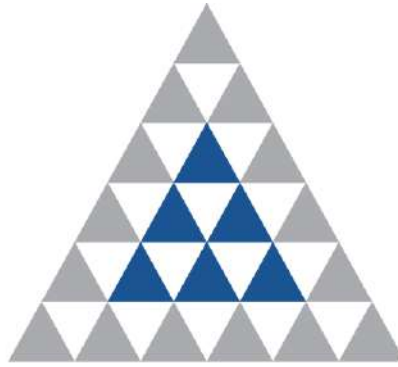


ANNEXURE I:

Civil Services Report



ATTERBURY

It's a matter of association

TECHNICAL REPORT FOR CIVIL ENGINEERING SERVICES

FOR

MEULENZICHT LANDGOED DEVELOPMENT, GEORGE

APRIL 2025

REVISION 0

COMPILED FOR:



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REPORT DETAILS:

Lyners Reference No:	C24051/AA
Client	Atterbury (Pty) Ltd
Report prepared by:	F van Eck, G Wallace
Client representative	J Prinsloo, G van den Berg
Revision record and date	Revision 0
Keywords	Civil Services Report, Meulenzicht Landgoed

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1. INTRODUCTION

Atterbury (Pty) Ltd appointed Neil Lyners & Associates (Pty) Ltd (hereafter referred to as Lyners) to compile a civil engineering services report for the Meulenzicht Landgoed Development in George.

The report will deal with the following matters:

- The availability of civil engineering services;
- Planning of the civil engineering services.

The various developments will consist of the following land uses:

- Residential Zone II and III;
- Open Spaces;
- Agricultural.

2. AVAILABLE INFORMATION AND INVESTIGATIONS

The following information was available to us for the investigation:

- Sub-division plan (revision P) received from Nuvorm on 14 April 2025 (See **Annexure A**);
- Existing services information received from George Municipality and GLS (See **Annexure B**);
- Detail and topographic survey of the entire property completed in November 2024;
- Geotechnical conditions from preliminary geotechnical soil investigation (See **Annexure G**).

3. LOCATION OF THE WORKS

The proposed development, Meulenzicht Landgoed, are located on Erf 25537, situated north of the National Route 2 (N2) and east of Urbans Boulevard, between the Modderrug River and the Swart River.

The site is easily accessible via Urbans Boulevard, a formal surfaced road. The GPS coordinates for Meulenzicht Landgoed are 33°59'12.31"S, 22°31'21.69"E.



4. SITE TOPOGRAPHY, DRAINAGE AND VEGETATION

The development area is situated at elevations ranging from approximately 213m to 172m above mean sea level (MSL). The site is predominantly covered with grassland, with clusters of trees concentrated in the lower-lying areas. It is surrounded by a variety of land uses, including residential developments, commercial developments and agricultural activities.

Natural drainage patterns direct surface water toward existing watercourses, which ultimately meet with the Swart River along the eastern boundary of the site.

5. HYDROLOGY AND CLIMATE

The Mean Annual Precipitation used for the preliminary investigation is 850mm per annum for the George area.

6. TRAFFIC IMPACT ASSESSMENT

ITS (Pty) Ltd was separately appointed by the Developer to investigate and comment on the concept Site Development Plan (SDP) as well as the expected transport related impacts of the proposed development on the surrounding road network. A copy of their report is provided in **Annexure F**.

7. EXTERNAL SERVICES

GLS Consulting Engineers was appointed by George Municipality to assist the Municipality as Water Services Authority with the master planning for water and sewer services in the George area. The proposed development footprint forms part of the Kraaibosch master plan.

The updated GLS drawings in **Annexure B** indicate the existing and proposed external (bulk) water and sewer services reticulations as obtained from the various authorities and reports. This drawing will be updated during future planning and final design phases.

7.1 Water

The local authority appointed GLS as the master planning consulting engineers for the investigation of the bulk water supply infrastructure.

The water Annual Average Daily Demand will be as per Guidelines (Red Book) standards and as discussed in the GLS correspondence (see **Annexure B**). Table 1 below indicates the water Annual Average Daily Demand (Based on the similar developments' historic consumption in the area):



Table 1: Annual Average Daily Demand for Water

Land Use	Unit of Measure (No/100m ² /ha)	No. Units (No/100m ² /ha)	UWD/Unit (kL/unit/d)	AADD Inc. UAW (kL/d)	Phase
Phase 1					
Residential (George & Wilderness) - Low density, large sized Residential stands	unit	83	0.938	77.81	B1
Sub-Total:		153		77.81	
Phase 2					
Residential (George & Wilderness) - Medium density, medium sized Residential stands	unit	49	0.813	39.81	B2
Sub-Total:		139		39.81	
Phase 3					
Residential (George & Wilderness) - Medium density, medium sized Residential stands	unit	25	0.813	20.31	B3
Sub-Total:		79		20.31	
Phase 4					
Residential (George & Wilderness) - Very Low density, extra large sized Residential stands	unit	70	1.125	78.75	B4
Sub-Total:		97		78.75	
Phase C					
Residential (George & Wilderness) - Very Low density, extra large sized Residential stands	unit	50	1.125	56.25	C
Sub-Total:		50		56.25	
Total for all Phases (kL/d):				272.94	
Allow for additional 10% future demand from neighboring properties		10%		27.29	
Total (kL/d):				300.23	

The total Annual Average Daily Demand will therefore be 300.23kL/day (3.5l/s) with a peak demand of 16.1l/s.

Water Treatment Capacity

The following treatment capacity of the existing infrastructure are confirmed in the GLS report (see **Annexure B**) and the George Municipality capacity letter (see **Annexure E**):

- The George Municipal Water Treatment Works (old and new) is currently operating under constraint;



- 20MI/day capacity upgrade of the new treatment works is in progress with an estimated completion date of February 2025;
- The treatment works will have sufficient capacity for the development in its entirety once the 20MI/day capacity upgrade is commissioned.

Bulk Pipelines and Pump Stations

The development falls within the George Main Zone and Kraaibosch reservoir zone.

- George Main zone: The reservoirs and bulk pipelines currently have sufficient capacity to service the development;
- Kraaibosch reservoir zone: The zone has sufficient capacity with the current theoretical demand, but insufficient capacity in the theoretical fully occupied demand, and cannot support the full development, i.e. the implementation of the next reservoir (2MI) is required to service the full development.

Connection Proposals

The technical report by GLS (see **Annexure B**) included 2 proposals for connection to the water network / system, which includes the master plan system and an interim solution.

- Interim solution proposal: To install an interim PRV connection on the existing 250mm Ø George main pipeline. The interim solution (refer to section 3.4.3 and 3.5.3 of the GLS technical report) is not accepted by George Municipality as a solution for this development and will not be considered further;
- Master Plan proposal: To service the Kraaibosch development node, the master plan includes the construction of a future 4MI reservoir and tower. The current tower has sufficient capacity to service the development, however the future 4MI reservoir will require construction to service the development. The municipality confirmed that the 4MI can be replaced with two 2MI reservoirs. For the development only one 2MI reservoir will be built and provision will be made in terms of land area for a future 2MI reservoir. See **Annexure E** for correspondence from George Municipality.

The current supply pipes to and from the existing reservoir and water tower will be relocated to the proposed road reserves as requested by the George Municipality. See **Annexure D**, drawing 24051-C-004-01.

7.2 Sewerage

The local authority appointed GLS as the master planning consulting engineers for the investigation of bulk sewer infrastructure.



The sewer Peak Daily Dry Weather Flow will be as per Guidelines (Red Book) standards and as discussed in the GLS correspondence (see **Annexure B**). Table 2 below indicates sewer Peak Daily Dry Weather Flow:

Table 2: Peak Daily Dry Weather Flow for Sewer

Land Use	Unit of Measure (No/100m ² /ha)	No. Units (No/100m ² /ha)	UWD/Unit (kL/unit/d)	Sewer Ratio (% x UWD)	PDDWF Excl. Infiltr. (kL/d)	Phase
Phase 1						
Residential (George & Wilderness) - Low density, large sized Residential stands	unit	83	0.938	49%	38.13	B1
Sub-Total:		153			38.13	
Phase 2						
Residential (George & Wilderness) - Medium density, medium sized Residential stands	unit	49	0.813	54%	21.50	B2
Sub-Total:		139			21.50	
Phase 3						
Residential (George & Wilderness) - Medium density, medium sized Residential stands	unit	25	0.813	54%	10.97	B3
Sub-Total:		79			10.97	
Phase 4						
Residential (George & Wilderness) - Very Low density, extra large sized Residential stands	unit	70	1.125	45%	35.44	B4
Sub-Total:		97			35.44	
Phase C						
Residential (George & Wilderness) - Very Low density, extra large sized Residential stands	unit	50	1.125	45%	25.31	C
Sub-Total:		50			25.31	
Total for all Phases(kL/d):					131.35	
Allow for additional 10% future demand from neighboring properties		10%			13.13	
Total (kL/d):					144.48	

The total Peak Daily Dry Weather Flow will therefore be 144.48kL/day (1.7l/s) with a peak demand of 4.25l/s.



Wastewater Treatment Capacity

The following wastewater treatment capacity of the existing infrastructure are confirmed in the GLS report (see **Annexure B**) and the George Municipality capacity letter (see **Annexure E**):

- The Outeniqua Wastewater Treatment works currently has sufficient capacity to support the development.

Bulk Pipelines and Pump Stations

The development falls within the Outeniqua WWTW drainage area.

- The development falls within the future Kraaibosch 3 pump station drainage area. The infrastructure, refer to Figure 2 in the GLS technical report (see **Annexure B**), required to convey sewage of the proposed development to the south and west has not been implemented;
- Bulk conveyance infrastructure (pipelines and pump stations) will require implementation by the developer to connect to the Municipal sewer network if the developer want to proceed with the option to connect to the existing sewer network.

Connection Proposals

The technical report by GLS (see **Annexure B**) includes 3 proposals for connection to the sewer network / system, which includes the master plan system and 2 interim solutions.

- Interim solution proposal 1: The proposal includes the building of Kraaibosch 3 PS. The sewage generated from the development will gravitate to Kraaibosch 3 PS and from there the sewage will be pumped to Kraaibosch PS. The interim solution (refer to section 4.3.2, 4.3.4, 4.4.1 of the GLS technical report report) are not accepted by George Municipality as a solution for this development and will not be considered further;
- Interim solution proposal 2: The proposal includes the building of 3 internal small pump stations (Kraaibosch Ridge PS 2 to Kraaibosch Ridge 4 PS). The sewage generated from the development will gravitate to the 3 small pump stations and from there the sewage will be pumped to Kraaibosch PS. The interim solution (refer to section 4.3.2, 4.3.4, 4.4.1 of the GLS technical report report) are not accepted by George Municipality as a solution for this development and will not be considered further;
- Master Plan proposal: The proposal includes the implementation of the master plan solution, and that all sewage from or generated by the proposed development be conveyed via the system from Kraaibosch 3 PS to Thembaletu 6 PS via Kraaibosch 4 PS and Destiny Africa PS as indicated on Figure 2 in the GLS technical report.

George Municipality has further made 2 alternative connection proposals for the development namely (See **Annexure E**):



- Alternative proposal 1: The developer will be permitted to construct a conservancy tank, where practically possible to service parts of the development, in lieu of a connection to the Municipal network, and a discharge permit shall be issued permitting discharge of sewage at the Outeniqua WWTW. Due to the extent of the development the proposal is not practical but could be considered for very limited parts of the development, subject to the approval of the Municipality and the Developers capacity to service the conservancy tanks;
- Alternative proposal 2: Alternatively, design, implement, operate and maintain an on-site wastewater treatment package plant. The Developer should however note the requirements in terms of the National Water Act and registration as a Water Services Intermediary with the Municipality for compliance monitoring. The Developer should note that this proposal includes the added advantage of treated effluent that could potentially be used for non-potable use that will reduce the potable water demand.

Refer to **Annexure C** for the sewer package plant technical report from Alveo Water. The treated effluent will either be discharged into the existing watercourse or reused for irrigation purposes on the open green spaces. A copy of the correspondence from George Municipality confirming the option of a sewer package plant is included in **Annexure E**.

Alternative proposal 2 of George Municipality will be the Developer's preferred option for dealing with the internal sewage of the development.

7.3 Stormwater Drainage

The natural drainage patterns of the site channel the surface water flow towards existing watercourses situated in two valleys running through the centre of the two areas, which ultimately meet with the Swart River along the eastern boundary of the site. The natural drainage direction of the site will be incorporated in the internal network's detail design phase.

Existing stormwater infrastructure on the proposed development footprint consist of 450mm Ø stormwater pipes adjacent and crossing Urbans Boulevard road and Stormwater portal culverts crossing Urbans Boulevard road. The proposed development will not be connecting onto the existing 450mm Ø stormwater pipe network. The capacity of the existing stormwater culverts will be verified during detail design phase and will be upgraded if needed. The existing stormwater dam on Meulenzich Landgoed may be utilised as a 'wet' stormwater retention pond.

Annexure H contains a detailed Stormwater Management Plan for the development.

7.4 Access

Permanent access to Meulenzicht Landgoed development will be from newly built roads connecting via a proposed traffic circle onto the existing road Urban Boulevard which connects to the N2 highway.



During the construction phase, construction vehicles will make use of the temporary construction access road.

The TIA attached as **Annexure F** describes the requirement of a bridge over the Modderrig river in future when future areas to the east and south of Meulenzicht Landgoed develop.

8. INTERNAL SERVICES

The design of internal services will be done in accordance with the “Human Settlements Planning and Design Guideline (‘i.e., Red Book)”, along with George Municipality Civil Engineering Standards and Requirements for Services.

8.1 Roads

In general all internal roads will have a 12m or 14m wide road reserve with a 5.5m or 6.4m wide road. Road surfaces will be asphalt roads or interlocking paved roads with a 1.5m wide concrete or paved sidewalk. The different road surface finishes are subject to the final design. The kerb on the high side of the road will consist of a MK10 mountable kerb while the lower side will allow for a CK5 channel and mountable kerb to accommodate stormwater from the road surfaces. The proposed typical road cross section is shown on drawing 25041-C-002-201 in **Annexure D**.

The structural design period for all pavement layers will be 20 years. Structural design of layers will be in accordance with the TRH4 and the “Red Book” requirements.

The following pavement structures are envisaged, but are subject to final design:

Asphalt Roads

- 30mm and 35mm Medium continuously graded asphalt compacted to 93% maximum void less density;
- 150mm G4 Base course compacted to 98% maximum dry density;
- 150mm G5 Subbase compacted to 95% maximum dry density (100% for sand);
- 150mm G7 Upper selected layer compacted to 93% maximum dry density (100% for sand);
- 150mm G8 Lower selected layer compacted to 93% maximum dry density (100% for sand);
- 150mm Insitu material compacted to 90% maximum dry density (100% for sand).

Paving Roads

- 60mm and 80mm Paver on 20mm sand;
- 150mm C4 Base course compacted to 98% maximum dry density;
- 150mm G7 Upper selected layer compacted to 93% maximum dry density (100% for sand);
- 150mm G8 Lower selected layer compacted to 93% maximum dry density (100% for sand);
- 150mm Insitu material compacted to 90% maximum dry density (100% for sand).



Sidewalk

- 100mm 25MPa Concrete or 60mm Paver on 20mm sand;
- 125mm G5 Subbase compacted to 95% maximum dry density (100% for sand);
- 150mm G7 Upper selected layer compacted to 93% maximum dry density (100% for sand);
- 150mm Insitu material compacted to 90% maximum dry density (100% for sand).

8.2 Sewerage

The internal underground pipe network will be installed in the roadway, on the higher side of the roadway and inside erven that slopes away from the roads and will comply to the Municipality's minimum requirements with regards to vertical gradients as well as material.

The sewer system will consist of 160mm Ø and 200mm Ø uPVC (Class 34) pipes, sewer manholes and every erf will receive a 110mm Ø erf connection and will be clearly marked inside the erf. The proposed sewer layouts is shown on drawings 24051-C-003-02 and 24051-C-003-03 in **Annexure D**.

The internal sewer system will drain to localized small sewer pumpstations (See detail in **Annexure D**) that will pump to the proposed 360kL sewer package plant for wastewater treatment of the development. The sewer package plant forms part of the external bulk services as described at the end of paragraph 7.2. Refer to **Annexure C** for the sewer package plant technical report from Alveo Water. The treated effluent will either be discharged into the existing watercourse or reused for irrigation purposes on the open green spaces. A copy of the correspondence from George Municipality confirming the option of a sewer package plant is included in **Annexure E**.

8.3 Water

The proposed internal water network will be installed on the lower side of the road reserve (higher side of road) and will consist of the required isolating valves, fire hydrants, air valves, water meters and erf connections as per George Municipality Civil Engineering Standards and Requirements for Services.

The water system will consist of 110mm Ø, 160mm Ø and 200mm Ø uPVC (Class 12) pipes and every erf will receive a 25mm erf connection and will be clearly marked inside the erf. The proposed water layouts is shown on drawings 24051-C-004-02 and 24051-C-004-03 in **Annexure D**.

A 2MI reservoir will be constructed as part of the bulk civil services to supply the development with water. Additional land will be made available for the construction of another 2MI reservoir for future development needs.



The existing 150mm dia. water pipe that supplies the existing reservoir with municipal water, from the 250mm Ø pipe located in the N2 road reserve, will be relocated and replaced with a new 160mm Ø uPVC pipe. The existing 300mm Ø water pipe from the existing reservoir and which supplies the lower areas towards Victoria Bay will also be replaced and repositioned with a new 315mm Ø uPVC pipe.

8.4 Stormwater Drainage

The stormwater drainage will be designed in accordance with the philosophy of providing for a minor and major system. Careful attention will be given to the layout of the road reserves to drain, capture and convey stormwater away from the proposed development. This water can then be utilised to supplement the irrigation water supply.

The major system will consist of roads and open channels to ensure overland escape routes for the larger storm run-offs. The minor system will consist of kerb inlet catch pits and underground stormwater pipes with manholes. The proposed stormwater layouts is shown on drawings 24051-C-005-02 and 24051-C-005-03 in **Annexure D**.

The minor system will be designed to accommodate the 1 in 2 year return period run-offs and the major systems for the 1 in 50 year run-offs. The minimum pipe diameters will be 375 mm Class 100D for longitudinal runs and catch-pit connections.

The stormwater run-off from most of the area will drain towards existing water courses situated in two valleys running through the centre of the development. From there the stormwater run-off ultimately meets with the Swart River along the eastern boundary of the site.

At major outlet points, stormwater outlet structures will make provision for energy dissipation in stilling basins and erosion protection where required. During construction, special attention will be paid to the use of silt traps at stormwater inlets and at natural low points to prevent silt and rubbish to be deposited in the river.

A comprehensive stormwater management plan is attached in **Annexure H**.

8.5 Communication

As part of the installation of the civil engineering services, an underground sleeve layout, with junction boxes, will be installed to accommodate fibre services to be installed by a suitable services provider. The fibre system will consist of 110mm Ø pipes with a 50mm Ø erf connection and will be clearly marked inside the erf. The proposed fibre layouts is shown on drawings 24051-C-006-02 and 24051-C-006-03 in **Annexure D**.



9. WASTE MANAGEMENT

The development will be incorporated in the existing municipal waste infrastructure and the municipality will collect the waste at an approved collection point near or at the gatehouse of each development.

10. RECOMMENDATIONS

The following are recommendations to facilitate the successful development of this site:

- Construct a 2MI reservoir for the bulk water supply to the development and allocate additional land for the construction of a 2MI reservoir for future development needs in the area;
- Reroute existing bulk water pipes across the development;
- Construct a 360kL sewer package plant for the treatment and management of the wastewater generated from the development;
- Install internal civil engineering services as per this report;
- Update cost estimate after preliminary and detail design drawings;
- Appoint a geotechnical engineer to do a Phase 1 geotechnical investigation and report.
- Provide this report as input to the Environmental Application Process.

We trust you find above in order. Please feel free to contact us should you require additional information or have any queries.

Yours faithfully

Francois van Eck Pr Eng
for LYNERS



ANNEXURE A

Subdivision/Master Plan from Nuvorm



FUTURE PHASE

REMAINDER
Agricultural

MEULENZICHT
LANDGOED
65.9788 ha

PHASE 3

PHASE 4

Full title erven
227 units

Open Space

PHASE 1

Open Space

PHASE 2

PHASE 5

Treatment
Plant

Future road

Temporary access road to market

25541

25538

MEULENZICHT LANDGOED			
		Units	GLA
Phase B1	13,2258 ha		
Main entrance / Gatehouse		83	-
Full title erven			
Phase B2	3,9348 ha	49	-
Full title erven			
Phase B3	4,2971 ha	25	-
Full title erven			
Phase B4	15,2092 ha	70	-
Full title erven			
Phase B5	0,7482 ha		-
Treatment plant			
Phase C	28,5678 ha		-
Future Expansion			
		227 units	0 m²

nuvorm

architecture | urban design | landscape architecture | interior design

Unit 305 Oude Postkantoor
c/o Plein Street and, Bird Street
Stellenbosch

studio@nuvorm.com

NOTES

MEULENZICHT LANDGOED
65.9788 ha
227 units

MEULENZICHT
ATTERBURY

25537, 25538, 25541
KRAAIBOSCH

GEORGE

CONCEPT MASTER PLAN

CODE	PHASE	DISCIPLINE	NUMBER	REV
24AA	01	UD	1003	P



MEULENZICHT LANDGOED			
		Units	GLA
Phase B1	13,2258 ha		
Main entrance / Gatehouse		83	-
Full title erven			
Phase B2	3,9348 ha	49	-
Full title erven			
Phase B3	4,2971 ha	25	-
Full title erven			
Phase B4	15,2092 ha	70	-
Full title erven			
Phase B5	0,7482 ha		-
Treatment plant			
Phase C	28,5678 ha		-
Future Expansion			
		227 units	0 m²

NOTES

MEULENZICHT LANDGOED
65.9788 ha
227 units

CODE	PHASE	DISCIPLINE	NUMBER	REV
24AA	01	UD	1004	P



ANNEXURE B

GLS Service Availability Report and Correspondence (Water and Sewer)

06 September 2024

Director: Civil and Technical Services
George Municipality
PO Box 19
GEORGE
6530

ATTENTION: Ms Lindsay Mooiman

Ma'am,

**WATER AND SEWER MASTER PLANS: DEVELOPMENT OF PROPOSED TOWNSHIP/REZONING –
GEORGE ERVEN 25537, 25538, 25541 AND PORTION 400 OF THE FARM KRAAIBOSCH 195 (AAN DE MEULEN
& KRAAIBOSCH RIDGE)**

The request from Neil Lyners and Associated dated 26 April 2024 with regards to accommodating the proposed development in the George water system has reference.

This report is a technical report stating upgrades required in the water and sewer networks in the vicinity of the proposed development. The George Municipal engineering professional (yourself) will make a final decision on works to be implemented by the proposed development.

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Directors: RL Pole, AG Hingeston, AN Umichand

1 INTRODUCTION

1.1 Brief

This report is a technical report stating upgrades required in the water and/or sewer networks in the vicinity of the proposed development. The George Municipal engineering professional (yourself) will make a final decision on works to be implemented by the proposed development.

The latest master plans used in this analysis were the m2024-03 master plans.

1.2 Disclaimer

The investigation has been performed and this report has been compiled based on the information made available to GLS. All efforts, within budget constraints, have been made during the gathering of information to ensure the highest degree of data integrity. The information supplied to GLS by George Municipality and other Consultants at the outset of this assessment is assumed to be the most accurate representation of the existing system up to date hereof.

GLS hereby confirms that any contributions of the developer to the required construction of infrastructure and/or the upgrading of existing infrastructure, whether it be in the form of a capital contribution or in the form of constructing sections of new infrastructure, is a matter to be discussed and agreed upon between the developer and the George Municipality.

All costs shown in this report are year 2023/24 Rand value **estimates** and **include** 50% surcharge for P&Gs, contingencies and fees but **exclude** VAT.

1.3 Version control

<i>Issue Date</i>	<i>Type</i>	<i>Version</i>	<i>Remarks</i>
2024/07/08	Draft	1	Issued for comments and approval
2024/07/10	Revision	2	Added summaries for interim/alternative options
2024/08/05	Revision	3	Added phases for the development, removed internal schematic items.
2024/09/06	Revision	4	Updated summary of sewer costing

2 WATER DEMAND & SEWER FLOWS

2.1 Impact of the proposed development

The proposed development was taken into consideration in the master plan as part of the Sawmill development area.

The water demand and sewer return flow contribution of the proposed development is outlined in the table below:

Land Use	Unit of measure (No/100m2/ha...)	No. Units (No/100m2/ha...)	UWD/unit (kL/unit/d)	Sewer ratio (% x UWD)	AADD Inc. UAW (kL/d)	PDDWF Excl. Infil. (kL/d)
Phase 1		Estimated Start Date:		Estimated Occupation Date:		
Residential (George & Wilderness) - Medium density, medium sized Residential stands	unit	259	0.625	54%	210.44	113.64
Sub-Total		259			210.4	113.6
Phase 2		Estimated Start Date:		Estimated Occupation Date:		
Residential (George & Wilderness) - High density, small sized Residential stands	unit	207	0.625	63%	129.38	81.51
Flats (George & Wilderness) - Medium density Flat units up to 50 m ² (Footprint=0.6 and Storeys=1)	unit	220	0.625	80%	68.75	55.00
Sub-Total		427			198.1	136.5
Total		686			408.6	250.1

2.2 Revised Water Demand

The combined AADD for the proposed development as originally calculated and used in the analysis of the water distribution network in the master plan was 545.9 kL/d (theoretical demand).

The revised AADD, peak flow and fire flow calculated for the proposed development and used in this re-analysis of the water distribution network is 408.6 kL/d.

- Annual average daily demand of George Main zone = 198.1 kL/d
- Peak flow using a zone peak hour factor of 3.00[‡] = 5.70 L/s
- Annual average daily demand for Kraaibosch Tower zone = 210.5 kL/d
- Peak flow using a zone peak hour factor of 4.60[‡] = 11.20 L/s
- Fire flow (Low rise flats <= 3 storeys) using a peak hour factor of 2.0 = 20 L/s @ 10 m
- Fire flow (Residential) using a peak hour factor of 2.0 = 15 L/s @ 10 m

2.3 Revised Sewer Flow

The combined peak day dry weather flow (PDDWF) for the proposed development as originally calculated and used in the analysis of the sewer system in the master plan was 422.4 kL/d (theoretical flow).

The revised PDDWF (excluding infiltration) calculated for the proposed development and used in the re-analysis of the sewer system is 250.1 kL/d. The design flow, or instantaneous peak wet weather flow (IPWWF), is 6.6 L/s.

[‡] Higher peak flow factors might be applicable for internal networks.

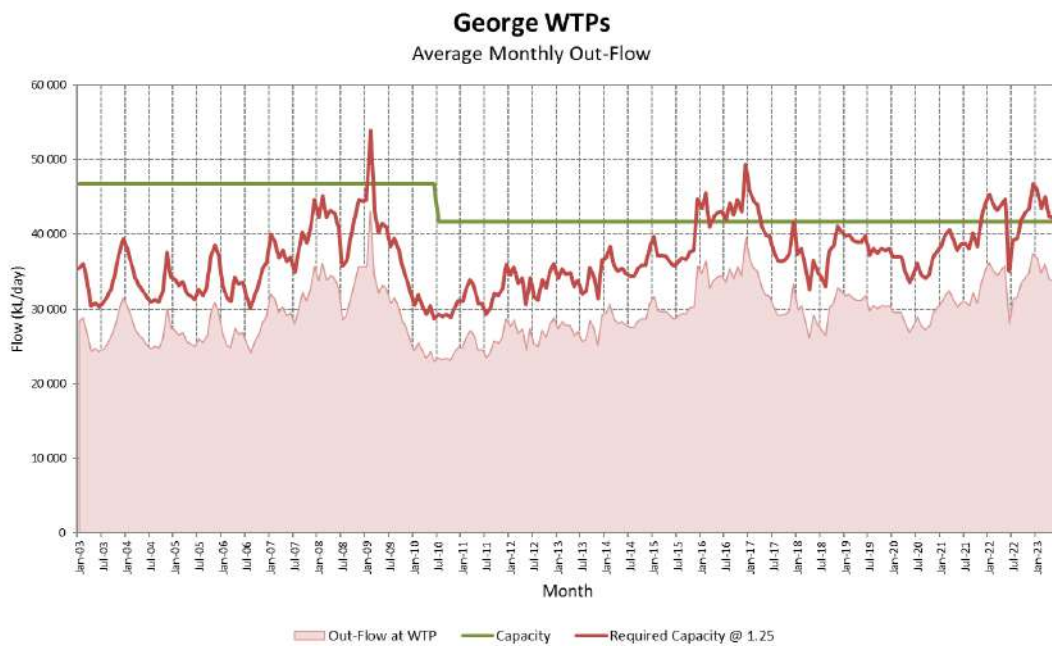
3 WATER DISTRIBUTION NETWORK

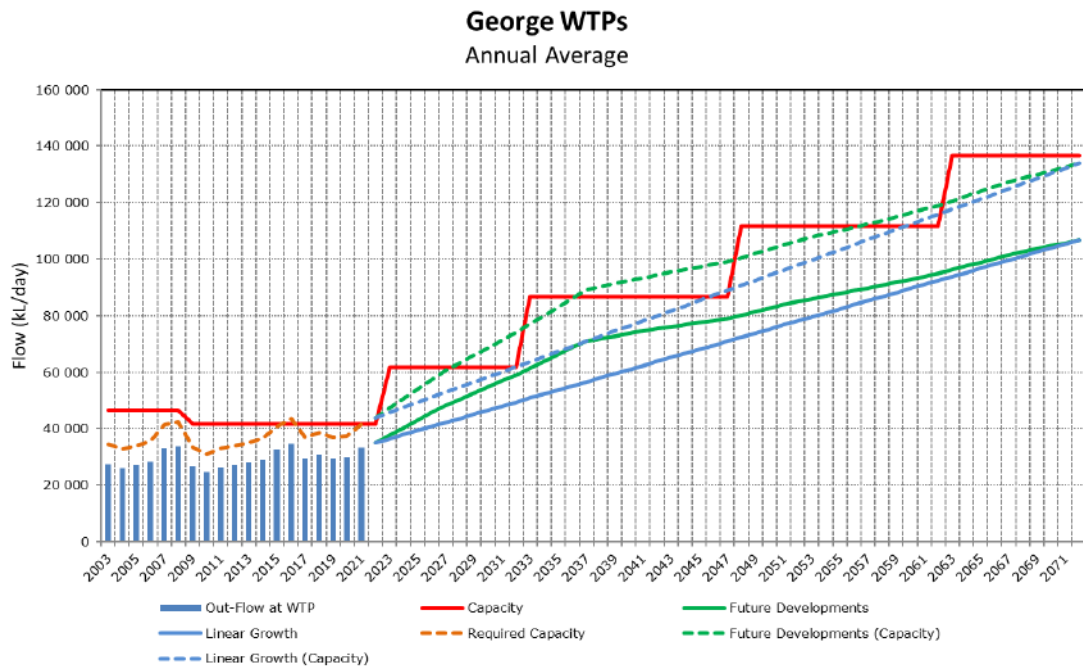
3.1 Water Resources

Water Treatment Plant capacity

The master plan indicates that the proposed development falls in the George Main zone and supplied from the Old and New George WTPs.

The two graph overleaf shows that the design capacity of the Old and New George WTPs (green line) has been exceeded by the average monthly required capacity (dark red line) a few times in the last decade. The WTPs are thus operating at risk and needs to be extended.





Based on available information the capacity, present flow and projected short-term flow are as follows:

George WTPs	Capacity	Comment
Existing Capacity	41 700 kL/d	Design capacity 46 200 kL/d
Measured Flow (incl. 1.25 factor)		
Annual Average (2003-2023)	43 537 kL/d	Maximum 2016/17
	-1 837 kL/d	No spare capacity available
Monthly Average (2003-2023)	56 022 kL/d	February 2009
	-14 322 kL/d	No spare capacity available
Monthly Average (2022/23)	48 599 kL/d	December 2022
	-6 899 kL/d	No spare capacity available
Modelled Flow (incl. 20% water loss and 1.25 factor)		
T_AADD (existing)	43 955 kL/d	m2024-03 MP
	-2 255 kL/d	No spare capacity available
3yr Projection	50 601 kL/d	
	-8 901 kL/d	No spare capacity available
5yr Projection	60 570 kL/d	
	-18 870 kL/d	No spare capacity available

Note: T_AADD: Theoretical Annual Average Daily Demand
The flow projections include all stands that are presently vacant but expected to be occupied over the next 5 years as well as all future areas likely to develop within the next 5 years

3.2 Distribution Zone

The master plan indicates that the proposed development falls partly in the George Main and Kraaibosch Tower zones as shown in **Figure 1 (Water)** attached.

An interim option was investigated to accommodate the Kraaibosch Ridge component of the development in the George Main zone until construction of the additional Kraaibosch reservoir.

3.3 Categorisation of required upgrades

The items are categorised as follows:

- General system specific MP Items – required to address capacity issues and backlogs in the bulk and reticulation systems serving the proposed development, but not specifically required for the development per se.
- Development specific MP Items – new additions to (or deviations from) the existing Master Plan, required specifically for the proposed development, as a result of more accurate information relative to the original estimate of future development.

It is important to note that all proposed items are schematic in nature, final size and location is subject to a complete design by a suitably qualified engineer. The final locality in particular is subject to legislative requirements including but not limited to pipes not crossing private stands, no servitudes registered in private stands and no pipes in stands with an area less than 400m².

3.4 Bulk Water Supply

Reservoir storage capacity

One of the main considerations in bulk water supply is reservoir storage capacity and in the assessment of storage capacity, two demand scenarios are considered.

The first (Theoretical Current Demand) scenario represents the demand in the system as it is currently experienced, i.e. it only includes the demand for stands that are developed (vacant stands are ignored), and only due to land use rights currently being exercised. An allowance for 20% water losses is also included in the scenario.

The second (Theoretical Fully Occupied Demand) scenario is the planning scenario and represents the demand of all the existing stands, irrespective of whether they are developed or vacant. Most importantly, the demand is based on the zoning of each stand i.e. the maximum demand allowed for under existing land use rights (known as zoning rights). Ideally the existing system should have sufficient capacity for this scenario which represents all existing development rights. An allowance for 20% water losses is also included in this scenario.

The difference between the two demand scenarios becomes relevant when there is “perceived” spare storage capacity in the Theoretical Current Demand scenario and no storage capacity in the Theoretical Fully Occupied Demand scenario. This means that the storage capacity allotted to all existing stands (in the Theoretical Fully Occupied Demand scenario) is currently not utilised in the Theoretical Current Demand scenario, it is however still committed to the water demands derived from the zoning rights.

Reservoir capacity assessment (Theoretical Current Demand)

The current George Main zone AADD plus 20% UAW (Theoretical Current Demand) in the m2024-03 water model is 28 705 kL/d. The capacity of the existing Reservoirs @ Old WTP is 36 120 kL. The FCV is set at 565 L/s. Using these three input variables in a reservoir sizing analysis, it shows that the remaining spare capacity is 8 890 kL.

Type in values in shaded cells

Full zone 28 705 kL/d
 Direct zone 19 811 kL/d
 AADD **28 705** kL/d
 PDF **1.70** * AADD
 PWF **1.40** * AADD
 P3DF 1.51 * AADD

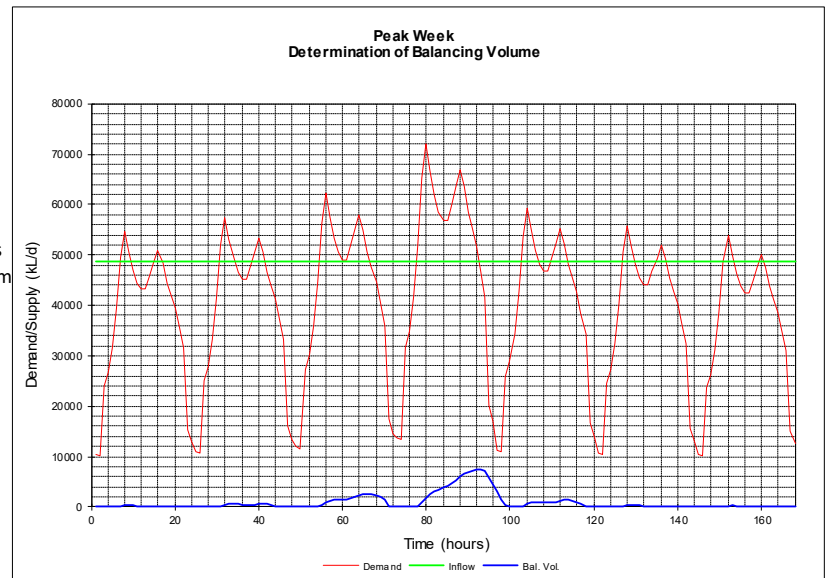
Supply **1.70** * AADD
 = 48 798 kL/d
 = 565 L/s

Pipe @ 1.8m/s
 632 mm

Bal. Vol. 7 419 kL/d
 = 6.2 h * AADD

			%
Pattern 1	Large zone	Large	69.0%
Pattern 2	Small zone	Medium	0.0%
Pattern 3	LC Housing	Small	0.0%
Pattern 4			0.0%
Pattern 5			0.0%
Pattern 6			0.0%
Pattern 7	Even	To a res.	31.0%
Must add up to 100 --> check			100.0%

Res @ Old WTP Site



VOLUME ANALYSIS (applies only to area directly supplied, i.e. not to the Pattern 7 supply)

Capacity	36 120 kL	=	43.8 h x AADD
Required balancing	7 419 kL	=	9.0 h x AADD
Available volume	28 701 kL	=	34.8 h x AADD
Required emergency	19 811 kL	=	24.00 h x AADD
Spare capacity	8 890 kL	=	10.8 h x AADD

Reservoir capacity assessment (Theoretical Current Demand)

The current Kraaibosch Reservoir zone AADD plus 20% UAW (Theoretical Current Demand) in the m2024-03 water model is 284 kL/d. The capacity of the existing Kraaibosch Reservoir is 1 000 kL. The FCV is set at 8 L/s. Using these three input variables in a reservoir sizing analysis, it shows that the remaining spare capacity is 569 kL.

Type in values in shaded cells

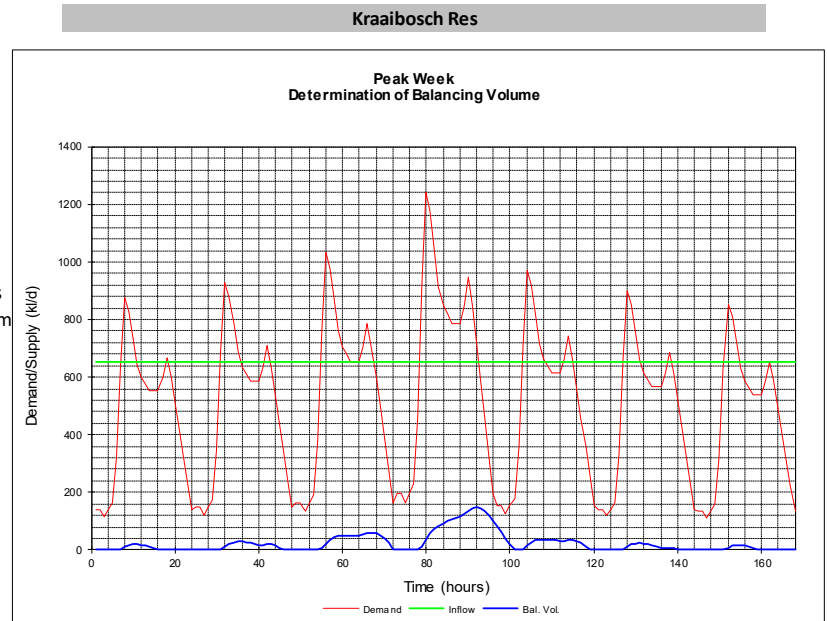
Full zone 284 kL/d
 Direct zone 284 kL/d
 AADD **284** kL/d
 PDF **2.30** * AADD
 PWF **1.80** * AADD
 P3DF 1.99 * AADD

Supply **2.30** * AADD
 = 654 kL/d
 = 8 l/s

Pipe @ 1.8m/s
 73 mm

Bal. Vol. 147 kl
 = 12.4 h * AADD

			%
Pattern 1	Large zone	Large	0.0%
Pattern 2	Small zone	Medium	100.0%
Pattern 3	LC Housing	Small	0.0%
Pattern 4			0.0%
Pattern 5			0.0%
Pattern 6			0.0%
Pattern 7	Even	To a res.	0.0%
Must add up to 100 --> check			100.0%



VOLUME ANALYSIS (applies only to area directly supplied, i.e. not to the Pattern 7 supply)

Capacity	1 000 kl	=	84.5 h x AADD
Required balancing	147 kl	=	12.4 h x AADD
Available volume	853 kl	=	72.0 h x AADD
Required emergency	284 kl	=	24.00 h x AADD
Spare capacity	569 kl	=	48.0 h x AADD

Reservoir capacity assessment (Theoretical Fully Occupied Demand)

The current George Main zone AADD plus 20% UAW (Theoretical Fully Occupied Demand) in the m2024-03 water model is 34 671 kL/d. The capacity of the existing Reservoirs @ Old WPT is 36 120 kL. The FCV is set at 682 L/s. Using these three input variables in a reservoir sizing analysis, it shows that the remaining spare capacity of 4 401 kL is sufficient to cater for the proposed development.

Type in values in shaded cells

Full zone 34 671 kL/d
 Direct zone 22 831 kL/d
 AADD **34 671** kL/d
 PDF **1.70** * AADD
 PWF **1.30** * AADD
 P3DF 1.42 * AADD

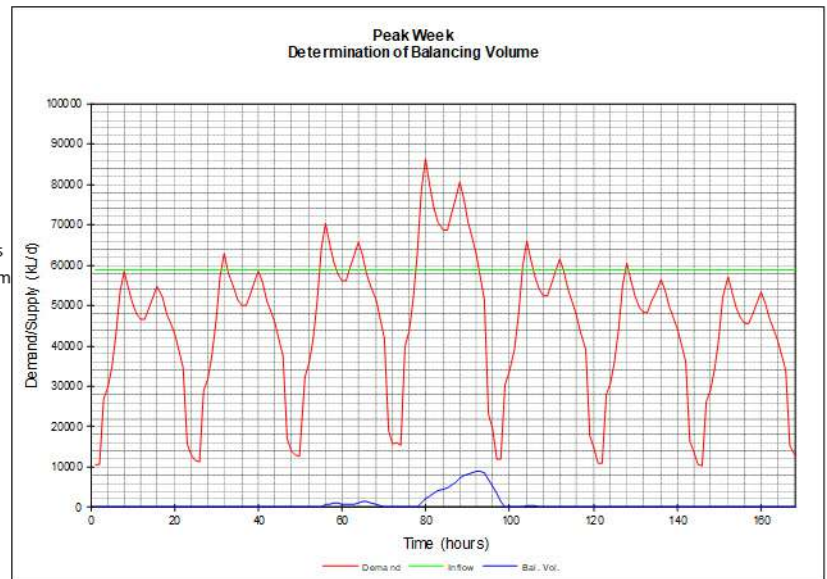
Supply **1.70** * AADD
 = 58 940 kL/d
 = 682 L/s

Pipe @ 1.8m/s
 695 mm

Bal.Vol. 8 888 kL/d
 = 6.2 h * AADD

			%
Pattern 1	Large zone	Large	65.9%
Pattern 2	Small zone	Medium	0.0%
Pattern 3	LC Housing	Small	0.0%
Pattern 4			0.0%
Pattern 5			0.0%
Pattern 6			0.0%
Pattern 7	Even	To a res.	34.1%
Must add up to 100 --> check			100.0%

Res @ Old WPT Site



VOLUME ANALYSIS (applies only to area directly supplied, i.e. not to the Pattern 7 supply)

Capacity	36 120 kL	=	38.0 h x AADD
Required balancing	8 888 kL	=	9.3 h x AADD
Available volume	27 232 kL	=	28.6 h x AADD
Required emergency	22 831 kL	=	24.00 h x AADD
Spare capacity	4 401 kL	=	4.6 h x AADD

Reservoir capacity assessment (Theoretical Fully Occupied Demand)

The current Kraaibosch Reservoir zone AADD plus 20% UAW (Theoretical Fully Occupied Demand) in the m2024-03 water model is 34 671 kL/d. The capacity of the existing Kraaibosch Reservoir is 1 000 kL. The FCV is set at 15 L/s. Using these three input variables in a reservoir sizing analysis, it shows that the remaining spare capacity of 119 kL is insufficient to cater for the proposed development.

DETERMINATION OF RESERVOIR BALANCING VOLUME and/or REQUIRED SUPPLY RATE

Type in values in shaded cells

Full zone 581 kl/d
Direct zone 581 kl/d
AADD 581 kl/d
PDF 2.30 * AADD
PWF 1.80 * AADD
P3DF 1.99 * AADD

Supply 2.30 * AADD

= 1335 kl/d

= 15 l/s

Pipe @ 1.8m/s
105 mm

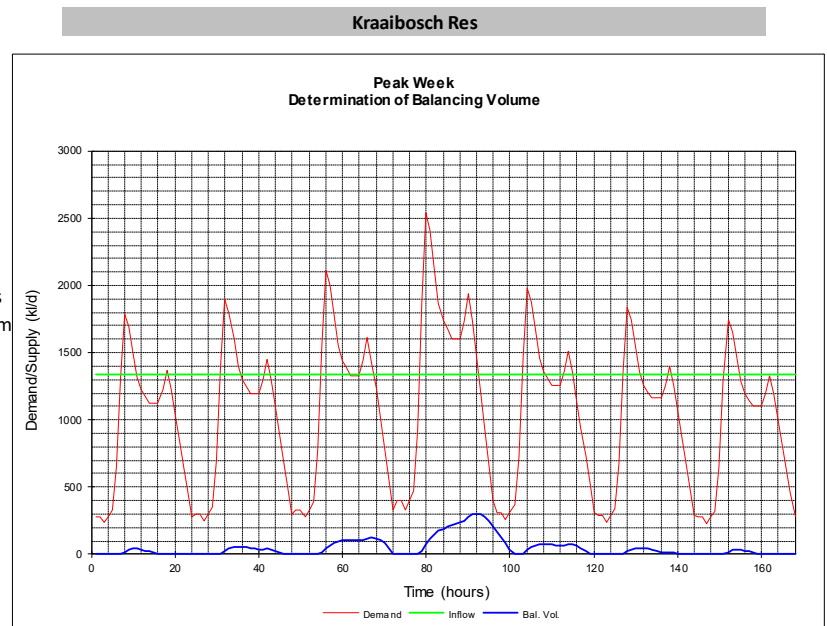
Bal.Vol. 300 kl

= 12.4 h*AADD

%

Pattern 1	Large zone	Large	0.0%
Pattern 2	Small zone	Medium	100.0%
Pattern 3	LC Housing	Small	0.0%
Pattern 4			0.0%
Pattern 5			0.0%
Pattern 6			0.0%
Pattern 7	Even	To a res.	0.0%

Must add up to 100 --> check 100.0%



VOLUME ANALYSIS (applies only to area directly supplied, i.e. not to the Pattern 7 supply)

Capacity 1 000 kl = 41.3 h x AADD

Required balancing 300 kl = 12.4 h x AADD

Available volume 700 kl = 28.9 h x AADD

Required emergency 581 kl = 24.00 h x AADD

Spare capacity 119 kl = 4.9 h x AADD

Tower storage capacity assessment and supply rate

Water towers serve merely to sustain pressure in a network and should not be regarded as facilities for balancing peaks and for emergency supply. Because of their relatively small volumes, the supply rates to towers must be such that they can be kept full at all times.

On the other hand, volumes must be large enough to allow room for operation of pumps filling the tower (where applicable) such that the number of pump cycles per day is limited. The following guidelines were used for evaluation and planning of water towers:

- Supply rate into tower : 1,0 to 1,1 x PHF x AADD
- Tower storage : 2 h to 6 h x AADD

The Kraaibosch tower has a capacity of 100 kL and the supply pump station has one operational and one standby pump set, each with a supply duty point of 55 L/s at 35 m head.

Scenario:	Theoretical Current Demand	Theoretical Fully Occupied Demand	Theoretical Fully Occupied Demand (incl. the proposed development)
Parameter:			
Existing Capacity (kL)	100	100	100
AADD (kL/d)	284	581	791
Peak Flow (L/s)	9.8	18.9	30.1
Peak Factor (current)	3.00	2.80	3.30
Storage (hours)	±8	±4	±3
Supply rate (L/s)	10.9	20.7	33.2
Existing Pump Station (L/s)	55.0	55.0	55.0

It is evident that both the Kraaibosch tower and its supply pump station has capacity to accommodate the proposed development.

3.4.1 Existing bulk water system considerations

Items presented here are for the attention of the George Municipal engineering professional (yourself) so as to highlight existing shortfalls or the imminent potential thereof.

General items required to alleviate existing problems in the bulk water system:

Item No	Description	Extent	Size	Cost	Pro-rata Cost
Existing WTPs (Old WTP and New WTP)					
GMR_B01.01	Water Treatment Facility to install: New WTP	20 500 m ³ /d @	254 m EGL	R 287 482 000	R 1 888 334 0.66%
	Existing: Old WTP	20 000 m ³ /d @	254 m EGL	n.a.	n.a.
	Existing: New WTP	20 000 m ³ /d @	254 m EGL	n.a.	n.a.
	Existing: Ebb-and-Flow WTP	1 700 m ³ /d @	254 m EGL	n.a.	n.a.
GMR_B01.06	Pipe to install	7 m x	500 mm Ø	R 543 000	R 5 478 1.01%
GMR_B01.07d	Pump Only to install: New WTP PS	220 L/s @	55 m	R 2 136 000	R 21 548 1.01%
Total				R 290 161 000	R 1 915 359

3.4.2 Accommodation of the proposed development in the bulk water system

Development specific items required in the bulk water system:

Item No	Description	Extent	Size	Cost	Pro-rata Cost
Existing external system (George Main zone)					
Development - Phase 2 (Aan de Meulen)					
GMR_01.02	Pipe to install	186 m x	450 mm Ø	R 2 057 000	R 128 033 6.2%
GMR_01.03	Pipe to install	128 m x	315 mm Ø	R 691 000	R 114 856 16.6%
GMR_01.04	Pipe to install	179 m x	355 mm Ø	R 1 224 000	R 121 791 10.0%
GMR_01.11a	Pipe to install	187 m x	450 mm Ø	R 1 926 000	R 102 221 5.3%
Sub-Total				R 5 898 000	R 466 901
Existing external system (Kraaibosch Reservoir and Tower zone)					
Development - Phase 1 (Kraaibosch Ridge)					
KBR_B01.02a	Pipe to install	58 m x	500 mm Ø	R 1 065 000	R 44 837 4.2%
KBR_B01.03	Reservoir to install: Kraaibosch Res	4 000 m ³ @	209 m TWL	R 17 550 000	R 738 855 4.2%
KBR_B01.04a	Pipe to install	34 m x	500 mm Ø	R 863 000	R 36 332 4.2%
Sub-Total				R 19 478 000	R 820 024
Total				R 25 376 000	R 1 286 924

3.4.3 Accommodation of the proposed development in the bulk water system (interim period)

Development specific items required in the bulk water system prior to the construction of the additional Kraaibosch reservoir:

Item No	Description	Extent	Size	Cost	Pro-rata Cost
Existing external system (George Main zone) - interim option					
Development - Phase 1 (Kraaibosch Ridge)					
GMR_01.03 # ¹	Pipe to install	128 m x	315 mm Ø	R 691 000	R 114 856 16.6%
GMR_01.04 # ¹	Pipe to install	179 m x	355 mm Ø	R 1 224 000	R 121 791 10.0%
Sub-Total				R 1 915 000	R 236 647
Development - Phase 2 (Aan de Meulen)					
GMR_01.02	Pipe to install	186 m x	450 mm Ø	R 2 057 000	R 128 033 6.2%
GMR_01.11a	Pipe to install	187 m x	450 mm Ø	R 1 926 000	R 102 221 5.3%
Sub-Total				R 3 983 000	R 230 254
Total				R 5 898 000	R 466 901

Notes: #¹ An interim PRV was proposed for Kraaibosch 195-21 development. If not implemented under Kraaibosch 195-21, it can be moved as per Figure 1 (Water). Alternatively a new interim PRV connection can be made on the existing 250mmØ George main pipeline at either of the proposed connection points presented on Figure 1 (Water).

3.5 Water Reticulation System

Accommodation of the proposed development, with its revised AADD, requires implementation of the following additions and adjustments to the *existing* water system as indicated in **Figure 1 (Water)**.

3.5.1 Existing water reticulation system considerations

Items presented here are for the attention of the George Municipal engineering professional (yourself) so as to highlight existing shortfalls or the imminent potential thereof.

General items required to alleviate existing problems in the water distribution system:

Item No	MP Type	Description	Extent	Size	Cost	Pro-rata Cost
None						
Total					R -	R -

3.5.2 Accommodation of the proposed development in the water reticulation system

Development specific items required in the water distribution system (including fire flow requirements):

Item No	Description	Extent	Size	Cost	Pro-rata Cost
Existing external system (Kraaibosch Reservoir and Tower zone)					
Development - Phase 1 (Kraaibosch Ridge)					
KBT_F01.03	Pipe to install	395 m x	355 mm Ø	R 2 172 000	R 417 517 19.2%
Total				R 2 172 000	R 417 517

3.5.3 Accommodation of the proposed development in the water reticulation system (interim period)

Development specific items required in the water distribution system (including fire flow requirements) prior to the construction of the additional Kraaibosch reservoir:

Item No	Description	Extent	Size	Cost	Pro-rata Cost
Existing external system (Kraaibosch Reservoir and Tower zone)					
Development - Phase 1 (Kraaibosch Ridge)					
KBT_F01.03 # ¹	Pipe to install	395 m x	355 mm Ø	R 2 172 000	R 417 517 19.2%
KBT_F01.04 # ³	Pipe to install	147 m x	355 mm Ø	R 986 000	R 233 583 23.7%
KBT_F01.05 # ³	Pipe to install	185 m x	355 mm Ø	R 1 171 000	R 277 410 23.7%
KBT_F08.01a # ³	Pipe to install	31 m x	160 mm Ø	R 187 000	R 187 000 100.0%
KBT_F08.01b # ³	Pipe to install	152 m x	160 mm Ø	R 283 000	R 283 000 100.0%
KBT_F08.03 # ²	Pressure Reducing Valve to install	233 m EGL	100 mm Ø	R 304 000	R 304 000 100.0%
Total				R 5 103 000	R 1 702 511

Notes: #¹ The 355mm Ø is to be isolated from Kraaibosch tower supply until the additional Kraaibosch reservoir is constructed and the interim PRV decommissioned.

#² Interim PRV was proposed for Kraaibosch 195-21 development. If not implemented under Kraaibosch 195-21, it can be moved as per Figure 1 (Water).

#³ Depending on the final position of the proposed interim PRV, these items can be omitted.

The proposed connection points to the existing water distribution system are shown in **Figure 1 (Water)**.

3.6 Internal Reticulation

The internal network design on the property of the proposed development is beyond the scope of this report. However, the consulting engineer for the development is required to allow for the fire flow demand as listed in 2.2 above on the internal networks.

For internal network design purposes the water distribution network provides the following energy gradelines (EGLs) at the proposed connection points (see **Figure 1 (Water)**).

Connection Point	Static		Residual		Fire Flow		Ground Level
	EGL (m a.s.l.)	Head (m)	EGL (m a.s.l.)	Head (m)	EGL (m a.s.l.)	Head (m)	(m a.s.l.)
Future system - George Main							
Point A	295.0	92.5	275.2	72.7	269.9	67.4	202.5
Future system - Kraaibosch Reservoir and Tower							
Point B	233.0	29.4	227.4	23.8	226.7	23.1	203.6
Future system - George Main (interim period)							
Point C	233.0	37.8	232.0	36.8	230.2	35.0	195.2
Point D	233.0	28.9	232.0	27.9	230.2	26.1	204.1

4 SEWER CONVEYANCE NETWORK

4.1 Sewer Drainage Area

The master plan indicates that the proposed development falls in the future Kraaibosch 3 PS drainage area as shown in **Figure 2 (Sewer)** attached. This drainage area drains to the Outeniqua WWTW.

An interim option was investigated to accommodate the proposed development in the existing sewer system via the existing Kraaibosch PS as the master plan option requires the construction of the Kraaibosch 3 PS, Kraaibosch 4 PS and the Destiny Africa PS.

4.2 Categorisation of required upgrades

The items are categorised as follows:

- General MP Items – required to address capacity issues and backlogs in the bulk and reticulation systems serving the proposed development, but not specifically required for the development per se.
- Development specific MP Items – new additions to (or deviations from) the existing Master Plan, required specifically for the proposed development, as a result of more accurate information relative to the original estimate of future development.

It is important to note that all proposed items are schematic in nature, final size and location is subject to a complete design by a suitably qualified engineer. The final locality in particular is subject to legislative requirements including but not limited to pipes not crossing private stands, no servitudes registered in private stands and no pipes in stands with an area less than 400m².

4.3 Bulk Sewer Drainage

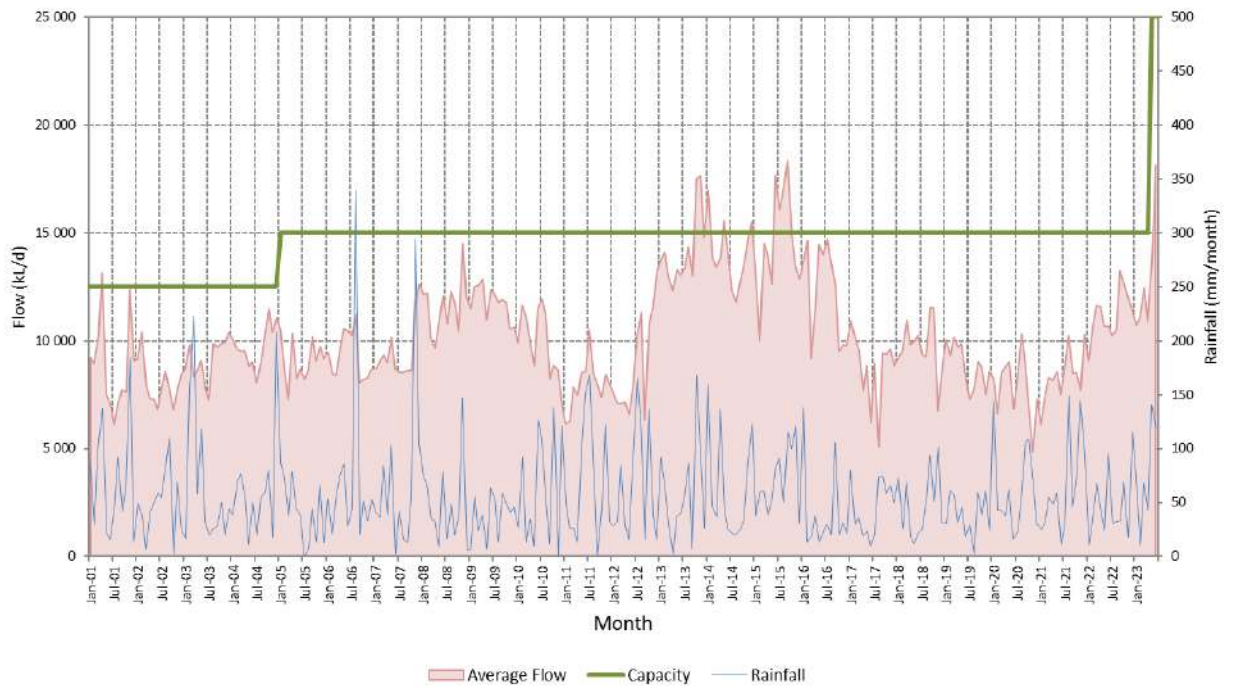
Accommodation of the proposed development, with its revised PDDWF, requires implementation of the following additions and adjustments to the existing sewer system as indicated in **Figure 2 (Sewer)**.

Wastewater Treatment Works capacity

The graph overleaf shows that the design capacity of the Outeniqua WWTW (green line) has been exceeded by the Average Monthly Flow (light red shaded area) a few times in the last decade. The WWTW has since been upgraded and is thus not operating at risk.

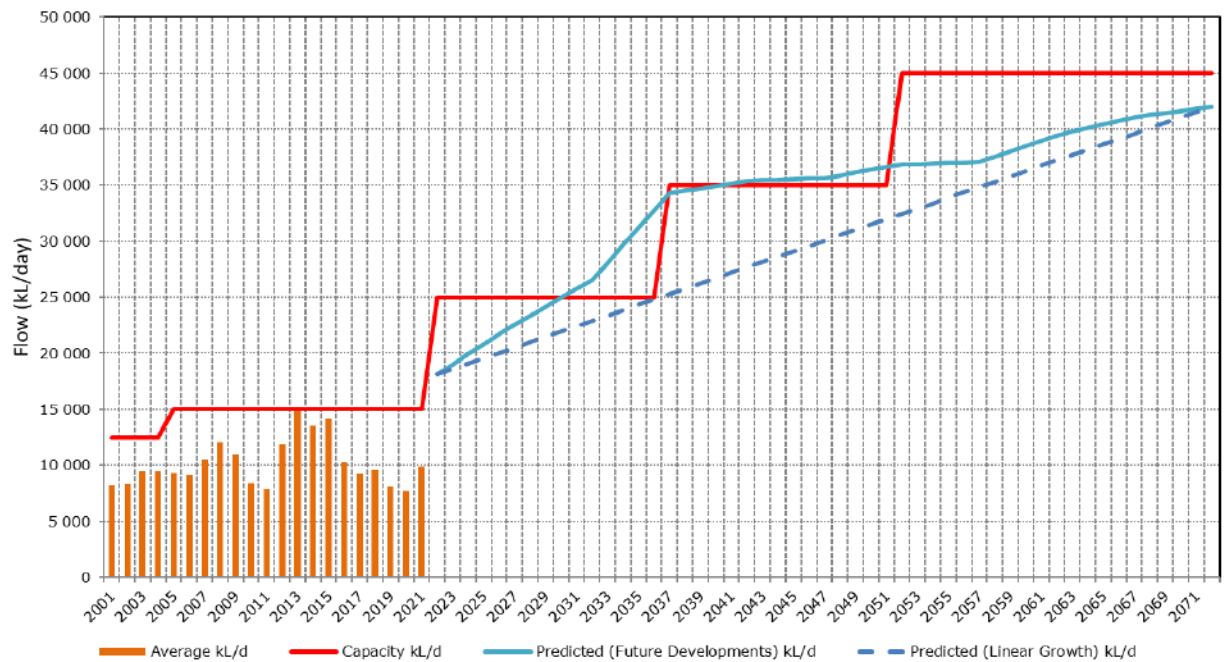
Outeniqua WWTW

Average Monthly Flow



Outeniqua WWTW

Annual Average (incl. WTP Sludge @ $\pm 1\,950$ kL/d)



Based on available information the capacity, present flow and projected short-term flow are as follows:

Outeniqua WWTW	Capacity	Comment
Existing Capacity	25 000 kL/d	
Measured Flow		
Annual Average (2001-2023)	14 846 kL/d	Maximum 2013/14
	10 154 kL/d	Spare capacity available
Monthly Average (2001-2023)	10 591 kL/d	September 2015
	14 409 kL/d	Spare capacity available
Monthly Average (2022/23)	13 761 kL/d	May 2023
	11 239 kL/d	Spare capacity available
Modelled Flow		
T_PDDWF (existing)	18 113 kL/d	m2024-03 MP - Incl. WTP sludge flow = 1 260 kL/d
	6 887 kL/d	Spare capacity available
3yr Projection	20 781 kL/d	Incl. WTP sludge flow = 1 260 kL/d
	4 219 kL/d	Spare capacity available
5yr Projection	22 561 kL/d	Incl. WTP sludge flow = 1 260 kL/d
	2 439 kL/d	Spare capacity available

Note: T_PDDWF: Theoretical Peak Daily Dry Weather Flow (Total Wastewater Flow, Peak day in week)
The flow projections include all stands that are presently vacant but expected to be occupied over the next 5 years as well as all future areas likely to develop within the next 5 years

4.3.1 Existing bulk sewer system considerations

Items presented here are for the attention of the George Municipal engineering professional (yourself) so as to highlight existing shortfalls or the imminent potential thereof.

General items required to alleviate existing problems in the bulk sewer system:

Item No	MP Type	Description	Existing Diam (mm)	New Diam (mm)	Length (m)	Design Flow	Cost	Pro-rata Cost
Existing bulk system (from Thembaletu 6 PS to Outeniqua WWTW)								
OT_20.02	MP	Upgrade existing Rising	400	800	4	873.6 L/s	R 1 278 000	R 15 715 1.23%
OT_20.03	MP	Upgrade existing Rising	500	800	12	873.7 L/s	R 1 453 000	R 17 864 1.23%
OT_37.04	MP	Upgrade existing Gravity	315	450	8	494.7 L/s	R 209 000	R 4 538 2.17%
OT_61.01	# ¹ MPi	Upgrade existing Pump Station (Investigate first): Thembaletu PS 6	-	-	-	494.7 L/s	R 20 573 000	R 446 726 2.17%
OT_61.02a	# ¹ MPi	Upgrade existing Rising (Investigate first)	250	650	351	494.7 L/s	R 6 294 000	R 136 669 2.17%
OT_61.02b	# ¹ MPi	Upgrade existing Rising (Investigate first)	250	650	31	494.7 L/s	R 1 368 000	R 29 705 2.17%
OT_61.02c	# ¹ MPi	Upgrade existing Rising (Investigate first)	250	650	330	494.7 L/s	R 5 970 000	R 129 634 2.17%
Sub-Total							R 37 145 000	R 780 850
Existing WWTW (Outeniqua WWTW)								
	-	-	-	-	-	-	R -	R - 1.00%
Sub-Total							R -	R -
Total							R 37 145 000	R 780 850

Notes: #¹ A first phase upgrade of the Thembaletu 6 PS to 240 L/s is planned in the short term.

4.3.2 Existing bulk sewer system considerations (interim period)

Items presented here are for the attention of the George Municipal engineering professional (yourself) so as to highlight existing shortfalls or the imminent potential thereof.

General items required to alleviate existing problems in the bulk sewer system for the interim connection prior to construction of the Kraaibosch 4 and Destiny Africa PSs:

Item No	MP Type	Description	Existing Diam (mm)	New Diam (mm)	Length (m)	Design Flow	Cost	Pro-rata Cost
Existing bulk system (from Meul PS to Outeniqua WWTW) - Interim option 1/2								
OT_03.01	#1 MP	Upgrade existing Pump Station: Meul PS	-	-	-	405.0 L/s	R 9 640 000	R 255 686 2.65%
OT_03.02	#1 MPi	Upgrade existing Rising (Investigate first)	450	650	484	405.0 L/s	R 8 341 000	R 221 232 2.65%
OT_09.01	#2 MPi	Upgrade existing Gravity (Investigate first)	700	1 000	18	475.4 L/s	R 718 000	R 16 224 2.26%
OT_09.02	#2 MPi	Upgrade existing Gravity (Investigate first)	700	1 000	26	476.0 L/s	R 889 000	R 20 062 2.26%
OT_09.03	#2 MPi	Upgrade existing Gravity (Investigate first)	600	900	14	498.1 L/s	R 553 000	R 11 926 2.16%
OT_09.04	#2 MPi	Upgrade existing Gravity (Investigate first)	700	825	260	483.5 L/s	R 4 638 000	R 103 043 2.22%
OT_10.01	MP	Upgrade existing Pump Station: Schaapkop PS	-	-	-	590.7 L/s	R 11 055 000	R 201 037 1.82%
OT_10.02	MP	Upgrade existing Rising	500	700	154	590.7 L/s	R 4 456 000	R 81 033 1.82%
OT_10.03	#2 MPi	Upgrade existing Gravity (Investigate first)	999	1 000	316	591.7 L/s	R -	R - 1.82%
OT_10.04	#2 MPi	Upgrade existing Gravity (Investigate first)	999	1 000	32	837.1 L/s	R -	R - 1.28%
OT_10.05	#2 MPi	Upgrade existing Gravity (Investigate first)	999	1 000	9	1 536.1 L/s	R -	R - 0.70%
OT_10.06	#2 MPi	Upgrade existing Gravity (Investigate first)	999	1 000	4	698.9 L/s	R -	R - 1.54%
Sub-Total							R 40 290 000	R 910 244
Existing bulk system (divert flow from Meul PS to Thembaletu 6 PS) - Interim option 1/2								
OT_20.02	MP	Upgrade existing Rising	400	800	4	873.6 L/s	R 1 278 000	R 15 715 1.23%
OT_20.03	MP	Upgrade existing Rising	500	800	12	873.7 L/s	R 1 453 000	R 17 864 1.23%
OT_37.04	MP	Upgrade existing Gravity	315	450	8	494.7 L/s	R 209 000	R 4 538 2.17%
OT_27.01	#3 MPa	Abandon existing Pump Station: Thembaletu PS 1	-	-	-	- L/s	R 287 000	R - 0.00%
OT_27.02	#3 MPa	Abandon existing Rising	200	250	867	- L/s	R 10 000	R - 0.00%
OT_38.01	#3 MPa	Abandon existing Pump Station: Thembaletu PS B	-	-	-	- L/s	R 287 000	R - 0.00%
OT_38.02	#3 MPa	Abandon existing Rising	79	90	99	- L/s	R 10 000	R - 0.00%
OT_39.01	#3 MPa	Abandon existing Pump Station: Thembaletu PS A	-	-	-	- L/s	R 287 000	R - 0.00%
OT_39.02	#3 MPa	Abandon existing Rising	79	90	91	- L/s	R 10 000	R - 0.00%
OT_50.01	MPa	Abandon existing Pump Station: Parkdene PS 2	-	-	-	- L/s	R 287 000	R - 0.00%
OT_50.02	MPa	Abandon existing Rising	150	200	227	- L/s	R 10 000	R - 0.00%
OT_51.01	MPa	Abandon existing Pump Station: Parkdene PS 3	-	-	-	- L/s	R 287 000	R - 0.00%
OT_51.02	MPa	Abandon existing Rising	150	200	151	- L/s	R 10 000	R - 0.00%
OT_58.02	#2 MPi	Upgrade existing Gravity (Investigate first)	200	450	47	22.9 L/s	R 458 000	R - 0.00%
OT_61.01	MPi	Upgrade existing Pump Station (Investigate first): Thembaletu PS 6	-	-	-	494.7 L/s	R 20 573 000	R 446 726 2.17%
OT_61.02a	#2 MPi	Upgrade existing Rising (Investigate first)	250	650	351	494.7 L/s	R 6 294 000	R 136 669 2.17%
OT_61.02b	#2 MPi	Upgrade existing Rising (Investigate first)	250	650	31	494.7 L/s	R 1 368 000	R 29 705 2.17%
OT_61.02c	#2 MPi	Upgrade existing Rising (Investigate first)	250	650	330	494.7 L/s	R 5 970 000	R 129 634 2.17%
OT_62.01	#3 MP	Upgrade existing Pump Station: Thembaletu PS 7	-	-	-	50.0 L/s	R 5 670 000	R - 0.00%
OT_62.02	#3 MP	Upgrade existing Rising	200	250	1 170	50.0 L/s	R 3 169 000	R - 0.00%
OT_F91.02a	FM	New Gravity	-	160	109	2.8 L/s	R 279 000	R - 0.00%
OT_F91.02b	FM	New Gravity	-	160	80	2.8 L/s	R 546 000	R - 0.00%
OT_F91.03	FM	New Gravity	-	160	964	3.9 L/s	R 2 043 000	R - 0.00%
OT_F92.02a	FM	New Gravity	-	160	36	1.5 L/s	R 127 000	R - 0.00%
OT_F92.02b	FM	New Gravity	-	160	95	1.5 L/s	R 642 000	R - 0.00%
OT_F92.03	FM	New Gravity	-	160	157	2.5 L/s	R 377 000	R - 0.00%
OT_F93.02a	FM	New Gravity	-	160	56	1.5 L/s	R 169 000	R - 0.00%
OT_F93.02b	FM	New Gravity	-	160	89	1.5 L/s	R 605 000	R - 0.00%
OT_F94.02	#3 FM	New Gravity	-	200	514	35.6 L/s	R 1 265 000	R - 0.00%
OT_F94.03	#3 FM	New Gravity	-	250	515	35.9 L/s	R 1 512 000	R - 0.00%
OT_F94.04	#3 FM	New Gravity	-	250	211	36.2 L/s	R 654 000	R - 0.00%
OT_F94.05	#3 FM	New Gravity	-	315	1 631	52.8 L/s	R 5 801 000	R - 0.00%
OT_F95.02	#3 FM	New Gravity	-	160	9	0.1 L/s	R 72 000	R - 0.00%
OT_F96.02	#3 FM	New Gravity	-	160	24	0.1 L/s	R 102 000	R - 0.00%
OT_F97.02	#3 FM	New Gravity	-	160	25	16.2 L/s	R 104 000	R - 0.00%
Sub-Total							R 62 225 000	R 780 850
Existing WWTW (Outeniqua WWTW)								
	-	-	-	-	-	-	R -	R - 0.22%
Sub-Total							R -	R -
Total							R 102 515 000	R 1 691 095

Notes:

#1 Upgrading of the Meul PS is currently underway.

#2 In the master plan an investigation of this pipe is proposed implying that not all information on slopes, inverts etc. was available. The pipe should therefore first be investigated through field inspections and surveys to verify that upgrading is in fact required.

#3 Construction of an outfall sewer and upgrading to Thembaletu PS 7 is underway.

4.3.3 Accommodation of the proposed development in the bulk sewer system

Development specific items required in the bulk sewer system:

Item No	MP Type	Description	Existing Diam (mm)	New Diam (mm)	Length (m)	Design Flow	Cost	Pro-rata Cost
Future bulk system (from Thembaletu 6 PS to Outeniqua WWTW)								
OT_F04.03	FM	New Gravity	-	160	409	7.6 L/s	R 898 000	R 535 255 59.6%
OT_F04.04	FM	New Gravity	-	160	40	21.8 L/s	R 135 000	R 66 522 49.3%
OT_F05.01	FM	New Gravity	-	160	315	0.6 L/s	R 703 000	R 703 000 100.0%
OT_F05.02	FM	New Gravity	-	160	338	0.9 L/s	R 751 000	R 536 548 71.4%
OT_F06.01	FM	New Pump Station: Kraaibosch3 PS	-	-	-	26.3 L/s	R 5 452 000	R 2 226 821 40.8%
OT_F06.02a	FM	New Rising	-	160	655	26.3 L/s	R 1 077 000	R 439 891 40.8%
OT_F06.02b	FM	New Rising	-	160	39	26.3 L/s	R 206 000	R 84 139 40.8%
OT_F06.02c	FM	New Rising	-	160	309	26.3 L/s	R 518 000	R 211 572 40.8%
OT_F07.02	FM	New Gravity	-	160	235	13.5 L/s	R 538 000	R 221 776 41.2%
OT_F32.01	FM	New Gravity	-	315	218	93.2 L/s	R 992 000	R 114 335 11.5%
OT_F32.02	FM	New Gravity	-	200	612	94.6 L/s	R 1 838 000	R 208 708 11.4%
OT_F32.03	FM	New Gravity	-	315	251	157.7 L/s	R 1 133 000	R 77 176 6.8%
OT_F32.04	FM	New Gravity	-	315	72	207.8 L/s	R 367 000	R 18 972 5.2%
OT_F35.01	# ¹ FM	New Pump Station: Kraaibosch4 PS	-	-	-	207.8 L/s	R 14 168 000	R 732 400 5.2%
OT_F35.02	# ¹ FM	New Rising	-	450	1 442	207.8 L/s	R 12 631 000	R 652 946 5.2%
OT_F36.01	FM	New Gravity	-	315	214	210.5 L/s	R 977 000	R 49 857 5.1%
OT_F36.02	FM	New Gravity	-	525	213	257.8 L/s	R 4 844 000	R 201 840 4.2%
OT_F36.03	FM	New Gravity	-	315	20	336.1 L/s	R 144 000	R 4 602 3.2%
OT_F37.01	# ² FM	New Pump Station: Destiny Africa PS	-	-	-	336.1 L/s	R 18 685 000	R 597 186 3.2%
OT_F37.02	# ² FM	New Rising	-	550	1 214	336.1 L/s	R 13 102 000	R 418 749 3.2%
Total							R 79 159 000	R 8 102 295

Notes: #¹ A potential first phase of Kraaibosch 4 PS could be 50 L/s and a 355mm Ø rising main.
#² A potential first phase of Destiny Africa PS could be 100 L/s and a 450mmØ rising main.

4.3.4 Accommodation of the proposed development in the bulk sewer system (interim period)

Development specific items required in the bulk sewer system for the interim connection prior to construction of the Kraaibosch 4 and Destiny Africa PSs:

Item No	MP Type	Description	Existing Diam (mm)	New Diam (mm)	Length (m)	Design Flow	Cost	Pro-rata Cost
Future bulk system (from Meul PS to Outeniqua WWTW) - Interim option 1								
OT_F04.03	FM	New Gravity	-	160	409	7.6 L/s	R 898 000	R 535 255 59.6%
OT_F04.04	FM	New Gravity	-	160	40	21.8 L/s	R 135 000	R 66 522 49.3%
OT_F05.01	FM	New Gravity	-	160	315	0.6 L/s	R 703 000	R 703 000 100.0%
OT_F05.02	FM	New Gravity	-	160	338	0.9 L/s	R 751 000	R 536 548 71.4%
OT_F06.01	FM	New Pump Station: Kraaibosch3 PS	-	-	-	26.3 L/s	R 5 452 000	R 2 226 821 40.8%
OT_F06.02d	# ³ FA	New Rising (Alternative)	-	160	276	26.3 L/s	R 465 000	R 189 925 40.8%
OT_F06.02e	# ³ FA	New Rising (Alternative)	-	160	1 522	26.3 L/s	R 2 478 000	R 1 012 117 40.8%
OT_F07.02	FM	New Gravity	-	160	235	13.5 L/s	R 538 000	R 221 776 41.2%
Total							R 11 420 000	R 5 491 963

Notes: #³ The master plan proposes that the development area drain to the Thembaletu PS 6 with a prerequisite for this option being the construction of the Destiny Africa and Kraaibosch 4 pumping systems. As part of interim accommodation of the development, the proposed Kraaibosch 3 PS could pump to the existing Kraaibosch PS. In future a rising main to the future Kraaibosch 4 PS can be constructed.

Item No	MP Type	Description	Existing Diam (mm)	New Diam (mm)	Length (m)	Design Flow	Cost	Pro-rata Cost
Future bulk system (from Meul PS to Outeniqua WWTW) - Interim option 2								
OT_F04.05	# ⁴ FA	New Rising (Alternative)	-	110	210	7.3 L/s	R 258 000	R 158 511 61.4%
OT_F04.06	# ⁴ FA	New Pump Station (Alternative): Kraaibosch Ridge PS 4	-	-	-	7.3 L/s	R 3 162 000	R 1 942 681 61.4%
OT_F05.03	# ⁴ FA	New Rising (Alternative)	-	90	186	3.0 L/s	R 211 000	R 211 000 100.0%
OT_F05.04	# ⁴ FA	New Pump Station (Alternative): Kraaibosch Ridge PS 2	-	-	-	3.0 L/s	R 1 825 000	R 1 825 000 100.0%
OT_F06.02e	# ⁴ FA	New Rising (Alternative)	-	160	1 522	26.3 L/s	R 2 478 000	R 1 601 749 64.6%
OT_F07.03	# ⁴ FA	New Pump Station (Alternative): Kraaibosch Ridge PS 3	-	-	-	17.0 L/s	R 3 738 000	R 3 738 000 100.0%
Total							R 11 672 000	R 9 476 941

Notes: #⁴ An alternative for the interim accommodation of the development without Kraaibosch 3 PS, is the construction of two pumping stations (Kraaibosch Ridge 2 and 4) to lift sewer flow over the watershed to a main Kraaibosch Ridge PS 3. This would include constructing the Kraaibosch 3 interim rising main up to Kraaibosch Ridge 3 PS. With further phased development Kraaibosch PSs 2 - 4 can be decommissioned in favour of Kraaibosch 3 PS and the rising main extended or decommissioned for a rising main to Kraaibosch 4 PS.

4.4 Sewer reticulation system

Accommodation of the proposed development, with its revised PDDWF, requires implementation of the following additions and adjustments to the *existing* sewer system as indicated in **Figure 2 (Sewer)**.

4.4.1 Existing sewer reticulation system considerations

Items presented here are for the attention of the George Municipal engineering professional (yourself) so as to highlight existing shortfalls or the imminent potential thereof.

General items required to alleviate existing problems in the existing sewer system:

Item No	MP Type	Description	Existing Diam (mm)	New Diam (mm)	Length (m)	Design Flow	Cost	Pro-rata Cost
Existing collector system (from Meul PS to Outeniqua WWTW) - Interim option 1/2								
OT_34.03	MPi	Upgrade existing Gravity (Investigate first)	315	450	42	89.9 L/s	R 425 000	R 50 783 11.9%
Total							R 425 000	R 50 783

4.4.2 Accommodation of the proposed development in the sewer reticulation system

Development specific items required in the existing sewer system:

Item No	MP Type	Description	Existing Diam (mm)	New Diam (mm)	Length (m)	Design Flow	Cost	Pro-rata Cost
Development - Phase 1 (Kraaibosch Ridge)								
OT_F04.02	FM	New Gravity	-	160	681	5.2 L/s	R 1 458 000	R 1 458 000 100.0%
OT_F07.04	FM	New Gravity	-	160	743	9.6 L/s	R 1 587 000	R 1 587 000 100.0%
Development - Phase 2 (Aan de Meulen)								
OT_F04.01	FM	New Gravity	-	160	222	4.4 L/s	R 513 000	R 513 000 100.0%
OT_F07.05	FM	New Gravity	-	160	171	0.8 L/s	R 406 000	R 406 000 100.0%
Total							R 3 964 000	R 3 964 000

The proposed connection point to the existing sewer system is shown in **Figure 2 (Sewer)**.

In **Figure 2 (Sewer)** pipes in future development areas are indicated schematically.

The above Design Flows (or IPWWF) and thus pipe sizes were calculated taking cognizance of future developments upstream of the proposed development. In this regard, sewer pipes within the proposed development must be designed (layout and sizing) to receive a Design Flow from the following future connection point (see Figure 2 (Sewer)).

Connection Point	Design Flow (L/s)
Point A	0.78

As the Design Flow already accommodates stormwater ingress, the pipes can be designed to flow 100% full with the Design Flows provided above.

5 SUMMARY

Water supply:

Summary of costing:	Cost	Pro-rata Cost
General items required to alleviate existing problems in the bulk water system	R 290 161 000	R 1 915 359
Development specific items required in the bulk water system	R 25 376 000	R 1 286 924
General items required to alleviate existing problems in the water distribution system	R -	R -
Development specific items required in the water distribution system (including fire flow requirements)	R 2 172 000	R 417 517
Total	R 317 709 000	R 3 619 801

Summary of costing - Interim option (Kraaibosch Ridge PRV):	Cost	Pro-rata Cost
General items required to alleviate existing problems in the bulk water system	R 290 161 000	R 1 915 359
Development specific items required in the bulk water system	R 5 898 000	R 466 901
General items required to alleviate existing problems in the water distribution system	R -	R -
Development specific items required in the water distribution system (including fire flow requirements)	R 5 103 000	R 1 702 511
Total	R 301 162 000	R 4 084 771

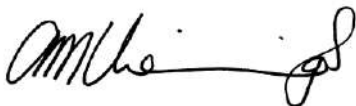
Sewer drainage:

Summary of costing (Master Plan):	Cost	Pro-rata Cost
General items required to alleviate problems in the bulk sewer system:	R 37 145 000	R 780 850
Development specific items required in the bulk sewer system:	R 79 159 000	R 8 102 295
General items required to alleviate problems in the existing sewer system:	R -	R -
Development specific items required in the existing sewer system:	R 3 964 000	R 3 964 000
Total	R 120 268 000	R 12 847 146

Summary of costing - Interim option 1 (Kraaibosch 3 PS):	Cost	Pro-rata Cost
General items required to alleviate problems in the bulk sewer system:	R 102 515 000	R 1 691 095
Development specific items required in the bulk sewer system:	R 11 420 000	R 5 491 963
General items required to alleviate problems in the existing sewer system:	R 425 000	R 50 783
Development specific items required in the existing sewer system:	R 3 964 000	R 3 964 000
Total	R 118 324 000	R 11 197 840

Summary of costing - Interim option 2 (Kraaibosch Ridge PSs):	Cost	Pro-rata Cost
General items required to alleviate problems in the bulk sewer system:	R 102 515 000	R 1 691 095
Development specific items required in the bulk sewer system:	R 11 672 000	R 9 476 941
General items required to alleviate problems in the existing sewer system:	R 425 000	R 50 783
Development specific items required in the existing sewer system:	R 3 964 000	R 3 964 000
Total	R 118 576 000	R 15 182 818

Yours sincerely,



Per: A Vienings (Pr. Eng.)
GLS Consulting

(Report done by: J Rudolph)

REQUEST FROM CONSULTANT TO GLS

24051CG -Sawmill Development - George : GLS Services Availability Report



George Wallace <gwallace@lyner>

To: Johann Rudolph

Cc: Francois van Eck



Reply



Reply All



Forward



Fri 2024/04/26 13:04



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Middag Johann,

Hoor by Flip jy hou bietjie wittebrood maar is weer Maandag terug op kantoor.

Ons benodig n beskikbaarheid van dienste verslag (water en riool) vir n nuwe ontwikkeling op die ou 'Sawmill' langs die N2.

Kan ons dalk Dinsdag oggend 30April so 08h30 dalk n 'teams' meeting doen om net bietjie agtergrond te gee?

Bevestig asseblief.

Groete,

George Wallace B Tech | Civil Technologist | Tel: 044 887 0223 | Mobile: 084 569 5373



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RE: Technical assessment: Kraaibosch Ridge & Aan de Meulen



Johann Rudolph <johann.rudolph@gls.co.za>

To George Wallace

Cc Francois van Eck

You replied to this message on 20/11/2024 15:32.



George Erven 25537_25538_25541 and 195 Ptn 400 - Report Letter (Rev3).pdf
1 MB

Dag sê George,

Hier is die vorige verbruike (laaste wysiging op 6 September) en nuutste verbruike:

Land Use	Unit of measure	No. Units	UWD/unit	Sewer ratio	AADD Inc. UAW	PDDWF Excl. Infiltr.	Development
	(No/100m2/ha...)	(No/100m2/ha...)	(kL/unit/d)	(% x UWD)	(kL/d)	(kL/d)	
Phase 1		Estimated Start Date:		Estimated Occupation Date:			
Residential (George & Wilderness) - Medium density, medium sized Residential stands	unit	70	0.813	54%	56.88	30.71	A1
Residential (George & Wilderness) - Low density, large sized Residential stands	unit	83	0.938	49%	77.81	38.13	B1
Sub-Total		153			134.69	68.84	
Phase 2		Estimated Start Date:		Estimated Occupation Date:			
Flats (George & Wilderness) - Medium density Flat units up to 50 m² (Footprint=0.6 and Storeys=1)	unit	90	0.313	80%	28.13	22.50	A2
Residential (George & Wilderness) - Medium density, medium sized Residential stands	unit	49	0.813	54%	39.81	21.50	B2
Sub-Total		139			67.94	44.00	
Phase 3		Estimated Start Date:		Estimated Occupation Date:			
Residential (George & Wilderness) - Medium density, medium sized Residential stands	unit	54	0.813	54%	43.88	23.69	A3
Residential (George & Wilderness) - Medium density, medium sized Residential stands	unit	25	0.813	54%	20.31	10.97	B3
Sub-Total		79			64.19	34.66	
Phase 4		Estimated Start Date:		Estimated Occupation Date:			
Residential (George & Wilderness) - Medium density, medium sized Residential stands	unit	27	0.813	54%	21.94	11.85	A4
Residential (George & Wilderness) - Very Low density, extra large sized Residential stands	unit	70	1.125	45%	78.75	35.44	B4
Sub-Total		97			100.69	47.28	
Phase 5		Estimated Start Date:		Estimated Occupation Date:			
Flats (George & Wilderness) - Low density Flat units up to 50 m² (Footprint=0.6 and Storeys=1)	unit	205	0.375	76%	76.88	58.43	A5
Sub-Total		205			76.88	58.43	
Phase 6		Estimated Start Date:		Estimated Occupation Date:			
Business/Commercial - Business 1 - Business 4 - Medium < 5 000m²	100m²	25	0.875	63%	21.88	13.78	A6
Sub-Total		25			21.88	13.78	
Phase 7		Estimated Start Date:		Estimated Occupation Date:			
School, crèche, educational - Building and grounding	100m²	10	0.750	58%	7.50	4.35	A7
Flats (George & Wilderness) - Low density Flat units up to 50 m² (Footprint=0.6 and Storeys=1)	unit	40	0.375	76%	15.00	11.40	A7
Sub-Total		50			22.50	15.75	
Total		748			488.8	282.7	

Die rioolafloop sluit infiltrasie uit, die infiltrasie volume word per meter pyflyn in ag geneem (m.a.w. die volume is suiwer afloop van elke erf).

Johann Rudolph *BTech Civil Eng*
Civil Engineering Technologist II



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ANNEXURE C

Sewer Package Plant Technical Report from Alveo Water

Conventional Activated Sludge with
Membrane Bioreactor WWTP

DESIGN REPORT

for

**OUMEULEN VILLAGE AND MEULENZICHT
LANDGOED DEVELOPMENT, GEORGE**

November 2024

REV.	DATE	ISSUED TO	AUTHOR	REVIEWED
0	27/11/2024	George Wallace	Meyer de Villiers	

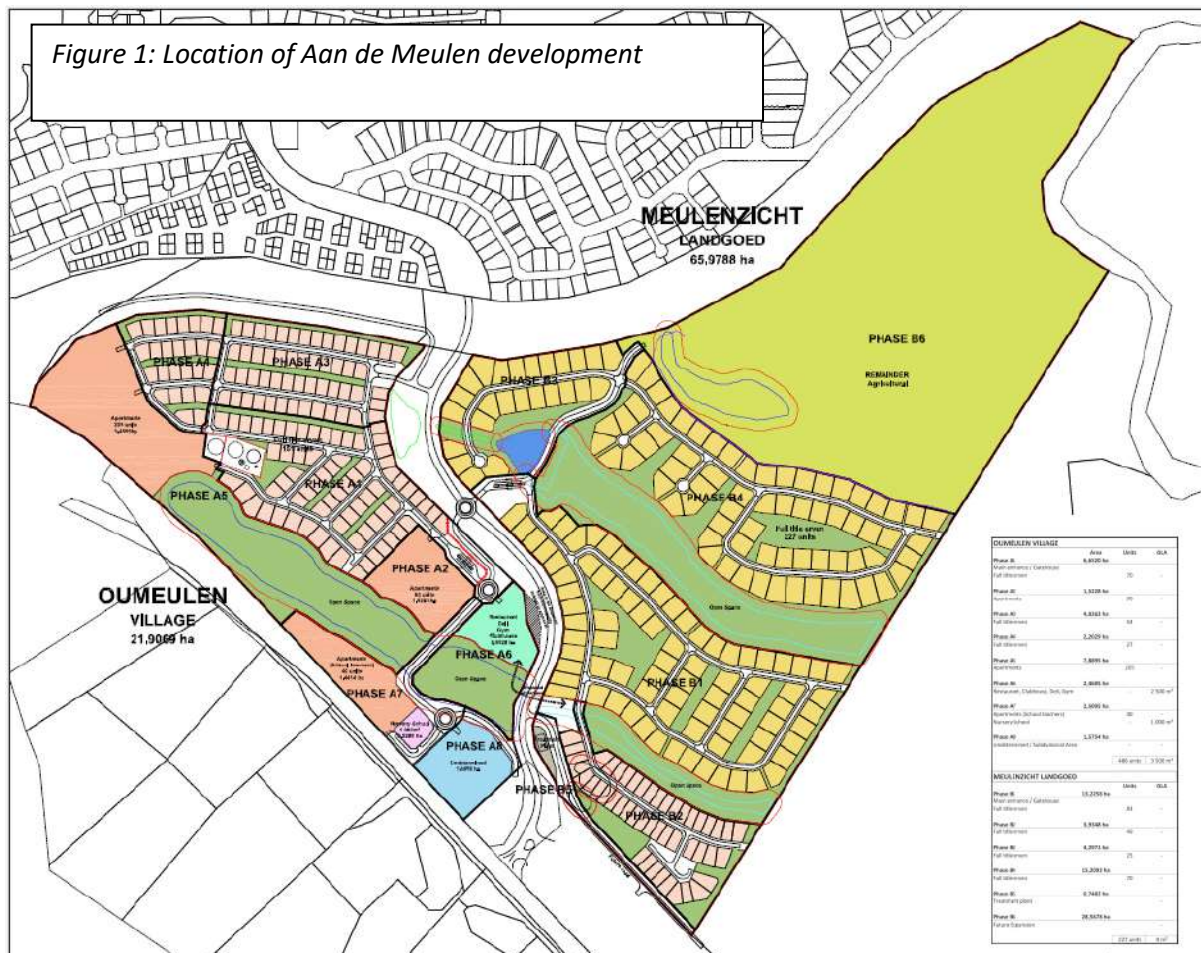
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1 Introduction

The Oumeulen Village and Meulenzicht Landgoed development by Atterbury Properties is a new development planned for the Kraaibosch area between George and Wilderness. It is located next to the N2 opposite the turnoff to Victoria Bay. The development consists of mainly residential plots and units developed over several phases on the rolling hills between several valleys draining towards the Indian Ocean.



The Peak Daily Dry Weather Flow (PDDWF) has been calculated by GLS Infrastructure Planning as 308.05kℓ/day (see table below). Assuming a 15% infiltration rate for wet weather conditions the Peak Daily Wet Weather Flow (PDWWF) will be taken as 354.25kℓ/day.



Table 1: Wastewater Yield Table

Land Use	Unit of Measure (No/100m2/ha)	No. Units (No/100m2/ha)	UWD/Unit (kL/unit/d)	Sewer Ratio (% x UWD)	PDDWF Excl. Infiltr. (kL/d)	Phase
Phase 1						
Residential (George & Wilderness) - Medium density, medium sized Residential stands	unit	70	0.813	54%	30.71	A1
Residential (George & Wilderness) - Low density, large sized Residential stands	unit	83	0.938	49%	38.13	B1
Sub-Total:		153			68.84	
Phase 2						
Flats (George & Wilderness) - Medium density Flat units up to 50 m ² (Footprint=0.6 and Storeys=1)	unit	90	0.313	80%	22.50	A2
Residential (George & Wilderness) - Medium density, medium sized Residential stands	unit	49	0.813	54%	21.50	B2
Sub-Total:		139			44.00	
Phase 3						
Residential (George & Wilderness) - Medium density, medium sized Residential stands	unit	54	0.813	54%	23.69	A3
Residential (George & Wilderness) - Medium density, medium sized Residential stands	unit	25	0.813	54%	10.97	B3
Sub-Total:		79			34.66	
Phase 4						
Residential (George & Wilderness) - Medium density, medium sized Residential stands	unit	27	0.813	54%	11.85	A4
Residential (George & Wilderness) - Very Low density, extra large sized Residential stands	unit	70	1.125	45%	35.44	B4
Sub-Total:		97			47.28	
Phase 5						
Flats (George & Wilderness) - Low density Flat units up to 50 m ² (Footprint=0.6 and Storeys=1)	unit	205	0.375	76%	58.43	A5
Sub-Total:		205			58.43	

Phase 6						
Business/Commercial - Business 1 - Business 4 - Medium < 5 000m ²	100m ²	25	0.875	63%	13.78	A6
Sub-Total:		25			13.78	
Phase 7						
School, creche, educational - Building and grounding	100m ²	10	0.750	58%	4.35	A7
Flats (George & Wilderness) - Low density Flat units up to 50 m ² (Footprint=0.6 and Storeys=1)	unit	60	0.375	76%	17.10	A7
Sub-Total:		70			21.45	
Phase C						
Residential (George & Wilderness) - Very Low density, extra large sized Residential stands	unit	50	1.125	45%	25.31	C
Sub-Total:		50			25.31	
Total for all Phases(kL/d):					313.75	
Allow for additional 10% future demand from neighboring properties		10%			31.38	
Total (kL/d):					345.13	

In order to buffer the hourly peak in the morning and evening, a 12 hour concrete buffer tank will be incorporated upstream of the bioreactor.

No wastewater sample has been provided as the development has not been constructed, so the wastewater plant design was based on typical medium to high strength wastewater influent quality as listed in Table 2.

Table 2: Assumed influent water quality

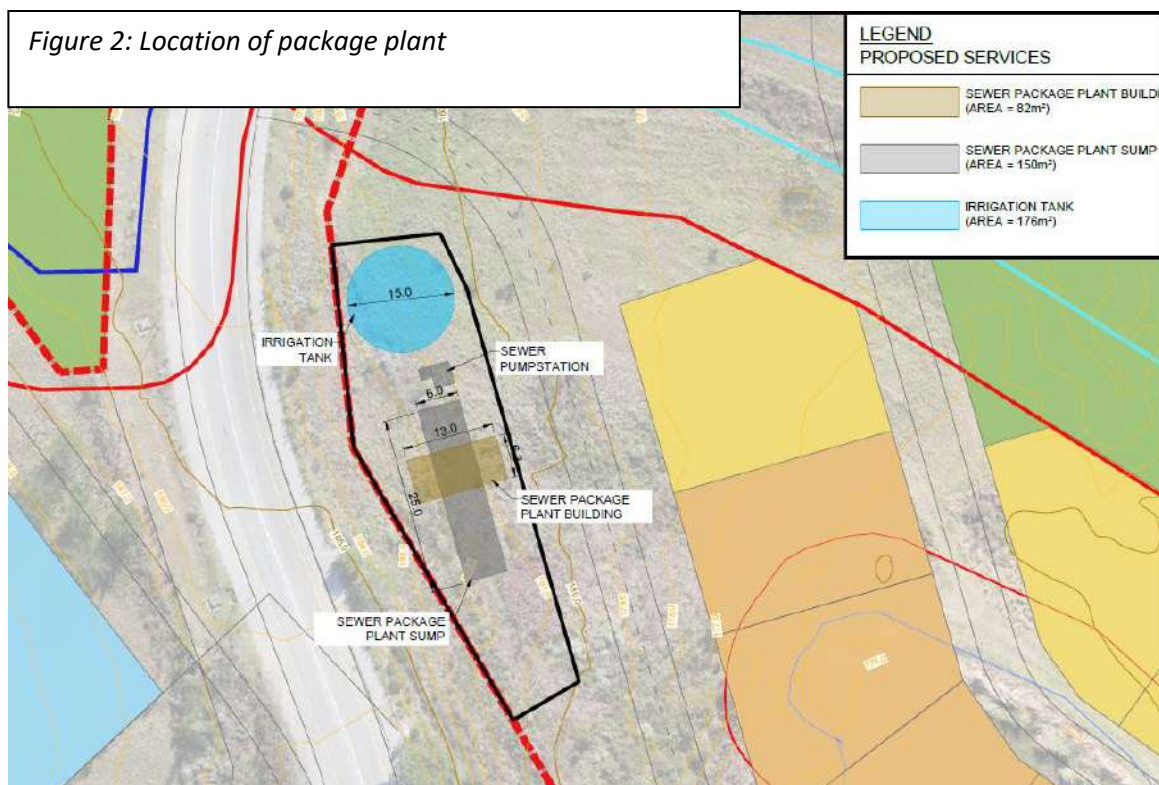
Parameter	Unit	Maximum Value
Influent COD (mg COD/l)	mg/ℓ	800
Influent TKN (mg N/l)	mg/ℓ	40
Free and saline ammonia	mg/ℓ	25
Influent Total Phosphorus (mg P/l)	mg/ℓ	12
Total Suspended Solids (mg TSS/l)	mg/ℓ	450
Fats, Oils and Grease	mg/ℓ	30
Alkalinity (mg/l as CaCO ₃)	mg/ℓ	150

The wastewater will be treated to the Department of Water and Sanitation's General Discharge Limits, as shown in Table 3 below:

Table 3: General Limits of discharge

Parameter	General Limit
COD (mg COD/l)	75
Ammonia as Nitrogen (mg N/l)	6
Nitrate as Nitrogen (mg N/l)	15
Orthophosphates (mg P/l)	10
Total Suspended Solids (mg TSS/l)	25
Faecal Coliform (per 100ml)	1000

The package plant will be located alongside the access road of the development as per Figure 2.



2 Technical Description

Alveo Water's state of the art Membrane Bioreactor (MBR) Wastewater Treatment Plant (WWTP) is constructed and installed inside an underground concrete structure. It is our proposed solution for a rapid, cost effective and aesthetically pleasing decentralized wastewater treatment solution.

2.1 General Process Description

Conventional Activated Sludge (CAS) plants use natural bacteria to break down organic matter as well as convert waste into stable sludge, treated effluent and gases such as carbon dioxide (CO₂), methane (CH₄) and nitrogen (N₂). The three main groups of active bacteria are aerobic, anaerobic, and anoxic. Anaerobic bacteria are prominent in the equalisation chamber, anoxic bacteria are prominent in the anoxic chamber and aerobic bacteria are prominent in the aeration chamber.

Membrane Bioreactor (MBR) technology combines simple microfiltration with bio-digestion to reap the benefits of combined physical separation and biological removal. The dependency of effluent quality on influent quality is removed with an MBR system and thus MBR systems consistently provide quality effluent water. Furthermore, the minimal transfer of suspended solids through the MBR system allows the concentration of active bacteria to increase as much as four (4) times that possible in a CAS plant. This ensures that superior bio-digestion occurs with the use of an MBR at a fraction of the area required when using CAS alone.

Figures 3 to 5 below illustrate civil wastewater treatment plants recently commissioned. These plants are without equal in South Africa and unmatched in design, technology and built quality throughout the world.



Figure 3: Concrete underground MBR Treatment Plant Inlet Works



Figure 4: Concrete underground MBR equipment room and sludge silos



Figure 5: Recently completed MBR plant showing inlet works and control room

2.2 Block Flow Diagram

The block flow diagram gives a simplified indication of the process that will be followed for the treatment of effluent water received at the Aan de Meulen WWTP.

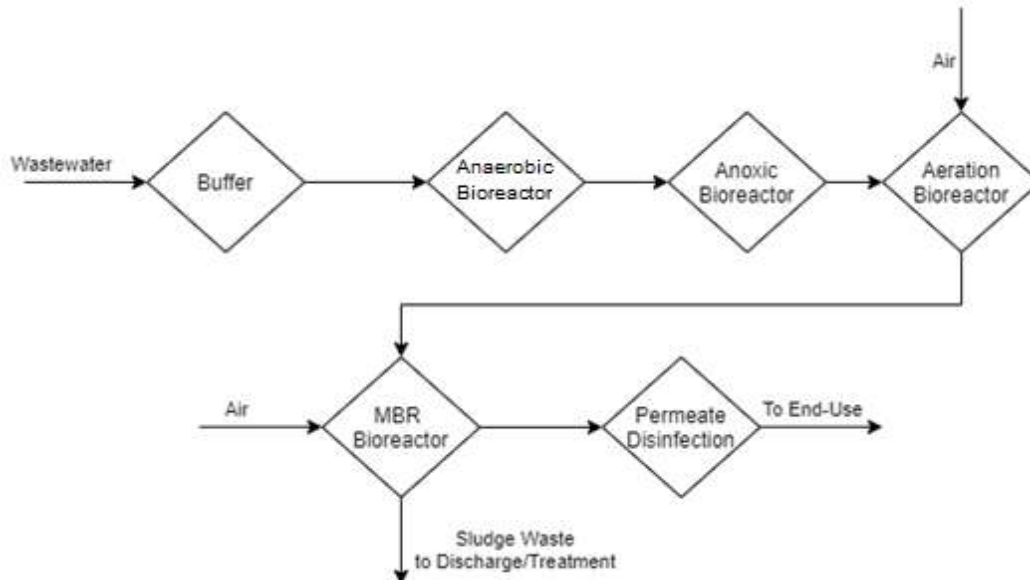


Figure 6: Typical process flow diagram for treatment works

2.3 Treatment Process Description

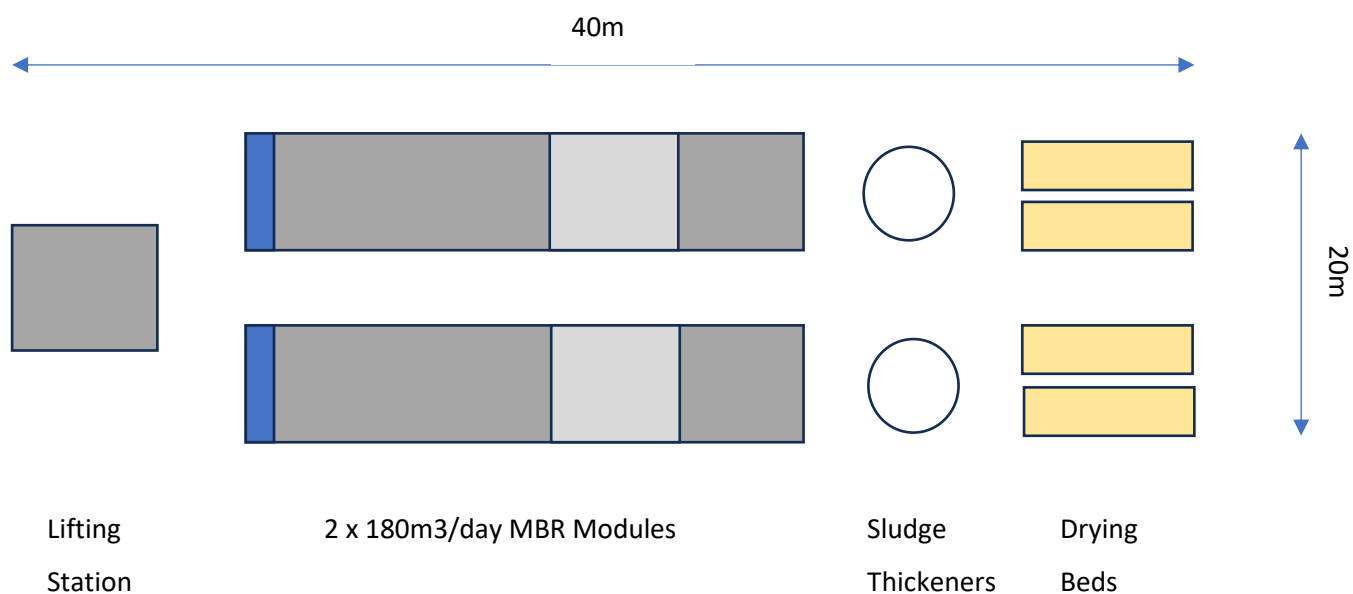
Upstream of the WWTP, Alveo Water will install the following equipment before and in the 12 hour buffer tank:

- 20 mm handrake screen (coarse)
- 10mm automatic front rake screen (medium)
- Duty/standby buffer pumps, to feed the WWTP

The WWTP will be constructed in concrete, which will house the following:

- 12 hour buffer tank
- 3mm fine parabolic screen
- Anoxic section packing or mixer
- Aerobic section diffuser disks and pipework
- MBR membranes on stainless steel stands
- Blowers for aeration and membrane scouring
- Permeate pumps to remove water from MBR chamber
- Sludge thickening silos
- Sludge drying bags
- UV and sodium hypochlorite disinfection
- CIP tank and skid to clean membranes periodically
- All electrical control, cabling and instrumentation required for a fully functional plant

2.4 Plant Layout



2.5 Electrical Requirements

An estimate of the power consumption of the plant can be summarised in Table 4 as follows:

Table 4: Estimated power consumption for 360kl/d plant

Drive	Motor kW	kWh per day
Buffer Pump	7.5	90
Anoxic Mixer	4.5	90
RAS Pump	6	138
Permeate Pump	4.5	60
Aeration Blower	22	506
Scour Blower	18	414
Chlorine Dosing Disinfection	0.1	2
UV Light	0.75	18
Other (Lights, Fan)	1	23
Total:	64.35	1341

The WWTP has to run all the time to maintain healthy biological activity. Therefore, a standby generator must be budgeted for if Eskom power is used and load shedding is assumed to continue. The estimated generator size for this plant would be 100kVA.

3 Cost Estimate

3.1 Capital Costs

Table 5 below summarises the civil, mechanical and electrical costs associated with the proposed MBR WWTP. Please note that this is an initial estimate of the plant cost and as such, is subject to change upon finalization of the development, site, location and design of the plant. At present, an underground concrete plant has been priced for budget purposes to accommodate 360 kℓ/d of influent with an assumed COD of approximately 800 mg/ℓ.

Table 5: Capital cost breakdown for the proposed concrete wastewater treatment works

Section	Description	Amount
	CONCRETE WORK FOR STRUCTURE	
1	Civil, Concrete and Building Work	R 4 150 000.00
	Sub-Total	R 4 150 000.00
	MECHANICAL AND ELECTRICAL	
2	Inlet works	R 750 000.00
3	Mechanical equipment	R 3 100 00.00
4	Electrical Equipment	R 700 000.00
5	Design & Overheads	R 375 000.00
	Sub-Total	R 4 925 000.00
	Transport, Installation and Commissioning	
6	Transport, Installation, Commissioning & P&Gs	R 450 000.00
	Sub-Total	R 450 000.00
	TOTAL EXCLUDING VAT	R 9 525 000.00

* Cost per kilolitre R26 458/kℓ

The cost of spares and consumables are not included and is the client's responsibility and they will have to indicate which spares and the quantity of such spares to be included in the price.

3.2 Operational Costs

Approximately 40230 kWh will be consumed by the plant per month at maximum design flow. However, as this is a budget level pricing, a detailed design can be drawn up to minimize energy consumption by utilizing high efficiency motors, variable speed drives and advanced blower control systems.

