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KEI MOUTH ECO ESTATE

ENGINEERING SERVICES REPORT

VIZIRAMA 150 (PTY) Ltd.

JUNE 2017

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1. INTRODUCTION

1.1 General Description of Project.

The project entails the development of 50 high income residential erven, two lodge sites each with a capacity of 100 beds and a recreational/ boathouse facility. Two suitable dam sites have been identified, and these will be developed concurrently with the installation of the bulk infrastructure. All the residential erven as well as the lodges and recreational/boathouse facility will be interlinked by means of internal strip roadways. The development will be known as the Kei Mouth Eco Estate.

1.2 Purpose of Report.

The purpose of this report is to outline the various bulk engineering services that will be required for the successful implementation of this development. Detailed bulk engineering services will be dealt with more comprehensively during the design stages of the development, and once the required statutory planning and EIA approvals have been obtained.

2. TERMS OF REFERENCE.

JDS Planning & Design have been appointed by Ilizwe Town and Regional Planners on behalf of Vizirama 150 (Pty)Ltd to prepare an Engineering Services Report as described in Clause 1.2 above.

3. BACKGROUND INFORMATION.

3.1 Location and Site Description.

3.1.1 Location.

The proposed Kei Mouth Eco Estate is situated approximately 7km by road from the coastal village of Kei Mouth in the Eastern Cape Province and falls under the overall jurisdiction of the Amathole District Municipality and the Great Kei Local Municipality.

The proposed development is approximately 90 km by road from the coastal metropolis of East London and is situated on the banks of the great Kei River, approximately 4km upstream of the river mouth. The development will overlook the river mouth estuary and the Indian Ocean. It also overlooks the former homeland of the Transkei situated on the opposite bank of the river.

Access to the development from East London to the West and Mthatha/Durban to the East would be along the MN10129 via the MR00697 to Kei Mouth from the N2 highway between Mthatha/Durban and East London.

A Locality Map is included under Appendix A as Figure A1.

3.1.2 Site Description.

The development comprises of the farms 73, 76 and 79, Komga of the farm Rocky Ridge situated within the jurisdiction of the Amathole District Municipality and the Great Kei Local Municipality .

The Proposed development is bounded by the Great Kei River on the East, the farms 1/80 and 11/80 on the South, the farms 74 and 75 on the North and the farms 72, 77,78 and 82 to the West.

The area of the development is 599,18ha of which 21,26ha will comprise of the residential erven, the two lodge sites, the recreational facility and the internal roadways.

A contoured Site Development Plan is included under Appendix A as Figure A2.

As can be deduced from the contoured Site Development Plan the proposed development area is relatively steep with slopes in excess 20% of with a series of plateau's and valleys that generally fall from the North Western side of the site towards the Great Kei River situated along the Eastern boundary of the development.

The residential erven have been sited in clusters along the plateus of the site and orientated in such a manner as to provide clear and unobstructed vistas of the Great Kei River mouth, estuary and Indian Ocean.

The site is pristine and comprises of grassland and shrub interspersed by areas of dense bush containing indigenous tree species such as Acacia, Silver Oak, Common Wild Fig ,Red Milkwood and Knobwood to name a few as well as many varieties of shrub and plant life. Additionally the area abounds with many varieties of wildlife and birdlife.

4. CLIMATE, HYDROLOGY AND GEOLOGY.

4.1 General Climate.

Kei Mouth is located at longitude -32.6788°S and latitude 28.3666°E and thus enjoys a mild climate with humid wet summers and dry mild winters. The prevailing coastal winds are predominantly from the South West and the South East and can vary from gentle breezes to gale force at times, typical of this coastal region.

The area receives about 824mm of rain per year, with most rainfall occurring during summer. It receives the lowest rainfall (13mm) in June and the highest (92mm) in November. The average midday temperatures for Kei Mouth range from 20.4°C in July to 25.4°C in February. The region is the coldest during July with temperatures dropping to 9.5°C on average during the night.

4.2 Hydrology.

As can be seen from the Site Development plan, the development is interspersed with defined water courses sloping towards the Great Kei River bordering the Eastern side of the site. The clusters of housing erven and the lodge site to the South have been positioned along the high lying plateaus in such a manner as to mitigate any potential flooding due to excessive storms. The lodge and recreational facility site on the banks of the Great Kei River will be positioned on the crest of the hill defined by the contours. This will mitigate any potential flooding.

A 1:100 year flood line analysis was undertaken by Walters & Associates and it has been determined that the year flood line varies from approximately 8,30m above mean sea level upstream to approximately 7,70m above mean sea level downstream of the development.

As can be seen from the Site Development Plan, all the residential erven, lodge sites and the recreational facility have been sited well above the flood line determination.

The Flood Line Analysis report is available under separate cover.

4.3 Geology.

Geologically the area belongs to the Beaufort Group which is part of the Karoo System and is made up of sedimentary mudstones and sandstones with scattered dolorite intrusions consisting of dykes and sills.

A detailed geotechnical report was done by Controlab from East London.
Eight trial holes were dug to refusal yielding the following results:

a) No ground water seepage was visible and no indication of high water tables was evident.
b) Consistent soil conditions varying between Aeolian and Residual soils were evident in all the test pits.
c) The foundation indicators displayed soils of low to medium expansiveness.
d) The material analysed within each trial hole varied from a G6 to a G10 material with the decomposed dolerite being of a G7 quality, suitable for building and roadworks.

Soil Percolation Tests were undertaken by means of digging three one metre deep test pits at locations where housing clusters were envisioned.

The percolation rates varied between 50 and 60 mm/hr.

