Part D Prelude-Symphony-Bach Hybrid Flood Alleviation Concept Note

Prepared by AIVIA for Drakenstein Municipality and the GIZ

Version 1

31 October 2024

PART D PRELUDE-SYMPHONY-BACH HYBRID FLOOD ALLEVIATION CONCEPT NOTE I

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Abbreviations

BA – Basic Assessment

CAPEX – Capital Expenditure

CCAP - Climate Change Action Plan

CFRPS - Community Flood Risk Perception Study

DFFE – Department of Forestry, Fisheries and the Environment

DM - Drakenstein Municipality

DWS - Department of Water and Sanitation

EA – Environmental Authorisation

EAP - Environmental Impact Assessment Practitioner

ECO - Environmental Control Officer

ECSA - Engineering Council of South Africa

EIA - Environmental Impact Assessment

EPWP - Expanded Public Works Programme

FAES – Flood Alleviation Ecosystem Services

HGM - Hydrogeomorphic

HFA - Hybrid Flood Alleviation

IDP - Integrated Development Plan

KPA – Key Performance Area

KPIs - Key Performance Indicators

LCA - Landscape Character Assessment

LiDAR – Light Detection and Ranging

MMC - Members of the Mayoral Committee

NEMA – National Environmental Management Act

NbS – Nature-based Solutions

NGO - Non-governmental Organisation

NPO - Non-profit Organisation

OHSA – Occupational Health and Safety Act

OPEX – Operational Expenditure

PCSWMM – Personal Computer Storm Water Management Model

PDO - Pre-determined Objective

PES – Present Ecological State

PPP – Public-Private Partnerships

PSOC – Personnel Specification Occupational Classification

SACPLAN – South African Council for the Planners

SAGC - South African Geomatics Council

SDBIP - Service Delivery and Budget Implementation Plan

SDF - Spatial Development Framework

SDG – Sustainable Development Goals

SOP - Standard Operating Procedure

DM SSN – Drakenstein Municipality Smart Safety Network

TLB – Tractor-Loader-Backhoe

WET-Health – Wetland Health

WULA – Water Use Licence Application

Project Summary: Prelude-Symphony-Bach Street Stormwater Pond Network HFA Project

Project rationale, objectives and approach of project

The Groenheuwel Catchment is drained by the Boontjies River and an unnamed watercourse. These rivers discharge into the Berg River via the Vosmaar and Van der Stel canals, west of Jan van Riebeek Drive.

An unnamed river passes through the Prelude Avenue site flowing in a north-westerly direction from Hawequa Bos Pad Road through agricultural areas where it passes through a channelled valley-bottom wetlands, a wetland flat, and an unchanneled valley-bottom wetland before reaching the urban edge. In the urban area, the unnamed river runs in the northerly direction passing depression wetlands and a wetland flat before reaching Green Valley Estate. The river then flows north-west across Bo Dal Josaphat passing through formal and informal residential areas such as Siyahlahla 2 informal settlement and Fairyland (Adjacent to Groenheuwel Primary - Marikana)/Marikana. The river crosses a depression wetland before entering the Prelude site on the south-eastern corner of the existing retention dam before cutting diagonally through via a lined low flow channel.

The Prelude Avenue site's 100-year status quo flood extents indicate that the areas downstream of the Prelude Avenue area are exposed to flood depths of up to 0.5 m. The cause of the flooding downstream is as a result of overland flows that are being experienced in the area and the limited capacity of the Van Der Stel Canal and the railway culvert to convey the flows.

The proposed network of stormwater ponds proposed for the **Prelude-Symphony-Bach Street Stormwater Pond Network HFA Project** aims to reduce flood exposure, manage stormwater, improve water quality, and integrate community recreational spaces while addressing the unique characteristics of each site. The project will include the activation and formalisation of a network of sport facilities to promote active and healthy communities. The project site includes Erf: 24144, 16755, 22273, 17317, 527/7, 16654, 16705, 22263, 16578, 16579, 17080, 17085, 17320, 16998, 17091, 23707. Connecting pathways between these land pockets are also included in the site concept.

Prelude (Erf 16645 and Erf 22263) is the site of an existing pond and low flow channel, and total 2.47 hectares. The proposal for this section of the site includes:

- Creating a meandering channel and stormwater treatment wetland
- Sports field with swale and seating
- Riparian Vegetation, and culverts connecting the ponds (Prelude and Symphony)

Symphony (Erf 16775) is 6.7 hectares in size and is located next to the Groenheuwel Cemetery. The proposal for this section of the site includes:

- Cascaded stormwater attenuation facilities
- Sports field for cricket
- Pedestrian walkways
- Meadow grass planting

- Soup kitchen
- Community garden

Bach Street (Erf 17091) 2,6 hectares in size, and is an open space on the corner of Bach and Jan van Riebeeck Drive. It is currently used as an open space and cricket field. The proposal for this section of the site includes:

- Stormwater pond/swale
- Sports field for cricket
- Pedestrian Walkways
- Meadow grass planting
- Playground
- Netball courts

Existing Parks

The upgrade of the existing parks will support the Programme Objectives to create **healthy, well-managed and maintained municipal infrastructure and public spaces**.

The **impact of the proposed interventions at the projects site for the 100-year return period is reduced flood depths immediately to the west in the residential area**. Further downstream there is a reduction in flow depths in the order of 0.25m in the 100-year flood near Drommedaris Street to the north of the Van Der Stel Canal.

Prelude-Symphony-Bach

- Roads
- Watercourses
- Prelude-Symphony-Bach HFA Project Site
- Potential Site Boundary
- Site Boundary
- Catchment Boundaries
- Urban Edge (2024)
- Ward Boundaries
- Affected Erven
- Urban Infill
- Urban Footprint
- Green Space

Wetlands

- Depression
- 100yr Floodline

Alignment With Municipal Objectives:

The project aligns with all municipal objectives. It is particularly relevant to Strategic Objective 4, given the strong alignment with maintenance and provision of infrastructure for sustainable service delivery.

Municipal Strategic Objective	Alignment
To ensure good governance and compliance.	X
To ensure financial sustainability to meet statutory requirements.	X
To ensure an efficient and effective organisation supported by a competent and skilled workforce.	X
To provide and maintain the required physical infrastructure and to ensure sustainable and affordable services	X
To plan, promote investment and facilitate economic growth.	X
To facilitate, support and promote social and community development.	X

Key Performance Area (KPA) and Pre-Determined Objective (PDOs)

KPAs refer to the areas within the business unit for which an individual or group is logically responsible. PDOs are the areas identified as important or crucial, where a result will assist in the achievement of the set objectives or goal (DM IDP, 2024:67).

It is recommended that this project be located within **KPA 4: Infrastructure and Services**, under **PDO 23: Transport, Roads, and Stormwater. This is directly aligned with the Strategic Objective *to provide and maintain the required physical infrastructure and to ensure sustainable and affordable services.***

Estimated total project cost

The following table provides a summary of the estimated costs associated with the project.

Cost Category	CAPEX vs OPEX	Total Amount (ZAR)
Planning and Design Cost	CAPEX	8 874 649,85
Construction and Implementation Costs	CAPEX	94 402 518,00
Operation and Maintenance Costs	OPEX	2 476 050,36
Miscellaneous Costs	CAPEX/OPEX	350 000,00
Grand Total		**106 103 218,21**

The above costing is based on information available at the time of developing the concepts. The Planning and Design costs must be further refined upon the final determination of the specialist studies required. Construction and Implementation Costs as well as Monitoring and Maintenance Costs will be further refined. As the engineering design development progresses, refined estimates can be prepared by the

Quantity Surveyor / Cost Estimating Consultant. This would consider local and context specific considerations for the various items.

Drakenstein's Prioritisation Project and Capital Expenditure Criteria

CRITERIA FOR PRIORITISATION		
1	Is **legislation regulating this project?**	
	Legislation regulates this project. A non-exhaustive list of national legislation is provided. The Constitution of the Republic of South Africa, 1996; The National Water Act, 1998 (Act No. 36 of 1998); The National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998); The Municipal Systems Act, 2000 (Act No. 32 of 2000); The Disaster Management Act, 2002 (Act No. 57 of 2002); The Water Services Act, 1997 (Act No. 108 of 1997), Spatial Planning and Land Use Management Act (Act No. 16 of 2013), Climate Change Act (Act No. 22 of 2024); Republic of South Africa (2000). Promotion of Equality and Prevention of Unfair Discrimination Act. Act No 4 of 2000. Chapter 5, Section 28; Additional provincial and local legislation and by-laws may also be applicable.	**Y**
2	Will this project **enhance service delivery (roads and storm water, electricity, water, sanitation, and refuse)?**	
	This project will enhance service delivery (roads and storm water, water, sanitation, and refuse). The project seeks to achieve flood risk reduction benefits through the development of hybrid flood alleviation interventions- leveraging nature-based solutions for **stormwater** management to complement conventional 'grey' service delivery approaches. The project serves to facilitate more resilient stormwater management and protect communities, private property and municipal infrastructure through flood risk reduction. The Prelude Avenue area's status quo flood extents for the 100-year return period indicates that the areas downstream of the Prelude Avenue area are susceptible to flood depths of up to 0.5m. The cause of the flooding downstream is as a result of overland flows that are being experienced in the area and the limited capacity of the Van Der Stel Canal and the railway culvert. The system downstream of Prelude-Symphony-Bach sites consists of a series of lined canals which discharge into the Van Der Stel canal just downstream of Jan Van Riebeeck Drive. The Van Der Stel canal ultimately discharges into the Berg River through a culvert beneath the existing railway. The overland flood depths downstream are generally less than 0.5m and increase in depth closer to the railway line. The use of the Prelude Avenue area for attenuation would assist with reducing flood depths downstream. An additional benefit is that since the railway culverts do not have sufficient capacity for flows, the excess flow can be conveyed in a northern direction towards the Drommedaris project site to link the two project sites and unlock additional attenuation benefits. Optioneering at the Prelude Avenue site could result in further flood depth reduction downstream by optimising the outlets of the proposed ponds, including a flood wall along the perimeter of the proposed ponds to increase attenuation volume for larger flood events.	**Y**

CRITERIA FOR PRIORITISATION		
	The results of the PCSWMM undertaken for the DM HFA Project (AIVIA, 2024) show that the Van der Stel Canal does not have sufficient capacity to convey the 100-year flood (current scenario). Based on the results, residential and commercial properties on both sides of the Canal are vulnerable to flooding and are anticipated to experience modelled flood depths up to 1m. **It is therefore essential that flood alleviation measures be introduced in this area to alleviate flood risk.** The project will also facilitate **improved solid waste management, water quality and wetlands condition** through the incorporation of features such as forebays and treatment ponds. The concept incorporates the existing depression wetland area on the Groenheuwel cemetery site, and through this intervention the aim is to improve the ecological state of the wetland and enhance its water treatment ecosystem services. The introduction of this NbS is intended to reduce the negative impact of the untreated effluent currently entering the system along the upstream informal settlements. Refuse removal will also be addressed through this project, with the placement of refuse bins at each site and servicing of the proposed forebay.	
3	Is this **project an essential service?**	
	This project is an essential service. **The project supports essential service delivery functions related to roads, stormwater, water, sanitation and refuse removal. It will also provide essential community facilities and supports the reduction of flood risk experienced by the community.** The proposed stormwater parks include a combination of stormwater management, the introduction and enhancement of community facilities through improved safety and amenity, and improved solid waste management, which will provide essential services to the Groenheuwel community.	**Y**
4	Will the execution of this project **stimulate investment in the local economy?**	
	The project will lead to the creation of permanent and temporary jobs linked to Planning and Design, Construction and Implementation, and Operation and Maintenance phases of the project. The improved urban environment and showcasing of successful implementation with community buy-in may also serve to improve investor confidence in the area. Wages earned by local workers from Drakenstein will increase available incomes for spending in the local economy, making a small investment impact.	**Y**

CRITERIA FOR PRIORITISATION		
	The level of investment estimated in the planning and design and construction phase of this project will create an estimated **197 indirect jobs** in the national economy, in supply of the required inputs for the project. Estimated level of expenditure is expected to induce **304 jobs** in the economy as project workers spend their wages. Many of these will be in Drakenstein if local suppliers are used. Investment return is anticipated to be 1.68 times the initial amount in income for the economy, resulting in an **economic benefit of about R180 million** to the economy. This intervention has significant potential to improve public space in the area, increasing investment potential.	
5	Will this project **enhance the quality of life of our local community and be for the benefit of the local community?**	
	The project aims to enhance the quality of life the local community and be for the benefit of the local community. The proposed project will reduce flood risk and enhance water quality to reduce flood exposure, improve environmental health and the safety and well-being of surrounding communities. Recreational benefits are achieved through the incorporation of sports fields, play parks and pedestrian movement routes. The sites will be available to the public and serve to formalise, improve and connect existing spaces to improve the experience of the community and provide access to recreational opportunities in a safe and accessible manner. Universal accessibility principles should be applied to ensure that the site accommodates all non-motorised transport users and people with physical disabilities. The site should also be designed such that there is legibility for children and adults. Parks should be designed with adults and children in mind. The provision of community facilities will engender and enhance ownership by the community.	
6	Will this **project lead to permanent job creation?**	
	The project components will include opportunities for job creation for local communities during the construction phases and operation and maintenance phases. The operation and maintenance in relation to the open spaces, landscaping, solid waste management, play area equipment and the stormwater ponds will require on-going human resource contributions. This may include the involvement of community members in voluntary project stewardship, the leveraging of the enhanced public works programme (EPWP), as well as other job creation opportunities. See also the Job Creation Potential Section. Secondary effects of expenditure in the local economy will also create permanent jobs in the local and national economy. A high-level estimate of permanent direct and induced jobs is provided in the jobs estimates.	

