



SMEC INTERNAL REF. C1877

Preliminary Design Report

Upgrading of Stormwater systems in Boland Park, Mossel Bay

Client Reference No. TDR 110/2019
Prepared for Mossel Bay Municipality
28 July 2023

Document Control

Document	Preliminary Design Report
File Location	P:\C1877_Upgrade of Stormwater MBay\3_Working\Reports\02) Prelim Design Report
Project Name	Preliminary Design Report
Project Number	C1877
Revision Number	Revision 1

Revision History

Revision No.	Date	Prepared By	Reviewed By	Approved for Issue By
0	8/08/2022	B Bartlett	A Delport	W Annandale
1	28/7/2023	A Delport	J Huogh	W Annandale

Issue Register

Distribution List	Date Issued	Number of Copies
Mossel Bay Municipality	9/09/2022	1

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1 General

1.1 Introduction

SMEC South Africa was appointed by the Mossel Bay Municipality through their Multi-Year Professional Services Framework Contract: TDR 110/2019: Appointment of Consulting Engineers for Various Municipal Infrastructure and Building Projects, for the Upgrading of Stormwater Systems in Boland Park, Diaz Beach & Voorbaai. This document relates to the formalising and upgrading of the stormwater channel in Boland Park only.

1.2 Locality

Boland Park falls within the boundaries of Mossel Bay in the Garden Route District Municipality in the province of the Western Cape. The local authority is the Mossel Bay Municipality. Refer to Figure 1-1 below for the general locality of works and Figure 1-2 for the location of the project.

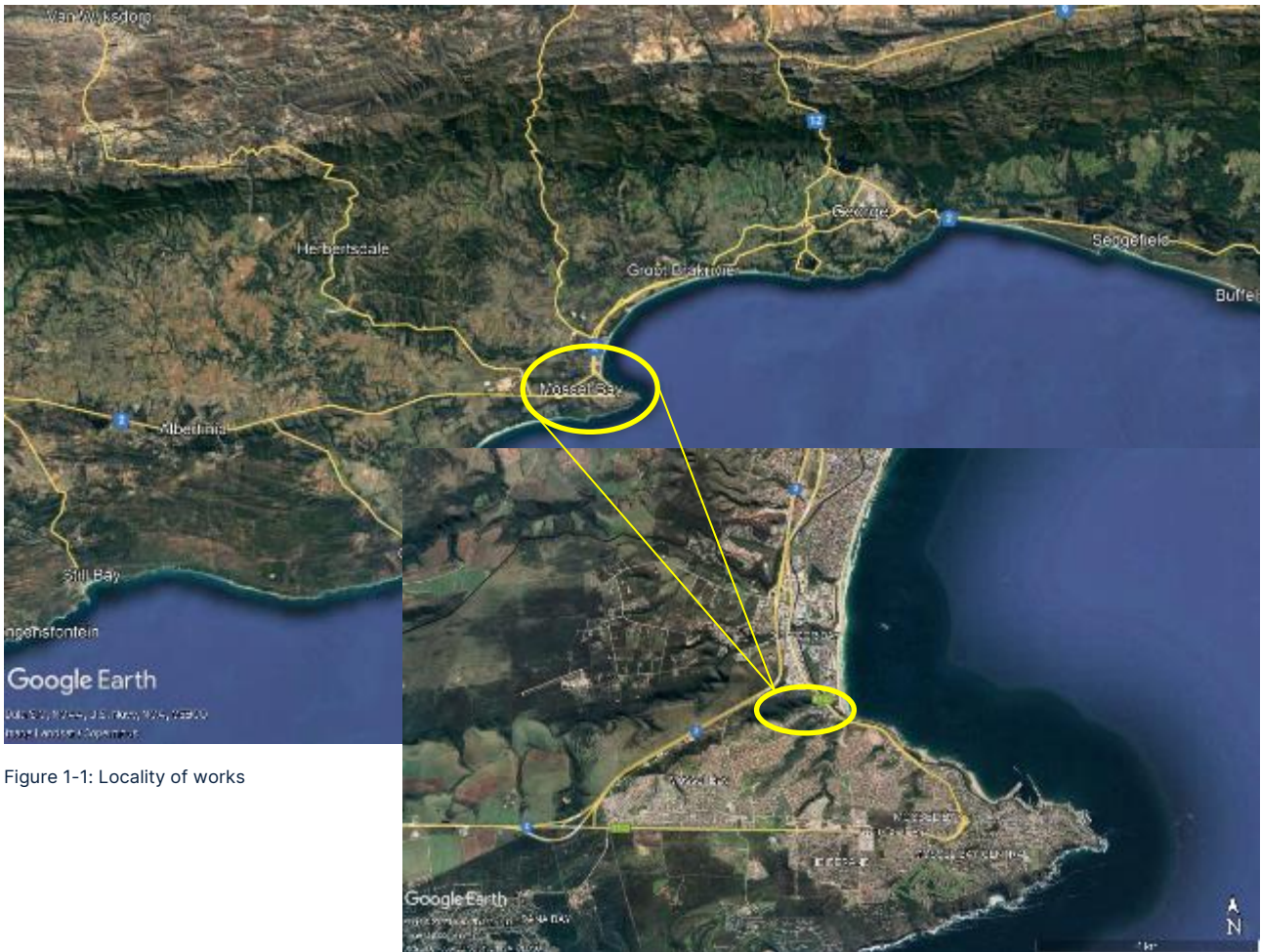


Figure 1-1: Locality of works



Figure 1-2: Locality of Boland park

1.3 Objectives of this report

The objective of this Preliminary Design report is to advise the Mossel Bay Municipality of the concept of the design and high-level cost estimates of this project. This report is based on the conclusions and recommendations from previously prepared documents (discussed later in this report), outcomes of various meetings and discussions with the client, as well as detailed site investigations and visual inspections which were undertaken. After approval of this report, the detailed design report will commence based on the findings and recommendations from this report.

2 Scope of Works

2.1 Employer's Objectives

The Mossel Bay Municipality has the following objectives:

- To extend the existing Gabion structure in Boland Park, Mossel Bay;
- To deliver public services infrastructure using labour-intensive construction methods wherever technically and economically feasible; and
- To comply with all funding conditions.

2.2 Detailed Scope of Works

The Mossel Bay Municipality appointed SMEC for ECSA's full scope of services for the following 3 projects included in their capital stormwater project work package:

- Upgrade Stormwater Channel, Boland Park Phase 1, Voorbaai; (This Report)
- New Stormwater system in Diaz Beach; and (Separate Report)
- Upgrade Stormwater capacity, Industry Road, Voorbaai. (Separate Report)

This report only relates to the Upgrading of the Boland Park Stormwater Channel, while the other two projects are discussed in separate reports.

2.2.1 Upgrade Stormwater Channel, Boland Park Phase 1, Voorbaai

There is an existing watercourse conveying stormwater from the higher-lying areas through Boland Park towards the ocean where it discharges. A portion of this watercourse has previously been upgraded and formalized to a gabion and grass block channel crossing Louis Fourie Road.

