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GRINDROD SEAMUNYE RICHARDS BAY STORMWATER MANAGEMENT PLAN REPORT GRB.P003.2022.004 (REV 0)

FEBRUARY 2023

EMPLOYER:	CONSULTING ENGINEER:
GRINDROD PROPERTY, DIVISION OF GHSA P.O. BOX 1 DURBAN 4001 TEL: (035) 761 3531 FAX: (035) 797 9033	ILIFA AFRICA ENGINEERS (PTY) LTD P. O. BOX 10812 MEERENSEE 3901 TEL: (035) 753 1083 FAX: (035) 753 1094

TITLE : **STORMWATER MANAGEMENT PLAN REPORT**	GRINDROD SEAMUNYE – STORMWATER MANAGEMENT PLAN REPORT	
ILIFA PROJECT NO :	**DATE :**	**REPORT STATUS :**
R22-071-00	06/02/2023	Rev 0

CARRIED OUT BY :	**COMMISSIONED BY :**
Ilifa Africa Engineers (Pty) Ltd P. O. Box 10812 **MEERENSEE** 3901 Tel: +27 35 753 1083 Fax: +27 35 753 1094 E-mail: rbay@ilifa.biz	**Grindrod Property, division of GHSA** P. O. Box 1 **DURBAN** 4001 Tel: +27 82 820 6813 Fax: +27 35 797 9033 E-mail: Hugen.Naidu@grindrod.com
AUTHOR:	**CLIENT CONTACT PERSON:**
N. Naumann	H. Naidu

SYNOPSIS :

Grindrod Seamunye Stormwater Management Report

KEY WORDS :

Introduction, Stormwater Management Plan objectives, Technical situation analysis and evaluation, Conceptual design and review, Suitability of existing stormwater infrastructure, Required changes to existing stormwater infrastructure, Required additions to existing stormwater infrastructure, Water quality, Design of new stormwater infrastructure, Grindrod Seamunye water balance, Project development and phasing, Operational, management and monitoring systems and responsibilities

QUALITY VERIFICATION

This report has been prepared under the controls established by a certified ISO 9001:2015 quality management system developed by Ilifa Africa Engineers (Pty) Ltd.

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Verification	Capacity	Name	Signature	Date
By Author	Engineer	N. Naumann	[signature]	06/02/2023
Checked by	Regional Manager	J. Scalliet	[signature]	06/02/2023
Authorized by	Regional Manager	J. Scalliet	[signature]	06/02/2023

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GRINDROD SEAMUNYE – RICHARDS BAY

STORMWATER MANAGEMENT PLAN REPORT
(REV 0)

TABLE OF CONTENTS **PAGE**

DRAWING LIST

GRINDROD SEAMUNYE – RICHARDS BAY

STORMWATER MANAGEMENT PLAN REPORT
(REV 0)

1. INTRODUCTION

1.1 Appointment

Ilifa Africa Engineers was appointed on 26 September 2022 by Grindrod to develop a Storm Water Management Plan (SWMP) for the Grindrod Seamunye premises in Richards Bay. As part of the appointment, the stormwater management plan will be presented in the form of a report supported by drawings. The development of the stormwater management plan report will follow the guidelines set out in the Best Practice Guideline G1 Storm Water Management issued by the Department of Water Affairs and Forestry, 2006.

1.2 Terms of Reference

Grindrod has appointed Ilifa Africa Engineers as a professional services provider to assist with compiling the necessary documentation to submit to the Department of Water and Sanitation (DWS) for compliance with the regulator's requirements. The Storm Water Management Report forms part of the necessary documentation to be submitted to DWS.

1.3 Design standards

The standards utilized as guidelines in the development of this management plan was based on the following publications:

- "The Neighbourhood Planning and Design Guide" 2019 as issued by the Department of Human Settlements
- The South African National Roads Agency LTD: Drainage Manual, 2006, 5th Edition
- SAWB: Design rainfall depths at selected stations in South Africa
- Department of Water Affairs and Forestry, 2006. Best Practice Guideline G1 Storm Water Management
- Department of Water Affairs and Forestry, 2006. Best Practice Guideline G2: Water and Salt Balances

1.4 Information

Information required to compile the stormwater masterplan was obtained from the following sources:

- BVI Consulting Engineers : Stormwater infrastructure design proposals
- BVI Consulting Engineers : Survey Data
- City of uMhlathuze : Cadastral Data
- City of uMhlathuze : Aerial Imagery
- City of uMhlathuze : Wetland and River Delineation
- Talbot Laboratories : Stormwater test results and waste classification
- Davies Lynn & Partners : Geotechnical Investigation Report
- SRK Consulting : Borehole Logs
- Grindrod : Materials MSDS

2. STORM WATER MANAGEMENT PLAN OBJECTIVES

The objectives of this report will be to present the development of the storm water management plan for the Grindrod Seamunye premises. The objectives of the storm water management plan can be summarised as follows:

- Establish clean and dirty areas.
- Identify areas where surface hydrology is affected.
- Identify the location and characteristics of all existing water management infrastructure.
- Route all clean stormwater away from dirty areas and associated dirty water.
- Determine the suitability and capacity of all existing stormwater infrastructure to accommodate a defined precipitation event.
- Define stormwater infrastructure changes required.
- Define the water quantity and quality requirements of all the water uses.
- Undertake preliminary design of new stormwater infrastructure required.
- Develop water balance.
- Ensure sustainability within the storm water management system.
- Ensure all statutory requirements with regards to storm water management are met.

3. TECHNICAL SITUATION ANALYSIS AND EVALUATION

3.1 Classification of areas according to land use

To determine the quality of surface water runoff from precipitation, it is necessary to determine the characteristics of the substances that comprise the ground surface over which the surface water flows. Surface water runoff is highly susceptible to contamination when brought into contact with ground surface contaminants. To prevent the contamination of clean surface water runoff it is imperative that clean surface water runoff collected in clean areas are separated from dirty areas and associated dirty surface water runoff. The figure below is an arial image of the Grindrod Seamunye premises with areas identified and allocated numbers for classification.

Figure 1: Arial image of Grindrod Seamunye premises with numbers allocated to areas for classification

Ground surface water from the premises was collected on the 12th October 2022 and issued to Talbot Laboratories for chemical assessment in accordance with the Waste Management and Classification Regulations 2013 (GN R634). The chemical assessment of the ground surface water in terms of GN R634 concluded that the water sample had no applicable waste constituent, characteristic, property, or hazard identified. Considering that material such as coal will be stockpiled on site, the overland flow of stormwater is expected to be laden with material fines in the form of suspended solids. Due to the aforesaid, the distinct land uses at the Grindrod Seamunye premises will govern the area classifications. The figure below, an extract from BPG G1: Storm Water Management, provided guidance in the classification of areas at the Grindrod Seamunye premises.

Classification	Area	Comment
Clean	Undisturbed land area	Regional geology or agricultural practices may contaminate runoff.
	Formal residential areas with services	Generally only suspended solids (SS) and Chemical Oxygen Demand (COD) to consider
	Administrative offices	Generally only SS to consider
	Tarred roads	Tarred roads are not expected to be contaminated by waste, coal or discard, but may have a run off volume implication.
	Newly rehabilitated areas Clean water dams	SS to be considered
Moderately dirty	Workshops and storage yards (where oil is not handled)	Specifically at gold mines. Coal mine workshops are included if the ground surface is not covered with coal fines.
	Poorly rehabilitated areas	SS and other contaminants to consider
	Roads *	If it carries traffic that bears coal, discard, slurry, waste rock, slimes, etc.
Dirty	Beneficiation plants and other plants	Special chemicals in use, e.g. cyanide, may also contaminate storm water.
	Workshops and storage yards where oil is handled or ground is covered in fines	Oils, grease and soap, dissolved and suspended contaminants
	Opencast pits	SS and other contaminants to consider
	Residue deposits	Includes coal discard, slurry facilities, slimes dams, waste rock dumps and sand dumps.
	Raw material or product stockpiles	Dissolved and suspended contaminants
	Unrehabilitated areas	Dissolved and suspended contaminants
	Haul roads	Dissolved and suspended contaminants
	Adit areas	Dissolved and suspended contaminants
	Pollution control dams	Depends on contents of dams

Figure 2: Area classifications based on land use – BPG G1: Storm Water Management

Table 1 below provides the characteristics and subsequent classification of the areas numbered in Figure 1.

Table 1: Numbered areas classified based on land use

Area Number	Area Description	Area Land Use	Area Classification
1	Office Blocks	Administrative Offices	Clean
2	Parking	Tarred Roads	Clean
3	Warehouses (Roofs)	Roofing	Clean
4	Stockyards	Residue deposits, raw material stockpiles, haul roads	Dirty
5	Workshop (Roofs)	Roofing	Clean
6	Railway Tracks	Undisturbed land	Clean

The figure below illustrates the clean and dirty areas at the Grindrod Seamunye premises as categorised in Table 1.

Figure 3: Clean and dirty areas at the Grindrod Seamunye premises classified based on land use

To determine the potential interaction between clean surface water runoff from clean areas and dirty surface water runoff from dirty areas, structures that impede and/or divert the overland flow of stormwater need to be identified. The figure below depicts the general flow direction of surface water at the Grindrod Seamunye premises and outlines influential structures.

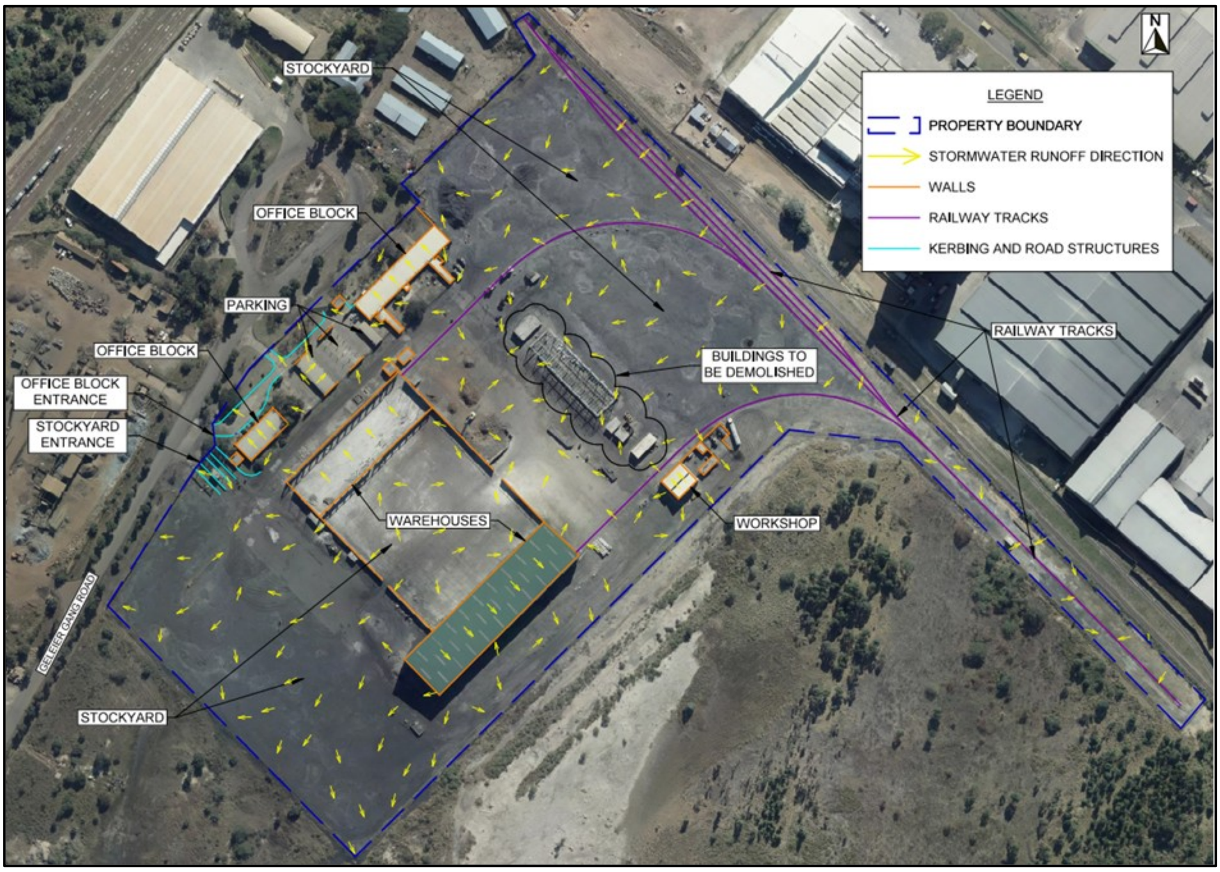

Figure 4: Flow direction of surface water influential structures

Surface water accumulated at the stockyards will flow in a general South to South-Eastern direction towards the adjacent undisturbed vacant land. The topography of the stockyards are irregular and do not bear defined stormwater drainage routes. The presence of structures on site such as building walls, railway tracks and road kerbs artificially define the current stormwater catchments, however most of which do not contribute to the separation of surface water runoff from clean and dirty areas.

The figure below defines the required barriers between clean and dirty areas to separate associated clean and dirty surface water.

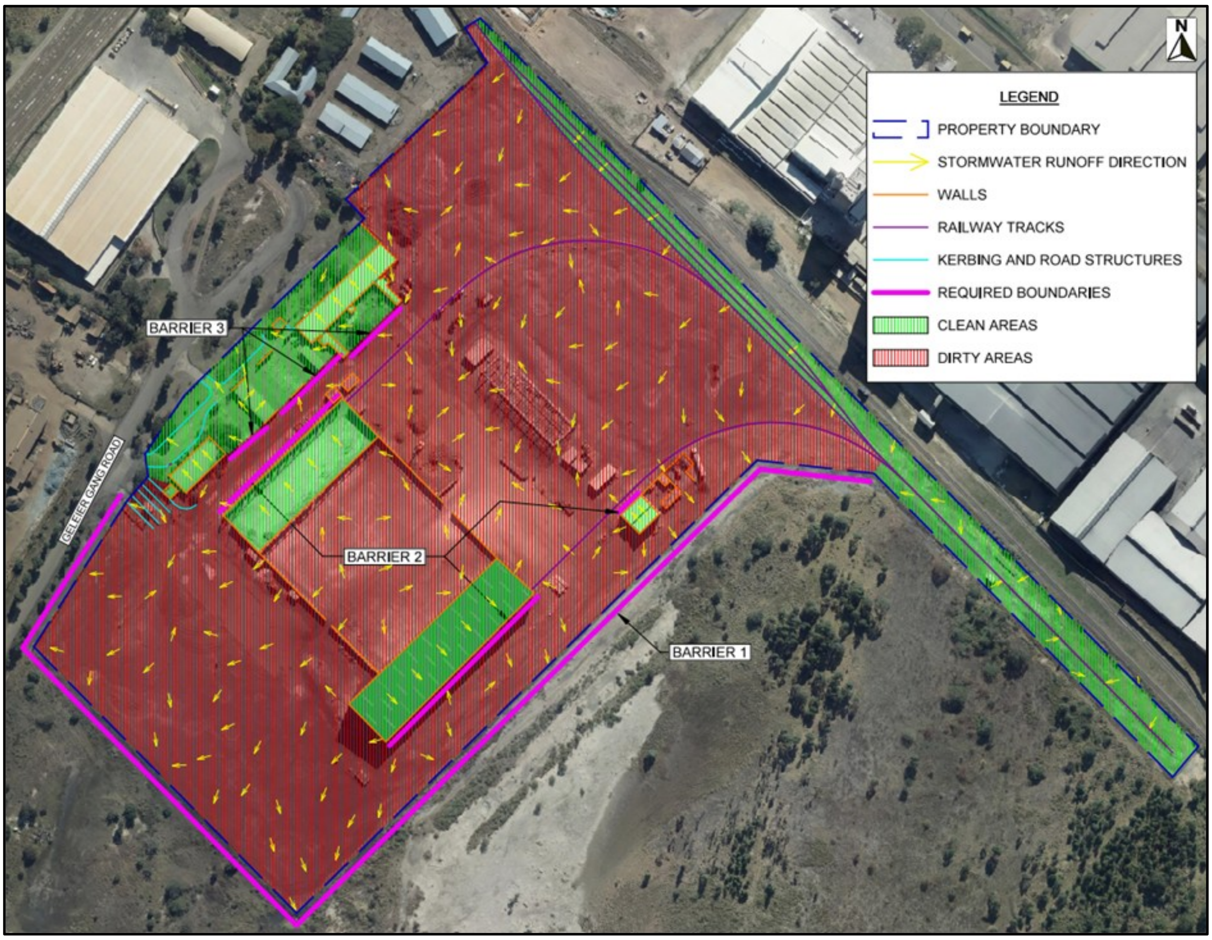

Figure 5: Required barriers between clean and dirty areas

Site observations and survey data reveal that there are currently no measures in place to prevent dirty water runoff from the stockyard area from progressing onto the clean undisturbed land at the South. Barrier 1 is required to collect dirty stormwater from the stockyard and convey the water to a location where it can be adequately discharged.

The warehouses central of the premises have undergone renovations in 2021 whereby new roofs were installed. The renovations however did not include for roof gutters and rainwater currently drains onto the surrounding ground. The rainwater from the roof of the warehouses and adjacent workshop is considered clean due to their elevation above the ground operations and minimal expected influence the operations and associated material have on them. Barrier 2 in the form of gutters and down pipes are required to collect the clean rainwater expected from the warehouses and workshop roofs. Water harvesting by means of collecting the clean roof rainwater in dedicated tanks will prevent the clean water from being contaminated.

Considering the absence of formalised hard surfaces at the stockyard areas and some of the haulage roads, the topography is susceptible to change due to erosion and mechanical activity. Topographical high points were identified adjacent the proposed barrier 3, however this could change. Barrier 3 in the form of kerbs or walls will be required to prevent the dirty water from the stockyard area from progressing onto the clean area to the West.

Considering the office blocks and parking areas are clean areas and the surface water runoff direction from the area is to the West, no stormwater management design will be required to prevent the interaction between clean and dirty water.

3.2 Impact on surface hydrology

The Grindrod Seamunye premises is an established site and is currently in full operation. It is to our understanding that Grindrod have not planned any construction works and/or earthworks within the near future that we would consider having an impact on surface hydrology. Grindrod has however previously enlisted service providers to design a new warehouse structure that would be positioned between the two existing warehouses on site. It is uncertain as to when the proposed warehouse will be constructed and if the designs will be amended. When the new warehouse is constructed, it should include stormwater management infrastructure similar to what will be proposed for the existing warehouses on site.

It must be noted that this report will provide surface water management designs that will need to be implemented by Grindrod and will include the construction of water management infrastructure that will affect the flow and behaviour of surface hydrology.

3.3 Existing stormwater management infrastructure

Site investigations and survey data reveal that there are no stormwater ponds or stormwater channels at the Grindrod Seamunye premises. Survey data did however reveal that there are existing stormwater drainage pipes and manholes serving only a portion of the site. The Figure below illustrates the existing stormwater pipes and manholes at The Grindrod Seamunye premises.

Figure 6: Existing stormwater pipeline network at the Grindrod Seamunye premises

As shown in the above Figure, the existing stormwater pipeline network only serves the central and Western portion of the Grindrod Seamunye premises. The stormwater pipeline network connects to the municipal stormwater network that discharges into an earth channel adjacent an existing railway track at the West of Grindrod Seamunye premises. It is believed that the stormwater collected and convey by the network does not undergo any form of treatment or filtration before being discharged into the municipal stormwater network. Site observations revealed that numerous manholes were laden with silt and stagnant water, indicating the stormwater network is not functioning. Existing survey information did not provide details on the stormwater pipes and manholes and their sizes are subsequently unknown. Considering that the majority of the existing network serves a classified dirty area, and the network outlet is to the natural environment, the network within the Grindrod Seamunye premises may need to be abandoned and dirty water redirected for adequate discharge.

4. CONCEPTUAL DESIGN AND REVIEW

The stormwater drainage design is aimed at managing clean and dirty surface water runoff at the Grindrod Seamunye premises in accordance with regulatory requirements. With reference to section 3.1 of this report, the drainage catchments of interest will be those that potentially contribute to the contamination of clean surface water runoff by association with dirty areas. The objective of the conceptual designs will be to separate surface water runoff from clean and dirty areas. Considering the irregularity of the topography at the stockyards, it is proposed that the ground surfaces be formalised and shaped to promote surface water runoff in the direction of intended stormwater infrastructure. The catchments will be defined by proposed new ground topography, existing impeding structures and anticipated location of new stormwater infrastructure.

4.1 Identified catchment areas

The Figure below depicts the extent of the major catchments associated with draining surface water at the Grindrod Seamunye premises.

Figure 7: Major catchments of interest identified at the Grindrod Seamunye premises

The major catchments identified, and the positioning of new stormwater infrastructure will be discussed hereunder:

- **Catchment 1**

  The current general flow direction of surface water within catchment 1 is to the South. To minimise earthworks, the formalisation of the stockyard ground surfaces should align with the existing general topography where feasible. With or without the proposed formalised surfaces, the Southern border of the premises is expected to receive the stormwater collected in catchment 1. An integrated stormwater network throughout the premises will be required to effectively collect and convey stormwater from catchment 1.

  Taking into consideration the operations of the site and expected movement of vehicles, subdividing catchment 1 will minimise the interaction between the site operations and overland flow of stormwater. Utilising existing impeding structures on site and expected vehicle routes, catchment 1 can be divided into four sub-catchments, as shown in Figure 8 below.

  The formalisation of the stockyard surfaces is discussed later in the report whereby it is proposed the new surfaces maintain the general down slope direction to the South.

  Considering the relatively large size of catchment 1, a significant amount of stormwater is expected during a 1:50 year flood event. To ensure the receiving infrastructure can manage the expected volume of stormwater from catchment 1, it will be necessary to attenuate the stormwater in an attenuation pond whereby the stormwater can be pumped at a controlled rate into the receiving infrastructure.