Typical service and maintenance costs will be required. Below is an estimate of the running cost of the plant. Please note that this excluded diesel for the standby generator.

Table 2: Estimated chemical consumption

Description	Quantity	Expected monthly cost (R/m)
Labour	10	R 4 500.00/m
Transport	80	R 480.00/m
Sodium Hypo	200	R 3 200.00/m
TOTAL		R 8 180.00/m

3.3 Delivery

The expected delivery time for this plant will be **7 months** from date of order. The concrete structure is estimated to take approximately 5 months to build, while the installation of the mechanical and electrical equipment should take two months to complete.

3.4 Qualifications

- All prices are quoted in South African Rand (ZAR)
- Prices exclude Value Added Taxes (VAT)
- The estimate is valid for 6 months whereafter prices must be adjusted for inflation.

3.5 Exclusions and Battery Limits

Description	Alveo Water Responsibility	Client Responsibility
Sewer pumpstations		✓
Sewer rising mains		✓
Buffer sump	✓	
Buffer pumps and screens to WWTP	✓	
Site preparation, bulk earthworks		✓
Excavation and final earthworks	✓	
Fencing, landscaping, lighting, security, access road		✓
Loading and delivery of equipment to site	✓	
Generator or backup power		✓
Installation and commissioning of equipment	✓	
Sludge drying	✓	
Sludge disposal		✓
Treated water tanks, pumps and reticulation to end use		✓



ANNEXURE D

Preliminary Civil Engineering Layout Drawings



LEGEND	
EXISTING SERVICES	
	CONTOURS
	FENCELINE
	ELECTRIC FENCE
	GATE
	EDGE OF TAR
	PAVING EDGE
	SIGN BOARD
	GRAVEL ROAD
	CONCRETE ROAD
	CONCRETE FEATURES
	BUILDINGS
	ELECTRIC POLES
	STREET LAMP
	OVER HEAD POWERLINE
	FLOW DIRECTION & DIAMETER
	STORMWATER CONDUIT
	STORMWATER LABELS
	STORMWATER CATCHPITS
	STORMWATER MANHOLE
	HYDRANT/VALVE BOX
	VALVE MANHOLE
	WATER TAP VALVE
	WATER SCOUR VALVE
	WATER AIR VALVE
	EMBANKMENTS & SLOODS
	ROAD SIGN
	RODING EYE
	BENCHMARKS
	EDGE OF CONCRETE
	CABLE COVERS
	BOUNDARY
	AREA OF DENSE VEGETATION
	TREES
	DENSE VEGETATION
	WET LANDS
	DAM EDGE
	GUARD RAIL
	SEWER CONDUIT
	SEWER MANHOLES
	SEWER LABEL
	BOTTOM KERB
	EDGE OF KERBING
	GIS CADASTRAL
	CALCULATED CADASTRAL
	JOJO TANK
	SERVITUDE ROAD
	SERVITUDE PIPELINE
	PIPELINE BRIDGE

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REV	DESCRIPTION	DATE	REV BY/CHKD
REVISIONS			

DESIGNED	GW
DRAWN	HMV
CHECKED	MF

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ENGINEER: _____

DATE: 2024-12-08

APPROVED

CLIENT: _____

DATE: _____

CLIENT

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PROJECT

OUMEULEN VILLAGE AND MEULENZICHT LANDGOED DEVELOPMENT (GEORGE)

TITLE

EXISTING SERVICES LAYOUT

SCALE 1:1250 on A0

SHEET 1 OF 1

CONTRACT No.

PROJECT No. 24051 CG

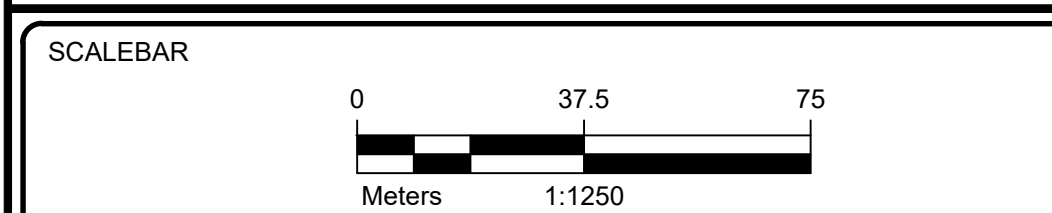
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COORDINATE SYSTEM: WGS84 / Lo Z3°

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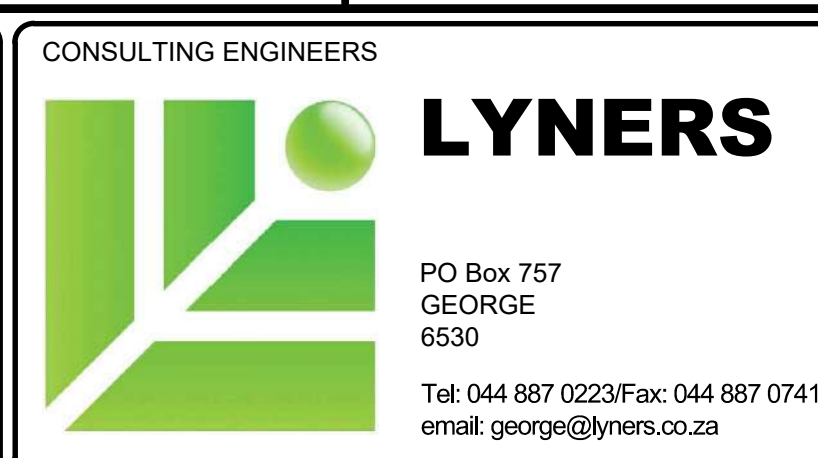
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REVISIONS

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DATE:	_____

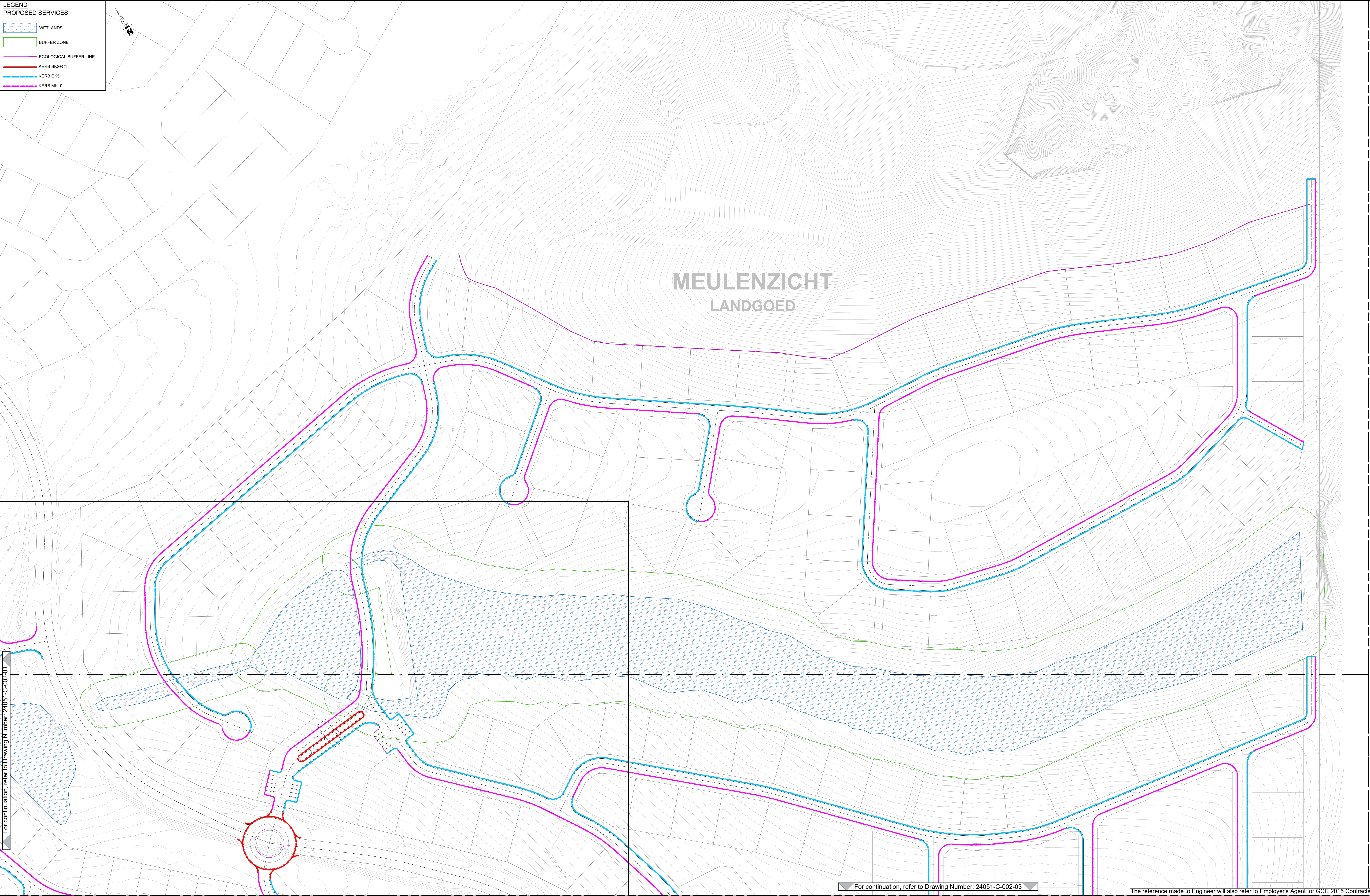
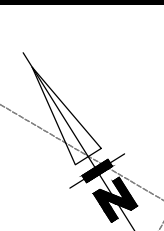


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TITLE	KEY PLAN LAYOUT

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CONTRACT No.	PROJECT No.	
	24051 CG	
DRAWING No.		REV
24051-C-001-05		
COORDINATE SYSTEM: WGS84 UTM ZONE 18N		

LEGEND
PROPOSED SERVICES

- WETLANDS
- BUFFER ZONE
- ECOLOGICAL BUFFER LINE
- KERB BK2+C1
- KERB CKS
- KERB MK10



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0 22.5 45
Meters 1:750

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REVISIONS				

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DRAWN	HMV
CHECKED	MF

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DATE: 2024-12-09

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OUMEULEN VILLAGE AND MEULENZICHT LANDGOED DEVELOPMENT (GEORGE)

TITLE

KERB LAYOUT: MEULENZICHT SECTION 1

SCALE 1:750 on A0 SHEET 1 OF 1

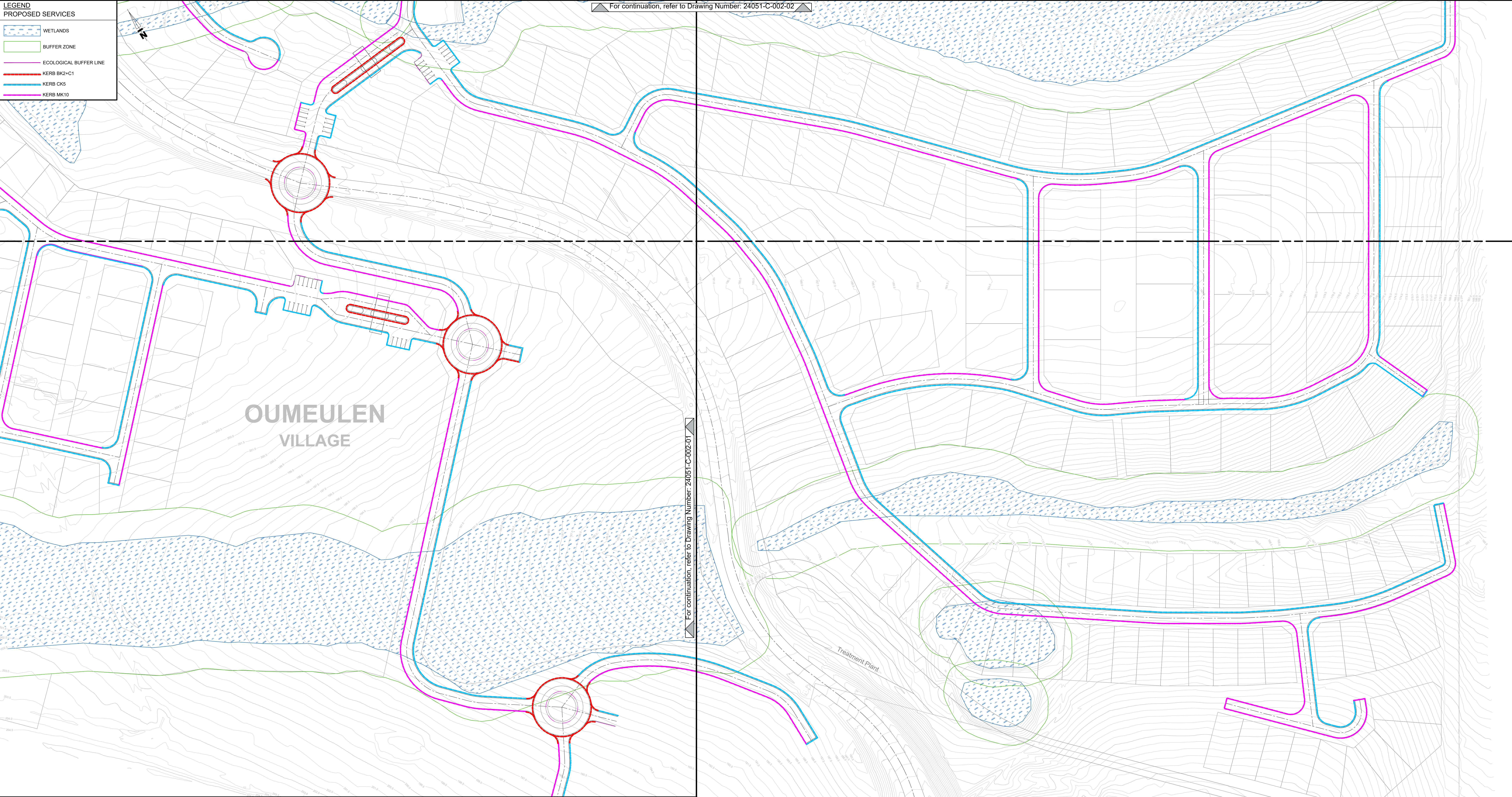
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DRAWING No. **24051-C-002-02** REV A

COORDINATE SYSTEM: WGS84 / UTM 28S

LEGEND
PROPOSED SERVICES

- WETLANDS
- BUFFER ZONE
- ECOLOGICAL BUFFER LINE
- KERB BK2+C1
- KERB CK5
- KERB MK10



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OUMEULEN VILLAGE AND MEULENZICHT LANDGOED DEVELOPMENT (GEORGE)

TITLE

KERB LAYOUT: MEULENZICHT SECTION 2

SCALE on A0 SHEET

1:750 1 OF 1

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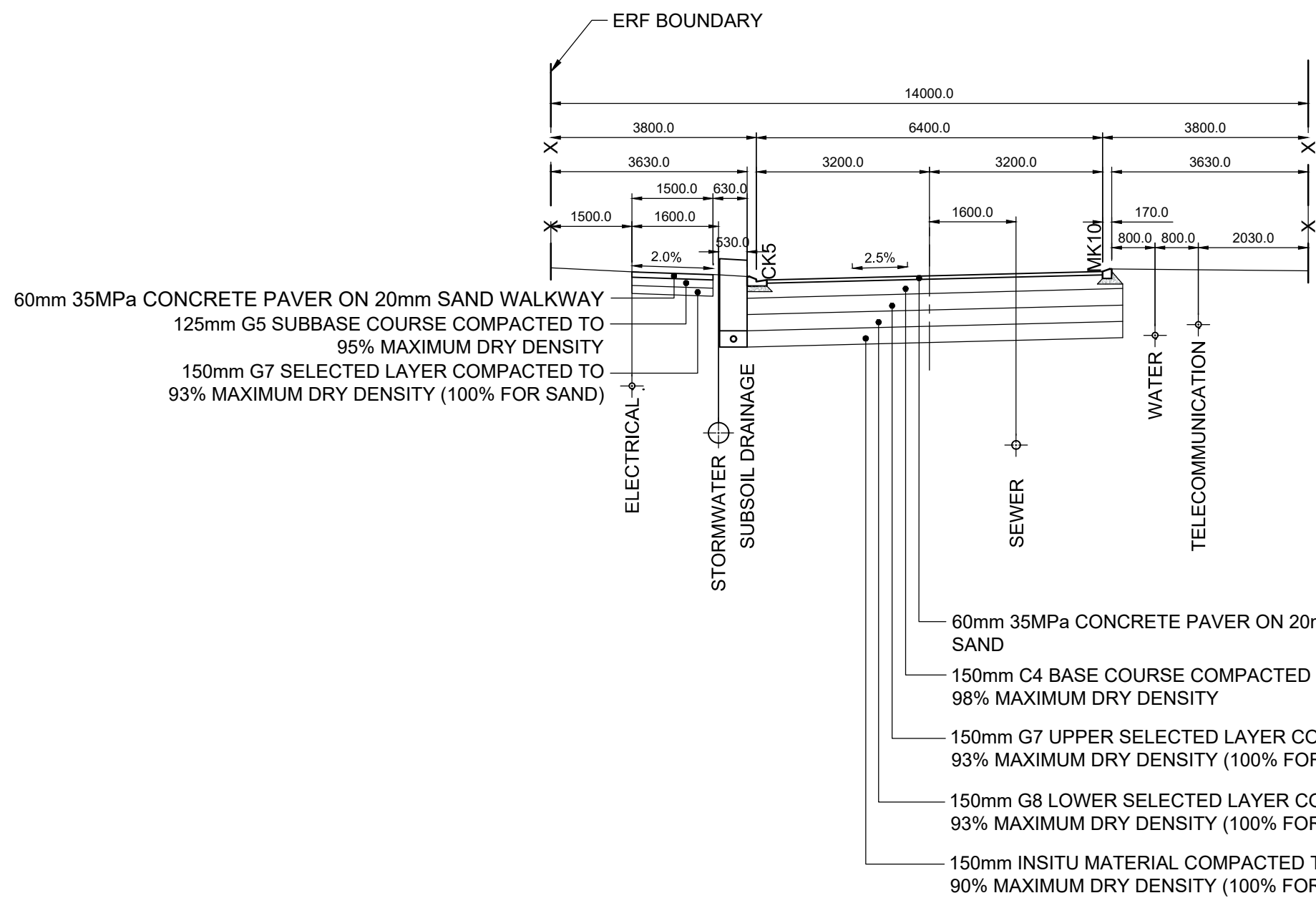
24051 CG 24051 CG

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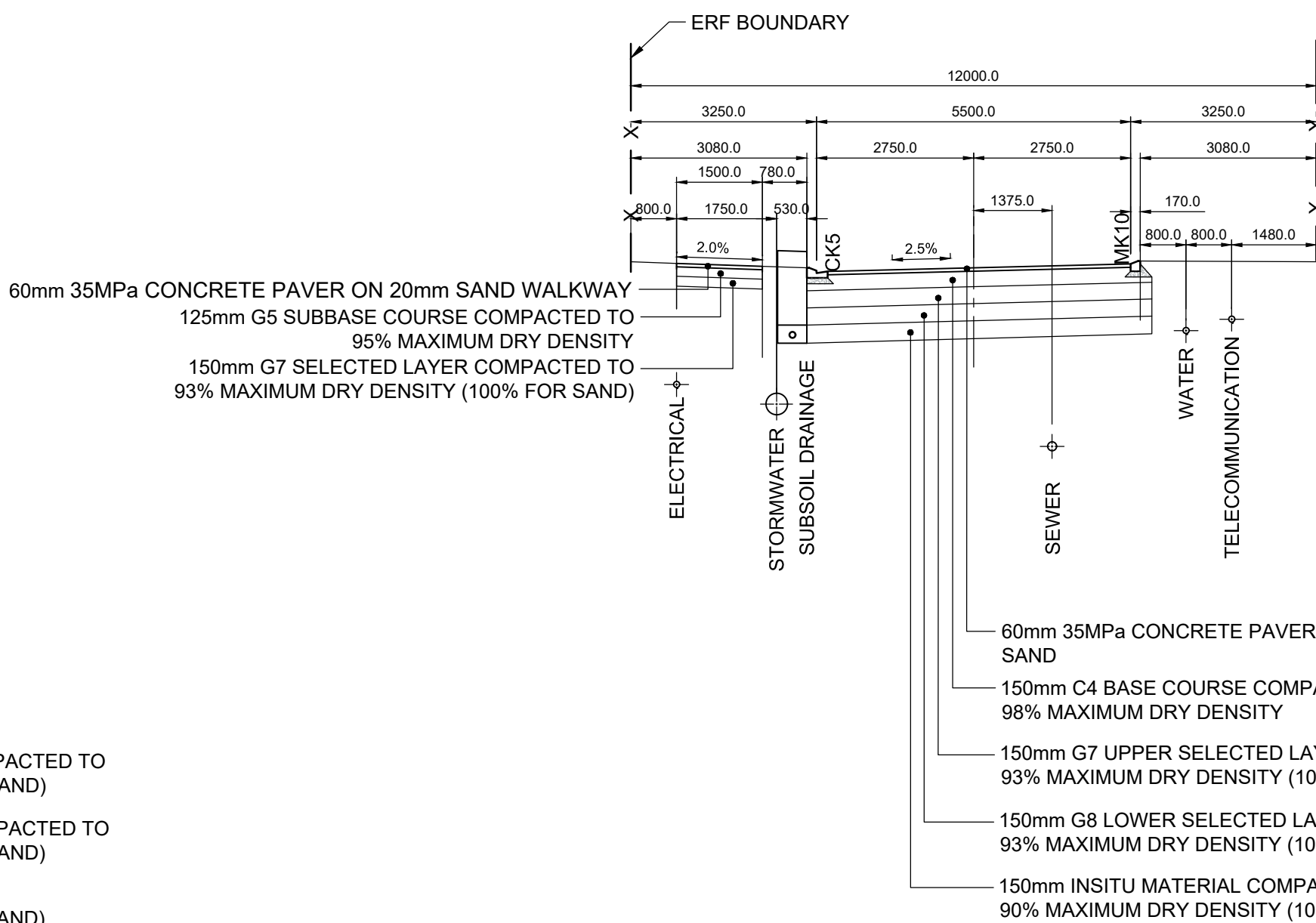
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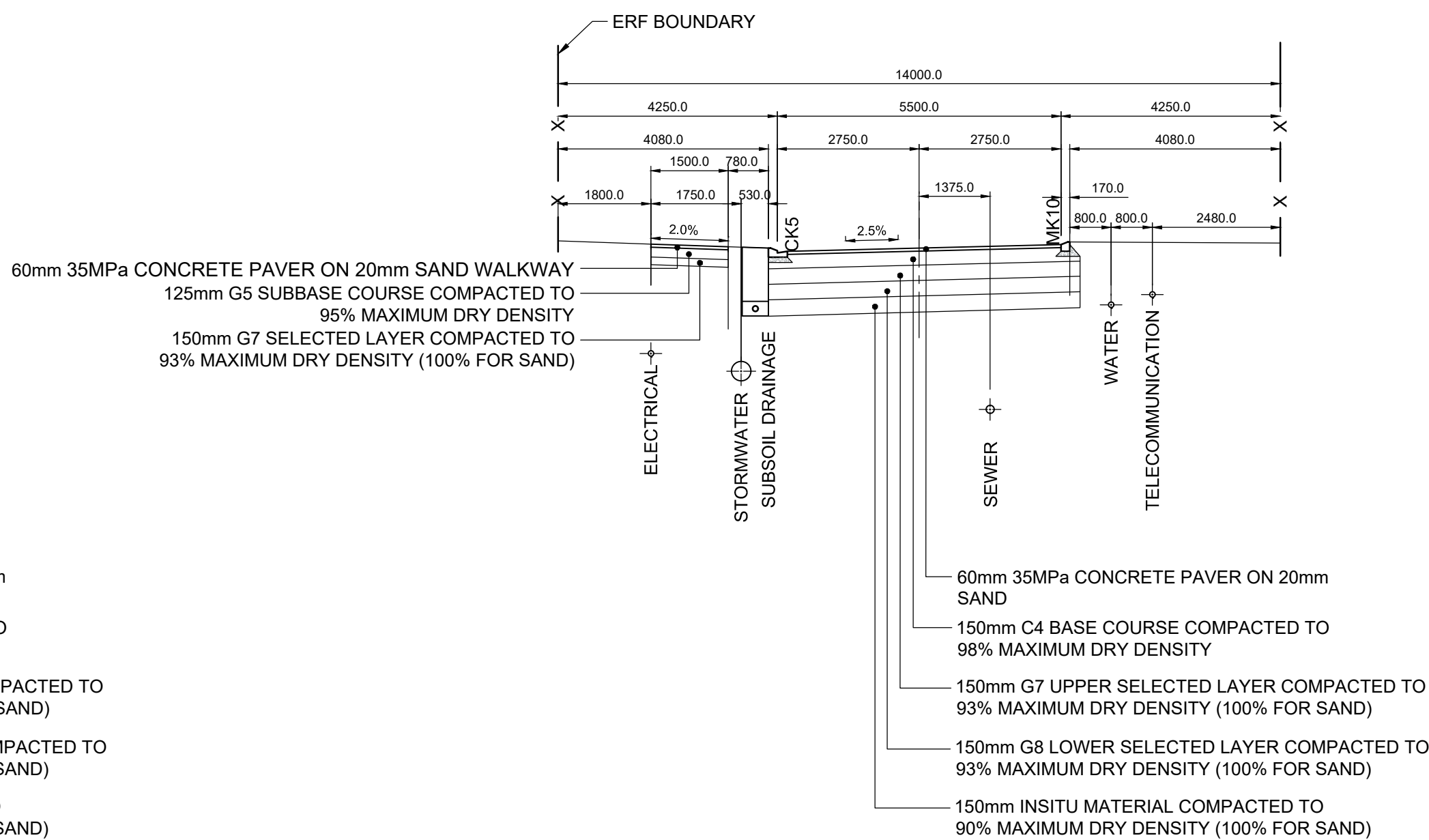
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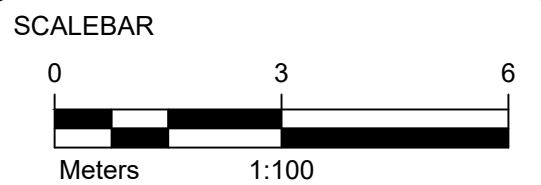


12m ROAD RESERVE: 5.5m ROAD
TYPICAL CROSS SECTION - FOR PAVING
SCALE 1:100



14m ROAD RESERVE: 5.5m ROAD
TYPICAL CROSS SECTION - FOR PAVING
SCALE 1:100

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DRAWN	GW	
CHECKED	FvE	

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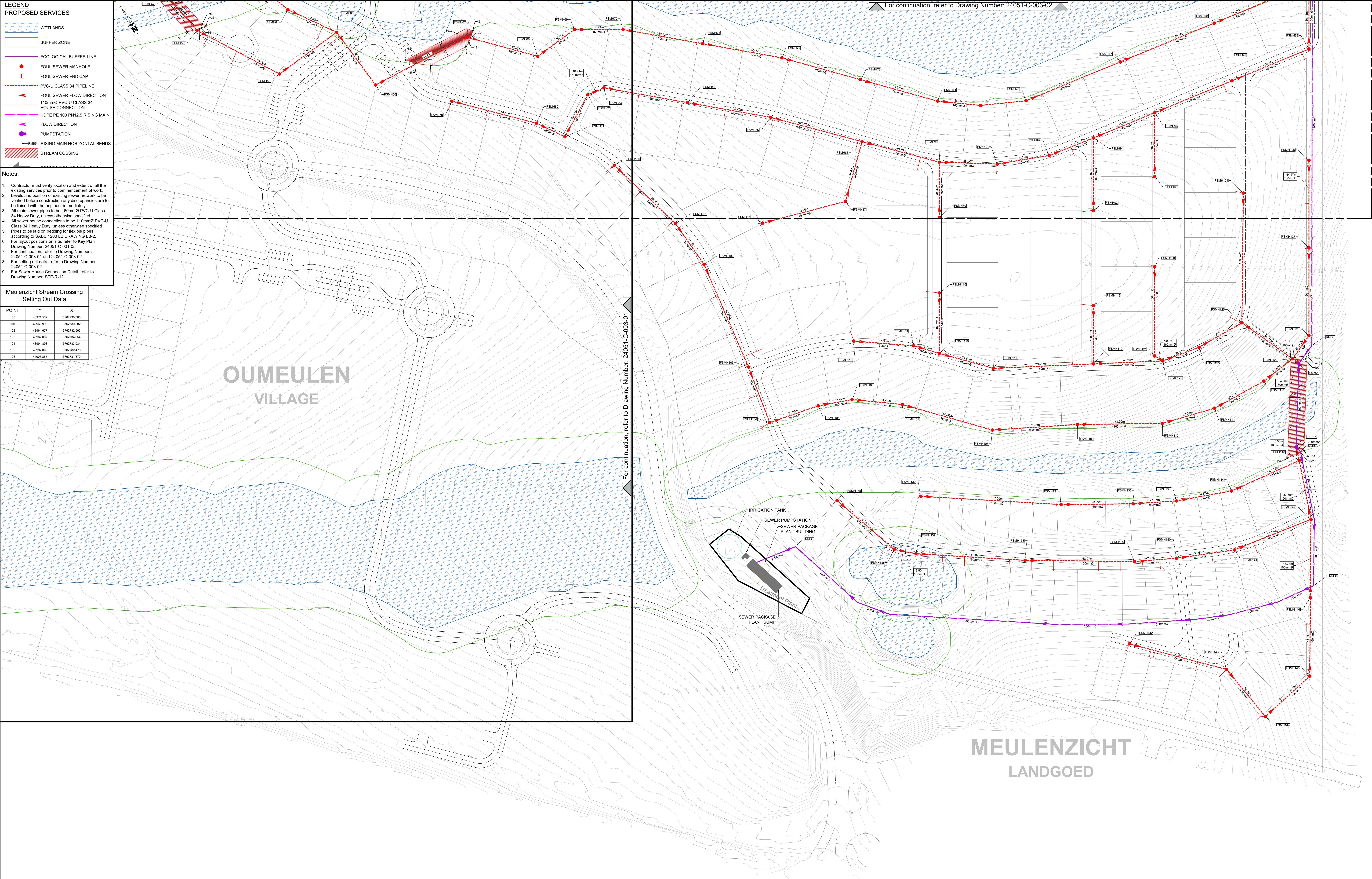
PROJECT

OUMEULEN VILLAGE AND
MEULENZICHT LANDGOED DEVELOPMENT (GEORGE)

TITLE

ROADS
TYPICAL CROSS SECTION

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CONTRACT No.	PROJECT No. 24051CG
DRAWING No. 24051-C-002-201	REV A
COORDINATE SYSTEM: WGS84 / Lo7"	



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0 22.5 45

Meters

1:750

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For Plot Size: 24051 CG - SAWMILL DEVELOPMENT - GEORGE (DRAWINGS) 1:2 ACTIVE 24051-C-003-01 (SEWER LAYOUT - OUMEULEN).DWG

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2024-12-09

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REVISIONS				

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DRAWN	HMV
CHECKED	MF

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ENGINEER: _____

DATE: 2024-12-09

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CLIENT: _____

DATE: _____

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PROJECT

OUMEULEN VILLAGE AND MEULENZICHT LANDGOED DEVELOPMENT (GEORGE)

TITLE

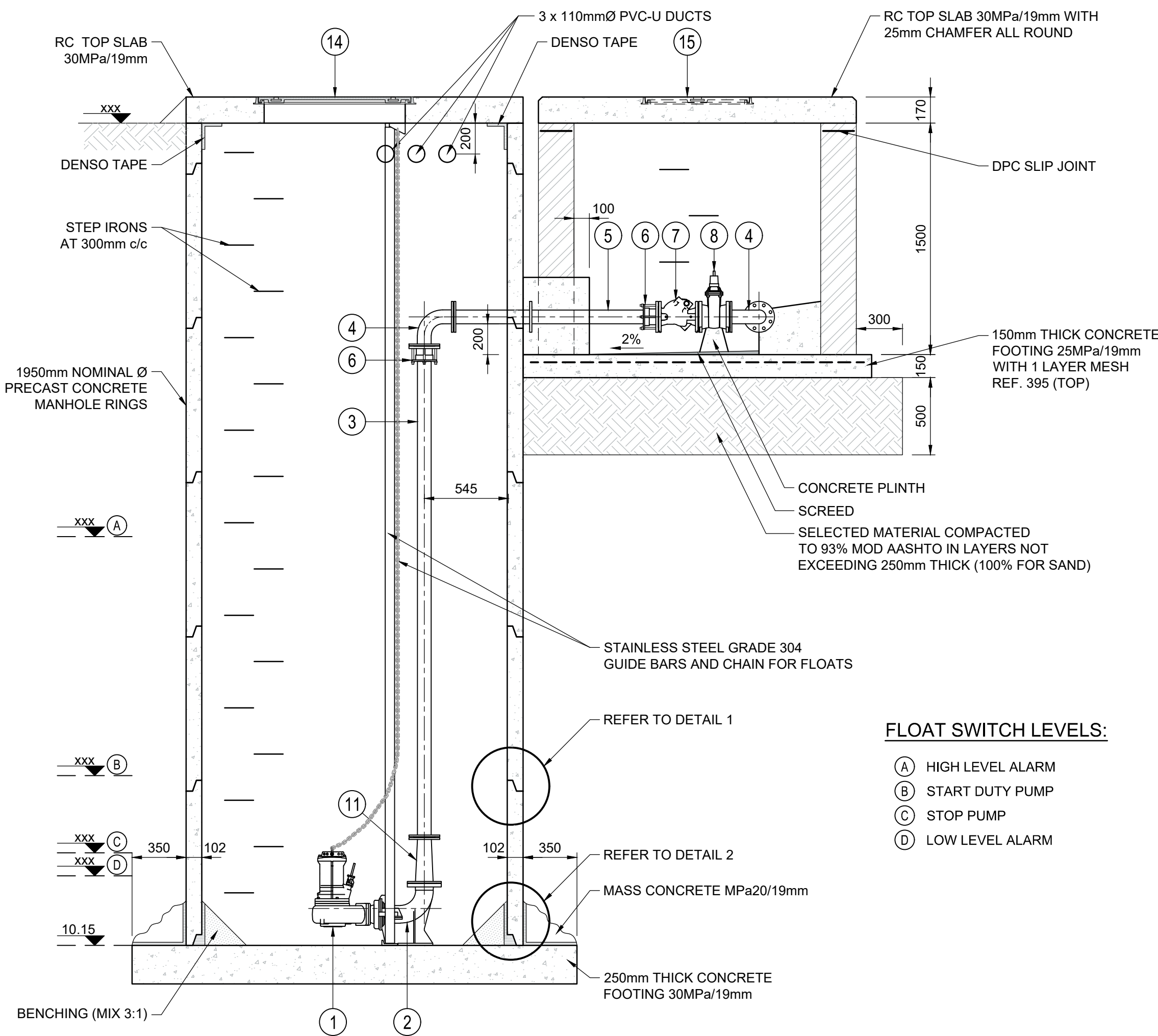
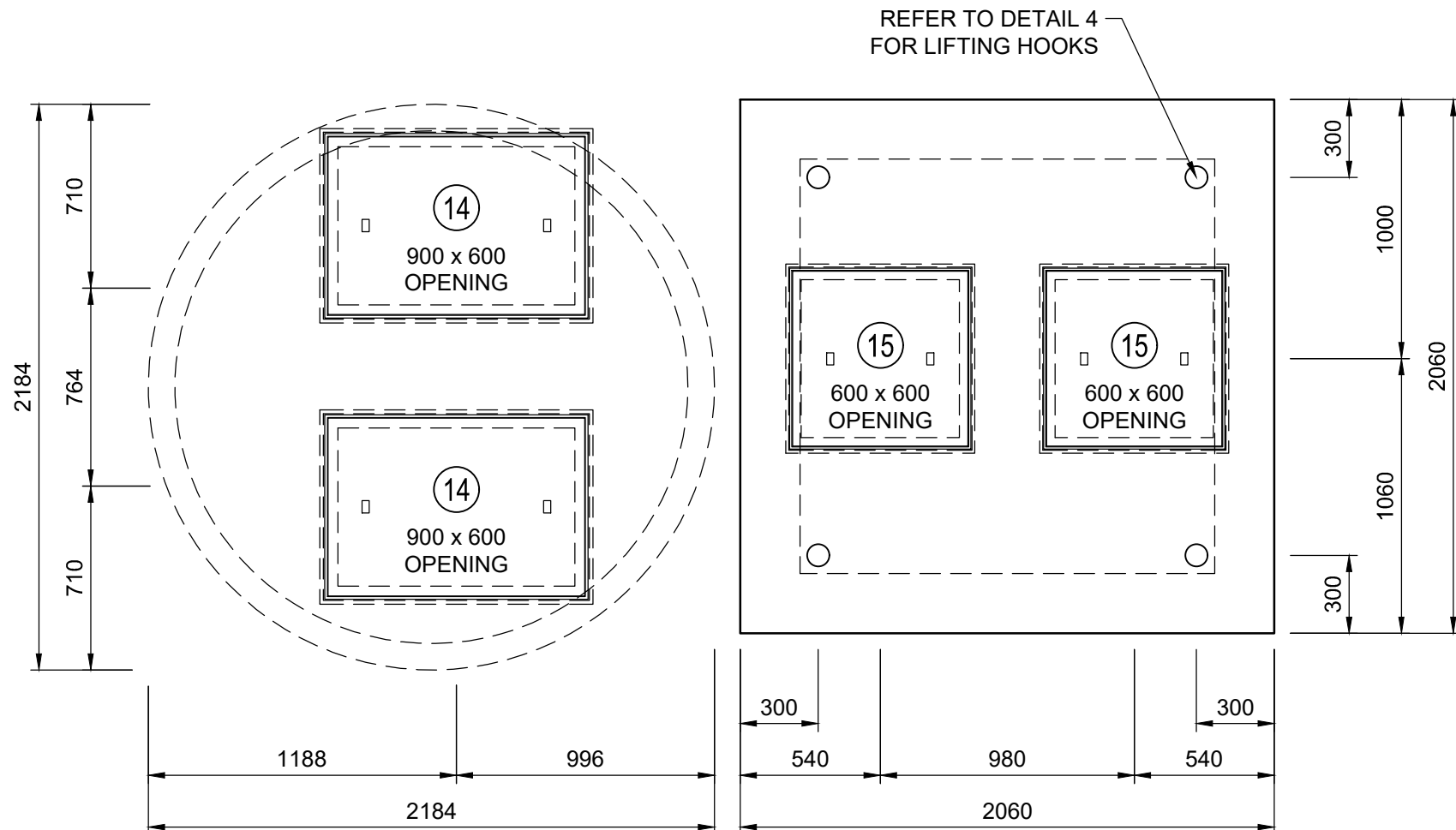
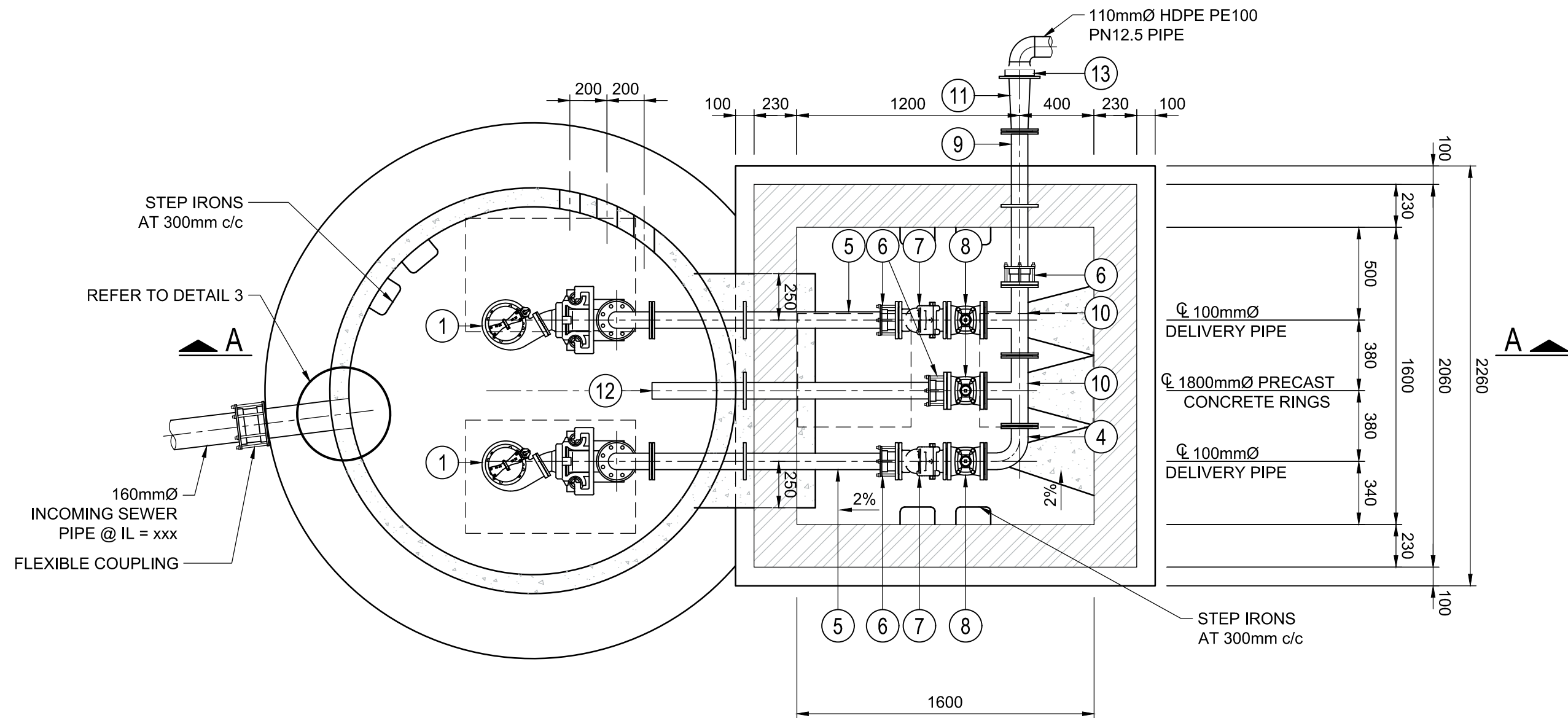
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SCALE 1:750 on A0 SHEET 1 OF 1

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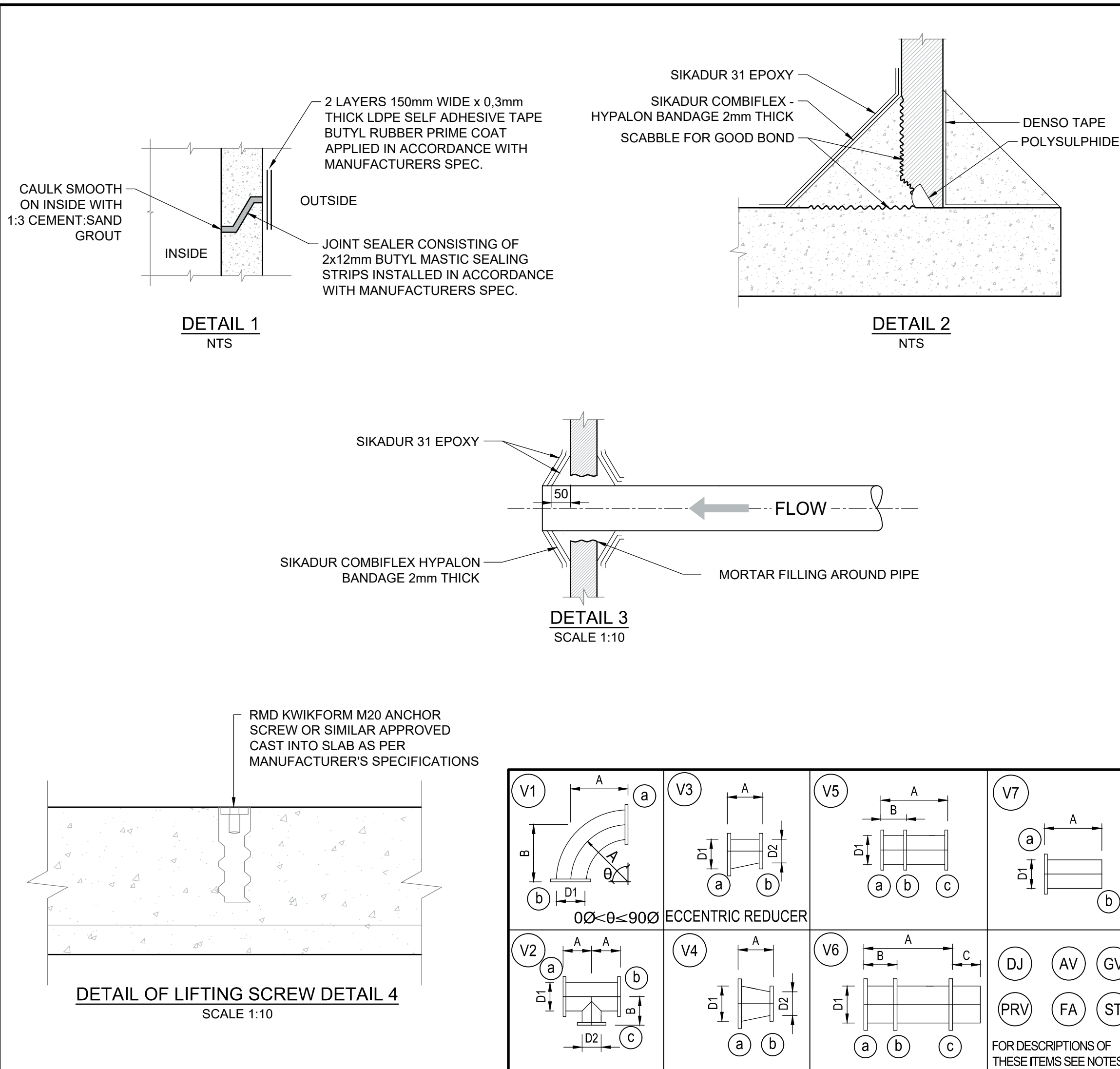
DRAWING No. **24051-C-003-03** REV A

COORDINATE SYSTEM: WGS84 / Lo 23°



FLOAT SWITCH LEVELS:

- (A) HIGH LEVEL ALARM
- (B) START DUTY PUMP
- (C) STOP PUMP
- (D) LOW LEVEL ALARM



Notes:

1. Materials

Steel and stainless steel pipes shall comply with the following

- 1.1 Stainless steel pipes shall be grade 304 and shall comply with ANSI B36.19M Schedule 10S.
- 1.2 Mild steel pipes up to 150mmØ shall be seamless, medium class steel pipes manufactured in accordance with SANS 62.
- 1.3 Mild steel pipes of 200mmØ and greater shall be manufactured in accordance with SANS 719 shall be grade C pipe material and the wall thickness shall be in accordance with table 2, column 3 of SANS 719.
- 1.4 Flange drilling shall be in accordance with SANS 1123: table 1000/3.
- 1.5 All nuts, bolts, hooks or other steel items inside the pump station and valve chamber that are not protected by galvanising, must be stainless steel.
- 1.6 Dimensions of all pipes, fittings, valves, etc. must be submitted for approval on a shopdrawing before any material is ordered.
- 1.7 Step irons to be Calcamite-type or approved equivalent.

2. Corrosion protection of pipes, specials, couplings and valves

- 2.1 Corrosion protection internal and external to all steel pipes to be double hot-dipped galvanising after manufacture.
- 2.2 Mild steel pipes shall be galvanised and coated with three layers of Carbogard 891, 125 micron dry film thickness (DFT) per layer.
- 2.3 SABS approval certificates of all coatings and galvanizing to be delivered to the engineer for approval.
- 2.4 All mild steel pipe work buried in the ground shall be externally protected by a wrapping system. The specification for the wrapping system is as follows:
 - Clean surface to required standard (minimum preparation ST2 according to SI6 055900-1967)
 - Brush or spray Denso priming solution or Denso S105 paste Denso mastic to create profile for Denso tape, so as to ensure that there are no air voids forming beneath the Denso tape.
 - Denso tape (petrolatum tape) wrapped spirally around prepared area.
 - Double wrap polyethylene tape (minimum 300 micron thick).
- 2.5 All valves (including check valves) shall have a sinter epoxy powder coatings on interior and exterior metal surfaces.
- 2.6 Backfilled material compacted to 93% MOD AASHTO (100% for sand) unless otherwise specified
- 2.7 Nuts and bolts to be Grade 304 s/s with approved anti-seize compound.

3. Openings

- 3.1 All openings in precast pump station rings must be closed with class 20MPa/19mm concrete after the pipes have been installed.

4. General

- 4.1 All dimensions shown on this drawing shall be verified by the contractor in order to ensure that on-site requirements are met. Dimensions may vary depending on the type and make of items such as valves. Any discrepancies must be reported to the engineer prior to the ordering of any materials.
- 4.2 Final position of pumps & guiderails to be determined once puddle pipes have been fixed into place

4. Pumps

- 5.1 Robot Submersible Vortex pump. Model: DWP22-30DD with 130mmØ impeller to suit V100 Duckfoot bend.
- 5.2 Float switches on stainless steel chain at A, B, C and D as indicated on drawing.

DESCRIPTION OF COUPLINGS AND VALVES

SHAPE	DESCRIPTION
DB	V100 DUCKFOOT BEND OR SIMILAR APPROVED
FA	HDPE STUB END WITH STAINLESS STEEL TABLE 1000/3 BACKING RING, CONTINUOUSLY BUTT WELDED TO PIPE
GV	DOUBLE-FLANGED, NON-RISING SPINDLE, CLOCKWISE CLOSING, WITH HANDWHEEL RESILIENT SEAL GATE VALVE TO SABS 664 - 10 BAR AVK OR SIMILAR APPROVED
NRV	DOUBLE-FLANGED, CAST IRON SINGLE DOOR SWING CHECK VALVE TO SABS 144, 10 BAR AVK OR SIMILAR APPROVED
VJ	KAMFLEX BLACK PN10 FLANGE ADAPTOR WITH s/s GRADE 316 BUTS AND BOLTS

LEGEND

●	STAINLESS STEEL
□	EXACT LENGTH TO BE DETERMINED ON SITE
★	FLANGED END
W	WELDED (ALL WELDING TO BE DONE BY MANUFACTURER OF PIPES AND NOT ON SITE)
#	SCOUR TEE
∞	THREAD FEMALE CONNECTION
8	THREAD MALE CONNECTION

PIPE SCHEDULE

Item No.	Shape	D1 (mm)	D2 (mm)	A (mm)	B (mm)	C (mm)	Ø (deg)	Flanges			Quantity
								a	b	c	
1	PUMPS (Refer to notes for Particular Specification)							-	-	-	2
2	DB	100	-	-	-	-	-	*	*	*	2
3	V5	80	-	□3150	-	-	-	*	*	*	2
4	V1	80	-	190	190	-	90	*	*	*	3
5	V5	80	-	□1300	500	-	-	*	*	*	2
6	VJ	80	-	-	-	-	-	*	*	*	6
7	NRV	80	-	-	-	-	-	*	*	*	2
8	GV	80	-	-	-	-	-	*	*	*	3
9	V5	80	-	800	400	-	-	*	*	*	1
10	V2	80	-	190	190	-	-	*	*	*	2
11	V4	100	80	300	-	-	-	*	*	*	3
12	V5	80	-	□1550	500	-	-	*	*	*	1
13	FA	100	-	-	-	-	-	*	*	*	1
14	900 x 600mm SAINT GOBAIN COVER AND FRAME TYPE 9E OR SIMILAR APPROVED							*	*	*	2
15	600 x 600mm SAINT GOBAIN COVER AND FRAME TYPE 9A OR SIMILAR APPROVED							*	*	*	2

FOR DESCRIPTIONS OF THESE ITEMS SEE NOTES

SCALEBAR



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All dimensions must be verified on site before the works commence. Refer any discrepancies to the Engineer.

REV	DESCRIPTION	DATE	REV BY	CHKD
A	ISSUED FOR INFORMATION	'24-12-09	GW	FVE
REVISIONS				

DESIGNED	GW	'24-12
DRAWN	GW	'24-12
CHECKED	FvE	'24-12

CONSULTING ENGINEERS

LYNERS

PO Box 757
GEORGE
6530

Tel: 044 887 0223/Fax: 044 887 0741
email: george@lyners.co.za

APPROVED	ENGINEERS: _____
DATE: _____	2024-12-09
APPROVED	CLIENT: _____
DATE: _____	

CLIENT

ATTERBURY

It's a matter of association

PROJECT

**OUMEULEN VILLAGE AND MEULENZICHT
LANDGOED DEVELOPMENT (GEORGE)**

TITLE

**TYPICAL DETAIL OF SEWAGE
PUMPSTATION (FPS)**

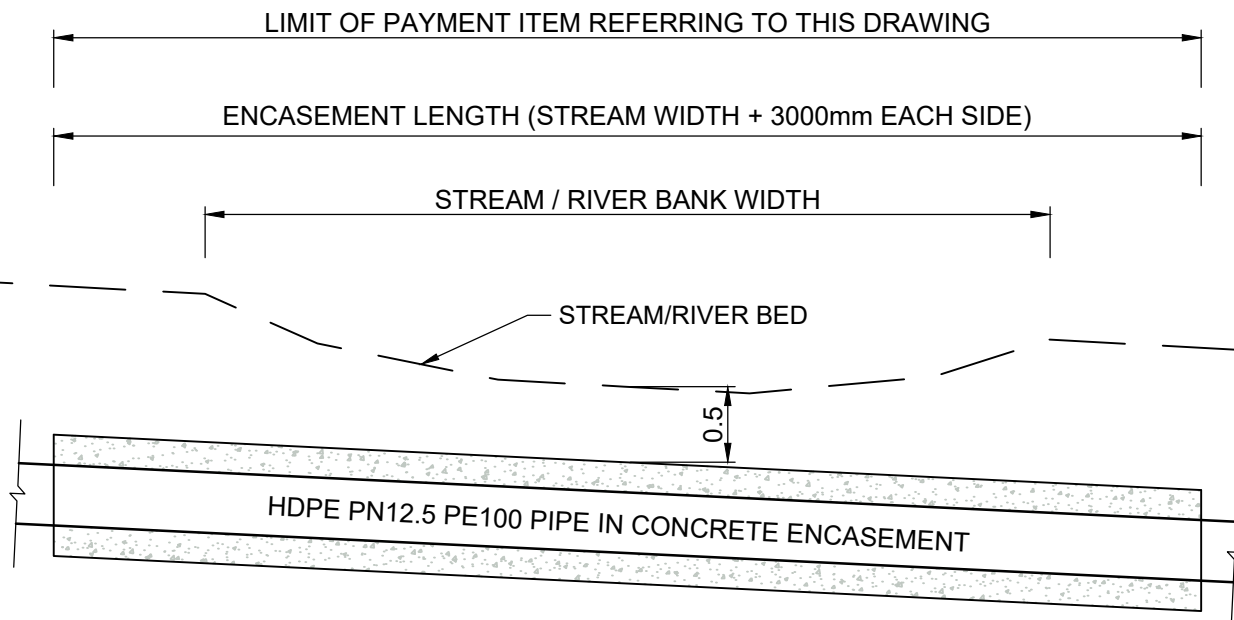
SCALE on A1	SHEET
AS SHOWN	1 OF 1
CONTRACT No.	PROJECT No.
	24051 CG
DRAWING No.	REV
24051-C-003-101	A
COORDINATE SYSTEM: WGS84/Lo23°	

iso full bleed a4 (210,00 x 297,00 mm)

lyniers-AutoCAD.ctb

2025-02-18

U:\WERKET\2400\24051 CG - SAMMILL DEVELOPMENT - GEORGET\DRAWINGS\1.2 ACTIVE\24051-C-003-102 (STREAM CROSSING).DWG

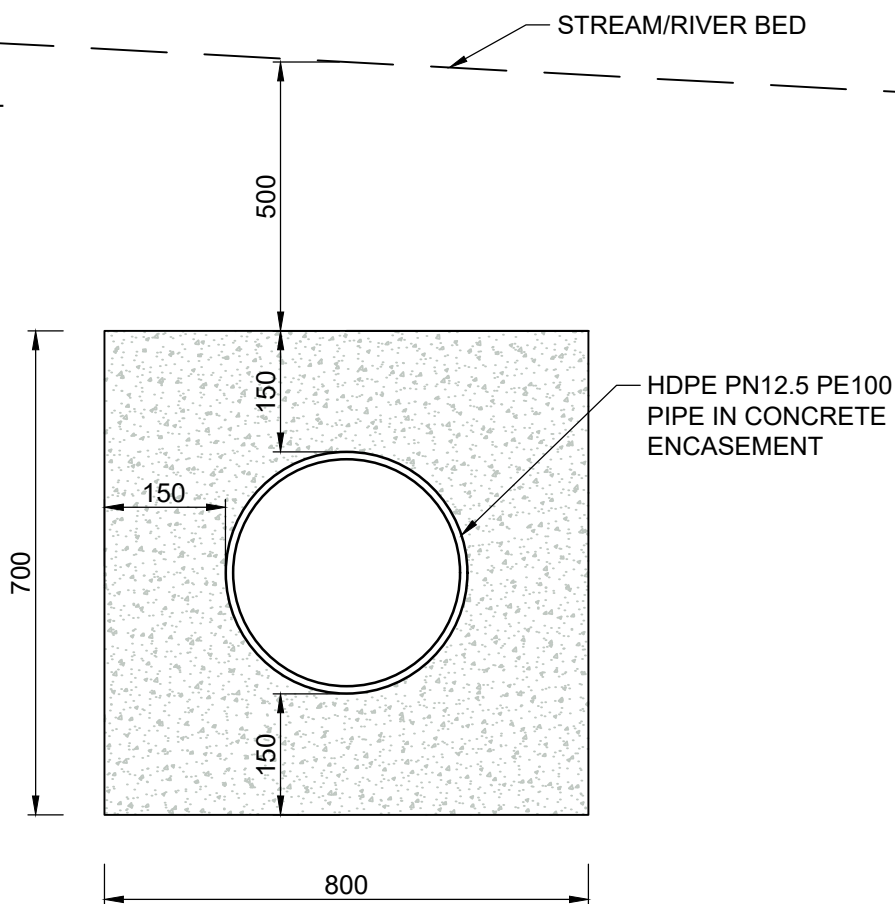


WATER CROSSING - LONGITUDINAL SECTION

N.T.S.

NOTES:

1. ANCHOR BLOCK AND FITTINGS NOT INCLUDED UNDER PAYMENT FOR WATER CROSSING
2. PRICE MUST INCLUDE DEALING WITH WATER WHERE APPLICABLE
2. ENCASEMENT CONCRETE MUST HAVE STRENGTH 25/19
3. BACKFILL 500mm ABOVE PIPE WITH EXCAVATED MATERIAL
4. PAYMENT FOR EXCAVATION AND BACKFILLING PAID SEPARATELY UNDER PIPE TRENCHES



WATER CROSSING - CROSS SECTION

N.T.S.

The reference made to Engineer will also refer to Employer's Agent for GCC 2015 Contracts

CONSULTING ENGINEERS



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PO Box 757
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6530

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TITLE

WATER CROSSING DETAIL

PROJECT No.
C24051

SCALE on A4
ON_DRAWING

DRAWING No.
24051-C-003-01

REV
A

APPROVED :
FVE

DRAWN
GW

DATE
'25-02

CHECKED
FVE

DATE
'25-02

LEGEND
PROPOSED SERVICES

WETLANDS

BUFFER ZONE

ECOLOGICAL BUFFER LINE

WATER METER CHAMBER

T-PIECE

BENDS

ENDCAP

FIRE HYDRANT

REDUCER

110mmØ PVC-U CLASS 16 WATER PIPELINE UNLESS OTHERWISE SHOWN

32mmØ HDPE PE 100 PN 16 WATER CONNECTION

25mmØ HDPE PE 100 PN 16 DOUBLE WATER CONNECTION

STREAM CROSSING

Notes:

- Contractor must verify location and extent of all the existing services prior to commencement of work.
- Levels and position of existing water network to be verified before construction any discrepancies are to be liaised with the engineer immediately.
- All main water pipes to be 110mmØ PVC-U Class 16 Heavy Duty, unless otherwise specified.
- All water house connections to be 32mmØ PVC-U Class 16 Heavy Duty, unless otherwise specified.
- Pipes to be laid on bedding for flexible pipes according to SABS 1200 LB DRAWING LB-2.
- For layout positions on site, refer to Key Plan Drawing Number: 24051-C-001-05
- For continuation, refer to Drawing Numbers: 24051-C-004-02 and 24051-C-004-03
- For Water House Connection Detail, refer to Drawing Number: STE-W-29G

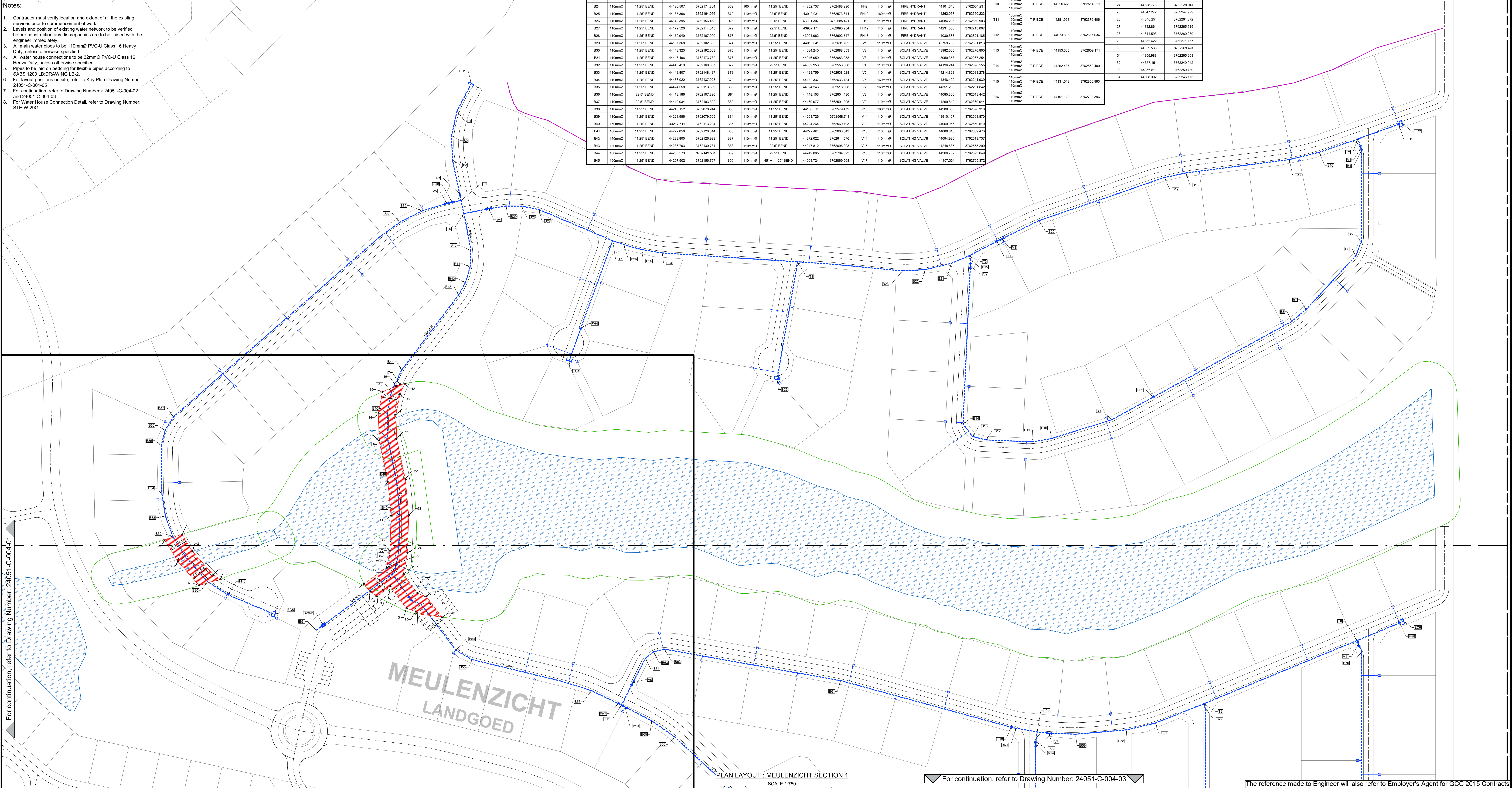
MEULENZICHT FITTINGS SETTING OUT DATA				
ID	DIA	PART	Y	X
B1	110mmØ	11.25° BEND	44182.280	3762045.191
B2	110mmØ	11.25° BEND	44192.301	3762036.349
B3	110mmØ	11.25° BEND	44199.090	3762034.136
B4	110mmØ	22.5° BEND	43760.072	3762033.133
B5	110mmØ	22.5° BEND	43787.970	3762036.972
B6	110mmØ	22.5° BEND	43794.648	3762031.897
B7	110mmØ	11.25° BEND	43834.554	3762032.595
B8	110mmØ	11.25° BEND	43845.076	3762034.091
B9	110mmØ	11.25° BEND	43861.135	3762037.349
B10	110mmØ	11.25° BEND	43866.573	3762037.946
B11	110mmØ	11.25° BEND	44005.802	3762037.727
B12	110mmØ	11.25° BEND	44027.358	3762038.909
B13	110mmØ	45° BEND	44032.846	3762033.254
B14	110mmØ	45° BEND	44033.607	3762044.281
B15	110mmØ	22.5° + 11.25° BEND	43880.908	3762027.790
B16	110mmØ	11.25° BEND	43781.212	3762021.271
B17	110mmØ	11.25° BEND	43797.234	3762016.740
B18	110mmØ	11.25° BEND	43851.234	3762051.086
B19	110mmØ	11.25° BEND	43863.028	3762050.812
B20	110mmØ	11.25° BEND	43836.227	3762059.738
B21	110mmØ	11.25° BEND	43860.723	3762063.889
B22	110mmØ	11.25° BEND	44005.164	3762029.085
B23	110mmØ	11.25° BEND	44016.636	3762022.802
B24	110mmØ	11.25° BEND	44126.507	3762017.344
B25	110mmØ	11.25° BEND	44135.366	3762016.599
B26	110mmØ	11.25° BEND	44142.396	3762016.459
B27	110mmØ	11.25° BEND	44172.520	3762011.043
B28	110mmØ	11.25° BEND	44179.949	3762017.000
B29	110mmØ	11.25° BEND	44187.368	3762012.365
B30	110mmØ	11.25° BEND	44443.323	3762192.668
B31	110mmØ	11.25° BEND	44446.496	3762173.782
B32	110mmØ	11.25° BEND	44446.219	3762016.897
B33	110mmØ	11.25° BEND	44443.807	3762148.437
B34	110mmØ	11.25° BEND	44438.922	3762127.028
B35	110mmØ	11.25° BEND	44424.558	3762113.389
B36	110mmØ	22.5° BEND	44418.186	3762107.320
B37	110mmØ	22.5° BEND	44410.034	3762103.362
B38	110mmØ	11.25° BEND	44243.152	3762078.244
B39	110mmØ	11.25° BEND	44228.986	3762079.569
B40	160mmØ	11.25° BEND	44217.511	3762113.394
B41	160mmØ	11.25° BEND	44222.956	3762120.814
B42	160mmØ	11.25° BEND	44229.800	3762105.929
B43	160mmØ	11.25° BEND	44236.703	3762130.734
B44	160mmØ	11.25° BEND	44286.073	3762149.581
B45	160mmØ	11.25° BEND	44297.902	3762156.757

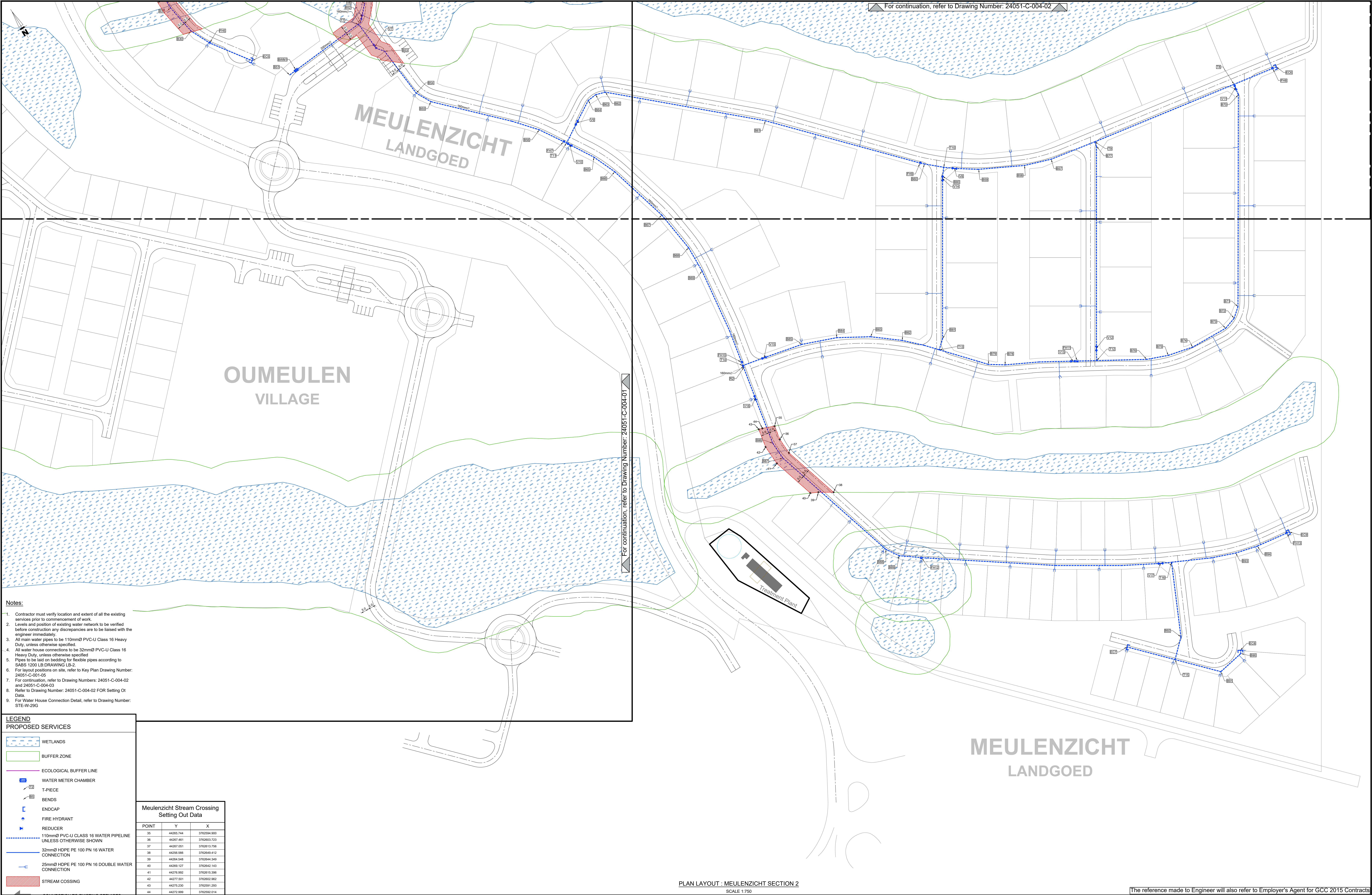
MEULENZICHT FITTINGS SETTING OUT DATA				
ID	DIA	PART	Y	X
B46	160mmØ	11.25° BEND	44306.951	3762169.241
B47	160mmØ	11.25° BEND	44314.392	3762165.844
B48	160mmØ	11.25° BEND	44322.300	3762201.112
B49	160mmØ	11.25° BEND	44331.249	3762218.803
B50	160mmØ	11.25° BEND	44342.694	3762235.905
B51	200mmØ	22.5° BEND	44405.721	3762248.628
B52	160mmØ	11.25° BEND	44330.818	3762244.445
B53	160mmØ	22.5° BEND	44347.715	3762287.553
B54	160mmØ	22.5° BEND	44348.885	3762290.199
B55	160mmØ	22.5° BEND	44358.887	3762309.816
B56	160mmØ	11.25° BEND	44391.563	3762365.402
B57	110mmØ	11.25° BEND	44031.287	3762545.565
B58	110mmØ	11.25° BEND	44047.244	3762540.088
B59	110mmØ	11.25° BEND	44072.917	3762526.855
B60	110mmØ	11.25° BEND	44099.677	3762505.169
B61	110mmØ	11.25° BEND	44169.422	3762430.591
B62	110mmØ	11.25° BEND	44244.612	3762592.559
B63	110mmØ	22.5° + 11.25° BEND	44250.585	3762600.482
B64	110mmØ	22.5° + 11.25° BEND	44256.386	3762612.078
B65	160mmØ	11.25° BEND	44272.105	3762692.939
B66	160mmØ	11.25° BEND	44265.985	3762407.588
B67	160mmØ	11.25° BEND	44255.481	3762445.071
B68	160mmØ	11.25° BEND	44262.180	3762472.139
B69	160mmØ	11.25° BEND	44267.597	3762484.960
B70	110mmØ	22.5° BEND	43919.931	3762573.644
B71	110mmØ	22.5° BEND	43961.307	3762585.421
B72	110mmØ	22.5° BEND	43967.171	3762590.254
B73	110mmØ	22.5° BEND	43964.962	3762692.747
B74	110mmØ	11.25° BEND	44018.641	3762691.782
B75	110mmØ	11.25° BEND	44034.240	3762688.053
B76	110mmØ	11.25° BEND	44046.950	3762683.058
B77	110mmØ	22.5° BEND	44002.983	3762650.688
B78	110mmØ	11.25° BEND	44123.759	3762633.928
B79	110mmØ	11.25° BEND	44132.337	3762653.184
B80	110mmØ	11.25° BEND	44094.246	3762551.568
B81	110mmØ	11.25° BEND	44148.103	3762604.430
B82	110mmØ	11.25° BEND	44169.977	3762591.905
B83	110mmØ	11.25° BEND	44185.511	3762579.479
B84	110mmØ	11.25° BEND	44203.728	3762599.741
B85	110mmØ	11.25° BEND	44204.294	3762590.793
B86	110mmØ	11.25° BEND	44272.481	3762603.343
B87	110mmØ	11.25° BEND	44272.022	3762614.576
B88	110mmØ	22.5° BEND	44247.812	3762696.903
B89	110mmØ	22.5° BEND	44242.865	3762704.623
B90	110mmØ	45° + 11.25° BEND	44094.724	3762689.568

MEULENZICHT FITTINGS SETTING OUT DATA				
ID	DIA	PART	Y	X
B91	110mmØ	45° + 11.25° BEND	44111.385	3762872.262
B92	110mmØ	22.5° BEND	44120.877	3762864.977
B93	110mmØ	11.25° BEND	44094.205	3762814.790
B94	110mmØ	11.25° BEND	44090.453	3762818.295
B95	160mmØ	22.5° BEND	44351.119	3762283.288
B96	160mmØ	Water Meter Chamber	44402.738	3762248.248
B97	200mmØ	END CAP	44167.035	3762033.209
B98	110mmØ	END CAP	43732.588	3762332.313
B99	110mmØ	END CAP	44109.483	3762297.917
B100	110mmØ	END CAP	44203.713	3762195.578
B101	110mmØ	END CAP	44420.878	3762228.877
B102	110mmØ	END CAP	43881.600	3762571.451
B103	110mmØ	END CAP	44152.736	3762828.360
B104	110mmØ	END CAP	44093.921	3762887.645
B105	110mmØ	END CAP	44028.825	3762821.418
B106	110mmØ	FIRE HYDRANT	43734.695	3762331.837
B107	110mmØ	FIRE HYDRANT	43804.172	3762398.682
B108	110mmØ	FIRE HYDRANT	44028.592	3762286.989
B109	110mmØ	FIRE HYDRANT	44188.148	3762183.445
B110	110mmØ	FIRE HYDRANT	44375.475	3762265.122
B111	110mmØ	FIRE HYDRANT	44211.824	3762084.395
B112	110mmØ	FIRE HYDRANT	44282.943	3762274.762
B113	110mmØ	FIRE HYDRANT	43864.157	3762571.025
B114	110mmØ	FIRE HYDRANT	44101.946	3762504.231
B115	110mmØ	FIRE HYDRANT	44023.997	3762535.233
B116	110mmØ	FIRE HYDRANT	44094.205	3762660.903
B117	110mmØ	FIRE HYDRANT	44231.856	3762171.007
B118	110mmØ	FIRE HYDRANT	44030.583	3762821.185
B119	110mmØ	ISOLATING VALVE	43759.768	3762331.813
B120	110mmØ	ISOLATING VALVE	43862.605	3762270.800
B121	110mmØ	ISOLATING VALVE	43959.353	3762287.254
B122	110mmØ	ISOLATING VALVE	44198.244	3762698.955
B123	110mmØ	ISOLATING VALVE	44214.823	3762693.278
B124	110mmØ	ISOLATING VALVE	44346.459	3762241.259
B125	110mmØ	ISOLATING VALVE	44351.230	3762281.862
B126	110mmØ	ISOLATING VALVE	44085.306	3762518.442
B127	110mmØ	ISOLATING VALVE	44209.842	3762280.044
B128	110mmØ	ISOLATING VALVE	44208.806	3762278.310
B129	110mmØ	ISOLATING VALVE	43910.107	3762599.870
B130	110mmØ	ISOLATING VALVE	44089.898	3762590.510
B131	110mmØ	ISOLATING VALVE	44086.610	3762650.473
B132	110mmØ	ISOLATING VALVE	44094.980	3762619.737
B133	110mmØ	ISOLATING VALVE	44246.685	3762555.290
B134	110mmØ	ISOLATING VALVE	44066.702	3762573.648
B135	110mmØ	ISOLATING VALVE	44107.331	3762705.373

MEULENZICHT T-PIECE SETTING OUT DATA				
ID	SIZE	PART	Y	X
R1	110mmØ	REDUCER	44205.817	3762082.435
R2	110mmØ	REDUCER	44262.752	3762055.737
T1	110mmØ	T-PIECE	44207.204	3762086.222
T2	110mmØ	T-PIECE	43758.545	3762326.505
T3	110mmØ	T-PIECE	43890.291	3762265.541
T4	110mmØ	T-PIECE	44064.338	3762216.744
T5	110mmØ	T-PIECE	44146.631	3762151.082
T6	110mmØ	T-PIECE	44209.816	3762093.355
T7	200mmØ	T-PIECE	44302.545	3762244.576
T8	110mmØ	T-PIECE	43909.713	3762596.060
T9	110mmØ	T-PIECE	44002.395	3762550.830
T10	110mmØ	T-PIECE	44090.661	3762514.221
T11	110mmØ	T-PIECE	44281.963	3762376.406
T12	110mmØ	T-PIECE	44073.896	3762067.034
T13	110mmØ	T-PIECE	44153.505	3762069.171
T14	110mmØ	T-PIECE	44202.487	3762552.400
T15	110mmØ	T-PIECE	44131.512	3762850.993
T16	110mmØ	T-PIECE	44101.122	3762798.396

Meulenzicht Stream Crossing Setting Out Data				
POINT	Y	X		
1	44451.413	3762159.717		
2	44441.428	3762162.307		
3	44441.403	3762173.380		
4	44439.505	3762191.164		
5	44436.531	3762195.368		
6	44448.516	3762191.940		
7	44451.488	3762174.185		
8	44369.008	3762240.816		
9	44353.115	3762239.605		
10	44348.611	3762232.198		
11	44335.574	3762216.274		
12	44328.896	3762199.122		
13	44318.743	3762176.700		
14	44310.749	3762163.231		
15	44302.459	3762154.312		
16	44294.108	3762155.589		
17	44291.799	3762166.194		
18	44285.205	3762167.167		
19	44294.685	3762160.638		
20	44302.734	3762169.357		
21	44309.661	3762180.988		
22	44317.703	3762203.102		
23	44326.399	3762221.331		
24	44330.775	3762239.041		
25	44347.272	3762247.972		
26	44346.251	3762261.372		
27	44342.884	3762265.615		
28	44341.593	3762280.280		
29	44352.422	3762271.157		
30	44352.996	3762269.491		
31	44355.988	3762265.203		
32	44357.151	3762249.942		
33	44356.511	3762250.730		
34	44368.390	3762246.173		





SCALEBAR

0 22.5 45

Meters

1:750

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All dimensions must be verified on site before the works commence. Refer any discrepancies to the Engineer.

REV	DESCRIPTION	DATE	REV'D	CHK'D
A	ISSUED FOR INFORMATION	2024-12-09	HMV	MF
REVISIONS				

DESIGNED	GW
DRAWN	HMV
CHECKED	MF

CONSULTING ENGINEERS

LYNERS

PO Box 757
GEORGE
6530

Tel: 044 887 0223 Fax: 044 887 0741
email: george@lyniers.co.za

APPROVED

ENGINEER: _____

DATE: 2024-12-09

APPROVED

CLIENT: _____

DATE: _____

CLIENT

ATTERBURY

It's a matter of association

PROJECT

OUMEULEN VILLAGE AND MEULENZICHT LANDGOED DEVELOPMENT (GEORGE)

TITLE

WATER LAYOUT: MEULENZICHT SECTION 2

SCALE 1:750 on A0 SHEET 1 OF 1

CONTRACT No. PROJECT No. 24051 CG

DRAWING No. 24051-C-004-03 REV

COORDINATE SYSTEM: WGS84 / Lo 23°

LEGEND

PROPOSED SERVICES

WETLANDS

BUFFER ZONE

ECOLOGICAL BUFFER LINE

STORMWATER MANHOLE

STORMWATER DOUBLE CATCHPIT

STORMWATER HEADWALL

STORMWATER FLOW DIRECTION

CLASS 1000 CONCRETE PIPE

Notes:

1. The contractor must verify the location and extent of all the existing services prior to commencement of work.

2. For typical Stormwater Manhole Detail refer to Detail Drawing Number: STE/SW-99A.

3. For typical Double Kerb Inlet Gully and Catchpit details, refer to Detail Drawing Number: STE/SW-53.

4. Levels and position of existing Stormwater network must be verified before construction. Any discrepancies are to be confirmed with the engineer immediately.

5. Catchpits deeper than 1.0m, shall have step irons according to Detail Drawing Number: STE/SW-53.

6. For detail of sub-surface drain layerworks, refer to Detail Drawing Number: STE/SW-12.

7. For layout positions on site, refer to Key Plan Drawing Number: 24051-C-001-05.

8. For continuation, refer to Drawing Numbers: 24051-C-005-02 and 24051-C-005-03.

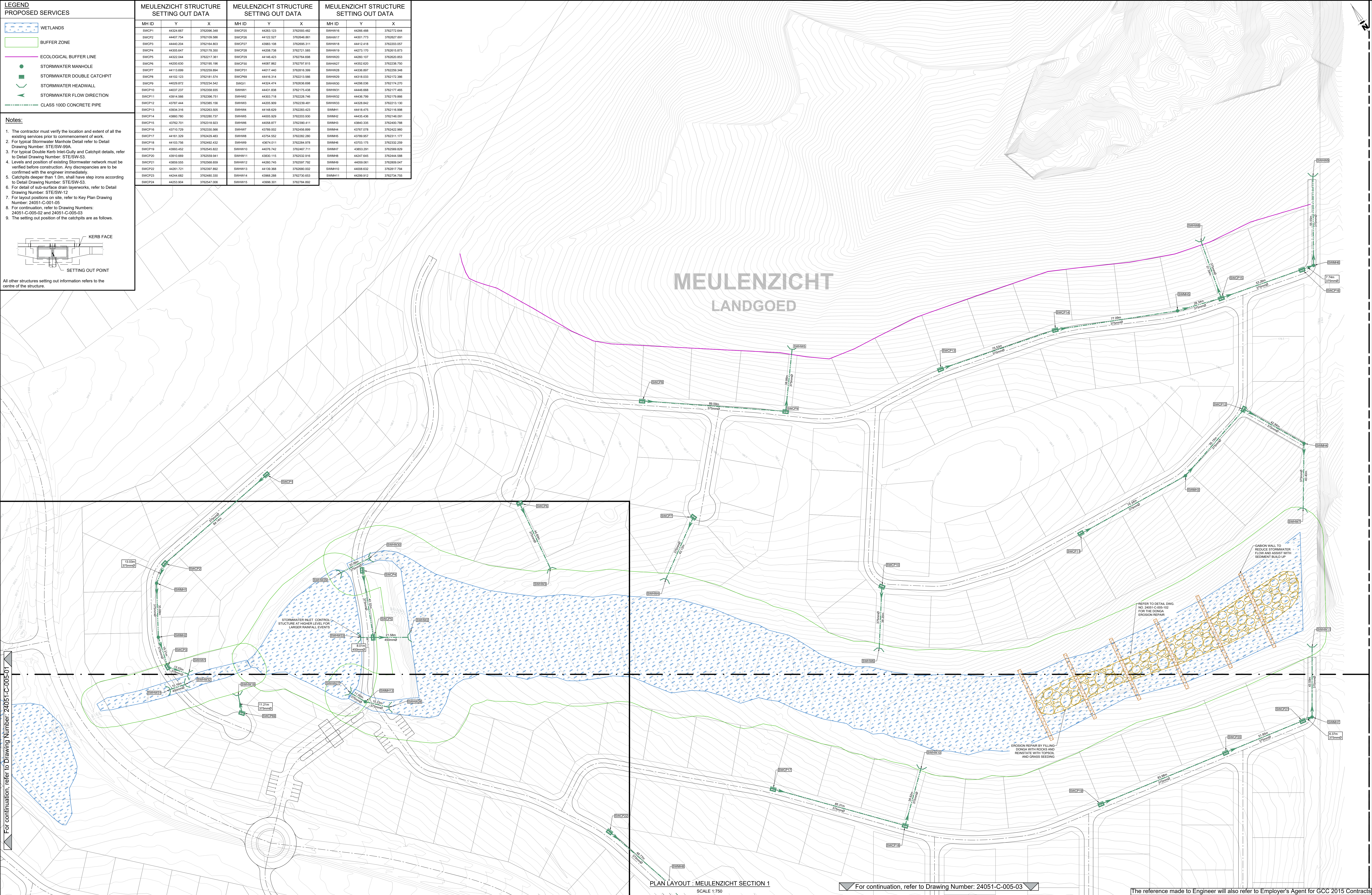
9. The setting out position of the catchpits are as follows.

KERB FACE

SETTING OUT POINT

All other structures setting out information refers to the centre of the structure.

MEULENZICHT STRUCTURE SETTING OUT DATA				MEULENZICHT STRUCTURE SETTING OUT DATA				MEULENZICHT STRUCTURE SETTING OUT DATA			
MH ID	Y	X		MH ID	Y	X		MH ID	Y	X	
SWCP1	44324.967	3762096.348		SWCP25	44265.123	3762098.482		SWHW16	44266.488	3762775.641	
SWCP2	44407.154	3762109.389		SWCP26	44122.537	3762094.961		SWHW17	44261.723	3762652.691	
SWCP3	44440.204	3762184.903		SWCP27	43983.108	3762695.311		SWHW18	44412.418	3762653.057	
SWCP4	44305.647	3762178.350		SWCP28	44206.738	3762751.585		SWHW19	44273.170	3762615.873	
SWCP5	44322.044	3762217.361		SWCP29	44146.423	3762764.668		SWHW20	44260.107	3762620.853	
SWCP6	44200.630	3762195.196		SWCP30	44087.862	3762797.815		SWHW21	44362.620	3762238.750	
SWCP7	44113.699	3762239.894		SWCP31	44017.440	3762816.399		SWHW22	44336.897	3762239.340	
SWCP8	44102.125	3762181.574		SWCP32	44162.374	3762713.366		SWHW23	44318.033	3762179.346	
SWCP9	44029.872	3762324.542		SWCP33	44234.474	3762836.699		SWHW24	44398.036	3762174.270	
SWCP10	44037.237	3762358.935		SWHW1	44431.838	3762175.438		SWHW25	44446.968	3762177.465	
SWCP11	43914.666	3762396.751		SWHW2	44303.718	3762226.746		SWHW26	44436.799	3762179.866	
SWCP12	43787.444	3762385.156		SWHW3	44205.909	3762230.481		SWHW27	44328.842	3762213.130	
SWCP13	43934.316	3762283.505		SWHW4	44148.629	3762283.423		SWHW28	44418.475	3762116.998	
SWCP14	43860.780	3762280.737		SWHW5	44005.929	3762203.990		SWHW29	44435.436	3762146.091	
SWCP15	43762.701	3762318.823		SWHW6	44059.877	3762295.411		SWHW30	44340.338	3762450.788	
SWCP16	43710.729	3762330.565		SWHW7	43799.002	3762446.899		SWHW31	43787.078	3762452.960	
SWCP17	44181.328	3762432.483		SWHW8	43754.552	3762582.280		SWHW32	43780.957	3762311.177	
SWCP18	44103.756	3762492.432		SWHW9	43674.011	3762584.978		SWHW33	43703.175	3762332.259	
SWCP19	43993.452	3762545.622		SWHW10	44076.742	3762487.711		SWHW34	43853.291	3762569.829	
SWCP20	43910.669	3762559.941		SWHW11	43830.115	3762532.916		SWHW35	44247.645	3762444.588	
SWCP21	43859.305	3762588.659		SWHW12	44260.745	3762597.782		SWHW36	44059.061	3762809.047	
SWCP22	44261.721	3762597.862		SWHW13	44139.368	3762680.002		SWHW37	44068.632	3762817.794	
SWCP23	44344.662	3762480.330		SWHW14	43968.288	3762730.653		SWHW38	44299.912	3762734.795	
SWCP24	44253.904	3762547.906		SWHW15	43996.301	3762764.892					



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DRAWN

HMV

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MF

CONSULTING ENGINEERS

LYNERS

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GEORGE
6530
Tel: 044 887 0223/Fax: 044 887 0741
email: george@lyniers.co.za

APPROVED

ENGINEER: _____

DATE: _____

2025-02-20

APPROVED

CLIENT: _____

DATE: _____

CLIENT

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PROJECT

OUMEULEN VILLAGE AND MEULENZICHT LANDGOED DEVELOPMENT (GEORGE)

TITLE

STORMWATER LAYOUT: MEULENZICHT SECTION 1

SCALE

1:750

on A0

SHEET

1 OF 1

CONTRACT No.

PROJECT No.

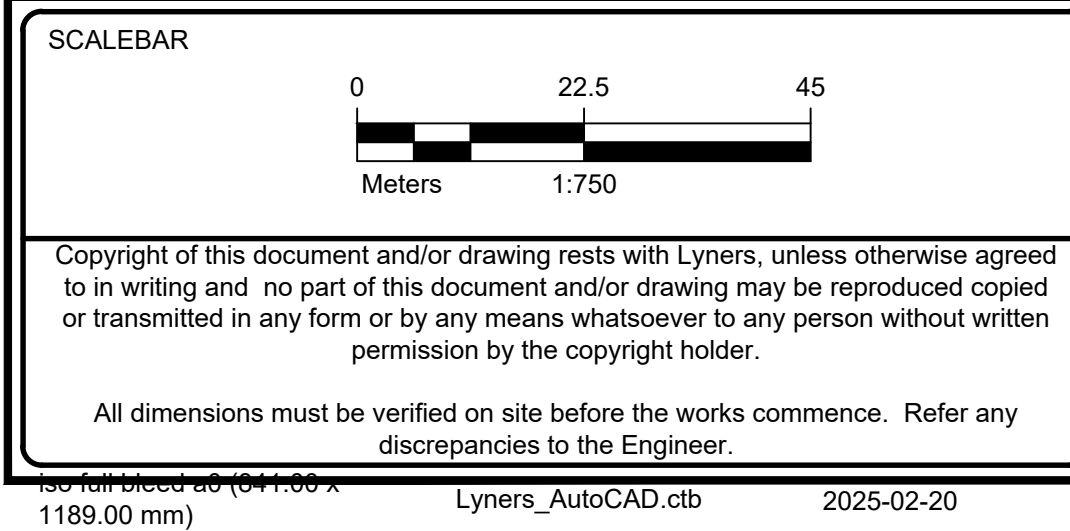
24051 CG

DRAWING No.

24051-C-005-02

COORDINATE SYSTEM:

WGS84 / Lo Z3°



REV	DESCRIPTION	DATE	REV'D	CHK'D
A	ISSUED FOR INFORMATION	2024-12-09	HMV	MF
REVISIONS				

DESIGNED	GW
DRAWN	HMV
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email: george@lyniers.co.za

APPROVED	ENGINEER: _____
DATE:	2025-02-20
APPROVED	CLIENT: _____
DATE:	_____

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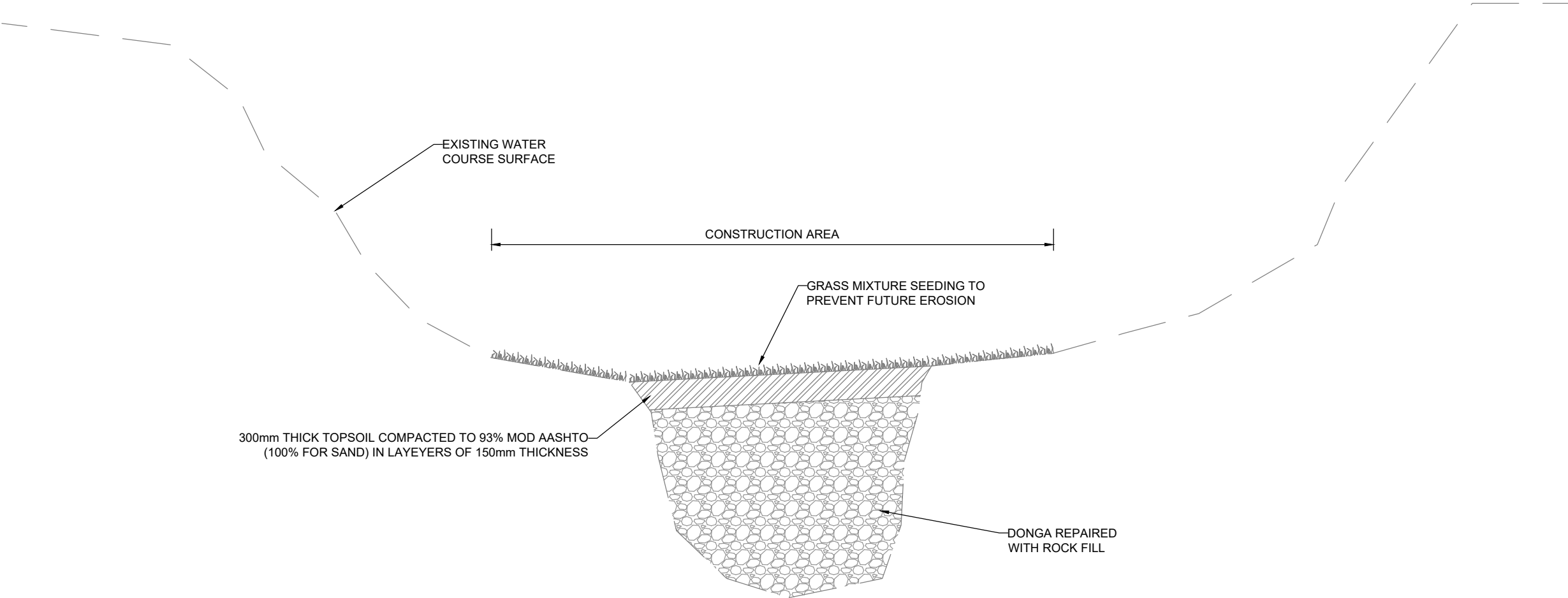
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PROJECT	OUMEULEN VILLAGE AND MEULENZICHT LANDGOED DEVELOPMENT (GEORGE)
TITLE	STORMWATER LAYOUT: MEULENZICHT SECTION 2

SCALE	on A0	SHEET
1:750		1 OF 1
CONTRACT No.		PROJECT No.
		24051 CG
DRAWING No.		REV
24051-C-005-03		A
COORDINATE SYSTEM: WGS84 / Lo 23°		

NOTES:

- 1. Contractor must verify location and extent of all the existing services prior to commencement of work.
- 2. Contractor to stay within the construction area.
- 3. Levels and position of existing donga erosion to be verified before construction, any discrepancies are to be liaised with the engineer immediately.



TYPICAL CROSS SECTION
FOR DONGA REPAIR

SCALE 1:50

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A	ISSUED FOR INFORMATION	'25-02-19	GW	FvE
REV	DESCRIPTION	DATE	REV BY	CHKD
REVISIONS				

DESIGNED	GW	25-02
DRAWN	GW	25-02
CHECKED	FvE	25-02

CONSULTING ENGINEERS



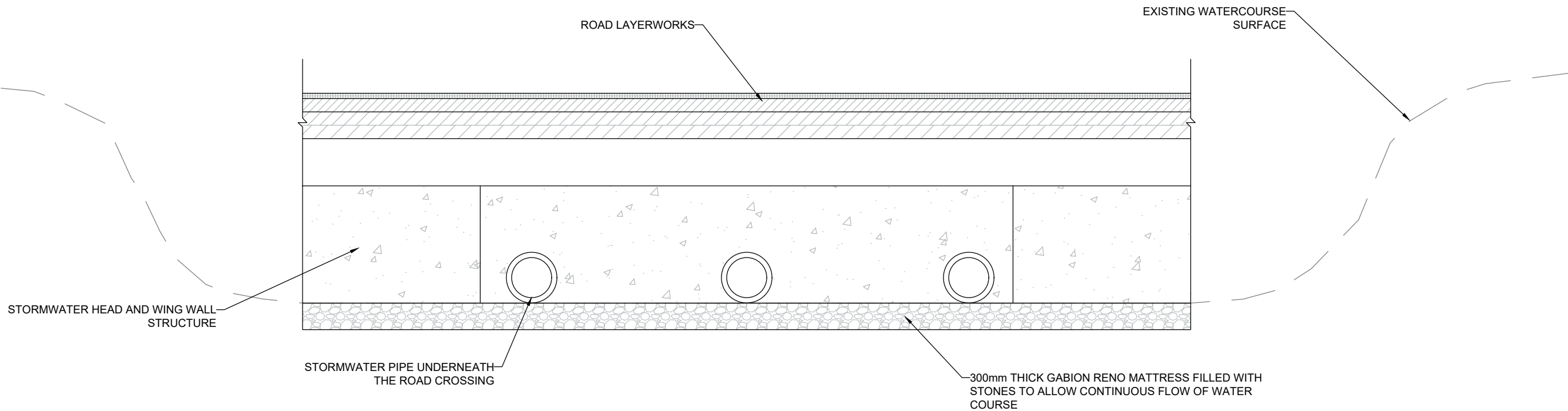
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PROJECT	OUMEULEN VILLAGE AND MEULENZICHT LANDGOED DEVELOPMENT (GEORGE)
TITLE	TYPICAL DETAIL OF DONGA EROSION REPAIR

SCALE	on A3	SHEET
1:50		1 OF 1
CONTRACT No.	PROJECT No.	
	24051CG	
DRAWING No.		REV
24051-C-005-102		
COORDINATE SYSTEM: WGS84 / Lo 23°		



**TYPICAL CROSS SECTION
FOR ROAD CROSSING OVER STREAM**

SCALE 1:50

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A	ISSUED FOR INFORMATION	'25-02-19	GW	FvE
REV	DESCRIPTION	DATE	REV BY	CHKD
REVISIONS				

DESIGNED	GW	25-02
DRAWN	GW	25-02
CHECKED	FvE	25-02

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PROJECT
OUMEULEN VILLAGE AND MEULENZICHT
LANDGOED DEVELOPMENT (GEORGE)

TITLE
TYPICAL DETAIL OF ROAD
STREAM CROSSING

SCALE on A3
1:50

SHEET
1 OF 1

CONTRACT No.

PROJECT No.
24051CG

DRAWING No.
24051-C-005-103

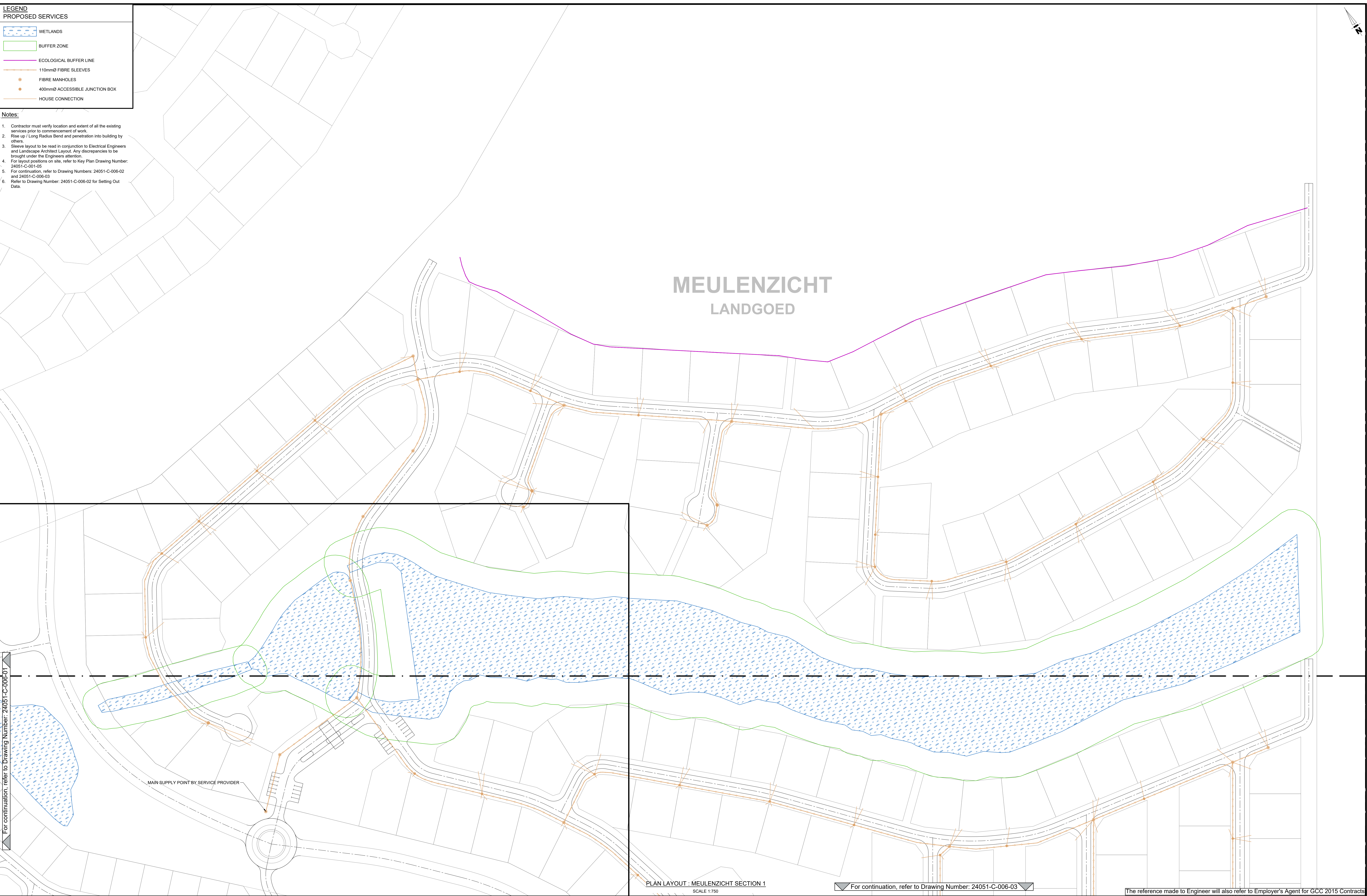
COORDINATE SYSTEM: WGS84 / Lo 23°

REV
A

LEGEND
PROPOSED SERVICES

- WETLANDS
- BUFFER ZONE
- ECOLOGICAL BUFFER LINE
- 110mmØ FIBRE SLEEVES
- FIBRE MANHOLES
- 400mmØ ACCESSIBLE JUNCTION BOX
- HOUSE CONNECTION

- Notes:
- Contractor must verify location and extent of all the existing services prior to commencement of work.
 - Rise up / Long Radius Bend and penetration into building by others.
 - Sleeve layout to be read in conjunction to Electrical Engineers and Landscape Architect Layout. Any discrepancies to be brought under the Engineers attention.
 - For layout positions on site, refer to Key Plan Drawing Number: 24051-C-001-05
 - For continuation, refer to Drawing Numbers: 24051-C-006-02 and 24051-C-006-03
 - Refer to Drawing Number: 24051-C-006-02 for Setting Out Data.



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A	ISSUED FOR INFORMATION	2024-12-09	HMV	MF

DESIGNED: GW

DRAWN: HMV

CHECKED: MF

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email: george@lyniers.co.za

APPROVED

ENGINEER: _____

DATE: 2024-12-09

APPROVED

CLIENT: _____

DATE: _____

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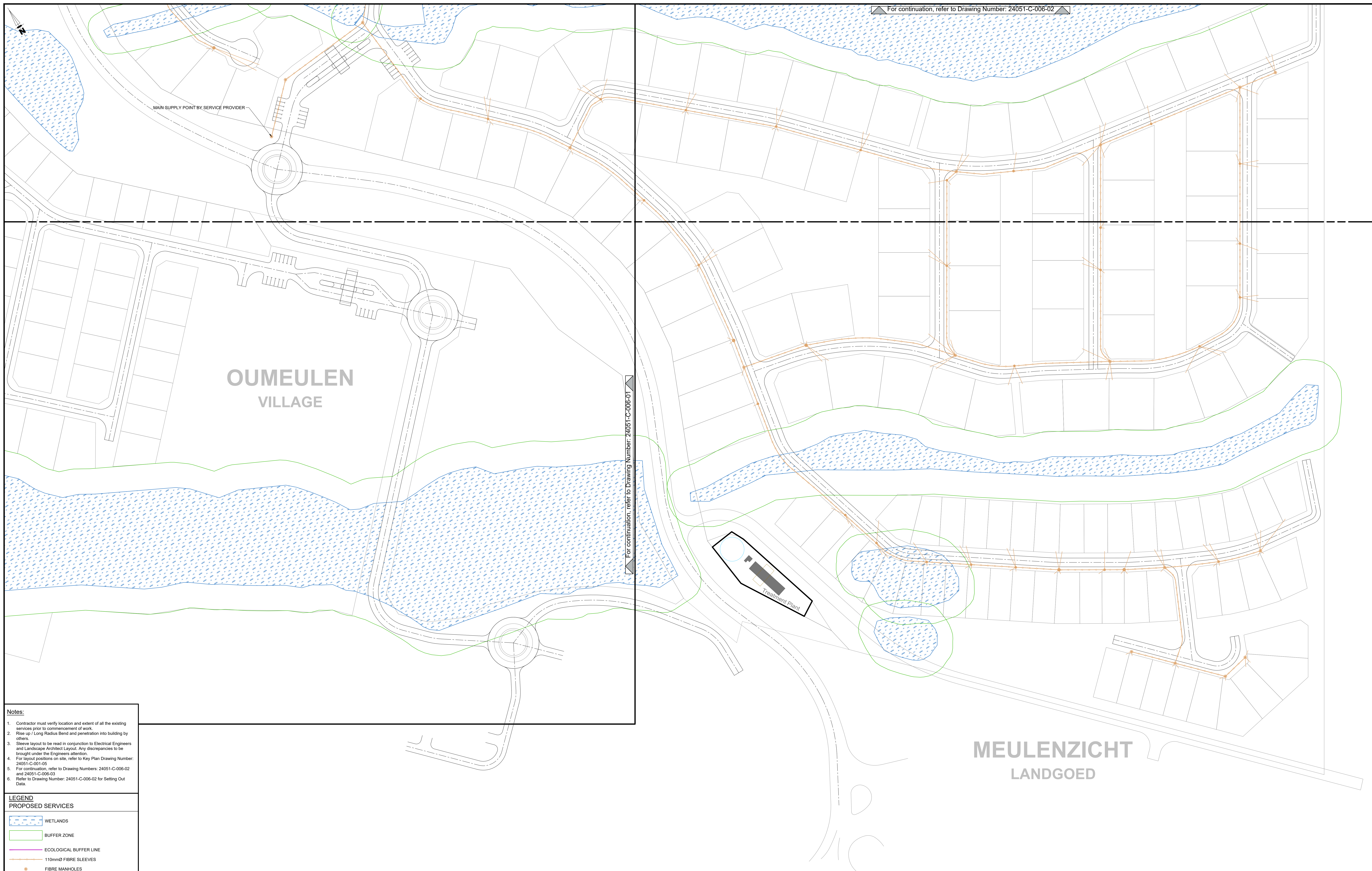
PROJECT

OUMEULEN VILLAGE AND MEULENZICHT LANDGOED DEVELOPMENT (GEORGE)

TITLE

FIBRE LAYOUT: MEULENZICHT SECTION 1

SCALE 1:750	on A0	SHEET 1 OF 1
CONTRACT No.	PROJECT No. 24051 CG	
DRAWING No. 24051-C-006-02		REV 
COORDINATE SYSTEM: WGS84 / Ls 23°		

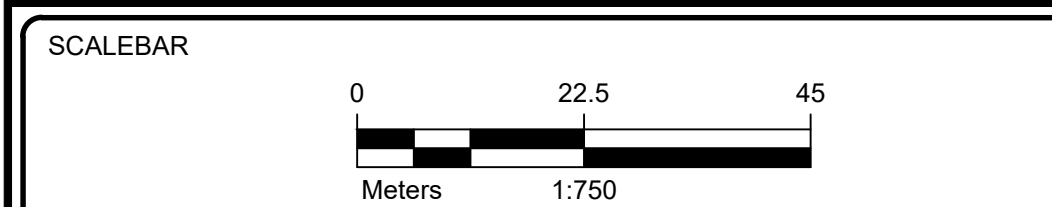


Notes

1. Contractor must verify location and extent of all the existing services prior to commencement of work.
2. Rise Up / Long Radius Bend and penetration into building by others.
3. Sleeve layout to be read in conjunction to Electrical Engineers and Landscape Architect Layout. Any discrepancies to be brought under the Engineers attention.
4. For layout positions on site, refer to Key Plan Drawing Number 24051-C-001-05.
5. For continuation, refer to Drawing Numbers: 24051-C-006-02 and 24051-C-006-03
6. Refer to Drawing Number: 24051-C-006-02 for Setting Out Data.

