PROPOSED NEW
HOUSING DEVELOPMENT

SUBDIVISION OF REM FARM 1388 KUILSRIVER (KALKFONTEIN)

CIVIL ENGINEERING SERVICES PRELIMINARY DESIGN REPORT

REPORT NO. 25-005/01 : REVISION NO. 0

MARCH 2025

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SUBDIVISION OF REM FARM 1388, KUILSRIVIER

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1 INTRODUCTION

1.1 TERMS OF REFERENCE

E2C Consulting Engineers has appointed by the Azalea Ventures (Pty) Ltd to undertake the planning and implementation of the subdivision of farm 1388, Kuilsrivier.

1.2 GENERAL DESCRIPTION OF PROJECT

The proposed residential development on Farm 1388 is located along the western bank of the Kuils River, north of Wesbank and east of Belhar, Cape Town in the Western Cape Province. This report is based on the development of an estimated 436 Single Residential sites (SR1), 2 General Residential sites with total area of 0.63ha (estimated yield of 50 units) and a General Business site with total area of 0.58ha. The subdivision area Portion 450 (possible residential and ancillary uses) has not been considered in this report. Refer to Annexure C for proposed zoning and subdivision layout of Farm 1388, Kuilsrivier.

1.3 PURPOSE OF REPORT

This report outlines the recommended levels of service and the design standards (City of Cape Town) and requirements. It establishes the design criteria that will be applied to the project and describes the preliminary bulk earthworks and municipal services that will be required for the project.

This Preliminary Design Report deals with the required internal civil engineering services. These include bulk earthworks, water reticulation, sewer reticulation, stormwater management infrastructure and roads.

2 BACKGROUND INFORMATION

2.1 DESCRIPTION OF THE SITE

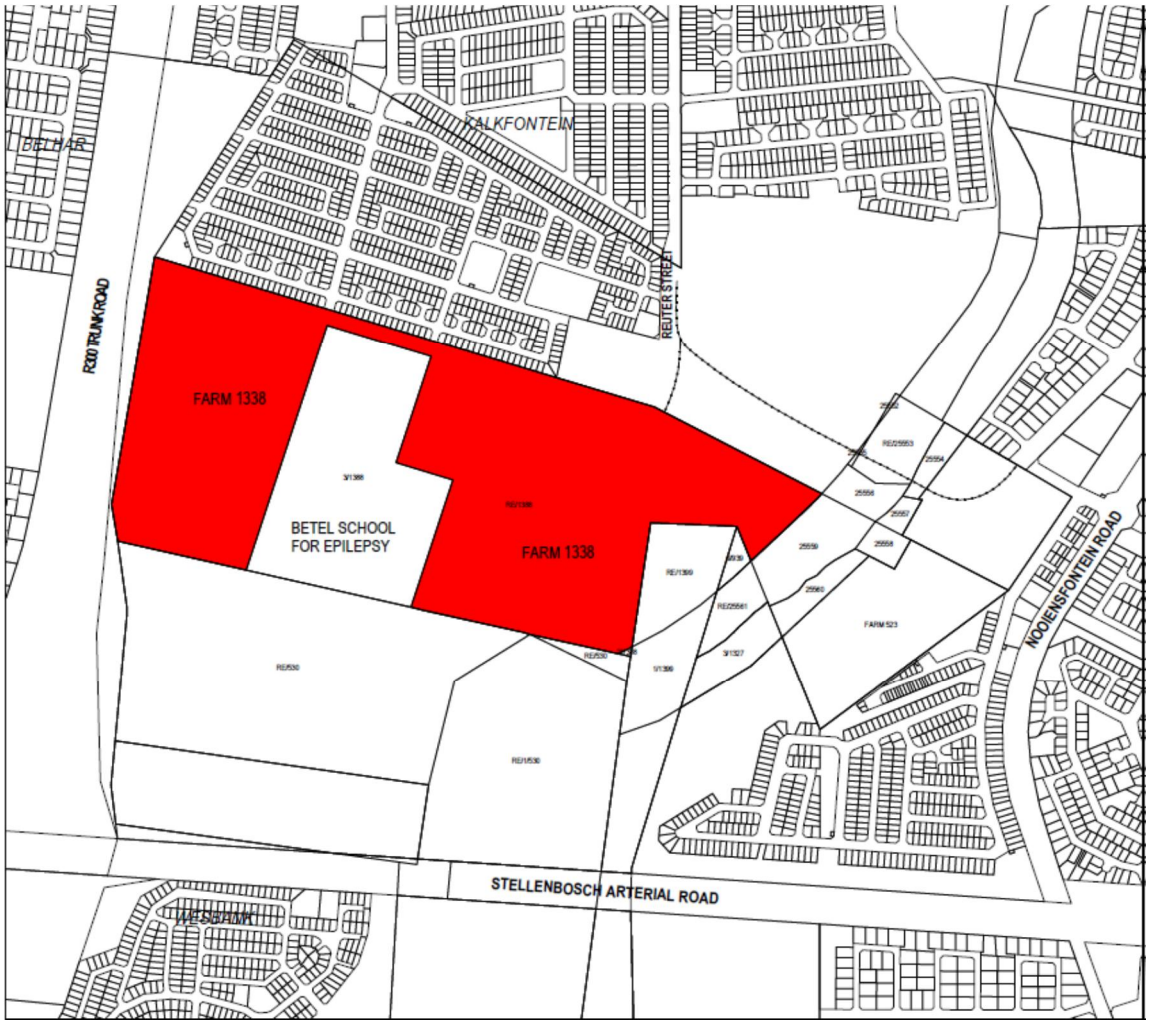
Farm 1388 is located approximately ±30km east of the City of Cape Town CBD. An existing residential area borders the site to the north, Kuils River to the east and the Betel Primary School for Epilepsy located centrally to Rem Farm 1388, splitting the main figure in two.

The total site area of Farm 1338 measures approximately 20.2 Ha in extent, of which 12.15 Ha will be allocated to the current housing development.

The topography of the site is flat with localized low and high points. The overall fall is generally from west to east towards the Kuils River.

The centre of the site is situated at 33°57'2" S 18°39'54"E.

Figure 2-1: Farm 1388 Locality Map



The site is currently undeveloped with temporary roads, foul sewer, water and stormwater infrastructure crossing the site. These services are currently servicing the Betel Primary School of Epilepsy. The undeveloped site is covered in grass, scattered trees and bushes with small wetland/marshy areas occurring in some of the lower lying areas to the east of the site. The fall is generally from west to east.

2.2 RAINFALL, HYDROLOGY & GEOLOGY

2.2.1 Rainfall Statistics

The Mean Annual Precipitation (MAP) from the nearest rainfall station (Latitude – 33º57', Longitude 18º40') is 533 mm. The 24-hour rainfall is summarised in Table 2-1.

Table 2-1: Rainfall Depth

Rainfall Classification	Return Period					
	1 in 2 year	1 in 5 year	1 in 10 year	1 in 20 year	1 in 50 year	1 in 100 year
Existing rainfall data from the nearest station (mm/h)	47.0	63.1	74.9	87.1	104.2	118.2

2.2.2 Review of Previous Hydrological Studies

A study performed in September 2007 by *Ninham Shand (Pty) Ltd* determined the position of the 1:50 and 1:100 flood lines for the area, as well as the considered performance of the existing canal under 1:100 year flood conditions. These flood lines are depicted on Drawing No. 402198 CT1(see Annexure A) included in the report.

Kuils / Eerste River Catchment: High Level Stormwater Master Plan – Volume By prepared by Gibb – Engineering and Science prepared in October 2013.

The 1:50 year recurrence interval (major storm) will be managed as surface flow on road carriageways and be temporarily detained by a dry detention basin to reduce downstream quantity impacts. The water will continue to flow through the enhanced swales to bio-retention areas, filtering into a micro-pool before discharging directly into the Kuils River Canal.

Note: Full Local Stormwater Management Plan Report will be made available upon request.

2.2.3 Geology

A geotechnical investigation is to be conducted within the next few months and can be made available upon request when completed.

2.3 EXISTING SERVICES

2.3.1 Waste Water

An existing 200mmØ sewer line flowing in a south easterly direction can be found along the north eastern edge of the proposed site and discharges into the Nooiensfontein Pump Station which is located on the eastern side of the Kuils River. This network services the existing residential buildings located along the northern edge of Rem Farm 1388. A temporary 160mmØ sewer network, which services the Betel Primary School is located along the central spine of the site and flows from west to east. This network connects to a 200mmØ collector, located in the north eastern corner of the proposed development along Old Nooiensfontein Drive.

The development falls in the catchment of the Bellville Wastewater Treatment Works (WWTW) which has capacity to treat the wastewater.

Refer to Annexure B for a letter from COCT regarding the confirmation of Sanitation capacity.

Figure 2-2: Existing Foul Sewer Network

2.3.2 Water

In the immediate vicinity of the proposed site, there is a lack of existing services information. The GIS department has verified there is a 160mmØ reticulation line at Dorothy Street and a 110mmØ line at Bhokwe Road. Both these lines can be found northwest of the proposed development. In the south along the northern verge of Stellenbosch Arterial a 700mmØ distribution main can be found and adjacent to it a 800mmØ distribution main can be found. To the west of the proposed development a 450mmØ main can be found along the western verge of the R300.

Refer to Annexure B for a letter from COCT regarding the confirmation of Bulk Water capacity.

The following is an extract from this letter:

'*On consultation with our reticulation colleagues, they advised that a better connection would be to the 450mm main on west side of the R300. This main is in the Belhar PRV zone and is able to provide a peak head of 30m. A method of directional drilling will have be used in the construction of the link. The developer will have to obtain all the approvals by the appropriate authorities for this work to be performed*'.

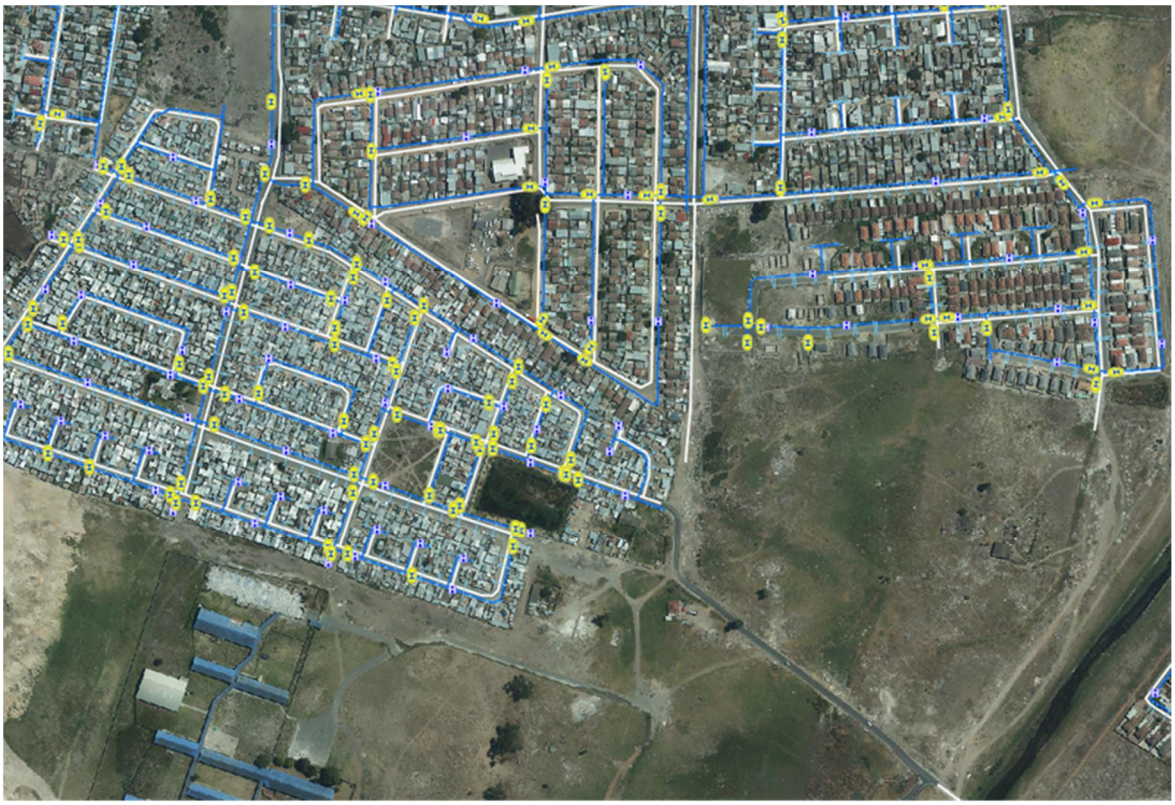


Figure 2-3: Existing Water Network

2.3.3 Stormwater

An existing 525mmØ stormwater pipeline, found along the north eastern portion of the development and drains to a 600mmØ pipeline in a south easterly direction, which then discharges into the Kuils River. A 375mmØ pipe network servicing the Petal Primary School can be found along the northern edge, within the proposed development and flowing in a south easterly direction. This pipe system later dischargers into a lined earth drain, which in turn dischargers into the Kuils River in a easterly direction.

Figure 2-4: Existing Stormwater Network

2.3.4 Roads

Currently the only access to the proposed development is via Old Nooiensfontein Road and then via Petal Primary School Road, found on the western side of the Kuils River low bridge crossing. The section of Old Nooiensfontein Road found on the western side of the low bridge crossing will have to be re-constructed as its alignment does not fall within the road reserve boundary. Petal Primary School Road is also a temporary access road to the school and will have to be demolished, with access to the school to be incorporated in the proposed development's road network.

As stated in the TIA, the primary access to the site will be via the south-westward extension of Reuter Street, and Old Nooiensfontein Road will be the secondary access point to the development.

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3 DESIGN CRITERIA AND PRINCIPLES

The scope of the project is to provide municipal services to each of the erven within the site, and includes the following:

- Bulk earthworks,
- Roads and stormwater infrastructure,
- Internal water supply reticulation network including erf connections,
- Internal sewer reticulation including erf connections

The design of services for the Subdivision of Farm 1388 will be based on the provision of 436 high-density residential erven, comprising of Single Storey Units, which will be decided by the urban planning layout that must be submitted for approval.

3.1 REFERENCES

The following documents will be referred to for all services:

- City of Cape Town, Standards and Guidelines for Roads and Stormwater, Version 4, September 2024.
- The Neighbourhood Planning and Design Guide (the “Red book”), July 2019.
- Guidelines for the Provision of Engineering Services for Residential Townships (the “Blue book”).
- Service Guidelines and Standards for Water and Sanitation City of Cape Town, Version 3.3, June 2019.

3.2 ROADWORKS

The documents listed below will be used as additional references for the design of the roadworks:

- TRH 14: Guidelines for Road Construction Materials.
- Draft UTG 7: Geometric Design of Urban Local Residential Streets.

The roads which are affected by the Retreat housing development project are classified as follows:

- Nooiensfontein Drive Class 3 Minor Arterial
- Old Nooiensfontein Road Class 5A Street
- Southward Ext. of Reuter Street Class 4 Collector

The applicable geometric design criteria are dependent on the road function and design speed. Some of the roads in the above list already exist, and hence their geometric design criteria have been fixed and will not be altered. The new bulk roads will most likely be used by taxis and will also provide low volume vehicle and pedestrian access to residential units. As such the desired maximum speed of vehicles should be limited to 40 km/h.

Horizontal alignment will require a minimum centreline radius of 50 m, and bell mouths at intersections will generally have a radius of 8,0 m.

Vertical alignment will utilize vertical curves of length based on a minimum K value of 6 for both crest and sag curves, however, for minor changes in grade, the actual curve length should not be less than 20 m.

Structural layer works and surfacing will be chosen to suit the road category, considering the CoCT minimum standards.

3.3 STORMWATER

In addition to the references listed in 3.2, the principles and criteria applicable to the stormwater system will be based on the following documents:

- Management of Urban Stormwater Impacts Policy, Catchment, Stormwater and River Management Branch of the City of Cape Town.
- Stormwater Management Planning and Design Guidelines for New Developments, Catchment, Stormwater and River Management Branch of the City of Cape Town.
- UTG 4: Guidelines for Urban Stormwater Management.
- Georgia Stormwater Management Manual Volume 2 (Technical Handbook).

In terms of the CoCT Policy, a stormwater management plan is required to investigate options and provide proposals for improving the quality, and controlling the quantity and rate of runoff, to reduce the downstream impact of stormwater discharge from any development. Water sensitive urban design principles are required to be incorporated through the application of sustainable urban drainage systems. For this project, a separate stormwater management plan has been prepared. The stormwater drainage will consist of two separate components:

- the minor system, which will cater for storms of up to a two-year recurrence interval, and
- the major system, which will cater for larger storms up to a 50-year recurrence interval.

The runoff will be determined using the Rational Method with rainfall intensity values determined from the rainfall data prepared by the CoCT in 2011. The closest grid position to the site is located at a latitude of 33° 57' S and longitude of 18° 40" E, which has a Mean Annual Precipitation (MAP) of 533 mm. The data for this grid position has been used to generate Intensity-Duration-Frequency curves, and these curves will be used to determine the applicable rainfall intensity and hence determine the runoff from the various rainfall events.

The project will be an end of line development, thus posing no flooding risk to downstream infrastructure and properties.

The City of Cape Town water quality criteria will be met through the implementation of overland swales located in a greenbelt along the eastern and south eastern area of the site.

The various elements of the stormwater system will as far as possibly comply with the following:

General:

- to comply with the CoCT standard detail drawings

Pipelines:

- minimum diameter of 300 mm for catchpit connections
- minimum diameter of 375 mm for longitudinal pipelines
- pipe type reinforced concrete
- pipe class 300 to 525 mm diameter 100D
  600 mm diameter 75D
  750 mm diameter 50D
- joints to be spigot and socket with rubber ring seal
- bedding to be class B for rigid pipes
- located under low side of carriageway, 1,5 m from road centreline
- minimum slope of 1 in 60 for 300 mm diameter pipe
  1 in 360 for 375 mm diameter pipe
  based on minimum velocity for larger pipes
- minimum velocity of 0,9 m/s at 80% full
- maximum velocity of 3,5 m/s
- minimum cover 1,0 m under roadways

0,75 m elsewhere

- maximum manhole spacing of 90m

Catchpit/Kerb inlets:

- maximum length of overland flow to be 120 m
- maximum kerb inlet spacing of 90 m
- percentage flow past a kerb inlet not to exceed 20 %
- connection pipe length not to exceed 15 m
- kerb inlet opening to be 100 mm high
- Catchpit to catchpit connections are not acceptable.