- **Catchment 2**

  Catchment 2, being the roofs of the warehouses and workshop, have a defined slopes sufficient for the drainage of rainwater. To collect and conserve the rainwater received by the roofs, gutters, down pipes, and water storage tanks will need to be installed. Catchment 2 can be divided into three separate sub-catchments associated with each roof, being catchment 2.1, 2.2 and 2.3, as shown in Figure 8 Below. The stored rainwater can be harvested and used on site in lieu of municipal sourced water for purposes of washing, dust suppression, etc. Considering that material on site may contain fines susceptible to wind movement, dust suppression using the harvested rainwater is recommended to avoid any potential accumulation of fines on the warehouse roofs.

- **Catchment 3**

  Considering catchment 3 has an existing down slope direction to the West, there is no concern that the clean water from this catchment will progress on to dirty areas within the premises. Since catchment 3 is developed with formalised hard surfaces, buildings and kerbs, the stormwater in the catchment will need to be managed with stormwater infrastructure to prevent localised flooding and to ensure adequate discharge into the municipal stormwater network. The existing stormwater network central of catchment 3 may be refurbished and modified to serve catchment 3 exclusively. Catchment 3 can be divided into three sub-catchments based on the position of existing stormwater infrastructure and can be seen in Figure 8 below.

- **Catchment 4**

  The railway tracks on site extend above the existing ground level, limiting the interaction of stormwater expected on either side. The Northern section of the catchment is comprised mostly of railway tracks and the ground is significantly flat. Rainwater expected in this catchment is expected to accumulate between the railway tracks and infiltrate into the ground. At the Southern section of the catchment, stormwater is expected to flow away from the railway track and onto adjacent land. No new stormwater infrastructure is proposed for catchment 4 as the clean water is expected to infiltrate into the ground, evaporate and/or flow into the adjacent natural environment.

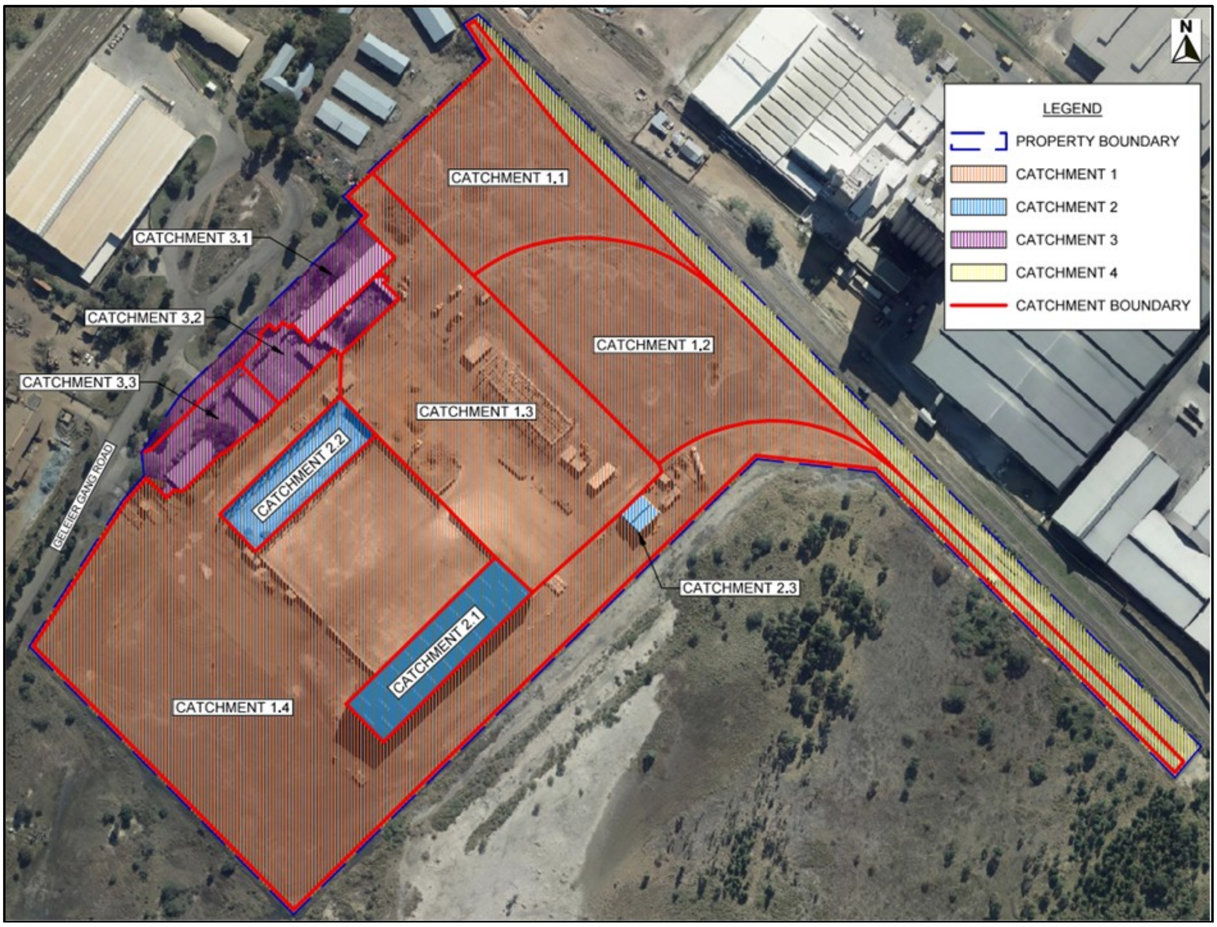

Figure 8: Sub-catchments identified at the Grindrod Seamunye premises.

4.2 Catchment properties

The runoff coefficient for each catchment is calculated based on the characteristics of the catchment.

The catchments are characterised by percentage rural, percentage urban and percentage open water bodies. The calculated factors are ratioed to the associated percentage and added together to make the total catchment runoff coefficient.

The rural runoff coefficient for each catchment is calculated based on the catchment surface slope, permeability of the soil in the catchment and the vegetation characteristics in the catchment.

From the geotechnical investigation report compiled by Davies Lynn & Partners, it was established that the Grindrod Seamunye premises is underlain by a cover of unconsolidated and partly consolidated sediments of aeolian and alluvial origin. The said sediments are in turn underlain by weathered calcarenite and coquina of the Uloa Formation of Miocene age, which is then typically underlain by siltstones of the St Lucia Formation of Cretaceous age. The permeability of the soils can be described as impermeable to semi permeable. The permeability factor of the rural runoff coefficient was therefore calculated based on the assumption that 50% of the catchments soil is semi-permeable and 50% of the catchments soil is impermeable.

The vegetation factor of the rural runoff coefficient was based on the visual assessment of the ground conditions. The aforementioned factor varies for each catchment.

The surface slope factor of the rural runoff coefficient was based on the aerial survey of the area and varies for each catchment.

The urban runoff coefficient for each catchment was calculated based on the percentage of the urban area that are streets, city/residential and/or industrial areas. The aforementioned factor was determined by site assessments and using the orthophoto imagery of the catchments.

Considering our proposal for the formalisation of the stockyards, the catchment properties will be based on the assumption that our proposal will be adopted, resulting in the worst-case scenario with respect to runoff coefficients.

The tables below provide the properties for the respective catchments.

Table 2: Catchment rural properties

CATCHMENT RURAL PROPERTIES							
Catchment	**% Rural**	**Slope (m/m)**	**Permeability**	**No Vegetation (%)**	**Light Bush (%)**	**Grassland (%)**	**Rural Coefficient**
1.1	100	<0.1	100% Impermeable	100	0	0	0.65
1.2	100	<0.1	100% Impermeable	100	0	0	0.65
1.3	0	-	-	-	-	-	-
1.4	27	<0.1	100% Impermeable	100	0	0	0.65
2.1	0	-	-	-	-	-	-
2.2	0	-	-	-	-	-	-
2.3	0	-	-	-	-	-	-
3.1	66	<0.1	50% Semi-Permeable 50% Impermeable	0	0	100	0.55
3.2	32	<0.1	50% Semi-Permeable 50% Impermeable	0	0	100	0.55
3.3	8	<0.1	50% Semi-Permeable 50% Impermeable	0	0	100	0.55
4	100	<0.1	50% Semi-Permeable 50% Impermeable	100	0	0	0.6

Table 3: Catchment urban properties

CATCHMENT URBAN PROPERTIES					
Catchment	**% Urban**	**Industrial Area (%)**	**Residential (%)**	**Streets (%)**	**Urban Coefficient**
1.1	0	-	-	-	-
1.2	0	-	-	-	-
1.3	100	0	0	100	0.95
1.4	61	0	0	100	0.95
2.1	100	100	0	0	0.95
2.2	100	100	0	0	0.95
2.3	100	100	0	0	0.95
3.1	34	100	0	0	0.95
3.2	68	18	0	82	0.95
3.3	92	33	0	67	0.95
4	0	-	-	-	-

Table 4: Catchment – Water bodies

Catchment	% Water Bodies	Coefficient
1.1	0	-
1.2	0	-
1.3	0	-
1.4	12	1
2.1	0	-
2.2	0	-
2.3	0	-
3.1	0	-
3.2	0	-
3.3	0	-
4	0	-

Table 5: Absolute catchment properties

CATCHMENT PROPERTIES			
Catchment	**Catchment Area (km²)**	**Longest Path (km)**	**Runoff Coefficient**
1.1	0.010000	0.177	0.65
1.2	0.014595	0.293	0.65
1.3	0.020208	0.298	0.95
1.4	0.055466	0.652	0.87
2.1	0.003752	0.030	0.95
2.2	0.002991	0.030	0.95
2.3	0.000258	0.008	0.95
3.1	0.003309	0.031	0.69
3.2	0.002319	0.103	0.82
3.3	0.002676	0.091	0.92
4	0.010514	0.601	0.60

4.3 Design parameters

The following design parameters were adopted when undertaking hydrological calculations:

- Mean Annual Precipitation (MAP) : 1255mm/annum (Richards Bay Municipality)
- Minor system : 50-year recurrence interval
- Runoff calculations : Rational method
- Area reduction Factor : 100% (0-10 Km²)

Civil Designer Software was utilised in performing all hydrological calculations.

4.4 Conceptual designs

- **Catchment 1**

  With a total combined area of 100,269 m², the four identified sub-catchments will need to be inter-connected to form a network that drains Catchment 1 of surface water runoff. The Figure below demonstrates schematically the position of proposed stormwater infrastructure and associated drainage flow directions.

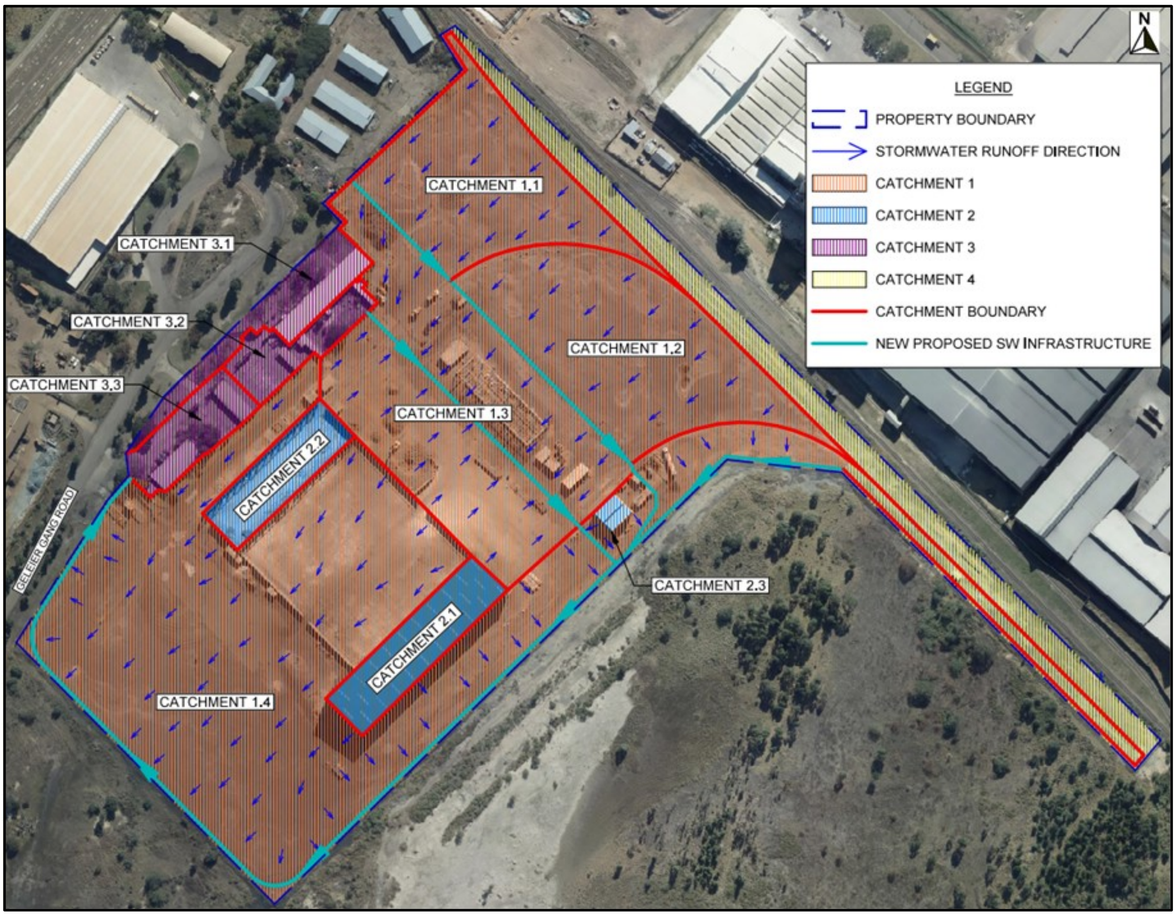

Figure 9: Proposed positioning of new stormwater infrastructure to serve catchment 1

To ensure the stockyards are effectively drained of surface water, the stockyards will need to be formalised with sloped hard surfaces. Considering the existing terrain and existing infrastructure on site, the proposed hard surfaces of catchment 1 will have varying slopes of between 0.5% to 5.3% to tie into existing infrastructure and ensure effective drainage of surface water.

In the event of a 1:50 year flood, the following maximum flow rates are expected from the respective sub-catchments:

Table 5: Catchment 1 flow rates

CATCHMENT 1	
SUB-CATCHMENT	**FLOW RATE (m^3/s)**
1.1	0.5739
1.2	0.7920
1.3	1.0100
1.4	2.3057

Taking into consideration the proposed upgrade of the stockyards and the expected movement of vehicles, stormwater runoff from catchment 1 will be best managed by a combination of lined channels and concrete stormwater pipes. The benefit of channels is they allow the collection of stormwater along their length whereas the benefit of concrete stormwater pipes is they allow the conveyance of stormwater underground in areas where the ground surface is developed. As discussed under section 4.1 of this report, an attenuation pond will be required to manage the stormwater collected from catchment 1 and allow for the controlled discharge into the receiving infrastructure.

The Figure below indicates the type of stormwater infrastructure proposed for catchment 1.

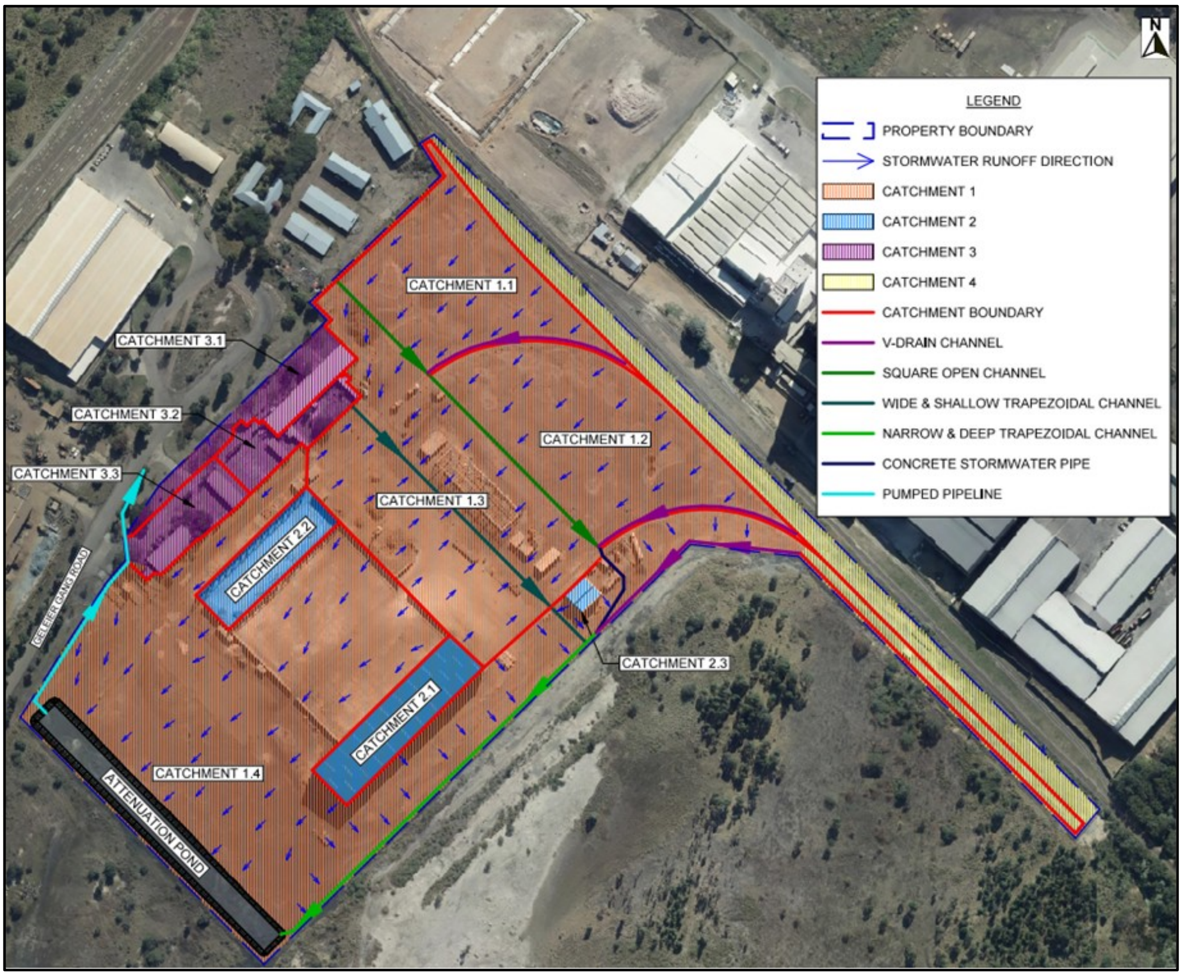

Figure 10: Proposed stormwater infrastructure for catchment 1

The proposed stormwater infrastructure sizes and configuration will be discussed under section 9 of this report.

- **Catchment 2**

With a total combined area of 7,001m², the three identified sub-catchments are independent from one another and will each require dedicated rainwater management and collection systems. The Figure below demonstrates schematically the position of proposed stormwater infrastructure and associated drainage flow directions.

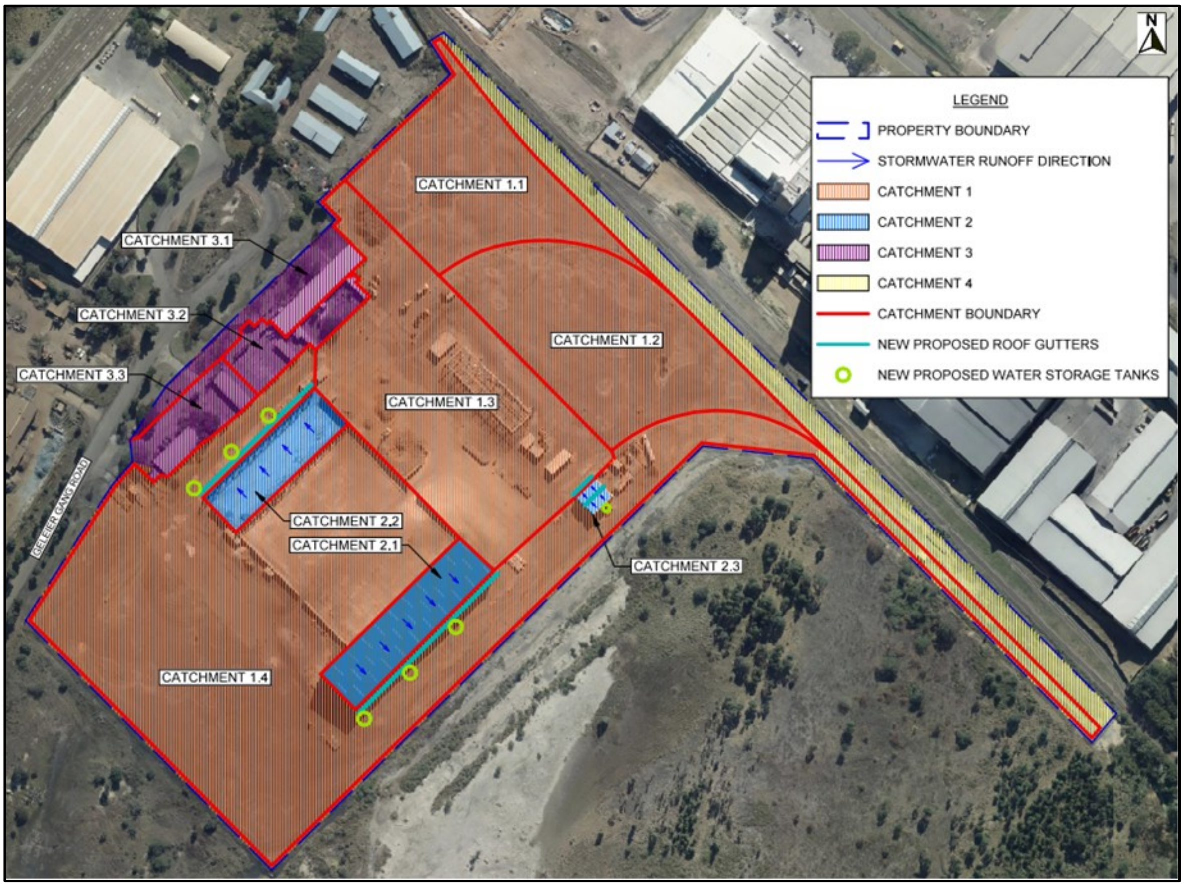

Figure 11: Proposed stormwater infrastructure for catchment 2

To ensure the proposed water storage tanks and gutters are of easily obtainable sizes, catchments 2.1 and 2.2 have been divided into equal areas respectively. In the event of a 1:50 year flood, the following maximum flow rates are expected in the respective sub-catchments:

Table 6: Catchment 2 flow rates

CATCHMENT 2		
SUB-CATCHMENT	**CATCHMENT SUB-DIVISION**	**SUB-DIVISION FLOW RATE (m^3/s)**
2.1	8	0.0279
2.2	6	0.0297
2.3	2	0.0077

Preliminary calculations reveal that sub-catchments 2.1 and 2.2 will require 200x200mm box gutters with a minimum slope of 1:200m/m. Catchment 2.1 will require 8 down pipes whereas catchment 2.2 will require 6. Sub-catchments 2.3 will require 130x130mm box gutters with a minimum slope of 1:200m/m and drained by 2 separate down pipes.

