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Stormwater Management Plan

DEVELOPMENT OF A PORTION OF THE REMAINDER OF ERVEN 464 GEORGE, 324 AND 2819 PACALTSDORP (GWAYANG DEVELOPMENT SITE)

George Municipality

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Approval			
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Contents

Annexures

1 Introduction

1.1 Background to Report

The George Municipal area has seen a period of rapid growth in recent years, resulting in an increased demand for affordable housing and commercial properties.

The preliminary project proposal is to prepare the entire property for full development of the site, in a phased manner, to include the following components:

a) A municipal utility area component (Wastewater Treatment);
b) An industry and service trade precinct;
c) An industrial component;
d) A residential area including various typologies and urban-living supportive uses;
e) A continuous and sustainable conservation/open space system which ties into a sustainable urban drainage system (SuDS);
f) A tourism/trade corridor area and urban gateway uses; and
g) Possible Energy projects.

The ultimate intent of the Municipality is to create fully serviced erven for sale, if required, to support an integrated mixed-use development: the aim being optimal use of the land, within the strategic site context.

The current layout consists of 136 group housing units on 4 stands, 1832 apartment housing units on 7 stands, 29 light industry and service trade and 21 heavier industrial zoned stands, 1 stand earmarked for public facilities such as creches and religious centers, 4 stands zoned as open or conservation areas and 11 business zoned sites.

Zutari will look at the road design and civil services for the proposed development which includes the necessary infrastructure to collect and control stormwater runoff where required.

1.2 General and Development Location

The proposed development area is located within the urban area of George, situated to the south and east of Groeneweide Park residential area and the George Show Grounds and to the west of the Tamsui Industrial area. The site is restricted to the North by the R102 (Airport Road), and to the South by the N2 National Road. The western side of the site encompasses the Gwayang Wastewater Treatment Works (WWTW) and shooting range. The remaining area of the site is generally vacant and used for cattle grazing.

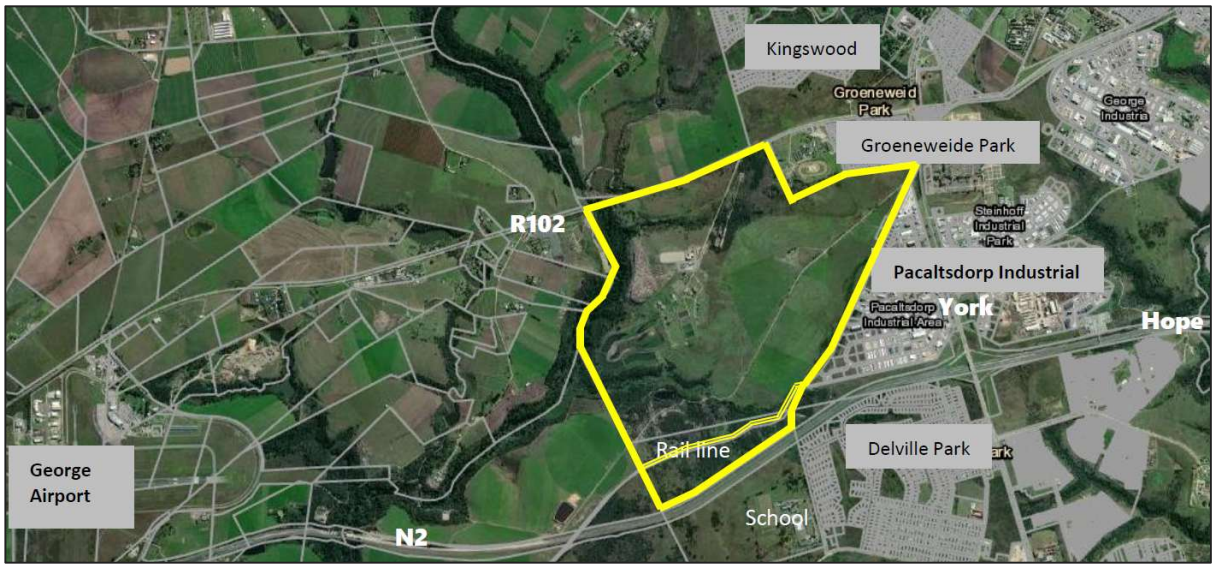


Figure 1 : Locality Map

2 Objective of Report

The objective of this report is to :

- Analyze the local catchment area in order to :
  - Determine the 1:5 year (minor system) flow rates at points of interest; and
  - Determine sizes for stormwater drainage pipes, culverts and / or channels within the proposed development.
  - Determine the effect of external stormwater runoff and how this can be accommodated through the proposed development.
- Make recommendations with respect to the discharge of runoff.
- Prepare drawings showing the outlet structure components and possible mitigating measures for stormwater drainage and erosion control.

This report includes a conceptual design of the proposed bulk stormwater system. The report and drawings are to be used as a guide to prepare stormwater management systems and detail designs for the future development rollout and are not for construction purposes.

3 Design Criteria and Standards

3.1 Design Criteria

The following document serves as the basis for the detail design criteria and standards:

- The Neighbourhood Planning and Design Guide (“Red Book”).

3.2 Construction Specifications

All materials and workmanship shall comply with the specifications as set out in the South African National Standards for Civil Engineering (SANS).

3.3 Stormwater System

The stormwater system forms an integral part of the road and urban planning layout. The system rests on three legs, the minor system, the major system and an emergency system. Minor storms are catered for in the pipe system while major storms are routed through a linked system of roads and public open spaces using attenuation techniques. The emergency system recognizes failure of the minor and major system by storms greater than provided for in the major system or in the event of malfunction of the minor system by providing continuous overland flow routes to minimize flooding of residential areas.

3.3.1 Minimum design criteria for stormwater system

The criteria to be used for the design of the system are the following:

- Minor system: 5 year return period conveyed in an underground pipe system. Preferably the overland flow shall not exceed a depth of 200mm;
- Major system: 50 year return period.
  The difference between the 5 year and 50 year to be conveyed in the road prism with flow depth not exceeding 150mm within the road reserve width;
- The minimum gradients for pipelines will be designed to give a minimum velocity of 0.7m per second with the pipes flowing full;
- The maximum flow velocity shall be 3.5m per second;
- Major Stormwater overflows are to be provided to convey the excess storm water from the streets into designated public open spaces;
- Stormwater flow velocities in road ways will be kept as low as possible and related to the surface finish to prevent scour and erosion; and
- Roads will be graded to ensure free and continuous flow to the main Stormwater system and to prevent localized ponding at intersections.

3.3.2 Pipelines/Culverts

- Stormwater pipes will generally be class 50D, 75D or 100D as required by the loading and installation conditions;
- Pipes will be laid on Class C bedding;
- The minimum cover on pipes will be 0.80m; and
- The minimum pipe diameter will be 450mm for longitudinal runs and catch pit connections.

3.4 Road System

The road system forms an integral part of the local area plan.

3.4.1 Design criteria for roads

The design criteria for roads are the following:

- Road reserve widths: 10m, 13m, 16m and 25m;
- Design life of the roads: 20 years;
- Subgrade CBR: 15 to 20;
- Subbase CBR: 45 minimum (processed crushed stone);
- Base course CBR: 80 minimum (processed crushed stone);
- Surfacing: Asphalt, paving or Cape Seal;
- Minimum road longitudinal grade: 0.475%; and
- Minimum road cross fall: 2-3% depending on final road surfacing type.