The Scope of Work for this project is to formalise the remaining upstream portion of the channel located adjacent to residential properties. The portion to be upgraded will take on the profile of the existing structure where the new channel ties onto the existing channel. Further upstream the channel will be more aligned with the watercourse profile and cross-section. The cleaning and de-silting of the existing channels will also be included in the scope of work.

2.3 Scope of Professional Services

The Scope of Professional Services entails the full scope of services as detailed in ECSA's Guideline for Services and Processes for Estimating Fees for Persons Registered in terms of the Engineering Profession Act, 2000 (Act No. 46 of 2000), and includes the following:

- Stage 1: Inception
- Stage 2: Preliminary Design, also known as Concept and Viability (this report)
- Stage 3: Detailed Design
- Stage 4: Contract Documentation and Procurement
- Stage 5: Contract Administration
- Stage 6: Close-out

2.4 Additional Services

2.4.1 Environmental Considerations

Due to the nature of the works in Boland Park, Hilland Environmental was appointed on a quotation basis as the Environmental Consultant, to ensure compliance with the relevant regulations. Allowance for the following was included in their appointment:

- Maintenance Management Plan
- Full Basic Assessment Report
- Application and submission to DEADP

It is further expected that the EIA approval would require the services of an Environmental Control Officer for the duration of construction and allowance will be included for this.

Various additional specialist studies may be required during the abovementioned process, including the following:

- Botanical
- Fauna
- Freshwater
- Heritage

Allowance for these specialist studies was made on the Provisional Cost Estimates, however, this will only go ahead when required.

2.4.2 Occupational Health and Safety Considerations

An OH&S Representative will be appointed, on a three-quotation basis, to carry out and build on the Baseline Risk Assessment for the Contract and include monthly audits for the duration of the project. This will be done by analysing the site-specific risks, as well as the proposed design. This will be in line with the latest Construction Regulations.

2.4.3 Topographical Survey

There are no surveys available for the area under consideration. Eden Geomatics has been appointed on a quotation basis, and the survey has been completed and received on 14 December 2021

2.4.4 Geotech

It is not expected that geotechnical investigations are required for a project of this nature and the proposed structure to be implemented. The anticipated excavation depth is expected to be minimal with only topsoil removal and leveling. The gabions and grass block structures proposed are intended for the purpose to be installed in poor and wet founding conditions. Access to the watercourse by excavation machines (TLB) is further not possible before construction activities started. A temporary access path is to be constructed when required only after the commencement of construction.

2.5 Wayleaves

The work to be done on Boland Park is within an existing natural watercourse. All existing services above ground i.e., water, sewer, fence lines, stormwater, and existing gabion structures are shown on the survey. The below-ground services will be highlighted with wayleaves from the Municipality by each relevant department and shown on construction drawings as existing services.

The exact positions of the below-ground services will be determined on-site by exposing them through hand excavation during construction.

Before commencing with the works, the Contractor is responsible to obtain final approval from the local authorities or service providers. It is anticipated that approval will be required from the following authorities:

- Mossel Bay Municipality
 - Stormwater infrastructure
 - Sewer infrastructure
 - Water infrastructure
 - Electrical infrastructure, including Eskom
 - Traffic
- Telecommunication Service Providers

2.6 Design Standards

The applicable standards and guidelines to be adopted are as follows:

- Neighbourhood Planning and Design Guide (Department of Human Settlements);
- The SANS 1200 Specifications.

The Mossel Bay Municipality does not have standard Stormwater design criteria or standards, and therefore it is proposed that industry guidelines and standards will be adopted.

The standards call for the following:

- The 5-year recurrence interval for minor systems
- The 50-year recurrence interval for major systems
- Overland flow route available for all trapped low points
- No open channels across road intersections
- Gabion structures to be of zinc-coated steel wire and PVC coated type

3 Site Investigation

3.1 Visual Assessment

A visual assessment was conducted by SMEC and representatives from Mossel Bay Municipality to determine the scope of work of the project.

The following is a summary of the site investigations. The existing watercourse, which accommodates surface runoff from the catchments west and southwest of Boland park, with the watershed between the N2 Freeway and beyond the R102 (Louis Fourie Rd) (catchments Bca1, Bca2, Bca3, and Bca4 in Figure 3-1) is located in Boland Park, between residential houses and discharges east of the R102 (Louis Fourie Road) into the ocean.