Manholes:

- required at all horizontal and vertical changes in direction
- all pipe connections to be crown to crown

Subsoil drains:

- provide where water table is less than 0.8m below surface

3.4 WATER SUPPLY

The design of the water supply will be based on the CoCT guidelines and standards, using the following:

• Residential water demand	600 l / erf / day (checked at 750 l / erf / day)
• Peak Factor	minimum of 4,4 (based on equivalent erven)
• Fire Fighting (low-risk group 3)	Hydrants at a maximum spacing of 120 m
• Fire Flow	900 l / min (15 l/s) for duration of 1 hour
• Maximum Head	90 m (under static conditions)
• Minimum Residual Head flow)	24 m (under Peak Demand), 6 m (under fire

Table 3-1: Estimated Water Demand

Type	Number	Unit	Litres/ day	AADD (l/d)	AAWD (kl/d)	Peak Factor	Peak Demand (l/s)
Housing	436	No.	750	327,000		4.4	
General Residential (Flats)	50	No.	700	35,000		4	
Local Business	2900	Per 100m2	400	11600		4	
Total				373,600	**373.6**		19.83

The estimated future water demand of the new development is 19.83 l/s.

The water demand table will be revised based on the finalised Town Planning Layout. The CoCT confirmed that the Bulk water supply infrastructure in the Kalkfontein network does not have sufficient capacity to cater for the increased demand on the water supply infrastructure. However, the Belhar PRV zone located on the western side of the R300 has sufficient capacity to cater for the increased demand on the water supply infrastructure. Confirmation of the connection point needs to be verified with the Reticulation Branch.

Refer to Annexure B for correspondence in this regard from CoCT.

The water supply to the development will be constructed in accordance with the following:

General	:	-	to comply with the CoCT standard detail drawings
Water mains	:	-	minimum diameter of 110 mm for distribution mains
		-	pipes to be PVC-U Class 12 complying with SABS 966
		-	bedded in flexible pipe bedding to SABS 1200 LB
		-	located under high side of carriageway, 1,5 m from kerb face
		-	generally located 0,6 m from erf boundaries when not along roads
		-	laid at minimum slope of 0,3 %
		-	pipes to be laid with cover of 1,0 m under roadways and 0,8 m elsewhere
Isolating valves	:	-	to be positioned such that a maximum of 4 valves need to be closed to isolate a section of pipeline
		-	to be spaced such that the total length of main included in an isolated section does not exceed 600 meters
		-	to be installed opposite erf splay boundaries where possible
		-	to be resilient seal type with epoxy applied to all internal and external surfaces
		-	to be class 16 with non-rising spindles and cast-iron cap tops
		-	to be clockwise opening/anti-clockwise closing, with direction of opening to be clearly marked on valve body or spindle cap
Fire hydrants	:	-	to be Ainsworth with 65 mm diameter London round thread

with cap top and securing chain

- to have epoxy applied to all internal and external surfaces
- to be clockwise opening/anti-clockwise closing, with cast iron cap tops
- to be installed with flanged CI extension piece to ensure that depth does not exceed 400 mm

Fittings / specials :
- all bends, tees, reducers for use with PVC-U pipes shall be class 16, ductile iron with spigot and socket rubber ring joints, coated internally and externally with 250-micron thick fusion bonded thermoplastic
- mild steel fabricated fittings shall be hot dip galvanised to SANS 121 (ISO 1461), coated internally and externally with 0,25 mm thick fusion bonded thermoplastic
- all bolted connections to use grade 316 stainless steel bolts, nuts and washers

Erf connections :
- pipe to be HDPE Type IV PN16 to SABS 533-2 (PE63 to ISO 4427) jointed with black, polypropylene, injection moulded, compression fittings
- Saddles shall be ductile iron or cast iron, secured with grade 316 stainless steel bolts, nuts, and washers, and wrapped in Denso tape

Water meters :
- shall be 15 mm plastic bodied, semi positive, rotary piston, volumetric type complying with SABS 1529 – 1:1994
- fitted with a pulse output facility (1 pulse/0,5l), a non-return valve and a three-way brass ballcock with trickle flow facility. the meter body must be manufactured from specially blended polyacetal, fitted with a hinged lid and viewing slot, and a special dual-purpose key for lid and valve.
- shall be fitted with SABS approved DZR brass couplings, with 20 mm female threaded, designed to retract when loosened to allow fitting or removal of the meter without complete disassembly

Bulk water meter chambers:

- Bulk water meter chambers to be painted externally with coats to approve water tightness.

- In the case of private developments, the valves directly after the bulk water meter chambers, shall be fitted with hand wheel, instead of a cast iron cap top.

3.5 WASTE WATER

The sewage discharge has been calculated in terms the "Guidelines for Human Settlement Planning and Design" in accordance with the following:

- Average daily flow 500 l/erf/day
- Persons per dwelling unit 7
- Peak Factor 2.5
- Allowance for extraneous flow 15 %
- Minimum velocity 0,7 m/s

Table 3-2: Estimated Sewage Discharge

Sewage Contribution			**Peak domestic sewer demand**				**Infiltration**		**Peak flow**
Type of contributor	Qty	flow/pe	Inflow	PF	Peak instant. flow	Cumulative flow	Infiltration allowance	Total	Q_s
			q_s			**$Sq_s.A$**	**%**		
[-]	[No.]	[L/d]	[L/d]	[-]	[L/s]	[L/s]	[L/s]	[L/s]	[L/s]
Domestic	436	500	218000	2.5	6.31	6.31	15.0%	0.95	**7.256**
General Residential (Flats)	50	600	30000	2.5	0.87	7.81	15.0%	0.13	**1.000**
General Business	2900m2	400	11600	2.5	0.34	8.15	15.0%	0.05	**0.390**
Total			259600		7.51			1.13	**8.640**

The estimated future sewage discharge of the new development is 8.64 l/s.

The sewage discharge table will be revised according to the approved Urban Planning Layout.

The City of Cape Town has confirmed that the Bellville Wastewater Treatment Works is able to accommodate this development but upgrades to the existing sewer network will be required to cater for the additional sewage discharge from the development.

The waste water drainage from the development will be constructed in accordance with the following:

General : - to comply with the CoCT standard detail drawings

- conventional waterborne sewerage system providing separate connections to individual erven will be provided

Pipelines :

- diameter of 110 mm for erf connections and 160 mm for main sewers
- pipes to be PVC-U Class 34 complying with SABS 791
- bedded in flexible pipe bedding to SABS 1200 LB
- located under centerline of carriageway
- generally located 1,4 m from erf boundaries when not along roads
- minimum slope for erf connections of 1 in 60
- minimum slope for 160 mm diameter main sewers:

  1 in 90 for up to 10 dwelling units

  1 in 120 for 11 to 80 dwelling units

  1 in 150 for 81 to 110 dwelling units

  1 in 180 for 111 to 130 dwelling units

  1 in 200 for over 131 dwelling units
- minimum full flow velocity of 0,9 m/s
- maximum velocity of 3,5 m/s
- minimum cover to pipe of 1.0 m
- maximum manhole spacing will be 90 m

Manholes :

- required at all horizontal and vertical changes in direction
- all pipe connections to be crown to crown
- shall be constructed using precast concrete units manufactured with dolomitic aggregate and low alkali sulphate resistant cement to SABS 471
- manhole covers and frames shall be ductile iron hinged slam lock type 2A in accordance with SABS 558
- step irons shall be installed in all manholes deeper than 1,2m

Erf connections:

- connection depth shall generally be 1.0m
- combined connections for 2 or more properties will be permitted but with the connection to main sewer at 160mm diameter

4 INFRASTRUCTURE PROPOSALS

4.1 EARTHWORKS

The existing ground levels are uneven, with numerous localised trapped low points. It is necessary to carry out bulk earthworks operations over the majority of the site to remove the high areas and fill the low areas, while also compacting the loose surface soils to make the area more suitable for housing development and all finish floor levels of all structures are above the 1 in 100 year floodline level.

In addition, the areas that have been contaminated by the dumping of builder's rubble will have to be rehabilitated through excavation and disposal of the refuse and contaminated soil and replaced with suitable imported engineered fill material.

The preliminary design for the bulk earthworks indicates that the site will require substantial earthworks to create favourable slopes for roads, services, overland stormwater drainage, and to ensure the lower lying eastern portion of the proposed development is above the 1:100 year floodline level. Bulk earthwork constraints exist along the western border and north western corner of the site due to the existing Betel Primary School and existing houses respectively.

It is advisable not to amend these existing levels as that could lead to unintended consequences. The existing levels along these site boundaries must thus be fixed for future development.

The north western portion of the site will be shaped in such a way to create a fall from north to south, with central portion of the site being split centrally by a high point created along the north western edge through to the south eastern edge of the site. This will result in the site being split into two main catchment areas with low points located in south eastern corner and north eastern corner of the site respectively. This will also ensure that roads will be neither too steep nor too flat, and underground gravity services can be provided at moderate slopes in reasonably shallow trenches.

All fill or residual in-situ material at the surface will be compacted in layers to a minimum of 90 % of Modified AASHTO maximum density, or 100 % for sand. On completion of the bulk earthworks operations, the site will be protected from wind erosion by mixing straw into the upper 150 mm layer of the earthworks platform.

4.2 ROADWORKS

The proposed development on Rem Farm 1388 will have a moderate effect on the current road network. It was however noted in the TIA study (Annexure D) that certain new road links, as well as road intersection upgrades that were set as conditions of approval for neighbouring developments and which will also be required for the proposed development on Rem Farm 1388. The proposed housing development at Rem Farm 1388 in Kalkfontein is supported from a traffic and transportation perspective provided that the recommendations in Traffic Impact Assessment report are adhered to.

Access to the development will be via the southward extension of Reuter Street, which will extend through the development and terminate at the southern property boundary. The internal roads will be designed with a 8m and 10m road reserve (see Figure 4-1 & 4-2).

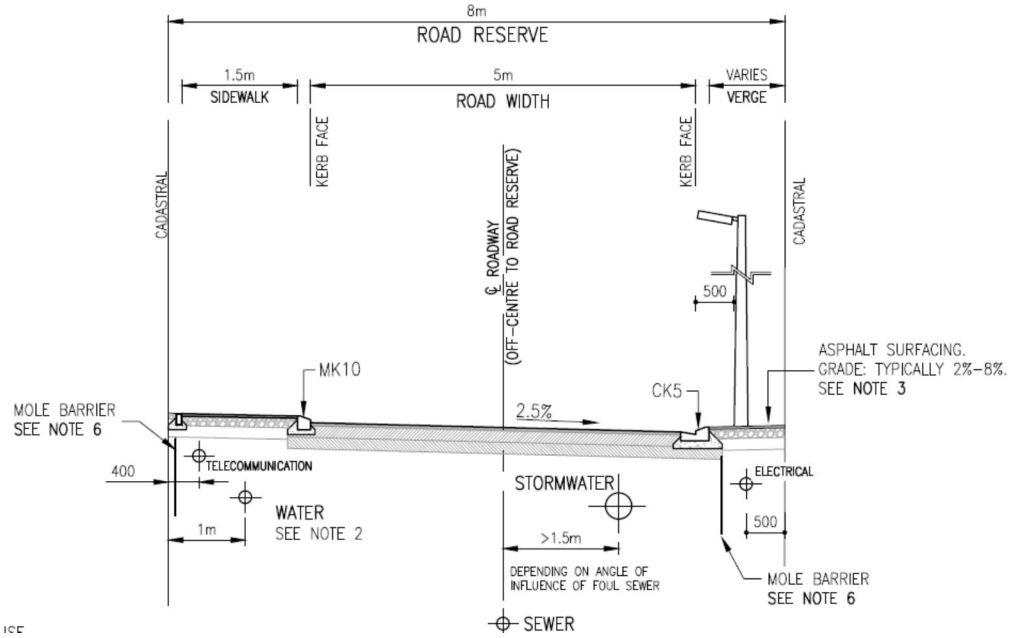


Figure 4-1: 8m Road Reserve Typical Cross Section

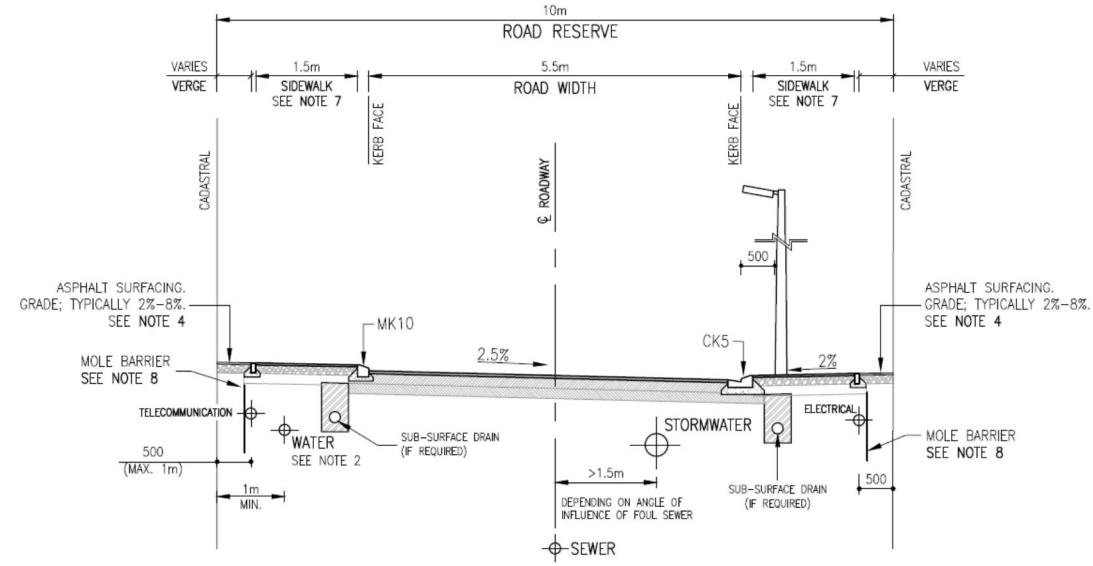


Figure 4-2: 10m Road Reserve Typical Cross Section

4.2.1 Pedestrian Facilities

Sidewalks will be required throughout the development. Sidewalks will be constructed immediately adjacent to the kerbs at the road edge. Raised intersections will be constructed to the level of the sidewalks as a traffic calming measure. They will serve to reduce speeds, increase driver awareness, and will also provide a clear crossing for pedestrians.

4.2.2 Construction of New Roadways

The Class 5 local access roads will have a 6.5, 5.5 and 5.0m surfaced width and be provided with sidewalks on both sides of the roadway. The road reserve width will be 16, 10 and 8m respectively.

Local access roads will have a crossfall of 2,5 % in the opposite direction to the prevailing ground slope, so as to retain the overland stormwater runoff on the roadway.

Mountable kerbs (type MK10) will be provided on the high side of each road with mountable kerbs and channels (type CK5) on the low side. Double channels (type C1) will replace the mountable kerbs and channels where parking is provided along the low side of the road. Barrier kerbs (type BK2) will replace the mountable kerbs around bell mouths at intersections.

Class 5 access residential roads will typically comprise a 40mm asphalt surfacing, 150 mm thick G4 base course layer, and a 150 mm thick G5 subbase layer on top of a 150 mm thick G7 selected subgrade layer.

The new roads will have 1.5-2.0 m wide sidewalks adjacent to the kerb on both sides, sloping at 2 % towards the roadway. They will consist of a 30 mm thick asphalt surface, over a 150 mm thick G5 subbase and a 150 mm thick G7 selected layer. The outer edge will be retained by a sunken kerb.

4.3 STORMWATER DRAINAGE

The preliminary design of the overall stormwater system is based on the following principles:

Runoff from the residential areas will generally flow overland, towards and onto the roads.

The roads will provide the primary drainage paths for both the minor and major storm events.

Runoff from the minor events will be collected by kerb inlets or grate inlets and conveyed to the discharge point by an underground piped system. The underground piped system will discharge at chosen locations into stormwater detention facilities found in the south eastern and north eastern corners of the development, where it will further infiltrate into the groundwater and recharge downstream wetlands.

The proposed development on Rem Farm 1388 poses no flooding risk to downstream infrastructure or properties, all major/minor storm events will be directed to the proposed detention pond.

In accordance with CoCT Policy, stormwater management is required to address both quality and rate of runoff. Quality is dealt with through the provision of swales, or by means of sedimentation and filtration structures. The rate of runoff is addressed by providing an attenuation swale and detention pond to decrease the post-development runoff from various storm events to the pre-development levels.

Stormwater detention ponds will be constructed in the south eastern and north eastern corner of the development. The detention pond will attenuate runoff for major storm intervals up to 1:50 years.

The diversion of the runoff emanating from the hardened / impervious surfaces constructed as part of the development, i.e., houses; roads; etc., will drain stormwater away from the housing units via a conventional underground stormwater culvert system; including catchpits; manholes; gullies; pipes etc., to the proposed pond.

Underground bulk stormwater pipelines will only be provided as necessary to deal with:

Surface runoff from the various upgraded and new intersections.

Surface runoff that will accumulate onto the new sections of roadway.

Underground flow from adjacent areas that must be conveyed to the overland channel.

The stormwater reticulation layout plan and water quality treatment areas are indicated on 25-005- 400 - R - 00 Stormwater Layout Plan attached to Annexure A.

4.4 WATER SUPPLY

The extent of water supply to be included in the bulk services contract will include:

Installation of 110mm water mains along new roads, including erf connections and One (1) connection point to existing pipeline for water provision to new proposed internal reticulation. Connection point and pressure need to be confirmed by CoCT. The immediate reticulation network does not have sufficient capacity to serve the development, therefore the distribution main located on the western side of the R300 has been recommended as a possible connection point. However, confirmation of the connection point needs to be verified with the Reticulation Branch.

The water reticulation layout plan is indicated on drawing 25-005- 200 - R - 00 Water Reticulation Layout Plan attached to Annexure A.

4.5 WASTE WATER

The extent of sewerage drainage to be included in the bulk services contract will include:

Amendment of existing manhole cover levels and possible rehabilitation or reconstruction of existing bulk sewer manholes.

Decommissioning and removal of existing temporary sewerage drainage systems crossing the proposed development.

Installation of sewer pipelines along new roads, including erf connections and connection points for internal reticulation.

The sewerage reticulation layout plan is indicated on drawings 25-005- 300 - R - 00 Sewer Reticulation Layout Plan attached to Annexure A.

4.6 DUCTS

Ducts shall be installed in accordance with the requirements of ESKOM and the CoCT Electrical and Telecommunication Departments.

All ducts shall comprise either 110 mm or 160 mm diameter class 6 PVC-U pipes, and all road crossings shall be sealed with end caps.

The draw wire shall be secured to a 150 x 150 x 150 mm grade 20 MPa/19 mm concrete marker, which shall be installed with a depth of cover of 50-100 mm below final level. The Contractor shall keep accurate records of the exact position of each duct.

The location and type of duct across roads shall be clearly marked by means of pre-cast recessed kerbs, or alternatively by incisions in the top of the kerb. The incisions shall be 5 mm thick with 75 mm high lettering. The recess shall be painted with polyacrylic roof paint.

Electrical services report submitted separately.

