

## PAPER 7

# A TRANSFORMATIVE RIVERINE MANAGEMENT PROGRAM : A BUSINESS CASE FOR A NATURE BASED ADAPTATION PROGRAM TO PROTECT CITY INFRASTRUCTURE AND SO MUCH MORE...

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## ABSTRACT

So often engineers look for hard solutions to reduce risk to infrastructure and forget about looking at nature and the options that it can provide. The same is true in eThekweni Municipality when it comes to damage to road crossings and rivers, particularly during heavy rains and floods. Engineering solutions helped to reduce some of the risk but often it is not enough. The analysis of the cause of this damage highlighted the role of alien vegetation and solid waste in these blockages and damages.

The Sihlanzimvelo project was born in a meeting of the eight departments mandated with looking after eight different facets of the same rivers. Eight departments with reduced budgets and staff compliments.

This project looked to remove alien vegetation and waste from the streams through the engagement of unemployed people from the communities, who were upskilled in business skills to form co-operatives who were then contracted by the city.

The program ran for 9 years on 300km of stream, and we became aware of many more benefits than just the main reason of reducing the risk to culvert road crossings. This became the basis for the development of an all-encompassing program called the Transformative Riverine Management Program.

Through the C40 Climate Finance Facility we have been able to carry out a Benefit Cost Analysis and have demonstrated that by managing our natural assets we can achieve the goal of risk reduction and at the same time achieve many other goals of socio-economic and environmental value.

This is a case study of Nature Based Adaptation which is cost effective, and which is making our city more resilient in the face of climate change.

## 1. INTRODUCTION

Municipal engineers are required to design, install, and maintain infrastructure to support the urban framework of the city they serve. In addition to the normal engineering knowledge there is a requirement for basic knowledge of the non-engineering processes and areas which impact on the construction and maintenance of this infrastructure. These are areas such as town-planning, environmental, health etc.

In essence, the engineer is required to understand the whole system in which they are operating.

There is no better example of a system, than that of a riverine catchment where every action has a reaction which can positively or negatively impact the infrastructure which we are responsible for and therefore the people we serve in our cities.

Our urban rivers have for many years been neglected and the services which these systems provide, have been ignored and undervalued. These

services include, amongst others, disposal, management and cleansing of the urban stormwater, ecological services (such as water provision, water purification, flood attenuation, biodiversity etc), amenity services (such as recreation) and socio-economic services (such food gardens and vegetation harvested for crafts).

We have taken these areas for granted and now as city inhabitants, are paying a price for this neglect.

These areas have become waste areas full of alien vegetation and solid waste where children won't play for fear of snakes attracted by the rats feeding on the waste dumped by communities or the broken glass and rusting metal or the criminals lurking amongst the tall Spanish reeds which infest our natural waterways. Poor water quality in these rivers also creates health challenges and has a negative impact on important tourism assets like Durban's estuaries and beaches.

The proliferation of alien vegetation and the increase in solid waste also translates into blockage material for the city's many culverts and this creates a serious risk of damage to roads and property as highlighted by the April 2022 flood which devastated our city.

In 2016 I presented on the installation of debris walls as an engineering response to attempt to reduce this risk and this has had some success. However, this is a systemic problem which requires a system-based solution – this was the driver for the creation of the Transformative Riverine Management Program (TRMP).

It is my hope that as we share this exciting story that more cities will see the benefit of a collective effort to reclaim, rehabilitate and manage our urban streams and rivers, as we strive to make our cities resilient in the face of climate change and economic stresses.

The water connects us all.

## 2. THE HISTORY OF INTERSECTORAL COOPERATION ON CLIMATE CHANGE AND THE TRANSFORMATIVE RIVERINE MANAGEMENT

The eThekweni Municipality tried a top down (i.e., policy-driven) approach to include climate change in the operations of the city and this was largely unsuccessful as climate change was primarily seen as an environmental issue by municipal technical sectors.

