MONTAGU

PROPOSED HOUSING DEVELOPMENT OF MANDELA SQUARE

ON REMAINDER ERVEN 1 & 937

TECHNICAL REPORT ON THE PROVISION OF CIVIL INFRASTRUCTURE SERVICES

REPORT NO. R01496

28 JUNE 2024

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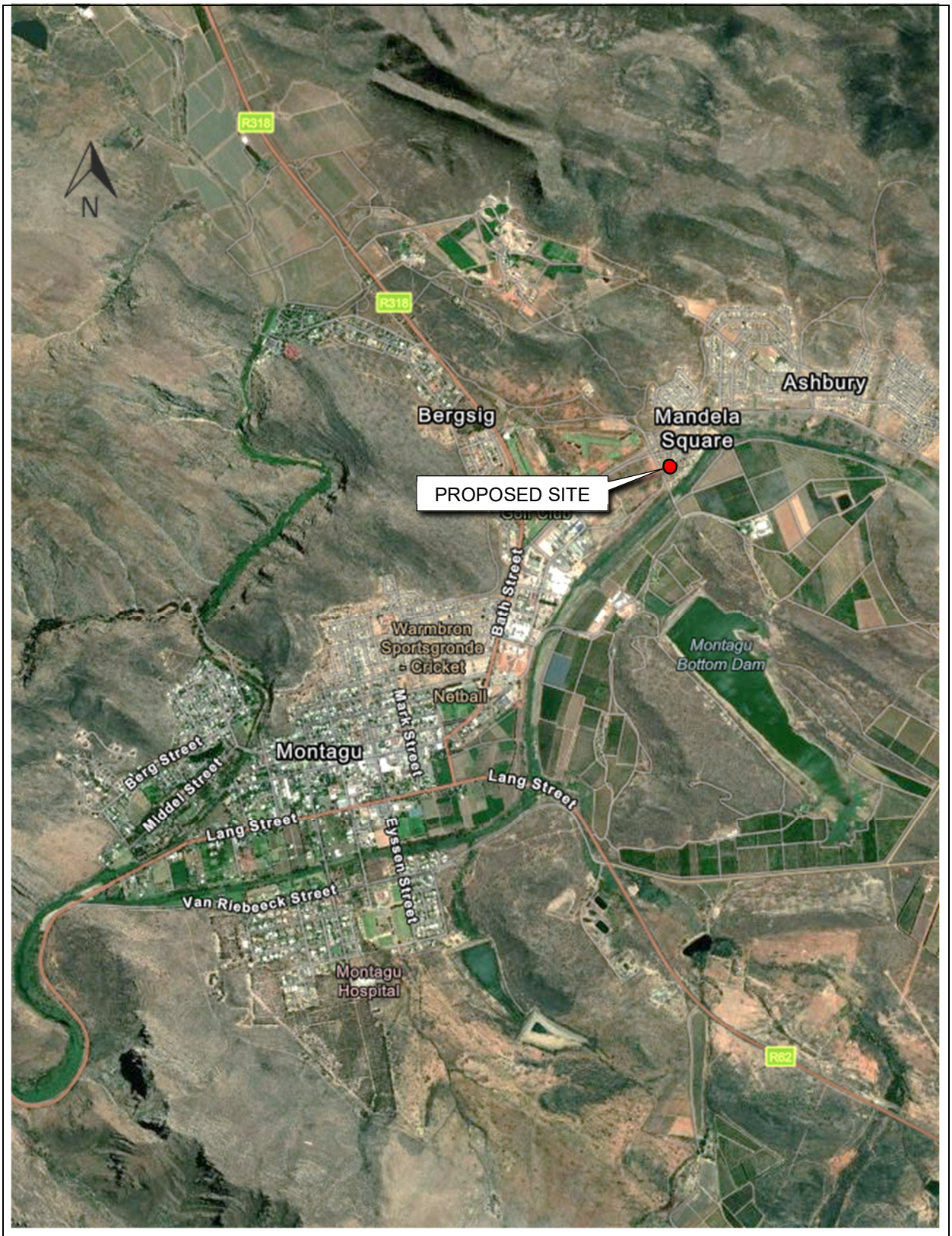

LOCALITY PLAN

PROPOSED HOUSING DEVELOPMENT OF MANDELA SQUARE ON REMAINDER ERVEN 1 & 937

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1. INTRODUCTION

Asla Devco appointed V3 Consulting Engineers (Pty) Ltd to prepare a services report for the provision of Civil Infrastructure Services to the proposed housing development on Remainder Erven 1 & 937, Montagu known as Mandela Square.

The proposed development as depicted by Urban Dynamics Western Cape's Layout drawing dated 12 March 2024 and attached as Annexure A, comprises of the following:

- 4 x Informal Housing & Ablution Blocks zoned as Single Residential Zone II, with approximate area of 3.06ha
- 2 x Utility Blocks zoned as Utility Zone, with approximate area of 0.10ha
- 4 x Roads zoned as Transportation Zone, with approximate area of 0.50ha

2. DESIGN AND CONSTRUCTION STANDARDS

The minimum standards proposed for the civil services and pertaining infrastructure will comply with the recommendations made by the Department of Human Settlements (Western Cape Government) in respect of the A Grade Engineering Services subsidy.

This is also in compliance with the "Guidelines for Human Settlements, Planning and Design" as compiled under patronage of the Department of Housing by CSIR Building & Construction Technology (also known as the "Red Book") as well as any specific requirements prescribed by the Langeberg Municipality.

The relevant code of standards (i.e. SANS 1200, etc.) should be made applicable to material and construction standards.

3. TOPOGRAPHY

Remainder Erven 1 & 937 (the site) is approximately 3.66 hectare in size and is currently occupied by informal Structures (shacks) and undeveloped grasslands.

Figure 1: Site Topography

The topography of the area is characterized by gentle to moderate sloping terrains varying between 1:8 and 1:17, draining in a South Easterly direction into a watercourse to the South and is regarded as suitable for development.

A flood analysis was done by Fraser Consulting Engineers cc and the proposed development will be located above the 1:100 flood line.

4. GEOTECHNICAL CONDITIONS

A Geotechnical Investigation was conducted by Outeniqua Geotechnical Services, Report dated 10 November 2021 and attached as Annexure B, on the perimeter of the proposed development. Soils consisted of a mantle of alluvial SILTY SAND & GRAVELS, COBBLES & BOULDERS overlying sandstone rock at varying depth and potential expansive (low to moderate expansive Classification H).

Though the site is deemed to be suitable for Low-Cost Development, special care should be taken into the design of Terrasse and the Stormwater systems should take into account the location and topography of the site and the low soil permeability which can lead to increased run-off. Refer to Annexure B for full Geotechnical report.

5. PROPOSED SERVICES

5.1 Sanitation

5.1.1 Internal Sewage Removal

Sewage will be removed by means of a waterborne gravity sewer network connected to the existing municipal network via a proposed sewer pump station, South of the development area.

The gravity sewer network will consist of 160mm diameter uPVC sewer pipes and 1,0m diameter concrete sewer manholes. The estimated length of the network is approximately 250m and approximately 14 manholes will need to be constructed.