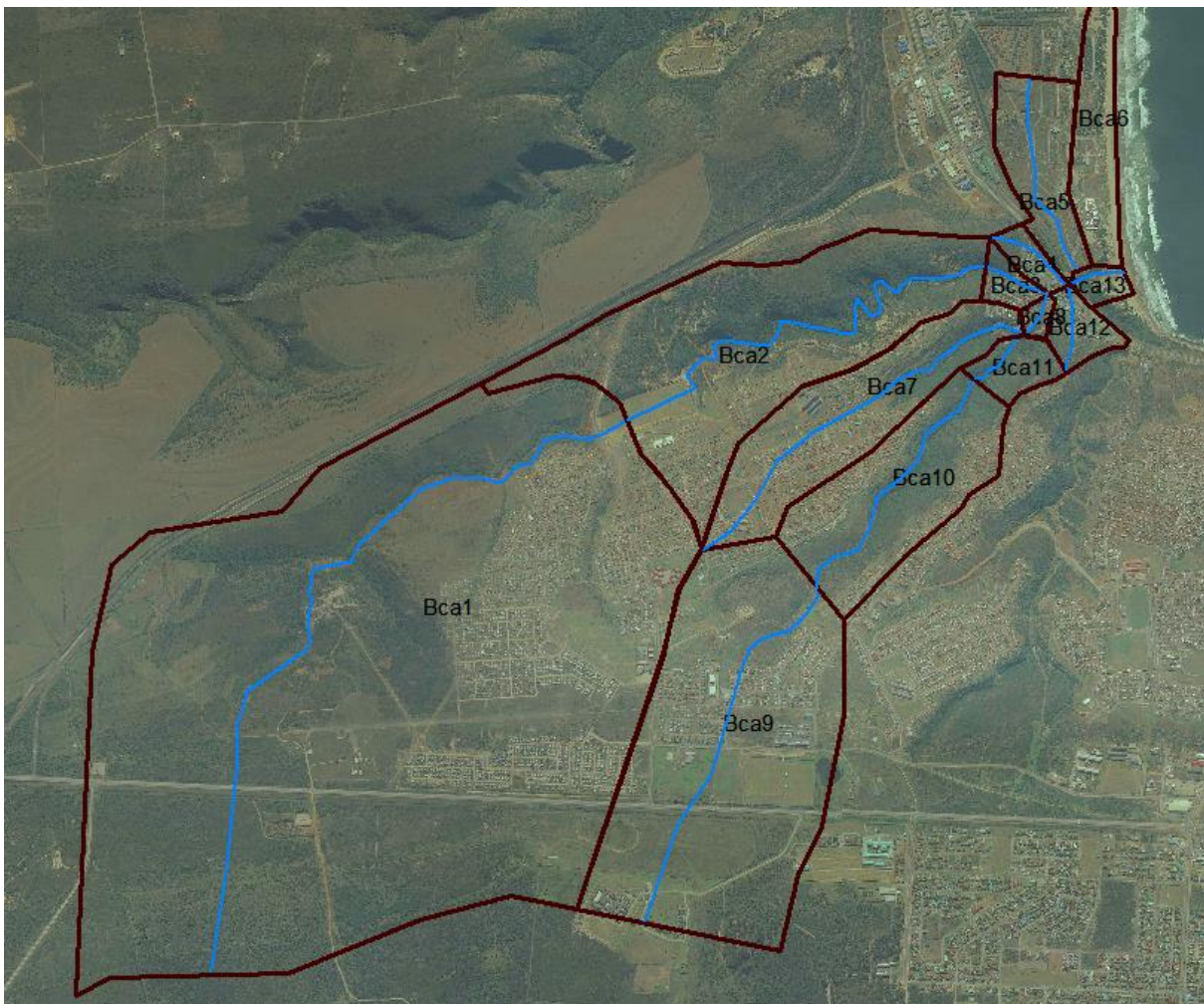


Figure 3-1: Boland Park Stormwater Catchments

A portion of this watercourse in Boland Park has previously been formalised to a gabion structure channel with a grass block lined floor. Figure 3-2 shows the extent of the existing formalised channel portion.



Figure 3-2: Extent of existing channel

3.1.1.1 Existing channel

The existing gabion structure seems to be structurally sound and in good condition. The floor of the existing Stormwater Channel is currently silted up and overgrown with weeds and requires cleaning and maintenance.

Figure 3-4 shows the condition of the existing structure, and provides the cross-section of the existing formalised channel which is to be adopted for the extension. As can be seen from the picture, space is very limited, and the channel extends from boundary to boundary.



Figure 3-3: Boland Park existing gabion structure

3.1.1.2 Watercourse

Sections of the unformalized portion of the watercourse adjacent to built-up areas are showing signs of erosion and possible slippage of the watercourse banks. The residents have put informal measures in place in an attempt to slow down the erosion to prevent total failure and slippage of the watercourse banks, as can be seen in Figure 3-4.



Figure 3-4: Boland Park embankment erosion

The remainder of the watercourse, on the day of the site visit, was overgrown by weeds and bushes, as can be seen in Figure 3-5 and Figure 3-6.

On the day of the site visit, it was also noted that a recent sewer spillage occurred and signs of this could be seen in the watercourse. It is known that a bulk sewer line is located upstream, outside the project boundaries, and crossing the watercourse. It is suspected that this is where sewer spillage could have originated. This however falls outside of the scope of this project, but the Municipality is however made aware of this. This poses a significant threat to the environment and is also a health risk that creates hazardous conditions which may result in delays in implementation and increased costs.



Figure 3-5: Boland Park upstream of existing Stormwater Channel



Figure 3-6: Weeds in the Existing Stormwater Channel in Boland Park

3.1.1.3 Road Bridge

During the site investigation it was noted that the bridge over the channel had some rust marks visible. As this falls outside our scope of works it is then recommended that a investigation be done on the bridge as a matter of safety.



a



Figure 3-7: Below Bridge Deck

4 Preliminary Design Particulars

4.1 Upgrade Stormwater Channel, Boland Park Phase 1, Voorbaai

The Mossel Bay Stormwater Management Master Plan (MBSWMP), compiled by VelaVKE in August 2006, Ref. VKE0541/01/02 & VKE0542/01/1 (Master Plan Phase 2 (B)) analysed the capacities of the Boland Park stormwater system in detail.

The following summarises the recommended conditions for the existing stormwater infrastructure.

- (a) **The Boland Park stormwater system is essentially adequate in its present state.** The existing conditions are similar to what was analysed in the MBSWMP. The extent and profile of the existing channel have not changed since the MBSWMP was done.
- (b) **The capacity of the stormwater culverts under Louis Fourie and the railway line can accommodate the 1:100-year flood without causing a backwater effect in the main channel through Boland Park if the upstream conditions are met.** The conditions and size of the culvert crossing the R102 (Louis Fourie Road) and railway bridge have not changed in size since the MBSWMP was developed and is similar to what has been analysed .
- (c) **Considering that increasing the capacity of the main channel in the future will be very difficult, the Council must ensure that the increased runoff due to future developments is attenuated to the predevelopment state within the catchment where the development takes place.** The analysis in 2006 was done with the drainage area fully developed with the runoff attenuated to predevelopment flows.

Following the flooding of the Boland Park developments, before the development of the MBSWMP, the main outfall channels were upgraded to a trapezoidal channel with a gabion basket structure, and a detention facility was constructed upstream. The detention dam, in the form of bunded-sports fields, has been built at the outfall of Bca1 (Figure 4-1) to protect Boland Park. The runoff from catchment Bca1 is intended to be attenuated in the detention facility at node B16 (Figure 4-1).



Figure 4-1: Boland Park Stormwater System Model

The benefit of this detention facility on the sports fields is illustrated by the following two profiles showing the maximum depths reached during the 100-year flood in the main channel through the crossing of Louis Fourie Road.

