forecast reduction in loading in sewage to the Estuary.

The reduction in sewage volume discharged to the Estuary was calculated by first establishing a base line for the combined system. Utilising the validated combined system hydraulic model, a range of design rainfall events was simulated and the total sewage and stormwater discharged to the Estuary was quantified. The combined system hydraulic model was then altered to include the proposed infrastructure and once again, the same design rain fall events were simulated and the discharge quantified. The modelled reductions in sewage volume discharged to Estuary post-mitigation works could then be readily calculated.

West Launceston Diversion

This diversion is expected to provide the greatest value for money project related to the combined system. Part of the LSIP, it has support of TasWater which is an important feature for progressing its implementation.

Currently, the West Launceston and Trevallyn sewage catchments, despite being separated from stormwater, are piped to the join the combined system at the Margaret Street Pump Stations. While under dry weather flow conditions this does not cause problems, in wet weather events the untreated sewage can bypass the pump station to Ti Tree Bend and spill into the Estuary.

In order to facilitate this mitigation option, upgrade works will be required to the sewer mains between West Launceston and the Ti Tree Bend STP. In summary, the works required include:

- Diversion of the West Launceston trunk sewer across the South Esk River;
- Installation of a new transfer main between West Tamar Road and Ti Tree Bend STP including connection of West Tamar No. 1 Pump Station and crossing of the Tamar Estuary; and
- Connection works at Ti Tree Bend.

This project is estimated to have a capital cost of $4.6 million and lead to approximately a 19 per cent reduction in sewage loading to the Estuary. This option also has ongoing operational costs in new and increased pumping costs which would be incurred by TasWater. The present value of costs (capital and operational) of this action over a thirty year period is $5.6 million.

New Combined Rising Main

The works include the decommissioning of the Old Margaret Street Pump Station (OMSPS) and diverting these flows to the New Margaret Street Pump Station (NMSPS) and increasing the combined low (sewage) flows to the STP from approximately 400 L/s to 800 L/s. To accommodate the additional flows, it is proposed that a new rising main be constructed to connect the upgraded NMSPS to Ti Tree Bend.

In addition to reducing the sewage loading discharged to the Estuary from the Margaret Street site, benefits of constructing a rising main between NMSPS and Ti Tree Bend include the following:

- Reduced flow in the City Rising Main enabling greater flows to be discharged from St John Street Sewage Pump Station and the Forster Street Pump Station;
- Provides the opportunity for a significant area of habitat rehabilitation at Ti Tree Bend;
- All flows will be screened prior to discharge at the Margaret Street site (currently CSO from Old Margaret Street Pump Station are not screened); and
- Provides an alternative discharge route (system redundancy) to the STP in the event that the City Rising Main is "out of service".

To achieve the full benefit of this increased flow, it will be necessary to upgrade the Ti Tree Bend STP so that this additional volume (and the associated pathogens) is not overflowed to the Tamar River after the inlet works at the Ti Tree Bend STP during high inflow periods. It is proposed that the land adjacent Ti Tree Bend (owned by the City of Launceston, currently known as the "silt ponds") be converted to a wetland system with additional buffer undercover storage.

The land available at the silt ponds would enable the construction of a 10 hectare wetland. It is likely that the wetland would still require some undercover storage to mitigate the effect of odour.

In summary, the project will include:

1. Works upstream of New and Old Margaret Street PS to divert flows to NMSPS (making OMSPS redundant);
2. Installation of new high head sewage pumps to increase the total sewage pump capacity to (nominally) 800L/s;
3. Installation of rising main works to connect NMSPS to both the proposed storage facility and Ti Tree Bend STP;
4. Reconfiguration of St John Street Sewage Pump Station including the required rising main upgrade from the pump station to the City Rising Main (junction in the vicinity of the Charles Street Bridge) to increase the pump rate to Ti Tree Bend to approximately 500-600L/s;
5. Reconfiguration of Forster Street to increase the pump rate to Ti Tree Bend to approximately 500-600L/s; and
6. Works to a storage and wetland at Ti Tree Bend as described above.

The capital cost of this option is estimated at $26.8 million (total present costs over 30 years of $34.9 million) and is expected to result in a reduction in loading to the Estuary of 28 per cent of current load.

Offline storages

The proposed three offline storage projects are all grounded in the same theory. That is, with a large rain event following a period of dry, there is currently a “first flush” of untreated sewage and highly contaminated stormwater that may overflow from the system. While overflows may continue with continuing high rainfall, the amount of sewage in the system is not at the high levels of this first flush.

The off line storages are proposed at three locations that will help capture much of the first flush effluent, such that it can be bled back into the system when rainfalls subside and can be treated at the Ti Tree Bend STP plant.

The first of these storages is planned for a location adjacent to the New Margaret Street Pump Station and would be the largest storage planned at 4.2 mega litres. It would preferably be located underground in Kings Park, but there are heritage issues that would need to be considered in any construction. Its capital cost is estimated at $10.0 million ($11.4 million present value of total costs) and is expected to reduce the sewage loading to the Estuary from the combined system by approximately 21 per cent.

The second storage is proposed to be underground on vacant land adjacent to the Forster Street Pump Station and would nominally be 2.5ML. It is estimated to cost $8.4 million ($9.7 million total present cost) and would reduce sewage load by approximately 6 per cent.

The last storage is proposed to be underground in the vicinity of Black Bridge and Boland Street (near to the Esplanade) and would nominally be 3.0ML. It is estimated to cost $6.7 million ($7.6 million total present cost) and would reduce sewage load by approximately 9 per cent.

It should be noted that these reductions in load are predicated on the storages being empty before rain events.

The South Launceston Diversion

Under dry weather flow conditions, the sewage flows from the catchments associated with the South Launceston trunk sewer are directed to Ti Tree Bend STP, however under wet weather conditions, a series of Combined System Overflow Pump Stations (at Shields, Tamar and Willis Streets) lift sewage contaminated stormwater over the levee banks into the North Esk River to minimise the risk of flooding to the lower level areas of Launceston.

The intention of this project would be to reduce the sewage component of the discharge to the Estuary from the pump stations located at Shields Street, Tamar Street and Willis Street by diverting the flow via a new rising main direct to Ti Tree Bend.

In order to facilitate this mitigation option, a variety of works will be required to upgrade the sewer system between Hoblers Bridge Road and the Ti Tree Bend STP. In summary, the works required include:

- Diversion of the South Launceston trunk sewer to a new pumping facility in the vicinity of Black Bridge and Boland Street;
- Diversion of the Boland Street SPS rising main to the new pumping facility;
- Installation of a new transfer main between the proposed pumping facility and Ti Tree Bend STP; and
- Connection works at Ti Tree Bend.

