Dutch Disaster Risk Reduction & Surge Support (DRRS) Programme Report

Roadmap to achieve a comprehensive flood resilience strategy for the Prospecton area in the South Durban Basin

Durban, South Africa

Final – 1 October 2024

Contents

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List of abbreviations (alphabetically)

ANC	African National Congress
CBD	Central Business District
CRISP	Climate Resilience Implementation Plan for Spatial Planning
CFRMP	Coastal Flood Risk Management Plan
CSCM	Coastal, Stormwater and Catchment Management
CBA	Cost-Benefit Analysis
DA	Democratic Alliance
CoGTA	Department of Cooperative Governance and Traditional Affairs
DBSA	Development Bank of Southern Africa
DRM	Disaster Risk Management
DDM	District Development Model
D/MCSCs	District/Metro Coordination Steering Committees
DDOP	Durban Dig-Out Port
DCCS	Durban Climate Change Strategy
DRRS	Dutch Disaster Risk Reduction and Surge Support
ESIA	Environmental and Social Impact Assessment
FAP	Functional Area Plan
GDP	Gross Domestic Product
ISA	Infrastructure South Africa
IDP	Integrated Development Plan
KZN	Kwazulu-Natal
LAP	Local Area Plan
MSL	Mean Sea Level
MCA	Multi-Criteria Analysis
MSP	Multi-Stakeholder Platform
NPC	National Planning Commission
O&M	Operation & Maintenance
PICC	Presidential Infrastructure Coordinating Commission
PMU	Project Management Unit
SANRAL	South African National Roads Agency SOC Ltd
SAPREF	South African Petroleum Refineries
SAWS	South African Weather Services
SAB	South African Breweries
SDF	Spatial Development Framework
SMART	Specific, Measurable, Achievable, Relevant, and Time-Bound
SIP	Strategic Integrated Projects
TA	Technical Assistance
TSAM	Toyota South Africa Motors

Executive Summary

The flood event

In April 2022 a severe flood event occurred in the coastal zone of Kwazulu-Natal (KZN) Province in South Africa, causing massive human, social and economic losses. Flooding of the Prospecton area, which is part of the South Durban Basin, resulted from three breaches in the Umlaas Canal, and was further exacerbated by excessive rainfall in the area.
The South Durban Basin, which hosts major industrial and commercial activities, was one of the worst affected areas. However, no comprehensive damage assessment was done to estimate the extent and impact of the flood in this area. Such an assessment however is essential for disaster risk management and recovery planning, as well as for long-term resilience and adaptation strategies.

Request eThekwini

In March 2023, eThekwini Municipality requested the assistance of the Dutch Disaster Risk Reduction and Surge Support (DRRS) programme to help formulate a plan that will comprehensively increase the flood resilience of the South Durban Basin and looks beyond the pre-flood situation to ensure the area is building back better. As a response to this request, the DRRS programme commissioned an economic flood risk assessment for the Prospecton. It also mobilized a team of experts who visited Durban in the week of 8 July 2024 to develop a roadmap to achieve a comprehensive flood resilience strategy for the Prospecton area in the South Durban Basin. This document describes this roadmap.

Understanding the situation

Prospecton is a low-lying, flood prone area which used to be a larger estuary in which the Mlazi River and Isipingo River confluence towards the sea. With embankments on both sides, the area is topographically considered ‘a bathtub’. The governance in the area is very complex and scattered with different national, provincial and municipal governments responsible for different infrastructure assets. This leads to a siloed approach towards resolving problems in the area. The exposure and vulnerability to flooding in this area is large, partly as a result of the N2 highway (which is considered an economic corridor to the South Coast) and the high density of industrial companies in this area. This economic zone is an important driver for the local GDP and provides many job opportunities for the local communities. The vulnerability to flooding is especially high for fluvial (river) flooding.
Various root causes for flooding were identified resulting in a long-list of causes, covering technical, social, economic, environmental and institutional aspects. These were subsequently screened and prioritised. Key root causes include a lack of pro-active spatial planning, lack of enforcement of planning and bylaws, lack of asset management (including essential maintenance), insufficient co-operation between (and within) the various national, provincial and local agencies and insufficient funding. Also insufficient dissemination of flood warnings and insufficient community engagement were identified as potential root causes.

Flood risk in Prospecton

The economic flood risk assessment carried out concluded that the total damage estimate of the April 2022 flood event was R75 billion, while the economic flood risk (or estimated annual damage) is estimated to be R500 million per year. Relative to the 2022 GDP in eThekwini Municipality of R461 billion and the estimated GDP in the South Durban area of R90 billion, this risk is deemed too high and creates a clear sense of urgency to act. While the sense of urgency is clear from an economic perspective, it does not mean that future risk reduction measures should solely focus on the economy. It should also address the social and environmental challenges. This area is an important economic driver for local GDP and provides many jobs for the local communities.

Strategy for flood resilience

The high flood risk, the multiple flood hazards, the past floods, the complex governance and the large variety of stakeholders demand a new approach towards flood risk management. Various internationally recognized frameworks and concepts were used to arrive at a holistic and integrated approach to solve

the challenges in the Prospecton area. These frameworks and concepts discuss 1) a risk-based approach that allows for planning a more flexible, adaptive and cost-effective response, 2) a holistic look at selecting risk reduction measures including the multi-layer safety approach, the various phases of the disaster management cycle and the grey-green-blue approaches, 3) a multi-disciplinary approach that includes social, economic, environmental, and institutional factors and identifies measures that are linked to other ambitions in the area to create co-benefits, 4) the need for a multi-stakeholder management approach that involves inclusion of all relevant stakeholders as part of the flood resilience strategy development and implementation and 5) appraisal of flood resilience strategies using MCAs and CBAs to meet defined objectives.

Arriving at a roadmap and priority actions

Numerous technical, institutional, social, environmental and financial building blocks were identified and further elaborated to form a high-level strategy. These building blocks focused on various stages of the project development cycle and included a list of priority actions for the short-term. Each of the building blocks were linked to an overall planning as well as to a lead organization. As such the roadmap provides guidance as to how flood resilience can be improved in the next 4 years and onwards.
To move the process forward, priority actions were defined aimed at 1) establishing sense of urgency, 2) establishing ownership & drive, 3) securing funding, 4) being prepared in meantime and 5) tackling unknowns, in particular flood risk associated with both the Umlaas Canal (dike safety) and the Shongweni Dam (dam safety) as well as flood risk of Isipingo and Mbokodweni Rivers.

The main high priority actions are:

- identify a champion in each sphere of the District Development Model (DDM) process as well as obtain SIP status;
- develop a long-term vision, that underlines the importance, urgency and the long term ambition while clarifying the ownership of the Umlaas Canal going forward as Transnet is the current asset owner of the Umlaas Canal;
- formulate an inter-agency agreement and set up a Project Management Unit, ensuring ownership and mandate;
- design a financing strategy for the entire project;
- develop an emergency response plan, in particular as repairs are ongoing and in view of uncertainties linked to key assets such as the Umlaas Canal and Shongweni Dam, helping to reduce flood risk should an event strike again;
- Carry out studies to address important unknowns (perform a safety assessment for Shongweni Dam as well as for Umlaas Canal, carry out assessments of the coastal flood risk and flood risk related to Isipingo and Mbokodweni Rivers).

1. General background

In April 2022 a flood event occurred in the coastal zone of the Kwazulu-Natal (KZN) Province in South Africa, including the Greater Durban area and South Coast. The area received more than 300mm of rain in 24 hours (approximated return period T = 50 years). This led to widespread flooding, with 459 people losing their lives and 88 people still missing by the end of May 2022. Over 4 000 homes were destroyed, 40 000 people left homeless, and 45 000 people were temporarily left unemployed. Preliminary estimates from eThekwini Municipality suggests R5.6 billion damage to roads, R1.9 billion damage to housing, several billion rands of damage to infrastructure and 248 damaged schools. The cost of infrastructure and business losses amounted to an estimated US$2 billion (or more than R36 billion). The flood was the most catastrophic natural disaster yet recorded in KZN Province in collective terms of lives lost, homes and infrastructure damaged or destroyed and economic impact according to (Grab & Nash, 2023).

In the aftermath, the national Government of South Africa mobilised teams from other provinces to assist KZN with assessing the damage in the province. These assessments mostly focussed on water treatment plants and pumping stations. Municipalities were tasked with complementing the national teams' assessments with their own damage assessments. Unfortunately, no comprehensive damage assessment was done to estimate the flood damage of the flood event in the South Durban Basin. A theoretical assessment of interest was done by the Economic Development Control Centre, Economic Research Strategy and Innovation Department and Economic Development Unit of eThekwini Municipality (eThekwini Municipality, 2022). This study looked at the businesses at risk using the theoretical 100-year flood line. It showed that Springfield Park, Prospecton and Clairwood were the three suburbs where the greatest number of businesses were at risk. It also used Valuation Roll data (i.e. property value data compiled by the local government which is used to determine the amount of property taxes that needs to be paid) to confirm that industries represent the largest market value at risk (~R3.7 billion) compared to other land uses. Based on this theoretical assessment, Springfield Flats is considered the top suburb at risk, while Prospecton is the second suburb at risk. The 2022 flood event showed that Prospecton was indeed at great risk, including being a major driver for the local economy. The impact on businesses in this area was substantial with reported flood depths up to 3m. The biggest flood impacts were suffered by Toyota South Africa Motors (TSAM), Mondi Merebank and South African Petroleum Refineries (SAPREF). The economic zone of Prospecton provides thousands of jobs for local communities, provides work for many smaller suppliers in the region and is also an important source of tax income for eThekwini Municipality which allows the municipality to provide services to residents in its area.

1.1. Request for DRRS Support

Since the flood event, progress has been made in restoring essential services and ensuring interim measures are in place to allow most business to return to full production. However, with damages to infrastructure assets, business running low on production and some even threatening to cease operations, the businesses in Prospecton (and the South Durban Basin at large) will remain vulnerable to flooding and a potential for disinvestment remains.

In April 2023, eThekwini Municipality therefore requested the assistance of the Dutch Disaster Risk Reduction and Surge Support (DRRS) programme to help formulate a plan that will comprehensively increase the flood resilience of the South Durban Basin and looks beyond the pre-flood situation to ensure the area is built back better. The request can be found in Annex I and specifically asks for the following technical assistance:

- Develop, with the various role-players, a hydraulic model of the Umlaas River system with the inclusion of predicted future climate change impacts.
- Develop, with the various role-players, the mitigation options available.
- Utilise the hydraulic model to test the mitigation options and determine the risk reduction provided by each possible intervention.
- Develop high level costings for each of the considered options.
- Develop a cost-benefit analysis for each of the considered options.

As a response to this request the DRRS programme first conducted a desktop study (Royal HaskoningDHV, 2023) which was a concise assessment to evaluate the relevance of the request for technical assistance and specify potential follow up priorities in the South Durban Basin. This study included a quick scan to better understand the context of the South Durban Basin, identified other (ongoing) plans in the South Durban Basin, assessed the likelihood of follow-up of recommendations for flood risk mitigation measures and detailed a possible scope of works and required expertise needed for a possible DRRS team intervention.

One of the recommendations of the desktop study was to execute a flood risk assessment to better understand the existing economic flood risk in the Prospecton area. This assessment would help to create a sense of urgency and appraise possible risk reduction measures as part of the flood resilience strategy. The details of this economic flood risk assessment (Royal HaskoningDHV, 2024) are described in more detail in section 2.2.

The economic flood risk assessment was performed in the first half of 2024 and its results informed the DRRS team of experts that visited Durban in the week of 8 July 2024. The scope of the DRRS team was further refined and aimed at developing a roadmap to achieve a comprehensive flood resilience strategy for the Prospecton area in the South Durban Basin. The study was undertaken in a short period of time and based on information that was made available by eThekwini and other stakeholders who were involved in the process.

The area of interest is bounded in the South by the Mbokodweni River, to the Southwest by the Isipingo River, to the West by the watershed divide of Isipingo, to the North by the watershed divide of the local watershed divide of Merebank and to the East by the Indian Ocean. The area of interest lies within eThekwini wards 90, 68, 76 and 88. It is important to note that this area of interest is defined based on the impacts that have presented itself during the 2022 flood. However, a holistic approach to flood risk reduction requires exploring the whole system as well as measures that lie in- and outside of this specific area of interest, including the whole catchments.

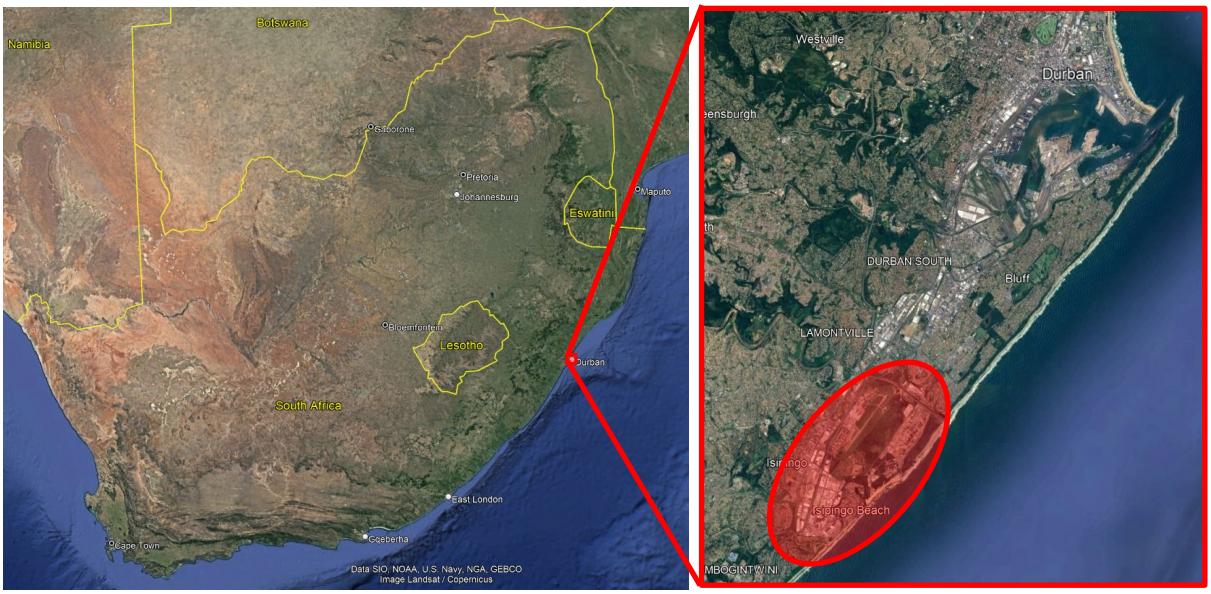


Figure 1-1: Problem location with location of Durban in South Africa (left) and Prospecton area in South Durban Basin (right) (source; Google Earth)

1.2. Political, social, and economic context

1.2.1 Politics

Politics determines how societies are governed through public decisions and governmental institutions influencing society's direction (Deutsch, 1970). The government must set a favourable political and legal framework to steer the course. The private sector is crucial for generating wealth through employment and income, and civil society mobilises groups for economic, social, and political engagement (Van der Waldt, 2022).

In the 2024 election, the African National Congress (ANC) lost its majority in Parliament. A government of national unity was formed, with the ANC and the Democratic Alliance (DA) as the largest parties. In KwaZulu-Natal, the Inkatha Freedom Party (IFP), ANC, DA, and the New Freedom Party (NFP) formed a provincial unity government. The election's impact extended to the local government level, where the former mayor, Mxolisi Kaunda, was appointed to the National Council of Provinces, and Cyril Xaba was elected to lead eThekwini (Mlondo, 2024).

In this dynamic landscape, it is crucial to consider political will at all levels to invest in the eThekwini flood resilience roadmap. Political will involves the determination and commitment of leaders to address specific issues through policies, resource distribution, and strategies. It is essential for the successful advancement of the roadmap, requiring leaders to recognise the severity of the flooding problem and its impact on the environment, public health, and the economy, and to provide sufficient funds and personnel. To effectively address challenges related to future flooding events in the Prospecton area, decision-makers must take bold and decisive action, with unwavering political will being a critical element for implementing the roadmap to mitigate future flooding. This is a key point of attention in arriving at the roadmap.

