PRELIMINARY DESIGN REPORT FOR THE CIVIL ENGINEERING SERVICES TO SERVE THE INFORMAL SETTLEMENT AREA OF:

HLALANI, KNYSNA

MAY 2013

REVISION A

PREPARED FOR:
THE MANAGER: INTEGRATED HUMAN SETTLEMENT
KNYSNA MUNICIPALITY
PO Box 21
KNYSNA
6570

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1. EXECUTIVE SUMMARY

HLALANI is a relatively large development node located in the intersection of the N2 national road and the Noetzie road. It has been used as an informal settlement for many years and been earmarked by the Knysna Municipality for formalization and future subsidized low income housing.

There are currently approximately 340 informal structures on the site which have no access to basic services except for 17 stand pipes which provide potable water to this community. There is no availability of proper sanitation facilities and the community share approximately 60 long drop toilets randomly spread on the site.

The site is relatively steep along the adjacent roadways, typical of most areas in the northern areas therefore costly to service but nevertheless justifiable considering the land availability constraints in Knysna within close proximity to municipal bulk services, schools and public transport (the site borders on the N2 national road). Some sections of the proposed internal road network require considerable cut depths of up to two meters and associated retaining structures. Vehicle access will be limited to erven with direct access to internal roads only. Pedestrian walkways have been introduced to allow access to sites not bordering along the main internal road network.

However, the Municipality has indicated to us that in general it has limited capacity to provide additional bulk infrastructure services, particular sewerage treatment capacity, to service new developments in the whole of Knysna Greater Area and not particularly for this specific site in isolation. The Municipality is planning to start with the installation of services in Oupad within the next few months and once the sewage connection to his area is completed the problems identified with regards to the provision of bulk sewage to Hlalani can simultaneously be resolved.

The Dam-se-bos reservoir which currently supplies potable water to Hlalani has also sufficient spare capacity to provide this development node with the required amount of water.

The total estimated cost including services, land rehabilitation and top structures amount to R 35,833,319.55 excluding Value Added Tax.

- Provision of services R 8,292,336.75
- Top structures & Platforms R 27,540,982.80
- Total R 35,833,319.55
- Cost per stand R 132,716.00
2. INTRODUCTION

Sintec Engineering Consultants were instructed by the Knysna Municipality to submit this report for the purpose of the N6 application currently being processed by SSI.

The report includes a general overview identifying the availability of bulk services, preliminary internal design of civil engineering services and respective cost estimate.

The extent of the development is depicted in the Locality Plan enclosed in the attached appendix as Annexure A. The proposed subdivision consist of 273 single residential erven & 2 church sites (refer to VPM Planning’s report).

3. SITE DESCRIPTION

3.1 Existing infrastructure

- The area earmarked for subdivision is currently used as an informal settlement. The only basic service available is the provision of 17 water stand pipes which provides potable water to approximately 170 informal structures.
- Water is supplied via a temporary connection on the Noetzie road which originates from the Dam-se-bos reservoir and crossing the N2 national road.
- No waterborne sewage reticulation is available. It is estimated that there are 60 long drop toilets available for community usage. Pressure tests randomly carried out on a few stand pipes have recorded pressure readings of between 1.5 and 2 bar
- Existing roadways are generally in poor condition. The only vehicular access is a temporary entrance from the N2.

3.2 Topography

- The areas identified for subdivision are generally very steep in the areas adjacent to the Noetzie road. The site is characterized by a narrow ridge on the western side which slopes towards a well defined eastern channel on the eastern side.
- The ridge slopes down towards the N2 to the north and the Noetzie road to the west
- The terrain gradient vary throughout the site from a relatively flat area along the crest of the ridge to very steep towards the surrounding roads.

3.3 Informal structures

There are currently approximately 170 informal structures in this area, most of which will eventually have to give way to formalized housing units.
4. CIVIL ENGINEERING SERVICES

Calculations are based on the guidelines for Human Settlements Planning & Design for the estimation of water and sewerage services.