3.5 Standard of Engineering Services to be provided

Level of services regarding roads and stormwater are as follows:

3.5.1 Roads and stormwater

- Road widths will be 4.5m in 10m and 13m reserves and 6m in 16m reserves;
- Subgrade, Subbase and Base materials will be imported;
- Subsurface drainage will not be required;
- The underground piped stormwater drainage system will have a minimum of 450mm diameter;
- Where roads are surfaced, paving or asphalt surface will be provided;
- Combination kerbs, CK5 will be provided on the low side of all roads to drain stormwater towards catch pits;
- Mountable kerb, MK10 will be provided on the higher side of the roads;
- Barrier kerbs, BK2 and Channel, C1 will be installed around bell mouths. Bellmouth radiuses will be a minimum of 6m.
- All stormwater drains will be provided with a sand trap of at least 500mm deep.

4 Existing Stormwater Network

Currently, no formal stormwater infrastructure exists within the boundaries of the proposed site. The site has a fairly low slope gradient, increasing towards natural drainage lines, and the in-situ soils have a low permeability. The Geotechnical Investigation indicated that surface water was encountered in some small existing dams and localised depressions across the site.

Historical irrigation with wastewater from the Gwayang Wastewater Treatment Works have created what appears to be wetlands in some of the fields previously used for grazing, which forms part of the proposed development. Several small instream dams have been constructed along the wetland on the eastern extent of the site, bordering the Pacaltsdorp Industrial area. These dams provide habitat for various birds and animals and are providing a valuable ecosystem, as well as serving as stormwater detention ponds during periods of high rainfall. The site also contains several small natural drainage lines.

The watercourses and wetlands are the current catchment source point of the proposed site. The internal stormwater will be designed in such a manner that it follows the natural topography of the site, and the outflow will be dispersed via energy dissipating outlets towards the natural drainage paths and existing wetland towards the eastern extent of the site to assist in reducing the risk of erosion and the establishment of wetlands for the purpose of stormwater attenuation.

5 Stormwater Runoff Calculation

The calculated stormwater runoff is as follows:

Description	Gwayang Development Site	
MAP (mm)	588mm	
Area	183.4 ha	
Design Period	1:5 years	
Runoff Q (l/s)	Pre-Development	Post Development
	5932	12588
Dispersal areas	Watercourses	Watercourses

From the above it can be seen that there will be a significant increase in volume of stormwater as a result of the proposed development.

6 Proposed Design

The proposed layout of the development is still in draft format and the final stormwater layout and design will be done as soon as the layout has been finalized and approved. **Annexure A** shows the proposed extent of the development as well as proposed coverage. **Annexures B** shows the proposed stormwater services layout.

The objective is to disperse stormwater by applying sustainable urban drainage systems (SuDS), such as attenuation/detention space and swales. The focus will be to protect the existing watercourses and wetlands and to not add any further negative impacts to these natural habitats. The topography slopes naturally to the southwestern corner of the site. Possible locations of attenuation ponds will be investigated during the detailed design stages of the project, but this specific area would ideally be incorporated as a stormwater attenuation area, including utilisation of the existing small dams on the site. From a pollution reduction and flow velocity perspective, provision will be made to include sufficient attenuation space in this respect, especially for the industrial areas, of which the details of the type of industries are unknown at present.

A conventional stormwater network consisting of stormwater catch pits, manholes and headwalls will convey the stormwater generated in the area towards the proposed energy dissipation outlets and attenuation areas, as mentioned before. This will reduce the peak runoff towards the existing drainage lines. **Annexures C** and **D** show typical examples of energy dissipation and silt retention structures.

Accumulated stormwater will be dispersed by means of various energy dissipating structures to minimize the effect of peak runoff downstream. Detention could be required to maintain current flow conditions; however, these detention facilities will have to be adequately designed during the detailed design stages of the project. The area defined as an artificial wetland with the combination of existing instream dams, offer an opportunity for the improvement of water quality and it is therefore considered to incorporate this feature into the stormwater management of the planned development. No untreated water should however be allowed to enter these wetlands.

It is proposed that the stormwater generated upstream of the development be conveyed through the development by means of both an underground system as well as an emergency overland flow system. However, all upstream stormwater generated by the existing developed area will have to be dealt with through the proposed development. Various roads will be crossing the watercourses within the proposed layout. Box culverts or stormwater pipes will be used to allow uninterrupted flow under the roads.

Road crossings at environmentally sensitive zones should be dealt with by means of large box culverts with a buried base, allowing the wetland habitat to be continuous through the culvert and also allow wildlife to move through.

A site specific and detailed stormwater design including mitigating measures as described in this report will be done within this framework following the finalization of the layout and may vary slightly from what is presented in this plan.

7 Floodlines

None of the industrial and residential properties forming part of the proposed development project are directly affected by any floodlines.

8 Spatial Planning Considerations

It is proposed that the Spatial Development Plan (SDP) take cognisance of the required stormwater management. This includes:

- Provision of stormwater escape routes between erven to direct minor and major flows towards the existing watercourse and wetlands areas;
- Roads linking the proposed site with the proposed access road should not restrict stormwater run-off;
- No erven should be constructed too close to existing watercourses to impede overland flows or be infringing on the National Water Act (1998) Section 144;
- Silt fences or sediment barriers to be installed around the perimeter of the construction site to trap sediment-laden runoff and prevent it from entering the surrounding watercourses;
- Cut and fill are to be kept away from the delineated watercouses;
- Vegetation outside of the development area should not be cleared;
- The laydown areas must be constructed on flat surfaces with a minimum distance of 20m from buffer areas; and
- Incorporation of the existing watercourses and attenuation ponds in the final SDP, if applicable.

9 Stormwater Management Techniques: During Construction

The stormwater surface run-off water will be managed carefully during construction. The following management techniques will be implemented:

- Temporary cut-off channels and berms;
- Routing of run-off towards the existing watercourse and current drainage routes;
- Erosion protection by means of gabions, Reno mattresses, Geofabric and/or any combination thereof;
- Construct check dams or sediment basins for flooded construction areas to be drained into, if need be, to trap sediment and facilitate sediment settlement before runoff reaches the non-perennial drainage line;
- All bare areas should be revegetated with appropriate locally occurring species to bind the soil and limit erosion potential;.
- Topsoil should be removed and stored in a designated area separately from subsoil and away from construction activities. Topsoil should be reapplied where appropriate as soon as possible in order to encourage and facilitate rapid regeneration of the natural vegetation in cleared areas;
- All hazardous storage containers and storage areas must meet relevant SABS standards to prevent leakage and contamination of surface and groundwater;
- Compliance with a site specific Environmental Management Plan;

- Provision for dealing with water, in accordance with SABS 1200, will be stipulated in the Project Specification and Contract Documents. Of specific importance will be the following clauses:

    i. Clause 5.5 in SABS 1200 A;
    ii. Clause 5.3 in SABS 1200 AA;
    iii. Clause 5.1.3 in SABS 1200 D; and
    iv. Clause 5.1.2 in SABS 1200 DB.