(Refer to attached drawing 11044000-001 for the preliminary design as Annexure C).

5.1.2 Bulk Sewage Removal

A new bulk gravity sewer main pipe was recently constructed in 2022 up to the proposed development. The proposed new internal sewer network will connect to this main line and will drain to the existing Montagu sewer pump station (M1) approximately 2100m South of the proposed development.

The additional hydraulic loading on the WWTW system is estimated at 26,2 kℓ/day (@95% of AADD)

The Municipality confirmed that the Waste Water Treatment Works (WWTW) have sufficient capacity for the proposed development.

5.2 Water

5.2.1 Internal Water Supply

The development will be serviced by means of a water network consisting of uPVC water pipes of 75mm to 110mm diameter (total estimated length 650m) installed in road reserves. The proposed connection point is to a newly constructed 200mm uPVC supply line West of the development.

The fire-risk category assumed is “Low-risk (group 4)” for which no specific fire-fighting provision is required. Hydrants will however be located at convenient points ensuring the spacing does not exceed 240m (estimated total = 7).

Isolating valves will be installed in valve chambers and placed in accordance with the design guidelines (estimated total = 5).

(Refer to attached drawing 11044000-001 for the preliminary design as Annexure C).

5.2.2 Bulk Water Supply for Domestic Usage

A new bulk Water main pipe was recently constructed in 2022 up to the proposed development.

The development will be supplied with potable water from the existing Municipal water treatment works.

The estimated water usage is 27,6 kℓ/day (3.06ha x 9kℓ/ha/d).

The Municipality confirmed adequate water at the recommended residual pressure is available for the development and that the Water Treatment Works (WTW) has sufficient capacity for the development.

5.3 Roads and Storm water

5.3.1 Internal Roads

The development will be accessed via an existing surfaced roads from Montagu. All new roads for the proposed development will be provided with a permanent surface finish (30mm Asphalt) and will be 4.5m wide. Edging/kerbs will be provided on the sides of the roads in accordance with the standards. A gravel sidewalk will be provided on one side of the road.

The total estimated area to be surfaced is 2 600m² with associated kerbs and edging.

It is anticipated that the existing road network leading up to the development will be able to accommodate the increase in traffic. This will however need to be confirmed by means of a TIA of Traffic Statement from a Traffic Engineer.

(Refer to attached drawing 11044000-001 for the preliminary design as Annexure C).

5.3.2 Storm water drainage and management

Storm water from the proposed development area currently follows preferential drainage paths to the South-East to a water course. It is proposed that the storm water be directed in the roads reserves by means of the road geometry, kerbs and storm water pipes through-out the development where it will be discharged in a controlled manner into the existing water course. To achieve the above, concrete storm water pipes ranging from 375mm to 450mm in diameter (total estimated length = 270m) with associated catch pits and junction boxes will need to be installed.

The proposed site is situated above the 1:100 return flood line which will be demarcated by a security fence.

(Refer to attached drawing 11044000-001 for the preliminary design as Annexure C).

5.4 Refuse Removal

Refuge removal will be done by the Langeberg Municipality as part of their normal services provided.

No hazardous waste is expected to be generated and waste will be normal household waste.

6. CONCLUSION

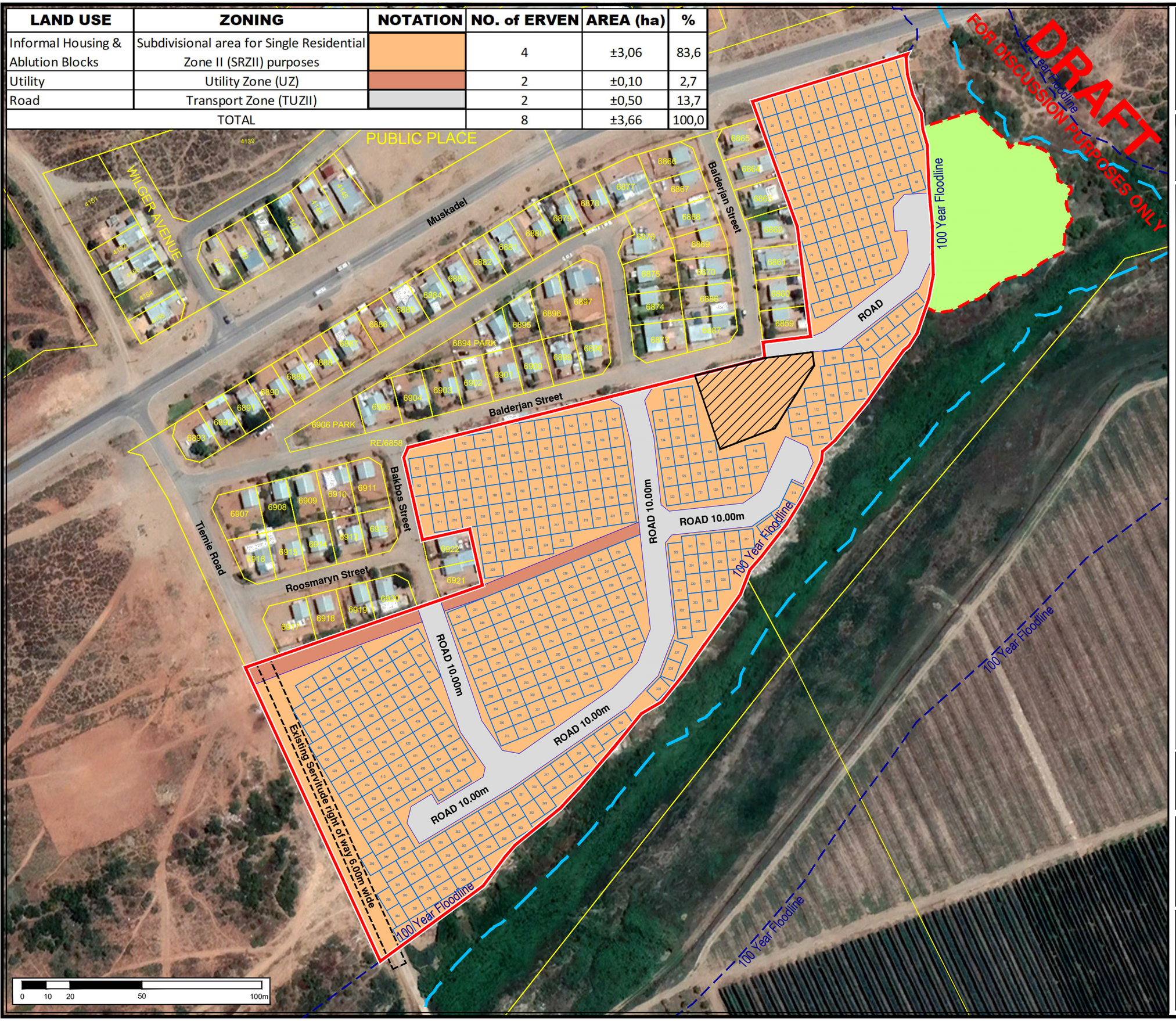
The Site is deemed to be viable for development and will contribute positively to the greater development of Bonnievale.