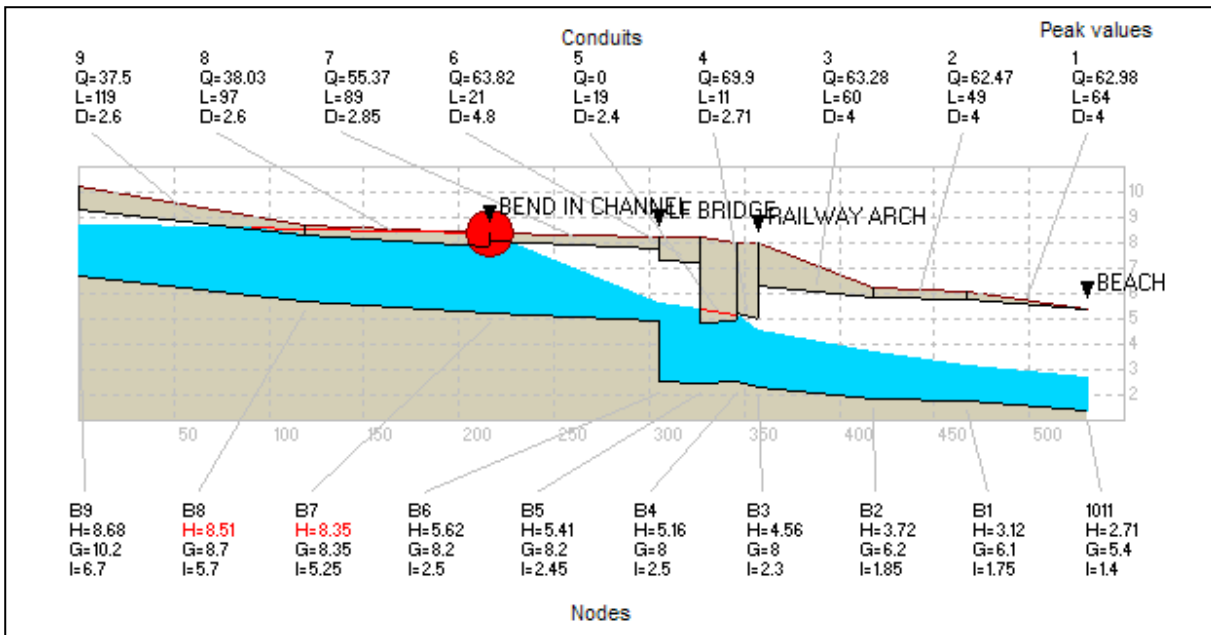


Figure 4-2: Boland Park Outfall without Detention Dam

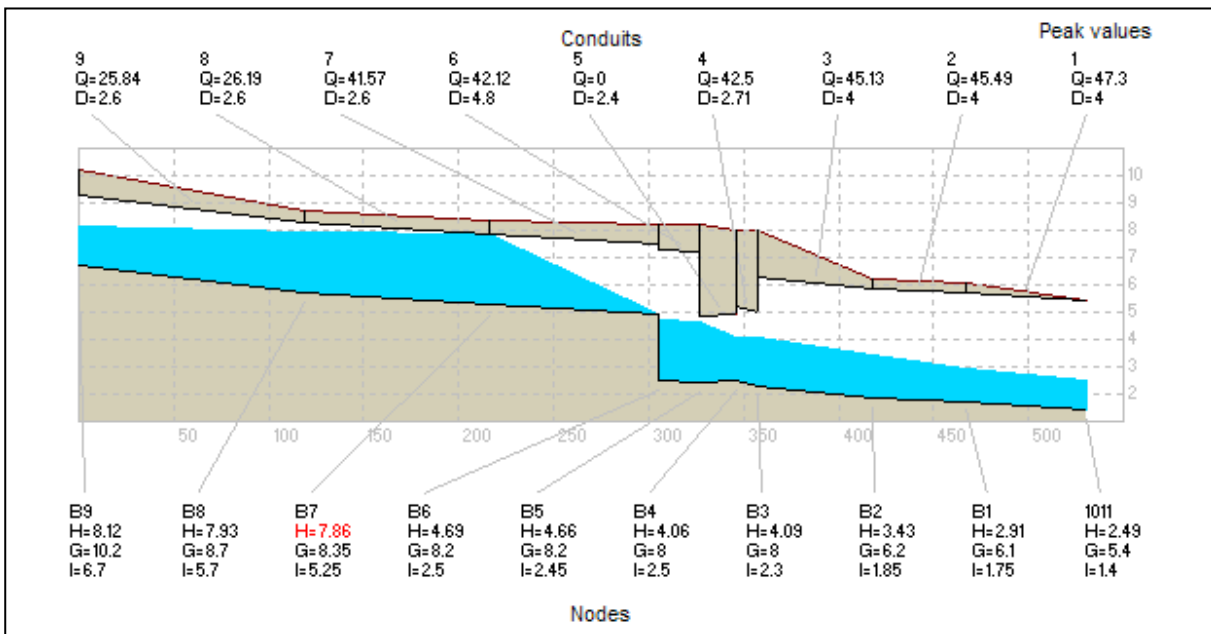


Figure 4-3: Boland Park Outfall with Detention Dam

The detention dam reduces and detains the peak flow from catchment Bca1 from 26 m³/s to 19 m³/s, which reduces the peak channel flow from Bca1 and Bca2 at node B8 (Figure 4-2 and Figure 4-3) in Boland Park from 37.5 m³/s to 25.8 m³/s. The detention dam at B16 is an important element in the stormwater system and needs to be maintained.

From recent aerial imagery as shown in Figure 4-4 it is clear that flooding has left the detention dam damaged with a flow path eroded, which provides minimal attenuation and which leaves the downstream infrastructure and properties at risk of flooding and damage.



Figure 4-4: Damaged attenuation measures

In addition to the failing attenuation measures, it seems the developments are extending beyond what was allowed for in the MBSWMP and approved by the council. Figure 4-5 shows the extent of the informal settlements in the valley. This will result in the runoff further exceeding what was expected as the ground cover conditions is now different than what was allowed for in the MBSWMP model and flow will exceed the design capacity of the channel.

From the above, it is clear that the upstream conditions, as summarised in bullet (b) earlier in this section, are not met and the downstream infrastructure is at risk of flooding and damage. It is therefore essential that the attenuation measures be re-instated, and maintained with possible improvements to limit the peak runoff into the channel through Boland Park to prevent future failure as part of this project.

The detention storage potential of the river valley above the culvert should also be considered (Figure 4-5), as it would be relatively inexpensive to modify the road culvert headwall to provide the required flow control and cause temporary impoundment of flood water upstream of the culvert. The public safety aspects would have to be considered as people are living in informal settlements close to the riverbanks. The landfill area below Thembelihle Crescent could also be designed to attenuate storm runoff along this water course as an added measure.