- **Catchment 3**

With a total combined area of 8,304 m², the three identified sub-catchments have defined drainage routes due to formalised ground surfaces and existing structures. Advancing on the existing stormwater infrastructure in the catchments, concrete stormwater pipes and inlet structures have been strategically positioned to effectively drain the catchments of stormwater. The Figure below demonstrates schematically the position of proposed stormwater infrastructure and associated drainage flow directions.

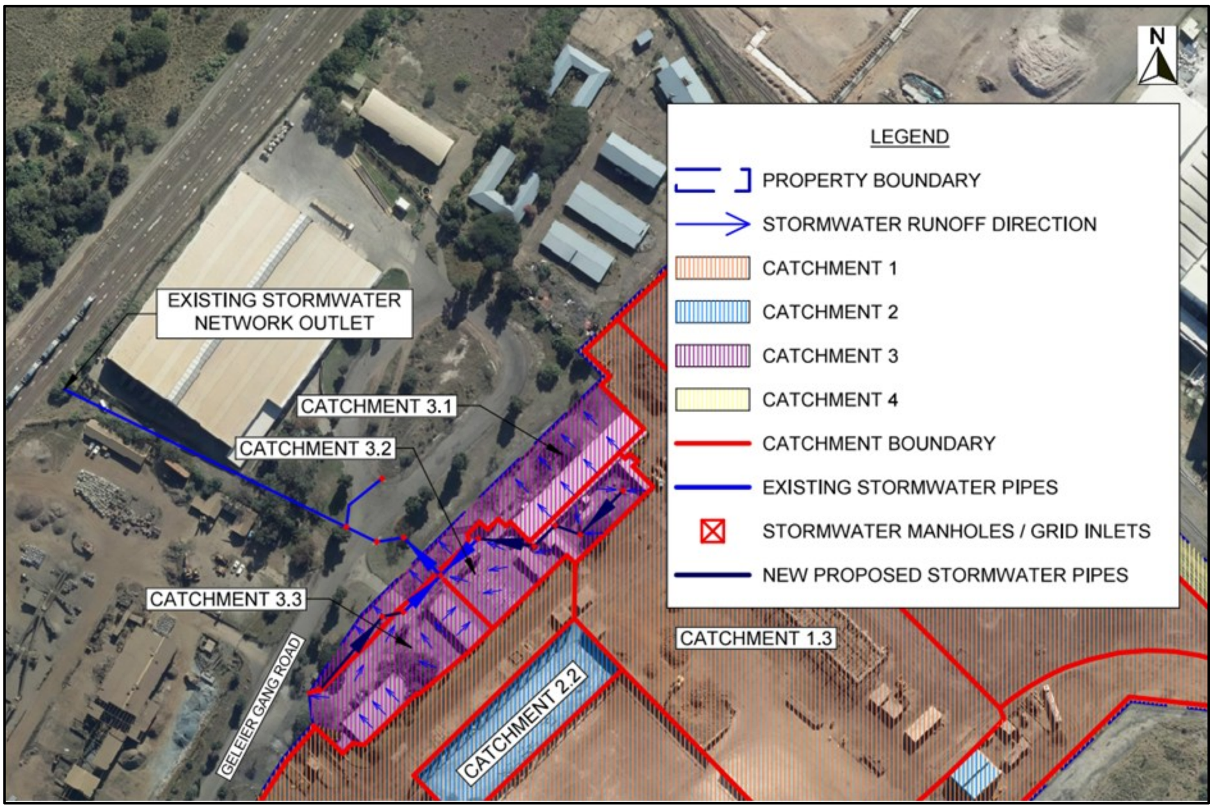

Figure 12: Proposed stormwater infrastructure for catchment 3

In the event of a 1:50 year flood, the following maximum flow rates are expected from the respective sub-catchments:

Table 7: Catchment 3 flow rates

CATCHMENT 3	
SUB-CATCHMENT	**FLOW RATE (m^3/s)**
3.1	0.1000
3.2	0.1330
3.3	0.1580

Catchment 3.1 borders the property perimeter to the North West, being the direction where stormwater is expected to flow. Catchment 3.1 requires no stormwater management as the stormwater from the catchment is expected to flow to Geleier Gang Road to the North West where existing muicipal stormwater infrastructure will suffice in collecting the expected stormwater.

The existing stormwater pipelines and manhole within catchment 3 can be utilised, however the manhole invert levels may require alterations to allow for the connection of the new proposed stormwater pipes and manholes.

- **Catchment 4**

With a total area of 10,514 m², catchment 4 comprises of railway tracks over comparatively level ground. Catchment 4 exhibits no defined drainage routes albeit the presence of railway tracks that protrude the ground level and have the potential to impeded overland flow of stormwater. No stormwater infrastructure is proposed for catchment 4 as it is expected that stormwater received by the catchment will collect between the railway tracks and infiltrate into the ground or eventually flow into neighbouring land. Aside from trains using the railways, no other traffic or operations is expected in catchment 4. The Figure below depicts catchment 4 and illustrates the general flow direction of stormwater.

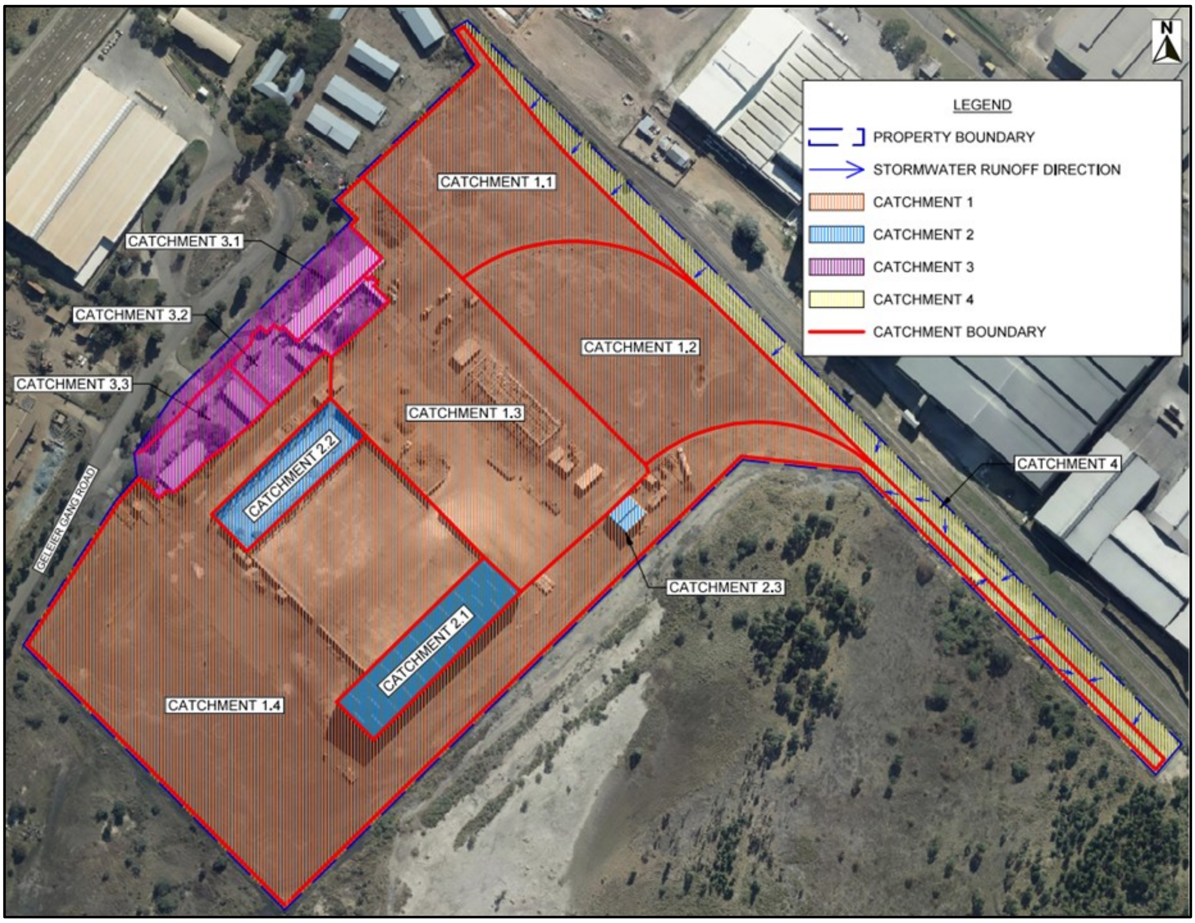

Figure 13: Catchment 4 with illustrated general flow direction of stormwater

4.5 Construction, Operational, Decommissioning and Post Closure Phases

The construction, operational, decommissioning and post closure phases of the identified stormwater infrastructure required for the respective Stormwater Networks will be discussed hereunder.

- **Lined Open Channels**

  The construction commences with delineating the route where the channel is to be constructed. An excavator will lead by excavating a trench in line with the proposed channel route at a depth and slope in accordance with the design. The excavator will thereafter excavate the walls of the trench to a slope in accordance with the design. Excess excavated material will need to be appropriately discarded of or stored for reuse elsewhere. To ensure ground stability, the channel in-situ material will need to undergo compaction to the designed MOD AASHTO density. It may be required that additional material be imported for the construction of designed layer works, depending on the designed surface material type, and expected overhead vehicular movement. For concrete lined channels, formwork will need to be constructed along the channel where required. In accordance with the design, reinforcement will need to be prefabricated, imported, and installed prior the placement of concrete. Depending on the concrete design and quantity required, concrete may be mixed on site or commercially sourced. The placement of concrete will need to be accompanied by vibration to mitigate potential honeycombing. The concrete will need to be placed to the designed thickness and have the required finish. Saw-cut joints in the hardened concrete may be required and will need to be made using a concrete grinder and the joints sealed to the engineer’s requirements. For paved channels, bedding sand will need to be imported, placed and levelled in accordance with the design. Pavers to be utilised will presumably be of interlocking type with thickness in accordance with the design. The pavers will need to be placed in the required configuration whereafter fine grade sand will need to be swept over the pavers to fill the paving joints. The pavers will require compaction which can be done using a plate compactor.

It is imperative that after construction, the site be cleared of all construction debris and litter that may have resulted from the construction process. It is vital that spill mitigation processes are in place and are implemented to safeguard the natural environment in the event of a spillage or contamination of the natural surroundings during and/or after construction.

On the completion of the construction and the commissioning of the channels, maintenance processes will need to be implemented to ensure the channel is in optimal functioning condition. Maintenance of the lined stormwater channels includes, but is not limited to, regular inspections of the channel route, regular clearance of vegetation growing within or alongside the channel and regular clearance of deposits within the channel. Mechanical damage or age-related deterioration of the channels will need to be attended to when apparent.

Decommissioning of the channels will require the demolition and removal of the surface layer (i.e. concrete or pavers). The channel layer works will be of natural material and can be retained. The channel will require backfilling with imported soil to achieve predeveloped levels. To prevent soil erosion of the backfill material, grass sods need to be installed over all exposed ground and fixed in position with wooden pegs. The grass sods will require frequent watering and maintenance to ensure they take to the underlying topsoil.

Regular inspections of the earth channel route post closure will be required. Erosion along the channel route may indicate the need to undertake corrective measures such as backfilling the area of erosion and planting grass sods to protect the soil from further erosion.

- **Concrete Stormwater Pipes**

The construction commences with delineating the stormwater pipe route and marking the positions of the manholes / junction boxes. The excavator will lead by excavating a trench in line with the designed stormwater pipe route at a depth in accordance with the design. To minimise the risk of collapse, pipe trenches should not be left open for extended periods of time and the pipeline should be installed in sections. The construction site will move along the proposed stormwater pipeline route, starting with excavating the pipe trench and ending with backfilling the trench and compacting to natural ground level. The excavated trench material will be temporarily stored on site until utilised as backfill. Once the trench excavation is to the designed depth and length, bedding material will need to be imported. Utilising an excavator, the bedding material will be placed at the bottom of the trench excavation to a designed layer thickness and compacted to the required MOD AASHTO density. The stormwater pipe will thereafter be placed above the bedding material. Backfilling will take place in accordance with the design requirements. The construction of stormwater manholes and grid inlet structures will require the import of precast concrete manhole covers and bricks. The manhole base will be constructed using site batched concrete, cast to the designed manhole invert level. The manhole walls will be constructed of brick in accordance with the design requirements. Backfilling around the manhole will need to be undertaken in layers and compacted in accordance with the design.

It is imperative that after construction, the site be cleared of all construction debris and litter that may have resulted from the construction process. It is vital that spill mitigation processes are in place and are implemented to safeguard the natural environment in the event of a spillage or contamination of the natural surroundings during and/or after construction.

On the completion of the installation and the commissioning of the stormwater pipeline network, maintenance processes will need to be in place to ensure the stormwater pipeline is in optimal functioning condition. Maintenance of the Stormwater pipeline infrastructure includes, but is not limited to, regular inspections of the pipe route, regular clearance of ground vegetation along pipeline routes, regular clearance of deposits within the pipelines and yearly maintenance of the manholes. To ensure ease of access to any portion of the stormwater pipeline route, sufficient ground clearance is required for the efficient mobilisation of personal and resources in the event maintenance on the stormwater pipeline or manholes is required.

Decommissioning of stormwater pipelines may involve the excavation and removal of the pipes from underground. The aforesaid may however be a costly and timeous process and is not recommended. Alternatively, the pipes may be retained underground and all inlet structures to the pipe network be demolished and backfilled to prevent the ingress of stormwater. Regular inspections of the pipe route post closure will be required. Localised flooding, erosion and/or depressions along the pipe route may indicate the collapse of the decommissioned pipeline underground and will as a consequence require the removal of the pipeline.

- **Attenuation Pond**

The construction commences with marking the pond bank perimeter. An excavator will lead by excavating the pond area to a depth in accordance with the design. The excavator will thereafter shape the banks to a slope in accordance with the design. Excavated material will need to be appropriately discarded of or stored for reuse elsewhere. To prevent the saturation of the underlying soils, a liner barrier system will need to be installed in accordance with the detailed design. The pond proposed will need to be trafficable to allow for maintenance, hence the pond will require a hard surface layer manufactured from concrete. In accordance with the detailed design, reinforcement will need to be prefabricated, imported, and installed prior the placement of concrete. Due to the large quantity of concrete expected, concrete will need to be commercially sourced. The placement of concrete will need to be accompanied by vibration to mitigate potential honeycombing. The concrete will need to be placed to the designed thickness and have the required finish. Saw-cut joints in the hardened concrete may be required and will need to be made using a concrete grinder and the joints sealed to the engineer's requirements. The inlet and overflow structures will comprise of reinforced concrete and the construction thereof will need to comply with the detailed design requirements.

It is imperative that after construction, the site be cleared of all construction debris and litter that may have resulted from the construction process. It is vital that spill mitigation processes are in place and are implemented to safeguard the natural environment in the event of a spillage or contamination of the natural surroundings during and/or after construction.

On the completion of the construction and the commissioning of the attenuation pond, maintenance processes will need to be implemented to ensure the pond is in optimal functioning condition. Maintenance of the pond includes, but is not limited to, regular inspections of the pond surface, regular clearance of vegetation growing along the pond perimeter and regular clearance of deposits within the pond. Mechanical damage or age-related deterioration of the pond surface will need to be attended to when apparent.

Decommissioning of the attenuation pond will require the demolition and removal of the surface layer. It is expected that the underlying liner barrier system will include HDPE material and / or geofabrics, all of which will need to be removed. Natural liner material can be retained underground. The pond will require backfilling with imported soil to achieve predeveloped levels. To prevent soil erosion of the backfill material, grass sods need to be installed over all exposed ground and fixed in position with wooden pegs. The grass sods will require frequent watering and maintenance to ensure they take to the underlying topsoil.

Regular inspections of the pond area post closure will be required. Erosion at the pond area may indicate the need to undertake corrective measures such as backfilling the area of erosion and planting grass sods to protect the soil from further erosion.

5. SUITABILITY OF EXISTING STORMWATER INFRASTRUCTURE

The suitability of the existing stormwater infrastructure at the Grindrod Seamunye premises will be assessed on functionality and on the principals and objectives set out in the BPG G1: Storm Water Management. The figure below is an extract from the BPG G1: Storm Water Management, from which the adequacy of the existing stormwater infrastructure will be assessed.

There are four primary principles that need to be applied in the development and implementation of a SWMP.

1 Clean water must be kept clean and be routed to a natural watercourse by a system separate from the dirty water system while preventing or minimising the risk of spillage of clean water into dirty water systems. This will limit the reduction in water flow to the receiving water environment/catchment (loss of water to the catchment) and thus increase the water available in the water resource to other users.

2 Dirty water must be collected and contained in a system separate from the clean water system and the risk of spillage or seepage into clean water systems must be minimised. The containment of dirty or polluted water will minimize the impact on the surrounding water environment.

3 The SWMP must be sustainable over the life cycle of the mine and over different hydrological cycles and must incorporate principles of risk management. Portions of the SWMP, such as those associated with waste management facilities, may have to remain after mine closure since management is required till such time that the impact is considered negligible and the risk no longer exists.

Figure 14: Principals and guidelines for the assessment of stormwater infrastructure. Extract from the BPG G1: Storm Water Management

The figure below illustrates the layout of the existing stormwater infrastructure at the Grindrod Seamunye premises. The existing manhole positions were obtained from as-built information supplied by Grindrod, however the existing manhole cover levels, invert levels and connecting pipe sizes were not available.

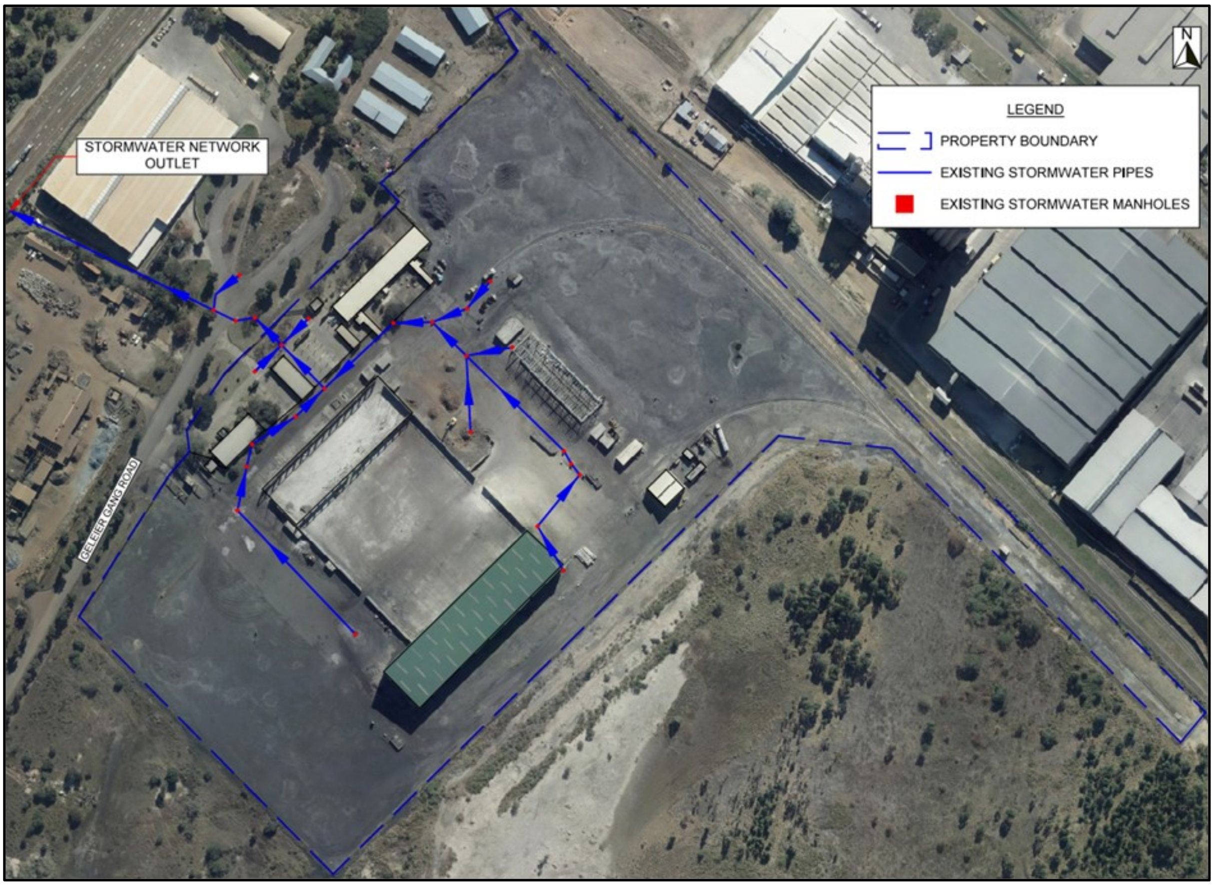

Figure 15: Existing stormwater pipeline network at the Grindrod Seamunye premises

As mentioned under section 3.3 of this report, the existing stormwater infrastructure serves only a portion of the site. Considering the respective area classifications, the existing stormwater network currently collects stormwater from clean and dirty areas and discharges into the municipal stormwater network. It was established that the said municipal stormwater network discharges adjacent railway tracks to the West of the site whereafter it is believed to be collected by natural streams. It can therefore be concluded that the existing stormwater infrastructure at the Grindrod Seamunye premises does not allow for the separation of clean and dirty surface water runoff and is not designed to manage dirty water as the receiving environment is a natural watercourse.