--END--

ANNEXURE A

PROPOSED SUPER BLOCK LAYOUT

LAND USE	ZONING	NOTATION	NO. of ERVEN	AREA (ha)	%
Informal Housing & Ablution Blocks	Subdivisional area for Single Residential Zone II (SRZII) purposes		4	±3,06	83,6
Utility	Utility Zone (UZ)		2	±0,10	2,7
Road	Transport Zone (TUZII)		2	±0,50	13,7
TOTAL			8	±3,66	100,0



MONTAGU
MANDELA SQUARE
REMAINDER ERVEN 1 & 937

PROPOSED SUPER BLOCK LAYOUT PLAN

- Subject Area = ±3.66ha
- Cadastral Boundaries
- Proposed Layout
- 100 Floodline
- River Centreline
- Potential Unit Yield = 470 (8m x 6m)
- Estimated Position of Existing Creche Site

PLEASE NOTE:
All boundary line positions, distances and property sizes need to be verified by a Professional Land Surveyor.

DATE 12 March 2024

SCALE See linescale

PLAN NO. 1

FILE NAME:

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CLIENT

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ANNEXURE B

PHASE 1 GEOTECHNICAL REPORT

PHASE 1 GEOTECHNICAL REPORT

PROPOSED SUBSIDY HOUSING PROJECT IN MANDELA SQUARE MONTAGU, WESTERN CAPE

10 November 2021

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0	10.11.2021	I.Paton Pr Sci Nat Pr Tech Eng	S. Ngema BSc Geol	I.Paton Pr Sci Nat Pr Tech Eng
				

Authors qualifications and affiliations:

Iain Paton has a Bachelor's degree with Honours in Geology and a Master's degree in Geotechnical Engineering with over 25 years' experience in the construction, mining and energy industries. Iain Paton is a registered professional with the South African Council for Natural Scientific Professions (SACNSP) and the Engineering Council of South Africa (ECSA) and is a member of the South African Institute of Engineering and Environmental Geologists (SAIEG), the Geotechnical Division of the South African Institute of Civil Engineering (SAICE) and the Institute of Municipal Engineering of South Africa (IMESA).

Declaration of independence:

The author of this report is independent professional consultant with no vested interest in the project, other than remuneration for work associated with the compilation of this report.

General limitations:

1. The investigation has been conducted in accordance with generally accepted engineering practice, and the opinions and conclusions expressed in the report are made in good faith based on the information at hand at the time of the investigation.
2. The contents of this report are valid as of the date of preparation. However, changes in the condition of the site can occur over time as a result or either natural processes or human activity. In addition, advancements in the practice of geotechnical engineering and changes in applicable practice codes may affect the validity of this report. Consequently, this report should not be relied upon after an eclipsed period of one year without a review by this firm for verification of validity. This warranty is in lieu of all other warranties, either expressed or implied.
3. Unless otherwise stated, the investigation did not include any specialist studies, including but not limited to the evaluation or assessment of any potential environmental hazards or groundwater contamination that may be present.
4. The investigation is conducted within the constraints of the budget and time and therefore limited information was available. Although the confidence in the information is reasonably high, some variation in the geotechnical conditions should be expected during and after construction. The nature and extent of variations across the site may not become evident until construction. If variations then become apparent this could affect the proposed project, and it may be necessary to re-evaluate recommendations in this report. Therefore, it is recommended that Outeniqua Geotechnical Services is retained to provide specialist geotechnical engineering services during construction in order to observe compliance with the design concepts, specifications and recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction. Any significant deviation from the expected geotechnical conditions should be brought to the author's attention for further investigation.
5. The assessment and interpretation of the geotechnical information and the design of structures and services and the management of risk is the responsibility of the appointed engineer.

EXECUTIVE SUMMARY

Outeniqua Geotechnical Services was appointed by Asla Devco to undertake a Phase 1 geotechnical site investigation for a proposed subsidy housing project in Mandela Square, Montagu, in the Western Cape Province. The investigation was carried out in accordance with SANS 634: Geotechnical Investigations for Township Developments.

The site investigation involved a desk-top study of existing geotechnical data, a walk over survey and detailed subsurface investigation on the site. The subsurface investigation involved conducting a total of 6 test pits with a TLB/Backactor, to a maximum depth of 2.5m. Test pits were profiled by an engineering geologist, and representative samples of various soil horizons were collected for laboratory tests. Insitu DCP penetration tests were conducted from ground level next to each test pit.

At the time of the investigation, the site consisted of a densely populated informal settlement called the in Mandela Square township, which was approximately 5km northeast of the town centre of Montagu. The climate of the region was classified as temperate, dry (Weinert Climatic-N No. ~5-7.5) and the vegetation was sparse and highly transformed due to existing settlement. The site drained in a southerly direction into the Kingna River, which was flowing along the southern boundary of the site.

The geological maps indicated that the site was underlain by Quaternary alluvium which is underlain by feldspathic sandstone of the Hex River Formation of the Ceres Group. Test pits confirmed that the general natural soil profile consisted of silty sandy gravels of alluvial origin, which were underlain by soft sandstone rock of the Hex River Formation. The upper 0.7m of the soil profile was found to be potentially compressible and/or collapsible to varying degrees, but bearing capacity improved significantly below this level. Due to the infill nature of the site, the natural soils were expected to be overlain in many areas by a layer of uncontrolled fill of varying thickness and consisting mainly of a mixture of soil, rubble & rubbish/solid waste.

It was anticipated that site clearance would entail removal of informal residents to temporary facility, demolition of shacks, site grubbing, carting to spoil, and some bulk earthworks to create access roads, minor cut to fill platforms and possibly low retaining walls. The recommended foundation system for light residential structures with bearing pressures limited to 50kPa included light rafts or nominally reinforced strip foundations at normal shallow founding depths on well compacted soil to minimise settlement.

The site was generally considered suitable for the proposed development of subsidy housing, but some geotechnical constraints were identified which require further attention and which may have implications for the engineering design.

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1. Introduction and terms of reference

Outeniqua Geotechnical Services Outeniqua Geotechnical Services was appointed by Asla Devco to undertake a Phase 1 geotechnical site investigation for a proposed subsidy housing project in on Rem Erf 1 & Rem Erf 937 Montagu in the Western Cape Province, which was located approximately 5km north east of the town centre (see locality map in **Figure 1**).

The physical and geotechnical nature of the site was investigated for the civil engineering design and project planning process, and the investigation was carried out in accordance with SANS 634: Geotechnical Investigations for Township Developments.

The general purpose of the investigation was to:

- Describe the location, topography and geology of the proposed site;
- Investigate and describe the soil types and expected founding conditions for new structures;
- Highlight any problem soils, slope stability or drainage issues;
- Estimate the bearing capacity, settlement and/or swell potential of the soil;
- Classify the excavations in terms of SABS 1200D;
- Determine the suitability of the site for housing purposes and make recommendations for the design of earthworks, foundations and engineering services;
- Classify the site in terms of the NHBRC Residential Site Designations for project enrolment purposes.