5 CONCLUSIONS AND RECOMMENDATIONS

In conclusion, the salient points contained in this report are summarised below:

In terms of the project brief, E2C Consulting Engineers are appointed to carry out the design of engineering infrastructure for the Subdivision of Rem Farm 1388, Housing Project. The Housing Project civil services comprise the design and installation of roadways, sidewalks, stormwater facilities, water mains, sewer mains and service ducts. The criteria used for the design as well as the preliminary design proposals for all the bulk earthworks and civil services are fully described in the report.

The site is suitable for the construction of the residential development, provided adequate bulk earthworks is carried out to remove all unsuitable fill material and to create required ground slopes for the implementation of roads and services. The City of Cape Town must be consulted during the development of the stormwater management plan and detail design.

ANNEXURE A

DRAWINGS

MBONGOLO STREET

HOUTKAPPER STREET

EXIST. 525Ø SW

EXIST. 600Ø SW

EXIST. 600Ø SW

EXIST. 600Ø SW

25555

437

438

439

440

441

442

443

444

445

446

447

448

450

1.2m WIDE X 0.5m DEEP SWALE

PROPOSED DETENTION POND

TOP OF CANAL

KUILS RIVER

TYPICAL IN-STREAM LITTER TRAP. USING NETTING OR BOOMS TO TARGET FLOATING LITTER

6/939

RE/1399

RE/25561

3/1327

1/1399

2/1388

RE/530

3/1388

BET-EL SCHOOL

LEGEND

- PROPOSED STORMWATER SWALE
- PROPOSED STORMWATER PIPE WITH HEADWALL
- PROPOSED STORMWATER PIPE WITH MANHOLE
- PROPOSED CATCHPIT
- EXISTING STORMWATER

100 mm ON ORIGINAL A0 DRAWING

REV	DATE	REVISION DESCRIPTION	DRAWN	REV	DATE	REVISION DESCRIPTION	DRAWN
00	05-03-2025	FOR INFORMATION PURPOSES ONLY					

APPROVAL - CLIENT

NAME:.....

DATE:.....

SIGNATURE :.....

CIVIL ENGINEERS

ebrahim engineering consultants

HEAD OFFICE
153 KROMBOOM ROAD
CRAWFORD
ATHLONE
7764
TEL : (021) 696 4599
FAX : (021) 697 5757

DISCIPLINE: CIVIL

CLIENT: AZELEA VENTURES (PTY) LTD

PROJECT DESCRIPTION: CONSTRUCTION OF CIVIL ENGINEERING SERVICES FOR SUBDIVISION OF REM FARM 1388, KUILSRIVIER

DRAWING TITLE: PROPOSED STORMWATER LAYOUT

FUNCTION	NAME	SIGNATURE
DESIGNED BY	M. EBRAHIM	
DRAWN BY	M. EBRAHIM	
DESIGN CHECKED BY	I. EBRAHIM	
DRAWING CHECKED BY	I. EBRAHIM	
APPROVAL - CONSULTANT		
NAME	I. EBRAHIM	SIGNATURE
PROFESSIONAL REG No.	9270069	

DRAWING STATUS CODES:
D=DRAFT, P=PRELIMINARY, F=FINAL, C=CONSTRUCTION, T=TENDER, R=REPORT, A=AS-BUILTRECORD

FIRST ISSUE DATE: MARCH 2025

SCALE: 1:750 | SHEET: 1 OF 1 | SHEET SIZE: A0

PROJ. No.	SUB-No.	DISCIPLINE	NUMBER	STATUS	REVISION
25	005	10	400	R	00

MBONGOLO STREET

HOUTKAPPER STREET

CONNECTION TO EXISTING 450mm Ø WATER MAIN LOCATED ON WESTERN SIDE OF R300 TO BE CONFIRMED BY WATER RETICULATION BRANCH OF CITY OF CAPE TOWN.

437

438

439

440

441

442

443

444

445

446

447

448

449

450

PROPOSED DETENTION POND

PROPOSED DETENTION POND

BET-EL SCHOOL

3/1388

KUILS RIVER

TOP OF CANAL

RE/25561

RE/1399

RE/530

1/1399

2/1388

3/1327

6/939

25555

LEGEND

- PROPOSED WATERMAIN
- PROPOSED ISOLATION VALVE
- PROPOSED FIRE HYDRANT

REV	DATE	REVISION DESCRIPTION	DRAWN
00	05-03-2025	FOR INFORMATION PURPOSES ONLY.	

APPROVAL - CLIENT

NAME:.....

DATE:.....

SIGNATURE :.....

CIVIL ENGINEERS

ebrahim engineering consultants

HEAD OFFICE
153 KROMBOOM ROAD
CRAWFORD
ATHLONE
7764
TEL : (021) 696 4599
FAX : (021) 697 5757

DISCIPLINE: STRUCTURES

CLIENT: AZELEA VENTURES (PTY) LTD

PROJECT DESCRIPTION: CONSTRUCTION OF CIVIL ENGINEERING SERVICES FOR SUBDIVISION OF REM FARM 1388, KUILSRIVIER

DRAWING TITLE: PROPOSED WATER LAYOUT

FUNCTION	NAME	SIGNATURE
DESIGNED BY	M. EBRAHIM	
DRAWN BY	M. EBRAHIM	
DESIGN CHECKED BY	I. EBRAHIM	
DRAWING CHECKED BY	I. EBRAHIM	
APPROVAL - CONSULTANT		
NAME	I. EBRAHIM	
PROFESSIONAL REG No.	9270069	SIGNATURE

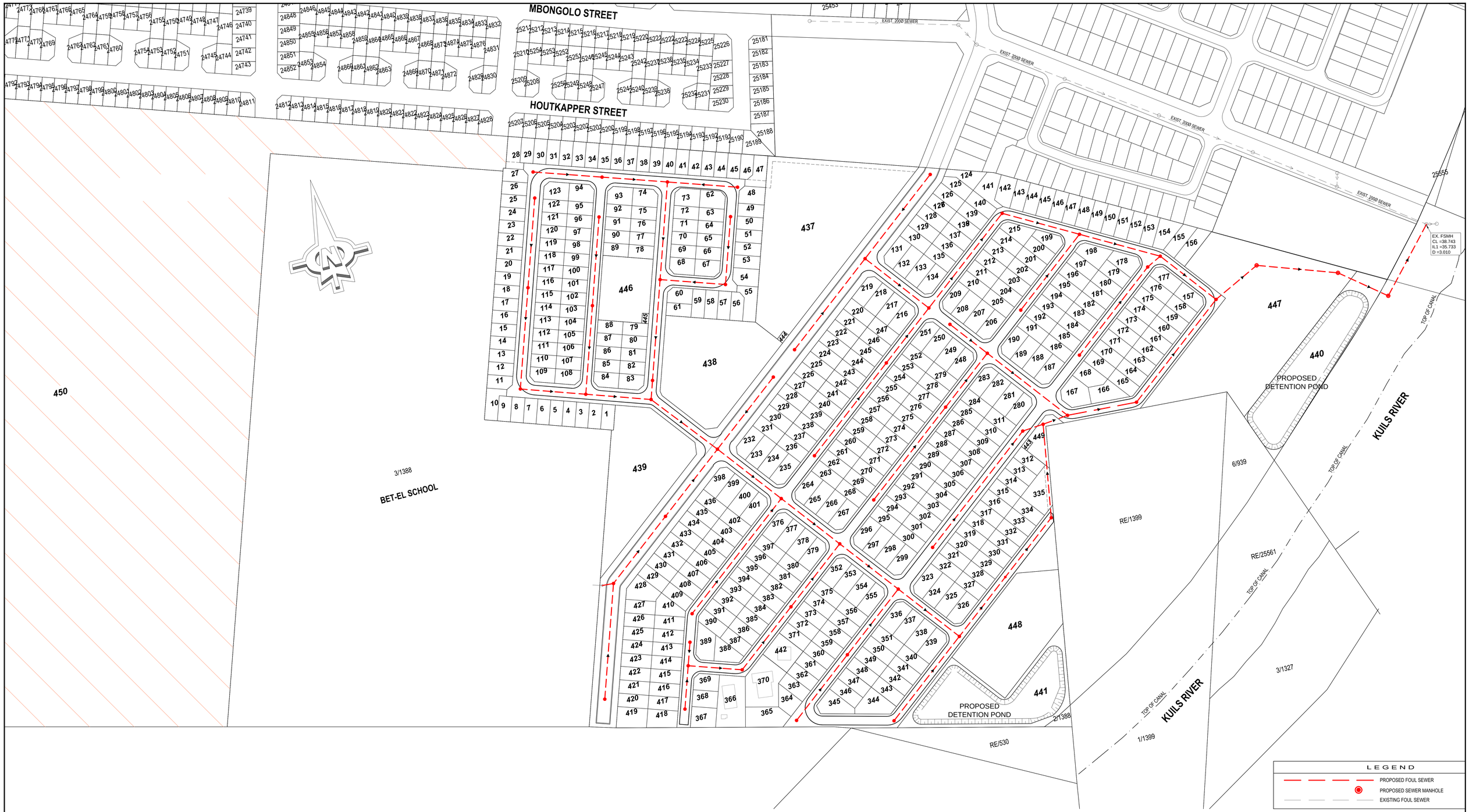
100 mm ON ORIGINAL A0 DRAWING

DRAWING STATUS CODES:
D=DRAFT P=PRELIMINARY T=TENDER F=FINAL C=CONSTRUCTION A=AS-BUILT/RECORD R=REPORT

FIRST ISSUE DATE: MARCH 2025

SCALE: AS SHOWN | SHEET: 1 OF 1 | SHEET SIZE: A0

PROJ. No.	SUB-No.	DISCIPLINE	NUMBER	STATUS	REVISION
	- 01 -	04 -		- C -	



100 mm ON ORIGINAL A0 DRAWING

REV	DATE	REVISION DESCRIPTION	DRAWN
00	05-03-2025	FOR INFORMATION PURPOSES ONLY	

APPROVAL - CLIENT

NAME:.....

DATE:.....

SIGNATURE :.....

CIVIL ENGINEERS
ebrahim engineering consultants
HEAD OFFICE
153 KROMBOOM ROAD
CRAWFORD
ATHLONE
7764
TEL : (021) 696 4599
FAX : (021) 697 5757

DISCIPLINE: CIVIL

CLIENT: AZELEA VENTURES (PTY) LTD

PROJECT DESCRIPTION: CONSTRUCTION OF CIVIL ENGINEERING SERVICES FOR SUBDIVISION OF REM FARM 1388, KUILSRIVIER

DRAWING TITLE: PROPOSED FOUL SEWER LAYOUT

FUNCTION	NAME	SIGNATURE
DESIGNED BY	M. EBRAHIM	
DRAWN BY	M. EBRAHIM	
DESIGN CHECKED BY	I. EBRAHIM	
DRAWING CHECKED BY	I. EBRAHIM	
APPROVAL - CONSULTANT		
NAME	I. EBRAHIM	
PROFESSIONAL REG No.	9270069	SIGNATURE

DRAWING STATUS CODES:
D=DRAFT P=PRELIMINARY F=FINAL T=TENDER R=REPORT C=CONSTRUCTION A=AS-BUILT/RECORD

FIRST ISSUE DATE: MARCH 2025
SCALE: 1:750
SHEET: 1 OF 1
SHEET SIZE: A0

PROJ. No.	SUB No.	DISCIPLINE	NUMBER	STATUS	REVISION
25	005	10	300	R	00

Section No	Current Flood Levels (masl)	
	1 in 50 year (250 m^3/s)	1 in 100 year (307 m^3/s)
1500	39.75	39.9
1420	39.35	39.46
1340	39.4	39.44
1240	39.37	39.37
1160	39.34	39.26
1080	39.4	39.3
970	39.44	39.44
Bridge	39.53	39.58
945	38.22	38.31
850	38.32	38.49
740	38.15	38.36
640	37.95	38.16
540	37.73	38
440	37.53	37.85
350	37.4	37.74
270	37.39	37.72
200	37.24	37.54
100	36.52	36.73
0	36.4	36.6

Section No	Flood Levels with Infilled Development Area (masl)	
	1 in 50 year (250 m^3/s)	1 in 100 year (307 m^3/s)
1500	39.76	39.93
1420	39.41	39.36
1340	39.45	39.47
1240	39.42	39.4
1160	39.4	39.3
1080	39.41	39.26
970	39.38	39.31
Bridge	39.48	39.51
945	38.22	38.31
850	38.32	38.49
740	38.15	38.36
640	37.95	38.13
540	37.73	38
440	37.53	37.85
350	37.4	37.74
270	37.39	37.72
200	37.24	37.54
100	36.52	36.73
0	36.4	36.6

NOTES:

1. The positions of the floodlines shown on this drawing are approximate. If the positions of the floodlines are to be fixed on the ground the flood levels listed in the table on this drawing should be used.
2. Dotted floodlines indicate uncertainty regarding the positions of the floodlines due to insufficient ground level data or the existence of secondary flow paths.
3. The floodlines refer to water levels and not to energy levels.
4. The recommended raising of the development area has little effect on water levels in locations other than the development area. Both the 1:50 and 1:100 year floodlines are contained by the right hand bank of the canal up to the low level Bet-El School Bridge.

LEGEND:

- 1:50 year floodline
- 1:100 year floodline
- Estimated 1:50 and 1:100 year floodline
- Post infill position of 1:50 and 1:100 year floodline
- Cross section

No	AMENDMENTS	APPR.	DATE

SURVEYED	XXX
SURVEY PLOTTED	MM
DRAWN	DMB
DRAWING CHECKED	CW

PROJECT MANAGER
DATE 4 SEPTEMBER 2007

PROJECT DIRECTOR
DATE 4 SEPTEMBER 2007

NINHAM SHAND CONSULTING SERVICES CAPE TOWN

SHINING OAKS

PROPOSED SHINING OAKS DEVELOPMENT

KUILS RIVER 1:50 AND 1:100 YEAR FLOODLINES

SCALE 1:2500

SHEET 1 OF 1

DRAWING No 402198 CT 1

ANNEXURE B

COCT CAPACITY CONFIRMATION LETTER

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD
Making progress possible. Together.

Water & Sanitation Head Office
Cnr Voortrekker & Mike Pienaar Blvd
Bellville 7530
Tel: **021 400 5219**
Fax: **021 970 3140**
E-mail: water.info@capetown.gov.za
Evaluator: Z.Hare

Water & Sanitation Head Office
Cnr Voortrekker & Mike Pienaar Blvd
Bellville 7530
Umnxeba: **021 400 5219**
Ifeksi: **021 970 3140**

Water en Sanitasie Hoof Kantoor
H/V Voortrekker & Mike Pienaar Blvd
Bellville 7530
Tel: **021 400 5219**
Faks: **021 970 3140**

15/05/2024

Ref:20240513_Z

Mahir Ebrahim
E2C Consulting Engineers
153 Kromboom Road
Athlone, Cape Town
mahir@e2c.co.za

COMMENT ON WATER AND SANITATION DEVELOPMENT CONDITIONS FOR THE PROPOSED IMPACT OF ERF 1388: KALKFONTEIN, CAPE TOWN

Background

This comment covers the impact of the Proposed Applications on Erf 1388: Kalkfontein, Cape Town. The development is for 900 low to middle income housing units.

The site is zoned as Agriculture (AG) and is vacant with a school in the midst.

The report provides an overview of the existing water and sewer infrastructure near the development, associated conditions and technical requirements to be implemented with respect to this application. The information provided in this report is based on City of Cape Town master plan model. The report provides an overview of the existing water and sewer infrastructure near the development.

Description	**Potable Water Demand**				**Sewer Flow***	
Erf 1388: KALKFONTEIN, CAPE TOWN	**Quantity (Units/Area/ No. people)**	**Total AADD (kl/d)**	**Peak Flow (l/s) PF=3.5**	**Fire Flow (l/s)**	**Total ADWF (kl/d)**	**Peak Flow (Dry weather) (l/s) (PF=2.5)**
	900 units	675	27.3	25	450	13

***Based on AADD and ADWF provided by client**

The proposed water demand and sewer run off is very conservative, the engineer will have to provide evidence of water saving measures to reduce water demand at individual household level. If there is an expectation of back-yard dwellings then the figures will be plausible.

Water Reticulation

Distribution zone

The proposed development is not situated within any specific distribution zone. The adjacent distribution zones include Kalkfontein PRV, Kuilsriver West, Wesbank PRV, and Hangley PRV, all of which are part of the CMC110 network.

Present situation

In the immediate vicinity of the proposed site, there is a lack of existing infrastructure information. The closest connections available are a 75mm reticulation line located 425m north of the site and a 110mm line northwest of the site. However, these connections are insufficient to support the anticipated load from the proposed development.

The GIS department has verified that the Petal Primary school is currently supplied by either a 160mmØ line at Dorothy Street or an 110mmØ line at Bhokwe Road. However, the pressure in the Kalkfontein network is not adequate to sustain a peak flow rate of 27.3 litres per second. During peak hours, the pressure drops to 10 meters, which is insufficient for the proposed development.

A possible solution would be to connect to the 700mmØ distribution main along Stellenbosch Arterial downstream of the Pressure Reducing Valve (PRV). However, confirmation of this connection point is necessary from the Reticulation section, as connections to distribution mains are typically not permitted under normal circumstances.

Adjacent to the 700 mm main there is also an 800 mm distribution main the details of the is important as there may be access challenges to an appropriate connection point.

On consultation with our reticulation colleagues, they advised that a better connection would be to the 450mm main on west side of the R300. This main is in the Belhar PRV zone and is able to provide a peak head of 30m. A method of directional drilling will have be used in the construction of the link. The developer will have to obtain all the approvals by the appropriate authorities for this work to be performed.

Engagement will be required with the reticulation officials (Ndzululwazi.Joni@capetown.gov.za , Graham.Alexander@capetown.gov.za) to discuss alternate connection points the development will have to be part of one of the four surrounding zones mentioned above.

Due to Cape Town striving to become a water sensitive city, water saving initiatives is to be implemented by the developer.

Refer to figure 1 & 2.

Bulk Water

No infrastructure under the control of the City of Cape Town's Bulk Water Branch exists in the immediate vicinity of the proposed development shown in the application.

The City of Cape Town's bulk supply system has sufficient water resource, treatment, bulk storage and conveyance capacity to supply the estimated average daily demand of 675 kl/day of the proposed development.

Sewer Reticulation

Drainage area

The proposed development is located within the operational area of the Bellville Wastewater Treatment Works (WWTW). The sewer gravitates in a southerly direction along Old Nooiensfontein Drive until it reaches the Nooiensfontein Pump Station (PS). From there, the sewage is pumped directly to the Bellville WWTW.

Present situation

The closest connection point is the 200mm Ø collector located east of the development along Old Nooiensfontein Drive. This connection currently maintains a flow rate of 3.75 l/s. However, with the addition of the proposed development's load to the system, the relative spare capacity diminishes to a range of 30%. This places the system at the brink of having no spare capacity, indicating a potential need for line upgrading to accommodate the increased demand. The upgrade will be required from the connection point to the Nooiensfontein pump station.