6. REQUIRED CHANGES TO EXISTING STORMWATER INFRASTRUCTURE

With due regard of the discussion under Section 5 of this report, it can be concluded that the existing stormwater network does not comply with regulatory requirements. Taking into consideration the concept stormwater designs, most of the existing stormwater network will provide no benefit to adequately manage stormwater on site. The Figure below illustrates the existing stormwater infrastructure to be abandoned.

Figure 16: Existing stormwater infrastructure to be excluded from the stormwater management plan

As discussed under Section 4.4 of this report, the stormwater pipelines and manholes to be retained may require alterations to align with the new proposed stormwater infrastructure. The alterations, if so required, must be established during detailed design.

7. REQUIRED ADDITIONS TO EXISTING STORMWATER INFRASTRUCTURE

As discussed under Section 6 of this report, only a section of the existing stormwater infrastructure at the Grindrod Seamunye premises will be retained. The existing stormwater pipes and manholes can only be integrated if inspected and found to be structurally sound and functional. The Figure below illustrates the integration between the existing stormwater infrastructure and proposed new stormwater infrastructure.

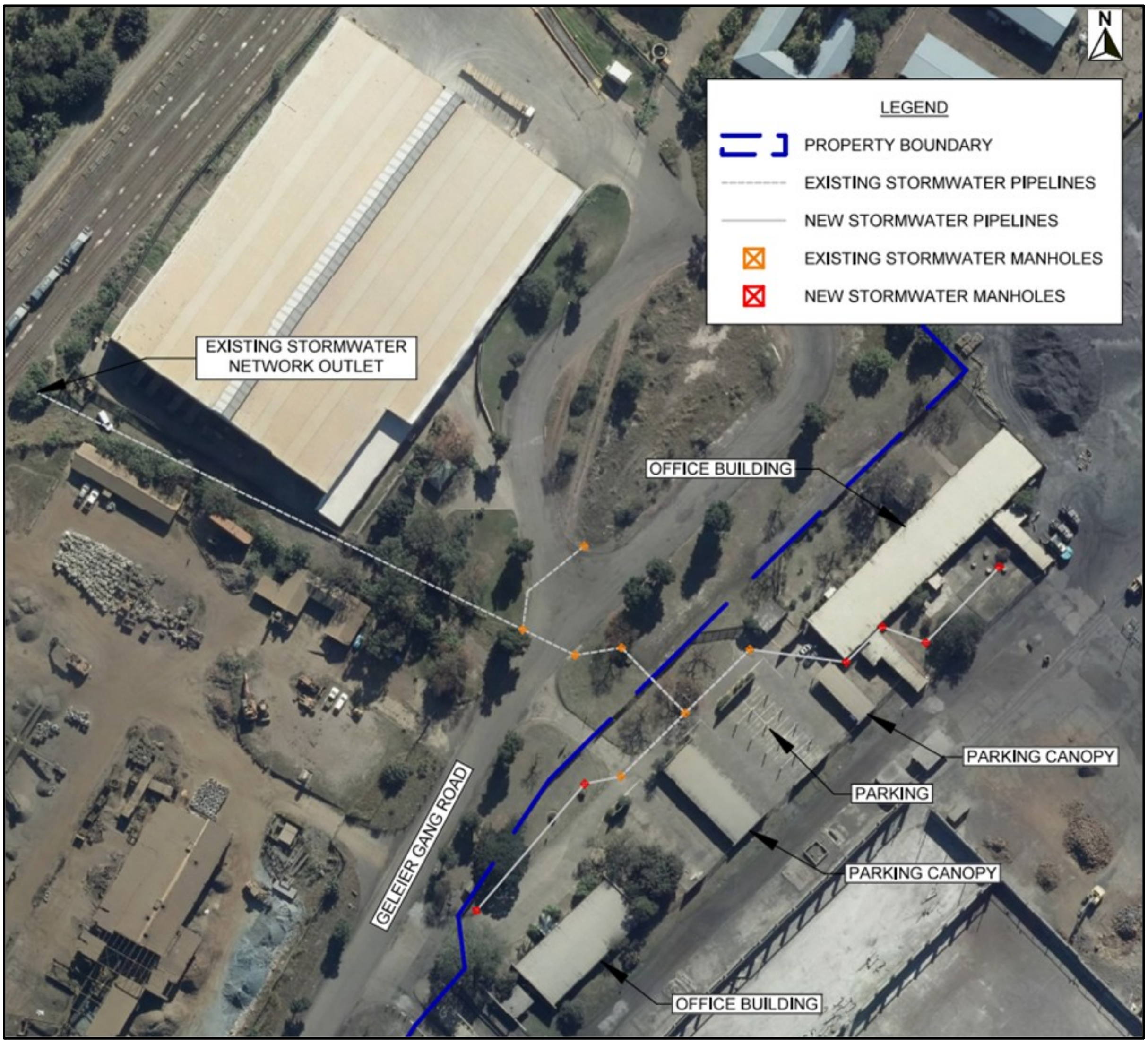

Figure 17: Stormwater infrastructure to drain clean stormwater from catchment 3

8. WATER QUALITY

Surface water samples was collected from the Grindrod Seamunye premises on the 12th October 2022 and issued to Talbot Laboratories for chemical assessment in accordance with Waste Management and Classification Regulations 2013 (GN R634). Considering that material such as coal will be stockpiled on site, the overland flow of stormwater is expected to be laden with material fines in the form of suspended solids. Due to the aforesaid, stormwater from the classified dirty areas is prohibited from being discharged into the environment and municipal stormwater network. The chemical assessment was also undertaken to establish if any of the proposed stormwater infrastructure designs, such as channels, will need to include for liner barrier systems to protect underlying soils from potential pollutants.

The chemical assessment of the ground surface water in terms of GN R634 concluded that the water sample had no applicable waste constituent, characteristic, property, or hazard identified. The Figure below is an extract from the waste assessment and classification report compiled by Talbot Laboratories.

Preliminary assessment in terms of GN R634 and GN R636 concluded:

Reference	Clause	Applicability
GN R634 A1.2(a)	Listed General Waste	None identified
GN R634 A1.2(b)	Listed Hazardous Waste	None identified
GN R636 S.5	**Current Prohibition/Restriction from Disposal**	**Y (1)(q)(ii)**
GN R636 S.5	**Future Prohibition/Restriction from Disposal**	**Y (1)(r)(iv)**

Note: No treatment or stabilization of the waste has been advised.

Listed general waste per GN R634 Annexure 1 (2)(a):

- No applicable waste constituent, characteristic, property, or hazard was identified.

Listed hazardous waste per GN R634 Annexure 1 (2)(b):

- No applicable waste constituent, characteristic, property, or hazard was identified.

Currently prohibited or restricted waste in terms of disposal per GN R636 (5):

- Type 0, Prohibited Waste per GN R636 (5)(1)(q)(ii) Waste with a moisture content >40% or that liberates moisture under pressure in landfill conditions, and which has not been stabilised by treatment. Analytical value of: 100 %.

Waste listed in GN R636 Section 5 (1) and (2), with future prohibition from or restriction to disposal:

- Future Prohibited Waste per GN R636 (5)(1)(r)(iv) >6% Total Organic Carbon (TOC). Non-hazardous waste with analytical value of: 33 %. (Prohibited from: Aug 2028)

Figure 18: Extract from waste assessment and classification report compiled by Talbot Laboratories

As indicated in the Figure above, surface water from the Grindrod Seamunye premises exhibited no applicable waste constituent, characteristic, property, or hazard with reference to GN R634. The samples did however classify as type 0, prohibited waste as per GN R636 and can be attributed to the fact that the samples were liquids with site material fines. The classification as per GN R636 is considered negligible as the stormwater will not be discarded at a landfill site. stormwater infrastructure designs proposed for Grindrod Seamunye will not need to include for specialised liner barriers however will need to allow for the management of suspended solids.

The stormwater received from classified dirty areas at the Grindrod Seamunye premises must either undergo treatment prior to discharge into the environment or be discharged into the municipal sewer network. Treating the stormwater will be a costly exercise and it is proposed the stormwater be discharged into the existing municipal sewerage system in accordance with the uMhlathuze Local Municipality Water Services Bylaws, Notice 30 of 2020.

Hydrological calculation revealed that 4761.7m^3 of dirty stormwater is expected from catchment 1 in the event of a 1:50 year flood, more than what the existing municipal sewerage infrastructure is expected to manage. Due to aforesaid, the stormwater from catchment 1 will need to be attenuated in a pond whereby the rate at which the stormwater discharges into the municipal sewerage system can be managed by pumps. The proposed attenuation pond will be designed to allow the material fines suspended within the stormwater to settle. The settled fines will need to be regularly removed from the attenuation pond and adequately disposed of. The table below provides the constituent limits for disposal in the municipal sewerage system and the results of the assessment undertaken on the samples received from site.

Table 8: Sample results compared to municipal effluent acceptance limits

Physical / Aesthetic Parameters	Unit	Limit	Result
pH @ 25°C	pH units	6.5<pH<10	6.80
Total Dissolved Solids	mg/L	500	334
Chemistry (Macro) Parameters	**Unit**	**Limit**	**Result**
Chloride as Cl	mg/L	500	7.96
Fluoride as F	mg/L	5	0.19
Sulphate as SO_4	mg/L	250	79.00
Sulphide as S	mg/L	1	TBC
Zinc as Zn	mg/L	5	0.04
Chemistry (Micro) Parameters	**Unit**	**Limit**	**Result**
Arsenic as As	µg/L	5000	<80.00
Boron as B	µg/L	5000	<160
Cadmium as Cd	µg/L	5000	<170
Chromium as Cr	µg/L	5000	<160
Cobalt as Co	µg/L	5000	<170
Copper as Cu	µg/L	5000	<170
Cyanide as CN	µg/L	10000	20.0
Iron as Fe	µg/L	5000	TBC
Lead as Pb	µg/L	5000	<80
Manganese as Mn	µg/L	5000	<170
Mercury as Hg	µg/L	1000	<3.10
Nickel as Ni	µg/L	5000	<180
Selenium as Se	µg/L	5000	<630
Titanium as Ti	µg/L	5	TBC
Organic Parameters	**Unit**	**Limit**	**Result**
Fats, Oils & Grease	mg/L	50	TBC
Phenols	µg/L	5000	<3
Surfactants - Anionic	mg/L	500	TBC

TBC: To be confirmed with additional testing

The limits indicated in the table above can be found in the uMhlathuze Local Municipality Water Services Bylaws, Notice 30 of 2020. Test results of the samples collected from Grindrod Seamunye do not have any physical, chemical, or organic parameters that exceed the limits of discharge into the municipal disposal system. It is therefore recommended that Grindrod submit a permit application to uMhlathuze Local Municipality for the discharge of dirty stormwater into the municipal sewerage system. The design of new stormwater infrastructure will be undertaken assuming Grindrod acquires a permit from uMhlathuze Local Municipality for the discharge of dirty stormwater into the municipal sewerage system. The Figure below depicts the layout of municipal sewerage infrastructure in the vicinity of Grindrod Seamunye.

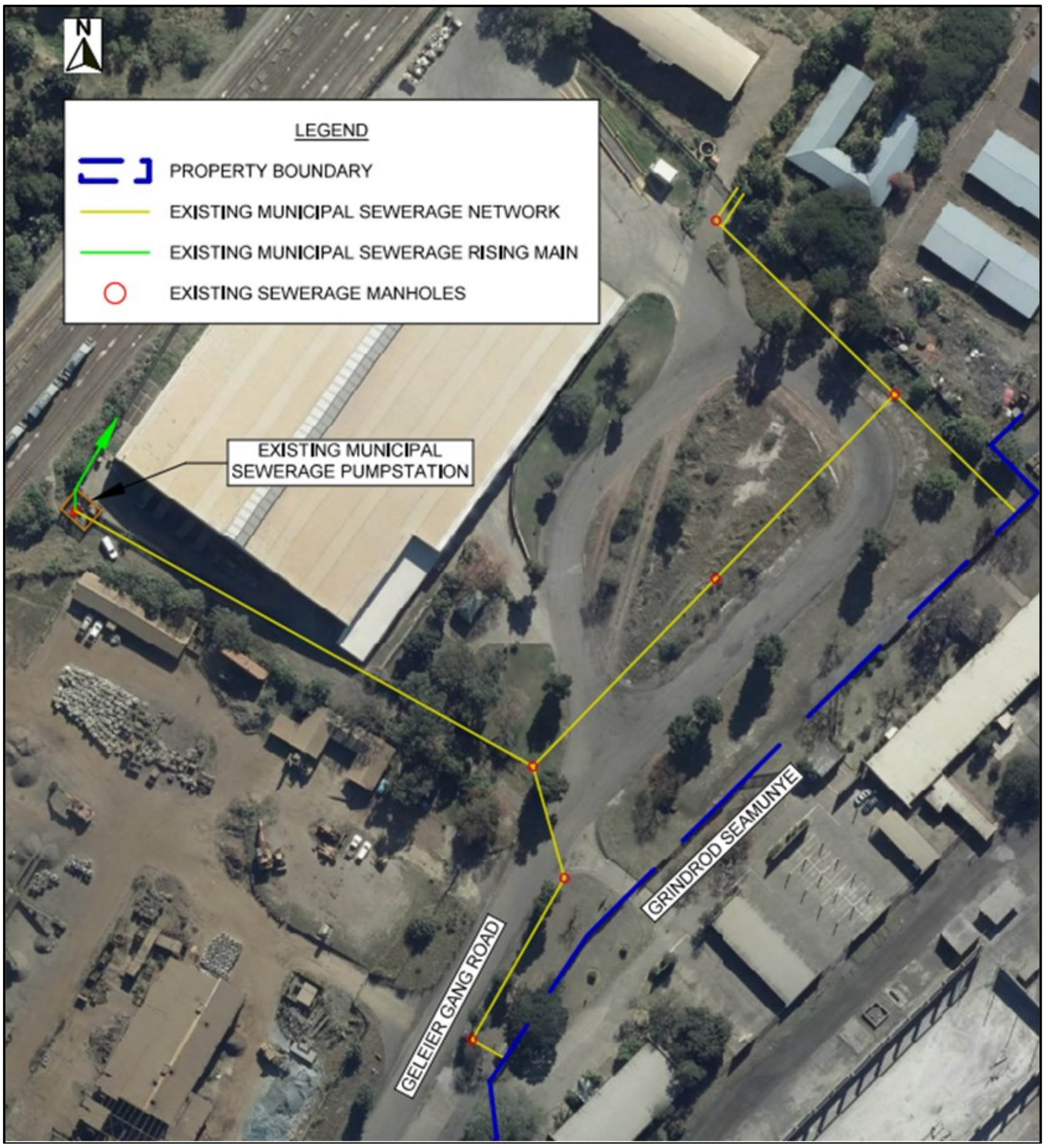

Figure 19: Municipal sewerage system in the vicinity of Grindrod Seamunye

9. DESIGN OF NEW STORMWATER INFRASTRUCTURE

Grindrod has previously acquired stormwater infrastructure designs developed by BVi Consulting Engineers. This section of the report will focus primarily on the hydrological calculations and modelling undertaken to verify the size and configuration of new stormwater infrastructure required at Grindrod Seamunye. Civil Designer Software version 8.5 will be the primary programme of use for design. The Design parameters outlined under Section 4 of this report will govern the sizing of new infrastructure and the Layout of the new infrastructure will conform to the conceptual designs. The designs will be discussed separately with reference to the associated stormwater catchment.

9.1 Catchment 1

Catchment 1 comprises predominantly of open areas where material is stockpiled. During a precipitation event, surface water runoff from catchment 1 is expected to be laden with suspended solids, consequently being classified as dirty. As discussed under section 8 of this report, the dirty stormwater runoff from catchment 1 will need to be attenuated in a pond before being pumped into the municipal sewerage system. The fines expected in the stormwater will settle in the attenuation pond and will require regular removal. Taking into consideration the movement of vehicle and the stockpiling of material in the catchment, the implementation of stormwater channels is expected to provide the most effective means of collecting surface water runoff in the catchment with minimal interference with site operations. The design of stormwater infrastructure for catchment 1 will be further divided into the identified sub catchments.

9.1.1 Catchment 1.1 & 1.2

Catchments 1.1 and 1.2 are areas where material is stockpiled. As discussed under section 4.4 of this report, it is imperative that the stockpile areas are formalised with designed slopes to effectively drain the area of surface water in the event of a precipitation event. The stormwater infrastructure design to serve catchments 1.1 and 1.2 will be based on the assumption that the stockpile areas will be formalised with a slope of at least 0.5%. Hydrological calculations reveal that stormwater collected by catchments 1.1 and 1.2 will have a maximum runoff of 0.3926m³/s and 0.5419m³/s respectively during a 1:50 year flood event. The Figures below demonstrate the layout and performance of the stormwater infrastructure dedicated to collecting and conveying stormwater from catchments 1.1 and 1.2.

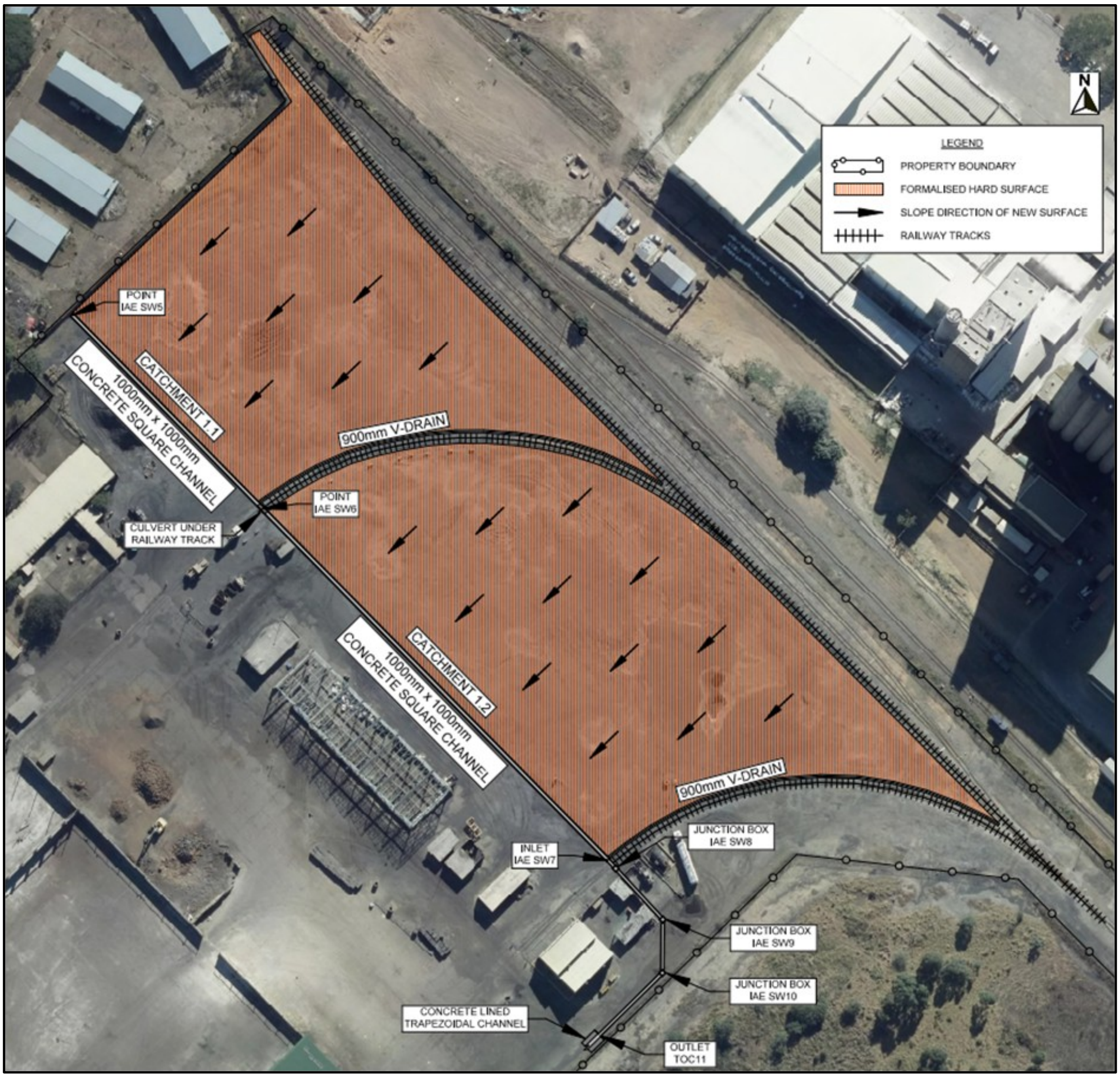

Figure 20: Stormwater infrastructure proposed for collecting stormwater from catchments 1.1 and 1.2

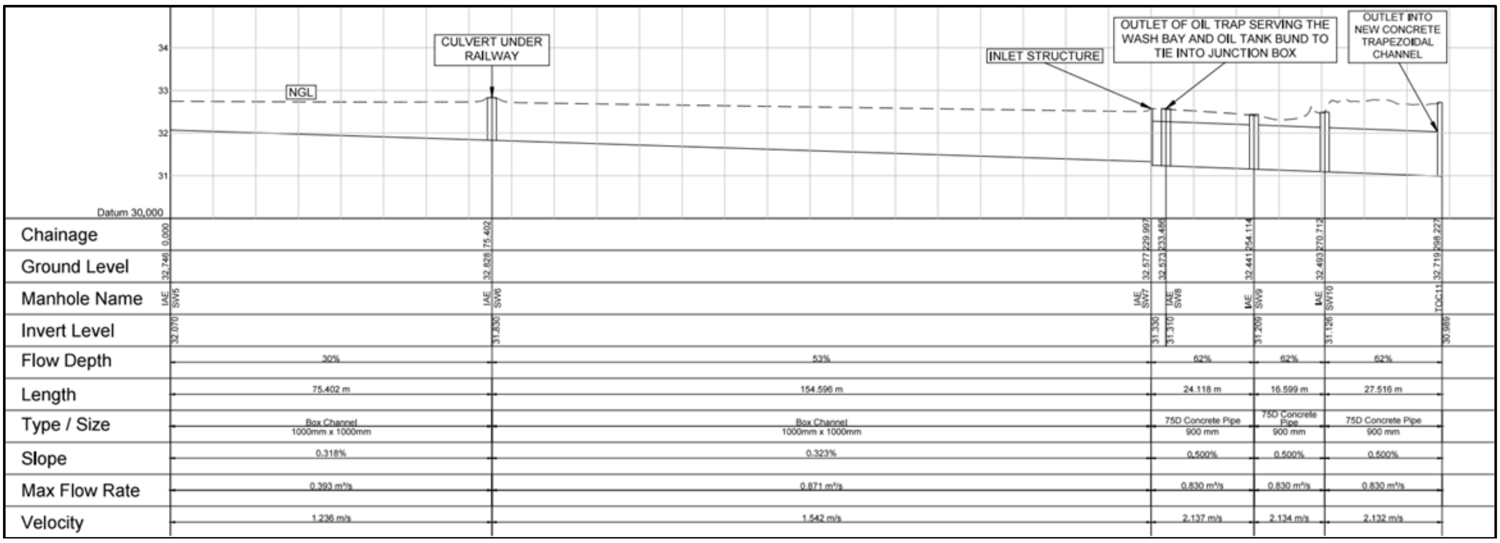

Figure 21: Long section of proposed new stormwater infrastructure between IAE SW5 and TOC11.