4.1 WATER

The water reticulation system will consist of the following (Refer drawing 145 – P – 01):

- 75mm (± 990 m), 110 mm (± 1440 m) & 160 mm (± 48 m) Ø Class 9 uPVC mainline and shall comply with SABS 966,
- All water lines will comply with the requirements of SABS 1200 L: Medium Pressure Pipe lines,
- All Flanges and accessories shall be drilled to comply with BS 4504, table 16/11 for working pressure of 1600 kPa,
- All cast iron fittings shall be Rilsan coated and after installation all fittings, specials, valves and the appurtenant nuts and bolts shall be covered with a protective paste (Densopaste or similar) and there after the smeared surfaces shall be wrapped in an impregnated tape (Densotape or similar). All bolts and nuts shall be stainless steel as per SABS,
- Isolating valves shall be class 10 resilient seal valves, epoxy coated, double Socketed, anti-clockwise closing, with capped top and non-rising spindle,
- Fire hydrant will be the London Round Thread Type,
- All pipe lines will be bedded on a selected granular material. These materials shall comply to Class B bedding and SABS 1200 LB and shall be non-cohesive and free-draining.

Water demand generated by the proposed development:

- 280 erven @ 600l/day/erf = 162 m³/day (1.88 l/s),
- Peak Demand (PF = 5) = 9.38 l/sec

Storage requirements:

- Domestic: 48 hrs = 324.0 m³
- Fire flow (moderate risk) = 57.6 m³
- Total storage required = 381.6 m³

Water supply will be extracted from the existing bulk connection point provided to the south eastern side of the development. This area is served by the 2 Ml Dam-se- Bos Reservoir.

4.2 SEWERAGE (Refer drawing 145 – P – 02)

Initially we have proposed two (2) options that Knysna Municipality could consider for Hlalani waterborne sewage reticulation and their mainline connection.

They were:

1. OPTION 1
Installation of an outfall sewer along the Noetzie road measuring approximately 900m in length connecting to the existing Hornlee reticulation.

2. OPTION 2
Connect to the proposed Oupad sewage reticulation once this new reticulation system is connected to the municipal waterborne reticulation

From further discussions with the Knysna Municipalities' technical department Option 1 (Hornlee reticulation system) was already working at full capacity and therefore unable to deal with the additional effluent generated from Hlalani.

Option 2 has now been decided upon and a new bulk 300 mm Ø uPVC has already been partly installed to cater for this and other future developments in the area. The construction and installation of this 300 mm Ø mainline will in all likelihood be commissioned by end July 2013.

This system of pipes collects effluent water, which may contain solids in suspension from the individual sites, to two (2) newly proposed sewer pump stations.

These pumpstation would discharge into the existing pipe network as shown on drawing 145 – P – 02.

The proposed system would consist of the following:

- 160 mm Ø uPVC (±2450 m) Solid Wall SABS 791 Class 34 400 kPA or similar spigot & socket pipes for mainline,
- 110 mm Ø uPVC (±810 m) Solid Wall SABS 791 Class 34 400 kPA or similar spigot & socket pipes for residential connections, All sewer mains will have a minimum grade of 1 in 100,
- Internal drainage will have a minimum grade of 1 in 60,
- Sewer manholes will be 1.05 m Ø ROCLA or similar approved precast concrete rings with concrete covers and frames. Medium duty covers for roadside verges and non trafficked areas and heavy duty concrete covers and frames will be specified for trafficked areas. It is recommended that all the joints on the precast rings be sealed for water ingress with a 100 x 1 mm wide Polyurethane Bandage,
- All pipe lines will be bedded on a selected granular material. These materials shall comply to Class B bedding and SABS 1200 LB and be non-cohesive and be free-draining. Initial tests have shown that the on-site material would be suitable for selected fill,

The new pumpstations will be equipped with two submersible pumps and a sump (“wet well system”). The size and depth of the sump will be sized to accommodate four hours of emergency storage based on the average dry weather flow (ADWF) which reaches the pumpstation.

In the hydraulic design both minor and major losses will be taken into account. Deposition of solids must be prevented by maintaining a velocity of at least 0.7 m/s. Very high velocities should be avoided in order to limit friction losses. For this reason a maximum of 2.5 m/s is prescribed.
As no initial allowance for emergency power failure will be provided at the pump stations, each sump’s capacity will be increased to ensure a minimum of 4 hours emergency storage. This will be based on the ADWF that reaches the pumpstations.