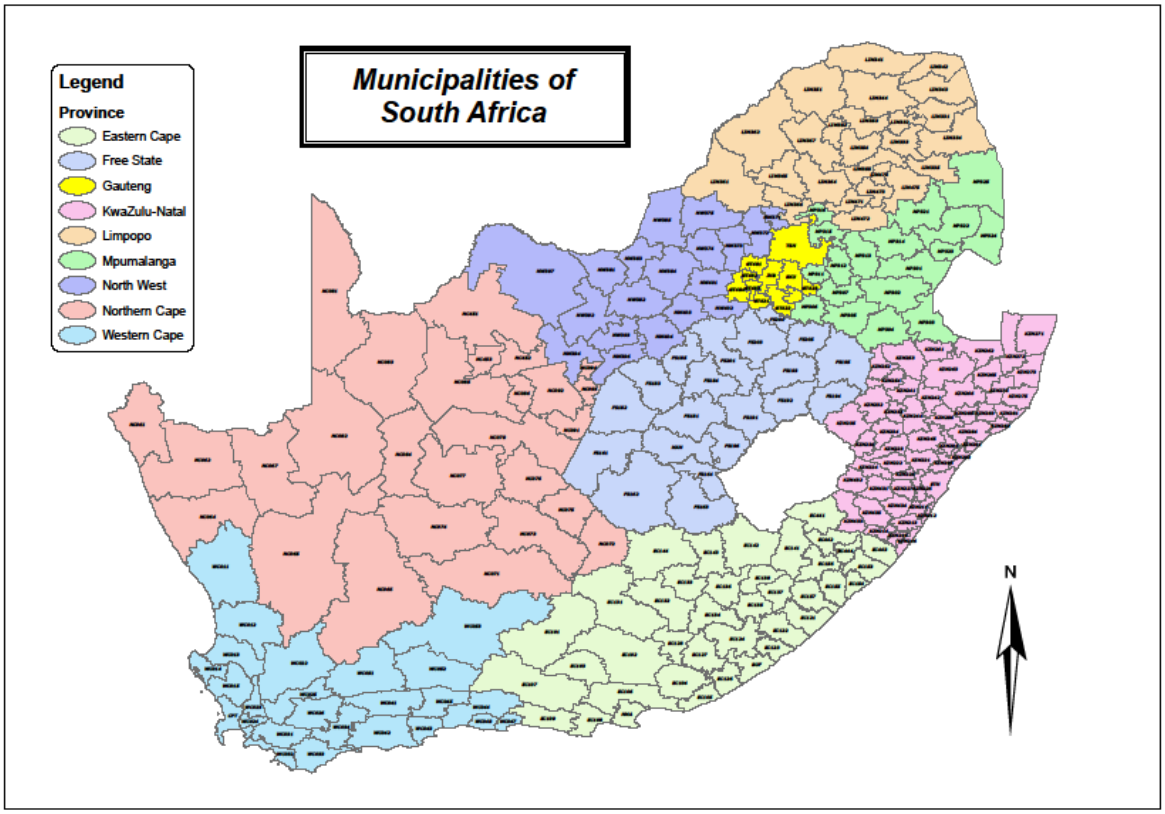


Figure 1-2 Provincial Boundaries (Source: MDB, 2013)

1.2.2 *Demography*

KwaZulu-Natal is South Africa's second-most populated province, with a population of 12.4 million in 2022. The eThekwini Municipality, with a population of 4.2 million in 2022, makes up the largest share of the total population in the province. eThekwini experienced significant population growth, rising from 3.5 million in 2011 to 4.2 million in 2022. The municipality boasts the highest proportion of working-age individuals (15-64 years) at 72.2%, while approximately 27.2% of the population is made up of children (0-14 years) and 6.4% is elderly (65 and above) (Stats SA 2024a). Nevertheless, eThekwini's employment rate was 47.6% in the first quarter of 2024 (Stats SA, 2024b). The municipality also has the highest population density in the province, with 1,659 persons per square kilometre, exceeding the provincial average of 132 persons per square kilometre by over 12 times. The average household size increased from 3.6 in 2011 to 3.8 in 2022. Overall, eThekwini's population profile is characterised by a large, densely populated urban area with a significant working-age population and high educational attainment (Stats SA, 2024a).

Figure 1-3 Map of KwaZulu Natal

1.2.3 *Economics*

KwaZulu-Natal's economic profile reflects a diverse and dynamic labour market with variations across sectors and regions. The unemployment rate has ranged from 35.6% to 46.8%, fluctuating over time. Despite substantial employment growth, the province struggles to maintain stable employment levels (Stats SA, 2024b). The province's economic performance declined in 2022, with the gross domestic product (GDP) contracting by -1.4% in the second quarter. The provincial growth rate was expected to decrease to 0.5% in 2023 before slightly increasing to 0.8% and 2.3% in 2024 and 2025. KwaZulu-Natal's exports accounted for 16.8% of the provincial GDP in 2022 (KZNPG, 2023).

The province is facing economic challenges, including global financial instability, electricity supply constraints, and the aftermath of flooding. Extreme weather events can directly impact economic outcomes such as output, investment, and productivity. The devastating flooding and record-high blackouts in 2022 contributed to the -1.4% contraction in the province's GDP. eThekwini is a key economic hub of KZN, contributing about 60.5% (around R461 billion) of the province's real GDP in 2022, with the South Durban GDP estimated at R90 billion (eThekwini presentation "Flood infrastructure funding", 2023). The municipality has faced challenges such as the energy crisis and the disruptions caused by flooding in 2022 (KZNPG, 2023) negatively influencing the GDP.

eThekwini's informal economy is significant and growing, consisting of street trading and other informal activities. It provides livelihoods and contributes to the overall economic landscape. The South Durban Basin Area Based Management team, in collaboration with eThekwini's Business Support Unit (Informal Trade), regulates, registers, and provides facilities for street traders. While the specific size of the informal economy is not available, it is rapidly growing in the South Durban Basin (CoGTA, 2022).

1.3. Area information

Prospecton is located several meters above sea level and is relatively flat. It is surrounded by higher topographic elements, such as the Isipingo hills on the West, the river/canal embankments on the North and South, and the coastal dunes on the East which create a "bathtub"-type of setting. Figure 1-4 shows the topography of the Prospecton area using the 2016 LiDAR survey data (in feet above msl).

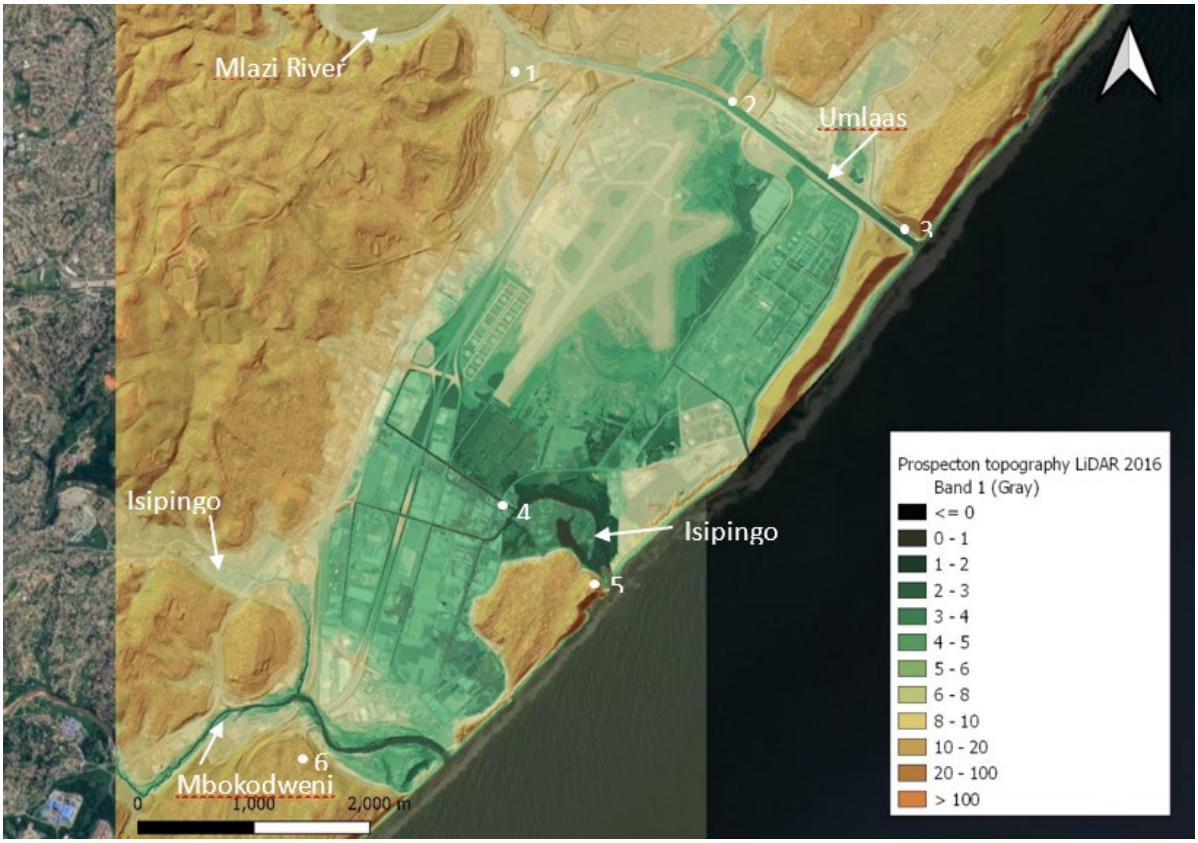


Figure 1-4: Topography of the Prospecton area including main water bodies and site visit locations (legend values are in meter above mean sea level, numbers 1 to 6 refer to photographs in Table 1-1 below)

On the northern edge, the Mlazi River enters into the Umlaas Canal near the location where the N2 highway crosses the R102 South Coast Road. The catchment area of the Mlazi River is 957 km^2 and includes the Shongweni Dam (see Figure 1-5) which was built in 1927 and is located 43 km upstream of the Umlaas Canal. The entire catchment is hilly, and the land is predominantly being used for forestry, agriculture or human settlement purposes. The upper reaches of the catchment consist of large timber plantations while further towards the coast, much of the catchment is used for sugarcane farming. Approximately 19% of the catchment area has been developed with peri-urban or urban settlements with the far downstream reaches of the catchment consisting of several relatively densely populated suburban and township developments (AECOM, 2024).

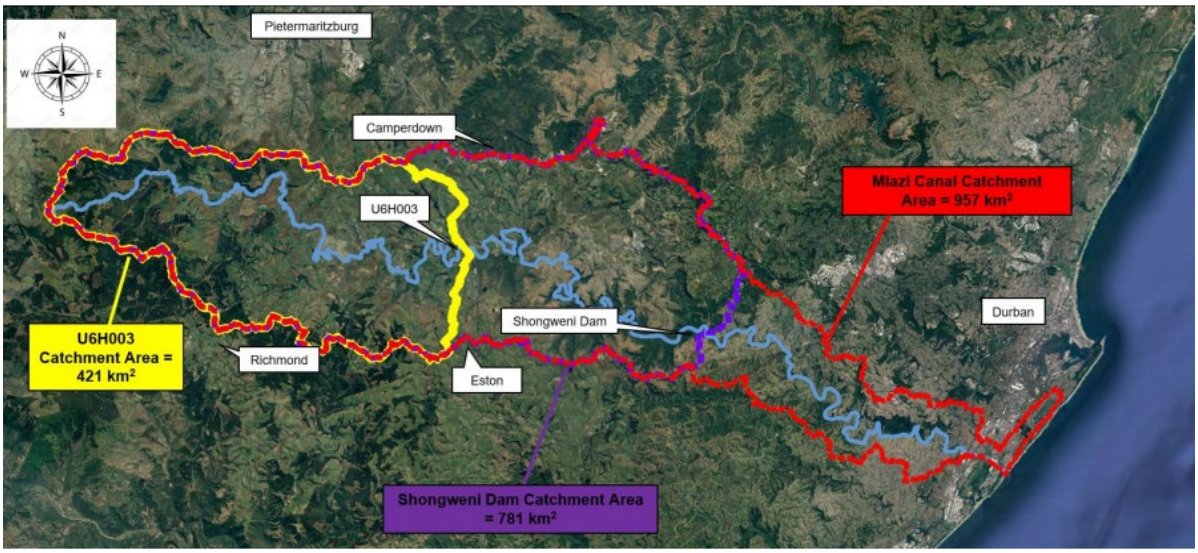


Figure 1-5: Mlazi River Catchment and location of Shongweni Dam (AECOM, 2024)

On the southern edge of Prospecton, the Isipingo River and Mbokodweni River confluence in the South-West corner of Prospecton and then discharge into the Indian Ocean. Prospecton is highly susceptible to flooding due to its low-lying nature. The Isipingo Estuary located in Prospecton used to be fed by both the Isipingo River and Mlazi River which converge before discharging to the sea. The estuary went through a phase of initial urbanisation and a period of commercial agriculture. With the development of the Airport (historically a large swamp) and the Prospecton area, the Mlazi River was canalised in 1952 resulting in the Umlaas Canal, after which the Isipingo River was diverted to the Mbokodweni River in the South. As a result of the diversions of both the Isipingo River and Mlazi River, the Isipingo Estuary is now primarily fed through local runoff from Prospecton and surrounding suburbs in the Isipingo Hills. Due to the reduced volumes of fresh water entering the Isipingo Estuary, sandbars are developing at the estuary mouth which disconnects the estuary from the sea. Settlement of infrastructure and land subsidence within the Prospecton Area have not been identified as a factor influencing flood risk.

The land use in the Prospecton area includes mostly industrial, commercial, agricultural and residential land uses. Figure 1-6 below shows a map of the various land use polygons using the eThekwini Municipality Open GIS Database, Open Street Maps and satellite imagery. Some informal settlements are present near the Isipingo River and between Ernest Clokie Road and Isipingo Beach. Successful agricultural enterprises exist such as market-driven farming in Isipingo. Furthermore, there is a large informal traders' economy active in Prospecton. The formal businesses and industries provide thousands of jobs to the local communities. Most businesses are also suppliers to the larger industrial companies, like TSAM.

From a flood risk point of view, there are several important infrastructure assets in the area which are worth mentioning. A selection is described below:

- The N2 highway is located in the area which is considered the 'artery to the South' and an important economic corridor.
- The Umlaas Canal is an essential asset. It is more than 70 years old, almost 3,800 meters long and is a concrete trapezoidal canal with a 0.9m parapet wall. It was originally designed for a maximum discharge of 1,806 m3/s. However, Arcus GIBBS (2004) concluded that based on the geometry and the roughness of the Umlaas Canal the maximum canal capacity with water levels at the top of the banks was 1,000 m^3/s. With water levels at the top of the parapet walls, the maximum canal capacity was 1,350 m^3/s, which is less than the design capacity. This is likely caused by the localised low points of the parapet wall and the likely assumption of a more favourable roughness coefficient in the original design. The parapet walls were not designed to function as protective elements, but more as additional height elements to deal with wave action and freeboard (personal communication eThekwini Municipality). The Umlaas canal has failed and flooded on three occasions: May 1959, September 1987 and April 2022. After the 1987 flood the Umlaas Flood Working Committee was established. It agreed that the 1 in 100-year design water level was the benchmark. This would be the minimum capacity required for the eThekwini Municipality to take over the canal and the maintenance from the Transnet Port Authority.
- Along the Isipingo and Mbokodweni River there is an earthen berm preventing water from entering the Prospecton area from the South. This asset has not been given much attention yet but is an important asset to protect the area against flooding.
- The drainage network in the South and West sections of Prospecton that drain towards Isipingo Estuary are important assets (e.g. concrete canals, culverts, bridges, retention area) that needs to operate efficiently to reduce the amount of pluvial flooding during intense rainfall events. The drainage function can be improved in terms of retention, capacity and maintenance.
- The infrastructure assets present on all the industrial plots are also important to mention, since they are responsible for the safe keep of the large economic value in this area. The vulnerability of these assets to flood damage (both direct and indirect) plays in an important role in the amount of flood risk that is present in this area.

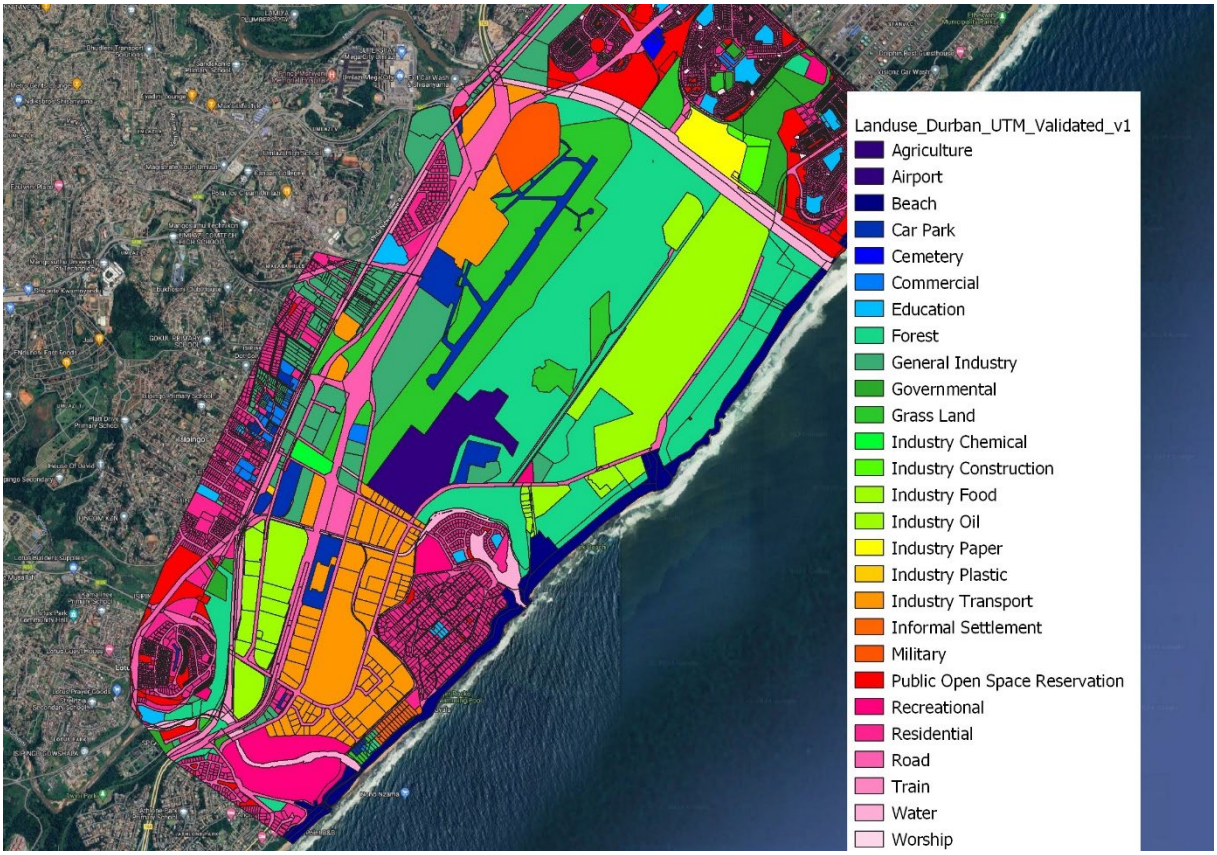
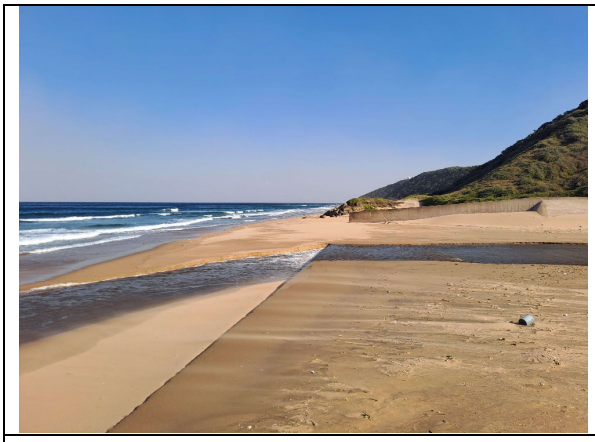


Figure 1-6: Land uses in the area of interest

During the visit of the DRRS Team to Durban in the week of 8 July 2024, a site visit was undertaken to six locations. These locations are indicated in Figure 1-4 and a selection of photographs per location are shown in Table 1-1.