10 Stormwater Management Techniques: Post-Construction

The factors to consider in Stormwater Management falls broadly into two main categories, namely those related to quantity and those related to quality.

Any development brings about changes to the natural environment of a site, which in turn has an effect or disrupts the natural hydrological cycle. Changes include, among other:

- Increase in impermeable surfaces (roads, roofs etc.) resulting in lower infiltration, higher run-off volumes and velocities;
- Changes to natural flow routes through earthworks, infrastructure and shaping of terrain; and
- Changes to local water course environment and ecology.

The management of the increased run-off volumes and velocities is important as it can be detrimental to the receiving drainage system and communities downstream of the site, as it could cause severe erosion, property damage and even loss of life.

By restricting peak flows to pre-development levels, the *status quo* of the catchment is maintained. This could be achieved through the implementation of the following recommended practices, as described in paragraphs 10.1 and 10.2 below.

10.1 Infiltration and Dissipation

By dispersing the run-off to various outfalls spread across the site, the recharge of the underground water table is promoted, and the risk of erosion reduced.

Energy dissipating structures combined with Reno mattresses to prevent scouring and erosion will be utilised creating a high friction factor and thereby reduce the velocity of stormwater. Refer to Annexures C and D for further information regarding energy dissipation structures.

The installation of Reno mattresses and gabion boxes at outlets acts as energy dissipaters and stilling basins. These structures are also used as silt traps to prevent the loss of silt to the natural water courses. Silt that gets trapped on the Reno mattresses acts as a growing medium for vegetation which thereby accelerates the re-establishment of natural vegetation. This rehabilitated vegetation also acts as a dissipation medium, resulting in attenuated run-off. Suitable/appropriate plants should be investigated for the vegetation of gabion structures.

10.2 Attenuation

Attenuation functions by the principle of allowing large flows of water to enter a facility but limiting the outflow by having a small opening at the low point in the facility. The difference between in- and outflows is temporarily stored in an allocated space within which safe storage/detention can occur.

Attenuation in the form of large dams will not be possible in this instance due to limited space, but rainwater in the proposed development will be discharged onto the road and flow into inlet works/catchpits. The water will then proceed to the lowest point flowing out to the headwall. The aim is to ensure the maximum percentage of rainwater flows to the catchment source point near the proposed development area.

10.3 Maintenance of the stormwater system

The ongoing sustainability of the stormwater system relies on the effective maintenance of all individual stormwater components and infrastructure. The George Municipality will take ownership of any stormwater infrastructure in the public road reserves or open spaces and ensure that the stormwater system is in good repair, in a healthy state and regularly serviced. It would be advisable that a landscaping plan should be compiled and implemented for the area to ensure the use and implementation of Sustainable Drainage Systems (SuDS), as recommended, is adhered to.

11 Conclusions and Recommendations

The planning of stormwater design elements must always be seen as a holistic process which incorporates much more than the infrastructural elements required in adequately dealing with stormwater. It affects a range of environmental goals and management principles and aims not only to mitigate negative impacts but actively promote positive modifications in its application.

The design approach to be adopted for the proposed development and as discussed above, can be summarised by the use and implementation of Sustainable Drainage Systems (SuDS) with the objective of attenuating stormwater onsite and reducing volumes of stormwater input in watercourses summarised as follows:

- Promotion of on-site infiltration;
- Minimise the concentration of stormwater;
- Maintain pre-development run-off levels as far as possible;
- Enforcement of management principles;
- Identify escape routes for major floods;
- Rainwater harvesting must be installed at all buildings;
- Use of permeable paving and sunken gardens to encourage infiltration into the soil;
- Building control and architectural guidelines for residents and businesses to be compiled to promote on-site stormwater management;
- All headwall outlets and associated erosion control structures (e.g. reno mattresses and gabions) must be inspected and maintained on a routine basis. Reno mattress structures to be inspected after heavy rains to determine if any erosion around or below the mattress has taken place or if stones have been dislodged;
- Control of alien invasive plant species must be carried out within all buffer areas to encourage recolonisation by indigenous vegetation and improve the structural integrity of the buffer;

- Guidelines for residents and industries must be drawn up which prohibit dumping of hazardous materials into stormwater drains;
- Responsible discharge of stormwater into downstream systems. No untreated water to be allowed to enter the stormwater system. This can be achieved by the formation of swales on the roadside;
- On-site waste treatment prior to discharge, in the case of industrial sites, to be investigated during the detail design phase; and
- Allowing for the necessary attenuation where possible.

While the detail design was beyond the scope of Zutari's appointment, certain aspects will require further consideration during the detail design stage, they are:

- Stormwater needs to be responsibly conveyed to the existing watercourses;
- Stormwater collected along the watercourses needs to be able to reach the existing drainage infrastructure downstream;
- The site development plan needs to adequately provide for servitudes to accommodate major flows;
- Crossing of environmentally sensitive areas by means of box culverts spanning the entire wetland area, with a minimum finished height of approximately 1,5m and re-vegetated bottom, should be considered;
- Maximisation of attenuation of the rainwater that most water can be catched up.

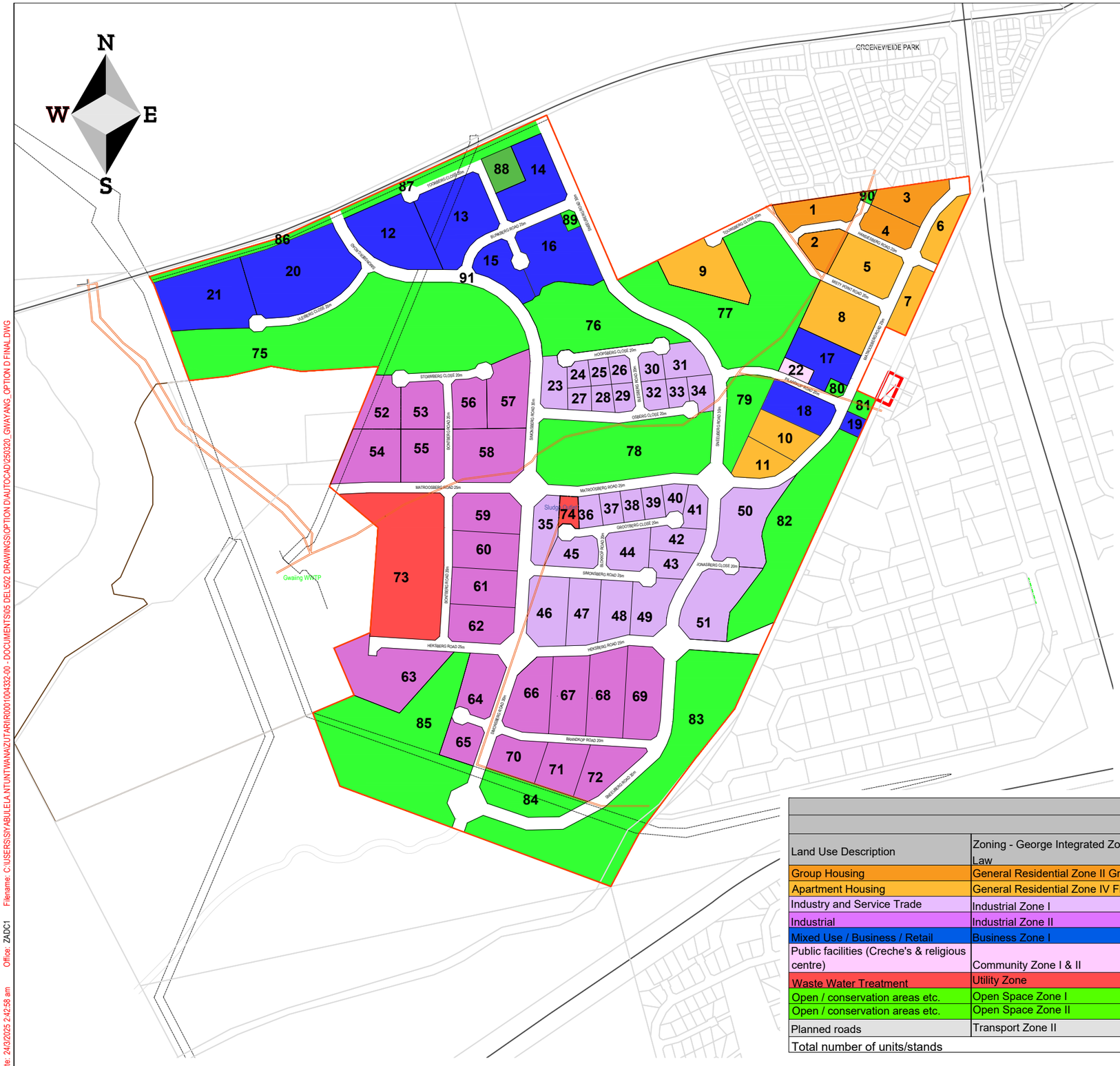
As indicated in this report, the proposed site's stormwater will be managed in a responsible manner and be safely discharged into the surrounding drainage system, without any detrimental impacts to the environment or communities.