The construction of the rising main to facilitate this diversion will enable the connection of the separated sewer catchments located in the Inveresk precinct. With significant development imminent due to the relocation of the University of Tasmania's Launceston campus, the potential to convey sewage flows from the precinct directly to Ti Tree Bend STP will reduce the sewage loading at Forster Street and therefore; the volume of sewage ultimately discharged to the Estuary during wet weather flow conditions.

The capital cost of this project is estimated at $18.1 million (total present costs of $22.4 million) and is expected to result in a reduction in loading to the Estuary of approximately 13 per cent of current load. It should be noted that the proposed route of construction for the trunk sewer diversion would likely require much upheaval through Launceston's eastern suburbs and as such would need careful management. This project is also potentially part of the LSIP strategy.

Decreased loading in context

To put these loading reductions in some further context, the pump records for the New Margaret Street Pump Station indicate that a CSO to the Estuary from this location occurred on approximately 50 days during the period of 1 January 2017 – 10 October 2017. Based on theoretical pump rates, 60 per cent of these overflows were of magnitude 5ML or less (please note, these overflow volumes do not include volume of discharge from the Old Margaret Street pump station). With the proposed 4.2ML holding tank and increased pump rate to Ti Tree Bend, it is likely the frequency of CSO at this location will more than halve.

Furthermore, the modelling showed a significant percentage decrease in the sewage loading to the Estuary in the more frequent events (i.e. rainfall of a level that occurs 12 events per year or more). The reduction of sewage loading discharged to the Estuary by events of magnitude 12EY or more totalled approximately 85 per cent.

5.7 Regulatory and "Green" Infrastructure Findings

Overflows from Launceston's combined sewage and stormwater system are not subject to the conditions contained within the Ti Tree Bend STP's Environment Protection Notice. The Department of Primary Industries Parks Water and Environment's Sewage Pumping Station Environmental Guidelines 1999 recommend that every effort should be made to minimise the impact of combined overflows, however the guidelines have no legal force. It would appear that the combined overflows are outside the statutory framework, other than section 23A of the *Environmental Management and Pollution Control Act 1994* where overflows could be called in under the general environment nuisance provisions.

The working group found that changes to the legislative and regulatory environment could be made to incentivise works within the combined system to reduce the environmental harm caused by discharges to the Estuary. Given an appropriate regulatory environment appropriate goals, objectives and strategies could be identified for the combined system.

In order to decrease contaminants entering Launceston's waterways, a review of legislation, regulations and policy is recommended. It is best practice throughout the western world to regulate combined system overflows with conditions such as:

- Elimination of CSOs during dry weather.
- Pollution prevention programs to reduce containments in CSOs.
- Public notification to ensure that the public receives adequate notification of CSO occurrences and impacts, and the location of CSO outfalls.
- Minimise or eliminate solid and floatable materials' discharge to the receiving environment from CSOs.
- Improved operation and regular maintenance programs for the sewer system and CSO outfalls.
- Maximum use of the collection system for storage.
- Maximise flow to treatment plants.
- Accurate and timely reporting of all CSO events, including date, time, location, and quality and volume of the effluent discharged, including discharge from gravity overflows.
- Review and modification of pre-treatment requirements to ensure that CSO impacts are minimised.
- Ambient monitoring to effectively characterise CSO impacts and the efficacy of CSO controls.

These frameworks need not need to go as far as prescribing the load or concentration of overflows, but instead ensure that the asset owner or service provider is moving towards best possible practice and optimising the whole system for the benefit of the Estuary.

Other potential benefits of legislative or regulatory acknowledgement of the combined system is, in the context of a $400 million plus cost to fully separate the system, is that it legitimises the system's existence and changes the conversation from "third world infrastructure" to "permissible infrastructure that exists in other modern cities throughout the world.

To this end, it is proposed that a first step in considering regulatory change is for the Department of Primary Industries, Parks and Environment to prepare a discussion paper on the potential options, costs and benefits of changed regulatory arrangements for the combined system. The paper should be developed by the end of the first quarter of 2018 and should seek stakeholder views on the options presented.

Other policy improvements are also worth considering, including requirements for consideration of water sensitive urban design (WSUD), particularly for new buildings, major developments or new subdivisions. In order to ensure the success of the implementation of any improved WSUD policy, education and training must be developed for the general community, planners, regulators and construction industry. Compliance monitoring of the installation and operation of WSUD devices is also considered critical for success. This is largely an issue for planning authorities in the catchment.

5.8 Recommendations

The working group ranked the priority projects outlined at section 5.5 primarily according to the effectiveness of the option in reducing the sewage loading ultimately received by the Estuary.

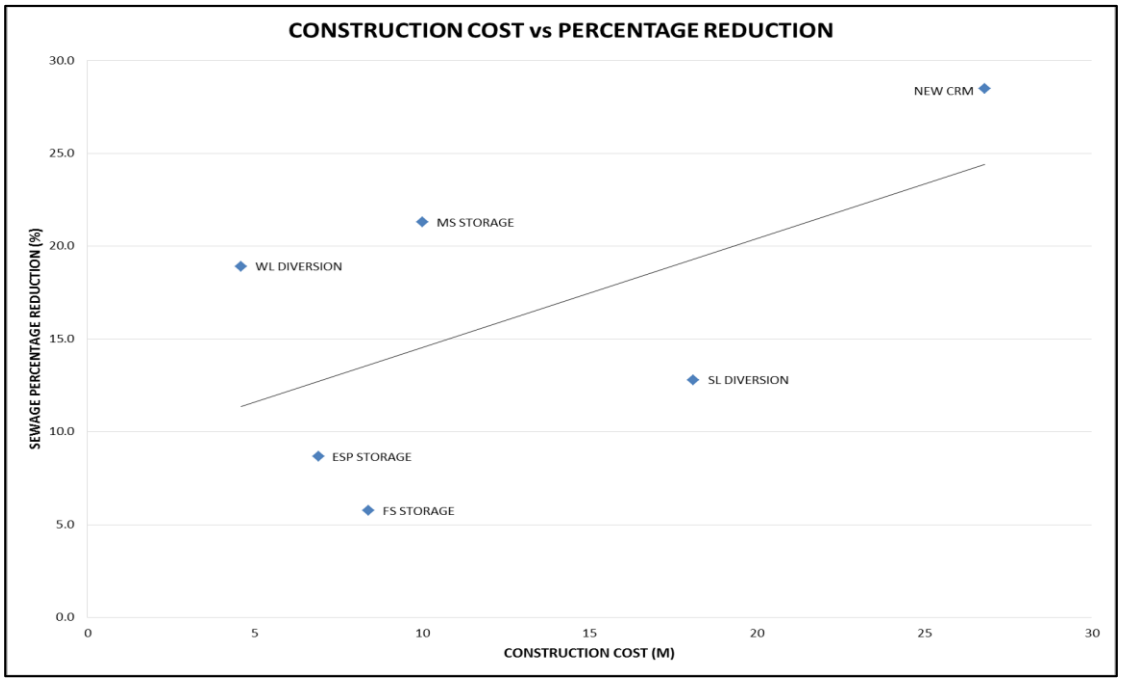

Figure 9. Costs and benefits of hard infrastructure combined system projects

From Figure 9, it is clear that three projects provide above average return of investment, those are:

1. The West Launceston Diversion;
2. The New Combined Rising Main; and
3. The offline storage located at New Margaret Street Pump Station.