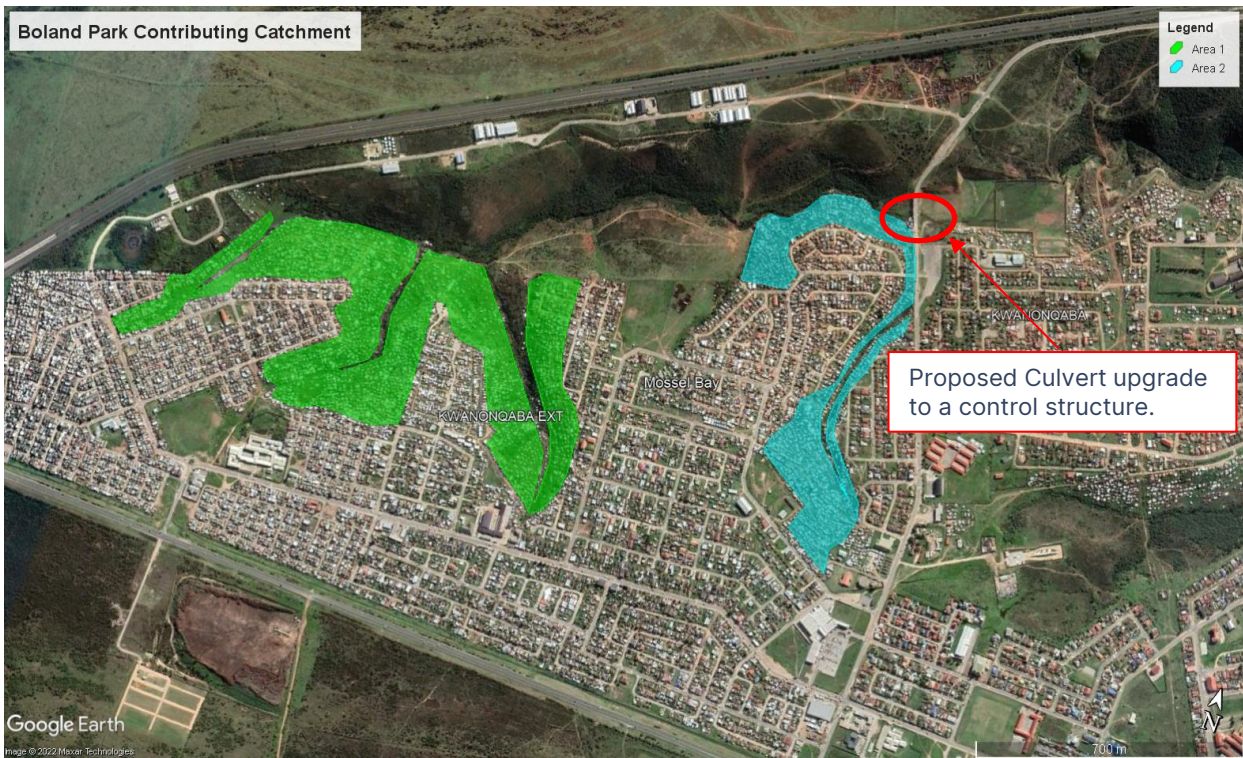


Figure 4-5: Informal development in drainage area

4.1.1 Proposed channel

The main channel has been constructed as a trapezoidal channel with gabion basket side walls at 2:1 and a grass block lined floor. As the channel has already been developed to its maximum size and it would be very difficult and costly to increase the capacity.



Figure 4-6: Existing Stormwater Channel Profile to be adopted

It is proposed to adopt the existing profile as shown in Figure 4-6 where the new portion ties onto the existing section and follows a profile of the watercourse section to minimise earthworks. Typical cross sections are shown in Figure 4-7 along the alignment of the portion to be upgraded. This is proposed to protect the embankment from further erosion as identified during the site investigation.