LEGEND
PROPOSED SERVICES

 WETLANDS
 BUFFER ZONE
 ECOLOGICAL BUFFER LINE
 110mmØ FIBRE SLEEVES
 FIBRE MANHOLES
 400mmØ ACCESSIBLE JUNCTION BOX
 HOUSE CONNECTION

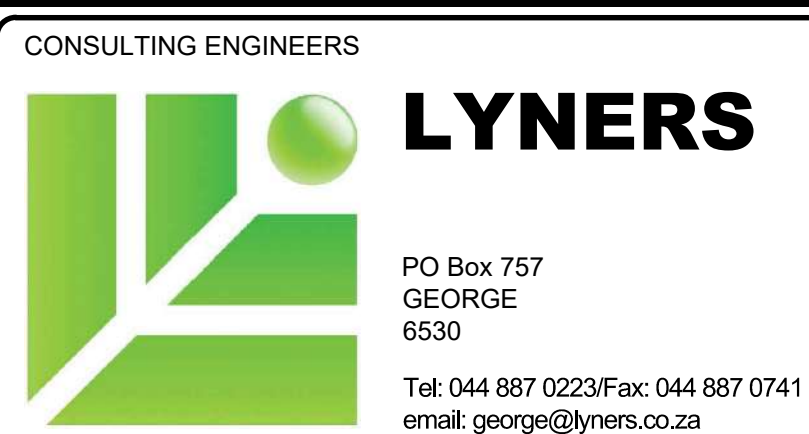


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A	ISSUED FOR INFORMATION	2024-12-09	HMV	M
REV	DESCRIPTION	DATE	REV BY	CH
REVISIONS				

DESIGNED	GW	
DRAWN	HMV	
CHECKED	MF	



<u>APPROVED</u>	
ENGINEER:	
DATE:	2024-12-09
<u>APPROVED</u>	
CLIENT:	
DATE:	

CLIENT



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PROJECT	OUMEULEN VILLAGE AND MEULENZICHT LANDGOED DEVELOPMENT (GEORGE)
TITLE	FIBRE LAYOUT: MEULENZICHT SECTION 2

SCALE 1:750	on A0	SHEET 1 OF 1
CONTRACT No.	PROJECT No. 24051 CG	
DRAWING No. 24051-C-006-03		REV
COORDINATE SYSTEM: WGS84 / Lo 23°		

The reference made to Engineer will also refer to Employer's Agent for GCC 2015 Contracts

PLAN LAYOUT : MEULENZICHT SECTION 2
SCALE 1:750



ANNEXURE E

George Municipality Capacity Letter and Correspondence (Water and Sewer)

Reference number: Kraaibosch Ridge and Aan de Meulen (Erf 25537, 25538, 25541 and Erf 195/400)
Date: 06 September 2024

Enquiries: M Geyer
Tel: 044 801 9268 (internal extension 1607)

Neil Lyners and Associates (Pty) Ltd
Fairview Office Park Building 8
1st Street
Bergsig
George
6530

Attention: Mr G Wallace / F van Eck

ERF 25537, 25538, 25541 AND ERF 195/400 (KRAAIBOSCH RIDGE AND AAN DE MEULEN): WATER AND SANITATION CAPACITY FOR PROPOSED DEVELOPMENT

The accommodation of the proposed development in the George Municipal water and sanitation system refers.

The Civil Engineering Services (CES) Directorate confirms that the proposed development was taken into account as part of the:

- Sawmill development area, and
- future water and sanitation master plans forming part of the George Municipal development area.

The water demand and sewer flow were recalculated based on the information provided.

Upon conclusion of the above, the appointed master planning consultant, GLS, provided the required technical detail on a concept level to confirm the water and sanitation system upgrades required and associated estimated costs to support the proposed development.

It should be noted that the technical detail provided by GLS does not absolve the developer from appointing a civil engineering consulting firm to prepare the designs required for the various services required to support the development.

1. PROPOSED DEVELOPMENT FOOTPRINT

The proposed implementation plan of the development is included as part of the technical report/assessment, and forms part of the Kraaibosch master plan.

The erven are located along the N2 in the Kraaibosch development node. Refer to figure 1 below.



Figure 1: Proposed implementation plan (Aan de Meulen and Kraaibosch Ridge)

2. WATER AND SANITATION BULK INFRASTRUCTURE CAPACITY: EXISTING INFRASTRUCTURE

2.1. TREATMENT CAPACITY

a) Water Treatment

- The Water Treatment Works (old and new) is currently operating under constraint.
- A 20MI/day capacity upgrade of the new treatment works is in progress with an estimated completion date of February 2025.
- The treatment works will have sufficient capacity for the development in its entirety once the 20MI/day capacity upgrade is commissioned.

b) Wastewater Treatment

- The Outeniqua Wastewater Treatment works currently has sufficient capacity to support the development.

2.2. BULK PIPELINES AND PUMP STATIONS

a) Water

The development falls within the George Main Zone and Kraaibosch reservoir zone.

- George Main zone: The reservoirs and bulk pipelines currently have sufficient capacity to service the development.
- Kraaibosch reservoir zone: The zone has sufficient capacity with the current theoretical demand, but insufficient capacity in the theoretical fully occupied demand, and cannot support the full development, i.e. the implementation of the next reservoir (4ML) is required to service the full development.

b) Sanitation

The development falls within the Outeniqua WWTW drainage area.

- The development falls within the future Kraaibosch 3 pump station drainage area. The infrastructure, refer to figure 2 below, required to convey sewage of the proposed development has not been implemented.
- Bulk conveyance infrastructure (pipelines and pump stations) will require implementation by the developer to connect to the Municipal sewer network.

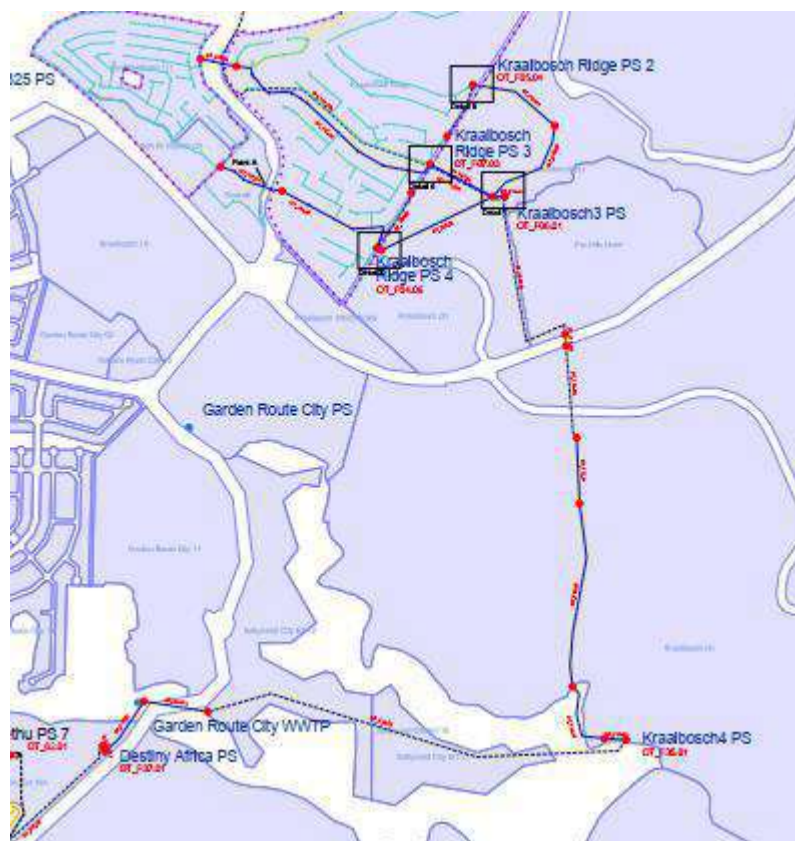


Figure 2: Kraaibosch 3 PS via Destiny Africa PS drainage area proposed infrastructure upgrades

3. PROPOSALS FOR CONNECTION

3.1. WATER INFRASTRUCTURE

General

All infrastructure beyond the extent of the current infrastructure (bulk and link services) as well as the reticulation internal to the development is considered development specific and is for the full cost of the developer (design and implementation and associated environmental cost etc.).

All such required link and internal water infrastructure will require the necessary maintenance and operation by the developer or subsequent HOA/POA and utility company, except where agreed/stated otherwise.

Bulk services over and above the requirements of the development:

The alignment of these services will have to be coordinated and agreed to between the various surrounding developers (Sasol Garage etc.) and the George Municipality.

The services agreement should include these costs and services for payment by other Developers once they make use of the service provided by this proposed development and, for the offsetting of development charges as applicable.

Alternatively, the Developer will have to wait until the construction of the reservoir can be implemented by the George Municipality which is subject to funding approval and prioritization by Council.

Existing infrastructure

The Municipal water network / system extend to the existing Kraaibosch reservoir and tower, located on the Aan de Meulen development footprint. Refer to figure 3 below.



Figure 3: Existing water infrastructure in Kraaibosch development node

Proposals

The technical report by GLS includes 2 proposals for connection to the water network / system, which includes the master plan system (intended system – proposal 1) and an interim solution. The interim solution (refer to section 3.4.3 and 3.5.3 of the report) is not accepted by the Municipality as a solution for this development and will not be considered further.

Proposal 1 – master plan system:

To service the Kraaibosch development node, the master plan includes the construction of a future 4ML reservoir and tower. The current tower has sufficient capacity to service the development, however the future 4ML reservoir will require construction to service the development.

This proposal is included as part of the total cost discussed in section 5.

Explanation of principle of setting off cost against development charges: The cost for the construction of the reservoir only over and above the developer's pro-rata contribution can be off set against the development charges payable for water services, resulting in a balance of R1 533 419.00 excluding VAT payable by the developer, subject to any other off set that may also be applicable. Refer to table 1 below.

Table 1: Off-set of development charges example

Estimated total cost of reservoir only (item KBR_B01.03)	R17 550 000.00
Pro-rata contribution for reservoir (item KBR_B01.03)	R738 855.00
Balance	R16 811 145.00
Development charges: Water services	R18 344 564.00
Balance (payable by the developer)	R1 533 419.00

Note:

- Estimated and subject to annual escalation
- The full estimated cost of the reservoir only is considered in the above table and does not include/consider other infrastructure that require full implementation by the developer that is over and above the requirements of the development.

3.2. SANITATION INFRASTRUCTURE

General

All infrastructure beyond the extent of the current infrastructure (bulk and link services) as well as the reticulation internal to the development is considered development specific and is for the full cost of the developer (design and implementation and associated environmental cost etc.).

All such required link and internal sewer infrastructure will require the necessary maintenance and operation by the developer or subsequent HOA/POA and utility company.

Bulk services over and above the requirements of the development:

The alignment of these services will have to be coordinated and agreed to between the various surrounding developers (Garden Route City, Far Hills Country Hotel and Sasol Garage etc.) and the George Municipality for the connection of developed areas outside the urban edge.

The services agreement should include these costs and services for payment by other Developers once they make use of the service provided by this proposed development and, for the offsetting of development charges as applicable.

Alternatively:

- the Developer will have to wait until the construction of the bulk services to be implemented by the George Municipality which is subject to funding approval and prioritization by Council, or
- Implement alternative bulk solutions as described below to service the development until such time that the bulk services become available.

The services agreement should include these costs and services for payment by other Developers once they make use of the service provided for by this proposed development.

Existing infrastructure

The municipal sewer system only extends to the Kraaibosch pump station located Northwest of the proposed development.



Figure 4: Extent of Municipal Sewer Network / System

Proposals

The technical report by GLS includes 3 proposals for connection to the sewer network / system, which includes the master plan system (intended system – proposal 1) and 2 interim solutions. The interim solutions (refer to section 4.3.2, 4.3.4, 4.4.1 of the report) are not accepted by the Municipality as solutions for this development and will not be considered further.

Proposal 1:

The proposal includes the implementation of the master plan solution, and that all sewage from or generated by the proposed development be conveyed via the below system indicated in figure 5.

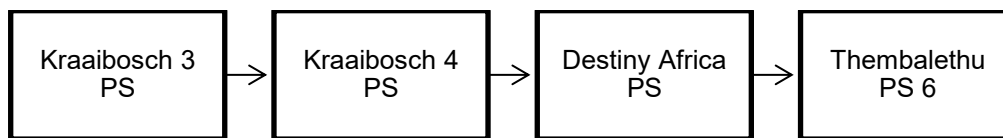


Figure 5: Proposed sewage conveyance system

The Kraaibosch 3 pump station and associated pipeline is development specific and are required irrespective of the proposal to be implemented.

The Kraaibosch 4 PS and associated pipelines is not a dedicated development specific infrastructure component as other developments and existing areas will be connecting to this pump station in future (date unknown). The implementation of this pump station and its pipelines are however required to drain to the Municipal network. A phased implementation approach can be considered to suit the needs of the development only, but is subject to design, review and approval by the George Municipality. The Developer will therefore be required to implement the portion required to service the development.

The Destiny Africa pump station and rising main is within the early planning stages and environmental authorization is required to implement the pump station and associated pipelines. Although the Municipality is planning to obtain approval for the ultimate pump station capacity, the Municipality will only implement the extent required. The Developer will therefore be required to implement the portion required to service the development.

The upgrade to Thembaletu pump station 6 and its associated rising main is underway and will be completed within the next 36 months.

Only once the infrastructure listed above have been implemented, will the Developer be in a position to connect to the municipal sewer system through this proposal.

Proposal 2 – alternative (not applicable to entire development):

The developer will be permitted to construct a conservancy tank, where practically possible to service parts of the development, in lieu of a connection to the Municipal network, and a discharge permit shall be issued permitting discharge of sewage at the Outeniqua WWTW.

Due to the extent of the development the proposal is not practical but could be considered for very limited parts of the development, subject to the approval of the Municipality and the Developers capacity to service the conservancy tanks.

Proposal 3 - alternative:

Alternatively, design, implement, operate and maintain an on-site wastewater treatment package plant.

The Developer should however note the requirements in terms of the National Water Act and registration as a Water Services Intermediary with the Municipality for compliance monitoring.

The Developer should note that this proposal includes the added advantage of treated effluent that could potentially be used for non-potable use that will reduce the potable water demand.

4. CONCLUSION

In conclusion:

- The existing water infrastructure cannot accommodate the full proposed development without the implementation of the new Kraaibosch 4ML reservoir and associated pipelines and until the WTW has sufficient capacity, and
- The existing sewer infrastructure cannot accommodate the proposed development until such time that the bulk sewerage system as described above have been implemented. The developer is therefore permitted to consider the implementation of alternative solutions in order to develop.
- The Municipality has no short- or medium-term intention, plan or budget to implement any of the bulk water or sewer infrastructure specific to this development's requirements.

5. COST

The estimated pro-rata (excluding VAT) cost for water and sanitation infrastructure upgrades in support of the development amounts to:

Table 2: Associated estimated cost of water and sewer services

Description	Bulk System	Reticulation System	Total
<u>Pro-rata cost only (3.4.1, 3.4.2 and 3.5.2):</u>			
Water (pro-rata items)	R3 202 283.00	R417 517.00	R3 619 800.00
<u>Associated pro-rata and full cost (3.4.1, 3.4.2 and 3.5.2):</u>			
Water (pro-rata items)	R1 915 359.00	-	R1 915 359.00
Water (full cost items)	R25 376 000.00	R2 172 000.00	R27 548 000.00
Total estimated water cost			R29 463 359.00 ¹
<u>Associated pro-rata cost only (4.3.1, 4.3.3 and 4.4.2):</u>			
Sewer (pro-rata items)	R8 883 145.00	R3 964 000.00	R12 847 145.00
<u>Associated pro-rata and full cost (3.4.1, 3.4.2 and 3.5.2):</u>			
Sewer (pro-rata items)	R780 850.00	-	R780 850.00
Sewer (full cost items)	R79 159 000.00	R3 964 000.00	R83 123 000.00
Total estimated sewer cost			R83 903 850.00 ¹

The full cost and pro-rata cost indicated by GLS and captured in this letter is an estimated cost only, is not based on a detailed design and subject to change and is furthermore subject to change based on actual construction cost.

Development specific items are for the cost of the developer and cannot be off set against the development contributions, however the full infrastructure required to support the development must be installed.

Notes:

¹ The full cost of water and sewer infrastructure is applicable and those associated general upgrades. In order to connect to the Municipal sewer and/or water network / system the developer will have to design and construct the infrastructure. A cost apportionment model will have to be developed in order to reimburse the developer for cost incurred that was incurred over and above the required contribution. Should the developer spend less than the amount assigned to the developer, such shortfall shall be paid to the Municipality, or should the developer spend in excess of the required contribution, such excess amount shall be reimbursed

from the contributions of other developers and paid to the developer as and when such contributions are received by the Municipality. Such arrangements shall be covered in the service agreement.

6. DEVELOPMENT CHARGES

The current total Development Charges (DC's) relating to Civil Engineering Services (water services only), and in accordance with the current guidelines, for the proposed development were calculated on 14 August 2024 based on the site development plan and amount to R21 096 248.60 ² including VAT.

²Exclusions:

- a. Sewer development charges:
 - No charge is levied at this stage as the development is unable connect to the Municipal sewer network, the charges will however become payable once the development can connect to the sewer system. The development charges calculated for sewer services on 14 August 2024 based on the site development plan amount to R12 770 699.40 including VAT.
 - Should the Developer elect to implement Proposal 3 to service the Development, the payment of sewer DC's may be excluded.
- b. Road infrastructure: Development charges for roads are not determined as this will be determined in terms of the *Road based Development Contributions for the Welgelegen Area*.

The Developer is reminded of the following Clause relating to the calculation of development charges:

"Any amendments or additions to the proposed development which is not contained within the calculation sheet as stated in clause 2 above which might lead to an increase in the proportional contribution to municipal public expenditure, will result in the recalculation of the development charges and the amendment of these conditions of approval or the imposition of other relevant conditions of approval."

The DCs included in this letter is an indication of the charges due and are not confirmed as the final amount payable.

In addition, the DCs amount is subject to amendment based on annual escalation and applicable at the time that development contributions are due for payment. The Council has an approved Development Contributions Policy and guidelines for the calculation of DC's.

7. BULK INFRASTRUCTURE IMPLEMENTATION

The developer will be required to perform the necessary project management services from commencement to close out for implementation of the bulk infrastructure, excluding water and wastewater treatment works upgrades.

The deliverables per stage shall be submitted to the Civil Engineering Services Directorate (CES) for review and approval in line with Municipal standards and the CES Directorate shall be invited to attend all construction progress meetings.

8. COMMENCEMENT OF DEVELOPMENT

This letter confirms the status of capacity of infrastructure at the time of writing this letter. Capacity is not reserved for any development.

The development, in its entirety or in phases, is subject to confirmation by the Director: Civil Engineering Services regarding the availability of water supply & treatment capacity and sanitation bulk conveyance & treatment capacity at the time of the development implementation, or if developed in phases before the commencement of each phase.

A development/implementation program is to be provided by the Developer when requesting confirmation of the capacity from the Director: Civil Engineering Services. If the Developer does not adhere to the program provided and approved by the Director: Civil Engineering Services, the Director: Civil Engineering Services will be entitled to revise the availability of such bulk capacity.

No development may connect to the municipal water and sewer system unless the required bulk and link infrastructure is available, and a services agreement/memorandum of agreement (if applicable) is signed between the Developer and the Municipality.

Yours faithfully,



JANNIE KOEGELENBERG
DIRECTOR: CIVIL ENGINEERING SERVICES

ANNEXURES:

- A Technical report and SDP
- B Water and sewer masterplan items figures

ANNEXURE A

06 September 2024

Director: Civil and Technical Services
George Municipality
PO Box 19
GEORGE
6530

ATTENTION: Ms Lindsay Mooiman

Ma'am,

**WATER AND SEWER MASTER PLANS: DEVELOPMENT OF PROPOSED TOWNSHIP/REZONING –
GEORGE ERVEN 25537, 25538, 25541 AND PORTION 400 OF THE FARM KRAAIBOSCH 195 (AAN DE MEULEN
& KRAAIBOSCH RIDGE)**

The request from Neil Lyners and Associated dated 26 April 2024 with regards to accommodating the proposed development in the George water system has reference.

This report is a technical report stating upgrades required in the water and sewer networks in the vicinity of the proposed development. The George Municipal engineering professional (yourself) will make a final decision on works to be implemented by the proposed development.

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Directors: RL Pole, AG Hingeston, AN Umichand

1 INTRODUCTION

1.1 Brief

This report is a technical report stating upgrades required in the water and/or sewer networks in the vicinity of the proposed development. The George Municipal engineering professional (yourself) will make a final decision on works to be implemented by the proposed development.

The latest master plans used in this analysis were the m2024-03 master plans.

1.2 Disclaimer

The investigation has been performed and this report has been compiled based on the information made available to GLS. All efforts, within budget constraints, have been made during the gathering of information to ensure the highest degree of data integrity. The information supplied to GLS by George Municipality and other Consultants at the outset of this assessment is assumed to be the most accurate representation of the existing system up to date hereof.

GLS hereby confirms that any contributions of the developer to the required construction of infrastructure and/or the upgrading of existing infrastructure, whether it be in the form of a capital contribution or in the form of constructing sections of new infrastructure, is a matter to be discussed and agreed upon between the developer and the George Municipality.

All costs shown in this report are year 2023/24 Rand value **estimates** and **include** 50% surcharge for P&Gs, contingencies and fees but **exclude** VAT.

1.3 Version control

<i>Issue Date</i>	<i>Type</i>	<i>Version</i>	<i>Remarks</i>
2024/07/08	Draft	1	Issued for comments and approval
2024/07/10	Revision	2	Added summaries for interim/alternative options
2024/08/05	Revision	3	Added phases for the development, removed internal schematic items.
2024/09/06	Revision	4	Updated summary of sewer costing

2 WATER DEMAND & SEWER FLOWS

2.1 Impact of the proposed development

The proposed development was taken into consideration in the master plan as part of the Sawmill development area.

The water demand and sewer return flow contribution of the proposed development is outlined in the table below:

Land Use	Unit of measure (No/100m2/ha...)	No. Units (No/100m2/ha...)	UWD/unit (kL/unit/d)	Sewer ratio (% x UWD)	AADD Inc. UAW (kL/d)	PDDWF Excl. Infil. (kL/d)
Phase 1		Estimated Start Date:		Estimated Occupation Date:		
Residential (George & Wilderness) - Medium density, medium sized Residential stands	unit	259	0.625	54%	210.44	113.64
Sub-Total		259			210.4	113.6
Phase 2		Estimated Start Date:		Estimated Occupation Date:		
Residential (George & Wilderness) - High density, small sized Residential stands	unit	207	0.625	63%	129.38	81.51
Flats (George & Wilderness) - Medium density Flat units up to 50 m ² (Footprint=0.6 and Storeys=1)	unit	220	0.625	80%	68.75	55.00
Sub-Total		427			198.1	136.5
Total		686			408.6	250.1

2.2 Revised Water Demand

The combined AADD for the proposed development as originally calculated and used in the analysis of the water distribution network in the master plan was 545.9 kL/d (theoretical demand).

The revised AADD, peak flow and fire flow calculated for the proposed development and used in this re-analysis of the water distribution network is 408.6 kL/d.

- Annual average daily demand of George Main zone = 198.1 kL/d
- Peak flow using a zone peak hour factor of 3.00[‡] = 5.70 L/s
- Annual average daily demand for Kraaibosch Tower zone = 210.5 kL/d
- Peak flow using a zone peak hour factor of 4.60[‡] = 11.20 L/s
- Fire flow (Low rise flats <= 3 storeys) using a peak hour factor of 2.0 = 20 L/s @ 10 m
- Fire flow (Residential) using a peak hour factor of 2.0 = 15 L/s @ 10 m

2.3 Revised Sewer Flow

The combined peak day dry weather flow (PDDWF) for the proposed development as originally calculated and used in the analysis of the sewer system in the master plan was 422.4 kL/d (theoretical flow).

The revised PDDWF (excluding infiltration) calculated for the proposed development and used in the re-analysis of the sewer system is 250.1 kL/d. The design flow, or instantaneous peak wet weather flow (IPWWF), is 6.6 L/s.

[‡] Higher peak flow factors might be applicable for internal networks.

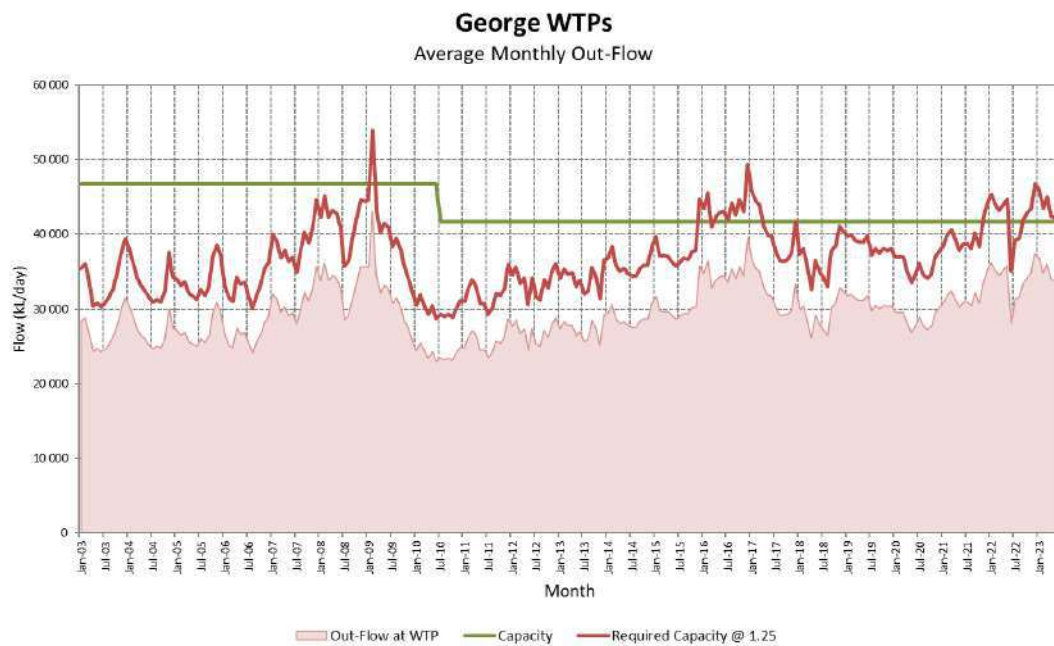
3 WATER DISTRIBUTION NETWORK

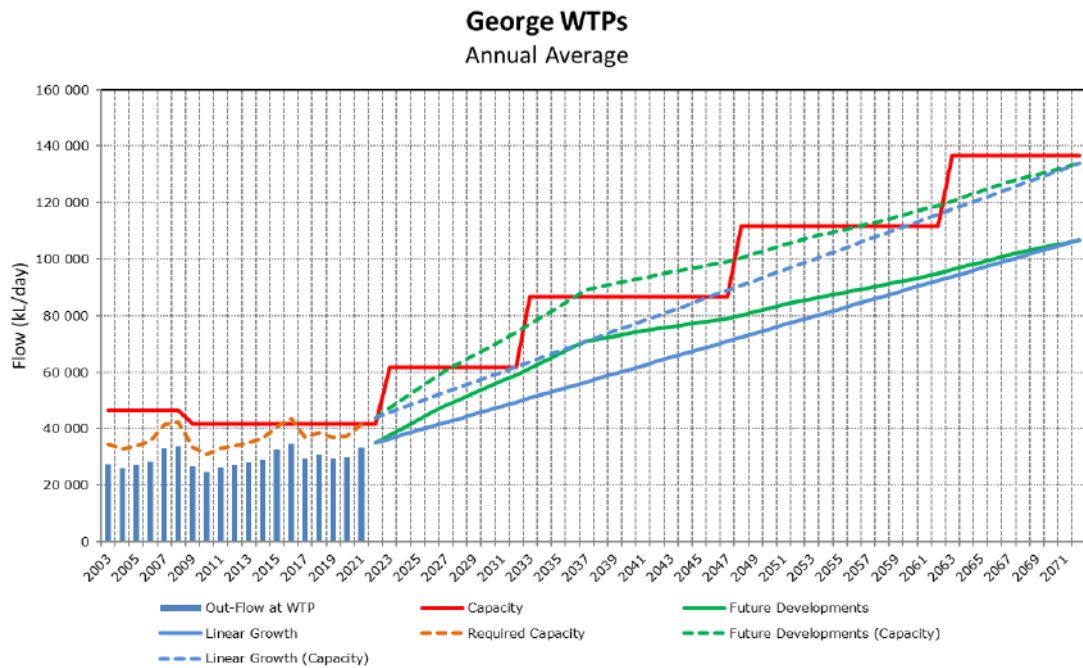
3.1 Water Resources

Water Treatment Plant capacity

The master plan indicates that the proposed development falls in the George Main zone and supplied from the Old and New George WTPs.

The two graph overleaf shows that the design capacity of the Old and New George WTPs (green line) has been exceeded by the average monthly required capacity (dark red line) a few times in the last decade. The WTPs are thus operating at risk and needs to be extended.





Based on available information the capacity, present flow and projected short-term flow are as follows:

George WTPs	Capacity	Comment
Existing Capacity	41 700 kL/d	Design capacity 46 200 kL/d
Measured Flow (incl. 1.25 factor)		
Annual Average (2003-2023)	43 537 kL/d	Maximum 2016/17
	-1 837 kL/d	No spare capacity available
Monthly Average (2003-2023)	56 022 kL/d	February 2009
	-14 322 kL/d	No spare capacity available
Monthly Average (2022/23)	48 599 kL/d	December 2022
	-6 899 kL/d	No spare capacity available
Modelled Flow (incl. 20% water loss and 1.25 factor)		
T_AADD (existing)	43 955 kL/d	m2024-03 MP
	-2 255 kL/d	No spare capacity available
3yr Projection	50 601 kL/d	
	-8 901 kL/d	No spare capacity available
5yr Projection	60 570 kL/d	
	-18 870 kL/d	No spare capacity available

Note: T_AADD: Theoretical Annual Average Daily Demand
The flow projections include all stands that are presently vacant but expected to be occupied over the next 5 years as well as all future areas likely to develop within the next 5 years

3.2 Distribution Zone

The master plan indicates that the proposed development falls partly in the George Main and Kraaibosch Tower zones as shown in **Figure 1 (Water)** attached.

An interim option was investigated to accommodate the Kraaibosch Ridge component of the development in the George Main zone until construction of the additional Kraaibosch reservoir.

3.3 Categorisation of required upgrades

The items are categorised as follows:

- General system specific MP Items – required to address capacity issues and backlogs in the bulk and reticulation systems serving the proposed development, but not specifically required for the development per se.
- Development specific MP Items – new additions to (or deviations from) the existing Master Plan, required specifically for the proposed development, as a result of more accurate information relative to the original estimate of future development.

It is important to note that all proposed items are schematic in nature, final size and location is subject to a complete design by a suitably qualified engineer. The final locality in particular is subject to legislative requirements including but not limited to pipes not crossing private stands, no servitudes registered in private stands and no pipes in stands with an area less than 400m².

3.4 Bulk Water Supply

Reservoir storage capacity

One of the main considerations in bulk water supply is reservoir storage capacity and in the assessment of storage capacity, two demand scenarios are considered.

The first (Theoretical Current Demand) scenario represents the demand in the system as it is currently experienced, i.e. it only includes the demand for stands that are developed (vacant stands are ignored), and only due to land use rights currently being exercised. An allowance for 20% water losses is also included in the scenario.

The second (Theoretical Fully Occupied Demand) scenario is the planning scenario and represents the demand of all the existing stands, irrespective of whether they are developed or vacant. Most importantly, the demand is based on the zoning of each stand i.e. the maximum demand allowed for under existing land use rights (known as zoning rights). Ideally the existing system should have sufficient capacity for this scenario which represents all existing development rights. An allowance for 20% water losses is also included in this scenario.

The difference between the two demand scenarios becomes relevant when there is “perceived” spare storage capacity in the Theoretical Current Demand scenario and no storage capacity in the Theoretical Fully Occupied Demand scenario. This means that the storage capacity allotted to all existing stands (in the Theoretical Fully Occupied Demand scenario) is currently not utilised in the Theoretical Current Demand scenario, it is however still committed to the water demands derived from the zoning rights.

Reservoir capacity assessment (Theoretical Current Demand)

The current George Main zone AADD plus 20% UAW (Theoretical Current Demand) in the m2024-03 water model is 28 705 kL/d. The capacity of the existing Reservoirs @ Old WTP is 36 120 kL. The FCV is set at 565 L/s. Using these three input variables in a reservoir sizing analysis, it shows that the remaining spare capacity is 8 890 kL.

Type in values in shaded cells

Full zone 28 705 kL/d
 Direct zone 19 811 kL/d
 AADD **28 705** kL/d
 PDF **1.70** * AADD
 PWF **1.40** * AADD
 P3DF 1.51 * AADD

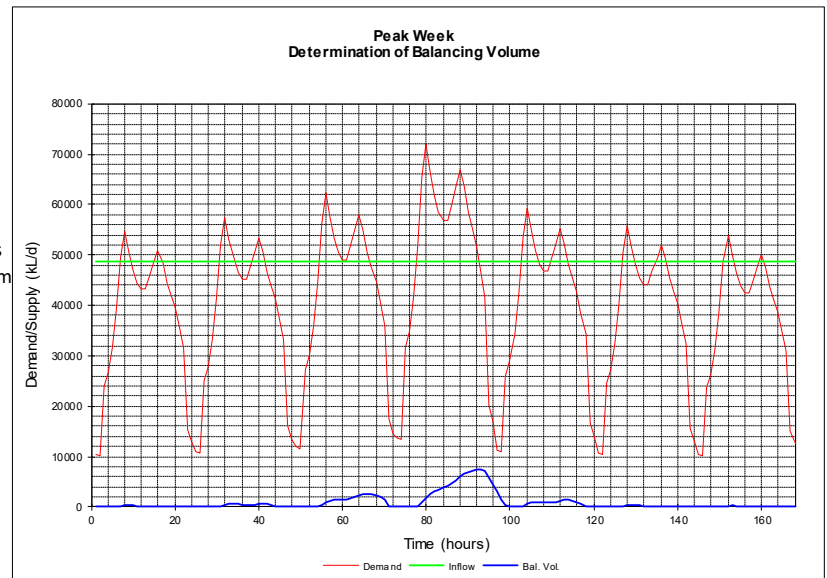
Supply **1.70** * AADD
 = 48 798 kL/d
 = 565 L/s

Pipe @ 1.8m/s
 632 mm

Bal. Vol. 7 419 kL/d
 = 6.2 h * AADD

			%
Pattern 1	Large zone	Large	69.0%
Pattern 2	Small zone	Medium	0.0%
Pattern 3	LC Housing	Small	0.0%
Pattern 4			0.0%
Pattern 5			0.0%
Pattern 6			0.0%
Pattern 7	Even	To a res.	31.0%
Must add up to 100 --> check			100.0%

Res @ Old WTP Site



VOLUME ANALYSIS (applies only to area directly supplied, i.e. not to the Pattern 7 supply)

Capacity	36 120 kL	=	43.8 h x AADD
Required balancing	7 419 kL	=	9.0 h x AADD
Available volume	28 701 kL	=	34.8 h x AADD
Required emergency	19 811 kL	=	24.00 h x AADD
Spare capacity	8 890 kL	=	10.8 h x AADD

Reservoir capacity assessment (Theoretical Current Demand)

The current Kraaibosch Reservoir zone AADD plus 20% UAW (Theoretical Current Demand) in the m2024-03 water model is 284 kL/d. The capacity of the existing Kraaibosch Reservoir is 1 000 kL. The FCV is set at 8 L/s. Using these three input variables in a reservoir sizing analysis, it shows that the remaining spare capacity is 569 kL.

Type in values in shaded cells

Full zone 284 kL/d
 Direct zone 284 kL/d
 AADD **284** kL/d
 PDF **2.30** * AADD
 PWF **1.80** * AADD
 P3DF 1.99 * AADD

Supply **2.30** * AADD
 = 654 kL/d
 = 8 l/s

Pipe @ 1.8m/s
 73 mm

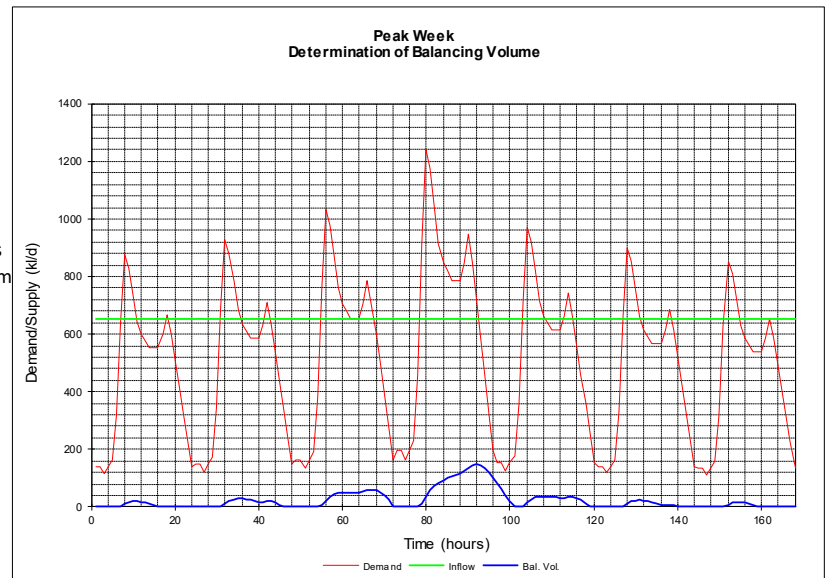
Bal. Vol. 147 kl
 = 12.4 h * AADD

%

Pattern	Zone	Category	%
Pattern 1	Large zone	Large	0.0%
Pattern 2	Small zone	Medium	100.0%
Pattern 3	LC Housing	Small	0.0%
Pattern 4			0.0%
Pattern 5			0.0%
Pattern 6			0.0%
Pattern 7	Even	To a res.	0.0%

Must add up to 100 --> check **100.0%**

Kraaibosch Res



VOLUME ANALYSIS (applies only to area directly supplied, i.e. not to the Pattern 7 supply)

Capacity	1 000 kl	=	84.5 h x AADD
Required balancing	147 kl	=	12.4 h x AADD
Available volume	853 kl	=	72.0 h x AADD
Required emergency	284 kl	=	24.00 h x AADD
Spare capacity	569 kl	=	48.0 h x AADD

Reservoir capacity assessment (Theoretical Fully Occupied Demand)

The current George Main zone AADD plus 20% UAW (Theoretical Fully Occupied Demand) in the m2024-03 water model is 34 671 kL/d. The capacity of the existing Reservoirs @ Old WPT is 36 120 kL. The FCV is set at 682 L/s. Using these three input variables in a reservoir sizing analysis, it shows that the remaining spare capacity of 4 401 kL is sufficient to cater for the proposed development.

Type in values in shaded cells

Full zone 34 671 kL/d
 Direct zone 22 831 kL/d
 AADD **34 671** kL/d
 PDF **1.70** * AADD
 PWF **1.30** * AADD
 P3DF 1.42 * AADD

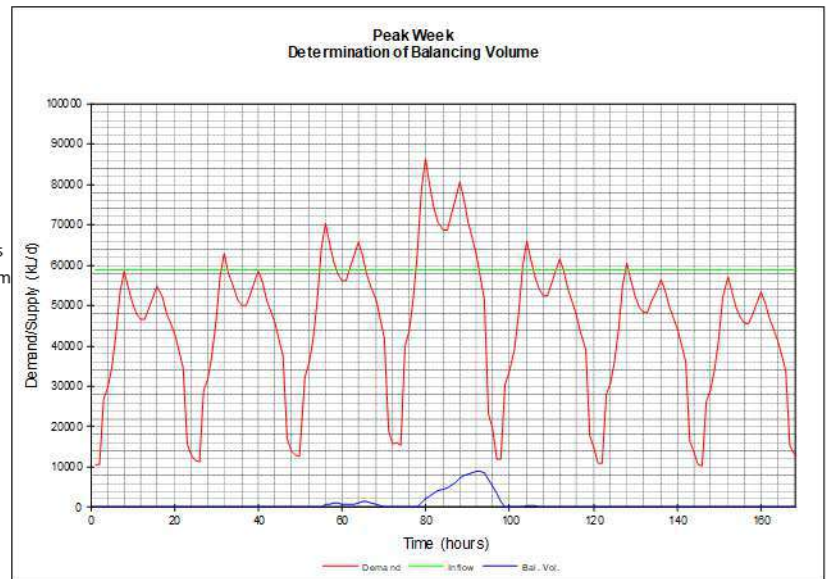
Supply **1.70** * AADD
 = 58 940 kL/d
 = 682 L/s

Pipe @ 1.8m/s
 695 mm

Bal.Vol. 8 888 kL/d
 = 6.2 h * AADD

			%
Pattern 1	Large zone	Large	65.9%
Pattern 2	Small zone	Medium	0.0%
Pattern 3	LC Housing	Small	0.0%
Pattern 4			0.0%
Pattern 5			0.0%
Pattern 6			0.0%
Pattern 7	Even	To a res.	34.1%
Must add up to 100 --> check			100.0%

Res @ Old WTP Site



VOLUME ANALYSIS (applies only to area directly supplied, i.e. not to the Pattern 7 supply)

Capacity	36 120 kL	=	38.0 h x AADD
Required balancing	8 888 kL	=	9.3 h x AADD
Available volume	27 232 kL	=	28.6 h x AADD
Required emergency	22 831 kL	=	24.00 h x AADD
Spare capacity	4 401 kL	=	4.6 h x AADD

Reservoir capacity assessment (Theoretical Fully Occupied Demand)

The current Kraaibosch Reservoir zone AADD plus 20% UAW (Theoretical Fully Occupied Demand) in the m2024-03 water model is 34 671 kL/d. The capacity of the existing Kraaibosch Reservoir is 1 000 kL. The FCV is set at 15 L/s. Using these three input variables in a reservoir sizing analysis, it shows that the remaining spare capacity of 119 kL is insufficient to cater for the proposed development.

DETERMINATION OF RESERVOIR BALANCING VOLUME and/or REQUIRED SUPPLY RATE

Type in values in shaded cells

Full zone 581 kl/d
 Direct zone 581 kl/d
 AADD **581** kl/d
 PDF **2.30** * AADD
 PWF **1.80** * AADD
 P3DF 1.99 * AADD

Supply **2.30** * AADD

= 1 335 kl/d

= 15 l/s

Pipe @ 1.8m/s
 105 mm

Bal.Vol. 300 kl

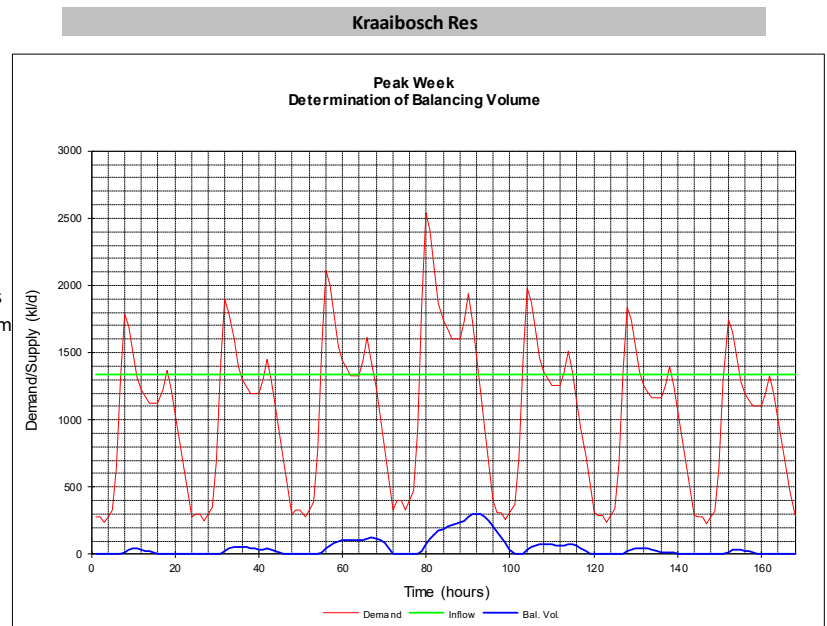
= 12.4 h*AADD

%

Pattern	Zone	Category	%
Pattern 1	Large zone	Large	0.0%
Pattern 2	Small zone	Medium	100.0%
Pattern 3	LC Housing	Small	0.0%
Pattern 4			0.0%
Pattern 5			0.0%
Pattern 6			0.0%
Pattern 7	Even	To a res.	0.0%

Must add up to 100 --> check

100.0%



VOLUME ANALYSIS (applies only to area directly supplied, i.e. not to the Pattern 7 supply)

Capacity **1 000** kl = 41.3 h x AADD

Required balancing 300 kl = 12.4 h x AADD

Available volume 700 kl = 28.9 h x AADD

Required emergency 581 kl = **24.00** h x AADD

Spare capacity 119 kl = 4.9 h x AADD

Tower storage capacity assessment and supply rate

Water towers serve merely to sustain pressure in a network and should not be regarded as facilities for balancing peaks and for emergency supply. Because of their relatively small volumes, the supply rates to towers must be such that they can be kept full at all times.

On the other hand, volumes must be large enough to allow room for operation of pumps filling the tower (where applicable) such that the number of pump cycles per day is limited. The following guidelines were used for evaluation and planning of water towers:

- Supply rate into tower : 1,0 to 1,1 x PHF x AADD
- Tower storage : 2 h to 6 h x AADD

The Kraaibosch tower has a capacity of 100 kL and the supply pump station has one operational and one standby pump set, each with a supply duty point of 55 L/s at 35 m head.

Scenario:	Theoretical Current Demand	Theoretical Fully Occupied Demand	Theoretical Fully Occupied Demand (incl. the proposed development)
Parameter:			
Existing Capacity (kL)	100	100	100
AADD (kL/d)	284	581	791
Peak Flow (L/s)	9.8	18.9	30.1
Peak Factor (current)	3.00	2.80	3.30
Storage (hours)	±8	±4	±3
Supply rate (L/s)	10.9	20.7	33.2
Existing Pump Station (L/s)	55.0	55.0	55.0

It is evident that both the Kraaibosch tower and its supply pump station has capacity to accommodate the proposed development.

3.4.1 Existing bulk water system considerations

Items presented here are for the attention of the George Municipal engineering professional (yourself) so as to highlight existing shortfalls or the imminent potential thereof.

General items required to alleviate existing problems in the bulk water system:

Item No	Description	Extent	Size	Cost	Pro-rata Cost
Existing WTPs (Old WTP and New WTP)					
GMR_B01.01	Water Treatment Facility to install: New WTP	20 500 m ³ /d @	254 m EGL	R 287 482 000	R 1 888 334 0.66%
	Existing: Old WTP	20 000 m ³ /d @	254 m EGL	n.a.	n.a.
	Existing: New WTP	20 000 m ³ /d @	254 m EGL	n.a.	n.a.
	Existing: Ebb-and-Flow WTP	1 700 m ³ /d @	254 m EGL	n.a.	n.a.
GMR_B01.06	Pipe to install	7 m x	500 mm Ø	R 543 000	R 5 478 1.01%
GMR_B01.07d	Pump Only to install: New WTP PS	220 L/s @	55 m	R 2 136 000	R 21 548 1.01%
Total				R 290 161 000	R 1 915 359

3.4.2 Accommodation of the proposed development in the bulk water system

Development specific items required in the bulk water system:

Item No	Description	Extent	Size	Cost	Pro-rata Cost
Existing external system (George Main zone)					
Development - Phase 2 (Aan de Meulen)					
GMR_01.02	Pipe to install	186 m x	450 mm Ø	R 2 057 000	R 128 033 6.2%
GMR_01.03	Pipe to install	128 m x	315 mm Ø	R 691 000	R 114 856 16.6%
GMR_01.04	Pipe to install	179 m x	355 mm Ø	R 1 224 000	R 121 791 10.0%
GMR_01.11a	Pipe to install	187 m x	450 mm Ø	R 1 926 000	R 102 221 5.3%
Sub-Total				R 5 898 000	R 466 901
Existing external system (Kraaibosch Reservoir and Tower zone)					
Development - Phase 1 (Kraaibosch Ridge)					
KBR_B01.02a	Pipe to install	58 m x	500 mm Ø	R 1 065 000	R 44 837 4.2%
KBR_B01.03	Reservoir to install: Kraaibosch Res	4 000 m ³ @	209 m TWL	R 17 550 000	R 738 855 4.2%
KBR_B01.04a	Pipe to install	34 m x	500 mm Ø	R 863 000	R 36 332 4.2%
Sub-Total				R 19 478 000	R 820 024
Total				R 25 376 000	R 1 286 924

3.4.3 Accommodation of the proposed development in the bulk water system (interim period)

Development specific items required in the bulk water system prior to the construction of the additional Kraaibosch reservoir:

Item No	Description	Extent	Size	Cost	Pro-rata Cost
Existing external system (George Main zone) - interim option					
Development - Phase 1 (Kraaibosch Ridge)					
GMR_01.03 # ¹	Pipe to install	128 m x	315 mm Ø	R 691 000	R 114 856 16.6%
GMR_01.04 # ¹	Pipe to install	179 m x	355 mm Ø	R 1 224 000	R 121 791 10.0%
Sub-Total				R 1 915 000	R 236 647
Development - Phase 2 (Aan de Meulen)					
GMR_01.02	Pipe to install	186 m x	450 mm Ø	R 2 057 000	R 128 033 6.2%
GMR_01.11a	Pipe to install	187 m x	450 mm Ø	R 1 926 000	R 102 221 5.3%
Sub-Total				R 3 983 000	R 230 254
Total				R 5 898 000	R 466 901

Notes: #¹ An interim PRV was proposed for Kraaibosch 195-21 development. If not implemented under Kraaibosch 195-21, it can be moved as per Figure 1 (Water). Alternatively a new interim PRV connection can be made on the existing 250mmØ George main pipeline at either of the proposed connection points presented on Figure 1 (Water).

3.5 Water Reticulation System

Accommodation of the proposed development, with its revised AADD, requires implementation of the following additions and adjustments to the *existing* water system as indicated in **Figure 1 (Water)**.

3.5.1 Existing water reticulation system considerations

Items presented here are for the attention of the George Municipal engineering professional (yourself) so as to highlight existing shortfalls or the imminent potential thereof.

General items required to alleviate existing problems in the water distribution system:

Item No	MP Type	Description	Extent	Size	Cost	Pro-rata Cost
None						
Total					R -	R -

3.5.2 Accommodation of the proposed development in the water reticulation system

Development specific items required in the water distribution system (**including fire flow requirements**):

Item No	Description	Extent	Size	Cost	Pro-rata Cost
Existing external system (Kraaibosch Reservoir and Tower zone)					
Development - Phase 1 (Kraaibosch Ridge)					
KBT_F01.03	Pipe to install	395 m x	355 mm Ø	R 2 172 000	R 417 517 19.2%
Total				R 2 172 000	R 417 517

3.5.3 Accommodation of the proposed development in the water reticulation system (interim period)

Development specific items required in the water distribution system (**including fire flow requirements**) prior to the construction of the additional Kraaibosch reservoir:

Item No	Description	Extent	Size	Cost	Pro-rata Cost
Existing external system (Kraaibosch Reservoir and Tower zone)					
Development - Phase 1 (Kraaibosch Ridge)					
KBT_F01.03 # ¹	Pipe to install	395 m x	355 mm Ø	R 2 172 000	R 417 517 19.2%
KBT_F01.04 # ³	Pipe to install	147 m x	355 mm Ø	R 986 000	R 233 583 23.7%
KBT_F01.05 # ³	Pipe to install	185 m x	355 mm Ø	R 1 171 000	R 277 410 23.7%
KBT_F08.01a # ³	Pipe to install	31 m x	160 mm Ø	R 187 000	R 187 000 100.0%
KBT_F08.01b # ³	Pipe to install	152 m x	160 mm Ø	R 283 000	R 283 000 100.0%
KBT_F08.03 # ²	Pressure Reducing Valve to install	233 m EGL	100 mm Ø	R 304 000	R 304 000 100.0%
Total				R 5 103 000	R 1 702 511

Notes: #¹ The 355mm Ø is to be isolated from Kraaibosch tower supply until the additional Kraaibosch reservoir is constructed and the interim PRV decommissioned.

#² Interim PRV was proposed for Kraaibosch 195-21 development. If not implemented under Kraaibosch 195-21, it can be moved as per Figure 1 (Water).

#³ Depending on the final position of the proposed interim PRV, these items can be omitted.

The proposed connection points to the existing water distribution system are shown in **Figure 1 (Water)**.

3.6 Internal Reticulation

The internal network design on the property of the proposed development is beyond the scope of this report. However, the consulting engineer for the development is required to allow for the fire flow demand as listed in 2.2 above on the internal networks.

For internal network design purposes the water distribution network provides the following energy gradelines (EGLs) at the proposed connection points (see **Figure 1 (Water)**).

Connection Point	Static		Residual		Fire Flow		Ground Level
	EGL (m a.s.l.)	Head (m)	EGL (m a.s.l.)	Head (m)	EGL (m a.s.l.)	Head (m)	(m a.s.l.)
Future system - George Main							
Point A	295.0	92.5	275.2	72.7	269.9	67.4	202.5
Future system - Kraaibosch Reservoir and Tower							
Point B	233.0	29.4	227.4	23.8	226.7	23.1	203.6
Future system - George Main (interim period)							
Point C	233.0	37.8	232.0	36.8	230.2	35.0	195.2
Point D	233.0	28.9	232.0	27.9	230.2	26.1	204.1

4 SEWER CONVEYANCE NETWORK

4.1 Sewer Drainage Area

The master plan indicates that the proposed development falls in the future Kraaibosch 3 PS drainage area as shown in **Figure 2 (Sewer)** attached. This drainage area drains to the Outeniqua WWTW.

An interim option was investigated to accommodate the proposed development in the existing sewer system via the existing Kraaibosch PS as the master plan option requires the construction of the Kraaibosch 3 PS, Kraaibosch 4 PS and the Destiny Africa PS.

4.2 Categorisation of required upgrades

The items are categorised as follows:

- General MP Items – required to address capacity issues and backlogs in the bulk and reticulation systems serving the proposed development, but not specifically required for the development per se.
- Development specific MP Items – new additions to (or deviations from) the existing Master Plan, required specifically for the proposed development, as a result of more accurate information relative to the original estimate of future development.

It is important to note that all proposed items are schematic in nature, final size and location is subject to a complete design by a suitably qualified engineer. The final locality in particular is subject to legislative requirements including but not limited to pipes not crossing private stands, no servitudes registered in private stands and no pipes in stands with an area less than 400m².

4.3 Bulk Sewer Drainage

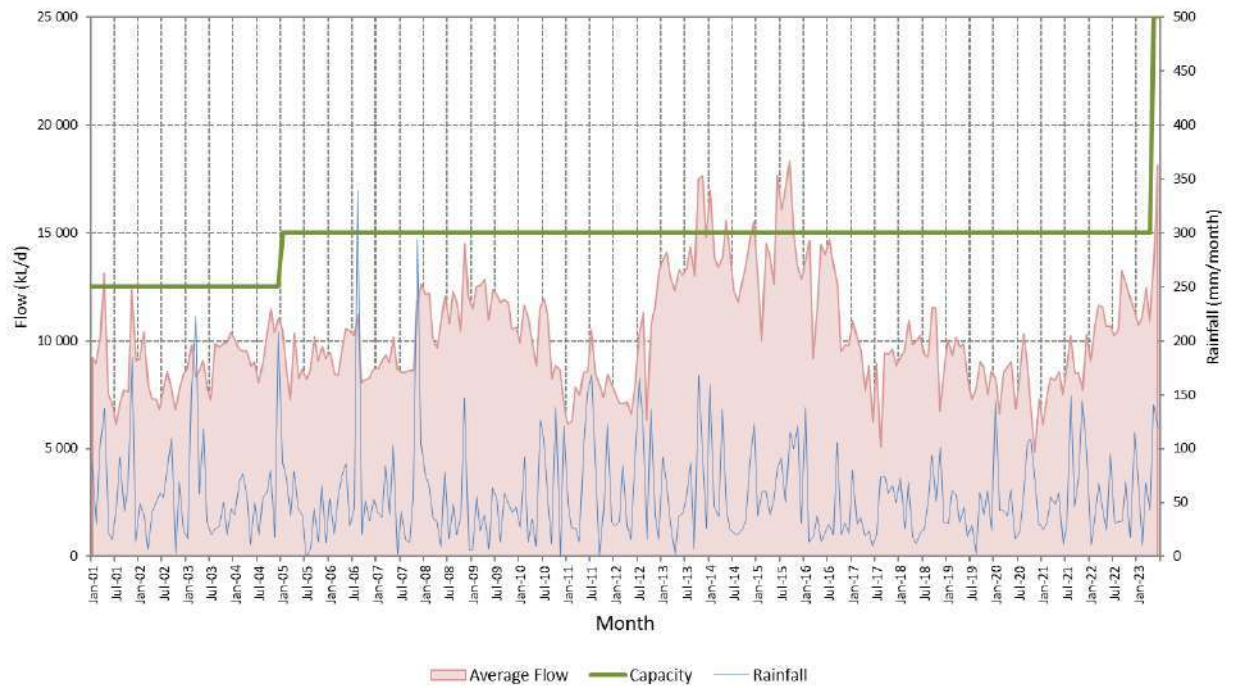
Accommodation of the proposed development, with its revised PDDWF, requires implementation of the following additions and adjustments to the existing sewer system as indicated in **Figure 2 (Sewer)**.

Wastewater Treatment Works capacity

The graph overleaf shows that the design capacity of the Outeniqua WWTW (green line) has been exceeded by the Average Monthly Flow (light red shaded area) a few times in the last decade. The WWTW has since been upgraded and is thus not operating at risk.

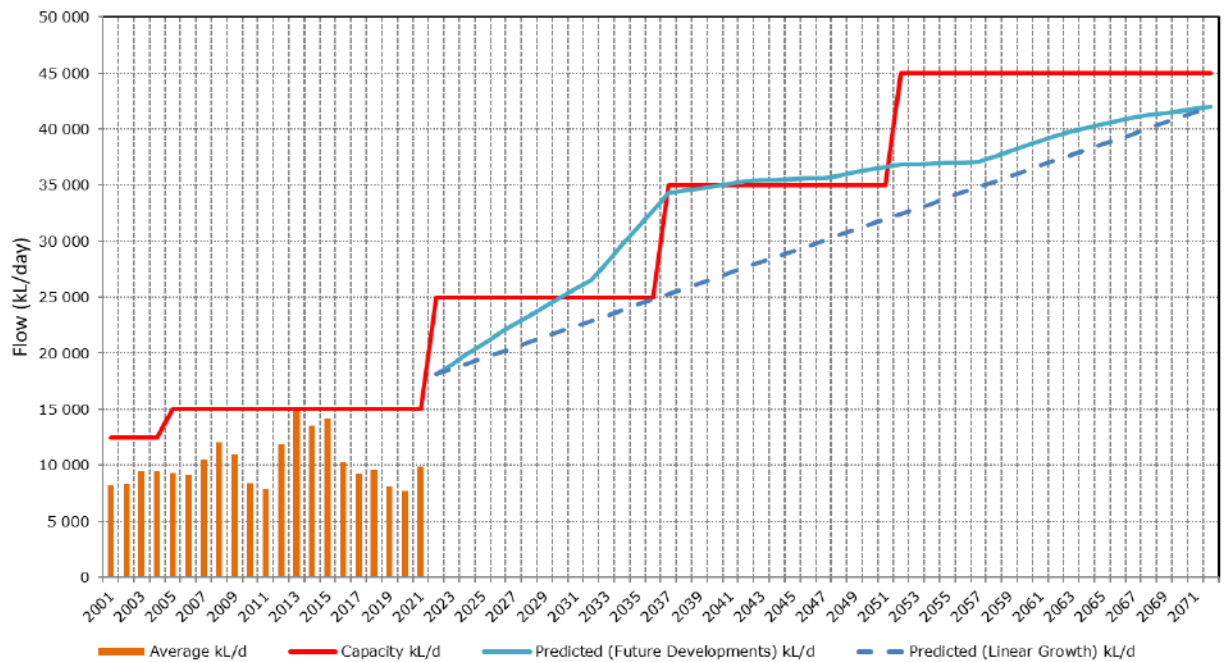
Outeniqua WWTW

Average Monthly Flow



Outeniqua WWTW

Annual Average (incl. WTP Sludge @ $\pm 1\,950$ kL/d)



Based on available information the capacity, present flow and projected short-term flow are as follows:

Outeniqua WWTW	Capacity	Comment
Existing Capacity	25 000 kL/d	
Measured Flow		
Annual Average (2001-2023)	14 846 kL/d	Maximum 2013/14
	10 154 kL/d	Spare capacity available
Monthly Average (2001-2023)	10 591 kL/d	September 2015
	14 409 kL/d	Spare capacity available
Monthly Average (2022/23)	13 761 kL/d	May 2023
	11 239 kL/d	Spare capacity available
Modelled Flow		
T_PDDWF (existing)	18 113 kL/d	m2024-03 MP - Incl. WTP sludge flow = 1 260 kL/d
	6 887 kL/d	Spare capacity available
3yr Projection	20 781 kL/d	Incl. WTP sludge flow = 1 260 kL/d
	4 219 kL/d	Spare capacity available
5yr Projection	22 561 kL/d	Incl. WTP sludge flow = 1 260 kL/d
	2 439 kL/d	Spare capacity available

Note: T_PDDWF: Theoretical Peak Daily Dry Weather Flow (Total Wastewater Flow, Peak day in week)
The flow projections include all stands that are presently vacant but expected to be occupied over the next 5 years as well as all future areas likely to develop within the next 5 years

4.3.1 Existing bulk sewer system considerations

Items presented here are for the attention of the George Municipal engineering professional (yourself) so as to highlight existing shortfalls or the imminent potential thereof.

General items required to alleviate existing problems in the bulk sewer system:

Item No	MP Type	Description	Existing Diam (mm)	New Diam (mm)	Length (m)	Design Flow	Cost	Pro-rata Cost
Existing bulk system (from Thembaletu 6 PS to Outeniqua WWTW)								
OT_20.02	MP	Upgrade existing Rising	400	800	4	873.6 L/s	R 1 278 000	R 15 715 1.23%
OT_20.03	MP	Upgrade existing Rising	500	800	12	873.7 L/s	R 1 453 000	R 17 864 1.23%
OT_37.04	MP	Upgrade existing Gravity	315	450	8	494.7 L/s	R 209 000	R 4 538 2.17%
OT_61.01	# ¹ MPi	Upgrade existing Pump Station (Investigate first): Thembaletu PS 6	-	-	-	494.7 L/s	R 20 573 000	R 446 726 2.17%
OT_61.02a	# ¹ MPi	Upgrade existing Rising (Investigate first)	250	650	351	494.7 L/s	R 6 294 000	R 136 669 2.17%
OT_61.02b	# ¹ MPi	Upgrade existing Rising (Investigate first)	250	650	31	494.7 L/s	R 1 368 000	R 29 705 2.17%
OT_61.02c	# ¹ MPi	Upgrade existing Rising (Investigate first)	250	650	330	494.7 L/s	R 5 970 000	R 129 634 2.17%
Sub-Total							R 37 145 000	R 780 850
Existing WWTW (Outeniqua WWTW)								
	-	-	-	-	-	-	R -	R - 1.00%
Sub-Total							R -	R -
Total							R 37 145 000	R 780 850

Notes: #¹ A first phase upgrade of the Thembaletu 6 PS to 240 L/s is planned in the short term.

4.3.2 Existing bulk sewer system considerations (interim period)

Items presented here are for the attention of the George Municipal engineering professional (yourself) so as to highlight existing shortfalls or the imminent potential thereof.

General items required to alleviate existing problems in the bulk sewer system for the interim connection prior to construction of the Kraaibosch 4 and Destiny Africa PSs:

Item No	MP Type	Description	Existing Diam (mm)	New Diam (mm)	Length (m)	Design Flow	Cost	Pro-rata Cost
Existing bulk system (from Meul PS to Outeniqua WWTW) - Interim option 1/2								
OT_03.01	#1 MP	Upgrade existing Pump Station: Meul PS	-	-	-	405.0 L/s	R 9 640 000	R 255 686 2.65%
OT_03.02	#1 MPi	Upgrade existing Rising (Investigate first)	450	650	484	405.0 L/s	R 8 341 000	R 221 232 2.65%
OT_09.01	#2 MPi	Upgrade existing Gravity (Investigate first)	700	1 000	18	475.4 L/s	R 718 000	R 16 224 2.26%
OT_09.02	#2 MPi	Upgrade existing Gravity (Investigate first)	700	1 000	26	476.0 L/s	R 889 000	R 20 062 2.26%
OT_09.03	#2 MPi	Upgrade existing Gravity (Investigate first)	600	900	14	498.1 L/s	R 553 000	R 11 926 2.16%
OT_09.04	#2 MPi	Upgrade existing Gravity (Investigate first)	700	825	260	483.5 L/s	R 4 638 000	R 103 043 2.22%
OT_10.01	MP	Upgrade existing Pump Station: Schaapkop PS	-	-	-	590.7 L/s	R 11 055 000	R 201 037 1.82%
OT_10.02	MP	Upgrade existing Rising	500	700	154	590.7 L/s	R 4 456 000	R 81 033 1.82%
OT_10.03	#2 MPi	Upgrade existing Gravity (Investigate first)	999	1 000	316	591.7 L/s	R -	R - 1.82%
OT_10.04	#2 MPi	Upgrade existing Gravity (Investigate first)	999	1 000	32	837.1 L/s	R -	R - 1.28%
OT_10.05	#2 MPi	Upgrade existing Gravity (Investigate first)	999	1 000	9	1 536.1 L/s	R -	R - 0.70%
OT_10.06	#2 MPi	Upgrade existing Gravity (Investigate first)	999	1 000	4	698.9 L/s	R -	R - 1.54%
Sub-Total							R 40 290 000	R 910 244
Existing bulk system (divert flow from Meul PS to Thembaletu 6 PS) - Interim option 1/2								
OT_20.02	MP	Upgrade existing Rising	400	800	4	873.6 L/s	R 1 278 000	R 15 715 1.23%
OT_20.03	MP	Upgrade existing Rising	500	800	12	873.7 L/s	R 1 453 000	R 17 864 1.23%
OT_37.04	MP	Upgrade existing Gravity	315	450	8	494.7 L/s	R 209 000	R 4 538 2.17%
OT_27.01	#3 MPa	Abandon existing Pump Station: Thembaletu PS 1	-	-	-	- L/s	R 287 000	R - 0.00%
OT_27.02	#3 MPa	Abandon existing Rising	200	250	867	- L/s	R 10 000	R - 0.00%
OT_38.01	#3 MPa	Abandon existing Pump Station: Thembaletu PS B	-	-	-	- L/s	R 287 000	R - 0.00%
OT_38.02	#3 MPa	Abandon existing Rising	79	90	99	- L/s	R 10 000	R - 0.00%
OT_39.01	#3 MPa	Abandon existing Pump Station: Thembaletu PS A	-	-	-	- L/s	R 287 000	R - 0.00%
OT_39.02	#3 MPa	Abandon existing Rising	79	90	91	- L/s	R 10 000	R - 0.00%
OT_50.01	MPa	Abandon existing Pump Station: Parkdene PS 2	-	-	-	- L/s	R 287 000	R - 0.00%
OT_50.02	MPa	Abandon existing Rising	150	200	227	- L/s	R 10 000	R - 0.00%
OT_51.01	MPa	Abandon existing Pump Station: Parkdene PS 3	-	-	-	- L/s	R 287 000	R - 0.00%
OT_51.02	MPa	Abandon existing Rising	150	200	151	- L/s	R 10 000	R - 0.00%
OT_58.02	#2 MPi	Upgrade existing Gravity (Investigate first)	200	450	47	22.9 L/s	R 458 000	R - 0.00%
OT_61.01	MPi	Upgrade existing Pump Station (Investigate first): Thembaletu PS 6	-	-	-	494.7 L/s	R 20 573 000	R 446 726 2.17%
OT_61.02a	#2 MPi	Upgrade existing Rising (Investigate first)	250	650	351	494.7 L/s	R 6 294 000	R 136 669 2.17%
OT_61.02b	#2 MPi	Upgrade existing Rising (Investigate first)	250	650	31	494.7 L/s	R 1 368 000	R 29 705 2.17%
OT_61.02c	#2 MPi	Upgrade existing Rising (Investigate first)	250	650	330	494.7 L/s	R 5 970 000	R 129 634 2.17%
OT_62.01	#3 MP	Upgrade existing Pump Station: Thembaletu PS 7	-	-	-	50.0 L/s	R 5 670 000	R - 0.00%
OT_62.02	#3 MP	Upgrade existing Rising	200	250	1 170	50.0 L/s	R 3 169 000	R - 0.00%
OT_F91.02a	FM	New Gravity	-	160	109	2.8 L/s	R 279 000	R - 0.00%
OT_F91.02b	FM	New Gravity	-	160	80	2.8 L/s	R 546 000	R - 0.00%
OT_F91.03	FM	New Gravity	-	160	964	3.9 L/s	R 2 043 000	R - 0.00%
OT_F92.02a	FM	New Gravity	-	160	36	1.5 L/s	R 127 000	R - 0.00%
OT_F92.02b	FM	New Gravity	-	160	95	1.5 L/s	R 642 000	R - 0.00%
OT_F92.03	FM	New Gravity	-	160	157	2.5 L/s	R 377 000	R - 0.00%
OT_F93.02a	FM	New Gravity	-	160	56	1.5 L/s	R 169 000	R - 0.00%
OT_F93.02b	FM	New Gravity	-	160	89	1.5 L/s	R 605 000	R - 0.00%
OT_F94.02	#3 FM	New Gravity	-	200	514	35.6 L/s	R 1 265 000	R - 0.00%
OT_F94.03	#3 FM	New Gravity	-	250	515	35.9 L/s	R 1 512 000	R - 0.00%
OT_F94.04	#3 FM	New Gravity	-	250	211	36.2 L/s	R 654 000	R - 0.00%
OT_F94.05	#3 FM	New Gravity	-	315	1 631	52.8 L/s	R 5 801 000	R - 0.00%
OT_F95.02	#3 FM	New Gravity	-	160	9	0.1 L/s	R 72 000	R - 0.00%
OT_F96.02	#3 FM	New Gravity	-	160	24	0.1 L/s	R 102 000	R - 0.00%
OT_F97.02	#3 FM	New Gravity	-	160	25	16.2 L/s	R 104 000	R - 0.00%
Sub-Total							R 62 225 000	R 780 850
Existing WWTW (Outeniqua WWTW)								
	-	-	-	-	-	-	R -	R - 0.22%
Sub-Total							R -	R -
Total							R 102 515 000	R 1 691 095

Notes:

#1 Upgrading of the Meul PS is currently underway.

#2 In the master plan an investigation of this pipe is proposed implying that not all information on slopes, inverts etc. was available. The pipe should therefore first be investigated through field inspections and surveys to verify that upgrading is in fact required.

#3 Construction of an outfall sewer and upgrading to Thembaletu PS 7 is underway.

4.3.3 Accommodation of the proposed development in the bulk sewer system

Development specific items required in the bulk sewer system:

Item No	MP Type	Description	Existing Diam (mm)	New Diam (mm)	Length (m)	Design Flow	Cost	Pro-rata Cost
Future bulk system (from Thembaletu 6 PS to Outeniqua WWTW)								
OT_F04.03	FM	New Gravity	-	160	409	7.6 L/s	R 898 000	R 535 255 59.6%
OT_F04.04	FM	New Gravity	-	160	40	21.8 L/s	R 135 000	R 66 522 49.3%
OT_F05.01	FM	New Gravity	-	160	315	0.6 L/s	R 703 000	R 703 000 100.0%
OT_F05.02	FM	New Gravity	-	160	338	0.9 L/s	R 751 000	R 536 548 71.4%
OT_F06.01	FM	New Pump Station: Kraaibosch3 PS	-	-	-	26.3 L/s	R 5 452 000	R 2 226 821 40.8%
OT_F06.02a	FM	New Rising	-	160	655	26.3 L/s	R 1 077 000	R 439 891 40.8%
OT_F06.02b	FM	New Rising	-	160	39	26.3 L/s	R 206 000	R 84 139 40.8%
OT_F06.02c	FM	New Rising	-	160	309	26.3 L/s	R 518 000	R 211 572 40.8%
OT_F07.02	FM	New Gravity	-	160	235	13.5 L/s	R 538 000	R 221 776 41.2%
OT_F32.01	FM	New Gravity	-	315	218	93.2 L/s	R 992 000	R 114 335 11.5%
OT_F32.02	FM	New Gravity	-	200	612	94.6 L/s	R 1 838 000	R 208 708 11.4%
OT_F32.03	FM	New Gravity	-	315	251	157.7 L/s	R 1 133 000	R 77 176 6.8%
OT_F32.04	FM	New Gravity	-	315	72	207.8 L/s	R 367 000	R 18 972 5.2%
OT_F35.01	# ¹ FM	New Pump Station: Kraaibosch4 PS	-	-	-	207.8 L/s	R 14 168 000	R 732 400 5.2%
OT_F35.02	# ¹ FM	New Rising	-	450	1 442	207.8 L/s	R 12 631 000	R 652 946 5.2%
OT_F36.01	FM	New Gravity	-	315	214	210.5 L/s	R 977 000	R 49 857 5.1%
OT_F36.02	FM	New Gravity	-	525	213	257.8 L/s	R 4 844 000	R 201 840 4.2%
OT_F36.03	FM	New Gravity	-	315	20	336.1 L/s	R 144 000	R 4 602 3.2%
OT_F37.01	# ² FM	New Pump Station: Destiny Africa PS	-	-	-	336.1 L/s	R 18 685 000	R 597 186 3.2%
OT_F37.02	# ² FM	New Rising	-	550	1 214	336.1 L/s	R 13 102 000	R 418 749 3.2%
Total							R 79 159 000	R 8 102 295

Notes: #¹ A potential first phase of Kraaibosch 4 PS could be 50 L/s and a 355mm Ø rising main.
#² A potential first phase of Destiny Africa PS could be 100 L/s and a 450mmØ rising main.

4.3.4 Accommodation of the proposed development in the bulk sewer system (interim period)

Development specific items required in the bulk sewer system for the interim connection prior to construction of the Kraaibosch 4 and Destiny Africa PSs:

Item No	MP Type	Description	Existing Diam (mm)	New Diam (mm)	Length (m)	Design Flow	Cost	Pro-rata Cost
Future bulk system (from Meul PS to Outeniqua WWTW) - Interim option 1								
OT_F04.03	FM	New Gravity	-	160	409	7.6 L/s	R 898 000	R 535 255 59.6%
OT_F04.04	FM	New Gravity	-	160	40	21.8 L/s	R 135 000	R 66 522 49.3%
OT_F05.01	FM	New Gravity	-	160	315	0.6 L/s	R 703 000	R 703 000 100.0%
OT_F05.02	FM	New Gravity	-	160	338	0.9 L/s	R 751 000	R 536 548 71.4%
OT_F06.01	FM	New Pump Station: Kraaibosch3 PS	-	-	-	26.3 L/s	R 5 452 000	R 2 226 821 40.8%
OT_F06.02d	# ³ FA	New Rising (Alternative)	-	160	276	26.3 L/s	R 465 000	R 189 925 40.8%
OT_F06.02e	# ³ FA	New Rising (Alternative)	-	160	1 522	26.3 L/s	R 2 478 000	R 1 012 117 40.8%
OT_F07.02	FM	New Gravity	-	160	235	13.5 L/s	R 538 000	R 221 776 41.2%
Total							R 11 420 000	R 5 491 963

Notes: #³ The master plan proposes that the development area drain to the Thembaletu PS 6 with a prerequisite for this option being the construction of the Destiny Africa and Kraaibosch 4 pumping systems. As part of interim accommodation of the development, the proposed Kraaibosch 3 PS could pump to the existing Kraaibosch PS. In future a rising main to the future Kraaibosch 4 PS can be constructed.

Item No	MP Type	Description	Existing Diam (mm)	New Diam (mm)	Length (m)	Design Flow	Cost	Pro-rata Cost
Future bulk system (from Meul PS to Outeniqua WWTW) - Interim option 2								
OT_F04.05	# ⁴ FA	New Rising (Alternative)	-	110	210	7.3 L/s	R 258 000	R 158 511 61.4%
OT_F04.06	# ⁴ FA	New Pump Station (Alternative): Kraaibosch Ridge PS 4	-	-	-	7.3 L/s	R 3 162 000	R 1 942 681 61.4%
OT_F05.03	# ⁴ FA	New Rising (Alternative)	-	90	186	3.0 L/s	R 211 000	R 211 000 100.0%
OT_F05.04	# ⁴ FA	New Pump Station (Alternative): Kraaibosch Ridge PS 2	-	-	-	3.0 L/s	R 1 825 000	R 1 825 000 100.0%
OT_F06.02e	# ⁴ FA	New Rising (Alternative)	-	160	1 522	26.3 L/s	R 2 478 000	R 1 601 749 64.6%
OT_F07.03	# ⁴ FA	New Pump Station (Alternative): Kraaibosch Ridge PS 3	-	-	-	17.0 L/s	R 3 738 000	R 3 738 000 100.0%
Total							R 11 672 000	R 9 476 941

Notes: #⁴ An alternative for the interim accommodation of the development without Kraaibosch 3 PS, is the construction of two pumping stations (Kraaibosch Ridge 2 and 4) to lift sewer flow over the watershed to a main Kraaibosch Ridge PS 3. This would include constructing the Kraaibosch 3 interim rising main up to Kraaibosch Ridge 3 PS. With further phased development Kraaibosch PSs 2 - 4 can be decommissioned in favour of Kraaibosch 3 PS and the rising main extended or decommissioned for a rising main to Kraaibosch 4 PS.

4.4 Sewer reticulation system

Accommodation of the proposed development, with its revised PDDWF, requires implementation of the following additions and adjustments to the *existing* sewer system as indicated in **Figure 2 (Sewer)**.

4.4.1 Existing sewer reticulation system considerations

Items presented here are for the attention of the George Municipal engineering professional (yourself) so as to highlight existing shortfalls or the imminent potential thereof.

General items required to alleviate existing problems in the existing sewer system:

Item No	MP Type	Description	Existing Diam (mm)	New Diam (mm)	Length (m)	Design Flow	Cost	Pro-rata Cost
Existing collector system (from Meul PS to Outeniqua WWTW) - Interim option 1/2								
OT_34.03	MPi	Upgrade existing Gravity (Investigate first)	315	450	42	89.9 L/s	R 425 000	R 50 783 11.9%
Total							R 425 000	R 50 783

4.4.2 Accommodation of the proposed development in the sewer reticulation system

Development specific items required in the existing sewer system:

Item No	MP Type	Description	Existing Diam (mm)	New Diam (mm)	Length (m)	Design Flow	Cost	Pro-rata Cost
Development - Phase 1 (Kraaibosch Ridge)								
OT_F04.02	FM	New Gravity	-	160	681	5.2 L/s	R 1 458 000	R 1 458 000 100.0%
OT_F07.04	FM	New Gravity	-	160	743	9.6 L/s	R 1 587 000	R 1 587 000 100.0%
Development - Phase 2 (Aan de Meulen)								
OT_F04.01	FM	New Gravity	-	160	222	4.4 L/s	R 513 000	R 513 000 100.0%
OT_F07.05	FM	New Gravity	-	160	171	0.8 L/s	R 406 000	R 406 000 100.0%
Total							R 3 964 000	R 3 964 000

The proposed connection point to the existing sewer system is shown in **Figure 2 (Sewer)**.

In **Figure 2 (Sewer)** pipes in future development areas are indicated schematically.

The above Design Flows (or IPWWF) and thus pipe sizes were calculated taking cognizance of future developments upstream of the proposed development. In this regard, sewer pipes within the proposed development must be designed (layout and sizing) to receive a Design Flow from the following future connection point (see Figure 2 (Sewer)).

Connection Point	Design Flow (L/s)
Point A	0.78

As the Design Flow already accommodates stormwater ingress, the pipes can be designed to flow 100% full with the Design Flows provided above.

5 SUMMARY

Water supply:

Summary of costing:	Cost	Pro-rata Cost
General items required to alleviate existing problems in the bulk water system	R 290 161 000	R 1 915 359
Development specific items required in the bulk water system	R 25 376 000	R 1 286 924
General items required to alleviate existing problems in the water distribution system	R -	R -
Development specific items required in the water distribution system (including fire flow requirements)	R 2 172 000	R 417 517
Total	R 317 709 000	R 3 619 801

Summary of costing - Interim option (Kraaibosch Ridge PRV):	Cost	Pro-rata Cost
General items required to alleviate existing problems in the bulk water system	R 290 161 000	R 1 915 359
Development specific items required in the bulk water system	R 5 898 000	R 466 901
General items required to alleviate existing problems in the water distribution system	R -	R -
Development specific items required in the water distribution system (including fire flow requirements)	R 5 103 000	R 1 702 511
Total	R 301 162 000	R 4 084 771

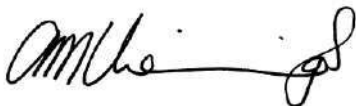
Sewer drainage:

Summary of costing (Master Plan):	Cost	Pro-rata Cost
General items required to alleviate problems in the bulk sewer system:	R 37 145 000	R 780 850
Development specific items required in the bulk sewer system:	R 79 159 000	R 8 102 295
General items required to alleviate problems in the existing sewer system:	R -	R -
Development specific items required in the existing sewer system:	R 3 964 000	R 3 964 000
Total	R 120 268 000	R 12 847 146

Summary of costing - Interim option 1 (Kraaibosch 3 PS):	Cost	Pro-rata Cost
General items required to alleviate problems in the bulk sewer system:	R 102 515 000	R 1 691 095
Development specific items required in the bulk sewer system:	R 11 420 000	R 5 491 963
General items required to alleviate problems in the existing sewer system:	R 425 000	R 50 783
Development specific items required in the existing sewer system:	R 3 964 000	R 3 964 000
Total	R 118 324 000	R 11 197 840

Summary of costing - Interim option 2 (Kraaibosch Ridge PSs):	Cost	Pro-rata Cost
General items required to alleviate problems in the bulk sewer system:	R 102 515 000	R 1 691 095
Development specific items required in the bulk sewer system:	R 11 672 000	R 9 476 941
General items required to alleviate problems in the existing sewer system:	R 425 000	R 50 783
Development specific items required in the existing sewer system:	R 3 964 000	R 3 964 000
Total	R 118 576 000	R 15 182 818

Yours sincerely,



Per: A Vienings (Pr. Eng.)
GLS Consulting

(Report done by: J Rudolph)

REQUEST FROM CONSULTANT TO GLS

24051CG -Sawmill Development - George : GLS Services Availability Report



George Wallace <gwallace@lyner>

To: Johann Rudolph

Cc: Francois van Eck



Reply



Reply All



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Middag Johann,

Hoor by Flip jy hou bietjie wittebrood maar is weer Maandag terug op kantoor.

Ons benodig n beskikbaarheid van dienste verslag (water en riool) vir n nuwe ontwikkeling op die ou 'Sawmill' langs die N2.

Kan ons dalk Dinsdag oggend 30April so 08h30 dalk n 'teams' meeting doen om net bietjie agtergrond te gee?

Bevestig asseblief.

Groete,

George Wallace B Tech | Civil Technologist | Tel: 044 887 0223 | Mobile: 084 569 5373



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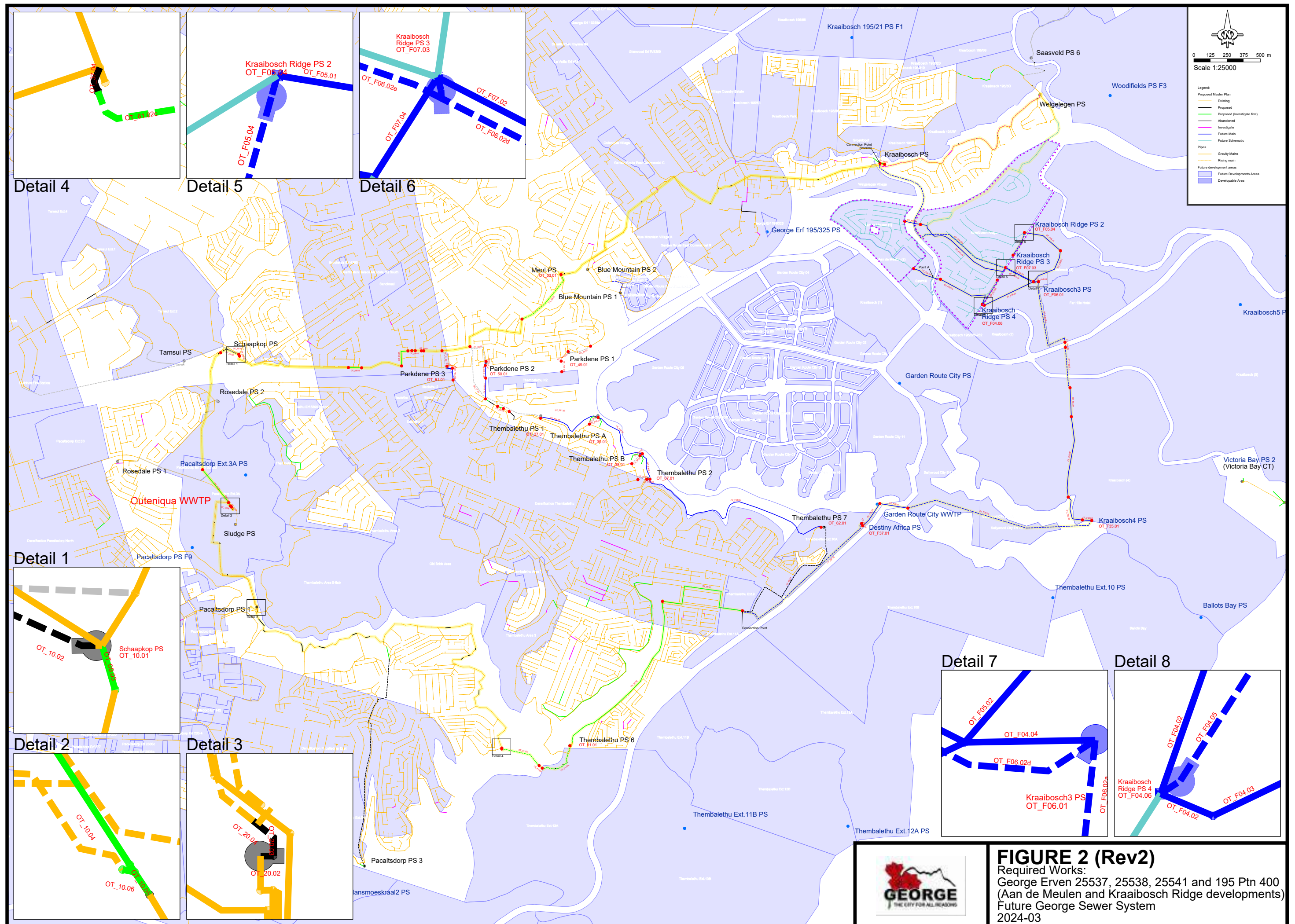
Neil Lyners and Associates (Pty) Ltd | Professional Consulting Engineers & Project Managers

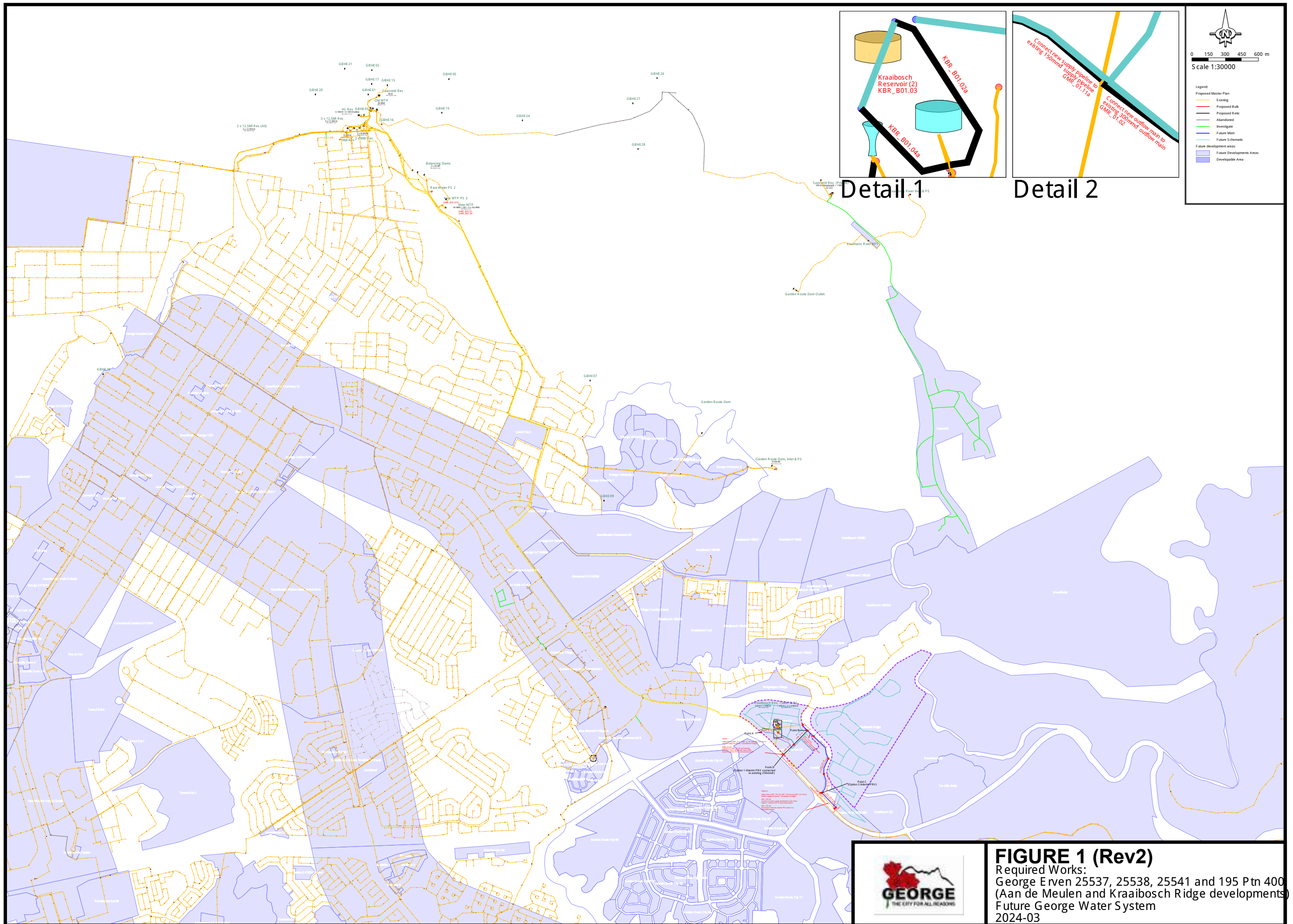
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ANNEXURE B





George Wallace

From: Melanie Geyer <mgeyer@george.gov.za>
Sent: Tuesday, 15 October 2024 09:15
To: Francois van Eck
Cc: George Wallace; Ricus Fivaz
Subject: Aan de Meulen & Kraaibosch Ridge [Filed 15 Oct 2024 12:20]
Attachments: Outlook-npjsdqqw

Categories: Filed by Mail Manager

Dear Francois and George

Following our discussion on 01 October 2024, I have had further discussions with the Operational Departments and can confirm the following:

1. Reservoirs:
 - a. Steel reservoirs are not accepted
 - b. Smaller reservoirs will be considered, but no smaller than 2ML. I will send a separate email to Johann to look at locating only 1 4ML reservoir on the Kraaibosch Ridge / Aan de Meulen sites and the other elsewhere.
 - c. A reminder of the availability of land required to accommodate the reservoirs, and that a number of smaller reservoirs (2 x 2ML) to make up the master plan requirement (4ML) will require a larger footprint than just one 4ML reservoir.
2. Water connection: A connection from the PRV remains unacceptable and won't be considered by the operational department, even in the short term.
3. Accommodation of some sewage flows (43 erven) at the Welgelegen pump station: The sewer operational departments have extensive issues with the Welgelegen and Kraaibosch pump stations due to stormwater infiltration that have not been resolved and the timeframe for the resolution of this aspect is unknown at this stage. Connection for even a portion of the sewage outflow as discussed in the meeting cannot be considered at this stage, thus all sewage will have to be conveyed and treated to the on-site package plant

Please advise if there is anything that I have missed or that you require clarity on.

Regards,

Melanie Geyer

Manager: Infrastructure Planning
Civil Engineering Services Directorate

Office: 044 801 9268

Email: mgeyer@george.gov.za



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ANNEXURE F

Traffic Impact Assessment from ITS

Transport Impact Assessment

Meulenzicht Estate & Oumeulen Village

George, Western Cape

February 2025

5th Floor

Imperial Terraces

Carl Cronje Drive

Tyger Waterfront

Bellville, 7530

(021) 914 6211 (T)

e-mail: mail@itsglobal.co.za

SUMMARY SHEET

Report Type	Transport Impact Assessment
Title	Meulenzicht Estate & Oumeulen Village
Location	George, Western Cape
Client	Atterbury
Reference Number	ITS 4730
Project Team	Christoff Krogscheepers Inge van Tonder
Contact Details	Tel: 021 914 6211
Date	February 2025
Report Status	Draft
File Name	G:\4730 TIA Saagmeule Welgelegen George\12 Reports\Issued\4730 TIA Meulenzicht_OuMeulen George_IvT_2025-02-20.docx

This transport study was prepared by a suitably qualified and registered professional traffic engineer. Details of any of the calculations on which the results in this report are based will be made available on request.

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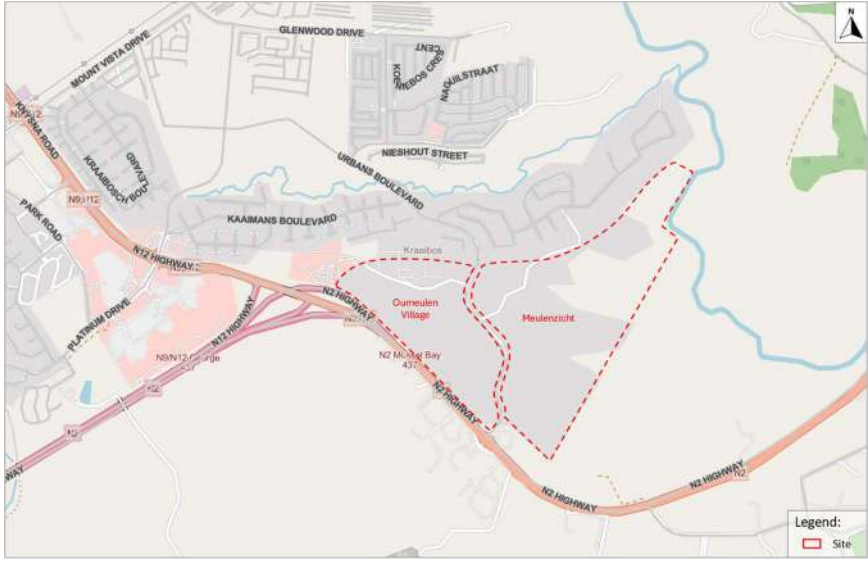
Annexure B: Tables

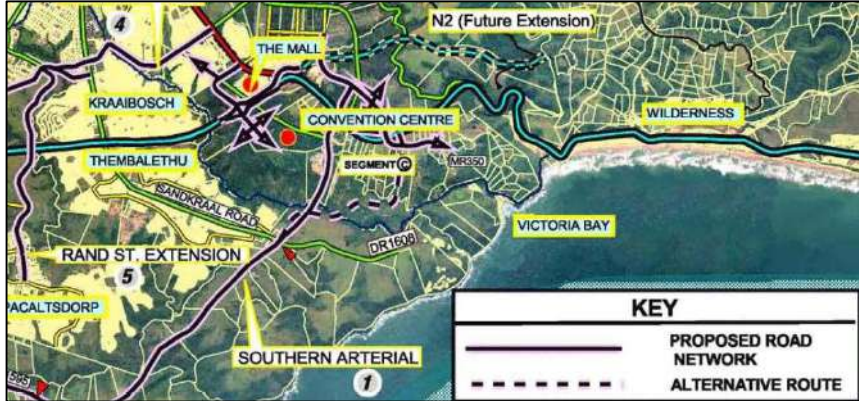
Annexure C: Future Road Network

Abbreviations

COTO	Committee of Transport Officials
Ha	Hectare
HCM	Highway Capacity Manual
LOS	Level of Service
NMT	Non-motorised Transport
SATGR	South African Trip Generation Rates
SQM	Square Meters (m ²)
TIA	Transport Impact Assessment
V/C	Volume to Capacity Ratio
WCG	Western Cape Government

Transport Impact Assessment

1 Purpose of Study	This report assesses the expected transport-related impact of the proposed Oumeulen Village and Meulenzicht Developments in George, Western Cape. These will be referred to as The Development. This study summarises the estimated transport impacts of the proposed land uses on the existing and future road networks within the vicinity. It provides an assessment of the transport impacts sufficiently so to identify any required mitigation measures.
2 Locality	The proposed development is in George, Western Cape, on Erven 25537, 25538 and 25541. See the vicinity map below. It is adjacent to the Welgelegen Development and partially covers the defunct sawmill which is sometimes used for a Saturday market. It is located east of the N2/Knysna Street interchange and straddles Urbans Boulevard also previously referred to as the Welgelegen Access Road. The alignment of the proposed future extension of the N2 is situated to the north and forms the northern boundary.  <i>Figure 1: Locality Plan</i>
3 Proposed Land Uses	The proposed development comprises of the following land uses: Meulenzicht Estate: • 227 Full Title Erven Oumeulen Village: • 151 Full Title Erven • 355 Apartments • Restaurant, clubhouse, deli and gym – 2 500 m² • Nursery School – 1 000 m² Refer to Appendix A, Figure A1 for the site development plan. The restaurant, clubhouse, deli and gym will be primarily for the residents in the area. The Oumeulen Village includes Phases A1-A7 and Meulenzicht Landgoed includes Phases B1-B4. Phase A8 and Phase C does not form part of this investigation. The impact assessment is based on the development fully constructed by the year 2030.

4 Existing Roadways	The following roads are located in proximity of the development: • N2: Class 1 highway with two lanes per direction and a posted speed of 100/80 km/h. No parking is allowed along this road and there is a median and street lighting in both directions. • Knysna Rd: Class 2 primary arterial with two lanes per direction and posted speed varying between 60 km/h and 80 km/h. No parking is available along this median-divided road. Street lighting is provided in both directions. • Urbans Boulevard: Class 3 road with one lane per direction with shoulders and sidewalks on both sides of the road. Street lighting is provided in both directions. This road provides access to the Welgelegen Estate and the Outeniqua Family Market. It will also be the primary access to the proposed development.
5 Future Roadways	A significant amount of planning has gone into the road network within the vicinity of the proposed development, and this is documented in several studies of which the most noteworthy are: • George Roads Master Plan (See Figure 2) • Kraaibosch Roads Master Plan (See Figure 3) • Welgelegen Roads Master Plan (See Figure 4) An extract of the most recent George Roads Master plan is provided in Figure 2 below and also refer to Annexure C for the larger George Roads Master Plan.  <i>Figure 2: Extract from the Approved George Roads Masterplan</i>  <i>Figure 3: Kraaibosch Roads Master Plan (SMEC 2022)</i>



- The extension of the N2 to the west across the existing Sawmill, south of the Welgelegen Estate and to the north of the proposed development. The timeframe for this future extension is unclear, but this was considered in the development of the SDP and this transport study.
- The extension of Urbans Boulevard across the Modderrug River to link up with Road 5.3 in the Kraaibosch Area in line with the roads planning in the areas. One key consideration is at what point is the link and the bridge across the river required.
- A link between Urbans Boulevard and the N2 at the Victoria Bay intersections.
- Primary Access in/out of the area is via Urbans Boulevard and the roundabout intersection with the N2. This intersection is currently being upgraded and the roundabout is reconstructed as part of an upgrade project of the N2.
- It is planned to extend Urbans Boulevard to the west in what has been labelled the Southern Arterial.

During the development of the SDP for the proposed development, the long-term road plans were considered. This includes the public transport needs along these links which could in the future be used by the GoGeorge Bus system.

6 Analyses Hours	The traffic analyses for the TIA were based on the weekday AM and PM peak hours. The following peak hours are representative of the traffic in the study area: • Weekday AM peak hour: 07:15 to 08:15 • Weekday PM peak hour: 16:30 to 17:30
7 Scenarios Analysed	The transport impacts of the proposed development were analysed for the following scenarios: 1. 2025 Existing Traffic Conditions

	2. 2030 Background Traffic Conditions. Existing Traffic conditions with an additional 4% growth per year for 5 years along the major routes to account for other developments in the surrounding areas. 3. 2030 Total traffic conditions (Background traffic + Development trips) a) Background traffic plus Oumeulen Village development trips b) Background traffic plus Meulenzicht Landgoed development trips c) Background traffic plus all development trips The traffic growth assumptions used to analyse future scenarios are discussed in Section 10.
8 Study Intersections (existing control)	The following intersections are included in the study: • Intersection 1: Knysna Road / St George's Road / Servitude Road • Intersection 2: Knysna Road / Garden Route Mall Access Road • Intersection 3: Knysna Road / N2 Off-ramp • Intersection 4: Knysna Road / N2 On-ramp • Intersection 5: N2 / Urbans Boulevard / Sasol Roundabout • Intersection 6: Urbans Boulevard / Development Access The existing geometry and control of the intersections included in the study are included in Appendix A, Figure A2.
9 Existing Intersection Operations	The evaluation of the existing intersection operations was based on the 2025 peak hour traffic volumes. All the intersection operation analyses were performed in accordance with the procedures stated in the latest Highway Capacity Manual (HCM). The intersections in the study area were analysed to determine the level of service (LOS), delay per vehicle (in seconds) and volume per capacity (V/C) for each intersection in the peak hour. Refer to Annexure A, Figure A3 and Figure A4 for the weekday AM and PM peak hour traffic operations for the existing traffic conditions. Based on the existing conditions analysis it is evident that all the intersections are operating acceptably during both the typical weekday AM and PM peak hours. There are no improvements required at any of the study intersections for the existing conditions.
10 2030 Background Conditions	The 2030 Background Conditions include the 2025 Existing Conditions with a 4% growth rate applied along the N2 for 5 years. A 4% growth was determined by comparing the October 2023 hourly flow on the N2 with the May 2024 hourly. These volumes are measured by a SANRAL counting station just south of the N2/Knysna Road I/C. This is a relatively high annual growth rate and is unlikely to be sustained over a prolonged period. It was used for this study to ensure that a conservative future demand scenario is tabled, specifically considering all the developments currently occurring in this area of George and Kraaibosch. A summary of the traffic volumes and the analysis based on the background traffic demand is included in Appendix A, Figure A5 and Figure A6. Based on the background conditions analysis it is evident that all the intersections are operating acceptably during both the typical weekday AM and PM peak hours. There are no improvements required at any of the study intersections for the existing conditions.

11 Site Development Plan (SDP)

The SDP was developed together with the full professional team. The final version of the SDP is included in **Annexure A**. The salient points to note from a traffic perspective are the following:

- Both developments will be getting access via a single access (Roundabout controlled) off Urbans Boulevard. The topography of Urbans Boulevard and the sight distance requirements for side road accesses necessitate a single access. This results in two substantial portions of land getting access via a single security entrance and a single roundabout access onto Urbans Boulevard.
- The need and requirements to provide a link road through to the N2/Victoria Bay Intersection are provided to the north of the Sasol Property boundary. The Victoria Bay Link Road intersects with Urbans Boulevard within the inside of a horizontal curve. The location and the sight distances were checked and are acceptable. The link road turns back to the south to run along the property boundary of the neighbouring land (Sasol Property, Erf 197/278). The proposal is to build the road and define the road reserve around the property boundary so that both landowners provide equal land for the road. Access to the Sasol Property is shown indicatively on the SDP since it can be located at any reasonable location along the property boundary. The construction of this road is not included in the proposed development. It is not required by the development. The road reserve should be made available to the municipality. See the alignment below of the link road from an extract of the SDP.

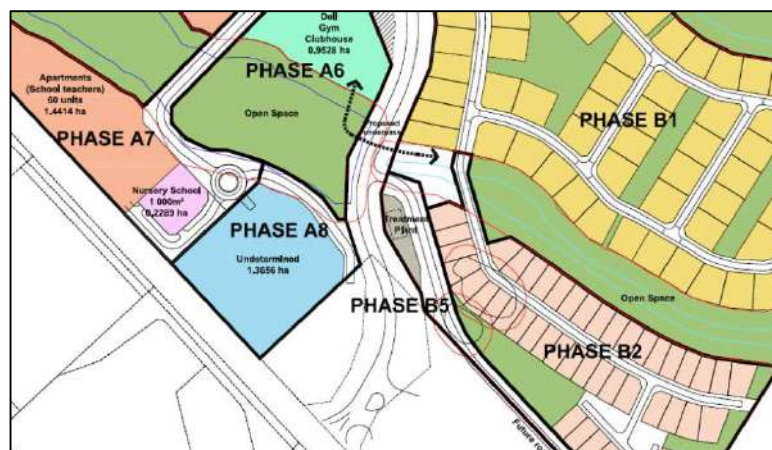


Figure 5: Alignment of future link road to N2/Victoria Bay intersection

- The erf illustrated in blue and labelled Phase A8 is not in the hands of the current developer. It is the remainder of Erf 197/287 which was created when Urbans Boulevard was constructed. Access to this erf is provided via the internal road network outside of the proposed security areas.
- A temporary construction access is shown off Urbans Boulevard immediately to the south of the future N2 road reserve. This access will be temporary and will also in the meantime give access to the Garden Route Farmers Market. It will be closed at some point in the future.
- The security gatehouses and storage lengths ahead of these gatehouses are illustrated and show sufficient storage space to avoid entering queues spilling back into the public right-of-way.

- No specific land uses have been assigned to Phase A8 and Phase B6. These are future phases and will have to be treated as such in the approvals and conditions of approval.
- The hatched area indicated in the following extract from the SDP is part of the existing road reserve. From closer analysis, it seems this land is not required for road purposes and it would be possible to re-purpose the land and include it as part of the developable land.

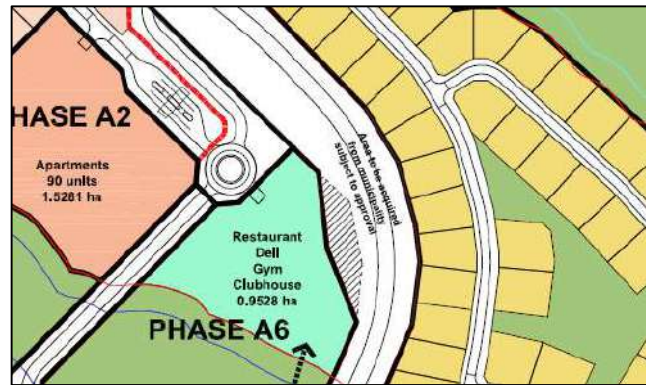


Figure 6: Road Reserve (hatched area) available for re-purposing

12 Trip Generation Rates and Development Trips

All the trip generation rates used to determine the expected development trips are from the South African Trip Data Manual (COTO TMH17, 2013). The analysis of the trip generation for the proposed development is provided in **Appendix B, Table 4** and summarised below in **Table 1**.

Table 1: Expected Development Trips

Land Use	AM Peak Hour			PM Peak Hour		
	Total Trips	In	Out	Total Trips	In	Out
Meulenzicht Estate						
Full title erven	227	57	170	227	159	68
Total	227	57	170	227	159	68
Oumeulen Village						
Full title erven	151	38	113	151	106	45
Apartments	302	75	226	302	211	91
Nursery School	10	5	5	7	4	3
Restaurant, Deli, Gym and Clubhouse	25	13	13	25	13	13
Phase A8 and Phase B6 (Future)						
Total	488	131	357	484	333	151
TOTAL	715	187	527	711	492	219

Note that the trips from Phase 8A and C were not included in the above trip generation estimate. The specific land uses on these areas have not been determined since they are future phases.