Quantifying the benefits of these first three projects cumulatively, it is estimated that the reduction in sewage discharged to the Estuary from the combined system would be 53 per cent for an estimated $41.4 million investment.

This is not to say that the other projects are not of value, but there are diminishing returns to investment. Figure 10 displays the cumulative reductions in sewage discharged to the Estuary based on the following proposed packages of works:

1. The West Launceston Diversion;
2. 1 + The New Combined Rising Main;
3. 2 + The offline storage located at New Margaret Street Pump Station;
4. 3 + The South Launceston Diversion in conjunction with the offline storage proposed to service the Esplanade; and
5. 4 + The offline storage located at Forster Street Pump Station;

However, all of these priority project are recommended to be progressed. To put the proposed mitigation options in perspective, Figure 10 also displays separation as a stand-alone option.

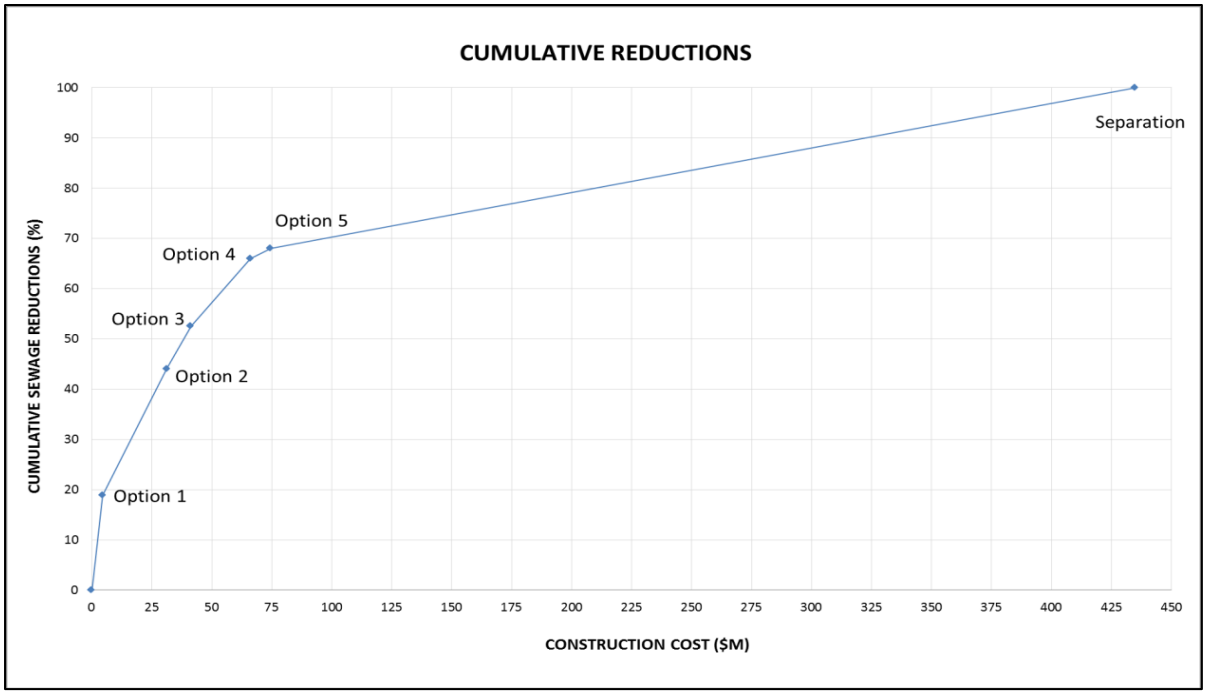

Figure 10. Cumulative costs and benefits of hard infrastructure combined system projects

Full separation of the system has an estimated cost of $435 million and assumes that this would decrease combined system overflows to the Estuary by 100 per cent. It is clear the proposed mitigation projects provide significant value for money (approximately a 70 per cent reduction in combined system sewage load for an estimated $74.6 million total investment).

Project	Cost ($ million)
Esplanade storage	6.7
Forster St storage	8.4
New Margaret St storage	10.0
South Launceston Diversion	18.1
West Launceston Diversion	4.6
New combined rising main	26.8
Total	**74.6**

Table 3. Proposed hard infrastructure projects and costs

It should be noted that the Estimates for the LSIP works (West Launceston and South Launceston Diversions) have been provided by TasWater directly. These estimates have been undertaken on the preliminary design of the pipelines and pump stations for the transfer systems and include allowances for design, approvals and construction. The construction cost estimates have been calculated by John Holland within a +/- 20 per cent limit of accuracy.

Estimates for non-LSIP options have been prepared based on conceptual designs, using similar construction rates used for LSIP. Estimates include an allowance of 20 per cent (of construction cost) for engineering/approvals, and 30 per cent construction contingency.

Recommended changes to the regulatory, policy and operational environment of the combined system should also be considered by relevant authorities. The recommended discussion paper on the current regulatory arrangements for the combined system is scheduled for release within three months, while planning authorities would be encouraged to consider policy and operational changes as soon as possible.

6. Expected outcomes of investments and actions proposed

6.1 Impact of Catchment Action investment recommendations

Investments at all Catchment Action budgets are shown to be very cost effective at reducing pollutant concentrations in Tamar Estuary Zone 1, particularly for enterococci (see Figure 7). There is clear evidence of decreasing returns to scale of investment against this goal with 30 to 55 per cent of the potential decrease in concentration achieved with the first 1.7 per cent of investment ($2 million option).

Even with decreasing returns to scale of investment, the $10 million investment option still represents a very cost effective option for reducing in Tamar Estuary Zone 1 concentrations with over 45 per cent of potential sediment reduction, roughly 60 per cent of potential nutrient reduction and over 80 per cent of enterococci reductions achieved for only 8.5 per cent of the $117 million, fully funded investment cost.

As was the case with loads, decreases in sediment concentrations in Zone 1 are likely to be significantly underestimated by the modelling. This means that significant decreases in sediments exported to Tamar Estuary Zone 1 can be expected with these investments.