Table 1-1: Overview of field visit photographs

	
1) Restored R102 berm with scour protection	2) Construction works in Umlaas Canal to close one of the two breaches

	
3) Outlet of the Umlaas Canal	4) Significant accumulation of litter at the start of the Isipingo Estuary near confluence of the Prospecton and Isipingo Canals
	
5) Outlet pipe to connect Isipingo Estuary to the Indian Ocean	6) Viewing point in northern direction overlooking the Mbokodweni River and Prospecton

1.4. Stakeholders and institutional context

The active stakeholders in the South Durban Basin are many public and private players. Most stakeholders were engaged in different South Durban Basin Task Group meetings. The success of the DDM, Strategic Integrated Projects (SIP), and the eThekwini Presidential Working Group depends on involving key stakeholders to comprehensively address governance and service delivery challenges. Table 1-2 below categorises stakeholders by their roles and government levels involved in these programmes.

Table 1-2 Stakeholders involved

Stakeholder Category	Stakeholders
National Government Departments and entities	The Presidency Department of Cooperative Governance and Traditional Affairs (CoGTA) National Planning Commission (NPC)
Provincial Government	Premier's Offices Provincial Departments of Cooperative Governance KwaZulu-Natal Department of Transport
Local Government	eThekwini Metropolitan Municipality and relevant line-function departments District Coordination Hubs District Coordination Steering Committee
Intergovernmental Bodies	Presidential Coordinating Council Premier's Coordinating Forum

	District/Metro Coordination Steering Committees (D/MCSCs) Presidential Infrastructure Coordinating Commission (PICC)
Other Stakeholders	Communities in and around the South Durban Basin. Private Sector (e.g. TSAM, Mondi, SAPREF, and SAB) Civil Society organisations (e.g., Durban Chamber of Commerce, rate payers' associations, and political parties represented by ward councillors) Other stakeholders such as South African Weather Service (SAWS) and Transnet Port Authority

The PICC decides the economic and social significance of projects to qualify as SIPs. The eThekwini Presidential Working Group focuses on improving support, addressing administrative matters, enhancing services, and attracting investments. Community and private sector buy-in are crucial for legitimacy. Government and civil society play important roles in ensuring the successful implementation of initiatives. Other key stakeholders that play a role are the South African National Roads Agency Limited (SANRAL), Transnet (e.g., Transnet Port Authority), and the KwaZulu Department of Transport.

The District Development Model

The National Government chose eThekwini as the pilot of the DDM because of its diverse development needs and representativeness of the broader South African landscape. The development model aims to address challenges in governance and service delivery by promoting synergy between national, provincial, and local priorities, enhancing the overall system, and ensuring budgets and programmes are based on community needs. CoGTA will manage the DDM at the national level, coordinating local government capacity building and shared resourcing, among other responsibilities. The NPC will support the cascading of the National Development Plan and ensure that national policies and plans are responsive to local circumstances. The Presidency ensures national policies align with district development, convenes intergovernmental sessions, and provides guidance to provinces. Premier's Offices oversee district-based coordination, while local governments coordinate unified plans and project delivery for each district and metropolitan area (CoGTA, 2022; SABC, 2019).

Strategic Integrated Projects

The Infrastructure Development Act No. 23 of 2014 (RSA, 2014) defines strategic integrated projects (SIP) as projects considered of significant economic or social importance to the country and intended to contribute to national strategies or policies related to infrastructure development (Tennet et al., 2024). The PICC is essential to help coordinate the development and implementation of such infrastructure. The Commission decides whether a project is economically and socially significant (RSA, 2014; DPWI, 2022).

The eThekwini Presidential Working Group

The Presidency established the eThekwini Presidential Working Group with the aim of enhancing support from national and provincial governments to address administrative issues in the municipality, improve water and sanitation, and attract new investments. In April 2024, the President led a delegation to meet with the Durban Chamber of Commerce. The ministers with the President included those from Public Enterprises, Water and Sanitation, Electricity, and Public Works and Infrastructure. At the meeting, eight priority areas were named: governance and financial sustainability, water and sanitation, safety and security, tourism revitalisation, roads, bridges, transport, human settlements, disaster response, and communication and stakeholder management (The Presidency, 2024b).

1.5. Recent developments

After the emergency response phase directly after the 2022 flood, the eThekwini Municipality moved towards the recovery phase as part of disaster risk management. The South Durban Basin Technical Task Group was formed which meets every 2 months and gives an update on all the flood related projects in the area to relevant stakeholders (see Table 1-3). There also used to be a South Durban

Basin Financial Task Group, which had the objective to explore how the possible risk reduction measures could be financed. The task group looked at what the measures were and how to set up partnerships to finance these measures. Discussions took place with the Department of Trade, Industry and Competition, provincial government, National Treasury and Transnet (Royal HaskoningDHV, 2023). Furthermore, there is a Presidential Working Group that reports on the status of recovery to the Presidency of South Africa.

Table 1-3: Overview of recent and ongoing developments (source: eThekwini Municipality Engineering Unit (2024))

Project	Implementing agent	Cost estimate	Expected completion	Type
Clark Road Sea Outfall (pipe & culvert)	eThekwini Municipality	R50 million	December 2024	Pluvial
Prospecton Road Canal and Road Upgrade	eThekwini Municipality	R186 million	June 2026	Pluvial
Upstream Attenuation Facility	eThekwini Municipality	R9.5 million	September 2024	Pluvial
N2 Relief Culvert and Canal	SANRAL	R350 million	Tender award is expected soon. After award a further 10 months to completion	Pluvial
Technical investigation of Mbokodweni and Isipingo River diversion berms	eThekwini Municipality	R0.2 million	January 2025	Fluvial
Repair of the Existing Umlaas Canal	Transnet Properties	R80 million	April 2025	Fluvial
Repair Existing Diversion Berm	Department of Transport	R30 million	Completed October 2023	Fluvial

1.6. Reader

After this introductory chapter, Chapter 2 will provide a deeper analysis of the existing flood risk situation at Prospecton in the broadest sense. This zooms in on the spatial planning context, providing an overview of plans that are in place. Subsequently the flood hazard and flood risk are described in detail. Most of this detail has been derived from the study carried out by Royal HaskoningDHV in the first half of 2024. The chapter then provides an overview of the various institutions and stakeholders that play a role. Finally a root cause analysis is presented as to what are the main causes underlying the undesirably high flood risk in Prospecton.

Chapter 2 provides a robust starting point to arrive at the roadmap in Chapter 3. Various frameworks are initially provided with guiding principles for strategy development. These frameworks have been shared and discussed with stakeholders during various workshops, ensuring all parties are looking in the same direction. This has also helped define the main drivers and objectives overlying any initiative to reduce flood risk in Prospecton. A broad range of so-called building blocks have been defined that jointly will tackle the root causes and can be combined in a high-level strategy. These have been prioritised and phased, to arrive at the overall roadmap. This includes tangible recommendations regarding the financing of the numerous activities.

Finally, Chapter 4 provides brief conclusions and recommendations regarding the roadmap.

2. Analysis

2.1. Existing plans for the Prospecton area

The area of interest is located within South Durban Basin and includes 4 wards. Various plans already exist for the area of interest and a selection of plans is briefly described in Annex II. It is important that these plans are considered while drafting a comprehensive flood resilience strategy for this area to ensure the strategy is aligned with the broader urban development and climate adaptation goals.

Overall the plans provide a comprehensive basis for spatial planning. In general it would be good to have a comprehensive flood risk management plan for the various catchments as well as for the coast. Building on the Royal HaskoningDHV (2024) economic flood risk study, with respect to Prospecton this would at least entail carrying out similar assessments for the Isipingo and Mbokodweni catchments as well as for the eThekwini coast.

Several other challenges identified are:

- Lack of pro-active spatial planning, aimed at decreasing vulnerability, decreased hard surfaces, insufficient awareness, insufficient alternatives to live elsewhere;
- Lack of enforcement in relation to spatial planning (e.g. ignoring plans, illegal infrastructure and settlements);
- Lack of monitoring & evaluation and ensuring all plans are regularly updated.

2.2. Water system analysis

2.2.1 Flood hazards

The Prospecton area is prone to several flood hazards that have been assessed in more detail by Royal HaskoningDHV (2024) and AECOM (2024a, 2024b). There are three types of hazards to consider for this area which will be briefly discussed here.

The pluvial flood hazard is the hazard caused by heavy rainfall that exceeds the capacity of the drainage system, resulting in surface water accumulation and flooding. Pluvial flooding can occur anywhere but is especially likely in urban areas with high imperviousness, low infiltration, and limited storage. In the area of interest, pluvial flooding has been experienced recently during high-intensity storms on 10 October 2017 and 22 April 2019. It is important that three sub-catchments need to be distinguished in the area of interest: 1) the sub-catchment draining Isipingo Hills and Southern Prospecton towards Isipingo Estuary, 2) the sub-catchment draining the area East of the old airport and the SAPREF site towards a sea outlet South of the SAPREF site and 3) the sub-catchment North of the Umlaas Canal that drains some open fields and the Mondi Merebank site. Drainage water from the latter location is directed towards a drainage canal running parallel to and north of the Umlaas Canal towards the sea. eThekwini Municipality and AECOM developed an integrated 1D-2D PCSWMM hydrological and hydraulic model for the first sub-catchment. Royal HaskoningDHV (2024) developed simplistic rain-on-grid models for the other two catchments. Storm events for five different return periods were simulated to better understand the flood depths and extents.

The fluvial flood hazard is the hazard caused by overflowing rivers or streams that exceed their channel capacity and inundate adjacent land areas. Fluvial flooding can occur due to heavy rainfall, rapid snowmelt, dam failures, or upstream catchment changes. In the area of interest, the fluvial flood hazard can come from three rivers. The Mlazi River on the northern side and the Isipingo River and Mbokodweni River on the southern side. The latter two rivers have so far not raised any concern for Prospecton, but need to be investigated in further detail to understand what the actual flood hazard is.

The Mlazi River discharge has been described in various studies and a large uncertainty exists around the statistics of extreme discharge values. AECOM (2024b) has investigated the historical values and

also developed a catchment-model for the Mlazi catchment. It appears that the previous flood peak flows determined by the DWA (1988) and Arcus GIBB (2002) are quite conservative and considering that the PCSWMM results correlate reasonably well with the results of the statistical analysis (which are preferred to deterministic and empirical methods used in previous studies) the new model results are accepted. AECOM (2024b) hence estimates that the 50-, 100- and 200-year return period discharges at Umlaas Canal are respectively 813 m^3/s, 1,351 m^3/s and 1,948 m^3/s.

During the April 2022 flood, the Umlaas Canal breached on three locations being the R102 Berm near Umlazi Mega City and two locations on either side of the Umlaas Canal just upstream of Mondi Merebank. The latter two locations also breached during the 1987 flood. AECOM (2024a) also developed a HEC-RAS model of the Umlaas Canal and Prospecton area which was used to run several extreme flooding scenarios to better understand the flood depths and extents (Royal HaskoningDHV, 2024).

The coastal flood hazard is the hazard caused by storm surges, wave overtopping, or coastal erosion caused by extreme weather events. The outlet of the Umlaas Canal is a concrete slab at an elevation of about +1.3m MSL (see figure 5 in Table 1-1) while the Highest Astronomical Tide according to the South African Navy Hydrographic Office is about +1.6m MSL. Combinations of high tide, storm surge and wave runup are likely able to push some water into the Umlaas Canal, but not to an extent that it increases the flood hazard in the canal. eThekwini Municipality have investigated coastal hazards as well as the joint probability of coastal and fluvial/pluvial events and have indicated that the coastal hazard is low for Prospecton. Coastal influence is mostly noticed through a backwater effect in the drainage systems at Isipingo Estuary and the outlet at SAPREF, but these disruptions too are reported to be minimal and of short duration. They may become more problematic in future or when these elevated coastal water levels coincide with simultaneous runoff from the Prospecton area. The coastal flood hazard is therefore considered to be low and not included in this assessment. Nevertheless, further studies are recommended to provide sound documentation on the matter and to better understand how future coastal conditions may adversely impact this area. It goes without saying that strategies proposed, if any, should at all times be based on studies that go beyond the coast of just the Prospecton area.

2.2.2 Existing flood risk

The economic flood risk assessment performed by Royal HaskoningDHV (2024) arrived at the various flood hazard maps to quantify flood damages for these different flood events. The focus of this study was on current flood risk, only qualitative statements are provided regarding future flood risk, which will likely be worse due to climate change, population growth and economic growth. The hazard maps were derived using an analysis of return periods for both pluvial and fluvial events, see Figure 2-1 below. To put the fluvial event of April 2022 into perspective, the return period is estimated to be in the range of 325-425 years. Looking at the Umlaas Canal in particular, it is estimated that its capacity is such that it can deal with a 100-year fluvial event, i.e. well below the capacity needed for the April 2022 event. As indicated in chapter 1, the return period of the pluvial event of April 2022, being more than 300 mm of rainfall in a 24-hour period, is in the order of 50 -100 years.

The exposure and vulnerability data in the area was based on various land use sources, Valuation Roll data, literature values and comprehensive interviews with selected companies in the area. The combination of hazard, exposure and vulnerability data led to quantitative estimates of flood damage for both the 2022 flood event as well as hypothetical flood events. The study concludes that the direct and indirect damages incurred in the area during the 2022 event amount to approximately R75 billion (or 4.1 billion US Dollars). This estimate has been verified with the local stakeholders and the economic department of eThekwini Municipality who confirms the ballpark estimate. This damage value far exceeds previous estimates that did not include the business interruption of business in the area. See Figure 2-2 for the reconstructed hazard associated with the 2022 fluvial event.

Pluvial return periods

#	Return period (years)	24-hour rainfall depth (mm)
1	10	191
2	20	234
3	50	298
4	100	354
5	200	416

Fluvial return periods – Mlazi River

#	Peak discharge (m3/s)	Return period (years)
1	1351	100
2	1948	200
3	2200	260 – 300
4	2400	325 - 425

Figure 2-1: Analysis of return periods (Royal HaskoningDHV, 2024)

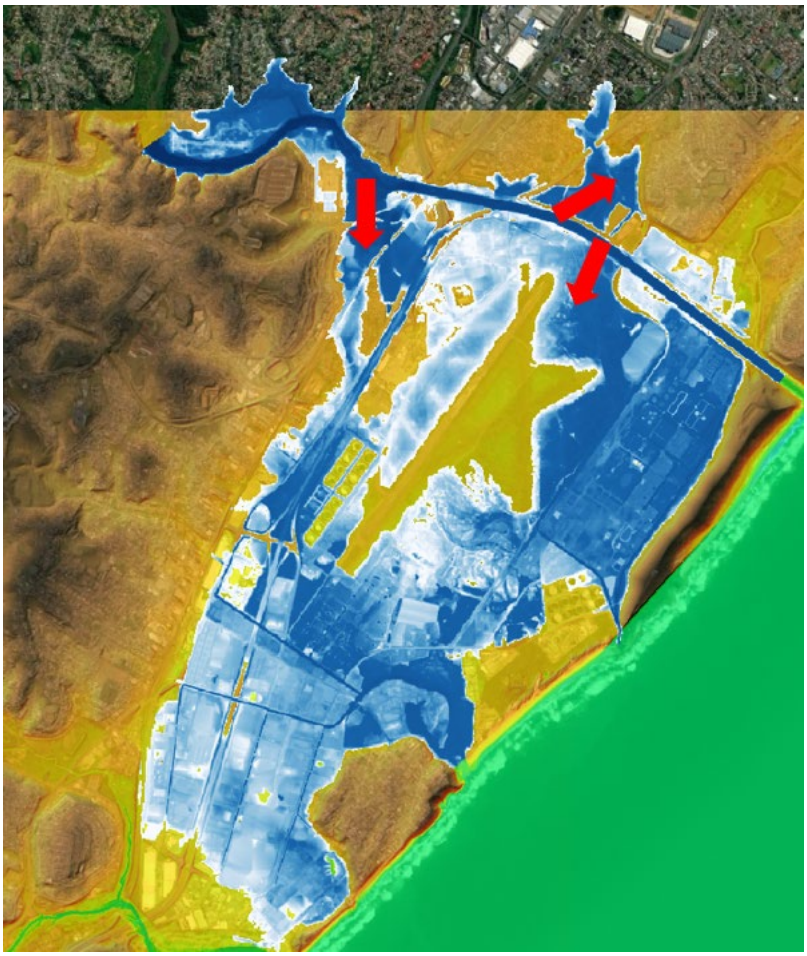


Figure 2-2: Reconstructed April 2022 fluvial event with the three breach locations as red arrows

The damages for the hypothetical flood events were also quantified and used to develop an economic risk profile. The estimated annual damage for pluvial and fluvial flooding is respectively R100 million (or $6.3 million) and R415 million (or $22.4 million). The pluvial and fluvial flood hazards are assumed to be independent hazards that are a result of different type of weather systems (cutoff-lows vs. local convective rainfall). Hence, the economic risk of both hazards is calculated separately and summed up resulting in a total economic risk of about R500 million per year (or almost $29 million per year).

These estimates for the 2022 flood damage and the annual economic flood risk are very large compared to the estimated GDP in the South Durban area of R90 billion. In comparison, the post-disaster needs assessment (PDNA) following Tropical Cyclone Idai in 2019 concluded that the recovery needs

amounted to USD 2.9 billion for Mozambique (compared to USD 4.1 billion for Prospecton). The flood damage and annual economic flood risk was also perceived too high for the stakeholders that were consulted. These estimates show the sense of urgency and revives the call for action to act following this flood event. Climate change and sea level rise could potentially exacerbate matters, increasing the urgency of the matter.