a

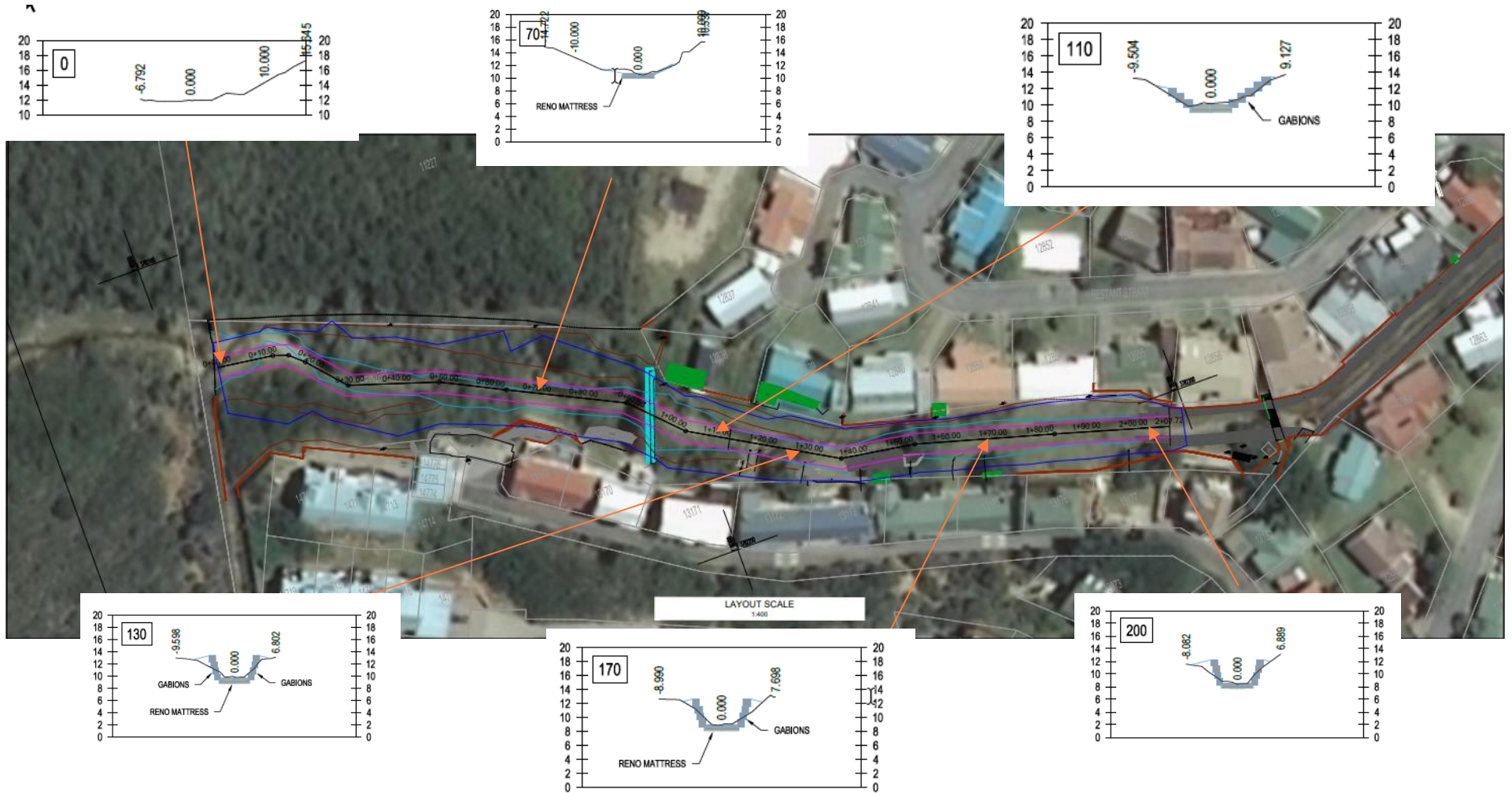


Figure 4-7: Proposed Profile and Sections to be adopted

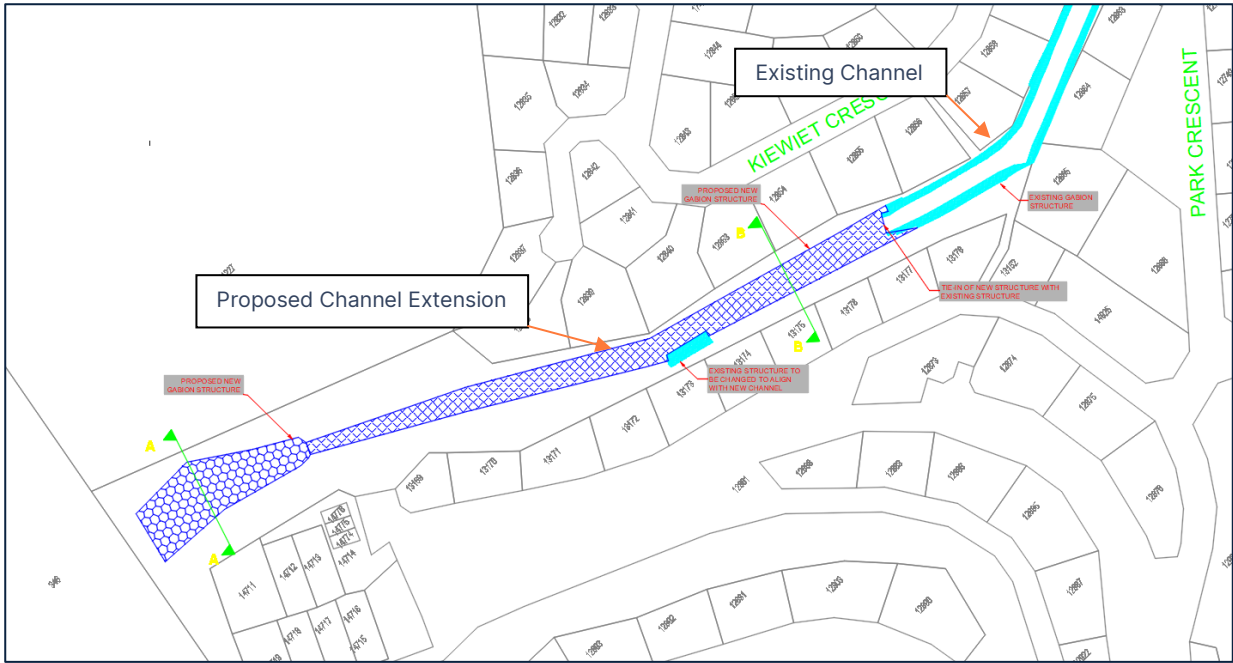


Figure 4-8: Extent of Proposed Stormwater Channel

5 Project Budgets

The Mossel Bay Municipality intends to implement the construction of the stormwater infrastructure over a multi-year period to be aligned with the availability of funding in each financial year.

5.1 Allocated Budget

Table 5-1: Available Project Budgets

ESTIMATED SUMMARY OF PROJECT COSTS					
No	Project Group	2022 / 2023 CRR	2023 / 2024 CRR	2024 / 2025 CRR	TOTAL
1	Upgrade SW Boland Park	R 350 000.00	R 450 000.00	R 500 000.00	R 1 300.000.00
TOTAL					R 1 300 000.00

5.2 Construction Budgets

Based on the recommendations outlined in the report, the construction cost estimate, reflected in the tables below, was prepared using high-level estimates of market-related rates tendered in recent tenders for items of a similar nature. The estimate reflected should not be considered final and is subject to change with the completion of detailed designs. The tables below show the budgets as per SMEC's high-level construction cost estimate.

Provision has been made for 20% P&G's, as well as 10% Contingencies.

Table 5-2: Upgrade Stormwater Channel, Boland Park Voorbaai Cost Estimate (Prelim Design)

BOLAND PARK CONSTRUCTION COST ESTIMATE			
No	Description	Unit	Amount
1	P&G (20%)	Sum	R 861 754.97
2	Site Clearance	Sum	R 110 812.50
3	Earthworks	Sum	R 421 321.88
4	Gabions and Stone Pitching	Sum	R 3 177 525.00
5	Detention dam repair	Sum	R 1 284 487.50
6	Culvert changes	Sum	R75 000.00
5	SUB TOTAL CONSTRUCTION COST (Excluding VAT)		R 5 930 901.85
6	10% Contingencies		R 593 090.18
7	TOTAL (Excluding VAT) (A)		R 6 523 992.03
8	15% VAT		R 978 598.81
9	TOTAL (Including VAT)		R 7 502.590.84

5.3 Professional Fees

The proposed fee arrangement is in line with our appointment for TDR 110/2019. Allowance is made for a 10% discount on the ECSA fees.

Based on the Scope of Works as outlined, ECSA recommends a fee of between 6% and 8% for a Category A project with a value of R 11 500 000.00. The professional fee should then be adjusted for project value in line with Figure 4.1 of Clause 4.3.4 of these guidelines. We are therefore able to offer our services to the Mossel Bay Municipality at a Professional fee of **7.3%** based on an estimated construction value of **R5 930 901.85** (Excl. Vat & Contingencies), of **R 389 660.25** (excluding VAT). In line with our appointment, no provision has been made for disbursements.

Table 5-3: Proposed Professional Fee Arrangement

PROFESSIONAL FEES ESTIMATE				
No.	Description	%	Amount	Total
1	Professional Fees			R 432 955.84
	Discount offered as per appointment	-10%		-R 43 295.58
1.1	Inception	5%	R 21 647.79	
1.2	Concept & Viability	25%	R 108 238.96	
1.3	Design Development	25%	R 108 238.96	
1.4	Documentation & Procurement	15%	R 64 943.38	
1.5	Contract Administration & Inspection	25%	R 108 238.96	
1.6	Close-out	5%	R 21 647.79	
	Total (excluding VAT) (B)			R 389 660.25
	15% VAT			R 58 449.04
	Total (including VAT)			R 491 404.87

In addition to the above, the following Sub-Consultants are envisaged to be required during investigations and in the execution of the project. Please be advised that all costs shown are provisional and are subject to change. Costs will however be proven to the Mossel Bay Municipality, and approval obtained before proceeding with the work.

Table 5-4: Estimated Additional Services

ESTIMATED ADDITIONAL SERVICES			
No	Description	Unit	Amount
1	Sub-Consultants		
1.1	Occupational Health and Safety	Prov. Sum	R 60 000.00
1.2	Geotechnical	Prov. Sum	R 35 000.00
1.3	Environmental	Sum	R 262 000.00
1.4	Survey	Sum	R 54 000.00
2	Sub Total (Sub-Consultants)		R 411 000.00
3	10% Mark-up on Sub consultants		R 41 100.00
4	TOTAL ADDITIONAL SERVICES (Excluding VAT) (C)		R 452 100.00
5	15% VAT		R 67 815.00
6	TOTAL ADDITIONAL SERVICES (Including VAT)		R 519 915.00

5.4 Project Budget Summary

The table below indicates the summary of the estimated high-level cost, in line with SMEC's construction cost estimate, and with the risks and assumptions outlined to the Mossel Bay Municipality.