The following aspects will make up this system:

- Two (2) Flyghts’ or similar approved submersible pumps. These pumps will be capable of pumping solids of up to 80 mm ø and will be equipped to be able to self cleanse the bottom of the well. These small pumps are less likely to block as they will be fitted with low efficiency vortex impellers,
- Starting and stopping of the pumps will automatically occur by predetermined water levels in the sump. This will be done using float controls or electrodes. The controls will be placed as to restrict pump starts to between 4 to 8 per hour for the submersible pumps,
- Provision will be made for controlling pumps manually during emergencies and also for maintenance purposes.
- 75mm (± 1150 m) Ø Class 9 uPVC rising mainline and shall comply with SABS 966
- It is recommended that all the joints on the sump be sealed for water ingress and to prevent possible leakages. This will be achieved using waterproofing agents like 100 x 1 mm wide Polyurethane Bandages along with Sikagard 70 or other similar approved products

Effluent: Using the Harmon Formula to determine the peak factor (calculated at 3.8) and an average of 50% infiltration we summarize as follows:

- ADWF: 140 m³ / day (1.62 l/s),
- PWWF: 1,064 m³ / day (12.31 l/s),

4.3 SOLID WASTE

- Average solid waste per household = 0.12 m³ / week,
- Total solid waste = 33.6 m³ / week.

Knysna Municipalities Community Services has confirmed that all solid waste generated will be transported by road to PetroSA in Mosselbay.

4.4 ROADS & STORMWATER

4.4.1 Access

Access to the site is via an illegal entrance from the N2 which is considerably dangerous. The proposed access is therefore from the Noetzie road instead.

4.4.2 Roadways (refer to Drg no. 145 – P - 03)

The proposed width of the primary link road is 4.50 m with secondary roads of 3.8 m wide. It will consist of two structural layers and concrete paving blocks.
Certain sections of the roadways are very steep and in such instances we have allowed for the formalization of pathways.

It may be necessary to import rockfill on the lower sections of the road due to geotechnical characteristics.

The layer works will be designed for the anticipated traffic loads.

- Bottom layer: 150 mm thick in-situ layer compacted to 95 % mod. ASSHTO;
- Sub-base layer: 150 mm thick G7 layer imported from commercial sources and compacted to 95 % mod. AASHTO,
- Base layer: 150 mm thick G5 layer imported from commercial sources compacted to 98 % mod AASHTO,
- The wearing surface of all the roads will consist of segmented paving blocks, 65 mm thick and placed on 25mm thick bedding sand. Edges will be constructed with a concrete edge kerbing,
- The minimum road cross fall will be 2.5% and be mostly sloping against the natural gradient of the site. A minimum longitudinal fall of 0.5% shall be adhered to.
- Road gradients vary with certain sections of road reaching gradients in excess of 20 %. In sections steeper was classified as pathways only

It is envisaged that ± 3375 m³ of construction waste (cut to spoil, excavations etc.) will be generated per month during construction stage. A old existing “borrow pit/quarry”, as depicted below, has been allocated and approved by Knysna Municipality.
4.3 Stormwater drainage

Provision for effective stormwater drainage should be made by means of a combination of underground pipes and concrete lined V-drains running parallel to the roadways and discharging into the natural water courses. Energy dissipaters will be placed strategically to minimize the additional runoff into the water courses.

4.5 Bulk services

The Municipality's Technical Department has now indicated that Option 2 is acceptable for Hlalani to connect to. This proposed new 300 mm Ø mainline, which Hlalani will connect to, is currently under construction and should be completed by end July 2013. The Municipality has made provision for water supply through an existing 160 mm Ø connection point.

4.6 Cost Estimate

These civil Engineering costs are based on current (August 2012) rates received through contracts of similar nature and is for the complete servicing of the 273 residential stands:

We highlight the following pertaining the costs (All costs exclude VAT):

- Total cost for the provision of services = R 8,292,336.75
- Estimated cost per Erf (excl VAT) = R 30,712.36