CRITERIA FOR PRIORITISATION		
	The level of investment estimated in the planning and design and construction phase of this project will create an estimated **197 indirect jobs** in the national economy, in supply of the required inputs for the project. Estimated level of expenditure is expected to induce **304 jobs** in the economy as project workers spend their wages. Many of these will be in Drakenstein if local suppliers are used. Investment return is anticipated to be 1.68 times the initial amount in income for the economy, resulting in an **economic benefit of about R180 million** to the economy. This intervention has significant potential to improve public space in the area, increasing investment potential.	
7	Is this project labour intensive/ will this project lead to **temporary job creation?**	
	The project components will include opportunities for job creation for local communities during the construction phases and operation and maintenance phases. The operation and maintenance in relation to the open spaces, landscaping, solid waste management, play area equipment and the stormwater ponds will require on-going human resource contributions. This may include the involvement of community members in voluntary project stewardship, the leveraging of the enhanced public works programme (EPWP), as well as other job creation opportunities. Secondary effects of expenditure in the local economy will also create permanent jobs in the local and national economy. A high-level estimate of permanent direct and induced jobs is provided in the jobs estimates. The proposed interventions in Prelude and Bach Streets will likely create an estimated **31 job-years in the design and construction phases**, along with an estimated 2 permanent jobs in maintenance. In the **design phase, the eight temporary job-years** created will nearly all be highly skilled jobs in professional firms (Engineering, Landscape Architecture, Planning, Scientific Services). All of these jobs will be green jobs. In the **construction phase, the 23 job-years** created will include three highly skilled job-years, ten semi-skilled job-years, and ten low-skilled job-years. All of these will be green jobs except for seven semi-skilled jobs, which will be for guards for 24-hour site security. All maintenance jobs are green jobs. See also the Job Creation Potential Section D3.7.	**Y**
8	**Will this capital expenditure / project generate significant additional revenue for the municipality?**	

CRITERIA FOR PRIORITISATION		
	The project is not likely to generate significant additional revenue for the municipality. However, the components of the project provide essential basic services to communities and aims to respond to the need for flood risk reduction in the area. As such, the benefit of this project includes the protection of municipal and private infrastructure, the protection of livelihoods and community assets, and may result in cost savings due to improved infrastructure maintenance and management. This infrastructure does not sit in any of the trading services departments and is therefore not a direct revenue generator. Some elements may have access charges (such as braai facilities, and bird watching facilities) but these revenues will be small. They are likely to have operating cost reduction impacts on both water services and solid waste services. Natural water treatment services provided by these interventions will reduce water treatment costs for water abstracted form the Berg River. Increased litter trapping mechanisms provided by the intervention will also reduce damage to water infrastructure and cost of ad hoc waste removal elsewhere in the stormwater system and the municipality. The net effect is likely an increased surplus or reduced deficit in water services and solid waste management and reduced operating costs in stormwater management.	N
9	Will this **project improve the aesthetic appearance of the city / town?**	
	The project will improve the aesthetic appearance of the city. The project seeks to achieve an improved urban realm and placemaking to support the functionality and improvement of the urban environment through the introduction of pedestrian movement corridors, the creation of safe and accessible public spaces including sports fields, and the promotion of urban integration. The introduction of street furniture aims to improve the attractiveness of the area as place of gathering, and the connectivity of the Prelude-Symphony-Bach properties through pedestrian movement corridors will aim to improve the urban environment. This project will provide for improved appearance of Groenheuwel residential area through the creation of a network of sporting infrastructure and flood alleviation opportunities along major roads. The project also includes the upgrading of existing parks to achieve improved amenity.	
10	Will the execution of this project **contribute to the social upliftment of the community?**	
	Recreational benefits are achieved through the incorporation of sports fields, a play park and pedestrian movement routes. The community noted that restorative and sporting spaces are very much required and supported and suggested that pleasant and well-maintained open spaces would provide the recreational benefits that are much needed by the community. The activation of the site can also offer job creation opportunities for surrounding communities.	**Y**

CRITERIA FOR PRIORITISATION		
11	Does this project comply with the **developmental directions of the municipality's spatial development framework?**	
	The project aligns with the **developmental directions of the municipality's spatial development framework.** Land use change will have a significant impact on catchment hydrology and flood risk. Development is associated with an increase in impermeable surfaces which will contribute to increased runoff and peak discharges in the absence of attenuation interventions. Activating this area though the development of **multi-functional open spaces inclusive of community facilities** aligns with the municipal SDF, which has designated the erven on which this project is located for Green Space and Community Use. This will allow for the protection and active use of green space. The community use spatial element includes the land uses compatible with the proposal **including recreational facilities (i.e. fields, courts**, and **sports fields)**. The protection of green space will also aid in ensuring that current sites earmarked for green/open space remain undeveloped and able to serve as permeable surfaces, particularly given the scarcity of land for development. This is particularly critical given that land use change was found to be a key driver for changing hydrology.	**Y**
12	**Must this project be implemented now?**	
	The project is essential to achieve the required flood risk reduction outcomes necessary to alleviate flooding. See also Point 2 in this table.	**Y**
13	**Is there a time factor involved for this capital expenditure / project that will negatively influence any other capital expenditure / project or foreign investment in infrastructure?**	
	The project forms part of the broader Drakenstein Municipality Hybrid Flood Alleviation Programme, and this project was identified as part of the Stage 1 Priority/ Catalytic Projects.	**Y**

D3.1. Informants: Prelude-Symphony-Bach Street Stormwater Pond Network HFA Project

Urban Context

This Prelude-Symphony-Bach Hybrid Flood Alleviation Project is located upstream in **Ward 13** of the Groenheuwel Catchment and is named after streets that form the northern boundary of these sites. The site includes fourteen **municipal-owned** erven, totalling approximately **31,16 hectares**. Two of these erven (16654 and 22263) are located north of Symphony Way. A section of the project site (Erf 16654 and 22263) formed part of the Landscape Character Assessment and was identified as having a "**Low-flow channel and detention pond**" Character. The existing 'Prelude Street' low-flow channel and detention pond are located on this portion of the site. The third erf (16755) is located south of Symphony Way and is the proposed extension of the existing Prelude Street detention pond. The fourth erf (17091) forming this site is located with Bach Street in the north and Jan van Riebeeck Drive to the west. The Bach Street site is relatively high in elevation in comparison to its surrounds and is currently used by the community as a cricket pitch. The southern boundary is adjacent to an unnamed waterway that flows through from the Prelude Pond in the east. A combination of two identified intervention sites (Prelude-Symphony and Bach) formed the basis of this project site. The site concept includes provision for connectivity between the main sites (Prelude, Symphony and Bach) and the erf numbers connecting the main site are: 527/7, 17317, 22273, 24144, 16705, 16578, 16579, 17080, 17085, 17320, 16998, and 23707.

The properties on which the sites are located are earmarked for Green Space (16654 and 22263) and Community Use (16755 and 17091) in the DM SDF. The SDF notes the following regarding community uses: "*This spatial element includes the following land uses: a) Community and social facilities (libraries, community halls, municipal offices, clinics, Thusong centres, charitable organisations, CBOs, NPOs, etc.), including recreational facilities (i.e. fields, courts, stadiums, club house, gym, ablutions, medical, etc.); and b) Educational facilities such as crèches (e.g., ECDs), primary and secondary schools and tertiary institutions, which includes ancillary uses such as sports fields, boarding facilities and student accommodation.* An integrated plan for the development of the site could enable the realisation of components of the envisaged use as per the SDF.

The areas to the north-west of the Prelude-Symphony portion of site are primarily residential.

The area to the east of the existing Prelude Pond and low flow channel is primarily residential, including both formal and informal housing typologies. The area is a grassed depression with a low-flow channel that passes diagonally through the site towards the Berg River. Pedestrian movement was observed on the top of the low banks rather than through the depression although it is easily accessible. There are however strong desire lines that cut through the detention pond suggesting that there is pedestrian movement through the pond during the dry season. All the surrounding houses turn their back onto the space except for those along Prelude Avenue that face towards the space. Most properties have visually impermeable boundary walls. A sewer line runs through the Prelude Avenue section of the site.

The Groenheuwel cemetery is located east of Erf 16755 and moving further east on Bo-Dal Josafat are residential areas including Fairyland (Bo-Dal Street) and Siyahlahla 1 (Bo-dal Street).

The Allandale Correctional Facility is situated south of the Symphony Street Section of the site. The prison grounds are owned by the national government, and an opportunity has been identified to connect this site to the flood alleviation in the larger area since there is attenuation potential identified – particularly for irrigation purposes.

The community was engaged as part of the concept plan workshops (despite not forming part of the CFRPS). Residents of the Marikana Informal Settlement reported that they experience significant flooding and solid waste management challenges

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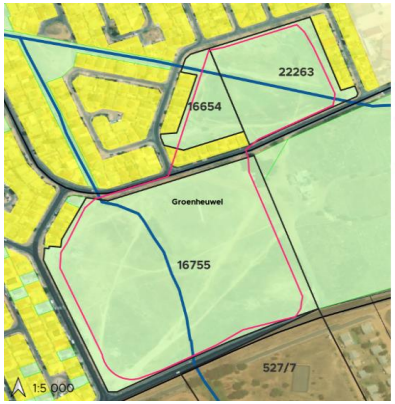
within the areas upstream of the Prelude Street Low flow channel. The community participants further noted that the same challenges are prevalent and in more formal residential areas, mentioning the corner of Chopin and Symphony Avenue as a flooding area. The community members attributed the flooding to the solid waste challenges experienced in the ward, noting that the lack of solid waste collection and solid waste management solutions result in solid waste pollution. Litter finds its way into the stormwater drains, and these blockages cause flooding as water is unable to move through the pipes. The community noted that they require refuse bags to be provided to each household as limited solid waste collection occurs, particularly in informal areas upstream of the project site. The community requested that regular solid waste collection take place (on a weekly basis) and that this would assist in managing the health and cleanliness of the community, whilst also assisting with the operation and maintenance of stormwater infrastructure. The community further noted that when floods are anticipated, sandbags are provided by the municipality, but even when these are provided, this solution is insufficient.

Part D Chapter 3 Map 1. Project Sites in the context of the SDF



Prelude Street Low-flow Channel and Detention Pond

- Roads
- Watercourses
- Urban Edge (2024)
- Catchment Boundaries
- Potential Site Boundary
- Affected Erven

Ownership

- Municipal
- National
- Private
- Provincial

Open Space (Bach and Jan van Riebeek)

- Roads
- Watercourses
- Urban Edge (2024)
- Catchment Boundaries
- Potential Site Boundary
- Affected Erven

Ownership

- Municipal
- Private
- Provincial

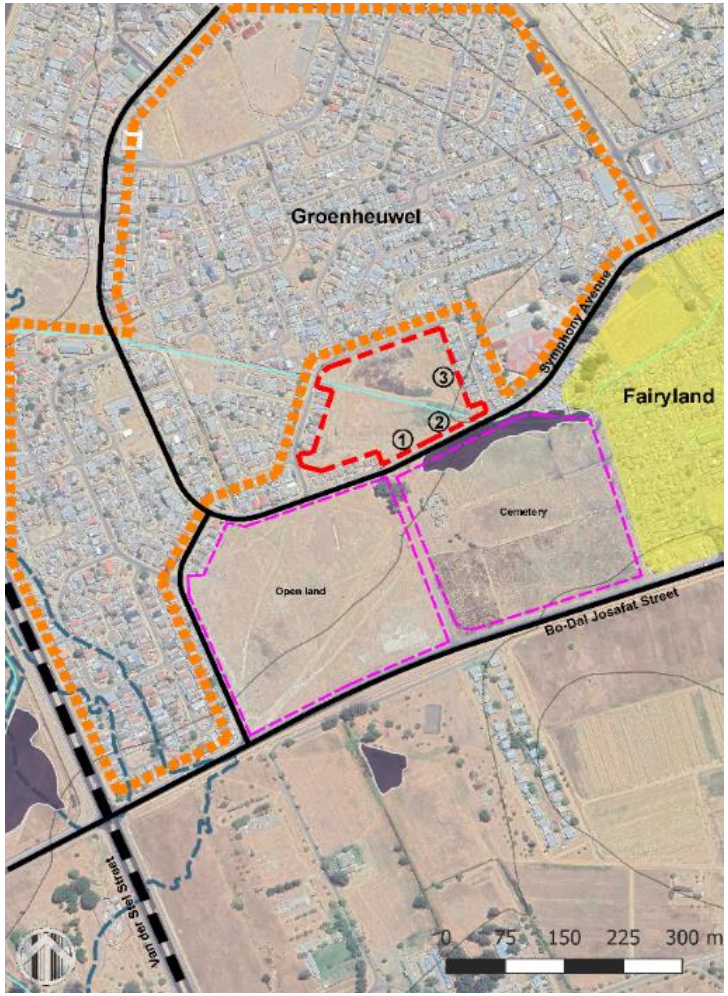
Part D Chapter 3 Map 2. Land ownership

Landscape Character of the Prelude Section of the site

The DM HFA LCA identified this area as having a **"Low-flow channel and detention pond"** character type.

Dominant landcover & Landscape elements include:

1. Visible dumping and pollution
2. Surrounding informal settlement
3. Surrounding residential neighbourhood
4. Grassed depression
5. Low-flow channel
6. Existing concrete culverts
7. No visible safety fencing



Part D Chapter 3 Map 3. LCA: Character Area Map

Based on the proximity of the **Prelude-Symphony section** of the site to an access road, there is no perceived amenity value for the community nearby but there is hydrological value in attenuating stormwater during heavy rains. There is full visibility across the site with no trees or existing vegetation along the edge of the site resulting in a harsh landscape during the warmer season. The space is open and exposed but is also held by the surrounding residential properties and play park which improves the perception of safety. The surrounding landscape is relatively flat with full visibility of the mountainous landscape.

The detention pond and low-flow channel currently has low perceived cultural value to the surrounding community as a utilitarian space that accommodates flooding during the rainy season. There is minimal ecological value as the vegetation is mown to maintain attenuation capacity. For those walking on the edge of the site, it is a harsh landscape with no shade.

There is visible solid waste pollution on the Prelude section of the site that can decrease the water quality once decomposed, and seep into the ground affecting the water table and overall catchment quality, as well as directly affecting the **water quality** in the channel with no evident litter traps or recycling/ waste collection maintenance. The concrete low-flow channel prevents infiltration during low flow periods.

Opportunities for NbS and associated co-benefits were identified in the LCA. These opportunities include improving water quality with riparian vegetation such as *Cyperus textilis, Elegia tectorum, Juncus effusus* and *Ficinia nodosa* (**Images 04-07**), improving comfort through shaded walking thoroughfares around the pond, and improving the edge interface between the low-flow depression and nearby boundary walls of residential development.

Part D Chapter 3 Image 1. This shows visible solid waste pollution within the detention pond.

Part D Chapter 3 Image 2 The low-flow channel exits a large concrete culvert and flows towards the Berg River.

Part D Chapter 3 Image 3. Residential boundary walls edge the detention pond that acts as a utilitarian area.

Part D Chapter 3 Image 4. *Cyperus textilis* (Mat sedge)

Part D Chapter 3 Image 5. Elegia tectorum (Cape thatching reed)

Part D Chapter 3 Image 6. Juncus effusus (Sedge)

Part D Chapter 3 Image 7. *Ficinia nodosa* (Vleibiesie)

Watercourses, Wetlands and Flood Risk

Rivers and Stormwater

The Groenheuwel Catchment is drained by the Boontjies River and an unnamed watercourse. These rivers discharge into the Vosmaar and Van Der Stel canals west of Jan van Riebeek Drive into the Berg River.

An unnamed river passes through the Prelude Avenue site flowing in a north-westerly direction from Hawequa Bos Pad Road through agricultural areas where it passes through a channelled valley-bottom wetlands, a wetland flat, and an unchanneled valley-bottom wetland before reaching the urban edge. In the urban area, the unnamed river runs in the northerly direction passing depression wetlands and a wetland flat before reaching Green Valley Estate. The river then flows north-west across Bo Dal Josaphat passing through formal and informal residential areas such as Siyahlahla 2 informal settlement and Fairyland (Adjacent to Groenheuwel Primary - Marikana)/Marikana. The river crosses a depression wetland before entering the Prelude site on the south-eastern corner of the existing retention dam before cutting diagonally through via a lined low flow channel.

The PCSWMM modelling results (1:100yr flood inundation – current)

The upper reaches of the Van der Stel Canal have the capacity to convey the 5-year flood, with overtopping occurring only in the lower reaches. For the 5-year flood, overtopping and flooding associated with the flood event are lower than 0.5 m. Overtopping of the Vosmar canal was observed for the 5-year flood with flood depths associated with this overtopping being less than 0.5 m. The Vosmaar and Van der Stel Canals do not have sufficient capacity to convey the 20- and 100-year flood.