Furthermore, downstream from this point, the system exhibits ample spare capacity to accommodate additional loads.

Refer to figure 1 & 3

Wastewater Treatment

The proposed development is located within the operational area of the Bellville Wastewater Treatment Works (WWTW). There is sufficient unallocated spare capacity to accommodate the 450 kl/d from this development.

Conclusion

The immediate reticulation network does not have capacity to serve the development. There is nearby distribution main on western side of the R300. However, confirmation of the connection point needs to be verified with the Reticulation Branch.

The sewer network will require upgrades in order to accommodate the load of the development.

The Bellville Wastewater Treatment Works is able to accommodate this development.

Conditions

The Water and Sanitation Department has no objection to the proposed development subject to the following conditions:

1. Development contributions are payable as per the Development Contribution Policy, to be quantified by the Regional Head. The amount payable escalates annually and will be the value determined at the time of payment.
2. All costs, relating to alterations to the existing water and sewerage systems on or near the site and the provision of new water and sewer connections to the site, will be for the account of the applicant.
3. The developer is to show evidence of water saving measures.
4. An agreement is required on the appropriate connection for the water supply. This could include an upgrade of the adjacent water reticulation network.
5. All downstream sewer upgrades to in place prior to any dwelling occupation.

6. All link services are required to be in place prior to any dwelling occupation.

Additional Technical Requirements

7. The water and sewer capacities that may be allocated according to this document shall not be reserved if not taken up before the lesser of 5 years or the approved development period.
8. Water and Sanitation municipal service plans to be designed according to Departmental Service Standards and be approved prior to construction.
9. The owner is responsible for application for the new water metered connection at the standard tariff to the Reticulation District Head. If an existing water meter is not accessible, this will include for the repositioning of the meter.
10. As built drawings of installed water and sewer services to be submitted to the City before transfer of erven will be allowed.
11. All services must be inspected and approved on completion, at which time a completion certificate will be issued, before transfer of erven will be allowed.
12. Water pipelines are to be disinfected as per Policy No EH 04/06 (copy available on request). A Health Clearance Certificate will be required prior to final approval of the water installation.
13. The results of all applicable tests on water and sewer pipelines must be made available, which must include a full CCTV report on sewer networks, prior to services handover.

General/ Disclaimer

1. Information provided is based on best available data.
2. The flows and pressures provided in this comment are theoretical and not measured

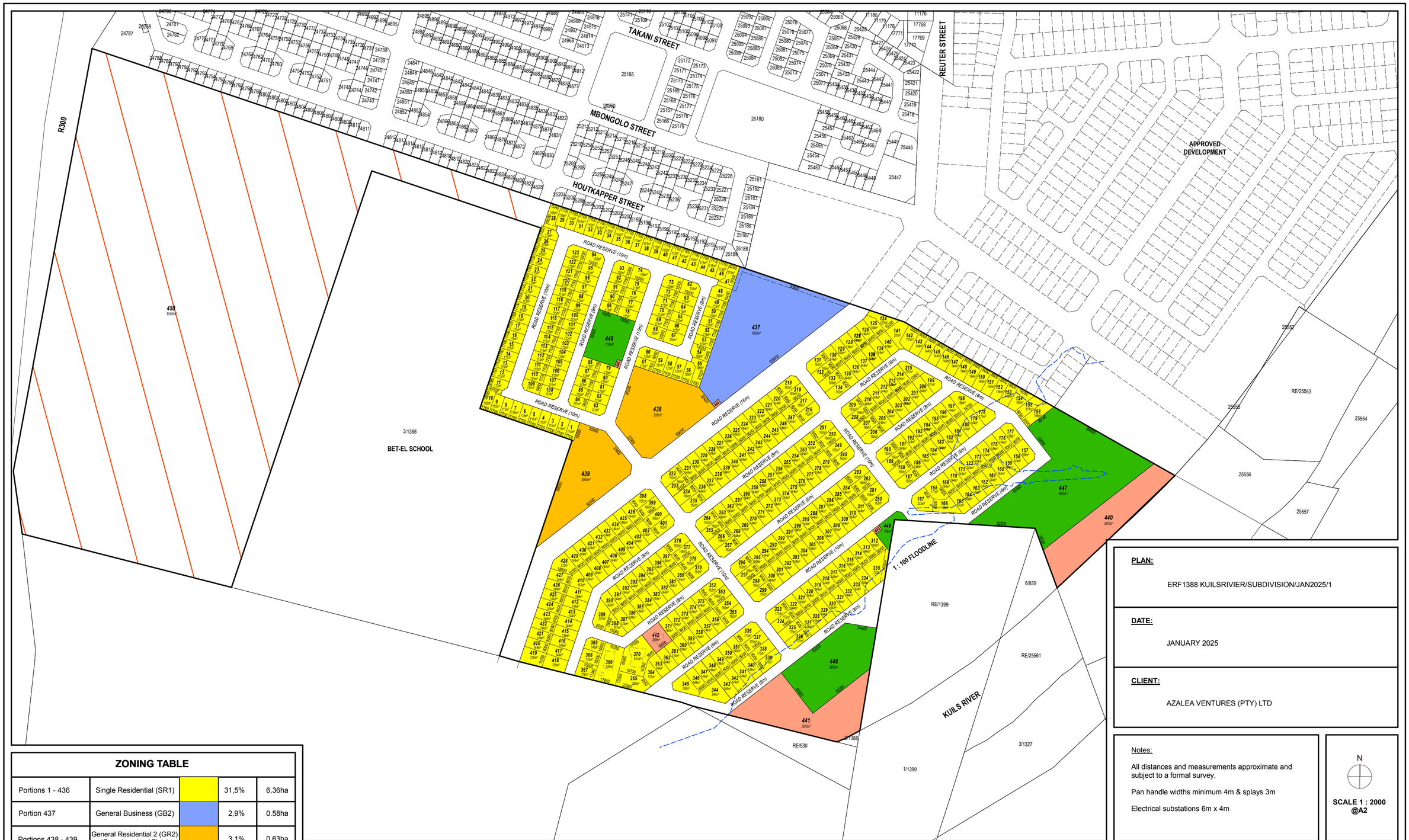
Yours Faithfully

On behalf of
Zolile Basholo
TECHNICAL SERVICES DIRECTOR: WATER & SANITATION DIRECTORATE

BRANCH	**CONTACT PERSON**	**INPUT PROVIDED**
Master Planning	Za-eemah Hare	15/05/2024
Bulk Water	Bulk water info	Awaiting Response
Reticulation	Ndzululwazi Joni, Larry Cronje	16/05/2024
Wastewater Treatment	Sven Sotemann	Awaiting Response

ANNEXURE C

PROPOSED SUBDIVISION LAYOUT & PHASING



ZONING TABLE

Portions 1 - 436	Single Residential (SR1)		31,5%	6,36ha
Portion 437	General Business (GB2)		2,9%	0.58ha
Portions 438 - 439	General Residential 2 (GR2) (Grouphousing / Flats)		3,1%	0,63ha
Portions 440 - 445	Utility Zone (UT)		3,1%	0,62ha
Portions 446 - 449	Open Space (OS2)		5,4%	1,08ha
Portion 450	Subdivisional Area (Residential & ancillary uses)		39,8%	8,04ha
Remainder	Transport Zone (TR2)		14,2%	2,88ha
Total			100%	20,19ha

REZONING AND SUBDIVISION - REMAINDER FARM 1388, KUILSRIVIER

PLAN:

ERF1388 KUILSRIVIER/SUBDIVISION/JAN2025/1

DATE:

JANUARY 2025

CLIENT:

AZALEA VENTURES (PTY) LTD

Notes:

All distances and measurements approximate and subject to a formal survey.

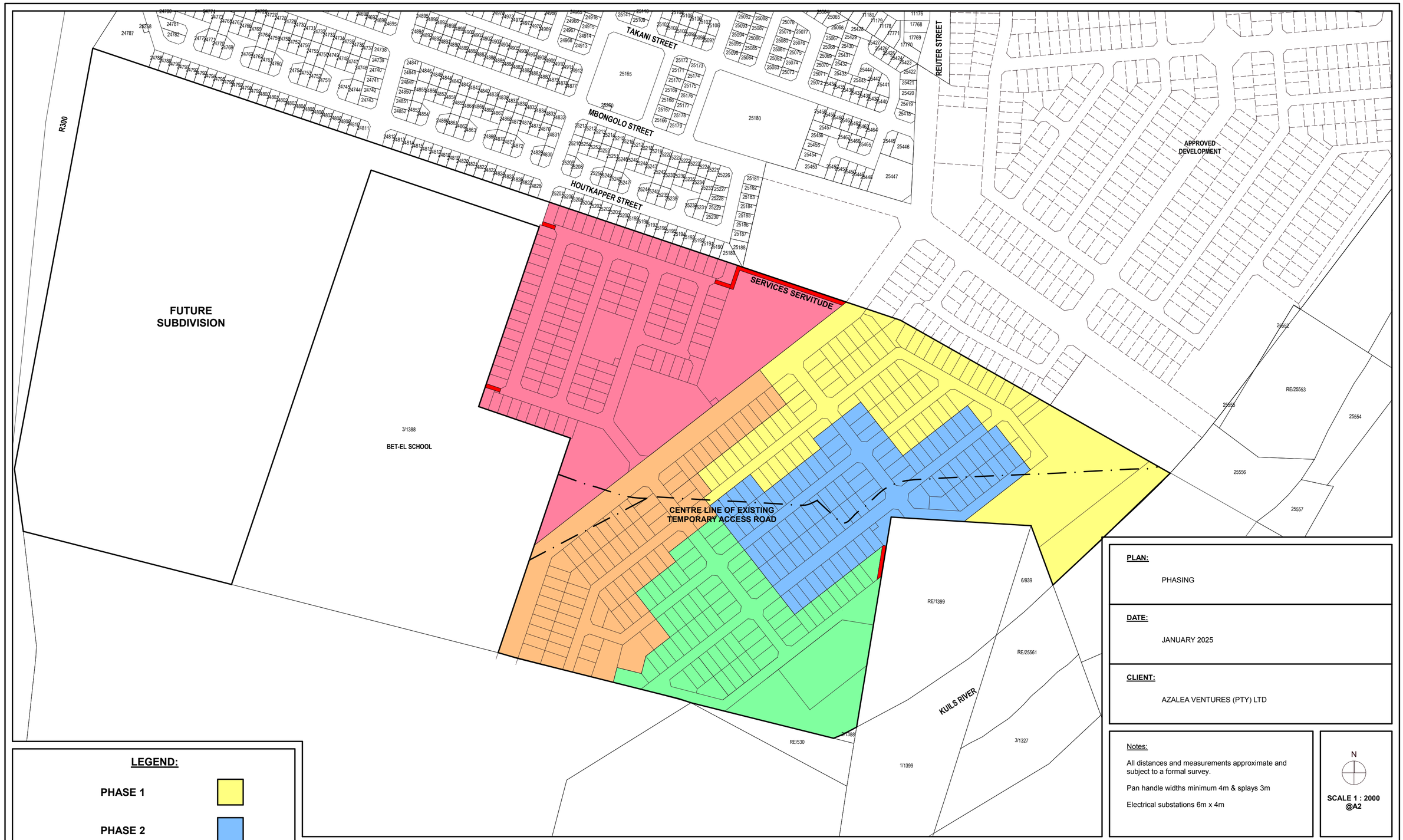
Pan handle widths minimum 4m & splays 3m

Electrical substations 6m x 4m

N

SCALE 1 : 2000 @A2

ATLAS
Town Planning
P.O. BOX 380, KUILSRIVIER, 7579
(021) 8017446



LEGEND:

- PHASE 1
- PHASE 2
- PHASE 3
- PHASE 4
- PHASE 5

REZONING AND SUBDIVISION - REMAINDER FARM 1388, KUILSRIVIER

PLAN:
PHASING

DATE:
JANUARY 2025

CLIENT:
AZALEA VENTURES (PTY) LTD

Notes:

All distances and measurements approximate and subject to a formal survey.

Pan handle widths minimum 4m & splays 3m

Electrical substations 6m x 4m

N

SCALE 1 : 2000 @A2

ATLAS
Town Planning
P.O. BOX 380, KUILSRIVIER, 7579
(021) 8017446

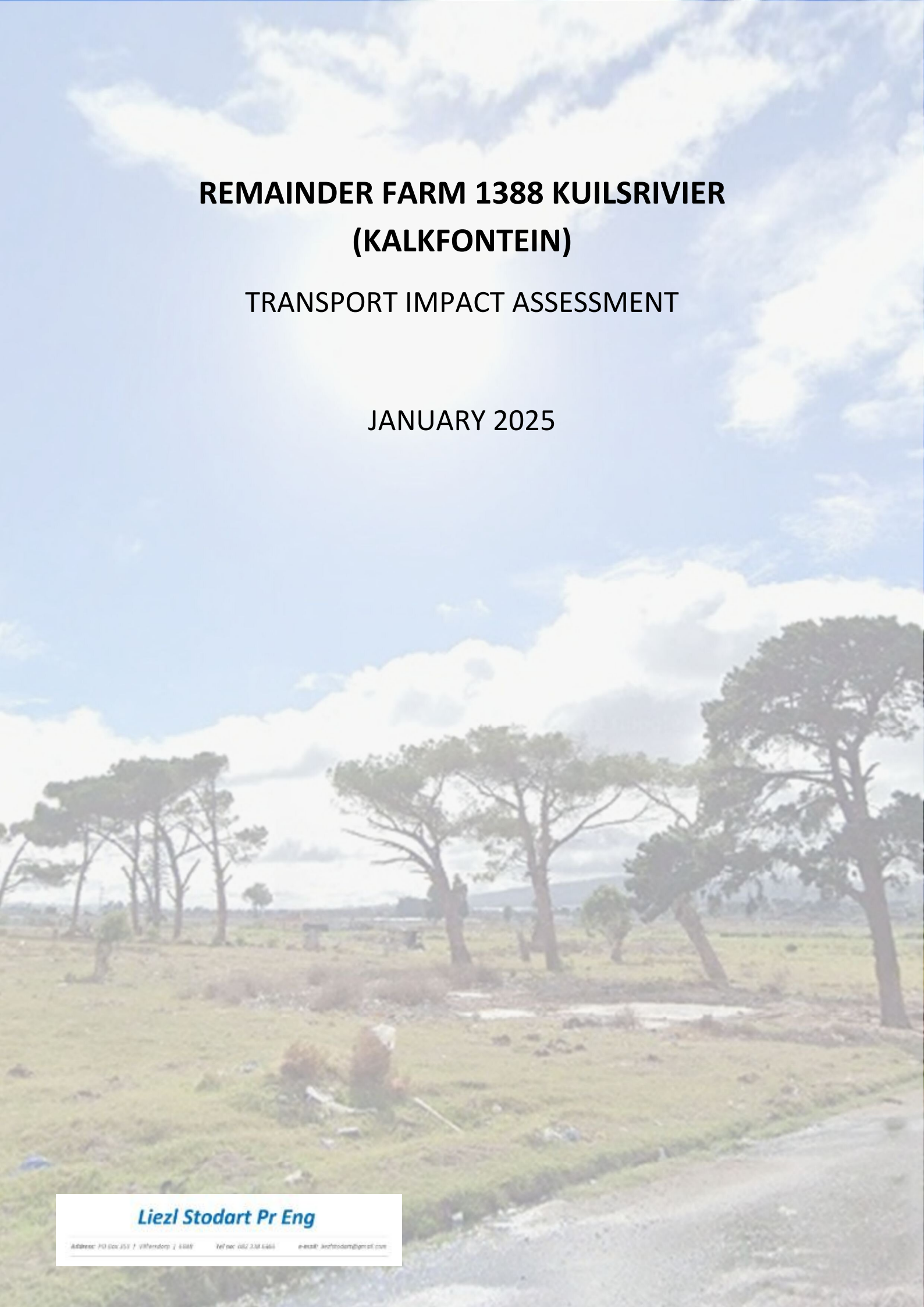
ANNEXURE D

TRAFFIC IMPACT ASSESSMENT

REMAINDER FARM 1388 KUILSRIVIER (KALKFONTEIN)

TRANSPORT IMPACT ASSESSMENT

JANUARY 2025



Liezl Stodart Pr Eng

COVER PAGE

Certification

It is herewith certified that this Transport Impact Assessment has been prepared according to the requirements of the South African Traffic Impact and Site Traffic Assessment Manual.

L. Stodart
M. Eng Pr. Eng (2008 0316)
Tel: 082 338 6466
E-mail: liezlstodart@gmail.com

Application details:

a) Municipality name: City of Cape Town

b) Type of assessment: Transport Impact Assessment

c) Particulars of the Site Development Plan: Rezoning and subdivision – Remainder Farm 1388, Kuilsrivier | ATLAS Town Planning | Plan: Erf1388 Kuilsrivier/Subdivision/Jan2025/1 | January 2025

d) Erf numbers and farm names: Remainder Farm 1388, Kuilsrivier

e) Client details: Sal Qureshi, Shining Oak Investments

f) Date of report: January 2025

g) Name and address of the Assessor: Liezl Stodart Pr Eng, PO Box 359, Villiersdorp, 6848

INDEX

ANNEXURES

1. BACKGROUND

This transport impact assessment accompanies the application for the rezoning and subdivision of Remainder Farm 1388, Kuilsrivier. The site is located to the south of the Kalkfontein residential area, north of Stellenbosch Arterial and east of the R300. The Bet-El School for epiliptici borders Rem Farm 1388 on the western side. The location is shown in ***Figure 1***, *Annexure B*. The property is approximately 20,19ha in size and is zoned as Community Zone 2 and Agricultural. The development proposal is in line with the zoning of the surrounding area.

2. DEVELOPMENT PROPOSAL

The development will entail the rezoning of Remainder Farm 1388 and subdivision into 436 single residential erven, 44 group housing units, one business erf and supporting land uses. Access is proposed via the southward extension of Reuter Street. Provision is made for the possible future road link to Stellenbosch Arterial. The development proposal is shown in ***Figure 2*** (*Rezoning and subdivision – Remainder Farm 1388, Kuilsrivier*).

3. CONDITIONS OF APPROVAL FOR NEIGHBOURING DEVELOPMENTS

There are certain new road links, as well as road and intersection improvements that were set as conditions of approval for neighbouring developments and which will also be required for the Rem Farm 1388 development. The conditions of approval relating to transport infrastructure for the Hamilton Estate development (Ref T/CE 18/6/8/44, 31 March 2010), Highbury (Case ID 168739, 20 October 2011), and the City of Cape Town Kalkfontein Housing Project (Application No. 70155440, 11 August 2014), as well as the improvements recommended in the 2024 TIA for the next phase of Hamilton Estate are shown in ***Figure 3,*** *Annexure B*.