<table>
<thead>
<tr>
<th>LINE</th>
<th>SECTION</th>
<th>DESCRIPTION</th>
<th>AMOUNT</th>
<th>AMOUNT PER ERF</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>PRELIMINARY &amp; GENERAL</td>
<td>R 728,356.32</td>
<td>R 2,697.62</td>
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<td>B</td>
<td>2</td>
<td>WATER RETICULATION</td>
<td>R 764,497.01</td>
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<td>C</td>
<td>3</td>
<td>SEWER RETICULATION (INCL. PUMPSTATIONS)</td>
<td>R 2,604,574.90</td>
<td>R 9,942.67</td>
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<td>4</td>
<td>ROADS</td>
<td>R 2,071,030.33</td>
<td>R 7,670.48</td>
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<td>E</td>
<td>5</td>
<td>STORMWATER</td>
<td>R 306,748.35</td>
<td>R 1,136.11</td>
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<td>F</td>
<td></td>
<td>SUB-TOTAL: (LINES A + B + C + D + E)</td>
<td>R 6,555,206.91</td>
<td>R 24,278.54</td>
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<tr>
<td>G</td>
<td></td>
<td>ALLOW 10% FOR CONTINGENCIES</td>
<td>R 665,520.69</td>
<td>R 2,427.86</td>
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<tr>
<td>H</td>
<td></td>
<td>SUB-TOTAL: (LINES F + G)</td>
<td>R 7,210,727.60</td>
<td>R 26,706.40</td>
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<tr>
<td>I</td>
<td></td>
<td>ALLOW 15% FOR PROFESSIONAL FEES + DISBURSEMENTS</td>
<td>R 1,091,809.14</td>
<td>R 4,005.66</td>
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<td>J</td>
<td></td>
<td>TOTAL: CIVIL ENGINEERING WORKS: (LINES H + I)</td>
<td>R 8,292,336.75</td>
<td>R 30,712.36</td>
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</table>
Due to the steep topography of the terrain, a considerable number of platforms and retaining walls are envisaged. In order to arrive at an average cost per stand we have considered different options as these are included part Annexure C.

The total estimate for land rehabilitation and top structures:

<table>
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<th>Amount Per ERF</th>
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<tr>
<td>A</td>
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<td>Blocks &amp; Other Masonry Units</td>
<td>R 2,171,922.00</td>
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<td>B</td>
<td>2</td>
<td>Sands &amp; Aggregates</td>
<td>R 210,820.13</td>
<td>R 8,033.43</td>
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<td>C</td>
<td>3</td>
<td>General Items</td>
<td>R 2,343,728.94</td>
<td>R 8,680.47</td>
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<td>D</td>
<td>4</td>
<td>Plumbing</td>
<td>R 746,718.38</td>
<td>R 2,773.03</td>
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<td>E</td>
<td>5</td>
<td>Roof Structure</td>
<td>R 2,231,563.60</td>
<td>R 8,266.81</td>
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<td>F</td>
<td>6</td>
<td>Windows</td>
<td>R 947,163.20</td>
<td>R 3,507.57</td>
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<td>G</td>
<td>7</td>
<td>Cement</td>
<td>R 576,144.00</td>
<td>R 2,141.27</td>
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<td>H</td>
<td>8</td>
<td>Raft Foundations</td>
<td>R 4,630,500.00</td>
<td>R 17,150.00</td>
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<td>I</td>
<td></td>
<td><strong>Sub-Total: (Lines A to H)</strong></td>
<td>R 13,869,074.25</td>
<td>R 51,360.94</td>
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<tr>
<td>J</td>
<td></td>
<td>Allow 10% for contingencies</td>
<td>R 1,396,007.42</td>
<td>R 6,136.69</td>
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<tr>
<td>K</td>
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<td><strong>Sub-Total: (Lines I + J)</strong></td>
<td>R 15,255,981.67</td>
<td>R 56,503.64</td>
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<tr>
<td>L</td>
<td></td>
<td>PHP Process: Administration &amp; Labour</td>
<td>R 8,750,000.00</td>
<td>R 25,000.00</td>
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<td>M</td>
<td></td>
<td><strong>Total: Top Structure Estimate: (Lines K + L)</strong></td>
<td>R 22,005,981.67</td>
<td>R 81,503.64</td>
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PRELIMINARY DESIGN
TYPICAL PLACING OF 40m³ DWELLING ON TERRAIN SLOPES OF 1:3 (33% GRADIENT)
(WORST CASE SCENARIO)