Part D Chapter 3 Map 4. Groenheuwel catchment zoomed in (100-year flood)

During the 20- and 100-year flood scenario, these canals overtop and flood the adjacent industrial areas. Flood depths associated with this overtopping range from 0.1 to 2.1 m for the 20-year flood and 0.1 to 2.3 m for the 100-year flood.

The canal draining central Groenheuwel cannot contains the 5- 20-, and 100-year flood (see map), overtops and floods the residential area west of the canal. It should be noted that the flood depths associated with this overtopping are shallow and are less than 0.5 m for all return periods considered.

Wetlands

Wetlands offer three flood alleviation ecosystem services (FAES) – namely Flood Attenuation, Streamflow Regulation, and Water Quality Enhancement, where the following ratings apply:

- 0= absence
- 1 = poor
- 2 = moderate
- 3 = high
- 4 = very high

These FAES differ in relation to the position of the wetland relative to the overall catchment. In the DM HFA Programme, the catchments were each divided into upper, middle and lower reaches. The FAES also differ depending on the type of wetland, as different wetland types are able to offer different levels for each respective FAES. The ability of a specific wetland to provide the three FAES in relation to their location in the catchment is detailed in the DM HFA Ecological Assessment (Ecological, Infrastructure and Infrastructure Assessment, AIVIA, 2024), where the rating of the potential for supply of ecosystem services by a wetland or river, based on hydrogeomorphic (HGM) type, and climatic setting (humid to sub-humid, and semi-arid) is further explained. For this study, all scores apply to wetlands and rivers in good condition and the process was adapted from WET-EcoServices Version 2 (Kotze et al., 2020).

This provides guidance on the nature of intervention that might be required to rehabilitate, restore or protect the wetlands to enable them to offer the maximum FAES as they would if they were in good condition.

The actual condition of the wetland is also known, based on the DM HFA Ecological Assessment, which used the rapid Level 1A WET-Health assessment protocol (MacFarlane et al., 2020) to determine the **Present Ecological State of the hydrology, geomorphology, water quality and vegetation of the wetlands in the three catchments forming part of the DM HFA**. The method is based on the hydrogeomorphic (HGM) approach to wetland typing, providing a PES score for a wetland within each of the four condition modules – hydrology, geomorphology, water quality and vegetation - and a combined overall score for wetland health. The PES score provides a quantitative measure of the extent, magnitude and intensity of deviation from the reference or unimpacted condition, and places the wetland in a wetland health category, A – F. The Level 1A WET-Health assessment uses land cover as a surrogate for the severity or magnitude of an impact, where this is assumed to be linked to land use.

Part D Chapter 3 Table 1. Present Ecological State categories used to define the overall health or integrity of a wetland (from MacFarlane et al., 2020). Colour-coding is according to the River EcoStatus Monitoring Programme of DWS.

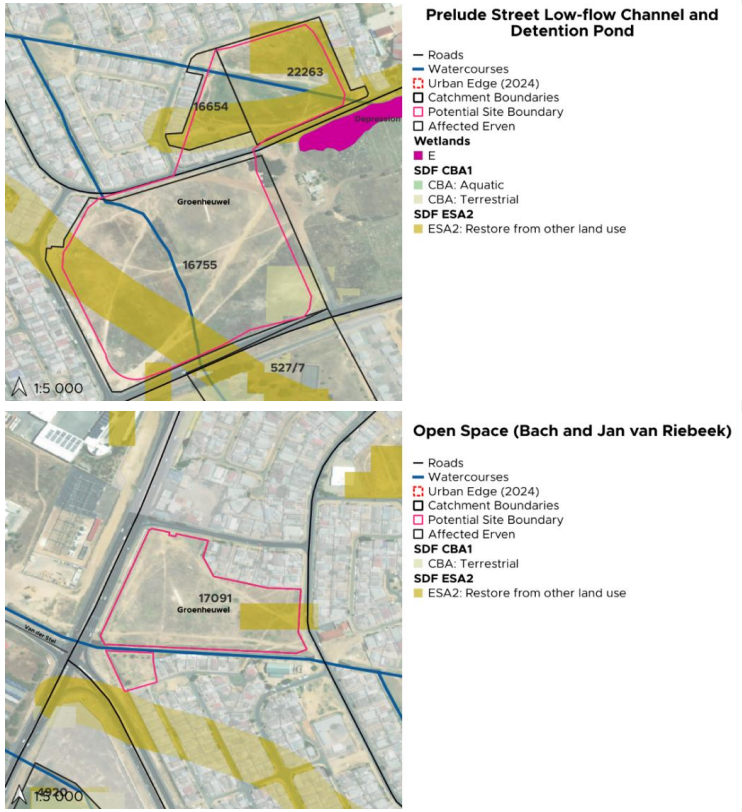
CATEGORY	PES SCORES (%)	DESCRIPTION
A	90 – 100	Unmodified, natural.
B	80 – 89	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.
C	60 – 79	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats and biota may have taken place.
D	40 – 59	Largely modified. A large change in ecosystem processes and loss of natural habitats and biota has occurred.
E	20 – 39	The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognisable.
F	0 – 19	Modifications have reached a critical level, and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.

The site's properties do not include any wetlands within their boundaries. However, there is a depression wetland located just south of erf 22263 and east of 16755.

Part D Chapter 3 Table 2. Flood Alleviation Ecosystem Services Provided by wetlands in relation to the project site based on optimal condition. (Ecological, Infrastructure and Land Use Report, AIVIA, 2024)

HGM types:	Ecosystem services:		
	Flood attenuation	Streamflow regulation	Water quality regulation
Depression	2	1	2
	2.5	0.5	1.5

The wetland PES was scored as a PES E, meaning *that the change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognisable*. This also suggests that the depression wetland is not currently providing the abovementioned ecosystem services to the full extent possible.



Part D Chapter 3 Map 5. Wetlands and Watercourses

Informants Summary

The Prelude-Symphony-Bach site is located within Ward 13 and was originally considered as two separate sites. The extension of the Prelude low flow channel and pond to the site located across Symphony on the south (erf 16755) next to the Cemetery was originally part of the Drommedaris Stormwater Master Plan (2015). The Bach Street site was identified in the DM HFA Workshop #1 (August 2021), given its status as an underutilised open space.

The existing Prelude Pond experiences solid waste management challenges, and there are known challenges with effluent flowing through the site from the east, impacting communities downstream. Whilst not located on site, a wetland is located on the cemetery property, and this depression wetland is currently in poor condition, and should thus be optimised to release its potential in terms of FAES.

Whereas the existing Prelude Pond is designated as green space, the other two areas (Bach and Erf 16755 next to the cemetery) are both earmarked for community use in the SDF.

The north-western corner of Erf 16755 will include the development of a soup kitchen in the future, presenting the opportunity to link with other community facilities in this area of the site.

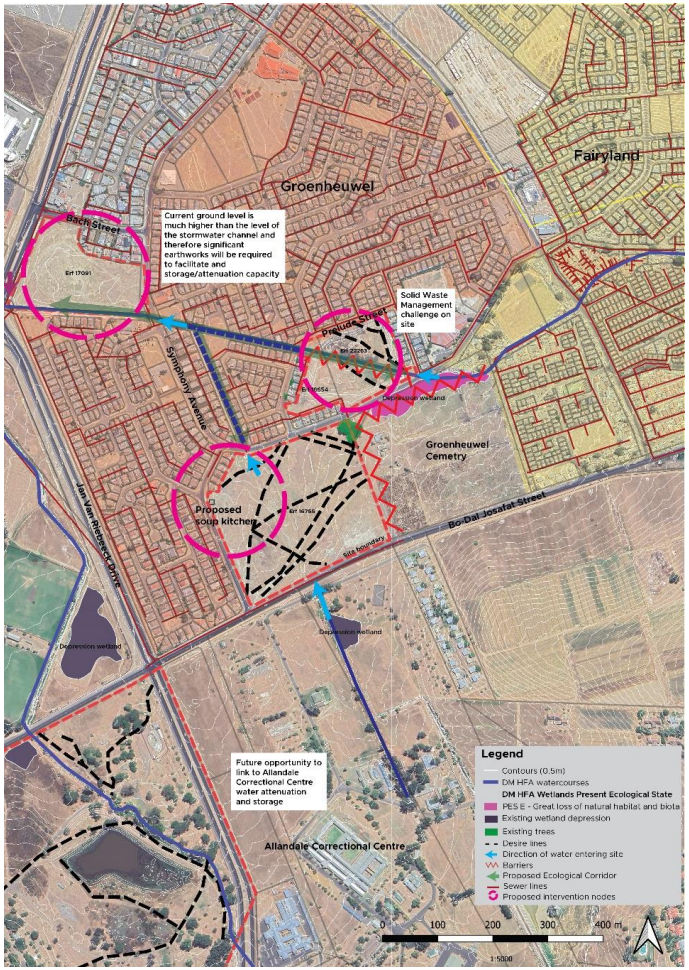
By retaining the soup kitchen and the existing utilisation of these spaces as sporting grounds, there is an opportunity to ensure that the site concepts incorporate community uses.

Key Opportunities:

- The connection of the properties through the creation of a walking route along a more formalised pedestrian pathway
- Enhancing the community node on the northwestern corner of 16755 (Symphony) to incorporate other community uses, and the remainder of the property for the development of a network of stormwater ponds that link to the existing Prelude Street Pond
- Leveraging the existing community park just west of Chorus Street that passes by the part toward south of Bach Street from the channel from Prelude Street
- Enhancing the Bach Street section of the site to further enhance the use of the site as a cricket field

The Informants Map is shown in **Error! Reference source not found.**, and is also p rovided in an Annexure to this report.

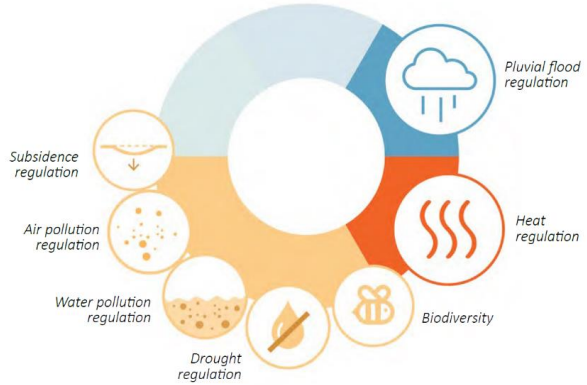
The Prelude-Symphony areas will offer the opportunity for flood attenuation infrastructure, noting the previous identification of this area in the SWMP. The Bach Street site has also been identified for its potential in the development of flood attenuation infrastructure, noting that the site will likely require significant earthworks.



Part D Chapter 3 Map 6. Informants Map

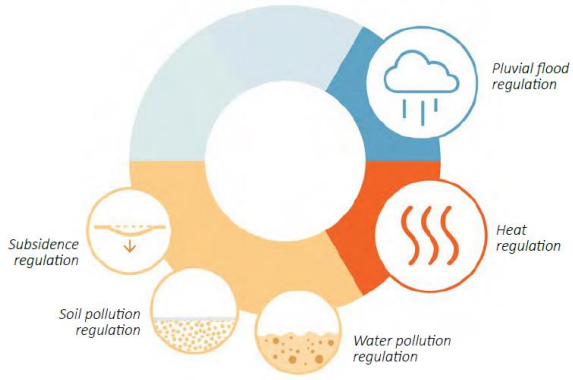
D3.2. Concept Design: Prelude-Symphony-Bach Street Stormwater Pond Network HFA Project

The sites along Prelude, Symphony and Bach Streets together with existing parks presents an opportunity to create a network of hybrid flood alleviation interventions to reduce flood risk and provide co-benefits with a specific sporting theme. The proposal incorporates the PES E (**depression wetland** located on the Groenheuwel Cemetery site (east of the "symphony street site"). The integration of the area within the intervention aims to rehabilitate the wetland to restore its water treatment ecosystem services and improve the poor water quality caused by solid waste pollution and untreated effluent from underserviced residential areas upstream. The concept incorporates the existing pond on Prelude Street, along with the existing play park, the Open Space on Symphony Avenue, the existing park area along Chorus Street, and the Open Space on the corner of Bach and Jan van Riebeeck forming a network of **stormwater parks**. All the sites offer specific sport and recreation opportunities for the local communities, which are to be retained and integrated into the concept design.



Part D Chapter 3 Figure 1. Functions of Open Spaces (Source: World Bank, 2021)

There are several functions and benefits associated with the components of the concept. Part D Chapter 3 Figure 1 provides a summary of the functions associated with Open Green Spaces, given that the improvement and activation of existing green spaces to function as effective recreation spaces are a primary focus of the project. Part D Chapter 3 Figure 2 shows the functions of bioretention areas, which *'can be adapted to a variety of urban environments. It can take many forms and shapes for different functions and contexts. Bioretention basins, vegetated swales, rain gardens, retention ponds, infiltration trenches, and detention ponds are some examples of bioretention systems. Depending on the stormwater volume to be collected, a water retention area can be either dry or wet.' (World Bank, 2021: 141).*



Part D Chapter 3 Figure 2. Functions of bioretention areas including detention ponds/ stormwater attenuation facilities (Source: World Bank, 2021)

Prelude-Symphony-Bach Concept Plan

The proposed network of stormwater ponds proposed for the **Prelude-Symphony-Bach Street Stormwater Pond Network HFA Project** aim to manage stormwater, improve water quality, and integrate community recreational spaces while addressing the unique characteristics of each site. The project will include the activation and formalisation of a network of sport facilities to promote active and healthy communities. The project site includes Erf: 24144, 16755, 22273, 17317, 527/7, 16654, 16705, 22263, 16578, 16579, 17080, 17085, 17320, 16998, 17091, 23707. Connecting pathways between these land pockets are also included in the site concept.

Prelude (Erf 16645 and Erf 22263) is the site of an existing pond and low flow channel, and total 2.47 hectares. The proposal for this section of the site includes:

- Creating a meandering channel and stormwater treatment wetland
- Sports field with swale and seating
- Riparian Vegetation, and culverts connecting the ponds (Prelude and Symphony)

Symphony (Erf 16775) is 6.7 hectares in size and is located next to the Groenheuwel Cemetery. The proposal for this section of the site includes:

- Cascaded stormwater attenuation facilities
- Sports field for cricket
- Pedestrian walkways
- Meadow grass planting
- Soup kitchen
- Community garden

Bach Street (Erf 17091) is 2,6 hectares in size, and is an open space on the corner of Bach and Jan van Riebeeck Drive. It is currently used as an open space and cricket field.

- Stormwater pond/swale
- Sports field for cricket
- Pedestrian Walkways
- Meadow grass planting
- Playground
- Netball courts

Existing Parks

The upgrade of the existing parks will support the Programme Objectives to create **healthy**, **well-managed and maintained municipal infrastructure and public spaces**. The components of the concept plan are described below.

Concept Design Community Workshops were held on 17 October and 18 October 2024, where community participants were given the opportunity to provide input to the concepts. The input is reflected in the discussion of the concepts in this section, and where possible these have been reflected in the updated concept design or the description of the components linked thereto.