Generally the geology of the area will not have an adverse effect on the development.

The Geotechnical report is available under separate cover.

5. EXISTING BULK INFRASTRUCTURE.

5.1 Bulk Electrical Supply.

The village of Kei Mouth is supplied by an existing 22kVa Eskom power line. The route of this power line follows the MR00697 access road to Kei Mouth.

Eskom have already provided a connection together with a transformer from this power line to farm 77 of the Farm Rocky Ridge.

5.2 Bulk Water Supply.

There is no existing bulk water supply pipelines either on or in the near vicinity of the site

5.3 Sewage Reticulation.

There is no existing sewer pipelines either on or near the site.

5.4 Stormwater.

Stormwater runoff is overland and is conveyed by a system of natural watercourses all discharging into the Great Kei River.

5.5 Roadways.

Access to the development is via the surfaced MR00697 roadway to Kei Mouth, and a suitable intersection to the development has already been constructed and provided with appropriate de-acceleration and acceleration lanes. It is not envisioned that this intersection will need any further upgrading as the traffic volume due to the development will not be dramatically altered

From the intersection there is an existing gravel road, the MN10129 which services a Bed and Breakfast establishment approximately 1km from the intersection, and the condition of this gravel road is from reasonable to poor. The distance from this turn off to the boundary of the development is approximately 600m and the condition of this roadway is very poor.

It is envisioned that the entire length of roadway from the intersection of the MR00697 to the boundary of the development will need to be upgraded to provide a proper and safe access to the development.

The access roadway is shown in Appendix A as Figure A3.

6. PROPOSED INFRASTRUCTURE

6.1 Electrical Supply.

The supply of electricity to the development as well as the internal electrical reticulation will be undertaken by a qualified Electrical Engineer. All internal reticulation will be via underground cable.

Arrangements to provide bulk electricity to the development from farm 77 of the Farm Rocky Ridge will need to be made by the developer and it is recommended that these arrangements be made timeously.

An bulk Electrical Supply Layout is shown in Appendix A as Figure A4.

6.2 Telkom.

An application for Telkom supply will be lodged with Telkom by the Developer. The Telkom supply route will be along the existing access roadway to the development and thereafter reticulated to the dwellings, lodges and recreational facility.

6.3 Water Requirements for the Development

6.3.1 Water Demand.

Table 6.3.1 which is based on the Guidelines for Human Settlement Planning and Design indicates the expected water demands for the site.

Table 6.3.1: Water Demand.

Land Use	No	Unit	Demand (l/day/Unit)	Ave. Annual Daily Demand (kl)	Peak Factor	Instant Peak Demand (l/s)
Residential	50	Dwelling	1000	50	3.5	2.0
Lodge	200	Beds	150	30	3.5	1.2
Totals				**80**		**3.2**

The development will have an Average Annual Daily Demand (AADD) of 80kl and an instantaneous Peak Demand of 3.2 l/s is anticipated.

The Annual Demand will be 29200kl and the required Design Flow to satisfy the Annual Demand will therefore be 0,93 l/s.

6.3.1 Water Supply.

There are no adequate existing water supply pipelines in the immediate vicinity of the site, and to sustain the development it will therefore be necessary to provide an adequate supply of water by means of the following methods:

6.3.1.1 Borehole Supply.

A large dolerite dyke traverses the development from North West to South East and additionally it is perpendicular to the iCwili River upstream of the development. Dolerite dykes are well known for providing a suitable well field and the likelihood of finding an adequate supply of potable borehole water is extremely good. A recent borehole drilled on a similar dolorite dyke within the iCwili township catchment area returned a blow yield of 8l/s. It is recommended that a borehole investigation be undertaken to determine the best location for a borehole site.

6.3.1.2 Rainwater Harvesting.

The annual average rainfall is 824mm. However it must be assumed that there will be periods of drought, and for the purposes of a desktop calculation the average annual rainfall will be reduced by 50% to produce a more even annual average through the dry periods. The desktop potential yield from rainwater harvesting is illustrated in table 6.3.1.2.

Table 6.3.1.2: Potential Desktop Rainwater Harvesting

Unit	No	Assumed Roof Area (m²)	Rainfall (m)	Efficiency	Potential Harvest (kl/annum)
Dwelling	50	15,000	0,412	95%	5870
Lodges	2	3000	0.412	95%	1175
Recreational Facility	1	1500	0.412	95%	585

6.3.1.2 Earth Dams.

Two Potential dam sites have been identified and are shown on the Site Development Plan. The combined potential yield of these dams is 55000kl taking into account losses due to evaporation.

6.3.2 Water Supply vs Water Demand.

From analysis of water supply by means of the desktop rainwater harvesting shown in Table 6.3.1.2 it can be seen that the dwellings will have, on average, a conservative potential rain water supply for 4 months of the year. However, considering that most of the dwellings will be holiday homes and thus will only be occupied for short periods during any given year, the potential for having almost 100% supply from harvesting is high, but to be solely reliant on harvesting is not recommended as there will be prolonged dry periods form time to time.

The lodges will have a potential desktop supply for almost 2 months if solely reliant on rainwater harvesting and it is assumed that they will have an occupancy rate of 100% throughout the year.

The potential desktop water supply from rainwater harvesting for the recreational facility will, in all likelihood, be sufficient.

6.3.3 Water Supply - Recommendations.

6.3.3.1 Borehole Abstraction and Reservoir.

Although it can be seen that the water demand can be met by a combination of dam supply and rainwater harvesting, it would be unwise to be solely reliant upon this source alone. It is therefore recommended that the primary source of water supply for the development should be by means of borehole abstraction, and that the supply by means of the dams and rainwater harvesting be supplementary.