The concrete square channel depicted in Figure 20 will serve in collecting stormwater from catchments 1.1 and 1.2 along its length. Due to the expected high traffic volume in the area and the need for access to the stockpile areas, the square channel will require covers in the form of grating or reinforced concrete slabs strategically positioned to suite site traffic routes. Material fines and sediment is expected to accumulate in the proposed square channel and will require periodic clearing and jetting using harvested water. Typical configuration of the square channel can be seen in the Figure below.

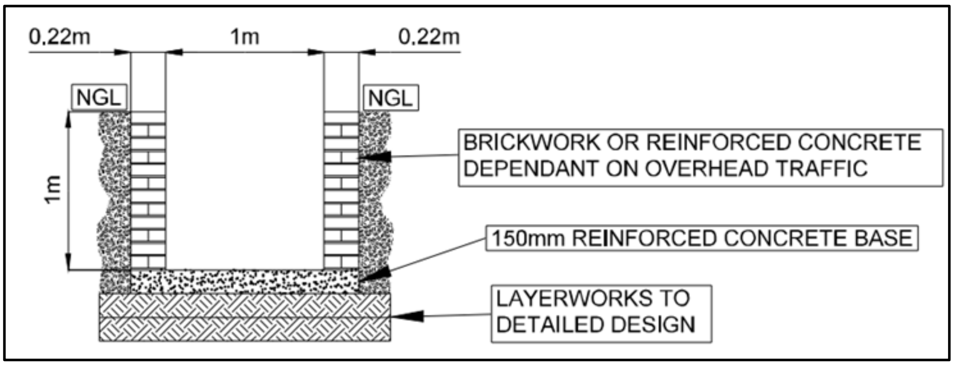

Figure 22: Typical cross-section of proposed square channel.

To avoid surface water runoff from accumulating at the railway tracks, it is proposed that a 900mm wide v-drains be constructed parallel to the railway tracks whereby it will serve in collecting stormwater from the Northeast and conveying stormwater to the proposed square channel to the Southwest.

The 900mm v-drains will require a minimum slope of 0.5% and have a configuration as shown in the Figure below.

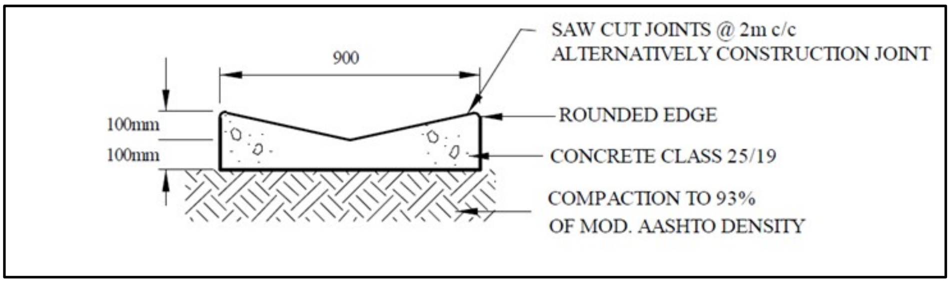

Figure 23: Typical cross-section of proposed v-drain

The installation of the concrete stormwater pipelines will need to be done in accordance with the detailed design with typical details shown in Figure below.

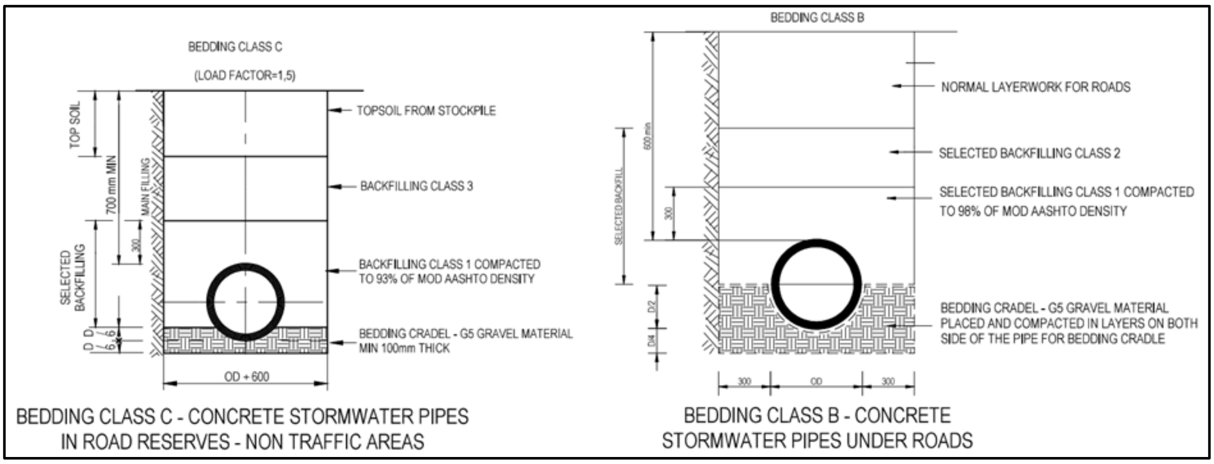

Figure 24: Typical installation detail for concrete stormwater pipes

The construction of the stormwater junction boxes will need to be done in accordance with the detailed design with typical details shown in Figure below.

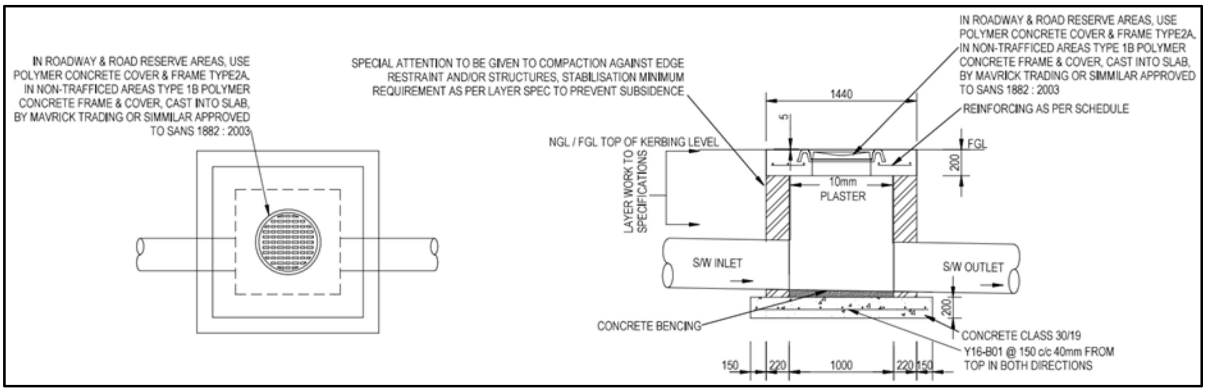

Figure 25: Typical construction detail for stormwater junction box

9.1.2 **Catchment 1.3**

Catchment 1.3 is not expected to receive any material for stockpiling and will cater predominantly for traffic. The ground surface of Catchment 1.3 will require shaping to achieve the required designed slopes for stormwater drainage and formalised through the construction of hard surfaces. The stormwater infrastructure design to serve catchment 1.3 will be based on the assumption that the area will be formalised with paving. Hydrological calculations reveal that stormwater collected by catchment 1.3 will have a maximum accumulated flow rate of 0.953m³/s during a 1:50 year flood event. The Figures below demonstrate the layout and performance of the stormwater infrastructure dedicated to collecting and conveying stormwater from catchment 1.3.

Figure 26: Stormwater infrastructure proposed for collecting stormwater from catchments 1.3

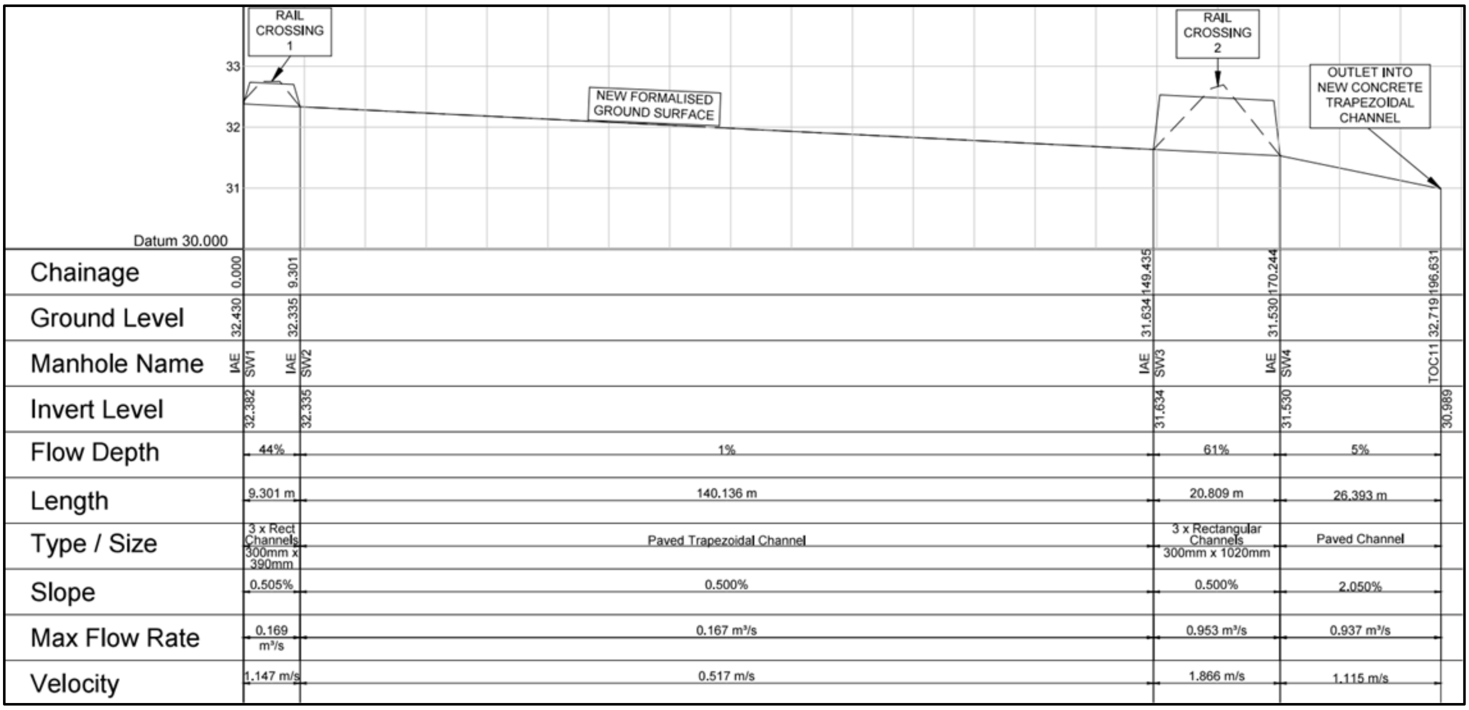

Figure 27: Long section of proposed new stormwater infrastructure between IAE SW1 and TOC11

As shown Figure 26, two existing railway tracks travers catchment 1.3. To ensure that stormwater can effectively drain from the catchment, the implementation of rectangular channels under the respective railway tracks are proposed. The configuration of the proposed rectangular channels at the respective railway crossings are shown in the figures below.

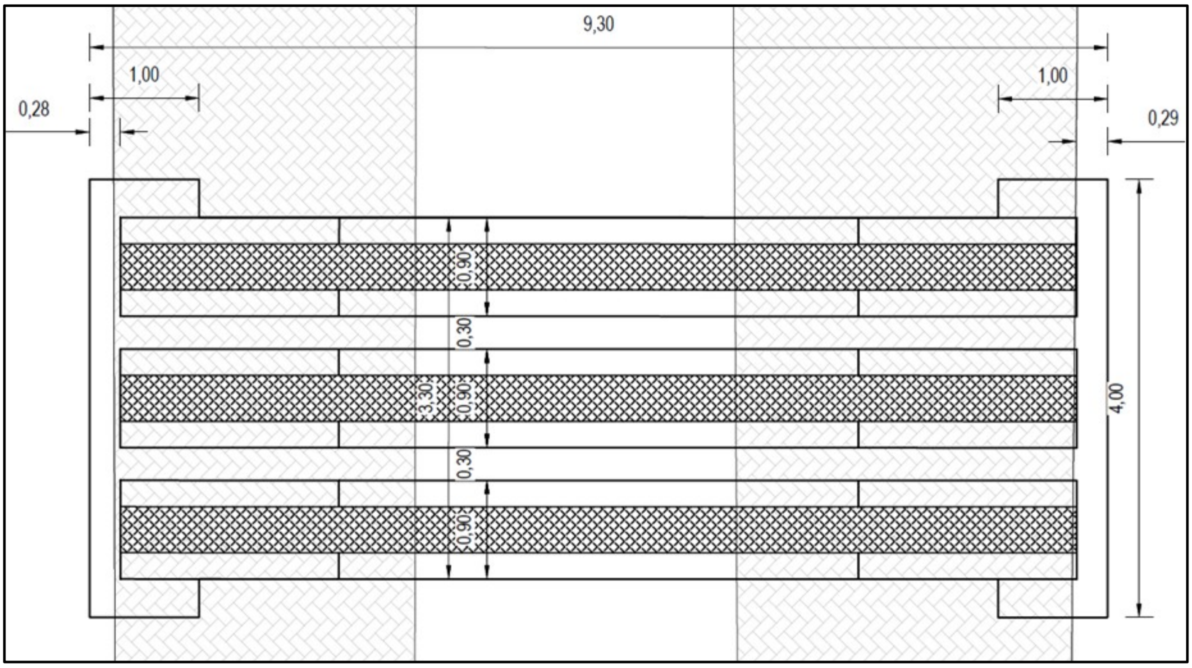

Figure 28: Plan view of proposed channels at railway crossing 1 between positions IAE SW1 and IAE SW2

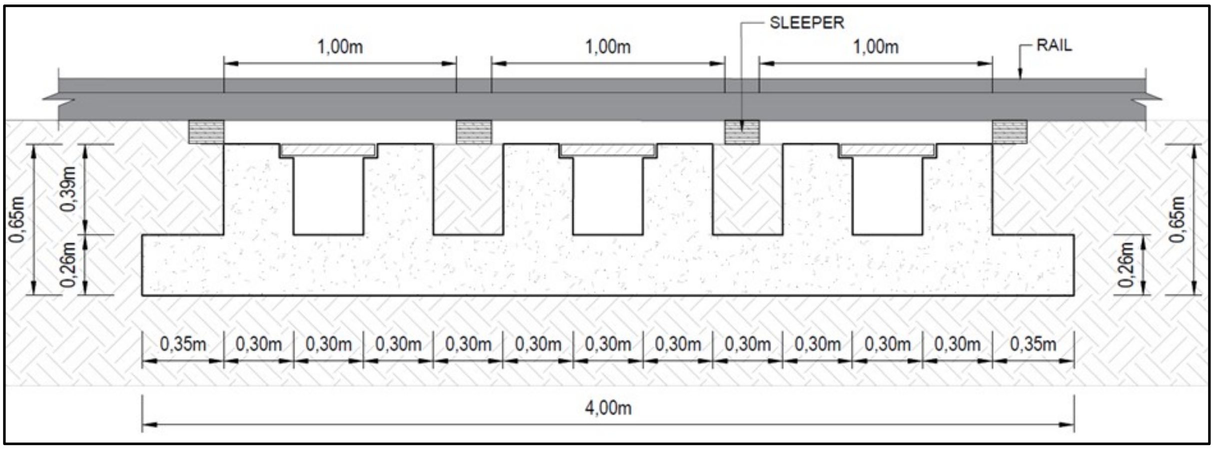

Figure 29: Section of proposed channels at railway crossing 1 between positions IAE SW1 and IAE SW2

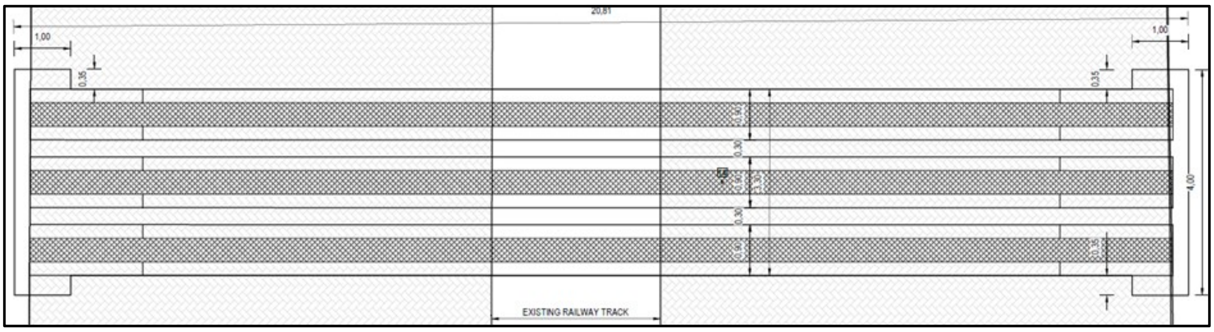

Figure 30: Plan view of proposed channels at railway crossing 2 between positions IAE SW3 and IAE SW4

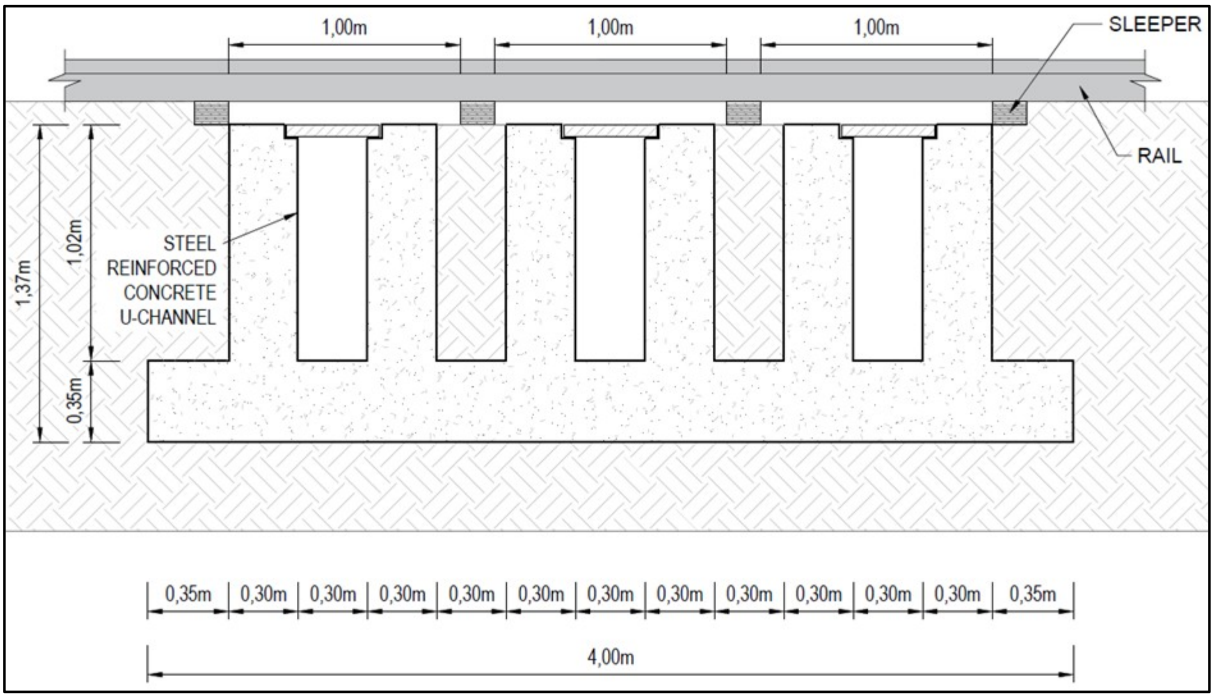

Figure 31: Section of proposed channels at railway crossing 2 between positions IAE SW3 and IAE SW4

Between the respective railway crossings, it is proposed the earth be formed into a trapezoidal shaped channel that would be trafficable. The figure below demonstrates the configuration of the channel proposed.