13 Trip Distribution	The expected trip distribution for the development during the AM and PM peak hours is based on the current traffic patterns, the type of development and the location of the major trip generators in the greater area. The estimated trip distribution is as follows: AM and PM Trip Distribution for residential and retirement units: • 80% to/from George CBD • 15% to/from Knysna • 5% to/from Cape Town Refer to Appendix A, Figure A7 for the future intersection lane configurations and controls as part of this development. Refer to Figures A8 and A9 for a summary of the trip distribution on the network in the AM and PM peak hours for the Oumeulen Village development. The added volumes due to the trips that are expected to be generated by the proposed development and the assumed trip assignment are also provided in Figures A8 and A9 for the AM and PM peak hours respectively. Refer to Figures A10 and A11 for a summary of the trip distribution on the network in the AM and PM peak hours for the Meulenzicht Landgoed development. The added volumes due to the trips that are expected to be generated by the proposed development and the assumed trip assignment are also provided in Figures A10 and A11 for the AM and PM peak hours respectively. Refer to Figures A12 and A13 for a summary of the trip distribution on the network in the AM and PM peak hours for the complete development. The total added volumes due to the trips that are expected to be generated by the proposed development and the assumed trip assignment are also provided in Figures A12 and A13 for the AM and PM peak hours respectively. Note that for the analysis, no traffic was assigned across the planned route across the Modderrug River to/from the Kraaibosch area. This is a conservative approach assuming that all traffic will have to access the larger road network via the N2 Roundabout at the Urbans Boulevard intersection with the N2.
14 Site Access	Access to the development will be via Urbans Boulevard currently providing access to the Welgelegen Estate and the Outeniqua Family Market. The Meulenzicht development and the OuMeulen Village will both have separate access control gates. A single-lane roundabout is proposed along Urbans Boulevard providing access to both developments, refer to Figure A7 and the discussion in Section 11 related to the SDP.
15 2030 Total Traffic Conditions	The 2030 total traffic includes the existing traffic volumes grown by 4% per annum for 5 years, plus the new traffic that will be generated by the development. Refer to Appendix A, Figure A14 and Figure A15, for the Total Traffic Conditions for Scenario 3a based on the expected total traffic demand if Oumeulen Village is fully developed, with the future lane configurations and control as provided in Figure A7. Based on the operational analyses of the 2030 Total Traffic Conditions, all intersections are expected to operate at acceptable levels of service and no

	additional mitigation measures would be required. Refer to Appendix A, Figure A16 and Figure A17, for the Total Traffic Conditions for Scenario 3b based on the expected total traffic demand if Meulenzicht Landgoed is fully developed, with the future lane configurations and control as provided in Figure A7. Based on the operational analyses of the 2030 Total Traffic Conditions, all intersections are expected to operate at acceptable levels of service and no additional mitigation measures would be required. An Refer to Appendix A, Figure A18 and Figure A19, for the Total Traffic Conditions for Scenario 3c based on the expected total traffic demand if both Oumeulen Village and Meulenzicht Landgoed are fully developed, with the future lane configurations and control as provided in Figure A7. Based on the operational analyses of the 2030 Total Traffic Conditions, all intersections are expected to operate at acceptable levels of service and no additional mitigation measures would be required. The exception is the southbound right-turn queue length along Knysna Road at the N2 westbound on-ramp. The storage of this right-turn lane should be increased from the current $\pm 30\text{m}$ to at least 120m. The space is available by repurposing the current painted island. No widening of the bridge is required. The analysis and subsequent conclusions are based on all traffic assigned to the N2/Urbans Boulevard roundabout intersection and no trips being generated by Phases A8 and B6. From the analysis, as summarised in Figures A9 and A10 it is evident that the two key intersections are the following: • N2/N9 Westbound onramp (Intersection 4): $V/C = 0.79$ during p.m. peak hour, ± 650 right turning vehicles. Although the delays are still acceptable the queue length will exceed available storage capacity and require more storage. • N2/Urbans Boulevard Roundabout (Intersection 5): $V/C = 0.76$ during a.m. peak hour. The operations of this intersection are still acceptable, but marginal increases in demand could result in operational failures. Therefore, it would be prudent not to allow further development along Urbans Boulevard unless the bridge and link to the Kraaibosch area across the Modderrug River are established. Hence, the total traffic from Phases A and B (Excluding Phase A8 and Phase C) can be accommodated without the link across the Modderrug River and hence without the requirement of a bridge. This should be verified through an updated TIA once most of the proposed uses on the property are operational. • The final design of the gatehouses to each of the estates in terms of the number of service lanes and storage requirements needs to be confirmed by a traffic statement.
16 Public Transport and Non-Motorised Transport	Existing Public Transport (PT) Facilities: There are no existing minibus taxi and/or bus routes within the immediate vicinity of the site. There are currently three phases of the GoGeorge bus service in operation in the George area. The existing bus routes can be seen in Appendix D.

	Planned PT Network: George Municipality/Western Cape Government is planning to extend the current GoGeorge Public Transport System services from George CBD to Victoria Bay in Phase 5 and the Nelson Mandela University (NMU) Phase 6. Planned route C59 to Victoria Bay will be running past the Sawmill site along the current N2. The bus route C59 between Vitoria Bay and George CBD can be routed to include the Welgelegen and Kraaibosch areas. Additionally, with the bridge over the Modder River, the M5 bus route to NMU can also be re-routed to include the Kraaibosch and Welgelegen Areas. Proposed PT Facilities: It is expected that public transport trips will be made to both estates and that there will be a need for dropping off and picking up facilities at the security gates or along Urbans Boulevard in dedicated public transport facilities. The latter would most probably only be feasible once Urbans Boulevard is constructed across the river to the Kraaibosch Area and the GoGeorge services are established along the boulevard. As part of the proposed roundabout along Urbans Boulevard, public transport laybys should be constructed on the downstream side of the roundabout. Existing Non-Motorised Transport (NMT) Facilities: Sidewalks and road shoulders are provided on both sides of Welgelegen Road. There are no dedicated cycle lanes on Welgelegen Road in the vicinity of the development site, forcing cyclists to either cycle on the shoulder of the roads or make use of the pedestrian sidewalk. Pedestrian/NMT Movements Pedestrians can access the Rademachers area via the existing sidewalks along Welgelegen Access Road which runs along the frontage of the proposed development and links to the N2 at the roundabout. There are sufficient pedestrian facilities at the roundabout to safely cross the N2. Proposed NMT Facilities: All new interior roads to be constructed as part of the proposed development need to provide sidewalks for pedestrians. Streetlights and traffic calming measures must also be provided in areas with high pedestrian movements/activity. It is not anticipated that dedicated cyclist facilities will be provided along the roads within the development. However, it is advisable to provide bike racks and bike storage facilities at the entrances to relevant buildings such as the gym. Cyclists can access the development via the existing shoulders along Urbans Boulevard but will have to use the normal traffic lanes within the development. The design speeds of the roadways within the development will be sufficiently low to ensure safe passage for cyclists.
17 Parking	No detailed SDPs have been developed for the individual phases of the development. The parking and parking ratios required by the George Municipal Planning By-Laws should be followed when these are developed.

18 Conclusion & Recommendations	The Meulenzicht and OuMeulen Village development is proposed on Erf 25537, 25538 and 25541 in George, Western Cape. The access to the proposed development is planned to be off Urbans Boulevard which currently provides access to the Outeniqua Family Market and Welgelegen Estate. It is expected that the proposed development will generate 715 vehicle trips in the AM peak hour (187 in/ 527 out) and 711 vehicle trips in the PM peak hour (492 in/219 out). Significant future road planning for the George area is in place and the planning of the development was done in terms of this planning, including the future eastwards extension of the N2, the extension of Urbans Boulevard across the Modderrug River to the Kraaibosch Area and the future link road between Urbans Boulevard and the N2/Victoria Bay intersection. It is expected that the traffic that will be generated by the latent rights in the surrounding area of the proposed development will result in an average annual traffic growth rate of $\pm 4\%$. This could be possible, at least over the short term, but unlikely sustainable over the longer term. However, it was used to allow for a conservative future scenario and taking into account the current growth in the area. From the capacity analysis of the different scenarios, the following can be concluded: • Existing Conditions: All the intersections are operating acceptably during both the typical AM and PM weekday peak hours. No improvements are required at any of the study intersections. • Background Conditions: All the intersections are expected to operate acceptably during both the typical AM and PM weekday peak hours. No improvements are required at any of the study intersections. • Site Development Plan: The SDP was developed taking into account all the long-term road planning in the area, including the future extension of the N2, the need for a link road between Urbans Boulevard and the N2 at the Victoria Bay intersection and access to land-locked properties not included in the development. The alignment and topography of Urbans Boulevard and the need for access to the N2/Victoria Bay link road limit the number of access opportunities off Urbans Boulevard. The optimal solution to service the land on either side of Urbans Boulevard was a single access point, controlled by a single-lane roundabout. A temporary access is proposed as a construction access and to also provide access via the SANRAL road reserve to the Garden Route Market. • Total Traffic Conditions: To accommodate the expected additional traffic that will be generated by the proposed development the following mitigation measures will be required: ○ Construct a single-lane roundabout (Intersection 6) to provide access to the Meulenzicht and OuMeulen Village. ○ Provide public transport laybys on either side of the roundabout along Urbans Boulevard. The design should be
--	---

	approved by the GoGeorge team. ○ Extend the ±30m southbound right turn lane at the N2/Knysna Road on-ramp to at least 120 m to accommodate the expected increase in queues. ○ Based on the expected total traffic from Phases A and B (excluding Phase A8 and Phase C) it is not required to extend Urbans Boulevard across the Modderrug River. The operations of Intersection 5 are still acceptable, but marginal increases in demand could result in operational failures. Therefore, it would be prudent not to allow further development along Urbans Boulevard unless the bridge and link to the Kraaibosch area across the Modderrug River are established. This should be verified through an updated TIA once most of the proposed uses on the property are operational. ○ Adequate provisions for cyclists and pedestrians should be made within the estates. These facilities should link logically to the sidewalks and shoulders along Urbans Boulevard. The public facilities such as the gym should also provide secure bicycle parking. ○ The parking ratios required by the George Municipal Planning By-Laws should be followed to determine the parking requirements for each use as the detailed site plans are developed. ○ Prior to the GoGeorge services operating along Urbans Boulevard, public transport users would be dropped off and picked up at the security entrances. Sufficient allowance should be made for these activities at the entrance gates. ● The proposed development should be capped at the uses and trips evaluated in this study. The evaluation excluded the trips to/from the portions labelled as Phases A8 and C. The traffic from these portions would most likely require that Urbans Boulevard be extended across the Modderrug River to link to the Kraaibosch Area. This should be confirmed through an updated TIA once most proposed uses are completed and operational. s It is concluded that the additional traffic from the proposed development can be accommodated on the transport network with minor mitigation requirements. It is recommended that the proposed development be approved from a transportation point of view provided that the required mitigation as defined in this study is in place.
--	---

REFERENCES

1. Highway Capacity Manual (HCM), Quality and Level-of-Service Concepts, Transportation Research Board, 9 March 2015
2. South African Road Classification and Access Management Manual, TRH26, Version 1.0, August 2012
3. South African Trip Data Manual, TMH17, Version 1.1, COTO, September 2013
4. Smec, Kraaibosch Roads Master Plan and Cost Apportionment Rev 5.2, April 2022
5. Vela VKE, Apportionment of Cost for Improvements and Additions to the Road Infrastructure in the Kraaibosch Area, January 2006

Annexure A

Figures

NOTES

MEULENZICHT LANDGOED
65.9788 ha
227 units

OUMEULEN VILLAGE
21.9069 ha
506 units
23 du/ha



**OUMEULEN
VILLAGE**
21.9069 ha

**MEULENZICHT
LANDGOED**
65.9788 ha

PHASE C

**REMAINDER
Agricultural**

OUMEULEN VILLAGE			
	Area	Units	GLA
Phase A1	6,6520 ha		
Main entrance / Gatehouse		70	-
Full title erven			
Phase A2	1,5228 ha	90	-
Apartments			
Phase A3	4,0262 ha	54	-
Full title erven			
Phase A4	2,2029 ha	27	-
Full title erven			
Phase A5	7,8895 ha	205	-
Apartments			
Phase A6	2,4605 ha	-	2 500 m²
Restaurant, Clubhouse, Deli, Gym			
Phase A7	2,5095 ha	60	-
Apartments (School teachers)		-	1 000 m²
Nursery School			
Phase A8	1,5754 ha	-	-
Undetermined / Subdivisional Area			
		506 units	3 500 m²

MEULENZICHT LANDGOED			
		Units	GLA
Phase B1	13,2258 ha	83	-
Main entrance / Gatehouse			
Full title erven			
Phase B2	3,9348 ha	49	-
Full title erven			
Phase B3	4,2971 ha	25	-
Full title erven			
Phase B4	15,2092 ha	70	-
Full title erven			
Phase B5	0,7482 ha	-	-
Treatment plant			
Phase C	28,5678 ha		-
Future Expansion			
		227 units	0 m²

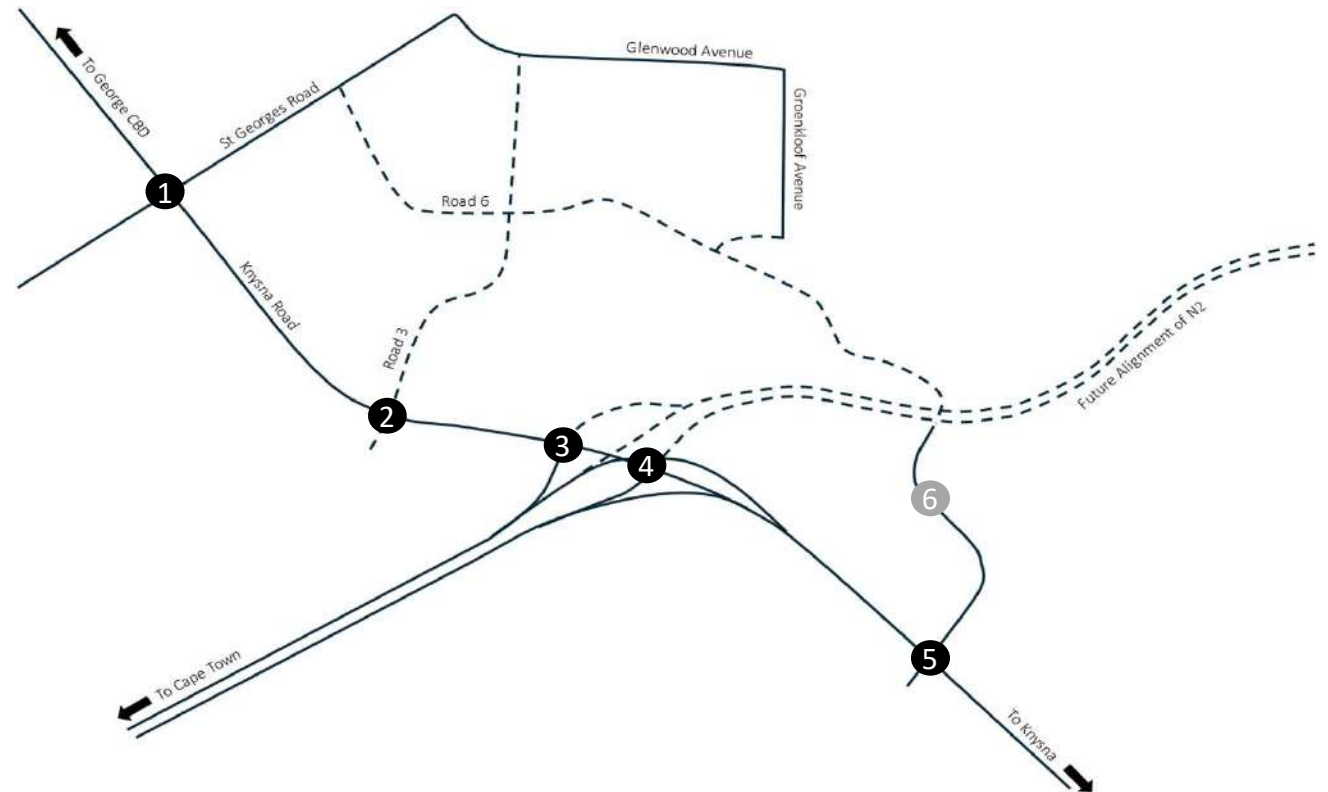
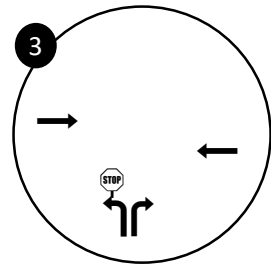
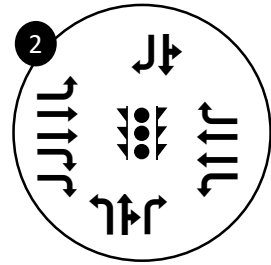
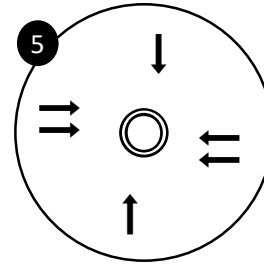
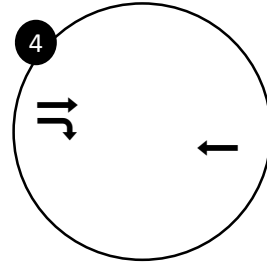
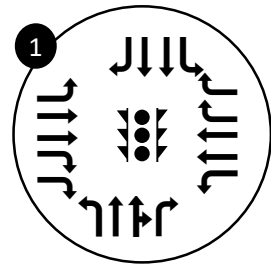
MEULENZICHT / OUMEULEN
ATTERBURY

25537, 25538, 25541
KRAAIBOSCH

GEORGE

CONCEPT MASTER PLAN

CODE	PHASE	DISCIPLINE	NUMBER	REV
24AA	01	UD	1000	N



Legend:

- Turning lanes and turning movements
- Stop Control
- Traffic Signal Control
- Roundabout (Yield Control)

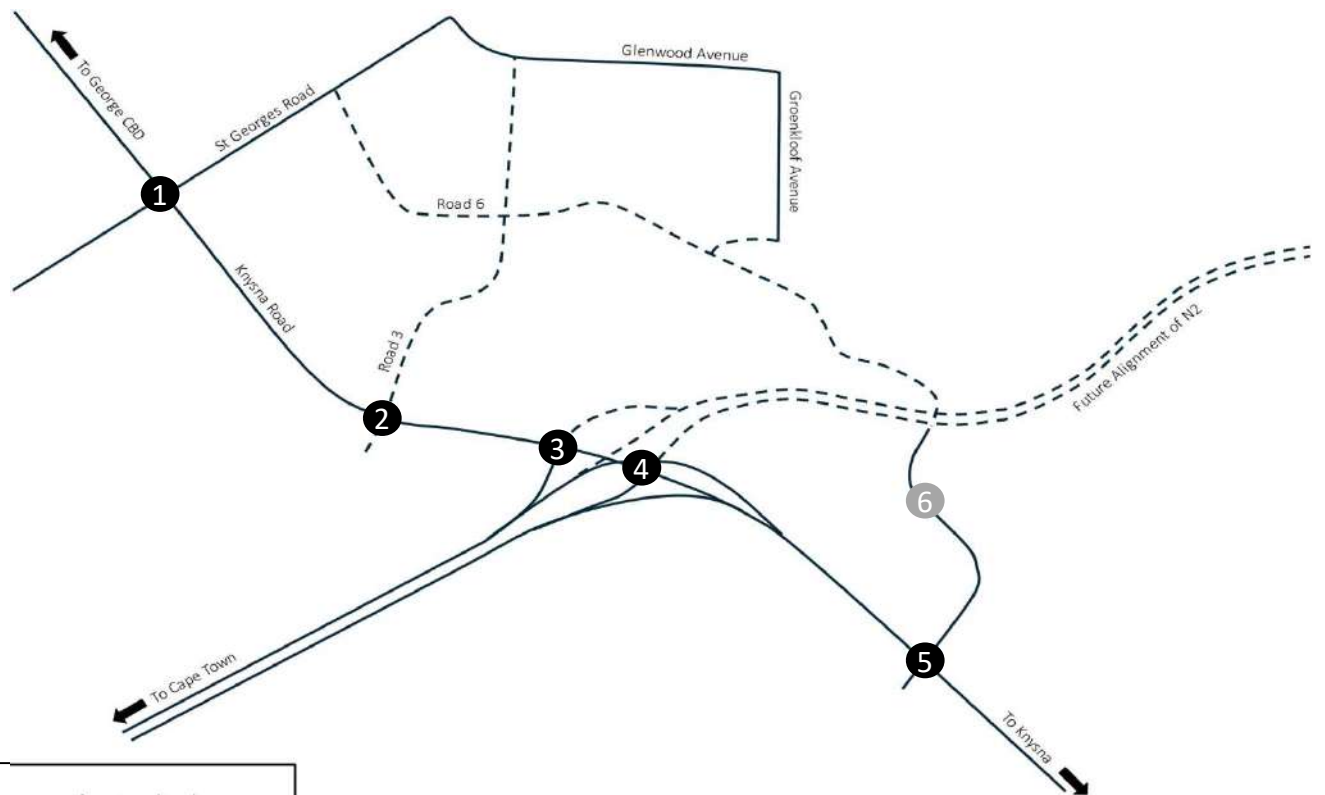
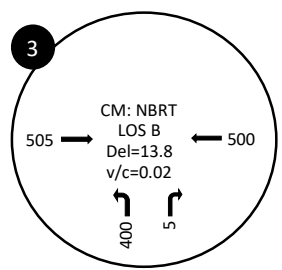
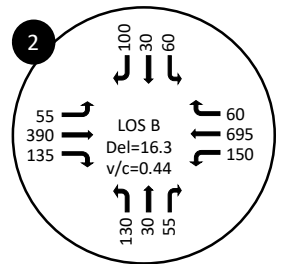
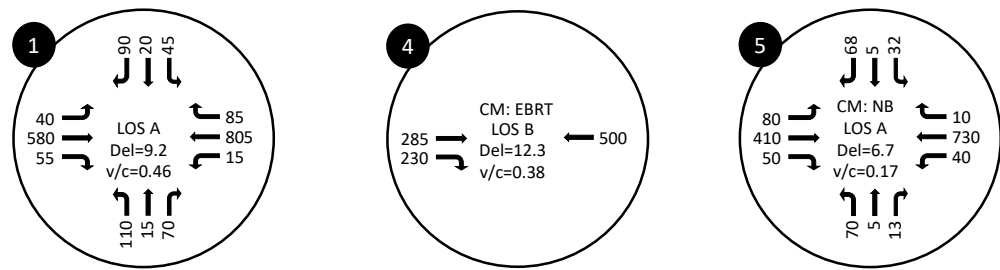
Diagrammatic / Not to Scale



Oumeulen Village and Meulenzicht Landgoed, George

Existing Conditions
Lane Configurations and Control

Figure:
A2



CM: Critical Movement
LOS: Level of Service of intersection if Signal or 4-way Stop or of Critical movement if unsignalised
DEL: Avg Delay per vehicle if signalised or for critical movement if unsignalised
V/C: Critical V/C Ratio
Turning movements
Free Flow Left Turn
Critical Movement
Overlap Left Turn

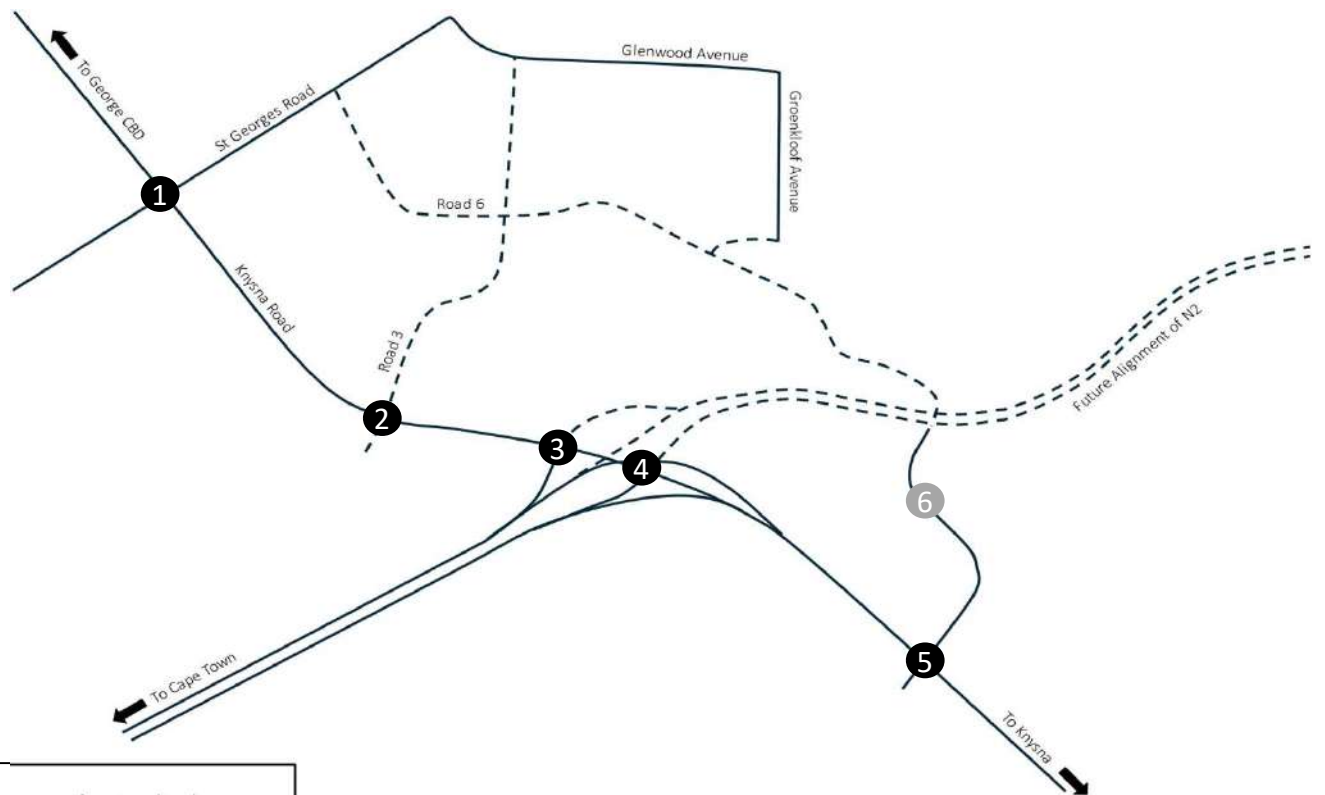
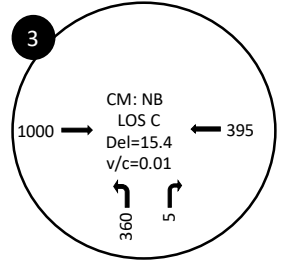
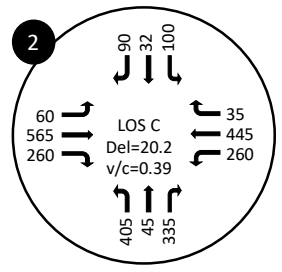
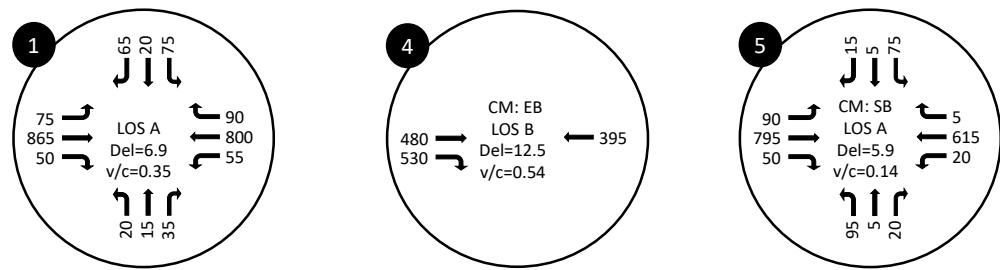
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Oumeulen Village and Meulenzicht Landgoed, George

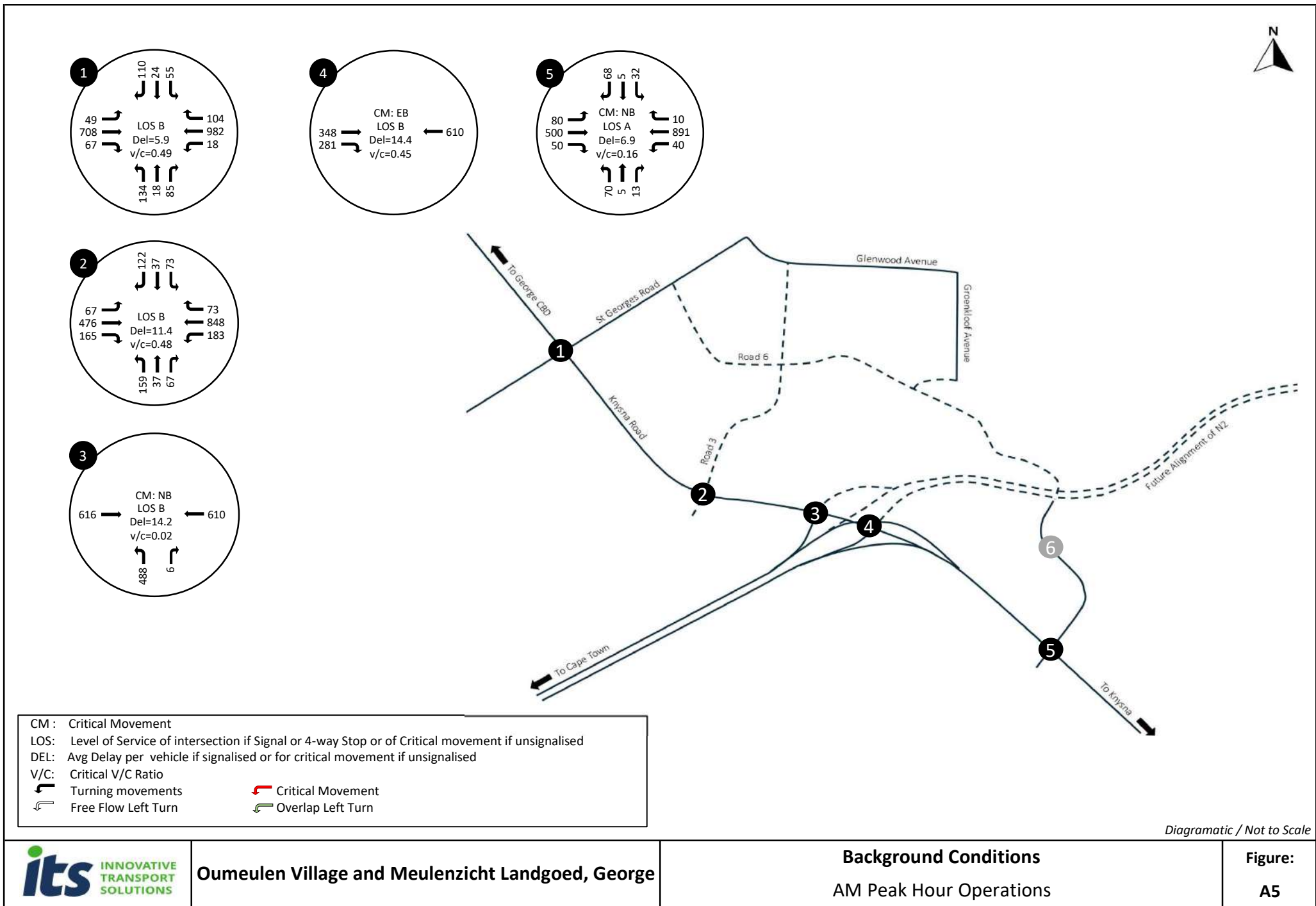
Existing Conditions
AM Peak Hour Operations

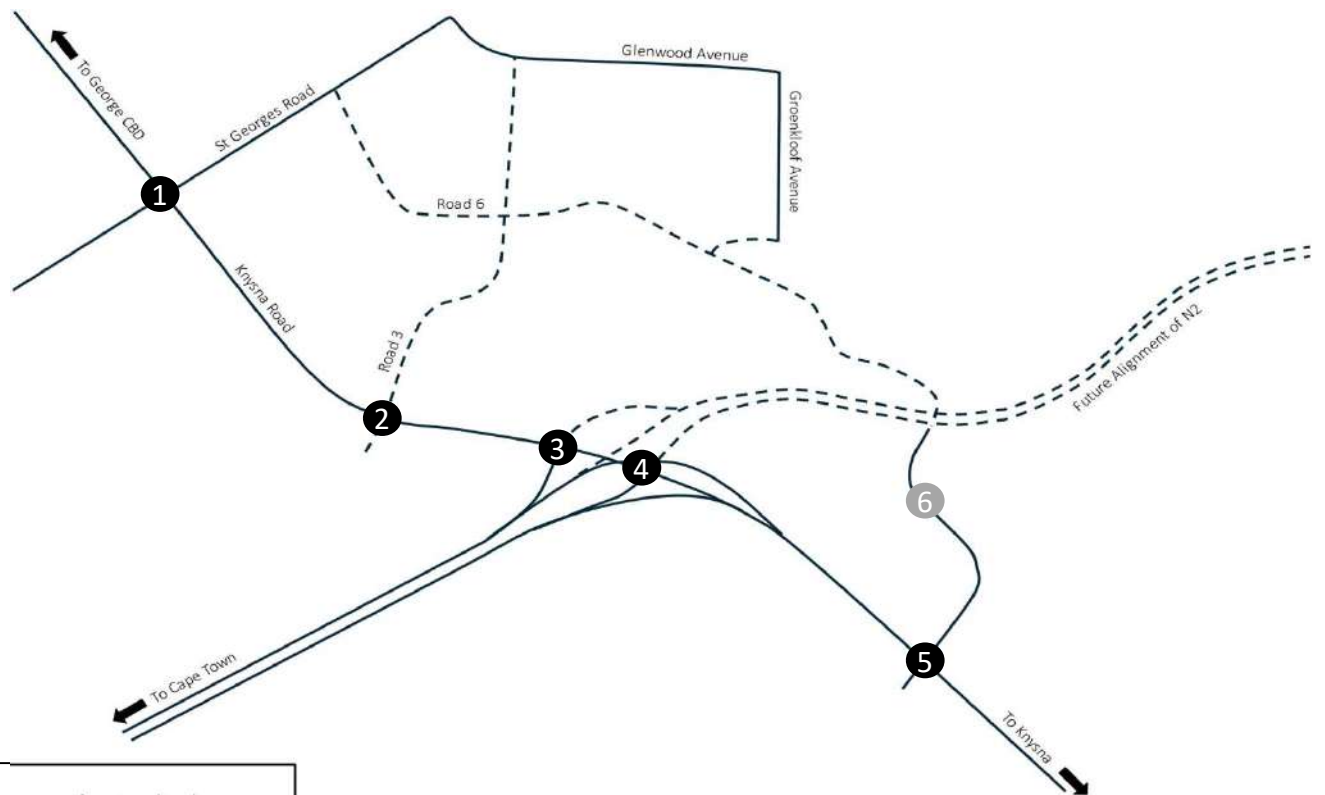
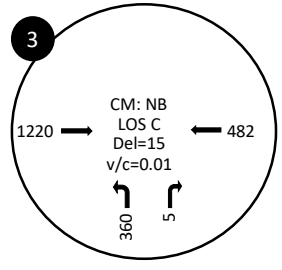
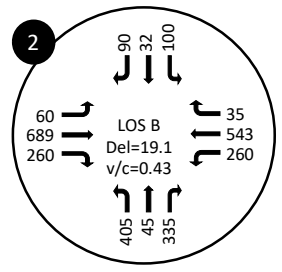
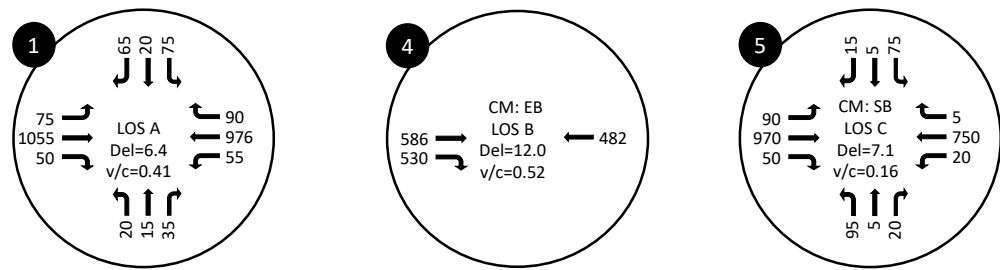
Figure:
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CM : Critical Movement
LOS: Level of Service of intersection if Signal or 4-way Stop or of Critical movement if unsignalised
DEL: Avg Delay per vehicle if signalised or for critical movement if unsignalised
V/C: Critical V/C Ratio
↩ Turning movements
↪ Free Flow Left Turn
↩ Critical Movement
↪ Overlap Left Turn

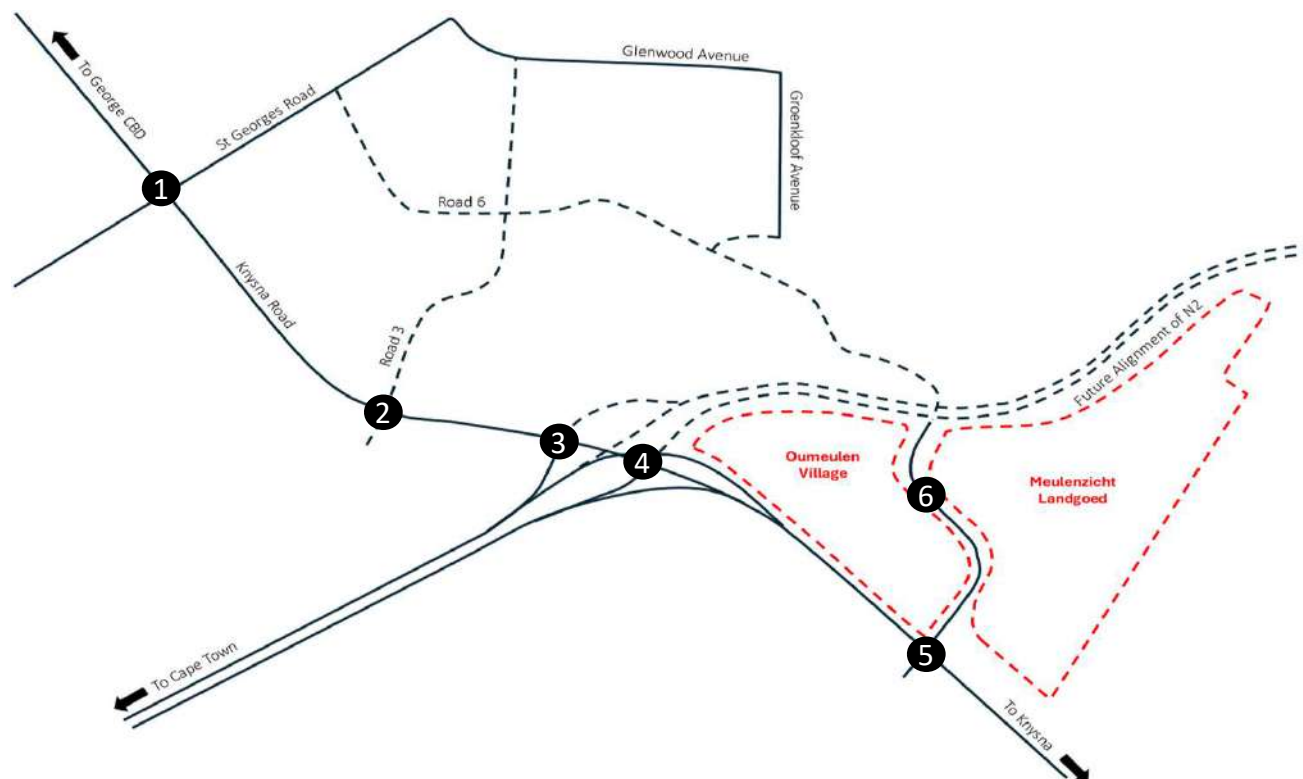
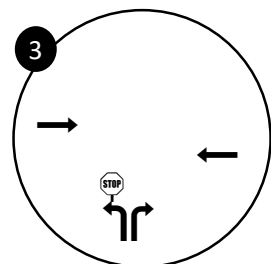
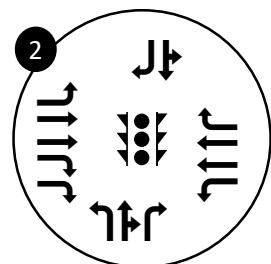
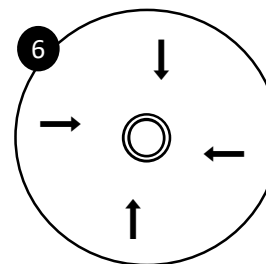
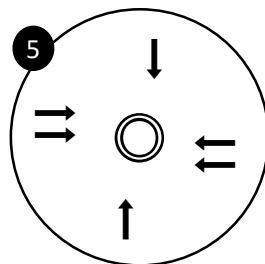
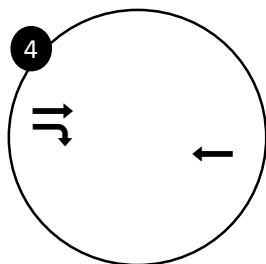
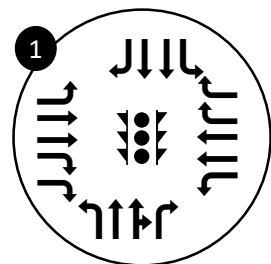
Diagrammatic / Not to Scale





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DEL: Avg Delay per vehicle if signalised or for critical movement if unsignalised
V/C: Critical V/C Ratio
Turning movements
Free Flow Left Turn
Critical Movement
Overlap Left Turn

Diagrammatic / Not to Scale



Legend:	
	Turning lanes and turning movements
	Stop Control
	Traffic Signal Control
	Roundabout (Yield Control)

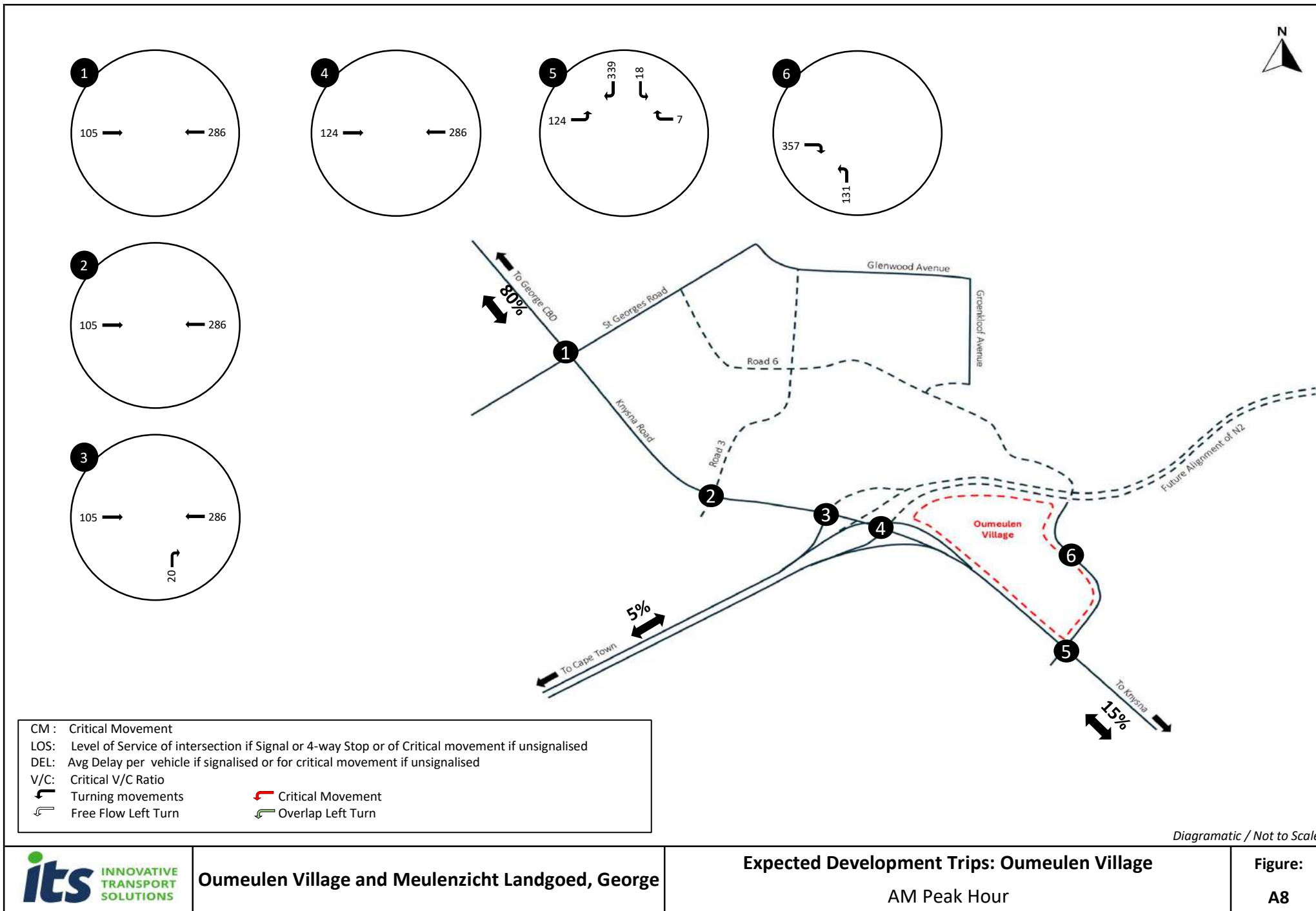
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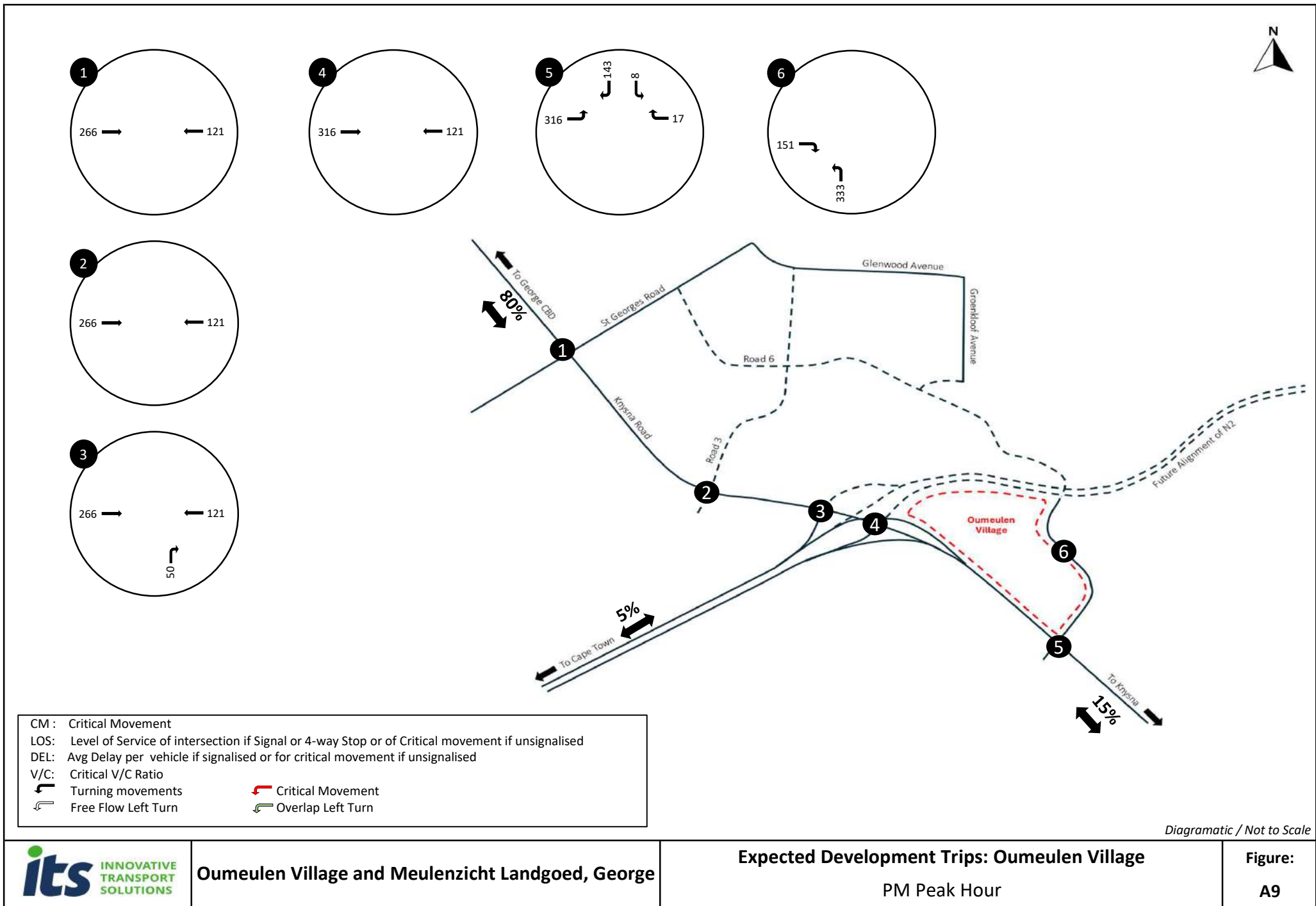


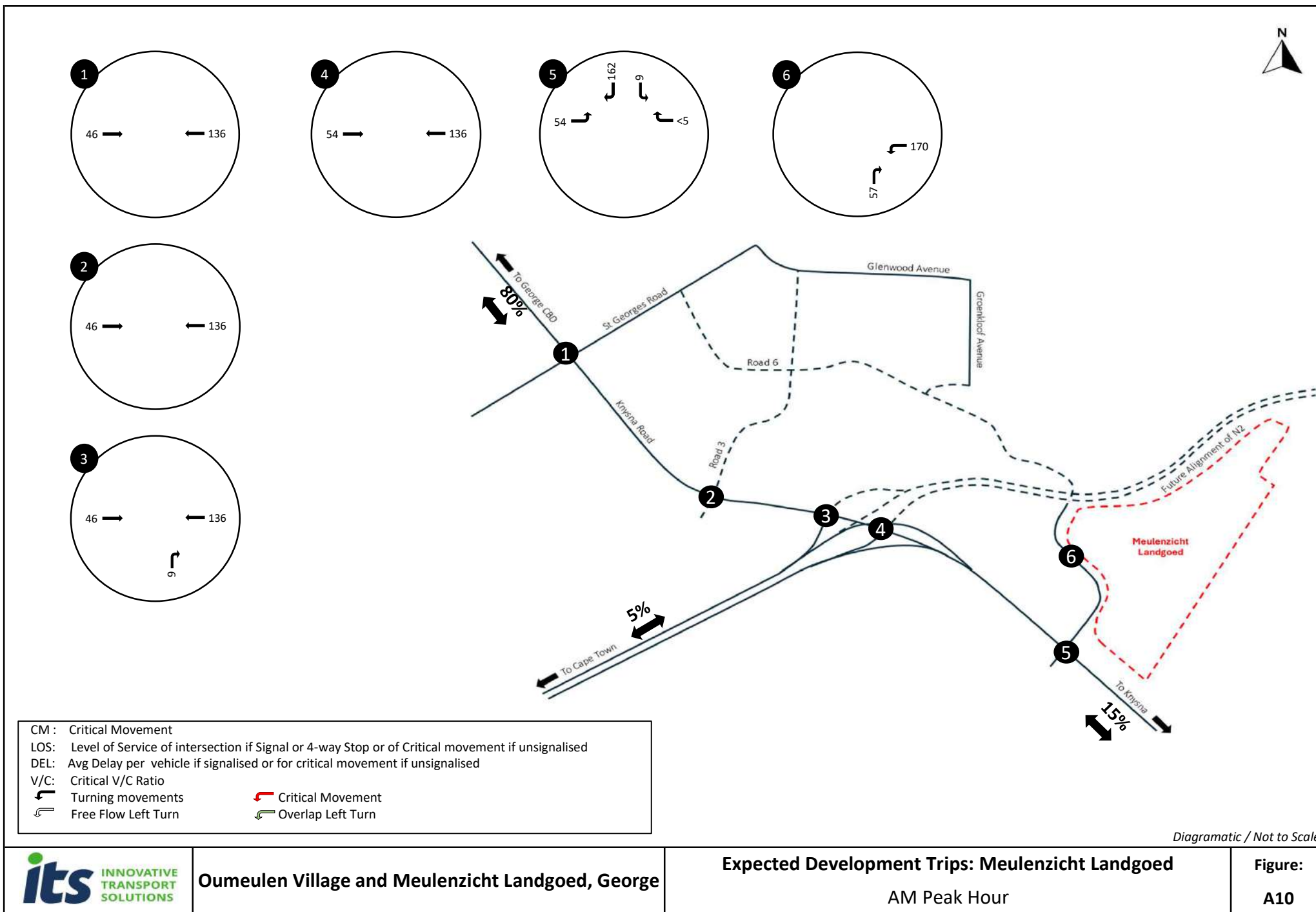
Oumeulen Village and Meulenzicht Landgoed, George

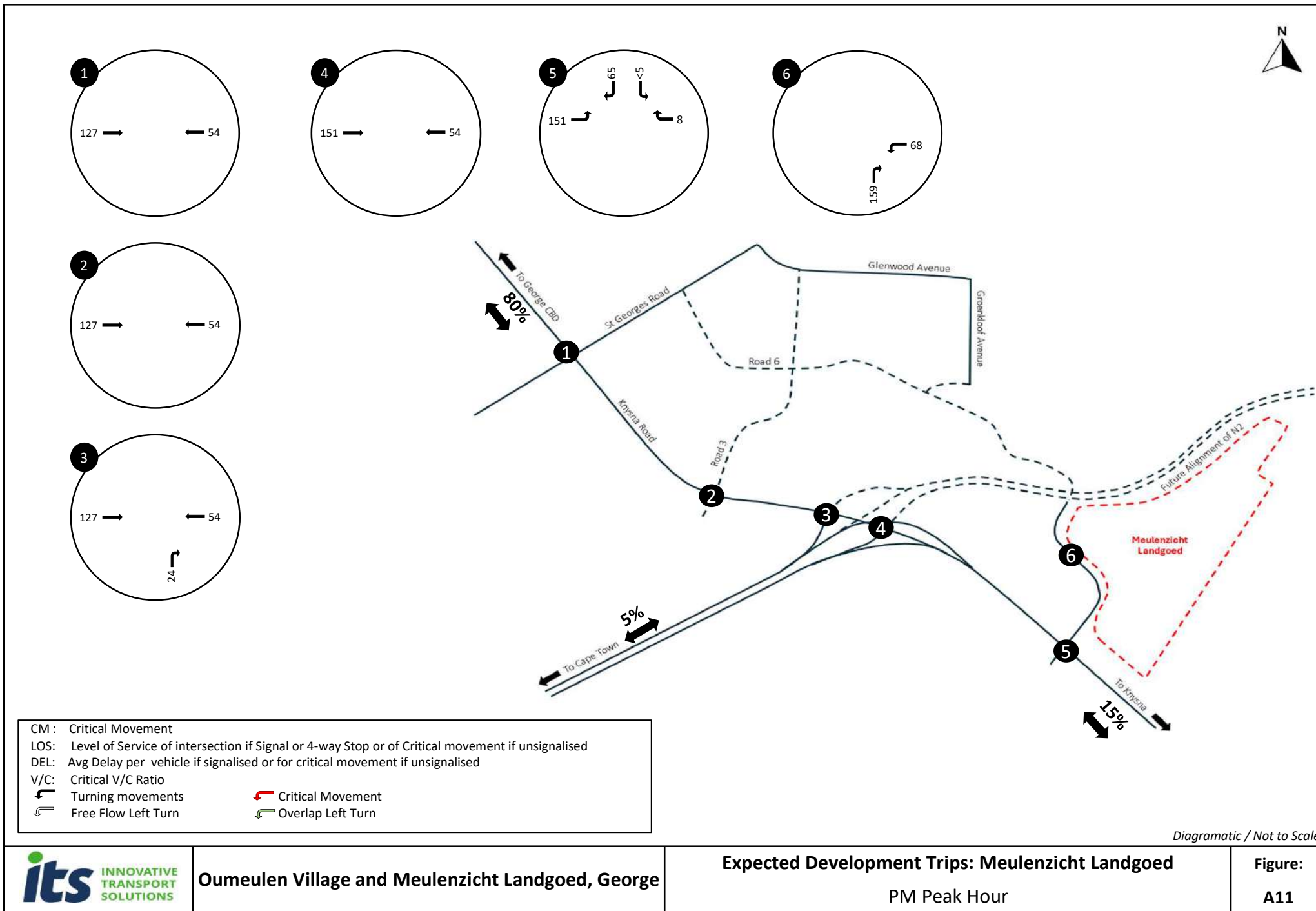
Total Conditions
Lane Configurations and Control

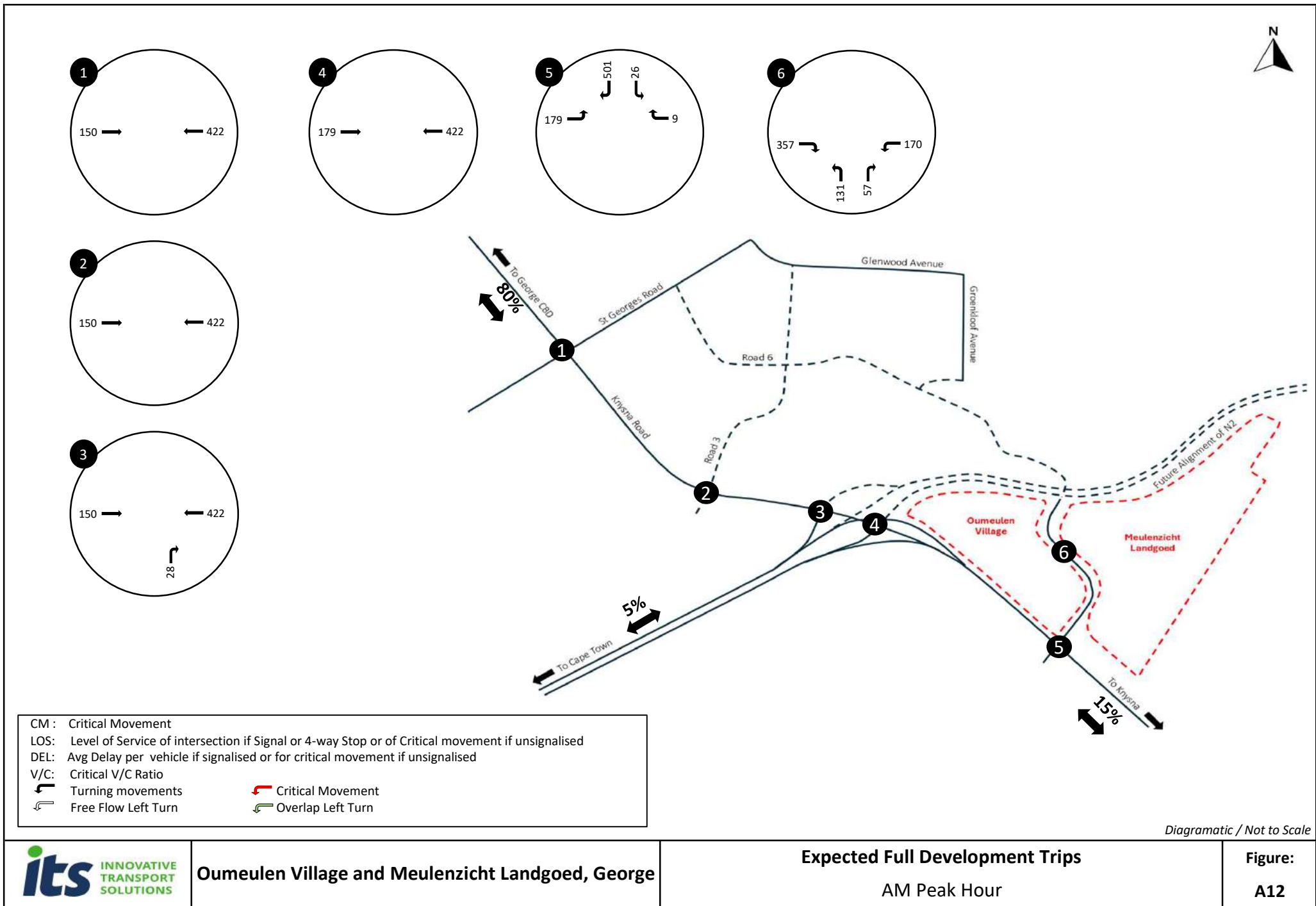
Figure:
A7

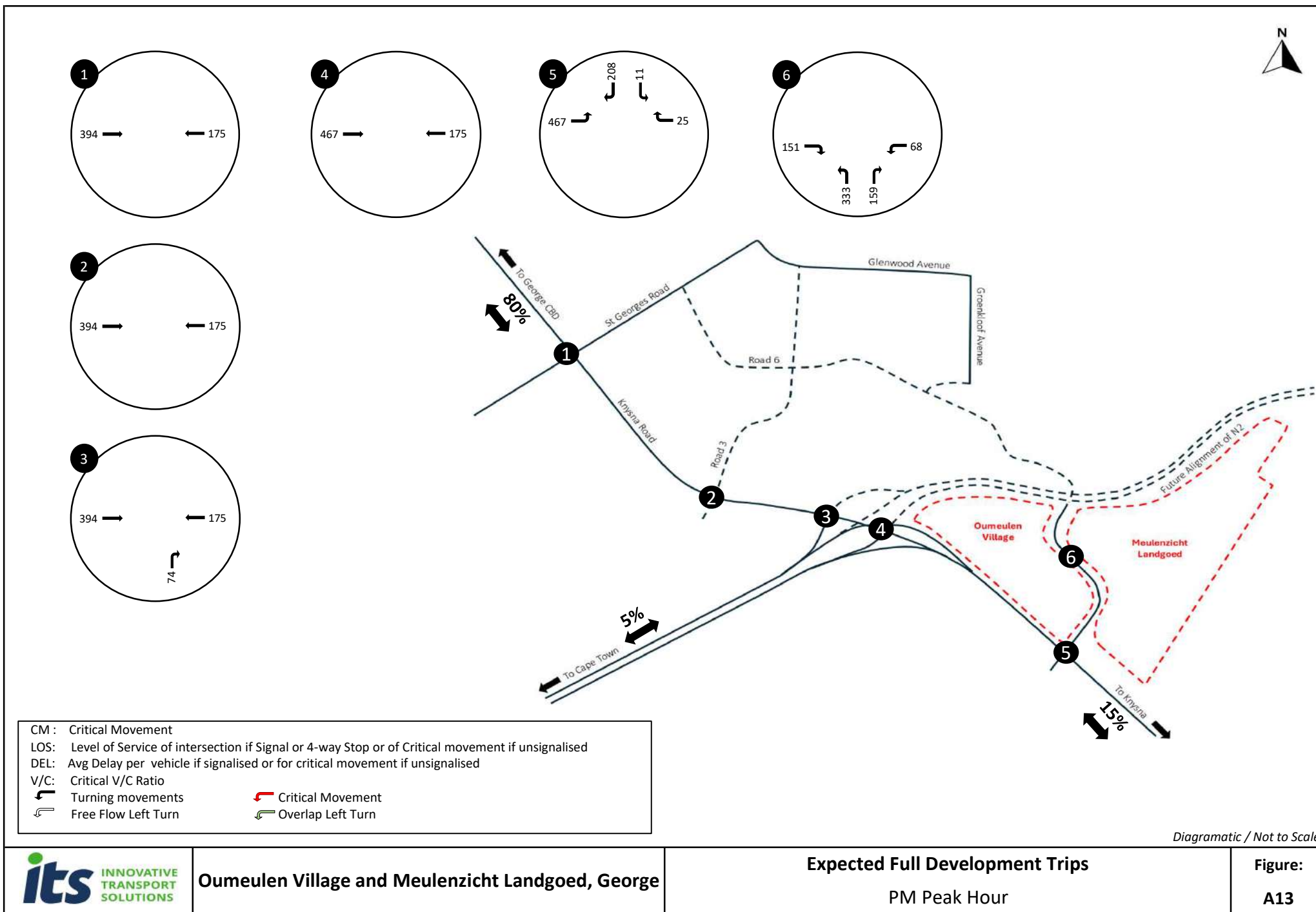


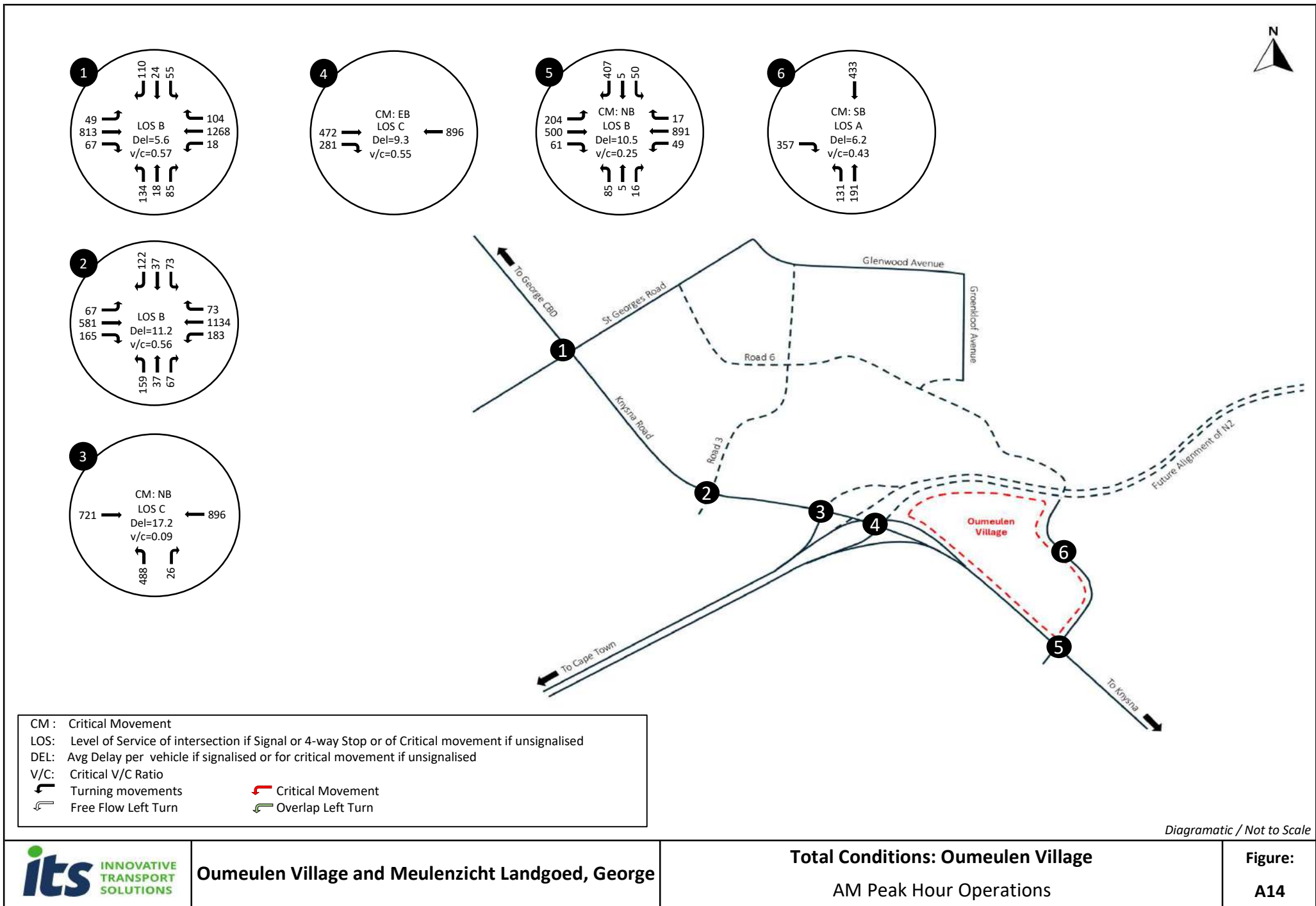






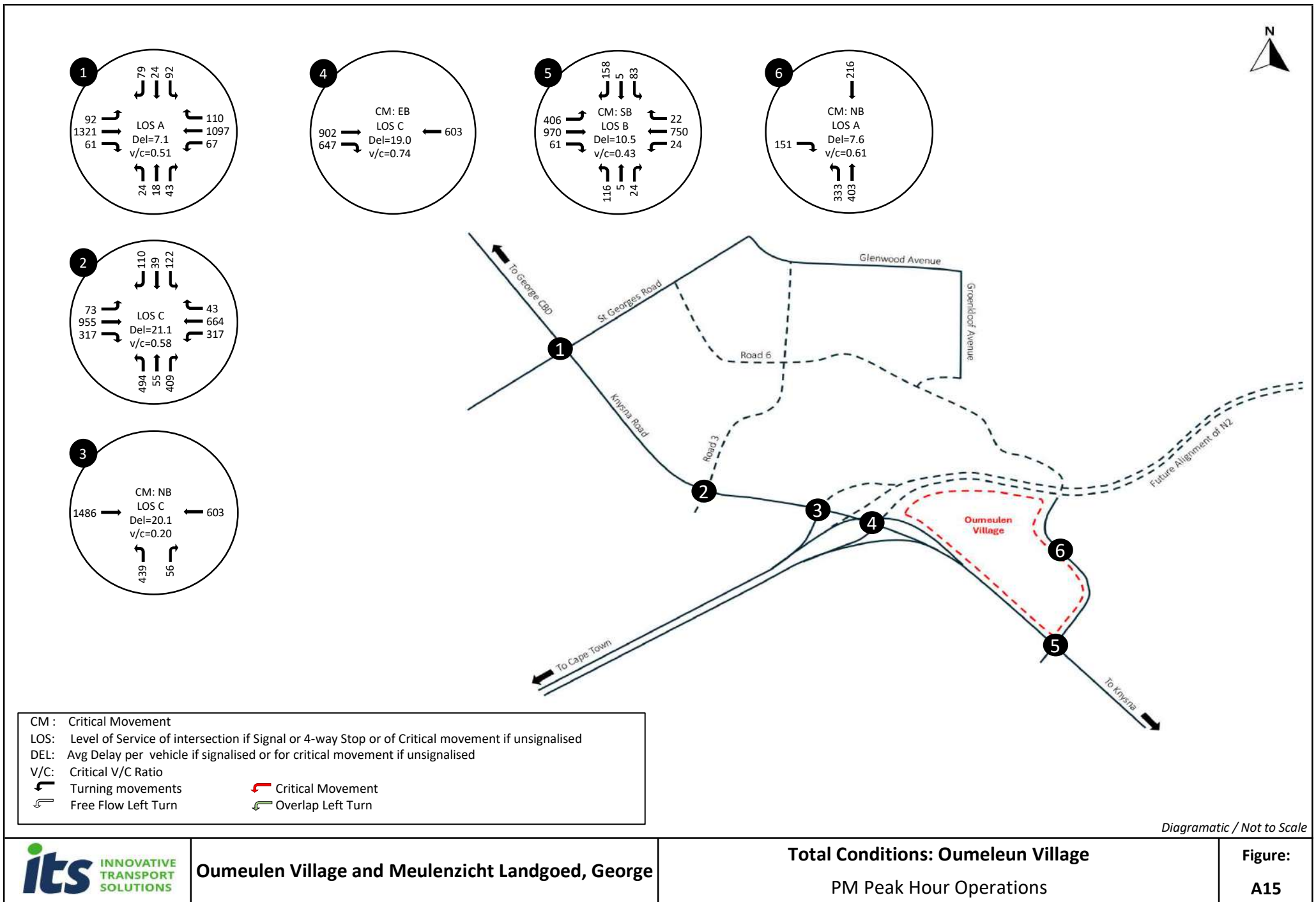


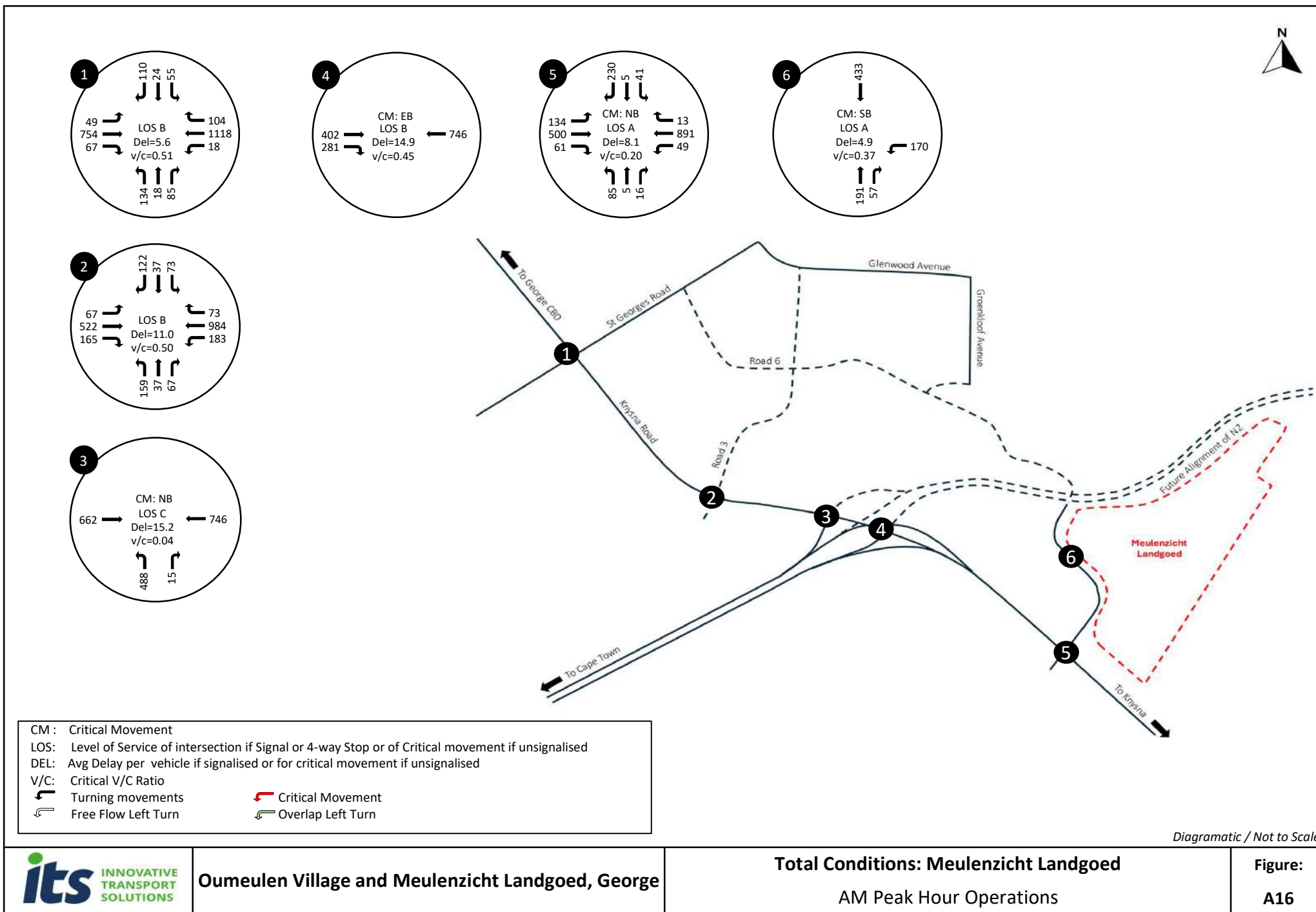


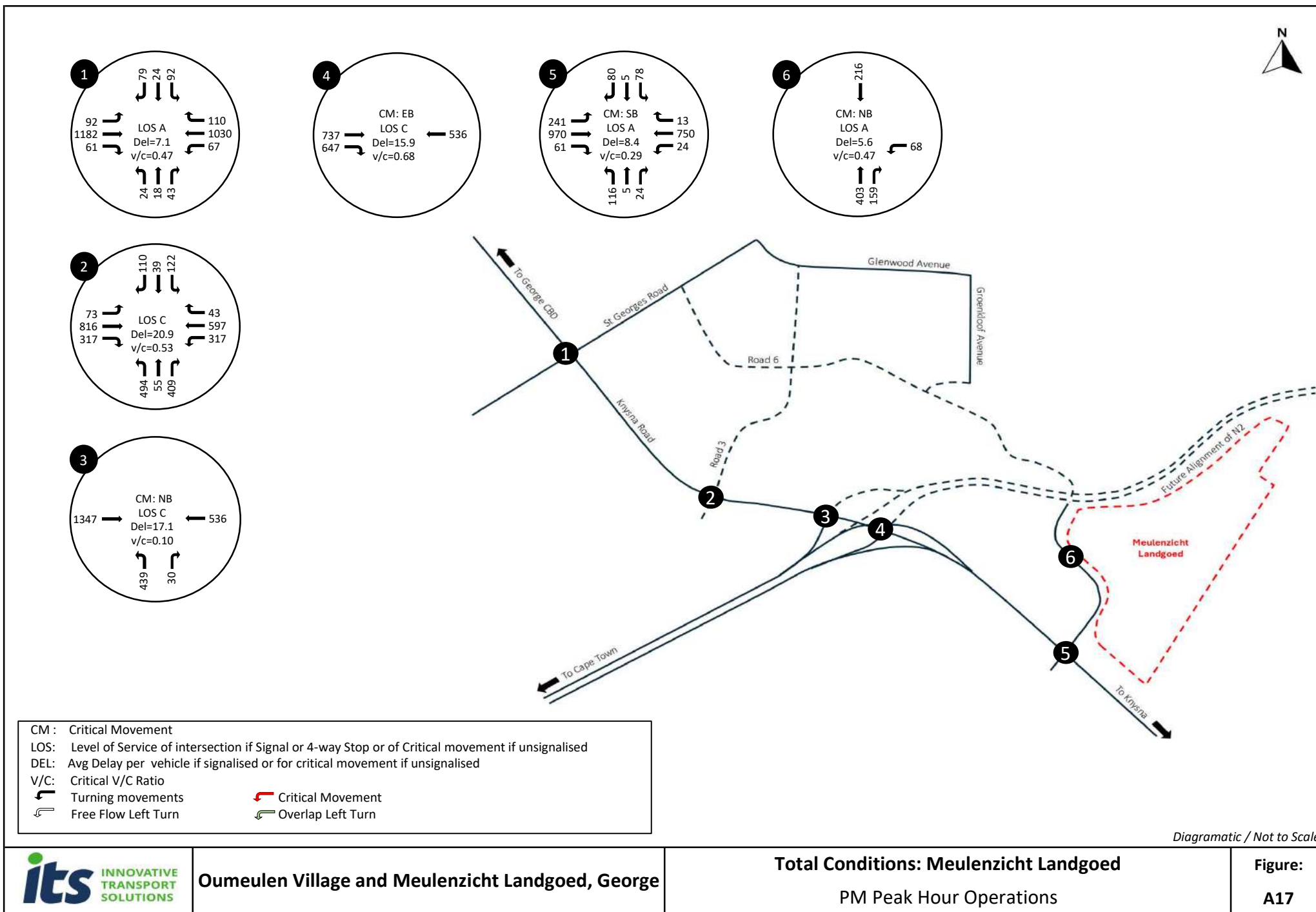


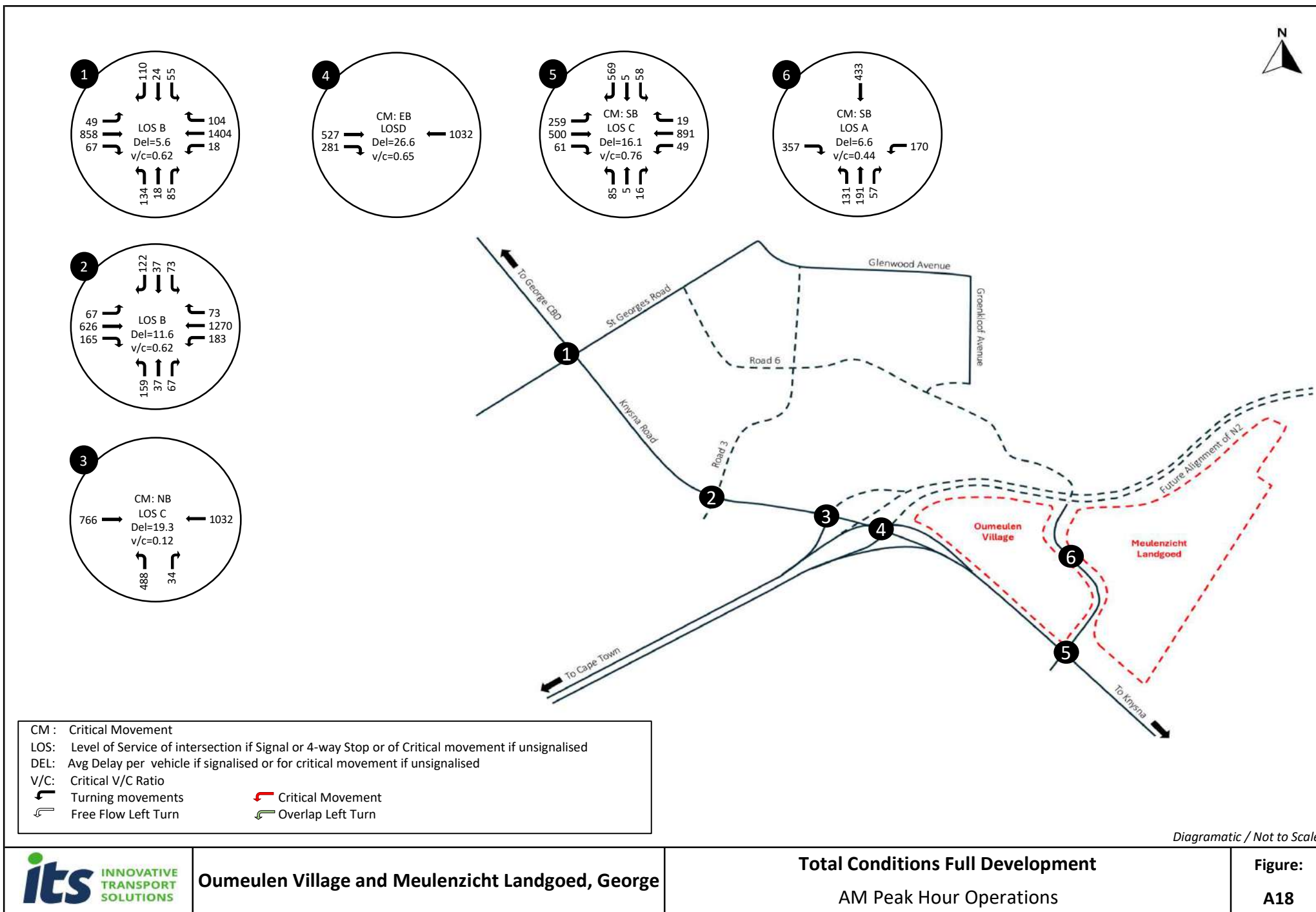
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 ↩ Turning movements
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 ↩ Critical Movement
 ↩ Overlap Left Turn

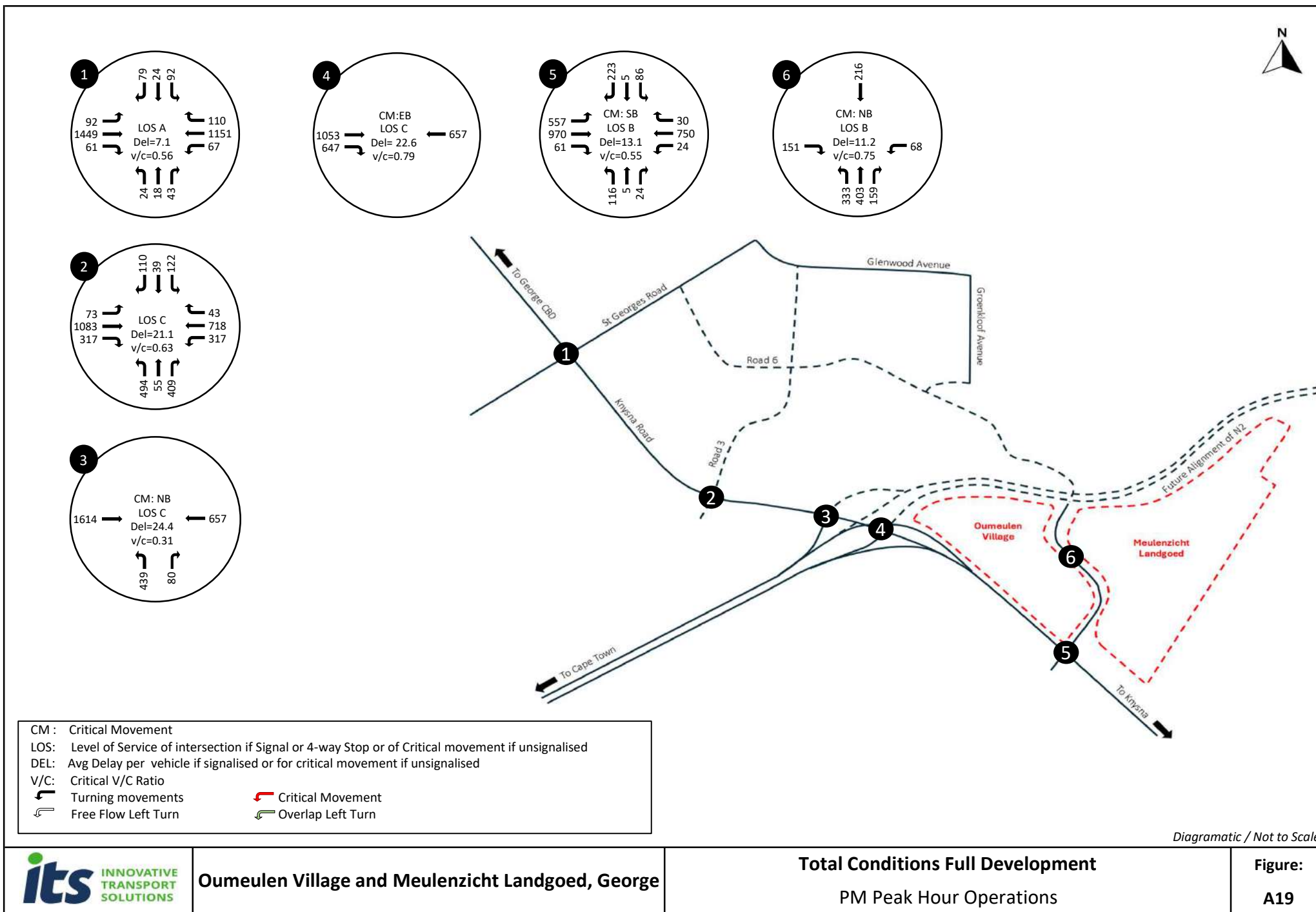
Diagrammatic / Not to Scale











Annexure B

Tables

Table 2: Proposed Land Use for the Meulenzicht and Oumeulen Village

Land Use	Comment	Extent	Units
Meulenzicht Estate			
Full title erven		227	units
Oumeulen Village			
Full title erven		151	units
Apartments		355	units
Nursery School	For use by residents in the immediate area	1 000	sqm
Restaurant, Deli, Gym, Clubhouse		2 500	sqm

Table 3: Trip Generation Rates for the AM and PM Peak Hours

Land Use	Extent	Units	Source	Weekday AM Peak			Weekday PM Peak		
				Base Rate	In	Out	Base Rate	In	Out
Meulenzicht Estate									
Full title erven	227	units	COTO 210	1.00	25%	75%	1.00	70%	30%
Oumeulen Village									
Full title erven	151	units	COTO 210	1.00	25%	75%	1.00	70%	30%
Apartments	355	units	COTO 231	0.85	25%	75%	0.85	70%	30%
Nursery School	1 000	sqm	See comment in Table 2	1.00	50%	50%	0.80	50%	50%
Restaurant, Deli, Gym, Clubhouse	2 500	sqm		1.00	50%	50%	1.00	50%	50%

Table 4: Expected Trip Generation for Proposed Development

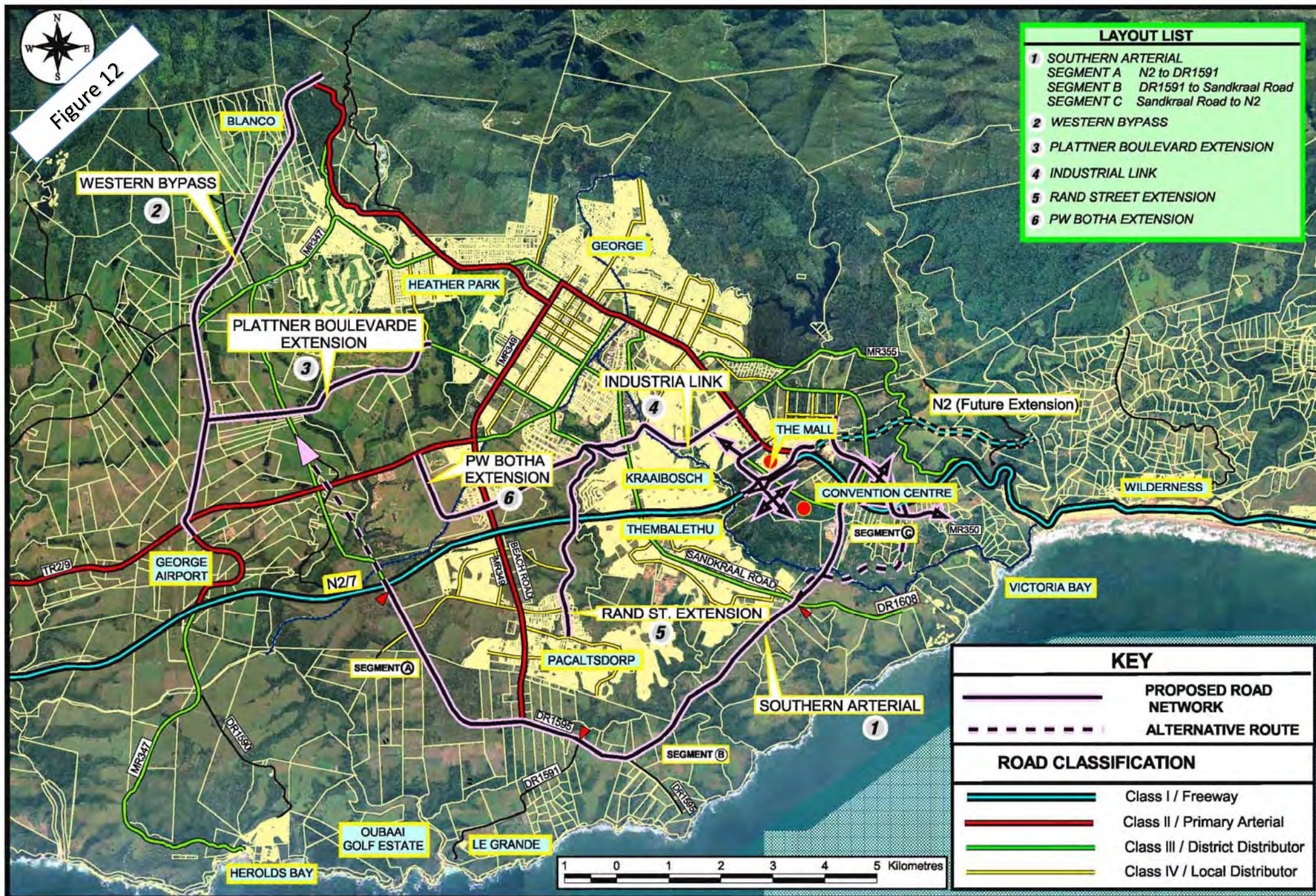
Land Use	Weekday AM Peak			Weekday PM Peak		
	In	Out	Total	In	Out	Total
Meulenzicht Estate						
Full title erven	57	170	227	159	68	227
Oumeulen Village						
Full title erven	38	113	151	106	45	151
Apartments	75	226	302	211	91	302
Nursery School	5	5	10	4	3	7
Restaurant, Deli, Gym, Clubhouse	13	13	25	13	13	25
Total	187	527	715	492	219	711

Annexure C

Future Road Network



Figure 12



LAYOUT LIST

- 1 SOUTHERN ARTERIAL
SEGMENT A N2 to DR1591
SEGMENT B DR1591 to Sandkraal Road
SEGMENT C Sandkraal Road to N2
- 2 WESTERN BYPASS
- 3 PLATTNER BOULEVARDE EXTENSION
- 4 INDUSTRIA LINK
- 5 RAND STREET EXTENSION
- 6 PW BOTHA EXTENSION

KEY

- PROPOSED ROAD NETWORK
- ALTERNATIVE ROUTE

ROAD CLASSIFICATION

- Class I / Freeway
- Class II / Primary Arterial
- Class III / District Distributor
- Class IV / Local Distributor

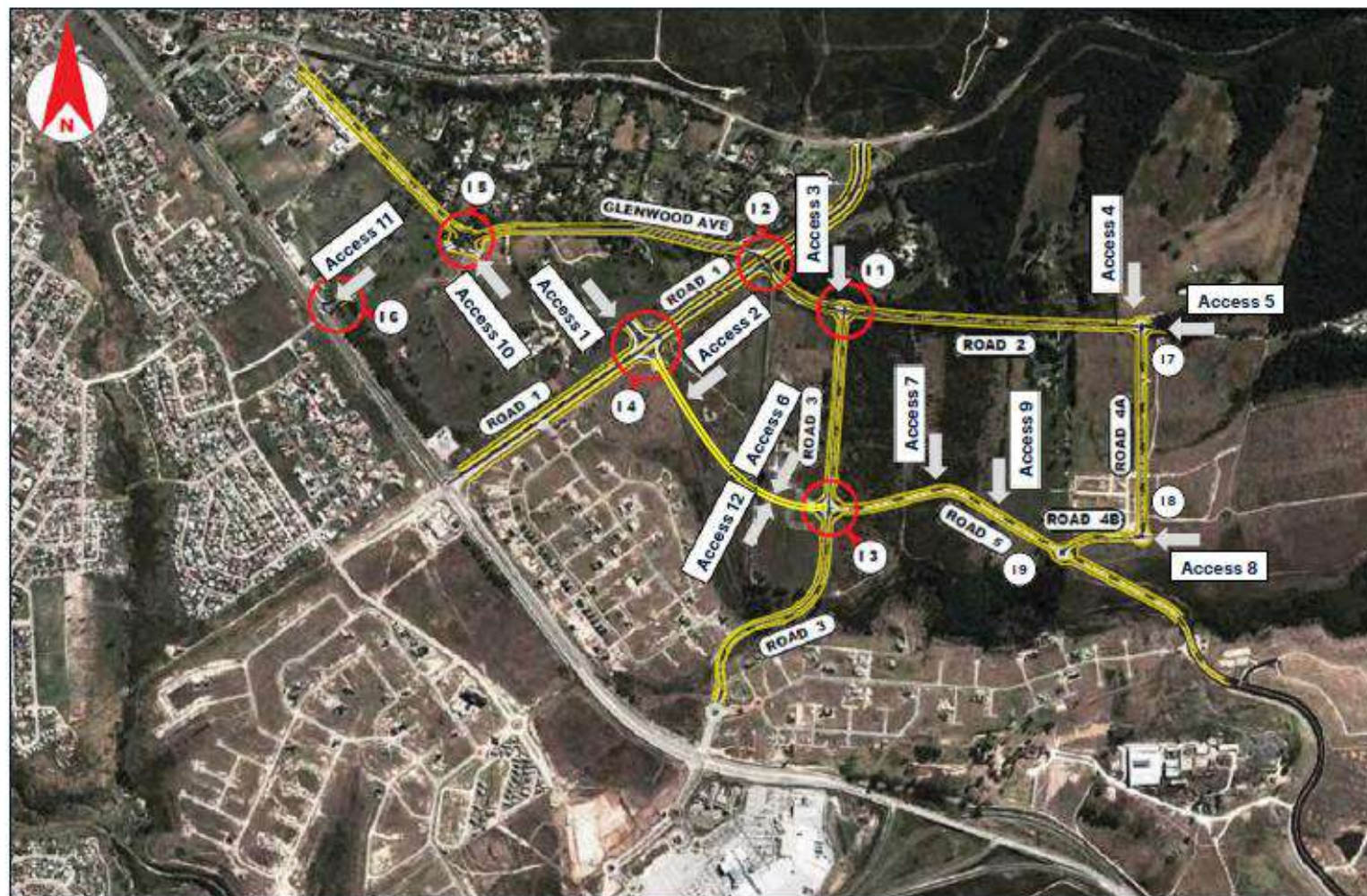


Figure 9-1: Kraaibosch Planned Development Accesses



ANNEXURE G

Preliminary Geotechnical Soil Investigation

AAN DE MEULEN DEVELOPMENT GEORGE

SOIL INVESTIGATION



JULY 2024

Author:
Llewelyn Heathcote

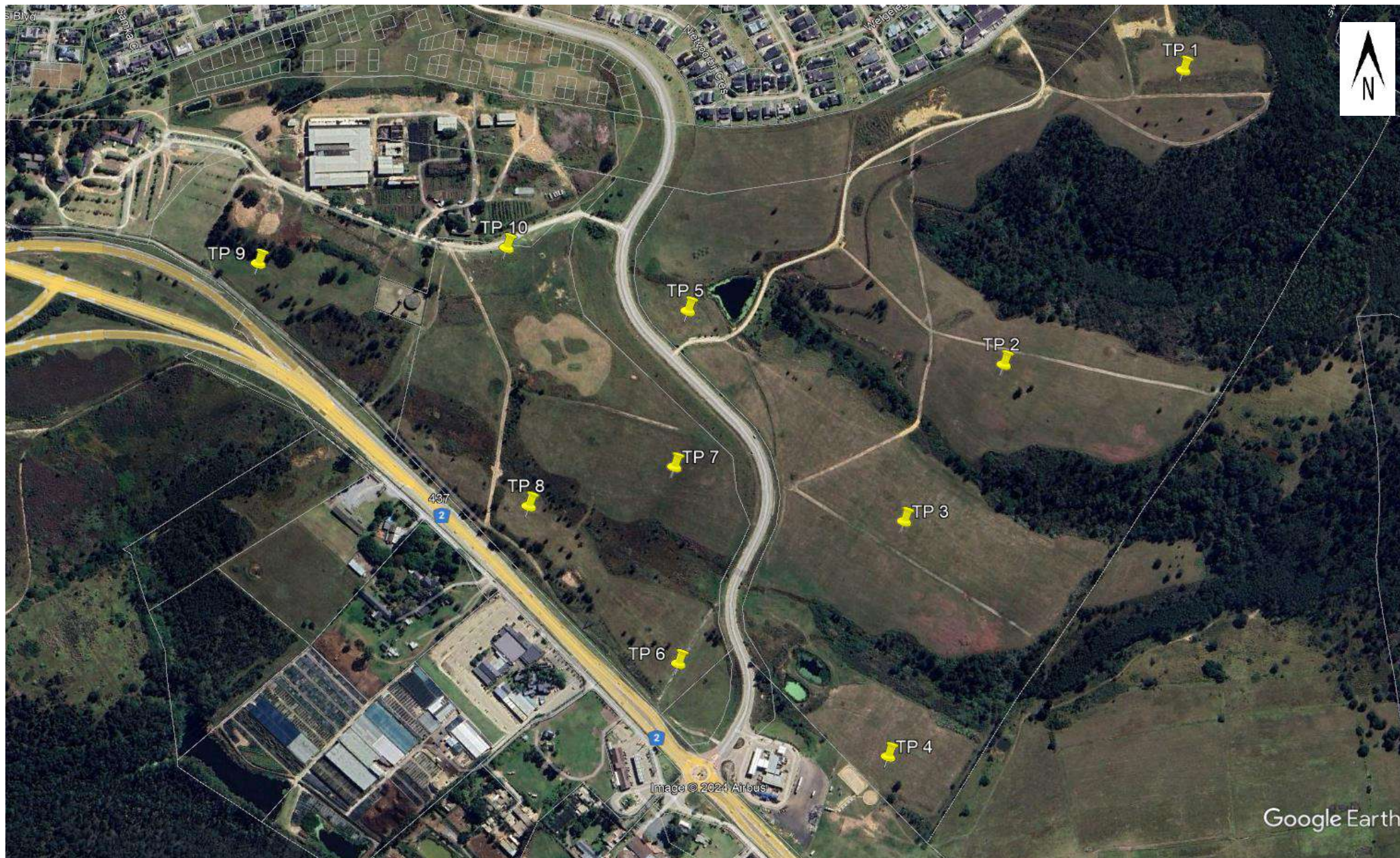


Figure 1:

Locality Plan

Scale:NTS



Outeniqua Lab (Pty) Ltd
Civil Engineering Laboratory



OUTENIQUA LAB (Pty) Ltd.

Registration No. 95/07742/07

Materials Testing Laboratory

6 Mirrorball Street, George : PO Box 3186, George Industria, 6536

Tel: 044 8743274 : Fax: 044 8745779 : e-mail: llewelyn@outeniqua.co.za

R-PROF-1-5

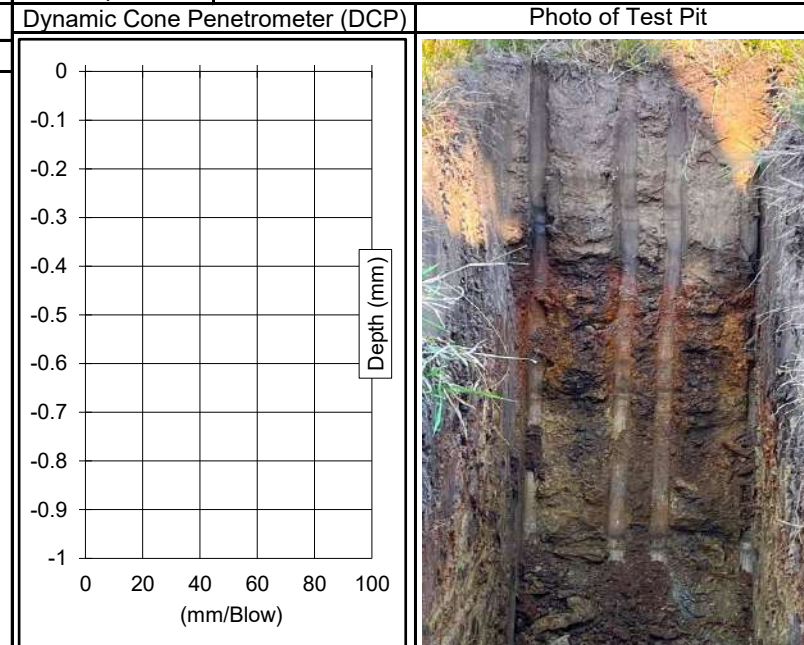
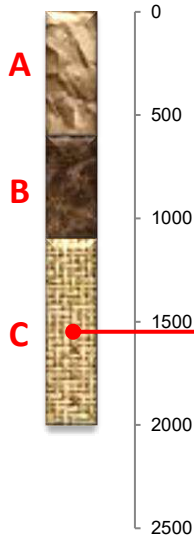
Jan-22

Customer :	Neil Lyners P O Box 757 George 6530
Project :	Aan de Meulen Development - George
Date Reported :	22/07/24

TP1

Datum:	@NGL	Co-ordinates:	
Key to symbols: ● Sample taken ▼ Water seepage			

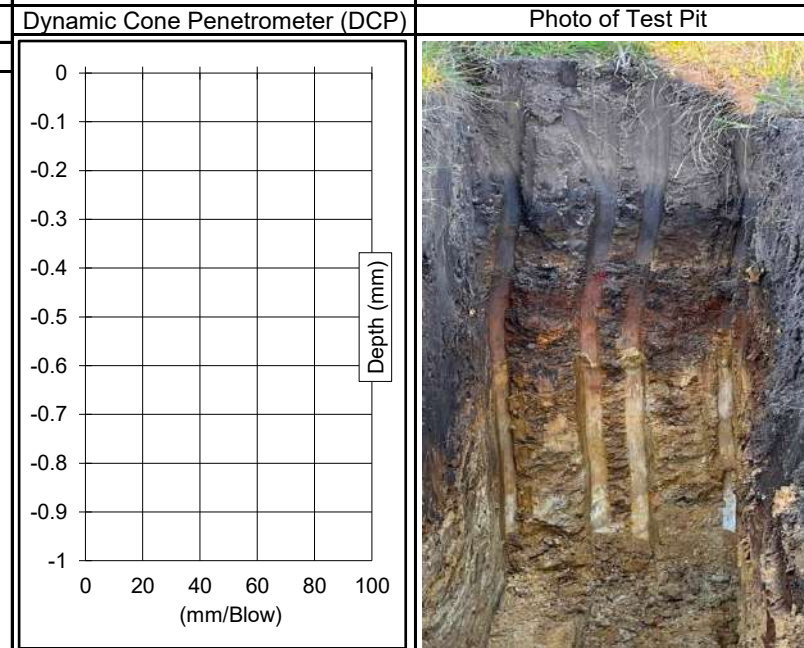
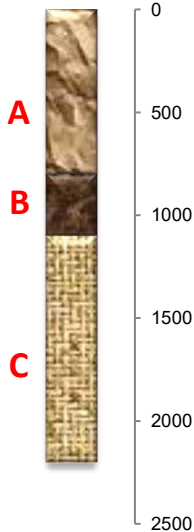
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(600 to 1100)	Slightly moist to moist, dark red mottled light yellowish orange, firm, slickensided, SILT/SILTY CLAY, residual.
(1100 to 2000)	Moist, light yellowish orange, firm, slickensided, SILT/SILTY CLAY BECOMING FINE GRAVEL, residual. (● Sample Taken: California Bearing Ratio & Moisture Content)



TP2

Datum:	@NGL	Co-ordinates:	
Key to symbols: ● Sample taken ▼ Water seepage			

(0 to 800)	Slightly moist, dark brown, medium dense, intact, SILTY SAND, transported.
(800 to 1100)	Slightly moist to moist, dark red mottled light yellowish orange, firm, slickensided, SILT/SILTY CLAY, residual.
(1100 to 2200)	Slightly moist to moist, light yellowish orange, firm, slickensided, SILT/SILTY CLAY BECOMING FINE GRAVEL, residual.





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Jan-22

Customer :

Neil Lyners
P O Box 757
George
6530

Project :

Aan de Meulen Development - George

Date Reported :

22/07/24

TP3

Datum:

@NGL

Co-ordinates:

Key to symbols:

● Sample taken

▼ Water seepage

(0 to 800) Slightly moist, dark brown, medium dense, intact, SILTY SAND, transported.

(800 to 1300) Slightly moist to moist, dark red mottled light yellowish orange, firm, slickensided, SILT/SILTY CLAY, residual.

(● Sample Taken: Foundation Indicator & Moisture Content)

(1300 to 2300) Slightly moist to moist, light reddish orange, firm, slickensided, SILT/SILTY CLAY BECOMING FINE GRAVEL, residual.

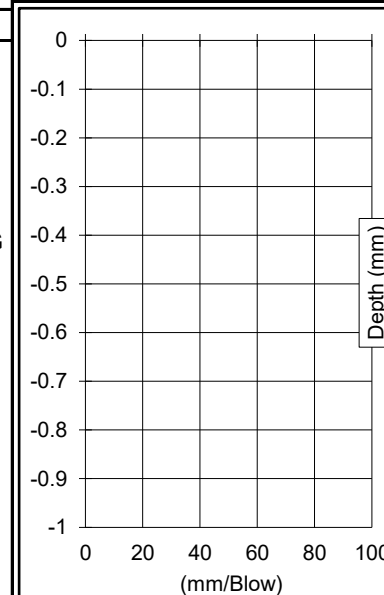
A

B

C

Dynamic Cone Penetrometer (DCP)

Photo of Test Pit



TP4

Datum:

@NGL

Co-ordinates:

Key to symbols:

● Sample taken

▼ Water seepage

(0 to 500) Slightly moist, dark brown, medium dense, intact, SILTY SAND, transported.

(500 to 1000) Slightly moist to moist, dark reddish brown, very dense, intact, FERRICRETE, pedogenic.
(● Sample Taken: California Bearing Ratio & Moisture Content)

(1000 to 2300) Slightly moist to moist, light reddish orange, firm, slickensided, SILT/SILTY CLAY BECOMING FINE GRAVEL, residual.