Dr Debra Roberts from the Environmental Planning and Climate Protection Department began a process of identifying individuals within the different sectors of the municipality that were sympathetic to the climate change agenda and could see the potential relevance to their work, and then set about capacitating these individuals to understand the specific threats of climate change to their sectors. This involved fostering "sector champions", or "climate change moles", who worked within their sectors to shift the understanding of their colleagues towards climate change threats to their sector/ work.

The initial sectors involved in this process were the stormwater and catchment management, sea level rise management, water, health,

and biodiversity protection sectors and out of this initial collaboration came the Municipal Adaptation Plan for the Water, Health, and Disaster Management sectors. This work resulted in good relationships being built between individuals within different sectors.

It was around the time of the above work, that the Durban Bremen partnership was introduced to the group. We were informed that there was a team of officials arriving from Bremen and there was a need to come together to identify the challenges being faced by the city. This was the catalyst for the team working together on developing the concept of a lighthouse project on the Umhlangane river system within eThekweni.

The idea of a system approach to river management and interventions began to take form.

The formalization of the Durban-Bremen partnership at a political level gave the team leverage to justify the time spent together to work on this project as well as the support of senior management.

Some of the team members were fortunate to travel to Bremen to look at the issues and successes in Bremen which further cemented the trust and relationships between these members from different sectors. We grew to know more about each other's sector and support each other as we exposed the interconnectedness between the work, we all did in working towards a more resilient city in the face of the climate change threat.

The Durban-Bremen partnership then opened the way for Durban to apply through Bremen for BMZ grant funding and we were successful in obtaining this funding for the rehabilitation of the Riverhorse Valley Wetland and surrounding watercourses. This funding created the opportunity for members from the environmental biodiversity section, the catchment management section, the water and sanitation section, and the economic development section to now collaborate in the implementation of a physical project related to climate resilience which needed input from all our sectors in order to be a success. As with any difficult task, the relationships between the team members, including those from Bremen, was strengthened and the project provided proof of how our efforts could be multiplied as we worked together across sectors.

About the same time, the Sihlanzimvelo project was started, and we were fortunate to be involved in this exciting beginning. As we worked on this project, we saw the benefits of the work being done in the riverine corridors. This project was also a cross sector collaboration and was providing proof of the cross-sector benefits that could be achieved.

The key question was "how do we capture, articulate, and value the benefits we were seeing in projects like Sihlanzimvelo and the Riverhorse wetland projects?", in order to prove that this was a better way of doing things in our city.

Jo Douwes came across the option of the C40 Climate Finance Facility (CFF) and the team came together to put forward the proposal of developing the business case for the expansion of the Sihlanzimvelo project.

As each member of the team and with the support of the CFF team, we realized that there were several initiatives in different sectors and within the private sector, that were focused on improving some aspect of the riverine corridors.

As a result, the project became the Transformative Riverine Management Program (TRMP) which was designed to incorporate the contributions from all sectors.

The CFF work is now complete. The exciting outputs are discussed further in this paper.

Key factors that have contributed to the success of the cross-sectoral collaboration that has characterized this work include:

- Strong sectoral champions who have been able to lead and drive new work in an institution that is often resistant to change.

- An ability to see connections across work areas and recognize the value in working together in areas of common interest and relevance.
- A willingness to be involved in exploratory work with evolving outcomes
- Clear areas of work in which to focus collaborative efforts. For example, the BMZ funding provided a structured space in which to work together. The same has been true for the work on the TRMP, which is supported by the C40 Cities Finance Facility.
- Mutual professional respect and trust, which has been built over many years of working together.

#### **a. Sihlanzimvelo Program**

In 2009, the eThekweni Municipality approved the Municipal Adaptation Plan, Health, and Water and one of the line items was to "Protect and Restore riparian vegetation so as to protect the integrity of riverbanks and retain biological buffers against flooding." This was a recognition of the need to look at our natural ecological assets in order to improve the city's resilience.

At the same time, the engineering unit of the city was concerned with the increase in damage related to blocked culverts. The incidence of blockage and damages was increasing and needed to be addressed. Work was being done in relation to the installation of debris walls however the need for a more proactive approach was clearly evident.

The initial investigations revealed that 70% of the blockage material was alien vegetation with the remaining 30% being solid waste. The April 2022 storms have confirmed this with an added finding which will be dealt with later in this report.