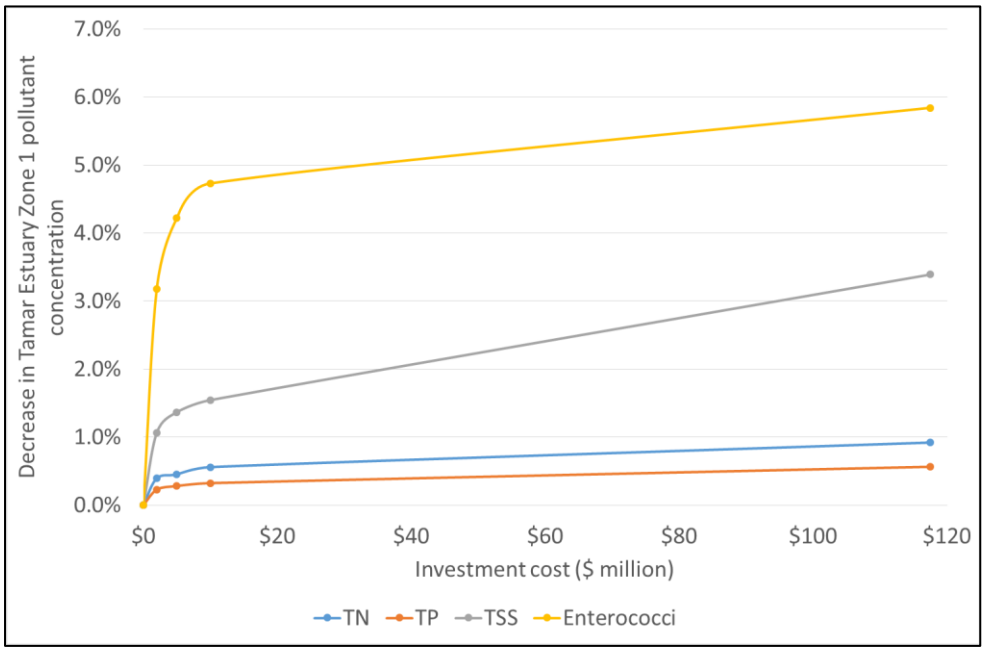

Figure 11. Decrease in pollutant concentrations in Tamar Estuary Zone 1 from balanced investment option

6.2 Impact of Combined System investment recommendations

As indicated in section 5.6, the six priority projects recommended in relation to the combined system will lead to more combined system flows going to Ti Tree Bend treatment plant and in turn reduced pathogen loads in Zone

1. Impacts of these individual projects on Tamar Estuary Zone 1 enterococci concentrations are shown in Figure 12.

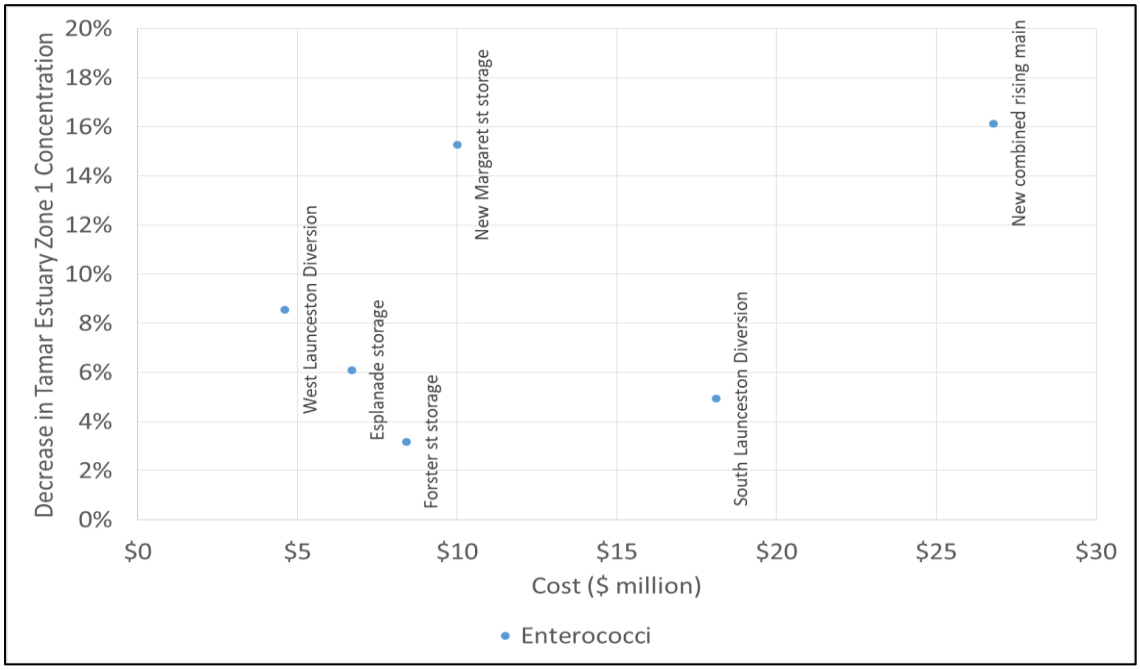

Figure 12. Decrease in Tamar Estuary Zone 1 Concentration - Enterococci

The New Margaret Street storage and New combined rising main can both be expected to lead to very substantial decreases in Tamar Estuary Zone 1 enterococci concentrations (15 per cent to 16 per cent). The West Launceston diversion is also very cost effective, leading to an 8 per cent decrease in concentrations for less than 20 per cent of the cost of the New combined rising main.

However, the expected increase in flows to Ti Tree Bend treatment plant required exploration to see how the plant's performance would be effected. Ti Tree Bend treatment plant was primarily designed to remove

suspended solids and treat pathogens from the combined system and, while has some benefits for reducing nutrient levels in effluent, it is not its primary purpose. The following figure shows how Ti Tree Bend functions.