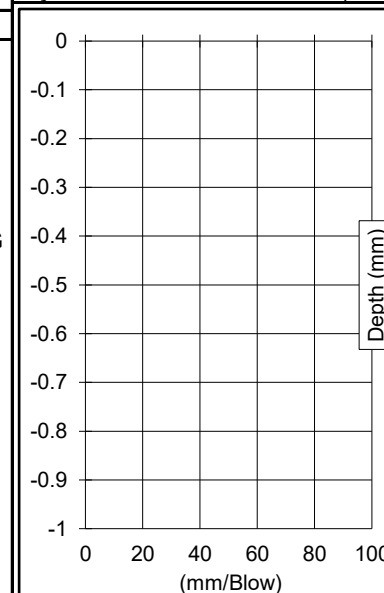
A

B

C

Dynamic Cone Penetrometer (DCP)

Photo of Test Pit



Director:

L Heathcote B-Tech. (Civil Eng.) & BSc Hons (Transport)



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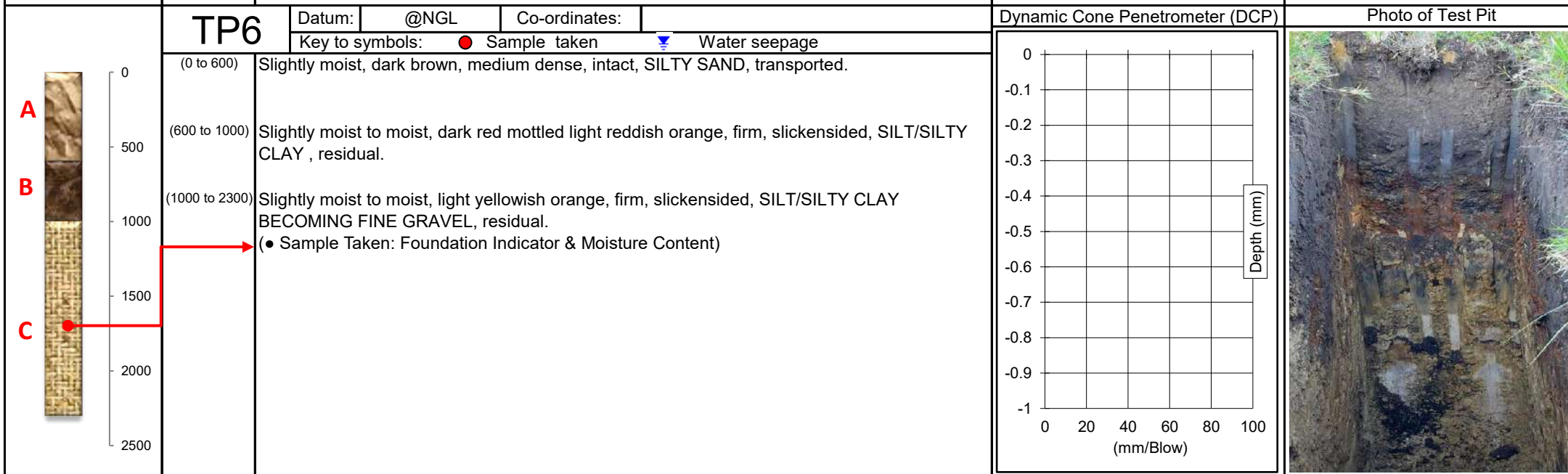
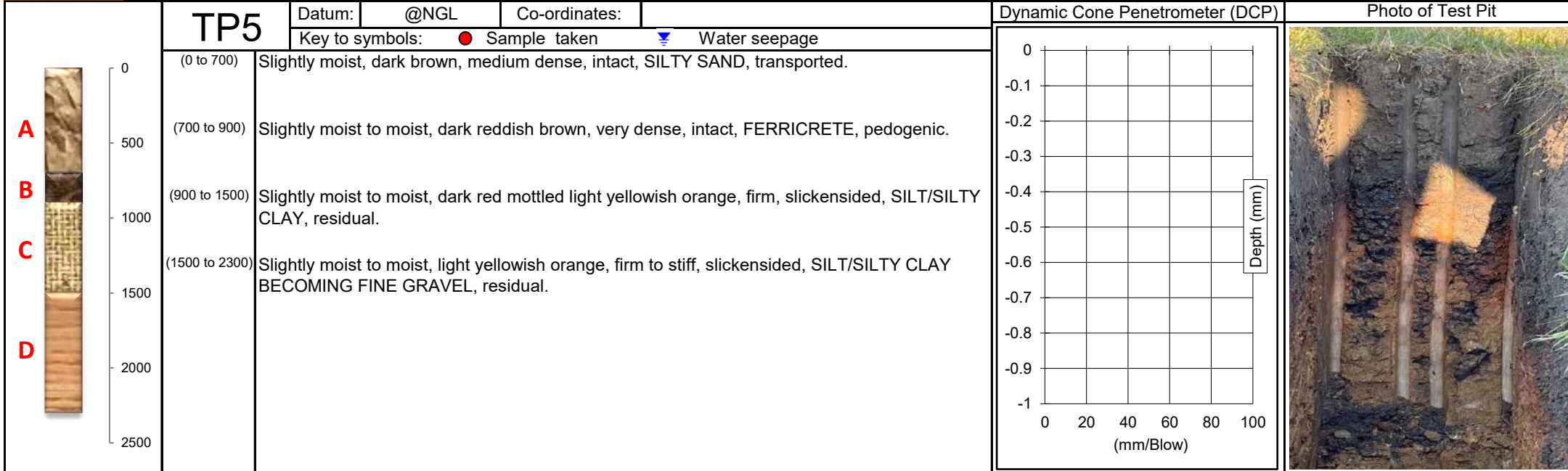
6 Mirrorball Street, George : PO Box 3186, George Industria, 6536

Tel: 044 8743274 : Fax: 044 8745779 : e-mail: llewelyn@outeniqua.co.za

R-PROF-1-5

Jan-22

Customer :	Neil Lyners P O Box 757 George 6530
Project :	Aan de Meulen Development - George
Date Reported :	22/07/24



Director:

L Heathcote B-Tech. (Civil Eng.) & BSc Hons (Transport)



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R-PROF-1-5

Jan-22

Customer :	Neil Lyners P O Box 757 George 6530
Project :	Aan de Meulen Development - George
Date Reported :	22/07/24

TP7		Datum:	@NGL	Co-ordinates:		Dynamic Cone Penetrometer (DCP)	Photo of Test Pit
		Key to symbols: ● Sample taken ▼ Water seepage					
	(0 to 500)	Slightly moist, dark brown, medium dense, intact, SILTY SAND, transported.					
	(500 to 700)	Slightly moist to moist, dark reddish brown, very dense, intact, FERRICRETE, pedogenic.					
	(700 to 1200)	Slightly moist to moist, dark red mottled light yellowish orange, firm, slickensided, SILT/SILTY CLAY, residual. (● Sample Taken: California Bearing Ratio & Moisture Content)					
	(1200 to 2300)	Slightly moist to moist, light yellowish orange, firm to stiff, slickensided, SILT/SILTY CLAY BECOMING FINE GRAVEL, residual.					
TP8		Datum:	@NGL	Co-ordinates:		Dynamic Cone Penetrometer (DCP)	Photo of Test Pit
		Key to symbols: ● Sample taken ▼ Water seepage					
	(0 to 800)	Slightly moist, dark brown, medium dense, intact, SILTY SAND, transported.					
	(800 to 1100)	Slightly moist to moist, dark reddish brown, very dense, intact, FERRICRETE , pedogenic.					
	(1100 to 1600)	Slightly moist to moist, dark red mottled light yellowish orange, firm, slickensided, SILT/SILTY CLAY, residual.					
	(1600 to 2300)	Slightly moist to moist, light yellowish orange, firm to stiff, slickensided, SILT/SILTY CLAY BECOMING FINE GRAVEL, residual.					

Director: L Heathcote B-Tech. (Civil Eng.) & BSc Hons (Transport)



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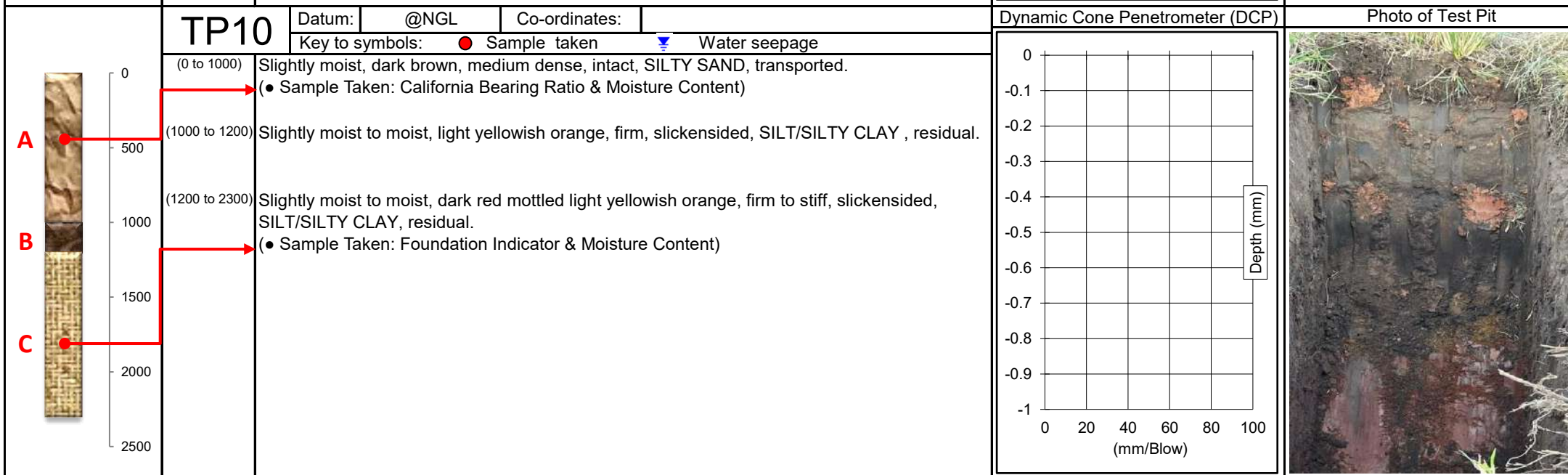
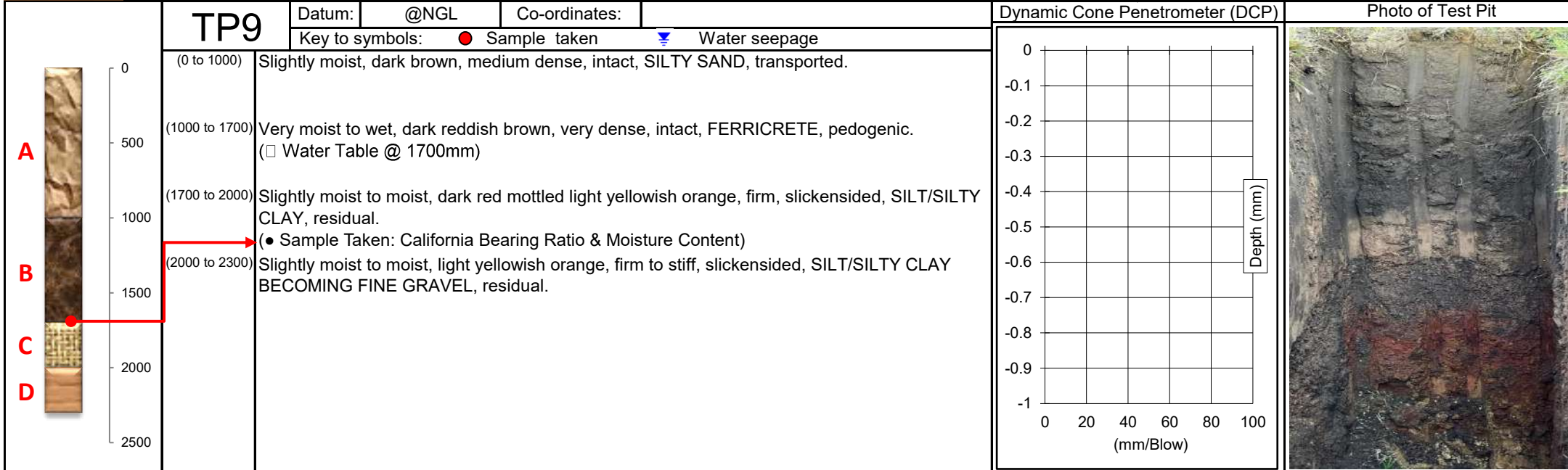
6 Mirrorball Street, George : PO Box 3186, George Industria, 6536

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R-PROF-1-5

Jan-22

Customer :	Neil Lyners P O Box 757 George 6530
Project :	Aan de Meulen Development - George
Date Reported :	22/07/24



Director:

L Heathcote B-Tech. (Civil Eng.) & BSc Hons (Transport)



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R-CBR-1-9

Jun-23



T0347

Customer :	Neil Lyners P O Box 757 George 6530	Project :	Aan de Meulen Development - George
		Date Received :	28/06/24
		Date Reported :	22/07/24
		Req. Number :	2335/24
Attention :	F van Eck	No. of Pages :	1 of 2

TEST REPORT CALIFORNIA BEARING RATIO

Sample Position (SV)		TP 1	TRH 14: Not Classified	TP 4	TRH 14: G4 Base (Natural)	88818		
Depth (mm)		1100-2000		500-1000				
Sample No		88818		88820				
Materials Description	Source	Trial Pit		Trial Pit				
	Colour	Light Yellowish Orange		Dark Reddish Brown				
	Soil Type	Silt/Silty Clay Becoming Fine Gravel		Ferricrete				
	Classification	Insitu		Insitu				
Material Indicators - (SANS 3001 Method GR1)							88820	
Percentage Passing	75 mm	100		100				Opinion
	63 mm	100		100				
	50 mm	100		100	100 - 100	*		
	37.5 mm	100		100	85 - 100	*		
	28 mm	100		100				
	20 mm	100		88	60 - 90	✓		
	14 mm	100		84				
	5 mm	100		60	30 - 65	✓		
	2 mm	97		39	20 - 50	✓		
	0.425 mm	81		23	10 - 30	✓		
0.075 mm	62.7		12.3	5 - 15	✓			
Material Indicators - (SANS 3001 Method PR5)						88818		
Grading Modulus *		0.59		2.25				
Coarse Sand Soil-Mortar (%)		16		41				
Atterberg Limits - (SANS 3001 Method GR10)								
Liquid Limit (%)		41		22	≤ 25		✓	
Plasticity Index (%)		16		4	≤ 6		✓	
Linear Shrinkage (%)		8.0		2.0	≤ 3		✓	
Material Strength - (SANS 3001 Method GR30,GR40 - SCALPED)								
MDD	Max Dry Density (kg/m³)	1848		2414				
	Optimum Moisture Content (%)	9.7		4.9				
	Mould Moisture Content (%)	9.9		5.1				
A	Relative Compaction (%)	100.0		100.0				
	Swell (%)	4.6		0.0	≤ 0.2	✓		
B	Relative Compaction (%)	95.2		94.6				
	Swell (%)	5.0		0.0				
C	Relative Compaction (%)	91.8		91.4				
	Swell (%)	7.5		0.1				
CBR	@100% Max Dry Density	2		156				
	@98% Max Dry Density	2		85	≥ 80	✓		
	@95% Max Dry Density	1		35				
	@93% Max Dry Density	1		19				
	@90% Max Dry Density	1		8				
Material Condition - (SANS 3001 Method GR20)						88818 88820		
Insitu Moisture Content (%)		19.1		6.7				
Soil Classification Of The Material Based Only On The Tests Results Above								
TRH 14 Specification:		Not Classified		G1 Base (26.5mm)				
AASHTO System		A-7-6		A-1-a / A-1-b / A-2-4				
Unified System		CL		GP-GM				
Tests marked with a (*) are NOT SANAS Accredited results.								

- Tests marked with a (*) are NOT SANAS Accredited results.
- Specimens sampled by Outeniqua Lab according to sampling Plan TMH 5 Methods MA2 (Trial Pit).
- Specimens sampled by Llewelyn Heathcote
- The weather conditions were such that there was no detrimental effect on the sample/s taken.

Llewelyn Heathcote
Technical Signatory
For Outeniqua Lab (Pty) Ltd.

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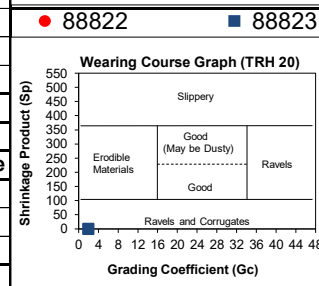
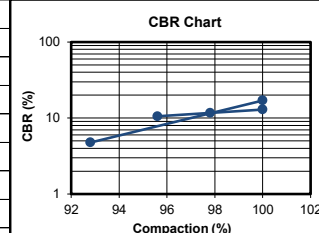
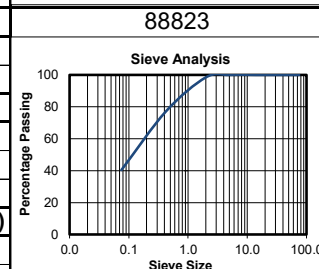
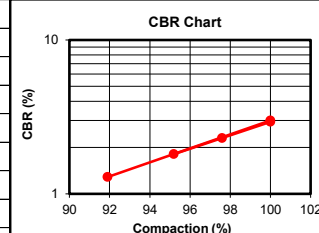
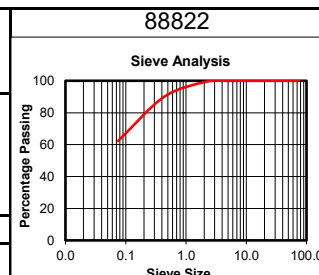
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Attention :	F van Eck	No. of Pages :	2 of 2

TEST REPORT CALIFORNIA BEARING RATIO

Sample Position (SV)		TP 7	TRH 14:	TP 10	TRH 14:		
Depth (mm)		700-1200	Not	0-1000	Not		
Sample No		88822	Classified	88823	Classified		
Materials Description	Source	Trial Pit		Trial Pit			
	Colour	Dark Red Mottled Light Yellowish Orange		Dark Brown			
	Soil Type	Silty/Silt Clay		Silty Sand			
	Classification	Insitu		Insitu			
Material Indicators - (SANS 3001 Method GR1)							
Percentage Passing	75 mm	100		Opinion	100		Opinion
	63 mm	100			100		
	50 mm	100			100		
	37.5 mm	100			100		
	28 mm	100			100		
	20 mm	100			100		
	14 mm	100			100		
	5 mm	100			100		
	2 mm	99			98		
	0.425 mm	90			77		
0.075 mm	62.4			40.4			
Material Indicators - (SANS 3001 Method PR5)							
Grading Modulus *		0.49		0.84			
Coarse Sand Soil-Mortar (%)		9		22			
Atterberg Limits - (SANS 3001 Method GR10)							
Liquid Limit (%)		52		Undetermined			
Plasticity Index (%)		18		SP			
Linear Shrinkage (%)		9.0		SP			
Material Strength - (SANS 3001 Method GR30,GR40 - SCALPED)							
MDD	Max Dry Density (kg/m³)	1704			2087		
	Optimum Moisture Content (%)	16.7			7.8		
	Mould Moisture Content (%)	16.9			7.9		
A	Relative Compaction (%)	100.0			100.0		
	Swell (%)	3.5			0.1		
B	Relative Compaction (%)	95.2			95.6		
	Swell (%)	4.6			0.1		
C	Relative Compaction (%)	91.9			92.8		
	Swell (%)	5.0			0.1		
CBR	@100% Max Dry Density	3			17		
	@98% Max Dry Density	2			12		
	@95% Max Dry Density	2			7		
	@93% Max Dry Density	1			5		
	@90% Max Dry Density	1			3		
Material Condition - (SANS 3001 Method GR20)							
Insitu Moisture Content (%)		25.1		8.3			
Soil Classification Of The Material Based Only On The Tests Results Above							
TRH 14 Specification:		Not Classified		Not Classified			
AASHTO System		A-7-5		A-4			
Unified System		MH		SM			



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- Specimens sampled by Llewelyn Heathcote
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Llewelyn Heathcote
Technical Signatory
For Outeniqua Lab (Pty) Ltd.

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Jan-22



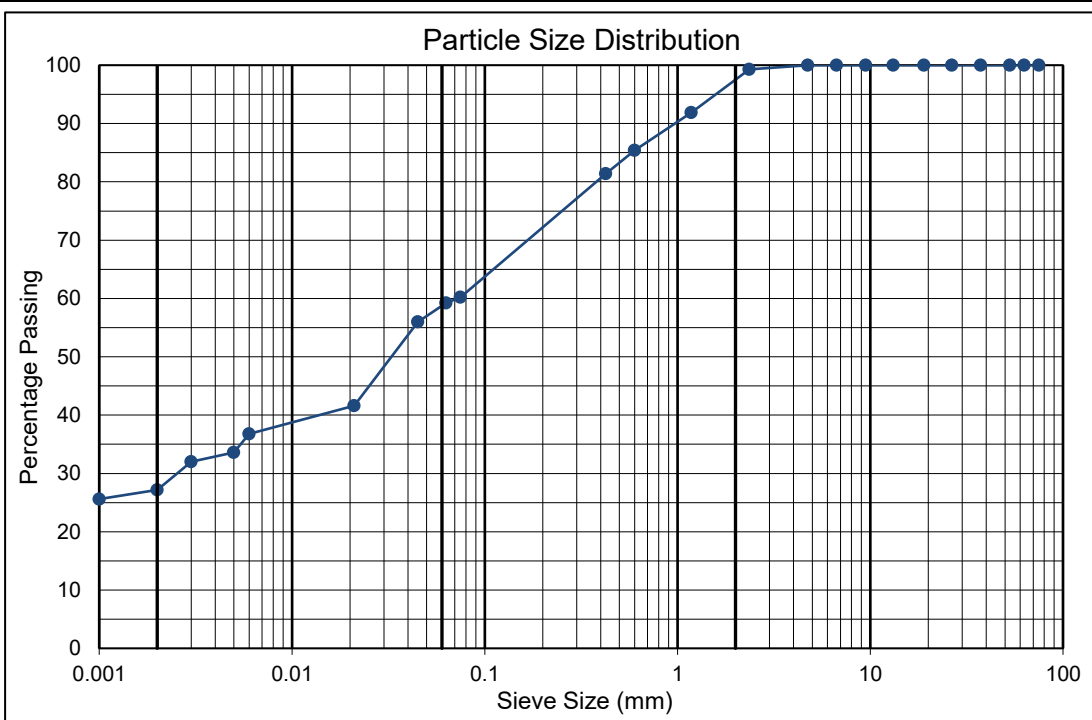
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		Req. Number :	2335/24
		No. of Pages :	1 of 4

TEST REPORT FOUNDATION INDICATOR - (ASTM Method D422)

Sample Position (SV)	TP 1
Depth (mm):	1100-2000
Sample No.:	88818
Materials Description	Trial Pit
Source	Light Yellowish Orange
Colour	Silt/Silty Clay Becoming Fine Gravel
Soil Type	Insitu
Classification	

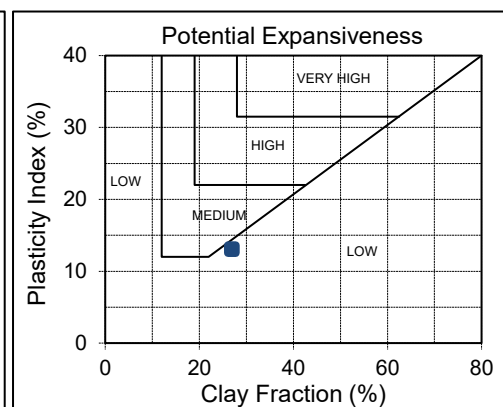
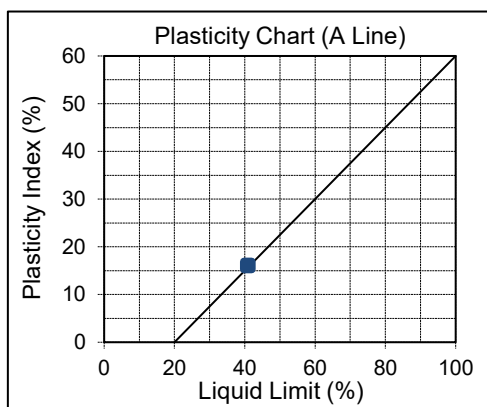
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63.0mm	100
53.0mm	100
37.5mm	100
26.5mm	100
19mm	100
13.2mm	100
9.5mm	100
6.7mm	100
4.75mm	100
2.36mm	99
1.18mm	92
0.6mm	85
0.425mm	81
0.075mm	60
0.063mm	59
0.045mm	56
0.021mm	42
0.006mm	37
0.005mm	34
0.003mm	32
0.002mm	27
0.001mm	26



Liquid Limit (%)	41
Plasticity Index (%)	16
Linear Shrinkage (%)	8
Moisture Content (%)	19.1

% Clay	27
% Silt	32
% Sand	38
% Gravel	3

Unified Soil Classification	CL
AASHTO Soil Classification	A-7-6



- Specimen sampled by Outeniqua Lab according to sampling Plan TMH 5 Methods MB1 (Stockpile).
- Specimens sampled by Llewelyn Heathcote
- The weather conditions were such that there was no detrimental effect on the sample/s taken.

Llewelyn Heathcote
Technical Signatory
For Outeniqua Lab (Pty) Ltd.

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Jan-22



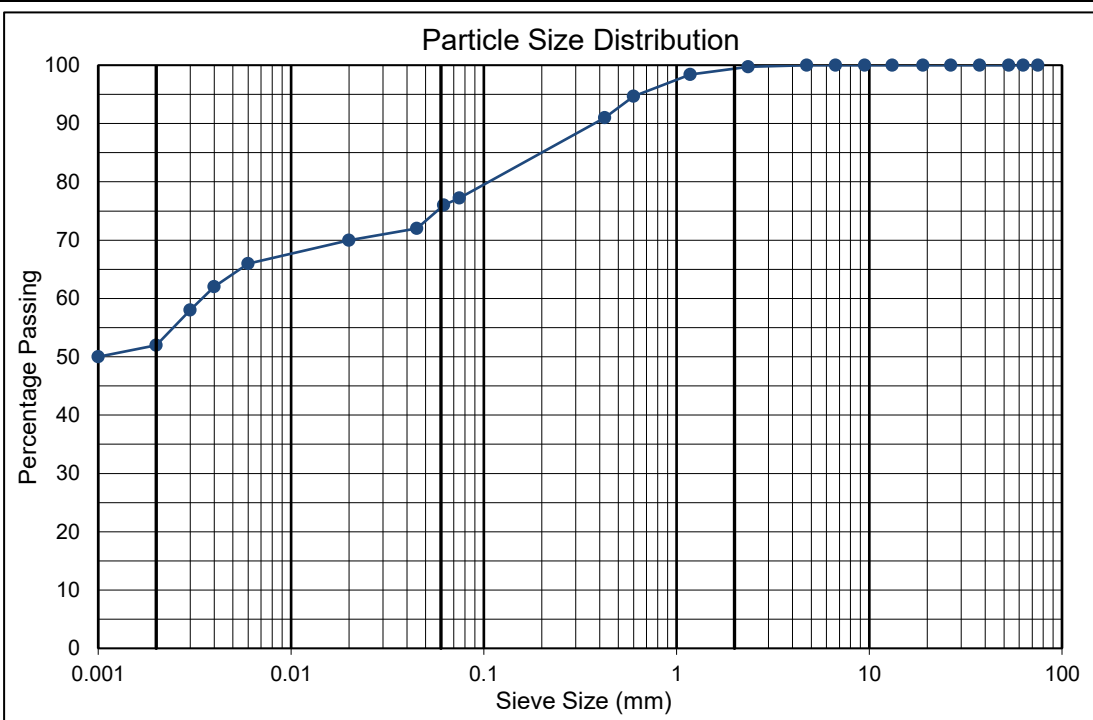
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TEST REPORT FOUNDATION INDICATOR - (ASTM Method D422)

Sample Position (SV)	TP 3
Depth (mm):	800-1300
Sample No.:	88819
Materials Description	Trial Pit
Source	Dark Red Mottled Light Yellowish Orange
Colour	Silty/Silt Clay
Soil Type	Insitu
Classification	

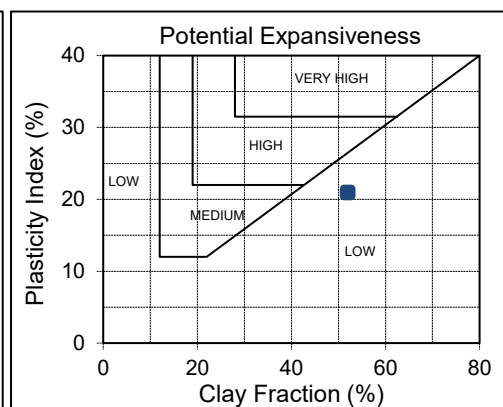
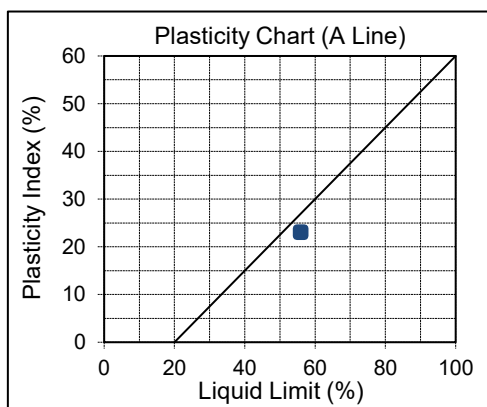
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53.0mm	100
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19mm	100
13.2mm	100
9.5mm	100
6.7mm	100
4.75mm	100
2.36mm	100
1.18mm	98
0.6mm	95
0.425mm	91
0.075mm	77
0.062mm	76
0.045mm	72
0.02mm	70
0.006mm	66
0.004mm	62
0.003mm	58
0.002mm	52
0.001mm	50



Liquid Limit (%)	56
Plasticity Index (%)	23
Linear Shrinkage (%)	12
Moisture Content (%)	25.5

% Clay	52
% Silt	23
% Sand	24
% Gravel	1

Unified Soil Classification	MH
AASHTO Soil Classification	A-7-5



- Specimen sampled by Outeniqua Lab according to sampling Plan TMH 5 Methods MB1 (Stockpile).
- Specimens sampled by Llewelyn Heathcote
- The weather conditions were such that there was no detrimental effect on the sample/s taken.

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Technical Signatory
For Outeniqua Lab (Pty) Ltd.

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Jan-22



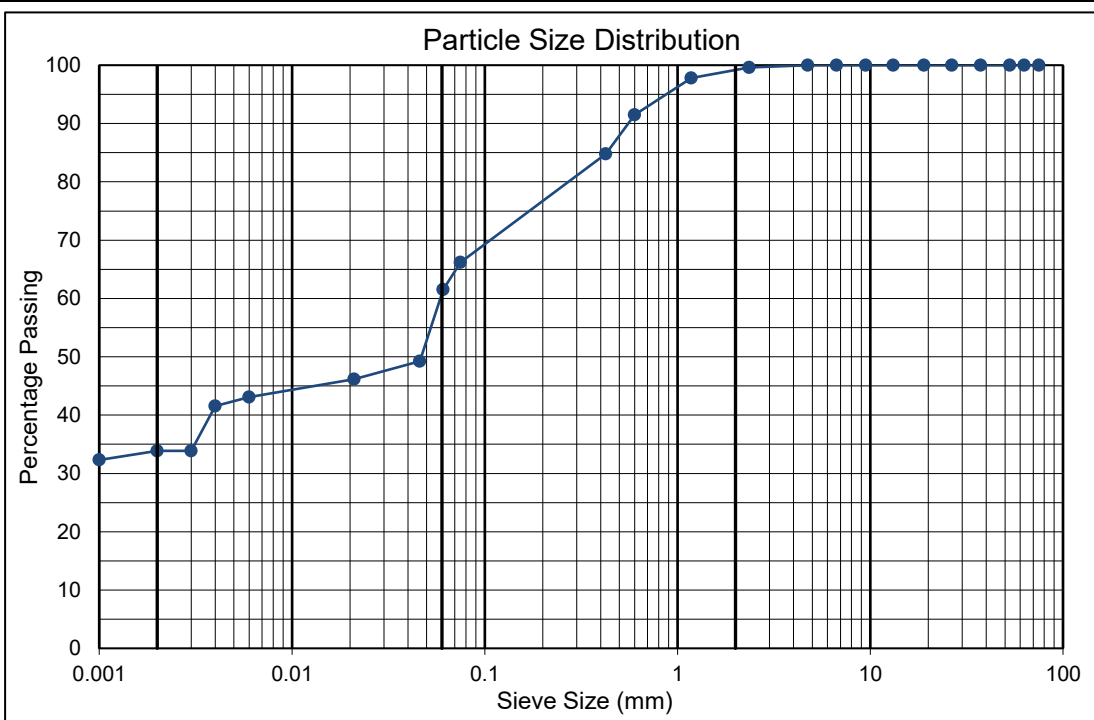
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TEST REPORT FOUNDATION INDICATOR - (ASTM Method D422)

Sample Position (SV)	TP 6
Depth (mm):	1000-2300
Sample No.:	88821
Materials Description	Trial Pit Light Yellowish Orange Silt/Silty Clay Becoming Fine Gravel Insitu

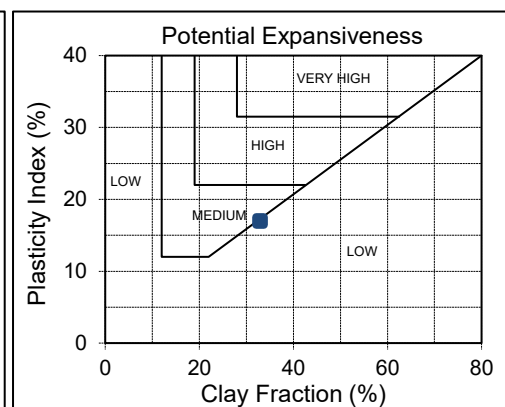
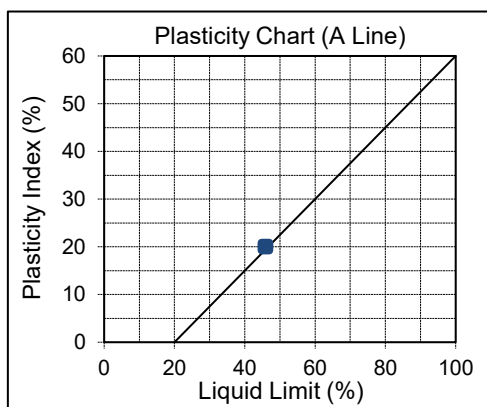
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37.5mm	100
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19mm	100
13.2mm	100
9.5mm	100
6.7mm	100
4.75mm	100
2.36mm	100
1.18mm	98
0.6mm	92
0.425mm	85
0.075mm	66
0.061mm	62
0.046mm	49
0.021mm	46
0.006mm	43
0.004mm	42
0.003mm	34
0.002mm	34
0.001mm	32



Liquid Limit (%)	46
Plasticity Index (%)	20
Linear Shrinkage (%)	10
Moisture Content (%)	22.4

% Clay	33
% Silt	28
% Sand	38
% Gravel	1

Unified Soil Classification	CL
AASHTO Soil Classification	A-7-6



- Specimen sampled by Outeniqua Lab according to sampling Plan TMH 5 Methods MB1 (Stockpile).
- Specimens sampled by Llewelyn Heathcote
- The weather conditions were such that there was no detrimental effect on the sample/s taken.

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For Outeniqua Lab (Pty) Ltd.

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Jan-22



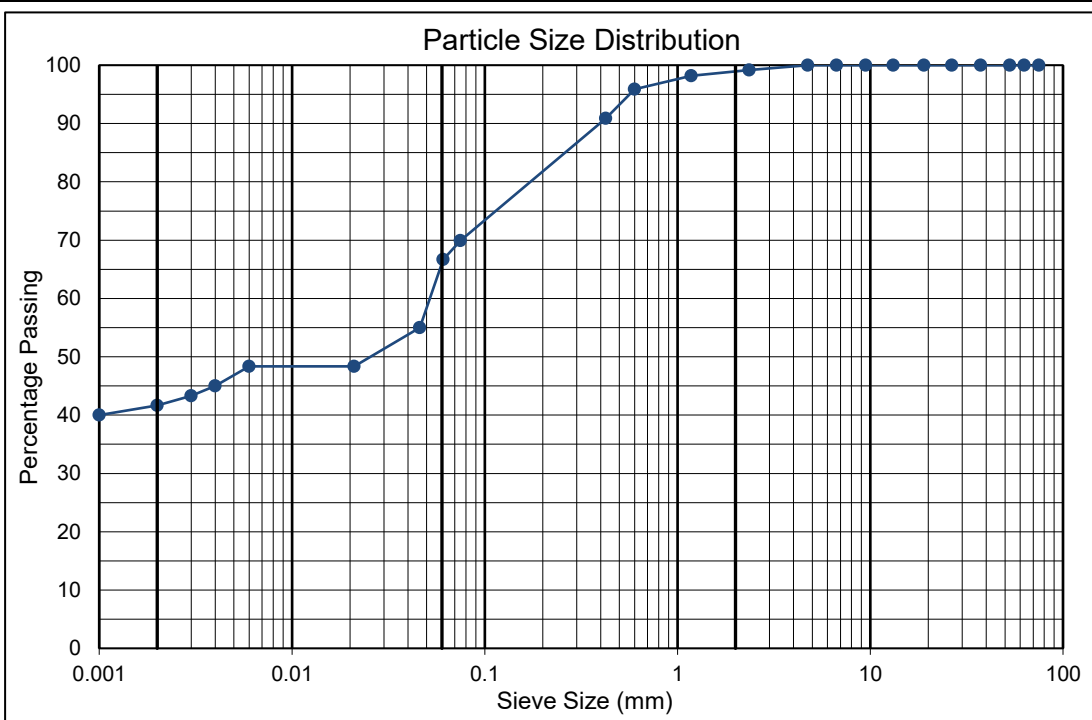
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		No. of Pages :	4 of 4

TEST REPORT FOUNDATION INDICATOR - (ASTM Method D422)

Sample Position (SV)	TP 10
Depth (mm):	1200-2300
Sample No.:	88824
Materials Description	Trial Pit Dark Red Mottled Light Yellowish Orange Silty/Silt Clay Insitu

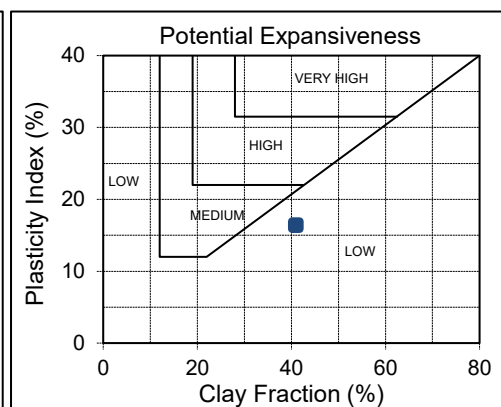
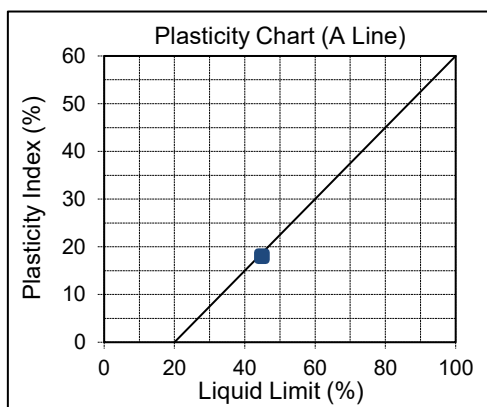
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19mm	100
13.2mm	100
9.5mm	100
6.7mm	100
4.75mm	100
2.36mm	99
1.18mm	98
0.6mm	96
0.425mm	91
0.075mm	70
0.061mm	67
0.046mm	55
0.021mm	48
0.006mm	48
0.004mm	45
0.003mm	43
0.002mm	42
0.001mm	40



Liquid Limit (%)	45
Plasticity Index (%)	18
Linear Shrinkage (%)	9
Moisture Content (%)	29.0

% Clay	41
% Silt	25
% Sand	33
% Gravel	1

Unified Soil Classification	ML
AASHTO Soil Classification	A-7-6



- Specimen sampled by Outeniqua Lab according to sampling Plan TMH 5 Methods MB1 (Stockpile).
- Specimens sampled by Llewelyn Heathcote
- The weather conditions were such that there was no detrimental effect on the sample/s taken.

Llewelyn Heathcote
Technical Signatory
For Outeniqua Lab (Pty) Ltd.

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Jun-21

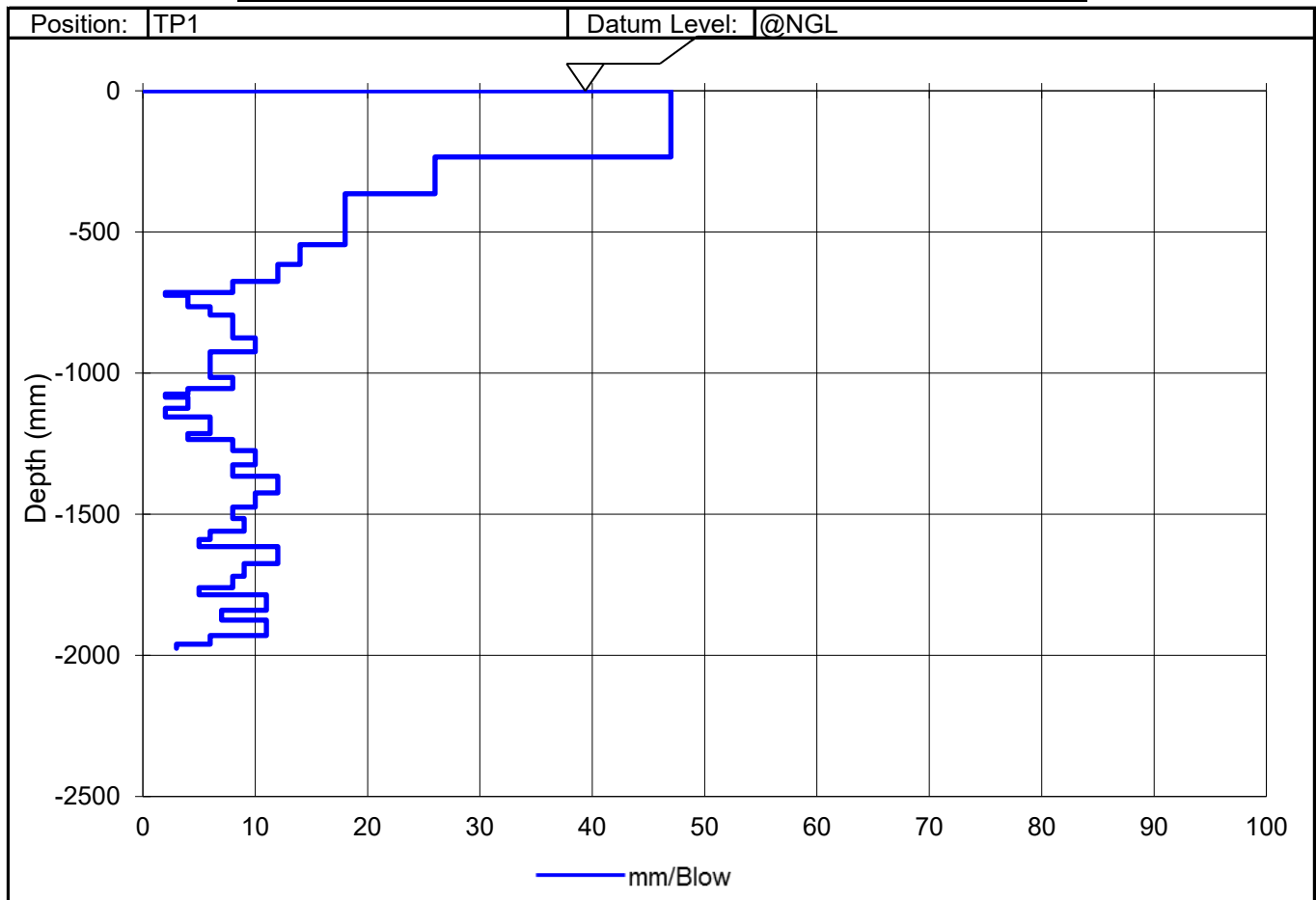


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Customer :	Neil Lyners P O Box 757 George 6530	Project :	Aan de Meulen Development - George
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TEST REPORT

DYNAMIC CONE PENETROMETER (DCP) - (TMH 6 Method ST6)



Notes:

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Ruaan Lesch
Technical Signatory
For Outeniqua Lab (Pty) Ltd.

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Jun-21

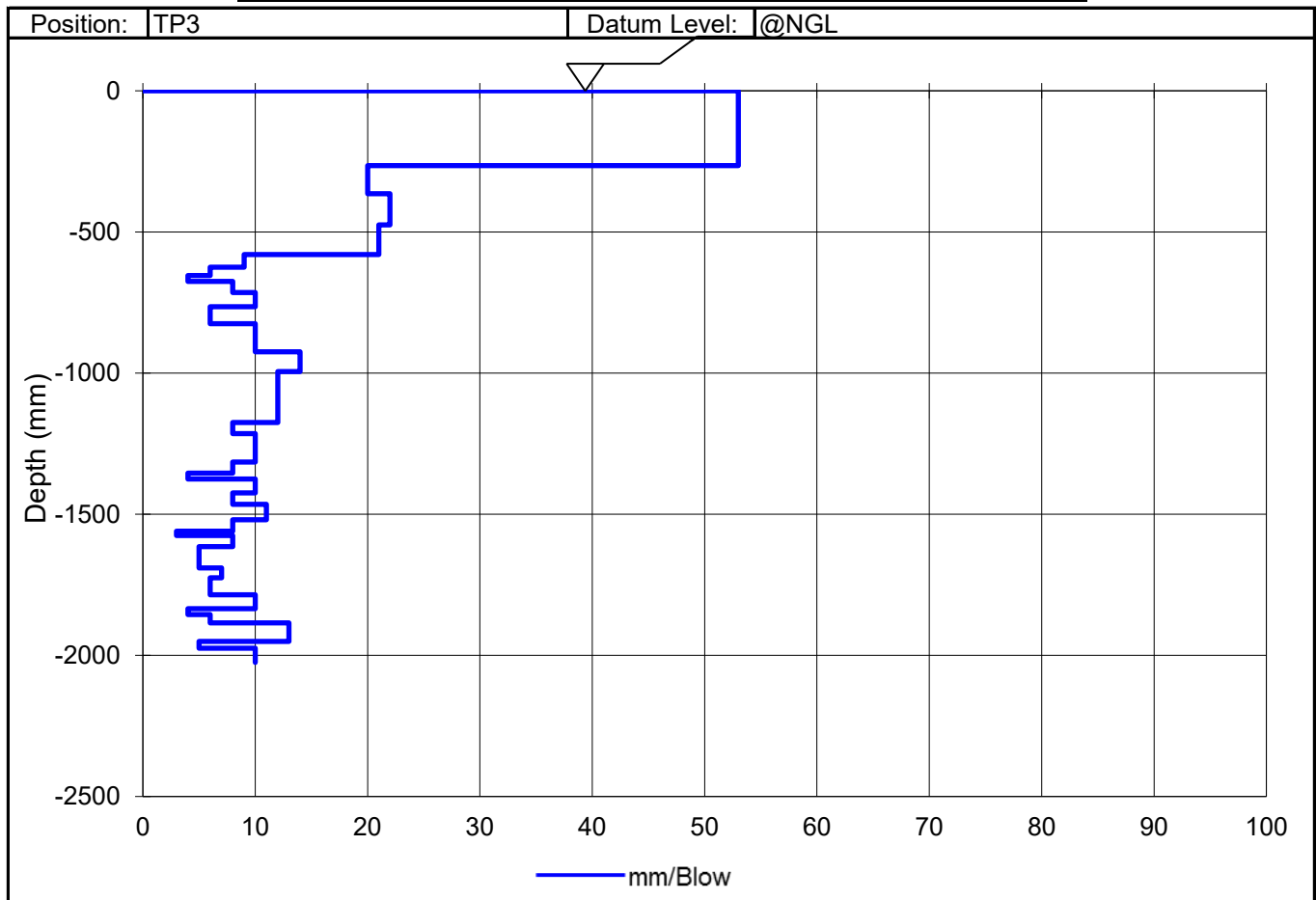


T0347

Customer :	Neil Lyners P O Box 757 George 6530	Project :	Aan de Meulen Development - George
		Date Received :	28/06/24
		Date Reported :	22/07/24
		Req. Number :	2335/24
Attention :	F van Eck	No. of Pages :	2 of 4

TEST REPORT

DYNAMIC CONE PENETROMETER (DCP) - (TMH 6 Method ST6)



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Jun-21

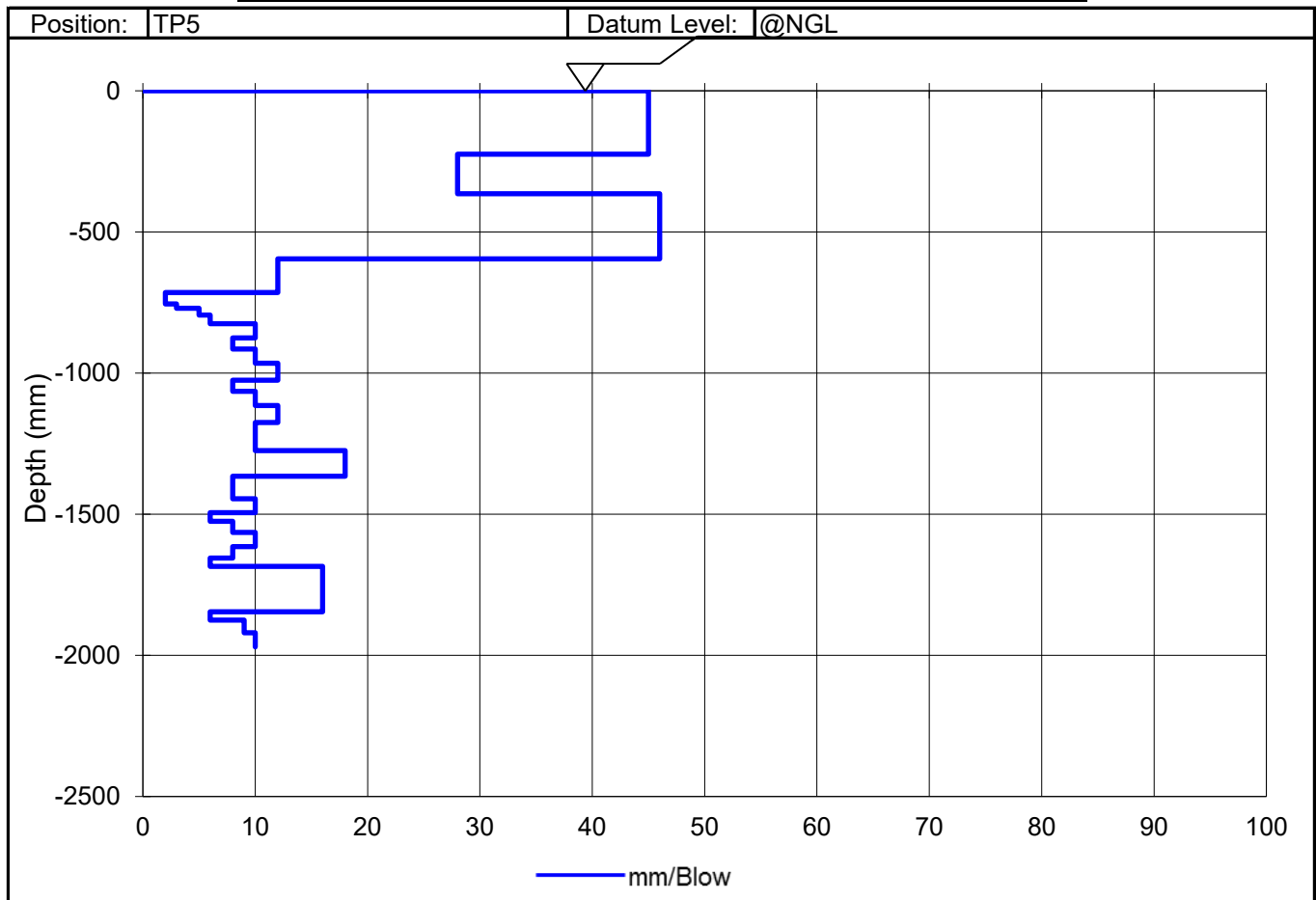


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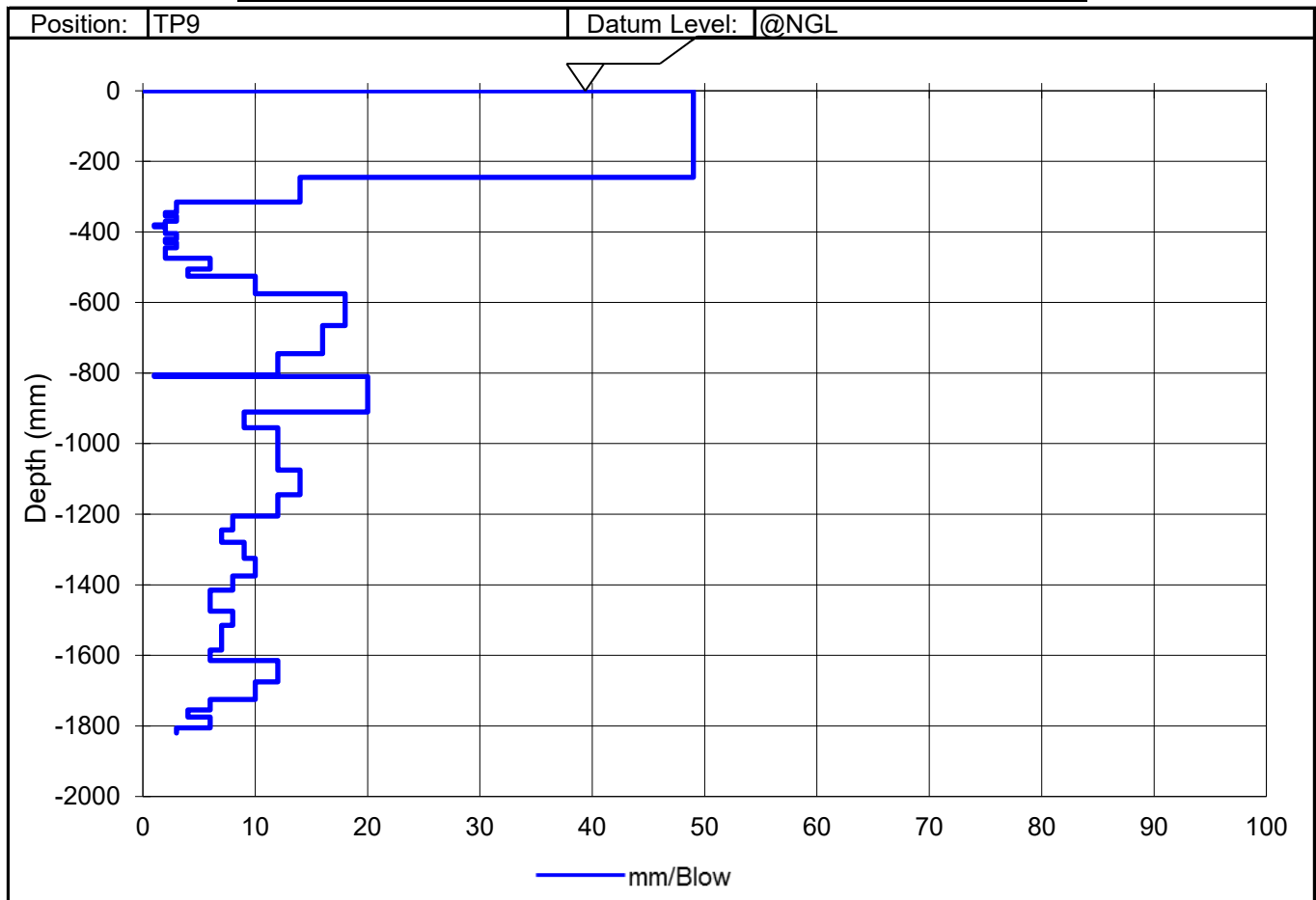


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ANNEXURE H

Stormwater Management Plan

ANNEXURE J:

Storm Water Management Plan



STORMWATER MANAGEMENT PLAN

FOR

MEULENZICHT LANDGOED DEVELOPMENT, GEORGE

APRIL 2025

REVISION 0

COMPILED FOR:



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Annexure D: Stormwater Runoff Calculations

Annexure E: Stormwater Layout Plan

Annexure F: Stormwater Details

Annexure G: Preliminary Geotechnical Soil Investigation



REPORT DETAILS:

Lyners Reference No:	C24051/AB
Client	Atterbury
Report prepared by:	F van Eck, G Wallace
Client representative	J Prinsloo, G van den Berg
Revision record and date	Revision 0
Keywords	Stormwater Management Plan, Meulenzicht Landgoed

SYNOPSIS:

Neil Lyners and Associates (Pty) Ltd was appointed by Atterbury (Pty) Ltd for the preparation of a Stormwater Management Plan for the proposed Development Meulenzicht Landgoed located on Erf 25537 in the George Municipal Area. The area under investigation was analysed with relevant codes of practice, policy and guidelines in mind. The need to provide a system that is effective, sustainable and that results in runoff of acceptable water quality was foremost when approaching the concept of the drainage system. For this reason, the design is reviewed using "The South African Draft Guidelines for Sustainable Urban Drainage Systems". Sustainable Urban Drainage Systems (SUDS) focuses on sustainability by attempting to imitate the natural hydrological cycle.

The upfront delineation of sensitive and wet areas to inform the development layout, the large open spaces incorporated into the development, the proposed dissipation of energy and partial retention of runoff all supports the inclusions of SUDS for the proposed development.

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1. INTRODUCTION

1.1 APPOINTMENT

Atterbury (Pty) Ltd appointed Neil Lyners & Associates (Pty) Ltd (hereafter referred to as Lyners) for the preparation of a Stormwater Management Plan for the Meulenzicht Landgoed Development located on Erf 25537 in George.

1.2 AVAILABLE INFORMATION AND INVESTIGATIONS

The following information was available to us for the investigation:

- Sub-division plan (revision P) received from Nuvorm on 14 April 2025;
- Existing services information received from George Municipality and GLS;
- Detail and topographic survey of the entire property completed in November 2024;
- Geotechnical conditions from preliminary geotechnical soil investigation (See **Annexure G**).

Field observations and testing were done in August 2024 and October 2024 by the freshwater specialist, James Dabrowski from Confluent, in addition to the above information to delineate wet areas in order to confirm sensitive stormwater drainage patterns. A layout drawing was generated, showing contour and cadastral information of the study area (See **Annexure B**).

1.3 EXECUTION OF THE APPOINTMENT

The area under investigation was analysed with relevant codes of practice, policy and guidelines in mind. Current stormwater management systems were assessed in order to reduce the impact of the proposed development on future operations. Local control mechanisms for the required flood return periods will be implemented where necessary, in order to ensure that capacities of regional drainage systems are not exceeded. The need to provide a system that is effective, sustainable and that result in runoffs of acceptable water quality was foremost when approaching the design of the drainage system.

The report takes into account legal requirements and constraints, management of stormwater runoff and recommendations regarding best practices relating to stormwater drainage systems.



1.4 LEGAL ASPECTS REGARDING STORMWATER

1.4.1 General

Along with the 2023 George Municipality By-laws amended from time to time, the applicable legal rules or norms with respect to drainage in South Africa are mainly contained in three sources, namely the common law, amended law (law announcement) and the statute law. The interpretation and quotation of the above fall outside the scope of this report, but a few essential points, regarded as important in the planning of drainage systems, often appear in the amended law and are summarised as follows:

- Nobody shall interfere with the natural flow of water in rural areas without statutory authority (authorised regulation);
- Statutory authority is no remission of responsibility to provide drainage works in a reasonable way. The conception “reasonable way” is determined and evaluated on the basis of three factors, namely the environmental factor, the cost factor and the degree of safety;
- To refrain from acting in a “reasonable way” where it is required, will be considered as illegitimate conduct.

In order to stay within the law and act in a legitimate way, should the possibility of interfering with natural flow exist, it will be advisable to negotiate with lower lying property owners and to conclude an agreement before any construction works commence.

Provisions of the following environmental standards, legislation as well as municipal regulations are applicable:

- National Water Act, Act No 36 of 1998;
- National Environmental Management Act, Act No 107 of 1998;
- Environmental Conservation Act, Act No 73 of 1989;
- Water Services Act, Act No 30 of 2004;
- George Municipality 's General Conditions for Stormwater Management Plans.

1.4.2 Prevailing norms of stormwater drainage

Comprehensive guidelines known as “Guidelines for the Provision of Engineering Services in Residential Townships” (July 1983) by the former Department of Community Development, as well as “Guidelines for the Provision of Engineering Services and Amenities in Residential Township Development” (1994) by the National Housing Council were published and have in general been accepted as the norm for the provision of engineering services in urban areas.

The following documents have been accepted in addition to the above-mentioned guidelines:



- The Neighbourhood Planning and Design Guidelines (2019 edition) and Municipal standards and specifications;
- The South African Draft Guidelines for sustainable Urban Drainage Systems (SUDS) that was drafted for as part of the Water research Commission of South Africa (WRC) project K5/1826: Alternative technology for Stormwater Management;
- George Municipality's General Considerations to be included in a Stormwater Management Plan. (See **Annexure C**).

In the light of the general application and support of the above-mentioned guidelines, it is accepted as minimum acceptable standards for stormwater drainage. Any deviation from these standards should be justified on the basis of environmental, economic and risk analysis.

For the purpose of this report these guidelines will thus apply throughout as reference and any deviation from that will be motivated.

2. TERRAIN

2.1 LOCATION OF THE WORKS

The proposed development, Meulenzicht Landgoed, are located on Erf 25537, situated north of the National Route 2 (N2) and on the western side of Urbans Boulevard, between the Modderrug River and the Swart River. The site is easily accessible via Urbans Boulevard, a formal surfaced road. The GPS coordinates for the Meulenzicht Landgoed site are 33°59'12.31"S, 22°31'21.69"E.

2.2 SITE TOPOGRAPHY, DRAINAGE AND VEGETATION

The development area is situated at elevations ranging from approximately 213m to 172m above mean sea level (MSL). The site is predominantly covered with grassland, with clusters of trees concentrated in the lower-lying areas. It is surrounded by a variety of land uses, including residential developments, commercial development and agricultural activities.

Natural drainage patterns direct surface water toward existing watercourses, which ultimately drain to the Swart River along the eastern boundary of the site.

2.3 EXISTING STORMWATER INFRASTRUCTURE

The natural drainage patterns of the site channel the surface water flow towards existing watercourses situated in three valleys running through the centre of the two areas, which ultimately drain to the Swart River along the eastern boundary of the site. The natural drainage direction of the site will be incorporated in the internal network's detail design phase.



Existing stormwater infrastructure on the proposed development footprint consist of 450mm Ø stormwater pipes adjacent and crossing Urbans Boulevard road and Stormwater portal culverts crossing Urbans Boulevard road. The proposed development will not be connecting onto the existing 450mm Ø stormwater pipe network. The capacity of the existing stormwater culverts will be verified during detail design phase. The existing stormwater dam on Meulenzicht Landgoed will be utilised as a wet stormwater pond. The wet stormwater pond will be a partial retention and polishing pond to reduce flow velocities and remove sediment and other contaminants.

2.4 REHABILITATION OF EXISTING EROSION DONGA

The erosion donga situated in the watercourse on the proposed Meulenzicht Landgoed will be rehabilitated to prevent any further erosion. The rehabilitation work will consist of filling the donga with large rocks of size 300mm diameter below the stream bed. A layer of 300mm thick topsoil will be placed and compacted on top of the rock fill. A mixture of endemic, indigenous grass seeds will be placed in the topsoil layer to quickly establish vegetation and reduce the risk of future erosion. Gabion structures will be placed along the rehabilitated area to reduce the stormwater flow velocity and to assist with sediment build up. Refer to drawing 24051-C-005-02 and 24051-C-005-102 in **Annexure F**. The construction footprint inside the water course will be kept to a minimum.

3. HYDROLOGY

3.1 STORMWATER RUNOFF CALCULATIONS

Various approved methods are used to execute hydrological calculations, with each based on its own method of calculation runoff from the catchment data. The results of these calculation methods can vary considerably as they only provide an approximation of actual events. Computer models, utilising various acceptable methods, will be used to calculate peak flows for the site under investigation. These results can then be compared to calculations based on the rational method and the most appropriate results will be applied in the design of the stormwater system. Please see **Annexure D**.

3.2 RISKS – COST CONSIDERATIONS AND DESIGN FLOOD FREQUENCIES

Although runoff calculations are performed with great care, it is still possible that the capacity of a system could be exceeded because of non-hydrological reasons such as poor management and insufficient maintenance. There are limits to the elimination of probabilities, mitigation or reduction in risk, as costs could become unattainably high in comparison with the benefit or reduced risks of options that are considerably cheaper.



Although the relationship between function, risk, capital development cost and maintenance cost plays a major role in determining the design flood frequency, it is assumed in general that the following flood frequencies should be provided for under normal circumstances:

- a) Minor system which is the system of pipes, culverts and channels, with stilling basins and erosion protections on the downstream ends, which provides capacity for more regular storms of a smaller nature. See **Annexure D**.
 - i) Residential : 1:2 to 1:5 years
 - ii) Institutional : 1:5 years
 - iii) High value general business, industrial areas and public works : 1:5 years
 - iv) Central business district : 1:5 to 1:10 years
- b) Major system which usually consists of streets, pipe culverts, box culverts and open channels, with erosion protection at the downstream ends, and is in place to deal with more severe storms. See **Annexure D**.

The major system will be designed to accommodate the 1:50 year storm.

4. STORMWATER DRAINAGE AND CONTROL SYSTEMS

4.1 GENERAL

4.1.1 Purpose and principles

As mentioned in paragraph 3.2, stormwater systems can be categorised into two systems, namely major and minor systems. The purpose and principles of stormwater control does not always necessitate minor and major floods being accommodated in a single system. In relatively small catchments the peak runoff and runoff volume of both the minor and major floods are usually of such low magnitude that they can be accommodated in a single system. As catchment areas increase in size, so it becomes less practical and more expensive to retain a single system. In such cases separate minor and major systems should be provided.



4.1.2 Minor system

The primary goal of minor systems is to ensure convenience of nearby residents and the safety of traffic during normal rain showers.

The minor system usually consists of road drainage channels and kerbs, kerb inlets, grid inlets, manholes, pipes, box culverts and small open channels for the rapid discharge of runoffs to the major drainage system.

The sizing of the elements are determined on the basis of short duration, high intensity storms taking into account concentrated flow entering the minor system.

Considering the occurrence of steep slopes in some of the proposed stormwater pipes, which will relate to high velocities, drop manholes and flatter sloped pipes will be introduced, where possible. Discharge headwalls at the ends of pipes will be equipped with stilling basins and erosion protection to decrease storm water velocities, spread the flows and prevent erosion. See **Annexure E** for a typical detail of the headwall installation

4.1.3 Major system

The major system will seldom be utilised to its full capacity as its purpose is to convey and control large floods.

If justified by costs or natural conditions, the major and minor flows could be accommodated in the same facility. Natural or manmade channels and large diameter culverts are examples. In this case the roads will convey the major storm water events and gabion mattresses will be installed at the down stream ends of the roads and stormwater outlet structures to decrease the flow velocities, dissipate the energy, spread the water and prevent erosion. See **Annexure E**.

4.1.4 Recommendations regarding design principles and considerations

Although dealt with in the “The Neighbourhood Planning and Design Guidelines (2019 edition) and Municipal standards and specifications.” it is imperative to emphasize a few aspects viewed as policy standpoints with regards to higher lying developments:

- New developments shall not adversely affect the safety risk within existing surrounding developments;
- Pollution of the major discharge system as a result of sedimentation, refuse, effluent and other chemical waste shall be actively controlled;



- In order to exercise a degree of control over new developments, the design assumptions, calculations and results shall be submitted to the Local Authority at completion of the detail design phase of the project.

4.2 SUSTAINABLE URBAN DRAINAGE SYSTEMS

4.2.1 General

In order to ensure the sustainability and environmental integrity of a stormwater management plan, it is advisable to consult “The South African Draft Guidelines for Sustainable Urban Drainage Systems”.

Sustainable Urban Drainage Systems (SUDS) focuses on sustainability by attempting to imitate the natural hydrological cycle, something that conventional drainage systems does not focus on. Once an area is developed, the natural permeability of the area is generally reduced as free draining surfaces are replaced with impermeable surfaces such as roofs, roads and paved areas. This process, together with the fact that subsoil is usually compacted during development reduces the infiltration capacity of the area. As development also results in loss of vegetation, the evapotranspiration of the area is also reduced.

Conventional drainage systems are more focused on reducing flooding and possible flood damage to an area (flood attenuation). The focus of the SUDS process is on flood attenuation as well as promoting more natural, sustainable drainage systems.

Great care will be taken during construction to demarcate the open spaces to prevent entry and compaction of the ground to retain the natural permeability to allow continued infiltration and to retain the vegetation to support evapotranspiration and natural polishing of runoff

4.2.2 SUDS Processes

The SUDS principle can be broken up into the following three key areas:

- Water quantity;
- Water quality;
- Biodiversity.

These key areas are elaborated on as follows:



4.2.2.1 Water quantity management

Stormwater quantities can be managed through inter alia the following processes that will be implemented:

- Capturing rainwater for supplementary water uses on site;
- Conveyance of stormwater (transfer from one location to another);
- Retention of large open areas within the development to allow infiltration, natural retention and groundwater recharge;
- Localized stormwater detention at outlet headwalls to protect receiving watercourses in the event of flooding and during high intensity rainfall events.

4.2.2.2 Water quality management

Water quality is promoted through cleaning or polishing of stormwater. This can be achieved through inter alia the following processes that will be implemented:

- Sedimentation – reducing flow velocities of stormwater runoff to allow sediment particles to fall out of suspension;
- Removal of nutrients and metals through plant-uptake;
- Disinfection/oxidation – breakdown of organic pollutants through extended exposure to ultra-violet light.

4.2.2.3 Biodiversity management

Biodiversity management is promoted through the following controls that will be implemented:

- Health and safety plans and implementation to prevent injury or death to people;
- Environmental risk assessment and management to promote longevity of the system;
- Recreation and aesthetics – enhancing visual appearance by creating attractive open spaces;
- Education and awareness – distribution of knowledge about stormwater management among interested and affected parties.

4.2.3 SUDS Selection

4.2.3.1 Selection Basics

To successfully manage stormwater a number of treatment processes may be required. This multiple process treatment is referred to in the SUDS guideline as a treatment train. A variety of



options or combinations of options may be necessary according to the individual requirements of the site. The three key points where intervention is required are as follows:

- Source controls – manage stormwater runoff as close to its source as possible;
- Local controls – manage stormwater runoff in the local area and;
- Regional controls – manage combined stormwater runoff from several developments. *(Not applicable to this area since the final run-off is discharged directly into river systems and no regional controls are available downstream of the site.)*

a) Source Controls

Source control alternatives that were considered include:

- Green roofs and sand filters;
- Retention of large open areas within the development to allow infiltration, natural filtration and evapotranspiration;
- Soakaways;
- Stormwater collection and reuse.

Green roofs are roofs covered in vegetation. The vegetation serves to delay runoff peaks as well as decrease runoff volumes. Green roofs also improve the biodiversity of post development areas. The limitations of this method of control includes a high set up cost due to the need to contract experienced professionals regarding the effects on the structure as well as vegetative requirements; the need for regular maintenance; and the possibility of roof failure if detained water leads to failure of waterproofing membranes. Due to these limitations this alternative will not be implemented.

Sand filters are generally utilised to improve the quality of stormwater runoff. They comprise of a sedimentation chamber as well as a filtration chamber. Filtration through the sand bed coupled with microbial action in the medium leads to removal of suspended particles, heavy metals and smaller particulates in stormwater runoff. Sand filters are expensive to implement, are generally unattractive and prone to clogging. Due to these reasons as well as the underlying clay conditions this alternative will not be recommended.

Soakaways are excavated pits filled with a porous medium, like coarse aggregate. Soakaways are used for temporary storage of stormwater, which is then allowed to infiltrate into the ground. Soakaways are suitable in most climatic conditions; significantly reduces runoff volume; and has design lives of up to 20 years if maintained correctly. This control is only suitable to small areas where infiltrating water will not adversely affect foundations of adjacent structures. There is also a need for regular maintenance. Due to the proposed development's large areas and quantities of run-off as well as the clay soils this alternative cannot be used.



Stormwater collection and reuse reduces runoff which reduces the potable water consumption rates of a development. Stormwater collection is also a good way to attenuate flood peaks. Storage facilities are easy to find and quick to install but may not be aesthetically pleasing. Rain water harvesting will therefore be implemented by means of water tanks that will be required at the proposed buildings on the site as per building regulation legislation requirements.

Unusually large open natural areas will also be retained in this development in support of SUDS principles. Regular corridors to these open areas allow frequent discharge points to the natural open areas which:

- Prevent the accumulation of all the stormwater of the development and one or two high concentrated release of stormwater points;
- Instead, regular points of release allow for the infiltration of stormwater in wide open natural drainage areas supporting the subsoil moisture requirements of the natural vegetation, which in turn polish the water and ensures a sustainable system with continued evapotranspiration;
- The large open spaces, kept in their natural state will naturally slowdown the run-off release and retain the flows and allow efficient infiltration.

b) Local controls

Local control alternatives as per “*The South African Draft Guidelines for Sustainable Urban Drainage Systems*” that were considered inter alia include:

- Headwalls with energy dissipators, refuse traps, stilling basins and gabion mattresses to decrease the stormwater velocities and spread the flow in order to reduce the risk of erosion.
(See **Annexure F**);

As part of the on-site water quantity and water quality management, the Stormwater Management Plan considerations of the George Municipality, as included in **Annexure C**, will be incorporated in the Services Report and the detail stormwater design phase of the development.

The mitigation recommendations mentioned in the *Aquatic Biodiversity Site Sensitivity Verification and Impact Assessment Report* prepared by Confluent will be investigated and implemented, if necessary, during the detail design stage of the project.



4.3 WATER QUANTITY MANAGEMENT

4.3.1 General

The natural drainage patterns of the site channel the surface water flow towards existing watercourses situated in three valleys running through the centre of the two developments, which ultimately meet with the Swart River along the eastern boundary of the site. As mentioned above a far wider area is retained around these drainage channels in support of the SUDS principles to contribute to a sustainable stormwater drainage solution. The natural drainage direction of the site will be incorporated in the internal network's detail design phase.

Careful attention was given to the layout of the road reserves to drain, retain/captured roof runoff, regularly release stormwater to the oversized open spaces and allow larger runoffs to drain in an and overland manner away from the proposed development. This retained/captured water can then be utilised to supplement the irrigation water demand. At major outlet points, stormwater outlet structures will make provision for energy dissipation, refuse intercepting and erosion protection where required. During construction, special attention will be paid to the use of silt traps at storm water inlets and at natural low points to prevent silt and rubbish from entering the river. The Study Area Drawing in **Annexure B** depicts the planned direction of stormwater flows.

4.3.2 Building on individual lots

As per "*The South African Draft Guidelines for Sustainable Urban Drainage Systems*", in order to create a more sustainable stormwater management system, a source control in the form of stormwater collection tanks at the buildings, will be used on site in order for stormwater to be reused for irrigation purposes. These tanks will be placed "in-line" on the building's gutter system. The tanks will make use of an inlet by-pass system which ensures that the initial roof runoff is not collected in the tanks.

The buildings on the individual lots will be equipped with a surrounding pipe network to accommodate downpipes. The remainder of the stormwater on site will be accumulated within catch pits and grid inlets.

4.3.3 Site area

An underground piped or open channel storm water system will collect the internal minor flood stormwater from the individual lots in several locations (to minimize concentrated flows) and convey these waters to the proposed stormwater head wall outlet stilling basins / detention facilities at the downstream ends of the developed areas before discharged at a reduced run-off rate onto the undeveloped natural vegetated areas.



The following measures to detain the post development stormwater runoff will be:

- Rainwater harvesting: The capturing of rooftop runoff from single residential units into water tanks are required by the Municipal building regulations and supported by the developers in order to save on individual erf water demands and to detain rainfall run-off volumes on each erf.
- Sheet flow: The stormwater runoff volume from erven will be reduced when sheet flowing overland through the extraordinary large vegetated open spaces allowed for between erven and the natural vegetation in valleys. The reduced flow velocity of stormwater will assist in detaining the volume of run-off and mitigate the risk of erosion.
- Stormwater headwalls: The stormwater headwalls will be equipped with energy dissipators, refuse traps, stilling basins and gabion mattresses to reduce the stormwater flow velocity, detain the increased run-off quantities and spread out the stormwater flow over a larger area. These measures will mitigate the risk of erosion at the stormwater outlets. (See **Annexure F**)
- Stormwater control at existing dam: Small diameter stormwater outlet pipes will be installed in the existing stormwater pond on the proposed Meulenzicht Development to allow the stormwater of both developments to flow through the pond at a reduced run-off rate. A larger stormwater pipe and overflow structure will be installed on a higher level to accommodate the larger rainfall event run-off.

The proposed road system, parking areas and open channels will be designed to make provision for conveyance of larger storms (storms in excess of the minor flood) towards existing vegetated open spaces and water courses situated in two valleys running through the centre of the developments. From there the stormwater run-off ultimately meet with the Swart River past the eastern boundary of the site. (See Study Area Drawing in **Annexure B**).

The detained stormwater from the proposed development is received directly by the Swart River to the East and should not potentially cause damage to or unduly inconvenience neighbouring properties.

4.4 WATER QUALITY MANAGEMENT

SUDS water quality design is based on the implementation of various control methods which forms a treatment train. If water goes through more than one treatment process there is more chance of prevention of pollution at a particular site.



Utilising the concept of a treatment train, water quality will first be addressed by street and parking cleansing for removal of litter and sand sized particles. Secondly the detention facility will control pollution as well as flooding by causing biological transformations and the settlement of solids. Thirdly the water quality will be improved by the many vegetated open spaces and by the natural vegetation in the valleys which are capable of absorbing pollutants within certain limits. They also have the added advantage of producing a unique eco-system.

As a fourth and final measure the storm water discharged from ponds will be further cleansed by the vegetated, erosion protected open channel systems downstream of the ponds.

Regular sweeping of paved areas will act as preventative measures, preventing litter and other pollutions from entering the stormwater system in the first place.

The pollutant removal capabilities of inter alia ponds as listed in “The South African Draft SUDS Guideline” are tabulated below:

Table 1: Pollutant removal capability of permeable pavements and detention ponds

Pollutant removal capability (%)	Control Measure: Detention ponds*
Total Settleable Solids	45 – 90
Hydro-carbons	30 – 60
Total Phosphorous	20 – 70
Total Nitrogen	20 – 60
Faecal Coli Forms	50 – 70
Heavy Metals	40 – 90

* Estimated values based on similar SUDS options

Disclaimer:

*The values quoted in this table may be used to assess the general relative performance of selected SUDS options and technologies to minimise the risk of stormwater runoff pollutants entering receiving watercourses. The values should **not** be considered or used as absolute values as the performance of SUDS and SUDS Treatment trains is subject to many complex variables that are site specific. These values should be used to support judgement when assessing the risk of system failure and to compare the relative performance between combinations of different SUDS Treatment trains.*



5. CONCLUSION

A minor stormwater system will be provided to improve safety and to reduce inconvenience during smaller rainfall events and a major system will be included to protect properties from flooding.

The upfront delineation of sensitive and wet areas which informed the initial development layout together with the further retention of large open areas and regular stormwater release points to these natural and vegetated areas are the main contributors to the effective and sustainable stormwater drainage system, which support the SUDS principles, for this proposed development.

In addition, refuse traps, stilling basins and erosion protection at these outlets are possible and will be included to further enhance the proposed solution of detaining increased run-off and mitigating erosion risks of rainfall events.

The extraordinary large open areas, which will be protected and vegetated during and after construction, will allow infiltration to sustain the ground water, natural filtration of runoff, spread out overland sheet flow and retention and reduction of peak flows to support the vegetation and evapotranspiration while detaining increased run-off and mitigating erosion risks of rainfall events.

The capturing of roof runoff from single residential units in tanks, will augment water for irrigation purposes and reduce the overall domestic water demand of the development. The tanks will also serve as a run-off detention facility on each erf.

The proposed stormwater system will thus provide an acceptable level of service to residents, reduce peak run-off, mitigate erosion risks, manage and improve water quality to an acceptable standard and support biodiversity.

We would like to thank Atterbury (Pty) Ltd, the George Municipality, various specialists and the Department of Environmental Affairs & Development Planning for their valuable contribution to the report and willing assistance in gathering information to prepare this stormwater management plan.

6. REFERENCES

- Water Research Commission of South Africa, Project K5/1826: Alternative technology for Stormwater Management, The South African Draft Guidelines for Sustainable Urban Drainage Systems (SUDS);
- George Municipality's General Considerations to be included in a Stormwater Management Plan;



- The Neighbourhood Planning and Design Guidelines (2019 edition) and Municipal standards and specifications;
- 2023 George Municipality By-laws.

We trust you find above in order. Please feel free to contact us should you require additional information or have any queries.

Yours faithfully

Francois van Eck, Pr Eng
for LYNERS



ANNEXURE A

Locality Plan



0 62.5 125 250 375 500 625

Meters

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All dimensions must be verified on site before the works commence.

Refer any discrepancies to the Engineer.

REV	DESCRIPTION	DATE	REV BY	CHKD
A	ISSUED FOR INFORMATION	2024-12-09	HMV	GW

REVISIONS

DESIGNED	GW
DRAWN	HMV
CHECKED	MF

CONSULTING ENGINEERS



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APPROVED

ENGINEERS: _____

DATE: _____

APPROVED

CLIENT: _____

DATE: _____

CLIENT



ATTERBURY

It's a matter of association

PROJECT

OUMEULEN VILLAGE AND
MEULENZICHT LANDGOED DEVELOPMENT
(GEORGE)

TITLE

LOCALITY LAYOUT

SCALE

1:10 000

CONTRACT No

PROJECT No

CG24051

DRAWING No

24051-C-000-01

COORDINATE SYSTEM: WGS84/Lo23°

SHEET

1

REV





ANNEXURE B

Study Area Drawing



ANNEXURE C

George Municipality 's General Conditions for Stormwater Management Plans

GEORGE MUNICIPALITY

STORMWATER MANAGEMENT PLAN - GENERAL CONSIDERATIONS TO BE INCLUDED

1. Storm water control systems for construction purposes will be constructed before any construction commences on the site. As construction progresses, the storm water control measures are to be monitored and adjusted to ensure complete erosion control and appropriate runoff control at all times during construction. Construction activities should be undertaken in such a manner earthworks on site are to be kept to an absolute minimum.
2. All services required by the development shall be designed to withstand the effects of flooding without risk of environmental pollution, or risk of damage, injury or loss to the property owner, residents and general public.
3. An owner of a property on which a private/public storm water system is located-
 - a) May not carry out any activity which will or which, in the opinion of the HOA/Governing Body/Municipality, could reasonably be expected to adversely affect the functioning of such storm water system;
 - b) Must keep such storm water system functioning effectively (at own cost); and
 - c) The HOA/Governing Body is responsible for (in the case of a private service) the refurbishment and reconstruction of storm water systems when required.
4. For a private service, the HOA/Body Corporate / Private entity shall ensure that no person will be permitted to –
 - i) Discharge, place or permit to enter into the storm water system –
 - a) Anything other than storm water;
 - b) Anything likely to damage the storm water system or interfere with the operation thereof;
 - c) Anything likely to pollute the water in the storm water system.
 - ii) Discharge from any place, or place onto any surface, any substance other than stormwater, where that substance could reasonably be expected to find its way into the storm water system;
5. The internal vehicle driveways and parking areas shall be designed and constructed to direct run-off away from the buildings/residences to eliminate the potential impact of storm water on property.
6. The developer will ensure the registration of a servitude on the property title for the public/private storm water drains for the purposes of maintenance and access.

7. The owners/body corporate must keep such storm water servitude open and accessible for purposes of maintenance; and ensure the system functions effectively.
8. For the maintenance of private drainage systems, it is the responsibility of a HOA / Body Corporate / private entity to-
 - a) Properly maintain in good working order at all times, the private storm water drainage network on the premises. This includes all pipes, gutters, storm water detention devices or other components as well as the drainage network itself.
 - b) Ensure that all open storm water drains are kept clear of any obstruction that impedes or is likely to impede the free flow of water, for a distance of at least 3 meters from the nearest margin of the storm water drain;
 - c) Ensure there will be no adverse effect on the quality of storm water which previously flowed beyond the boundaries of the property on which the activity occurs; or,
 - d) Ensure the flow of an storm water entering the property will not be adversely effected; or,
 - e) Ensure the point of discharge from the property is not altered.
 - f) Ensure no owner or occupier of the land on either side of any open drain shall deposit, or cause or permit to be deposited any material or thing that could cause or likely to cause obstruction within the drain.



ANNEXURE D

Stormwater Runoff Calculations

Project Number: C24051
Project Title: Oumeulen and Meulenzicht Development
Date: Wednesday, 04 December 2024
Calculation undertaken by: GW
Verification by: FVE
Catchment: Meulenzicht



CALCULATION OF RUN-OFF WITH THE RATIONAL METHOD FOR PRE DEVELOPMENT

NOTE:
1. ALTER ONLY GREEN CELLS
2. CELL No'S F26, F45 & L69 CONTAIN NOTES WITH APPLICABLE FACTORS

1 PHYSICAL CHARACTERISTICS OF THE SITE:

AREA km2	WEIGHTED AREA FACTORS (a+b+c=1)		
	Rural 1 a	Urban 0 b	Dams 0 c
0.65935			

WATER DROP LENGTH (km)
L1=URBAN AREA= 0 L2=STREAM FLOW= 0.32 L3=OVERLAND/SHEET= 0.48 L4=PIPE FLOW= 0

TOTAL LENGTH=(L1+L2+L3+L4)= 0.8 km

MAP= 850

1.1 RURAL PART

Refer to tabel 1 for values of Cs Cp and Cv

AVERAGE SLOPE %	Factor			Cs 2	1*2	PERMEABILITY	Factor			Cp 2	1*2	VEGETATION	Factor			Cv 2	1*2
	%1						%1						%1				
Veils and pans (<3%)	0.4	0.03	0.012			Very permeable	0	0.04	0			Thick bush/plantation	0	0.04	0		
Flat Areas (3 to 10%)	0.1	0.08	0.008			Permeable	0.7	0.08	0.056			Light bush/farm lands	0.5	0.11	0.055		
Hilly (10 to 30%)	0.5	0.16	0.08			Semi permeable	0.3	0.16	0.048			Grass lands	0.5	0.21	0.105		
Steep Areas(>30%)	0	0.26	0			Impermeable	0	0.26	0			No vegetation	0	0.28	0		
Total	1		0.1			Total	1		0.104			Total	1		0.16		

C1= 0.364

CHOOSE Ft Flat and permeable catchments Form Table 3.8 in Tab 11. Lyners doc extract

INFLUENCE OF RETURN PERIOD			
T(a)	F	C1	F*C1
2	0.5	0.364	0.182
5	0.55	0.364	0.20
10	0.6	0.364	0.22
20	0.67	0.364	0.24
50	0.83	0.364	0.30
100	1	0.364	0.36

1.2 URBAN PART

Refer to tabel 2 for Cu

DESCRIPTION	Factor			Cu 2	1*2
	%1				
Lawns and parks	0	0.13	0		
Residential	0	0.6	0		
Industrial	0	0.7	0		
Streets	0	0.9	0		
Total	0		0		

C2= 0

COMBINED C VALUES							
DESCRIPTION	T(a)	2	5	10	20	50	100
Rural (a)*C1		0.18	0.20	0.22	0.24	0.30	0.36
Urban (b)*C2		0.00	0.00	0.00	0.00	0.00	0.00
Dams (c)*1		0.00	0.00	0.00	0.00	0.00	0
COMBINED C VALUES		0.18	0.20	0.22	0.24	0.30	0.36

2 CONCENTRATION TIME (Tc)

URBAN FLOW

Bransby Williams
tc1=0.96*L1*0.5/(H*0.2*A1*0.1)

L1= 0.00 km
H1= 0.00 m
A1= 0.00 km2

tc1= 0.00 h

STREAM FLOW (Channel)

USBR
tc2=((0.87*L2*2)/((1000*S2)*0.385

S2=H2/0.75L2 (m/m)
H2= 11.50 m
S2= 0.05 m/m
L2= 0.32 km

tc2= 0.09 h

OVERLAND/SHEET FLOW

Kerby
tc3=0.604*((L3)/(S3*0.5))^0.467

S3=H3/L3
H3= 27.00 m
S3= 0.08 m/m
r= 0.30
L3= 0.48 km

tc3= 0.48 h

PIPE FLOW

Manning
tc4=1/3600*L4/((1/n)*R^2/3*S4^0.5)

L4= 0.00 km
H4= 0.00 m
S4= 0.00 m/m
d= 0.00 m
n= 0.000
tc4= 0.00 h

TOTAL CONCENTRATION TIME (Tc)= 0.57

3 RAINFALL INTENSITY

RETURN PERIOD	T (a)	2	5	10	20	50	100
		h (mm)	16	21	28	32	43
POINT RAINFALL							55
POINT INTENSITY i=h/tc			28.20	37.02	49.36	56.41	75.80
AREA REDUCTION FACTOR			1	1	1	1	1
AVERAGE INTENSITY I=ai			28.20	37.02	49.36	56.41	75.80

OBTAIN THESE FIGURES FROM CCT GRID RAINFALL FOR THE TIME FRAME CLOSEST TO Tc OR INTERPOLATE AS NECESSARY
READ FIGURE FROM ATTACHED GRAPH 3.7 ON TAB 12 GRAPHS

4 PEAK RUN-OFF

T(a)	2	5	10	20	50	100
Q=0.278*CI	0.940875332	1.3583888	1.975838	2.521545889	4.19748	6.468518

Project Number:	C24051
Project Title	Oumeulen and Meulenzicht Development
Date	Wednesday, 04 December 2024
Calculation undertaken	GW
Verification by:	FvE
Catchment:	Meulenzicht



CALCULATION OF RUN-OFF WITH THE RATIONAL METHOD FOR POST DEVELOPMENT

NOTE:

1. ALTER ONLY GREEN CELLS
2. CELL No's F26, F45 & L69 CONTAIN NOTES WITH APPLICABLE FACTORS

1 PHYSICAL CHARACTERISTICS OF THE SITE:

AREA	WEIGHTED AREA FACTORS (a+b+c=1)		
km2	Rural	Urban	Dams
0.65935	0.3 a	0.7 b	0 c

WATER DROP LENGTH (km)

L1=URBAN AREA=

0.21

L2=STREAM FLOW=

0.59

L3=OVERLAND/SHEET=

0.02

L4=PIPE FLOW=

0.065

TOTAL LENGTH=(L1+L2+L3+L4)=

0.885 km

MAP=

850

1.1 RURAL PART

Refer to tabel 1 for values of Cs Cp and Cv

AVERAGE SLOPE %	Factor	Cs	1*2	PERMEABILITY	Factor	Cp	1*2	VEGETATION	Factor	Cv	1*2
Vleis and pans (<3%)	0	0.03	0	Very permeable	0	0.04	0	Thick bush/plantation	0.1	0.04	0.004
Flat Areas (3 to 10%)	0.5	0.08	0.04	Permeable	0.7	0.08	0.056	Light bush/farm lands	0.2	0.11	0.022
Hilly (10 to 30%)	0.5	0.16	0.08	Semi permeable	0.3	0.16	0.048	Grass lands	0.7	0.21	0.147
Steep Areas(>30%)	0	0.26	0	Impermeable	0	0.26	0	No vegetation	0	0.28	0
Total	1		0.12	Total	1		0.104	Total	1		0.173

C1=

0.397

CHOOSE Ft

Fat and permeable catchments

Form Table 3.8 in Tab 11. Lyners doc extract

INFLUENCE OF RETURN PERIOD

T(a)	F	C1	F*C1
2	0.5	0.397	0.1985
5	0.55	0.397	0.22
10	0.6	0.397	0.24
20	0.67	0.397	0.27
50	0.83	0.397	0.33
100	1	0.397	0.40

1.2 URBAN PART

Refer to tabel 2 for Cu

DESCRIPTION	Factor	Cu	1*2
Lawns and parks	0.7	0.13	0.091
Residential	0.05	0.3	0.015
Industrial	0	0.65	0
Streets	0.25	0.8	0.2
Total	1		0.306

C2=

0.306

COMBINED C VALUES

DESCRIPTION	T(a)	2	5	10	20	50	100
Rural (a*F*C1)		0.06	0.07	0.07	0.08	0.10	0.12
Urban (b*C2)		0.21	0.21	0.21	0.21	0.21	0.21
Dams (c*1)		0.00	0.00	0.00	0.00	0.00	0
COMBINED C VALUES		0.27	0.28	0.29	0.29	0.31	0.33

2 CONCENTRATION TIME (Tc)

URBAN FLOW

Bransby Williams

$t_{c1} = 0.96 \cdot L^1 \cdot a \cdot S^1 (H^0.2 \cdot A^1)^{0.1}$

L1= 0.21 km

H1= 4.00 m

A1= 0.00 km2

t_{c1}= 0.22 h

STREAM FLOW (Channel)

USBR

$t_{c2} = (0.87 \cdot L^2 \cdot S^2) / (1000 \cdot S^2)^{0.385}$

S2=H2/0.75L2 (mm)

H2= 27.00 m

S2= 0.06 m/m

t_{c2}= 0.13 h

OVERLAND/SHEET FLOW

Kerbby

$t_{c3} = 0.604 \cdot ((L^3) / (S^3 \cdot 0.5))^{0.467}$

S3=H3/L3

H3= 0.50 m

S3= 0.03 m/m

t_{c3}= 0.15 h

PIPE FLOW

Manning

$t_{c4} = 1/3600 \cdot L^4 / (1/h \cdot R^{2/3} \cdot S^4 \cdot 0.5)$

L4= 0.07 km

H4= 4.00 m

S4= 0.06 m/m

t_{c4}= 0.01 h

TOTAL CONCENTRATION TIME (T_c)=

0.51

3 RAINFALL INTENSITY

RETURN PERIOD	T (a)	2	5	10	20	50	100
POINT RAINFALL	h (mm)	16	20	28	32	45	51
POINT INTENSITY i=h/t _c	i mm/h	31.56	39.45	55.24	63.13	88.77	100.61
AREA REDUCTION FACTOR	a	1	1	1	1	1	1
AVERAGE INTENSITY I=ai	I mm/h	31.56	39.45	55.24	63.13	88.77	100.61

OBTAIN THESE FIGURES FROM CCT GRID RAINFALL FOR THE TIME FRAME CLOSEST TO T_c OR INTERPOLATE AS NECESSARY
READ FIGURE FROM ATTACHED GRAPH 3.7 ON TAB 12 GRAPHS

4 PEAK RUN-OFF

T(a)	2	5	10	20	50	100
Q=0.278*CI _A	1.58379208	2.0228062	2.892221	3.401863892	5.093947	6.146523 m³/s



ANNEXURE E

Stormwater Layout Plan

LEGEND

PROPOSED SERVICES

WETLANDS

BUFFER ZONE

ECOLOGICAL BUFFER LINE

STORMWATER MANHOLE

STORMWATER DOUBLE CATCHPIT

STORMWATER HEADWALL

STORMWATER FLOW DIRECTION

CLASS 1000 CONCRETE PIPE

Notes:

1. The contractor must verify the location and extent of all the existing services prior to commencement of work.

2. For typical Stormwater Manhole Detail refer to Detail Drawing Number: STE/SW-99A.

3. For typical Double Kerb Inlet Gully and Catchpit details, refer to Detail Drawing Number: STE/SW-53.

4. Levels and position of existing Stormwater network must be verified before construction. Any discrepancies are to be confirmed with the engineer immediately.

5. Catchpits deeper than 1.0m, shall have step irons according to Detail Drawing Number: STE/SW-53.

6. For detail of sub-surface drain layerworks, refer to Detail Drawing Number: STE/SW-12.

7. For layout positions on site, refer to Key Plan Drawing Number: 24051-C-001-05.

8. For continuation, refer to Drawing Numbers: 24051-C-005-02 and 24051-C-005-03.

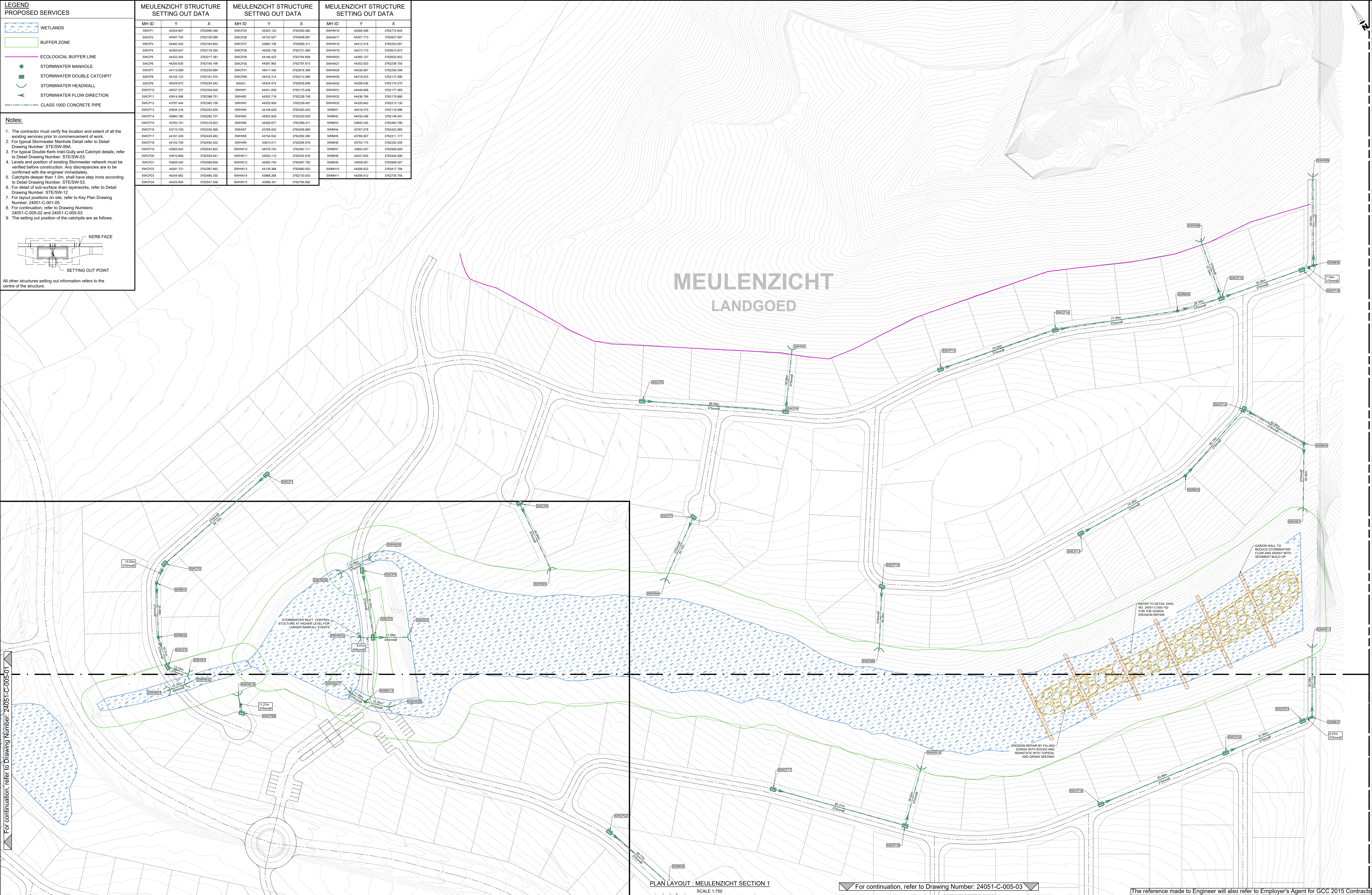
9. The setting out position of the catchpits are as follows.

KERB FACE

SETTING OUT POINT

All other structures setting out information refers to the centre of the structure.

MEULENZICHT STRUCTURE SETTING OUT DATA				MEULENZICHT STRUCTURE SETTING OUT DATA				MEULENZICHT STRUCTURE SETTING OUT DATA			
MH ID	Y	X		MH ID	Y	X		MH ID	Y	X	
SWCP1	44324.967	3762096.348		SWCP25	44265.123	3762096.482		SWHW15	44266.488	3762775.641	
SWCP2	44407.154	3762109.389		SWCP26	44122.537	3762094.961		SWHW17	44261.723	3762652.691	
SWCP3	44440.204	3762184.903		SWCP27	43983.108	3762695.311		SWHW18	44412.418	3762653.057	
SWCP4	44305.647	3762178.350		SWCP28	44206.738	3762751.585		SWHW19	44273.170	3762615.873	
SWCP5	44322.044	3762217.361		SWCP29	44146.423	3762764.688		SWHW20	44260.107	3762620.853	
SWCP6	44200.630	3762195.196		SWCP30	44087.862	3762797.815		SWHW22	44362.620	3762238.750	
SWCP7	44113.699	3762239.894		SWCP31	44017.440	3762816.399		SWHW28	44336.897	3762239.340	
SWCP8	44102.125	3762191.574		SWCP32	44162.314	3762713.368		SWHW29	44318.033	3762179.348	
SWCP9	44029.872	3762324.542		SWCP33	44234.474	3762836.699		SWHW30	44398.036	3762174.270	
SWCP10	44037.237	3762358.935		SWHW1	44431.838	3762175.438		SWHW31	44446.998	3762177.485	
SWCP11	43914.566	3762396.751		SWHW2	44303.718	3762226.746		SWHW32	44436.799	3762179.866	
SWCP12	43787.444	3762385.156		SWHW3	44205.909	3762230.481		SWHW33	44328.842	3762213.130	
SWCP13	43934.316	3762263.505		SWHW4	44148.629	3762263.423		SWHW34	44418.475	3762116.998	
SWCP14	43860.780	3762280.737		SWHW5	44005.929	3762203.990		SWHW35	44435.436	3762146.091	
SWCP15	43762.701	3762318.823		SWHW6	44059.877	3762295.411		SWHW36	44340.338	3762450.788	
SWCP16	43710.729	3762330.565		SWHW7	43799.802	3762446.890		SWHW37	43787.078	3762452.960	
SWCP17	44161.328	3762432.483		SWHW8	43754.552	3762582.280		SWHW38	43780.957	3762311.177	
SWCP18	44103.756	3762492.432		SWHW9	43674.011	3762584.978		SWHW39	43703.175	3762332.259	
SWCP19	43993.452	3762545.622		SWHW10	44076.742	3762487.711		SWHW40	43853.291	3762569.829	
SWCP20	43910.669	3762559.941		SWHW11	43830.115	3762532.916		SWHW41	44247.645	3762444.588	
SWCP21	43859.305	3762588.659		SWHW12	44260.745	3762597.782		SWHW42	44059.061	3762809.047	
SWCP22	44061.721	3762597.862		SWHW13	44139.368	3762680.002		SWHW43	44068.632	3762817.794	
SWCP23	44344.662	3762480.330		SWHW14	43968.288	3762730.653		SWHW44	44299.912	3762734.795	
SWCP24	44253.904	3762547.906		SWHW15	43996.301	3762764.892					



SCALEBAR

0

22.5

45

Meters

1:750

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All dimensions must be verified on site before the works commence. Refer any discrepancies to the Engineer.

DESIGNED

GW

DRAWN

HMV

CHECKED

MF

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GEORGE
6530
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APPROVED

ENGINEER:

DATE:

2025-02-20

APPROVED

CLIENT:

DATE:

CLIENT

ATTERBURY

It's a matter of association

PROJECT

OUMEULEN VILLAGE AND MEULENZICHT LANDGOED DEVELOPMENT (GEORGE)

TITLE

STORMWATER LAYOUT: MEULENZICHT SECTION 1

SCALE

1:750

on A0

SHEET

1 OF 1

CONTRACT No.

PROJECT No.

24051 CG

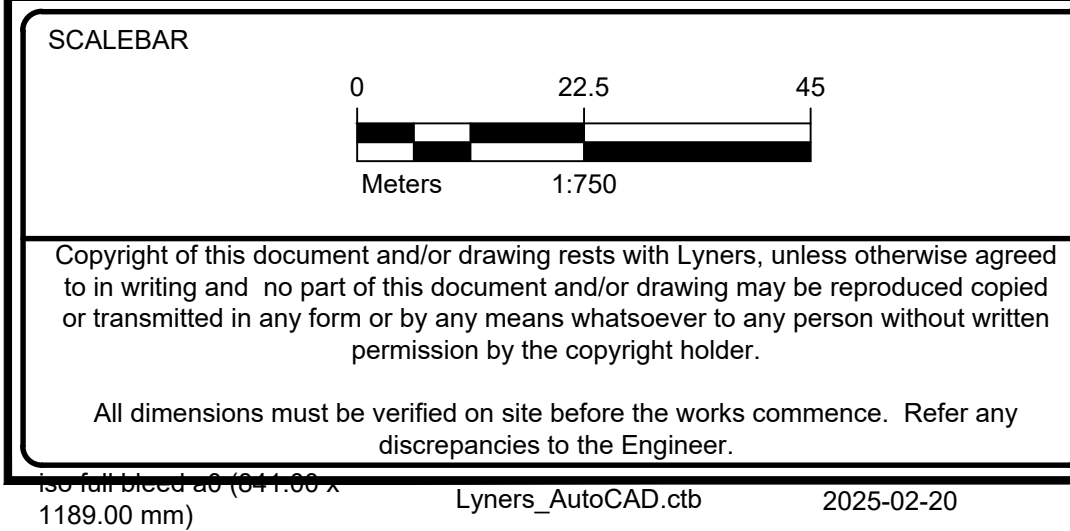
DRAWING No.