The general cleaning and minor repair maintenance of the culverts and roads vests with the Roads and Stormwater Maintenance department (RSWM) while major repairs and maintenance of the culverts vests with the Coastal, Stormwater and Catchment Management Department (CSCM). Mark Tomlinson, of RSWM, and Geoff Tooley, of the Coastal, Stormwater and Catchment Management department (CSCM), began to explore ways of addressing the source of the alien vegetation and the solid waste within the river systems.

We identified 8 city departments that were responsible for various aspects of the stream environments. The Environmental Health Department, Department of Water and Sanitation, Durban Solid Waste, RSWM, CSCM, Department of Parks, Recreation and Culture, and Environmental Planning and Climate Protection Department came together in 2007 to try and identify solutions to the problem. Mark Tomlinson and Geoff Tooley requested funding as it was hoped that resources (financial and human) could be pooled and allocated towards dealing with the problem.

After discussions with all these departments, Mark Tomlinson suggested the use of co-operatives (grown out of the community) to carry out this work and he agreed to take the lead on this project.

As some of the work to be done by the co-operatives would be to clear the culverts (a mandate of RSWM), the Deputy Head of RSWM agreed to the use of his budget for the establishment of this project. Unfortunately, other departments were reluctant to provide funding for this work even though it was addressing work related to their mandates. The primary reason for this related to Key Performance indicators (KPIs) and reluctance to entrust budget spend to another department.

Initially, capacity development activities were implemented to support the development of co-ops, after which eThekweni put out an Expression of Interest for application by co-ops to work on Sihlanzimvelo. All co-ops that were registered went through a training process for managing waste. Terms of Reference for a consultant were also shared; the responsibility of the consultant was to identify resident members who would be trained

as project assessors, who would provide a line of communication between co-ops and government. The focus of the project, initially, was on Inanda, KwaMashu, Ntuzuma and uMlazi as it was not possible to implement interventions across the whole city. The team prioritized streams that were severely degraded and near communities with high unemployment rates. They also sought to find areas that would reduce the need for transport of co-ops. (Transforming Southern African cities in a changing climate -Learning lab 3).

The main tasks of the co-operatives included:

- Clearing of culverts and storm water systems
- Minor erosion control of embankments
- Ditching to prevent water stagnation
- Litter and debris removal and disposal
- Cutting back of vegetation
- Alien vegetation control
- Planting of indigenous vegetation

The area of work is the waterway and 3m either side of the water. They are also required to report leaking sewers and erosion points.

Each co-operative is given 5km of stream to manage. The streams covered have a catchment less than 1000Ha as this relates to a normal stream depth below knee height. The reasoning behind this relates to safety concerns for the people working in the stream.

The state of the co-operative's length of stream is assessed each month against a set standard and the payment is determined based on the level of maintenance achieved. Hence payment is performance based.

The program preparation started in 2009 with the first co-operative starting work on the ground in November 2011. The length of stream initially covered was 295km however with the evidence produced through the C40 CFF business case work, this length has increased to 525km.

### 3. THE BUSINESS CASE AND C40 CLIMATE FINANCE FACILITY

The Sihlanzimvelo program began to produce results and maintenance teams on the ground were recording less blockages to culverts with the associated damage normally seen.

In addition to achieving the primary goal of the program a number of other benefits were emerging and being noticed by the city officials and the community on the ground.

It was at this stage that the need for capturing these benefits and developing a business case in order to leverage the expansion of the program from both city and external funds became critical. The search for a support funder for this work was found in the C40 Cities Finance Facility (C40 CFF).

Once the work with the C40 CFF started, and all role-players were engaged it became apparent that Sihlanzimvelo was just one of many initiatives happening within the riverine corridors of eThekweni. It was with this knowledge and the need to ensure that all programs contributed to the development of the business case and implementation plan, that the Transformative Riverine Management Program (TRMP) came into existence.