The application of this Plan on this project will lead to:

- Minimisation of the impacts of stormwater from new developments on receiving waters such as watercourses, wetlands, coastal waters, etc; and
- Prevention of further degradation of receiving waters by stormwater draining from existing developments, as well as in the long term the reversal of current undesirable stormwater impacts.

Annexure A

Site Development Plan



NOTATION	ERF NUMBER	ERF AREA sqm	ZONING (GEORGE INTEGRATED ZONING SCHEME)	NOTATION	ERF NUMBER	ERF AREA sqm	ZONING (GEORGE INTEGRATED ZONING SCHEME)
	1	11542 sqm	GENERAL RESIDENTIAL ZONE II GROUP HOUSING		47	11783 sqm	INDUSTRIAL ZONE I
	2	7515 sqm	GENERAL RESIDENTIAL ZONE II GROUP HOUSING		48	10281 sqm	INDUSTRIAL ZONE I
	3	11678 sqm	GENERAL RESIDENTIAL ZONE II GROUP HOUSING		49	11593 sqm	INDUSTRIAL ZONE I
	4	8164 sqm	GENERAL RESIDENTIAL ZONE II GROUP HOUSING		50	21592 sqm	INDUSTRIAL ZONE I
	5	16372 sqm	GENERAL RESIDENTIAL ZONE IV FLATS/APARTMENT		51	20313 sqm	INDUSTRIAL ZONE I
	6	7600 sqm	GENERAL RESIDENTIAL ZONE IV FLATS/APARTMENT		52	10624 sqm	INDUSTRIAL ZONE II
	7	8249 sqm	GENERAL RESIDENTIAL ZONE IV FLATS/APARTMENT		53	11284 sqm	INDUSTRIAL ZONE II
	8	19860sqm	GENERAL RESIDENTIAL ZONE IV FLATS/APARTMENT		54	17706 sqm	INDUSTRIAL ZONE II
	9	20122 sqm	GENERAL RESIDENTIAL ZONE IV FLATS/APARTMENT		55	12948 sqm	INDUSTRIAL ZONE II
	10	10621 sqm	GENERAL RESIDENTIAL ZONE IV FLATS/APARTMENT		56	9617 sqm	INDUSTRIAL ZONE II
	11	8716 sqm	GENERAL RESIDENTIAL ZONE IV FLATS/APARTMENT		57	16052 sqm	INDUSTRIAL ZONE II
	12	25103 sqm	BUSINESS ZONE 1		58	21173 sqm	INDUSTRIAL ZONE II
	13	27411 sqm	BUSINESS ZONE 1		59	14515 sqm	INDUSTRIAL ZONE II
	14	18839 sqm	BUSINESS ZONE 1		60	13623 sqm	INDUSTRIAL ZONE II
	15	10660 sqm	BUSINESS ZONE 1		61	13424 sqm	INDUSTRIAL ZONE II
	16	23893 sqm	BUSINESS ZONE 1		62	13148 sqm	INDUSTRIAL ZONE II
	17	14289 sqm	BUSINESS ZONE 1		63	27850 sqm	INDUSTRIAL ZONE II
	18	12839 sqm	BUSINESS ZONE 1		64	12607 sqm	INDUSTRIAL ZONE II
	19	2303 sqm	BUSINESS ZONE 1		65	7602 sqm	INDUSTRIAL ZONE II
	20	41165 sqm	BUSINESS ZONE 1		66	15785 sqm	INDUSTRIAL ZONE II
	21	30024 sqm	BUSINESS ZONE 1		67	16307 sqm	INDUSTRIAL ZONE II
	22	2662 sqm	COMMUNITY ZONE I & II		68	18083 sqm	INDUSTRIAL ZONE II
	23	7018 sqm	INDUSTRIAL ZONE I		69	18523 sqm	INDUSTRIAL ZONE II
	24	3116 sqm	INDUSTRIAL ZONE I		70	10894 sqm	INDUSTRIAL ZONE II
	25	3055 sqm	INDUSTRIAL ZONE I		71	11340 sqm	INDUSTRIAL ZONE II
	26	3226 sqm	INDUSTRIAL ZONE I		72	12610 sqm	INDUSTRIAL ZONE II
	27	3081 sqm	INDUSTRIAL ZONE I		73	59303 sqm	UTILITY ZONE
	28	3254 sqm	INDUSTRIAL ZONE I		74	3185 sqm	UTILITY ZONE
	29	3324 sqm	INDUSTRIAL ZONE I		75	125785 sqm	OPEN SPACE ZONE I
	30	3779 sqm	INDUSTRIAL ZONE I		76	39500 sqm	OPEN SPACE ZONE I
	31	7328 sqm	INDUSTRIAL ZONE I		77	75277 sqm	OPEN SPACE ZONE I
	32	4018 sqm	INDUSTRIAL ZONE I		78	58197 sqm	OPEN SPACE ZONE I
	33	3302 sqm	INDUSTRIAL ZONE I		79	15173 sqm	OPEN SPACE ZONE I
	34	4607 sqm	INDUSTRIAL ZONE I		80	1434 sqm	OPEN SPACE ZONE I
	35	8615 sqm	INDUSTRIAL ZONE I		81	2736 sqm	OPEN SPACE ZONE I
	36	4024 sqm	INDUSTRIAL ZONE I		82	48910 sqm	OPEN SPACE ZONE I
	37	3750 sqm	INDUSTRIAL ZONE I		83	88098 sqm	OPEN SPACE ZONE I
	38	3750 sqm	INDUSTRIAL ZONE I		84	16180 sqm	OPEN SPACE ZONE I
	39	3750 sqm	INDUSTRIAL ZONE I		85	81505 sqm	OPEN SPACE ZONE I
	40	3529 sqm	INDUSTRIAL ZONE I		86	7578 sqm	OPEN SPACE ZONE I
	41	5150 sqm	INDUSTRIAL ZONE I		87	13576 sqm	OPEN SPACE ZONE I
	42	7186 sqm	INDUSTRIAL ZONE I		88	6786 sqm	OPEN SPACE ZONE II
	43	6064 sqm	INDUSTRIAL ZONE I		89	1421 sqm	OPEN SPACE ZONE I
	44	9487 sqm	INDUSTRIAL ZONE I		90	816 sqm	OPEN SPACE ZONE I
	45	7751 sqm	INDUSTRIAL ZONE I		91	319202 sqm	TRANSPORT ZONE II
	46	15118 sqm	INDUSTRIAL ZONE I				