It is noted that the economic flood risk is the driver for showing the sense of urgency, but that it does not mean that any measures need to solely focus on the economic side of things. The next chapter clearly shows that an integrated, multi-disciplinary approach is required to solve the challenges in the area of interest. This means among others that social and environmental concerns need to be equally addressed in improving the Prospecton area.

For a more in-depth analysis of the flood risk at Prospecton, the reader is kindly referred to aforementioned study (Royal HaskoningDHV, 2024).

2.3. Institutions and stakeholders

Effective governance and development in South Africa require a clear understanding and strategic engagement with various stakeholders. The April 2022 floods have underscored the need for sustainable solutions, improved coordination, and meaningful community engagement in planning and response efforts. South Africa's three-sphere system highlights national, provincial, and local cooperative governance. The President's Co-ordinating Council promotes cooperation and coordination. The Department of CoGTA supports provinces and municipalities in their developmental roles (RSA, 1996; RSA, 2005; RSA, 2023a). Below is an outline of the relevant governmental mandates and non-governmental stakeholders' interests in the flood resilience roadmap.

- eThekwini Municipality is the local governmental body under which Prospecton falls. The municipality has various departments that for example are responsible for matters such as spatial planning, stormwater system management, disaster risk management, stakeholder engagement and community communication. As such eThekwini is responsible for flood risk management within the Prospecton Area for all municipal land. Although not their official mandate, eThekwini have developed an early warning system for the various rivers, including those relevant for Prospecton. They share their findings with the South African Weather Service (SAWS).
- The Department of Public Enterprises manages state-owned enterprises, overseeing efficiency, compliance, and strategic alignment with national goals. Transnet SOC Limited is being transferred to the Department of Transport (RSA, 2023a; Thorne, 2024).
- The Department of Transport and Transnet is responsible for developing transport infrastructure and services. Transnet focuses on providing an integrated freight transport system, including upgrading port infrastructure and rail networks (GCIS, 2024; Transnet, 2024). Transnet is the owner of the Umlaas Canal and hence is responsible for managing this asset and the flood risk associated with the canal.
- The KwaZulu-Natal Nature Conservation Management Act No. 9 of 1997 dictates that Ezemvelo KZN Wildlife is responsible for managing estuaries, among other conservation areas, in the province (KZNPG, 1997). The Isipingo Estuary is one of the key bottlenecks, hampering discharge of flood waters to sea. Due to this legal framework, eThekwini lacks the authority to oversee estuaries within its boundaries without first conducting an environmental impact assessment. This is particularly pertinent when considering the flood protection perspective and that the drainage canals in Prospecton flow into the Isipingo Estuary.
- Treasuries: The National Treasury ensures fiscal discipline and accountability in government spending, while the provincial treasuries manage the Provincial Revenue Fund (RSA, 1996; RSA, 2023a).

- Infrastructure South Africa (ISA) aims to address the infrastructure investment deficit and support prioritised projects, enhancing project delivery and speeding up investment (ISA, 2024). The ISA plays a crucial role in identifying, registering and constructing SIPs.
- South African Weather Service (SAWS) is responsible for issuing warnings related to weather conditions, including potential for floods.
- The Development Bank of Southern Africa (DBSA) promotes economic and human resources development through supporting development projects and infrastructure. The Infrastructure Fund provides viability gap funding for large-scale infrastructure investments (DBSA, 2020; Nhleko, 2024).
- The Zwelibomvu Community Trust are the owners of the Shongweni Dam and as such responsible for this asset. The dam as such has no flood risk management function, however any malfunctioning or failure could potentially result in unacceptable flood hazard and risk. So far there is no evidence of any safety assessments carried out by the Trust.
- The Private Sector: Companies like Mondi, TSAM, South African Breweries, and SAPREF have faced significant damage from the April 2022 floods, impacting their operations and requiring extensive recovery efforts (Mondi, 2022; Mark Lines, 2024; Mashego, 2022; Peyper, 2024). They have a direct stake in the roadmap's development and implementation and could become a vital partner in the endeavour. In principle they are responsible for flood risk management on their own plot.
- Communities have faced challenges related to flooding, including inadequate resources for proactive planning, ageing infrastructure, economic impacts, and loss of life. These challenges are exacerbated by other challenges, e.g., housing and unemployment, especially for those active in the informal economy and residents living in informal settlements. The community's involvement in planning and response is crucial for practical and feasible solutions (RSA, 2023a), considering the hardships they faced during the 2022 floods.

Strategic Engagement

Understanding the mandates, roles, and responsibilities of all entities involved is crucial for effective engagement. The Constitution outlines the roles and responsibilities of governmental and non-governmental actors and emphasizes the principle of cooperative governance. Public participation at all levels of decision-making is essential. Political will from all parties involved, including the eThekwini Municipality and community stakeholders, is crucial for the success of the flood resilience strategy.

2.4. Root cause analysis

The previous sections of this chapter set the scene with respect to flood risk management relevant for Prospecton. Only once the planning, the flood hazards and risks, and the institutional and stakeholder setting is understood, can the underlying root causes be identified. Subsequently, only once the root causes are understood, is it possible to define building blocks for strategies.

It has become clear that insufficient pro-active planning is in place (e.g. in relation to promoting soft surfaces and water retention), there is lack of enforcement (e.g. wetlands being illegally replaced by hard surfaces for container storage) and inconsistent flood risk management planning for fluvial, pluvial and coastal flood risk.

Regarding fluvial flood hazard and risk, it is also clear that the Shongweni Dam is not the root cause for the flooding per se, as it performed as designed and the resulting flood wave had dissipated by the time it had reached the Umlaas Canal. The root causes for fluvial flood hazard and risk must therefore be found in the overall behaviour of the catchment (including existing infrastructure such as the Umlaas Canal) and underlying factors (e.g. institutional). In this respect it should be noted that Umlaas Canal already failed in 1959, 1987 and again in 2022. Both 1987 and 2022 events resulted in actual breaches. Apparently, the design consists of an arrangement of concrete panels throughout the nearly 4 km long canal, of which the sides rest against sand-based embankments. A clear analysis as to how it failed was not presented and so far, the general assumption has been that failure is the result of overtopping

followed by erosion and subsequently breaching. However, growth of vegetation between the panels as well as the fact that all concrete works are now roughly 70 years old (no maintenance seems to be done) suggest that potentially seepage (resulting in piping and hence undermining of the embankments) could well be the initial cause of failure of the breaches. Due to poor access as well as vegetational over-growth inspection of the canals embankments is difficult. The failure mechanisms and an assessment of what is dominant needs to be investigated as soon as possible. This urgency is exacerbated by the fact that the ongoing repairs of the canal seem to be in line with the current canal design, making it possible that the same could happen again. Regarding pluvial flood hazard and risk, Royal HaskoningDHV (2024) shows a broad range of factors have surfaced from source, pathway to receptor. These have also been recorded from past events as well as during the site visits (e.g. 8 July 2024). In brief, these factors concern limited surfaces with infiltration potential, insufficient discharge capacity of existing drainage and blockages, insufficient protection of assets as well as having assets in vulnerable locations. Also here these root causes have underlying considerations (e.g. planning, institutional).

From an institutional and stakeholder perspective, various challenges are evident. Solid asset management approaches need to be in place with clear ownership, objectives and processes. This includes the Umlaas Canal, the Shongweni Dam, the storm water drainage system, the estuaries and road infrastructure (including bridges and culverts). Properly funded asset management has become increasingly difficult with cuts in funding (e.g. eThekwini in relation to storm water management). In addition, some of the key flood management infrastructure assets are owned by stakeholders with limited exposure to flood risk and limited cost recovery potential, which negatively impacts their willingness to fund proper asset management and reconstruction works (e.g. Transnet in relation to Umlaas Canal).

Also the various relevant departments of local, provincial and national government need to be coordinated better to avoid silo-ed approaches.

Based on this understanding two workshops were undertaken (9 and 10 July 2024) to further zoom in on the root causes. This was done iteratively, involving a broad range of stakeholders, including the local community. Initially a long list of root causes was derived, covering technical, social, economic, environmental and institutional aspects. In Table 2-1 only the high priority and important root causes are presented. In each case it was also established that the cause was relevant to fluvial as well as pluvial flood risk. The right-hand column indicates the main responsible actor to tackle that particular root cause.

Table 2-1: High level root causes for fluvial and pluvial flood risk for Prospecton

Root cause identified	Comments & potential underlying root causes	Main responsible actors
Lack of pro-active spatial planning	Increased vulnerability, increased hard surfaces. Insufficient awareness, insufficient alternatives to live elsewhere.	eThekwini Metropolitan Municipality
Lack of community engagement	Insufficient awareness. Community participation needs to go beyond 'ticking the box'. Tackling this provides also opportunities for community-based emergency response planning.	National Government (Departments of Cooperative Government and Traditional Affairs and Social Development), KwaZulu-Natal Provincial Government, eThekwini Metropolitan Municipality)
Lack of asset management	Concerns among others Shongweni Dam, Umlaas Canal, local drainage system, estuaries, but also other flood and water infrastructure. This involves understanding of assets as well as pro-active maintenance, replacement and futureproofing.	Department of Water and Sanitation, Department of Public Works and Infrastructure; Zwelibomvu Community Trust (Shongweni Dam), KwaZulu-Natal Department of Development, Tourism and Environmental Affairs (estuaries) Department of Transport (Transnet - Umlaas Canal), eThekwini Metropolitan Municipality,

Root cause identified	Comments & potential underlying root causes	Main responsible actors
Insufficient dissemination of flood warnings	Need to strengthen eThekwini's mandate and improve last-mile dissemination. Insufficient infrastructure in place to actually warn the public. South African Weather Services (SAWS) is currently talking to telecom providers, this needs to be progressed.	South African Weather Services (SAWS), eThekwini Metropolitan Municipality
Lack of enforcement	This pertains to aspects such as spatial planning (e.g. illegal infrastructure and settlements) and municipal bylaws. In part this becomes complicated by the fact that alternatives need to be provided, which is also difficult.	eThekwini Metropolitan Municipality
Insufficient co-operation	This spans national, provincial, municipal, but also within each government. Insular thinking, prevalence of short-term thinking. Mandates and responsibilities need to be streamlined.	Presidency, KwaZulu-Natal Provincial Government, and the eThekwini Metropolitan Municipality
Lack of monitoring & evaluation	This applies to all of the above. In all cases a systematic approach along Plan-Do-Check-Act is needed.	All of the above
Insufficient knowledge management	This applies to all of the above and refers to general understanding of the system.	All of the above including National Treasury
Insufficient funding	This applies to all of the above.	All of the above including National Treasury

Overarching the above is the fact that flood risk is not sufficiently recognised as a problem. Appropriate spatial planning and appropriate flood risk management in general need to be put higher on the agenda, with a clear vision as to how this needs to be addressed holistically, where possible also mobilising wider benefits for the communities and industries involved as well as environment.

3. Roadmap

Whereas the previous two chapters present the starting points and the main root causes from which a roadmap can be developed, this chapter elaborates on the roadmap to achieve a comprehensive flood resilience strategy. Section 3.1 proposes several methodological frameworks that are recommended to be considered during strategy development. These frameworks help arriving at a resilience strategy aimed at tackling the main identified root causes. This is followed by outlining the main drivers and objectives underlying the flood resilience strategy. Keeping this in mind, the various building blocks of the strategy can be defined. By linking the building blocks to each other, as well as to a planning and to action holders a roadmap is derived. This includes a practical proposal regarding organising the roadmap's execution as well as the financing of the numerous activities.

3.1. Proposed frameworks and concepts

To arrive at a high-level strategy and a roadmap to achieve comprehensive flood resilience for Prospecton is a complex process. Various frameworks and concepts can be used to help this process, both within the DRRS team as well as with all those involved during this DRRS project.
In the following a brief overview is given of these frameworks and concepts. For a more detailed description please see Annex III.

Risk-based approach to flood management

The comprehensive flood risk assessment involves assessing the probability and consequences of different flood scenarios and selecting the optimal combination of measures to reduce the expected losses (see schematic steps in Figure 3-1). It allows for a comprehensive and transparent evaluation of the costs and benefits of different interventions, as well as the trade-offs between them. Not only does this help the appraisal and business case of proposed measures, but it also helps in determining the most cost-effective protection level for an area. A risk-based approach also enables the consideration of uncertainties and variabilities in the input data and models, as well as the preferences and values of different stakeholders.

Figure 3-1: Steps of a comprehensive flood risk assessment and planning

Risk reduction measures – Multi-Layer Safety Approach & Disaster Management Cycle

To address and manage flood risk an integrated approach is needed. A framework widely used in many countries is the concept of the multi-layer safety approach (Klijn et al., 2012, Jonkman et al., 2008, Vandenboer et al., 2020)). This approach defines three layers to form a flood risk management strategy1) Prevention and protection measures; 2) Spatial planning measures and 3) emergency preparedness and response.

Critical starting point for defining a strategy on this basis is understanding your hazards and risks (e.g. magnitude, flood mechanisms, exposure, vulnerability) as well as existing capacities and capabilities to manage those hazards and risks.

In many countries the disaster management cycle is used as a framework to arrive at a flood risk management strategy (FEMA, 2020). The disaster management cycle has strong parallels with the multi-layer safety approach and advocates strategies that adopt a variety of measures.

Grey-green-blue measures

In line with the previous frameworks, when zooming in on prevention and protection (i.e. mitigation), one can further distinguish between the various types of measures. These are often classified as grey, green and blue measures and typically involve the following examples:

- Grey: generally man-made structures such as dams, levees, floodwalls and stormwater drainage systems;
- Green: permeable pavements, urban green spaces, swales, natural water retention, green roofs;
- Blue: involves river restoration, wetland restoration and flood plain reconnections and widening.

From a long term and sustainability perspective there is an increasing drive to progress green and blue measures as well-managed ecosystems have the potential to reduce the severity and risk of extreme climatic events. These measures, often called nature-based solutions, provide various environmental benefits and are part of ecosystem approaches that are already promoted in South-Africa (South African National Biodiversity Institute, 2019). It connects also strongly to the ambition to develop more water-sensitive cities as described by Carden et al. (2016). Nevertheless, the balance between all three types needs to be considered holistically, taking also political, social, economic, cultural practices, and space requirements into consideration.

Multi-disciplinary approach

The previous highlights that a multi-disciplinary approach is needed to manage flood risk in Prospecton. Not only is a risk-based and multi-layered safety approach required that covers the addresses the various components of the disaster management cycle, but the (reduced) impacts cover a wide range of aspects such as technical, social, economic, environmental, and institutional factors. Linked to this is also the need for a wide range of stakeholders to be involved and part of the overall strategy. Hence, the workshops held in July 2024 involved a broad range of disciplines and organisations. The multi-disciplinary approach also promotes a paradigm of looking beyond the engineering side of things and exploring socio-economic, environmental and institutional challenges and measures. It promotes identification and inclusion of measures that are linked to other ambitions in the area and create co-benefits.

Multi-stakeholder management

As part of the multi-disciplinary approach to manage flood risk effectively, a multi-stakeholder management approach is needed given the diverse range of governmental and non-governmental stakeholders impacted by flooding. For Prospecton it has become clear that there is a wide range of different stakeholders to consider and include. A clear engagement and community strategy is needed followed by an engagement and communication platform (as included in Figure 3-3: Proposed organogram of Project Management Unit).

Strategy appraisal, MCA & prioritisation

Throughout the whole process of the project life cycle (i.e. planning, feasibility studies, environmental impact assessment and design) options need to be assessed and appraised and decisions need to be taken as to what is taken forward. In defining strategies there may be merit in using themes. To illustrate, say we focus on fluvial flood risk only, we could define the following strategies for the Umlaas Canal:

- Do nothing – i.e. carry out repairs to Umlaas Canal and restore conditions.
- Build Back Better (civil engineering approach) – i.e. revisit and potentially revise the design, removing risk of breach. This also includes slope protection measures.
- Build Back Better (sustainability approach) - i.e. like civil engineering approach, however maximising opportunities in the catchment to lower flood peaks now and in future.
- Build Back Better (low maintenance approach) - i.e. similar to one of the previous two approaches, however with emphasis to minimise needed maintenance.

To appraise the strategies both a Multi-Criteria Analysis (MCA) and a Cost-Benefit Analysis (CBA) is recommended. The MCA would typically cover criteria and indicators linked to Technical / Implementability, Social, Economic and Environmental aspects. As various root causes and building

blocks also cover institutional aspects, it may also warrant adding Institutional criteria and indicators. The CBA would typically focus on costs of the strategy, which includes capital and operational expenditures, as well as the benefits (reduced flood risk, reduced fatalities) in time. The period assessed in the CBA should be commensurate with type of analysis undertaken; for planning phases this is generally in the order of 50 years.

3.2. Drivers and objectives

To identify the various building blocks that ultimately can form flood risk management strategies it is important to define the overarching drivers for the "project". These drivers – together with earlier mentioned root causes – can then be translated to objectives.

The key drivers were identified during the workshops and were defined as follows:

- Flood risk, including climate change, i.e. what is the fluvial, pluvial and costal flood risk, now and in future. A distinction needs to be made between Prospecton and the catchment.
- Economic development, i.e. which economic activities take place in Prospecton, including impacts on the wider South African economy, now and in future.
- Demographic development, i.e. what population is present and where in Prospecton, now and in future; this includes residents as well as commuting population;
- Sustainability, i.e. which environmental assets are present in Prospecton and in the wider catchment, now and in future.

Subsequently this was, keeping the root causes in mind, translated to the following objectives:

- Manage Flood Risk – now and in future to accepted levels.
- Reduce negative impact on the economy, including infrastructure.
- Reduce negative impact on the population.
- Reduce negative impact on the environment.
- Engage stakeholders throughout the process.
- Optimise total cost of ownership.
- Promote institutional strengthening, including enforcement.

Both the drivers as well as the objectives were supported by those present in the workshops. These objectives should be seen as an initial version. They are straight forward and robust. No doubt as matters progress, there may be a need to add objectives. This could entail softer aspects such as: promoting side benefits related to the local population (e.g. employment) and environment (e.g. restoration, waste management). Also there may be merit in defining a certain theme that applies to these objectives (to illustrate, in the Netherlands in the 1990s the concept and theme of Room for Rivers was introduced, emphasizing that safety would be pursued mainly by implementing such measures).