The primary purposes of the TRMP are

- Contribute to sustainable, efficient municipal delivery
- Limit climate risk and impacts to society
- Secure, valuable financial, socio-economic, human, and ecological benefits
- Build climate resilience

#### a. Sihlanzimvelo Program Benefits Identified

The identified benefits of the Sihlanzimvelo work can be combined into 4



FIGURE 1: Sihlanzimvelo Streams after work has been completed

main areas viz.

- Presence on the stream – safety, policing, early identification of problems
- Business/Job Creation – Improved business skills, local economy growth, jobs
- Clearing of Alien Vegetation – reduced blockages, improved biodiversity, reduced erosion
- Clearing of Solid waste – reduced blockages, recycling opportunities

#### b. C40 Climate Finance Facility (CFF)

It was recognised by C40 that although there was an abundance of funding and an abundance of good city climate change related projects, there was a gap in the ability of cities to translate these good projects into bankable projects which is what the global funders were looking for. This recognition led to the establishment of the C40 CFF.



The C40 CFF is made up of:

- C40 Cities Climate Leadership Group (C40)
- Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)
- German Federal Ministry for Economic Cooperation and Development (BMZ)
- British Department for Business, Energy, and Industrial Strategy (BEIS)
- United States Agency for International Development (USAID)

Funding partners:



The primary objectives of the C40 CFF are

- Reduce greenhouse gas emissions
- Sustainable financing of urban climate change investment projects
- Developing the capacity of city administrations to mobilize and access a broad range of financing instruments
- Sharing knowledge of CFF partner cities via peer-to-peer learning
- Developing partnerships between cities and investors/financiers and their representations.

#### c. The Business Case

The C40 CFF supported the city in the development of the business case through several studies and the business case along with the reports mentioned below at <https://www.c40cff.org/knowledge-library/resources-from-durban>.

The reports include

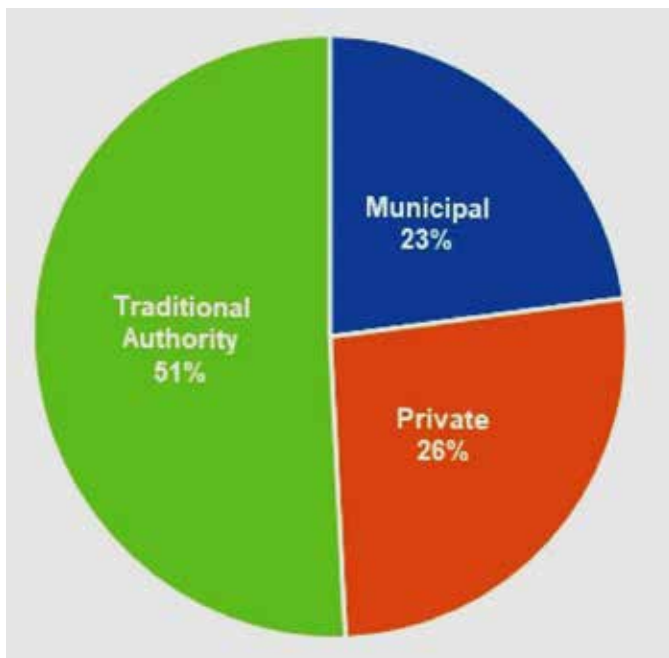
- TRMP Durban Benefit Cost Analysis Technical Report.
- TRMP Durban Green Economy report

- TRMP Durban River vulnerability assessment
- TRMP Durban Hydrological Vulnerability assessment
- TRMP Durban Regulatory Framework Final Report
- Regulatory Framework Final Report\_2011101
- TRMP Durban Business case for TRMP

The business case purpose of the TRMP is

- Contribute to sustainable, efficient municipal delivery
- Limit climate risk and impacts to society
- Secure, valuable financial, socio-economic, human, and ecological benefits
- Build climate resilience

In order to develop a business case based on all the evidence identified, a Benefit Cost Analysis (BCA) was developed for management of municipal, private, and traditional authority land in riverine areas. The land ownership was highlighted as one of the key factors to be considered when developing any program intervention due to regulation restrictions.