24051-C-005-02

COORDINATE SYSTEM:

WGS84 / Lo Z3°

U:\WERKKE\2400\24051 CG - SAWMILL DEVELOPMENT - GEORGE\DRAWINGS\1.2 ACTIVE\24051-C-005-01 (STORMWATER LAYOUT - OUMEULEN).DWG



REV	DESCRIPTION	DATE	REV'D	CHK'D
A	ISSUED FOR INFORMATION	2024-12-09	HMV	MF
REVISIONS				

DESIGNED	GW
DRAWN	HMV
CHECKED	MF

CONSULTING ENGINEERS

LYNERS

PO Box 757
GEORGE
6530

Tel: 044 887 0223 Fax: 044 887 0741
email: george@lyners.co.za

APPROVED

ENGINEER: _____

DATE: 2025-02-20

APPROVED

CLIENT: _____

DATE: _____

CLIENT

ATTERBURY

It's a matter of association

PROJECT

OUMEULEN VILLAGE AND MEULENZICHT LANDGOED DEVELOPMENT (GEORGE)

TITLE

STORMWATER LAYOUT: MEULENZICHT SECTION 2

SCALE 1:750 on A0 SHEET 1 OF 1

CONTRACT No. PROJECT No. 24051 CG

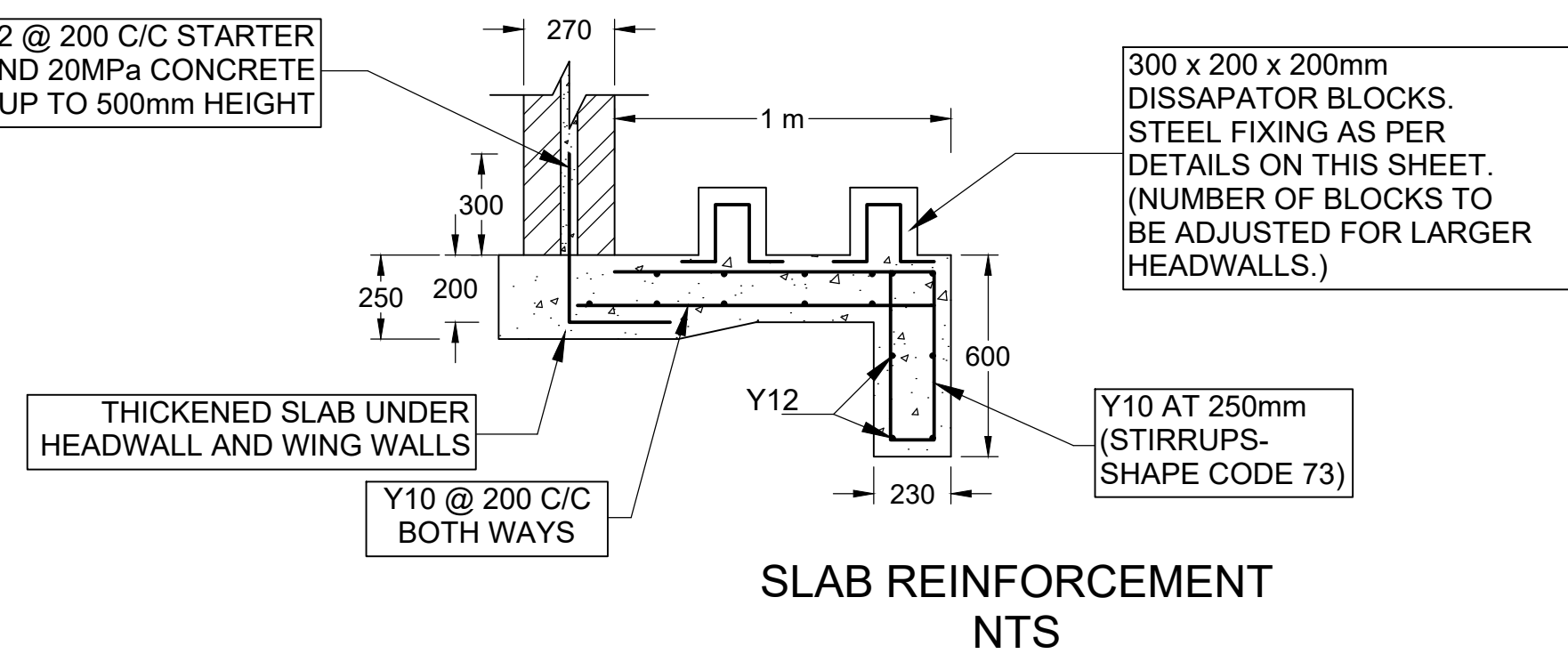
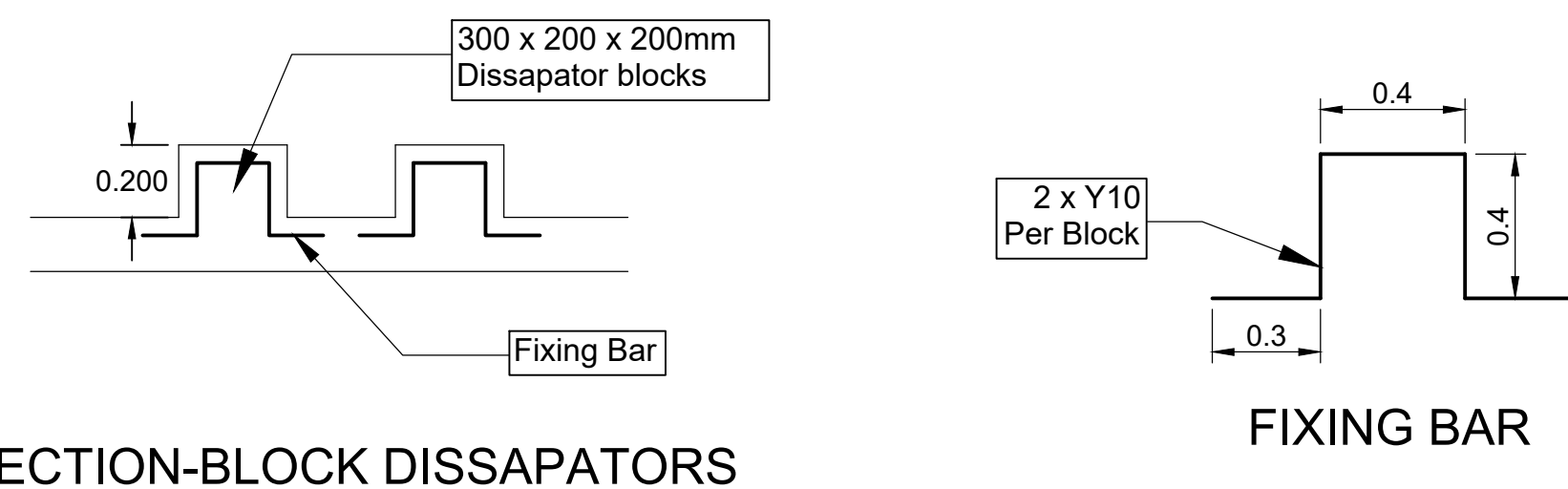
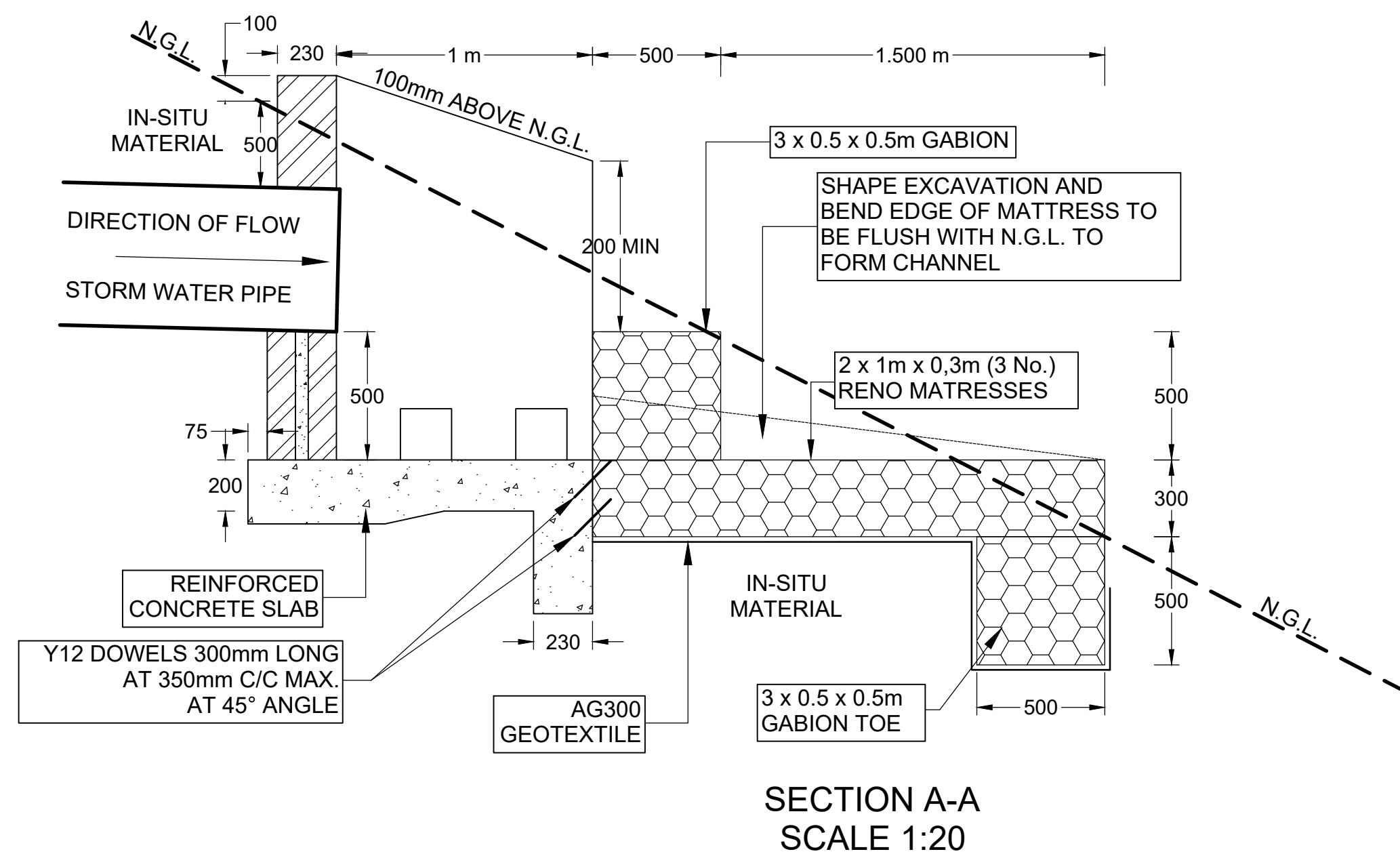
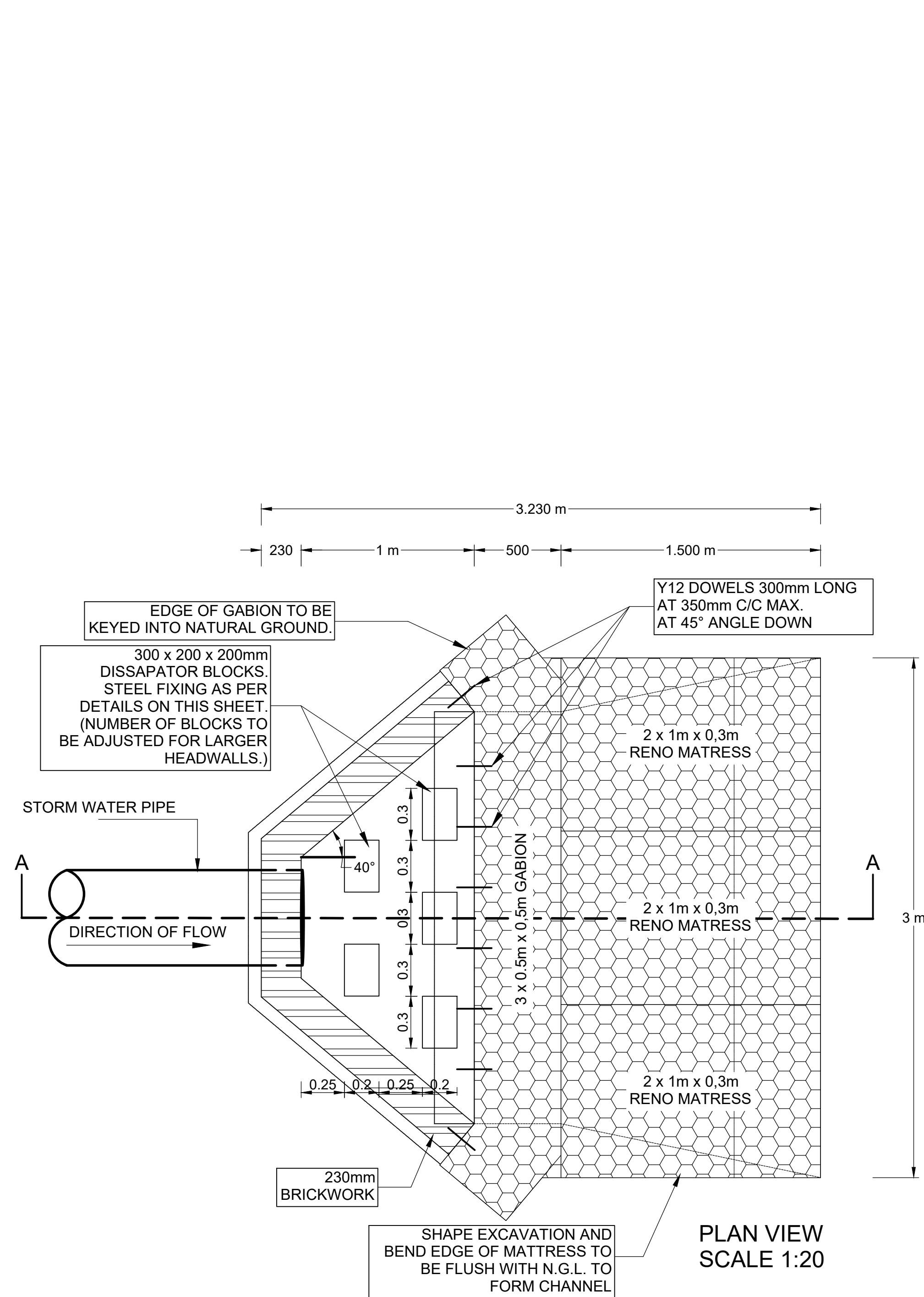
DRAWING No. 24051-C-005-03 REV

COORDINATE SYSTEM: WGS84 / Lo 23°

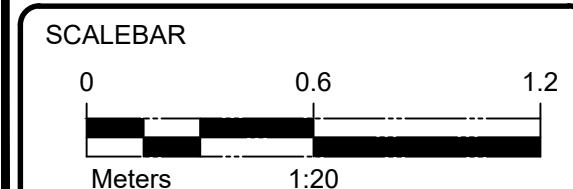


ANNEXURE F

Stormwater Details



The reference made to Engineer will also refer to Employer's Agent for GCC 2015 Contracts



REV	DESCRIPTION	DATE	REV BY	CHKD
A	ISSUED FOR INFORMATION	'24-12-09	GW	FvE
REVISIONS				

DESIGNED	GW	'24-12
DRAWN	GW	'24-12
CHECKED	FvE	'24-12

CONSULTING ENGINEERS

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email: george@lyniers.co.za

APPROVED	ENGINEERS:	DATE: 2024-12-09
APPROVED	CLIENT:	DATE:

CLIENT

ATTERBURY

It's a matter of association

PROJECT	OUMEULEN VILLAGE AND MEULENZICHT LANDGOED DEVELOPMENT (GEORGE)
TITLE	TYPICAL DETAIL OF STORMWATER OUTLET STRUCTURE

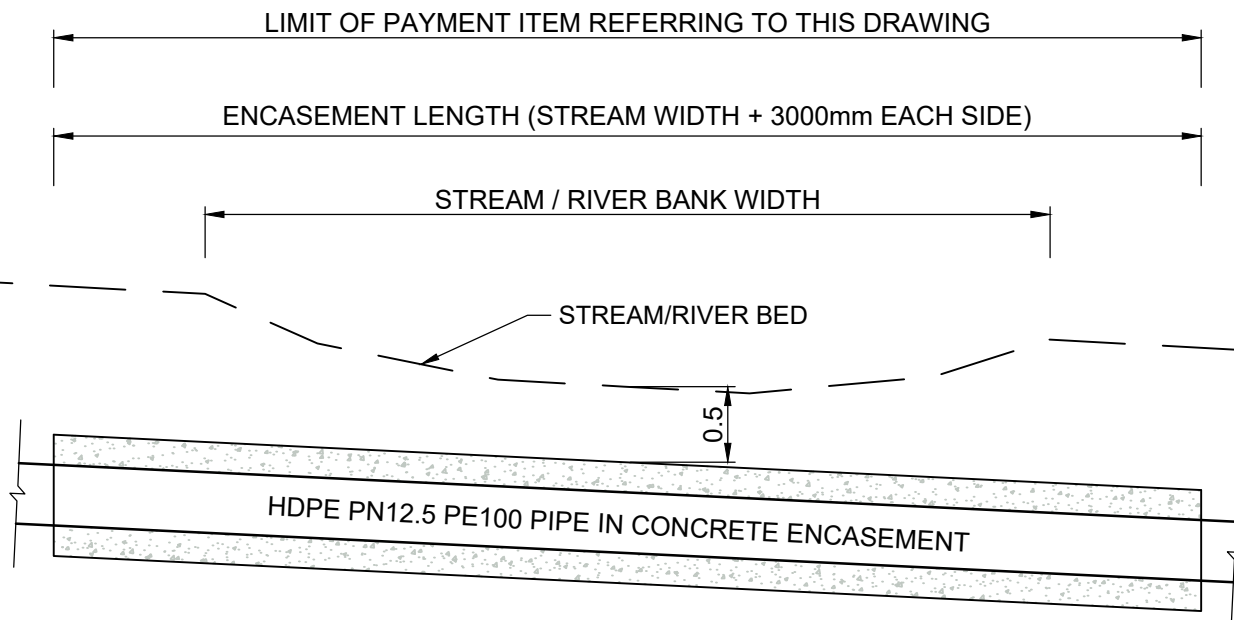
SCALE	on A1 1:20	SHEET 1 OF 1
CONTRACT No.	PROJECT No. 24051 CG	
DRAWING No.	REV 24051-C-005-101	
COORDINATE SYSTEM: WGS84 / L203		

iso full bleed a4 (210,00 x 297,00 mm)

lyniers-AutoCAD.ctb

2025-02-18

U:\WERKET\2400\24051 CG - SAMMILL DEVELOPMENT - GEORGET\DRAWINGS\1.2 ACTIVE\24051-C-003-102 (STREAM CROSSING).DWG

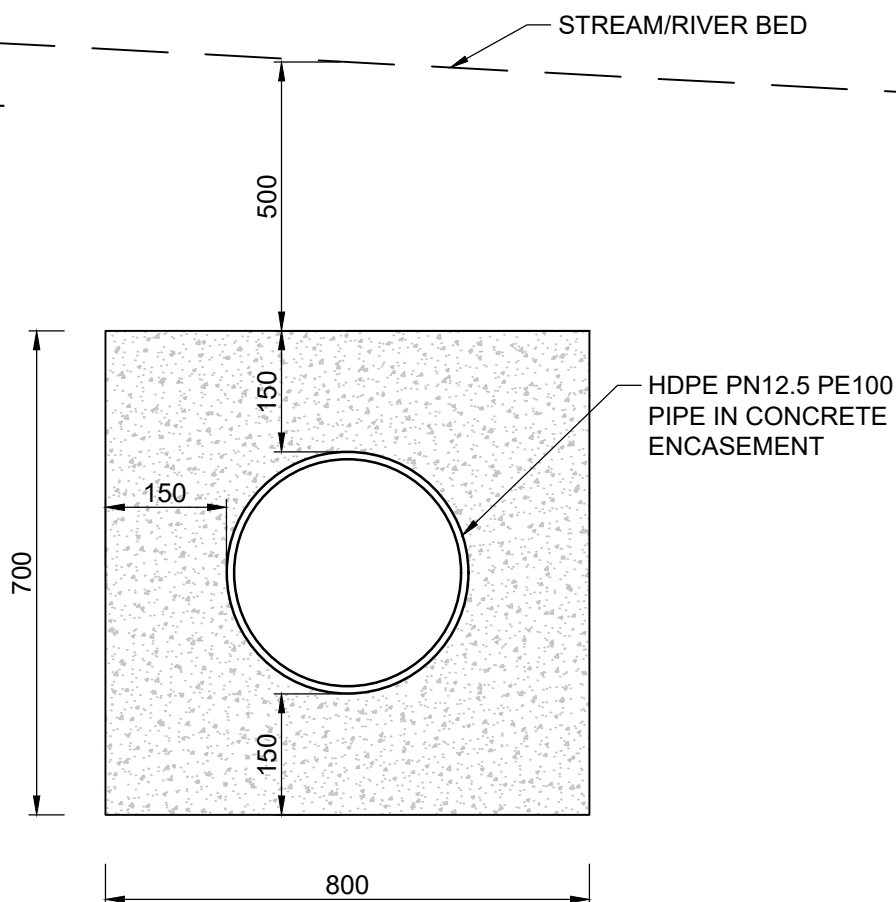


WATER CROSSING - LONGITUDINAL SECTION

N.T.S.

NOTES:

1. ANCHOR BLOCK AND FITTINGS NOT INCLUDED UNDER PAYMENT FOR WATER CROSSING
2. PRICE MUST INCLUDE DEALING WITH WATER WHERE APPLICABLE
2. ENCASEMENT CONCRETE MUST HAVE STRENGTH 25/19
3. BACKFILL 500mm ABOVE PIPE WITH EXCAVATED MATERIAL
4. PAYMENT FOR EXCAVATION AND BACKFILLING PAID SEPARATELY UNDER PIPE TRENCHES



WATER CROSSING - CROSS SECTION

N.T.S.

The reference made to Engineer will also refer to Employer's Agent for GCC 2015 Contracts

CONSULTING ENGINEERS



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GEORGE
6530

Tel: 044 887 0223/Fax: 044 887 0741
email: george@lyniers.co.za

TITLE

WATER CROSSING DETAIL

PROJECT No.
C24051

SCALE on A4
ON_DRAWING

DRAWING No.
24051-C-003-01

REV
A

APPROVED :
FVE

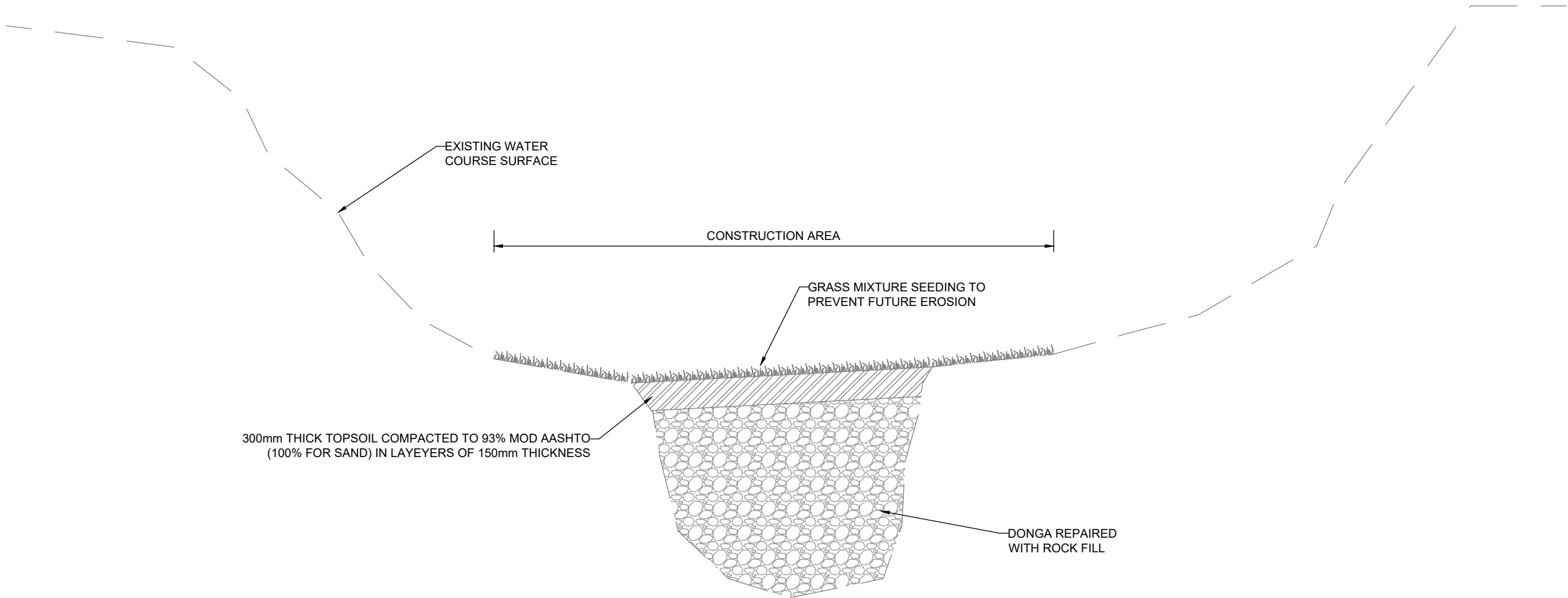
DRAWN
GW

DATE
'25-02

CHECKED
FVE

DATE
'25-02

- NOTES:
- 1. Contractor must verify location and extent of all the existing services prior to commencement of work.
 - 2. Contractor to stay within the construction area.
 - 3. Levels and position of existing donga erosion to be verified before construction, any discrepancies are to be liaised with the engineer immediately.



TYPICAL CROSS SECTION
FOR DONGA REPAIR

SCALE 1:50

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All dimensions must be verified on site before the works commence. Refer any discrepancies to the Engineer.

The reference made to Engineer will also refer to Employer's Agent for GCC 2015 Contracts

A	ISSUED FOR INFORMATION	'25-02-19	GW	FvE
REV	DESCRIPTION	DATE	REV BY	CHKD
REVISIONS				

DESIGNED	GW	25-02
DRAWN	GW	25-02
CHECKED	FvE	25-02

CONSULTING ENGINEERS



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GEORGE
6530

Tel: 044 887 0223/Fax: 044 887 0741
email: george@lyners.co.za

PROJECT

OUMEULEN VILLAGE AND MEULENZICHT
LANDGOED DEVELOPMENT (GEORGE)

TITLE

TYPICAL DETAIL OF
DONGA EROSION REPAIR

SCALE

on A3
1:50

SHEET

1 OF 1

CONTRACT No.

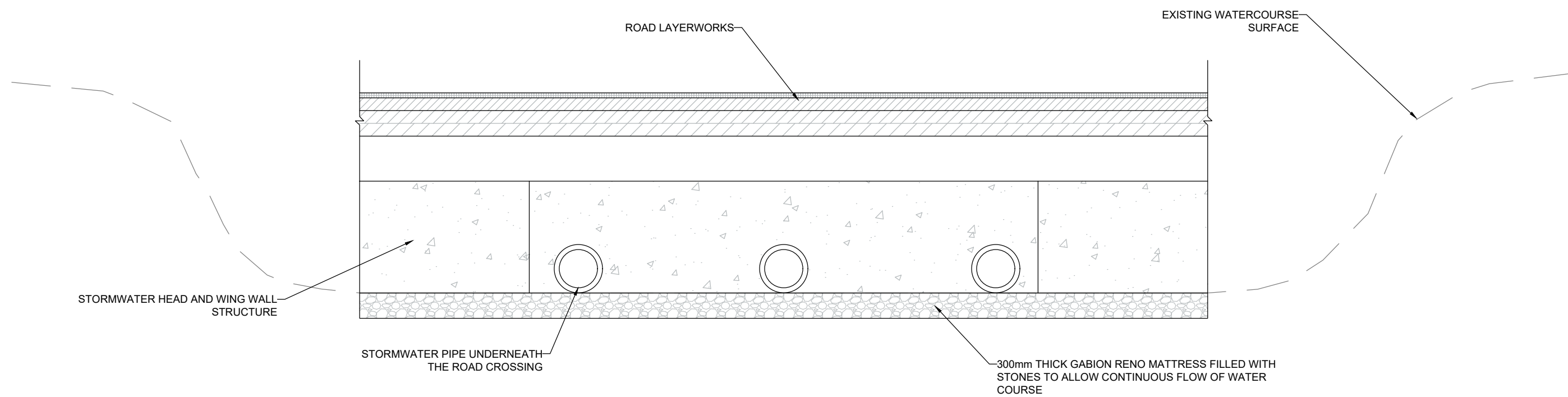
PROJECT No.
24051CG

DRAWING No.
24051-C-005-102

COORDINATE SYSTEM: WGS84 / Lo 23°

REV

A



**TYPICAL CROSS SECTION
FOR ROAD CROSSING OVER STREAM**

SCALE 1:50

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All dimensions must be verified on site before the works commence. Refer any discrepancies to the Engineer.

The reference made to Engineer will also refer to Employer's Agent for GCC 2015 Contracts

<table><tr><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td></tr><tr><td>A</td><td>ISSUED FOR INFORMATION</td><td>'25-02-19</td><td>GW</td><td>FvE</td></tr><tr><td>REV</td><td>DESCRIPTION</td><td>DATE</td><td>REV BY</td><td>CHKD</td></tr><tr><td colspan="5">REVISIONS</td></tr></table>																				A	ISSUED FOR INFORMATION	'25-02-19	GW	FvE	REV	DESCRIPTION	DATE	REV BY	CHKD	REVISIONS					<table><tr><td>DESIGNED</td><td>GW</td><td>25-02</td></tr><tr><td>DRAWN</td><td>GW</td><td>25-02</td></tr><tr><td>CHECKED</td><td>FvE</td><td>25-02</td></tr></table>			DESIGNED	GW	25-02	DRAWN	GW	25-02	CHECKED	FvE	25-02	CONSULTING ENGINEERS  LYNERS PO Box 757 GEORGE 6530 Tel: 044 887 0223/Fax: 044 887 0741 email: george@lyners.co.za		<table><tr><td>PROJECT</td><td>OUMEULEN VILLAGE AND MEULENZICHT LANDGOED DEVELOPMENT (GEORGE)</td></tr><tr><td>TITLE</td><td>TYPICAL DETAIL OF ROAD STREAM CROSSING</td></tr></table>		PROJECT	OUMEULEN VILLAGE AND MEULENZICHT LANDGOED DEVELOPMENT (GEORGE)	TITLE	TYPICAL DETAIL OF ROAD STREAM CROSSING	<table><tr><td>SCALE</td><td>on A3</td><td>SHEET</td></tr><tr><td>1:50</td><td></td><td>1 OF 1</td></tr><tr><td>CONTRACT No.</td><td colspan="2">PROJECT No. 24051CG</td></tr><tr><td colspan="2">DRAWING No. 24051-C-005-103</td><td>REV </td></tr><tr><td colspan="3">COORDINATE SYSTEM: WGS84 / Lo 23°</td></tr></table>		SCALE	on A3	SHEET	1:50		1 OF 1	CONTRACT No.	PROJECT No. 24051CG		DRAWING No. 24051-C-005-103		REV 	COORDINATE SYSTEM: WGS84 / Lo 23°		
A	ISSUED FOR INFORMATION	'25-02-19	GW	FvE																																																																			
REV	DESCRIPTION	DATE	REV BY	CHKD																																																																			
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1:50		1 OF 1																																																																					
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DRAWING No. 24051-C-005-103		REV 																																																																					
COORDINATE SYSTEM: WGS84 / Lo 23°																																																																							



ANNEXURE G

Preliminary Geotechnical Soil Investigation

AAN DE MEULEN DEVELOPMENT GEORGE

SOIL INVESTIGATION



JULY 2024

Author:
Llewelyn Heathcote

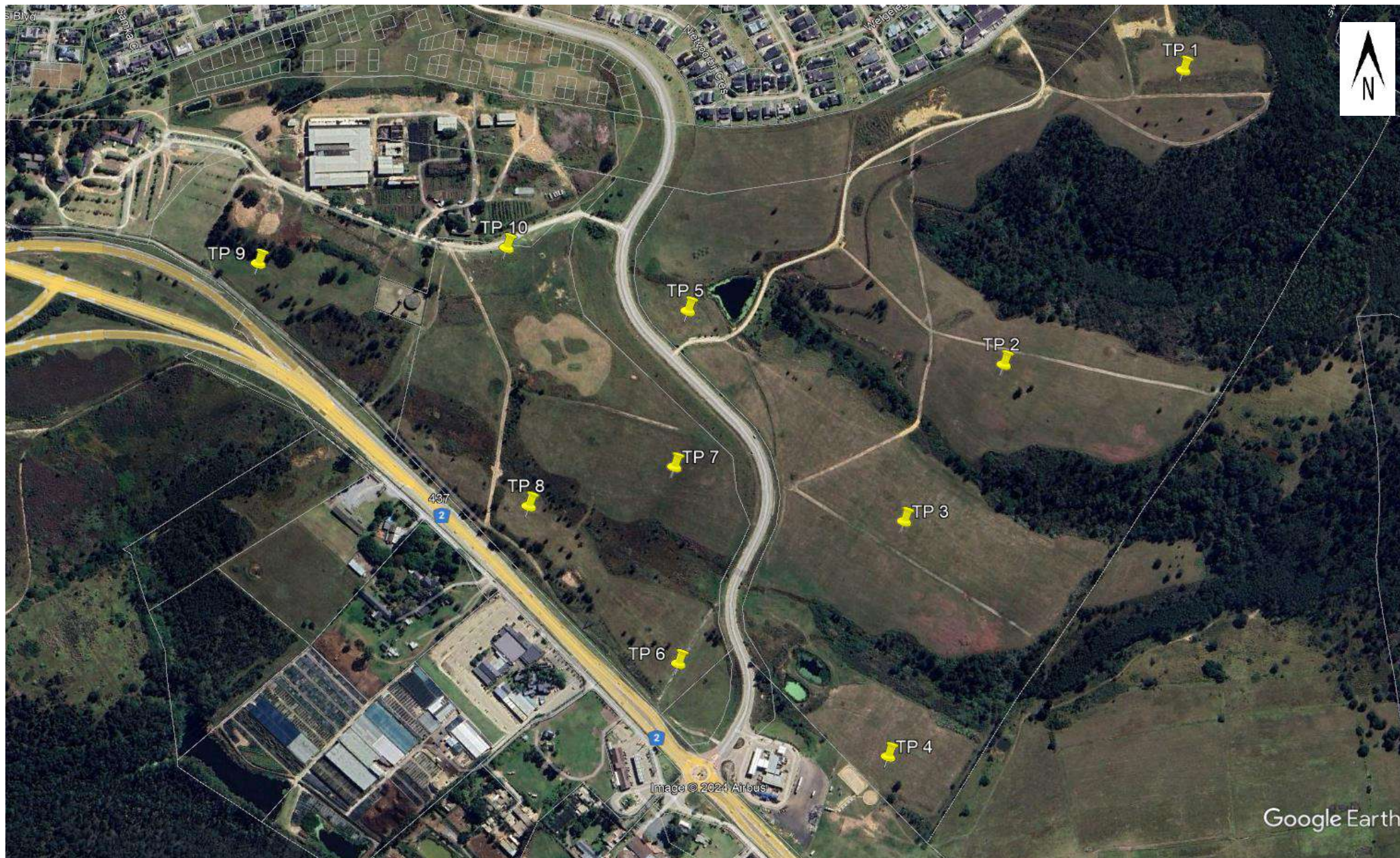


Figure 1:

Locality Plan

Scale:NTS



Outeniqua Lab (Pty) Ltd
Civil Engineering Laboratory



OUTENIQUA LAB (Pty) Ltd.

Registration No. 95/07742/07

Materials Testing Laboratory

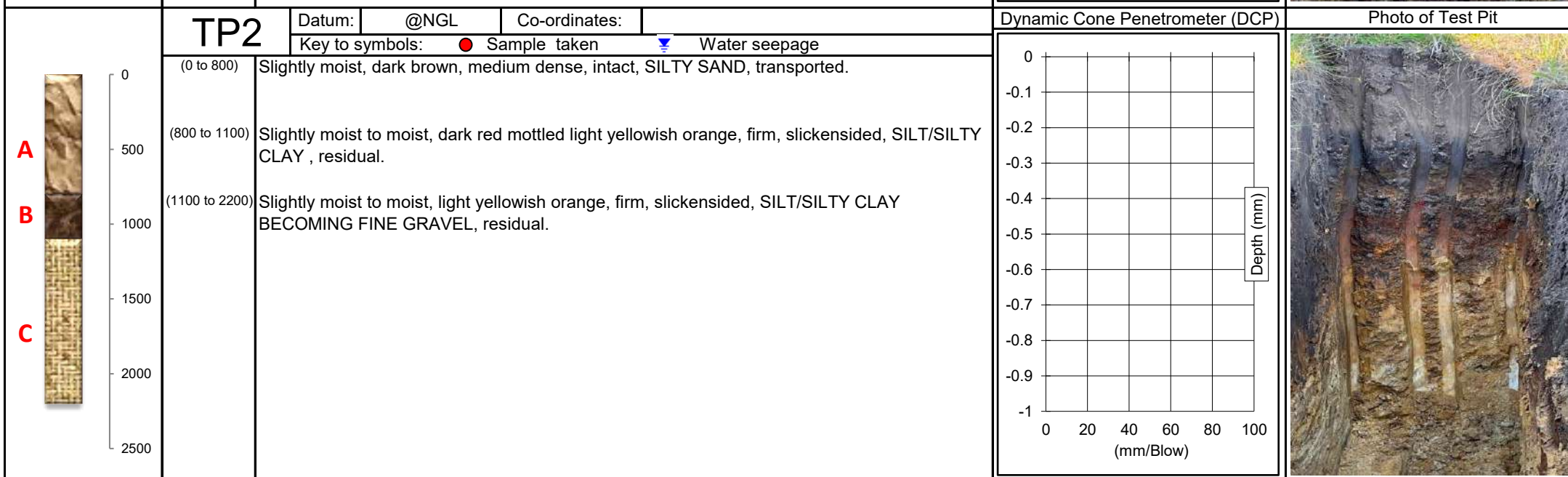
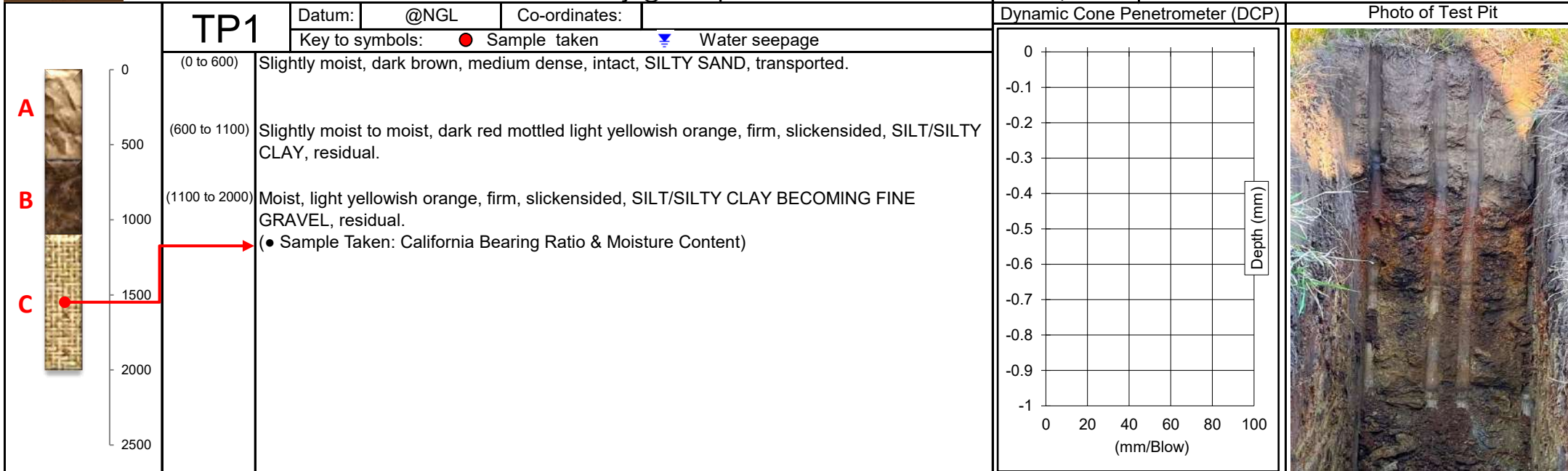
6 Mirrorball Street, George : PO Box 3186, George Industria, 6536

Tel: 044 8743274 : Fax: 044 8745779 : e-mail: llewelyn@outeniqua.co.za

R-PROF-1-5

Jan-22

Customer :	Neil Lyners P O Box 757 George 6530
Project :	Aan de Meulen Development - George
Date Reported :	22/07/24



Director:

L Heathcote B-Tech. (Civil Eng.) & BSc Hons (Transport)



OUTENIQUA LAB (Pty) Ltd.

Registration No. 95/07742/07

Materials Testing Laboratory

6 Mirrorball Street, George : PO Box 3186, George Industria, 6536

Tel: 044 8743274 : Fax: 044 8745779 : e-mail: llewelyn@outeniqua.co.za

R-PROF-1-5

Jan-22

Customer :

Neil Lyners
P O Box 757
George
6530

Project :

Aan de Meulen Development - George

Date Reported :

22/07/24

TP3

Datum:

@NGL

Co-ordinates:

Key to symbols:

● Sample taken

▼ Water seepage

(0 to 800)

Slightly moist, dark brown, medium dense, intact, SILTY SAND, transported.

(800 to 1300)

Slightly moist to moist, dark red mottled light yellowish orange, firm, slickensided, SILT/SILTY CLAY, residual.

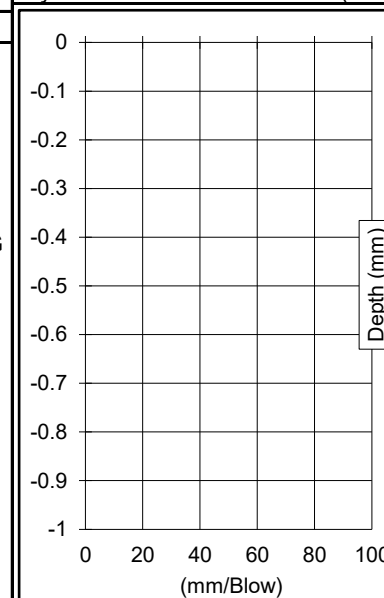
(● Sample Taken: Foundation Indicator & Moisture Content)

(1300 to 2300)

Slightly moist to moist, light reddish orange, firm, slickensided, SILT/SILTY CLAY BECOMING FINE GRAVEL, residual.

Dynamic Cone Penetrometer (DCP)

Photo of Test Pit



TP4

Datum:

@NGL

Co-ordinates:

Key to symbols:

● Sample taken

▼ Water seepage

(0 to 500)

Slightly moist, dark brown, medium dense, intact, SILTY SAND, transported.

(500 to 1000)

Slightly moist to moist, dark reddish brown, very dense, intact, FERRICRETE, pedogenic.

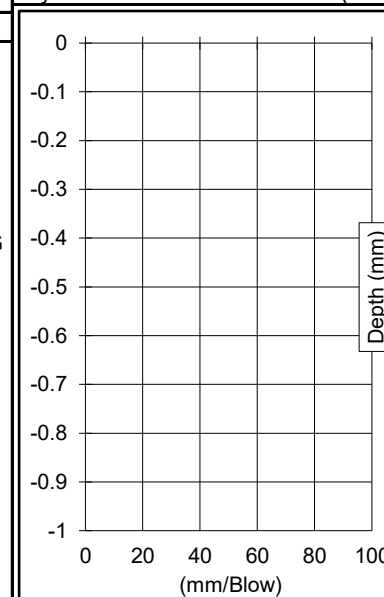
(● Sample Taken: California Bearing Ratio & Moisture Content)

(1000 to 2300)

Slightly moist to moist, light reddish orange, firm, slickensided, SILT/SILTY CLAY BECOMING FINE GRAVEL, residual.

Dynamic Cone Penetrometer (DCP)

Photo of Test Pit



Director:

L Heathcote B-Tech. (Civil Eng.) & BSc Hons (Transport)



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R-PROF-1-5

Jan-22

Customer :	Neil Lyners P O Box 757 George 6530
Project :	Aan de Meulen Development - George
Date Reported :	22/07/24

TP5		Datum:	@NGL	Co-ordinates:		Dynamic Cone Penetrometer (DCP)	Photo of Test Pit
		Key to symbols: ● Sample taken ▼ Water seepage					
(0 to 700)	Slightly moist, dark brown, medium dense, intact, SILTY SAND, transported.						
(700 to 900)	Slightly moist to moist, dark reddish brown, very dense, intact, FERRICRETE, pedogenic.						
(900 to 1500)	Slightly moist to moist, dark red mottled light yellowish orange, firm, slickensided, SILT/SILTY CLAY, residual.						
(1500 to 2300)	Slightly moist to moist, light yellowish orange, firm to stiff, slickensided, SILT/SILTY CLAY BECOMING FINE GRAVEL, residual.						

TP6		Datum:	@NGL	Co-ordinates:		Dynamic Cone Penetrometer (DCP)	Photo of Test Pit
		Key to symbols: ● Sample taken ▼ Water seepage					
(0 to 600)	Slightly moist, dark brown, medium dense, intact, SILTY SAND, transported.						
(600 to 1000)	Slightly moist to moist, dark red mottled light reddish orange, firm, slickensided, SILT/SILTY CLAY, residual.						
(1000 to 2300)	Slightly moist to moist, light yellowish orange, firm, slickensided, SILT/SILTY CLAY BECOMING FINE GRAVEL, residual. (● Sample Taken: Foundation Indicator & Moisture Content)						

Director: L Heathcote B-Tech. (Civil Eng.) & BSc Hons (Transport)



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Registration No. 95/07742/07

Materials Testing Laboratory

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R-PROF-1-5

Jan-22

Customer :	Neil Lyners P O Box 757 George 6530
Project :	Aan de Meulen Development - George
Date Reported :	22/07/24

TP7		Datum:	@NGL	Co-ordinates:		Dynamic Cone Penetrometer (DCP)	Photo of Test Pit
		Key to symbols: ● Sample taken ▼ Water seepage					
	(0 to 500)	Slightly moist, dark brown, medium dense, intact, SILTY SAND, transported.					
	(500 to 700)	Slightly moist to moist, dark reddish brown, very dense, intact, FERRICRETE, pedogenic.					
	(700 to 1200)	Slightly moist to moist, dark red mottled light yellowish orange, firm, slickensided, SILT/SILTY CLAY, residual. (● Sample Taken: California Bearing Ratio & Moisture Content)					
	(1200 to 2300)	Slightly moist to moist, light yellowish orange, firm to stiff, slickensided, SILT/SILTY CLAY BECOMING FINE GRAVEL, residual.					
TP8		Datum:	@NGL	Co-ordinates:		Dynamic Cone Penetrometer (DCP)	Photo of Test Pit
		Key to symbols: ● Sample taken ▼ Water seepage					
	(0 to 800)	Slightly moist, dark brown, medium dense, intact, SILTY SAND, transported.					
	(800 to 1100)	Slightly moist to moist, dark reddish brown, very dense, intact, FERRICRETE , pedogenic.					
	(1100 to 1600)	Slightly moist to moist, dark red mottled light yellowish orange, firm, slickensided, SILT/SILTY CLAY, residual.					
	(1600 to 2300)	Slightly moist to moist, light yellowish orange, firm to stiff, slickensided, SILT/SILTY CLAY BECOMING FINE GRAVEL, residual.					

Director: L Heathcote B-Tech. (Civil Eng.) & BSc Hons (Transport)



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Registration No. 95/07742/07

Materials Testing Laboratory

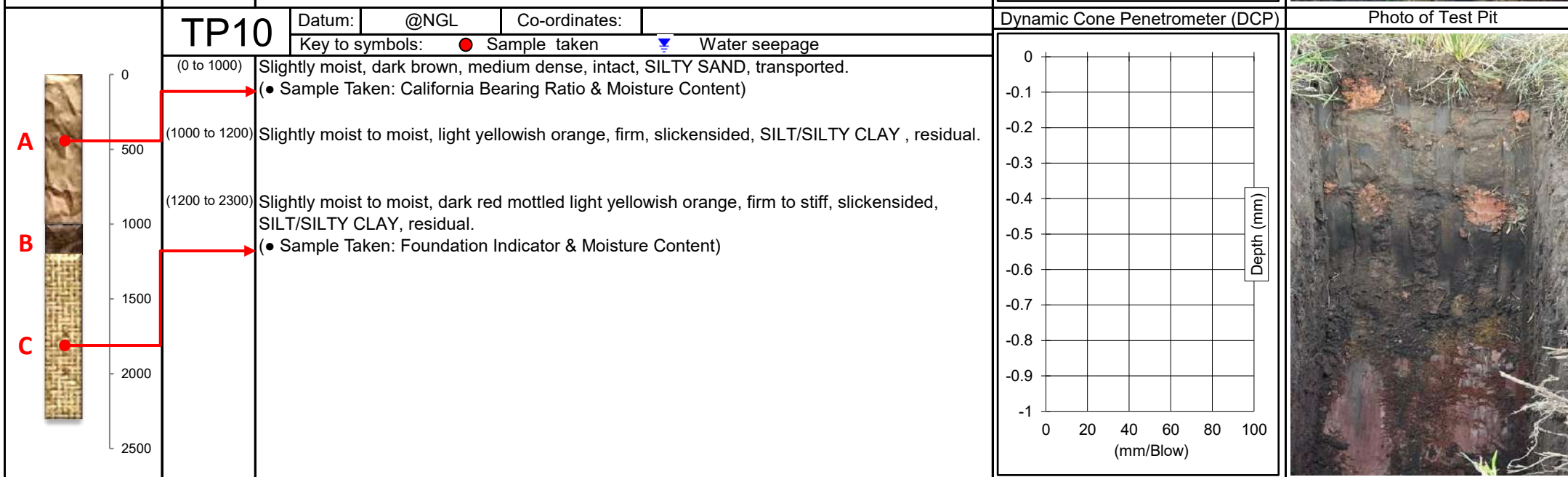
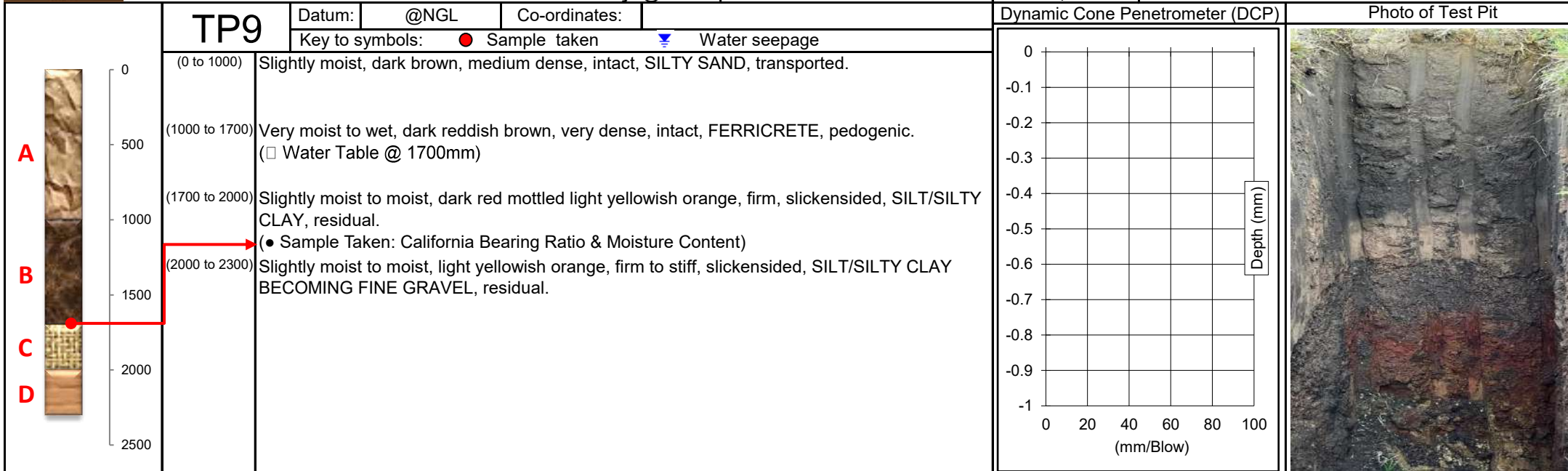
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Tel: 044 8743274 : Fax: 044 8745779 : e-mail: llewelyn@outeniqua.co.za

R-PROF-1-5

Jan-22

Customer :	Neil Lyners P O Box 757 George 6530
Project :	Aan de Meulen Development - George
Date Reported :	22/07/24



Director: L Heathcote B-Tech. (Civil Eng.) & BSc Hons (Transport)



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Materials Testing Laboratory

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Tel: 044 8743274 : Fax: 044 8745779 : e-mail: llewelyn@outeniqualab.co.za

R-CBR-1-9

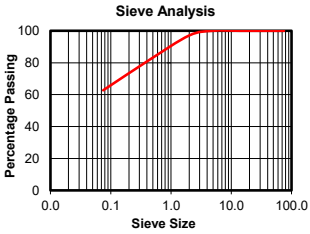
Jun-23

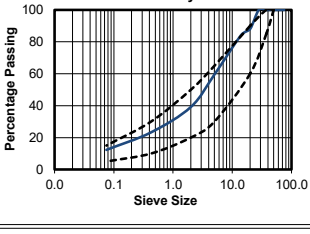
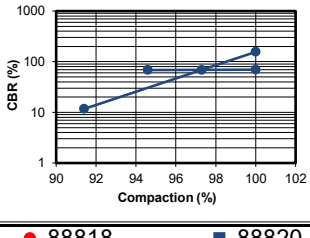
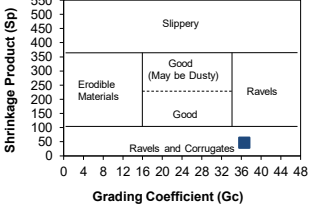


T0347

Customer :	Neil Lyners P O Box 757 George 6530	Project :	Aan de Meulen Development - George
		Date Received :	28/06/24
		Date Reported :	22/07/24
		Req. Number :	2335/24
Attention :	F van Eck	No. of Pages :	1 of 2

TEST REPORT CALIFORNIA BEARING RATIO

Sample Position (SV)		TP 1	TRH 14: Not Classified	TP 4	TRH 14: G4 Base (Natural)	88818 
Depth (mm)		1100-2000		500-1000		
Sample No		88818		88820		
Materials Description	Source	Trial Pit		Trial Pit		
	Colour	Light Yellowish Orange		Dark Reddish Brown		
	Soil Type	Silt/Silty Clay Becoming Fine Gravel		Ferricrete		
	Classification	Insitu		Insitu		
Material Indicators - (SANS 3001 Method GR1)						
Percentage Passing	75 mm	100		100		Opinion
	63 mm	100		100		
	50 mm	100		100	100 - 100	
	37.5 mm	100		100	85 - 100	
	28 mm	100		100		
	20 mm	100		88	60 - 90	
	14 mm	100		84		
	5 mm	100		60	30 - 65	
	2 mm	97		39	20 - 50	
	0.425 mm	81		23	10 - 30	
	0.075 mm	62.7		12.3	5 - 15	
Material Indicators - (SANS 3001 Method PR5)						
Grading Modulus *		0.59		2.25		
Coarse Sand Soil-Mortar (%)		16		41		
Atterberg Limits - (SANS 3001 Method GR10)						
Liquid Limit (%)		41		22	≤ 25	✓
Plasticity Index (%)		16		4	≤ 6	✓
Linear Shrinkage (%)		8.0		2.0	≤ 3	✓
Material Strength - (SANS 3001 Method GR30,GR40 - SCALPED)						
MDD	Max Dry Density (kg/m³)	1848		2414		
	Optimum Moisture Content (%)	9.7		4.9		
	Mould Moisture Content (%)	9.9		5.1		
A	Relative Compaction (%)	100.0		100.0		
	Swell (%)	4.6		0.0	≤ 0.2	✓
B	Relative Compaction (%)	95.2		94.6		
	Swell (%)	5.0		0.0		
C	Relative Compaction (%)	91.8		91.4		
	Swell (%)	7.5		0.1		
CBR	@100% Max Dry Density	2		156		
	@98% Max Dry Density	2		85	≥ 80	✓
	@95% Max Dry Density	1		35		
	@93% Max Dry Density	1		19		
	@90% Max Dry Density	1		8		
Material Condition - (SANS 3001 Method GR20)						
Insitu Moisture Content (%)		19.1		6.7		
Soil Classification Of The Material Based Only On The Tests Results Above						
TRH 14 Specification:		Not Classified		G1 Base (26.5mm)		
AASHTO System		A-7-6		A-1-a / A-1-b / A-2-4		
Unified System		CL		GP-GM		

88820 						
88820 						
88818 88820						
Wearing Course Graph (TRH 20) 						

Tests marked with a (*) are NOT SANAS Accredited results.

- Tests marked with a (*) are NOT SANAS Accredited results.
- Specimens sampled by Outeniqua Lab according to sampling Plan TMH 5 Methods MA2 (Trial Pit).
- Specimens sampled by Llewelyn Heathcote
- The weather conditions were such that there was no detrimental effect on the sample/s taken.

Llewelyn Heathcote
Technical Signatory
For Outeniqua Lab (Pty) Ltd.

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- The opinion column is an interpretation of the direct comparison between the quoted specification and the single test sample results obtained. The compliant (✓), non compliant (✗) and uncertain (*) opinion indicators are based on an approximate 95% level of confidence with reference to SAMM GUIDANCE 1, Issue 2 : 20 June 2007 Section 2.
- The uncertain (*) indicates that the test result is either equal to or is above / below the specified limit by a margin less than the measurement uncertainty; it is therefore not possible to state compliant (✓) or non compliant (✗) based on a 95% level of confidence with reference to SAMM GUIDANCE 1, Issue 2 : 20 June 2007 Section 2.
- This report (with attachments) is the correct record of all measurements made, and may not be reproduced other than with full written approval from the Director of Outeniqua Lab (Pty) Ltd.
- Measuring Equipment, traceable to National Standards is used where applicable. Results reported in this Test Report relate only to the items tested and are an indication only of the sample provided and/or taken.
- While every care is taken to ensure the correctness of all tests and reports, neither Outeniqua Lab (Pty) Ltd nor its employees shall be liable in any way whatever for any error made in the execution or reporting of tests or any erroneous conclusions drawn therefrom or for any consequence thereof.

Director: L Heathcote B-Tech. (Civil Eng.) & BSc Hons (Transport)



OUTENIQUA LAB (Pty) Ltd.

Registration No. 95/07742/07

Materials Testing Laboratory

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Tel: 044 8743274 : Fax: 044 8745779 : e-mail: llewelyn@outeniqua.co.za

R-CBR-1-9

Jun-23



T0347

Customer :	Neil Lyners P O Box 757 George 6530	Project :	Aan de Meulen Development - George
		Date Received :	28/06/24
		Date Reported :	22/07/24
		Req. Number :	2335/24
Attention :	F van Eck	No. of Pages :	2 of 2

TEST REPORT CALIFORNIA BEARING RATIO

Sample Position (SV)		TP 7	TRH 14:	TP 10	TRH 14:
Depth (mm)		700-1200	Not	0-1000	Not
Sample No		88822	Classified	88823	Classified
Materials Description	Source	Trial Pit		Trial Pit	
	Colour	Dark Red Mottled Light Yellowish Orange		Dark Brown	
	Soil Type	Silty/Silt Clay		Silty Sand	
	Classification	Insitu		Insitu	
Material Indicators - (SANS 3001 Method GR1)					
Percentage Passing	75 mm	100		100	
	63 mm	100		100	
	50 mm	100		100	
	37.5 mm	100		100	
	28 mm	100		100	
	20 mm	100		100	
	14 mm	100		100	
	5 mm	100		100	
	2 mm	99		98	
	0.425 mm	90		77	
0.075 mm	62.4		40.4		
Material Indicators - (SANS 3001 Method PR5)					
Grading Modulus *		0.49		0.84	
Coarse Sand Soil-Mortar (%)		9		22	
Atterberg Limits - (SANS 3001 Method GR10)					
Liquid Limit (%)		52		Undetermined	
Plasticity Index (%)		18		SP	
Linear Shrinkage (%)		9.0		SP	
Material Strength - (SANS 3001 Method GR30,GR40 - SCALPED)					
MDD	Max Dry Density (kg/m³)	1704		2087	
	Optimum Moisture Content (%)	16.7		7.8	
	Mould Moisture Content (%)	16.9		7.9	
A	Relative Compaction (%)	100.0		100.0	
	Swell (%)	3.5		0.1	
B	Relative Compaction (%)	95.2		95.6	
	Swell (%)	4.6		0.1	
C	Relative Compaction (%)	91.9		92.8	
	Swell (%)	5.0		0.1	
CBR	@100% Max Dry Density	3		17	
	@98% Max Dry Density	2		12	
	@95% Max Dry Density	2		7	
	@93% Max Dry Density	1		5	
	@90% Max Dry Density	1		3	
Material Condition - (SANS 3001 Method GR20)					
Insitu Moisture Content (%)		25.1		8.3	
Soil Classification Of The Material Based Only On The Tests Results Above					
TRH 14 Specification:		Not Classified		Not Classified	
AASHTO System		A-7-5		A-4	
Unified System		MH		SM	

88822

Sieve Analysis

88823

CBR Chart

88823

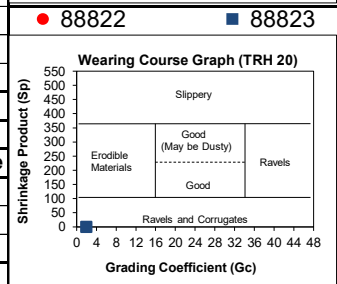
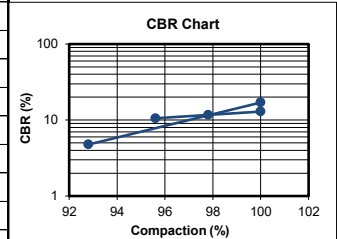
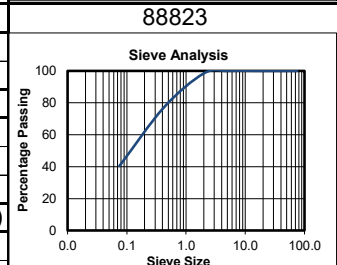
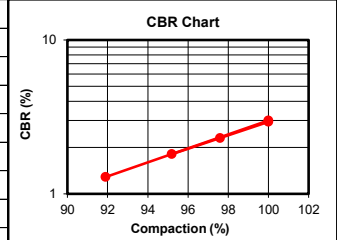
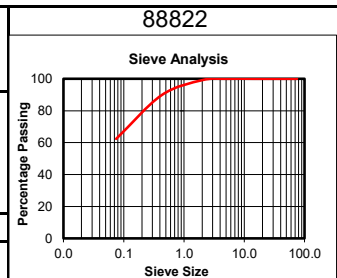
Sieve Analysis

CBR Chart

88822 **88823**

Wearing Course Graph (TRH 20)

Tests marked with a (*) are NOT SANAS Accredited results.



- Tests marked with a (*) are NOT SANAS Accredited results.
- Specimens sampled by Outeniqua Lab according to sampling Plan TMH 5 Methods MA2 (Trial Pit).
- Specimens sampled by Llewelyn Heathcote
- The weather conditions were such that there was no detrimental effect on the sample/s taken.

Llewelyn Heathcote

Technical Signatory

For Outeniqua Lab (Pty) Ltd.

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- The opinion column is an interpretation of the direct comparison between the quoted specification and the single test sample results obtained. The compliant (✓), non compliant (✗) and uncertain (*) opinion indicators are based on an approximate 95% level of confidence with reference to SAMM GUIDANCE 1, Issue 2 : 20 June 2007 Section 2.
- The uncertain (*) indicates that the test result is either equal to or is above / below the specified limit by a margin less than the measurement uncertainty; it is therefore not possible to state compliant (✓) or non compliant (✗) based on a 95% level of confidence with reference to SAMM GUIDANCE 1, Issue 2 : 20 June 2007 Section 2.
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Director: L Heathcote B-Tech. (Civil Eng.) & BSc Hons (Transport)



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Jan-22



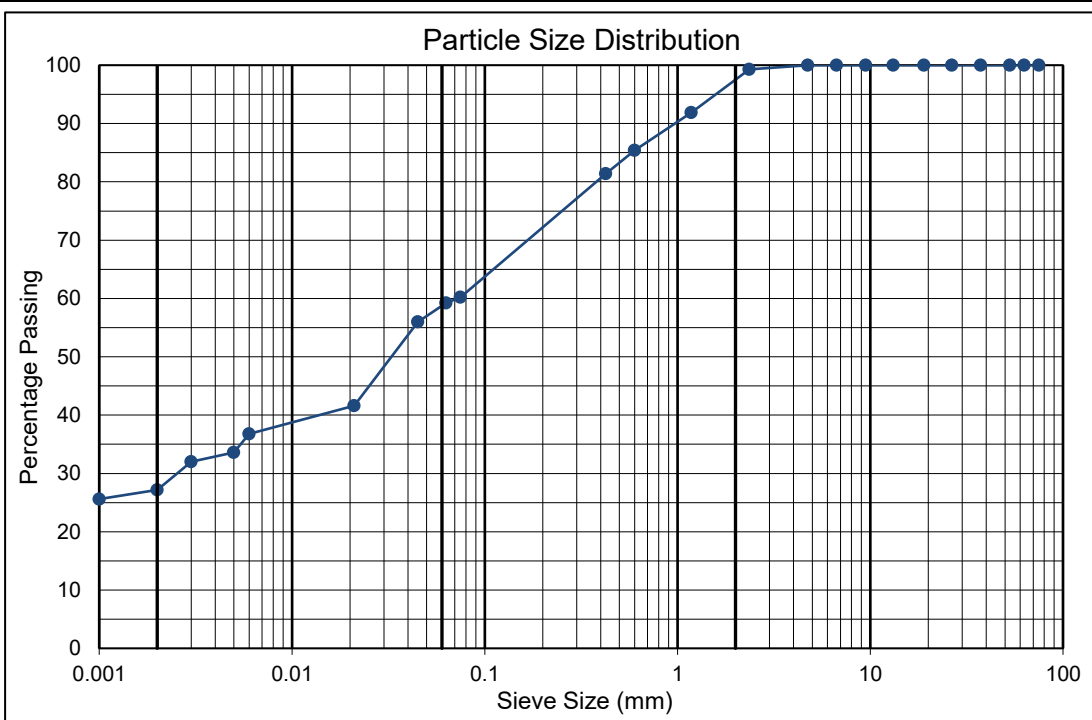
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	Attention : F van Eck	Date Received :	28/06/24
		Date Reported :	22/07/24
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TEST REPORT FOUNDATION INDICATOR - (ASTM Method D422)

Sample Position (SV)	TP 1
Depth (mm):	1100-2000
Sample No.:	88818
Materials Description	Trial Pit
Source	Light Yellowish Orange
Colour	Silt/Silty Clay Becoming Fine Gravel
Soil Type	Insitu
Classification	

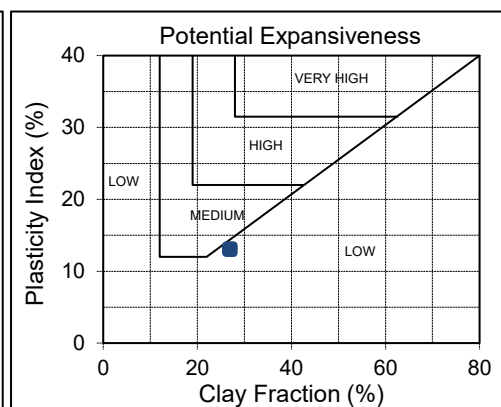
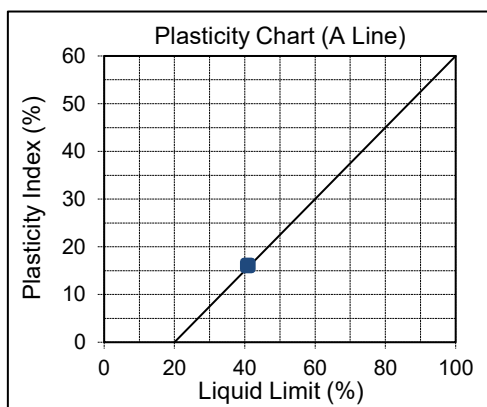
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63.0mm	100
53.0mm	100
37.5mm	100
26.5mm	100
19mm	100
13.2mm	100
9.5mm	100
6.7mm	100
4.75mm	100
2.36mm	99
1.18mm	92
0.6mm	85
0.425mm	81
0.075mm	60
0.063mm	59
0.045mm	56
0.021mm	42
0.006mm	37
0.005mm	34
0.003mm	32
0.002mm	27
0.001mm	26



Liquid Limit (%)	41
Plasticity Index (%)	16
Linear Shrinkage (%)	8
Moisture Content (%)	19.1

% Clay	27
% Silt	32
% Sand	38
% Gravel	3

Unified Soil Classification	CL
AASHTO Soil Classification	A-7-6



- Specimen sampled by Outeniqua Lab according to sampling Plan TMH 5 Methods MB1 (Stockpile).
- Specimens sampled by Llewelyn Heathcote
- The weather conditions were such that there was no detrimental effect on the sample/s taken.

Llewelyn Heathcote
Technical Signatory
For Outeniqua Lab (Pty) Ltd.

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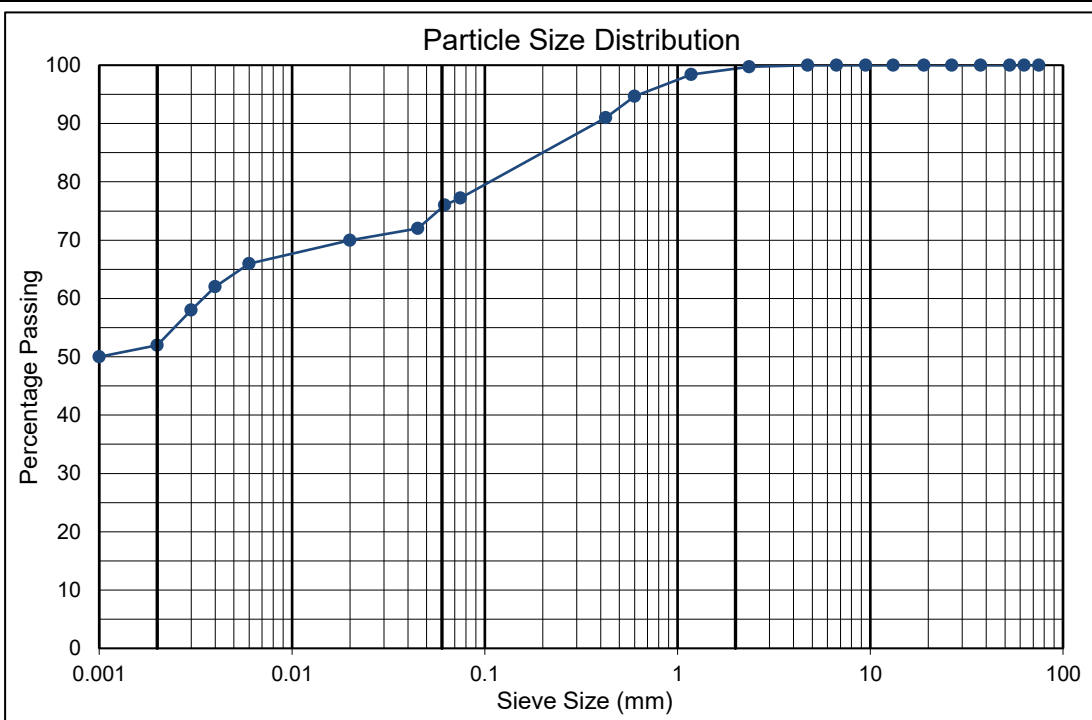
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TEST REPORT FOUNDATION INDICATOR - (ASTM Method D422)

Sample Position (SV)	TP 3
Depth (mm):	800-1300
Sample No.:	88819
Materials Description	Trial Pit
Source	Dark Red Mottled Light Yellowish Orange
Colour	Silty/Silt Clay
Soil Type	Insitu
Classification	

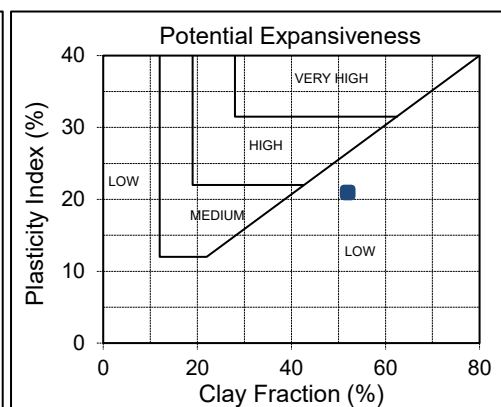
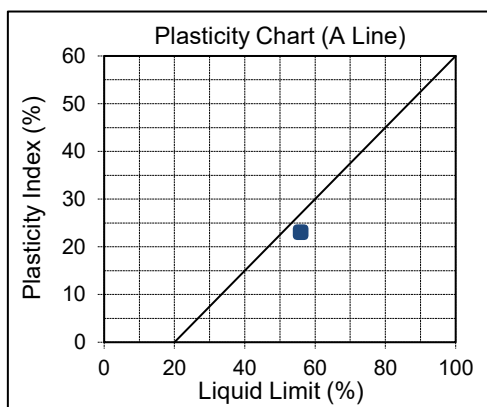
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19mm	100
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9.5mm	100
6.7mm	100
4.75mm	100
2.36mm	100
1.18mm	98
0.6mm	95
0.425mm	91
0.075mm	77
0.062mm	76
0.045mm	72
0.02mm	70
0.006mm	66
0.004mm	62
0.003mm	58
0.002mm	52
0.001mm	50



Liquid Limit (%)	56
Plasticity Index (%)	23
Linear Shrinkage (%)	12
Moisture Content (%)	25.5

% Clay	52
% Silt	23
% Sand	24
% Gravel	1

Unified Soil Classification	MH
AASHTO Soil Classification	A-7-5



- Specimen sampled by Outeniqua Lab according to sampling Plan TMH 5 Methods MB1 (Stockpile).
- Specimens sampled by Llewelyn Heathcote
- The weather conditions were such that there was no detrimental effect on the sample/s taken.

Llewelyn Heathcote
Technical Signatory
For Outeniqua Lab (Pty) Ltd.

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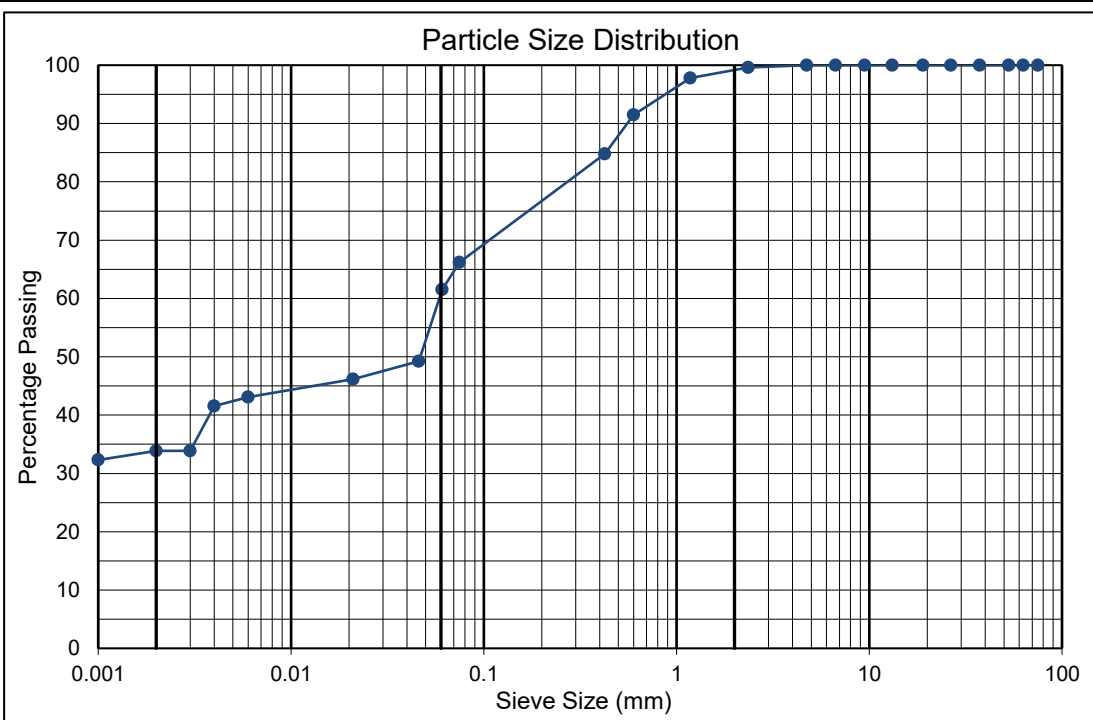
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TEST REPORT FOUNDATION INDICATOR - (ASTM Method D422)

Sample Position (SV)	TP 6
Depth (mm):	1000-2300
Sample No.:	88821
Materials Description	Trial Pit
Source	Light Yellowish Orange
Colour	Silt/Silty Clay Becoming Fine Gravel
Soil Type	Insitu
Classification	

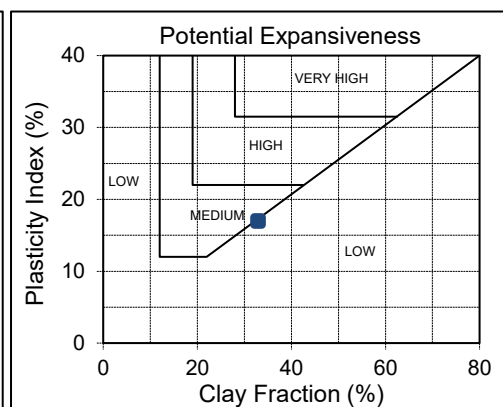
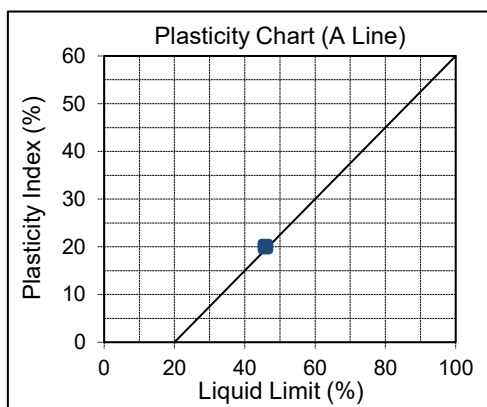
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53.0mm	100
37.5mm	100
26.5mm	100
19mm	100
13.2mm	100
9.5mm	100
6.7mm	100
4.75mm	100
2.36mm	100
1.18mm	98
0.6mm	92
0.425mm	85
0.075mm	66
0.061mm	62
0.046mm	49
0.021mm	46
0.006mm	43
0.004mm	42
0.003mm	34
0.002mm	34
0.001mm	32



Liquid Limit (%)	46
Plasticity Index (%)	20
Linear Shrinkage (%)	10
Moisture Content (%)	22.4

% Clay	33
% Silt	28
% Sand	38
% Gravel	1

Unified Soil Classification	CL
AASHTO Soil Classification	A-7-6



- Specimen sampled by Outeniqua Lab according to sampling Plan TMH 5 Methods MB1 (Stockpile).
- Specimens sampled by Llewelyn Heathcote
- The weather conditions were such that there was no detrimental effect on the sample/s taken.

Llewelyn Heathcote
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For Outeniqua Lab (Pty) Ltd.

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Jan-22



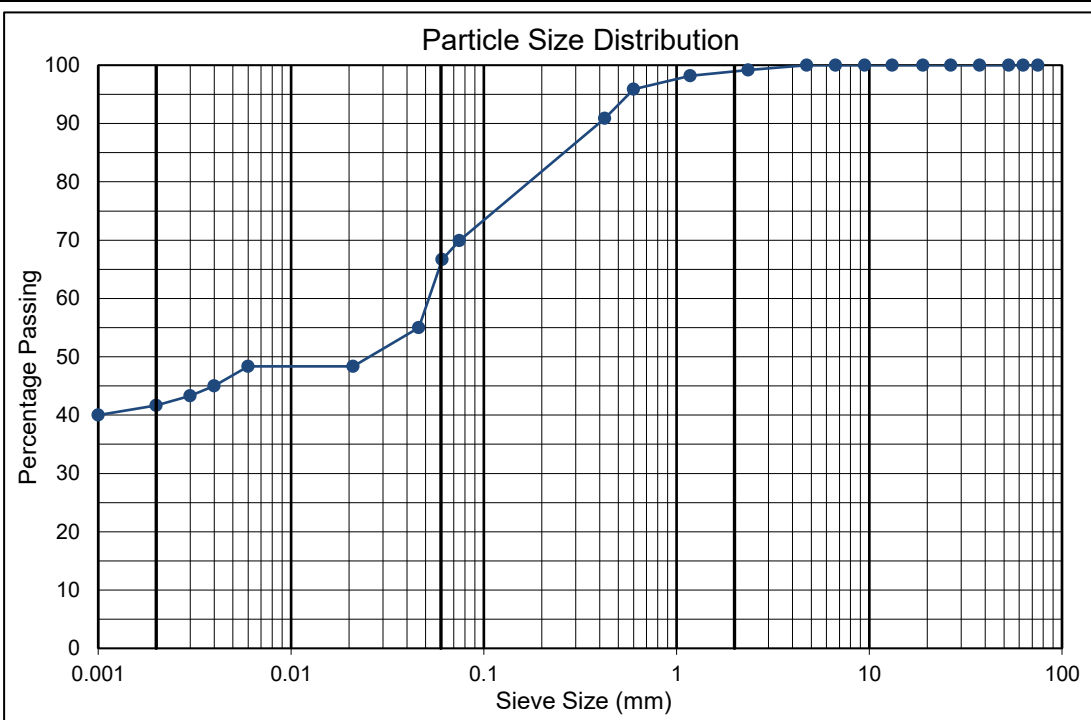
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TEST REPORT FOUNDATION INDICATOR - (ASTM Method D422)

Sample Position (SV)	TP 10
Depth (mm):	1200-2300
Sample No.:	88824
Materials Description	Trial Pit
Colour	Dark Red Mottled Light Yellowish Orange
Soil Type	Silty/Silt Clay
Classification	Insitu

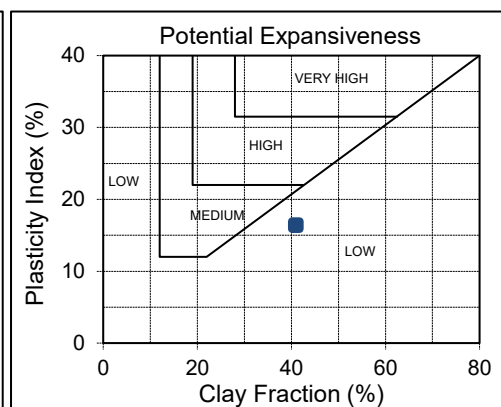
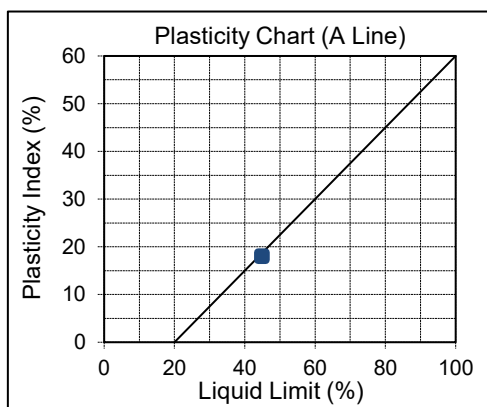
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53.0mm	100
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26.5mm	100
19mm	100
13.2mm	100
9.5mm	100
6.7mm	100
4.75mm	100
2.36mm	99
1.18mm	98
0.6mm	96
0.425mm	91
0.075mm	70
0.061mm	67
0.046mm	55
0.021mm	48
0.006mm	48
0.004mm	45
0.003mm	43
0.002mm	42
0.001mm	40



Liquid Limit (%)	45
Plasticity Index (%)	18
Linear Shrinkage (%)	9
Moisture Content (%)	29.0

% Clay	41
% Silt	25
% Sand	33
% Gravel	1

Unified Soil Classification	ML
AASHTO Soil Classification	A-7-6



- Specimen sampled by Outeniqua Lab according to sampling Plan TMH 5 Methods MB1 (Stockpile).
- Specimens sampled by Llewelyn Heathcote
- The weather conditions were such that there was no detrimental effect on the sample/s taken.

Llewelyn Heathcote
Technical Signatory
For Outeniqua Lab (Pty) Ltd.

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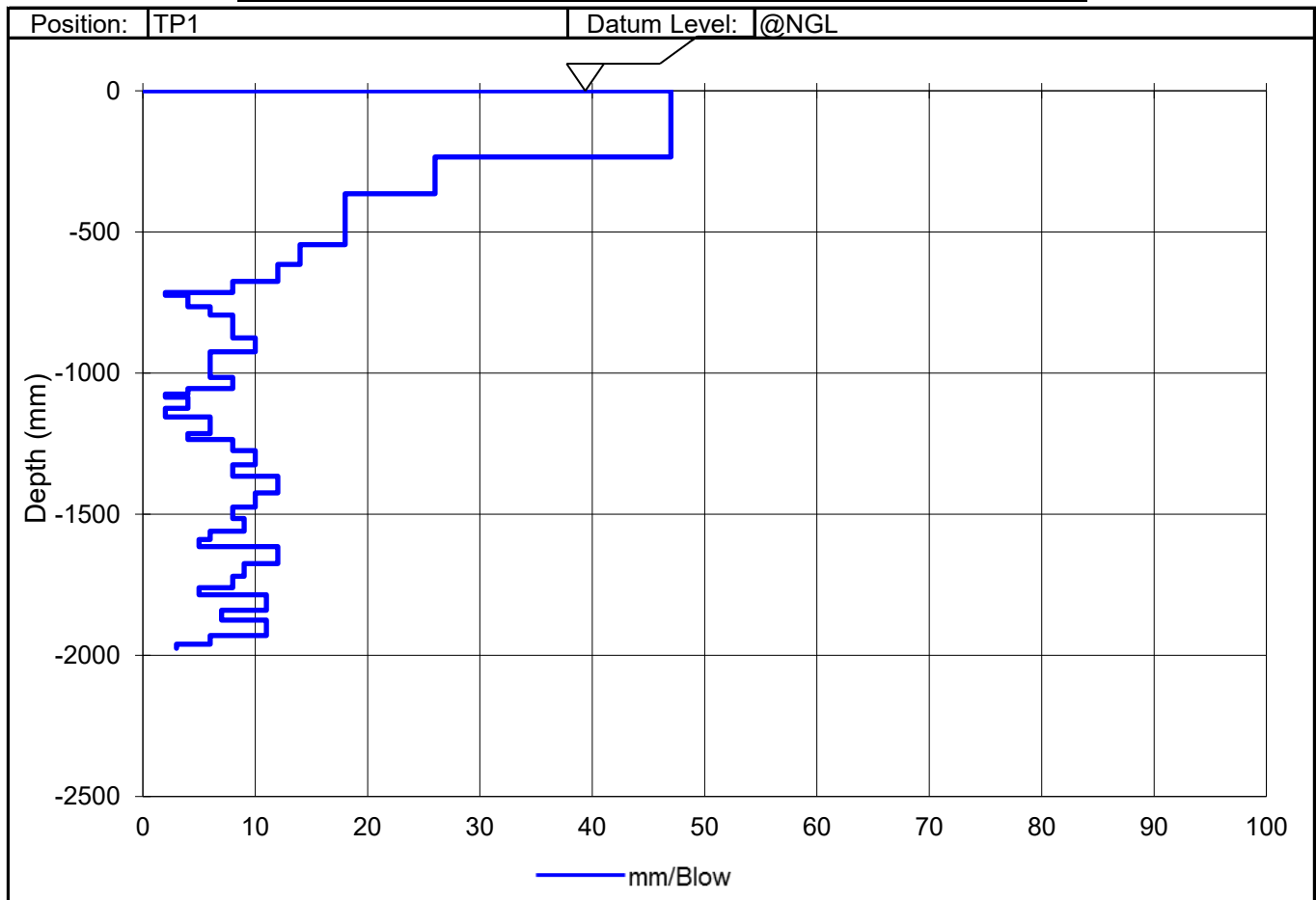


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TEST REPORT

DYNAMIC CONE PENETROMETER (DCP) - (TMH 6 Method ST6)



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Ruaan Lesch
Technical Signatory
For Outeniqua Lab (Pty) Ltd.

Director: L Heathcote B-Tech. (Civil Eng.) & BSc Hons (Transport)



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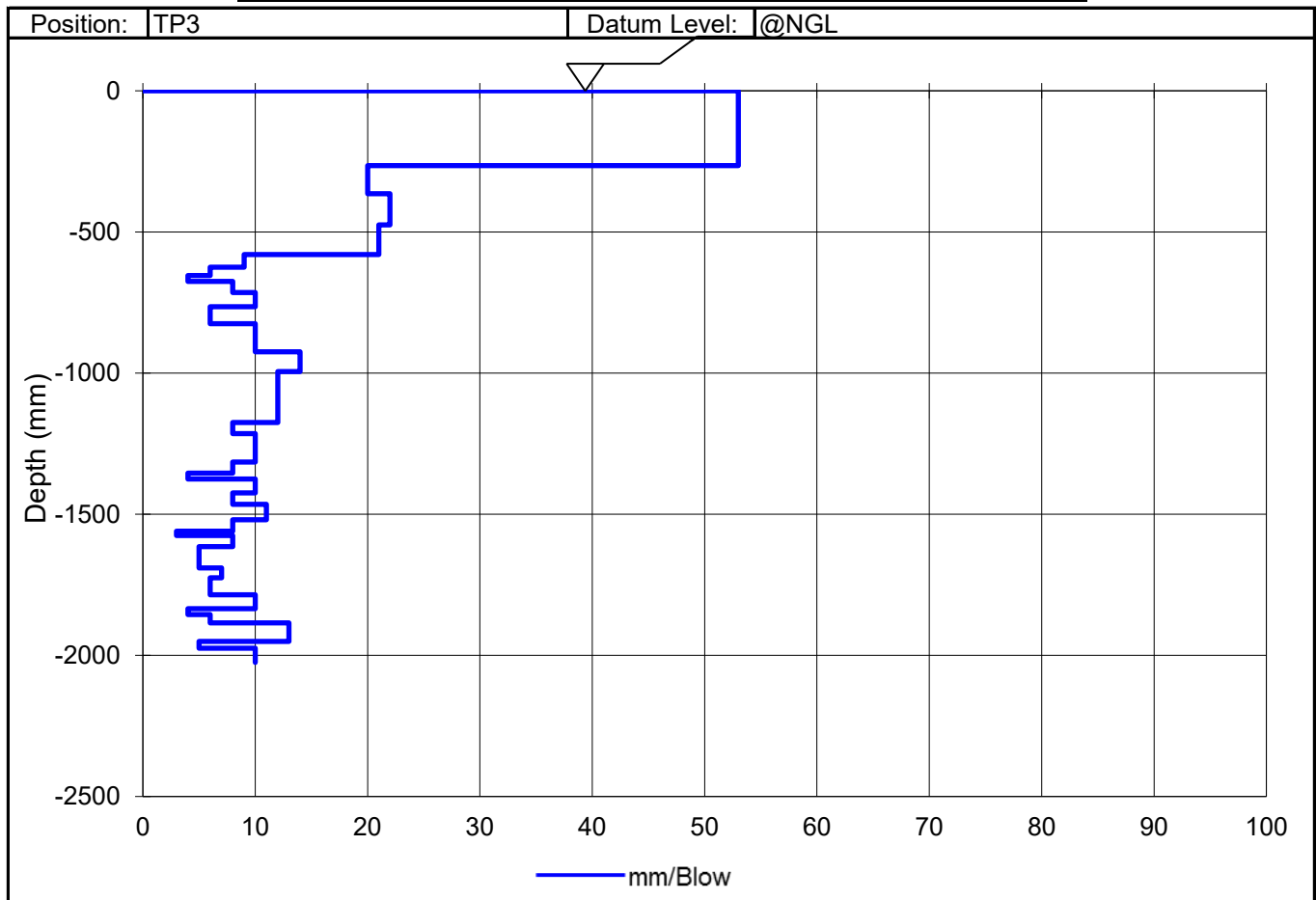


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TEST REPORT

DYNAMIC CONE PENETROMETER (DCP) - (TMH 6 Method ST6)



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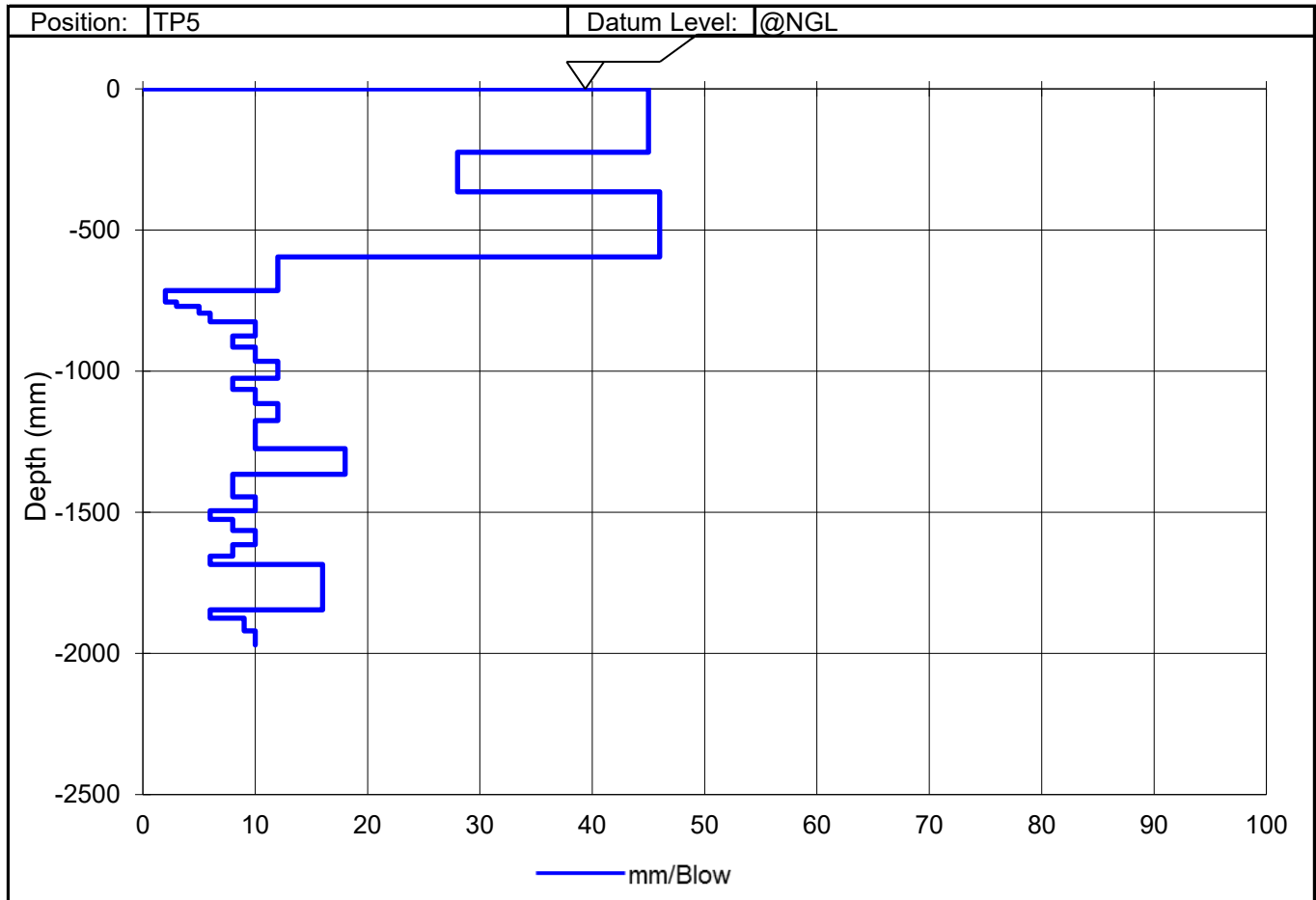


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DYNAMIC CONE PENETROMETER (DCP) - (TMH 6 Method ST6)



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Ruaan Lesch

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Director:

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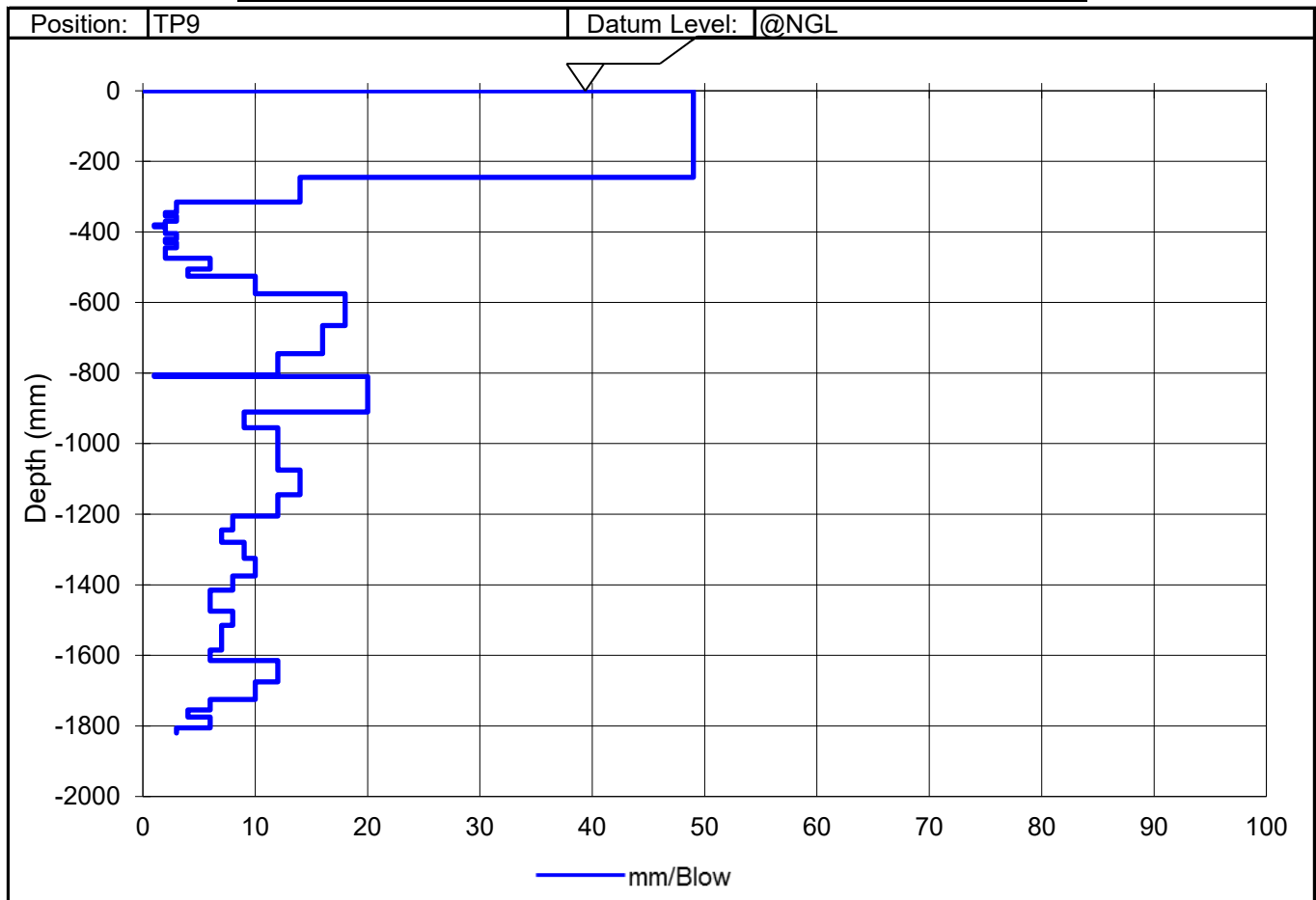


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DYNAMIC CONE PENETROMETER (DCP) - (TMH 6 Method ST6)



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³ Measuring Equipment, traceable to National Standards is used where applicable. Results reported in this Test Report relate only to the items tested and are an indication only of the sample provided and/or taken.

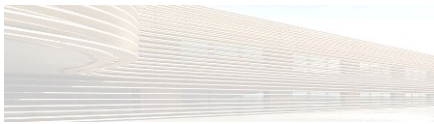
⁴ While every care is taken to ensure the correctness of all tests and reports, neither Outeniqua Lab (Pty) Ltd nor its employees shall be liable in any way whatever for any error made in the execution or reporting of tests or any erroneous conclusions drawn therefrom or for any consequence thereof.

Ruaan Lesch
Technical Signatory
For Outeniqua Lab (Pty) Ltd.

Director: L Heathcote B-Tech. (Civil Eng.) & BSc Hons (Transport)

ANNEXURE K:

Electrical Services Report



ENG-TENE-005 20221108

CLIENT: ATTERBURY



MEULENZICHT LANDGOED ELECTRICAL ENGINEERING SERVICES REPORT

FOR

PROJECT NO 24054EG

PROJECT NAME : MEULENZICHT LANDGOED – ELECTRICAL

DATE: MAY 2025

Compiled for :

**Atterbury
95 Dorp Street
Stellenbosch
7600**

Mr J Prinsloo

Prepared by :



**Neil Lyners & Associates (Pty) Ltd
P O Box 4901
TYGERVALLEY
7536
Tel: (021) 914 0300
Contact: Theo Potgieter
Email: theo@lynerns.co.za**

REPORT DETAILS :

Lyners Reference No: 24054EG
Client: Atterbury
Report prepared by: Jacques van Zyl
Client representative: Johan Prinsloo
Keywords: Meulenzicht Landgoed Electrical Services

Revision record and date: Rev 0 – May 2025

Date	Revision	Status	Format	Issued to:
May 2025	0		pdf	Johan Prinsloo

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This report was prepared for the sole use of Atterbury, based on information obtained from Atterbury and other parties including existing electricity services information. This report deals with the Electrical Engineering Services for the Development.

Lyners, its members and staff accept no responsibility for :

- Correctness of the information provided.
- Any matters outside the agreed scope of work.

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ANNEXURES

Annexure A: Subdivision/Master Plan from Nuvorm

Annexure B: Phasing Plan from Nuvorm

Annexure C: GLS Service Availability Report

Annexure D: George Municipality Capacity Letter

1. INTRODUCTION

Neil Lyners and Associates (Pty) Ltd ("Lyners") was requested to compile an Electrical Engineering Services Report for the planned Meulenzicht Landgoed Development in George.

This report investigates the preliminary electrical load requirements, supply capacity and upgrade details.

The various developments will consist of the following land uses:

- Residential Zone II and III
- Apartments
- Commercial
- Open Spaces
- Agricultural

2. SITE LOCATION

The proposed development, Meulenzicht Landgoed, is located on Erf 25537, situated north of the National Route 2 and adjacent to Urbans Boulevard, between the Modderrug River and the Swart River. The site is easily accessible via Urbans Boulevard, a formal surfaced road. The GPS coordinates for the Meulenzicht Landgoed site are 33°59'12.31"S, 22°31'21.69"E.

3. DETAILS OF THE DEVELOPMENT

The proposal is for a mixed-use residential development and will consist of the following :

Meulenzicht Landgoed – 227 Units in Total

- 227 Full Title Erven
- Gate House, Pumpstations

The Development will be constructed in phases as indicated by the Phasing Plan from Nuvorm. (See Annexure B).

4. ELECTRICAL LOAD ESTIMATE

The anticipated electrical load for this total development is **539.68kVA**, with details as follows :

Development Section	Electrical Demand (kVA)
Meulenzicht Landgoed	
227 x Full Title Erven	227 x 2.06 = 467.62
Gate House	2.06
Pumpstations	70

5. EXISTING ELECTRICAL CAPACITY

The specific area to be developed falls into the electricity supply area of George Municipality, and bulk services will therefore be provided from the nearest municipal network with adequate capacity.

GLS Consulting was appointed to model the Bulk 11kV Electrical Network of the area and report on the available grid capacity.

The **Electrical service availability technical report from GLS (See Annexure C)** refers to the existing 750kVA and 800kVA transformers for the sawmill as well as the 50kVA transformer for the reservoir. The report also refers to the additional 700kVA load added for the calculations.

6. BULK ELECTRICAL SERVICES DETAILS

A new 11kV underground ring feed must be installed through the development. New miniature substations must be installed on the ring feed to supply the specific areas of the development.

The one end of the ring will be connected at RS-N2 which will be the primary supply. The other end of the ring will be connected to the Future SS-Welgelegen, which will provide a back-up connection to the development.

The existing overhead 11kV line across the development to feed the reservoir transformer, must be replaced with an underground cable. All other existing overhead lines must be removed.

Bulk supply points must be installed to the erven for the school and restaurant/deli/clubhouse/gym.

Bulk supply points must be installed to the erven with apartments. The Developer will be responsible for installing submeters in each apartment.

7. INTERNAL ELECTRICAL SERVICES DETAILS

Consumer Distribution Units must be installed to feed the Full Title Erven.

All Full Title Erven owners must apply for George Municipality Prepaid Meters.

Prepaid electricity meters must be installed for streetlighting.

8. MUNICIPAL DEVELOPMENT CHARGES

Development Charges will be applicable as determined by the George Municipality.

9. RECOMMENDATIONS

All designs, material and equipment to be used as well as installation practices will be based on the guidelines for new electricity networks as dictated by George Municipality.

All completed networks, except for the streetlighting network, will be handed over to George Municipality once completed, who will then be responsible for the operation and maintenance thereof.

10. CONCLUSIONS

Lyners have investigated the proposed development opportunity and are satisfied that the Electrical Service Availability Technical Report from GLS indicated no electrical supply constraints in terms of available capacity and that the site is suitable for the intended development from an Electrical Engineering point of view.



**JACQUES VAN ZYL Pr Techni Eng
for LYNERS**

ANNEXURE A : SUBDIVISION/MASTERPLAN FROM NUVORM

NOTES

MEULENZICHT LANDGOED
65.9788 ha
227 units



MEULENZICHT LANDGOED			
		Units	GLA
Phase B1	13,2258 ha		
Main entrance / Gatehouse		83	-
Full title erven			
Phase B2	3,9348 ha		
Full title erven		49	-
Phase B3	4,2971 ha		
Full title erven		25	-
Phase B4	15,2092 ha		
Full title erven		70	-
Phase B5	0,7482 ha		
Treatment plant			-
Phase C	28,5678 ha		
Future Expansion			-

227 units | 0 m²

MEULENZICHT
ATTERBURY

25537, 25538, 25541
KRAAIBOSCH

GEORGE

CONCEPT MASTER PLAN

CODE	PHASE	DISCIPLINE	NUMBER	REV
24AA	01	UD	1003	P

ANNEXURE B : PHASING PLAN FROM NUVORM



MEULENZICHT LANDGOED			Units	GLA
Phase B1	13,2258 ha			
Main entrance / Gatehouse				
Full title erven		83	-	
Phase B2	3,9348 ha			
Full title erven		49	-	
Phase B3	4,2971 ha			
Full title erven		25	-	
Phase B4	15,2092 ha			
Full title erven		70	-	
Phase B5	0,7482 ha			
Treatment plant			-	
Phase C	28,5678 ha			
Future Expansion			-	

227 units | 0 m²

NOTES

MEULENZICHT LANDGOED
65.9788 ha
227 units

MEULENZICHT
ATTERBURY

25537, 25538, 25541
KRAAIBOSCH

GEORGE

PHASING PLAN

CODE	PHASE	DISCIPLINE	NUMBER	REV
24AA	01	UD	1004	P

ANNEXURE C : GLS EXISTING SERVICES REPORT

12 December 2024

Mr. George Wallace

Lyners Consulting Engineers

South Gate Building, Ground Floor, South Gate Entrance, Carl Cronje Dr,

Tyger Valley

Cape Town

7530

RE: Electricity Capacity Investigation Proposal for the Sawmill Development located in Kraaibosch, George

Dear Sir,

The request for GLS Consulting to investigate and comment on the electricity bulk power capacity study for the proposed developments near the Sawmill in George refers.

This document should inter alia be read in conjunction with the George Municipality MV Electrical Master Plan Phase 2 performed for the George Municipality, dated July 2024 [1].

The Sawmill or Kraaibosch Developments are in the Kraaibosch area of George, South of the Kraaibosch Manor and Welgelegen Estate and alongside the Eastern side of the N2. The development is comprised of Aan de Meulen (22.6 Ha) and Kraaibosch Ridge (66.12 Ha) as shown on Figure 1, both proposed lifestyle estates.



Figure 1: Location of the Kraaibosch developments

1 Introduction

1.1 Purpose

The purpose of this study is to conduct a comprehensive analysis of the electricity bulk power capacity for the proposed developments near the Sawmill in the Kraaibosch area of George. This investigation, commissioned by GLS Consulting, aims to ensure that the planned lifestyle estates, Aan de Meulen and Kraaibosch Ridge, have adequate and reliable electrical power infrastructure to meet the demands of future residents and businesses.

1.2 Study Area and Description

The Aan de Meulen development is divided into two sections: Aan de Meulen 1 and Aan de Meulen 2. Aan de Meulen 1 is planned to include 207 units designated for high-density residential use. Aan de Meulen 2 is projected to include 220 units designated for medium-density flats. Additionally, the Kraaibosch Ridge development will consist of 259 units designated for medium-density residential use.

Future development areas are key drivers impacting future demand and energy growth in George. Therefore, it is crucial to ensure there is sufficient demand capacity and adequate electrical infrastructure provision beforehand. Proper planning and investment in electrical infrastructure will support sustainable growth and meet the anticipated needs of these developments.

High density urban residents of UrbRes_7l_7h load class in Glenwood Substation electricity supply area have an ADMD (after-diversity maximum demand) of 2.06kVA/unit. Thus, the Sawmill developments is expected to have electricity saturation demand of the following after completion [1]:

- Aan de Meulen 1 – 196.52kVA
- Aan de Meulen 2 – 208.86kVA
- Kraaibosch Ridge – 245.88kVA

To ensure sufficient electricity capacity is available during the finalization of development plans in the Kraaibosch area, an analysis was conducted using a combined estimated maximum demand of 700 kVA. The developments are located within the Garden Route Mall Feeder Zone, which is part of the SS Glenwood Supply Zone.

This demand is supplied radially via the SS Garden – RS N2 and RS N2 – US1 Feeders. Both feeders consist of 11kV, 185mm² Aluminium PILC 3 Core underground cables. There are three existing transformers that can be utilized to meet the expected demand:

- Urbans Reservoir – 50kVA
- Urbans Saagmeule 800 – 800kVA
- Urbans Saagmeule 750 – 750kVA

1.3 Scope of study and Scenarios to be Analysed

Network simulation analysis was conducted to identify any thermal and voltage violations due to the additional capacity at the Sawmill Developments. Analysis was computed for the following two scenarios:

- i. **Scenario 1:** As-is analysis of the existing network (June 2024).
- ii. **Scenario 2:** Analysis of the existing network (June 2024) with the addition of 700kVA load at the Sawmill Area supplied from the 2 x 800kVA transformers, Urbans Saagmeule, via the 11kV underground cables from SS Garden route Mall (SS Garden – RS N2 and RS N2 – US1).

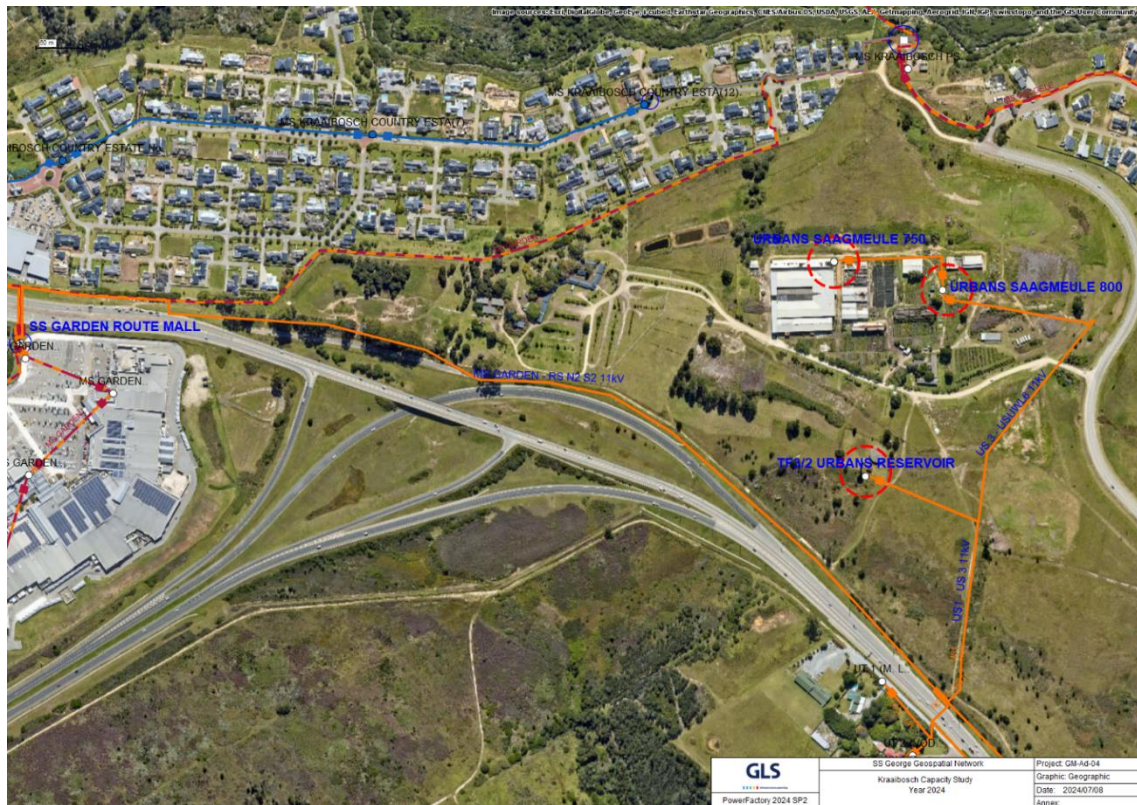


Figure 2: Network Connection at the Sawmill Development

2 Methodology

The methodology for this Capacity Investigation Study is designed to thoroughly evaluate the effects of the current and future loads on the existing electrical network. The study involves data collection, simulation and modelling, and analysis of the electrical network under different load scenarios. The following steps outline the detailed approach used in this study:

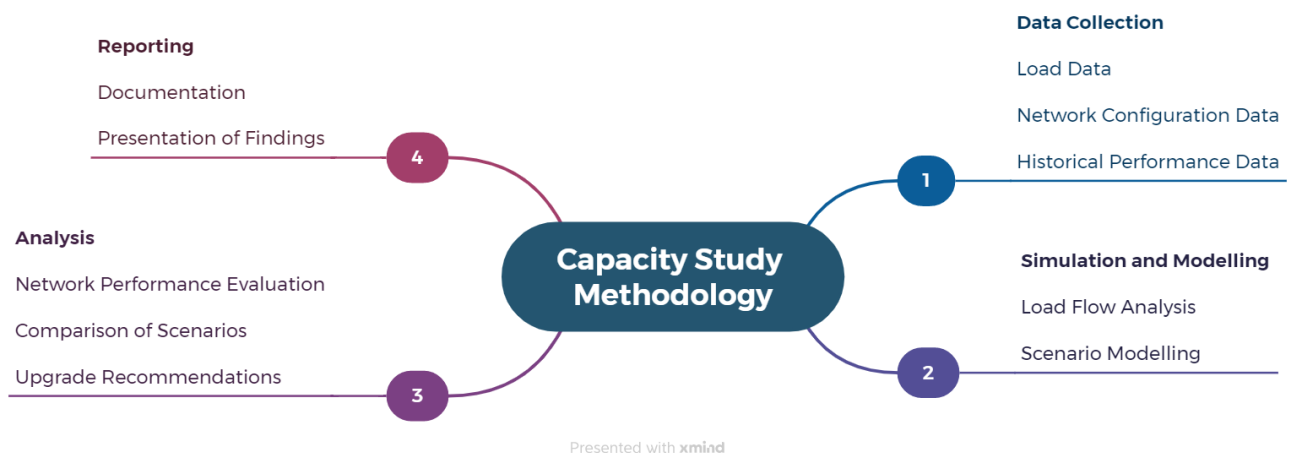


Figure 3: Capacity Investigation Methodology

2.1 Data Collection

2.1.1 Load Data:

- Gather detailed specifications and operational data for the network.
- Obtain current and historical load profiles to understand peak and average demand patterns.