The Orange dashed line represents a 3m wide servitude along the existing sewer line over ERF 1, 2, 8, 18, 34, 35, 45, 46, 58, 73, 74, 77, 78, 79, 80, 81, 84, 90 and 91

The Black dashed line represents a 20m wide existing electrical servitude line over ERF 7, 11, 16, 19, 23, 27, 32, 36, 41, 42, 47, 53, 55, 61, 68, 72, 76, 82, 88 and 93

Gwayang Development - George
Projected Land Use

Land Use Description	Zoning - George Integrated Zoning Scheme By-Law	Units	Stands	Density	Stand Size (average)	Area (ha)	FAR	GLA (m2)	% of total area	% of units
Group Housing	General Residential Zone II Group Housing	136	4	35	285	3.89	na	na	2%	6.9%
Apartment Housing	General Residential Zone IV Flats/Apartments	1832	7	200	1.3	9.16	1.0	91536	5%	93.1%
Industry and Service Trade	Industrial Zone I	na	29	na	0.8	20.28	0.8	162277	11%	na
Industrial	Industrial Zone II	na	21	na	1.5	30.57	0.8	244572	17%	na
Mixed Use / Business / Retail	Business Zone I	na	11	na	4	20.65	1.5	309786	11.4%	na
Public facilities (Creche's & religious centre)	Community Zone I & II	na	1	na	0.27	0.27	1.0	2662	0%	na
Waste Water Treatment	Utility Zone	na	2	na	na	6.25	na	na	3.4%	na
Open / conservation areas etc.	Open Space Zone I	na	15	na	na	57.62	na	na	31.8%	na
Open / conservation areas etc.	Open Space Zone II	na	1	na	1.0	0.68	na	na	0.4%	na
Planned roads	Transport Zone II	na	1	na	na	31.92	na	na	17.6%	na
Total number of units/stands		1968	92			181.3			100%	100%

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DISCLAIMER
IF CONSTRUCTION DRAWINGS ARE ISSUED UNSIGNED, THE MASTER WITH THE ORIGINAL SIGNATURE OF APPROVAL WILL BE HELD AT THE ZUTARI OFFICE OF THE APPROVER

REV	DATE	REVISION DETAILS	APPROVED
A	13-02-2025		R Shroder
B	14-02-2025		R Shroder
C	25-02-2025		R Shroder
D	19-03-2025		

SCALE	SIZE
AS SHOWN	A3

DRAWN: A Florence-Brander
DESIGNED: A Florence-Brander
REVIEWED: R Schroder

PRELIMINARY
NOT FOR CONSTRUCTION

APPROVED
DATE

PROJECT: Gwayang Industrial Development
TITLE: Sub-divisonal Layout and Zoning

DRAWING No. 1004332 – 0000 – DRG – UD – 000 – C
(PROJECT No. – WBS – TYPE – DISC – NUMBER – REV)

Annexure B

Stormwater Services Layout

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NOTES:

1. ALL WORK TO BE DONE IN ACCORDANCE WITH SANS 1200.

LEGEND:

PROPOSED:

- STORMWATER PIPES
- STORMWATER CATCHPIT
- STORMWATER JUNCTION BOX
- ROAD PAVED (80mm SA CONCRETE BLOCK)
- MOUNTABLE KERB (MK10)
- COMBINATION KERB (CK5)
- BARRIER KERB AND CHANNEL (BK2 & C1)
- ENERGY DISSIPATOR HEADWALL

EXISTING:

- WATER PIPE
- SEWER PIPE
- SEWER MANHOLE
- STORMWATER PIPE
- STORMWATER CATCHPIT
- STORMWATER JUNCTION BOX
- OVERHEAD POWER/TELEPHONE LINE
- VALVE
- FH FIRE HYDRANT
- FENCE
- BENCHMARKS

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REV	DATE	REVISION DETAILS	APPROVED
A	22/11/24	PRELIMINARY NOT FOR CONSTRUCTION	AC KEYSER

SCALE	SIZE
1:1000	A0

PRELIMINARY
NOT FOR CONSTRUCTION

DRAWN: E BURGER

DESIGNED: H LAUBSCHER

REVIEWED: M BOTHA

APPROVED
AC KEYSER ECSA-200670188
DATE

PROJECT

GWYANG INDUSTRIAL DEVELOPMENT

TITLE

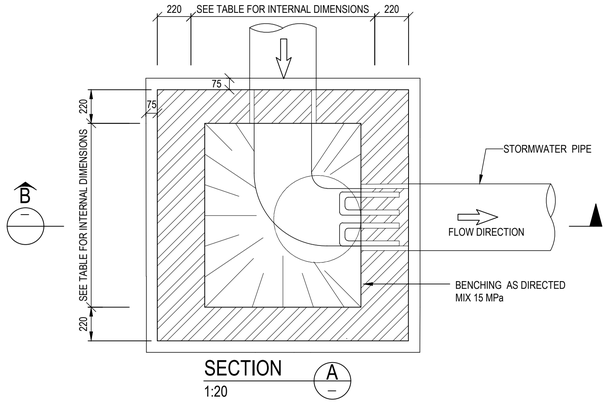
ROADS AND STORMWATER LAYOUT

DRAWING NUMBER

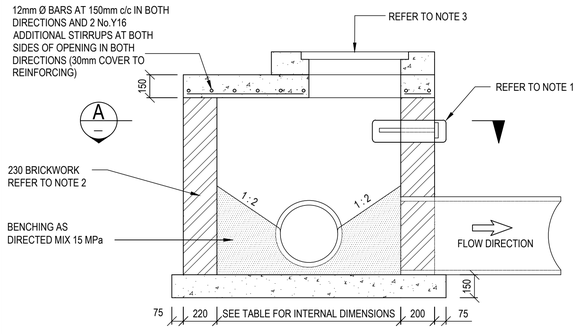
PROJECT No.	WBS	TYPE	DISC	NUMBER	REV
1004332-	0000 -	DRG -	CC -	0001 -	A