15 x 10m ERF
SLOPE 1:3
Scale 1:150

COST ESTIMATE: SITE GROUNDWORKS

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<th>Description</th>
<th>Unit</th>
<th>Quantity</th>
<th>Rate</th>
<th>Cost</th>
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</thead>
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<tr>
<td>1. Clear &amp; Grub</td>
<td>m³</td>
<td>145.96</td>
<td>8.86</td>
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<td>m³</td>
<td>115.02</td>
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<td>3. Retaining Wall complete (2,25m)</td>
<td>m³</td>
<td>33.76</td>
<td>334.50</td>
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<td>4. Trim, shape &amp; compact V-drain</td>
<td>m</td>
<td>33.51</td>
<td>30.05</td>
<td>1,008.08</td>
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<tr>
<td>5. Eakin, trim &amp; make good site</td>
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<td>1.00</td>
<td>935.73</td>
<td>935.73</td>
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<td>1,00</td>
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SILTY SANDS & SANDS

TRENCHES L11 or similar approved Retaining Wall System

Grass or Stone Planted V-Drain

Concrete Footing

End of Drains to be extended to boundary line

Section C - C
Scale 1:100

KNYSNA MUNICIPALITY

SITE GROUNDWORKS AND EXCAVATION DETAILS TYPE C

DESIGNED: HH  DATE: AUGUST 2012
DRAWN: HH  APPROVED: HH
CHECKED: HH  PRINTED: HH

SCALE: 1:100

AUGUST 2012

SINOCEC INDUSTRIAL SERVICES
TYPICAL PLACING OF 40m² DWELLING ON TERRAIN SLOPES OF 1:4 (25% GRADIENT)
(EXPECTED TYPICAL SCENARIO)

COST ESTIMATE: SITE GROUNDWORKS

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<th>Rate</th>
<th>Cost</th>
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<td>m³</td>
<td>154.77</td>
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<td>2. Excavate in soft material (bed, spoil)</td>
<td>m³</td>
<td>81.40</td>
<td>R 29.16</td>
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<td>3. Construct Retaining Wall complete (1.5m)</td>
<td>m³</td>
<td>22.50</td>
<td>R 327.50</td>
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<td>4. Trim, shape &amp; compact V-drain</td>
<td>m</td>
<td>33.51</td>
<td>R 30.05</td>
<td>R 1,006.86</td>
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<td>5. Clean, trim &amp; make good site</td>
<td>sum</td>
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15 x 10m ERF
SLOPE 1:4
Scale 1:150

SILTY SANDS & SANDS
TYPICAL PLACING OF 40m² DWELLING
ON TERRAIN SLOPES OF 1:6 (17% GRADIENT)

<table>
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<th>Cost</th>
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</thead>
<tbody>
<tr>
<td>1. Clear &amp; Grub</td>
<td>m³</td>
<td>145.95</td>
<td>R 5.56</td>
<td>R 855.27</td>
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<td>2. Excavate in soft material (incl. spoil)</td>
<td>m³</td>
<td>99.20</td>
<td>R 93.16</td>
<td>R 9,241.47</td>
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<td>3. Retaining Wall complete (1m)</td>
<td>m³</td>
<td>13.20</td>
<td>R 374.50</td>
<td>R 4,943.60</td>
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<td>4. Trim, shape &amp; compact V-dram</td>
<td>m</td>
<td>33.51</td>
<td>R 30.05</td>
<td>R 1,006.96</td>
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<tr>
<td>5. Clean, trim &amp; make good site</td>
<td></td>
<td>1.00</td>
<td>R 309.73</td>
<td>R 309.73</td>
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<td>6. Allowance for environmental control</td>
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<td>1.00</td>
<td>R 6535.00</td>
<td>R 6,535.00</td>
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<td><strong>Total</strong></td>
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<td><strong>R16,892.71</strong></td>
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15 x 10m ERF
SLOPE 1:6
Scale 1:150

SILTY SANDS & SANDS

**SITE GROUNDWORKS AND EXCAVATION DETAILS TYPE A**

Scale 1:100

---

**KNYSNA MUNICIPALITY**

**HLALANI DEVELOPMENT**

**PRELIMINARY DESIGN APPLICATION**

**DRAWING TITLE:**

**DESIGNER:**

**CHECKED:**

**DRAWN:**

**PLANTED:**

**SIGNED:**

**DATE:** AUGUST 2012

**DESIGN:**

**CHECK:**

**DRAWN:**

**B/E:**

**REV.:**

**DWG. NUMBER:** 145-P-20

**A**