PROPOSED LOW DENSITY RESIDENTIAL HOUSE DEVELOPMENT AT PORTION 31 OF THE FARM BUFFELSFONTEIN 250 BOGGOMS BAY, MOSSEL BAY, WESTERN CAPE

M 1 210 Rev 02

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CIVIL ENGINEERING SERVICES

1. INTRODUCTION

Cobus Louw Professional Engineer was appointed by FJ Orban to prepare the necessary Civil Engineering Service Report for the proposed low density eco development consisting of 13 residential houses of approximate 250m² on Portion 31 of the Farm Buffelsfontein 250, Boggoms Bay, Mossel Bay, Western Cape directly north of the existing town Boggoms Bay in the Municipal District of Mossel Bay Municipality.

The total size of the property is 23.774ha including some services servitudes been registered on the Western border of the property.

The 23.7740ha will be subdivided into a number of portions as described in the table below.

Erf No.	Extent (±)	Proposed Zoning
1 - 13	0.984ha	Single Residential Zone I with 13 erven of ±757m² each
14	0.292ha	Business Zone III (neighbourhood shop) with flats above ground floor and consent use for restaurant
15	0.853ha	General Residential Zone V (hotel) – 4-bedroom boutique hotel with the existing Sandpiper Leisure Centre
16	2.602ha	Open Space Zone II – Private Open Space
17	0.230ha	Utility Zone - municipal reservoir
Remainder	18.813ha	Agriculture Zone I Status quo remains
TOTAL	23.774ha	

Residences will consist of a footprint area of less than 250m².

Each residence will be provided by a basic access road, off grid electricity, on-site sewerage disposal, water harvesting will be compulsory. The Municipal water network in Boggoms Bay will be able to help water shortages during the dry seasons of the year.

2. LAND USE

2.1 Site Development Plan

Currently the zoning is Agricultural 1 (AGR1) for the total area.

Approximately 4.961ha is proposed to be rezoned to Subdivisional Area with the subsequent subdivision in the portions as described in the table included in Paragraph 1 above.

3. EXISTING SERVICES

3.1 Buildings

Existing quest house on the Southernmost corner of the Portion 31 of the Farm Buffelsfontein 250.

3.2 Water

A existing Municipal reservoir exist on the Western border of Portion 31 of the Farm Buffelsfontein 250. The reservoir is fed from the Municipal water network providing water to the town of Boggoms Bay.

The reservoir capacity is 0.5ML (500m^3) with a floor level of 81m and a full water level of 83.8m.

The reservoir is been fed by a Ø160mm water pipeline from the Municipal water network at the Petro SA premises 12.7km North East of Boggoms Bay.

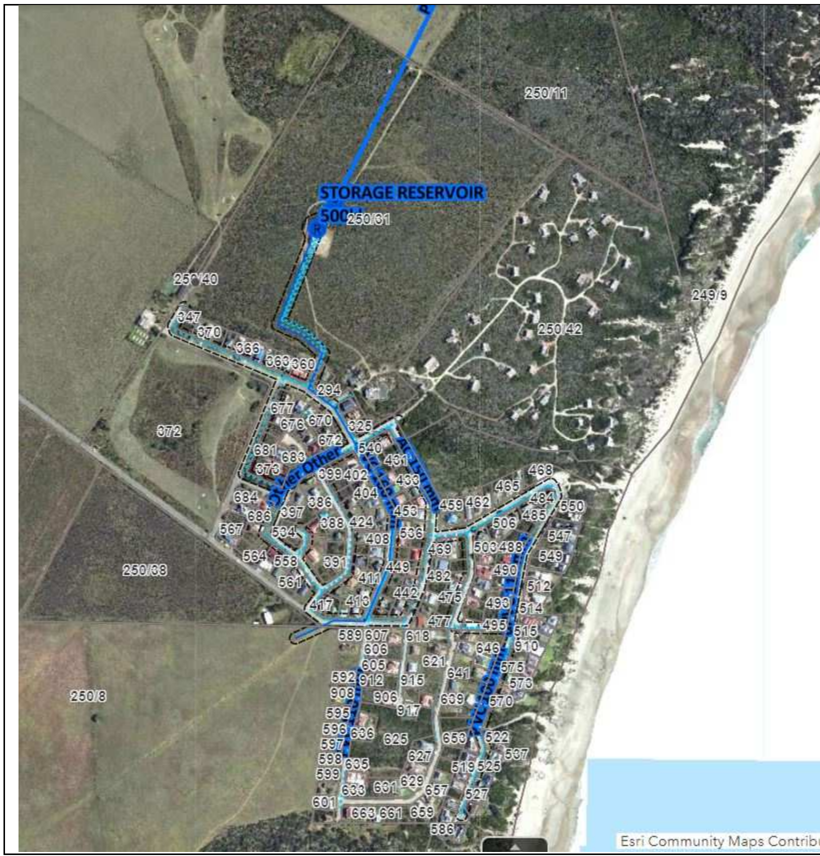

Figure D : Existing water network adjacent to the development area of Portion 31 of the Farm Buffelsfontein 250

3.3 <u>Sewerage</u>

None.