As a combination of borehole water, rainwater harvesting and dam water will be used for the development, it is also recommended that two separate reservoirs be constructed. One will be used for potable water abstracted from the borehole supply and the other will be used solely for fire fighting and irrigation and will be supplied by the dams. Water samples from the borehole will be analysed and a suitable water treatment plant will need to be designed to meet the requirements of the development. A backup generator for the borehole motor will be provided in case of electrical outages.

Tables 6.3.3.1(a) shows the reservoir size required for potable water abstracted from the borehole and is based on the Guidelines for Human Settlement Planning and Design. The reservoir has a 2 day storage capacity due to the system having a pumped supply from the borehole.

Table 6.3.3.1(a): Potable Water Reservoir

Design Flow (l/s)	48 Hour Reservoir Volume (kl)
0.93	160

Table 6.3.3.1(b) shows the reservoir size required for fire fighting and irrigation and is based on the Guidelines for Human Settlement Planning and Design for high income residential properties with a Fire Risk Category of Low Risk Group 1 and a Fire Flow of 15 l/s.

Table 6.3.3.1(b): Fire Fighting and Irrigation Reservoir

Design Flow (l/s)	2 Hour Reservoir Volume (kl)
15	110

The reservoir site together with the proposed supply pipelines is shown in Appendix A as Figure A5

6.3.3.2 Dam Supply.

Water from this source will be will be pumped to the reservoir. The reservoir will be fitted with a suitable float control mechanism to ensure that it will always be full. A backup generator for the dam pump motor will be provided in case of electrical outages.

6.3.3.3 Rainwater Harvesting.

Minimum storage tank/s of 40kl per dwelling and for the recreational facility are to be provided. Minimum storage tanks of 60kl per lodge are to be provided.

6.4 Sanitation.

Initially two methods of sewage disposal were considered, namely disposal by septic tank and disposal by commercially supplied package plants.

Based on the guidelines offered by the Department of Water Affairs, acceptable percolation rates for the implementation a septic tank system are between 100 and 300mm/hr. The percolation test results in Clause 4.3 above indicate rates of between 50 and 60mm/hr which would indicate the avoidance of a septic tank system.

Table 6.4, which is based on the Guidelines for Human Settlement Planning and Design indicates the expected effluent generated by the development.

Table 6.4: Effluent Generation

Land Use	No.	Unit	Ave Dry Weather Flow (l/d/e)	Ave Dry Weather Flow		Dry Weather Peak Flow Factor	Peak Dry Weather Flow (l/s)	Peak Wet Weather Flow (l/s)
				l/d	l/s			
Residential	50	Dwelling	1000	50,000	0.58	2.5	1.45	1.67
Lodge	200	Beds	160	32,000	0.37	2.5	0.93	1.07
Totals				**82,000**				**2.74**

The effluent generated by the proposed site is estimated at 2.74 l/s, or 82kl/day. There is currently no nearby wastewater treatment works in the area.

Various centralised and localised systems to treat the effluent generated by the proposed development are available.

For this development a package plant (Lilliput) system is being considered. Some of the features and benefits of the system are as follows:

i) Delivers exceptional reliability.
ii) Requires little power.
iii) Water Act compliant.
iv) Consistently meets Department of Water Affairs and Forestry discharge limits.
v) System operation is odourless and virtually silent.
vi) Environmentally friendly.
vii) The Lilliput water is clean, clear and 100% re-usable.

The sewer reticulation layout is shown in Appendix A as Figure A6.

6.5 Solid Waste

Waste generation rates are mostly dependant on the socio-economic status of the population. The Department of Water Affairs estimates waste generation at 3.5 kg per capita per day in affluent areas such as the proposed development.
Table 6.5 below provides an indication of how much waste will be generated per day by the development

Table 6.5: Waste Generation

Land Use	No.	Unit	No. of People per unit	Estimated No. Of People	Waste Generation/day	
					By Mass (kg)*	By Volume (m^3)**
Residential	50	Dwelling	4	200	700	1.4
Lodge	200	Beds	1	200	700	1.4
Totals per Day					1400	2.8
Totals per Week					9800	19.6

Notes:
** Based on a waste generation rate of 3.5kg/person/day.*
*** Based on a density of 500kg/m^3*

The waste for the proposed development will be transported by individual households to a proposed refuse area (local transfer station) located near the access control (gatehouse) to the development as illustrated on the Site Development Plan. The service provider, being either the municipality or private contractor, will be responsible for transporting waste from the development transfer stations to the nearest landfill disposal site.

The internal collection service, including the nature of the service and its frequency, could be customised in accordance with the home owner's association requirements. The frequency of the service should be at least once a week. However, the local transfer station must have sufficient capacity to temporarily store waste for a maximum period of 14 days (2 weeks) to allow for possible disruptions in the regular service. The development will be expected to comply with the requirement of the Amathole District Municipality and the Great Kei Local Municipality.

6.5 Roads.

The MN10129 access road from the MR00697 to the boundary of the development will need upgrading. Application to the Provincial Road authority will need to be made and the roadway will be designed and constructed to the applicable road standard for the class of access road required.

Internal roadways within the development will be reinforced concrete strip roads. These concrete strip roads are depicted on the Site Development Plan. The roads will generally follow the existing ground contours and will therefore offer a minimal footprint as no major road earthwork operations are envisaged. Suitable G7 quality founding materials for the concrete roads are sufficiently available on site.