4. STUDY AREA

The TMH 16 Traffic Impact Study Manual indicates that the primary study area should cover access to the site and external roads that may be impacted by the development, up to a maximum distance of 1.5km from the site. The primary study area shall be restricted to Class 4 and 5 roads in the vicinity, up to the first high order road. At least one intersection should be included in the study area. In this case the following elements were included:

- Stellenbosch Arterial
- Nooiensfontein Road
- Old Nooiensfontein Road
- Highbury Road
- Reuter Street
- Intersections between these roads

5. EXISTING ROAD INFRASTRUCTURE

Information on transport infrastructure in the vicinity of the site was obtained through a site visit conducted in September 2024 and from the transport impact assessments for Highbury Park, the City of Cape Town Kalkfontein Housing Project and Hamilton Estate.

Stellenbosch Arterial is a dual carriageway with two lanes per direction and a median island. The road carries about 5300 vehicles in the morning peak hour and about 4800 in the afternoon peak hour. There are paved sidewalks on both sides of the road.

New Nooiensfontein Road is an undivided two-lane, two-way road classified as a Class 3 Minor Arterial. There is no direct property access off this road and intersections with other high order roads are signalised. There is a paved sidewalk along the western side of the road. The road carries approximately 2000 vehicles (two-way) in the morning peak hour.

Highbury Road is a Class 4 Collector Road, carrying approximately 800 vehicles (two-way) in the morning peak hour. It is an undivided two-lane, two-way road with paved sidewalks. The road currently only extends up to Chapel Street (just west of New Nooiensfontein Road), but the road will, in future, be extended across the Kuils River all the way to Reuter Street. The extension will run through Hamilton Estate west of the river and will necessitate the construction of a new bridge over the river.

Old Nooiensfontein Road runs parallel to New Nooiensfontein and then crosses the Kuilsrivier via a low bridge to link up with Takani Road. The road carries relatively low traffic volumes.

Minor Road 86 (OP0086) runs from Old Nooiensfontein Road south-westwards towards the R300. The north-eastern section gives access to the Bet-El School and is surfaced. The section south-west of the school turnoff is a gravel track and is in fact barricaded to prohibit traffic from using the road. See ***Photo 7b*** in the ***Photo Pages, Annexure A***. The Provincial Roads Engineer has indicated that OP0086 is still a proclaimed road and that, should any development be planned on the land that is currently traversed by OP0086, the road needs to be deproclaimed and any property that currently takes access off OP0086 needs to be provided with alternative access. As shown in ***Figure 1***, the Rem Farm 1388 development will be built over OP0086. An alternative route will, however, be provided via Old Nooiensfontein Road and Reuter Street.

Belhar Drive is a Class 3 Minor Arterial. It is an undivided two-lane, two-way road with a paved sidewalk on the northern side. The City of Cape Town Road Network Plan shows that Belhar Drive will eventually be extended over the R300 (no interchange) to link up with Erica Drive in Belhar. Belhar Drive carries approximately 750 vehicles (two-way) in the morning peak hour.

Reuter Street is an undivided two-lane, two-way road with a sidewalk along the western side. The road is classified as a Class 4 Collector and carries approximately 900 vehicles (two-way) in the morning peak hour. The formal road extends southwards to Verenigde Street, whereafter it becomes an informal gravel track. Although the extension of Reuter Street to the southern edge of Hamilton Estate Phase 1 was a condition of approval for the development, the construction could not take place due to the encroachment of informal structures into the road reserve. The encroachment issue has not been addressed yet.

The roads described are shown in the ***Photo Pages*** (Annexure A) and in ***Figure 1*** (Annexure B).

6. ROAD NETWORK PLANNING

The City of Cape Town's Road Network Plan shows that Belhar Drive will be extended over the R300 to link up with Erica Drive in the west. A half diamond interchange with an on- and offramp to the R300 North is also shown. There have also been discussions about providing an alternative access to the Kalkfontein area through the northward extension of Wesbank Main Road. This option has in principle support from City of Cape Town and Provincial Roads officials.

7. EXISTING TRAFFIC

Traffic counts were done at the Stellenbosch Arterial / New Nooiensfontein Road and Highbury Road / New Nooiensfontein Road intersections on Tuesday 30 July 2024. The counts were done on a weekday during the school term and the day of the counts can therefore be classified as a "normal" day. The counts were supervised by Nick Venter of NVTS. Traffic counts for the Reuter Street / Belhar Drive intersection was obtained from the 2022 Hamilton Estate TIA and were adjusted by 3% per year to estimate 2024 volumes. The traffic count details are summarised in ***Table 1***.

Table 1: Traffic count details

Intersection	Morning peak hour	Afternoon peak hour	% Minibus taxis	% Buses	% Heavy vehicles
Stellenbosch Arterial / New Nooiensfontein	7:00 - 8:00	16:00 – 17:00	5%	<1%	4%
Highbury / New Nooiensfontein	7:00 - 8:00	16:00 - 17:00	5%	<1%	1%
Reuter St / Belhar Drive	6:15 – 7:15	15:00 – 16:00	15%	0%	2%

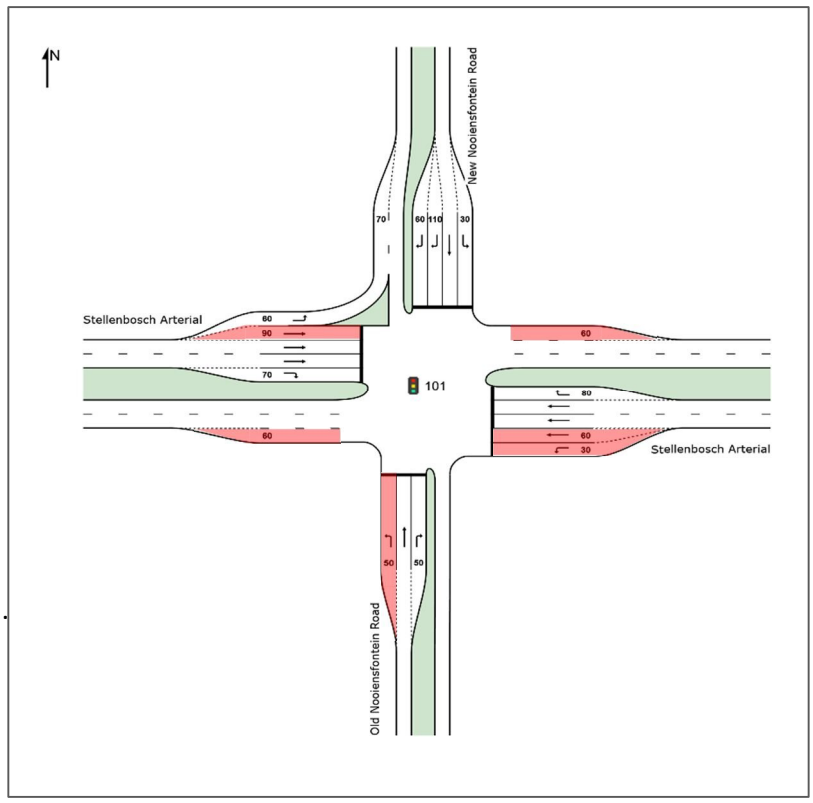
The intersections were analysed using SIDRA software. SIDRA calculates movement and intersection delays and assigns a service level based on the duration of the delay. A level of service A denotes an excellent service level with very little delay, whereas a level of service F represents very long delays and a breakdown in service. A level of service D is generally taken as the lowest acceptable standard. The results of the SIDRA analysis are summarised in ***Table 2***. Existing (2024) traffic volumes and service levels are shown in ***Figure 4***.

Table 2: Levels of service with existing (2024) traffic volumes

Intersection	Control measure	Morning peak hour		Afternoon peak hour	
		Intersection service level	Average intersection delay (s)	Intersection service level	Average intersection delay (s)
Stellenbosch Arterial / New Nooiensfontein	Signals – 2024 layout	F	134	F	85
	Diagram 1	D	46	D	48
Highbury / New Nooiensfontein	Signals	C	26	C	29
Reuter St / Belhar Drive	3-way stop	A	9	A	9

Despite an additional lane having been added on the northern New Nooiensfontein Road approach of the Stellenbosch Arterial / New Nooiensfontein Road intersection in 2016, service levels at this intersection are still poor. Service levels can be improved to acceptable levels by providing the additional lanes shown in ***Diagram 1***.

Diagram 1: Stellenbosch Arterial / New Nooiensfontein Road intersection layout required to accommodate 2024 traffic volumes



8. REM FARM 1388 DEVELOPMENT: PHASE 1

It is anticipated that the Rem Farm 1388 development will be completed in phases over the next ten years. Two scenarios were analysed in this assessment: The year 2029 with 50% of the development completed, and the year 2034 with the full development completed. The first instance is discussed in this paragraph.

8.1. Year 2029 background traffic demand estimation

Background traffic demand is constituted of two components: percentage growth and traffic build-up from other developments. An annual traffic growth rate of 3% was used to calculate percentage growth, as recommended for average growth areas in the TMH17 Trip Data Manual. Trips from the remaining phases of the Hamilton Estate development on Remainder Erf 22180 Kuilsrivier were also taken into account. The affected intersections were analysed with 2029 background traffic volumes. The results of the analysis are summarised in ***Table 3*** and shown in ***Figure 5***, Appendix B.

Table 3: Levels of service with Year 2029 background traffic volumes

Intersection	Control measure	Morning peak hour		Afternoon peak hour	
		Intersection service level	Average intersection delay (s)	Intersection service level	Average intersection delay (s)
Stellenbosch Arterial / New Nooiensfontein	Diagram 1 layout	F	100	F	109
Highbury / New Nooiensfontein	Signals	C	28	C	33
Reuter St / Belhar Drive	3-way stop	A	9	A	9

The Reuter Street / Belhar Drive and Highbury Road / New Nooiensfontein Road intersections are expected to continue operating at acceptable service levels with 2029 volumes, with no improvements required. The capacity of the Stellenbosch Arterial / New Nooiensfontein Road intersection with the layout shown in ***Diagram 1*** will be exceeded by 2029. Stellenbosch Arterial carries the highest traffic volumes, but excessive delays are caused by the nearly 1000 vehicles turning right from New Nooiensfontein Road North onto Stellenbosch Arterial. This points to the need for an alternative egress out of the Kalkfontein area. As mentioned in paragraph 6, the northward extension of Wesbank Main Road and the westward extension of Belhar Drive will help to get traffic in and out of Kalkfontein.

8.2. Phase 1 development trips

The trip generation rates recommended COTO TMH17 Trip Data Manual were used to calculate the trip generation potential of the Rem Farm 1388 development. The recommended afternoon peak hour rate for shopping centres is unrealistically high for the type of retail outlets found in low cost housing areas and therefore the morning peak hour rate was used. The adjustment factors for low vehicle ownership were applied to all land uses, and the factor for mixed use was applied to the commercial erf. The development's trip generation potential is summarised in ***Table 4*** on the following page.

Table 4: Rem Farm 1388 Kalkfontein: PHASE 1 trip generation potential

Land use	Units / GLA	Trip gen rate	Adj factor (low veh own)	Adj factor (mixed use)	Nett TGR	% In	% Out	Total	In	Out
Morning peak hour										
Single residential	218 units	1	40%		0,6	0,25	0,75	131	33	98
General business	1015 m^2	3,6	30%	10%	2,52	0,65	0,35	26	17	9
Group housing	22 units	0,85	40%		0,51	0,25	0,75	11	3	8
							Morning peak hour total	**168**	**52**	**115**

Afternoon peak hour										
Single residential	219 units	1	40%		0,6	0,7	0,25	131	92	33
General business	1015 m^2	3,6	30%	10%	2,52	0,5	0,5	26	13	13
Group housing	22 units	0,85	40%		0,51	0,7	0,3	11	8	3
							Afternoon peak hour total	**168**	**112**	**49**

It was assumed that the first half of the development would be finished before the completion of the Highbury Road Extension link and the construction of the new bridge over the Kuils River. For the 2029 scenario, the majority of trips were therefore distributed via Reuter Street. The 2029 trip distribution is shown in ***Figure 6.***

8.3. Phase 1 traffic impact

Trips generated by the first half of the Rem Farm 1388 development were added to Year 2029 background traffic volumes and the affected intersections were analysed with the increased traffic volumes in order to determine the development's traffic impact. Total traffic volumes and service levels are shown in ***Figure 7***. A summary of the analysis results is given in ***Table 5***.

Table 5: Levels of service with Total 2029 traffic volumes

Intersection	Control measure	Morning peak hour		Afternoon peak hour	
		Intersection service level	Average intersection delay (s)	Intersection service level	Average intersection delay (s)
Stellenbosch Arterial / New Nooiensfontein	Diagram 1 layout	F	89	F	110
Highbury / New Nooiensfontein	Signals	C	28	C	33
Reuter St / Belhar Drive	3-way stop	A	9	A	10

Rem Farm 1388 Phase 1 will add very few trips to the Stellenbosch Arterial / New Nooiensfontein Road intersection and will have a negligible impact at this intersection. The New Nooiensfontein Road / Highbury Road intersection will continue to operate at acceptable service levels, as will the Belhar Drive / Reuter Street intersection. From the comparison of pre- and post-development service levels, it can be concluded that Rem Farm 1388 Phase 1 will have a low traffic impact.

9. FULL DEVELOPMENT

9.1. Year 2034 background traffic demand estimation

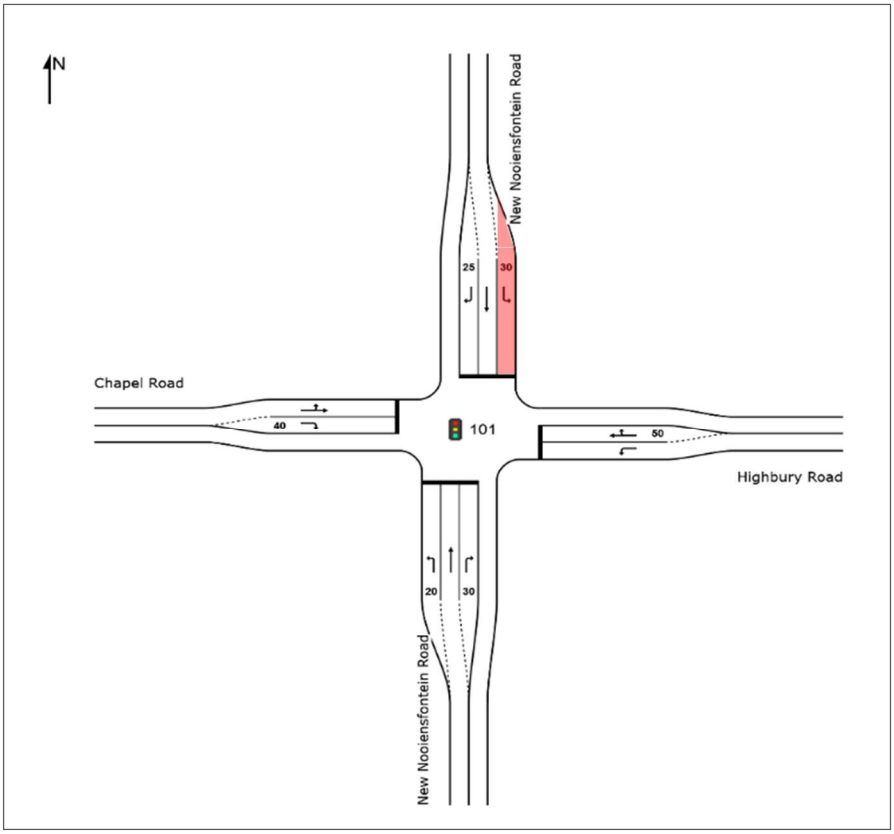
Year 2029 traffic volumes were increased by 3% per year to 2034 and added to Hamilton Estate trips to obtain 2034 background traffic volumes. Relevant intersections were analysed with the 2034 volumes. Year 2034 background traffic volumes and service levels are shown in ***Figure 8***. A summary of the analysis results is given in ***Table 6***.

Table 6: Levels of service with Year 2034 background traffic volumes

Intersection	Control measure	Morning peak hour		Afternoon peak hour	
		Intersection service level	Average intersection delay (s)	Intersection service level	Average intersection delay (s)
Stellenbosch Arterial / New Nooiensfontein	Diagram 1 layout	F	134	F	85
Highbury / New Nooiensfontein	Current layout	D	37	F	99
	Diagram 2 layout	C	34	C	33
Reuter St / Belhar Drive	3-way stop	A	9	A	10

Delays at the Stellenbosch Arterial / New Nooiensfontein Road intersection will increase even further if no alternative route out of Kalkfontein has been provided by 2034. All movements will operate at acceptable service levels with the layout shown in ***Diagram 2.*** The Belhar Drive / Reuter Street intersection will continue to operate at good service levels.

Diagram 2: Layout required at New Nooiensfontein Road / Highbury Road intersection for 2034 background traffic volumes



9.2. Development trips

The full Rem Farm 1388 development's trip generation potential is summarised in ***Table 7*** below. For the full development (2034), trips were distributed via Reuter Street and Old Nooiensfontein Road / Highbury Road Extension. The trip distribution is shown in ***Figure 9***.

Table 7: Full Rem Farm 1388 Kalkfontein trip generation potential

Land use	Units / GLA	Trip gen rate	Adj factor (low veh own)	Adj factor (mixed use)	Nett TGR	% In	% Out	Total	In	Out
Morning peak hour										
Single residential	436 units	1	40%		0,6	0,25	0,75	262	65	196
General business	2030 m^2	3,6	30%	10%	2,52	0,65	0,35	51	33	18
Group housing	44 units	0,85	40%		0,51	0,25	0,75	22	6	17
							Morning peak hour total	**366**	**104**	**231**
Afternoon peak hour										
Single residential	436 units	1	40%		0,6	0,7	0,25	262	183	65
General business	2030 m^2	3,6	30%	10%	2,52	0,5	0,5	51	26	26
Group housing	44 units	0,85	40%		0,51	0,7	0,3	22	16	7
							Afternoon peak hour total	**335**	**224**	**98**

9.3. Impact of full Rem Farm 1388 development

Trips from the full development were added to 2034 background traffic volumes and analysed to determine the traffic impact. The analysis results are summarised in ***Table 8***. Total 2034 traffic volumes and service levels are shown in ***Figure 10***.

Table 8: Levels of service with total traffic volumes

Intersection	Control measure	Morning peak hour		Afternoon peak hour	
		Intersection service level	Average intersection delay (s)	Intersection service level	Average intersection delay (s)
Stellenbosch Arterial / New Nooiensfontein	Diagram 1 layout	F	224	F	217
Highbury / New Nooiensfontein	Diagram 2 layout	D	48	D	44
Reuter St / Belhar Drive	3-way stop	A	9	A	10

The Farm 1388 development will increase traffic volumes at the Stellenbosch Arterial / New Nooiensfontein Road intersection by only 3%, but due to the already poor service levels delays

will increase even further. An alternative route out of Kalkfontein will be crucial by 2034. The upgraded Highbury Road / New Nooiensfontein Road intersection and the Reuter Street / Belhar Drive intersection will continue to operate at acceptable service levels.