Figure 1: Locality map of site

2. Information available

The following maps and plans were available for reference purposes and were reproduced in this report:

- Digital topo-cadastral and aerial photography data, obtained from the National Geospatial Information Department;
- 1:250 000 Geological map of the area, obtained from the Council for Geoscience;
- 1:1000000 Seismic Hazard Map of SA, obtained from the Council for Geoscience;
- Site development plan, provided by Asla Devco.

3. Nature of the investigation

The site investigation involved a desk-top study of existing geotechnical data, a walk over survey of the site, and a detailed subsurface investigation.

The subsurface investigation involved conducting a total of 6 test pits with a TLB/Backactor to a maximum depth of 2.5m/refusal in order to determine the geology, soil & groundwater conditions on the site. The number of test pits was determined primarily by the size of the site, in accordance with SANS 634, the expected complexity of the geology, and access across the site. The number of test positions was deemed sufficient in order to classify the soil conditions with a high degree of confidence.

Test pits were profiled by under the supervision of a qualified engineering geologist, and samples of various soil horizons were collected for laboratory tests. Insitu DCP penetration tests were conducted from ground level next to each test pit.

Soil samples were taken for the following lab tests to determine the engineering characteristics of the soil:

- Foundation Indicator tests (SANS 3001 and ASTM) to determine gradings, Atterberg limits and potential expansiveness (tested at Outeniqua Lab in George);
- MOD/CBR/Indicator tests (SANS 3001) to determine the compaction/strength properties (tested at Outeniqua Lab in George);
- Handheld Dynamic Cone Penetrometer (DCP) tests (TMH6 ST6) to determine soil
- pH & Conductivity tests (ASTM) to determine the soil aggressiveness to buried structures and services (tested at Labco in Cape Town);

The confidence in the information gained from the investigation was high as it generally concurred with expected conditions and information gained from previous site investigations in the area. Further investigations were not deemed necessary at that stage of the project.

4. Site description

The site was accessed via existing municipal roads to the north of the site, but maneuverability within and across the site was severely restricted due to the dense existing informal settlement.

The topography consisted of a predominantly south-facing gentle slope that drained into Kinga River, which flowed along the southern boundary of the site (see **Figures 2-3**). The vegetation cover was sparse and highly transformed due to the existing informal settlement (See **Figure 4**).