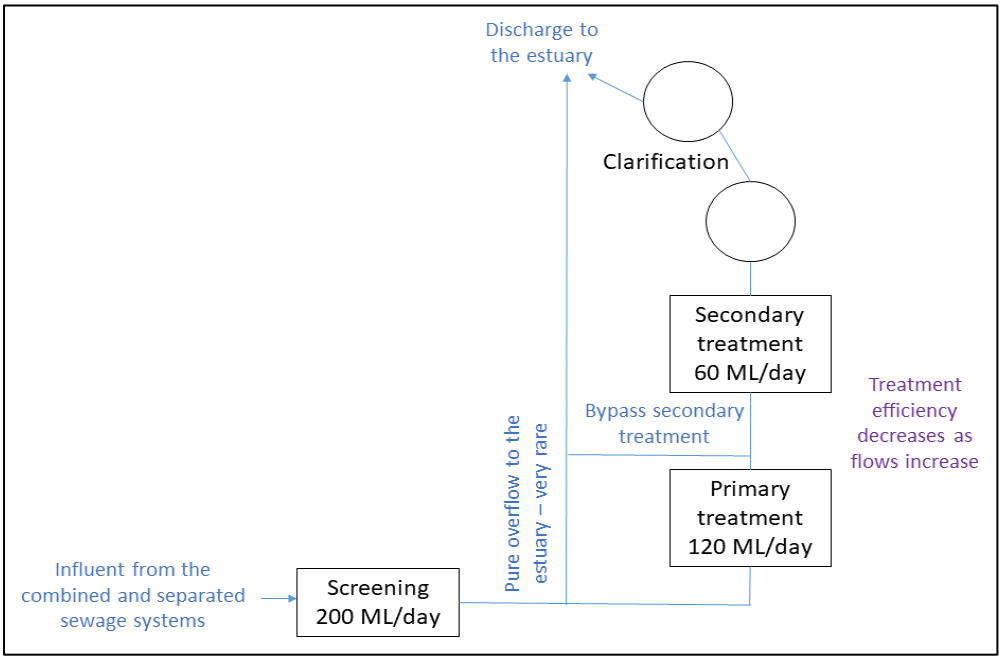

Figure 13. Ti Tree Bend treatment process

Essentially, flows of up to 200ML/day will receive screening going into the plant, which stops a lot of the large pathogen carrying matter overflowing straight into the Estuary in very large rainfalls. Up to 120ML/day of flow goes on to receive primary treatment (essentially chlorine dosing), while the balance is discharged to the Estuary after the initial screening. Around 60ML/day goes on to receive secondary treatment, with the remainder that has received primary treatment bypassing that stage and discharged to the Estuary. In dry weather conditions, flows at Ti Tree Bend are around 12.2 ML/day.

While the plant performs soundly with respect to treatment of pathogens in dry and low rainfall conditions, TasWater's available influent and effluent monitoring from the plant suggests that in times of high rainfall, where flows are large, there is decreased efficiency in primary and secondary plant performance in terms of treatment of nutrients. The available data is inconclusive on the degree of that efficiency loss, but it would seem that higher levels of flow have the impact of mobilising nutrients already in the plant, such that nutrient load exiting the plant is higher than the load entering the plant once flows reach around 30ML/day for nitrogen and 90ML/day for phosphorous.

As can be seen in Figure 14, the vertical change in the blue line represents the amount of avoided nitrogen from reduced combined system overflows due to the proposed projects, while the vertical change in the red line represents the increased nitrogen load that would exit Ti Tree Bend for the same level of flow.

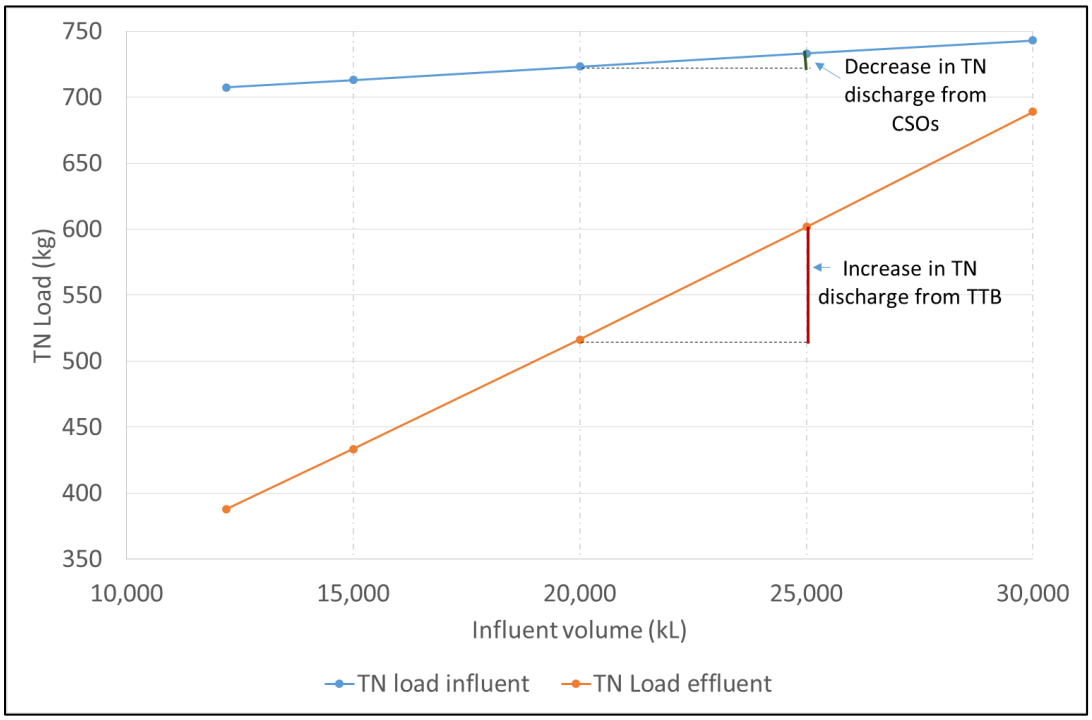

Figure 14. Example of change in TN load discharged with a change in influent volume

Clearly, while the benefits of the proposed projects for pathogen reduction are expected to be significant in total and have additional benefits in terms of reducing nutrient loads from combined system overflows, the Taskforce was of the view that all this benefit would be undone if the ecological health of the Estuary was made worse by a net higher level of nutrients then entering the Estuary.

TasWater had previously looked at the potential benefits of upgraded nutrient treatment at Ti Tree Bend, utilising analysis conducted by CH2M Australia Pty Ltd and this forms part of the Stage 2 LSIP planning that focuses on a series of improvements at the existing Ti Tree Bend plant which could total up to $100 million.

Through this work TasWater looked at the costs and effectiveness of several potential nutrient upgrade options, but for the purpose of this analysis the Working Group, in discussion with TasWater, incorporated intermittently aerated bioreactor, aerobic bioreactor and sidestream deammonification components. The cost of these works was estimated at around $10 million. CH2M Australia estimated total nitrogen effluent loads would decrease by roughly 53 per cent and total phosphorous by 72 per cent as a result of this upgrade.

These assumptions were added to the proposed combined system projects and Figure 15 shows the expected impacts on Tamar Estuary Zone 1 concentrations. This figure shows very substantial benefits of the treatment plant upgrade in terms of decreased nutrient concentrations. It is estimated that total phosphorous concentrations would be expected to decrease by 18 per cent and total nitrogen by 26 per cent. While the TasWater/CH2M work was largely desktop and further detailed design is needed to be confident about the costing of this project and the magnitude of these reductions, it would seem that an investment of $10 million in nutrient removal upgrade would offset the decline in performance expected at Ti Tree Bend with increased flows.