**FIGURE 2:** Ownership distribution of streams and rivers

Nine future riverine management scenarios were modelled in the BCA. These included:

- A “do nothing” scenario for municipal, private, and Traditional Authority land in riverine areas with climate change as a driver of river impacts.
- Upscaling of Sihlanzimvelo Stream Cleaning Programme on municipal land in upper catchments with climate change.
- A “basic management” scenario for private and Traditional Authority land in riverine areas with climate change, and
- A “transformative management” scenario for each of the three land ownership types with climate change impacts.

In the BCA, the costs, and benefits of implementation of these different riverine management models has been estimated at a city-wide scale. In order to do this the Ohlanga River Catchment was used, and the results extrapolated across the city.

A “transformative” riverine management approach is assumed to include an overarching “transformative riverine governance” umbrella implemented by eThekweni Municipality. This provides the necessary framework for

facilitating cross-sectoral and multi-stakeholder collaboration (including with other spheres of government) and creating enabling conditions for riverine management action across all riverine landowners in the city.

Implementation of transformative riverine management assumes a focus on positive social-ecological systems change in relation to rivers. Biophysical riverine management interventions include both ecological restoration and management at a systems scale, aiming to improve the functionality and resilience of rivers to urban impacts and climate change. The condition and/or management of the built/agricultural landscape surrounding rivers would also be improved, such that accelerated stormwater, sediment loads and pollution entering rivers is minimised.

Social interventions aim to build human, social and institutional capital in a way that promotes positive behaviour change and active river stewardship in response to a recognition of the value of rivers to people and the economy. Socio-economic and environmental benefits of riverine management are accelerated through circular economy initiatives that make productive use of solid waste and alien plant biomass – either arising from riverine management activities or as a means of reducing waste entering rivers. The social / economic use of riverine areas as places of recreation and tourist activities or harvesting of natural resources is assumed to be optimised within sustainable limits. Agriculture/food gardening on river floodplains is supported, where appropriate, to enhance resilience to increased river flooding and sedimentation, and to limit negative impacts on river ecosystems (Mander N, Mander M, Winnar G, Mark M and Butler A 2020).

The studies show that many of Durban’s rivers are already severely impacted by urban and agricultural development, and pollution. Due to this, it is estimated that the ecosystem services supplied by these urban rivers are 42% below the theoretical best case and that climate change will degrade these systems further, reducing ecosystem services supply by a further 11% by 2040.

The eThekweni Municipality will be directly affected, with annual damages to municipal road culverts alone due to increased climate change related flooding estimated at over R151 million by 2040. Declining river water quality will affect coastal tourism and property values, as well as the ability of riverine communities to access and use rivers for household water provision, crop irrigation, and recreation. The annual cost implications for the well-being of municipal citizens and coastal users is estimated to reach R224 million by 2040. (Only historic damages costs to culverts were available to use in this study and so it is recognized that costs indicated are lower than what will be experienced once all infrastructure damage is totaled).

Evidence from riverine management projects such as eThekweni Municipality’s Sihlanzimvelo Stream Cleaning Programme suggests that good condition, well-managed streams, and rivers can help buffer the municipality, citizens and businesses from the escalating flood and human health risks associated with climate change. They also contribute positively to societal well-being and cost-efficient municipal service delivery.

Modelling of various riverine management scenarios in the Ohlanga River Catchment demonstrated that investing in basic riverine management even with the added pressures brought by climate change - would be almost sufficient to keep ecosystem services at current (baseline) levels.

There are some riverine ecosystem services where riparian management actions alone would not be sufficient to entirely mitigate climate change related losses. A **transformative management** focus on both the riparian zone and the broader catchment could improve most ecosystem service levels an average of 10% above current levels, even with the effects of climate change factored in.