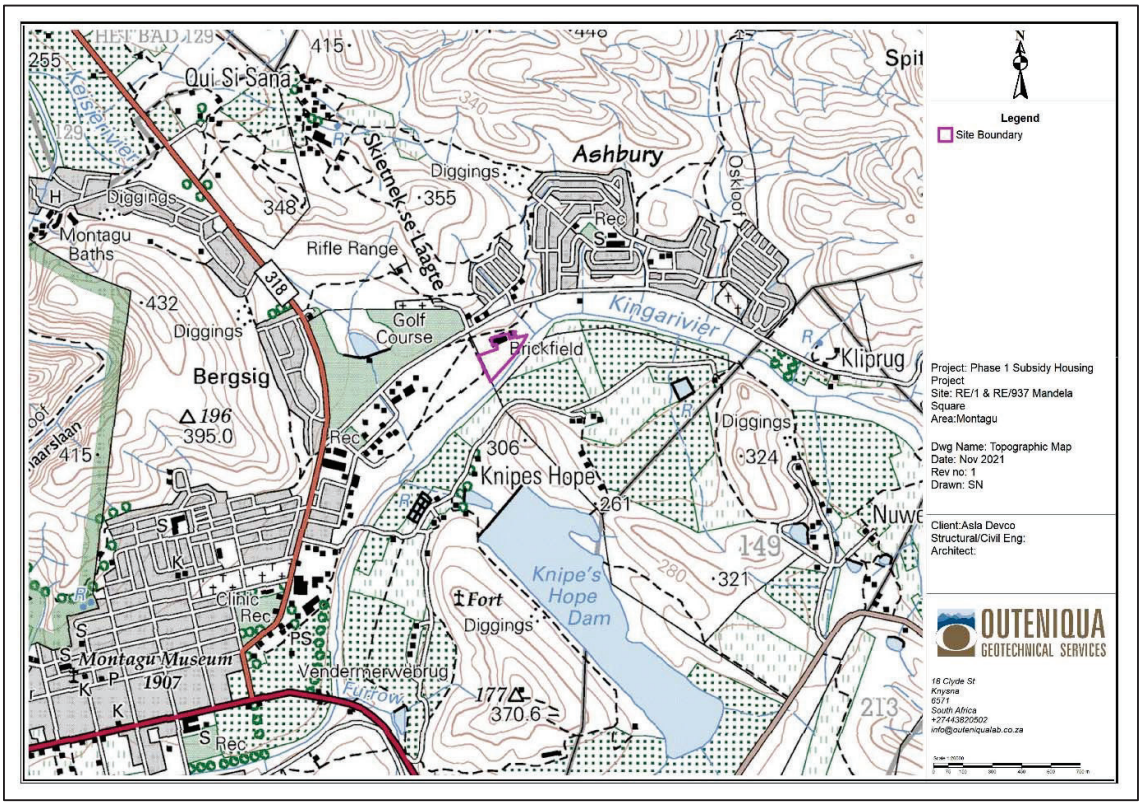


Figure 2: Topographical map of the site

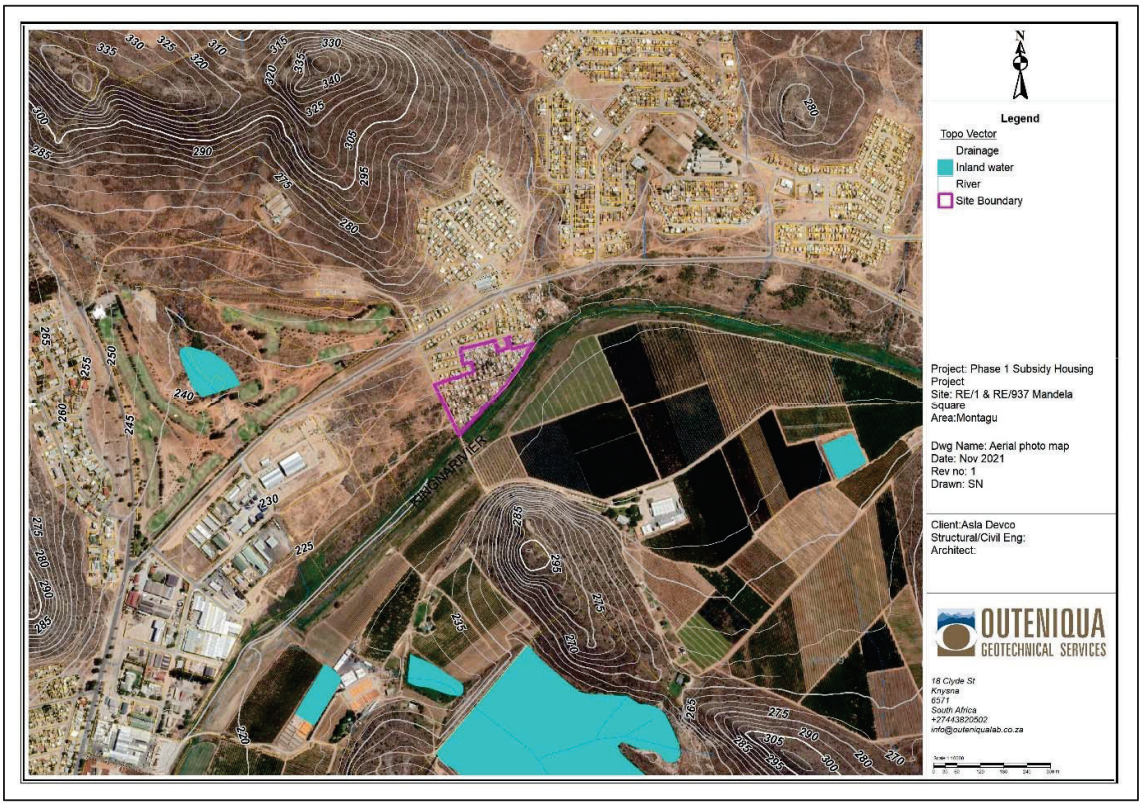


Figure 3: Aerial photo of site

Figure 4: Typical terrain and informal settlements on the site

5. Geology

The geological map on a 1:250 000 scale indicated that the site was underlain by Quaternary alluvium which was underlain by feldspathic sandstone of the Hex River Formation of the Ceres Group (see **Figure 5**). The bedrock was typically weathered in the area and is covered by a mantle of soil.

The map also indicated a series of dormant geological faults in the immediate vicinity of the site, but the risk of significant seismic activity in the area was generally deemed to be low. The geology was generally deemed to be macro-stable on low to moderate slopes and suitable for urban development with consideration for local geotechnical constraints.

6. Geotechnical Evaluation

6.1 Engineering and material characteristics

6.1.1 Topography, slopes and vegetation cover

Results of the investigation

The site was characterised by gently sloping terrain, with an average gradient of 1:20, but becoming steeper towards the southeastern corner of the site adjacent to the river. Topographic maps indicated that the site drained southwards into Kingarivier, which flowed adjacent to the site.

The natural vegetation had been highly transformed due to the existing informal settlement on the site, and mainly consisted of sparse log grass and very few trees.

Effect on the proposed development

The gently terrain was generally suitable for the proposed subsidy housing project, but set-back lines would have to be determined along the river. No major bush clearing or felling of large trees is anticipated, but temporary relocation of existing residents and demolition of informal structures would be required to clear the site in addition to minor earthworks to create access roads and platforms.

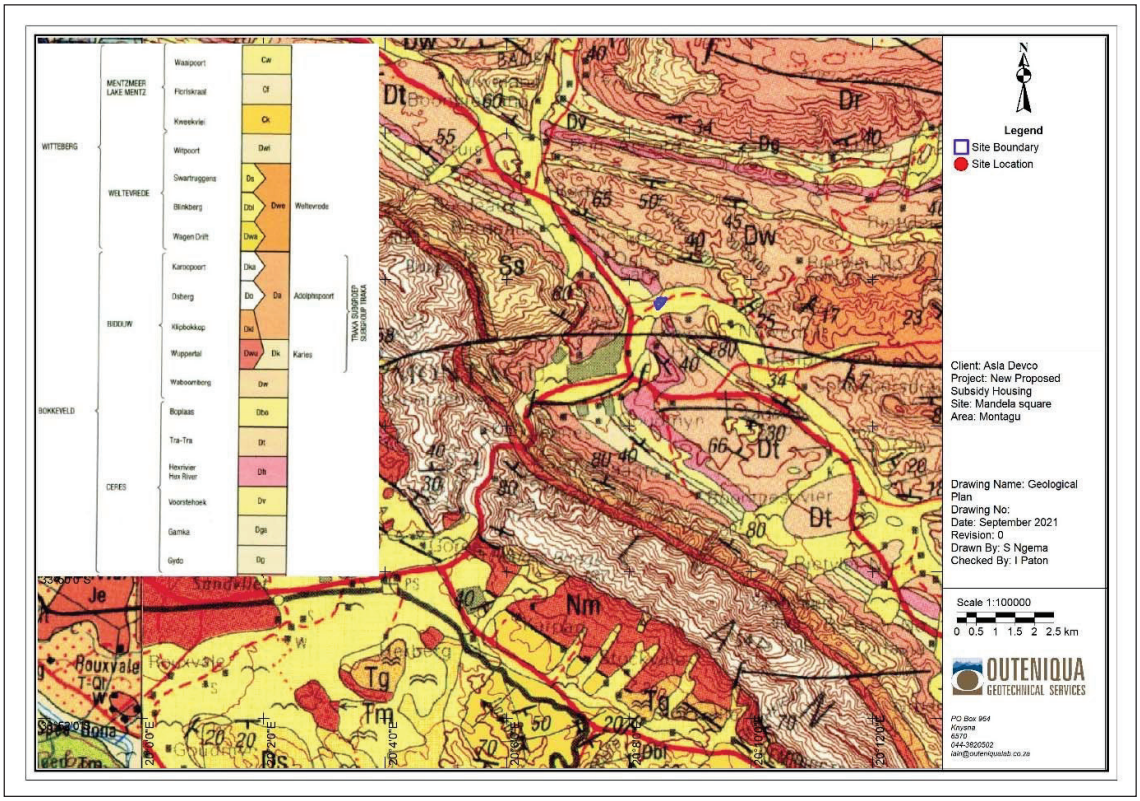


Figure 5: Geological map

6.1.2 Soil types and rock

Results of the investigation

The test pits indicated that the soil profile on the site was quite variable but generally consisted of a mantle of alluvial SILTY SAND & GRAVELS, COBBLES & BOULDERS overlying sandstone rock at varying depth.

Refusal of the TLB excavator was recorded on the basal rock or on alluvial boulders in all 6 test pits at depths varying from 0.65m to 2.0m (see **Figure 7**). The natural, insitu soils were generally dense at normal shallow founding depths (~NGL-0.6m) and were only slightly compressible/collapsible under light loads. Uncontrolled fill material that occurred on parts of the site (mainly northwest portion, near existing structures) was potentially highly compressible and highly unsuitable to carry even light structures. A summary of the test pit data and the thickness of the different soil horizons is provided in **Table 1**.

Effect on the proposed development

The soil profile was deemed to be generally suitable to accommodate urban development. The presence of shallow rock bode well for foundation stability but may hamper deep excavations for bulk services or platforming in some areas. Granular soils (sands, gravels) are generally suitable for use in bulk earthworks purposes, but clayey horizons may reduce the overall quality of potential fill material obtained from excavations on site. The presence of potentially compressible and/or active soils will require some consideration in the design of foundations. The geotechnical properties of the soil types are discussed in further detail below.

Figure 6: Typical orange alluvial soil exposed in test pits

Shallow bedrock encountered at TP3.