Annexure C

Energy Dissipation and Stormwater Details 1

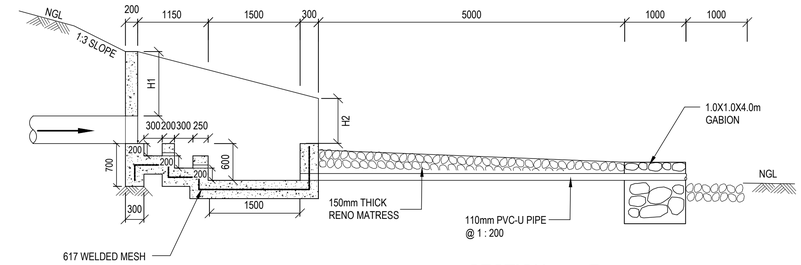


SECTION A
1:20



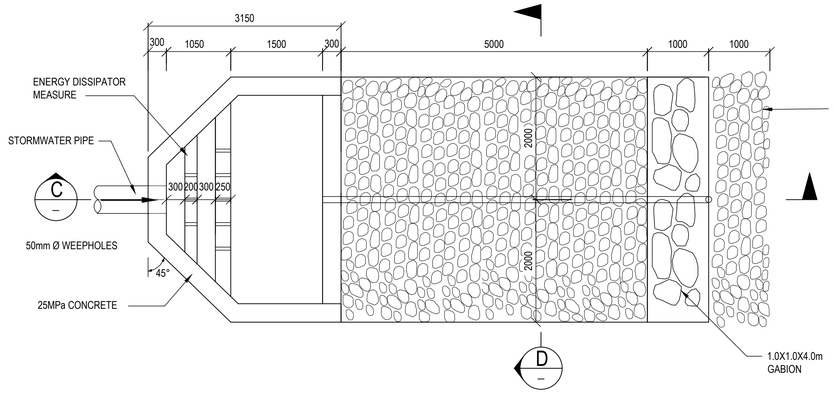
SECTION B
1:20

DETAIL: STORMWATER JUNCTION BOX 01

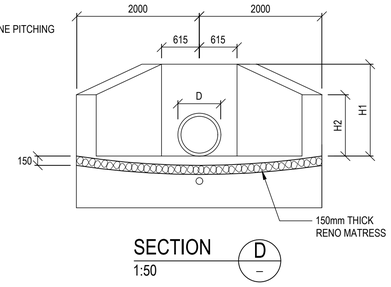


SECTION C
1:50

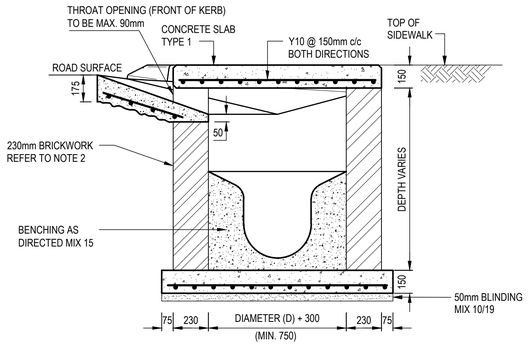
D	H1	H2
375mm	700mm	450mm
450mm	800mm	550mm
525mm	900mm	650mm
600mm	1000mm	750mm
900mm	1400mm	900mm



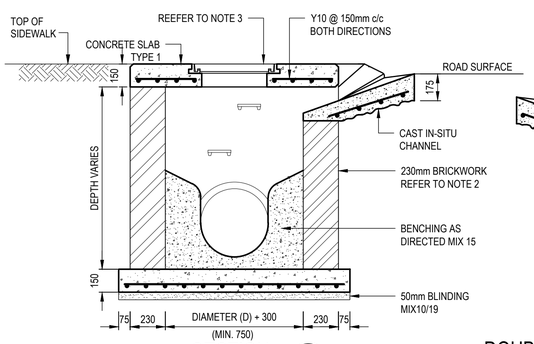
PLAN:
DETAIL: SILT RETENTION AND ENERGY DISSIPATER HEADWALL (375 - 600mm ND) 02
1:50



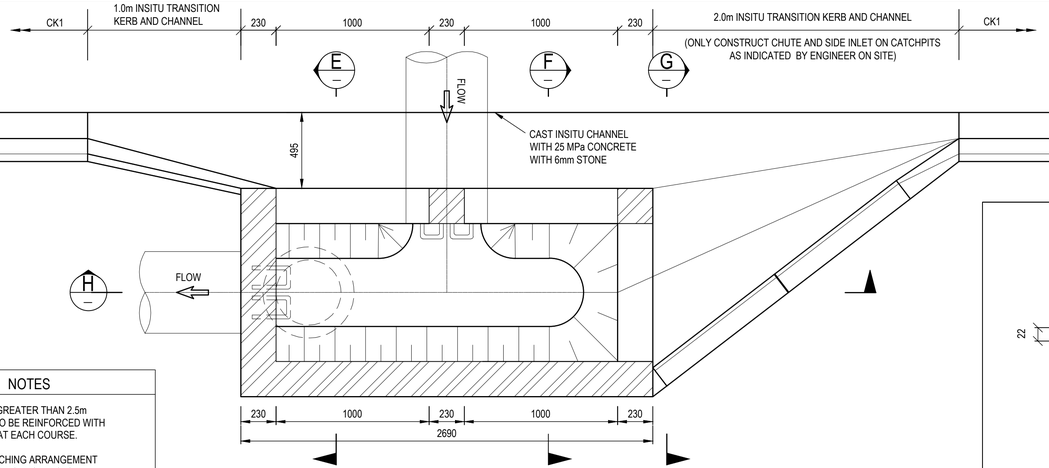
SECTION D
1:50



SECTION F
1:20



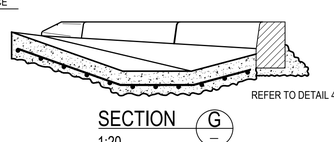
SECTION E
1:20



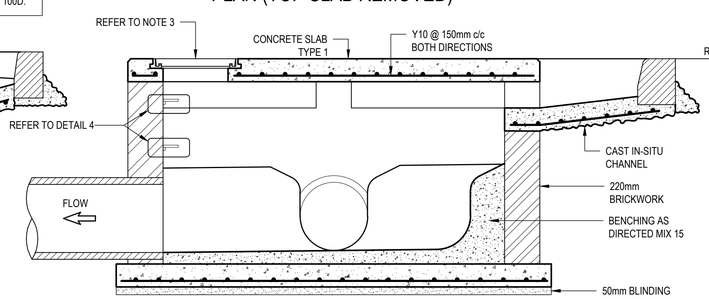
PLAN (TOP SLAB REMOVED)

NOTES

1. FOR DEPTHS GREATER THAN 2.5m BRICKWORK TO BE REINFORCED WITH BRICKFORCE AT EACH COURSE.
2. PIPE AND BENCHING ARRANGEMENT VARIES WITH CIRCUMSTANCES.
3. ALL STORMWATER PIPES ROCLA CLASS 100D.