6.6 Stormwater.

Stormwater discharge from roofs will be captured in storage tanks.

Generally stormwater runoff will discharge into the Great Kei River via the numerous natural water courses that abound throughout the development.

Where roadways intersect water courses, suitable stormwater culverts will be laid to allow for the flow of stormwater beneath the roadways. Suitable cross berms will be constructed at intervals along steep roadways to channel stormwater away and onto the natural terrain thus preventing any erosion from occurring. If needs be, suitable energy dissapators will be installed to both spread and minimise flow velocities.

Stormwater culverts will be designed to accommodate a 1:50 year storm event.

7. ENERGY EFFICIENCY MEASURES (HOUSEHOLDS)

It is proposed that the following measures be considered by the home owner's association to reduce the dependency of households in particular, but also the development as a whole, on electrical energy. Not all of these may be applicable, but could be introduced as the technology becomes more affordable.

(i) Behaviour management.

(ii) Technology.

(iii) Fuel switching.

7.1.1 Behaviour Management.

This simply means that home owners will be made aware of the benefits of being "energy wise". The various Eskom and municipal energy efficiency campaigns are examples of how it could be done. Particular focus could be placed on:

a) Cooking times.
b) Bathroom times.
c) Geyser switching, either manually or automatically.
d) Lowering geyser temperature settings.
e) Migrating from filament light sources to LED or florescent light sources.
f) Switching off equipment and electrical devices when not in use.

7.1.2 Technology.

Electrical energy consuming devices could be managed by use of technology such as:

a) Swimming pool pumps.
b) Geyser load control.
c) Select higher efficiency goods such as:
d) Fridges.
e) Washing machines.
f) Dish washers, etc.
g) Use of modern technologies for lighting such as LED's.

7.1.3 Alternate Energy.

Other sources of energy should be considered such as:

a) Solar water heating.
b) Gas for cooking.

This could be made a condition for the approval of plans by the relevant authority.

8. ENERGY EFFICIENCY MEASURES (COMMUNAL AREAS)

There are only three users of electricity, namely public area lighting, package plant and pumps:

a) Street lights are to be of the high energy efficiency type with Lux levels of 14.
b) All Pumps as well as the package plant need to be sized to an acceptable minimum to perform optimally.

9. CONCLUSIONS

Following the investigation and analysis it is concluded that:

- The topography and geology of the site is supportive of a development of this nature.
- Improvements to the existing access road will need to be made.
- The internal road network will be concrete strip roads.
- Suitably sized stormwater culverts (1:50 year flood) will be constructed beneath roadways crossing natural watercourses.
- Based on the water demand and the available water supply via rainfall harvesting, additional water supply is required from a backup point of view in case of a possible drought situation. In this regard, a borehole is required to supplement the water obtained from rainfall harvesting.
- Households will be required to have storage capacity for 40kl of harvested rainwater.
- Lodges will be required to have storage capacity for 60kl of harvested rainwater.
- The effluent generated by the development will be treated via a package plant (Lilliput), details of which will be provided at detailed design stage. An alternative would be to provide conservancy tanks.
- Waste generated from the development will need to be stored securely before collection.
- Bulk electrical will be most likely be supplied to the development from farm 77 and appropriate energy efficient systems should be implemented.
- Telecommunication will be supplied to the development once the demand has proved to be viable.

10. BIBLIOGRAPHY

- The Guidelines for Human Settlement Planning and Design (2005).
- Council for Geosciences Geographical Map.
- South African Weather Services.

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11. APPENDIX A: FIGURES

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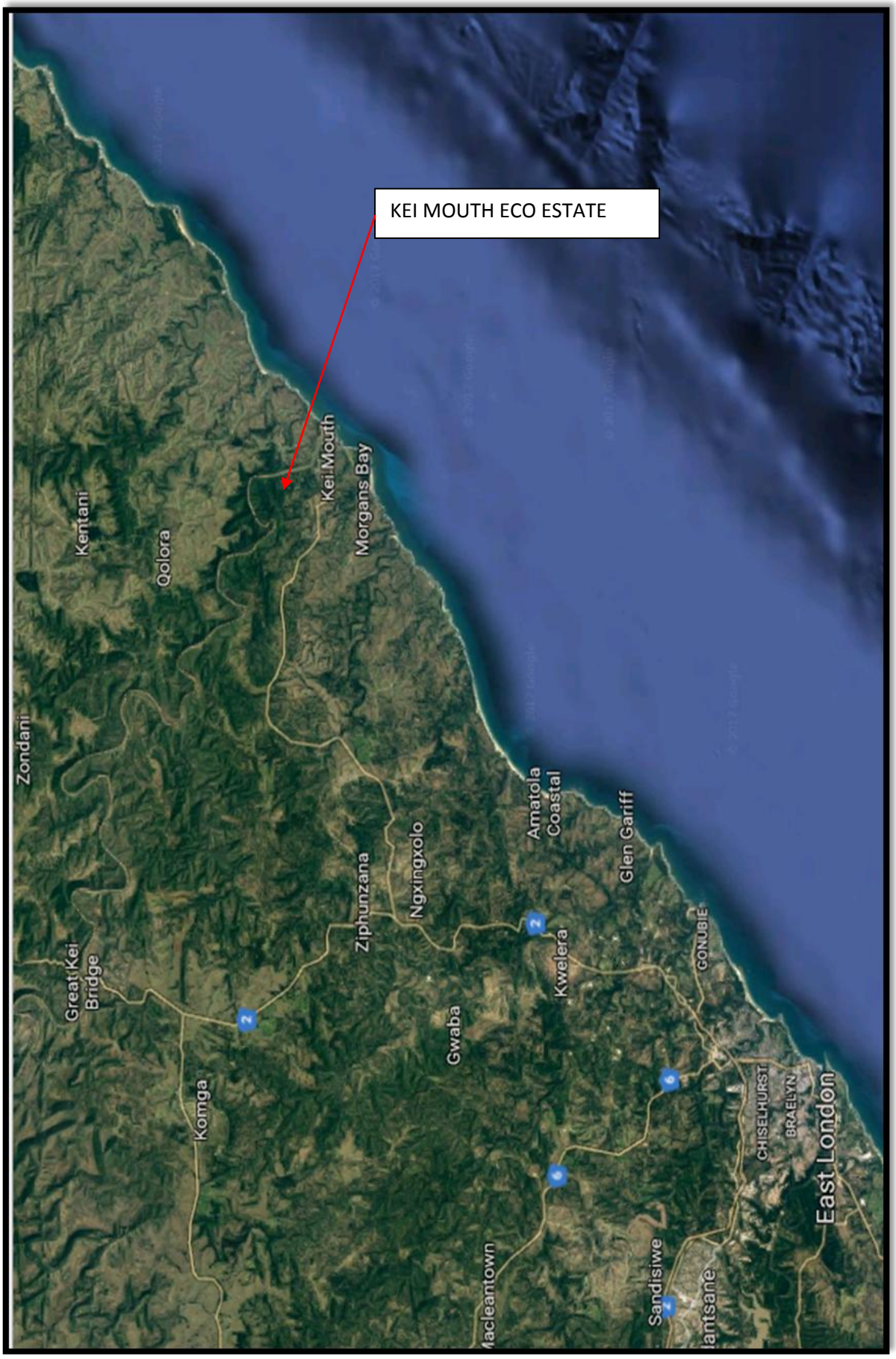