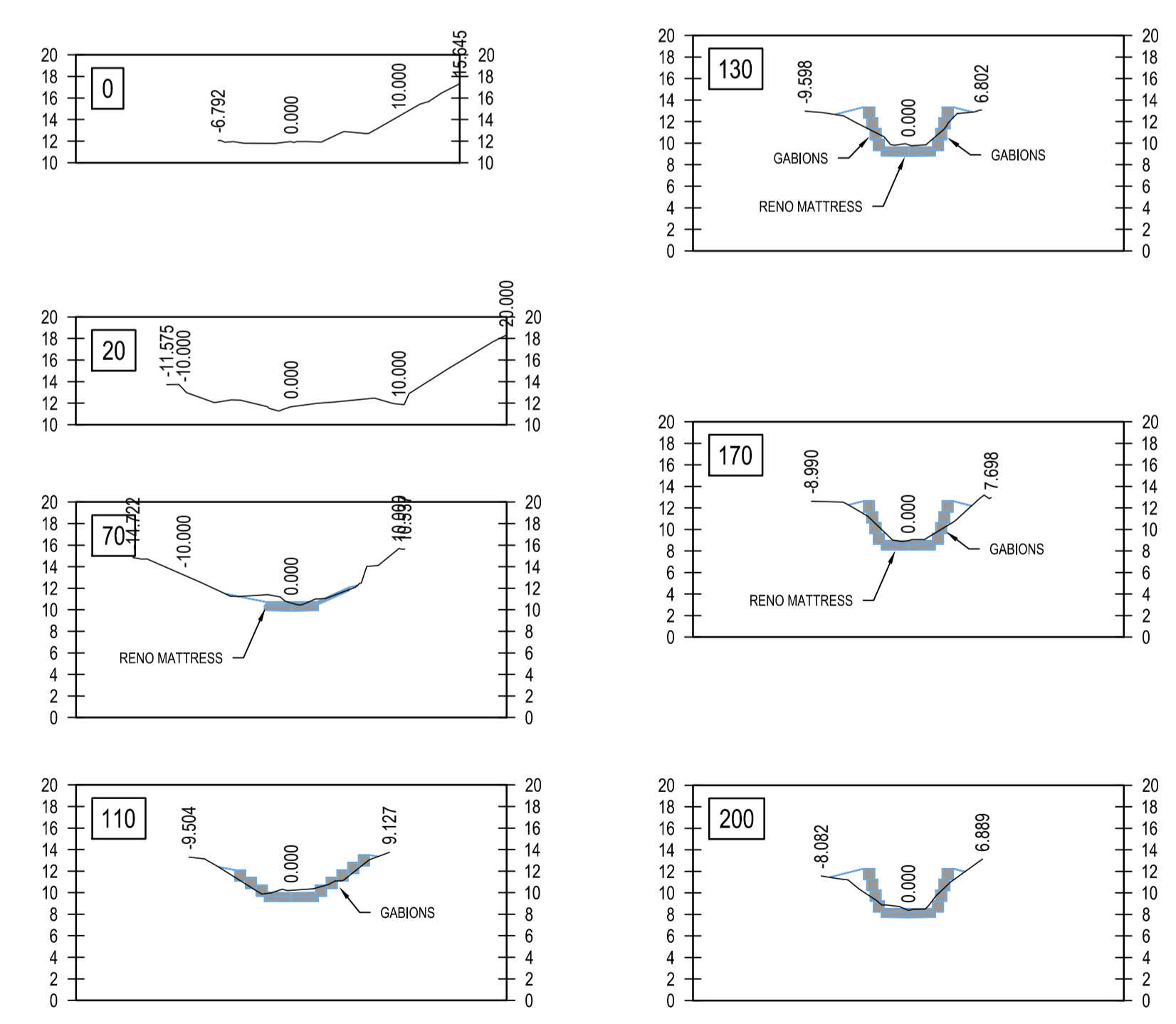
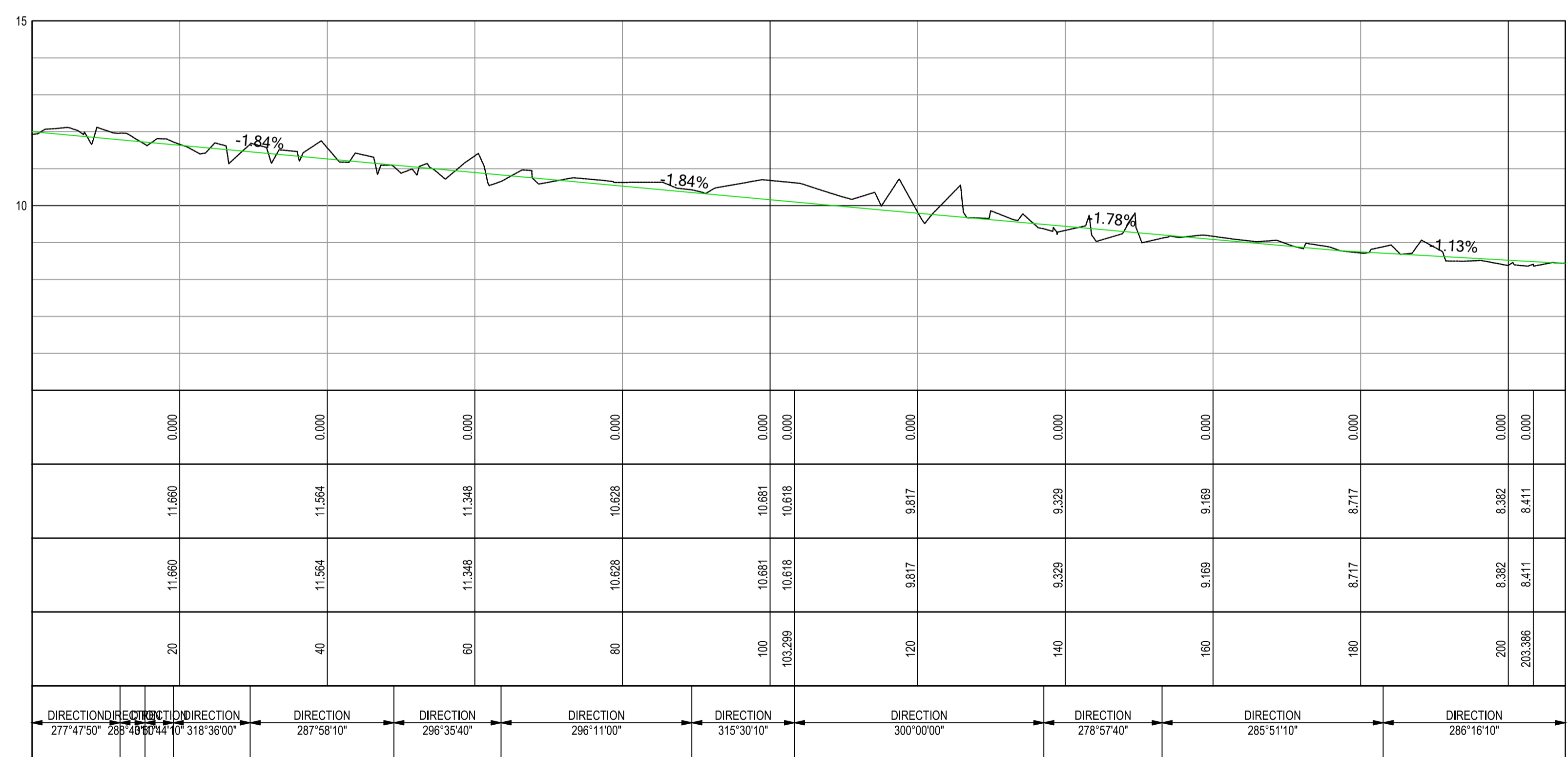
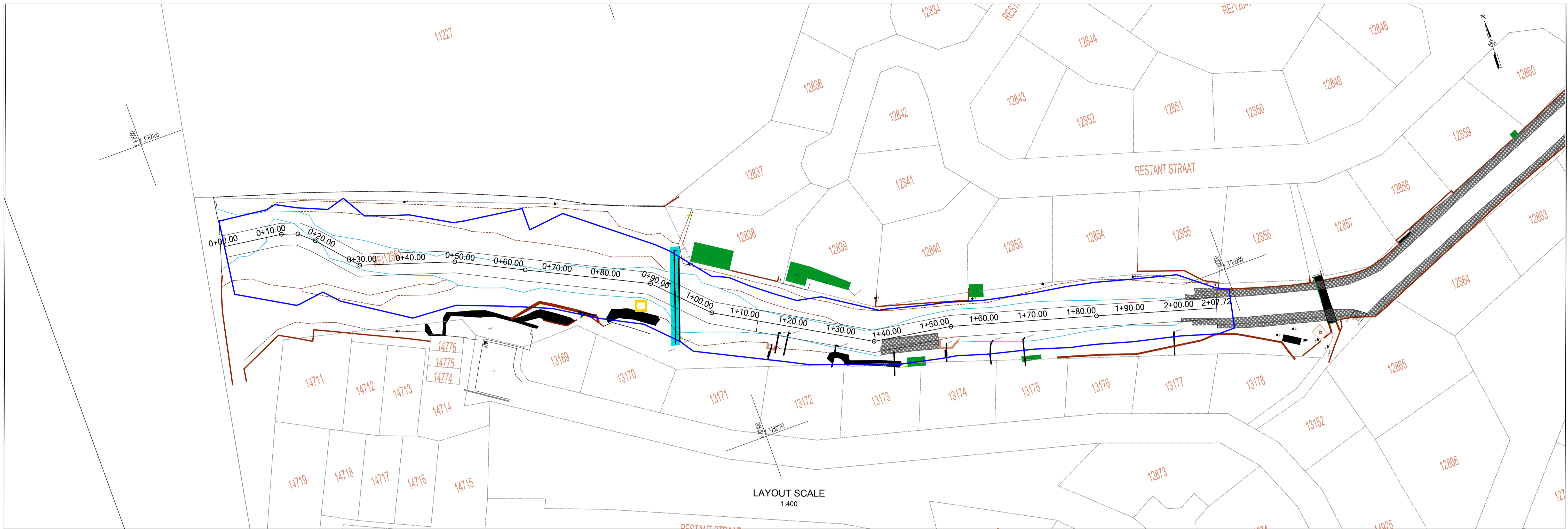
Table 5-5: Estimated Project Cost