Finally, it should be noted that these objectives need to be made SMART (Specific, Measurable, Achievable, Relevant, and Time-Bound), with well-defined indicators and quantification of their current status as well as their targets for the short as well as long term.

3.3. Building blocks and high-level strategy

Jointly with all stakeholders, based on the hazard and risk assessment (Royal HaskoningDHV, 2024) and the identified root causes for flood risk in Prospecton, an iterative approach was taken to define building blocks and gradually develop a high-level strategy. A total of four workshops were carried out, each building upon the previous and where needed refining the outcomes. This involved professionals at national, provincial and municipal levels as well as a wide range of stakeholders. As mentioned, the building blocks were initially categorised into the following types: technical, social, environmental, economic and institutional. Further to that they were cross referenced with the multi-layered safety framework to ensure a holistic approach is taken with respect to the strategy.

Following the workshops the results were critically reviewed. Further refinement took place, grouping each of the building blocks along the lines of a project development cycle. These are presented

schematically in Figure 3-2 and subsequently in Table 3-1. Table 3-1 provides more detail as to what type of building block it concerns and details regarding its timing, cost and project owner.

In the following the underlying rationale is provided for the schematic in Figure 3-2:

- Risk: To arrive at a flood resilience strategy for Prospecton, fluvial, pluvial and coastal flood risk must be known. At this moment in time, fluvial flood risk of Mlazi River as well as the pluvial flood risk of Prospecton are clear. Fluvial flood risk of Isipingo and Mbokodweni Rivers as well as coastal flood risk – although perceived as a lesser risk - require further substantiation and documentation.
- Understanding root causes: to arrive at a high-level strategy and a roadmap for flood resilience, it is essential that the root causes are understood. A long-list of causes have been identified and subsequent brought back to a prioritised list of (inter-related) causes.
- Setting the foundations for the way forward. Numerous building blocks have been identified that jointly at a high level will provide a robust strategy and way forward. However, prior to actioning those it is essential that a solid foundation is ensured, the so-called Priority actions. This is aimed at 1) establishing sense of urgency, 2) establishing ownership & drive, 3) securing funding, 4) being prepared in meantime and 5) tackling unknowns, in particular flood risk associated with both the Umlaas Canal (dike safety) and the Shongweni Dam (dam safety) as well as flood risk of Isipingo and Mbokodweni Rivers.
- Engagement & Communication: In line with international best practice as well as in line with requests during the workshops, engagement & communication right from the start will be essential. All affected and concerned parties need to be on board to maximise the success of the overall process.
- Project development and implementation: a whole array of projects have been (and will potentially be) identified, that will undergo a process of planning, design, construction / implementation and ultimately operation and maintenance.

In Figure 3-2 reference is made to the various build blocks given in Table 3-1.

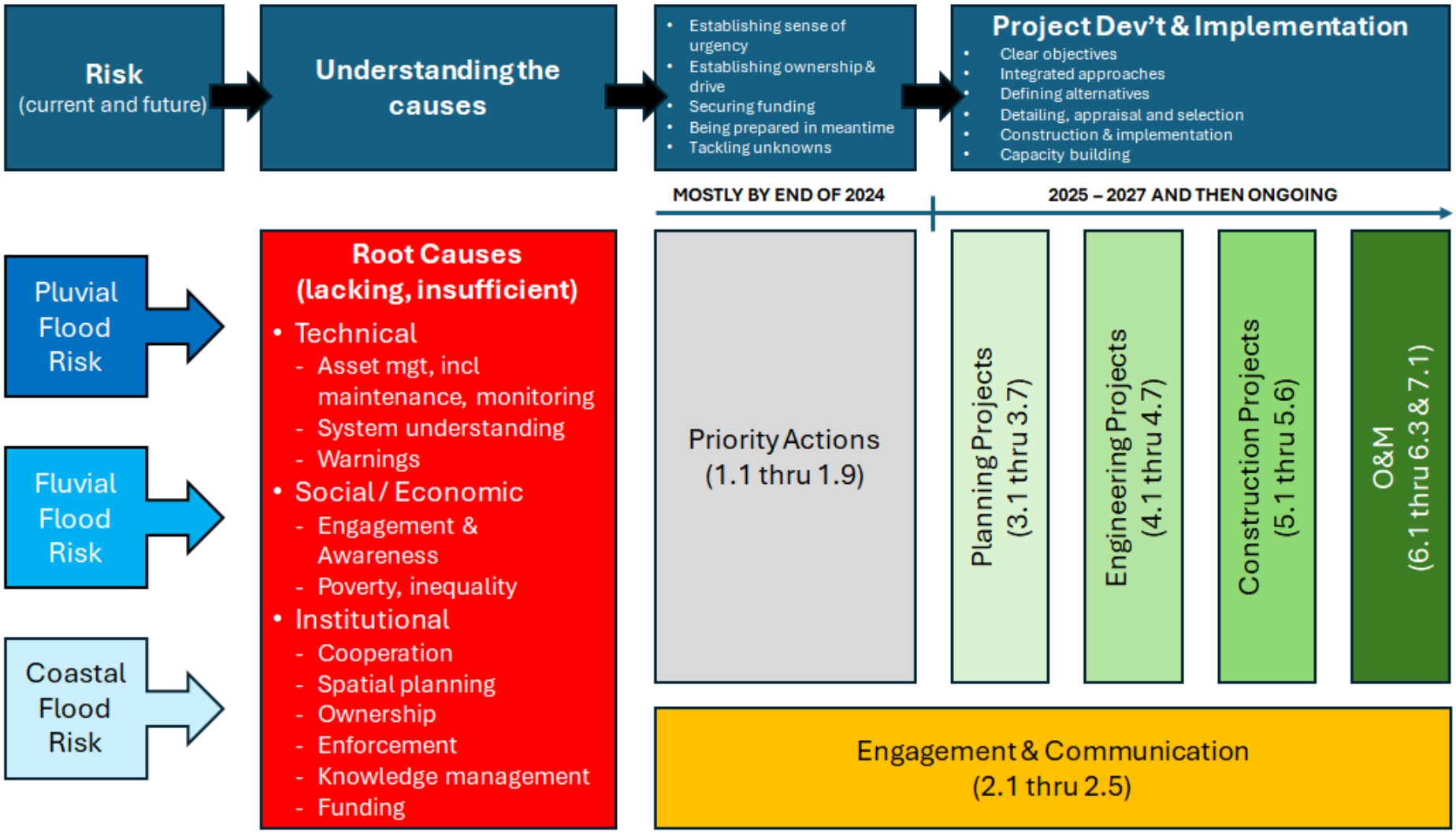


Figure 2-2: Arriving at a roadmap

Table 3-1: Building blocks and overall strategy

	No	Building Block	Type	Timing	Cost	Project owner
High priority	1.1	Champion & SIP Status	Inst & Fin	End of 2024	In-house	eThekwini will lead
	1.2	Long term vision	Inst & Fin	End of 2024	In-house	DDM
	1.3	Inter-agency agreement & Project management unit	Inst & Fin	End of 2024	In-house	eThekwini will lead
	1.4	Project financing and funding	Inst & Fin	End of 2024	In-house	eThekwini will lead
	1.5	Emergency Response Plan Prospecton, later Comprehensive community-based DRM plan	Inst & Fin	Initial Q3 of 2024 Elaborate in 2025	Low	DDM
	1.6	Safety Assessment Shongweni Dam	Technical	End of 2024	Low	To be determined
	1.7	Safety Assessment Umlaas Canal	Technical	End of 2024	Low	Transnet
	1.8	Study on Coastal Hydraulic Boundary Conditions	Technical	End of 2024	Low	eThekwini
	1.9	Study on Isipingo and Mbokodweni flood risk	Technical	End of 2024	Low	eThekwini
Engagement	2.1	Stakeholder Engagement Strategy	Social	End of 2024	Low	eThekwini
	2.2	Temporary measures for warning system	Technical	End of 2024	Low	eThekwini / CSCM
	2.3	Communication participation platform	Social	End of 2024	Low	eThekwini
	2.4	Awareness raising programme	Social	End of 2024	Low	eThekwini
	2.5	Permanent warning system	Technical	Q1 of 2025	Low	eThekwini / CSCM
Planning	3.1	Flood Risk Management Plan & ESIA Mlazi Catchment	Technical	Q2 of 2025	Relatively low	DWS Nat / Catchment Mgt Agency
	3.2	Flood Risk Management Plan & ESIA Isipingo / Mbokodweni	Technical	Q4 of 2025	Relatively low	DWS Nat / Catchment Mgt Agency
	3.3	FR Management Plan Pluvial	Technical	Q4 of 2025	Relatively low	eThekwini
	3.4	Isipingo estuary & mouth management plan	Environment	Q4 of 2024	Low	Province Env. Affairs
	3.5	Coastal Flood Risk Management Plan	Technical	Q4 of 2025	Relatively low	eThekwini
	3.6	Spatial planning & law enforcement (incl policy)	Inst & Fin	Initial this year	Low	eThekwini + SAPS
	3.7	High level plan linking above to formal plans	Institutional	Q4 of 2025	Relatively low	eThekwini / Province
Engineering &	4.1	Mlazi River / Umlaas Canal Flood alleviation scheme (Feasibility & Design & Contract docs)	Technical	Q4 of 2025	Relatively low	Transnet and eThekwini
	4.2	Isipingo / Mbokodweni Flood alleviation scheme (Feasibility & Design & Contract docs)	Technical	Q1 of 2025	Relatively low	eThekwini

	4.3	Pluvial flood alleviation scheme Prospecton, including reinstating wetlands (Feasibility & Design)	Technical	Q1 of 2025	Relatively low	eThekwini
	4.4	New flood early warning system (Feasibility & Design)	Technical	Q1 of 2025	Relatively low	eThekwini / CSCM
	4.5	Asset management System Umlaas Canal	Technical	Q1 of 2025	Relatively low	Transnet and eThekwini
	4.6	Asset management System Prospecton Drainage	Technical	Q1 of 2025	Relatively low	eThekwini
	4.7	Improved monitoring system	Technical	Ongoing	Low	eThekwini & DWS
Construction	5.1	Mlazi River / Umlaas Canal Flood alleviation scheme	Technical	2027	R2-3 billion	National + Transnet
	5.2	Isipingo & Mbokodweni measures	Technical	End of 2025	R1.5–2 million	eThekwini
	5.3	Pluvial flood alleviation scheme Prospecton	Technical	End of 2026	R50 million	eThekwini
	5.4	Wetlands restoration	Environment	End of 2026	few million Rand	eThekwini
	5.5	Isipingo estuary & mouth management plan	Technical	End of 2026	R25 million	Province Env Affairs
	5.6	New warning system	Technical	End of 2025	Relatively low	eThekwini
Operation & maintenance	6.1	O&M plans in place for Umlaas canal and Mlazi Catchment	Technical	2027	Relatively low	Transnet and eThekwini
	6.2	Isipingo & Mbokodweni measures	Technical	End of 2025	Relatively low	eThekwini
	6.3	O&M plans in place for pluvial system Prospecton	Technical	End of 2026	Relatively low	eThekwini
Other	7.1	Link to academia for knowledge management	Institutional	Ongoing	Low	eThekwini

In the following a brief description is given of each building block, grouped in line with the first column of the above table.

3.3.1 High priority studies

The following provides an overview of the high priority actions aimed at addressing urgent items and short-term decision making.

- Champion & SIP Status (no 1.1): The situation at eThekwini is important and urgent. Maintenance and proper understanding of key infrastructure such as Shongweni Dam and the Umlaas canal is missing. Furthermore, there is substantial population at risk as well as economic assets. It is essential to identify a champion as well as obtain SIP status to progress these challenges. eThekwini is the most logical party to identify and obtain respectively.
- Long term vision (no 1.2): To help progress the project(s), it is important to have a vision, that underlines the importance and urgency and defines the long-term goal. This vision should also clarify the future ownership of the Umlaas Canal and the role and responsibilities of Transnet has as current owner of the Umlaas Canal. Such a vision will provide direction as well as help ensure that all stakeholders are on board. It should be noted that any project implemented at Prospecton will require managing expectations of all involved.
- Inter-agency agreement and project management unit (no 1.3): The complexity and importance of the situation at Prospecton as well as the governance related to flood risk management in South Africa requires various agencies to be involved. As discussed and agreed during the workshops, it is recommended to arrive at an inter-agency agreement and project management unit, to ensure all involved are aligned and to have a vehicle to move the project forward. The project management unit (PMU) has the mandate (given under the inter-agency agreement) and will manage all underlying projects for the years to come (say 4) and in line with allocated budgets. The unit can be staffed by staff of the various organisations (who are seconded to the unit) as well as by e.g. consultants. Part of the staff are working on a full-time basis; others may be mobilized for shorter periods of time, aimed at completing specific tasks. This building block is further elaborated in Section 3.5.

  The fact that Transnet are the current owners of the Umlaas Canal is an important fact which should be addressed in the Inter-agency agreement. This could include the approach taken to move ownership from Transnet to eThekwini Municipality and resolving all issues related to the Umlaas Canal asset management (e.g. finances, capacity building).
- Project financing and funding (no 1.4): In order to progress the immediate activities, it is critically important to get these activities timely and fully funded. This in particular relates to the setting up and staffing of the Project Management Unit (especially in case external staff is recruited), as well as a number of critical studies, especially if these are conducted through external consultants or institutes.

  It is further recommended that the PMU is also charged with designing an effective financing strategy for the entire programme itself, as well as the bigger capital investments, for which project preparatory studies are still to be carried later on as part of the roadmap. The actual mobilization of finance for the heavy investment projects (e.g. Umlaas channel) can only be arranged once more detailed feasibility and technical studies are completed. This building block is further elaborated in Section 3.6.
- Emergency Response Plan Prospecton / Comprehensive community-based disaster risk management (DRM) plan (no 1.5): The Prospecton Area is currently at risk, in particular as the Umlaas Canal is still undergoing repair work. At the moment there is not a fully functional Emergency Response Plan, let alone a plan that has been subjected to training and exercises for those involved. Such a plan is essential. It is subsequently (i.e. in 2025) recommended to then further develop a Comprehensive community-based DRM Plan. This plan will no doubt also have to build on other studies mentioned here, e.g. safety assessments, understanding of the overall flood hazard and risk, including coastal and of the Isipingo and Mbokodweni catchments.

- Safety Assessment Shongweni Dam (no 1.6): The Shongweni Dam is a critical component in the behaviour of the Mlazi Catchment. Although it behaved in line with its design in April 2022, little is known of its actual condition. Its failure could have devastating impacts downstream. At present there is no up-to-date safety assessment of the dam and it is furthermore questionable whether the asset owners have the knowledge and understanding needed to manage and maintain such an assessment, let alone carry out such an assessment.

  Within the scope of this DRRS Study we will suffice with just mentioning the need of the safety assessment. It should be noted that the safety assessment is likely to highlight follow-up actions (e.g. asset management system, feasibility study, sedimentation issues, etc.). These are not presented in the following.

- Safety Assessment Umlaas Canal (no 1.7): The current owner of the Umlaas Canal is Transnet. The fact that they were not aware that they are the owners, highlights the importance of undertaking a safety assessment asap. The Canal relies on concrete panels and sand-based dikes. Inspections and maintenance have not been carried out and is also not possible in places due to vegetation obstructing (apparently non-existent) inspection paths. The current design has failed twice and seems to be repaired the same way again. This urgency is exacerbated by the fact that repairs are ongoing. Points of attention to be investigated are the condition of the concrete panels (now 70 years old) as well as potential failure mechanisms (e.g. piping, overtopping).

- Study on Coastal Flood Risk (no 1.8): At present Coastal flood risk seems to be low. Nevertheless, it is recommended to carry out a study to help assess coastal conditions for various stretches. An understanding of water level and wave characteristics and their statistics is essential as well as an understanding of morphological processes. If conditions indeed are favourable, no further actions are needed at Prospecton from a coastal perspective. If not, it is recommended to progress this and undertake coastal flood risk planning.

- Study on Isipingo and Mbokodweni Flood Risk (no 1.9): Similarly, the data on the Isipingo and Mbokodweni catchments is limited. Nevertheless, it is recommended to carry out a flood risk assessment for these rivers to ensure that the risk is understood as good as it can be. This study would ideally be to the same level of detail as (RHDHV, 2024).

3.3.2 Engagement actions

The following concerns engagement actions aimed at maximising buy-in from the community:

- Stakeholder Engagement Strategy (no 2.1): To progress the projects, it is important that all stakeholders are on board, that there is a clear process and that the approach to engagement is well defined. Good use can be made of existing infrastructure, such as the task force, communication the ward councillors, etc. A strategy should be defined, that also provides a basis for e.g. early warning, communication platforms and awareness raising. The sooner this strategy is made the better, as it will also enable a coordinated approach to early involvement of the communities.

- Temporary measures for warning system (no 2.2): In view of the current flood risks, it is important that a warning system is in place, that is tested and improved where necessary. In the short term this likely will need to rely on temporary measures. In later phases more sophisticated approaches (including text messaging, protection of critical telecom infrastructure) can be implemented (see item 4.4).

- Communication participation platform (no 2.3): One of the key elements of the stakeholder engagement strategy is to implement a communication platform. This is likely to be a combination of an internet-based platform with various more basic on-the-ground measures (regular meetings organised by ward councillors). Such a platform aligns with earlier mentioned multi-stakeholder platform (MSP).

- Awareness raising programme (no 2.4): In parallel an awareness raising programme should be carried out. A systematic approach is needed to ensure that the communities are aware of the flood hazard and risk in their areas, know what they can do to protect / save themselves and obviously also the measures that will still be implemented to further improve the situation. The programme will run indefinitely and there needs to be a clear approach to the evolving strategy that is in place.
- Permanent warning system (no 2.5): Eventually a permanent warning system needs to be in place, which is based on state-of-the-art forecasting tools (both meteo and hydro) that are linked to robust warning systems. However, before a permanent system can be selected and put in place, stakeholders (including the community) need to be engaged, such that what eventually is put in place has their buy-in.