FIGURE A1: LOCALITY PLAN (NOT TO SCALE

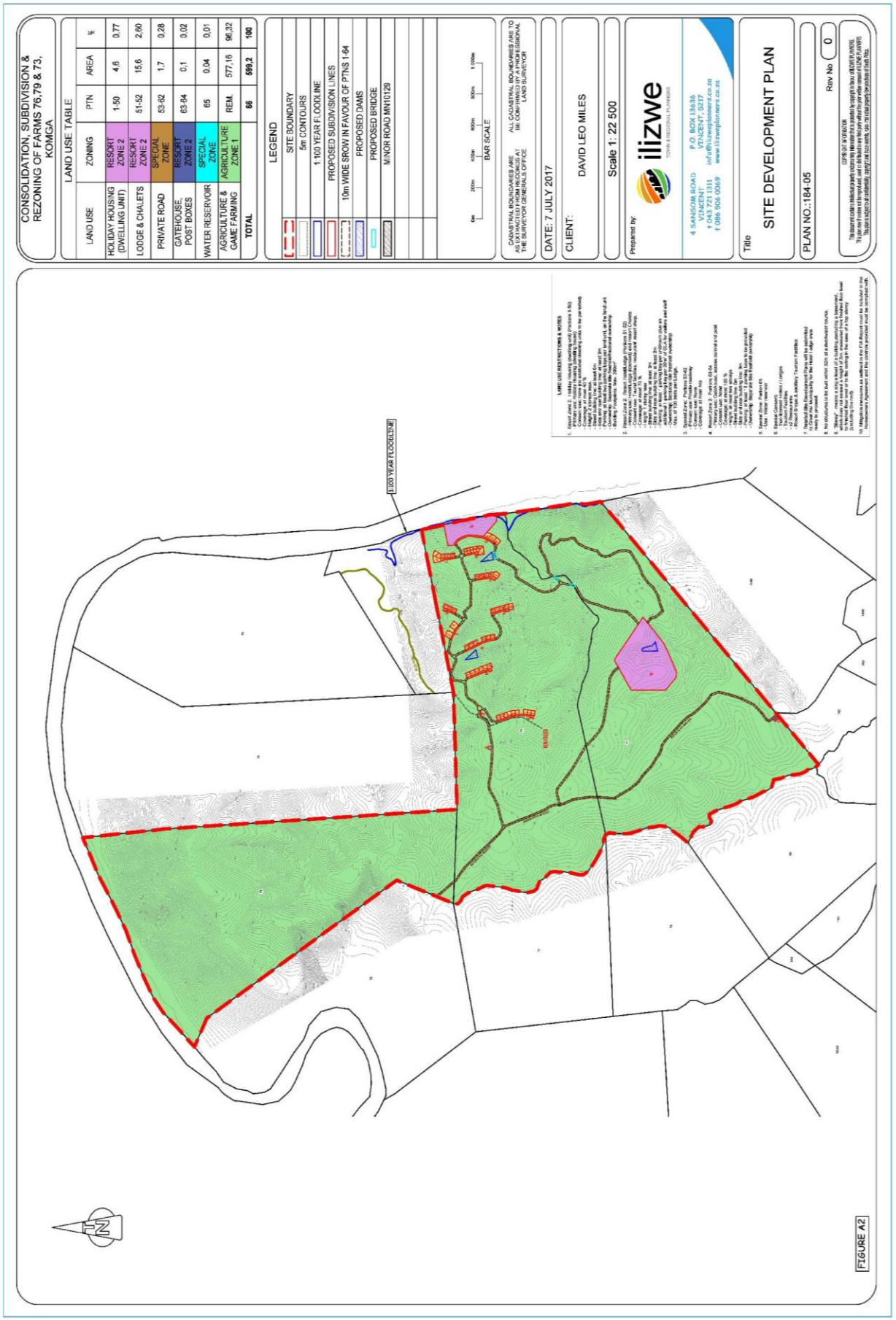


FIGURE A2: SITE DEVELOPMENT PLAN (NOT TO SCALE)