Table 1: Summary of soil horizons recorded in test pits (in mm)

Test pos. No.	*Imported (fill) soil*	*Transported soil*	*Residual soil*	*Rock*	*Total depth of test pit*	*Refusal*
TP1	-	0-900	-	900-1400	1400	Slow/partial
TP2	-	0-1900	-	-	1900	Slow/partial
TP3	0-200	-	-	200-350	350	Sharp
TP4	0-200	200-700	-	-	700	Slow/partial
TP5	-	0-500	-	-	500	Slow/partial
TP6	0-300	300-2000	-	-	2000	Slow/partial

6.1.3 Grading, Atterberg limits and potential expansiveness

Results of the investigation

Representative samples of different soil horizons were collected for Foundation Indicator tests in order to determine the index properties of the soil and evaluate their potential activity and suitability as a founding medium. A summary of the results of the tests are shown in **Table 2**. The tests indicated that the soils were grouped into the following categories according to the Universal Soil Classification system:

CL – Inorganic clays of low to medium plasticity, gravelly, sandy and silty clays;
GC – Clayey/silty gravels with low plasticity.

The tests confirmed that the soil types were variable, but dominated by gravel, and having a low plasticity and exhibiting a low potential expansiveness.

Table 2: Grading and Atterberg limits test results summary

Test Pit No	*Sample Depth (mm)*	*Atterberg Limits*			*Particle Analysis (%)*				*MC**	*PE***	*USC ****
		PI	*LL*	*LS*	*Clay*	*Silt*	*Sand*	*Gravel*			
TP1	0-700	13	30	6	20	24	23	33	3.7	Low	GC
TP2	900-1900	12	28	6	15	11	17	57	5.4	Low	GC
TP3	0-200	14	34	7	13	10	19	58	16.6	Low	GC
TP4	200-500	10	27	5	19	17	22	42	4.1	Low	GC
TP5	0-400	12	26	6	34	18	28	20	5.2	Low	CL
TP6	300-2000	15	35	7	24	24	24	28	4.4	Low	GC

Notes: 1 Moisture content 2 Potential expansiveness (Skempton's activity chart) 3 Unified Soil Classification System

Effect on the proposed development

The insitu soil types are generally considered benign in terms of earthworks and foundation design but coarse particles and sporadic elevated clay content may affect quality of the material as re-useable source in construction. Recommendations are provided in **Chapter 8**.

6.1.4 Moisture/density relationship and CBR

Results of the investigation

Representative soil samples were collected for Mod. AASHTO density, CBR and Road Indicator tests in order to determine the moisture-density relationship, compaction and CBR properties for road subgrade and/or general filling purposes. The results of the tests are summarized in **Table 3**.

Table 3: CBR test results summary

Test Pit No	*Sample Depth (mm)*	*CBR at*					*Swell (%)*	*PI (%)*	*GM*	*MDD/ OMC*	*TRH 14 Class*
		100 %	*98%*	*95%*	*93%*	*90%*					
TP1	0-700	70	37	15	8	3	0.8	13	1.21	2046/9.3	-
TP2	0-300	26	12	4	2	1	1	8	2.46	1845/13.9	-
TP5	0-400	20	13	7	4	2	0.6	12	0.95	2025/9.2	G9
TP6	0-400	42	27	14	9	5	0.8	15	1.18	2042/10.1	-

The test samples produced low CBR values, most likely due to elevated fines contents and plasticity.

Effect on the proposed development

The insitu soils may not serve as a consistent source of natural construction material and imported materials may be required for bulk filling, platform & road layerworks and pipe cradle material. Recommendations for earthworks and roads are given in **Chapter 8**.

6.1.5 Compressibility, collapse potential and bearing capacity

Results of the investigation

DCP tests generally refused within 1m on coarse granular (gravelly/bouldery) soil or soft rock. No major bearing capacity issues were detected in these tests, but the pinholed structure in fine alluvial soils indicated some compressibility/collapse potential. Moisture sensitivity was indicated in fine grained soils. All soils were considered slightly compressible and/or collapsible (C1 category).

Effect on the proposed development

Improved/modified foundation systems would be required to accommodate the expected soil movements. Foundation recommendations are discussed in more detail in **Chapter 8**.

6.1.6 Swell / heave

Results of the investigation

Test results indicated variable, low to medium clay content, with low PI, resulting in low total potential expansiveness (H Category).

Effect on the proposed development

Heave was unlikely to have an effect on foundation design.

6.1.7 Soil moisture, permeability and drainage

Results of the investigation

The site is located in a temperate climatic area (Weinert N-number ~ 5-7.5) where heavy or prolonged rainfall is not uncommon. The soils generally have a low permeability and are slow draining due to their slightly elevated fines content, so most rainfall will end up as run-off, and no permanent groundwater tables are expected. However, rainwater may infiltrate into topsoil layers over time and sub-surface seepage may occur after prolonged rainfall (seasonal shallow perched water tables).

Effect on the proposed development

The design of stormwater systems should take into account the location and topography of the site and the low soil permeability which can lead to increased run-off. The proximity of the site to a natural drainage line should also be considered in terms of flood lines. Stormwater systems would be required to collect, control, divert and discharge run-off in suitable locations into natural water courses. Stormwater run-off may also cause erosion or affect stability of excavations during construction. Site drainage recommendations are provided in **Chapter 9**.

6.1.8 Existing structures

Results of the investigation

At the time of the investigation the site was occupied by dense informal structures requiring demolition for development to occur.

Effect on the proposed development

Special measures are required to relocate residents and demolish existing informal structures.

6.1.9 pH and conductivity

Results of the investigation

Samples of *in situ* soils were collected for soil chemistry tests (pH & Conductivity) in order to determine the aggressiveness of the soil which can affect buried services and concrete foundations. A summary of the results of the pH and conductivity tests are shown in **Table 4**.

Table 4: pH and conductivity test results summary

Test Position	*pH*	*Conductivity (mS/m)*
TP1	8.9	174
TP2	7.9	134
TP3	6.5	144
TP4	7.8	356
TP5	7.6	122
TP6	9.3	173

Corrosion of metallic pipe fittings and concrete reinforcement may be negatively influenced by low or high pH, and high conductivity (indicating high concentration of dissolved salts

in the soils). An indication of the influence of pH and conductivity on the corrosiveness of soil is given in **Table 5**.

Table 5: Influence of pH and conductivity on the corrosiveness of soil

pH	*Conductivity (mS/m)*	*Potential Corrosiveness*
7-8	<10	Non-corrosive
5-6 or 9-10	10-20	Mildly corrosive
3-4 or 11-12	20-50	Corrosive
<3 or >12	>50	Highly corrosive

The lab results indicate slightly alkaline and high conductivity due to elevated fines contents and dissolved salts which cause rusting metallic structures.

Effect on the proposed development

HDPE or PVC pipe products will be suitable and buried metallic valves and fittings should be epoxy powder coated to protect against rust corrosion. Normal rebar cover in buried concrete foundations will suffice.

6.2 Slope stability and erosion

The natural slope gradient of the site is gentle to moderate and there were no signs of any macro instability at the time of the investigation. Temporary shallow excavations (<1m deep) are likely to be generally stable at near vertical angles for short periods, but permanent excavations/slopes exceeding 35° will require retaining walls. Erosion is unlikely to be a significant issue on the site, but contractors must take normal precautions to minimise erosion which could have an impact on the adjacent river.

6.3 Excavation classification with respect to services

Shallow soft rock or cobbles/boulders (rippable with 30t excavator with rock bucket) were encountered in all of the test holes, and excavations deeper than 1m can be classified as intermediate/hard in terms of SABS 1200D.