2.1.2 Network Configuration Data:

- Collect network diagrams, including the layout of the Sawmill area, SS-Glenwood substations, and the main feed supply routes.
- Gather details on existing network components such as transformers, switchgear, and conductors.

2.1.3 Historical Performance Data:

- Retrieve historical performance data of the electrical network, including voltage levels, power quality metrics, and incident reports.
- Analyse past instances of bottlenecks or reliability issues.

2.2 Simulation and Modelling

2.2.1 Load Flow Analysis:

- Utilize advanced load flow analysis software to model the electrical network.
- Input the collected data, including load profiles and network configuration, into the simulation tool.

2.2.2 Scenario Modelling:

- Scenario 1: Existing Installation (± 1 MVA Sawmill and surrounding area Load):
- Model the current load conditions with a combined load of approximately 1 MVA from and surrounding area.
- Simulate the load impact on both the main and/or ring feed supplies.
- Scenario 2: Future Installation ($\pm$ additional 700kVA Future Load):
- Model the future load conditions with a combined load of approximately 700kVA for the proposed development.
- Simulate the future load impact on the electrical network.

2.3 Analysis

2.3.1 Network Performance Evaluation:

- Assess the impact of the current and future loads on network performance metrics, including voltage levels, power losses, and reliability.
- Identify any existing or potential bottlenecks, shortcomings, and areas requiring immediate attention or upgrades.

2.3.2 Comparison of Scenarios:

- Compare the results of the load flow analysis for the existing and future load scenarios.
- Evaluate the differences in network performance and identify the additional strain imposed by the increased load.

2.3.3 Upgrade Recommendations:

- Based on the analysis, determine the necessary upgrading measures for both the main and ring feed supplies.
- Prioritize the recommended upgrades and improvements to ensure a reliable and high-quality supply of electricity to the point of connection.

2.4 Reporting

2.4.1 Documentation:

- Compile the findings, analysis, and recommendations into a comprehensive report.
- Include detailed simulation results, network diagrams, and supporting data in the appendices.

2.4.2 Presentation of Findings:

- Present the results and recommendations to relevant stakeholders, including the Municipality and other concerned parties.
- Provide a clear and concise summary of the impact study and the proposed solutions to address any identified issues.

This methodology ensures a thorough and accurate assessment of the impact of the expected development on the electrical network, facilitating informed decision-making for future upgrades and improvements.

3 Results and Analysis

Results of analysis were presented for elements on the immediate backbone of the network up to the potential point of connection to the Sawmill bulk electricity load.

Table 1 below presents the percentage line loading results of the analysis.

Table 1: Percentage Line Loading Results

Line Name	Type	Scenario 1 Loading (%)	Scenario 2 Loading (%)
MS GARDEN - RS N2 S1 11kV	11 kV 185mm ² Al PILC	57,7	72,3
MS GARDEN - RS N2 S2 11kV	11 kV 185mm ² Al PILC	57,7	72,3
RS N2 - US1 S1 11kV	11 kV 185mm ² Al PILC	19,9	34,2
US 3 - USUWL6 11kV	11kV C1 1x032C 50 11V 0xEW Overhead Delt	28,1	49,1
US20 - URBANS SAAGMEULE 800 11kV	11kV C1 1x032C 50 11V 0xEW Overhead Delt	28,1	49,1
US1 - US 3 11kV	11kV C1 1x032C 50 11V 0xEW Overhead Delt	29	50
USWL6 - US20 S1 11kV	11kV C1 1x032C 50 11V 0xEW Underground D	28,1	49,1
USWL6 - US20 S2 11kV	11kV C1 1x032C 50 11V 0xEW Underground D	28,1	49,1
USWL6 - UWL19 S1 11kV	11kV C1 1x032C 50 11V 0xEW Overhead Delt	14,1	24,6
USUWL19 - URBANS SAAGMEULE 750 11kV	11kV C1 1x032C 50 11V 0xEW Overhead Delt	14,1	24,6
US 3 - TF3/2 URBANS RESERVOIR 11kV	11kV C1 1x016C 50 11A 0xEW Overhead Delt	1,3	1,3

Table 2 below presents the per unit bus loading results of the analysis.

Table 2: Per Unit Bus Loading Results

Substation	Busbar	Scenario 1 Voltage (p.u.)	Scenario 2 Voltage (p.u.)
SS GARDEN ROUTE MALL	SS GARDEN ROUTE MALL 11 BB1	1,03	1,02
SS GARDEN ROUTE MALL	SS GARDEN ROUTE MALL 11 BB2	1,03	1,02
TF3/2 URBANS RESERVOIR	TF3/2 URBANS RESERVOIR 11_BB	1,01	1,00
URBANS SAAGMEULE 750	URBANS SAAGMEULE 750 11_BB	1,01	1,00
URBANS SAAGMEULE 800	URBANS SAAGMEULE 800 11_BB	1,01	1,00

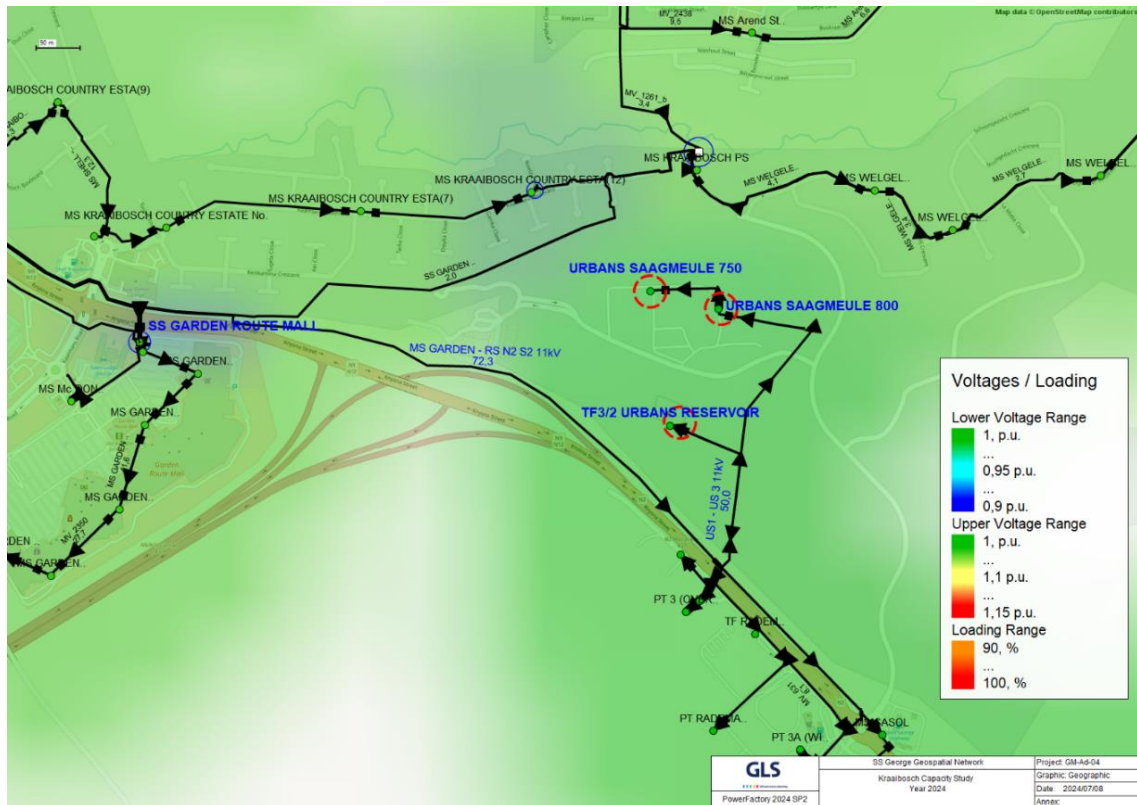


Figure 4: Resultant Heatmap – Scenario 2

4 Recommendations and Conclusion

Both the line and busbar loading results are within acceptable limits for Scenario 2 when the Sawmill load is connected to the existing network. There are no observed network violations, nor are there any foreseeable network upgrades required on the backbone feeder SS GARDEN - RS N2 to accommodate the increased demand from new developments.

However, it should be noted that the extra demand may place a strain on the existing transformers, Urban Saagmeule 700 and Urban Saagmeule 800. As the development progresses, more detailed plans may reveal the need for line routing adjustments to expand the network.

Importantly, the backbone feeder up to the point of connection is not experiencing any voltage or thermal overloads. This indicates that it is robust enough to accommodate the proposed additional demand.

We trust you find this of value.

Yours sincerely

GLS CONSULTING (PTY) LTD REG. NO.: 2007/003039/07

Tsolane Mokoena, Pr Eng

Senior Electrical Engineer, GLS Consulting

Email: Tsolane.Mokoena@glS.co.za

Tel: +27 21 880 0388

5 References

- [1] GLS Consulting, "Electricity MV Network Master Plan with Renewable Energy Grid Impact Assessment," GLS Consulting, Stellenbosch, 2024.

6 Appendix A: SLD

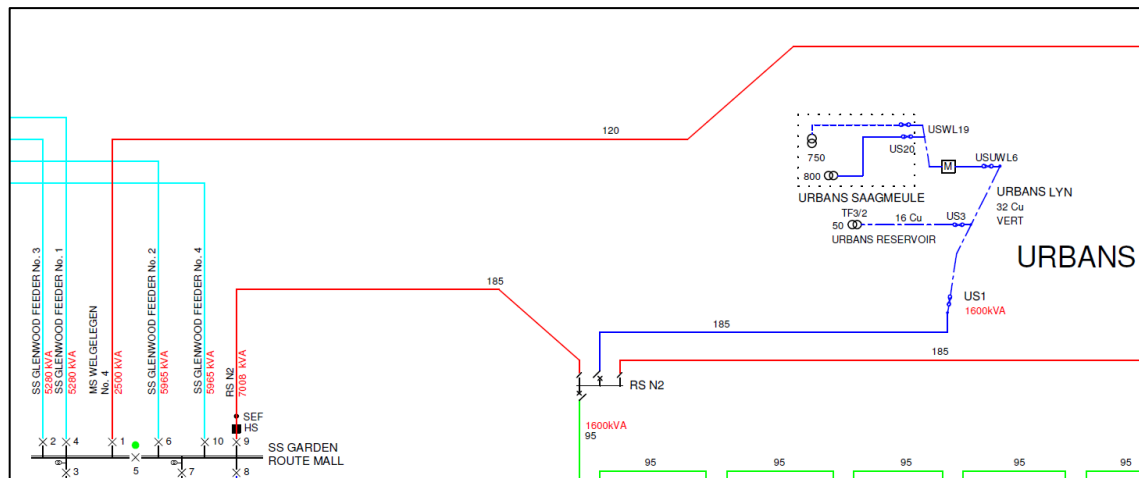


Figure 5: SLD taken from drawing ELM-04w33

7 Appendix B: Study Area



Figure 6: Future development study area

8 Appendix C: Additional Study Cases & Results

Two upgrade options are proposed as follows:

- Option 1: The addition of an RMU on the corner of Nietvoorbij Crecent and Welgelegen Boloulevard, form a ring with SS Garden Route via SS GARDEN MALL-MS WELGELEGEN No.4
- Option 2: The addition of a direct line from SS Garden Route to the Sawmill Development. Cable Route estimated to run along the N2.

Option 1:

The study Case below simulates the addition of a line which would intersect the SS Garden – MS Welgelegen 4 feeder. The line is assumed to be 70mm² Al PILC. See Figure 7 within the green encircled area. With an open point at US1, the results demonstrate a reduction in loading on the main SS Garden – RS N2 feeder increased loading on the Welegelegen feeders which will carry the additional load.

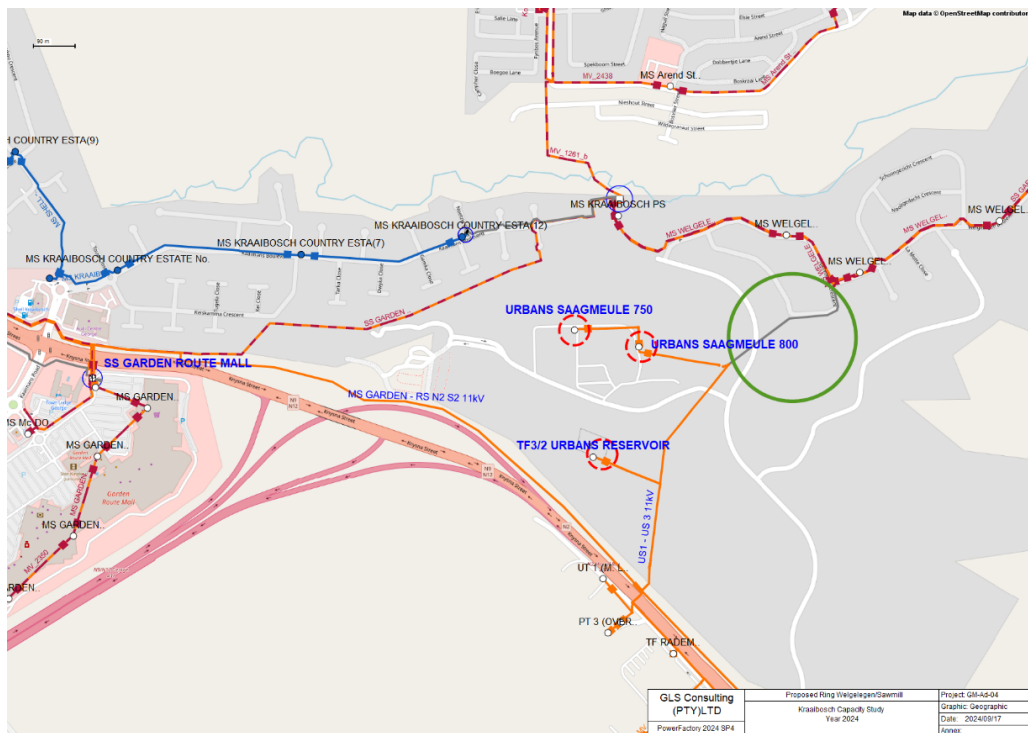


Figure 7: Proposed Line US20 - MS WELGELEGEN No.4

Table 3: Percentage Line Loading Results for additional study Case

Line Name	Type	Scenario 2 Loading (%)	Proposed line Loading (%)
SS GARDEN - RS N2 S1 11kV	11 kV 185mm2 Al PILC 3Core (Eskom) Under	72,4	37,7
SS GARDEN - RS N2 S2 11kV	11 kV 185mm2 Al PILC 3Core (Eskom) Under	72,4	37,7
RS N2 - US1 S1 11kV	11 kV 185mm2 Al PILC 3Core (Eskom) Under	34,3	0
RS N2 - US1 S2 11kV	11kV C1 1x032C 50 11V 0xEW Overhead Delt	50	0
US 3 - TF3/2 URBANS RESERVOIR 11kV	11kV C1 1x016C 50 11A 0xEW Overhead Delt	1,3	1,3
US 3 - USUWL6 11kV	11kV C1 1x032C 50 11V 0xEW Overhead Delt	49,2	0,9
US1 - US 3 11kV	11kV C1 1x032C 50 11V 0xEW Overhead Delt	50	0
US20 - URBANS SAAGMEULE 800 11kV	11kV C1 1x032C 50 11V 0xEW Overhead Delt	49,2	48,5
USWL6 - UWL19 S1 11kV	11kV C1 1x032C 50 11V 0xEW Overhead Delt	24,6	24,3

Line Name	Type	Scenario 2 Loading (%)	Proposed line Loading (%)
USUWL19 - URBANS SAAGMEULE 750 11kV	11kV C1 1x032C 50 11V 0xEW Overhead Delt	24,6	24,3
USWL6 - US20 S1 11kV	11kV C1 1x032C 50 11V 0xEW Underground D	49,2	48,5
USWL6 - US20 S2 11kV	11kV C1 1x032C 50 11V 0xEW Underground D	49,2	48,5
_Proposed New Line - US20 - MS WELGEL No.4	11 kV 70mm2 Al PILC 3Core (Eskom) Underg		62.8
SS GARDEN MALL-MS WELGELEGEN No.4 S1	11 kV 120mm2 Al PILC 3Core (Eskom) Under	2	28,4
SS GARDEN MALL-MS WELGELEGEN No.4 S2	11 kV 120mm2 Al PILC 3Core (Eskom) Under	2	28,4

The heatmap results in Figure 8 indicate a favorable impact on the per-unit (p.u.) voltage following the addition of the newly proposed line.

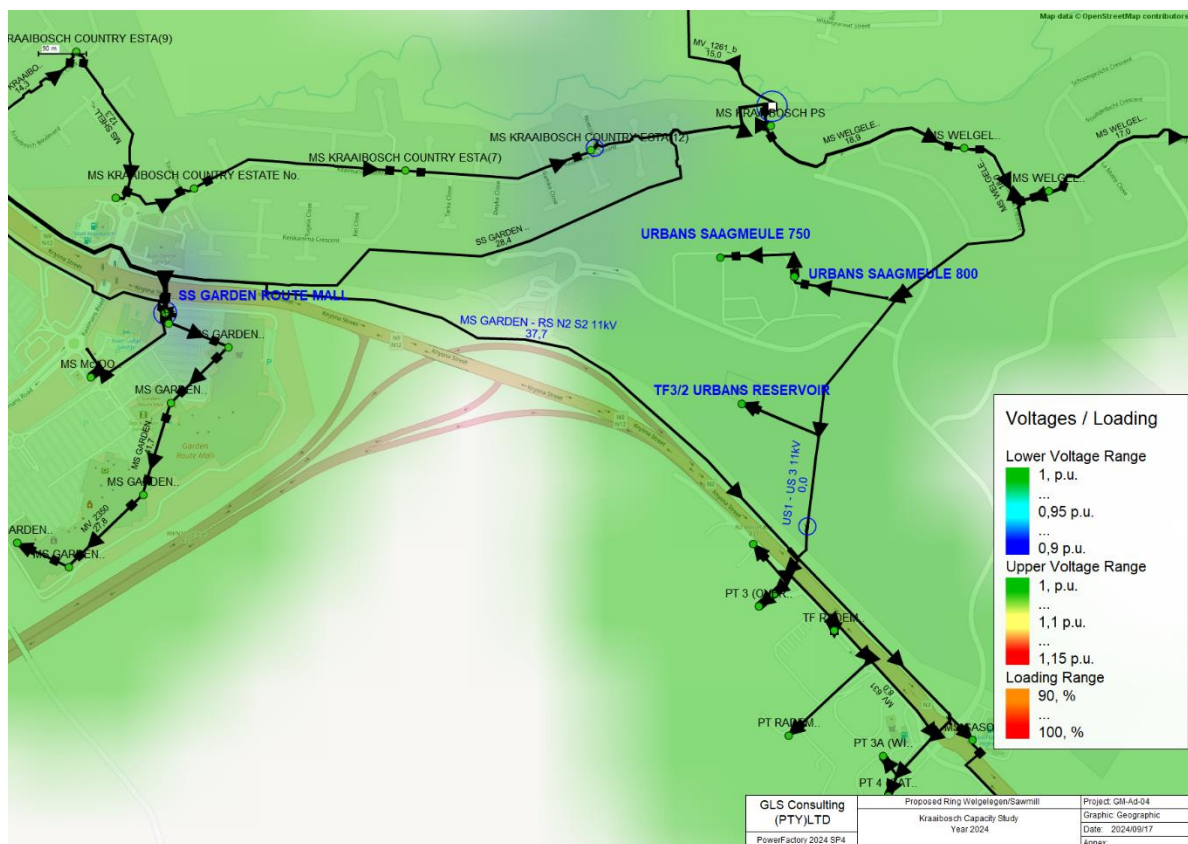


Figure 8: Heatmap Results Proposed New Line

Option 2:

The study Case below simulates proposed option 2 the addition of a direct line from SS Garden route to the new development. The line is assumed to be 185mm² Al PILC. See Figure 7 within the green encircled area. With an open point at US1, the results demonstrate a reduction in loading on the main SS Garden – RS N2 feeder.

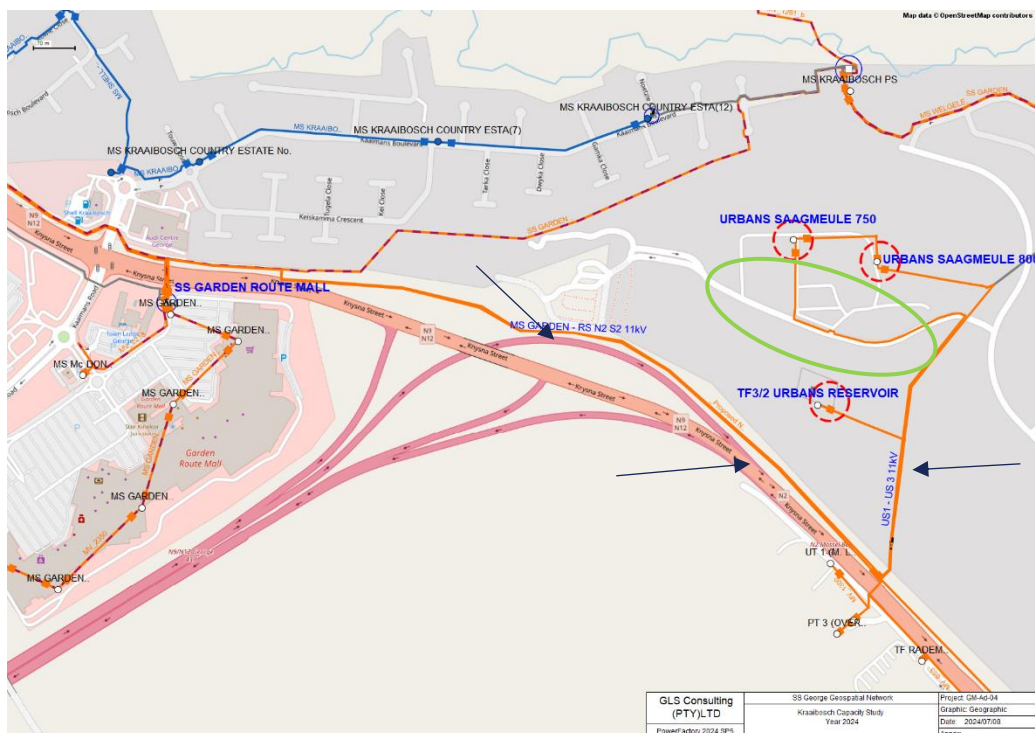


Figure 9: Proposed Line SS Garden Route Mall – Proposed Development

Table 4: Percentage Line Loading Results for additional study Case

Line Name	Type	Scenario 2 Loading (%)	Proposed line Loading (%)
SS GARDEN - RS N2 S1 11kV	11 kV 185mm ² Al PILC 3Core (Eskom) Under	72,4	37,7
SS GARDEN - RS N2 S2 11kV	11 kV 185mm ² Al PILC 3Core (Eskom) Under	72,4	37,7
RS N2 - US1 S1 11kV	11 kV 185mm ² Al PILC 3Core (Eskom) Under	34,3	0
RS N2 - US1 S2 11kV	11kV C1 1x032C 50 11V 0xEW Overhead Delt	50	0
US 3 - TF3/2 URBANS RESERVOIR 11kV	11kV C1 1x016C 50 11A 0xEW Overhead Delt	1,3	1,3
US 3 - USUWL6 11kV	11kV C1 1x032C 50 11V 0xEW Overhead Delt	49,2	0,9
US1 - US 3 11kV	11kV C1 1x032C 50 11V 0xEW Overhead Delt	50	0
US20 - URBANS SAAGMEULE 800 11kV	11kV C1 1x032C 50 11V 0xEW Overhead Delt	49,2	48,5
USWL6 - UWL19 S1 11kV	11kV C1 1x032C 50 11V 0xEW Overhead Delt	24,6	24,3
USUWL19 - URBANS SAAGMEULE 750 11kV	11kV C1 1x032C 50 11V 0xEW Overhead Delt	24,6	24,3
USWL6 - US20 S1 11kV	11kV C1 1x032C 50 11V 0xEW Underground D	49,2	48,5
USWL6 - US20 S2 11kV	11kV C1 1x032C 50 11V 0xEW Underground D	49,2	48,5
_Proposed New Line - SS GRM-Sawmill Dev	11 kV 185mm ² Al PILC 3Core (Eskom) Under		33.7
SS GARDEN MALL-MS WELGELEGEN No.4 S1	11 kV 120mm ² Al PILC 3Core (Eskom) Under	2	2
SS GARDEN MALL-MS WELGELEGEN No.4 S2	11 kV 120mm ² Al PILC 3Core (Eskom) Under	2	2

ANNEXURE D : GEORGE MUNICIPALITY CAPACITY LETTER

ANNEXURE L:

Traffic Impact Assessment

Transport Impact Assessment

Meulenzicht Landgoed

George, Western Cape

May 2025



5th Floor

Imperial Terraces

Carl Cronje Drive

Tyger Waterfront

Bellville, 7530

(021) 914 6211 (T)

e-mail: mail@itsglobal.co.za

SUMMARY SHEET

Report Type	Transport Impact Assessment
Title	Meulenzicht Landgoed
Location	George, Western Cape
Client	Atterbury
Reference Number	ITS 4730
Project Team	Christoff Krogscheepers Inge van Tonder
Contact Details	Tel: 021 914 6211
Date	May 2025
Report Status	Draft
File Name	G:\4730 TIA Saagmeule Welgelegen George\12 Reports\Issued\4730 TIA Meulenzicht_George_IvT_2025-05-14.docx

This transport study was prepared by a suitably qualified and registered professional traffic engineer. Details of any of the calculations on which the results in this report are based will be made available on request.

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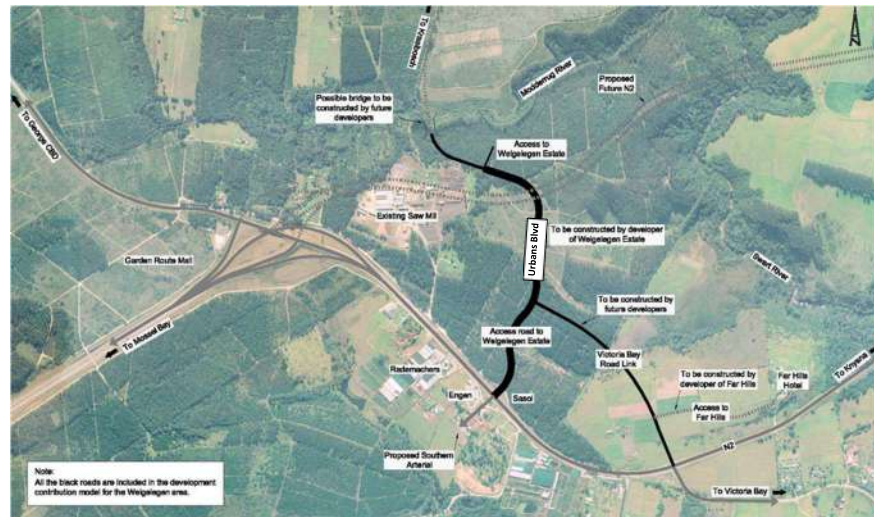
Appendix D: Future Road Network

Abbreviations

COTO	Committee of Transport Officials
Ha	Hectare
HCM	Highway Capacity Manual
LOS	Level of Service
NMT	Non-motorised Transport
SATGR	South African Trip Generation Rates
SQM	Square Meters (m ²)
TIA	Transport Impact Assessment
V/C	Volume to Capacity Ratio
WCG	Western Cape Government

Transport Impact Assessment	
1 Purpose of Study	This report assesses the expected transport-related impact of the proposed Meulenzicht Development in George, Western Cape. These will be referred to as The Development. This study summarises the estimated transport impacts of the proposed land uses on the existing and future road networks within the vicinity. It provides an assessment of the transport impacts sufficiently so to identify any required mitigation measures.
2 Locality	The proposed development is in George, Western Cape, on Erf 25537. See the vicinity map below. It is adjacent to the Welgelegen Development. It is located east of the N2/Knysna Street interchange and straddles Urbans Boulevard also previously referred to as the Welgelegen Access Road. The alignment of the proposed future extension of the N2 is situated to the north and forms the northern boundary. Figure 1: Locality Plan
3 Proposed Land Uses	The proposed development comprises of the following land uses: Meulenzicht Estate: • 227 Full Title Erven Refer to Appendix A, Figure A1 for the site development plan. The Meulenzicht Landgoed development includes Phases B1-B4. Phase C does not form part of this investigation. The impact assessment is based on the development fully constructed by the year 2030.

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	2. 2030 Background Traffic Conditions. Existing Traffic conditions with an additional 4% growth per year for 5 years along the major routes to account for other developments in the surrounding areas. 3. 2030 Total traffic conditions (Background traffic + Development trips) a) Background traffic plus Meulenzicht Landgoed development trip b) Background traffic plus the latent development trips (Oumeulen Village Landgoed) The traffic growth assumptions used to analyse future scenarios are discussed in Section 10.
8 Study Intersections (existing control)	The following intersections are included in the study: • Intersection 1: Knysna Road / St George's Road / Servitude Road • Intersection 2: Knysna Road / Garden Route Mall Access Road • Intersection 3: Knysna Road / N2 Off-ramp • Intersection 4: Knysna Road / N2 On-ramp • Intersection 5: N2 / Urbans Boulevard / Sasol Roundabout • Intersection 6: Urbans Boulevard / Development Access The existing geometry and control of the intersections included in the study are included in Appendix A, Figure A2.
9 Existing Intersection Operations	The evaluation of the existing intersection operations was based on the 2025 peak hour traffic volumes. All the intersection operation analyses were performed in accordance with the procedures stated in the latest Highway Capacity Manual (HCM). The intersections in the study area were analysed to determine the level of service (LOS), delay per vehicle (in seconds) and volume per capacity (V/C) for each intersection in the peak hour. Refer to Annexure A, Figure A3 and Figure A4 for the weekday AM and PM peak hour traffic operations for the existing traffic conditions. Based on the existing conditions analysis it is evident that all the intersections are operating acceptably during both the typical weekday AM and PM peak hours. There are no improvements required at any of the study intersections for the existing conditions.
10 2030 Background Conditions	The 2030 Background Conditions include the 2025 Existing Conditions with a 4% growth rate applied along the N2 for 5 years. A 4% growth was determined by comparing the October 2023 hourly flow on the N2 with the May 2024 hourly. These volumes are measured by a SANRAL counting station just south of the N2/Knysna Road I/C. This is a relatively high annual growth rate and is unlikely to be sustained over a prolonged period. It was used for this study to ensure that a conservative future demand scenario is tabled, specifically considering all the developments currently occurring in this area of George and Kraaibosch. A summary of the traffic volumes and the analysis based on the background traffic demand is included in Appendix A, Figure A5 and Figure A6. Based on the background conditions analysis it is evident that all the intersections are operating acceptably during both the typical weekday AM and PM peak hours. There are no improvements required at any of the study intersections for the existing conditions.

11 Site Development Plan (SDP)

The SDP was developed together with the full professional team. The final version of the SDP is included in **Annexure A**. The salient points to note from a traffic perspective are the following:

- Both developments will be getting access via a single access (Roundabout controlled) off Urbans Boulevard. The topography of Urbans Boulevard and the sight distance requirements for side road accesses necessitate a single access. This results in two substantial portions of land getting access via a single security entrance and a single roundabout access onto Urbans Boulevard.
- The need and requirements to provide a link road through to the N2/Victoria Bay Intersection are provided to the north of the Sasol Property boundary. The Victoria Bay Link Road intersects with Urbans Boulevard within the inside of a horizontal curve. The location and the sight distances were checked and are acceptable. The link road turns back to the south to run along the property boundary of the neighbouring land (Sasol Property, Erf 197/278). The proposal is to build the road and define the road reserve around the property boundary so that both landowners provide equal land for the road. Access to the Sasol Property is shown indicatively on the SDP since it can be located at any reasonable location along the property boundary. The construction of this road is not included in the proposed development. It is not required by the development. The road reserve should be made available to the municipality. See the alignment below of the link road from an extract of the SDP.

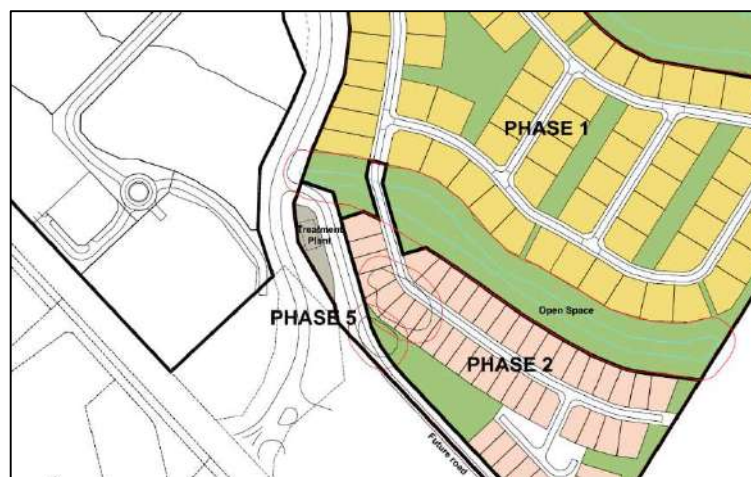


Figure 5: Alignment of future link road to N2/Victoria Bay intersection

- A temporary construction access is shown off Urbans Boulevard immediately to the south of the future N2 road reserve. This access will be temporary and will also in the meantime give access to the Garden Route Farmers Market. It will be closed at some point in the future.
- The security gatehouses and storage lengths ahead of these gatehouses are illustrated and show sufficient storage space to avoid entering queues spilling back into the public right-of-way.
- No specific land uses have been assigned to Phase A8 and Phase B6. These are future phases and will have to be treated as such in the approvals and conditions of approval.

12 Trip Generation Rates and Development Trips	All the trip generation rates used to determine the expected development trips are from the South African Trip Data Manual (COTO TMH17, 2013). The analysis of the trip generation for the proposed development is provided in Appendix B, Table 4 and summarised below in Table 1. <i>Table 1: Expected Development Trips</i> <table><tr><th rowspan="2">Land Use</th><th colspan="3">AM Peak Hour</th><th colspan="3">PM Peak Hour</th></tr><tr><th>Total Trips</th><th>In</th><th>Out</th><th>Total Trips</th><th>In</th><th>Out</th></tr><tr><td>Meulenzicht Estate</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Full title erven</td><td>227</td><td>57</td><td>170</td><td>227</td><td>159</td><td>68</td></tr><tr><td>TOTAL</td><td>227</td><td>57</td><td>170</td><td>227</td><td>159</td><td>68</td></tr></table> Note that the trips from Phase C were not included in the above trip generation estimate. The specific land uses on these areas have not been determined since they are future phases.	Land Use	AM Peak Hour			PM Peak Hour			Total Trips	In	Out	Total Trips	In	Out	Meulenzicht Estate							Full title erven	227	57	170	227	159	68	TOTAL	227	57	170	227	159	68
Land Use	AM Peak Hour			PM Peak Hour																															
	Total Trips	In	Out	Total Trips	In	Out																													
Meulenzicht Estate																																			
Full title erven	227	57	170	227	159	68																													
TOTAL	227	57	170	227	159	68																													
13 Trip Distribution	The expected trip distribution for the development during the AM and PM peak hours is based on the current traffic patterns, the type of development and the location of the major trip generators in the greater area. The estimated trip distribution is as follows: AM and PM Trip Distribution for residential and retirement units: • 80% to/from George CBD • 15% to/from Knysna • 5% to/from Cape Town Refer to Appendix A, Figure A7 for the future intersection lane configurations and controls as part of this development. Refer to Figures A8 and A9 for a summary of the trip distribution on the network in the AM and PM peak hours for the Meulenzicht Landgoed development. The added volumes due to the trips that are expected to be generated by the proposed development and the assumed trip assignment are also provided in Figures A8 and A9 for the AM and PM peak hours respectively. Note that for the analysis, no traffic was assigned across the planned route across the Modderrug River to/from the Kraaibosch area. This is a conservative approach assuming that all traffic will have to access the larger road network via the N2 Roundabout at the Urbans Boulevard intersection with the N2.																																		
14 Latent Developments	It is also planned to develop towards the west of Urbans Boulevard, namely Oumeulen Villagea, and the development will consist of the following land uses: • 151 Full Title Erven • 355 Apartments • Restaurant, clubhouse, deli and gym – 2 500 m² • Nursery School – 1 000 m²																																		

Refer to **Figure 6** below for the location of the Oumeulen Village development in relation to Meulenzicht Landgoed.



Figure 6: Meulenzicht Development

The following trips are expected as part of the development:

Table 2: Oumeulen Village Expected Trips

Land Use	AM Peak Hour			PM Peak Hour		
	Total Trips	In	Out	Total Trips	In	Out
Oumeulen Village						
Full title erven	151	38	113	151	106	45
Apartments	302	75	226	302	211	91
Nursery School	10	5	5	7	4	3
Restaurant, Deli, Gym and Clubhouse	25	13	13	25	13	13
Phase A8 and Phase B6 (Future)						
TOTAL	488	131	357	484	333	151

Refer to Annexure C for the site development plan for Oumeulen Village and the trip generation rates used for this development.

15 Site Access

Access to the development will be via Urbans Boulevard currently providing access to the Welgelegen Estate and the Outeniqua Family Market. The Meulenzicht development and the Oumeulen Village will both have separate access control gates. A single-lane roundabout is proposed along Urbans Boulevard providing access to both developments, refer to **Figure A7** and the discussion in Section 11 related to the SDP.

16 2030 Total Traffic Conditions

The 2030 total traffic includes the existing traffic volumes grown by 4% per annum for 5 years, plus the new traffic that will be generated by the development.

Scenario 3a:

Refer to **Appendix A, Figures A10 and A11**, for the Total Traffic Conditions for this scenario based on the expected total traffic demand if Meulenzicht Landgoed is fully developed, with the future lane configurations and control as provided in **Figure A7**. Based on the operational analyses of the 2030 Total Traffic Conditions,

	all intersections are expected to operate at acceptable levels of service. The storage of the right-turn lane, southbound along Knysna Road at the N2 westbound on-ramp, should be increased from the current $\pm 30\text{m}$ to at least 120m to accommodate the queue length. The space is available by repurposing the current painted island. No widening of the bridge is required. The analysis and subsequent conclusions are based on all traffic assigned to the N2/Urbans Boulevard roundabout intersection and no trips being generated by Phases C. From the analysis, as summarised in Figures A10 and A11, it is evident that the two key intersections are the following: • N2/N9 Westbound onramp (Intersection 4): $V/C = 0.68$ during p.m. peak hour, ± 647 right turning vehicles. Although the delays are still acceptable, the queue length will exceed available storage capacity and require more storage. • The final design of the gatehouses to each of the estates in terms of the number of service lanes and storage requirements needs to be confirmed by a traffic statement. Scenario 3b: Refer to Appendix A, Figures A12 and A13, for the expected trips and trip distribution of the Oumeulen Village development, with the future lane configurations and control as provided in Figure A7. Refer to Appendix A, Figures A14 and A15, for the expected trips for the full development. The expected trips for the Oumeulen Village development do not include the future Phase 8A and B6, as indicated on the SDP in Appendix C. Refer to Figures A16 and A17 for the 2030 Total Traffic Conditions for this scenario. Based on the operational analyses of the 2030 Total Traffic Conditions for this scenario, all intersections are expected to operate at acceptable levels of service and no additional mitigation measures would be required except for the following. • N2/Urbans Boulevard Roundabout (Intersection 5): $V/C = 0.76$ during a.m. peak hour. The operations of this intersection are still acceptable, but marginal increases in demand could result in operational failures. Therefore, it would be prudent not to allow further development along Urbans Boulevard unless the bridge and link to the Kraaibosch area across the Modderrug River are established. Hence, the total traffic from Meulenzicht Landgoed and Oumeulen Village (Excluding Phase A8 and Phase C) can be accommodated without the link across the Modderrug River and hence without the requirement of a bridge. This should be verified through an updated TIA once most of the proposed uses on the property are operational.
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17 Public Transport and Non-Motorised Transport	Existing Public Transport (PT) Facilities: There are no existing minibus taxi and/or bus routes within the immediate vicinity of the site. There are currently three phases of the GoGeorge bus service in operation in the George area. The existing bus routes can be seen in Appendix D. Planned PT Network: George Municipality/Western Cape Government is planning to extend the current GoGeorge Public Transport System services from George CBD to Victoria Bay in Phase 5 and the Nelson Mandela University (NMU) Phase 6. Planned route C59 to Victoria Bay will be running past the Sawmill site along the current N2. The bus route C59 between Vitoria Bay and George CBD can be routed to include the Welgelegen and Kraaibosch areas. Additionally, with the bridge over the Modder River, the M5 bus route to NMU can also be re-routed to include the Kraaibosch and Welgelegen Areas. Proposed PT Facilities: It is expected that public transport trips will be made to both estates and that there will be a need for dropping off and picking up facilities at the security gates or along Urbans Boulevard in dedicated public transport facilities. The latter would most probably only be feasible once Urbans Boulevard is constructed across the river to the Kraaibosch Area and the GoGeorge services are established along the boulevard. As part of the proposed roundabout along Urbans Boulevard, public transport laybys should be constructed on the downstream side of the roundabout. Existing Non-Motorised Transport (NMT) Facilities: Sidewalks and road shoulders are provided on both sides of Welgelegen Road. There are no dedicated cycle lanes on Welgelegen Road in the vicinity of the development site, forcing cyclists to either cycle on the shoulder of the roads or make use of the pedestrian sidewalk. Pedestrian/NMT Movements Pedestrians can access the Rademachers area via the existing sidewalks along Welgelegen Access Road which runs along the frontage of the proposed development and links to the N2 at the roundabout. There are sufficient pedestrian facilities at the roundabout to safely cross the N2. Proposed NMT Facilities: All new interior roads to be constructed as part of the proposed development need to provide sidewalks for pedestrians. Streetlights and traffic calming measures must also be provided in areas with high pedestrian movements/activity. It is not anticipated that dedicated cyclist facilities will be provided along the roads within the development. However, it is advisable to provide bike racks and bike storage facilities at the entrances to relevant buildings such as the gym. Cyclists can access the development via the existing shoulders along Urbans Boulevard but will have to use the normal traffic lanes within the development. The design speeds of the roadways within the development will be sufficiently low to ensure safe passage for cyclists.
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18 Parking	No detailed SDPs have been developed for the individual phases of the development. The parking and parking ratios required by the George Municipal Planning By-Laws should be followed when these are developed.
19 Conclusion & Recommendations	The Meulenzicht Landgoed development is proposed on Erf 25537 in George, Western Cape. The access to the proposed development is planned to be off Urbans Boulevard which currently provides access to the Outeniqua Family Market and Welgelegen Estate. It is expected that the proposed development will generate 227 vehicle trips in the AM peak hour (57 in/ 170 out) and 227 vehicle trips in the PM peak hour (159 in/68 out). Significant future road planning for the George area is in place and the planning of the development was done in terms of this planning, including the future eastwards extension of the N2, the extension of Urbans Boulevard across the Modderrug River to the Kraaibosch Area and the future link road between Urbans Boulevard and the N2/Victoria Bay intersection. It is expected that the traffic that will be generated by the latent rights in the surrounding area of the proposed development will result in an average annual traffic growth rate of $\pm 4\%$. This could be possible, at least over the short term, but unlikely sustainable over the longer term. However, it was used to allow for a conservative future scenario and taking into account the current growth in the area. It is planned to develop Oumeulen Village to the west of Urbans Boulevard. This development was included as part of the Total Traffic Conditions scenario (Scenario 3b). From the capacity analysis of the different scenarios, the following can be concluded: • Existing Conditions: All the intersections are operating acceptably during both the typical AM and PM weekday peak hours. No improvements are required at any of the study intersections. • Background Conditions: All the intersections are expected to operate acceptably during both the typical AM and PM weekday peak hours. No improvements are required at any of the study intersections. • Site Development Plan: The SDP was developed taking into account all the long-term road planning in the area, including the future extension of the N2, the need for a link road between Urbans Boulevard and the N2 at the Victoria Bay intersection and access to land-locked properties not included in the development. The alignment and topography of Urbans Boulevard and the need for access to the N2/Victoria Bay link road limit the number of access opportunities off Urbans Boulevard. The optimal solution to service the land on either side of Urbans Boulevard was a single access point, controlled by a single-lane roundabout. A temporary access is proposed as a construction access and to also provide access via the SANRAL road reserve to the Garden Route

	Market. • Total Traffic Conditions Scenario 3a: To accommodate the expected additional traffic that will be generated by the proposed development the following mitigation measures will be required: ○ Construct a single-lane roundabout (Intersection 6) to provide access to Meulenzicht Landgoed and Oumeulen Village. ○ Provide public transport laybys on either side of the roundabout along Urbans Boulevard. The design should be approved by the GoGeorge team. ○ Extend the ±30m southbound right turn lane at the N2/Knysna Road on-ramp to at least 120 m to accommodate the expected increase in queues. • Total Traffic Conditions Scenario 3b: ○ Based on the expected total traffic from Phases A and B (excluding Phase C and Phase 8A from Oumeulen Village) it is not required to extend Urbans Boulevard across the Modderrug River. The operations of Intersection 5 are still acceptable, but marginal increases in demand could result in operational failures. Therefore, it would be prudent not to allow further development along Urbans Boulevard unless the bridge and link to the Kraaibosch area across the Modderrug River are established. This should be verified through an updated TIA once most of the proposed uses on the property are operational. • Adequate provisions for cyclists and pedestrians should be made within the estates. These facilities should link logically to the sidewalks and shoulders along Urbans Boulevard. The public facilities such as the gym should also provide secure bicycle parking. • The parking ratios required by the George Municipal Planning By-Laws should be followed to determine the parking requirements for each use as the detailed site plans are developed. • Prior to the GoGeorge services operating along Urbans Boulevard, public transport users would be dropped off and picked up at the security entrances. Sufficient allowance should be made for these activities at the entrance gates. • The proposed development should be capped at the uses and trips evaluated in this study. The evaluation excluded the trips to/from the portions labelled as Phases A8 (Oumeulen Village) and C (Meulenzicht Landgoed). The traffic from these portions would most likely require that Urbans Boulevard be extended across the Modderrug River to link to the Kraaibosch Area. This should be confirmed through an updated TIA once most proposed uses are completed and operational. It is concluded that the additional traffic from the proposed development can be
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	accommodated on the transport network with minor mitigation requirements. It is recommended that the proposed development be approved from a transportation point of view provided that the required mitigation as defined in this study is in place.
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REFERENCES

1. Highway Capacity Manual (HCM), Quality and Level-of-Service Concepts, Transportation Research Board, 9 March 2015
2. South African Road Classification and Access Management Manual, TRH26, Version 1.0, August 2012
3. South African Trip Data Manual, TMH17, Version 1.1, COTO, September 2013
4. Smec, Kraaibosch Roads Master Plan and Cost Apportionment Rev 5.2, April 2022
5. Vela VKE, Apportionment of Cost for Improvements and Additions to the Road Infrastructure in the Kraaibosch Area, January 2006

Appendix A

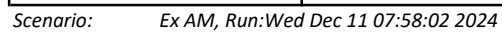
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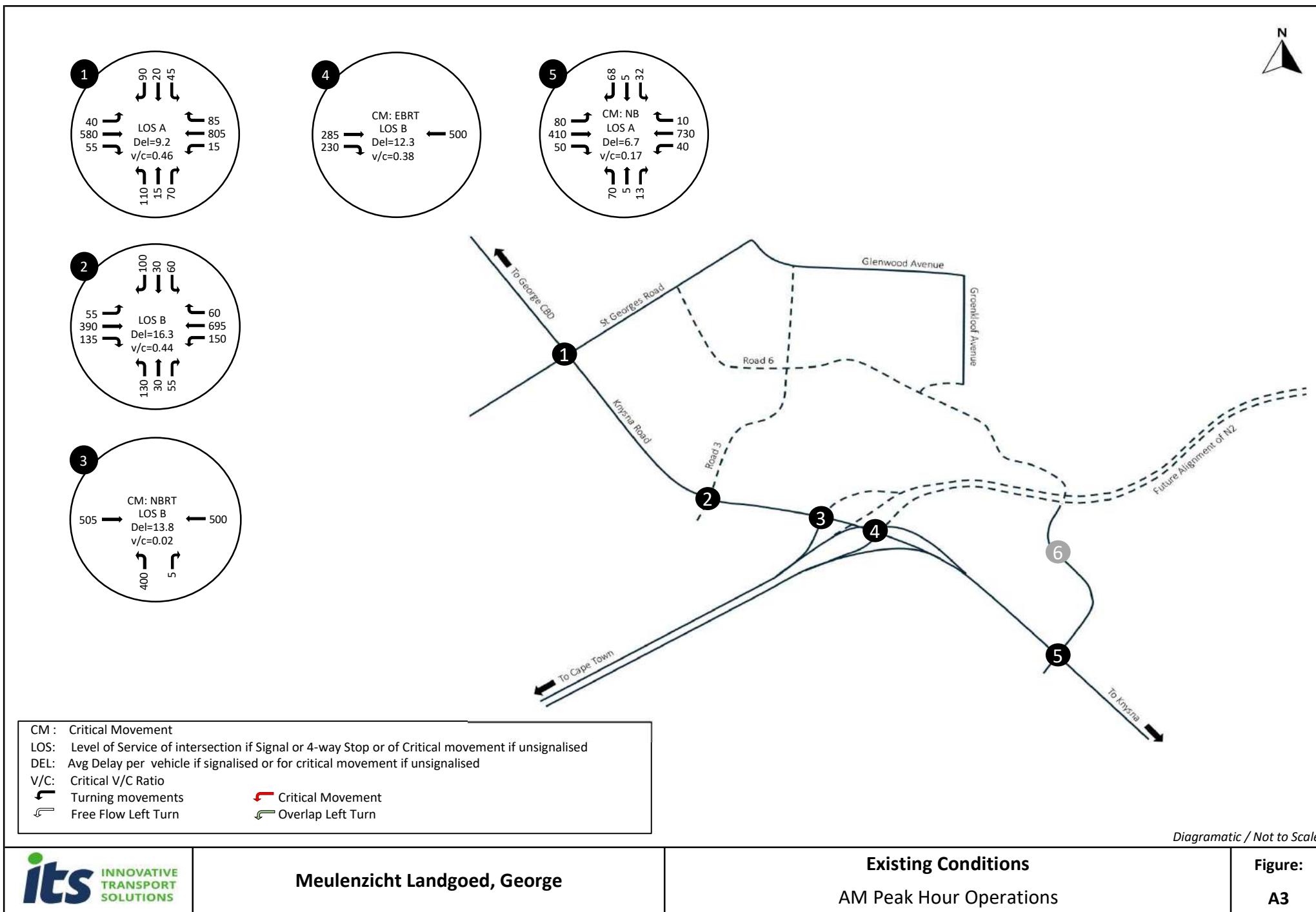


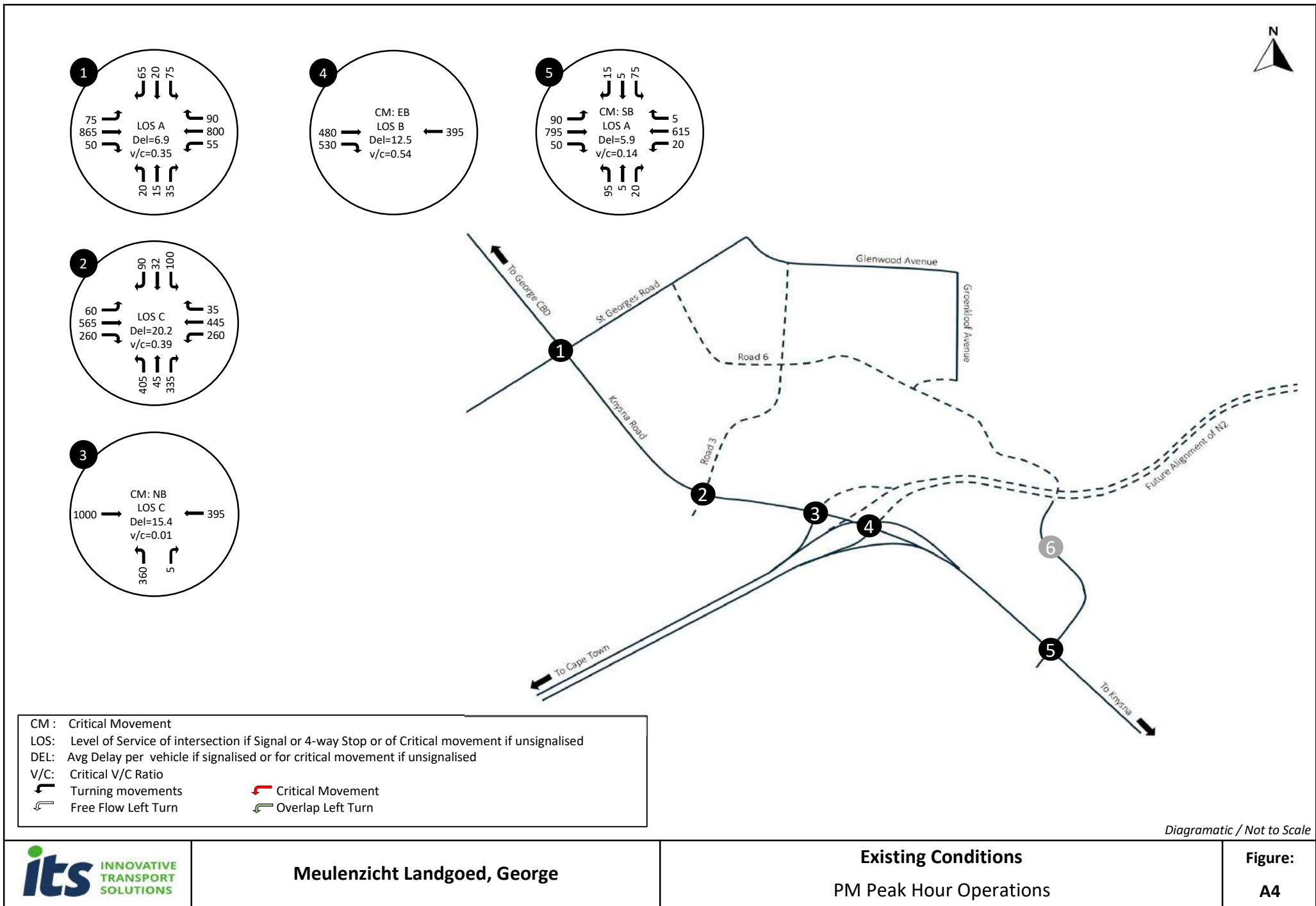
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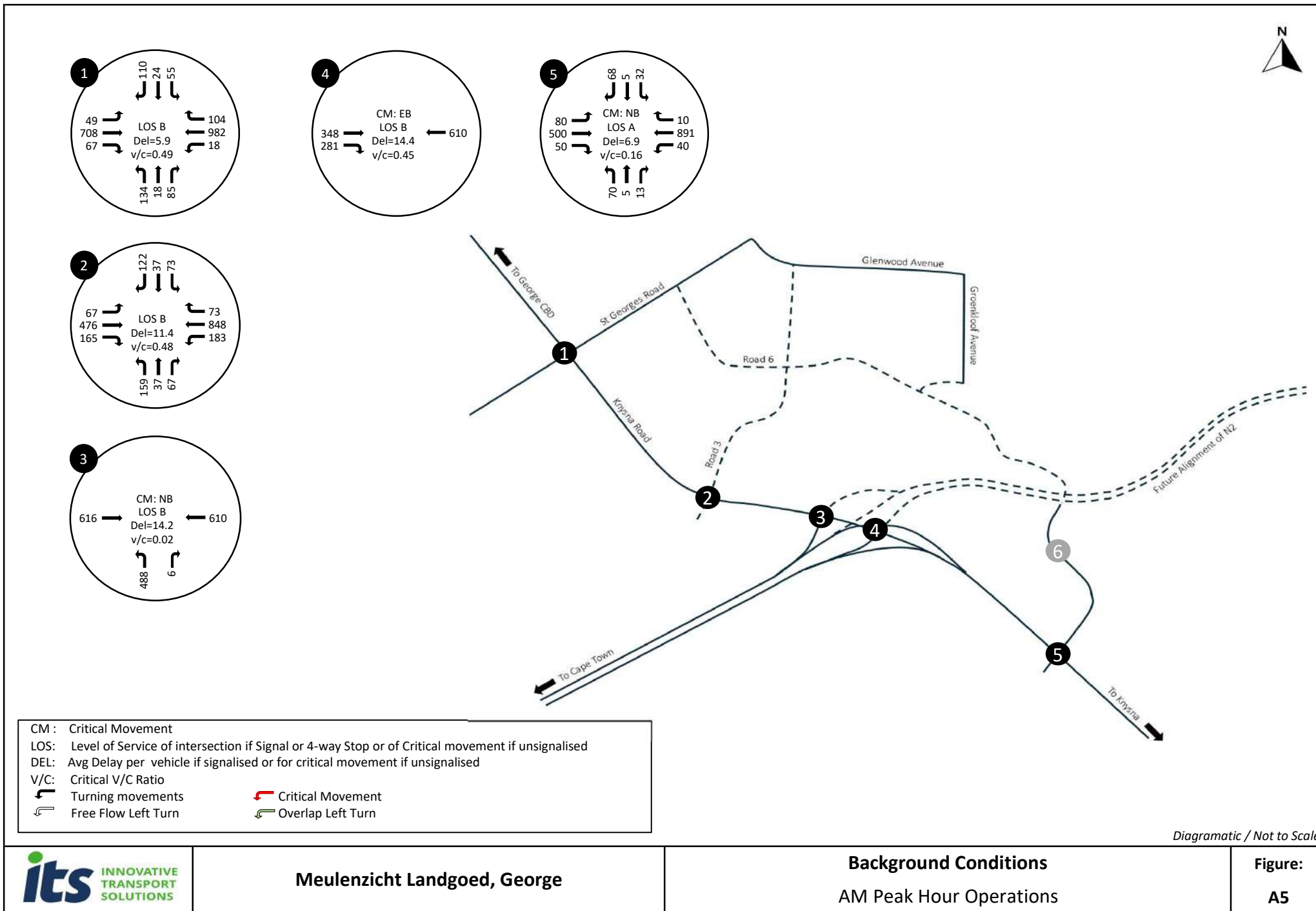
MEULENZICHT LANDGOED
65.9788 ha
227 units

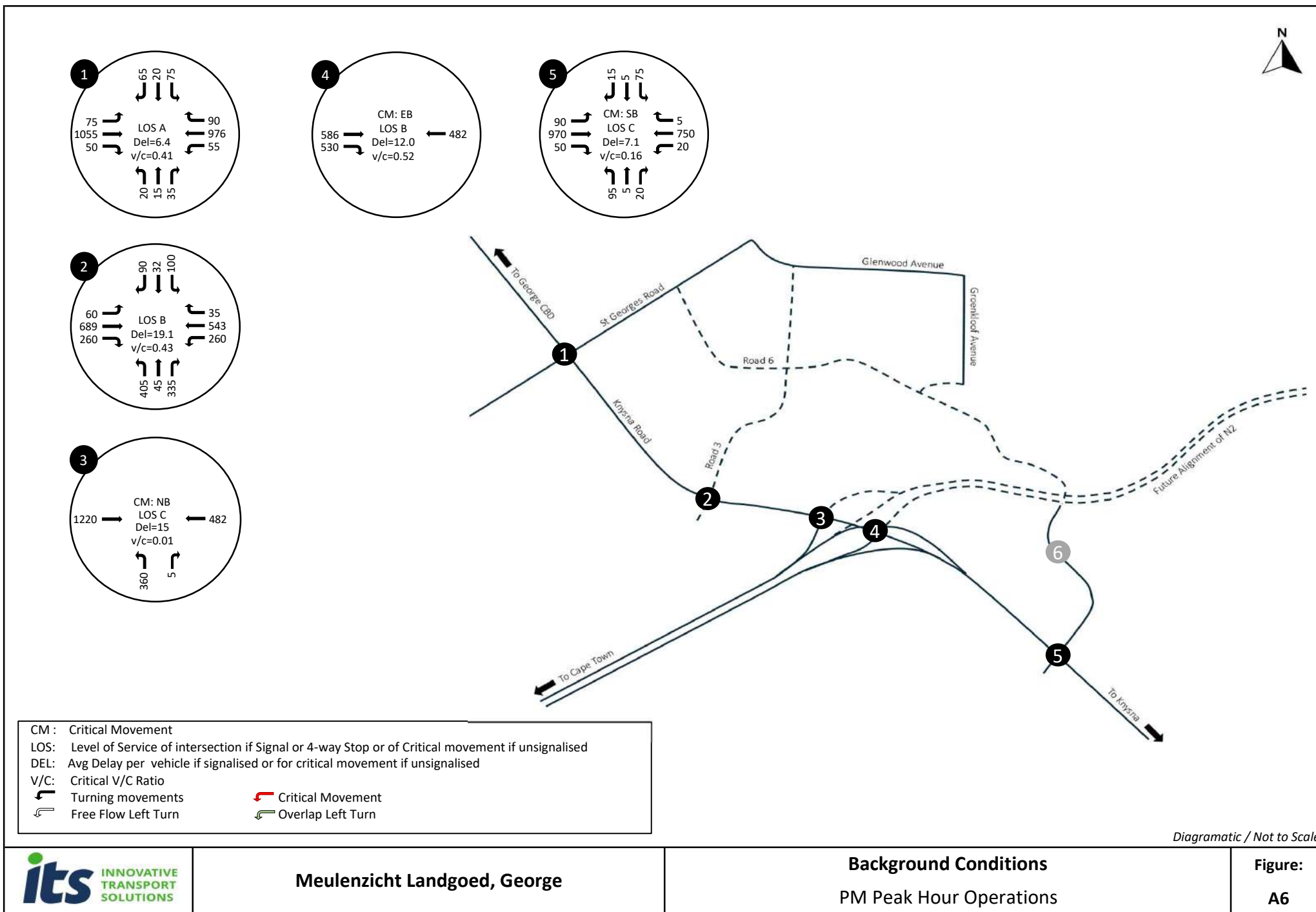
MEULENZICHT LANDGOED			
		Units	GLA
Phase B1	13,2258 ha		
Main entrance / Gatehouse		83	-
Full title erven			
Phase B2	3,9348 ha	49	-
Full title erven			
Phase B3	4,2971 ha	25	-
Full title erven			
Phase B4	15,2092 ha	70	-
Full title erven			
Phase B5	0,7482 ha		-
Treatment plant			
Phase C	28,5678 ha		-
Future Expansion			
		227 units	0 m²

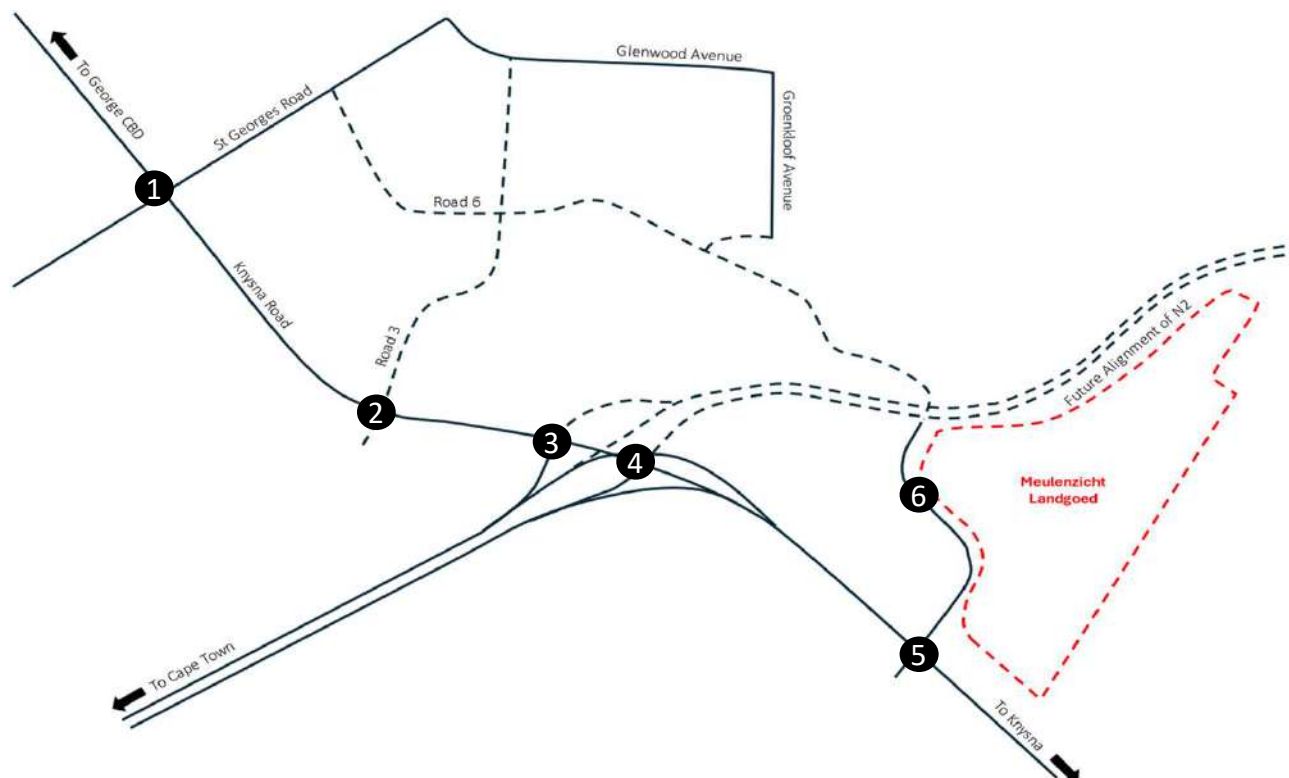
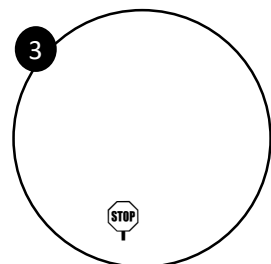
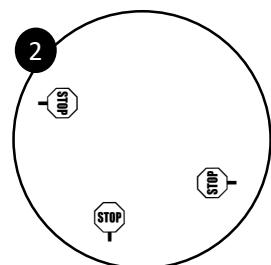
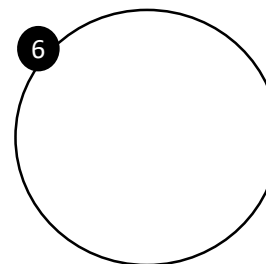
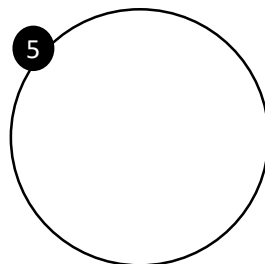
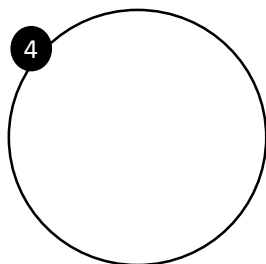
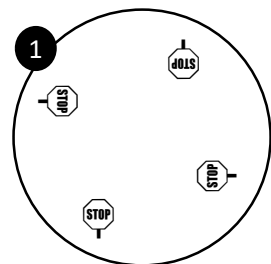












Legend:

- Turning lanes and turning movements
- Stop Control
- Traffic Signal Control
- Roundabout (Yield Control)

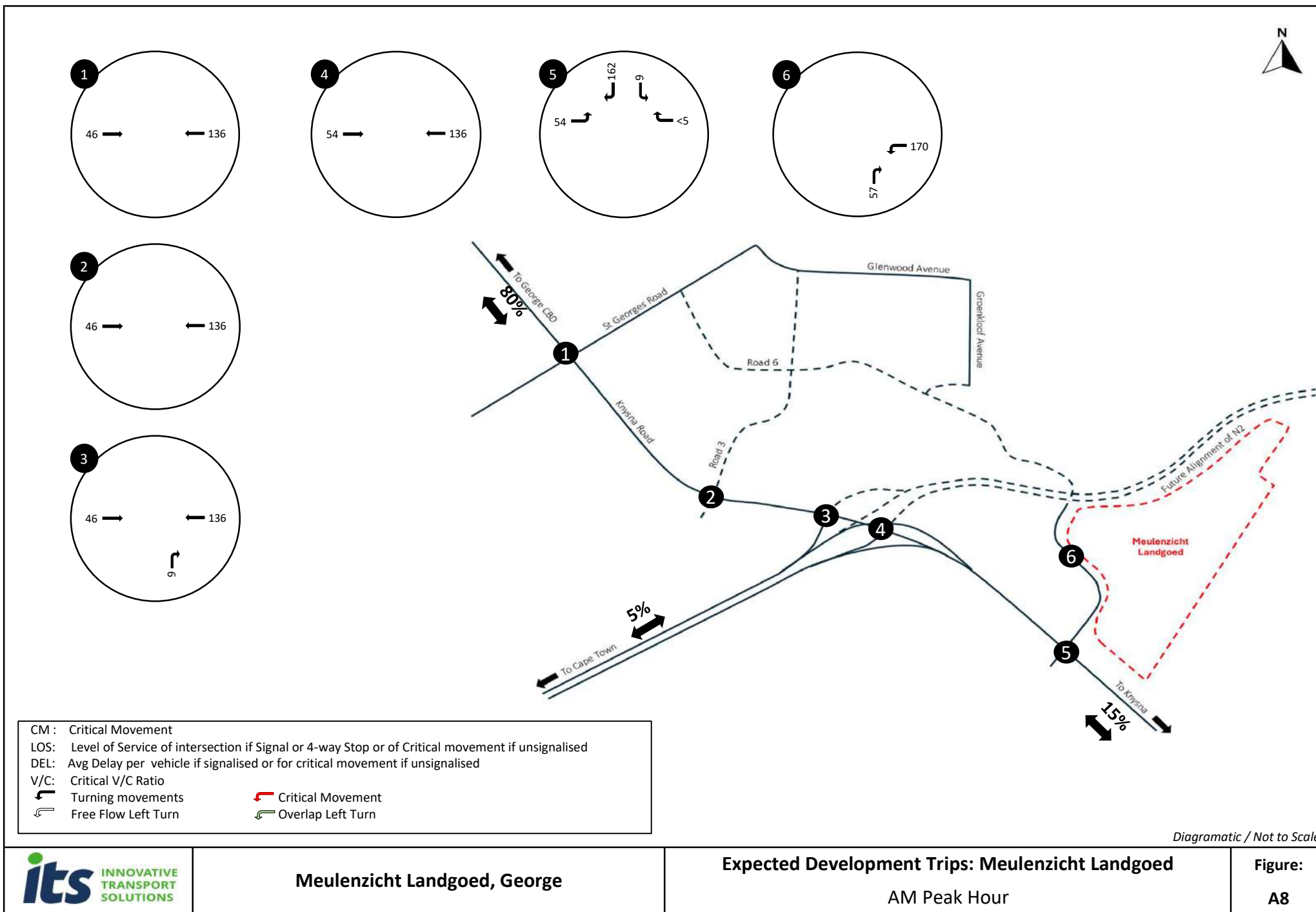
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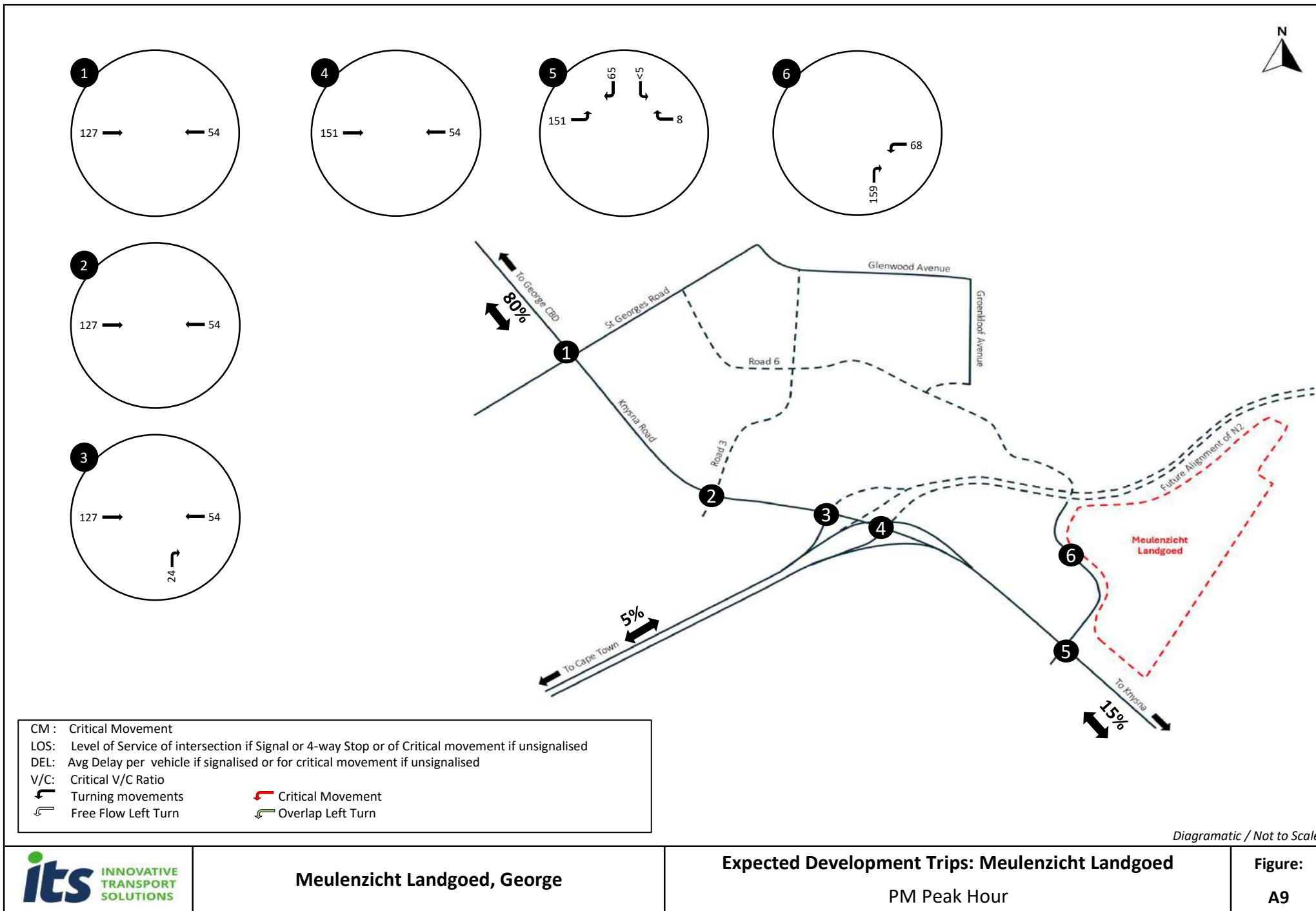


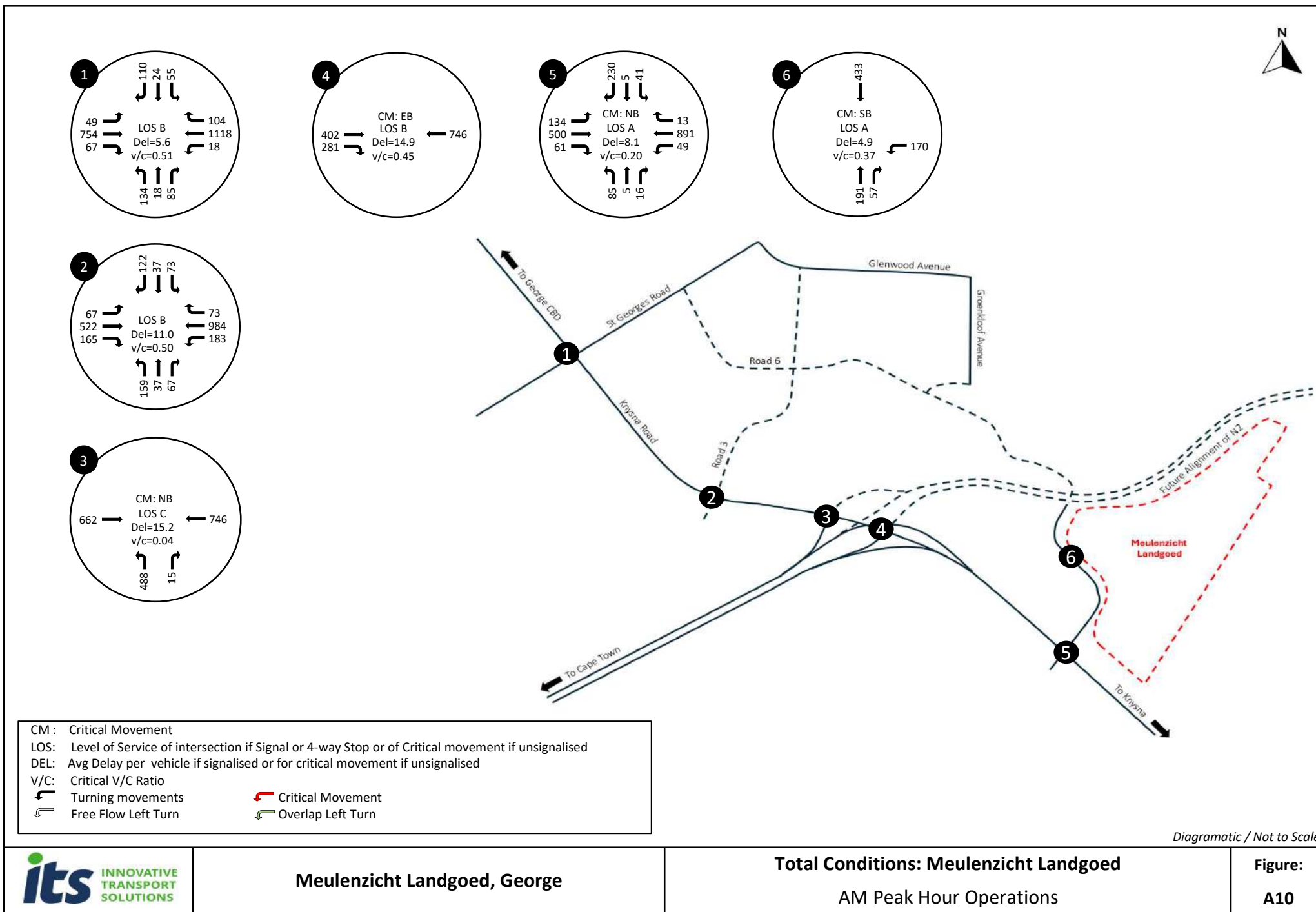
Meulenzicht Landgoed, George

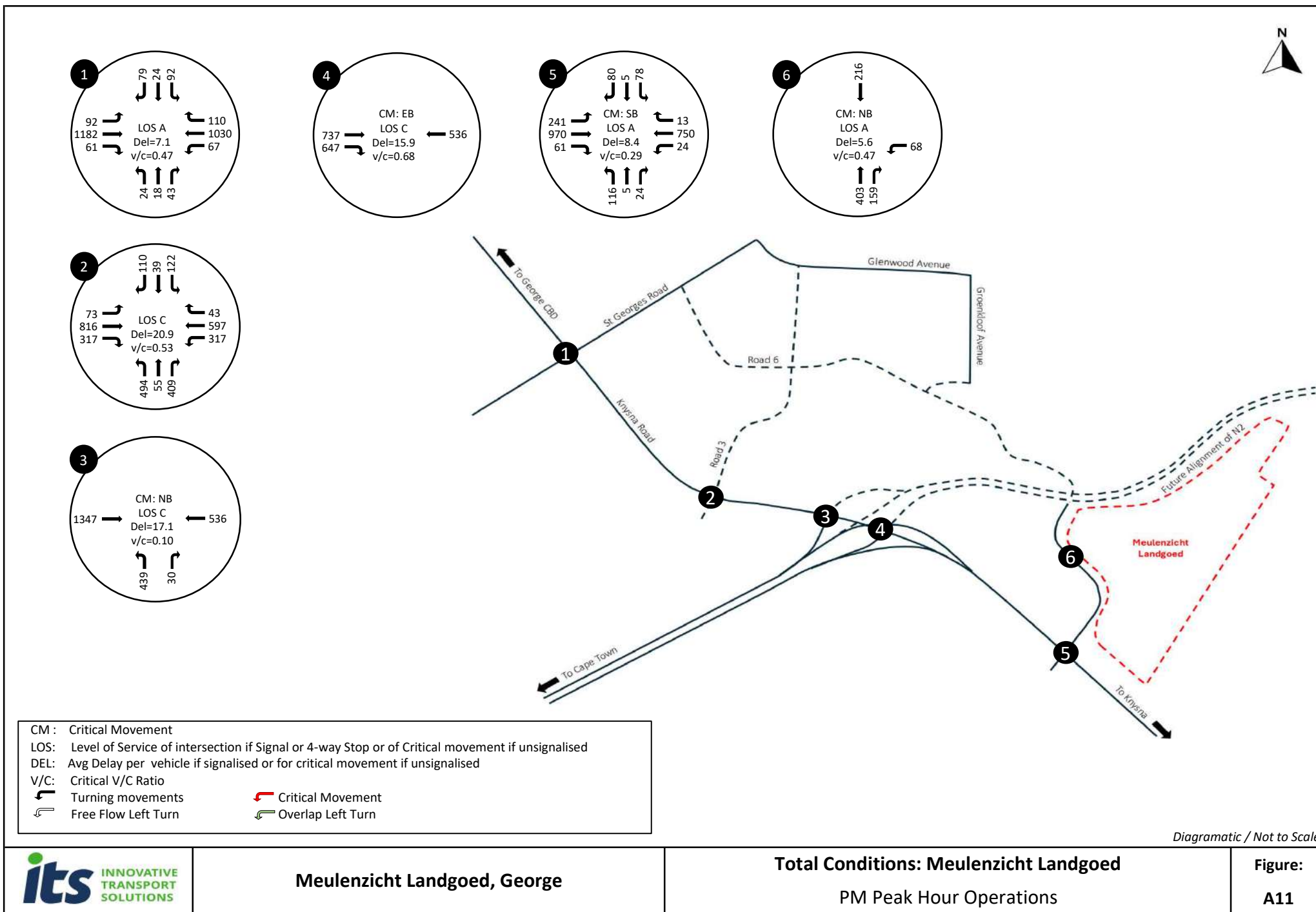
Total Conditions
Lane Configurations and Control

Figure:
A7

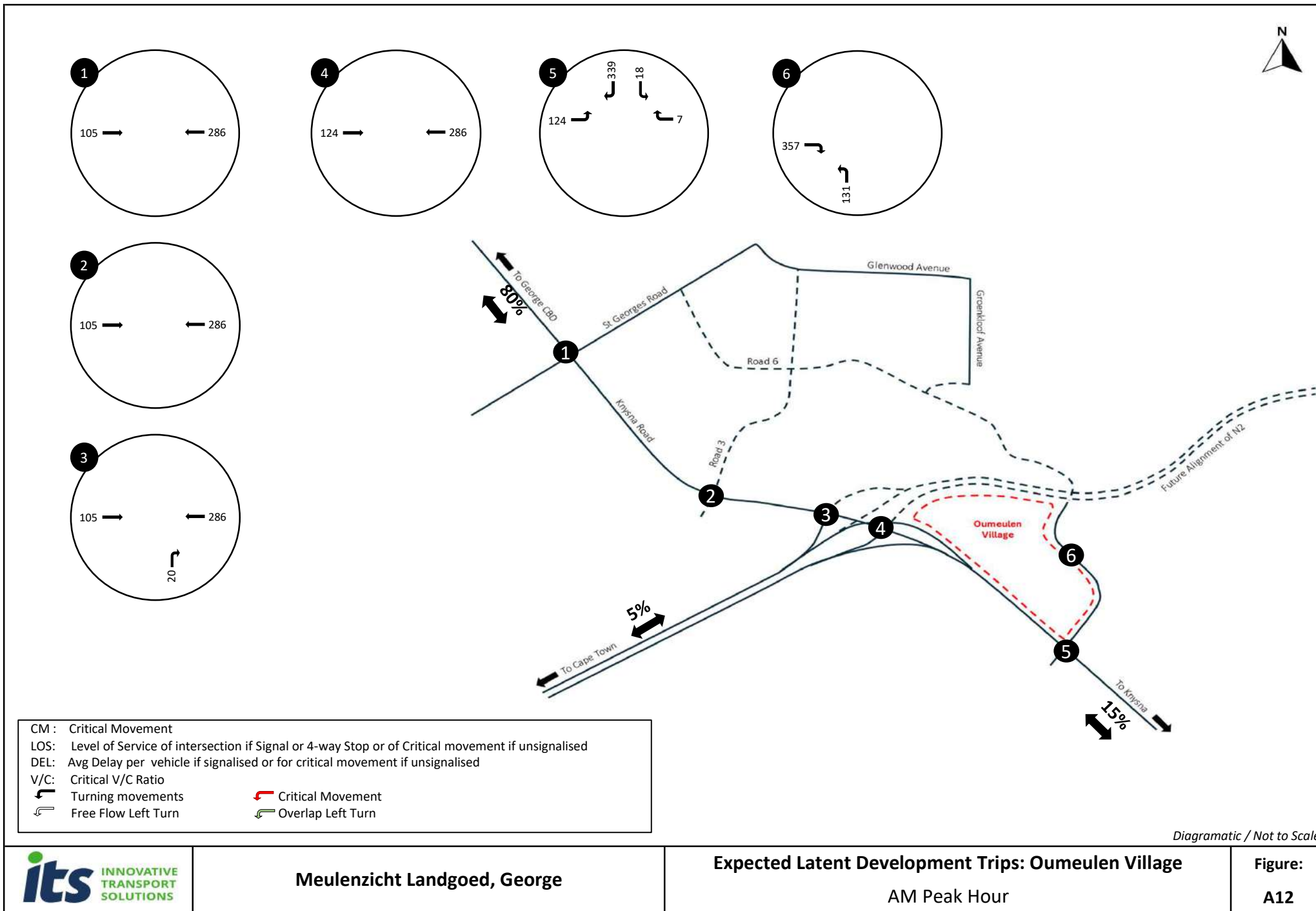


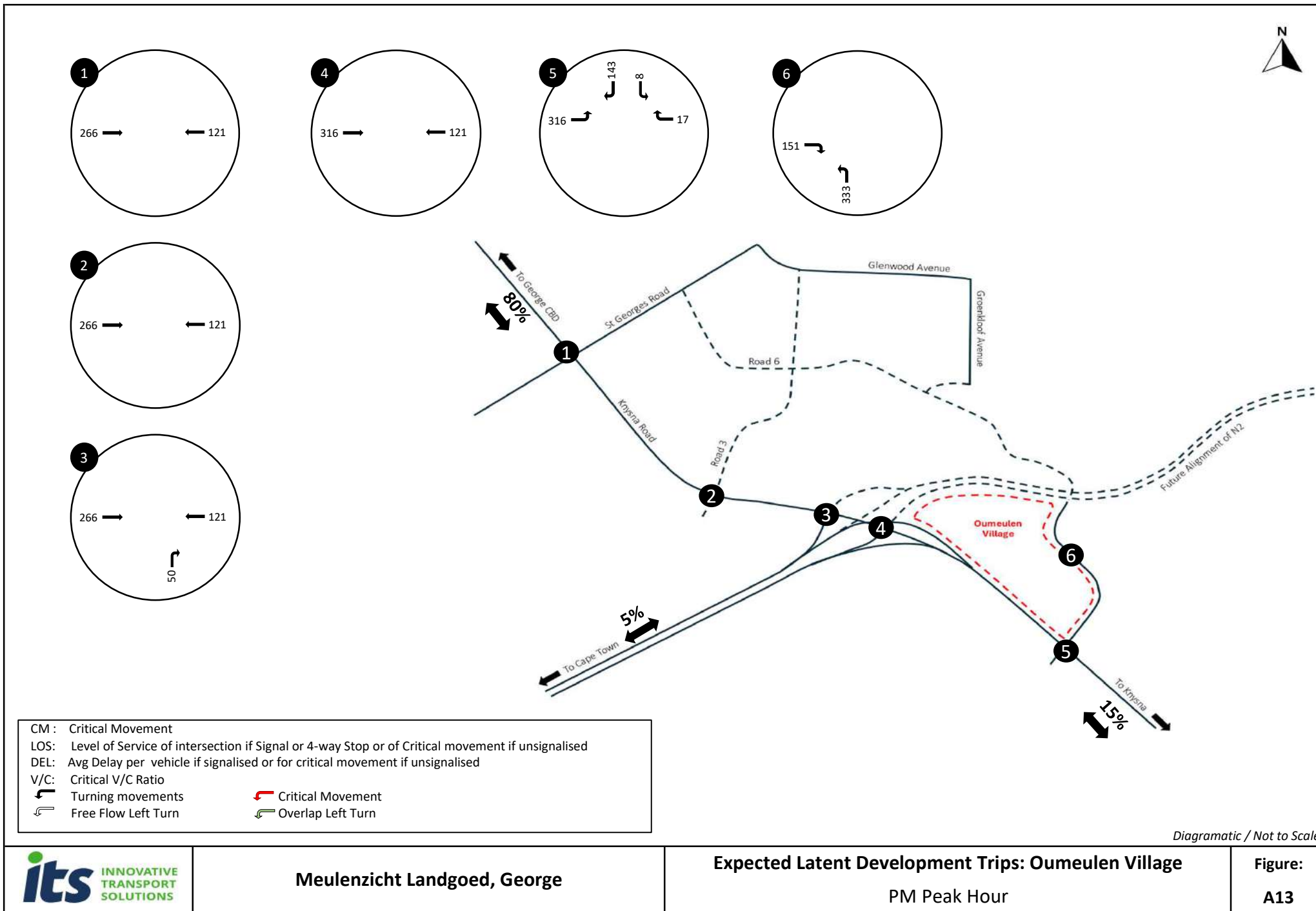


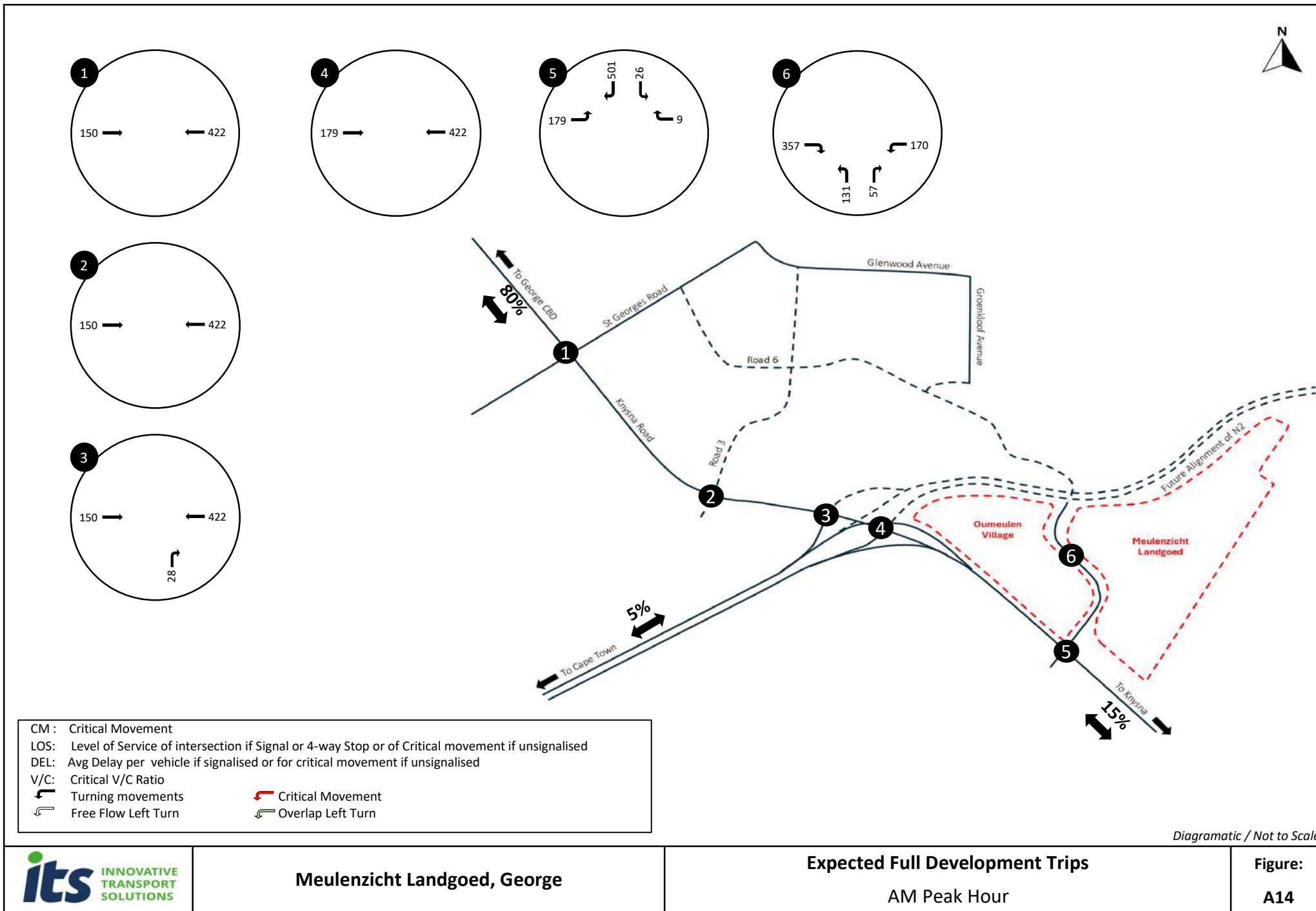


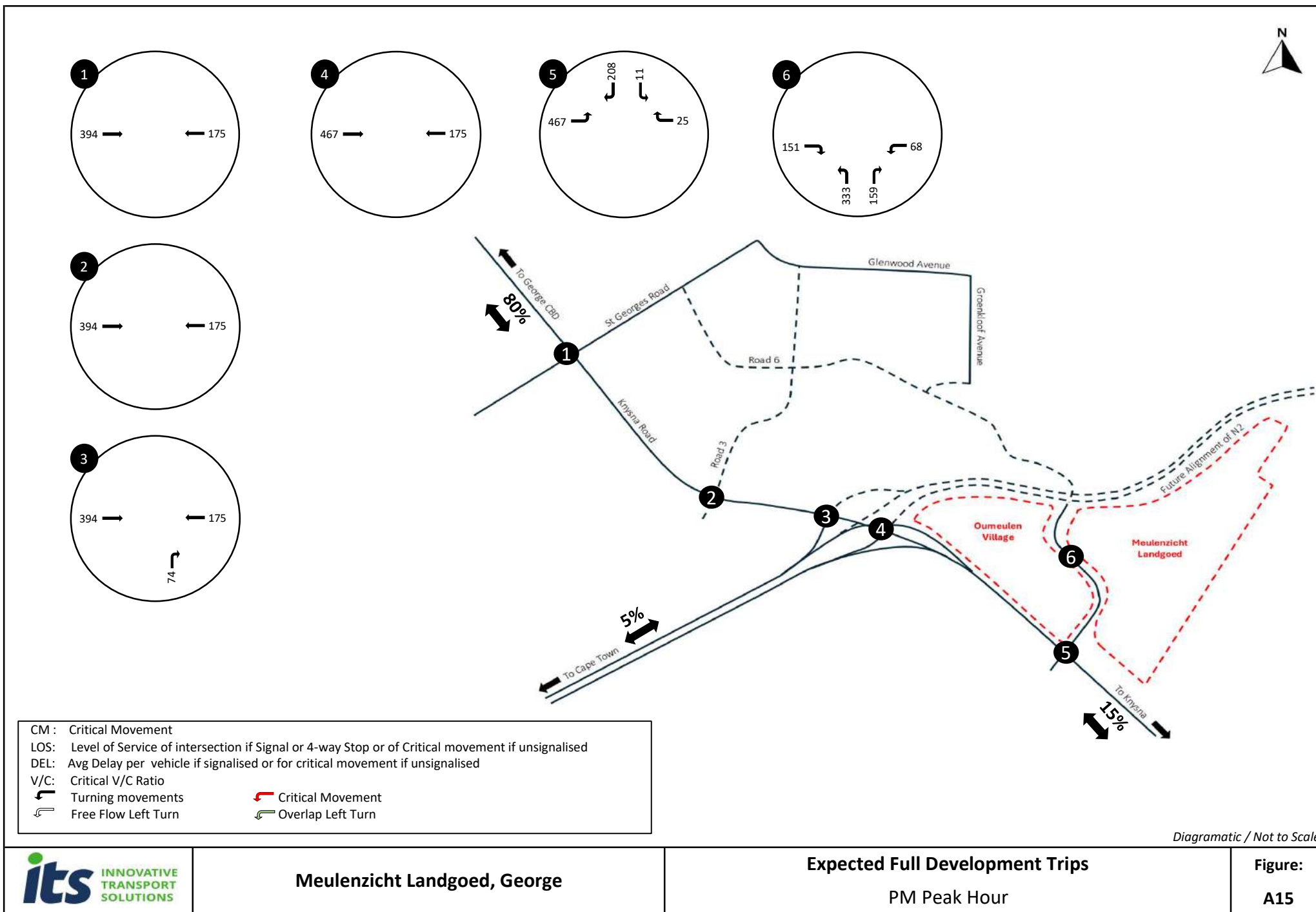


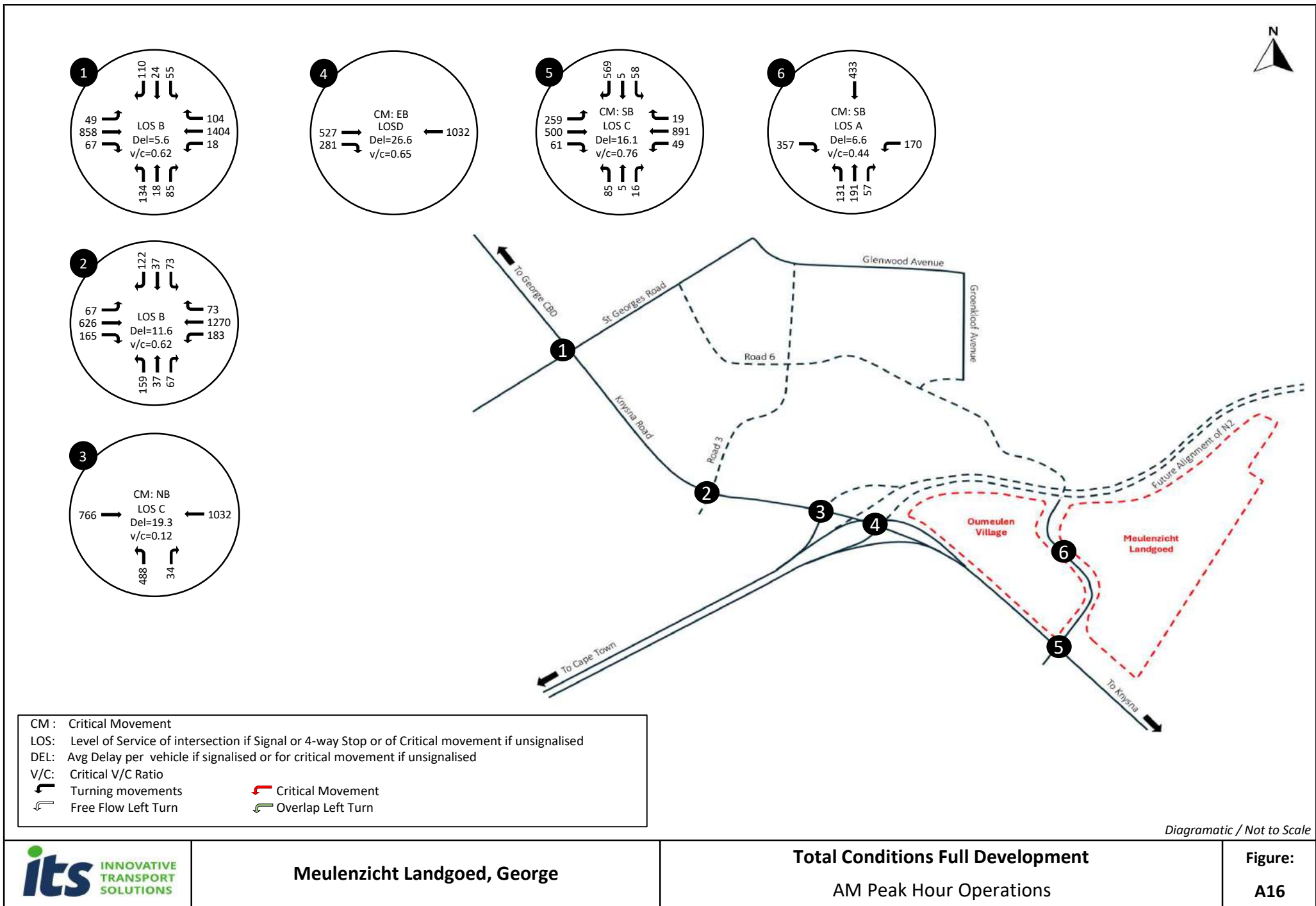
	Meulenzicht Landgoed, George	Total Conditions: Meulenzicht Landgoed PM Peak Hour Operations	Figure: A11
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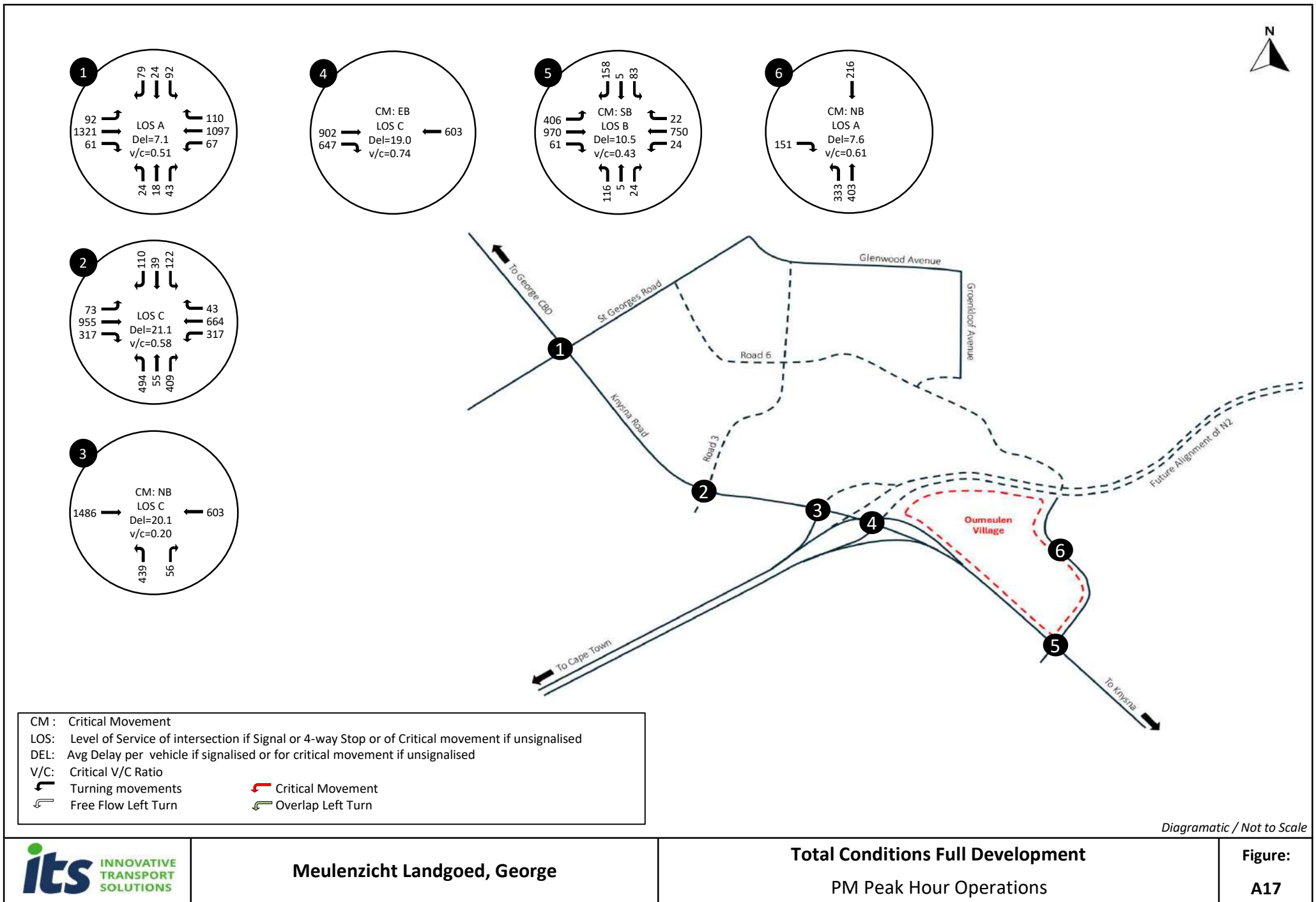












Appendix B

Tables

Table 3: Proposed Land Use for Meulenzicht Landgoed

Land Use	Comment	Extent	Units
Meulenzicht Landgoed			
Full title erven		227	units

Table 4: Trip Generation Rates for the AM and PM Peak Hours for Meulenzicht Landgoed

Land Use	Extent	Units	Source	Weekday AM Peak			Weekday PM Peak		
				Base Rate	In	Out	Base Rate	In	Out
Meulenzicht Estate									
Full title erven	227	units	COTO 210	1.00	25%	75%	1.00	70%	30%

Table 5: Expected Trip Generation for Meulenzicht Landgoed

Land Use	Weekday AM Peak			Weekday PM Peak		
	In	Out	Total	In	Out	Total
Meulenzicht Estate						
Full title erven	57	170	227	159	68	227
Total	57	170	227	159	68	227

Appendix C

Latent Development: Oumeulen Village

Table 6: Proposed Land Use for Oumeulen Village

Land Use	Comment	Extent	Units
Oumeulen Village			
Full title erven		151	units
Apartments		355	units
Nursery School	For use by residents in the immediate area	1 000	sqm
Restaurant, Deli, Gym, Clubhouse		2 500	sqm

Table 7: Trip Generation Rates for the AM and PM Peak Hours for Oumeulen Village

Land Use	Extent	Units	Source	Weekday AM Peak			Weekday PM Peak		
				Base Rate	In	Out	Base Rate	In	Out
Oumeulen Village									
Full title erven	151	units	COTO 210	1.00	25%	75%	1.00	70%	30%
Apartments	355	units	COTO 231	0.85	25%	75%	0.85	70%	30%
Nursery School	1 000	sqm	See comment in Table 2	1.00	50%	50%	0.80	50%	50%
Restaurant, Deli, Gym, Clubhouse	2 500	sqm		1.00	50%	50%	1.00	50%	50%

Table 8: Expected Trip Generation for Ouemeulen Village

Land Use	Weekday AM Peak			Weekday PM Peak		
	In	Out	Total	In	Out	Total
Oumeulen Village						
Full title erven	38	113	151	106	45	151
Apartments	75	226	302	211	91	302
Nursery School	5	5	10	4	3	7
Restaurant, Deli, Gym, Clubhouse	13	13	25	13	13	25
Total	131	357	488	333	151	484

Appendix D

Future Road Network

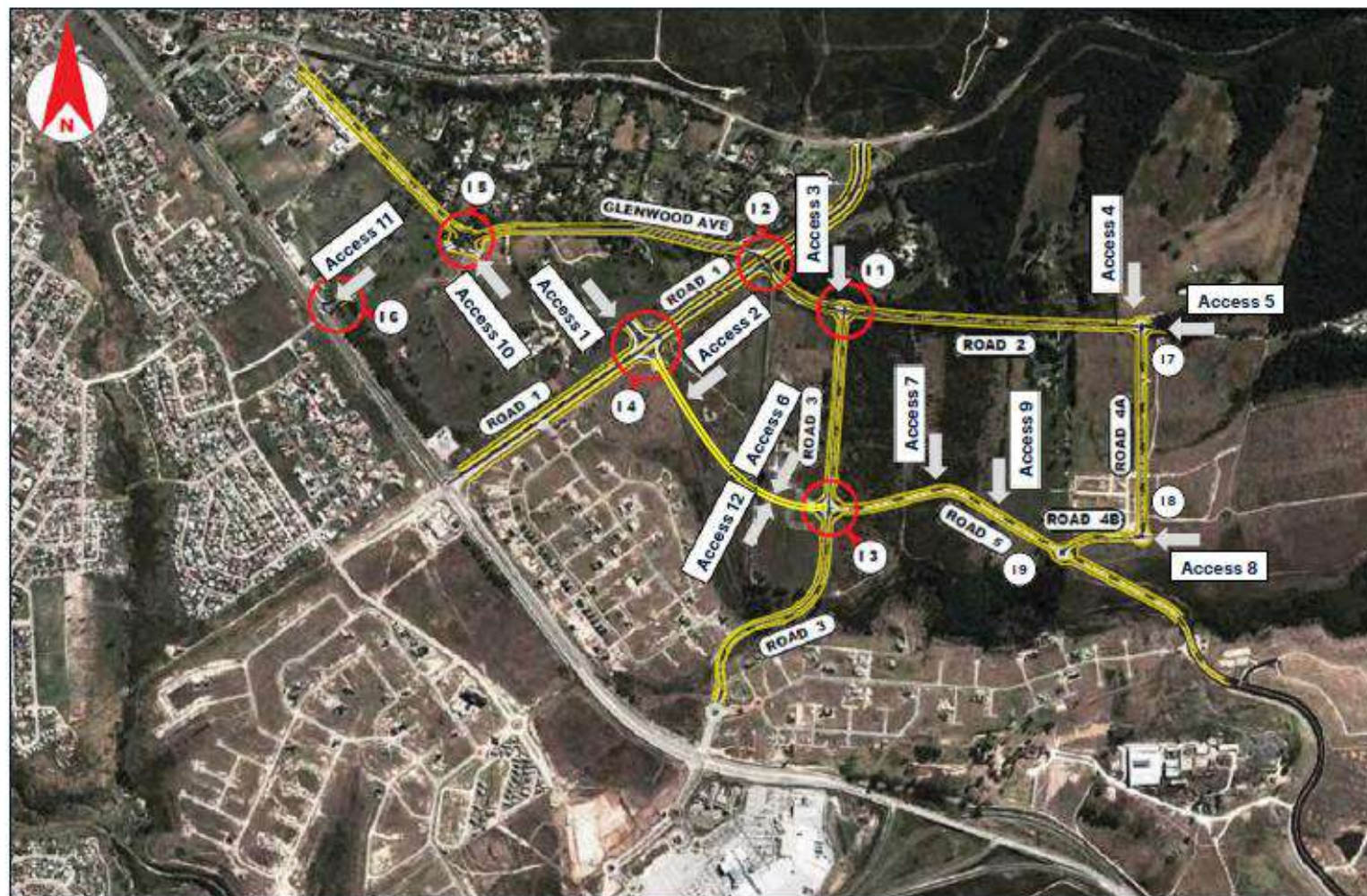
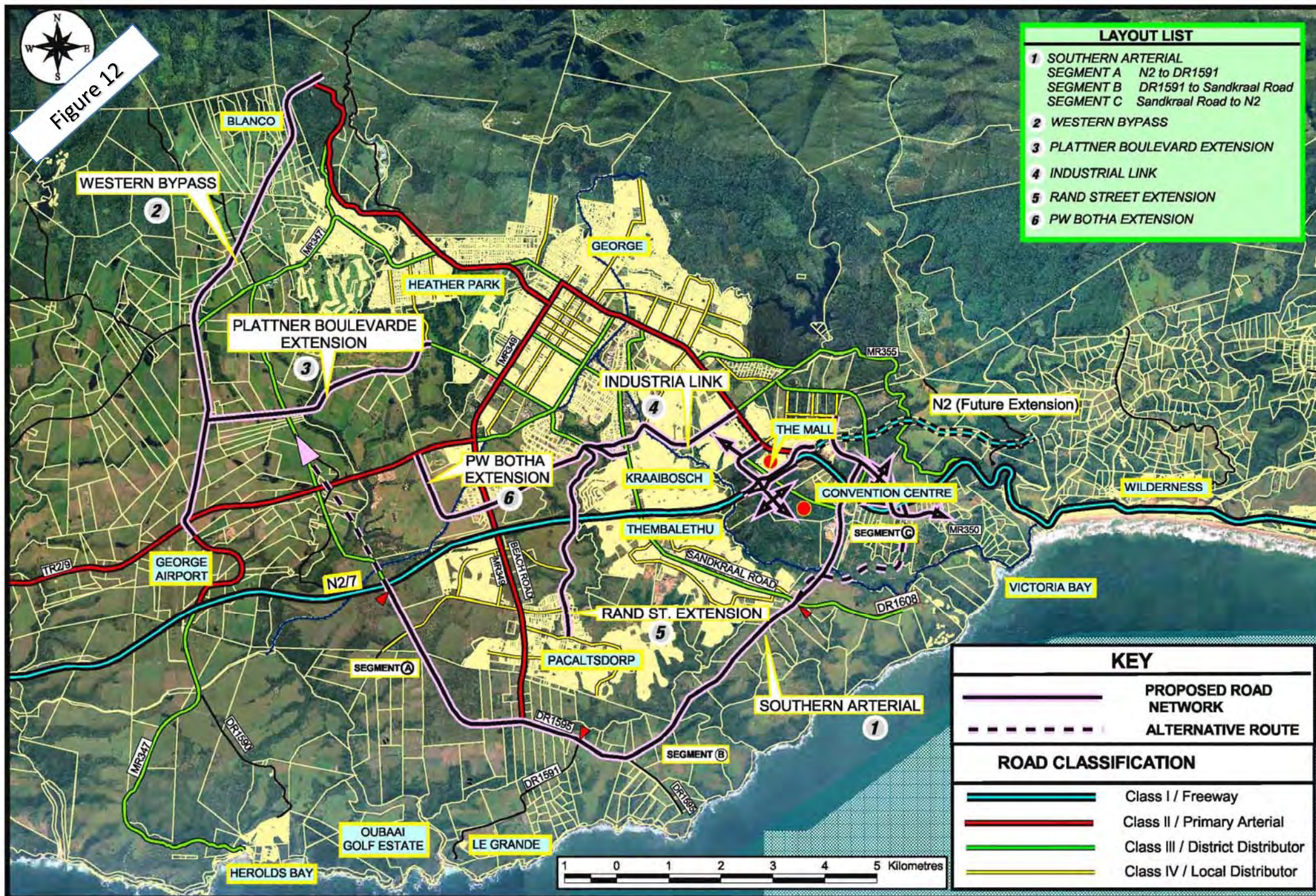


Figure 9-1: Kraaibosch Planned Development Accesses



Figure 12



LAYOUT LIST

- 1 SOUTHERN ARTERIAL
SEGMENT A N2 to DR1591
SEGMENT B DR1591 to Sandkraal Road
SEGMENT C Sandkraal Road to N2
- 2 WESTERN BYPASS
- 3 PLATTNER BOULEVARDE EXTENSION
- 4 INDUSTRIAL LINK
- 5 RAND STREET EXTENSION
- 6 PW BOTHA EXTENSION

KEY

- PROPOSED ROAD NETWORK
- - - - - ALTERNATIVE ROUTE

ROAD CLASSIFICATION

- Class I / Freeway
— Class II / Primary Arterial
— Class III / District Distributor
— Class IV / Local Distributor

ANNEXURE M:

Agricultural Potential Study

Agricultural Study – Land Potential – Meulenzicht - George Farm: 1377.