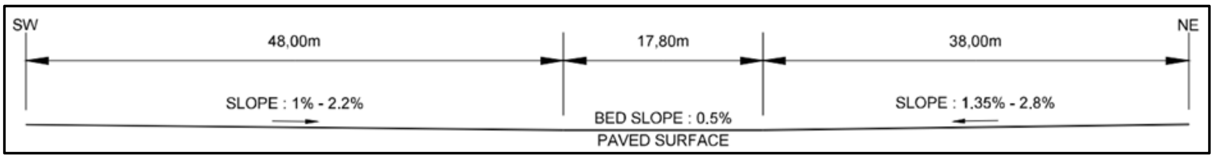

Figure 32: Cross-section of channel proposed between the existing railway tracks

9.1.3 Catchment 1.4

Catchment 1.4 comprises of areas that experience mostly traffic and areas that will receive material for stockpiling. As discussed under section 4.4 of this report, it is imperative that the stockpile areas are formalised with designed slopes to effectively drain the area of surface water in the event of a precipitation event. The stormwater infrastructure design to serve catchments 1.4 will be based on the assumption that the stockpile areas will be formalised with a slope of at least 0.5%. Hydrological calculations reveal that stormwater collected by catchment 1.4 and received from catchments 1.1, 1.2 and 1.3, will have a maximum flow rate of 1.9320m³/s during a 1:50 year flood event.

Due to the general slope of the site being to the South, it is proposed the attenuation pond be positioned along the Southern border of the property whereby it collects overland flow of stormwater from catchment 1.4 and receives the stormwater from catchments 1.1, 1.2 and 1.3. The Figures below demonstrate the layout and performance of the stormwater infrastructure dedicated to collecting stormwater from catchment 1.4 and conveying stormwater from catchments 1.1, 1.2 and 1.3.

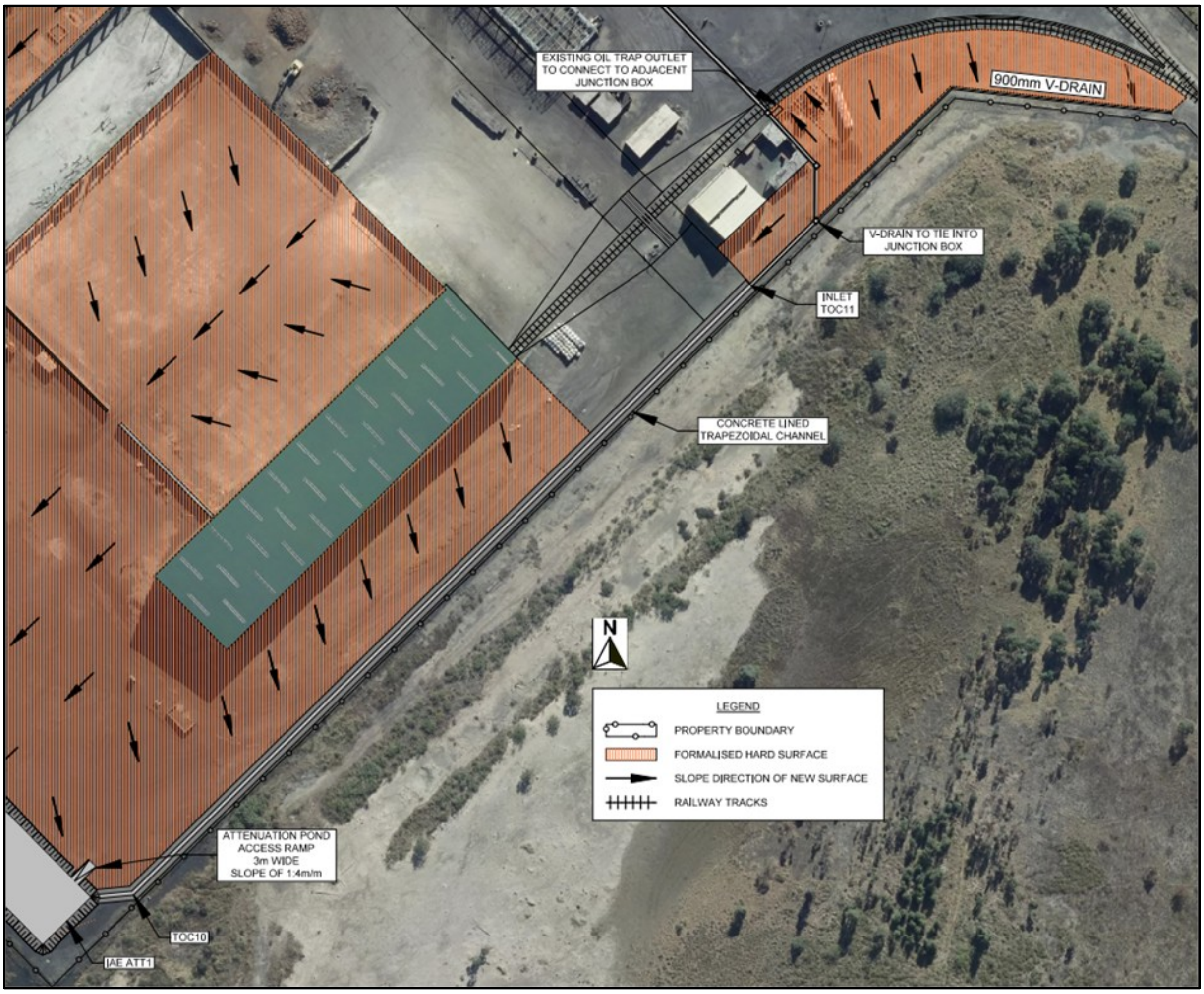

Figure 33: Stormwater infrastructure proposed for collecting stormwater from catchments 1.4

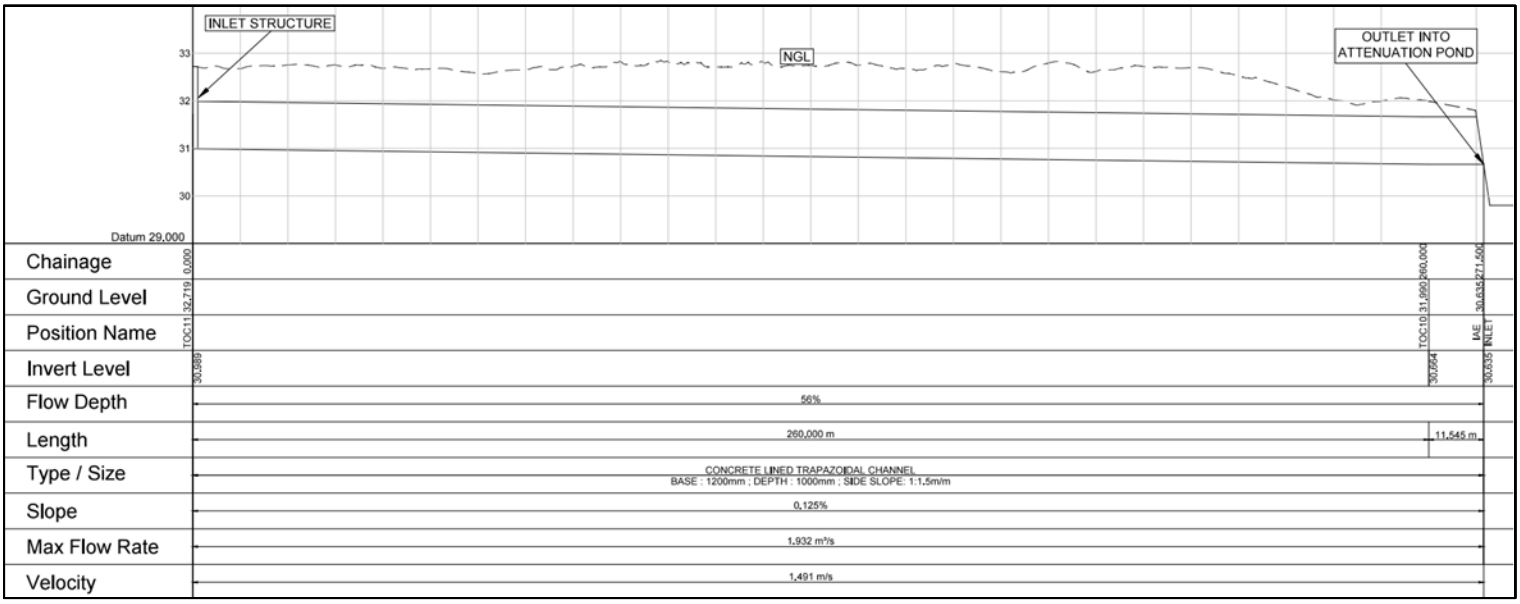

Figure 34: Long section of proposed new stormwater infrastructure between TOC11 and TOC10.

It is proposed that stormwater received by the Northern section of catchment 1.4 be collected and drained by a 900mm wide v-drain with a minimum slope of 0.5%. the proposed v-drain will drain into junction box IAE SW9 serving catchments 1.1 and 1.2. The typical configuration of a 900mm v-drain can be seen on Figure 23.

The open channel type proposed between position TOC11 and TOC10 is a trapezoidal channel with a typical configuration shown in the Figure below.

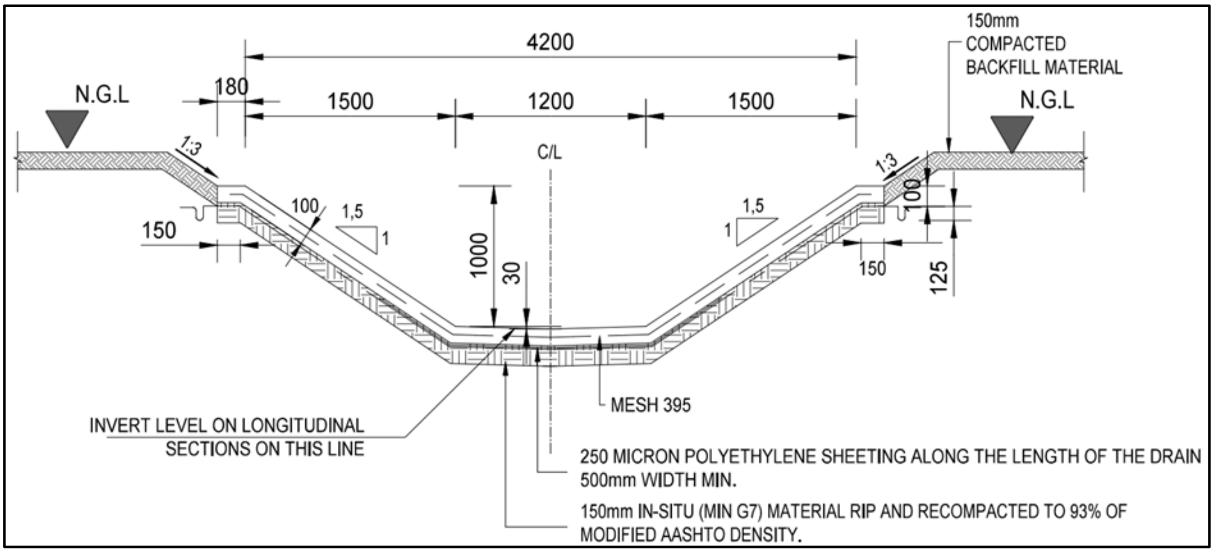

Figure 35: Typical cross-section of concrete lined trapezoidal channel.

It is recommended that the proposed channel be lined with reinforced concrete to prevent erosion, normally associated with earth channels, and to allow for easy maintenance using light weight earthmoving vehicles such as a “bobcat”. Beneath the concrete it is proposed a 250-micron polyethylene sheet be installed to mitigate the saturation and subsequent compromise of underlying soils in the event water leaks through the concrete joints.

Figure 36: Stormwater infrastructure proposed for collecting stormwater from catchments 1.4.

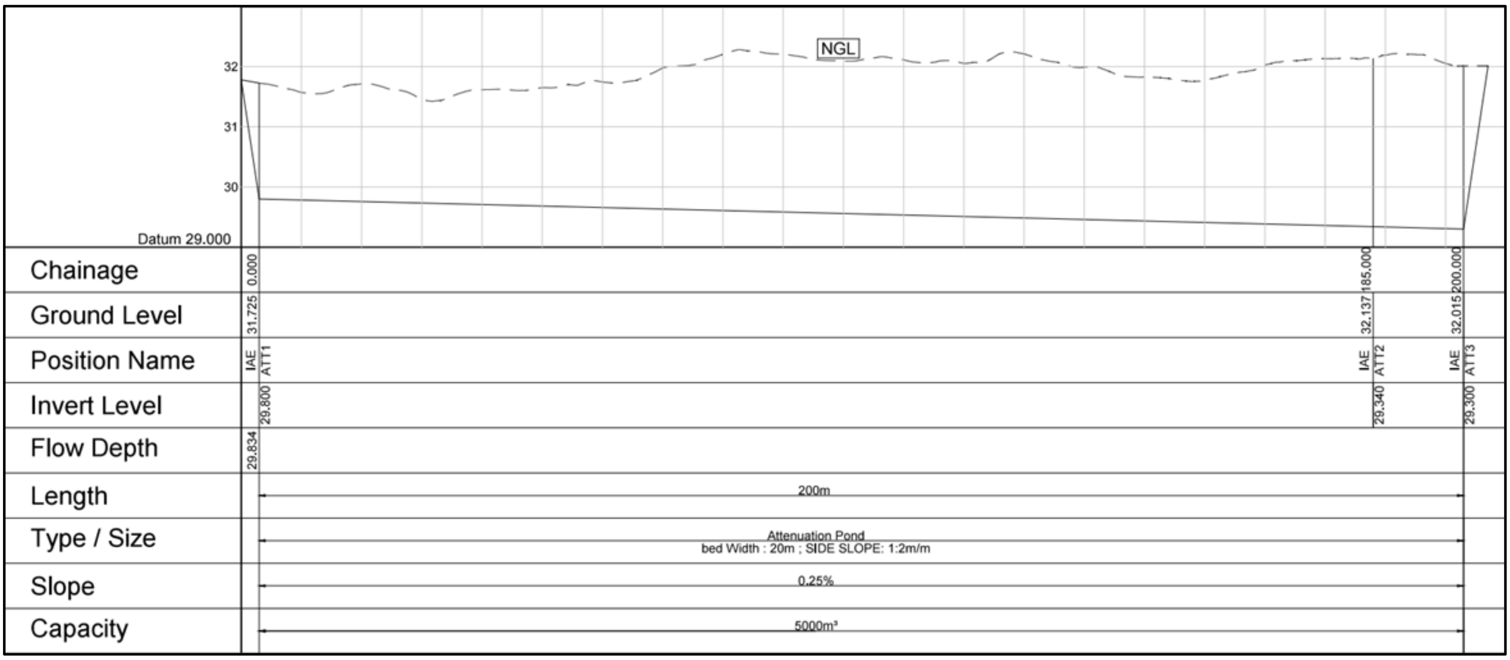

Figure 37: Long section of proposed new attenuation pond.

Due to the natural slope of catchment 1.4 to the South and Southwest, positioning the attenuation pond along the property Southern perimeter is deemed the most effective measure to collect overland flow of water from catchment 1.4 and attenuate stormwater from catchment 1 without extensive encroachment onto the stockpile areas.

A typical cross-section of the proposed attenuation pond is shown in the Figure below.

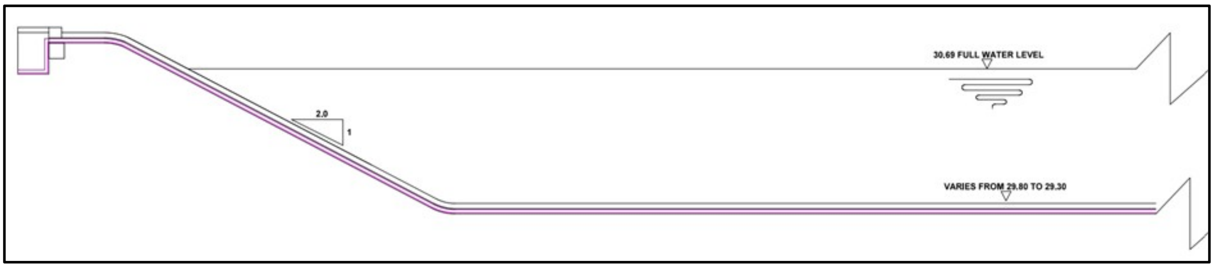

Figure 38: Cross-section of proposed new attenuation pond.

The type of liners and the installation thereof will need to be done in accordance with the detailed design with typical details shown in Figure below.

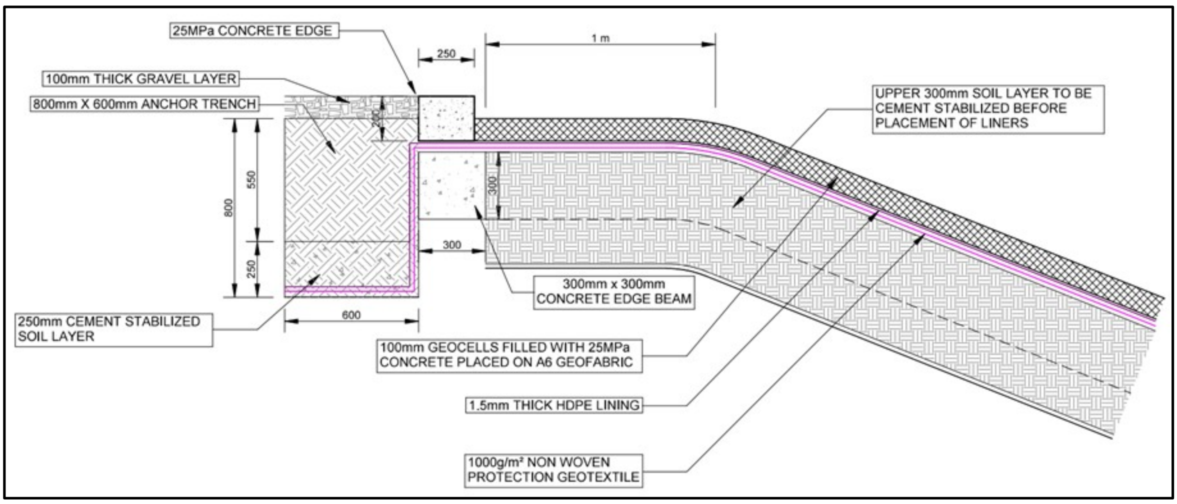

Figure 39: Typical liner details proposed for the new attenuation pond.

To ensure the proposed stormwater network complies with regulatory requirements, it is imperative that Grindrod obtain a permit through the uMhlathuze Local Municipality for the discharge of dirty stormwater into the municipal sewerage system.

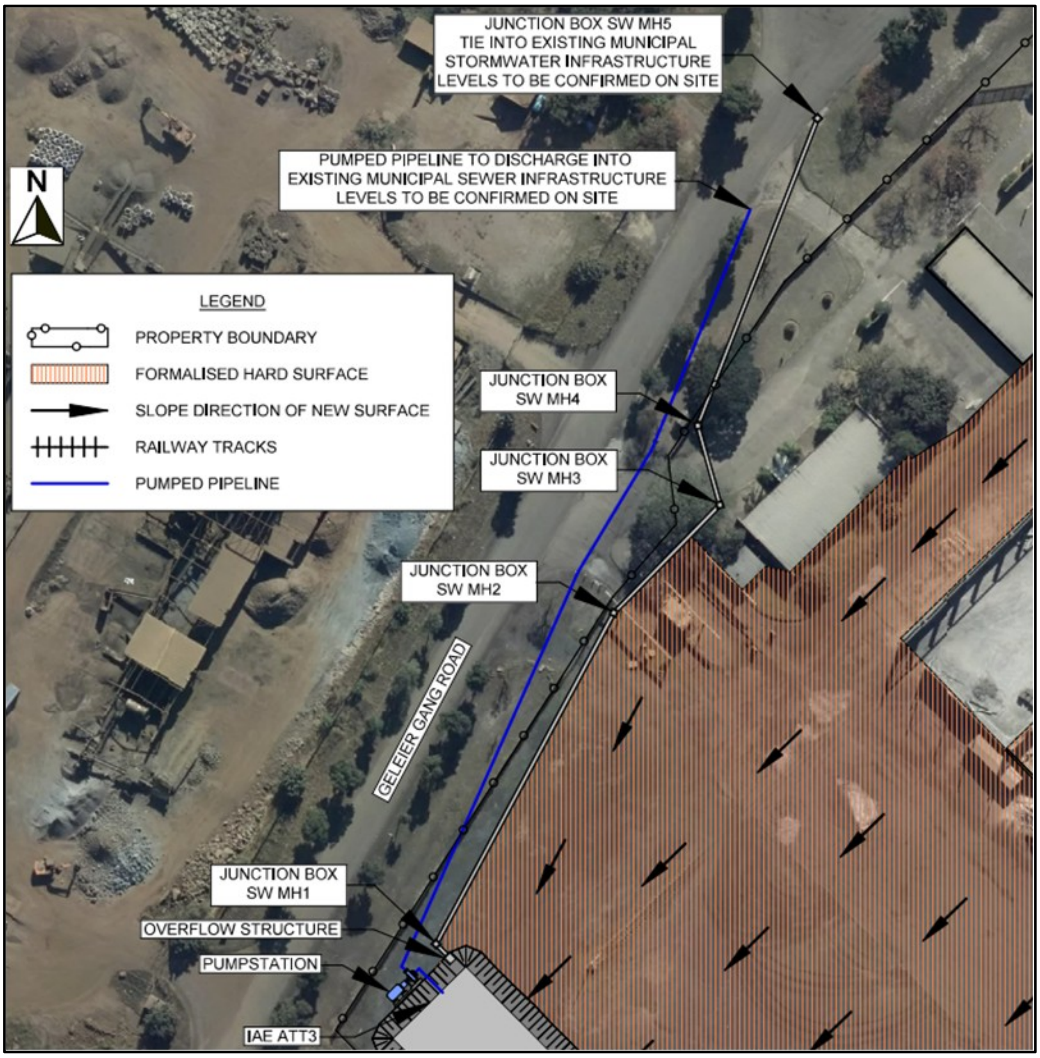

Figure 40: Stormwater infrastructure proposed for collecting stormwater from catchments 1.4.