The Concept Plan is shown in **Error! Reference source not found.**. It is also provided a s an Annexure hereto.

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Part D Chapter 3 Map 7. Concept Plan for Prelude-Symphony-Bach Hybrid Flood Alleviation Project (Prelude and Symphony)

Part D Chapter 3 Map 8. Concept Plan for Prelude-Symphony-Bach Hybrid Flood Alleviation Project (Bach)

Components of the Concept Layout Design

Introduction of a forebay and typha-reed beds at the Depression Wetland (Groenheuwel Cemetery)

The depression wetland is located in the north of the Groenheuwel Cemetery. The Present Ecological State of the wetland is "E". This means that *the change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognisable*. The incorporation of the wetland into the concept entails the rehabilitation of the wetland, the development of a forebay at the inlet and the introduction of typha-reed beds.

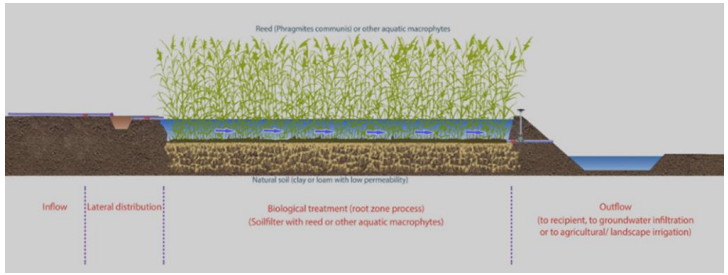
Forebay

The forebay will be situated at the eastern-most section of the wetland where water enters from the unnamed river from the east. The water flows west through the wetland toward the low flow channel and pond on Prelude Street. As the water flows through the wetland, the typha-reed beds offer an ecofriendly method of water treatment by filtering effluent and stormwater runoff.

Typha-reed beds

Typha-reed beds are proposed within the wetland area to aid in treating the heavily polluted stormwater passing through the unnamed river before it moves north-west toward the site of the existing Prelude Street Pond.

A survey of the existing wetland on the Groenheuwel Cemetery grounds will be necessary during the detailed design phase of the proposed intervention. This survey will delineate the wetland's exact boundaries to guide design decisions and ensure that no graves are disturbed. Establishing a clear boundary will also support the integration of the wetland into flood management strategies while preserving the integrity and sanctity of the cemetery.



Part D Chapter 3 Figure 3. Example of water movement and treatment process through the use of wetlands and typha-reed beds. (Source https://www.blumberg-engineers.com/en/ecotechnologies/reed-bed-treatment/).

Transforming the Prelude Street existing pond and low-flow channel to a multi-purpose stormwater park

Creating a meandering channel and stormwater treatment wetland

At the Prelude Street site, the existing detention pond and low flow channel provides an opportunity for flow management and natural water treatment. The channel is currently linear and running diagonally from the south-east of the site to the north-west. The proposal is to remove the concrete lining and redesign the channel to meander through the site. It is proposed that the treatment wetland and meandering is supported by the implementation of gabion structures as per Part D Chapter 3 Figure 4. This would slow the water flow and allow it to spread naturally, improving attenuation during low and medium flow scenarios and improving water treatment.

Part D Chapter 3 Figure 4. Gabion structures in a treatment wetland (Source: https://www.hargreaves.com/work/chattanooga-renaissance-park/).

Sports field with swale and seating

A sports field is proposed in the east as water enters the site from the wetland. This sports field will incorporate seating along the eastern embankment for spectators. It is proposed that this sports field be used for **soccer**. The sports field is proposed to be surrounded by a swale to assist in with the management of runoff small rainfall events and low to medium flow scenarios. Under high flow scenarios the sports field will be allowed to flood to enhance the pond's retention capacity.

Part D Chapter 3 Figure 5. Sports field with swale and seating (Source: Plan prepared by Design Space Africa and provided by City of Cape Town Catchment Stormwater and River Management Branch).

Community Participation Inputs

The community did not indicate that any sports are currently played at this site, potentially due to being wet, polluted and not well maintained. The participants were receptive to the proposal of leveraging the site for the purpose of recreation and suggested that the sports field allows for both soccer and netball. The community noted that any street furniture should be constructed from concrete or made from materials that would be difficult to remove to discourage vandalism and theft.

The community noted that they are willing to support the maintenance of the site if developed and would help to 'look after' the site as far as possible by also mobilising the community members and relating the importance of the upkeep of open spaces, parks and sports fields for use by the children within the community.

Key community ideas and inputs:

- Creating a sports field to be used for both soccer and netball
- Ensuring that street furniture is made from cement or materials that are difficult to remove to ensure that they do not get vandalised or stolen
- Creation of recreational areas that are family-oriented and inclusive of both adults and children

Riparian Vegetation

Planting riparian vegetation along the channel and pond is critical to promote ecological health and support water treatment. Native plants, such as reeds and grasses, will help stabilise the pond's banks, reduce soil erosion, and filter pollutants like nutrients and sediments from the stormwater. Additionally, these plants provide a habitat for wildlife and promote biodiversity, while their root systems enhance water infiltration and uptake of excess nutrients, contributing to improved water quality and overall ecosystem resilience.

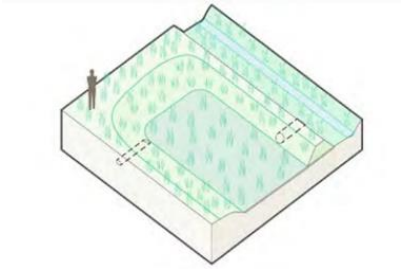
Culverts connecting the ponds

A culvert connecting the Prelude and Symphony ponds would be installed to connect the two sites. Culverts are proposed at key locations throughout the Prelude and Symphony sites to connect the pond network and allow for flow management. The positions require invert elevations, and flow rates will be determined during detailed design to optimise the flood alleviation potential.

Symphony Street

Cascaded stormwater attenuation facility/pond

The concept for the Symphony Street site focuses on creating three cascaded attenuation facilities. Two triangular shaped ponds will be located in the south-western corner and another in the south-eastern corner of the site. A third pond is proposed for the north-western corner of the site, the surface of which will also serve as the proposed cricket field when dry. To further improve flood attenuation, the channel flowing across the site would be redesigned to meander through this space and connect the ponds, enhancing water retention and ecological diversity. Excavation of the area would be required to strategically deepen and shape the area to create storage capacity and the cascade effect between the ponds. The depths of the ponds will be determined during detailed design.



Part D Chapter 3 Figure 6. Illustration of a Stormwater Pond (World Bank, 2021)

Part D Chapter 3 Figure 7. Example of a stormwater pond at Fullham Road, Mitchells Plain.

Sports field for cricket

As noted above, a sports field has been proposed on the site. Based on current use and community inputs, it will primarily serve as a cricket field. The cricket field will be integrated into the north-western pond for use during dry periods and allowed to flood when required. Seating will be integrated into the pond's embankment to accommodate spectators.

Part D Chapter 3 Figure 8. Precedent image of a multi-use sports field stormwater retention pond (https://tdhengineering.com/project/upgf-multiuse-athletic-field-intermittent-storm-water-detention-pond/)

Community Participant Input

Key community ideas and inputs:

- Development of a seating area
- Ensuring that street furniture is made from cement or materials that are difficult to remove to ensure that they do not get vandalised or stolen
- Better solid waste management – the DM to issue and collect refuse bags on a weekly basis

- Moving soccer to the Prelude Street sports field

Pedestrian Walkways

Between these two facilities, a natural area would be preserved where people can walk along a corridor that follows a current desire line crossing the site from the north-east to the south-west. This walkable corridor would support flood management and enhance public use.

Part D Chapter 3 Figure 9. Illustration of Pedestrian Pathways (Tzifa, A., & Nikolaidou, S. 2020).

The formalisation of pedestrian pathways along existing stormwater canals, particularly the section connecting the Prelude Street site (existing pond) with the park situated north of the north-western section of the Chorus Street loop.

Part D Chapter 3 Image 8. View of the Prelude Site facing east, showing pedestrian movement though the site (October 2024) (Source: AIVIA, 2024)

Meadow grass planting

The site will include meadow grass planting, which requires less frequent mowing, reducing the operation and maintenance requirement for the municipality.

Soup Kitchen

A soup kitchen is proposed along Chopin Avenue. A soup kitchen is currently run by a community member, and the development of the soup kitchen site will allow for the scaling up of the community upliftment project.

Community Garden

A community garden is proposed on the north-western side of the site adjacent to the soup kitchen.

Community Participation Inputs

The participants noted that the existing soup kitchen was of benefit to the community at large but expressed concern that the areas around the soup kitchen were not well-managed in terms of solid waste management, and the development of small patches of community gardens at the site promotes its aesthetic value.

Key community ideas and inputs:

- Improved solid waste management at the site.
- Scaling up the community gardens to ensure that the area around the soup kitchen is friendly, useful and aesthetically pleasing.

Optimising the Bach Street Site for recreation and water treatment

Terrestrial rehabilitation

The focus will be on terrestrial rehabilitation by enhancing the land surrounding the channel to support biodiversity and stabilise the area. Although limited in terms of flood attenuation, the convergence of two channels at this site presents an opportunity to create a soft, vegetated area where water can slow down, providing some treatment benefits before discharging into the channel.

For flood attenuation, both channels could potentially be allowed to overtop into a terraced section along the channel. This terracing would help slow water flow during heavy rainfall events, offering additional flood management capacity while incorporating natural elements to improve water quality.

Sports Fields and play parks

A cricket field is proposed as the central feature of the site. The site will also include multi-purpose courts on the east, as well as a playground.

Part D Chapter 3 Image 9. Bach Street Site showing the informal cricket field used by the community (October 2024) (Source: AIVIA, 2024)

Part D Chapter 3 Figure 10. Example of a Play Park: Mouille Point Play Park

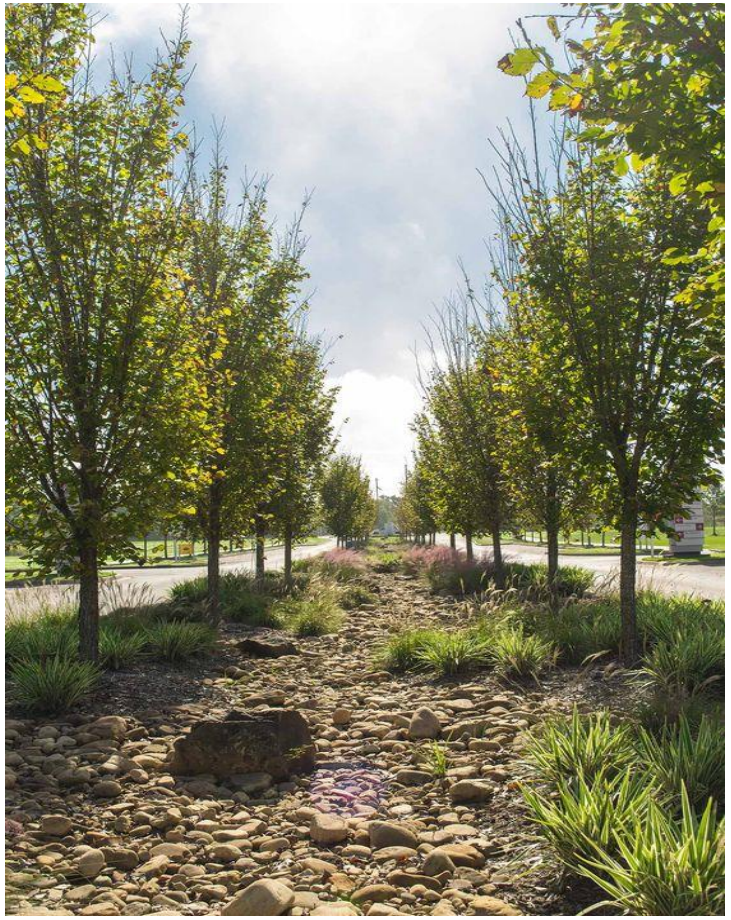
Swale

A swale with riparian vegetation to treat polluted stormwater run-off is proposed on the west of the site along Jan van Riebeeck Drive.

Swales are shallow grass-lined/vegetated channels used for stormwater drainage and infiltration (DHS, 2019). The channels typically comprise of flat bases, sloped sides, and are usually dry during non-rainfall periods. These provide alternative drainage interventions to hard-lined roadside gutters and pavements, offering aesthetic and recreational advantages. Additionally, the vegetated cover protects soil from wind and water erosion, reduces runoff rates, and enhances water quality through filtration

processes, with the potential to capture nutrients (DHS, 2019). Swales will be located around the sports fields and adjacent to canals to slow down the water and to allow for infiltration.

Part D Chapter 3 Figure 11. Planted swale at Mitchells Plain District Hospital



Part D Chapter 3 Figure 12. Planted swale

Solid Waste Management

The site will include public refuse bins to be collected at regular intervals, particularly along pedestrian pathways, within the park and at the sports fields. The cleaning of the site may make use of local labour through programmes such as the Expanded Public Works Programme (EPWP).

Community Participation Inputs

Solid waste management was noted to be a major issue at this site by community members. Participants noted that the entire network of open spaces would be improved if solid waste could be collected regularly, supported by the issuing of refuse bags on a weekly basis. The development of skips/bins/dumpsters at the site were not supported by the communities as they are unsafe for young children and the burning of contents causes health hazards.

Part D Chapter 3 Image 10. Chorus Street Park, showing well-maintained play equipment (October 2024) (Source: AIVIA, 2024)

Enhancing existing parks

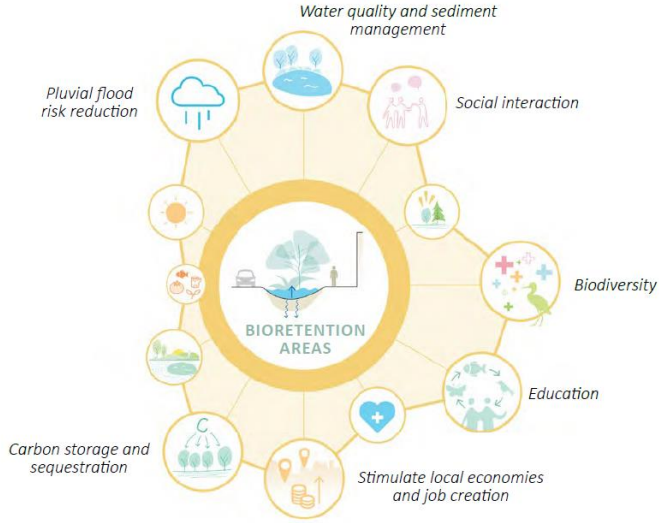
The concept includes the upgrade of two existing parks. The first is located on Erf 16654 between residential plots on Prelude and Symphony Avenue. The second park is located north of Chorus Street with the existing stormwater channel in the north. The concept includes the incorporation of the green space/traffic island north of the channel south of Sharp Street, with proposed road surface change to visually link the traffic island, with potential seating to increase passive surveillance with the park.