3.3.3 Planning aimed at planning approvals and arriving at justifiable plans

Planning in South Africa takes place at different levels, national, provincial and local. It will be important that any plans made do align with existing plans and if not that there is a mechanism to resolve this. For annual plans (e.g. Integrated Development Plan), this should not be a major challenge, but other plans have longer validity may pose a challenge. Potentially the SIP status can help address / resolve any discrepancies, arriving at a temporary agreement.

- Flood Risk Management Plan & ESIA Mlazi Catchment (no 3.1): It should be noted that the Prospecton area is part of two catchments. To address flood hazard and risk, the approach should focus on the catchment level. Such a plan needs to outline hazard and risk, investigate various alternative strategies (including impacts) covering all items of the multi-layer safety, appraise the strategies and select the preferred strategy. Subsequently, the approach to implementation and monitoring and evaluation needs to be spelled out. Ideally the plan includes a high-level ESIA. The plan will need to be approved and adopted, such that subsequent steps can be taken.
- Flood Risk Management Plan & ESIA Isipingo / Mbokodweni (no 3.2): This is similar to item 3.1, except will focus on the Isipingo / Mbokodweni catchments.
- Flood Risk Management Plan Pluvial (no 3.3): In both items 3.1 and 3.2 ideally pluvial flood risk in the Prospecton area is addressed as well. There may however be advantages to devote a separate plan to this.
- Isipingo estuary & mouth management plan (no 3.4): This is one of the bottlenecks for adequate drainage for pluvial flood risk and is highly intertwined with ecological drivers (e.g. mangroves, pollution management, sediment management). Key challenges need to be made explicit and alternative strategies need to be formulated and appraised. The mandate now lies with the province as stipulated in the KwaZulu-Natal Nature Conservation Management Act No. 9 of 1997 (see section 2.3). However potentially it would make sense to transfer this to eThekwini. The role of the community is significant here and needs to be integrated into the overall strategy.
- Coastal Flood Risk Management Plan (CFRMP) (no 3.5): At present coastal flood risk is expected to be low. Nevertheless, the coastal stretch along the Prospecton area is influenced by the draining rivers as well as the adjacent coastal stretches. It is recommended to arrive at a CFRMP, ensuring that coastal flood risk is considered, also for the long term, jointly with other aspects (including environment, social, economy).
- Spatial planning & law enforcement (incl. policy) (no 3.6): Solid spatial plans have been made from national, to provincial to local level. Within the scope of this project, it has not been possible to verify the alignment of all planning undertaken nor its underpinning by policies, but the workshops have surfaced the issue of poor enforcement. No doubt the initiatives that come forward from the roadmap need to align with existing planning. Some of the key challenges relate to informal settlements and removal of wetlands. To progress this, also stakeholder engagement will be essential. Also, alternatives will need to be sought for e.g. settlements.

- High-level plan linking above to formal plans (no 3.7): The complexity of all spatial plans and the underlying challenges, may warrant first arriving at a high-level plan that identifies gaps, overlaps and challenges. Such a plan will help identify if needed temporary spatial planning measures need to be put in place to allow for implementing measures of the roadmap.

3.3.4 Engineering work and design

The following provides an overview of the engineering work and design building blocks. This includes feasibility studies, detailed design & contract documents.

- Mlazi River / Umlaas Canal Flood alleviation scheme (Feasibility & Design & Contract) (no 4.1): Based on item 3.1 subsequent steps can be undertaken, starting with feasibility, design and contract documents. At the end of each step clear go-no-go decisions should be made, including recommendations for the next step. Potentially the feasibility study may highlight the need for an ESIA.

  Regarding the contract documents, a decision needs to be taken whether traditional contract or more innovative contract forms are used. The advantage of traditional contract forms is that they are likely to enhance the in-house knowledge and understanding of the system / asset. More innovative, integrated contract forms however can have advantages with respect to optimizing life cycle costs, reducing risk exposure of the public contracting authority (especially design, construction and maintenance risks), providing operational excellence through state-of-the-art asset management systems and potentially mobilizing private finance.

- Isipingo / Mbokodweni Flood alleviation scheme (Feasibility & Design & Contract docs) (no 4.2): Based on item 3.2, similar to item 4.1.

- Pluvial flood alleviation scheme Prospecton, including reinstating wetlands (Feasibility & Design & Contract) (no 4.3): Based on item 3.3, similar to item 4.1.

- New warning system (Feasibility & Design) (no 4.4): As indicated in item 2.5, eventually a permanent warning system needs to be in place, which is based on state-of-the-art forecasting tools (both meteo and hydro) that are linked to robust warning systems. eThekwini already have forecasting tools in place using the Delft-FEWS platform, linked to SAWS. Certain improvements can still be pursued and are currently underway, including improved robustness of radar systems, additional numerical weather prediction products (e.g. ECMWF), more hydro monitoring points as well as a robust Text Message Alerting system. Mandates of eThekwini in this respect should be enhanced. For new elements the feasibility and the design should be undertaken.

- Asset Management System Umlaas Canal (no 4.5): The Umlaas Canal is an asset that needs to be managed professionally. It is recommended to arrive at an asset management system, which provides an inventory of the various elements of the asset and includes e.g. conditions assessment, risk assessment, performance monitoring, maintenance and rehabilitation planning and financial planning. No doubt not only is such a tool needed, but follow-up also needs to be ensured. This includes staffing, protocols, training and exercises. Ideally the building of such a system is undertaken with and even by the asset manager.

  For such systems conventional database systems can be used. Also, more sophisticated software applications exist. What is best for this case, needs to be determined by the users.

- Asset Management System Prospecton Drainage (no. 4.6): This is similar to item 4.5, however focusses on the drainage system. For such systems various standard tools are already on the market and can be quite easily tuned to the needs of eThekwini.

- Improved monitoring system (no 4.7): eThekwini have already taken steps to improve the monitoring within the catchment. This has also proven to be quite a challenge as hardware installed is subject to theft and vandalism. Further extension of the monitoring system is desired, improving the understanding of the catchment hydrology. This could include meteo stations as well as hydro stations. The exact needs are still be defined and designed.

3.3.5 Construction of any works needed

In the following we will just suffice the list of building blocks of items 5.1 through 5.6. These build upon the design phase and the resulting proposed works. In each case this concerns the construction as well as supply and installation of any equipment and materials. In each case it is also recommended to ensure a defects and liability period of a year. This will also be favourable to eThekwini in handover matters.

It is recommended to have eThekwini take an active role during construction supervision, as this will enhance the in-house knowledge and understanding of the system.

For item 5.6, it is also recommended to ensure spare parts and redundancy are considered.

- Mlazi River / Umlaas Canal Flood alleviation scheme (no 5.1)
- Isipingo & Mbokodweni measures (no 5.2)
- Pluvial flood alleviation scheme Prospecton (no 5.3)
- Wetlands restoration (no 5.4)
- Isipingo estuary & mouth management plan (no 5.5)
- New warning system (no 5.6)

3.3.6 O&M - including ensuring all infrastructure is operated and maintained

In the following we will just suffice the list of building blocks of items 6.1 through 6.3. Operation and maintenance are essential and to date have been neglected for various reasons. These plans will no doubt also benefit from any Asset Management Systems that are put in place. Key element is also the financial planning aspects: annual budgets must be safeguarded in the years to come to ensure O&M is undertaken properly.

Where possible it would also be good to pursue community involvement in such O&M. Here are opportunities for job creation, that no doubt will also require education, training and exercises to ensure those involved do their work professionally.

- O&M plans in place for Umlaas Canal and Mlazi Catchment (no 6.1)
- O&M of Isipingo & Mbokodweni measures (no 6.2)
- O&M plans in place for pluvial system Prospecton (no 6.3)

3.3.7 Other

Link to academia for knowledge management (no 7.1): The various building blocks mentioned above all require input from professionals that understand the underlying engineering, science and socioeconomics. Staff of various degrees of education are thus needed. Also retirement and leaving of staff require new staff to be employed to ensure the work can be done. Close ties with universities are highly recommended and various avenues can be defined to strengthen these ties and to benefit each other. Examples are new recruits, joint research, education, training. In many countries students are offered internships or even can carry out research linked to projects that are undertaken, benefiting both sides. Potentially it may even be worth to formalise such ties, including establishing targets as to what this cooperation entails.

3.4. Appraisal

The first iteration on strategy development resulted in one strategy, while ideally one wants to develop several strategies using one or more themes which can be appraised to arrive at a preferred strategy after evaluation. As recommended in section 3.1 and Annex III, the appraisal needs to include both an MCA and a CBA. In view of the limited time available, only a very high-level appraisal was carried out

for one proposed strategy that is described in this roadmap document using the defined building blocks for the next four years.

The economic flood risk assessment for the Prospecton area (Royal HaskoningDHV, 2024) provided instrumental insights in the CBA for this strategy. Looking at the cost and benefits (as in a CBA) it is expected that the strategy should have a favourable outcome. The Umlaas Canal is a dominant component of the strategy (reducing fluvial flood risk) and will likely break even if total costs are lower than R3 billion.

When also subjecting the high-level strategy to technical, social, economic, environmental and institutional considerations (as would be the case in an MCA), it was felt that the strategy would be promising, and attendees of the workshops were in support of the outcome. The strategy was evaluated against the defined objectives, root-cause priorities and several criteria. The attendees did emphasize that to ensure success, there should be ample attention for the “softer” building blocks, e.g. elements that concern the local community.

In conclusion, an initial high-level attempt to appraise the strategy and its building blocks was performed and discussed. Overall, there is confidence that the strategy will tackle the root causes for the flood risk in Prospecton. When progressing the project, it is paramount that the objectives mentioned in section 3.2 are updated, clearly defined and widely agreed upon and that various strategies need to be developed and appraised in order to derive at a preferred strategy. The MCA and CBA will have to be done in detail, including an iterative process with stakeholders.

3.5. Project organisation model

The workshops conducted during the DRRS visit identified a number of priority root causes, which were analysed as to how they affect sound flood management systems and procedures (refer to paragraph 2.4). Specifically, the following priority root causes need to be addressed by improved institutional and (project) organizational arrangements which are capable to implement the selected integrated flood management strategy:

- Insufficient co-operation and coordination mechanisms among stakeholders, between various levels of government (national-provincial-local), but also within each individual organization. For example, it was identified by workshop participants that departments within eThekwini municipality often poorly coordinate between each other and work in isolation, leading to uncoordinated planning, suboptimal implementation and poor / erratic communication with key stakeholders.
- Lack of monitoring & evaluation. Systematic monitoring & evaluation mechanisms are either not in place or not done in an integrated manner.
- Insufficient knowledge management. Information is frequently only maintained at department level and not shared or used in a systematic inter-departmental level or across different institutes and stakeholders.
- Insufficient funding. Typically funding is insufficient and/or not available on time, or budgets are suddenly reduced during a financial year. Further, funding may be scattered with certain activities fully funded whereas other critical activities (e.g. project preparation, asset management) are under-funded or not given consideration at all. A sound, secure multi-year funding & financing strategy is needed covering all activities as identified in the selected flood management strategy.

Based on the root cause analysis outlined above and the notion that there are many stakeholders and agencies with different mandates, responsibilities and tasks concerning flood management in the Prospecton area as elaborated in paragraph 2.3, workshop participants identified the need for an inter-agency agreement as a critical building block.

Such an agreement will make the various mandates and roles clear and explicit to all stakeholders concerned and could include arrangements (including financial and asset management arrangements) regarding the transition of the ownership of the Umlaas channel from Transnet to eThekwini.

The inter-agency agreement could also provide a legal basis and mandate for the setting up of an inter-disciplinary project management unit which is charged with project coordination, development, implementation, continuous stakeholder communication & engagement and monitoring & evaluation during the development and implementation of the flood resilience strategy, estimated to last for 4 years approximately. Such a project management unit can be staffed through secondments from various departments from eThekwini municipality, KZN province, industries or external consultants. During the workshops it was discussed that both inter-agency agreement and project management unit are needed in order to improve co-ordination between agencies and between eThekwini departments, to set-up an integrated monitoring & evaluation systems to track implementation of the flood resilience strategy, to set-up a knowledge management system accessible to key stakeholders and academia, to prepare a sustainable financing and funding strategy and mobilize finance.

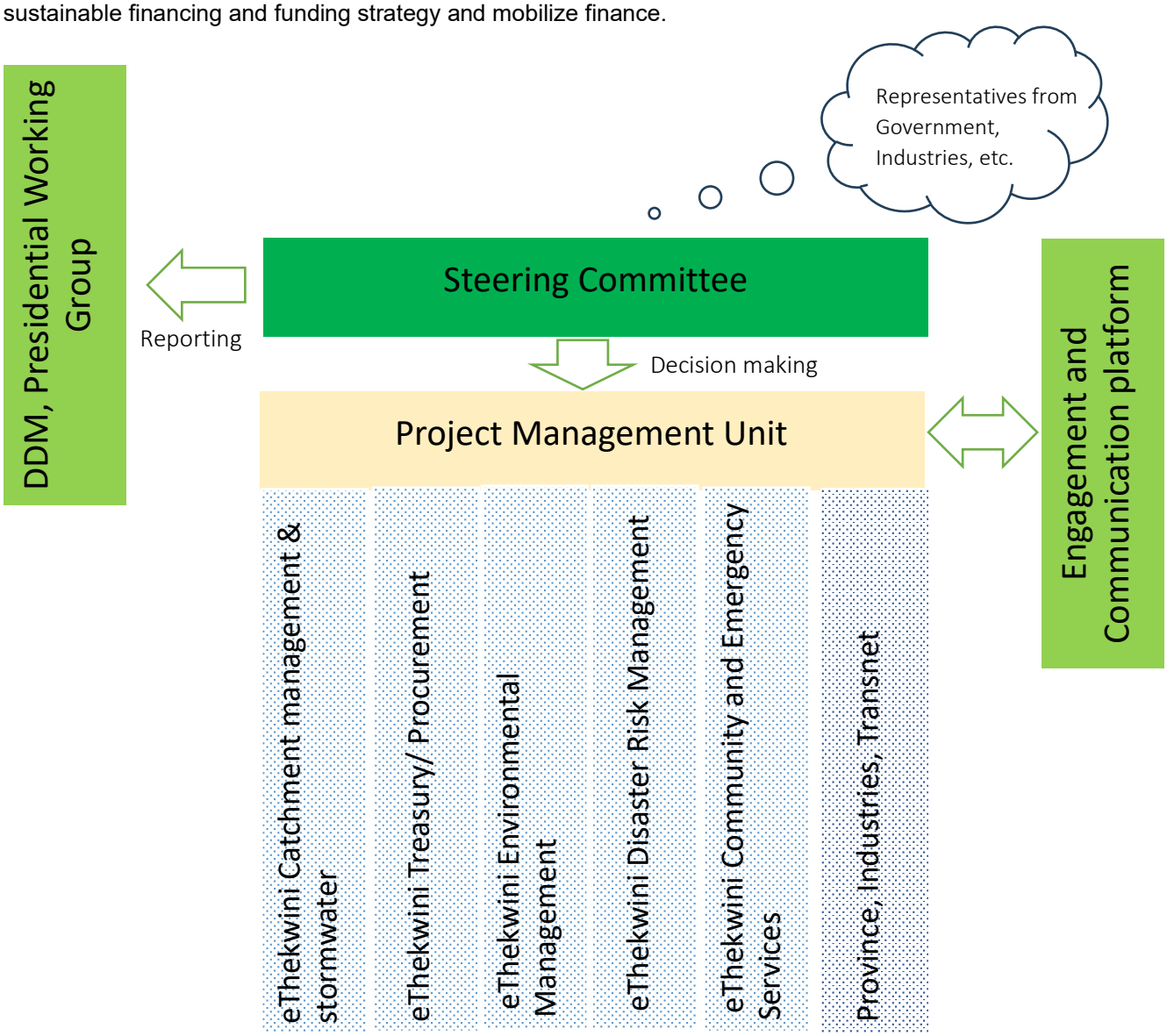


Figure 3-3: Proposed organogram of Project Management Unit

A Steering Committee with representatives from all three levels of Government and key stakeholders can set out the overall strategy, arrange funding and provide oversight and direction to the project management unit. Such a project organizational model can be tied in with the DDM by having a reporting

line to the D/MCSC and Presidential Working Group. The D/MCSC is also an institutional mechanism through which finance can be mobilized. An illustrative organigram of such a project management unit is shown in Figure 3-3.

3.6. Finance

In order to arrive at a high-level financing strategy, the following characteristics of improved flood protection in the Prospecton area need to be taken into account:

First, to identify potential sources of financing it is important to distinguish between financing and funding of projects:

- Financing of projects concerns the provision of capital for the investment phase of projects which needs to be repaid by the project owner to the provider of the capital (e.g. commercial or development bank, equity investor);
- Funding concerns the payment by a beneficiary for the provision of services (e.g. resident who pays a water supply or electricity tariff, but also non-reimbursable grant or subsidy paid by a national government to pay for a project investment).

Second, it should be noted that flood protection investments and measures in the Prospecton area are not revenue generating but have all the characteristics of a public good or service. There is no funding mechanism in place, such as a tariff or tax levied to beneficiaries (residents, industries, government institutes) to pay for improved flood protection. The lack of a direct revenue source impedes the potential for financing of flood protection investments, as there is no direct revenue source to repay the loan or interest.

However, although there is no direct financial revenue or cashflow generated by flood protection projects, the economic benefits of improved flood protection typically outweigh the economic costs of the additional investments and operation & maintenance costs. This is also the case for the Prospecton area as demonstrated in the economic assessment study of Royal HaskoningDHV (2024). This positive economic impact justifies the public funding through the South African public budget system. It would also provide justification for the provision of (international) concessional financing and/or (international) capital grants.

A third consideration is that during the workshops it became clear that industries in the Prospecton area in principle are willing to provide funding in the form of capital contributions to improved flood protection measures. Although flood management in the Prospecton area is a public task of eThekwini, a substantial part of the economic benefits of improved flood protection accrue to these same industries, hence their willingness to contribute. A further financial benefit for industries would be that they have to pay lower flood insurance premiums. Such co-financing by industries can be leveraged to access a range of infrastructure funds and facilities as will be identified below.