The westward extension of Highbury Road and the upgrading of the Old Nooiensfontein Road bridge over the Kuils River needs to be completed before the completion of the Rem Farm 1388. Development contributions from the Rem Farm 1388 can be added to the DC's from Hamilton Estate to fund these improvements.

It can be concluded that the Rem Farm 1388 development will have a moderate traffic impact.

10. ACCESS, INTERNAL ROAD LAYOUT AND PARKING

The development will obtain access via the south-westward extension of Reuter Street. This road will run through the development and will terminate at the southern property boundary, from where it can be extended towards the R300 in future, if required. This road will have a 16-metre wide reserve, the same as the section up to Belhar Drive. All other internal roads will have 8-metre wide reserves.

Reuter Street Extension should have a surfaced width of 6,8 metres and the lower order internal roads should have surfaced widths of 5,5 metres (5 metres for dead end streets). The Rezoning and Subdivision Plan shows that splays will be provided at all street corners and that turning space will be provided at the ends of dead-end streets.

11. PUBLIC AND NON-MOTORISED TRANSPORT

Minibus taxis make up a large percentage of the vehicles going to and from Kalkfontein and many pedestrians were noticed during the site visit. It is recommended that embayments for public transport vehicles should be provided along Reuter Street Extension. Sidewalks should be provided along at least one side of Reuter Street Extension.

12. CONCLUSIONS

It can be concluded that the proposed residential development on Rem Farm 1388 Kalkfontein will have a moderate traffic impact. Other conclusions drawn from the study are summarised below.

- The site is located to the south of the Kalkfontein residential area, north of Stellenbosch Arterial and east of the R300. The Bet-El School for epiliptici borders Rem Farm 1388 on the western side;
- The development will entail the rezoning of Remainder Farm 1388 and subdivision into 436 single residential erven, 44 group housing units, one business erf and supporting land uses;
- Access will be obtained via the southward extension of Reuter Street;
- There are certain new road links, as well as road and intersection improvements that were set as conditions of approval for neighbouring developments and which will also be required for the Rem Farm 1388 development;

- Minor Road 86 (OP0086) is a gravel track that runs from Old Nooiensfontein Road south-westwards towards the R300 and the Rem Farm 1388 development will be built over the road. OP0086 is still a proclaimed provincial minor road;
- An alternative route will be provided via Old Nooiensfontein Road and Reuter Street to the area that currently obtains access via OP0086;
- The City of Cape Town's Road Network Plan shows that Belhar Drive will be extended over the R300 to link up with Erica Drive in the west;
- There have been discussions with City of Cape Town and Provincial Roads officials about providing an alternative access to the Kalkfontein area through the northward extension of Wesbank Main Road. Allowance is made for the southward extension of Reuter Street through Rem Farm 1388 to link with that road in future;
- Despite an additional lane having been added on the northern New Nooiensfontein Road approach of the Stellenbosch Arterial / New Nooiensfontein Road intersection in 2016, service levels at this intersection are still unacceptable (LOS F);
- It is anticipated that 50% of Rem Farm 1388 will be developed by 2029 and 100% by 2034;
- Rem Farm 1388 Phase 1 will have a low traffic impact and no infrastructure improvements will be required;
- The full development will generate 335 trips (104 in, 231 out) in the morning peak hour and 335 trips (224 in, 98 out) in the afternoon peak hour;
- The Highbury Road / New Nooiensfontein Road intersection will have to be upgraded to accommodate Year 2034 background traffic volumes;
- The development will generate a considerable number of public and non-motorised transport trips.

14. RECOMMENDATIONS

The recommendations made in the Rem Farm 1388 transport impact assessment are summarised below.

- OP0086 will have to be deproclaimed and any property that currently takes access off OP0086 will have to be provided with alternative access;
- Reuter Street Extension should have a surfaced width of 6,8 metres and the lower order internal roads should have surfaced widths of 5,5 metres (5 metres for dead end streets);
- Embayments for public transport vehicles should be provided along Reuter Street Extension;
- Sidewalks should be provided along at least one side of Reuter Street Extension;
- Current (2024) service levels at the Stellenbosch Arterial / New Nooiensfontein Road intersection can be improved by adding more lanes as shown in ***Diagram 1***;
- The capacity of the Stellenbosch Arterial / New Nooiensfontein Road intersection with the Diagram 1 layout will be exceeded by 2029. This points to the need for an alternative egress out of the Kalkfontein area. The northward extension of Wesbank

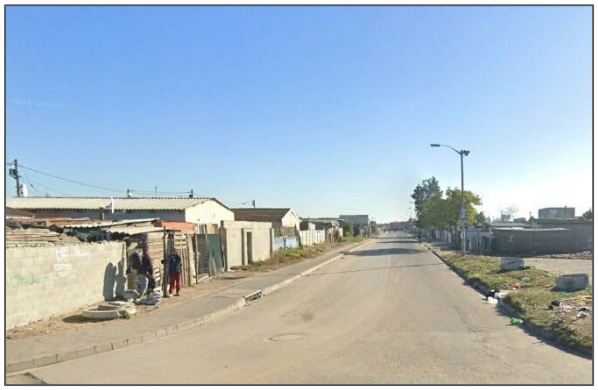
Main Road and the westward extension of Belhar Drive needs to be provided to serve this purpose;

- The capacity of the New Nooiensfontein Road / Highbury Road intersection will be exceeded by 2034 and a third lane will have to be added on the northern approach to reduce delays. See ***Diagram 2***;
- The westward extension of Highbury Road and the upgrading of the Old Nooiensfontein Road bridge over the Kuils River needs to be completed before the completion of the Rem Farm 1388. Development contributions from the Rem Farm 1388 can be added to the DC's from Hamilton Estate to fund these improvements.

ANNEXURE A: PHOTOGRAPHIC RECORD OF EXISTING TRANSPORT FACILITIES

1. Southern end of Reuter Street surfaced section (at Verenigde Street)

1a) Looking north along Reuter Street



1b) Looking east along Verenigde Street

1c) Looking south along Reuter St gravel section

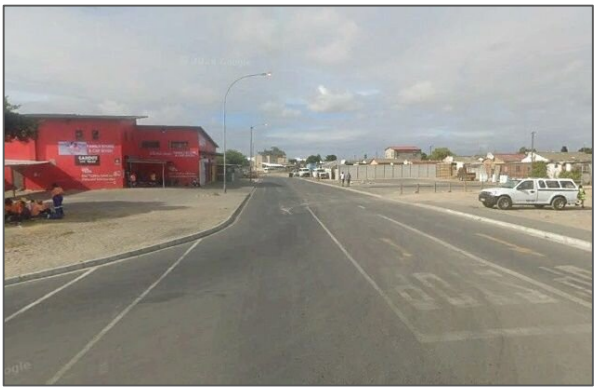
1d) Looking west along Verenigde Street

2. Reuter Street / Belhar Drive intersection

2a) Looking north along Reuter Street

2b) Looking east along Belhar Drive

2c) Looking south along Reuter Street



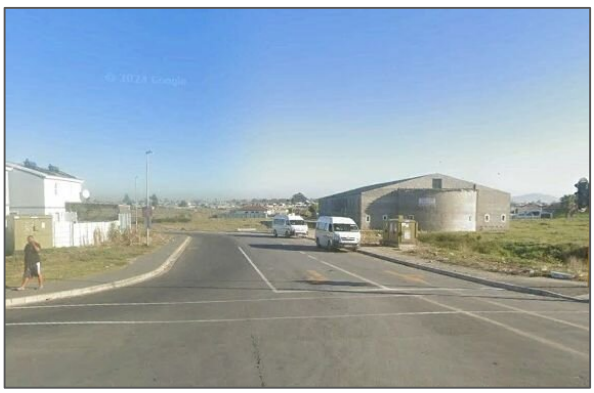
3. New Nooiensfontein Road / Highbury Road intersection

3a) Looking north-east along New Nooiensfontein

3b) Looking south-east along Highbury Road

3c) Looking south-west along New Nooiensfontein

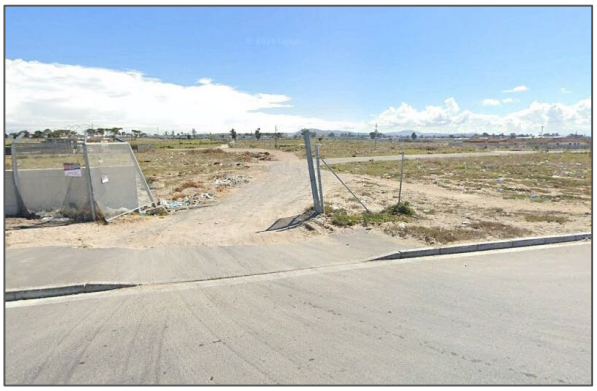
3d) Looking north-west along Highbury Road



4. Highbury Road and Chapel Road

4a) Looking towards Old Nooiensfontein Road from north-western end of Highbury Road

4b) Gravel track between Chapel Road and Old Nooiensfontein Road viewed from Chapel



5. Old Nooiensfontein Road / Old Nooiensfontein Road

5a) Looking north-east along Old Nooiensfontein

5b) Gravel track from Old Nooiensfontein to Highbury Road (looking east)

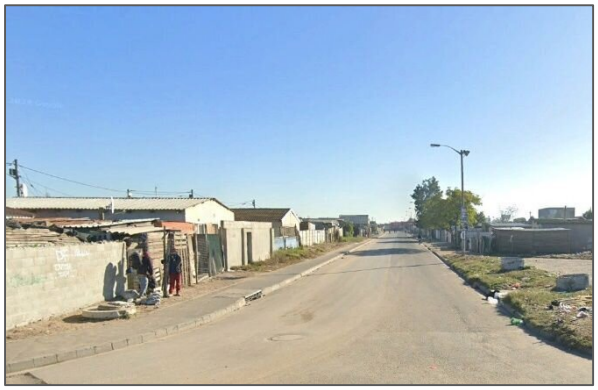
5c) Gravel track from Old Nooiensfontein to Chapel Road (looking south)

5d) Looking south-west towards Kuils River

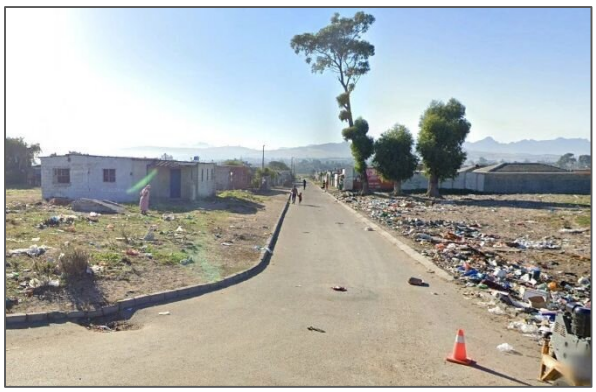
ANNEXURE A: PHOTOGRAPHIC RECORD OF EXISTING TRANSPORT FACILITIES

1. Southern end of Reuter Street surfaced section (at Verenigde Street)

1a) Looking north along Reuter Street



1b) Looking east along Verenigde Street



1c) Looking south along Reuter St gravel section

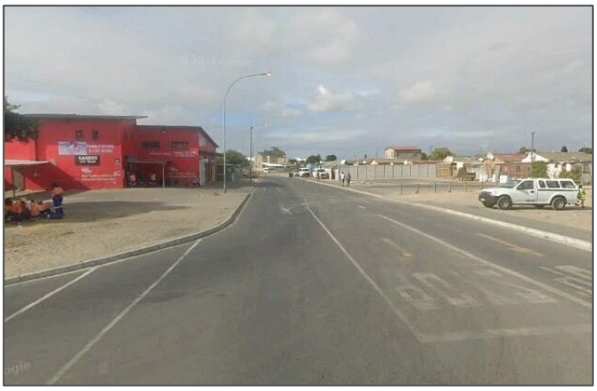
1d) Looking west along Verenigde Street

2. Reuter Street / Belhar Drive intersection

2a) Looking north along Reuter Street

2b) Looking east along Belhar Drive

2c) Looking south along Reuter Street



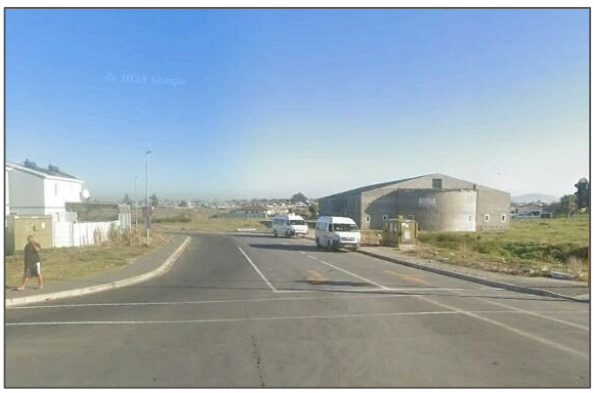
3. New Nooiensfontein Road / Highbury Road intersection

3a) Looking north-east along New Nooiensfontein

3b) Looking south-east along Highbury Road

3c) Looking south-west along New Nooiensfontein

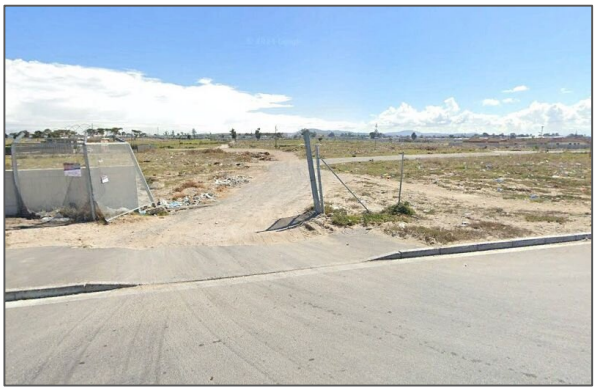
3d) Looking north-west along Highbury Road



4. Highbury Road and Chapel Road

4a) Looking towards Old Nooiensfontein Road from north-western end of Highbury Road

4b) Gravel track between Chapel Road and Old Nooiensfontein Road viewed from Chapel



5. Old Nooiensfontein Road / Old Nooiensfontein Road

5a) Looking north-east along Old Nooiensfontein

5b) Gravel track from Old Nooiensfontein to Highbury Road (looking east)

5c) Gravel track from Old Nooiensfontein to Chapel Road (looking south)

5d) Looking south-west towards Kuils River

6. Old Nooiensfontein Road / Minor Road 86 (OP0086)

6a) Looking south-east along Old Nooiensfontein towards Kuils River bridge

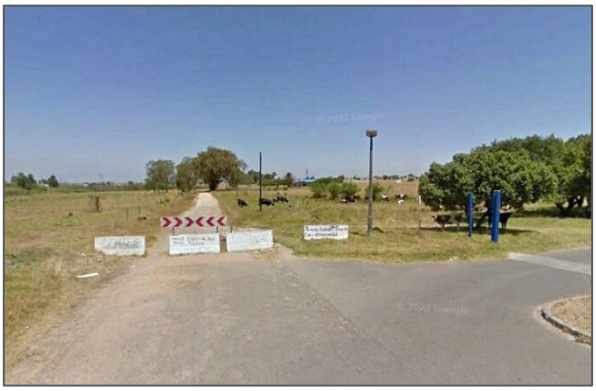
6b) Looking south-west along Bet-El school access road (OP0086)

6c) Looking north-west towards Kalkfontein residential area

7. Minor Road 86 (OP0086) / Bet-El School access

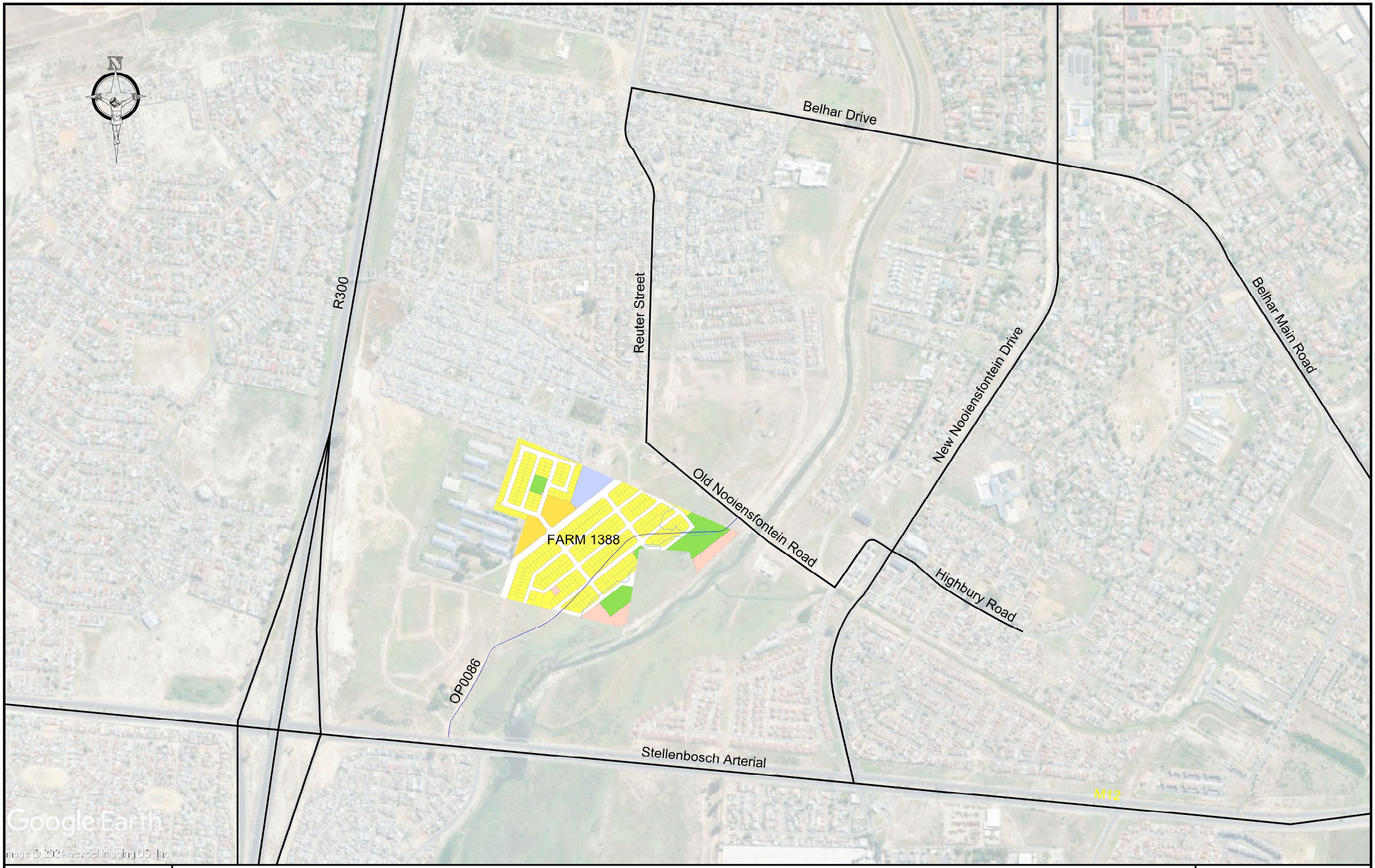
7a) Looking north-east along OP0086

7b) Looking south-west along OP0086 (road closed)