6.4 Impact of the geotechnical character of the site on subsidy housing developments

The applicable geotechnical subsidy variations are tabulated in **Table 6**.

Table 6: Site specific geotechnical subsidy variations

Geotechnical Conditions	*Category or type*	*Criteria*	*Precautionary measures*	*Applicable areas*	*Comment*
Seepage / groundwater	Category 1	Permanent or perched water tables less than 1.0m below ground surface	Subsurface drainage/improved damp-proofing measures to houses, service trenches to be dewatered during construction	N/A	Seasonal minor seepage
	Category 2	Permanent or perched water tables more than 1m but less than 1.5m below ground level	Service trenches to be dewatered during construction	N/A	
Erodability of soil	Category 1	High risk (Erodability index 1-8)	Retaining walls & earthworks to reduce slopes & surface drainage	N/A	

Geotechnical Conditions	***Category or type***	***Criteria***	***Precautionary measures***	***Applicable areas***	***Comment***
	Category 2	Medium risk (Erodability index 9-15)	Retaining walls & earthworks to reduce slopes	All areas	
Hard excavation	Category 1	Hard rock excavation to a depth of 1.5m	Additional cost of trench and foundation excavation	No	
	Category 2	Boulder excavation to a depth of 1.5m	Additional cost of trench, foundation and road excavation	All areas	
Dolomite	Category 1	Risk class 1&2 (Dolomite area class D2)	Additional cost of foundations	N/A	
	Category 2	Risk class 3&4 (Dolomite area class D3)	Additional cost of foundations	N/A	
Expansive Clays	Category 1	H1	Foundation design, building procedures and precautionary measures: Modified normal	No	
	Category 2	H2	Foundation design, building procedures and precautionary measures: Stiffened raft	No	
	Category 3	H3	Foundation design, building procedures and precautionary measures: Cellular rafts/piles	No	
Compressible and Collapsible soils	Category 1	C1	Foundation design, building procedures and precautionary measures: Modified normal	Yes	
	Category 2	C2	Foundation design, building procedures and precautionary measures: Light or heavy raft	No	
Compressible soils	Category 1	S1	Foundation design, building procedures and precautionary measures: Modified normal	No	
	Category 2	S2	Foundation design, building procedures and precautionary measures: Light or heavy raft	No	
Mining subsidence	Category 1	Old undermining to a depth of between 90-240m below surface where stope closure has ceased	Additional cost of foundations: Compaction below footings or raft	No	
	Category 2	Old undermining to a depth of between 90-240m below surface where total extraction has taken place	Additional cost of foundations: additional earthworks or soil reinforcement	No	
Seismic activity	Category 1	Mining induced seismic activity > 100cm/s^2	Additional cost of foundations: Stiffened strip footings or raft	No	
	Category 2	Natural seismic activity > 100cm/s^2	Additional cost of foundations: Stiffened strip footings or raft	No	

Geotechnical Conditions	*Category or type*	*Criteria*	*Precautionary measures*	*Applicable areas*	*Comment*
Topography	Category 1	Average ground slope flatter than 1:20	Increase depth of sewer & provision of pump station	No	
	Category 2	Average ground slope of between 1:11 and 1:20	Terracing for houses & additional earthworks to roads & storm water control measures	40% of site	*Estimated
	Category 3	Average ground slope of between 1:7.5 and 1:10	Terracing for houses & additional earthworks to roads & storm water control measures	50% of site	*Estimated
	Category 4	Average ground slope of between 1:5 and 1:7.4	Terracing for houses & additional earthworks to roads & storm water control measures	10% of site	*Estimated
	Category 5	Average ground slope steeper than 1:5	Terracing for houses & additional earthworks to roads & storm water control measures	No	
SCCCA	Southern Cape Coastal Condensation Area	Area subjected to severe condensation conditions	Plaster and paint on all external walls & 6.4mm gypsum plasterboard ceilings & 80mm thick glass fibre insulation	Yes	
Location of development site		Site more than 20km from major centres	Additional cost of transportation	Yes	Worcester 80km

7. Site classification

The site has been broadly mapped into distinguishable terrains according to the SAICE/NHBRC soil classifications assigned in **Table 7,** and the mapping is illustrated in **Figure 8**.

Table 7: Geotechnical terrain mapping

Terrain Unit	*Geotechnical Constraint*	*Expected movement (mm)*	*NHBRC Site Classification*
Terrain 1 (entire site)	Potentially compressible soil	5-10	C1
	Potentially expansive	<7.5	H
	Shallow rock/boulders (<1.5m)		R
	Uncontrolled fill/disturbed ground		P

Figure 8: Geotechnical terrain map

8. Foundation recommendations and solutions

8.1 Earthworks and structural foundations

Earthworks should be designed and conducted in accordance with SABS 1200D, COLTO 3300 or any site-specific specifications provided by the engineer. Foundations should be designed and constructed in accordance with the NHBRC Home Builders Manual, SANS 10400-H and/or as specified by the structural engineer.

Any uncontrolled fill material exposed during site clearance and earthworks, such as rubble, plastic, etc., should be cut to spoil or as per the engineers instructions. Some bulk earthworks and possibly low retaining walls may be required to create level platforms on sites where slopes exceed 1:10. In cut to fill operations, all organic matter should be removed from the footprint area before bulk earthworks. The insitu soils may not be entirely suitable for use in bulk fills, but can be used if it can be effectively compacted to the specified level and if approved by the engineer.

The recommended foundation system for the proposed single storey structures is reinforced strip foundations on insitu soils at a nominal founding depth of 600mm below GL with design bearing pressures limited to 75kPa. Alternative suitable methods include light rafts on compacted insitu soil or engineered platforms. All founding mediums should be compacted with a roller or trench rammer to achieve a minimum of 93% of the Mod. AASHTO density (<30mm/blow of DCP).

8.2 Road pavements

Access roads should be constructed in accordance with SABS 1200, COLTO, TRH4, TRH14, The Red Book or other applicable specifications and standards, or as directed by the engineer.

Test results indicate that the insitu soil is typically poor/marginal quality material and improvement of the subgrade is recommended with lower and upper SSG layers included in the design of roads at the engineers discretion.

General preparation of the roadbed should include the following:

- Cut to line and level;

- Compact to 90% MDD. Recommended moisture content before rolling is optimum moisture content (OMC) minus 2%;

- Remove any incompressible or wet soil and reinstate with G9 material or as directed by the engineer.

Table 8 serves as a guideline (to be checked by the engineer) for the design of a Category C flexible pavement in a wet region with a design life of 15 years with traffic loading of less than 3×10^6 E80s over 20 years (as per TRH4).

Table 8: Road layerworks recommendations (Cat C in wet climate)

Layer	*Material*	*Thickness mm*	*Required Compaction*
Seal	HMA or Cape Seal	TBD by engineer	
Base	Imported G2/3	100-150	100% MDD
Subbase	Imported G5/C4	100-150	95% MDD
USSG	Imported G7	100-150	93% MDD
LSSG	Imported G7/9	100-150	90% MDD
OR			
Seal	n/a	n/a	n/a
Base	Interlocking cement pavers	60-80	n/a
Subbase	Imported G5/C4	100-150	95% MDD
USSG	Imported G7	100-150	93% MDD
LSSG	Imported G7/9	100-150	93% MDD

9. Storm water drainage recommendations

The design and construction of storm water drainage should be carried out in accordance with SABS 1200LE, COLTO, The Red Book or other applicable standards, or as directed by the engineer.