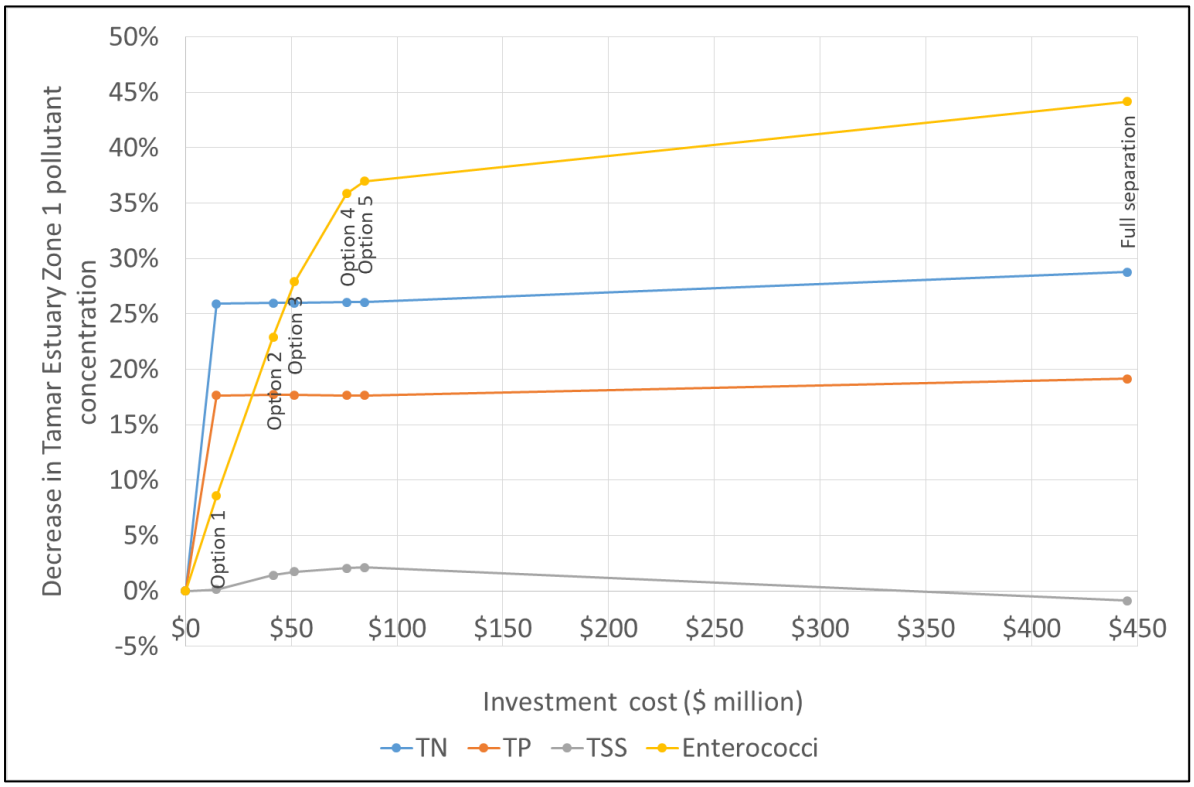

Figure 15. Cost versus estimated decrease in Tamar Estuary Zone 1 concentrations

This investment option allows the benefits of reduced combined system overflows in terms of enterococci to be retained while substantially decreasing nutrient concentrations, avoiding the potential decline that could be expected without such an upgrade.

6.3 Summary of investment plan and expected timing

The table below outlines the projects and actions recommended that the Taskforce believe will yield the best value for money improvements to the Estuary.

Projects	**Estimated Cost ($ million)**
Catchment Actions	
Brumbys-Lake, Macquarie, Meander & Tamar - Dairy	1.10
North Esk - Grazing	1.33
Upper Tamar – Grazing	1.66
Brumbys-Lake, Meander and South Esk – Grazing	5.41
Launceston sewage stormwater intrusion	0.50
Combined system actions	
Esplanade storage	6.7
Forster St storage	8.4
New Margaret St storage	10.0
South Launceston Diversion	18.1
West Launceston Diversion	4.6

New combined rising main	26.8
Ti Tree Bend plant nutrient removal upgrade	10.0
Total	**94.6**

Table 4. Summary of all proposed River Health Action Plan projects and actions

The catchment actions will need to be implemented in partnership with a number of key organisations. It is expected that grazing and dairy action programs would be implemented by NRM North in partnership with Dairy Tasmania and the Tasmanian Farmers and Graziers Association. Past experience in on-ground investments indicates that a planned investment of $1 million per year is appropriate.

It could be expected that finding farmers willing to undertake and co-fund investments may become progressively harder over time as the most able and willing are generally early adopters in any program. However this may be off-set to some extent by the momentum created by the relatively large scale of investment, with local landholders seeing the benefit of actions on neighbouring farms and the creation of new behavioural norms amongst local farming communities. The program will need to be flexible in terms of the approaches used to ensure ongoing adoption over time (for example the use of market based mechanisms or higher incentive rates for more difficult works may need to be considered).

Works to address sewage intrusion into Launceston's stormwater system would be led by Launceston City Council in partnership with TasWater as required. It is expected that these works would be undertaken over a 2 to 5 year period, depending on the scale of investment.

With respect to the combined system investments, the upgrade to Ti Tree Bend and the West Launceston Diversion would be the most sensible projects to commence first. It is expected that these upgrades could be completed in a two year time frame, but clearly require TasWater's involvement and agreement. The South Launceston Diversion is probably a more long term project given the upheaval it would likely require given its proposed route. This project may need three years to be undertaken. The offline storages and the new combined rising main from Margaret Street pump station could be completed in the period between Ti Tree Bend upgrade /West Launceston Diversion and the South Launceston Diversion.

7. Targets and monitoring

7.1 Reductions in concentrations in context

A full analysis of the impact of daily (or even more frequent) estuary pathogen concentrations is not currently possible given the lack of past event monitoring for pathogens in the Estuary and limitations with the existing modelling available. It is, however, possible to model a time series of combined system overflow loads discharged to the Estuary using the data provided from the hydraulic model developed by the Combined System Working Group and which underpins the estimates of average annual load changes. Figure 16 shows the daily estimated enterococci loads from combined system overflows based on rainfall data from Distillery Creek over an eight year period. This figure shows a comparison of estimated loads based on actual rainfall versus estimated discharge loads in those rainfall events after implementing all recommended combined system projects.