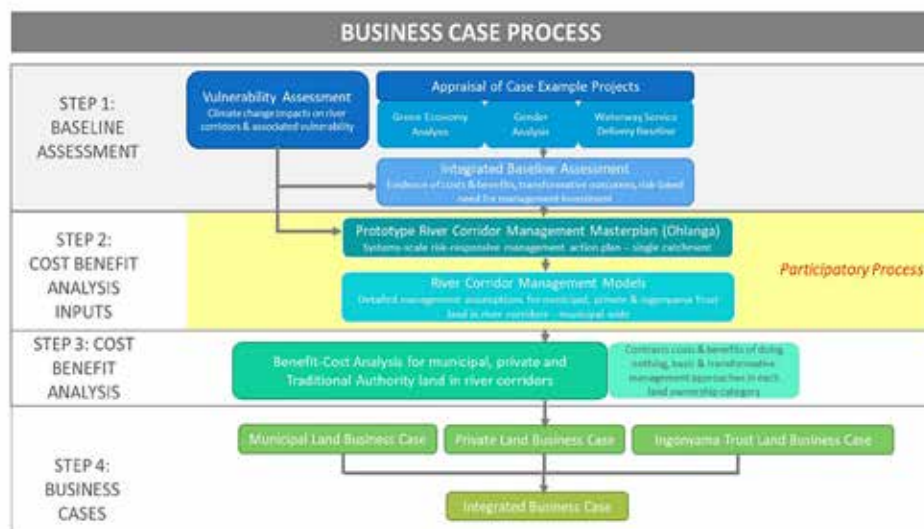


FIGURE 3: Business case process (Mander et al. 2020)

A “transformative” approach to riverine management that limits land use impacts on rivers, restores and manages riverine areas, could therefore reduce the city’s exposure to climate change risks and reduce current shortfalls in societal, financial, and economic benefits from rivers.

The benefit cost analysis shows that if the city upscaled the existing Sihlanzimvelo program on municipal land – approximately 1168km of river -this would cost the city annually approximately R92 million. The city would experience avoided damage costs to municipal culverts and road crossings of R59 million (this excludes damage to sewers, watermains and other municipal infrastructure). The societal benefits each year are estimated to be R177 million. 234 co-operatives would be needed to do the work which would translate to 1557 jobs. **This translates to R2.60 in benefits for every R1 spent by the city.** The additional green economy opportunities in terms of job creation and economic benefits have not been included.

The benefit cost analysis for a city-wide transformative riverine management program shows that an investment of R7.5 billion by the public and private sector is required over the next 20 years. This would result in an avoided cost of R1.9 billion to damage to municipal culverts and roads million (this excludes damage to sewers, watermains and other municipal infrastructure), R12 to R24 billion in societal benefits, greater than 9000 jobs and many additional green economy opportunities. **This translates to R1.80 to R3.40 in benefits for every R1 spent.**

The key message that has come out of this work is that a systems-focused approach is vital for the success of a transformative program.

- Costs likely to exceed direct benefits for individual landowners
- Coastal users benefit from upstream investment & have an incentive to contribute
- Managing upper catchment areas disproportionately important for limiting downstream risks & costs
  - Cost-sharing & resource pooling

needed to manage risks & opportunities at systems-scale

**d. Implementation Plan**

At the time of producing this paper we had only just completed the development of an implementation plan and so what is being presented is a proposed way forward developed by as many of the role-players working within the riverine space.

There are a few key aspects which need to be highlighted and which need to be followed for this program to succeed at the level required to make our program truly transformative. The rest of the details will develop as the various projects develop and grow.

These are:

- The program must remain as flexible as possible in order to include every initiative in this space, whether it is a large or small, short, or long duration initiative.
  - There needs to be a separation between the three required levels of co-ordination/facilitation, the implementing agents/fund managers and on the ground implementers.
  - There needs to be municipal co-ordination of the municipal programs – to maximise cross sector benefits
  - There needs to be private sector co-ordination – to maximise cross sector benefits
  - There needs to be co-ordination between the private and municipal co-ordination hubs.
  - River catchments cross municipal boundaries and so there needs to be co-ordination between neighbouring municipalities.
  - There is no right time to start any initiative – the key is to welcome all initiatives and find a way to co-ordinate the benefits.
  - Not all areas of the catchment will be covered in the short term. The key is to start somewhere, identify the gaps and find ways to facilitate the closing of these gaps.
- The required funding needs are for
- **Programme management:** Programme design & cost benefit analysis, integration, and coordination between municipal functions