Minor flood events can be handled with kerb inlets and underground pipes, which discharge at suitable points into existing stormwater network or natural drainage lines, as directed by the engineer. Stormwater from major flood events may be contained within the road prism but should not overflow into adjacent erven. Well-designed access roads with sufficient level difference from the adjacent property, and adequate side drains and culverts is recommended. Subsoil drains are recommended along roads (upslope side only).

The ponding of storm water around the exterior of houses can be avoided by shaping the ground levels around the exterior to create a fall away from the house and constructing a 1m wide a concrete apron with a 10% fall away from the house. This will also assist in minimizing erosion around the house. The finished floor level of all houses should be a minimum of 150mm above final ground level to prevent flooding.

10. Special precautionary measures

The following special measures are recommended as a precaution:

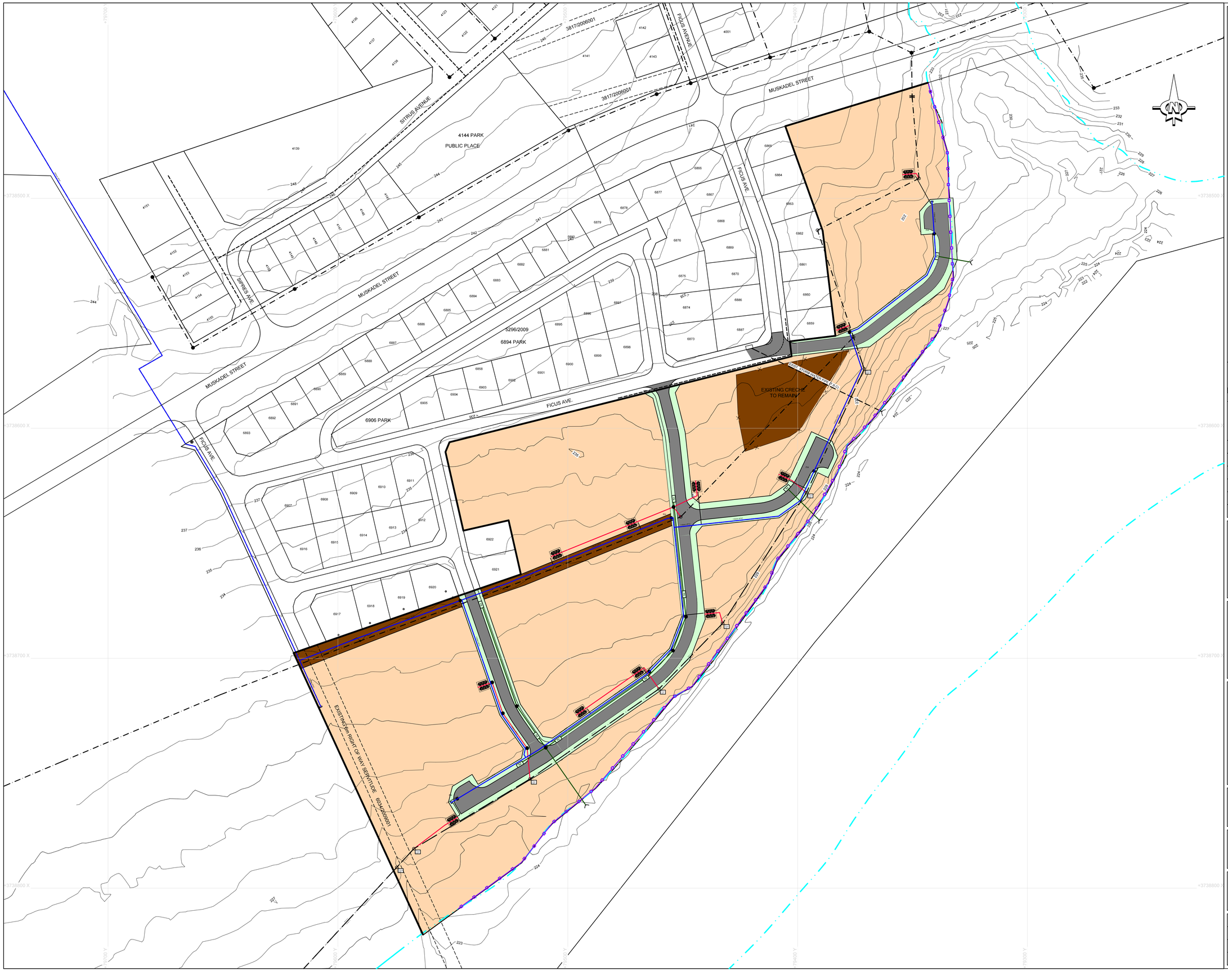
- A geotechnical specialist should be involved in earthworks and the construction of foundations to assist the engineer with quality control.
- Compaction control testing is essential during construction.

11. Conclusions

The site is potentially suitable for subsidy housing purposes, but there are some geotechnical constraints which may have an impact on the engineering design and subsidy variations. Some recommendations are offered for consideration by the civil and structural engineers but all information should be verified during construction and further investigations may be necessary.

ANNEXURE C

PROPOSED CIVIL INFRASTRUCTURE LAYOUT



NOTES

01. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS.

02. C.O.S. - CONFIRM ON SITE
E - EXISTING
L.O.C. - LIMIT OF CONSTRUCTION

03. ALL CO-ORDINATES OF PI'S, BC'S, EC'S, ETC. NEED TO BE SURVEYED AND CONFIRMED ON SITE PRIOR TO COMMENCEMENT OF WORKS.

04. NO DIMENSIONS MAY BE SCALED FROM DRAWINGS.

05. ANY ERRORS OR DISCREPANCIES ARE TO BE REPORTED TO THE ENGINEER FOR CLARIFICATION PRIOR TO ANY WORK BEING UNDERTAKEN.

06. UNLESS OTHERWISE SPECIFIED ALL CONCRETE WORKS TO BE 30MPa.

FOR INFORMATION
(FOR DISCUSSION PURPOSES ONLY)

0 100
100 MILLIMETRES ON ORIGINAL DRAWING

DRAWING REVISIONS:

A BEFORE CONTRACT COMMENCES

A AFTER CONTRACT HAS COMMENCED

No.	DATE	AMENDMENTS

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PROJECT
MONTAGU: MANDELA SQUARE
REMAINDER ERVEN 1 & 937

DRAWING DESCRIPTION
CIVIL SERVICES:
CONCEPT LAYOUT

DRAWING NO.
11044000-001

DESIGNED: DKJ		CHECKED: LA	
DRAWN: DKJ		SCALE: 1:750	A1
APPROVED: SJVM		DATE: 18/03/2024	
FILE PATH: Sharepoint\Mossel Bay - 11044000 Montagu Mandela Square\02 Concept\04 Draw\11044000-001(CONCEPT)			