Fourth, discussions with a range of financing institutes revealed that sound project preparation is critical to unlock any financing or (grant) funding, especially for the larger investment projects. Hence, the securing of a professional project management set-up, technical assistance (TA) and funding for project preparation activities is key to unlock financing or (grant) funding.

Based on the above considerations, the following high-level financing strategy is recommended. Table 3-2 provides further details of salient features and criteria of the key financing facilities mentioned below.

- Based on the large positive economic impact of improved flood protection in the Prospecton, apply and arrange for Strategic Investment Project (SIP) status as this would recognize the public importance of the project and unlock a range of National funding facilities and arrangements such as National Treasuries' *Budget Facility for Infrastructure*, as well as co-financing by the *Infrastructure Fund* hosted by the DBSA;

- Secure funding and staffing for the PMU. This should primarily be arranged for by eThekwini and industries, through secondments and funding, as typically development banks and IFIs will not fund (government) PMU staff remuneration;
- For critical high-priority studies and detailed project preparation studies (feasibility studies, engineering designs, environmental impact assessments) as identified in the roadmap, arrange for TA support and/or funding from existing facilities such as (non-exhaustive) *DBSA's project preparation division*, *NT/International Development Cooperation recently launched project preparation facility*, *C-40 cities financing facility*, *Invest International, Danish TA facility supporting the DWS.*
- Once the PMU is set-up, it needs to develop a more detailed financing & funding strategy, which specifically should work out an approach to (i) industrial capital contributions and approach to use this to leverage public finance (ii) multi-year eThekwini funding through its medium-term expenditure framework (iii) Transnet financing / transition of the Umlaas canal.
- After project preparation studies have been conducted, secure TA support for the financial structuring of the larger investment projects. The *Infrastructure Fund* offers TA support for this phase.
- Design a co-financing approach for the larger capital investment projects (e.g. Umlaas channel), leveraging industrial co-financing through capital contributions. Potential co-financing and funding sources are:
    - *Infrastructure Fund*, hosted by DBSA;
    - National Treasury's *Budget Facility for Infrastructure*;
    - DBSA's *Climate Environmental Finance Unit* (GCF and GEF accredited);
    - Invest International;
    - eThekwini budget:
        - Own capital budget;
        - Municipal bonds (DBSA has assisted eThekwini in arranging municipal bonds);
        - Explore potential for financing through value-capturing technique, if property values increase as a result of improved flood protection;
    - Industries: direct capital contributions, possibly in combination with financing against future eThekwini property tax rebates.
- Get multi-year, long term funding in place for asset management and operation & maintenance, through earmarking of existing eThekwini property tax rates or introduction of a specific flood management tax.

Table 3-2: Financing facilities

Financing facility	Type	Criteria
Infrastructure Fund (hosted by DBSA)	- TA support (financial structuring) - Capital grant - Concessional debt	- Capital + lifecycle value > R1 billion - SIP status - Blended finance / Co-financing / viability gap funding - Own / private finance required (industry capital contributions are eligible) - Must have feasibility study
National Treasury	- TA support (IDC's project preparation facility) - Capital grant (Budget for Infrastructure – BFI) - Disaster grant/finance facility for recovery and reconstruction	BFI: - Capital + lifecycle value > R1 billion - Support economic growth, social equity, and employment creation - Co-financing / viability gap funding - Must demonstrate the potential for the project to take on private, development or related financing (industry capital contributions are eligible) - Must have feasibility study
DBSA	- TA | project preparation division - Concessional finance through Climate Environmental Finance Unit (GCF, GEF, Climate Finance Facility) - Municipal borrowing - Municipal bonds	- must be in focus sector (water management / flood protection is eligible) - Support economic growth, social equity, and employment creation
Invest International	- TA grants (D2B, DRIVE TA, EUR 50-800K) - Capital grants (DRIVE) - Concessional finance	Capital grant (DRIVE): - Typical contract value between EUR 10 - 150 million - No cap on project value but maximum grant contribution of EUR 75 million - Project needs to be additional to the market i.e., not commercially viable - Maximum 35% co-financing - Local procurement law applies (emphasis on high quality standards, project definitions, regarding the sustainability and overall performance rather than a focus on the least-cost option) - Grant can be combined with other sources of finance (Note: Invest International may be able to offer an ECA-covered loan in cases where the final contract has a minimum of 20% Dutch content. For clarity, the grant does not require Dutch content)
C-40 Financing Facility	- TA support	
Danish TA facility	- TA support	

4. Conclusions and recommendations

Based on the analysis of the April 2022 flood event that was informed through various studies, interviews and workshops, the DRRS Team draws the following conclusions:

- The area of Prospecton is a low-lying area which used to be a larger estuary in which the Mlazi and Isipingo River confluence towards the sea. Hence, the area is historically flood prone. Due to land developments in the 20th century the area has been drained by diverting these rivers along the northern and southern side of Prospecton. With embankments on both sides, the area is topographically considered 'a bathtub' which highlights how flood-prone it is.
- The governance in the area of Prospecton is very complex and scattered with different national, provincial and municipal governments responsible for different infrastructure assets. This leads to a siloed and fragmented approach towards resolving problems in the area in which parties stick to their mandate and have limited incentive in solving the issues collaboratively.
- Various climate adaptation, land use and coastal management plans already exist for the area. Also there are two SIP projects located in the area of interest: the N2/N3 Corridor and the Durban Dig-Out Port (DDOP).
- The exposure and vulnerability to flooding in the Prospecton area is large, partly as a result of the N2 highway (which is considered an economic corridor to the South Coast) and the high density of industrial companies in this area. The vulnerability to pluvial flooding is reasonable but is high for fluvial flooding which is characterised by embankment breaches resulting in high water depths, long duration floods and sediment deposits. Another factor which is important to consider in terms of vulnerability is the cascading effects that a flood has on the economy. The large industrial players in the area provide thousands of jobs to the local communities and many smaller businesses are suppliers to these larger players which creates an economic dependency.
- Root causes for flooding were identified by governmental, private sector and local community stakeholders. It became clear that the operation of the Shongweni Dam was not a root cause for the 2022 flood event, but rather a lack of land use management and enforcement (in Prospecton as well as upstream in the Mlazi catchment) and spatial planning. Also insufficient and even absent asset management, insufficient dissemination of flood warnings, ineffective co-operation between institutions and stakeholders, lack of funding and limited knowledge of the system were identified as potential root causes.
- The major flood event prior to the 2022 event took place in 1987 and was very comparable. Then two breaches also occurred in the Umlaas Canal embankment. A working committee had recommended to increase the safety level of the canal to a higher standard, but no further improvements were made following that event. The current design has failed twice now and is currently being repaired in the same way again.
- The total infrastructure and business losses in KZN of the April 2022 flood event was estimated at over 2 billion USD (Grab & Nash, 2023). The new economic flood risk assessment by Royal HaskoningDHV (2024) for the Prospecton area showed a total damage value of 4.1 billion USD (or R75 billion) suggesting that the actual infrastructure and business losses in KZN might be much higher.
- The annual economic flood risk of R500 million per year is perceived too high for the consulted stakeholders. These estimates show a clear sense of urgency to act following this flood event. While the sense of urgency becomes clear from an economic perspective, it does not mean that any risk reduction measures should solely focus on the economy but should also address the social and environmental concerns.
- There is active discussion between municipal government and local private sector parties and local communities. The latter two stakeholder groups show a very strong personal and commercial

interest to have the issues resolved in a sustainable and integrated manner. These groups want to be actively involved in solving the flooding problems in the area of interest.

- Following the April 2022 flood event, eThekwini Municipality has worked with various stakeholders to implement several measures in the area. It is planned to implement the Clark Road Sea Outfall, upgrade the Prospecton Road Canal (rectangular profile) and Isipingo Canal (concrete lining), implement an attenuation facility and perform a technical investigation of the Mbokodweni and Isipingo River berms. In collaboration with KZN Department of Transport, the breach at the R102 has been repaired. SANRAL is planning to implement a relief canal and culvert for the N2 and, while Transnet Properties is repairing the two breaches in the Umlaas Canal to its former condition. The current recovery actions are all grey infrastructure measures. The current projects are not part of an integrated flood risk management strategy or vision and lack a holistic and collaborative approach to risk reduction measures.

Based on the conclusions, the following recommendations are presented:

- The high flood risk, the multiple flood hazards, lessons learned from historical floods, the complex governance and the larger variety of stakeholders demand for a new approach towards flood risk management. The April 2022 flood event clearly highlighted the need for adopting new frameworks to arrive at a more holistic and integrated approach to solve the challenges in the Prospecton area. This means among others that it is recommended:
    - To move towards a risk-based approach that allows for planning a more flexible, adaptive and cost-effective response.
    - To take a holistic look at selecting risk reduction measures. The multi-layer safety approach, the various phase of the disaster management cycle and the grey-green-blue approach are three perspectives to explore risk reduction measures in its full breadth. This also includes the consideration of the entire river basin than just looking at the Prospecton area.
    - To develop a strategy considering not only the technical aspects, but also including the social, economic, environmental, and institutional factors. Identification and inclusion of measures that are linked to other ambitions in the area, is promoted to create co-benefits. Linked to this is also the need for a multi-stakeholder management approach that involves inclusion of all relevant stakeholders as part of the development and implementation of the flood resilience strategy.
    - To appraise strategies throughout the whole process of the project life cycle (i.e. planning, feasibility studies, environmental impact assessment and design). The use of MCAs and CBAs are of vital importance to see how objectives are met in terms of the technical, social, economic, environmental and institutional aspects.
- This roadmap presents one high-level strategy that is based on a selection of building blocks identified by the DRRS Team and the stakeholders during various workshops. It is recommended to formulate clear objectives and develop various strategies to be appraised in detail. This is an iterative process with all relevant stakeholders that culminates in a preferred strategy. The identified building blocks are sorted in the categories:

    1) Priority actions
    2) Engagement
    3) Planning
    4) Engineering & design
    5) Construction
    6) Operation & maintenance
    7) Other.

    It is recommended to consider these building blocks in the definition of other strategies and complement these building blocks where needed.

    Figure 3-2 and Table 3-1 present a full overview of these building blocks. The following building blocks are recommended to be implemented in the short-term due to their importance and urgency:

- Identify a champion in each sphere of the DDM and to start the process of obtaining SIP status to progress these challenges.
- Develop a long-term vision that underlines the importance and urgency to act in this area and presents a long-term ambition. Such a vision provides direction and ensures that all stakeholders are on board. This vision should also include a clear agreement on the roles and responsibilities of the asset owners.
- Formulate an inter-agency agreement and set-up a PMU to ensure all relevant stakeholders are aligned and have a vehicle to move the project forward. The PMU has the mandate (as described in the inter-agency agreement) to manage all underlying projects for the years to come and in line with allocated budgets. The situation that Transnet is currently the owner of the Umlaas Canal and hence responsible for asset management and the associated flood risk needs to be discussed as well in the inter-agency agreement.
- Design an effective financing strategy 1) to initiate first actions, such as forming and staffing the PMU and executing critical studies and 2) to implement the preparatory studies required for actual mobilization of finance for the large investment projects (e.g. Umlaas Canal)
- Develop a dedicated Emergency Response Plan for the various stakeholders in the Prospecton area in the short-term. It is recommended to further develop this plan into a comprehensive community-based DRM Plan.
- Perform a dam safety assessment for Shongweni Dam to understand its condition and required maintenance.
- Perform a safety assessment for Umlaas Canal. Maintenance has not been carried out and is locally also not possible due to dense vegetation. The Canal relies on concrete panels and sand-based dikes. The current design has failed twice and seems to be repaired the same way again. Points of attention to be investigated are the condition of the concrete panels (now 70 years old) as well as potential failure mechanisms (e.g. piping, overtopping).
- Perform a coastal study to assess current and future coastal conditions for various stretches in terms of storm surge, wave and erosion characteristics. If the results suggest a significant coastal influence, it is recommended to proceed with a coastal flood risk plan to also identify measures to address flood risk.
- Perform a flood risk assessment for the Isipingo and Mbokodweni Rivers to better understand if these rivers pose a serious risk to Prospecton and to formulate appropriate action when needed. Similarly, if relevant, it is recommended to proceed with a flood risk plan to also identify measures to address flood risk

- In parallel to these Priority actions, it is recommended to progress the engagement & communication building blocks. This starts with deriving an engagement & communication strategy that tunes the follow-up actions to those affected and concerned.
- Discussions on the preferred project organisation model indicated that it is recommended to use both an inter-agency agreement and a PMU in order to improve co-ordination between agencies and between eThekwini departments, to set-up an integrated monitoring & evaluation system to track implementation of the flood resilience strategy, to set-up a knowledge management system accessible to key stakeholders and academia, to prepare a sustainable financing and funding strategy and to mobilize finance. A PMU organogram is visualised in Figure 3-3 and includes a Steering Committee with representatives from all three levels of Government and key stakeholders to set out the overall strategy, arrange funding and provide oversight and direction to the PMU. It is recommended this project organizational model is tied in with the DDM by having a reporting line to the D/MCSC and Presidential Working Group.
- A high-level financing strategy is recommended comprised of the following elements:
  - Secure SIP status to access available national financing facilities;

- Secure TA support and/or funding for the initial studies and project preparation activities primarily from existing TA facilities targeting South Africa, realizing this is key for unlocking financing for the larger investment projects;
- Arrange funding for the Project management Unit through eThekwini and industry secondments and budget;
- Arrange for TA support for the financial structuring of the co-financing of large investment projects upon substantial completion of key project preparation activities;
- Structure the co-financing of the larger investment projects by leveraging industry capital contributions;
- Arrange for multi-year, long term funding for asset management and operation & maintenance, through earmarking of existing eThekwini property tax rates or introduction of a specific flood management tax.

- The situation in Prospecton is unique, but numerous urban areas in South Africa have high flood risk, high density of commercial activities and/or communities and complex governance. It is therefore recommended to use the proposed process as a blueprint for other locations in Durban and the country. The workshops were attended by community representatives of various other regions, such as Springfield, Merebank and Mlazi, and showed appetite to scale this roadmap up beyond the Prospecton area.

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Annex I: Official Request

HUMAN SETTLEMENT, ENGINEERING & TRANSPORT CLUSTER
ENGINEERING UNIT

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DCM: HSET
0 3 APR 2023
RECEIVED
ETHEKWINI MUNICIPALITY

29 March 2023

To: Embassy of the Kingdom of the Netherlands
210 Florence Ribeiro Avenue
New Muckleneuk | Pretoria | South Africa
P.O. Box 117 | 0001 Pretoria | South Africa

ATTENTION: The Dutch Risk Reduction Team

SUBJECT: REQUEST FOR A DRR MISSION – TO ASSIST THE CITY OF DURBAN WITH A FEASIBILITY STUDY SPECIFICALLY ON FLOOD RESILIENCE AND RISK MITIGATION IN THE SOUTH DURBAN BASIN.

1. INTRODUCTION

The city is seeking technical assistance from the DRR Team to equip the city to recover more swiftly from the flood impacts and more particularly to assess mechanisms to build flood resilience and mitigation for the future. The assessment will give priority to the South Durban Basin which was greatly impacted.

2. BACKGROUND AND CONTEXT

In April 2022, the Province of Kwa-Zulu Natal in South Africa experienced heavy rainfall reaching in excess of 400mm over a 24-hour period in parts of the province's coastal belt resulting in the deaths of well over 400 people, with the largest area of impact being the eThekwini municipal area. A second round of heavy rains exceeding 250 millimetres in several areas occurred over the 21st and 22nd May. The urban, peri-urban and industrial areas of eThekwini bore the brunt of the flooding as road, stormwater, water, sanitation and electricity infrastructure was damaged and, in some instances, lost altogether.

3. THE SOUTH DURBAN BASIN (SDB)

The South Durban industrial basin is the second most concentrated industrial area in South Africa and makes a material contribution to regional supply chains across Sub-Saharan Africa. The impracticability of relocating industries, combined with the strategic location in relation to the Port, make these industrial areas a high priority for stormwater infrastructure upgrading while the replanning of all infrastructure systems is necessary to ensure that the area is resilient to such shocks in the future. This necessitates that, in addition to the immediate response in restoring services, the City embarks on a multi-year infrastructure redevelopment programme over the next

3-5 years. Without making such investments, the City's customer base will be severely eroded in the medium term.

While the damage and impact on the eThekwini area has been widespread, the concentration of impact on the South Durban Basin has been particularly severe. This area is home to the City's largest customers who are concentrated in the manufacturing sector. Apart from the damage to business property, stock and equipment, there has been damage to public infrastructure including road and stormwater infrastructure related to the Umlaas and Isipingo River catchments as well as electricity and sanitation infrastructure.

4. PROBLEM DESCRIPTION

The April 2022 floods highlight the serious shortcomings of the Umlaas canal and the serious economic risk it places on the South Durban Basin at present. The canal capacity is estimated at a 1 in 20-year flood while the flood flow of the April 2022 was estimated to be in the vicinity of a 1 in 200-year flow.

The 1987 floods which were not as severe in the Umlaas catchment as the April 2022 floods, highlighted the some of the risks and at the time some options were looked at regarding the upgrading of the canal, however these were never implemented.

The impact related to the small capacity of the canal, of the April 2022 floods on the economic viability of the South Durban Basin has highlighted the need for a clear understanding on the options available and how each option will reduce the risk of flooding to this area.

5. POST-FLOOD RESPONSE

About ten months after the flooding there has been progress made in restoring essential services and ensuring interim measures are in place to allow most businesses to return to full production. However, as firms such as Toyota, SAPREF, ENGEN, Mondi, etc return to production, damages to infrastructure leaves the area vulnerable to further disruption. It is within this context that SAPREF has written to the Minister of Minerals and Energy seeking an urgent intervention to address the electricity shortcomings. In addition, until further work is undertaken to build flood resilience for the area, businesses will remain vulnerable resulting in high level risk and potential for disinvestment.