7c) Looking north-west at Bet-El School entrance

ANNEXURE B: DRAWINGS



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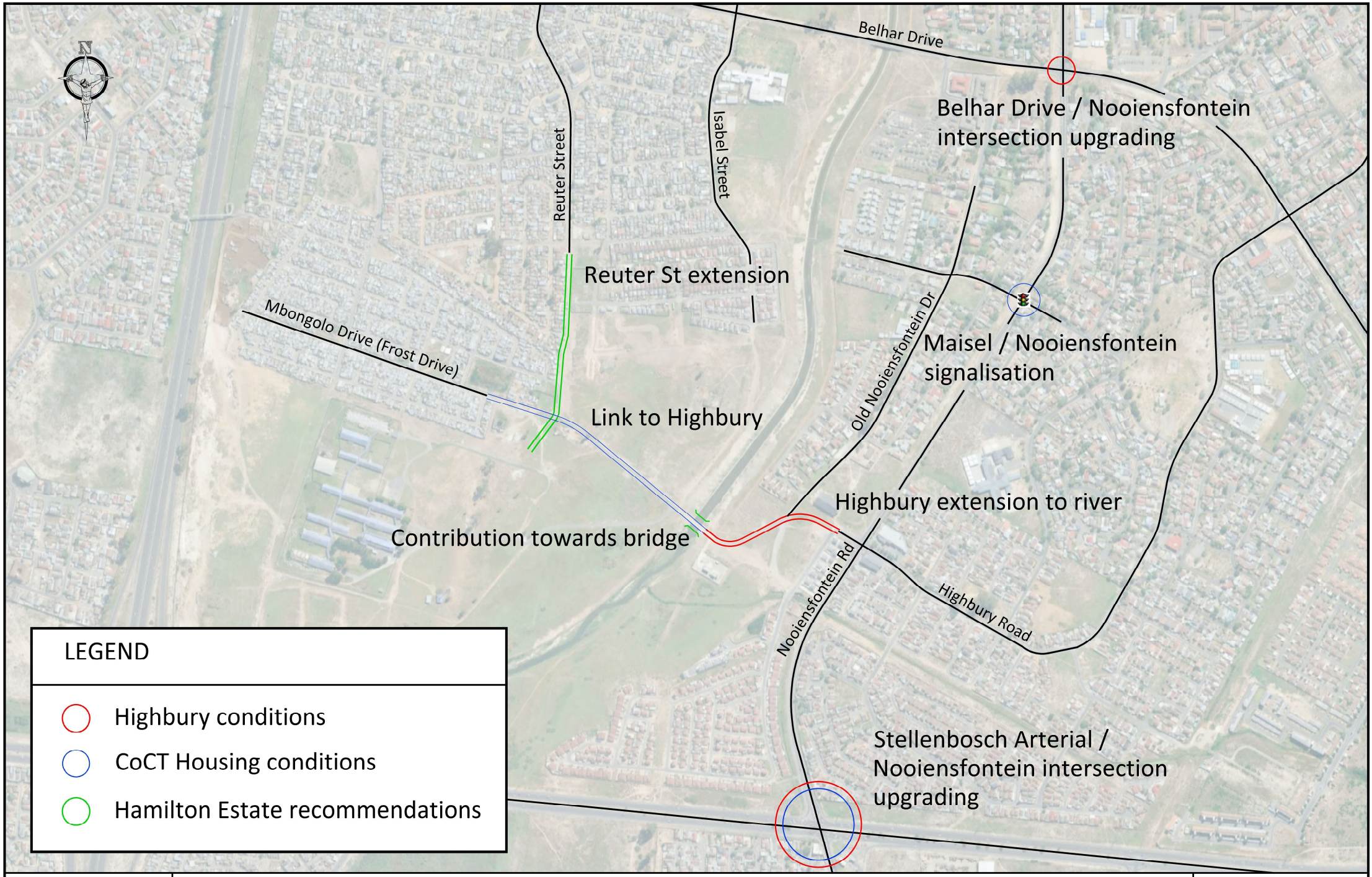
REMAINDER FARM 1388, KALKFONTEIN
LOCALITY PLAN

FIGURE 1
2024-12-12



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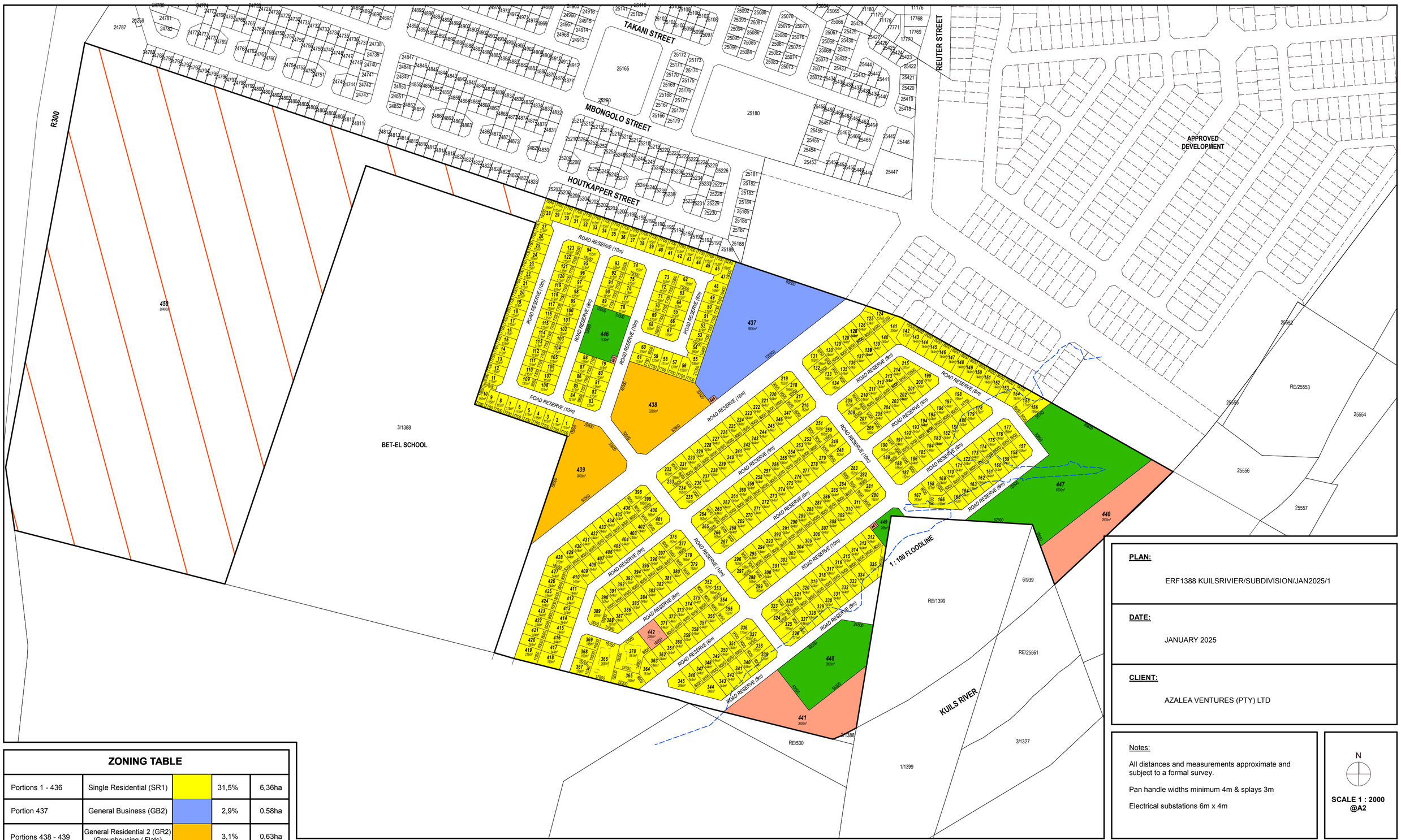
ROAD INFRASTRUCTURE IMPROVEMENT PROJECTS
KALKFONTEIN

FIGURE 3
2024-12-09



ZONING TABLE

Portions 1 - 436	Single Residential (SR1)		31,5%	6,36ha
Portion 437	General Business (GB2)		2,9%	0.58ha
Portions 438 - 439	General Residential 2 (GR2) (Grouphousing / Flats)		3,1%	0,63ha
Portions 440 - 445	Utility Zone (UT)		3,1%	0,62ha
Portions 446 - 449	Open Space (OS2)		5,4%	1,08ha
Portion 450	Subdivisional Area (Residential & ancillary uses)		39,8%	8,04ha
Remainder	Transport Zone (TR2)		14,2%	2,88ha
Total			100%	20,19ha

REZONING AND SUBDIVISION - REMAINDER
FARM 1388, KUILSRIVIER

PLAN:

ERF1388 KUILSRIVIER/SUBDIVISION/JAN2025/1

DATE:

JANUARY 2025

CLIENT:

AZALEA VENTURES (PTY) LTD

Notes:

All distances and measurements approximate and subject to a formal survey.

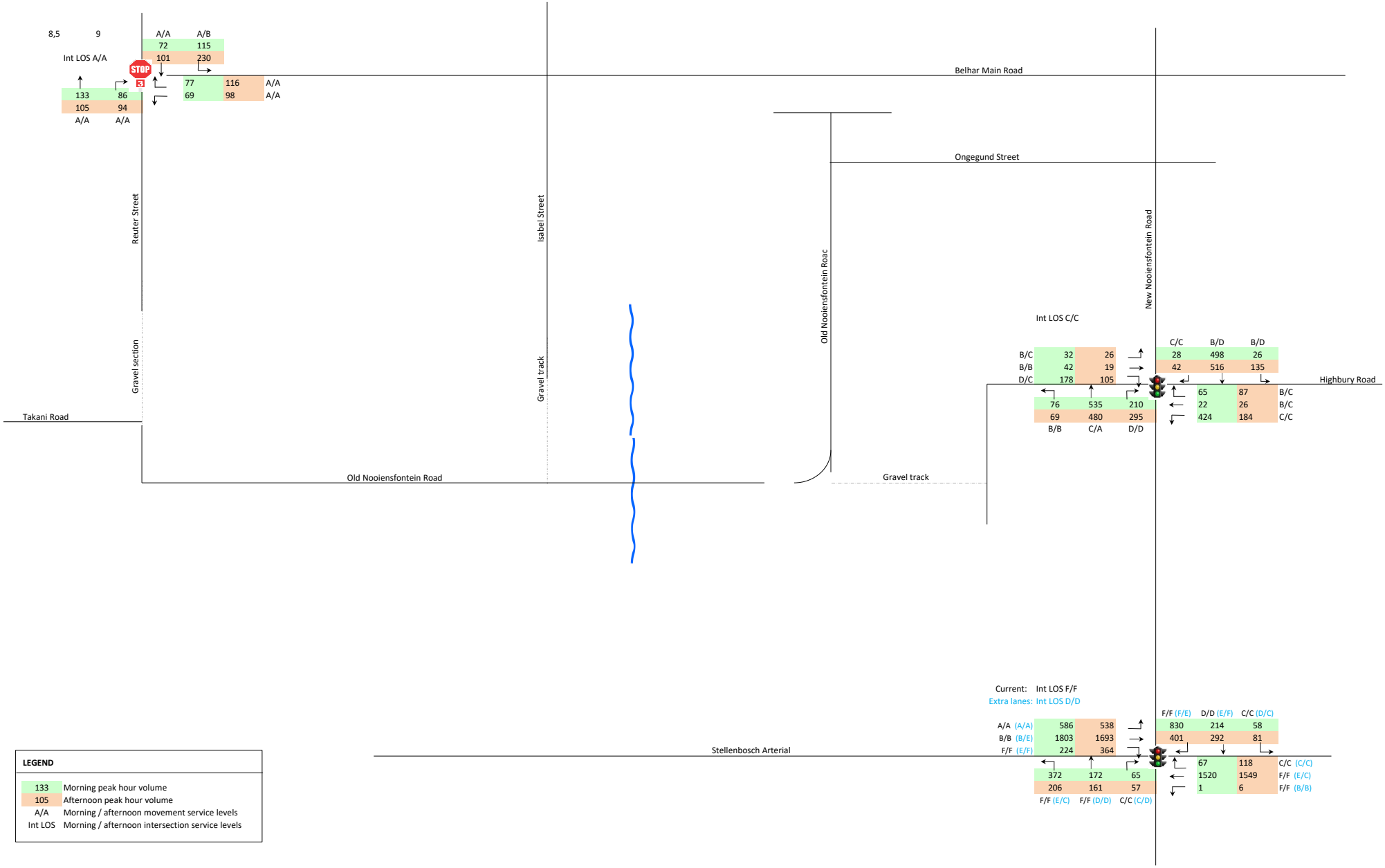
Pan handle widths minimum 4m & splays 3m

Electrical substations 6m x 4m

N

SCALE 1 : 2000 @A2

ATLAS
Town Planning
P.O. BOX 380, KUILSRIVIER, 7579
(021) 8017446



LEGEND	
133	Morning peak hour volume
105	Afternoon peak hour volume
A/A	Morning / afternoon movement service levels
Int LOS	Morning / afternoon intersection service levels

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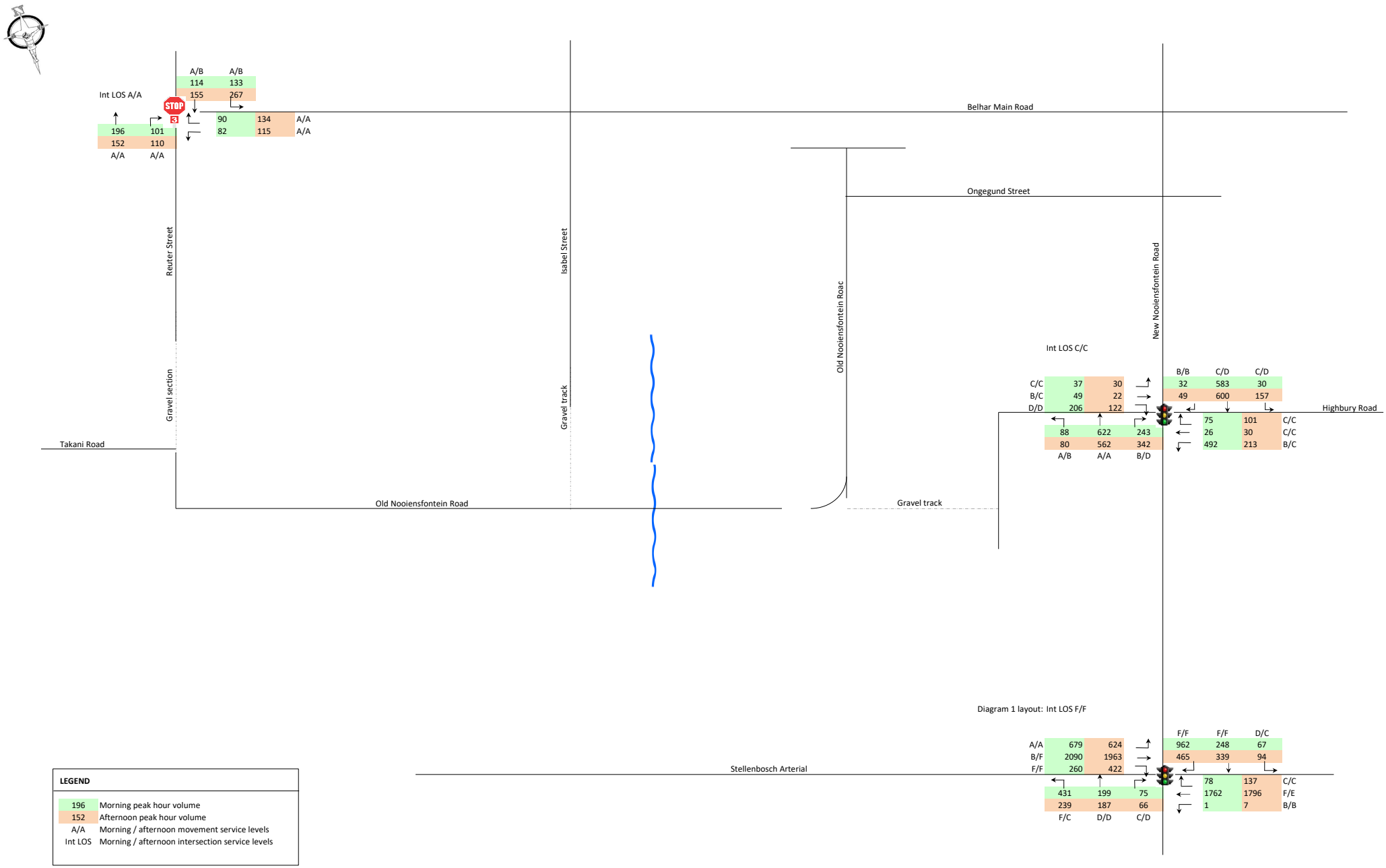
EXISTING 2024 TRAFFIC VOLUMES AND SERVICE LEVELS