D3.3. Benefits and Impact Potential: Prelude-Symphony-Bach Stormwater Pond Network HFA Project

The primary objective and benefit to be achieved from this project is Flood Risk Reduction, aligned to the overarching programme objective of building flood resilience. It is critical that flood risk reduction measures are not developed in isolation from the broader urban and natural environment and community context. As such, these four **interrelated** areas – **1) Flood Risk Reduction**, **2) Urban Management and Open Space Optimisation**, **3) Adaptation and Climate Resilience**, and **4) Community Empowerment and Participation** are identified as four broad groups of benefits that should be sought to give effect to the programme objectives at the project level.

A multitude of benefits can be achieved via the creation and enhancement of open green spaces and bioretention areas. These are summarised below, and are further explained in the context of this project.

Part D Chapter 3 Figure 13. Benefits of Open Green Spaces (Source: World Bank, 2021)

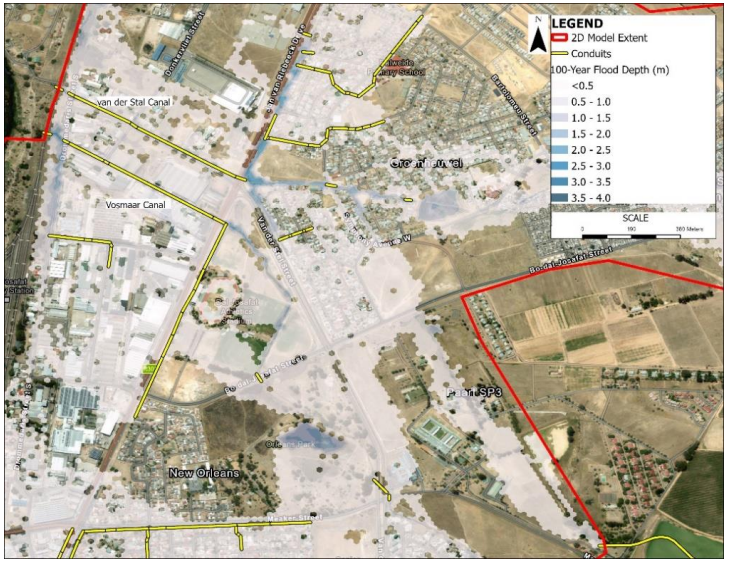


Part D Chapter 3 Figure 14. Benefits of Bioretention Areas (Source: World Bank, 2021)

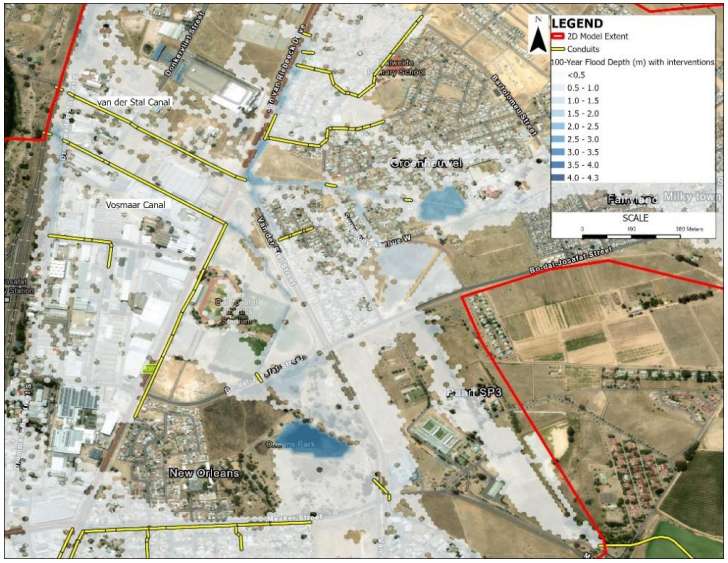
Improved Stormwater Management and Flood Risk Reduction Potential

The project site is currently open space, and opportunity exists to optimise the space. There is potential for the sites to be modified to include additional stormwater attenuation and natural treatment features. The system downstream of Prelude Avenue consists of a series of lined canals which discharge into the Van Der Stel canal just downstream of Jan Van Riebeeck Drive. The Van Der Stel canal ultimately discharges into the Berg River through a culvert beneath the existing railway. The current overland flood depths downstream are generally less than 0.5m and increase in depth closer to the railway line. The use of the site for attenuation would assist with reducing flood depths downstream. Additional benefit is that since the railway culverts do not have sufficient capacity for flows, the excess flow can be conveyed in a northern direction towards the Drommedaris project site to link the two project sites and unlock additional attenuation benefits.

Optioneering at the Prelude Avenue could result in further flood depth reduction downstream. This could include optimising the outlets of the proposed ponds and the inclusion of a flood wall along the perimeter of the proposed ponds to increase attenuation volume in larger floods.



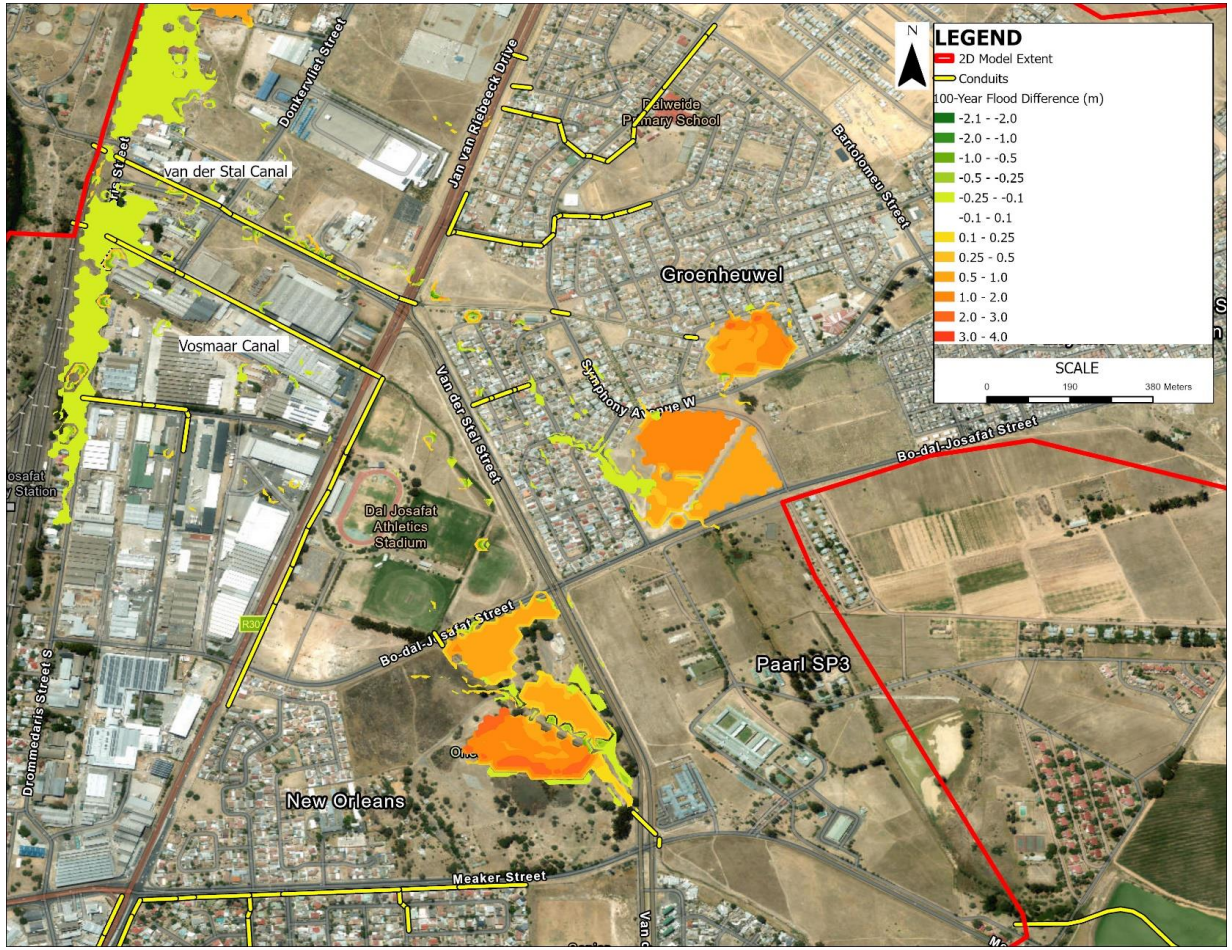
Part D Chapter 3 Map 9. Current Flood Extent (1:100yr)



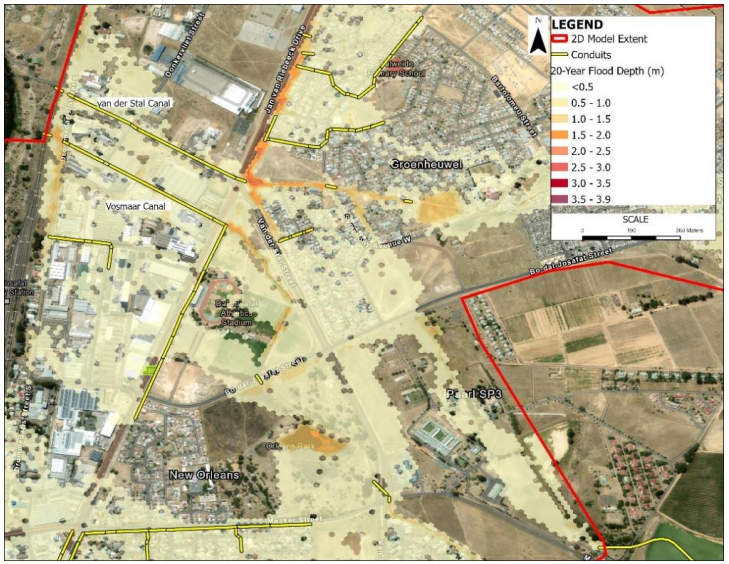
Part D Chapter 3 Map 10. Flood Extent (1:100yr) after intervention

The area's status quo flood extents for the 100-year flood indicates that the areas downstream of the project area are exposed to flood depths of up to 0.5m. The cause of the flooding downstream is overland flows that are being experienced in the area and the limited capacity of the Van Der Stel Canal and the railway culvert. The **impact of the proposed interventions at the project site for the 100-year is localised reduced flood depths immediately to the west of the residential area**. This can be seen in Part D Chapter 3 Map 11 which shows the decrease (green) or increase (red) in modelled flood depths as a result of the interventions. Further downstream there is a reduction in flood depths in the order of 0.25m in the 100-year flood near Drommedaris Street to the north of the Van Der Stel Canal which can be seen in Part D Chapter 3 Map 11.

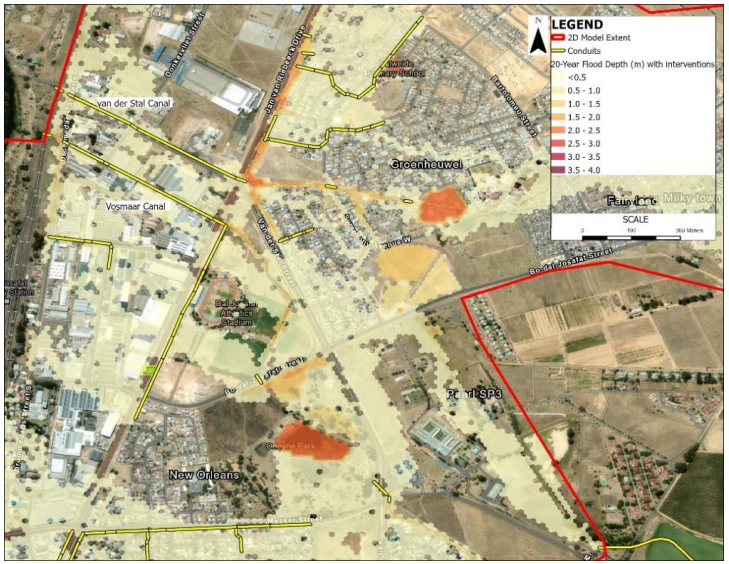
The increased flood depths presented on the map are aligned with the proposed attenuation interventions anticipated due to increased stormwater storage capacity to be generated on the proposed sites. The optimisation of the proposed attenuation capacity and function of the Prelude-Symphony-Bach Street intervention could result in the further reduction of flood exposure, specifically in the residential areas.



Part D Chapter 3 Map 11. Difference in Current Flood Extent vs After Intervention Flood Extent (1:100yr)



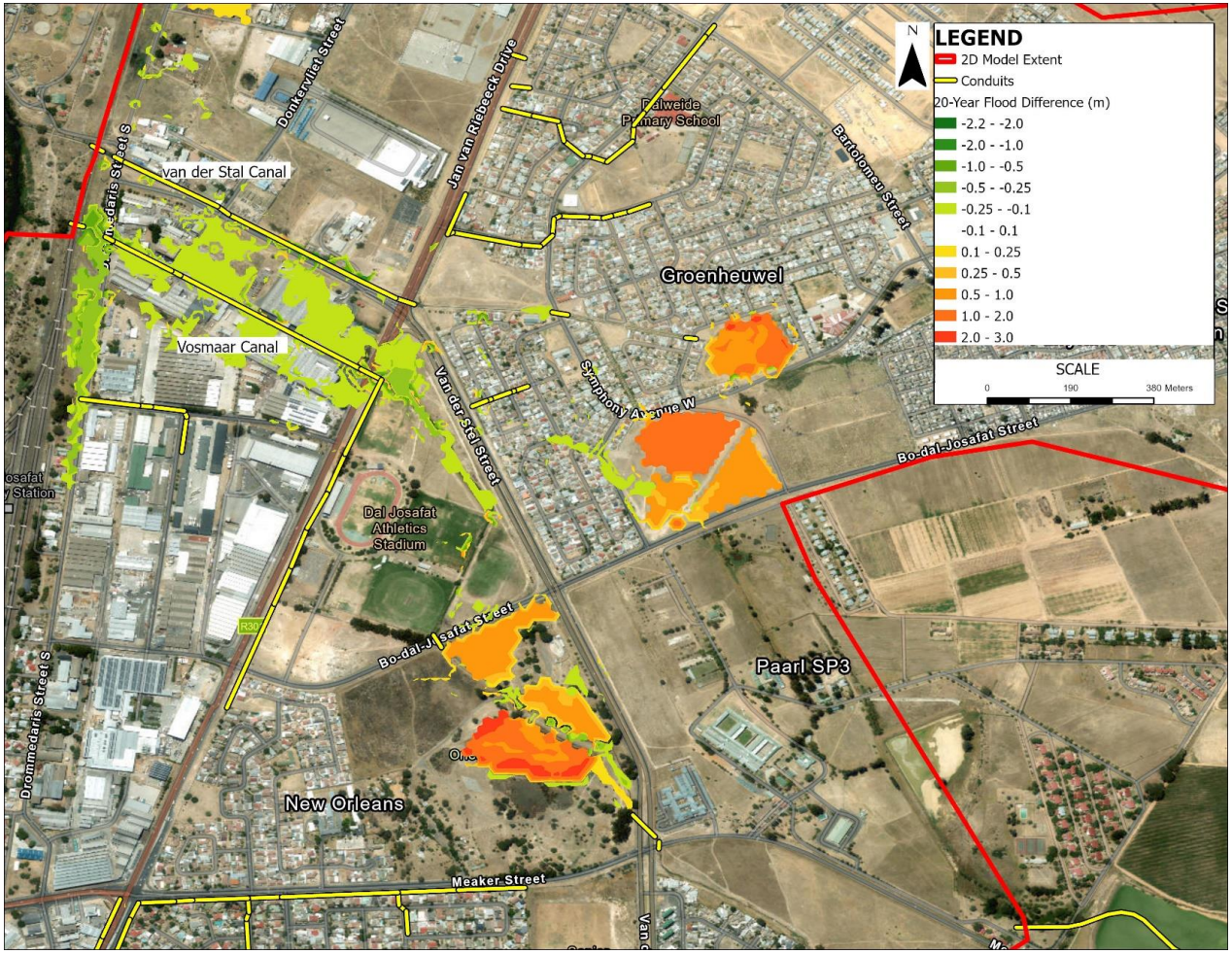
Part D Chapter 3 Map 12. Current Flood Extent (1:20yr)