This compliance statement has been prepared by Gert Jacobus Malan, a registered SACNASP Soil Scientist (128697). In terms of the National Environmental Management Act (Act No 107 of 1998) (NEMA) and the National Web based Environmental Screening Tool (Agricultural Recourses sensitivity, gazetted on 20 March 2020) and Site Sensitivity Verification Report, an Agriculture Assessment (Compliance statement) is required.

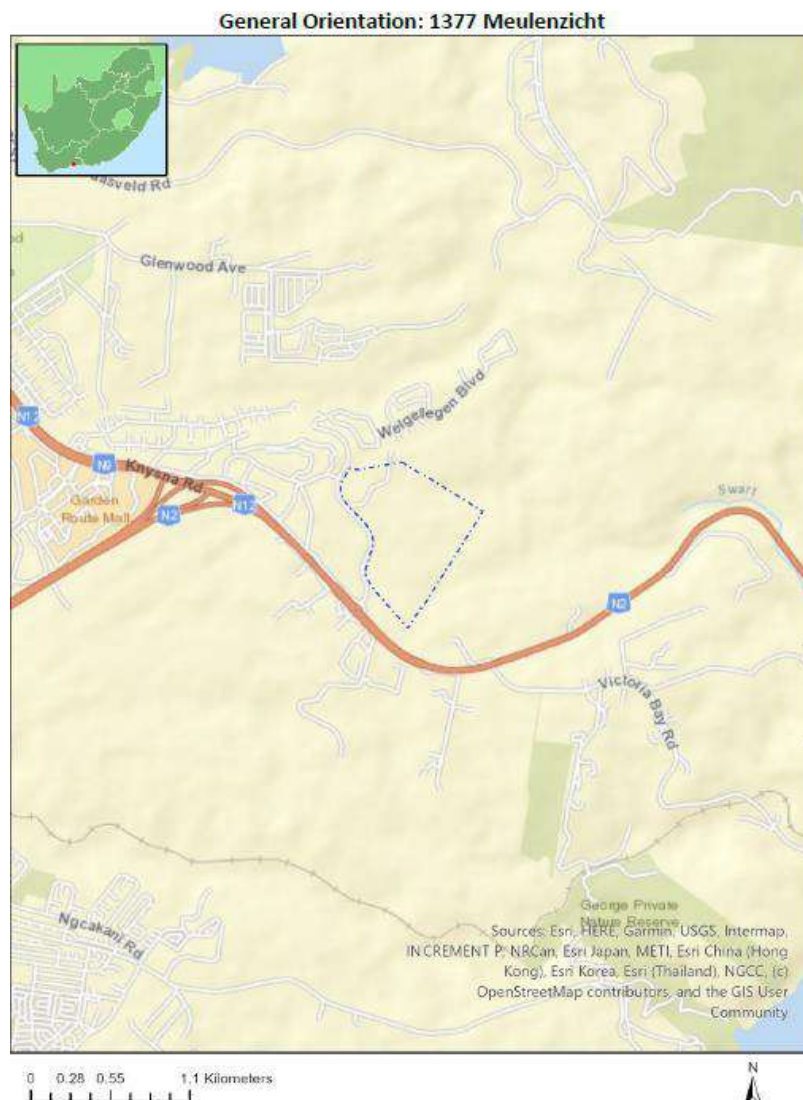


Figure 1. Cadastral details of site A- Meulenzicht.

Meulenzicht is located north of the N2 between Victoria Bay and George East (Fig1.).



Figure 2. Agricultural sensitivity of site – A.

Agriculture screening tool indicates **High sensitivity** for agriculture.

Soil Potential

A scouting soils survey was conducted to confirm the soil potential stipulated in the land type memoirs. Profile descriptions and locations in the Annex. (Profile details in Annex). A summary is compiled below (Table 1)

Table 1. Soil profile survey and Soil Agriculture Potential.

Profile No	Soil Type	Soil Potential (1-15)	Erosion Risk	Compaction Risk
1	Klapmuts	Medium (8)	High	High
2	Klapmuts	Medium (8)	High	High
3	Longlands	Low – (4)	High	High
4	Estcourt	Medium (7)	Very High	High

The soil types did correspond with the Land Type memoirs of the site (Table2). Duplex soil forms are the most abundant, comprising around 67% of the total area. Hydromorphic soils also make up a large percentage according to the memoirs. High potential soils was not observed during the scouting survey.

Table 3. Comparing to the land type memoirs DB33:

Soil Type	Distribution	Group
Estcourt	50%	Duplex
Sterkspruit	13%	Duplex
Longlands	9%	Plinthic
Kroonstad	8.5%	Hydromorphic
Swartland	4.5%	Duplex

Duplex soils are described as soils with an accumulation of clay in the subsoil, consequently removal of clay and silt from the topsoil. The duplex or "double story" is in referral to the two distinctly different layers on top of one another. The difference in texture and structure brings forth a multitude of challenges for agricultural use. Due to the high water infiltration rate of the topsoil, and the low hydraulic conductivity of the subsoil (Prisma/Pedocutanic) water can quickly build-up in the profile, causing waterlogging and anaerobic conditions.

Effective rooting depth in Duplex soils are limited by the subsoil structure, as well as the temporary waterlogging often experienced in the rain season. Due to the high sand content of the topsoil, duplex soils tend to compact easily, lowering agriculture potential.

The plinthic soils are characterised by cycle's oxidation and reduction (wet and dry) of iron and manganese oxides. Soft plinthic is classified by mottling and concretions and is non-indurated and can be cut with a spade when wet. Crop potential is very limited due to this waterlogging state.

Site Sensitivity Verification

Agricultural sensitivity, as classified by the national web-based screening tool, is directly linked to the capability of the land for agricultural production. The loss of high agricultural capability land will have a larger effect than the same area of low agricultural capability land. The conservation of agricultural land is a national priority since agriculture contributes a large portion to the South African domestic produce and food security.

All cultivated land is classified according to the national screening tool as high sensitivity, taking into account the fact that the cultivated land is currently being utilized. This does not take into account the soil, climate and topography. On the other side, uncultivated land is categorized by land capability (DAFF 2017) which takes into account soil, climate and terrain.

The agricultural sensitivity, as identified by the national screening tool, includes High, Medium and Low sensitivity. According to the Land Type survey soils of the area are shallow duplex soils which consists of sandy topsoil horizons with underlying clay horizons. These soils provide low permanent crop production potential. These soils are often designated for dryland agriculture. The climate, soils and terrain of the site is likely to make it suitable, to marginal for agricultural production.

The site sensitivity is hereby disputed to Medium Agriculture Sensitivity.

Agricultural Compliance Statement

Historically the site was used for plantations since the 1930's and has been taken out of forestry production.

The agricultural impact of the proposed development will be to permanently exclude the section from agriculture. The conclusion of this assessment is that the proposed development will not have an unacceptable negative impact on agricultural production of this plot, since it is not being used for agricultural production.

The permanent removal of potential agriculture land should be done with careful evaluation of the land potential. High potential agriculture land is protected and should be preserved for agricultural production. Land Type survey data indicates mostly medium agriculture production potential, this is confirmed by soil profile inspections on site. These soils are prone to erosion and waterlogging. In the absence of abundant irrigation water, agricultural production is limited to grazing and small grain production.

The agricultural protocol further states: 4 of 7

An applicant intending to undertake an activity identified in the scope of this protocol on a site identified by the screening tool as being of "medium" or "low" sensitivity for agricultural resources must submit an Agricultural Compliance Statement.

The above applies in this case.

The proposed development is therefore acceptable, and from an agricultural impact point of view.

The conclusion of this assessment on the acceptability of proposed development and the recommendation for approval is not subject to any conditions. In completing this statement, no assumptions have been made and there are no uncertainties or gaps in knowledge or data that are relevant to it. No further agricultural assessments of any kind is required for this application.

A handwritten signature in black ink, appearing to read 'GJ Malan', with a stylized, cursive script.

GJ Malan (Pri Sci. Nat.)

July 2024

Profile 1:

Terrain Unit:1

Erosion Risk: High

Soil Form: Klapmuts



Orthic A
Bleached A Horizon
Depth: 250 – 300mm
Clay Content: 10-15%
Mottling observed at 200mm depth

E-Horizon
White E-Horizon
Depth 200-300mm
Clay Content: 10-15%
Signs of wetness observed. Periodic Saturation.

Pedocutanic Horizon

Depth 300mm+
Clay Content: 25-30%

Profile 2

Terrain Unit: 1

Erosion Risk: High

Soil Form: Klapmuts



Orthic A Horizon
Bleached A-Horizon
Depth 300mm
Clay Content: 10-15%

E Horizon
White-E-horizon
Depth: 200-250mm
Clay Content: 10-15%

Signs of wetness observed. Periodic Saturation.

Pedocutanic Horizon

Depth 300mm+
Clay Content: 20-30%

Profile 3

Terrain Unit:3

Erosion Risk: High

Soil Form: Longlands

	Orthic A Horizon Bleached A-Horizon Depth 300-350mm Clay Content: 10-15%
	E Horizon White E-Horizon Depth 150-200mm Clay Content: 5-10% Signs of wetness observed. Periodic Saturation.
	Soft Plinthic Horizon Depth 400mm+ Clay Content: 20-25% Gleying observed below Soft Plinthic Horizon

Profile 4

Terrain Unit: 1

Erosion Risk: Very High

Soil Form: Estcourt

	Orthic A Horizon Bleached A-Horizon Depth: 300mm Clay Content: 10-15%
	E-Horizon White E-Horizon Depth: 200-300mm Clay Content: 5-10% Signs of wetness observed. Periodic Saturation.
	Prismacutanic B Horizon Clay Content: 30-40% Depth: 300mm+

Profile 5

Terrain Unit:3

Erosion Risk: Very High

Soil Form: Estcourt



Orthic A Horizon

Bleached A

Depth: 300mm

Clay Content: 10-15%

E-Horizon

White E-Horizon

Depth: 300-400mm

Clay Content: 5-10%

Signs of wetness observed. Periodic Saturation.

Prismacutanic B Horizon

Depth: 300mm+

Clay Content: 30-40%

Profile Positions

Legend



Google Earth

Image © 2025 Airbus

ANNEXURE N:

Aquatic Biodiversity Assessment

Proposed Housing developments on Erf 25537, Kraaibosch, George, Western Cape.

Aquatic Biodiversity Specialist Assessment.



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Author: Dr. J.M. Dabrowski (PhD)
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SACNASP: Pr. Sci Nat. (Water Resources – 114084)
Date: 24 June 2025
Version: Draft Final



EXECUTIVE SUMMARY

Confluent Environmental Pty (Ltd) was appointed by HilLand Environmental to provide aquatic specialist inputs for a proposed mixed-use development on Erf 25537 Kraaibosch, George, Western Cape. The proposed development site is located adjacent to the N2 approximately 5.5 km southeast of George's town centre. Several site visits were carried out during May and June 2024 during which time the entire extent of the proposed development footprint on the property was traversed by foot. Erf 25537 is characterised by low undulating hills that slope steeply down to watercourses (mapped as non-perennial streams). All mapped watercourses within the property boundaries were associated with wetland habitat.

The development involves the construction of Meulenzicht Landgoed residential estate (~36.9 ha in extent), which will comprise primarily of full title residential erven and a sewage package plant. Multiple roads, stormwater, sewage and water supply infrastructure will also need to be constructed. The treatment plant will discharge treated wastewater into a channelled valley-bottom wetland (W2). The development layout has been adapted to accommodate recommended 15 m buffers throughout, and apart from road crossings, all infrastructure will remain outside of the delineated area of wetlands.

The scale of the planned development covers a large area and presents several risks to aquatic biodiversity both within the development area and downstream towards the Kaaimans Estuary. Many of these risks can be mitigated to an appropriate level of impact subject to the implementation of prescribed mitigation measures. Sewage contamination and increased stormwater volumes pose the greatest risk to aquatic biodiversity for this development and is the prevailing threat to urban watercourses in and around the city of George. With respect to wastewater, the most serious impacts are generally associated with leaks due to blocked pipelines, malfunctioning pump stations or operational problems at the package plant. Maintenance and operation of the package plant must therefore be strictly enforced, monitored and routinely audited. Irrigation using treated wastewater must be prioritised over discharge into the watercourse whenever possible. Monitoring the impact of effluent discharge on the Swart River is challenging due to limited options to access the river. It is likely that the volume and quality of water flowing down the Swart River will be sufficient to dilute effluent discharged from the package plant – provided that effluent water quality falls within the General Limit. A more detailed analysis of flow volumes released from the Garden Route Dam is however required to assess this impact with higher confidence. Assimilation of pollutants (especially nutrients) is also expected to occur along W2 and is an important ecosystem service provided by wetlands. The ability of the wetland to assimilate pollutants is however dependent on maintaining the hydro-functional attributes of the wetland (e.g. a well vegetated channel that slows flow, allowing for assimilation of pollutants through absorption, adsorption and microbial decomposition). In this respect watercourses must be protected from erosion and incision caused by high stormwater flows. For this reason, it is recommended that additional attenuation of stormwater is accommodated onsite prior to discharge into watercourses, particularly for W2 and W3 which are confined, channelled systems located along steeper gradients.

A sewage package plant will be constructed as part of the development. According to GN 4167 of 2023, any Section 21 (c) and (i) water use associate with the operation of a sewage package plant (i.e. discharge of wastewater into a watercourse) is excluded from a General Authorisation. In addition, main sewage pipelines crossing watercourses are also excluded

from a General Authorisation. A Water Use License (WUL) will therefore be required for the development.

DECLARATION OF SPECIALIST INDEPENDENCE

- I consider myself bound to the rules and ethics of the South African Council for Natural Scientific Professions (SACNASP);
- At the time of conducting the study and compiling this report I did not have any interest, hidden or otherwise, in the proposed development that this study has reference to, except for financial compensation for work done in a professional capacity;
- Work performed for this study was done in an objective manner. Even if this study results in views and findings that are not favourable to the client/applicant, I will not be affected in any manner by the outcome of any environmental process of which this report may form a part, other than being members of the general public;
- I declare that there are no circumstances that may compromise my objectivity in performing this specialist investigation. I do not necessarily object to or endorse any proposed developments, but aim to present facts, findings and recommendations based on relevant professional experience and scientific data;
- I do not have any influence over decisions made by the governing authorities;
- I undertake to disclose all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by a competent authority to such a relevant authority and the applicant;
- I have the necessary qualifications and guidance from professional experts in conducting specialist reports relevant to this application, including knowledge of the relevant Act, regulations and any guidelines that have relevance to the proposed activity;
- This document and all information contained herein is and will remain the intellectual property of Confluent Environmental. This document, in its entirety or any portion thereof, may not be altered in any manner or form, for any purpose without the specific and written consent of the specialist investigators.
- All the particulars furnished by me in this document are true and correct.



Dr. James Dabrowski (Ph.D., Pr.Sci.Nat. Water Resources; SACNASP Reg. No: 114084)

June 2025



Mr. Franco de Ridder (MSc., Candidate Natural Scientist. Aquatic Science – 166398)

June 2025

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GLOSSARY

Aquatic Biodiversity	The variety of plant and animal life in water ecosystems, relevant to the study due to the site's proximity to potential water bodies.
Desktop Review	Preliminary assessment based on existing data and information, conducted prior to on-site investigations.
Erosion Control Methods	Techniques employed to prevent or minimize soil erosion, such as haybale check dams or silt fencing, crucial in areas with high inherent erosion potential.
Freshwater Ecosystem Priority Area (FEPA)	Designated areas of high importance for freshwater ecosystem conservation, identified as a sensitivity feature in the DFFE screening tool.
Site Assessment	Comprehensive evaluation of the proposed development site, including the identification of wetlands, watercourses, and soil characteristics.
Sensitivity	The degree to which a particular area or ecosystem is susceptible to disturbance or impact, crucial in determining potential environmental consequences.
Terrestrial Critical Biodiversity Area (CBA1)	A designation indicating the significance of the area's biodiversity on land.
Topography	The physical features of the land surface, considered for its potential influence on drainage and ecological features.
Wetland	An area where water covers the soil, or is present either at or near the surface, contributing to biodiversity and ecological significance.
Western Cape Biodiversity Spatial Plan (WCBSP)	A plan indicating categorized areas based on their ecological importance in the Western Cape region.

ABBREVIATIONS

CBA:	Critical Biodiversity Area
CD:NGI:	Chief Directorate: National Geo-spatial Information
DFFE:	Department of Environment, Forestry and Fisheries
DWAF:	Department of Water Affairs and Forestry
DWS:	Department of Water & Sanitation
EIS:	Ecological Importance and Sensitivity
ESA:	Ecological Support Area
FEPA:	Freshwater Ecosystem Priority Area
GA:	General Authorisation
GPS:	Global Positioning System
NEMA:	National Environmental Management Act
NFEPA:	National Freshwater Ecosystem Priority Areas
NWA:	National Water Act
NWM5:	National Wetland Map 5
SACNASP:	South African Council for Natural Scientific Professions
WCBSP:	Western Cape Biodiversity Spatial Plan
WUL:	Water Use License

1. INTRODUCTION

Confluent Environmental Pty (Ltd) was appointed by HilLand Environmental to provide aquatic specialist inputs for a proposed mixed-use development on Erf 25537 Kraaibosch, George, Western Cape. The proposed development site is located adjacent to the N2 approximately 5.5 km southeast of George's town centre. The closest perennial river to the property is the Swart River which is located adjacent to the north-eastern corner of the property and flows in a south-easterly direction before meeting the Kaaimans River, which flow into the Kaaimans Estuary (Figure 1). The scope of work for this report is guided by the legislative requirements of the National Environmental Management Act (NEMA) as well as the National Water Act (NWA).

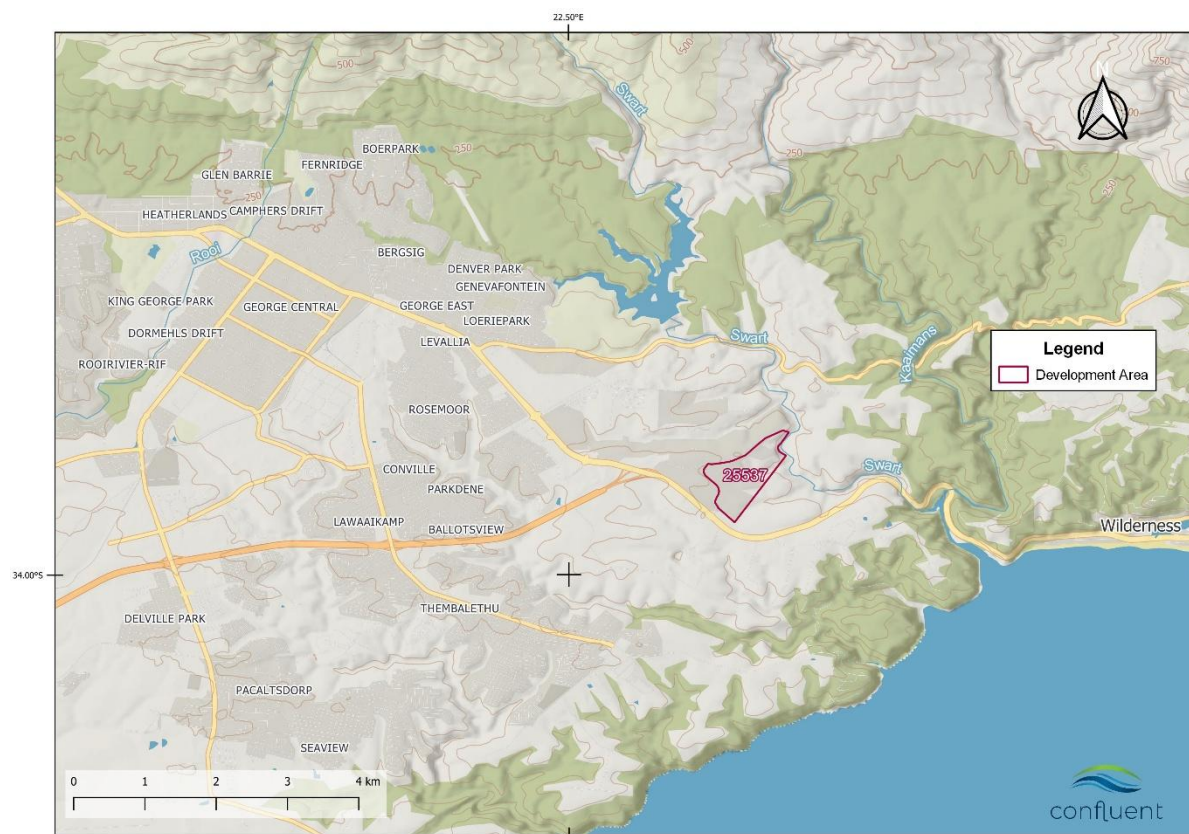


Figure 1. Map indicating the development area east of George, Western Cape.

1.1 Key Legislative Requirements

1.1.1 National Environmental Management Act

According to the protocols specified in GN 1540 (Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in Terms of Sections 24(5)(A) and (H) and 44 of the National Environmental Management Act, 1998, when Applying for Environmental Authorisation), assessment and reporting requirements for aquatic biodiversity are associated with a level of environmental sensitivity identified by the national web-based environmental screening tool. An applicant intending to undertake an activity identified in the scope of this protocol on a site identified by the screening tool as being of:

- **Very High** sensitivity for aquatic biodiversity, must submit an Aquatic Biodiversity Specialist Assessment; or

- **Low** sensitivity for aquatic biodiversity, must submit an Aquatic Biodiversity Compliance Statement.

According to the DFFE Screening Tool Erf 25537 has a **Very High** aquatic biodiversity sensitivity for the following reasons:

- The properties fall within a Strategic Water Source Area (SWSA).
- One or more aquatic Critical Biodiversity Areas (CBA) are mapped to occur within the property boundaries.
- Aquatic habitat (river) has been mapped to occur within or in close proximity to the properties.

1.1.2 National Water Act

The Department of Water & Sanitation (DWS) is the custodian of South Africa's water resources and therefore assumes public trusteeship of water resources, which includes watercourses, surface water, or aquifers. A watercourse means:

- A river or spring;
- A natural channel in which water flows regularly or intermittently;
- A wetland, lake or dam into which, or from which, water flows; and
- Any collection of water which the Minister may, by notice in the Gazette, declare to be watercourse, and

For the purposes of this assessment, a wetland area is defined according to the NWA (Act No. 36 of 1998):

“Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil”.

Wetlands must therefore have one or more of the following attributes to meet the NWA wetland definition (DWAf, 2005):

- A high water table that results in the saturation at or near the surface, leading to anaerobic conditions developing in the top 50 cm of the soil;
- Wetland or hydromorphic soils that display characteristics resulting from prolonged saturation, i.e. mottling or grey soils; and
- The presence of, at least occasionally, hydrophilic plants, i.e. hydrophytes (water loving plants).

No activity may take place within a watercourse unless it is authorised by the Department of Water and Sanitation (DWS). According to Section 21 (c) and (i) of the National Water Act, an authorization (Water Use License or General Authorisation) is required for any activities that impede or divert the flow of water in a watercourse or alter the bed, banks, course or characteristics of a watercourse. The regulated area of a watercourse for section 21(c) or (i) of the Act water uses means:

- a) The outer edge of the 1 in 100-year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam;

- b) In the absence of a determined 1 in 100-year flood line or riparian area the area within 100m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench (subject to compliance to section 144 of the Act); or
- c) A 500 m radius from the delineated boundary (extent) of any wetland or pan.

According to Section 21 (c) and (i) of the NWA, any water use activities that do occur within the regulated area of a watercourse must be assessed using the DWS Risk Assessment Matrix (GN4167) to determine the impact of construction and operational activities on the flow, water quality, habitat and biotic characteristics of the watercourse. Low-Risk activities require a General Authorisation (GA), while Medium or High-Risk activities require a Water Use License (WUL).

1.2 Assumptions and Exclusions

- A series of site visits were conducted in May and June 2024 which falls in the winter season. It is possible that sensitive features such as rare or unique biota (e.g. amphibians), plants or habitat were not observed during the site visit, but are influenced by season, time of day, flow level or vegetation cover. However, recent good rainfall would have meant that any wetland features would have been quite evident and easy to identify.
- Most of the site was mowed, making it difficult to accurately determine the edge of the wetland areas using vegetation indicators. Delineation therefore relied heavily on soil augering.

2. METHODS

2.1 Wetland Delineation

Wetlands are described by the National Water Act (Act 36 of 1998) as:

“Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.”

According to DWAF (2005) wetlands must have one or more of the following attributes:

- Wetland (hydromorphic) soils that display characteristics resulting from prolonged saturation;
- The presence, at least occasionally, of plants that grow in water saturated conditions (hyrdophytes or obligate wetland plants);
- A high water table that results in saturation at or near the surface, leading to anaerobic conditions developing in the top 50cm of the soil.

The boundary of the wetland was delineated in accordance with DWAF (2005) guidelines which considers the following four specific indicators:

- The Terrain Unit Indicator: Identifies those parts of the landscape where wetlands are more likely to occur;
- The Soil Form Indicator: Identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation;

- The Soil Wetness Indicator: Identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation (i.e. mottling and gleying within 50 cm of the soil surface); and
- The Vegetation Indicator: Identifies hydrophilic vegetation associated with frequently saturated soils.

The boundary of the wetland was determined by identifying the presence or absence of the combination of indicators mentioned above at selected points in the field. The location of soil augering points used to assess soil wetness were marked on a hand-held GPS and saturation zones were classified according to the soil wetness indicators as follows:

- Temporary Zone: Short periods of saturation (less than three months per annum) characterised by few high chroma mottles and minimal grey matrix (< 10 %).
- Seasonal Zone: Significant periods of wetness (at least three months per annum) characterised by many low chroma mottles and a grey matrix.
- Permanent Zone: Wetness all year round characterised by a prominent grey matrix and few to no high chroma mottles.

Auger points that showed no sign of saturation were classified as 'Dry'. All augering points were imported into GIS software and, in combination with aerial imagery and other site observations of vegetation indicators, were used to plot the boundary of the wetland.

2.2 Present Ecological State (PES)

2.2.1 Wetlands

WET-Health 2.0 is designed to assess the PES of a wetland by scoring the perceived deviation from a theoretical reference condition, where the reference condition is defined as the un-impacted condition in which ecosystems show little or no influence of human actions. In thinking about wetland health or PES, it is thus appropriate to consider 'deviation' from the natural or reference condition, with the ecological state of a wetland taken as a measure of the extent to which human impacts have caused the wetland to differ from the natural reference condition. Whilst wetland features vary considerably from one wetland to the next, wetlands are all broadly influenced/ by their climatic and geological setting and by three core inter-related drivers, namely hydrology, geomorphology and water quality. The biology of the wetland (in which vegetation generally plays a central role) responds to changes in these drivers, and to activities within and around the wetland. The interrelatedness of these four components forms the basis of the modular-based approach adopted in WET-Health Version 2. Desktop and field data were captured in GIS software and used to populate the Level 1 WET-Health tool (Macfarlane et al., 2020) which was used to derive the PES of the wetland HGM units. The magnitude of observed impacts on the hydrological, geomorphological, water quality and vegetation components of the wetland were calculated and combined as per the tool to provide a measure of the overall condition of the wetland on a scale from 1-10. Resultant scores were then used to assign the wetland into one of six PES categories as shown in Table 1 below.

Table 1: Wetland Present Ecological State (PES) categories and impact descriptions.

ECOLOGICAL CATEGORY	DESCRIPTION	IMPACT SCORE*	PES SCORE (%)*
A	Unmodified, natural.	0-0.9	90-100
B	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1-1.9	80-89
C	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	2-3.9	60-79
D	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4-5.9	40-59
E	Seriously modified. The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6-7.9	20-39
F	Critically modified. Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8-10	0-19

2.3 Ecological Importance and Sensitivity

2.3.1 Wetlands

The ecological importance of a water resource is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales (Duthie, 1999). Ecological sensitivity refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (Duthie, 1999). The Ecological Importance and Sensitivity (EIS) provides a guideline for determination of the Ecological Management Class (EMC). The revised method for the determination of the EIS of a wetland considers the three following ecological aspects (Rountree et al., 2013):

- **Ecological importance and sensitivity**
 - Biodiversity support including rare species and feeding/breeding/migration;
 - Protection status, size and rarity in the landscape context;
 - Sensitivity of the wetland to floods, droughts and water quality fluctuations.
- **Hydro-functional importance**
 - Flood attenuation;
 - Streamflow regulation;
 - Water quality enhance through sediment trapping and nutrient assimilation;
 - Carbon storage
- **Direct human benefits**
 - Water for human use and harvestable resources;
 - Cultivated foods;
 - Cultural heritage;
 - Tourism, recreation, education and research.

Each criterion is scored between 0 and 4, and the average of each subset of scores is used to derive a score for each of the three components listed above. The highest score is used to determine the overall Importance and Sensitivity category of the wetland system.

Table 2: Ecological importance and sensitivity categories. Interpretation of average scores for biotic and habitat determinants.

Ecological Importance and Sensitivity Category (EIS)	Range of Median	Recommended Ecological Management Class
<u>Very high:</u> Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these floodplains is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.	>3 and ≤4	A
<u>High:</u> Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these floodplains may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.	>2 and ≤3	B
<u>Moderate:</u> Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these floodplains is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.	>1 and ≤2	C
<u>Low/marginal:</u> Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these floodplains is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.	>0 and ≤1	D

2.4 Wetland and Buffer Determination

Buffer zones have been defined as a strip of land with a use, function or zoning specifically designed to act as barriers between human activities and sensitive water resources with the aim of protecting these water resources them from adverse negative impacts. Appropriate buffers were estimated based on buffer zone guidelines developed by Macfarlane and Bredin (2017). These guidelines estimate required buffer zone widths based on a combination of input parameters which include, *inter alia*, the nature of the activity and associated impacts, basic climatic and soil conditions, the PES and EIS of potentially affected watercourses and the implementation of appropriate mitigation measures.

3. CATCHMENT CONTEXT

3.1 Catchment Features

The property is located in the quaternary catchment K30C in the catchment of the Swart River (Figure 2). The main rivers draining this catchment are the Swart and Kaaimans, both of which originate in the Outeniqua Mountains to the north. The Swart River feeds the Garden Route Dam and terminates in the Kaaimans River Estuary. The project area falls within the South-Eastern Coastal Belt (20) Level 1 ecoregion (20.02 Level 2 Ecoregion), which is characterized by moderately undulating plains and low mountains with altitude ranging from 0 to 1 300 m above mean sea level. Watercourses are typically located at the base of relatively steep slopes. Mean annual precipitation for the catchment area is approximately 800 mm per year and occurs all year-round, with peaks in October to November and March to April. Dominant natural vegetation in the vegetation comprises broadly of fynbos, renosterveld, dune thicket, and afro-montane forest. Three non-perennial watercourses are indicated to drain the properties, each of which join the Swart River upstream of its confluence with the Kaaimans Estuary (Figure 3).

Soils in the catchment area are relatively shallow consisting of a diagnostic pedocutanic duplex soil, with a clear textural contrast between the A and B horizon. The B horizon is however heavily enriched with clay, which serves as a barrier to both root growth and water movement. Sub-surface water therefore tends to flow laterally over the top of the B horizon, through the more coarsely textured A horizon. In addition, the area falls within a very high rainfall and high rainfall intensity zone, which, in urban areas with a high proportion of impervious surfaces, results in the production of very large volumes of high energy stormwater (Table 3). For these reasons, soils are highly erodible and is undoubtedly the main cause of relatively widespread bank erosion and channel incision of urban watercourse in and around George.

Table 3. Summary of relevant catchment features for the proposed development area.

Feature	Description
Quaternary catchment	K30C
Mean Annual Runoff	186.61 mm
Mean Annual Precipitation	834.00 mm
Inherent erosion potential of soils (K-factor)	0.74, Very High
Rainfall intensity	Very High
Ecoregion Level II	20.02, Southeastern coastal belt
Geomorphological Zone	Upper Foothill
NFEPA area	Sub-quaternary reach 9093 and 9144, no FEPA.
Mapped Vegetation Type	FFg 5: Garden Route Granite Fynbos (CR: Critically Endangered)
Conservation	None

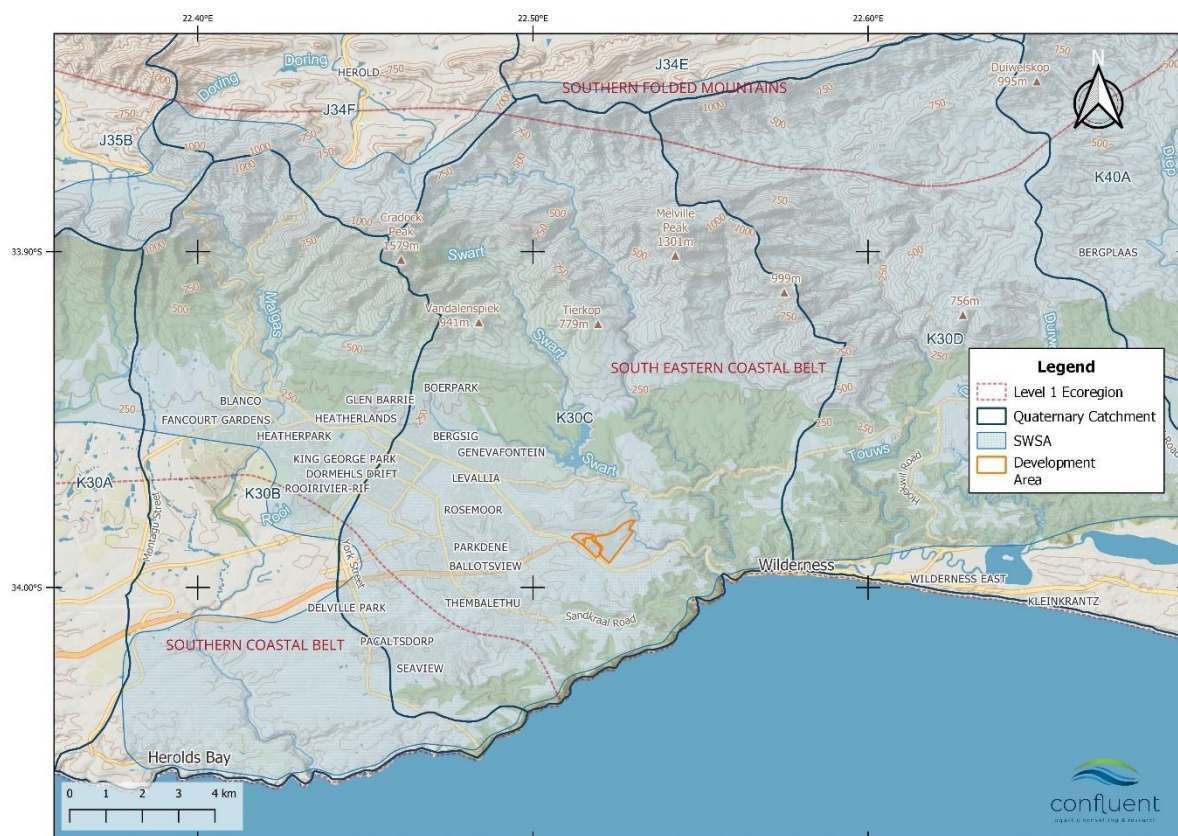


Figure 2. Erf 25537 in the quaternary catchment K30C.

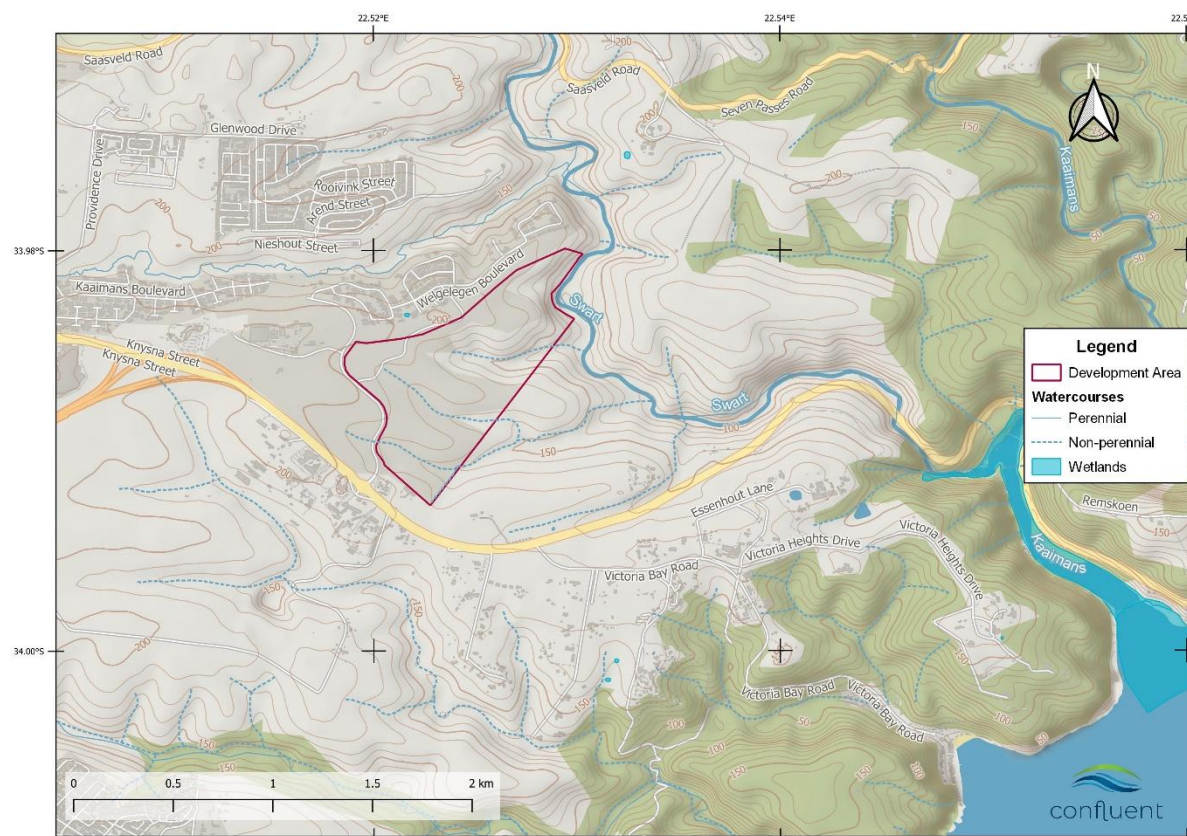


Figure 3: The proposed development area in relation to mapped watercourses.

3.2 Conservation and Catchment Management

3.2.1 Western Cape Biodiversity Spatial Plan

The main purpose of a biodiversity spatial plan is to ensure that the most recent and best quality spatial biodiversity information can be accessed and used to inform land use and development planning, environmental assessments and authorisations, natural resource management and other multi-sectoral planning processes. The WCBSP plan achieves this by providing a map of terrestrial and freshwater areas that are important for conserving biodiversity pattern and ecological processes – these areas are called Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs).

No aquatic CBAs or ESAs are mapped within the boundaries of any of the three properties. The three non-perennial rivers drain into the Swart River which has been designated as CBA2, indicating that it is modified system, but is still important for meeting biodiversity targets. The lower reaches of the Swart River and the Kaaimans River and Estuary are more natural CBA1 areas. Management objectives associated with these biodiversity categories are provided in (Table 4).



Figure 4. The proposed development area to mapped conservation features of the Western Cape Biodiversity Spatial Plan (2017).

Table 4. Definitions and objectives for conservation categories identified in the Western Cape Biodiversity Spatial Plan (WCBSP, 2017).

WCBSP Category	Definition	Management Objective
Critical Biodiversity Area 1 (CBA1)	Areas in a natural condition that are required to meet biodiversity targets, for species, ecosystems or ecological processes and infrastructure.	Maintain in a natural or near-natural state, with no further loss of habitat. Degraded areas should be rehabilitated. Only low-impact, biodiversity-sensitive land uses are appropriate.
Critical Biodiversity Area 2 (CBA2)	Areas in a degraded or secondary condition that are required to meet biodiversity targets, for species, ecosystems or ecological processes and infrastructure.	Maintain in a natural or near-natural state, with no further loss of habitat. Degraded areas should be rehabilitated. Only low-impact, biodiversity-sensitive land uses are appropriate.

2.3.3 Strategic Water Source Area

The project area falls within the Outeniqua Strategic Water Source Area (SWSA) (Figure 2), which is considered to be of national importance. SWSAs are defined as areas of land that either:

- Supply a disproportionate (i.e. relatively large) quantity of mean annual surface water runoff in relation to their size and so are considered nationally important; or
- Have high groundwater recharge and where the groundwater forms a nationally important resource; or
- Areas that meet both criteria (a) and (b).

SWSAs are vital for water and food security in South Africa and also provide the water used to sustain the economy. Given this context, management and implementation guidelines have been developed with the objective of facilitating and supporting well-informed and proactive land management, land-use and development planning in these nationally important and critical areas (Le Maitre, et al., 2018). The primary principle behind this objective is to protect the quantity and quality of the water they produce by maintaining or improving their condition. The proposed development footprint falls within an urban ‘working landscape’ and in this context the management objectives are:

- To maintain at least the present condition and ecological functioning of these landscapes;
- To restore where necessary; and
- To limit or avoid further adverse impacts on the sustained production of high-quality water.

A key objective in the management of SWSAs is to ensure the quantity and quality of water within and flowing from SWSAs is protected from developments that cause unacceptable and irreparable impacts. Development of roads, parking areas and other impervious surfaces, along with wetland draining or infilling has the potential to change quantities of water in watercourses by intercepting, increasing, reducing or diverting flows from their normal path. Water quality can be impacted by flow-related alterations, particularly increased flows as this usually results in altered sediment transport causing scouring, sedimentation and increased turbidity due to suspended sediments. Especially during the construction phase. The operational phase of urban developments increases the risk of toxic hydrocarbons and other road-based pollutants as well as sewage from leaking or blocked drains or pump stations impacting on water quality.

3.3 Desktop Present Ecological State

The property are located in the catchment of the Swart River which feeds into the Kaaimans Estuary. According to DWS (2014), the PES of the Swart River is D (Largely Modified), which is largely attributable to the Garden Route Dam which significantly reduces natural flows in the lower reaches of the river (Table 5). Other contributing factors include encroachment of alien invasive vegetation (primarily *Acacia mearnsii* and *Eucalyptus*) and manipulation of the river channel associated with the construction of road crossings. The Kaaimans Estuary is fed by the Kaaimans and Swart rivers. Due largely to the contribution from the Kaaimans River (which is not flow regulated and in a Largely Natural condition), the PES of the Kaaimans Estuary is B (Largey Natural) and is considered a priority estuary in terms of biodiversity importance (Van Niekerk et al., 2019a). The Kaaimans Estuary is classified as a warm temperate – predominantly open system, which are poorly protected in South Africa and have a Vulnerable ecosystem threat status (Van Niekerk et al., 2019b).

It is therefore essential that development in the catchment area of the estuary is managed with the aim of maintaining and improving water quality in the estuary. In this respect, developments must not cause an increase in the concentrations of pollutants, nutrients and sediment loads into the estuary. Considering the intention to discharge treated wastewater into the Swart River, water quality Resource Quality Objectives (RQOs) that have been gazetted for the estuary are of relevance and included in Table 6.

Table 5: Present Ecological State, Ecological Sensitivity and Ecological Importance for the Swart and Kaaimans rivers.

River	Present Ecological State	Ecological Importance	Ecological Sensitivity
Swart River	D (Seriously Modified)	Moderate	High
Kaaimans River	B (Largely Natural)	Very High	Very High

Table 6: Resource quality objectives (RQOs) set for the Kaaimans River Estuary (Government Notice 1298 – Proposed Classes of Water Resource and Resource Quality Objectives for the Breede-Gouritz Water Management Area).

Indicator	RQO Narrative	RQO Numeric
Dissolved Inorganic Nitrogen (DIP)	Inorganic nutrient concentrations not to exceed TPCs for macrophytes and microalgae	< 100 µg/L
Dissolved Inorganic Phosphorus (DIN)		< 20 µg/L
Turbidity		< 10 NTU (low flow season)
Dissolved Oxygen	System variables not to exceed TPCs for biota	> 5 mg/L
Enterococci	Concentrations of waterborne pathogens should be maintained in an Acceptable category for full contact recreation	≤ 185 Enterococci/100 ml (90th percentile)
<i>Escherichia coli</i>		≤ 500 E. coli/100 ml (90th percentile)

3.4 Historical Assessment

Erf 25537 has undergone noticeable changes throughout the past 20 years (2000 to 2020 - Figure 5). Historically, the property was under pine plantations in the years leading up to 2005. In the years leading up to 2011, the pine plantations were cleared on all properties and the land has remained fallow since then. Noticeable revegetation of drainage areas with wetland and riparian vegetation has occurred since the removal of forestry plantations. An instream dam and two smaller offstream dams were constructed on the property between 2009 and 2010.



Figure 5. Historical photos showing Erf 25537 through notable changes between 2005 and 2025 (Google Earth imagery) – red circles indicate dams.

4. SITE ASSESSMENT

Several site visits were carried out during May and June 2024 during which time the entire extent of the proposed development footprint on the property was traversed by foot (Figure 6). At the time of the site visits the weather varied from overcast to clear. The topography of Erf 25537 is characterised by low undulating hills that slope steeply down to watercourses (mapped as non-perennial streams). All mapped watercourses within the property boundaries

were associated with wetland habitat (mapped as W2 to W4 – Figure 7). The soil on the properties varies from sandy loam with a hard clay layer (found at a depth 30 to 40 + cm) below the surface, to clay that is associated with the wetland areas on the property. Most of the vegetation on the site was mowed, making it difficult to accurately determine the edge of the wetland areas through use of vegetation indicators.



Figure 6: GPS track walked in relation to the proposed development site.



Figure 7: Watercourses mapped within the development area.

4.1 Watercourse Classification

The wetland systems are not obviously visible in historical imagery but generally followed distinct linear areas that were either sparsely planted with pine trees or were not planted at all (Figure 5). Given the distinct soil characteristics of the area (i.e. a coarsely textured A horizon overlying a clay enriched B horizon) lateral sub-surface flows down slopes is expected to be an important source of water to these wetlands. Pines consume high volumes of water and their presence on the adjacent slopes would have deprived the wetlands of lateral sub-surface flows, reducing the extent (i.e. width) and visible footprint of the wetland systems. These wetland systems have become more visible since the pine plantations have been cleared.

4.1.1 W2

W2 is situated near the southern corner of Erf 25537. The wetland is classified as a Channelled Valley Bottom (CVB) and is situated at the bottom of a very confined, steep valley which, together with the steeper gradient of the valley bottom, favours the formation of a clearly defined channel (approximately 3 m in width). The wetland receives stormwater flows from a culvert beneath Urbans Boulevard (Figure 8). A narrow band of wetland vegetation lines either side of the channel dominated by species that include *Cyperus textilis*. Flow through the channel is seasonal following heavy downpours or periods of sustained rainfall. Lateral seepage from surrounding catchment area will sustain soil saturation along the banks for prolonged periods of time. Mottling observed in the auger samples indicates that the wetland is permanent to seasonal.

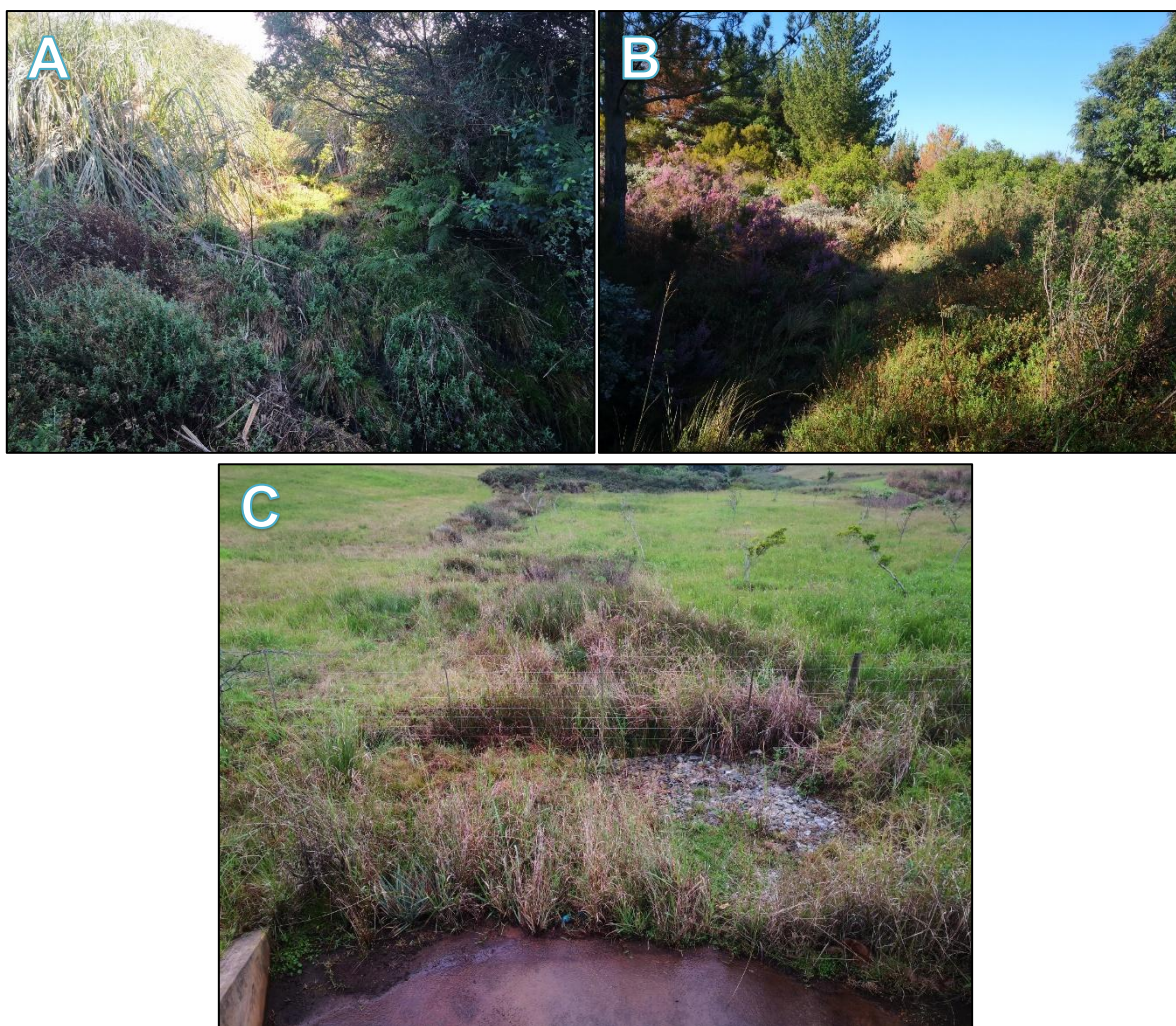


Figure 8: Photographs of W2 illustrating well vegetated channel (A and B) and a culvert from Urbans Boulevard discharging towards W2 (C).

4.1.2 W3

W3 is situated below an instream dam that captures stormwater runoff from a culvert beneath Urbans Boulevard and surface runoff from the sloped catchment area. The wetland receives concentrated surface flows when the dam overflows (via spillways located on either end of the dam wall) but is also sustained by lateral sub-surface flows from the adjacent steep slopes – as indicated by distinct mottling in the soil profile where vegetation is currently mowed. Dominant wetland plant species include *Cliffortia odorata* while the outer, seasonal margins of the wetland were characterised by *Centellas sp*, *Juncus effusus*, *Hypoxis sp.*, *Fuirena hirsuta* (Figure 9). Of notable concern is a significant headcut erosion gulley towards the lower end of the wetland which has resulted in an eroded channel, approximately 3 m lower than the elevation of the bed of the wetland. The erosion has revealed a clear profile of the soil and it is evident that the wetland was historically infilled with waste from the sawmill (e.g. planks, saw dust, metal bars etc.). Increased stormwater flows originating from Urbans Boulevard could have caused the initial erosion of the channel, which over time is likely to have deepened and moved further upstream in the direction of the dam. The channelled wetland area upstream of the dam is artificial and is sustained by stormwater flows from Urbans Boulevard.

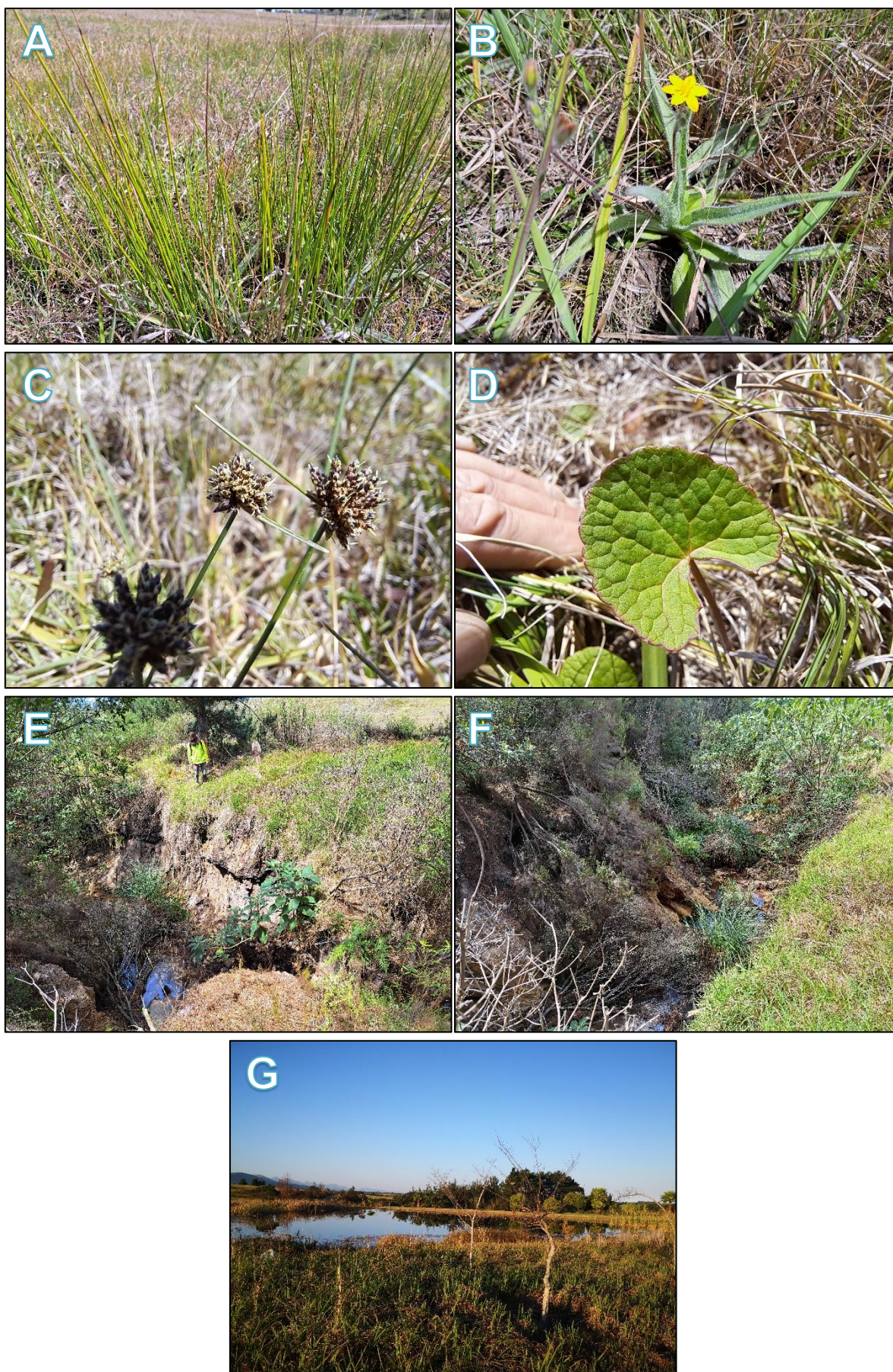


Figure 9: Wetland vegetation along the margins of W4 including *Juncus effusus* (A); *Hypoxis* sp. (B); *Fuirena hirsuta* (C); *Centellas* sp. (D); severely eroded channel (E & F); dam in upper reaches (G).

4.1.3 W4

W4 is a hillslope seep wetland situated in the upper slopes of the northern most watercourse. It extends from a mowed section of the slope and as the gradient flattens out slightly it broadens at the head of a valley, with a distinct zone of seasonally saturated soils dominated by *H. cymosum*, and *N. ivifolia* and a small patch of *Phragmites australis*. The gradient drops steeply down into the valley where a more well defined non-perennial stream channel develops. The seep wetland extends along the northern slopes of the valley and was characterised by saturated soils and a noticeable change in vegetation from typical fynbos species to wetland species where *H. cymosum* and *Schoenus sp.* were prominent. The entire extent of the seep was not mapped in detail, but it is expected that it will stretch further east along the valley, following along the line of the steep south-facing slopes.

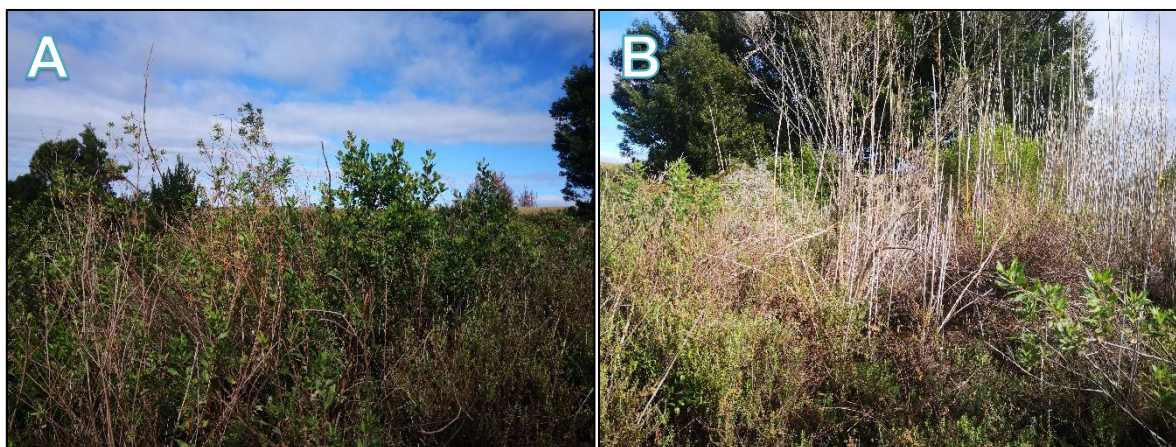


Figure 10: Wetland vegetation associated with the seep, including *Nidorella ivifolia* (A); and *Phragmites australis* (B).

5. AQUATIC ASSESSMENT

5.1 Present Ecological State

5.1.1 W2

- Receives stormwater runoff from Urbans Boulevard and from the Sasol petrol station, which has most likely contributed to a transition from an unchannelled to a channelled valley bottom wetland.
- Infilling has occurred along the southern bank of the wetland which has resulted in a more confined valley and has reduced the width of the wetland.
- Minor invasion by invasives along the length of the wetland (most notably by Pampas grass – *Cortaderia selloana* – further downstream)
- **PES: D (Largely Modified)** – Table 7

Table 7: Present Ecological State (PES) of W2.

Final (adjusted) Scores				
PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	6.3	5.2	1.2	4.0
PES Score (%)	37%	48%	88%	60%
Ecological Category	E	D	B	D
Trajectory of change	↑	↑	↑	
Confidence (revised results)	Medium	Not rated	Not rated	Not rated
Combined Impact Score	4.9			
Combined PES Score (%)	51%			
Combined Ecological Category	D			

5.1.2 W3

- The dam captures stormwater runoff from Urbans Boulevard which on the one hand protects the wetland from an increase in hydrological energy. On the other hand, the dam also captures natural surface runoff that would ordinarily have flowed into the wetland and base flow through the wetland will most likely have reduced.
- Flood peaks through the wetland have increased due to overflows from the dam which result in the transmission of high volume, high energy flows into the channel. This has caused channel incision in the upper reaches of the wetland (immediately below the dam wall). These flood peaks have also contributed to the severe headcut erosion gulley further downstream which has resulted in a transition to a severely eroded, incised channel with no wetland features.
- Historical infilling of the wetland with sawmill waste has occurred.
- Vegetation within the seasonal zone has been mowed (resulting in reduced surface roughness within the delineated wetland area and dominance of grassy species). There is minor invasion by alien invasives (e.g. *Pinus sp.* *A. melanoxylon* and *A. mearnsii*).
- PES: D (Largely Modified) – Table 8.**

Table 8: Present Ecological State (PES) of W3.

Unadjusted (modelled) Scores				
PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	6.1	3.2	1.0	5.0
PES Score (%)	39%	68%	90%	50%
Ecological Category	E	C	A	D
Combined Impact Score	4.6			
Combined PES Score (%)	54%			
Combined Ecological Category	D			

5.1.3 W4

- Minor impacts related to increased water inputs from adjacent roads and reduction in catchment roughness due to mowed vegetation.
- Minor levels of invasion by alien invasives (most notably *A. mearnsii*).

- **PES: C (Moderately Modified) – Table 9.**

Table 9: Present Ecological State (PES) of W4.

Unadjusted (modelled) Scores				
PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	2.9	2.3	0.9	2.3
PES Score (%)	71%	77%	91%	77%
Ecological Category	C	C	A	C
Combined Impact Score	2.2			
Combined PES Score (%)	78%			
Combined Ecological Category	C			

5.2 Ecological Importance and Sensitivity

5.2.1 W2

Small size, intermittent flows and low habitat diversity offers limited biodiversity support and landscape scale features. The wetland is sensitive to changes in water quality and flow (

- Table 10);
- Channelled valley bottom characteristics provide moderate pollutant assimilation capabilities (Table 11);
- No direct human benefits in terms of resources (i.e. water for abstraction, harvestable materials, tourism etc.) (Table 12).
- **EIS is Moderate.**

5.2.2 W3

Small size, intermittent flows and low habitat diversity offers limited biodiversity support and landscape scale features. The wetland is sensitive to changes in water quality and flow (

- Table 10);
- Channelled valley bottom characteristics provide moderate pollutant assimilation capabilities (Table 11);
- No direct human benefits in terms of resources (i.e. water for abstraction , harvestable materials, tourism etc.) (Table 12).
- **EIS is Moderate**

5.2.3 W4

Small size, intermittent flows and low habitat diversity offers limited biodiversity support land landscape (

- Table 10).
- Channelled flow characteristics results in comparatively fast flows through the system and together with the narrow extent of wetland habitat, attenuation, regulation and assimilation capacity is low (Table 11).
- No direct human benefits in terms of resources (i.e. water for abstraction, harvestable materials, tourism etc.) (Table 12).
- **EIS is Moderate.**

Table 10. Ecological Importance and Sensitivity criteria for the wetland.

Ecological Importance and Sensitivity	W2	W3	W4
Biodiversity Support			
Presence of Red Data species	0	0	0
Populations of unique species	0	0	0
Migration/feeding/breeding sites	0	0	1
Average	0	0	0.33
Landscape Space			
Protection status of wetland	0	0	0
Protection status of vegetation type	0	0	4
Regional context of the ecological integrity	1	1	1
Size and rarity of the wetland types present	1	1	1
Diversity of habitat types	1	1	1
Average	0.6	0.6	1.4
Sensitivity of Wetland			
Sensitivity to changes in floods	3	3	1
Sensitivity to changes in low flows	2	2	1
Sensitivity to changes in water quality	1	1	1
Average	2	2	1
ECOLOGICAL IMPORTANCE AND SENSITIVITY	2 (Moderate)	2 (Moderate)	1.4 (Moderate)

Table 11: Hydro-functional importance of the wetland.

Hydro-functional Importance		W2	W3	W4	
Regulating & supporting benefits	Flood attenuation		1	1	2
	Streamflow regulation		1	1	2
	Water quality enhancement	Sediment trapping	2	2	2
		Phosphate assimilation	2	2	2
		Nitrate assimilation	2	2	2
		Toxicant assimilation	2	2	2
		Erosion control	1	1	2
	Carbon storage		1	1	2
HYDRO-FUNCTIONAL IMPORTANCE		1.5 (Moderate)	1.5 (Moderate)	2 (Moderate)	

Table 12: Direct human benefit importance of the wetland.

Direct Human Benefits		W2	W3	W4
Subsistence benefits	Water for human use	0	0	0
	Harvestable resources/cultivated foods	0	0	0
Cultural benefits	Cultural heritage	0	0	0
	Tourism and recreation Education and research	0	0	1
DIRECT HUMAN BENEFITS		0 (Low)	0 (Low)	0.25 (Low)

6. BUFFER

Buffer determination considered the implementation of mitigation measures specified in the impact assessment below and was determined based on catchment and buffer characteristics listed in Table 13. Based on these inputs the buffer for the wetland is set to 15 m (Figure 11). The development has been adapted to accommodate the buffer throughout.

Table 13: Input parameters used to determine buffer widths for watercourses.

Parameter	Value
MAP	Up to 1000
Rainfall Intensity	70.9 – Zone 4 (Very High)
Soil SCS	A/B
Slope of Catchment	Gentle (2 – 10 %)
Slope of Buffer	Moderate (10 -20 %)
Soil erosion potential	0.74 (Very High)
Vegetation Characteristics	Fair
Soil Permeability	Low
Buffer Width	15 m

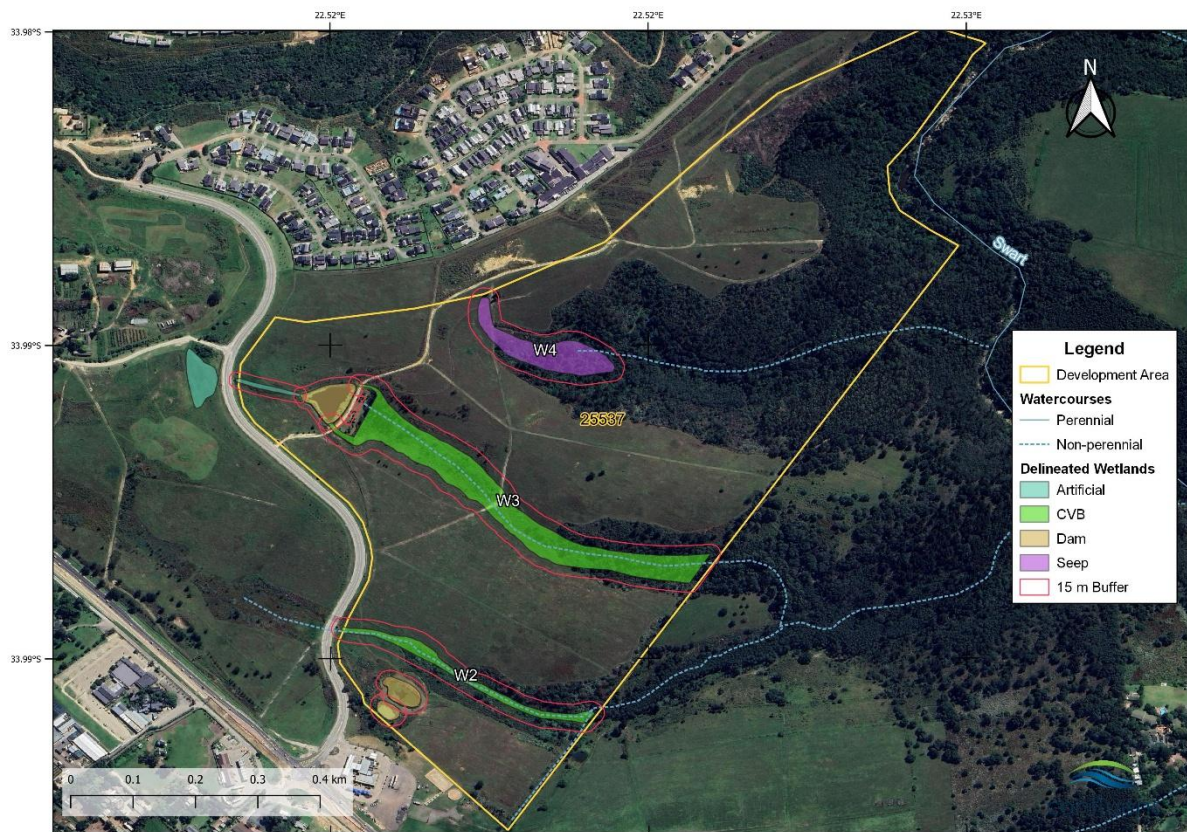


Figure 11: Map showing wetlands and recommended 15 m buffer area.

7. THE PROPOSED DEVELOPMENT

The development involves the construction of the Meulenzicht Landgoed bordered by Urbans Boulevard along the north-west (Figure 12). Meulenzicht Landgoed will comprise primarily of full title residential erven and a wastewater treatment plant that will service Meulenzicht as well as Oumeulen Village (west of Urbans Boulevard). Multiple roads, stormwater, sewage and water supply infrastructure will also need to be constructed. The treatment plant will discharge treated wastewater into W2.

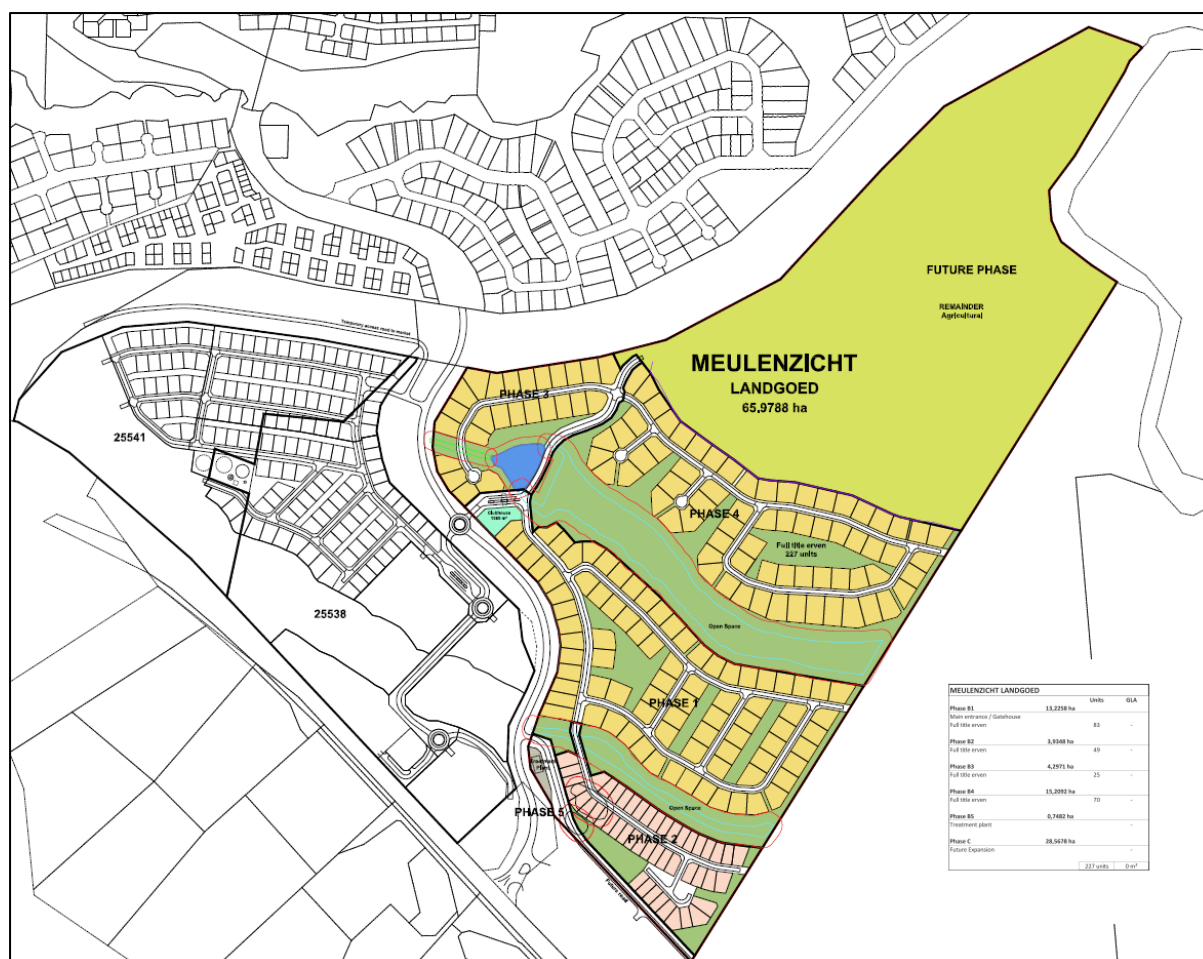


Figure 12: The latest site development plan (SDP) for Meulenzicht Landgoed.

7.1.1 Stormwater

- Limited stormwater detention/attenuation has been incorporated into the stormwater management plan and post-development flows for both estates will increase relative to pre-development flows (Table 14).

Table 14: Pre- and post-development runoff (m^3/s) for Meulenzicht Landgoed (Lyners, 2025).

Return Interval	Meulenzicht	
	Pre	Post
2	0.94	1.58
5	1.36	2.02
10	1.98	2.89
20	2.52	3.40
50	4.20	5.09
100	6.47	6.15

- Discharge headwalls at the ends of pipes will be equipped with stilling basins and erosion protection to decrease storm water velocities, spread the flows and prevent erosion at the outlets (Figure 13). These headwall outlets discharge into the buffer of wetland areas and will not be constructed within the delineated area of any wetland.

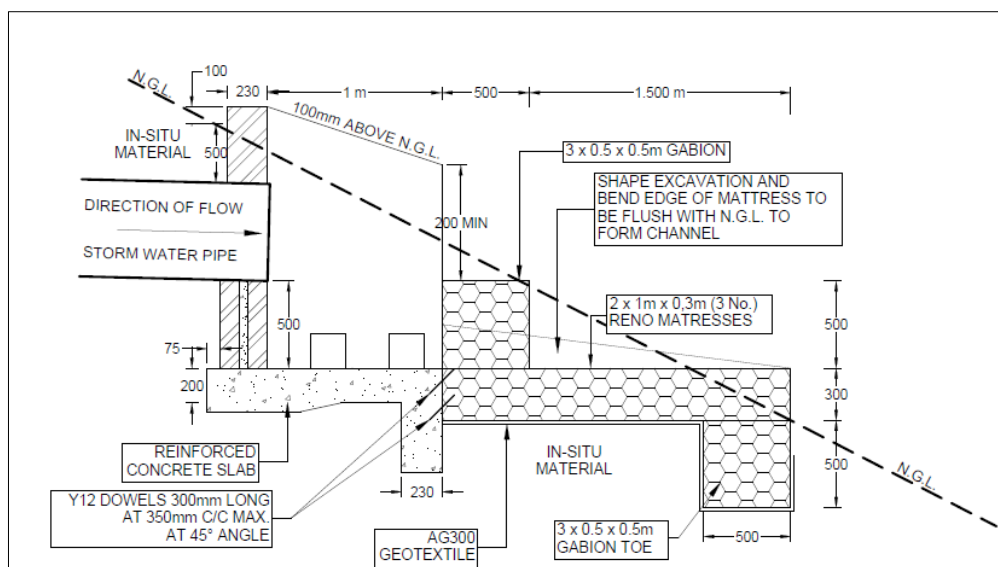


Figure 13: Section of proposed headwall outlets including stilling basins and erosion protection (Lyners, 2025).

7.1.2 Road Crossings

- Roads crossing watercourses will incorporate a 300 mm thick gabion reno mattress to a) achieve a stable roadbed and b) to allow baseflows to permeate through the crossing unimpeded. Culverts situated above the mattress will allow stormwater flows to pass through the crossing (Figure 14).

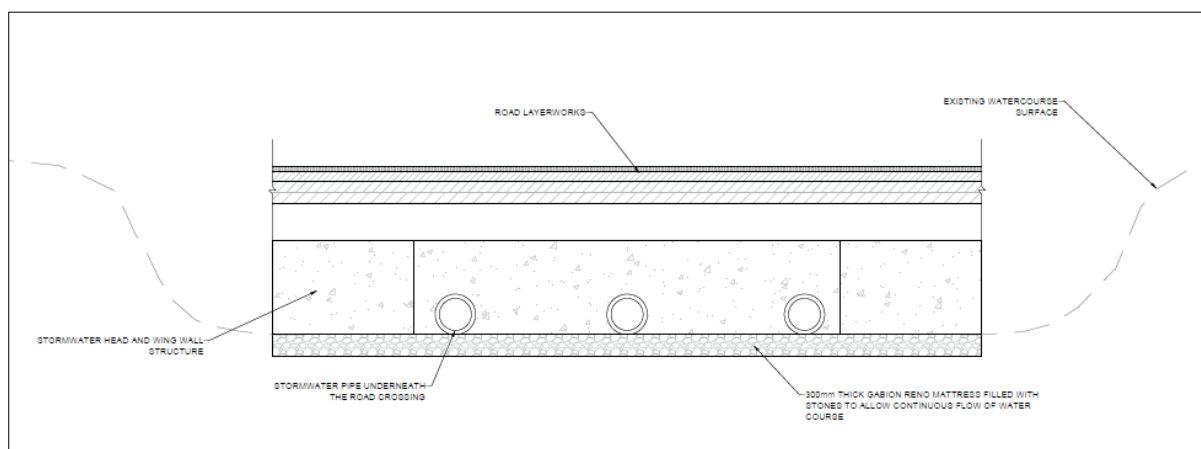


Figure 14: Typical detail of road stream crossing (Lyners, 2025).

7.1.3 Sewage

- The applicant will design, implement, operate and maintain a 360 kL on-site wastewater treatment package plant (Alveo Water Membrane Bioreactor) situated along the western perimeter of the Meulenzicht Landgoed.
- The internal sewer system will drain to localized small sewer pumpstations (5 in total located along the eastern perimeter of the development) that will pump to the proposed 360kL sewer package plant for wastewater treatment of the development.
- Sewer lines will cross several watercourses and will be buried beneath the bed of the watercourse and encased in concrete (Figure 15).

- The treated effluent will either be discharged into the W2 or reused for irrigation purposes on open green spaces.
- The wastewater will be treated to the Department of Water and Sanitation's General Discharge Limits (Table 15).

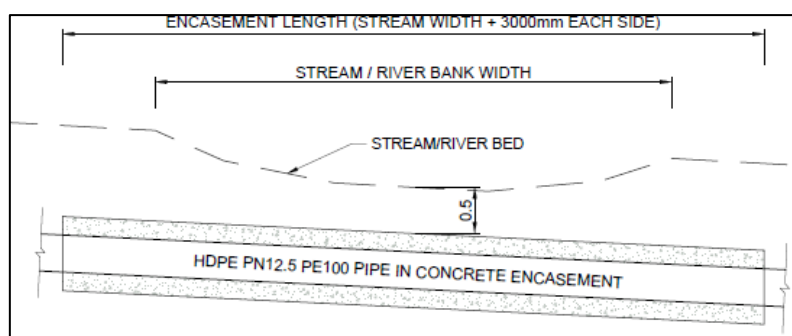


Figure 15: Longitudinal section of sewage pipelines crossing a watercourse (Lyners, 2025).

Table 15: DWS general limits for wastewater discharge.

Parameter	Concentration
COD	75 (mg COD/l)
Ammonia as Nitrogen	6 (mg N/l)
Nitrate as Nitrogen	15 (mg N/l)
Orthophosphates	10 (mg P/l)
Total Suspended Solids	25 (mg TSS/l)
Faecal Coliform	1000 (per 100 mL)

8. IMPACT ASSESSMENT

8.1 Layout & Design Phase

Certain aspects of the development require careful consideration prior to construction so as to minimise impacts during the operational phase. This is most relevant for the design of road crossings and stormwater infrastructure.

Impact 1: Alteration of hydrogeomorphological characteristics caused by constriction of flow at road crossings

Road crossings alter flow hydrodynamics and can impact the natural hydrogeomorphological attributes of a watercourse. Culverts are incorporated into the design to allow surface flows beneath the road. Culverts can result in the constriction of flow which could:

- Create a barrier to flow and sediment transport, which can potentially lead to inundation of habitat upstream of the road, leading to formation of permanently saturated and inundated areas
- Lead to more concentrated flow downstream of the road crossing, leading to scouring, erosion incision of the channel.
- Lead to erosion around culvert and wash out of the road.

	Without Mitigation	With Mitigation
Intensity	High	Moderate
Duration	Ongoing	Ongoing
Extent	Limited	Very limited
Probability	Almost certain	Unlikely

Significance	-78: Moderate	-33: Negligible
Reversibility	Medium	High
Irreplaceability	Medium	Low
Confidence	High	High
Mitigation: - Crossings must facilitate free flow of surface and subsurface water and no ponding or inundation of wetland habitat must occur upstream of road crossings; - Culverts beneath road crossings must be appropriately sized (i.e. must be sized according to the natural width of the channel) and must not result in concentrated, high energy flow downstream of the crossing. Stormwater flows must not be channelled to a narrower section of the channel. In this respect box culverts are recommended. - Stream bed and bank protection must be incorporated below road crossings.		

Impact 2: Channel erosion and incision caused by increased stormwater inputs into wetlands.

The scale of the development and the associated increase in area of impervious surfaces (roads, building etc.) will result in the generation of significant volumes of stormwater. Energy dissipation and erosion protection has been incorporated into the design of stormwater headwall outlets to prevent erosion at outlets.

Additional stormwater input into each of the wetlands will increase flow rates and flood peaks which can lead to erosion of the bed and banks and channel incision. This is a common problem in urban rivers and wetlands throughout George and the severe effects of stormwater on the ecological condition of watercourses is already evident in W3 (as described in Section 4.1.2). High rates of erosion in the catchment area also affect sensitive downstream habitat. In this respect the Kaaimans Estuary is under increasing pressure from urban developments in the Swart River catchment area.

Post development stormwater runoff is expected to increase and represents a Very High intensity of impact to water resources within the development area and to the Kaaimans Estuary. While energy dissipation at headwall outlets can mitigate against erosion of the embankments (at the point of discharge) – accumulated flow volumes within the channel will have a high likelihood of eroding and incising the channel of watercourses. This impact can only be mitigated by implementing Sustainable Drainage Systems (SuDS) on site aimed at encouraging attenuation and infiltration of water within the development prior to discharge into watercourses.

	Without Mitigation	With Mitigation
Intensity	Very High	Moderate
Duration	Ongoing	Ongoing
Extent	Local	Limited
Probability	Almost Certain	Probably
Significance	-90: Moderate	-48: Minor
Reversibility	Medium	High
Irreplaceability	Medium	Low
Confidence	High	High

Mitigation::

- Implementation of additional SuDS measures is required to attenuate stormwater onsite and reduce stormwater impacts to an appropriate level. It is recommended that the stormwater management plan for the development should align with the City of Cape Town urban stormwater impacts policy which requires 24 hour extended detention of the 1-year return

interval, 24-hour storm event. In addition to rainwater harvesting (which will be implemented as part of the stormwater management plan) the following must, *inter alia*, be considered:

- Swales and detention ponds can be incorporated into the open space network to attenuate stormwater runoff, encourage infiltration and reduce the speed, energy and volumes at which stormwater is discharged from the site;
- Use of permeable paving to encourage infiltration into the soil; and
- Use of retention ponds and artificial wetlands to capture stormwater runoff and prevent its discharge from the site.
- The headcut erosion in W3 must be rehabilitated according to the plan prescribed in Section 9 to prevent any further loss of wetland habitat. The following mitigation measures must be implemented during rehabilitation:
 - A single access point must be utilised to access the rehabilitation area;
 - Rehabilitation must be planned for the dry season to minimise the potential for floods to flow through the rehabilitation area during construction;
 - The filled area must ensure a continuous streambed profile with no sudden drops in elevation;
- The rehabilitated area must be inspected at least once a month and after any rainfall event exceeding 10 mm. Any signs of erosion must be addressed immediately.

Impact 3: Loss of wetland habitat due to construction of built infrastructure.

Transformation of wetland habitat is limited to road crossings. All other infrastructure will be located outside of the delineated area of each wetland or will be limited to a temporary disturbance (i.e. installation of sewage pipelines crossing wetlands). Apart from the access road to Phase A8, all infrastructure will be located outside of the designated buffer area.

	Without Mitigation	With Mitigation
Intensity	Low	Very Low
Duration	Permanent	Permanent
Extent	Very Limited	Very limited
Probability	Likely	Unlikely
Significance	-50: Minor	-30: Negligible
Reversibility	High	High
Irreplaceability	Low	Low
Confidence	High	High

Mitigation:

- Recommended buffers for each wetland must be clearly demarcated and indicated as No-Go areas. Access into buffer areas is only permitted for construction of stormwater and sewage infrastructure and road crossings.
- The access road to Phase A8 must remain outside of the delineated area of the wetland.
- Buffer areas must not be converted to lawns and must not be mowed.
- Indigenous vegetation must be allowed to re-establish within buffer areas and an alien invasive plant management plan must be drafted and implemented to control alien plant species in buffers and in delineated wetland areas.

8.2 Construction Phase

Impact 4: Erosion and sedimentation of wetland habitat caused by clearance of the site.

Clearance of vegetation to commence with construction of buildings and roads will expose bare soil which can erode and cause sedimentation of watercourses. This impact is particularly relevant for W2 to W4 which are located at the base of, or along steep slopes.

	Without Mitigation	With Mitigation
Intensity	High	Low
Duration	Short term	Brief
Extent	Limited	Limited
Probability	Almost Certain	Probably
Significance	-60: Minor	-28: Negligible
Reversibility	High	High
Irreplaceability	Low	Low
Confidence	High	High

Mitigation:

- Ensure that construction activities do not cause any preferential flow paths and concentrated surface runoff during rainfall events.
- Clearly demarcate the construction area and ensure that heavy machinery does not compact soil or disturb vegetation outside of these demarcated areas.
- Reduce transport of sediment through use of structures such as silt fences and biodegradable coir logs placed along the contour below the development footprint.
- Ensure that vegetation clearing is conducted in parallel with the construction progress to minimise erosion and runoff.
- Revegetate exposed areas once construction has been completed.
- Ensure that stormwater and runoff generated by hardened surfaces is discharged in retention areas (i.e. swales or retention ponds), to avoid concentrated runoff and associated erosion.
- Stockpiling must take place outside of the wetland areas and associated buffers. All stockpiles must be protected from erosion, surrounded by bunds and stored on flat areas where run-off will be minimised; and
- Recommended buffers for each wetland must be clearly demarcated and indicated as No-Go areas. Access into buffer areas is only permitted for construction of stormwater and sewage infrastructure and road crossings.



Figure 16: Examples of silt fences (left) and coir logs (right) used to trap sediment mobilised from steep slopes.

Impact 5: Disturbance and pollution of wetland habitat caused by construction activities.

The site is large and will result in the construction of a variety of infrastructure, including residential units, internal roads, sewage infrastructure, stormwater infrastructure, water reticulation network etc. This will result in high numbers of vehicles and construction workers on site and high quantities of construction materials brought onto the site. Laydown areas and stockpiles of construction materials and excavated topsoil will be required. Poor management of construction activities on site can result in physical disturbance of aquatic habitat and pollution through leaks and spills of hydrocarbons (i.e. fuel and oil from construction vehicles and machinery, bitumen for road surfacing etc.) and other construction materials (e.g. cement, paint etc.) The cumulative intensity of impact of these activities on wetland and river habitat can be significant.

	Without Mitigation	With Mitigation
Intensity	High	Low
Duration	Medium Term	Short Term
Extent	Limited	Limited
Probability	Likely	Unlikely
Significance	-55: Minor	-24: Negligible
Reversibility	High	High
Irreplaceability	Medium	Low
Confidence	High	High

Mitigation:

- Recommended buffers for each wetland must be clearly demarcated and indicated as No-Go areas. Access into buffer areas is only permitted for construction of stormwater and sewage infrastructure and road crossings.
- Restrict vehicle access to single points that are clearly demarcated;
- Working areas must be clearly demarcated and no vehicle access or disturbance must take place outside of demarcated areas;
- Excavators and all other machinery and vehicles must be checked for oil and fuel leaks daily. No machinery or vehicles with leaks are permitted to work in wetlands;
- No fuel storage, refuelling, vehicle maintenance or vehicle depots to be allowed within the buffer of the watercourse; and
- Refuelling and fuel storage areas, and areas used for the servicing or parking of vehicles and machinery, must be located on impervious bases and should have bunds around them (sized to contain 110 % of the tank capacity) to contain any possible spills;

- Contractors used for the project should have spill kits available to ensure that any fuel or oil spills are clean-up and discarded correctly;
- Adequate sanitary facilities and ablutions on the servitude must be provided for all personnel throughout the project area. Use of these facilities must be enforced (these facilities must be kept clean so that they are a desired alternative to the surrounding vegetation) and must be routinely serviced;
- No dumping of construction material on-site may take place;
- An alien invasive plant management plan needs to be compiled and implemented post construction to prevent the growth of invasives on cleared areas

Impact 6: Disturbance of habitat caused by the construction of sewer pipelines and stormwater infrastructure.

Sewage pipelines will run along low points immediately adjacent and across wetlands. While the wetlands are moderately to largely modified, it is important that construction of these linear structures is planned so that the hydro-functional attributes of the wetlands is maintained.

	Without Mitigation	With Mitigation
Intensity	High	Moderate
Duration	Medium Term	Brief
Extent	Limited	Very Limited
Probability	Certain	Certain
Significance	-77: Moderate	-49: Minor
Reversibility	High	High
Irreplaceability	Low	Low
Confidence	High	High

Mitigation:

- Recommended buffers for each wetland must be clearly demarcated and indicated as No-Go areas. Apart from pipelines crossing watercourses, all pipelines must remain outside of designated buffer areas.
- The location and alignment of all proposed infrastructure crossing wetlands must be clearly demarcated prior to the start of construction activities so as to minimise unnecessary impacts to wetland habitat;
- Soil excavated for the trench for the stormwater and sewage pipelines must be stockpiled along the outer edge of the trench furthest away from the wetland. Topsoil must be separated from subsoil and stockpiled separately;
- The trench must be filled (first with subsoil and then with topsoil) and reshaped to original contours such that no preferential flow paths are created;
- The backfilled trench and any other disturbed areas must be re-vegetated using an appropriate indigenous fynbos grassland mix. Temporary erosion control must be placed along the trench alignment until such time as vegetation has re-established;
- Cement/concrete used in the construction must not be mixed on bare ground or within the wetland or buffer area. An impermeable/bunded area must be established in such a way that cement slurry, runoff and cement water will be contained and will not flow into the surrounding environment, the stream or riparian zone or contaminate the soil;
- The watercourse must be inspected on a regular basis (at least weekly) by an appropriately qualified ECO for signs of disturbance, sedimentation and pollution during the construction phase. If signs of disturbance, sedimentation or pollution are noted, immediate action should

be taken to remedy the situation and, if necessary, a freshwater ecologist should be consulted for advice on the most suitable remediation measures; and

- Disturbed areas must be kept clear of alien vegetation and must be actively reshaped to natural contours and rehabilitated with indigenous, local vegetation.

Impact 7: Closure of offstream dams on aquatic biodiversity

The two offstream dams located towards the south of the development are planned to be closed. While these dams are aesthetically attractive features that provide habitat for limited bird species and aquatic biota, their closure is not considered a major loss of aquatic biodiversity.

	Without Mitigation	With Mitigation
Intensity	Low High	Very Low Moderate
Duration	Brief Medium term	Brief
Extent	Very Limited	Very Limited
Probability	Certain	Certain
Significance	-42: Minor -77: Moderate	-35: Negligible -49: Minor
Reversibility	High	High
Irreplaceability	Low	Low
Confidence	High	High

Mitigation:

- An opening in the wall of the dams must be made to allow water to slowly exit the dam in a controlled manner. This is to allow any aquatic biota (especially amphibians) to migrate from the dam prior to infilling.
- The dams must ideally be emptied during the winter season (from May to September outside of the breeding season for most biota) at least 3 weeks prior to infilling the dams.
- A survey of fish species occurring in the dams is recommended. Alien invasive or extra-limital indigenous fish species must not be translocated to alternative natural or artificial habitats and must be euthanised using appropriate ethical methods.
- Dams must be slowly emptied to allow existing biota .

8.3 Operational Phase

Impact 8: Impairment of water quality caused by increased stormwater inputs.

Vehicles, gardens and maintenance activities will result in increased runoff of fertilizers, pesticides and hydrocarbons. Intentional disposal of chemicals and other household products (e.g. paint) into the stormwater intentionally discarded into stormwater drains can also have a significant effect on water quality. Implementation of a SuDS principles can mitigate this impact through increased attenuation and filtration of pollutants on site (prior to discharge into the environment).

	Without Mitigation	With Mitigation
Intensity	Moderate	Low
Duration	Ongoing	Ongoing
Extent	Limited	Limited
Probability	Almost certain	Probably

Significance	-72: Minor	-44: Minor
Reversibility	High	High
Irreplaceability	Low	Low
Confidence	High	High
Mitigation: - Implementation of SuDS as recommended for Impact 2 will also help to improve water quality. - Guidelines for residents must be drawn up that prohibit dumping of hazardous materials into stormwater drains.		

Impact 9: Impairment of water quality caused by discharge of treated sewage effluent into W2

Treated effluent will be discharged into W2, which joins the Swart River and ultimately the Kaaimans Estuary. Flows in the Swart River are highly regulated due to the Garden Route Dam and dilution capacity in the Swart River is therefore reduced. Data on flows in the Swart River were not available at the time of compiling this report. The impact of effluent discharge from the package plant on water quality in the Swart River is dependent on the dilution capacity of the Swart River. This in turn is dependent on the volumes of water that are released from the Garden Route Dam in order to satisfy the reserve of the Swart River and Kaaimans Estuary. It is likely that some assimilation of pollutants will occur along W2 and further downstream after the confluence with W3. The ability of these wetland systems to assimilate pollutants is however dependent on maintaining their existing hydro-functional attributes.

The most serious impacts are generally associated with leaks due to blocked pipelines, malfunctioning pump stations or operational problems at the package plant. Monitoring and maintenance of the package plant and associated infrastructure (pump stations in particular) are essential to ensuring that impacts are mitigated to an appropriate level.

	Without Mitigation	With Mitigation
Intensity	Very High	High
Duration	Ongoing	Ongoing
Extent	Municipal Area	Municipal Area
Probability	Likely	Likely
Significance	-80: Moderate	-75: Moderate
Reversibility	High	High
Irreplaceability	Low	Low
Confidence	Low	Low

Mitigation:

- Re-use of treated wastewater (e.g. for irrigation of landscaped areas and open space areas) must be prioritised so as to minimise discharge of wastewater into the watercourse;
- The efficacy of the WWTP will rely on routine maintenance. A maintenance schedule for the package plant must be drafted and implemented;
- A signed service level agreement between the developer and a qualified service provider must be provided as a condition of authorisation;
- On-site operator must be thoroughly trained by the service provider and must be monitored in the operation of the plant for the first 3 months;
- A water quality monitoring plan must be compiled and must include the following:
 - Monitoring and analysis of treated effluent (prior to discharge into the watercourse) for all water quality parameters specified in the General Limit must be performed

weekly during the first 3 months in order to ensure the plant is functioning optimally. Thereafter samples must be collected and analysed every two weeks.

- TSS and pH must be measured at the effluent outlet daily using a calibrated handheld water quality meter. Any variations beyond the General Limit must be used to prompt an immediate response and appropriate corrective measures.
- All water quality parameters specified in the General Limit must be analysed in a sample collected directly from W3. Samples must be collected at the lower end of W3 near the eastern perimeter of the property.
- Pump Stations:
 - All pump stations must be inspected every second week for any signs of leaks or failure. A register of inspections and the status of each pump station must be maintained;
 - A contingency plan for load-shedding must be included in the design of the sewage network. Alternatively, each pump station must be provided with emergency storage to cater for a 4-hour power interruption; and
 - A maintenance plan for all pump stations must be drafted and implemented.
- Service level agreements, monitoring and maintenance plans must be audited on an annual basis.

8.4 Cumulative Impacts

Impact 10: Deterioration in water quality caused by increased stormwater flows and sewage infrastructure.

Cumulative impacts are primarily related to increased stormwater flows, sediment delivery and water quality deterioration in the Swart River catchment due to rapidly expanding high density developments in the catchment area. While the Swart River is relatively degraded, it does discharge into the Kaaimans Estuary which is considered Largely Natural (PES B). The cumulative impacts of development in the Swart River catchment are significant and pose a serious risk to the ecological health of the Kaaimans Estuary and to recreational users of the estuary. An example of this can be observed in Figure 17, which shows highly turbid water from the Swart River mixing with the Kaaimans Estuary during a high rainfall event.



Figure 17: Photograph showing highly turbid water from the Swart River mixing with the Kaaimans Estuary during a flood event in November 2023 (Photo: J. Dabrowski).

	Without Mitigation	With Mitigation
Intensity	High	Moderate
Duration	Ongoing	Ongoing
Extent	Municipal Area	Municipal Area
Probability	Certain	Probably
Significance	-105: Moderate	-56: Minor
Reversibility	Medium	High
Irreplaceability	Medium	Low
Confidence	High	High

Mitigation:

- Developments in the catchment area must incorporate SuDS as part of the stormwater management plan. It is recommended that plans should align with the City of Cape Town urban stormwater impacts policy which requires 24 hour extended detention of the 1-year return interval, 24-hour storm event;
- The assimilative capacity of the Swart River must be determined (taking flow releases from the Garden Route Dam into account) to determine whether effluent discharge can be adequately diluted.

9. REHABILITATION PLAN

The headcut erosion in the lower reaches of W3 must be rehabilitated to prevent any further erosion to the wetland. The following plan has been proposed:

- The rehabilitation work will consist of filling the donga with large rocks of size 300mm diameter below the stream bed (Figure 18).
- A layer of 300mm thick topsoil will be placed and compacted on top of the rock fill. A mixture of endemic, indigenous grass seeds will be placed in the topsoil layer to quickly establish vegetation and reduce the risk of future erosion. Additional wetland plant species that must be planted include the following:
 - *Cliffortia odorata*
 - *Helichrysum cymosum*
 - *Juncus effusus*
 - *Cyperus textilis*
 - *Nidorella ivifolia* (along the drier margins)
- Gabion structures will be placed along the rehabilitated area to reduce the stormwater flow velocity and to assist with sediment build up (Figure 19).

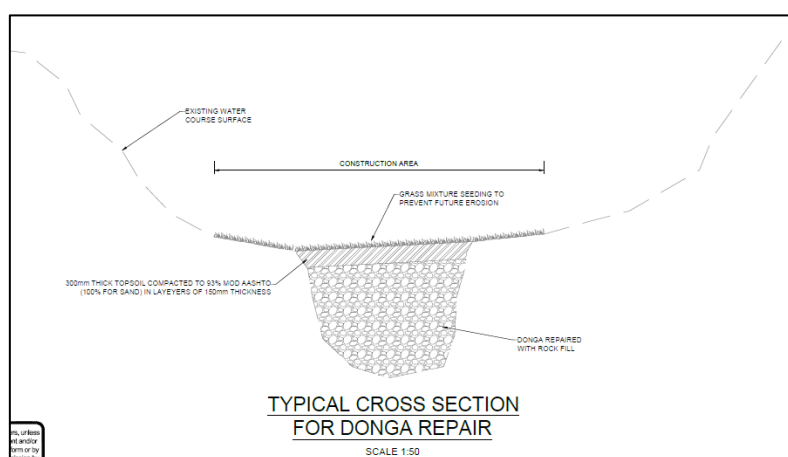


Figure 18: Cross-section of proposed rehabilitation works for W3.

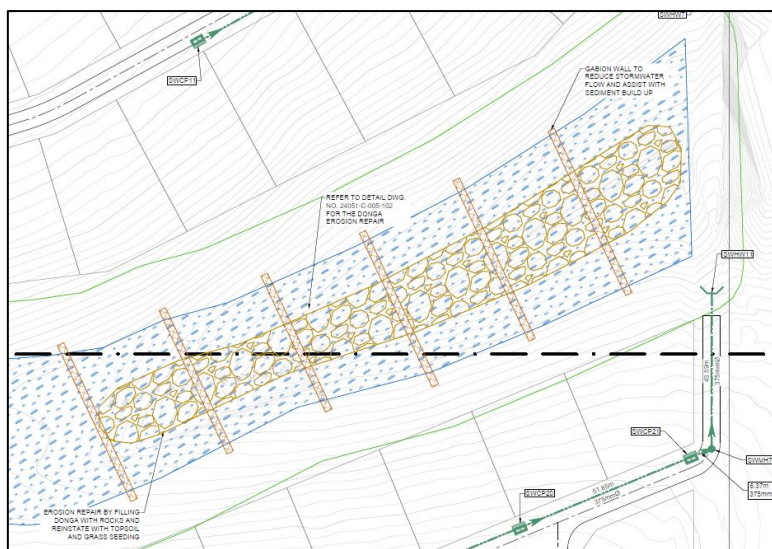


Figure 19: Plan view of the proposed rehabilitation works for W3.

10. WATER USE AUTHORISATION

A sewage package plant will be constructed as part of the development. According to GN 4167 of 2023, any Section 21 (c) and (i) water use (i.e. discharge of wastewater into a watercourse) is excluded from a General Authorisation. In addition, main sewage pipelines crossing watercourses are also excluded from a General Authorisation. A Water Use License (WUL) will therefore be required for the development.

11. CONCLUSION

The scale of the planned development covers a large area and presents several risks to aquatic biodiversity both within the development area and downstream towards the Kaaimans Estuary. Many of these risks can be mitigated to an appropriate level of impact subject to the implementation of prescribed mitigation measures.

Sewage contamination and increased stormwater volumes pose the greatest risk to aquatic biodiversity for this development and is the prevailing threat to urban watercourses in George. Maintenance and operation of the package plant must therefore be strictly enforced, monitored and routinely audited. Irrigation using treated wastewater must be prioritised over discharge into the watercourse whenever possible. Monitoring the impact of effluent discharge on the Swart River is challenging due to limited options to access the river. It is likely that the volume and quality of water flowing down the Swart River will be sufficient to dilute effluent discharged from the package plant – provided that effluent water quality falls within the General Limit. A more detailed analysis of flow volumes released from the Garden Route Dam is required to assess this impact with higher confidence. Assimilation of pollutants (especially nutrients) is also expected to occur along W2 and is an important ecosystem service provided by wetlands. The ability of the wetland to assimilate pollutants is however dependent on maintaining the hydro-functional attributes of the wetland (e.g. a well vegetated channel that slows flow, allowing for assimilation of pollutants through absorption, adsorption and microbial decomposition). In this respect watercourses must be protected from erosion and incision caused by high stormwater flows. For this reason, it is recommended that additional attenuation of stormwater is accommodated onsite prior to discharge into watercourses.

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APPENDIX 13: IMPACT ASSESSMENT METHODOLOGY

Individual impacts for the construction and operational phase were identified and rated according to criteria which include their intensity, duration and extent. The ratings were then used to calculate the consequence of the impact which can be either negative or positive as follows:

$$\text{Consequence} = \text{type} \times (\text{intensity} + \text{duration} + \text{extent})$$

Where type is either negative (i.e. -1) or positive (i.e. 1). The significance of the impact was then calculated by applying the probability of occurrence to the consequence as follows:

$$\text{Significance} = \text{consequence} \times \text{probability}$$

The criteria and their associated ratings are shown in Table 16.

Table 16: Categorical descriptions for impacts and their associated ratings

Rating	Intensity	Duration	Extent	Probability
1	Negligible	Immediate	Very limited	Highly unlikely
2	Very low	Brief	Limited	Rare
3	Low	Short term	Local	Unlikely
4	Moderate	Medium term	Municipal area	Probably
5	High	Long term	Regional	Likely
6	Very high	Ongoing	National	Almost certain
7	Extremely high	Permanent	International	Certain

Categories assigned to the calculated significance ratings are presented in Table 17.

Table 17: Value ranges for significance ratings, where (-) indicates a negative impact and (+) indicates a positive impact

Significance Rating	Range	
Major (-)	-147	-109
Moderate (-)	-108	-73
Minor (-)	-72	-36
Negligible (-)	-35	-1
Neutral	0	0
Negligible (+)	1	35
Minor (+)	36	72
Moderate (+)	73	108
Major (+)	109	147

Each impact was considered from the perspective of whether losses or gains would be irreversible or result in the irreplaceable loss of biodiversity of ecosystem services. The level of confidence was also determined and rated as low, medium or high (Table 18).

Table 18: Definition of reversibility, irreplaceability and confidence ratings.

Rating	Reversibility	Irreplaceability	Confidence
Low	Permanent modification, no recovery possible.	No irreparable damage and the resource isn't scarce.	Judgement based on intuition.
Medium	Recovery possible with significant intervention.	Irreparable damage but is represented elsewhere.	Based on common sense and general knowledge
High	Recovery likely.	Irreparable damage and is not represented elsewhere.	Substantial data supports the assessment