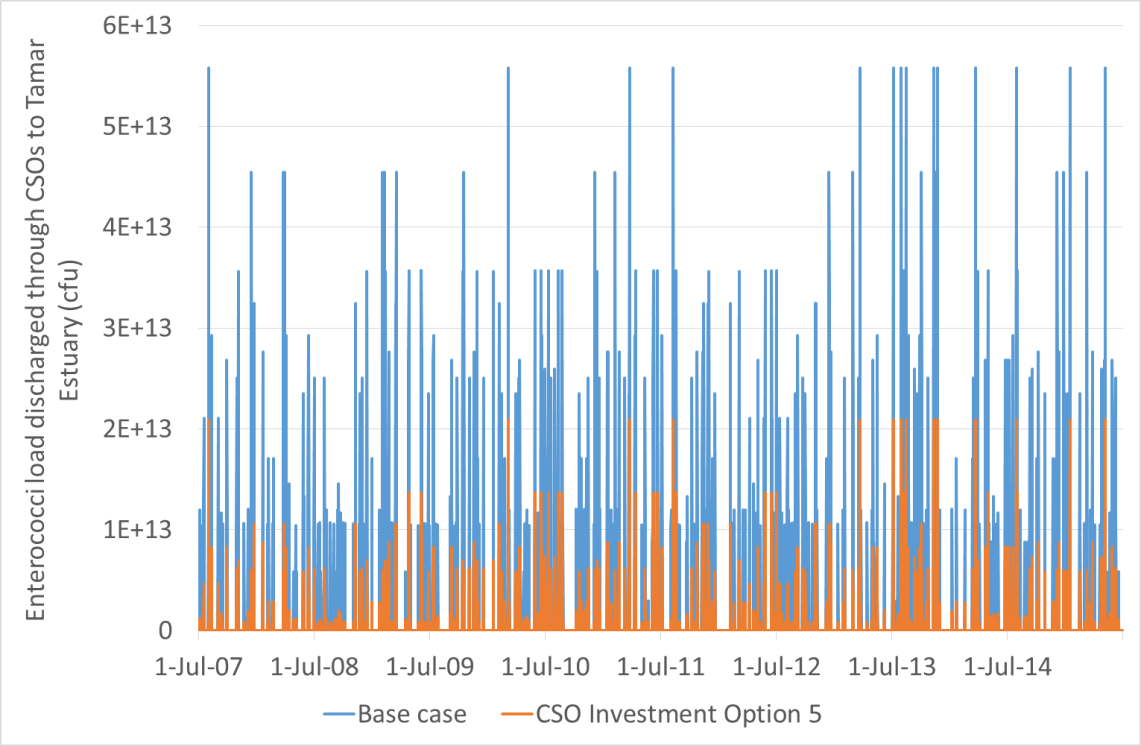

Figure 16. Modelled CSO loads based on rainfall for base case and rainfall with recommended combined system projects

This figure shows the very large expected decrease in enterococci loads overflowed for all events, ranging between 62 per cent and 93 per cent depending on the size of the rainfall event. The greatest relative decreases occur for low to medium rainfall events which are the most frequent events.

Given that combined system overflows are known to be a major driver of enterococci concentrations in Tamar Estuary Zone 1, these results indicate that very large decreases in concentration could be expected on days with small to medium rainfall. Very large events will still produce large spikes in enterococci discharged to the estuary, but these events are significantly less frequent.

7.2 Targets

In the coming months it is the Taskforce's intention to develop a set of targets in addition to the projected median concentration reductions for Zone 1, which convert these targets into expected reductions in the frequency of days where pathogen concentrations are above the primary contact threshold of 140cfu/100ml of enterococci. The Taskforce sees this as a tangible demonstration of the benefits of the concentration reduction in pathogens which will be more meaningful for communicating expected benefits of the investments to the community.

In order to develop these targets, more event monitoring of pollutant concentrations in the days following rainfall as well as additional modelling is required. It is the intent of the Taskforce to produce a set of target before the end of June 2018.

7.3 Monitoring

An evaluation framework should be developed against which activities undertaken by the body(ies) implementing the Taskforce's recommendations can be assessed. This evaluation framework should follow the MERI principles (Monitoring, Evaluation, Reporting, Improvement), which have an adaptive management focus, allowing lessons learned through doing to be incorporated into future actions.

This framework will require:

More monitoring of water quality in the estuary and the freshwater system

  - Estuary monitoring should build on the monthly sampling that has been undertaken by the TEER program. This monthly monitoring should be continued for all years. It should also be supplemented by event monitoring of some events in the estuary to allow better understanding of the estuary response to catchment and point source pollutant inputs to be developed.
  - Very limited monitoring of water quality in freshwater parts of the catchment is currently undertaken. It is recommended that additional monitoring be undertaken at a minimum in the North Esk and Meander river catchments where catchment actions are expected to have the most significant benefits.
  - Stream health monitoring using a system like the Australian River Assessment System (AUSRIVAS) methodology, or rank abundance sampling, to provide snapshots over time of the health of the TEER catchment's freshwater system. Again, these could be focused on the Meander and North Esk river systems where catchment actions are being targeted.

- Analysis of monitoring data and empirical modelling. Provision needs to be made for the analysis of monitoring data. There is no point in implementing greater monitoring regimes if there is not the dedicated resources to assess whether any of the benefits of actions can be observed and to allow the development of better understanding to refine management actions. This may include development or refinement of models that allow scenario testing or estimation of the benefits of management actions to date.
- It is recommended that Tamar estuary report cards produced by the TEER continue to be released on a biennial or annual basis and incorporate the findings of the increased monitoring and analysis. Potentially occasional freshwater system report cards could also be produced using monitoring data discussed above.

A State of the TEER report or similar should also be considered to provide a snapshot of progress in improving health of the estuary and freshwater systems.

Annual ongoing funding to support this regime will be necessary. While TEER members already provide significant support to existing activities an ongoing budget is required to ensure consistent monitoring data is able to be collected and reporting and communications undertaken. It has been estimated that a budget of $250,000 per year would be required to facilitate the increased total program, with a proportion of this (around $100,000) currently met by in-kind contributions from TEER members and the State Government.

8. Funding and Financing of priorities

8.1 TasWater LSIP

While the priority projects outlined for improving impacts of the combined system include projects potentially part of TasWater's LSIP, it should be noted that the timing and funding of these projects are at the discretion of TasWater and its regulators.

Under the current regulatory framework for the water and sewerage industry, TasWater is required to prepare a Price and Service Plan for three year "regulatory" periods, which need to gain the approval of the sectors technical regulators before funding is approved by the Economic Regulator.

As LSIP is still at more a strategic level, it is not clear where the sewerage catchment diversion projects sit in the timing of LSIP works (noting they are only a minor part of LSIP), let alone the wider TasWater program. Indications from TasWater are that funding for the first stage of LSIP (specific projects still to be determined) will be sought in the 2021-24 regulatory period. The second stage of LSIP, which would nominally include the nutrient treatment upgrade at Ti Tree Bend, currently has a ten year time horizon. Should the projects need to be brought forward, agreement would likely need to be reached with TasWater (and potentially its regulators and customers) to make this happen and would also likely need some negotiation with TasWater for costs they would not otherwise incur.

While TasWater are supportive of the projects identified, TasWater also note a number of factors that would influence its ability to deliver the proposed projects. These include the level of risk associated with the cost estimates for the LSIP components and any gap between funding allocated and delivery cost, the capacity of the market to deliver the projects in addition to TasWater's program over the third price and service plan period and TasWater's own internal resourcing and the level of involvement needed of it in delivering the projects.

While the Taskforce has not sought to recommend measures to improve the ecological health of the Estuary outside of the upgrade of the Ti Tree Bend, it should be noted that TasWater's LSIP Stage 1 has the potential to significantly reduce the effects of the seven wastewater treatment plants that discharge higher than desirable nutrient levels. In this respect, LSIP also represents a very important component to improving the ecological health of the Estuary.