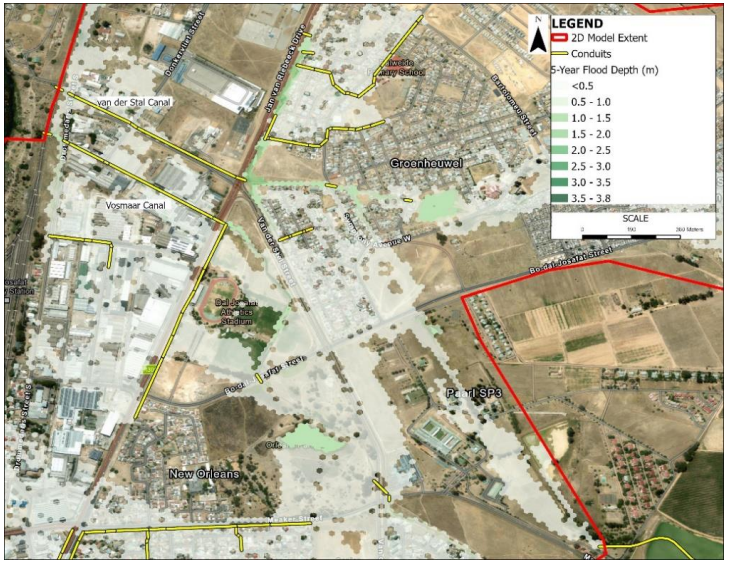
Part D Chapter 3 Map 13. Flood Extent (1:20yr) after intervention

The status quo flood extents for the 20-year flood indicates that the areas downstream of the site are exposed to flood depths of up to 0.5m. The cause of the flooding downstream is overland flows that are being experienced in the area and the limited capacity of the Van Der Stel Canal and the railway culvert. **The impact of the proposed interventions at the project site for the 20-year is reduced localised flood depths to the west in the residential area**. This can be seen in Part D Chapter 3 Map 14 which shows the decrease (green) or increase (red) in modelled flood depths as a result of the interventions. Further downstream there is a slight reduction in flow depths in the order of 0.25m in the 20-year flood near Drommedaris Street to the north of the Van Der Stel Canal which can be seen in Part D Chapter 3 Map 14.

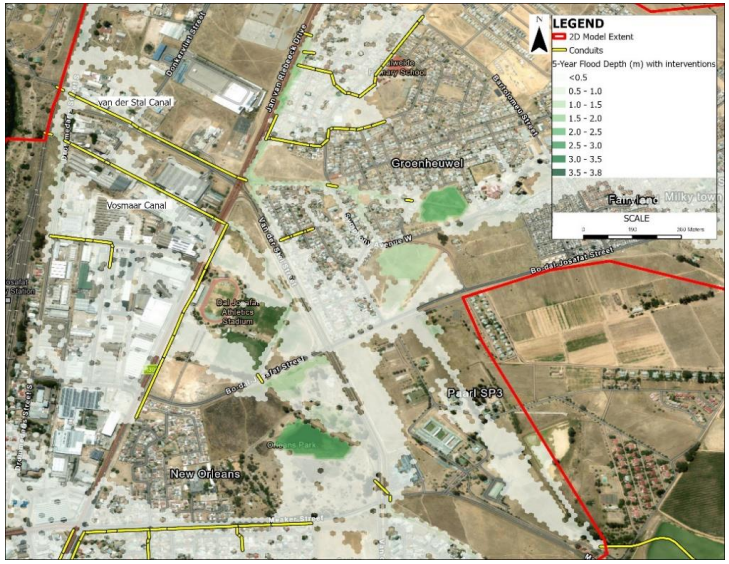
The increased flood depths presented on the map are aligned with the proposed attenuation interventions anticipated due to increased stormwater storage capacity to be generated on the proposed sites. The optimisation of the proposed attenuation capacity and function of the Prelude-Symphony-Bach Street intervention could result in the further reduction of flood exposure, specifically in the residential areas.


LEGEND
2D Model Extent
Conduits
20-Year Flood Difference (m)
-2.2 - -2.0
-2.0 - -1.0
-1.0 - -0.5
-0.5 - -0.25
-0.25 - -0.1
-0.1 - 0.1
0.1 - 0.25
0.25 - 0.5
0.5 - 1.0
1.0 - 2.0
2.0 - 3.0
SCALE
0
190
380 Meters
N
van der Stal Canal
Vosmaar Canal
Groenheuwel
Palmweide Primary School
Jan van Riebeeck Drive
Donkervliet Street
Bartholomeu Street
Van der Stel Street
Bo-dal-Josafat Street
Dal Josafat Athletics Stadium
Paarl SP3
New Orleans
Meaker Street
Drommedaris Street S

Part D Chapter 3 Map 14. Difference in Current Flood Extent vs After Intervention Flood Extent (1:20yr)



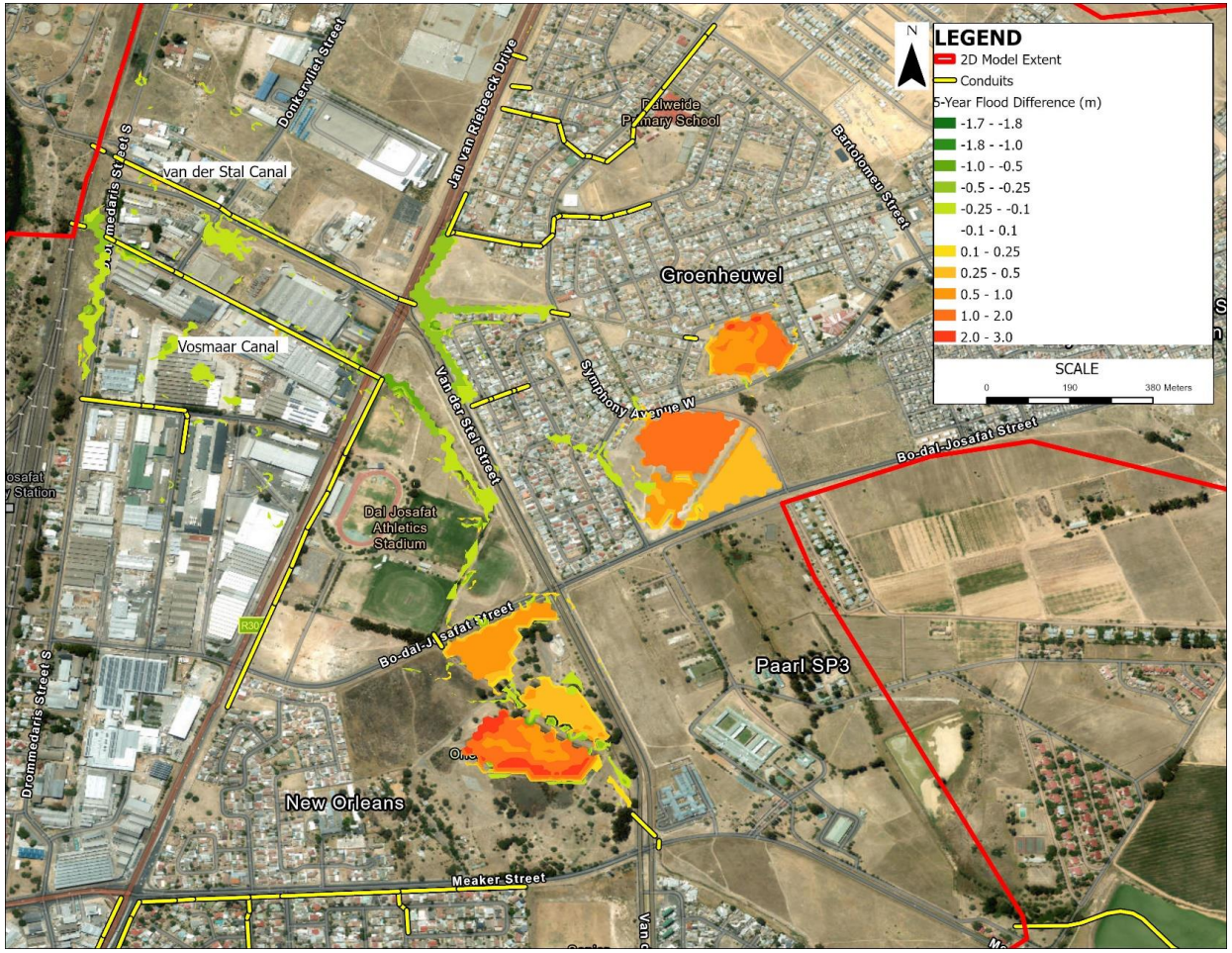
Part D Chapter 3 Map 15. Current Flood Extent (1:5yr)



Part D Chapter 3 Map 16. Flood Extent (1:5yr) after intervention

The Prelude Avenue area's status quo flood extents for the 5-year flood indicates that the areas downstream of the project site are exposed to flood depths of less than 0.5m. The cause of the flooding downstream is overland flows that are being experienced in the area. The impact of the proposed interventions at the Prelude Avenue area for the 5-year is reduced flood depths to the west in the residential area. This can be seen in Part D Chapter 3 Map 17 which shows the decrease (green) or increase (red) in flood depths as a result of the interventions. Upstream of Jan Van Riebeeck Drive there is a reduction in flow depths of up to 0.5m. Further downstream there is a slight reduction in flood depths in the order of 0.25m in the 5-year flood adjacent to the Van Der Stel Canal which can be seen in Part D Chapter 3 Map 17.

The increased flood depths presented on the map are aligned with the proposed attenuation interventions anticipated due to increased stormwater storage capacity to be generated on the proposed sites. The optimisation of the proposed attenuation capacity and function of the Prelude-Symphony-Bach Street intervention could result in the further reduction of flood exposure, specifically in the residential areas.



Part D Chapter 3 Map 17. Difference in Current Flood Extent vs After Intervention Flood Extent (1:5yr)

Urban Management and Open Space Optimisation

Recreation and Accessibility for all users

Recreational benefits are achieved through the incorporation of sports fields, play parks and pedestrian movement routes. The sites will be available to the public and serve to formalise, improve and connect existing spaces to **improve the experience of the community** and provide access to recreational opportunities in **safe and accessible manner**. Universal design principles have been applied to ensure that the site accommodates all non-motorised transport users and people with physical disabilities. The site should also be designed such that there is legibility for children and adults. Parks should be designed with adults and children in mind. The site therefore offers the opportunity to achieve the principles of universal design, and thus further planning and design should demonstrate the detail of how of these principles can be achieved, which will require participatory planning and meaningful engagement with intended end-users in surrounding communities.

National Strategic Framework on Universal Design and Access - Principles of Universal Design:

- **Equitable use -** Design that is useful and marketable to persons with diverse access needs.
- **Flexibility in use** - Design that accommodates a wide range of individual preferences and access needs
- **Simple and intuitive use** - Design that is easy to understand regardless of the user's experience, knowledge, language, skills or concentration level (in loco use)
- **Perceptible information** - Design that communicates necessary information effectively to the user regardless of ambient conditions or the users sensory access needs
- **Tolerance for error** - Design that minimises hazards and adverse consequences of accidental or unintended actions
- **Low physical effort** - Design that can be used efficiently and comfortably and with a minimum of fatigue or struggle
- **Size and space for approach and use** - Design that provides appropriate size and space for approach, reach, manipulation and use regardless of the user's body size, posture or mobility

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Improved Spatial Alignment and Land Use Management

Land use change will have a significant impact on catchment hydrology and flood risk. Development is associated with an increase in impermeable surfaces which will contribute to increased runoff and peak discharges in the absence of attenuation interventions. Activating this area though the development of **multi-functional open spaces inclusive of community facilities** aligns with the municipal SDF, which has designated the erven on which this project is located for Green Space and Community Use. This will allow for the protection and active use of green space. The community use spatial element includes **recreational facilities (i.e. fields and courts)** and uses such as **sports fields**. The protection of green space will also aid in ensuring that current sites earmarked for green/open space remain undeveloped and able to serve as permeable surfaces. This is particularly critical given that land use change was found to be a key driver for changing hydrology.

Placemaking and improvement to the aesthetic appearance of the city

The project seeks to achieve an improved urban realm and placemaking to support the functionality and improvement of the urban environment through the introduction of pedestrian movement corridors, the creation of safe and accessible public spaces including sports fields, and the promotion of urban integration. The introduction of street furniture aims to improve the attractiveness of the area as place of gathering, and the connectivity of the Prelude-Symphony-Bach properties through pedestrian movement corridors will aim to improve the urban environment. This project will provide for improved appearance of Groenheuwel residential area through the creation of a network of sporting infrastructure and flood alleviation opportunities along major roads.

Service delivery through stormwater management and Sustainable Urban Drainage Systems (SUDS)

The project seeks to achieve flood risk reduction benefits through the development of hybrid flood alleviation measures, leveraging nature-based solutions as complementary to more conventional 'grey' service delivery approaches. SUDS present an approach to stormwater/runoff management that aims to reduce downstream flooding, enhance infiltration into the ground, remove pollution, improve the quality of stormwater, reduce pollution in water bodies, and improve biodiversity. SUDS encourages natural drainage processes by circulating water back into the water cycle rather than just collecting and detaining it, recognising the importance of it as a resource. The processes identified in this section constitutes SUDS which focus on managing flow quantity, quality, amenity, and biodiversity. In addition, interventions can form a natural part of open spaces in a settlement and contribute to the quality of the environment and the aesthetics of a neighbourhood (DHS, 2019). The project therefore serves to facilitate more resilient stormwater management services, and to protect communities and municipal and private infrastructure through flood risk reduction.

Ecological Restoration and Rehabilitation and Water Quality Improvement

The concept incorporates the existing depression wetland area on the cemetery site, and through this intervention, the aim is to improve the ecological state of the wetland as its provision of FAES. The introduction of this NbS may also serve to reduce the negative impact of the untreated effluent currently entering the river and affecting water quality downstream.

Urban Cooling and Air Quality:

In urban areas, green infrastructure such as parks and urban wetlands help to cool surrounding areas by providing shade and reducing the urban heat island effect. This improves air quality and liveability, creating more pleasant environments for residents while also reducing energy demand for cooling.

Carbon Sequestration

Nature-based solutions, particularly those involving reforestation and wetland restoration, act as carbon sinks, helping to mitigate climate change by sequestering carbon dioxide from the atmosphere. This not only supports local climate goals, but also contributes to global efforts to reduce greenhouse gas emissions.