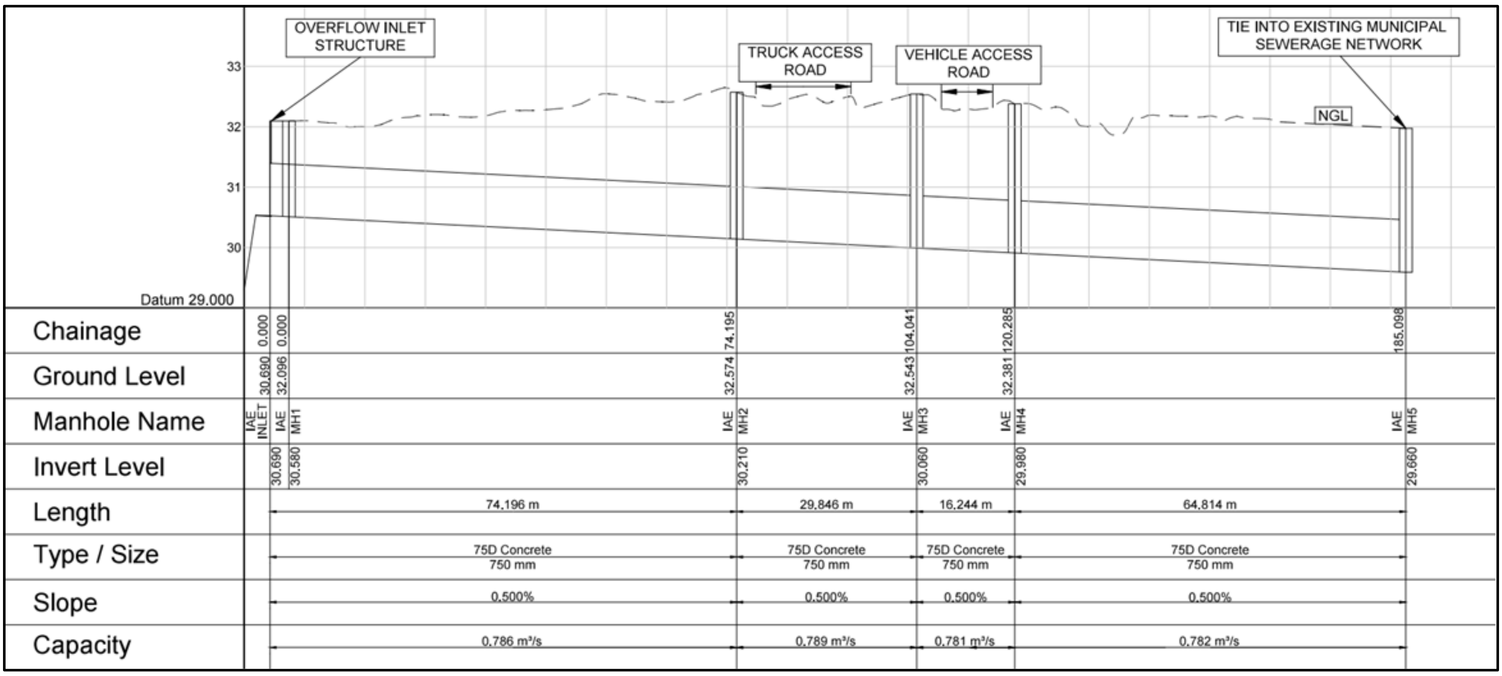

Figure 41: Long section of proposed new stormwater infrastructure between the attenuation pond overflow and IAE MH5.

The installation of the concrete stormwater pipelines and construction of junction boxes will need to be done in accordance with the detailed design with typical details shown in Figure 24 and Figure 25 respectively.

The discharge of stormwater into the municipal sewer system will be restricted to the available spare capacity within the existing sewer infrastructure. Discharge volumes could be restrictive and may impact on the final design solution. The existing sewer infrastructure will need to be investigated and assessed to verify acceptable rates of discharge. This will need to be investigate in depth during the detailed design stage should the municipality agree in principle that dirty stormwater be discharged into the sewerage system.

9.2 Catchment 2

Catchment 2 comprises the roofs of the warehouses and workshop. Stormwater collected by catchment 2 is classified as clean and will need to be safeguarded from contamination. As discussed under section 4.4 of this report, the most suitable measure of collecting stormwater from the identified roofs will be through the installation of gutters and down pipes. To avoid contamination, the clean stormwater will drain into dedicated water tanks for storage. The clean water collected can be used on site for operations or be used for maintenance such as the cleaning of the new proposed stormwater infrastructure. The design of stormwater infrastructure for catchment 2 will be further divided into the identified sub catchments.

9.2.1 **Catchment 2.1**

With a roof area of approximately 3860m², catchment 2.1 is expected to receive 120m³ of stormwater during a 1:50 year flood event. The maximum runoff expected is 0.2234m³/s. The Figures below demonstrate the layout of the stormwater infrastructure dedicated to collecting and conveying stormwater from catchment 2.1.

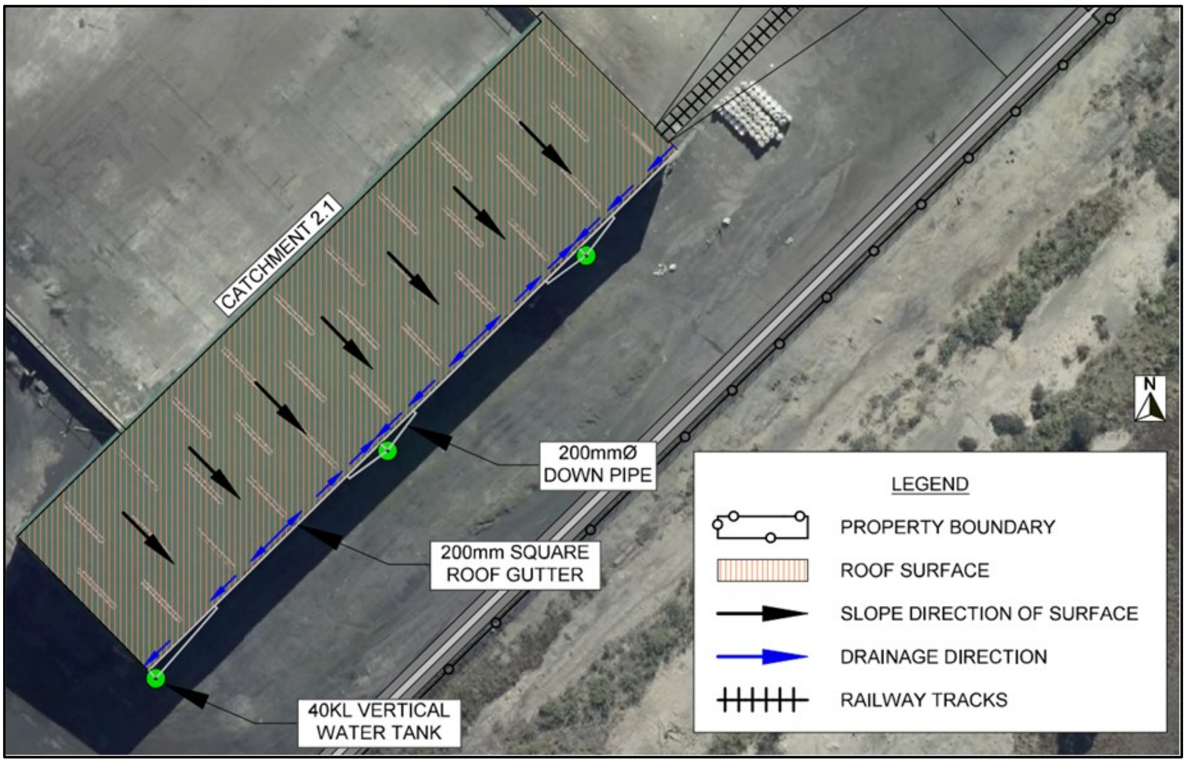

Figure 42: Stormwater infrastructure proposed for collecting stormwater from catchments 2.1

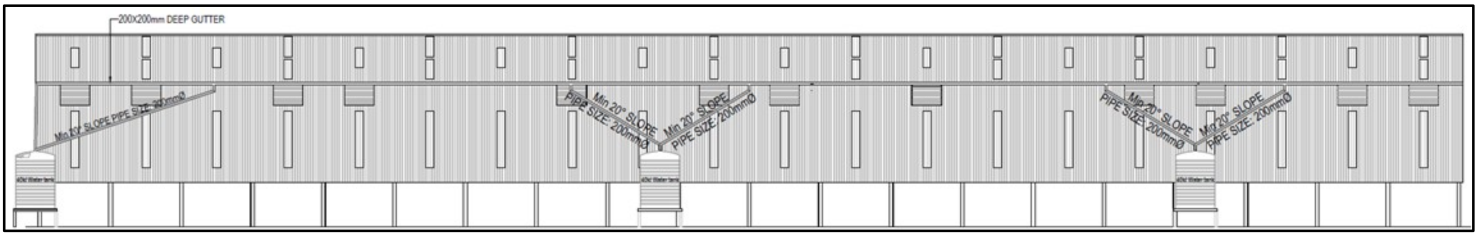

Figure 43: South elevation of building depicting the position of the required down pipes and water tanks.

The roof gutter sections will need to be 200mm x 200mm in size and will require a minimum slope of 0.4% to the respective dedicated downpipes. The downpipes, assuming circular, will need to be 200mm in diameter and will need to be strategically positioned to drain the maximum allowable stormwater from the roof gutters and discharge the maximum allowed to be received by the water tanks. Three 40KL vertical water tanks will be required to store the expected volume of stormwater during a 1:50 year storm event.

9.2.2 **Catchment 2.2**

With a roof area of approximately 3030m², catchment 2.2 is expected to receive 96m³ of stormwater during a 1:50 year flood event. The maximum runoff expected is 0.178m³/s. The Figures below demonstrate the layout of the stormwater infrastructure dedicated to collecting and conveying stormwater from catchment 2.1.

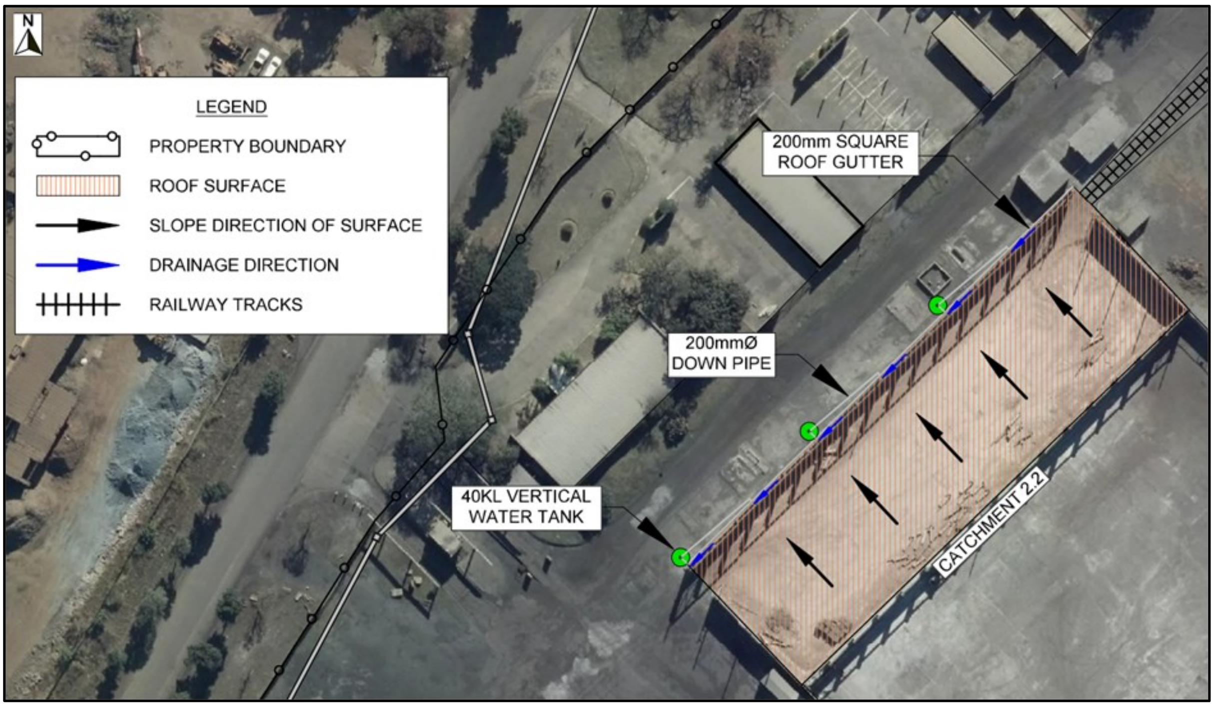

Figure 44: Stormwater infrastructure proposed for collecting stormwater from catchments 2.2

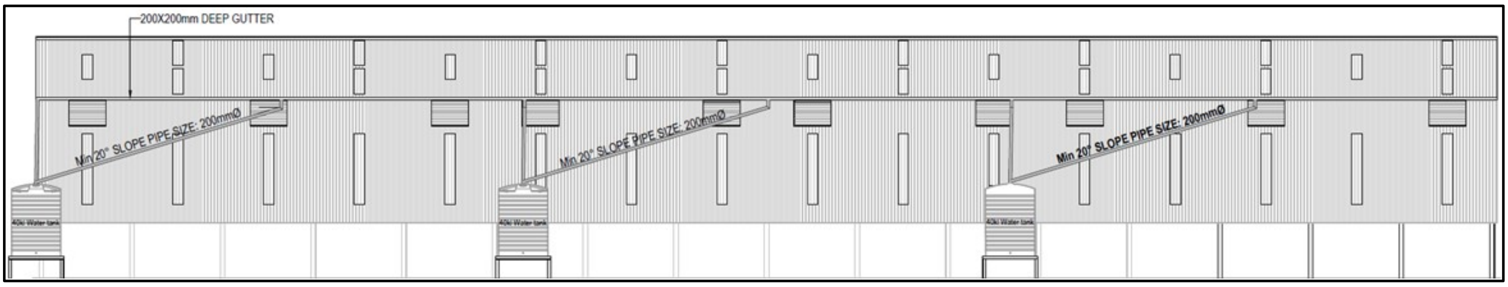

Figure 45: North-West elevation of building depicting the position of the required down pipes and water tanks

The roof gutter sections will need to be 200mm x 200mm in size and will require a minimum slope of 0.4% to the respective dedicated downpipes. The downpipes, assuming circular, will need to be 200mm in diameter and will need to be strategically positioned to drain the maximum allowable stormwater from the roof gutters and discharge the maximum allowed to be received by the water tanks. Three 40KL vertical water tanks will be required to store the expected volume of stormwater during a 1:50 year storm event.

9.2.3 Catchment 2.3

With a roof area of approximately 270m², catchment 2.2 is expected to receive 8.1m³ of stormwater during a 1:50 year flood event. The maximum runoff expected is 0.0154m³/s. The Figure below demonstrate the layout of the stormwater infrastructure dedicated to collecting and conveying stormwater from catchment 2.1.

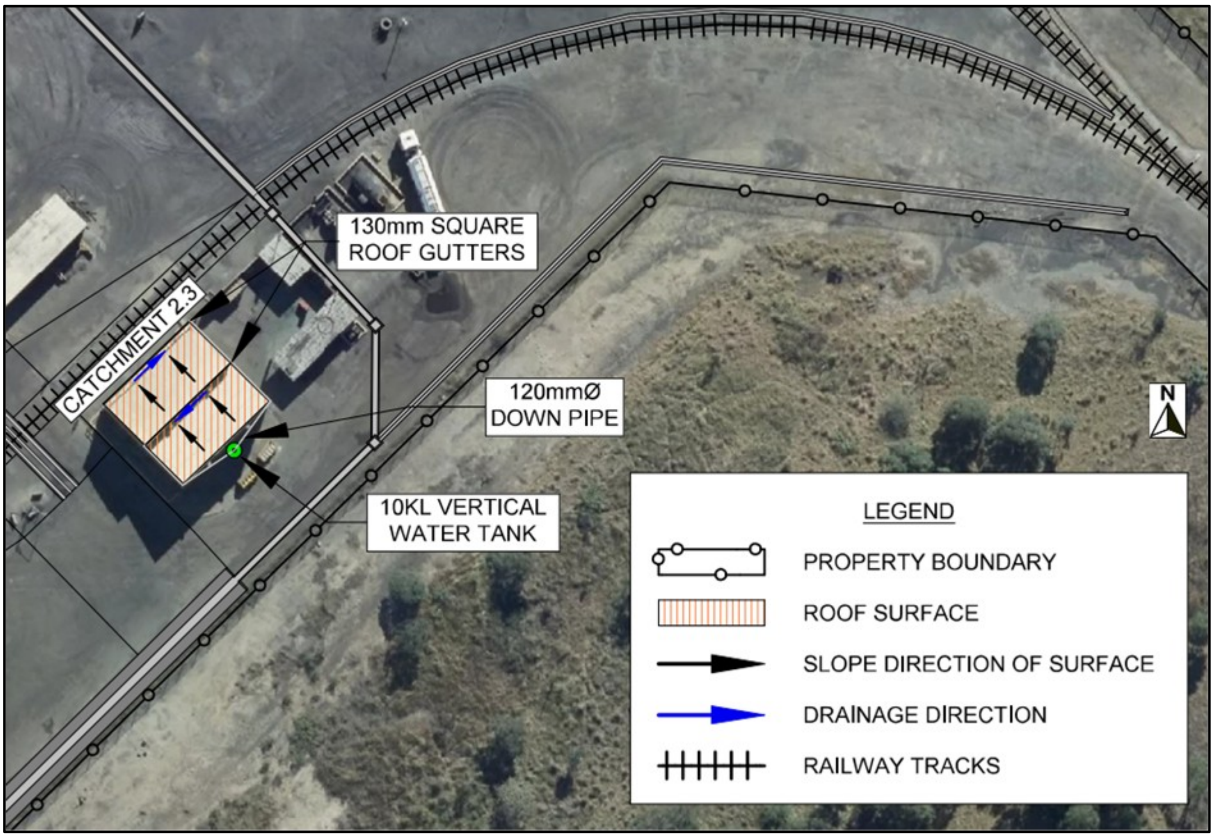

Figure 46: Stormwater infrastructure proposed for collecting stormwater from catchments 2.3

The roof gutter sections will need to be 130mm x 130mm in size will require a minimum slope of 0.4% to the respective dedicated downpipes. The downpipes, assuming circular, will need to be 120mm in diameter. A single 10KL vertical water tank will be required to store the expected volume of stormwater during a 1:50 year storm event.

9.3 Catchment 3

Catchment 3 comprises predominantly of parking areas, building roofs and open areas. Stormwater collected by catchment 3 is classified as clean and will need to be safeguarded from contamination. As discussed under section 4.4 of this report, the most suitable measure of collecting and conveying stormwater from catchment 3 will be through a combination of inlet manholes and concrete stormwater pipes. To avoid contamination, the clean stormwater will drain into the municipal stormwater network. The design of stormwater infrastructure for catchment 3 will be further divided into the identified sub catchments.

9.3.1 Catchment 3.2

Due to catchment 3.2 being classified as clean, the stormwater received by the area will need to drain exclusively into a clean stormwater network. Considering catchment 3.2 is an area with buildings and different land uses, the stormwater received by the catchment will not have a common drainage point or direction. The implementation of inlet manholes and concrete stormwater pipes will allow the collection of stormwater from multiple separated areas and drain the stormwater to a common outlet. To safeguard the stormwater collected in catchment 3.2 from contamination, it will be necessary to implement barriers in the form of kerbs to the Southeast of the catchment to prevent the ingress of dirty stormwater or material fines from the classified dirty area. The earth surrounding grid inlet manholes IAE PSW6 and IAE PSW5 will require shaping where possible to form slopes of at least 0.5% that fall to the grid inlet manholes. Hydrological calculations reveal that catchment 3.2 receives approximately 83.7m³ of rainwater during a 1:50 year flood event. The Figures below demonstrate the layout and performance of the stormwater infrastructure dedicated to collecting and conveying stormwater from catchment 3.2.

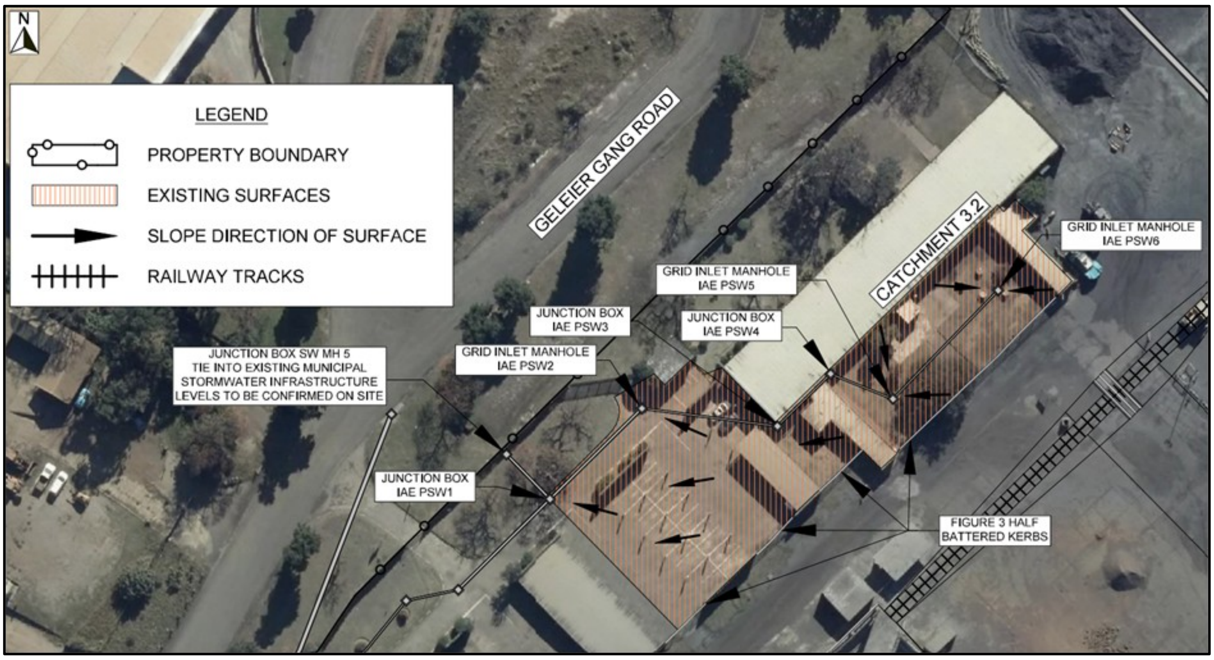

Figure 47: Stormwater infrastructure proposed for collecting stormwater from catchments 3.2

Manhole Name	IAE PSW6	IAE PSW5	IAE PSW4	IAE PSW3	IAE PSW2	IAE PSW1	SW MH5
Chainage	0,000	26,889	38,860	52,129	76,468	99,436	110,517
Ground Level	32,584	32,568	32,606	32,524	32,262	32,246	31,685
Invert Level	31,600	31,470	31,410	31,340	31,220	31,110	31,000

	IAE PSW6 – IAE PSW5	IAE PSW5 – IAE PSW4	IAE PSW4 – IAE PSW3	IAE PSW3 – IAE PSW2	IAE PSW2 – IAE PSW1	IAE PSW1 – SW MH5
Flow Depth	45%	55%	64%	73%	53%	83%
Length	26,889 m	11,971 m	13,269 m	24,339 m	22,968 m	11,082 m
Type / Size	50D Concrete 300 mm	50D Concrete 300 mm	50D Concrete 300 mm	75D Concrete 300 mm	75D Concrete 450 mm	75D Concrete 450 mm
Slope	0,5%	0,5%	0,5%	0,5%	0,5%	1,0%
Max Flow Rate	0,029 m³/s	0,040 m³/s	0,051 m³/s	0,059 m³/s	0,105 m³/s	0,277 m³/s
Velocity	0,909 m/s	1,007 m/s	1,087 m/s	1,079 m/s	1,264 m/s	2,018 m/s

Figure 48: Long section of proposed new stormwater infrastructure between IAE PSW6 and SW MH5

Manholes IAE PSW2 and IAE PSW1 are existing manholes with unknown invert levels. The invert levels of the said manholes need to be established during detailed design to determine if they can be fabricated to allow for the connection of the proposed upstream network. The installation of the concrete stormwater pipelines and construction of junction boxes will need to be done in accordance with the detailed design with typical details shown in Figure 24 and Figure 25 respectively. The field inlet manholes will need to be constructed in accordance with the typical details shown in the Figures below.