FIGURE 4
2024-12-12



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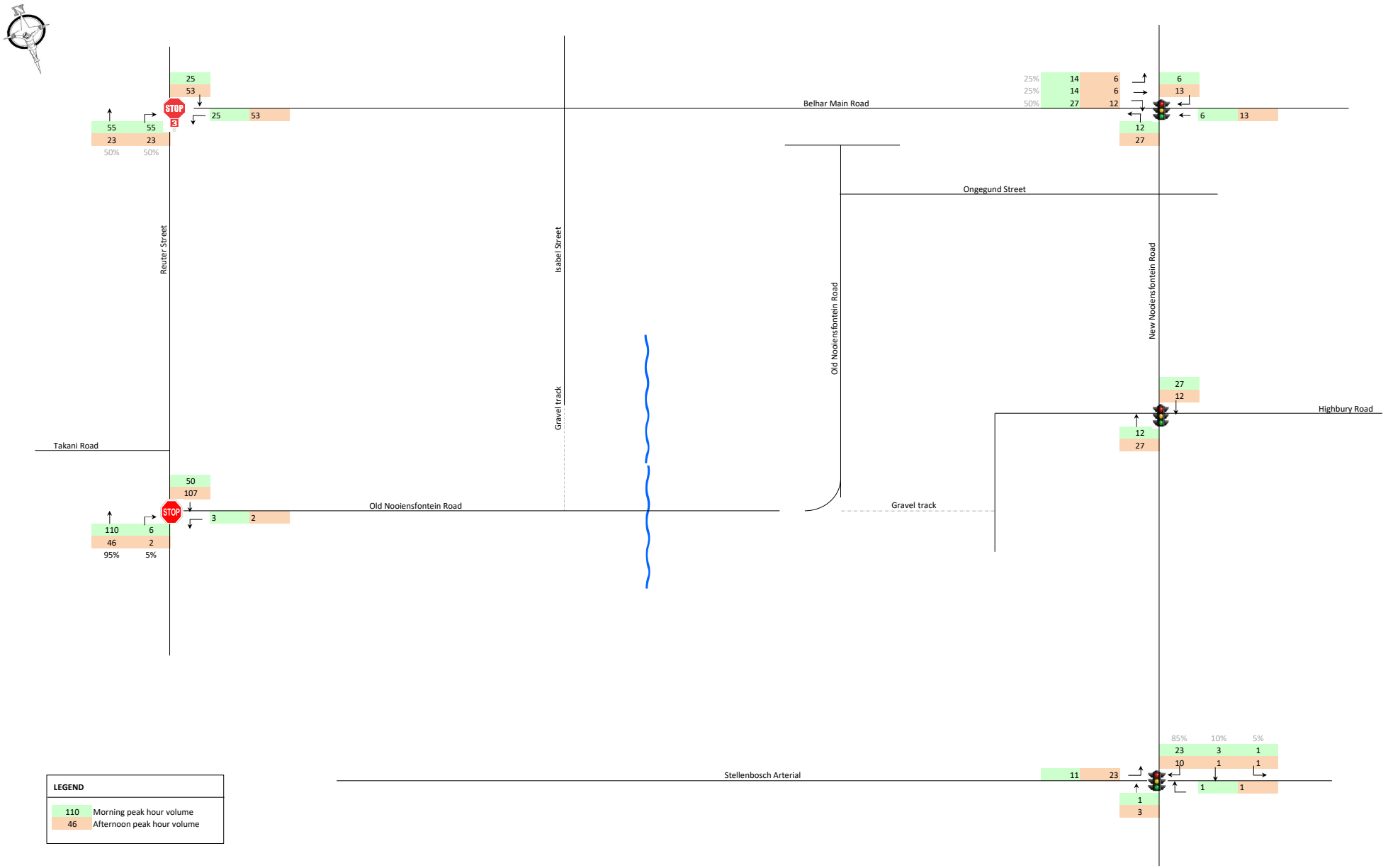
YEAR 2029 BACKGROUND TRAFFIC VOLUMES AND SERVICE LEVELS

FIGURE 5
2024-12-12



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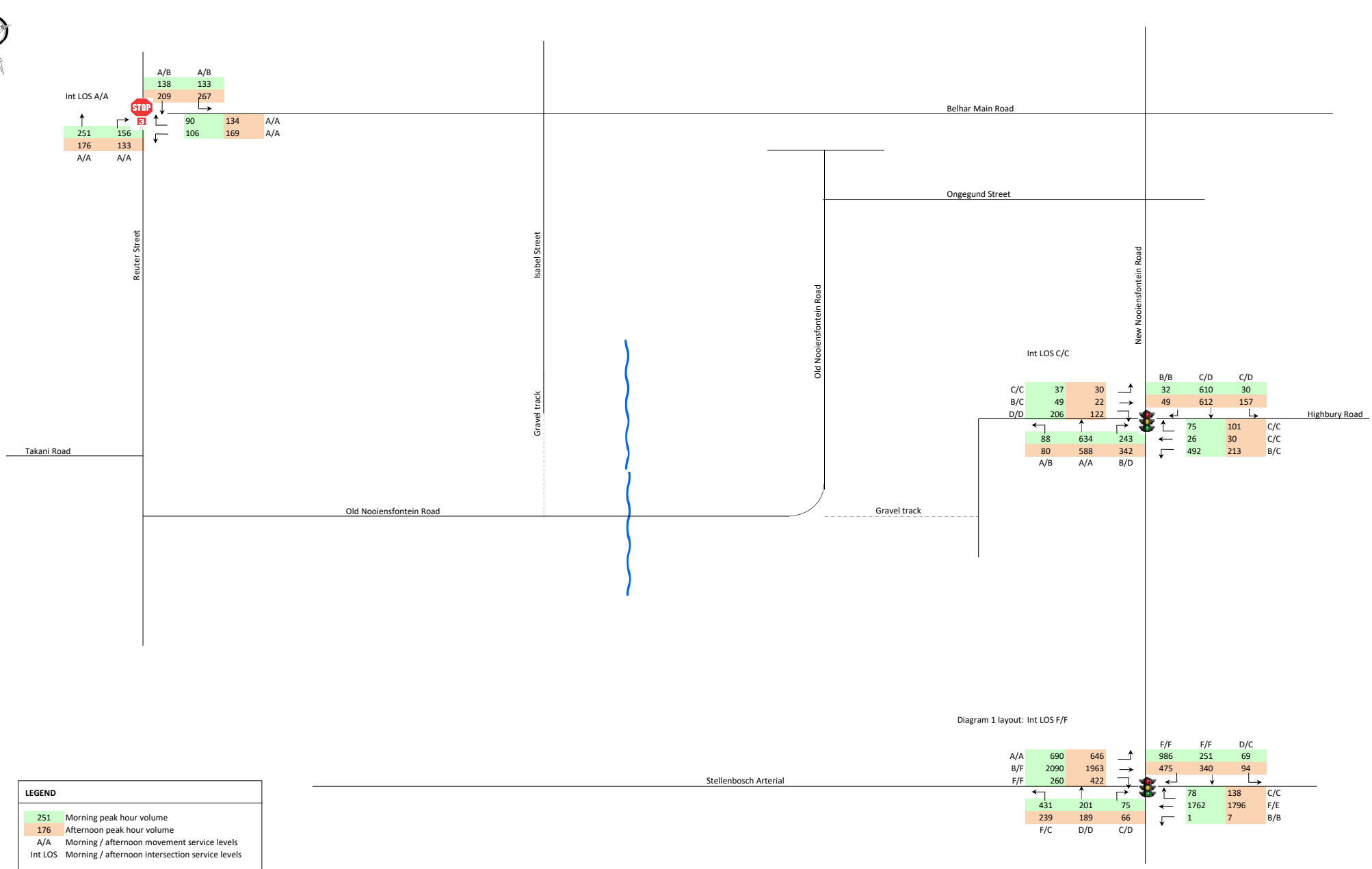
DISTRIBUTION OF REM FARM 1388 PHASE 1 TRIPS

FIGURE 6
2024-12-12



LEGEND

251	Morning peak hour volume
176	Afternoon peak hour volume
A/A	Morning / afternoon movement service levels
Int LOS	Morning / afternoon intersection service levels

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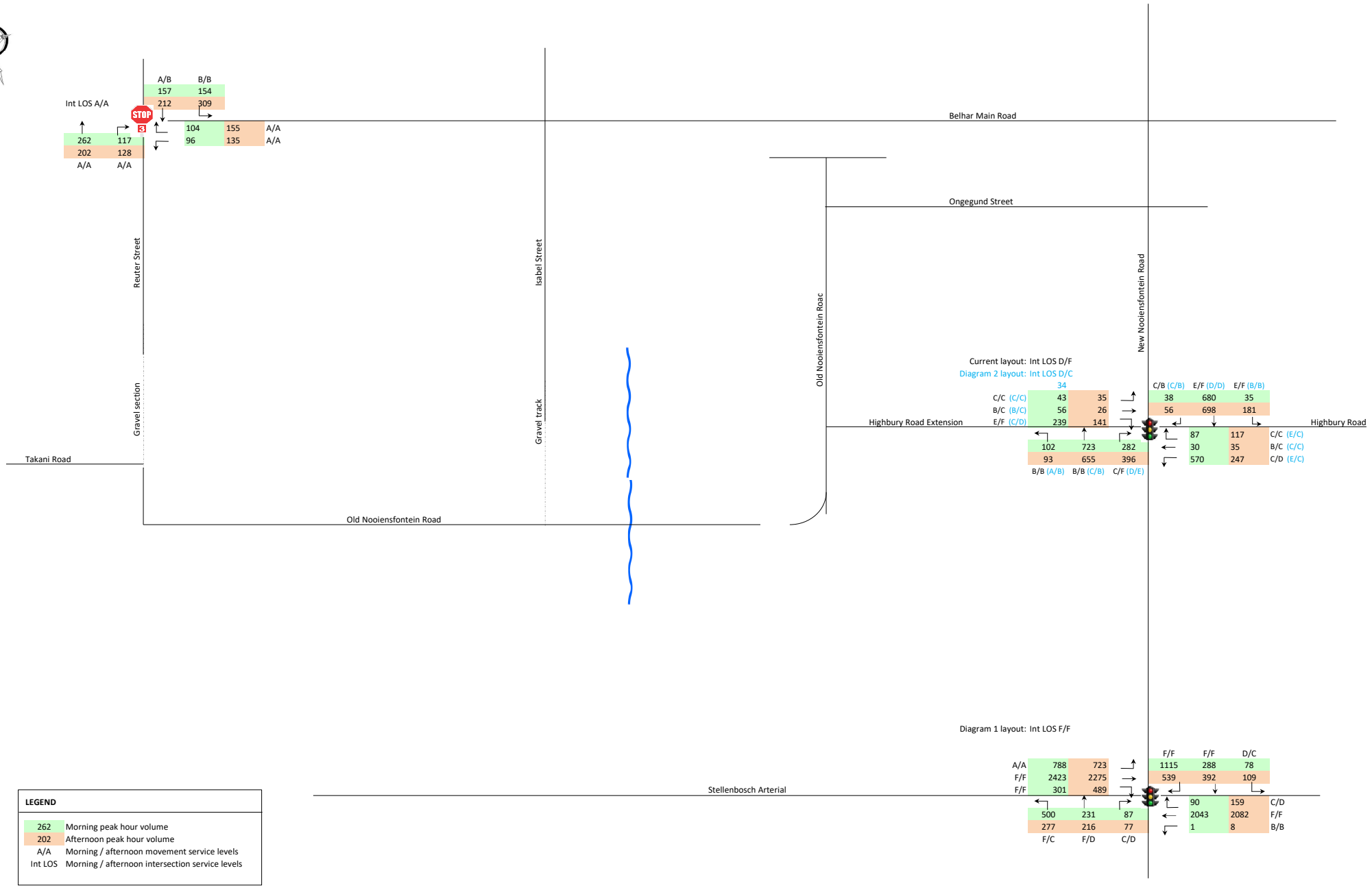
TOTAL 2029 TRAFFIC VOLUMES AND SERVICE LEVELS

FIGURE 7
2024-12-12



LEGEND

262	Morning peak hour volume
202	Afternoon peak hour volume
A/A	Morning / afternoon movement service levels
Int LOS	Morning / afternoon intersection service levels

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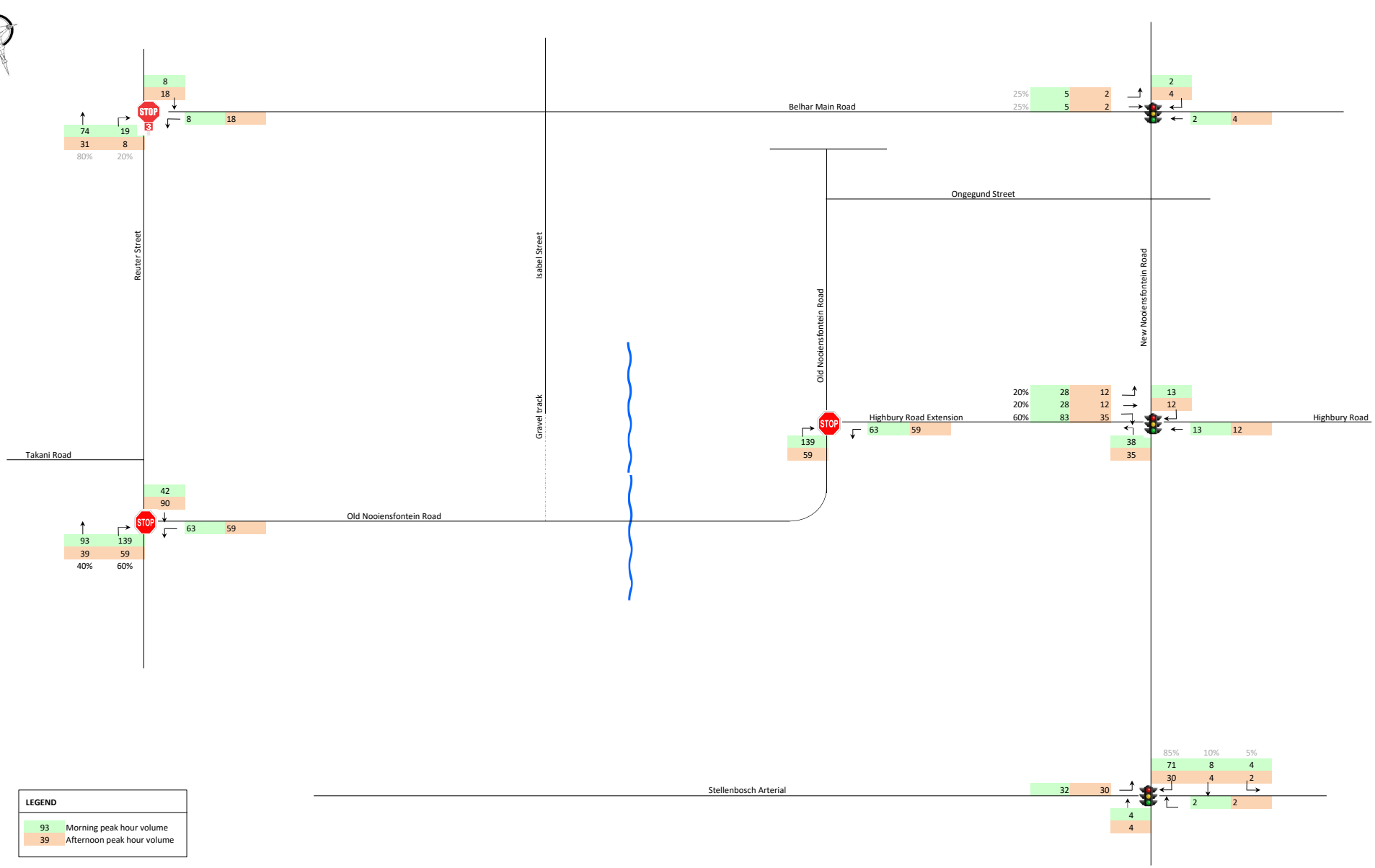
YEAR 2034 BACKGROUND TRAFFIC VOLUMES AND SERVICE LEVELS

FIGURE 8
2024-12-12



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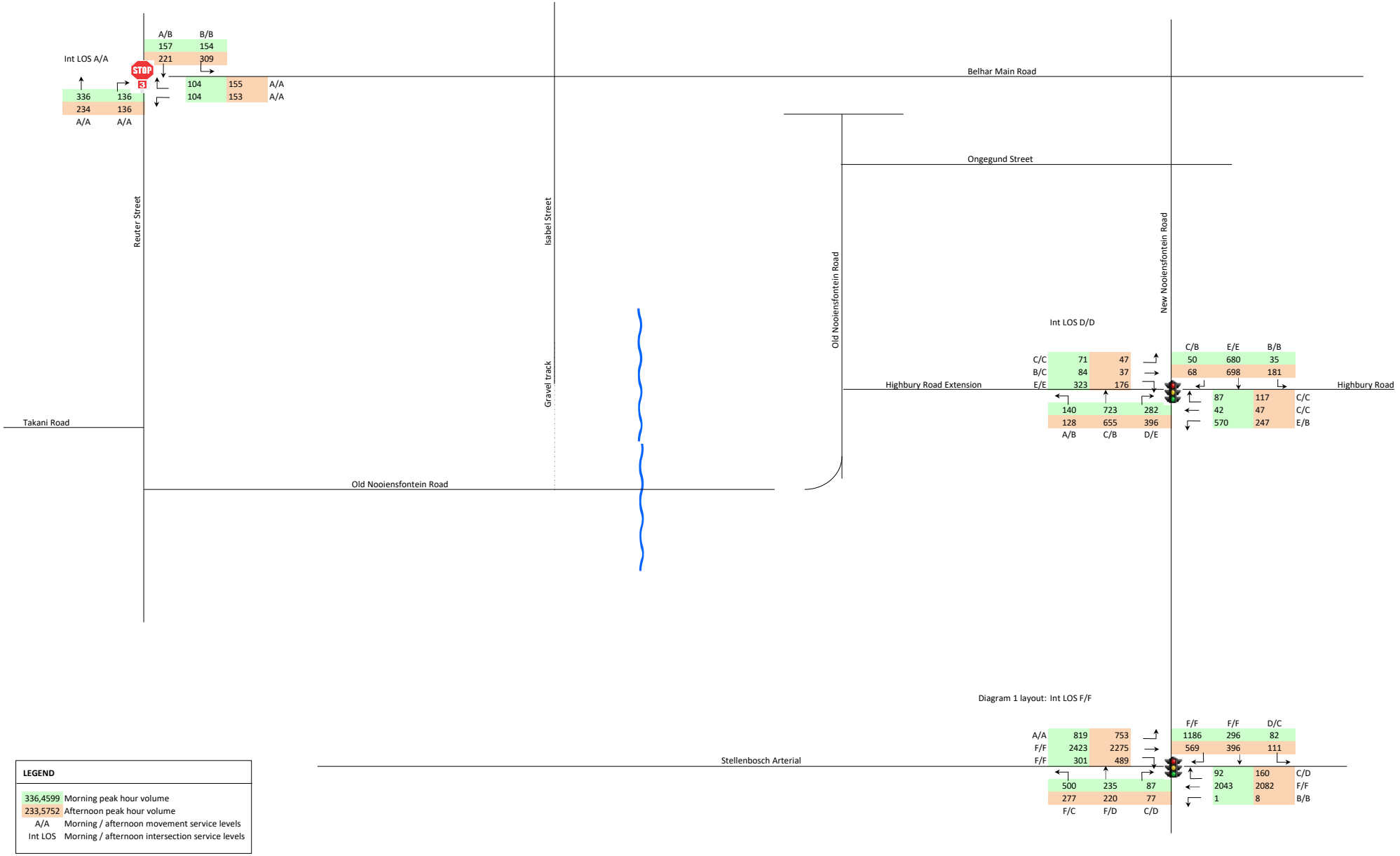
DISTRIBUTION OF REM FARM 1388 TRIPS (FULL DEVELOPMENT)

FIGURE 9
2024-12-12



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TOTAL 2034 TRAFFIC VOLUMES AND SERVICE LEVELS

FIGURE 10
2024-12-12