Solid Waste Management

Improved solid waste management aims to support a clean and healthy environment and limit the maintenance requirements arising from blockages of stormwater infrastructure resulting from litter.

Adaptation and Climate Resilience - Toward a climate resilient pathway

Drakenstein's Climate Change Action Plan (CCAP) includes a series of climate change objectives. The Prelude-Symphony-Bach Hybrid Flood Alleviation Project will support the following DM climate change objectives:

- **Water security and efficiency**
- **Climate resilient and low carbon development**
- **Biodiversity and ecosystem management**
- **Public health**
- **Disaster management**
- **Building response capacity through improved coordination and awareness**

In addition, the DM HFA identified the following core requirements for responsiveness to projected climate change:

- **Responsiveness to the changing catchment hydrology**
- **Responsiveness to more extreme drought and flood cycles**
- **Responsible land use management to protect ecological infrastructure and enhance urban permeable surfaces**

Cascaded attenuation facilities and stormwater ponds to improve resilience to droughts and floods, designed to reduce flood risk by slowing down and storing excess water. They reduce flood peaks, slow down water velocity and temporarily store excess stormwater. **The creation of stormwater ponds and the utilisation of sports fields provide a similar benefit,** provides climate change adaptation benefits through storage and absorption capabilities at times of heavy rainfall; reduced peak flows; decreased flood risk; and improved water quality. These interventions also provide adaptation benefits at times of drought as they increase infiltration and groundwater recharge, while also providing water storage potential.

The development of a swale, terrestrial rehabilitation and the replacement of the existing concrete channel with vegetation aim to improve resilience to address changing catchment hydrology. In urban areas, hybrid measures include upgrading drainage systems while integrating natural features such as bio-swales and permeable surfaces that manage water flow more sustainably. At the Prelude-Symphony-Bach site, the proposal incorporates terrestrial rehabilitation as well as the replacement of the existing concrete channel with vegetation, which provides climate change adaptation benefits through erosion control, water quality improvement, increasing infiltration rates, and making the catchment more **resilient to both drought and heavy rainfall**. The use of groundcover vegetation also prevents soil from becoming compacted, maintaining its ability to absorb water during storm events.

The active use and protection of open space and the retaining of permeable surfaces in urban areas is responsive to the need for sound land use management that will have a positive impact on the hydrology of the catchment and achieve carbon sequestration benefits.

Sustainable Development Goals

The Prelude-Symphony-Bach Street site interventions align with the following Sustainable Development Goals (SDGs):

- SDG 3: Good Health and Wellbeing – through the development of recreational spaces, promoting recreational activities, improving physical and mental wellbeing
- SDG 11: Sustainable Cities and Communities – through green infrastructure, increased climate resilience and the development of community recreational spaces
- SDG 13: Climate Action – Climate change adaptation through flood risk reduction
- SDG 14: Life below Water – Protection of aquatic habitats through the improvement of water quality
- SDG 15: Life on Land – Ecological restoration through terrestrial rehabilitation

Illustrated through the above-listed SDGs, the site has high sustainable development potential that promotes climate change adaptation through a reduction in flood risk in the Groenheuwel Catchment, while also providing downstream benefits.

Community empowerment, participation and governance

The project will offer direct benefits to the local community given its strategic location within Groenheuwel. The project offers the opportunity for meaningful engagement across a range of stakeholders.

- **Ward Councillor and Ward Committees:** These municipal structures should be leveraged as intermediaries with local communities and to support the attainment of community accountability. The community noted the importance of the ward councillor as a facilitator of the interventions and mobilisation of the community.

- **NGOs and NPOs:** The NGO and NPO sectors should be mobilised to support the project, and consideration should be given to the establishment of a community programme to facilitate 'eyes on the street'.

- **Civil Society Mobilisation:** The Groenheuwel Community has displayed a willingness to champion the intervention, particularly the **management of the sports fields since these are critical recreational spaces for the youth in the area.**

- **Youth and adult education and awareness** should be facilitated. Schools and other educational institutions could be encouraged to visit the site for educational purposes, supported by appropriate signage with educational materials. Schools in proximity to the site include **Dalweide Primary and Groenheuwel Primary which are located along Symphony Avenue.**

- **Job Creation Potential:** Project implementation will provide opportunities for job creation for local communities during the construction phases and operation and maintenance phases.
  While the construction phase job creation is set to be applicable only in the short term, the operation and maintenance in relation to the open spaces, landscaping, solid waste management, play area equipment and the stormwater ponds will require on-going human resource contributions. This may include the involvement of community members in voluntary project stewardship, the leveraging of the enhanced public works programme (EPWP), as well as other job creation opportunities. See also the Job Creation Potential Section.

D3.4. Project Lifecycle Stages and Duration: Prelude-Symphony-Bach Stormwater Pond Network HFA Project

The following sections provide an overview the typical phases of a project including:

- **Planning and Design of the Project**
- **Construction and implementation**
- **Operation and Maintenance**

This Section also provides an overview of the typical studies that may be required in relation to the Prelude-Symphony-Bach project.

The typical phases of a project lifecycle include:

Planning and Design of the project

This includes detailed feasibility studies, and the detailed design of the project. Importantly, this phase in the project lifecycle should see the meaningful engagement of potential project beneficiaries (local communities) and ensure that they are adequately engaged in the ideation of solutions and ensure that the stakeholder input is a key informant to the project components. The following activities typically form part of this Phase:

Feasibility Study and Initial Assessments

A **Basic Assessment** or full **Environmental Impact Assessment**. This may also include other specialist studies across a range of disciplines. The final list of specialist studies required should be determined during the feasibility study process, and can be guided by the Department of Forestry, Fisheries and Environment's (DFFE) Screening Tool. **The results of the screening tool are contained in Appendix: Prelude-Symphony-Bach DFFE Screening Tool Results.**

The environmental application (BA or EIA) as well as the Land Use Application forming part of the Permitting and Regulatory Approvals) will include a legally required public participation process. In order to maximise the opportunity for participatory planning, it is proposed that the project include additional stakeholder engagement (beyond the legally required public participation processes) to engage community members on a continuous basis in order to continue to the engagement process that has commenced in the design of the DM HFA Programme though the Community Flood Risk Perception Study (July 2024), and the Concept Design Community Workshop (October 2024).

Engineering design and planning

This will include the detailed design of the proposed hybrid flood alleviation infrastructure and other elements of the site layout.

Landscape design and planning

Landscape design and planning of hard and soft surfaces and river rehabilitation components of the site layout will be designed as part of this process.

Permitting and Regulatory Approvals

This refers to the relevant approvals necessary to proceed with the development. This will typically include **Land Use Applications (See Land Use Appendix) –** The details of the land use application can be determined during the preapplication meeting with the municipality, and the land use approval is typically contingent upon the completion of all specialist studies. The regulatory approvals will also include a **Water Use Licence Application (WULA).** The nature of the project is likely to trigger a full Water Use License (WULA) (as opposed to a General Authorisation). From time to time, the WULA process triggers additional specialist studies.

Additional approvals could be required throughout various phases, and specifically highlighted at this point in the sequence due to the development and environmental approvals that will likely be necessary from with the municipality and from the relevant competent authorities.

Part D Chapter 3 Table 3. Specialist studies required for the Project (subject to refinement) as part of the Planning and Design Phase of the Project

Feasibility Study and Assessment	
Environmental Authorisation (EA) (Basic Assessment or Environmental Impact Assessment)	Assumes a Basic Assessment. Detailed requirements to be determined by the competent authority. Full EIA will incur a greater cost. Specialist studies may include those listed below. The specialist studies will require confirmation from the local authority.
Geotechnical Investigation	
Topographical Surveys	
Urban Planning and Landscape Architecture	
Traffic Impact Assessment or Statement	
Heritage Impact Assessment	
Visual Impact Assessment (Level 3)	
Terrestrial Biodiversity Assessment	
Freshwater Impact Assessment (Aquatic Biodiversity Assessment Report)	
Constructed wetland technical assessment and planning (Treatment Wetland Specialist)	Will inform the Aquatic Biodiversity Assessment Report
Botanical Assessment	
Waste Management Impact Assessment	
Detailed Flood Study	

Feasibility Study and Assessment	
Stakeholder Engagement/Consultation Services	Mobilisation and community meetings. Excludes the engagements forming part of the EA or Land Use Application Process. Assumes 80-120 days of professional time.
Project Management (Feasibility Studies and Assessments)	
Engineering and Design	
Stakeholder Engagement/Consultation Services and Socio-economic Assessment	Mobilisation and community meetings. Excludes the engagements forming part of the EA or Land Use Application Process. Socio-economic Assessment can also be included.
Project Management (Engineering and Design)	
Water Use License (WULA)	A full WULA is assumed.
Land Use Application(s)	Detailed requirements (and therefore cost) to be determined based on requirements set out by the local authority
Project Management (Permitting and Regulatory Approvals)	

Construction and Implementation

This refers to the on-site construction of infrastructure and the delineation of space through landscaping, planting and movement corridors.

The following activities typically form part of this Phase:

- Site Preparation
- Construction of Infrastructure (e.g., levees, storm drains)
- Installation of Nature-Based Solutions (e.g., wetlands, green infrastructure)
- Planting and Vegetation
- Materials and Equipment
- Transport and Logistics
- Construction Supervision and Oversight

For this project, the following components were incorporated into the cost estimates:

- Earthworks
- Earthworks
- Erosion protection
- Flood walls / dykes
- Culverts and outlets
- Landscaping
- Site establishment
- Professional fees (Site staff)
- Contingencies

Operation and Maintenance

Critical to the long-term success of the project, operation and maintenance efforts will be required from a wide range of stakeholders. This may include the involvement of community members in voluntary project stewardship, the leveraging of the enhanced public works programme (EPWP), as well as other job creation opportunities.

The following activities typically form part of this Phase:

- Maintenance of Infrastructure (e.g., stormwater systems)
- Maintenance of Nature-Based Solutions (e.g., replanting, erosion control)
- Reporting and Evaluation
- Labour Costs (Monitoring & Maintenance)

This also includes:

- Legal and Insurance Costs
- Administrative and Overhead Costs

Project Duration

The project location is on municipal-owned and managed public open space. It is estimated that the project construction and implementation can be completed by year 3. It Is recommended that a detailed phasing plan be developed during the detailed design of the project. The starting year will be dependent upon the prioritisation of the DM HFA Stage 1 projects to be undertaken by the Drakenstein Municipality.

Project Phase	Y1	Y2	Y3	Y4	Y5
Planning and Design:					
Construction and Implementation					
Operation and Maintenance (on-going)					
Stakeholder Engagement and Community Participation					

D3.5. Institutional Capacity, Alignment and Resource Requirements: Prelude-Symphony-Bach Stormwater Pond Network HFA Project

Projects related to transformative adaptation and integrated planning are multi-disciplinary – requiring the buy-in and investment from a wide range of municipal and other stakeholders to achieve successful implementation and long-term project sustainability. The following table sets out the typical resources required during each phase of the project. This list is not exhaustive.

Part D Chapter 3 Table 4. Anticipated specialist inputs during the project lifecycle phases

Resource	Typical Role	Planning and Design	Construction and Implementation	Operation and Maintenance
Project Manager (Professionally registered engineer/ Professionally registered urban planner / Professionally registered construction project manager)	Oversee the delivery of the project, may require professionally registered engineer or urban planner (Detailed Design); Professionally Registered Engineer or Construction Project Manager (Construction and Implementation)			
Professionally Registered Environmental Impact Assessment Practitioner (EAP)	Undertake EIA or BA; coordination of relevant specialist studies; Undertake and oversee the WULA process.			
Environmental Control Officer (ECO)	An EAP may also be required for Environmental Compliance during construction and operation phases.			

Resource	Typical Role	Planning and Design	Construction and Implementation	Operation and Maintenance
Professionally Registered Geotechnical Engineer (ECSA)	Geotechnical investigations			
Professionally Registered Land Surveyor (SACG)	Conduct topographical survey			
Professionally Registered Town Planner (SACPLAN)	Oversee site design, provide urban planning specialist input, conduct the land use application, provide project management or support services to the project manager.			
Professional Registered Engineers (ECSA)	Detailed flood study (stormwater engineer); Roads Engineer (Traffic Impact Assessment)			
GIS Specialist	Undertake mapping and spatial analysis			
Heritage Practitioner	Heritage Impact Assessment and associated studies			
Professionally Registered Landscape Architect	Visual Impact Assessment			
Ecologist	Terrestrial Biodiversity Impact Assessment; Freshwater Impact Assessment			
Ichthyologist	Specialist study in relation to fish			

Resource	Typical Role	Planning and Design	Construction and Implementation	Operation and Maintenance
Treatment Wetland Specialist	Provision of technical details of the design of treatment wetlands			
Botanist	Botanical Assessment			
Waste Management Specialist	Waste Management Impact Assessment			
Public Participation Professional	Mobilisation and community meetings. Excludes the engagements forming part of the EA or Land Use Application Process. Socio-economic Assessment can also be included.			

In addition to the requirements above, which will typically be supplied by specialists, the DM will require the internal institutional capacity to support the successful delivery of the project through its lifecycle phases. The recommendation is therefore that this team be formed on the basis of the Departments, Divisions, and Sections that formed part of the DM HFA Programme design. This will therefore include, but not be limited to, the following:

Part D Chapter 3 Table 5. Recommended Municipal representation and roles

Municipal Representation	Typical Role
Environmental Manager/ EAP	Programme Co-ordinator; Environmental Expertise, Guidance on Land Use Application
Roads and Stormwater Engineer	Municipal Project Manager, Rodas and Stormwater Division, Guidance on Land Use Application, Construction Project Management

Municipal Representation	Typical Role
Spatial Planner	Spatial planning inputs, Guidance on Land Use Application
Land Use Planner	Land Use Planning inputs, Guidance on Land Use Application
Supply Chain Management Practitioner	Support with Supply Chain related activities in the procurement of services and materials
Water and Sanitation Engineer	Provide inputs on water and sanitation related matters
Parks section representative	Guidance and support in relation to the establishment of public parks and sport facilities, input and oversight of operation and maintenance of planting and fields.
Solid Waste Management	Responsible for the planning and operation of a site-based solid waste management strategy
EPWP, Projects, Programmes and Funding	
Portfolio Councillors	
Ward Councillors and Committee Members	Support to mobilise the community.

Part D Chapter 3 Table 6. Suggested Stakeholders and Roles

Other stakeholders	Typical Role
Provincial Government	Competent Authority for relevant permitting and approvals

Other stakeholders	Typical Role
National Government	Department of Water and Strategy
NGOs	Intermediary Support

In order to achieve the mainstreaming and integration of this project, the following additional recommendations are offered:

- Programme Coordination role should be fulfilled by the Environmental Section;
- Project Management for each of the Stage 1 DM HFA Priority Project should be championed by Stormwater Management and be situated within the stormwater management plan.