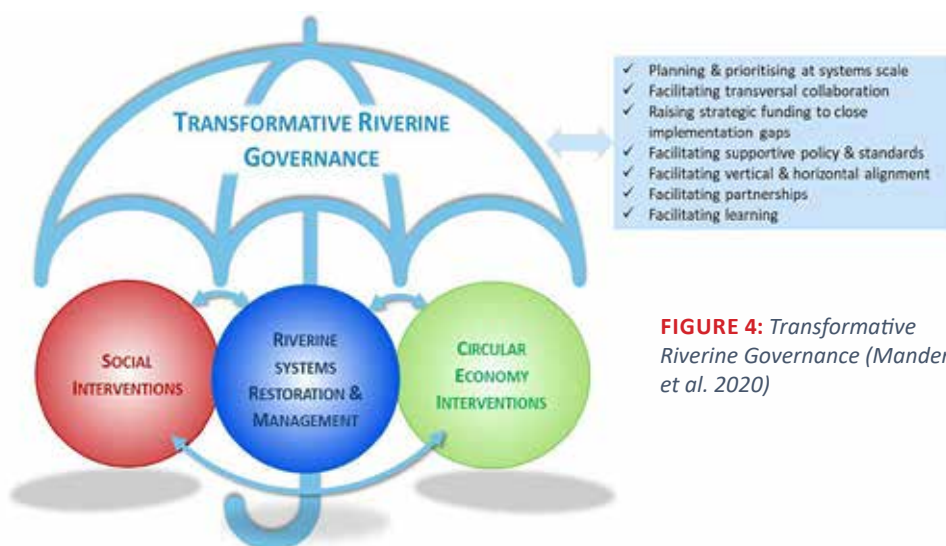
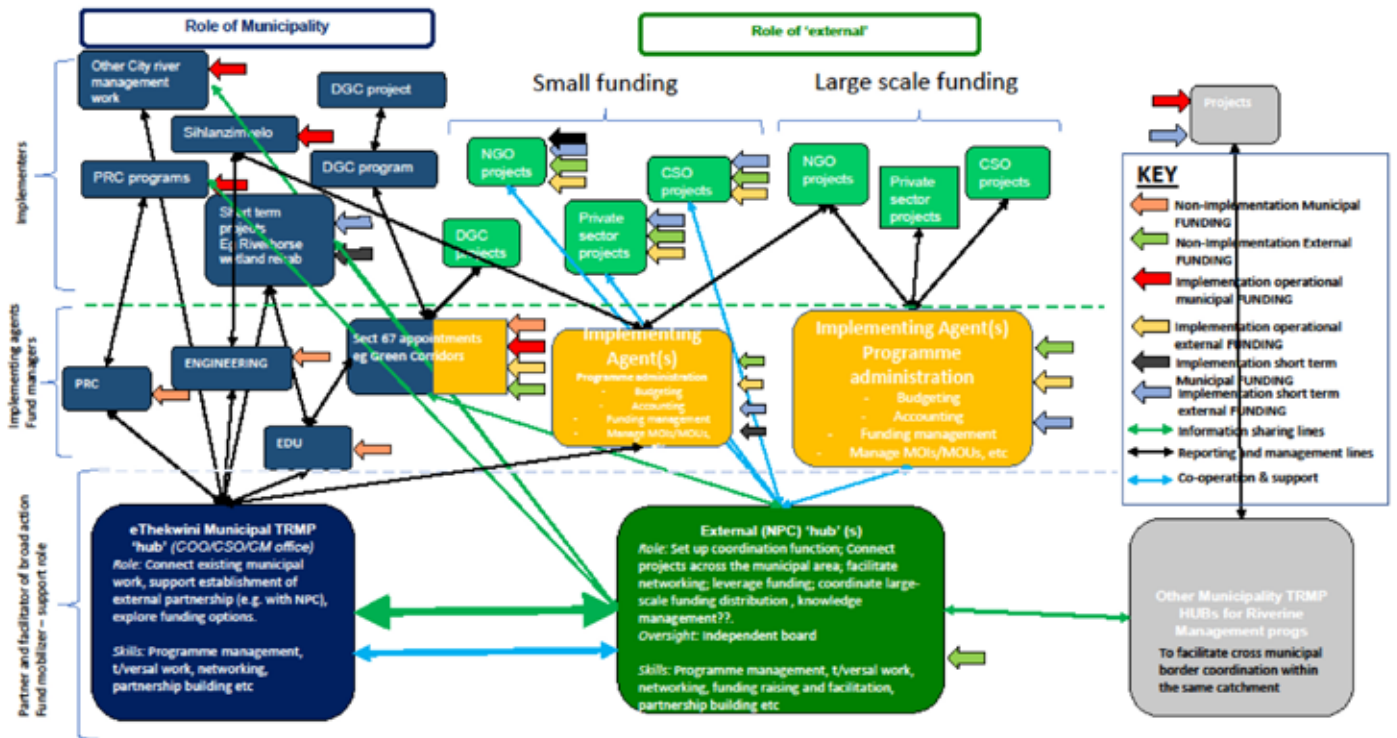