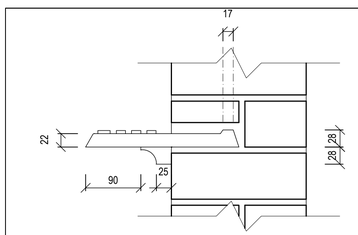


SECTION G
1:20

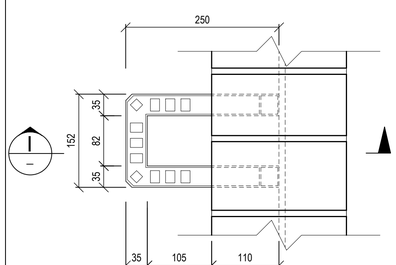


DOUBLE CATCHPIT WITH SIDE INLET 3
1:20

SECTION H
1:20



SECTION I
1 : 5



PLAN OF STEP IRON 4
1 : 5

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REV	DATE	REVISION DETAILS	APPROVED
A	1/4/2025	PRELIMINARY NOT FOR CONSTRUCTION	AC KEYSER

SCALE	AS SHOWN	SIZE	A1
DRAWN	E BURGER		
DESIGNED	H LAUBSCHER		
REVIEWED	M BOTHA		

PRELIMINARY
NOT FOR CONSTRUCTION

APPROVED
DATE
AC KEYSER ECSA-200670188

PROJECT

GWYANG INDUSTRIAL DEVELOPMENT

TITLE

GENERAL DETAILS

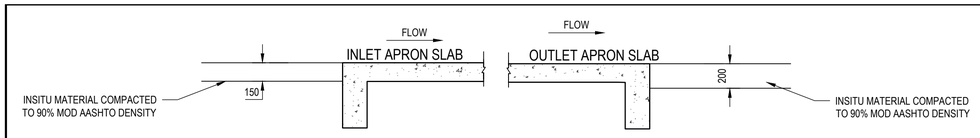
SHEET 1 OF 2

DRAWING NUMBER

PROJECT No.	WBS		TYPE		DISC		NUMBER	REV
1004332-	0000	-	DRG	-	CC	-	0010	- A

Annexure D

Energy Dissipation and Stormwater Details 2

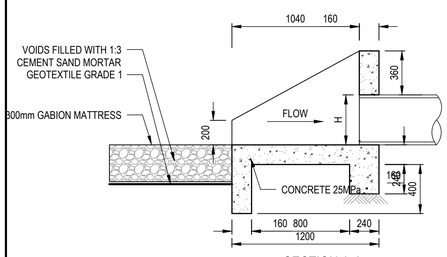


HEADWALL TYPE 1: INLET

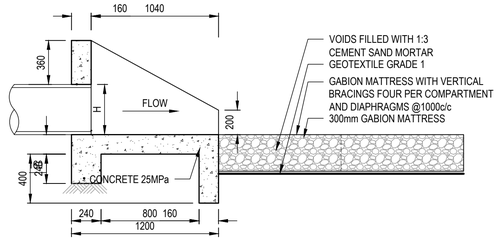
SCALE 1:25

HEADWALL TYPE 1: OUTLET

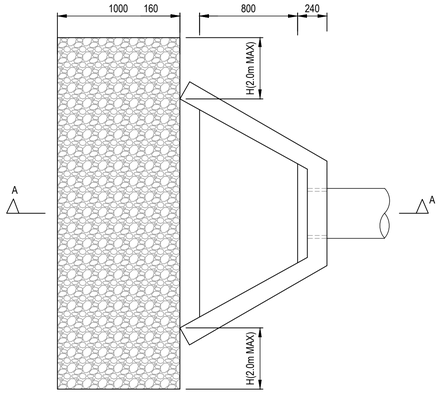
SCALE 1:25



SECTION A-A

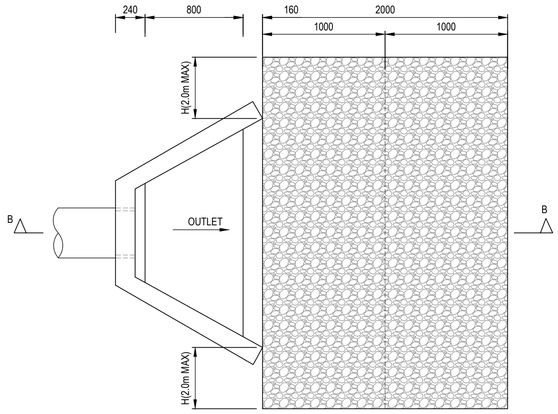


SECTION B-B



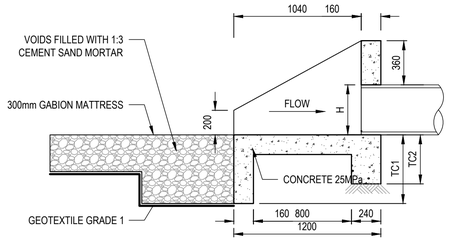
HEADWALL TYPE 2: INLET

SCALE 1:25

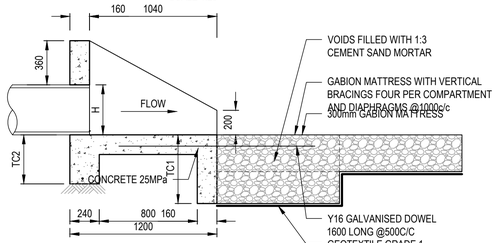


HEADWALL TYPE 2: OUTLET

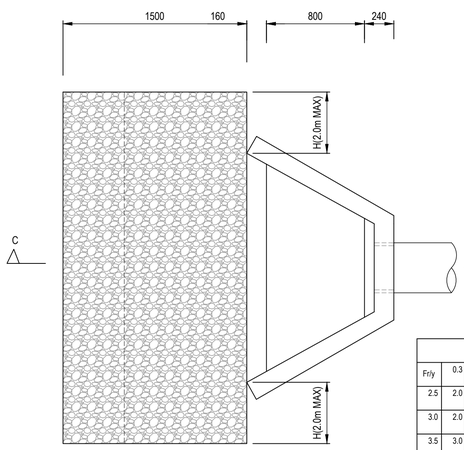
SCALE 1:25



SECTION C-C



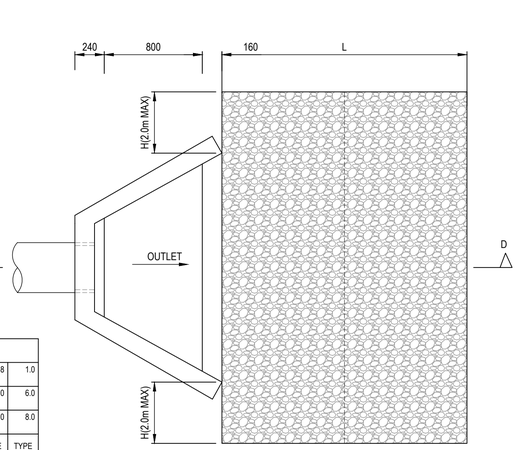
SECTION D-D



HEADWALL TYPE 3: INLET

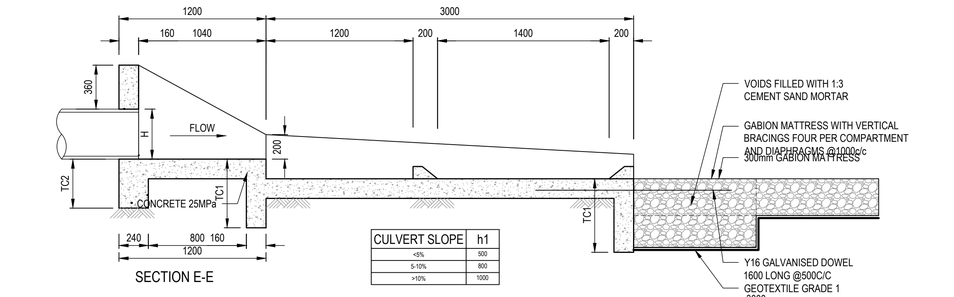
SCALE 1:25

L(m)					
Fr/y	0.3	0.6	0.7	0.8	1.0
2.5	2.0	3.0	4.0	5.0	6.0
3.0	2.0	4.0	6.0	8.0	8.0
3.5	3.0	6.0	8.0	TYPE 4 OF 5	TYPE 4 OF 5
4.0	4.0	8.0	TYPE 4 OF 5	TYPE 4 OF 5	TYPE 4 OF 5