The coordinator and Project Manager should also develop a project specific operation plan to develop detailed roles and responsibilities for each of the identified stakeholders. The way forward should include:

- Adopting the DM HFA Programme as part of the Stormwater Master Plan;
- Assigning the programme to a KPA 4 and PDO 23;
- Development of a detailed Implementation Plan for each of the Stage 1 DM HFA Projects, and aligning the project with additional PDOs;
- Development of a detailed Scheule of responsibilities per stakeholder at all stages of the project lifecycle; and
- Ensuring on-going community engagement and participatory planning.

Alignment With Municipal Objectives:

The project aligns will all municipal objectives. It is particularly relevant to Strategic Objective 4, given the strong alignment with infrastructure provision.

Part D Chapter 3 Table 7. Project Alignment with Municipal Strategic Objectives

Municipal Strategic Objective	Alignment
To ensure good governance and compliance.	X
To ensure financial sustainability to meet statutory requirements.	X
To ensure an efficient and effective organisation supported by a competent and skilled workforce.	X
To provide and maintain the required physical infrastructure and to ensure sustainable and affordable services	X
To plan, promote investment and facilitate economic growth.	X
To facilitate, support and promote social and community development.	X

Key Performance Areas (KPAs) and Pre-Determined Objectives (PDOs)

KPAs refer to the areas within the business unit for which an individual or group is logically responsible. PDOs are the areas identified as important or crucial, where a result will assist in the achievement of the set objectives or goal (DM IDP, 2024:67).

It is recommended that this project be located within **KPA 4: Infrastructure and Services**, under **PDO 23: Transport, Roads, and Stormwater. This is directly aligned with the Strategic Objective *to provide and maintain the required physical infrastructure and to ensure sustainable and affordable services.***

D3.6. Cost Estimates: Prelude-Symphony-Bach Stormwater Pond Network HFA Project

This section provides cost estimates for the Prelude-Symphony-Bach Stormwater Pond Network HFA Project. These estimates are based on the draft concepts and are indicative fees only. The construction and implementation costs are dependent on the outcomes of the Design and Planning process. The detailed costing of the Design and Planning process will be dependent upon the outcomes of the preapplication meeting and the requirements for feasibility studies, approvals and licenses as set out by the relevant competent authorities. *It is important to note that a Quantity Surveyor / Cost Estimating Consultant should be appointed to determine more accurate Construction and Implementation Costs. This would take into account local and context specific considerations for the various items. As the engineering design development progresses, refined estimates can be prepared by the Quantity Surveyor / Cost Estimating Consultant.*

Part D Chapter 3 Table 8. Estimated project costing

PRELUDE-SYMPHONY-BACH COSTING

Design and Planning Costs

Item Description	Estimated Cost (ZAR)	Comments (if any)
Feasibility Study and Initial Assessments	2 340 751,60	
Detailed Engineering Designs and Tender Documentation	4 994 016,29	No complexity factor has been applied
Detailed Landscape Architectural Design and Tender Documentation	1 242 881,96	
Permitting and Regulatory Approvals	297 000,00	
Subtotal	**8 874 649,85**	

Construction and Implementation Costs

PRELUDE-SYMPHONY-BACH COSTING		
Item Description	**Estimated Cost (ZAR)**	**Comments (if any)**
Earthworks	18 782 500,00	1m imported fill over entire site area
Erosion protection	6 547 125,00	
Flood walls/dykes	-	
Culverts and outlets	5 500 000,00	
Hard landscape works	5 224 500,00	
Soft landscape Works	14 048 250,00	
Riverine rehabilitation	6 089 600,00	
Total (1)	56 191 975,00	
Site establishment	11 238 395,00	20% of Total (1)
Total (2)	67 430 370,00	
Professional fees	13 486 074,00	20% of Total (2)
Contingencies	13 486 074,00	20 %
Subtotal	**94 402 518,00**	

Operation and Maintenance Costs

Item Description	**Estimated Cost (ZAR)**	**Comments (if any)**

PRELUDE-SYMPHONY-BACH COSTING		
Maintenance of Infrastructure (e.g., stormwater systems)	1 888 050,36	Recurring maintenance costs (Annual)
Maintenance of Nature-Based Solutions (e.g., replanting, erosion control)	438 000,00	Cost for the first year. The first year of maintenance would be the most intensive, thereafter (especially once 80% plant cover has been achieved) maintenance cost should reduce by one third.
Reporting and Evaluation	150 000,00	Annual reviews, audits
Subtotal	**2 476 050,36**	

Other Miscellaneous Costs

Item Description	Estimated Cost (ZAR)	Comments (if any)
Community Awareness, Skills Transfer and Education Campaigns	**350 000,00**	Detail of scope/cost to be defined at the discretion of the local authority
Subtotal	**350 000,00**	

106 103 218,21

Total Estimated Cost (Summary)

TOTAL ESTIMATED COST (SUMMARY) - PRELUDE-SYMPHONY BACH		
Cost Category	**Total Amount (ZAR)**	**CAPEX vs OPEX**
Planning and Design Cost	8 874 649,85	CAPEX
Construction and Implementation Costs	94 402 518,00	CAPEX
Operation and Maintenance Costs	2 476 050,36	OPEX
Miscellaneous Costs	**350 000,00**	CAPEX/OPEX
Grand Total	**106 103 218,21**	

Additional notes

The Design and Planning costs for the engineering design and tender documents can be split according to the ECSA guideline on Civil engineering projects (here): refer to Table 1 in the document.

Cost of the Works		**Basis of Fee Calculation**		**Total (Primary fee plus secondary fee)**
For projects up to R850 000		**Lump Sum or Time Basis**		
Where the cost of the works:		**Primary fee**	**Secondary fee**	
Exceeds	**But does not exceed**			
850 000	1 899 000	106 300	15%	
1 899 000	9 347 000	237 400	12%	
9 347 000	19 066 000	982 400	10.5%	
19 066 000	47 372 000	1 857 000	9.5%	
47 372 000	94 960 000	4 121 400	7%	
94 960 000	572 000 000	7 065 000	6.5%	
572 000 000		33 233 200	6%	

The portion of what is included in the design stage and what is included in the construction stage can be determined by using ECSA guidelines again (here) for civil engineering projects. These are as follows in terms of the engineering design split. Stage 1-4 could be classified as engineering design and then Stage 5 and 6 is the construction monitoring and close-out of the project.

Stage	Stage of Services Civil: Engineering Projects:	Typical percentage points for each stage
1	**Inception**	5
2	**Concept and Viability**	25
3	**Design Development**	25
4	**Documentation and Procurement**	25
5	**Contract Administration and Inspection**	15
6	**Close-Out**	5
		100%

D3.7. Job Creation Potential: Prelude-Symphony-Bach Hybrid Flood Alleviation Project

This section of the report provides an analysis of the Job Creation Potential for the Project.

The table shows the temporary and permanent jobs created by the project, temporary jobs are measured in job years, which are defined in the table, while permanent jobs are counted as jobs. An assessment is made of the jobs created as to how many constitute green jobs, in terms of the DFFE's definition. as well as the job-years. The table also provides an estimate of direct Jobs per skill level, as well as indirect and induced jobs, for the given level of investment estimated. The job seekers are based on the Drakenstein Municipality's database of job seekers dated to October 2024.

Part D Chapter 3 Table 9. Job Creation Potential.

PRELUDE-SYMPHONY-BACH DM HFA PROJECT										
Site: Prelude Street			**Total direct jobs**	**Direct Jobs per skill level** *Direct jobs are the extra jobs created in the delivery (design, construction/development) of an output and the operation of that output for the duration of its expected life. These direct jobs can be both temporary and permanent.*						**Estimated investment**
	Component	**Disciplines**		**Skilled (PSOC Level 3 and 4)**	**Semi-skilled (PSOC Level 2)**	**Low-skilled (PSOC level 1)**	**Green skilled**	**Green semi-skilled**	**Green low-skilled**	
Temporary *A temporary job means an employment opportunity created, for a limited time span, typically during the design and development of the infrastructure,*	Planning and design	Civil engineering (multiple disciplines), Landscape architects, Planner, EIA practitioner, Technical environmental specialists, Lawyer, Geotechnical engineer, Surveyor,	8	8	0	0	8	0	0	R 8 874 649.85

PRELUDE-SYMPHONY-BACH DM HFA PROJECT										
project of program. **(Job years)** *A job-year is a measure of the proportion of time a job is created for. One job year means one job for one year.*		Electrical engineer, Quantity surveyor								
Temporary (Job years)	Construction and implementation	Civil engineer, Landscape architect, Planner, Scientific specialist, OHSA officer, EC officer, Quantity surveyor, Site manager, Foreman, Site agent, Excavator operator, TLB Operator, Dump truck operator, Planter, Gabion basket maker, Carpenter, Security, General worker	23	3	10	10	3	3	10	R 94 402 518.00
Permanent *Means a full-time equivalent*	Maintenance and miscellaneous	Foreman, Mower operators, Planters, Driver, General worker	2	0	1	1	0	1	1	R 2 826 050.36

PRELUDE-SYMPHONY-BACH DM HFA PROJECT											
position which endures beyond the development phase of the intervention, through the expected useful life of the infrastructure, plan or program.											
Total			33	11	11	11	11	4	11	R	106 103 218.21
Jobseekers in ward			234								
Jobseekers in ward and adjacent ward			3390								
Indirect jobs *Indirect jobs are the jobs created to supply inputs into the output creation to provide inputs that the project requires.*			197								
Induced jobs *Induced jobs are the jobs created in all sectors by the increase in household spending created by the wages paid in the direct jobs and indirect jobs created, following the initial increase in demand in the given sector.*			304								

PRELUDE-SYMPHONY-BACH DM HFA PROJECT	
Discussion	• The proposed interventions in Prelude and Bach Streets will likely create an estimated 31 job-years in the design and construction phases, along with an estimated 2 permanent jobs in maintenance. In the design phase, the eight temporary job-years created will nearly all be highly skilled jobs in professional firms (Engineering, Landscape Architecture, Planning, Scientific Services). All of these jobs will be green jobs. • In the construction phase, the 23 job-years created will include three highly skilled job-years, ten semi-skilled job-years, and ten low-skilled job-years. All of these will be green jobs except for seven semi-skilled jobs, which will be for guards for 24-hour site security. All maintenance jobs are green jobs. • The semi-skilled jobs created, other than security will be excavator operators, TLB operators, dump truck operators, planters, and gabion basket makers. • There is a significant job seekers database for the ward and adjacent wards, with over 200 job seekers in the ward and over 3,000 in adjacent wards where the intervention will take place. The low skilled jobs could be sourced entirely from form the ward and adjacent wards, with the potential for upskilling these workers into the roles of security guard, planter, and gabion basket maker. • The level of investment estimated in the planning and design and construction phase of this project will create an estimated 197 indirect jobs in the national economy, in supply of the required inputs for the project. Estimated level of expenditure is expected to induce 304 jobs in the economy as project workers spend their wages. Many of these will be in Drakenstein if local suppliers are used. • Investment return is anticipated to be 1.68 times the initial amount in income for the economy, resulting in an economic benefit of about R180 million to the economy. This intervention has significant potential to improve public space in the area, increasing investment potential. • This infrastructure does not fall under any of the trading services departments and is therefore not a direct revenue generator. Some elements may have access or hire charges (such sports facilities). Some maintenance and rehabilitation costs for infrastructure will be reduced. This intervention contains specific elements to trap solid waste and improve water quality, which will help to reduce costs of stormwater management.

D3.8. Barriers and Risks: Prelude-Symphony-Bach Hybrid Flood Alleviation Project

The following register summarises the risks identified across the various phases of the project. The risks and mitigation measures should be refined as part of further design phases.

Part D Chapter 3 Table 10. Barriers and Risks.

Phase of project lifecycle	Risk	Mitigation Measures
Planning and Design	**Community:** Lack of community buy-in and support.	• Community participation during all phases of the project. • Consideration of the development of social compact. • Mobilisation of NGOs and NPOs to support the initiatives. • Ward Councillor and Ward Committee mobilisation to ensure an understanding of the local context and to promote meaningful engagement with community members.
Planning and Design	**Community:** Lack of meaningful engagement.	• Community participation during all phases of the project. • Ward Councillor and Ward Committee mobilisation to ensure an understanding of the local context and to promote meaningful engagement with community members. • Hosting events to raise awareness on the project.
Planning and Design	**Political:** Political acceptance.	• Gaining political buy-in through engagement with relevant political stakeholders and explaining the potential project impact and benefit.
Planning and Design	**Institutional:** Lack of transversal collaboration.	• Defining roles within each department for undertaking the project, and development Key Performance Indicators (KPIs) to create accountability for these responsibilities. • Development of Standard Operating Procedures (SOPs) for each of the relevant department to provide a clear overview of their roles and responsibilities.

Phase of project lifecycle	Risk	Mitigation Measures
Planning and Design	**Approvals**: The pedestrian crossings will need to be approved during planning which can be a timely process.	• Submission of pedestrian approvals in a timely manner.
Construction and Implementation	**Safety and security**: There is potential for safety and security concerns posed to workers during the construction and maintenance of the project.	• Ensuring the presence of law enforcement during construction and implementation to mitigate potential safety and security concerns. • Involvement of the Drakenstein Municipality Smart Safety Network (DM SSN) to enhance security on site.
Operation and Maintenance	**Solid waste management**: Solid waste dumping and limited solid waste management which may inhibit use of the site.	• SOPs to be developed for the Solid Waste Management Department, outlining roles and responsibilities. • The community noted that if solid waste bags are provided and collected weekly, then this would significantly improve solid waste management at the site. • Increase the aesthetic value of the area to encourage community ownership to protect the area.
Operation and Maintenance	**Safety and Security**: Non-motorised Transport (NMT) users may be at risk when crossing at this site.	• Ensuring the presence of law enforcement at the site. • Mobilising community/ neighbourhood watches at the site. • Patrols at the site to be undertaken by law enforcement officers.
Operation and Maintenance	**Safety and Security**: Risk of Drowning	• Ensuring adequate lighting. • Ensuring the presence of law enforcement at the site. • Mobilising community/ neighbourhood watches at the site.

Phase of project lifecycle	Risk	Mitigation Measures
		• Patrols at the site to be undertaken by law enforcement officers.
Operation and Maintenance	**Safety and Security**: Vandalism and theft of intervention materials.	• Ensuring the presence of law enforcement at the site. • Mobilising community/ neighbourhood watches at the site. • Patrols at the site to be undertaken by law enforcement officers. • Involvement of the Drakenstein Municipality Smart Safety Network. • Use of 'low value' materials or development of concrete structures embedded in the ground to prevent theft and vandalism.
Operation and Maintenance	Social acceptance/ ownership	• Involvement of Mayoral Committee Members (MMCs) in the project to enhance communication to community members, to provide local knowledge and to provide a representation of community members and concerns. • Development of Public-Private Partnerships (PPP) to develop a sense of ownership. • Inclusion of the project in budgeting processes. • Enhance job creation potential for community members as part of the operation and maintenance of the intervention. • Host events to spread knowledge and awareness on the project. • Mobilising community members to assist in managing the space and relating the importance of the upkeep of open spaces, parks and sports fields for use by the children within the community, to foster a sense of ownership.
Funding	Cost of implementation and ongoing maintenance.	• Integration of the project into the Service Delivery and Budget Implementation Plan (SDBIP) to receive priority funding allocation and increased visibility to potential funders. • Integration of the project into the IDP.

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