FIGURE 4: Transformative Riverine Governance (Mander et al. 2020)



**FIGURE 5:** Forms, functions, and relationships of TRMP institutional governance

and with eternal entities, fund raising, research, river management partnerships & institution building and monitoring & evaluation.

- **Riverine infrastructure:** grey infrastructure (canals, culverts, gabions, sand, and silt removal), ecological infrastructure (riparian tree planting, agro ecology and food gardens, artificial wetlands, weirs, clean ups) and recreational infrastructure (pocket parks, pedestrian bridges, outdoor gyms and play equipment , lighting, pathways, and benches)
- **River management services:** Sihlanzimvelo community-based stream cleaning, water quality monitoring and reporting faults in the sewerage system.
- **Socio-economic capital:** leadership development, community education and capacity building, enterprise development, green economy including circular economy & recycling learnerships, skills development and job placement.

**4. APRIL 2022 FLOODS -LEARNINGS**

The April 2022 floods within eThekweni were devastating with some areas receiving more than the 1 in 200-year event rainfall for a 24-hour period. The extent and duration of the rain meant that many of our medium size rivers flooded.

Extensive damage was experienced to infrastructure at river crossings and to services adjacent to the rivers. Analysis of the blockages show that the trend of blockages being caused by alien vegetation and solid waste has continued and the extent of the damage has been greatly increased due to these blockages.

There were far less blockages and damage where the streams were under Sihlanzimvelo management which is further proof of the benefits of a riverine management program.

It is estimated that as much as 95% of the blockages were because of vegetation blockage most of which was alien vegetation.



**FIGURE 6:** Caversham Road damage



**FIGURE 7:** Caversham Culvert blockage

The problems are summarised as follows.

- Alien vegetation grows faster with shallow root system that crowds out slower growing deep rooted indigenous plants
- Alien vegetation with the shallow root system is easily pulled out of the riverbanks during a flood.
- The exposed riverbanks are more easily eroded. – greater volumes of silt, larger trees are undermined and form part of the flotsam in the river, sewers and infrastructure along the river are more easily undermined.
- The increased volume of silt is deposited upstream of the blocked culverts thereby forcing the water out of the channel and into surrounding properties.
- Alien vegetation and trees form the primary blockage which collects all the solid waste in the flow – most of the solid waste would travel through the culverts without causing a blockage.
- The blockage causes the overtopping and the associated damage to road and service infrastructure.

## 5. CONCLUSIONS

Engineering solutions are required to address certain issues related to storm damage and those relate to capacity and design issues. However, our rivers are a system which require systems management hence the need for a Transformative Riverine Management System.

This business case proves that it is cheaper to proactively manage our urban river systems than to repair the damage to our grey infrastructure after every storm. It is also evident that this challenge requires government and the private sector to work together for the common good.

## 6. RECOMMENDATIONS

Our urban rivers and stream provide essential services and as such require to be maintained as other constructed assets within our city such as roads and watermains. There are many good riverine initiatives around our country which can add value to this program. These need to be shared and replicated to ultimately form part of a South African Transformative Riverine Management Program.

## 7. REFERENCES

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Business Case for Durban's Transformative Riverine Management Programme

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