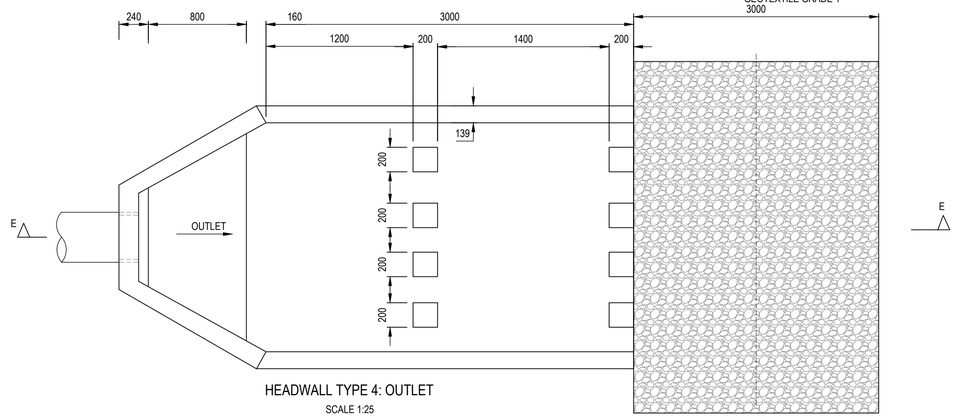
HEADWALL TYPE 3: OUTLET

SCALE 1:25



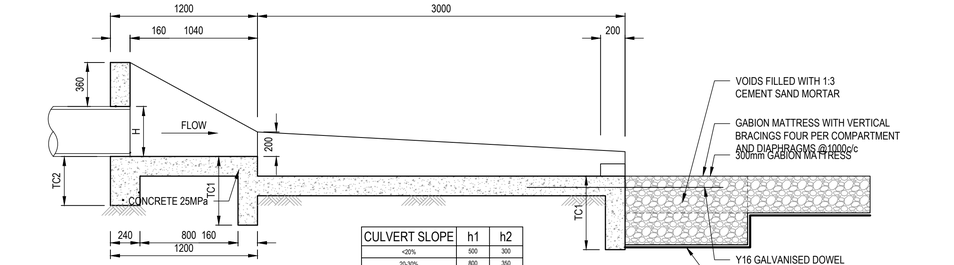
SECTION E-E

CULVERT SLOPE	h1
<5%	500
5-10%	800
>10%	1000



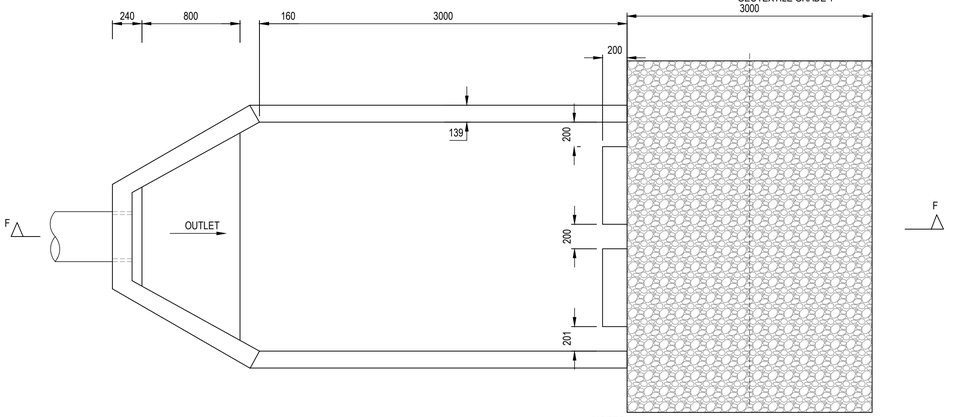
HEADWALL TYPE 4: OUTLET

SCALE 1:25



SECTION F-F

CULVERT SLOPE	h1	h2
<20%	500	300
20-30%	800	350
>30%	1000	400



HEADWALL TYPE 5: OUTLET

SCALE 1:25

NOTES:
1. V = WATER VELOCITY AT OUTLET
2. Fr = FROUDE NUMBER AT OUTLET
3. y = WATER DEPTH AT OUTLET (m)
4. GABIONS TO BE OMITTED
WHERE ROCK IS PRESENT

TYPICAL INLET/OUTLET STRUCTURES

SCALE 1:25

NOTES:
1. V = WATER VELOCITY AT OUTLET
2. Fr = FROUDE NUMBER AT OUTLET
3. y = WATER DEPTH AT OUTLET (m)
4. SOIL CONDITIONS TO BE TAKEN INTO ACCOUNT
5. CUT-OFF WALL GABIONS TO BE OMITTED WHERE ROCK IS PRESENT
6. MINIMUM CONCRETE COVER = 50mm
7. CONCRETE CLASS $\frac{25/20}{19}$
8. EF = EACH FACE, HT = HIGH TENSILE
9. REINFORCEMENT TO CONCRETE OUTLET STRUCTURE SIMILAR TO CULVERT APRON SLABS AND CUT-OFF WALLS
10. FOR CUT-OFF WALL DEPTHS AND GABIONS PROTECTION DEPTH REFER TO DWG. No BM-SW5-F
11.. 300mm GABION MATTRESSES AT INLET/OUTLET TO BE INSTALLED WITH DIAPHRAGMS AT 1000c/c

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REV	DATE	REVISION DETAILS	APPROVED
A	1/4/2025	PRELIMINARY NOT FOR CONSTRUCTION	AC KEYSER

SCALE	AS SHOWN	SIZE	A1
DRAWN	E BURGER		
DESIGNED	H LAUBSCHER		
REVIEWED	M BOTHA		

PRELIMINARY
NOT FOR CONSTRUCTION

APPROVED
DATE
AC KEYSER ECSA-200670188

PROJECT

GWYANG INDUSTRIAL DEVELOPMENT

TITLE

GENERAL DETAILS

SHEET 2 OF 2

DRAWING NUMBER

PROJECT No.	WBS	TYPE	DISC	NUMBER	REV
1004332-	0000	- DRG	- CC	- 0011	- A

Plot Date: 1/4/2025 9:40:51 am Office: ZAGRJ Filename: C:\USERS\ERIC.BURGER\ZUTARI\900\1004332-00 - DOCUMENTS\005 DELIVER\02 DRAWINGS\OPTION D\AUTOCAD\1004332-0000-DRG-CC-0010 REV A GENERAL DETAILS.DWG

In diversity there is beauty and there is strength.

MAYA ANGELOU

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