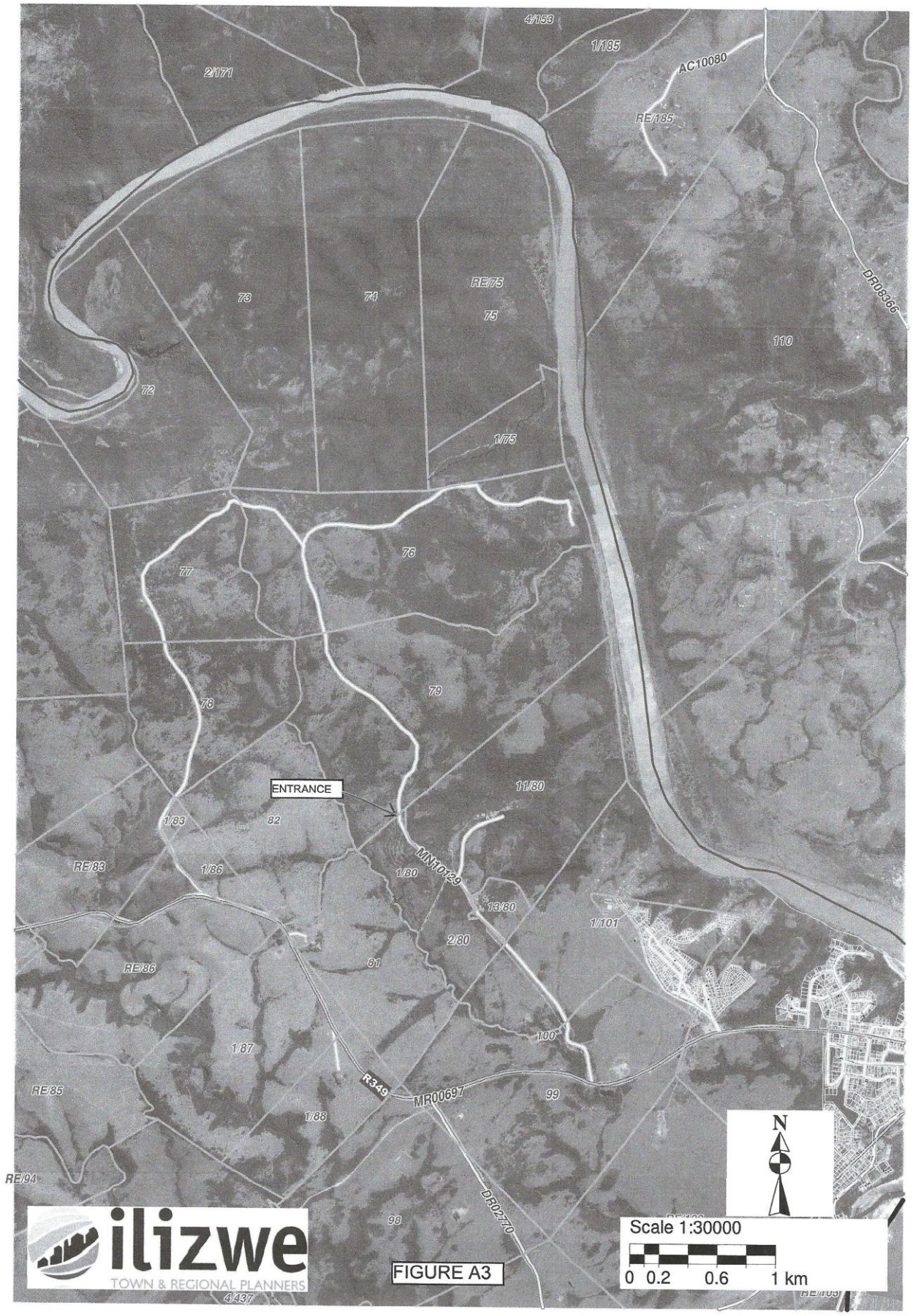


FIGURE A3: ACCESS ROADWAY LAYOUT

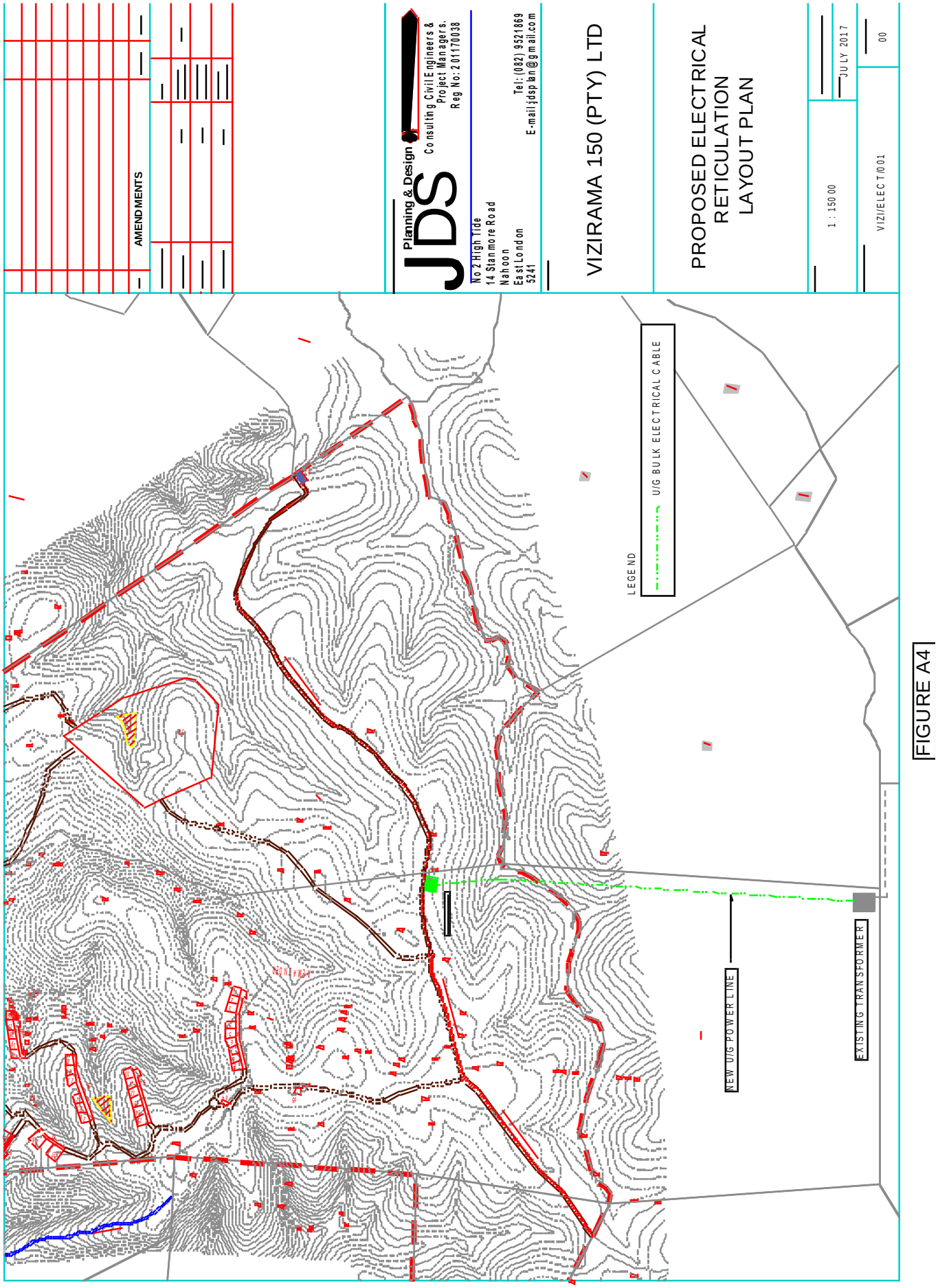


FIGURE A4: BULK ELECTRICAL RETICULATION (NOT TO SCALE)