While a submission was made to KZN COGTA in light of the disaster to access disaster funding, and noting that specific infrastructure assets are insured, the infrastructure build-back and upgrading towards greater resilience is substantially greater than both of these processes will cover. Ten months after the April flooding, the infrastructure funding mechanisms are still unclear. While substantial work has been undertaken by the infrastructure departments and partners to understand the challenges and to propose workable solutions, the funding of such interventions requires an approach that is inclusive of different government departments as well as the private sector with the view of identifying areas that are suitable for partnership models.

- **The Funding Workstream**

The eThekwini municipality's Economic Development Unit established a funding workstream that is aimed at: identifying priority projects in priority areas, leveraging funding mechanisms towards infrastructure re-development, and enhancing collaboration with other spheres of government. It was through this workstream that the Dutch government was identified as a possible funding source through their flood mitigation funding models namely the Drive to Build (D2B) and DRIVE. An outcome of this engagement was to formally request the Dutch Risk Reduction Team to assist eThekwini municipality through a program that assists local government of a country specifically related to flood resilience to make a short inventory analysis and determine possible solutions.

- **The Technical Workstream**

The eThekwini municipality's Engineering Unit established a technical workstream that is aimed at convening all the roleplayers affected by the Umlaas River System. These include

  - Government departments
    - eThekwini
    - SANRAL
    - DOT
    - TRANSNET
    - DWS
  - Private sector businesses
    - Toyota
    - SAB
    - Mondi
    - SAPREF
    - Chamber of Business
    - The Growth Coalition
  - Local Community representatives

The participants have met a number of times and have agreed to work together at the development of a mitigation plan for the SDB.

This cooperation has involved the sharing of technical reports and resources, and the development of some hydraulic models to test some local mitigation measures.

6. IMPACT OF FLOOD DAMAGES

Public infrastructure across various categories suffered extensive damage, including:

- National, Provincial and local Roads
- Stormwater infrastructure belonging to the Municipality
- Stormwater infrastructure belonging to Dept of Transport and Transnet
- Electricity infrastructure
- Sanitation and water infrastructure belonging to the Municipality
- Water infrastructure of Umgeni Water

- Water resources under the oversight of Dept of Water Affairs and Forestry
- Rail infrastructure belonging to Transnet (Freight) and PRASA (Public)
- Infrastructure supporting the Durban Port, belonging to Transnet

It is estimated that over 1 150 businesses suffered damage and loss as a direct result of the flood, while many more were impacted by landslides and failing infrastructure. Most of these businesses are in the manufacturing sector, followed by wholesale and retail trade.

Most businesses that responded to a survey indicated that they were not insured for flooding, which is consistent with engagements the city had with businesses as part of the industrial revitalisation programme in Jacobs and Prospecton. The high frequency of flood events has rendered strategic industrial areas within the city, including large parts of the South Durban Basin, as an unviable industrial location for the long term, in its current form.

7. REQUIRED ASSISTANCE

- Develop, with the various role-players, a hydraulic model of the Umlaas River system with the inclusion of predicted future climate change impacts.
- Develop, with the various role-players, the mitigation options available.
- Utilise the hydraulic model to test the mitigation options and determine the risk reduction provided by each possible intervention.
- Develop high level costings for each of the considered options.
- Develop a cost benefit analysis for each of the considered options.

8. CONCLUSION

We request for your prompt support in implementing a DRR Mission in the city of Durban particularly the South Durban Basin that was severely impacted during the torrential April flooding last year. Almost a year later, very little progress has been made into restoring the area to its former glory. With damages to infrastructure assets, businesses running low on production and some even threatening to seize operations, until further work is undertaken to build flood resilience for the area, these businesses will remain vulnerable resulting in high levels risk and potential for disinvestment.

Thanking you in advance for your consideration.

T. Zulu 03/04/2023.
Acting Head: Engineering Unit

B. Khanyile
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05-04-23

Annex II: Selection of plans that are relevant for Prospecton

Municipal plans include:

- eThekwini Municipal Spatial Development Framework (SDF) 2024-2025 (2024)
  This document is an integral component of the Integrated Development Plan (IDP) and a key spatial transformation tool which guides how the implementation of the IDP should occur in space. The SDF therefore guides the desirable spatial distribution of land uses within a Municipality in order to give effect not only to the spatial vision, goals and objectives of the Municipality but by directing where the city should intervene in space to achieve its transformational objective.
- Durban Climate Change Strategy (DCCS) (2022)
  A multi-sector climate change strategy developed for Durban which is an update from the original 2015 DCCS. It looks at four themes which are mitigation, adaptation, cross-cutting topics and enabling factors.
- Durban Climate Action Plan (2019)
  This document builds on the 2015 DCCS and is a city-wide plan that provides a pathway to transition Durban towards climate resilience and carbon neutrality by 2050, in a manner that is inclusive and leaves no one behind. The goal of the plan is to ramp up ambition and action that is required to limit temperature increase to 1.5°C.
- Climate Resilience Implementation Plan for Spatial Planning (CRISP) for the eThekwini Municipality (2019)
  A tool for promoting the integration of eThekwini's climate change response into its SDF. Specifically, the CRISP has taken recommended climate change adaptation and mitigation actions from the DCCS that are relevant to spatial planning and integrated these into the city's SDF and lower order plans.
- Durban Resilience strategy (2017)
  The city's first Resilience Strategy describing two resilience building priorities: '*Collaborative informal settlement action*' and '*Integrated and innovative planning at the interface between municipal and traditional governance systems'*. The strategy provides the opportunity for bold and transformative areas of action and describes the complex and fundamental development challenges faced by Durban and provides an authentic and appropriate starting point for local level resilience action.

Isipingo/Prospecton/SDB specific plans include:

- South Durban Basin Coastal Management Plan
- Isipingo Local Area Plan (LAP), Functional Area Plan (FAP) and Scheme Review (2016)
  Isipingo is identified as a priority Secondary CBD in need of regeneration and to this end the Isipingo LAP including FAPs and Scheme Review were prepared in 2016. The Isipingo LAP calls for improved catchment management and a rehabilitation of the dune areas subjected to uncontrolled settlement and the increase in industrial development adjacent to this area. Key strategies and proposals towards improved coastal management within the Isipingo LAP include:
  - Rehabilitate and develop the coastal strip
  - Protection of Rivers
  - Rehabilitation of Wetlands / Estuaries
  - Dedicated Coastal Management
  - Sustainable Development
  - Strict Environmental Authorisations

  There are various FAPs part of the Isipingo LAP, such as for the Isipingo Beach Functional Area, the Durban Dig-Out Port Functional Area and the SAPREF Functional Area.
- Isipingo Urban Design Framework (2019)
  This framework analyses and refines the role of the Isipingo Central Business District (CBD), defines a clear spatial development vision, rationalises the existing CBD layout, and develops a detailed urban design framework that includes structured informal trading spaces, designated areas

for public transport, an appropriate location of the proposed pedestrian bridge linking the CBD and the rail station, an appropriate location of the proposed multi-purpose centre, proposed areas for street upgrades and intersections and public realm and landscaping proposals.

- Isipingo Estuary Management Plan (2012)
  A strategic planning document that presents a vision, objectives and strategies for estuary management and defines various action plans for key result areas. It provides guidance for implementation, monitoring and evaluation.
- Isipingo Residential and Beach (including the Estuary) Development Zone guideline
- Durban Dig-Out Port (proposed development by 2030)

Annex III: Frameworks and concepts used in strategy / roadmap development

A. Risk-based approach to flood management

Flood management traditionally uses a standards-based approach that relies on predefined standards, criteria and guidelines. It focusses on prevention and protection measures and is aimed to keep floodwaters away from people and property. However, it often does not adequately account for the dynamic nature of flood risks and the potential for infrastructure failure.

As a result, the shift to a risk-based approach emerged to better understand and manage the complexities of flood hazards and their impacts offering a more nuanced, adaptive, integrated and sustainable flood management strategy. It involves a comprehensive assessment of flood hazards and risks, considering factors like probability, potential impacts, and vulnerabilities. It also tailors strategies and adopts a wide variety of measures to the specific conditions and needs of each area, allowing for more flexible and adaptive responses. This also includes whole-system thinking, incorporating a broader range of factors such as climate change projections, land use changes, and socioeconomics.

The comprehensive flood risk assessment involves assessing the probability and consequences of different flood scenarios and selecting the optimal combination of measures to reduce the expected losses (see schematic steps in Figure III-1. It allows for a comprehensive and transparent evaluation of the costs and benefits of different interventions, as well as the trade-offs between them. Not only does this help the appraisal and business case of proposed measures, but it also helps in determining the most cost-effective protection level for an area. A risk-based approach also enables the consideration of uncertainties and variabilities in the input data and models, as well as the preferences and values of different stakeholders.

Figure III-1: Steps of a comprehensive flood risk assessment and planning

B. Risk reduction measures

Multi-layer safety approach

To address and manage flood risk an integrated approach is needed. A framework widely used in many countries is the concept of the multi-layer safety approach (Klijn et al., 2012, Jonkman et al., 2008, Vandenboer et al., 2020)). This approach defines three layers to form a flood risk management strategy:

(1) Prevention and protection measures. This involves measures aimed at delaying or storing flood waters as well as ultimately protecting against flood waters.
(2) Spatial planning. This involves implementation of planning requirements, ensuring people, economy and environment are all in the most appropriate places, minimizing flood risk. Linked to this is that all are also aware of the risk they are exposed to.
(3) Emergency preparedness and response. Despite (1) and (2) there is always a residual flood risk that needs to be managed. In this case this involves being prepared as well as being able to respond to a (potential) flood event. Examples of measures are flood emergency response plans, flood forecasts, flood warnings, evacuation, shelters, mobile barriers and pumps.

Critical starting point for defining a strategy on this basis is understanding your hazards and risks (e.g. magnitude, flood mechanisms, exposure, vulnerability) as well as existing capacities and capabilities to manage those hazards and risks.

Disaster management cycles

In many countries the disaster management cycle is used as a framework to arrive at a flood risk management strategy (FEMA, 2020). The disaster management cycle has strong parallels with the multi-layer safety approach and advocates strategies that adopt a variety of measures. Mitigation typically covers the aforementioned prevention and protection. Two distinctly advantages of this framework is that it highlights that after an event there is a need to recover, involving restoration and reconstruction, as well as the cyclic approach, that after an event there is a need to learn and to improve ideally building back better.

Figure III-2: Disaster Management Cycle (Source: Figure 6.1, International Levee Handbook (CIRIA, 2013))

Grey-green-blue measures

In line with the previous frameworks, when zooming in on prevention and protection (i.e. mitigation), one can further distinguish between the various types of measures. These are often classified as grey, green and blue measures and typically involve the following examples:

- Grey: generally man-made structures such as dams, levees, floodwalls and stormwater drainage systems;
- Green: permeable pavements, urban green spaces, swales, natural water retention, green roofs;
- Blue: involves river restoration, wetland restoration and flood plain reconnections and widening.

From a long term and sustainability perspective there is an increasing drive to progress green and blue measures as well-managed ecosystems have the potential to reduce the severity and risk of extreme climatic events. These measures, often called nature-based solutions, provide various environmental benefits and are part of ecosystem approaches that are already promoted in South-Africa (South African National Biodiversity Institute, 2019). It connects also strongly to the ambition to develop more water-sensitive cities as described by Carden et al. (2016). Nevertheless, the balance between all three types needs to be considered holistically, taking also political, social, economic, cultural practices, and space requirements into consideration.

Green and ecological infrastructure play roles in enhancing urban and rural environments. Green infrastructure provides various benefits like biodiversity conservation, managing stormwater runoff, creating spaces for recreation, helps in mitigating the urban heat island effect and climate change adaptation. Ecological infrastructure found in rural or peri-urban areas includes forests, wetlands, and river systems. It delivers valuable services like water and climate regulation, supporting soil health, and mitigating natural disasters. These natural systems are essential for environmental sustainability and socio-economic development. Both types of infrastructure aim to provide ecosystem services, but green infrastructure is often integrated into urban settings, while ecological infrastructure is more about maintaining and restoring natural ecosystems. In some contexts, green and ecological infrastructures

are complementary, with green infrastructure serving as an extension of environmental infrastructure in urban areas (Meissner, 2022).

eThekwini employs a comprehensive strategy to incorporate green and ecological infrastructure into its policies, encompassing collaboration, research, and strategic planning. The municipality collaborates closely with diverse stakeholders, including experts from within and outside the eThekwini municipality, to formulate and execute such policies (Meissner, 2020). The Durban Metropolitan Open Space System (D'MOSS) is a central component of the municipality's green and ecological infrastructure approach. The system is worth mentioning since, it integrates measures to manage stormwater runoff and reduce the risk of flooding (Meissner, 2022). It, furthermore, helps moderate increased flood events by ensuring the protection and, if necessary, rehabilitation of wetlands and floodplains.

C. Multi-disciplinary approach

The previous highlights that a multi-disciplinary approach is needed to manage flood risk in Prospecton. Not only is a risk-based and multi-layered safety approach required that covers the addresses the various disaster management cycles, but the (reduced) impacts cover a wide range of aspects such as technical, social, economic, environmental, and institutional factors. Linked to this is also the need for a wide range of stakeholders to be involved and part of the overall strategy. Hence, the workshops held in July 2024 involved a broad range of disciplines and organisations. The multi-disciplinary approach also promotes a paradigm of looking beyond the engineering side of things and exploring socio-economic, environmental and institutional challenges and measures. It promotes identification and inclusion of measures that are linked to other ambitions in the area and create co-benefits.

This multidisciplinary approach is linked to the approach adopted during the workshops that took place: involving various disciplines on the DRRS team's side and various disciplines and a broad range of stakeholders involved on the project's side.

D. Multi-stakeholder management

As part of the multi-disciplinary approach to manage flood risk effectively, a multi-stakeholder management approach is needed given the diverse range of governmental and non-governmental stakeholders impacted by flooding. For Prospecton it has become clear in the workshops that there is a wide range of different stakeholders to consider and include. For example, both the private sector and communities have expressed their eagerness to contribute to the planning and implementing the flood resilience strategy, demonstrating a commitment to enhancing overall resilience. This may require an approach that transcends existing, legal requirements for stakeholder consultation and adopts an intimate collaboration model of trust, respect and feedback. Establishing a multi-stakeholder platform or partnership (MSP) could be an effective method of facilitating multi-stakeholder participation.

As collaborative structures, MSPs bring together stakeholders with varied perspectives and interests to address common issues, such as disaster management. They are forums for diverse individuals from government agencies and non-governmental organisations to the private sector, experts, and civil society to discuss, plan, and implement strategies. Taking diverse perspectives into account improves decision-making processes. Establishing MSPs facilitates joint decision-making, wherein stakeholders cooperate to identify issues, formulate strategies, and execute solutions. The aim of an MSP is to tackle specific problems or challenges in disaster management, like developing early warning systems, enhancing communication, and implementing recovery and mitigation measures (Ngqwala et al., 2017).

Effective disaster management MSPs facilitate two-way communication to ensure the free flow of information and active participation in the decision-making process. These platforms are crucial in coordinating and executing strategies. They can also promote more effective and inclusive practices, which ensures the involvement of all pertinent stakeholders (Ngqwala et al., 2017). The successful management of an MSP hinges on several factors, one of which is political will, as outlined under 1.2.

Several specific elements can ensure the sustainable longevity of an MSP. It must attract and maintain support from various government, private sector, and civil society stakeholders. This support can include

financial resources, legal mandates, and public backing. Building and maintaining trust is important. This ensures the MSP is authoritative and can deliver on its promises. Consistent and transparent processes build trust. Effective facilitation is a key to success. So too is, leadership, which provides direction and motivation. Achieving a power balance among stakeholders is challenging but necessary to avoid the dominance of a single group. Balancing power includes addressing structural inequalities and providing mechanisms for the meaningful participation of marginalised groups (Warner, 2006). This measure is significant and challenging, given South Africa's history of discrimination and lack of trust in successive governments since 1994. In this context,

Considering the latter, the MSP should have a clear mandate and well-defined roles for all participants. Stakeholders need to understand what is expected of them and what they can expect from the platform. This clarity helps to set and achieve realistic goals. Effective communication on progress and outcomes is vital to maintaining an MSP. Regular meetings, reports, and other communication tools can help. High levels of stakeholder involvement ensure they actively participate and that their interests are addressed. Engagement strategies may include training, awareness-raising, and capacity-building. There should be regular evaluation of the MSP's performance and outcomes. This helps identify what is working and what needs improvement (Warner, 2006).

E. Strategy appraisal, MCA & prioritisation

Throughout the whole process of the project life cycle (i.e. planning, feasibility studies, environmental impact assessment and design), appraisals of strategies play a role. In each phase this needs to be done in line with the requirements of that particular phase. In each of these phases, the formulation of alternatives is essential. For example: in the planning phase this would entail strategies, in design this would also entail alternatives for various items that are part of a strategy. In the initial phases, a decision needs to be made whether a strategy covers both fluvial and pluvial flood risk or whether this is split into two different projects and hence appraisals. No doubt there are interrelationships that need to be acknowledged (e.g. measures to reduce pluvial flood risk may also reduce fluvial flood risk). In defining strategies there may be merit in using themes. To illustrate, say we focus on fluvial flood risk only, we could define the following strategies for the Umlaas Canal:

- Do nothing – i.e. carry out repairs to Umlaas Canal and restore conditions.
- Build Back Better (civil engineering approach) – i.e. revisit and potentially revise the design, removing risk of breach. This also includes slope protection measures.
- Build Back Better (sustainability approach) - i.e. like civil engineering approach, however maximising opportunities in the catchment to lower flood peaks now and in future.
- Build Back Better (low maintenance approach) - i.e. similar to one of the previous two approaches, however with strong emphasis to minimise needed maintenance.

To appraise the strategies both a Multi-Criteria Analysis (MCA) and a Cost-Benefit Analysis (CBA) is recommended. The MCA would typically cover criteria and indicators linked to Technical / Implementability, Social, Economic and Environmental aspects. As various root causes and building blocks also cover institutional aspects, it may also warrant adding Institutional criteria and indicators.

The CBA would typically focus on costs of the strategy, which includes capital and operational expenditures, as well as the benefits (reduced flood risk, reduced fatalities) in time. The period assess should be commensurate with type of analysis. For planning generally in the order of 50 years.