8.2 Launceston City Council

Launceston City Council has indicated a willingness to provide funding towards the projects proposed for the combined system. At this stage, a dedicated amount has not yet been approved by Council, but any funds provided would be unconditional.

8.3 Department of Environment and Energy

As part of the initial announcement of the City Deal, the Federal Government through the Department of Environment and Energy committed $500,000 per annum for three years towards the work of the Taskforce. The Taskforce's discussions with the Department's officers suggests that its funding would most sensibly be allocated

to the proposed catchment actions. This funding would cover the proposed dairy related catchment initiatives and some of the grazing related program and it would therefore seem sensible to earmark them to these purposes. NRM North have had considerable success in implementing catchment based programs and would seem the likely organisation to deliver the funding if allocated to this purpose.

8.4 Clean Energy Finance Corporation

The Launceston City Deal required the Taskforce to explore the possible financing of desired projects with the Clean Energy Finance Corporation. On this basis, the Taskforce has held ongoing discussions with the CEFC as it has progressed its work.

The CEFC's scope is to provide financing for projects that increase the use of renewable energy, projects that deliver increased energy efficiency or which utilise low emission technologies and does so at lending rates less than that available from private sector banks.

The Combined System Working Group was consulted regarding whether the investment projects proposed would meet any of the CEFC's criteria for financing. Notwithstanding both TasWater and Launceston City Council have limitations on borrowings such that they can only borrow through the Tasmanian Government's financing arm, TasCorp (which would need alteration), it does not appear that any of the projects would yield material energy efficiency savings and indeed most projects require additional energy usage. The possible exception is the upgrade of Ti Tree Bend treatment plant which would need further examination.

9. Communication and education

It is important that the Taskforce, or any ongoing governance body formed to implement its recommendations, place a significant focus on communicating the recommendations in this Plan and educating the community as to what underlies the findings.

The reasons for this are varied, but primarily there appears to be both a misunderstanding of the natural processes which influence the Estuary and the previous interventions made to it and, possibly related to this, considerable divide between members of the community on what is required to improve Estuary health.

Assuming the recommendations within this Plan are funded and acted upon, there is a need to clearly articulate the work to be undertaken to improve water quality and the health of the estuary and river systems. It is recommended that the Taskforce and any body formed to implement its recommendations, should:

- Develop a detailed Communications Strategy. It should include a list of stories and key messages to be communicated, audiences and methods of engagement with these audiences. At a minimum the key stories to be communicated to the community should include:
    - The history and source of pathogens in the Estuary and how previous management has improved these;
    - The advantages and disadvantages of combined sewerage and stormwater systems
    - Sedimentation processes and the history of sediment management through dredging and other means. Ecological values of mudflats should also be included;
    - Flows down Gorge, their history, role and issues around managing flows for multiple benefits;
    - An overview of some of the works done to date and their impact including programs run by NRM North, Dairy Tasmania and City of Launceston;
    - The TEMT, its role and recommendations and where to from here; and
- Consider further the approach to communicating recreational water quality in the estuary. This might include development of an alert system through social media or a website, for example the release of advice or alerts when there's been a combined system overflow. Alternatively a system based on monitoring or predicted rainfall could also be used. The messages around safe recreation in the estuary should be reviewed in light of improved monitoring data (e.g. periods of exclusion after rainfall, practices to minimise risk). This may be linked to the additional work the Taskforce has flagged in setting targets related to primary contact.

10. Sedimentation

Following the strong feedback received through consultation, the Taskforce has resolved to engage a suitably qualified hydrologist/geomorphologist to assess the merits of the various proposals regarding the mitigation of sedimentation build up.

There have been a number of studies, going back many years, commissioned by parties including the Launceston City Council, the Launceston Flood Authority and Hydro Tasmania, in addition to a number of academic research papers, many of which have explored and, in some cases, debunked theories put forward around how to manage sedimentation. These studies will be reviewed by the consultant engaged by the Taskforce when assessing the merits of the proposals received.

While the Taskforce is committed to examining the proposals, based on the information gathered through its work, its current view is there are natural mechanisms of weathering, erosion and deposition that result in the ongoing modification of the Estuary and there is a limit to what can be achieved in reducing the impacts of sedimentation.

The Combined System Overflow Working Group's Investment Plan goes into some detail around these processes, but, in lay terms, the Estuary is what is known as a drowned river valley that formed between 6,500 and 13,000 years ago when sea level rose around 60m to near its current level. The natural process for drowned river valleys is to infill and eventually become alluvial (muddy) plains and deltas.

The Tamar Estuary is characterised by a three to four metre tidal range and large freshwater inputs from the North Esk and South Esk rivers. The combination of a large sediment load from the catchment and strong tidal currents results in rapid sedimentation in the upper reaches of the estuary.

While the main channel is quite deep in the lower estuary, reaching 45 metres in depth near Bryants Bay, upstream of Swan Point at Paper Beach the Estuary is subject to rapid infilling through sedimentation and becomes very shallow near Launceston. Tidal mudflats border the main channel of the estuary throughout its length.

Though there are potential issues with silt raking which mean consideration needs to be given to the balance between environmental outcomes and flood protection, it is proven in its ability to displace the sediment build up and maintain a level of visual and recreational amenity in the upper reaches. The Taskforce aims to report on this issue, including any viable alternatives, in the first quarter of 2018.

11. Ongoing governance

The Launceston City Deal flagged that the Taskforce would give consideration to the future governance of the Estuary and the Taskforce has resolved to engage further advice on this issue. While there are a number of models that are used elsewhere in the country, particularly models that install catchment management authorities to ensure water health, the roles of TasWater and Launceston City Council in delivering on this aim are not a usual part of that model.

While the existing structures of the TEER have been extremely successful in bringing all relevant stakeholders together and much has been advanced by TEER in understanding the Estuary, monitoring its health and setting targets for it, perhaps one deficiency has been its inability to attract large scale funding to address some of the issues outlined in this Plan.

A continuum of option will be explored from collaborative models like TEER and the similar Derwent Estuary Program in the South of the State, through to legislatively backed governance models. However, the key questions that will be asked through this work will be what the objectives and functions of the body should be and how best these would be performed, with the structural form following from that.

As with the work underway on sedimentation, it is intended that the Taskforce will deliver a report with recommendations in the first quarter of 2018.

Appendices

1. Tamar Facts
2. Catchment Action Working Group Technical Report and Investment Plan
3. Combined System Overflow Working Group Investment Plan
4. An Investment Plan for improving water quality in the Tamar Estuary: Combined System Overflows Technical Report

Tamar Estuary Management Taskforce

C/- Infrastructure Tasmania

4 Salamanca Place
Hobart TAS 7000 Australia

Phone: 03 6166 3463

Email: temt@stategrowth.tas.gov.au

Web: https://www.stategrowth.tas.gov.au/infrastructure_tasmania/tamar_estuary_management_taskforce/