ESTIMATED SUMMARY OF PROJECT COSTS		
No	Description	Amount
1	Total Estimated Project Cost	
1.1	Construction Cost (A)	R 6 523 992.03
1.2	Professional Fees (B)	R 389 660.25
1.3	Additional Costs (C)	R 452 100.00
2	Sub Total (A+B+C)	R 7 365 752.28
3	15% VAT	R 1 104 862.84
4	TOTAL ESTIMATED PROJECT COSTS (Including VAT)	R 8 470 615.12

6 Conclusion and Recommendations

- (a) The existing gabion channel has previously been developed to the full extent available between the property boundaries. It is proposed to tie onto the existing profile and adopt the same structure i.e, gabion walls with a grass block lined floor. The structure will further upstream follow the watercourse profile to limit excavation.
- (b) The existing channel previously constructed has the design capacity to accommodate the 1 in 100-year flood runoff with the detention dam upstream in place and functional. From recent aerial photos is clear that extensive damage to the detention dam has occurred and that the attenuation of runoff is no longer controlled. It is recommended to re-instate the attenuation of stormwater by repairing the damaged embankment and outlet control structure at the sports fields. It is further proposed to put an additional control structure, by changing the existing culvert structure to an outlet control structure to increase the attenuation of stormwater, however only after the informal settlements have been relocated as mentioned in the bullet below.
- (c) From recent aerial Photos, it is clear that illegal informal settlements have taken place outside the formal township area and are nearing the watercourse in the valley. This results in the ground cover conditions being different than what was modelled in the MBSWMP and results in an increased peak runoff. With the lack of detention of stormwater due to the damaged detention infrastructure, the risk of flooding is higher. It is recommended that the Municipality relocate the residents to a more suitable and safer area which has been formalised.
- (d) The main sewer outfall crossing the watercourse just west of Boland Park has surcharged before our site investigation and spilled into the watercourse. This may cause health risks to the community and environment if happening regularly. Should this sewer overflow during construction, this may cause delays which will lead to additional costs for the project. It is recommended that the Municipality undertake the regular maintenance of this pipe to avoid blockages and repair damaged sections.
- (e) The allocated budget will not cover the full scope of works, and additional funding will be required should the project be implemented in it's entirety. It is recommended to phase the project implementation to secure additional funding.

Appendix A Preliminary Design Drawings



NGL -----
INVERT -----

SCALES:
Horizontal 1:500
Vertical 1:100

DATUM 5.000

DEPTH TO INVERT	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
INVERT LEVELS	11.660	11.564	11.348	10.628	10.681	10.618	9.817	9.329	9.169	8.717	8.382	8.411	8.411	8.411	8.411	8.411	8.411	
GROUND LEVELS ON CL	11.660	11.564	11.348	10.628	10.681	10.618	9.817	9.329	9.169	8.717	8.382	8.411	8.411	8.411	8.411	8.411	8.411	
DISTANCE (m)	20	40	60	80	100	103.386	120	140	160	180	200	203.386	203.386	203.386	203.386	203.386	203.386	
HORIZONTAL ALIGNMENT	DIRECTION 277°47'50"		DIRECTION 287°58'10"		DIRECTION 296°35'40"		DIRECTION 296°11'00"		DIRECTION 315°30'10"		DIRECTION 300°00'00"		DIRECTION 278°57'40"		DIRECTION 285°51'10"		DIRECTION 286°16'10"	

NOTE:
ALL DIMENSIONS TO BE CHECKED ON SITE BEFORE ANY WORK IS
PUT IN HAND. REFER ANY DISCREPANCIES TO THE ENGINEER.

FOR APPROVAL

NO.	DATE	DESCRIPTION	INITIAL
1	22-02-2023	REVISED GABION CHANNEL SECTIONS	BB
0	05-04-2022	FOR APPROVAL	BB

DESIGNED	M GWETHA
CHECKED	B BARTLETT (PR TECH ENG)
DRAWN	M GWETHA
CHECKED	B BARTLETT (PR TECH ENG)

SIGNED _____
SMEC South Africa

DATE _____

SMEC
South Africa
Member of the Surbana Jurong Group

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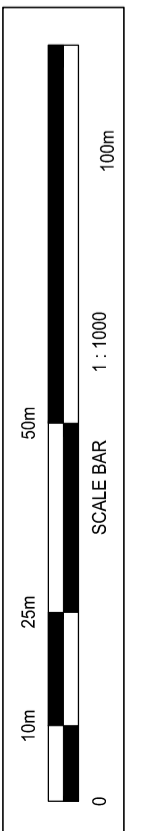
SIGNED _____
Mosel Bay Municipality

DATE _____

MOSELBAY MUNICIPALITY

**LAYOUT AND STORMWATER LONGSECTION:
BOLAND PARK**

SIZE A 1	SCALE S H O W N
PROJECT DRAWING NUMBER C 1 8 7 7 - 1 0 0 - 0 0 1	
REV 0 1	SHEET No. 0 1 OF 0 1



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