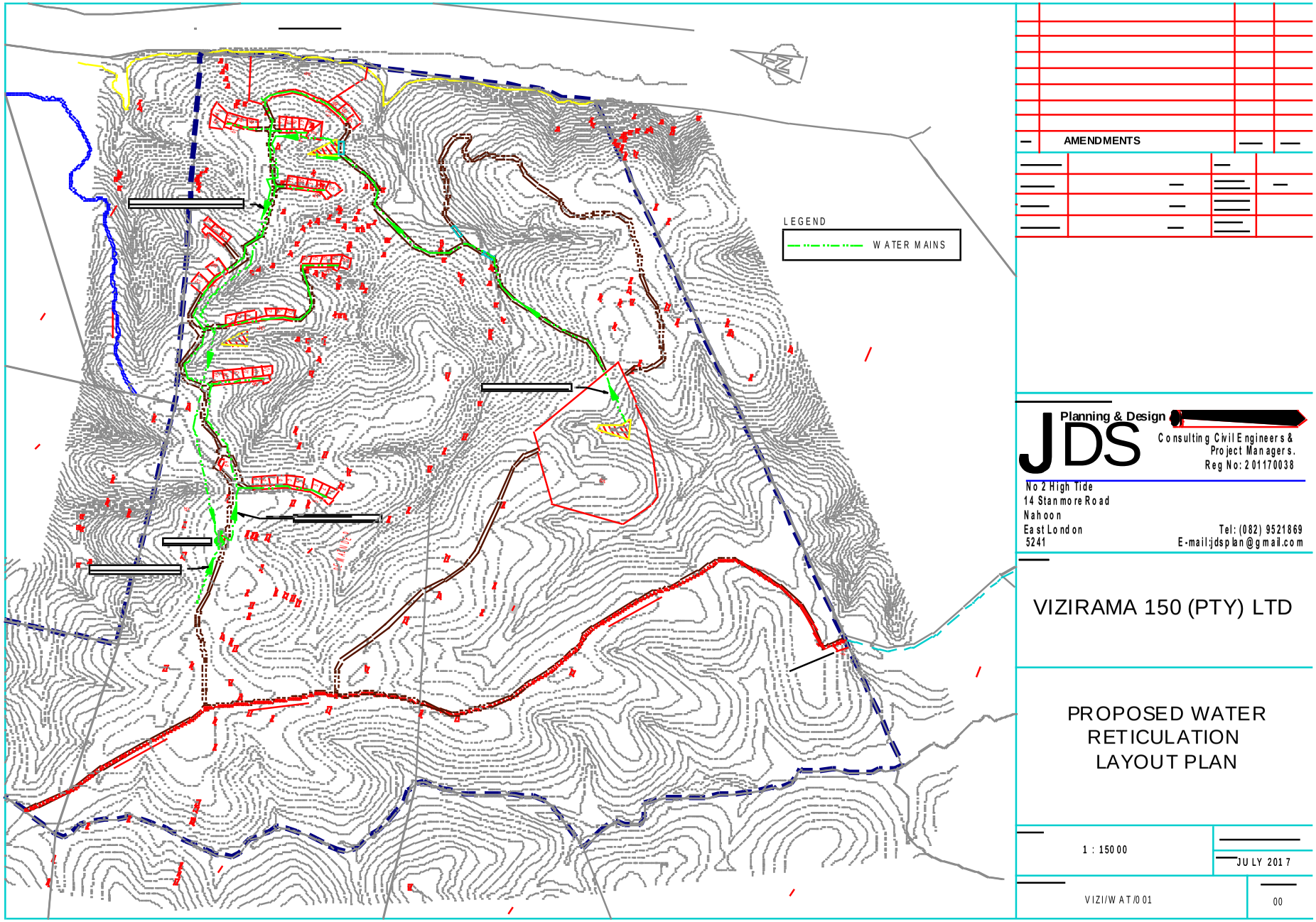
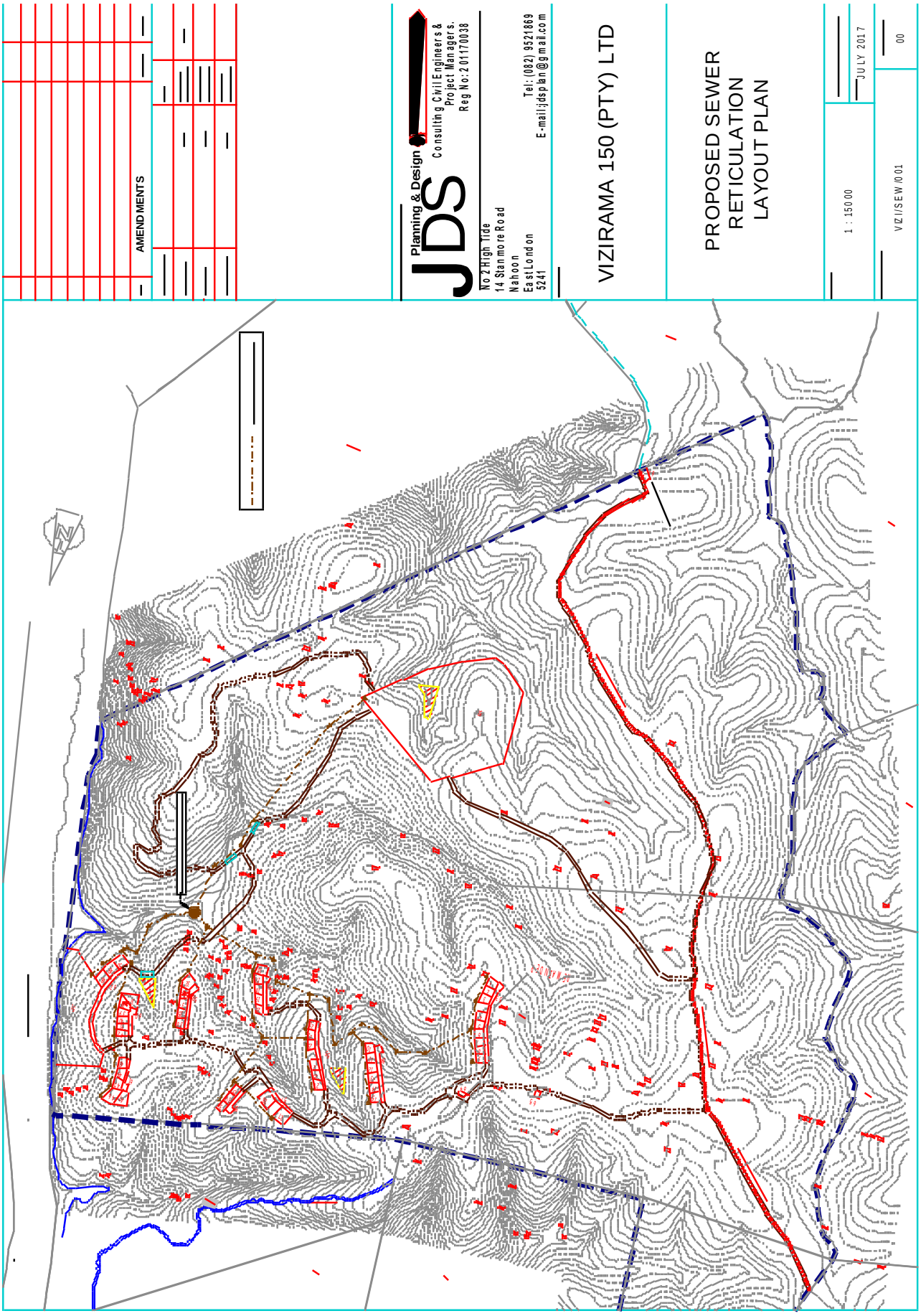


FIGURE A5

FIGURE A5: BULK WATER RETICULATION (NOT TO SCALE)



[FIGURE A6]

FIGURE A6: BULK SEWER RETICULATION (NOT TO SCALE)

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13. APPENDIX C: ABBREVIATIONS

13.1 LIST OF ABBREVIATIONS

AADD	Average Annual Daily Demand.
ha	hectare
hr	hour
kl/day	kilolitre per day
kVA	kilovolt Amp
kV	kilovolt
l/d/e	litres per day per erf
l/min	litres per minute
l/s	litres per second
m	metre
mm	millimetre
SDP	Site Development Plan
m^2	square metre
m^3	cubic metre