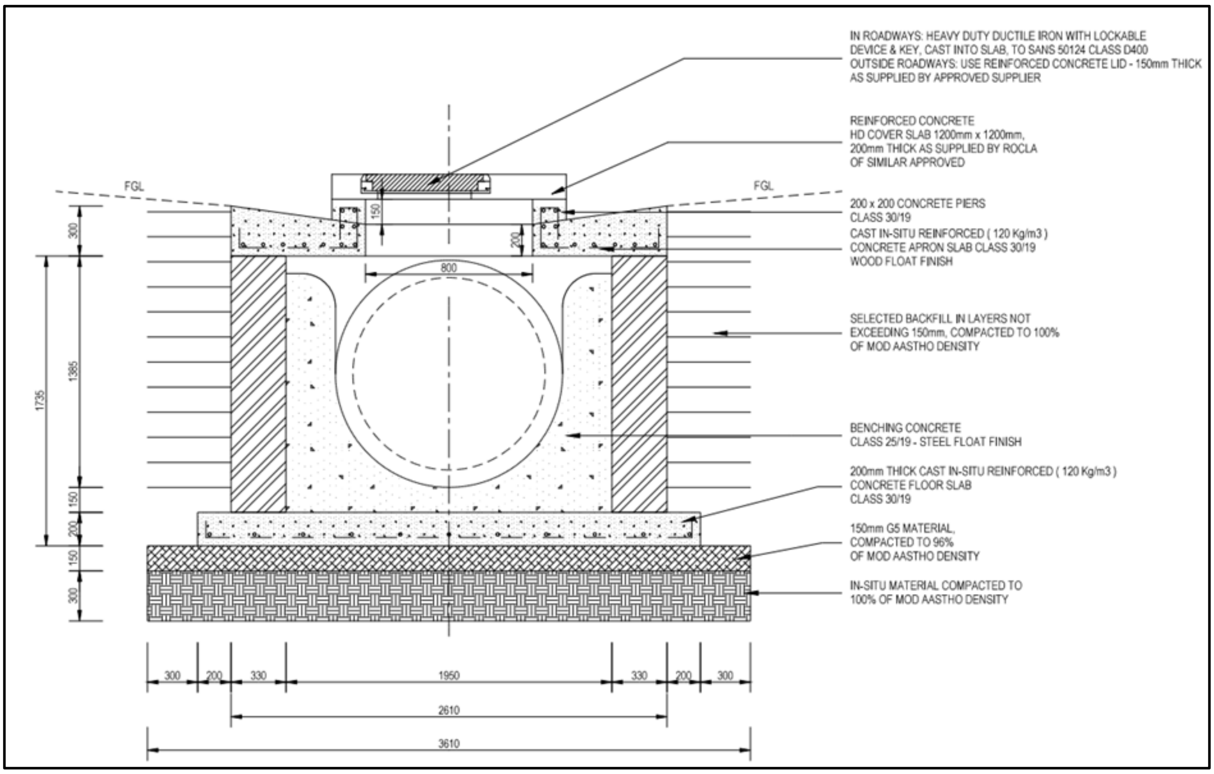

Figure 49: Section of typical field inlet manhole

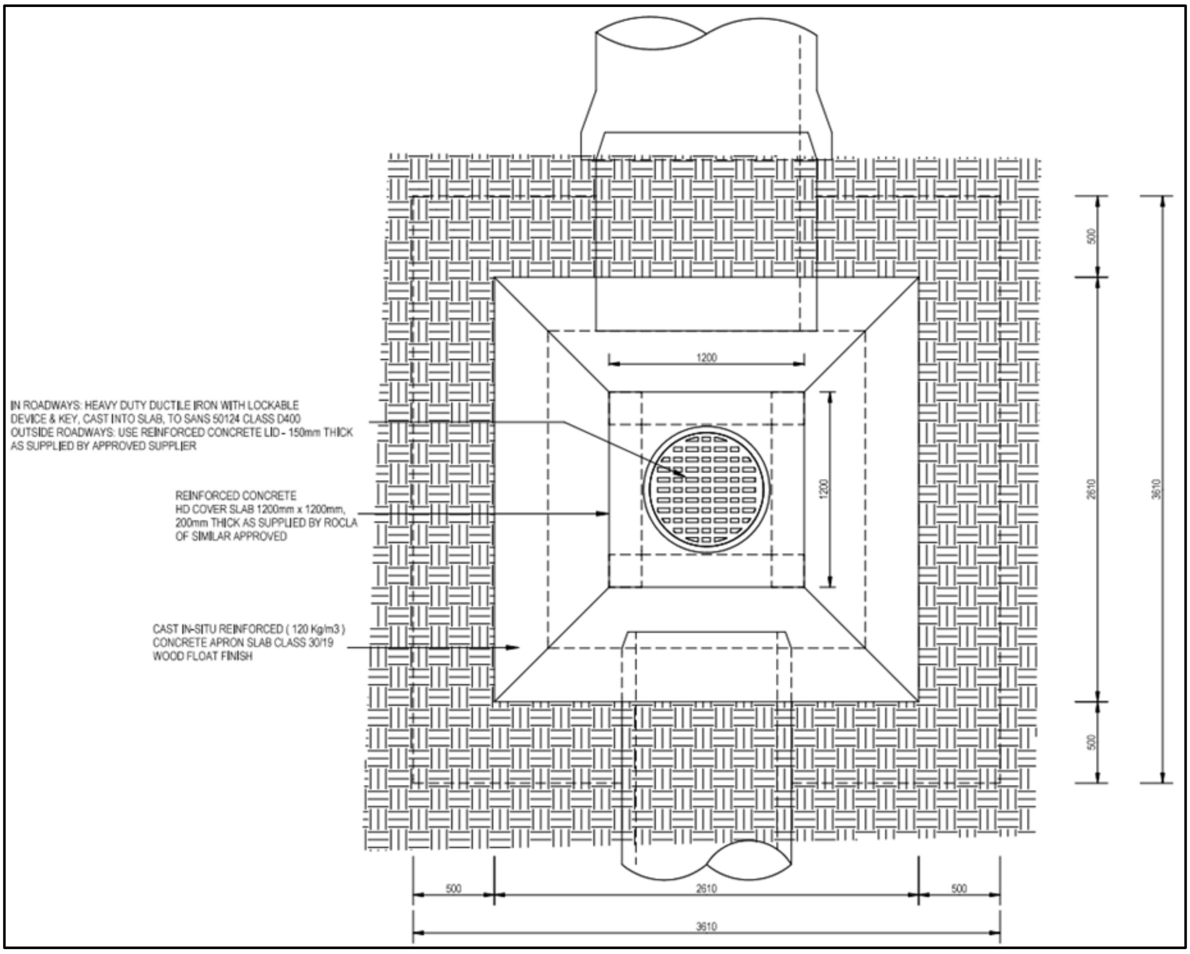

Figure 50: Plan view of typical field inlet manhole

9.3.2 Catchment 3.3

Due to catchment 3.3 being classified as clean, the stormwater received by the area will need to drain exclusively into a clean stormwater network. Considering catchment 3.3 is an area with buildings and different land uses, the stormwater received by the catchment will not have a common drainage point or direction. The implementation of inlet manholes and concrete stormwater pipes will allow the collection of stormwater from multiple separated areas and drain the stormwater to a common outlet. To safeguard the stormwater collected in catchment 3.3 from contamination, it will be necessary to implement barriers in the form of kerbs to the Southeast of the catchment to prevent the ingress of dirty stormwater or material fines from the classified dirty area. Hydrological calculations reveal that catchment 3.2 receives approximately 73.98m³ of rainwater during a 1:50 year flood event. The Figures below demonstrate the layout and performance of the stormwater infrastructure dedicated to collecting and conveying stormwater from catchment 3.3.

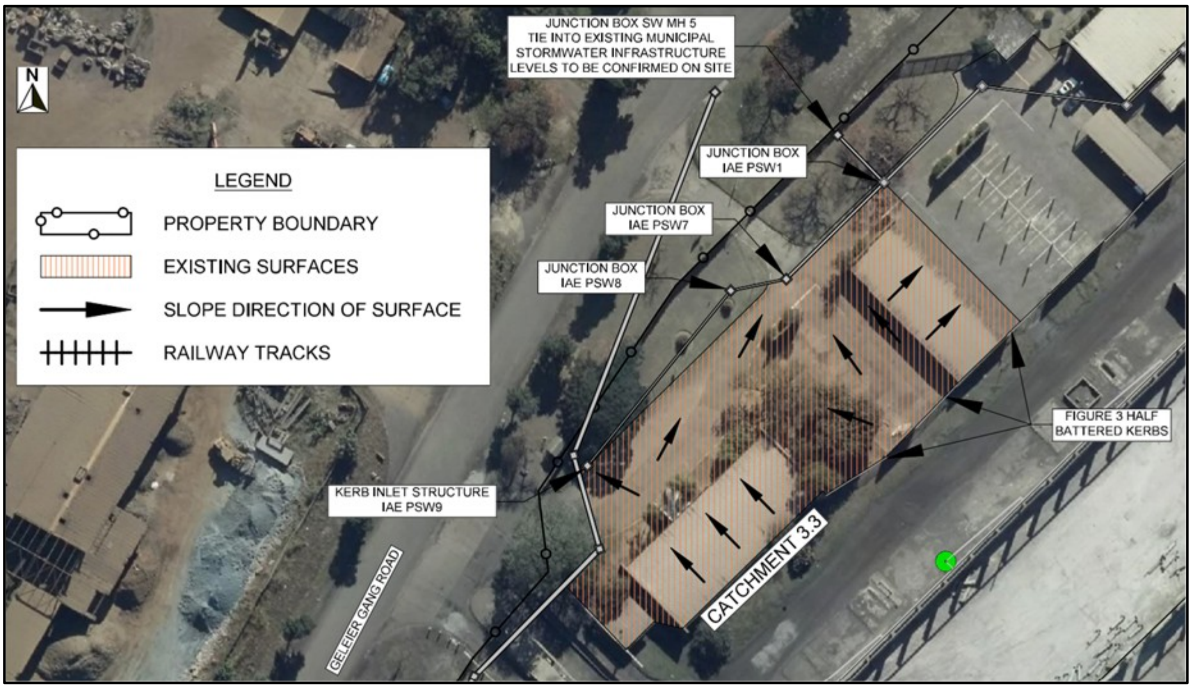

Figure 51: Stormwater infrastructure proposed for collecting stormwater from catchments 3.3.

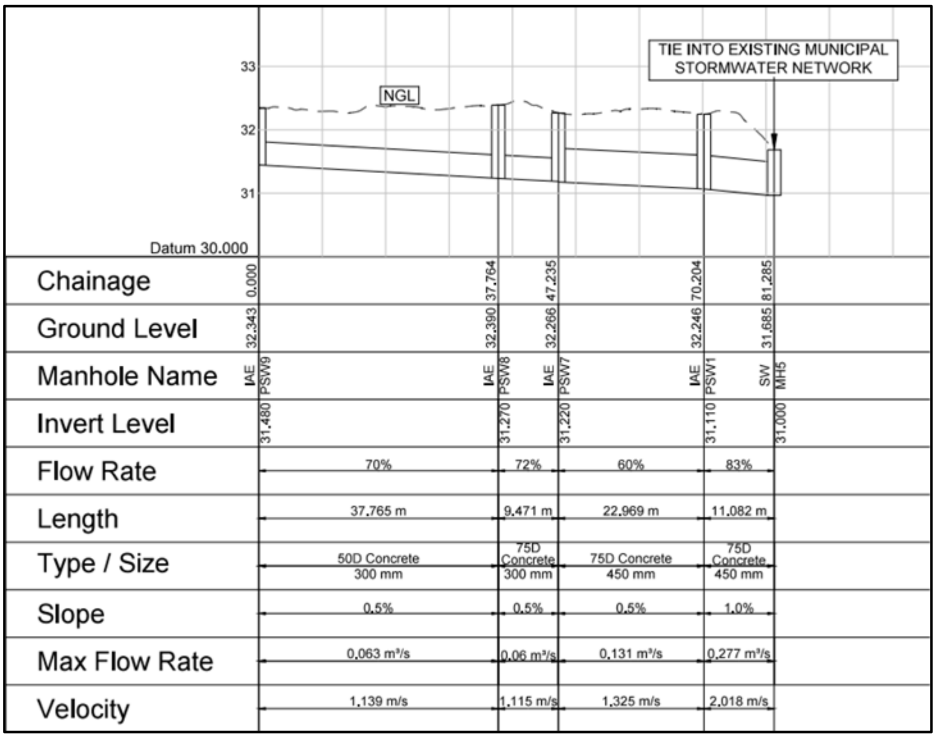

Figure 52: Long section of proposed new stormwater infrastructure between IAE PSW9 and SW MH5

Manhole IAE PSW7 is an existing manhole with an unknown invert level. The invert level of the said manhole needs to be established during detailed design to determine if they can be fabricated to allow for the connection of the proposed upstream network. The installation of the concrete stormwater pipelines and construction of junction boxes will need to be done in accordance with the detailed design with typical details shown in Figure 24 and Figure 25 respectively. The field inlet manholes will need to be constructed in accordance with the typical details shown in the Figure 49 and 50.

10. GRINDROD SEAMUNYE WATER BALANCE

Site operations at Grindrod Seamunye is not dependant on water. Grindrod Seamunye does however receive water from City of uMhlathuze for domestic uses. The water balance will only take into consideration the stormwater received during a 1:50 year flood event and will not include the potable water supplied by City of uMhlathuze. Utilising the results obtained from the hydrological calculations for the respective catchments, the water balance for Grindrod Seamunye can be summarised as shown in the Figure below.

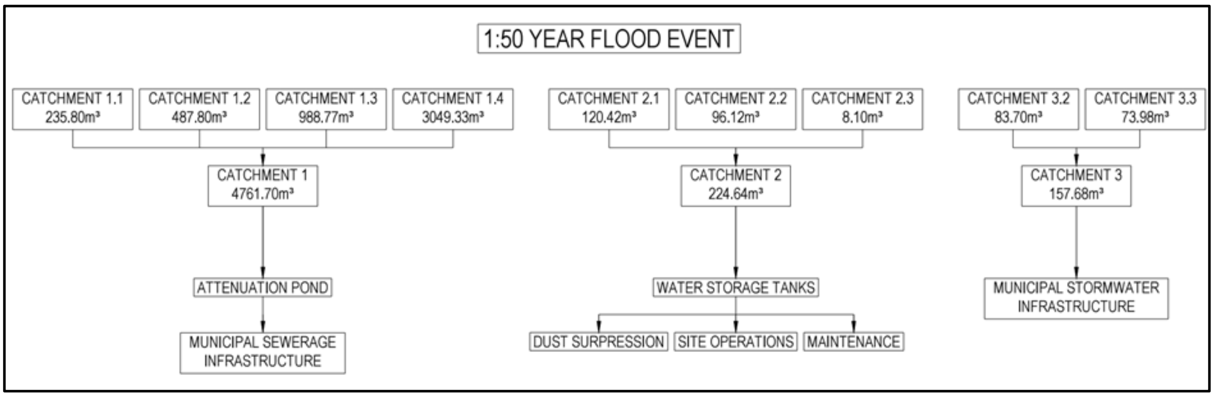

Figure 53: Water balance indicating stormwater volumes expected during a 1:50 year flood event

11. PROJECT DEVELOPMENT AND PHASING

A total of three stormwater infrastructure projects have been identified under the Grindrod Seamunye Stormwater Management Plan. A summary of the projects and an engineering determination of priority can be found in the table below.

Table 9: Phasing of identified stormwater infrastructure projects

Project Name	Project Priority	Project Description	Required Infrastructure
Stockyards & Attenuation Pond	1	Construction of new stormwater infrastructure to collect and convey dirty stormwater to attenuation pond. Stormwater from attenuation pond to be pumped into municipal sewerage network.	• New square channels • New V-drains • New concrete stormwater pipes • New junction box manholes • New formalised hard surfaces • New attenuation pond • New pumpstation • New rectangular channels • New concrete lined trapezoidal channel and associated structures
Admin buildings and parking	2	Construction of new stormwater infrastructure to collect and convey clean stormwater to municipal stormwater network.	• New concrete stormwater pipes • New junction box manholes • New field inlet manholes

Warehouse roofing	3	Construction of new stormwater infrastructure to collect and convey clean stormwater to water storage tanks.	• New roof gutters • New down pipes • New vertical water storage tanks

12. OPERATIONAL, MANAGEMENT AND MONITORING SYSTEMS AND RESPONSIBILITIES

12.1 Allocation of Responsibilities

After the construction of the new stormwater infrastructure, Grindrod will need to identify and appoint personnel who will have the responsibility of managing the operation of the stormwater infrastructure at Grindrod seamunye. The appointed personnel will have the responsibility of ensuring that the stormwater infrastructure at Grindrod Seamunye are functioning optimally.

12.2 Education

It is imperative that Grindrod educates employees with regards to water management, particularly the conservation of water and the protection of land and water from pollution. Grindrod will also need to educate employees on the importance of the new stormwater infrastructure and how any employee can assist in ensuring the system functions optimally by reporting any defects or maintenance that may be required.

12.3 Maintenance

Maintenance will be key to ensuring the stormwater infrastructure is functioning optimally. The following will need to be considered with regards to the maintenance of the stormwater infrastructure.

12.3.1 **Operation management plan**

It will be to Grindrod's advantage to develop and implement an operations management plan during the operations of the stormwater infrastructure at Grindrod Seamunye. The operations management plan will need to include management procedures, maintenance procedures, resource requirements, contingency plans, etc. The operations management plan will be necessary in insuring the optimal functioning of the stormwater infrastructure at Grindrod Seamunye.

12.3.2 **Recognition of maintenance capacity**

Grindrod will need to at all times keep record of maintenance capacity and ensure there are sufficient resources available to undertake any maintenance the stormwater infrastructure may require to function optimally.

12.3.3 **Training of maintenance staff**

To ensure maintenance on stormwater infrastructure is undertaken correctly, Grindrod will need to train the responsible employees on how to adequately undertake maintenance on the stormwater infrastructure. Responsible employees will also need to be trained on how to identify issues with the stormwater infrastructure and how to effectively choose the corrective maintenance.

12.3.4 **Maintenance equipment and materials**

Grindrod will need to establish which equipment and materials will be the most effective and efficient in facilitating the maintenance of the stormwater infrastructure. Grindrod will need to ensure that the maintenance material and equipment are at all times functioning optimally and can be utilised at any given time when required.

12.3.5 Preventative maintenance procedures

Preventative maintenance involves continuous to periodic maintenance on infrastructure to prevent the infrastructure from failing in terms of functionality or integrity. Preventative maintenance on stormwater infrastructure includes, but is not limited to, cleaning, refurbishment or reconstruction. Grindrod will need to establish preventative maintenance procedures and ensure they are implemented during the lifespan of the stormwater infrastructure.

12.3.6 Corrective maintenance procedures

Corrective maintenance involves maintenance required on infrastructure when it becomes apparent the infrastructure is not functioning optimally or has become damaged. Corrective maintenance on stormwater infrastructure includes, but is not limited to, repair, replacement or reconstruction. Grindrod will need to establish corrective maintenance procedures and implement the procedures when it becomes apparent the stormwater infrastructure is not functioning optimally.

12.3.7 Maintenance period

After the construction of the new stormwater infrastructure, Grindrod will need to establish the frequency at which maintenance will be required. Maintenance on the stormwater infrastructure will depend on how much fines is expected on site and the susceptibility of the fines to overland flow of water. Maintenance on site will also depend on the frequency of vehicle movement on site and the wear and tear the proposed stormwater infrastructure is expected to receive.

GRINDROD SEAMUNYE - RICHARDS BAY STORMWATER MANAGEMENT PLAN REPORT (REV 0)

COMMISSIONED BY: GRINDROD PROPERTY, DIVISION OF GHSA

PROJECT NUMBER: GRB.P003.2022.004

Approved by:	Signature:	Date:
H. Naidu		07-02-2023
Z. Cele		07/02/2023
B. Ndlovu		07/02/2023
P. Caley		07/02/2023
P. Venter		07/02/2023