3.4 <u>Access and Roads</u>

Bonito Street in Boggoms Bay creates a dead end at the Southwestern boundary of Portion 31 of the Farm Buffelsfontein 250. The historically town layout indicate that the expantion direction of the town is in this direction. Access will be from the existing streets of Boggoms Bay.

3.5 <u>Storm water</u>

None.

The area is naturally drained to a Southern direction with a number of local low and high points all over the property. Typical of natural dune habitat. A number of local depressions create a situation that almost all stormwater runoff will drain via the in-situ sandy soil conditions into the underground.

4. IN-SITU GROUND CONDITIONS

The in-situ soil types encountered surficially about the site are fine grained non plastic sands with a Typical Permeability Class of Moderate to High (600 – 6 000) mm/day.

The bearing capacity of the in-situ soil will typically range from 50-200kPa depending of the depth below natural ground level. At ±2 000mm below natural ground level 200kPa bearing capacity could be expected.

5. PROPOSED CIVIL ENGINERING SERVICES

5.1 House Construction

Houses will be built by conventional building methods and house footprints will be determine as site specific positions to keep existing flora into consideration.

Roof designs will be in such a way to maximize solar electricity harvesting, the same principal will be applicable for rainwater harvesting.

5.2 Water

5.2.1 A uPVC water network will be installed connecting to the existing Municipal water network.

Water during the construction phase a metered water connections will be available to monitor water usage during the house build Phase of the project.

5.2.2 Water for long term household use.

The expected water usage will be between 1 500 – 1 750 litre / day / household. The household water network will be compiled in such a way that harvested rainwater usage will be priority.

The recommended freshwater storage capacity per household will be 10 000 litre. The water storage tanks must be placed in such a way that it does not negatively influence the skyline.

We are from the opinion that none of the proposed house positions will comply to the minimum residual head for general household purposes of 24m. Even for the water head receiving from the Municipal reservoir.

Natural ground levels at house footprint levels vary between 62 and 77m.

For this purpose, a pressure pump will be required for water distribution in and around all houses to comply to the minimum residual head for general household purposes of 24m.

5.2.3 Water for Fire-flow design criteria

The development area be classified as moderate risk in regard to fire risk based at the existing vegetation in the area.

Moderate-risk areas required a fire-flow rate of 1500 litre / min for a period of 4 hours at a minimum residual head of 15m.

5.2.4 Reservoir storage capacity vs design criteria

Currently there is 310 residential erven in Boggoms Bay and 13 new erven is planned via this application.

With the planned development taken into consideration the average water demand could be summarized as followed:

Average water usage per day	- 5.61litre/sek
Peak daily usage	- 11.66litre/sek
Required reservoir storage capacity without fire demand	- 500m³
Required reservoir storage capacity with fire demand	- 800m³

To adhere to the reservoir capacity requirements with the necessary fire flow taken into consideration each residence in the proposed development will require at least 15 000litre storage capacity.

General household recommendations

It is proposed that the proposed development be equipped with the following water saving technology:

- **Dual Flush Toilets**
- **Low flow shower heads –** It is proposed that the residential units be equipped with low flow shower heads, as these can not only reduce water consumption by up to 50%, but also the energy required for water heating by up to 50% (Earth easy, 2008 - http://eartheasy.com/live_lowflow_aerators.htm). Low flow shower heads make use of either aerators or pulse systems to reduce the flow without compromising the quality of the shower. The choice of shower head is up to the homeowner, but must have a flow of less than 7 liters per minute.
- **Low flow faucets -** Low flow faucets use aerators to reduce the flow of the water. These are either built into the faucet or added as an aftermarket product. The faucets in bathrooms should have a peak flow of less than 10 liters per minute.
- **Geyser and pipe insulation -** Apart from the savings in terms of energy as detailed above, insulating geysers and pipes save water, as shorter periods of running the tap to get hot water are required. Homeowners must be required to install geyser and pipe insulation and this must be included in their building guidelines.

5.3 Sewerage

The calculated sewerage and grey water generation from the development has been calculated as 500 - 750 litre / day / household.

It is recommended that all wastewater from the residential units been treated as follows:

- All grey water from bathrooms, laundry and kitchen areas be directly diverted to a constructed / artificial wetland system.
- All black water (organic products) from the bathrooms, laundry and kitchen areas be diverted to a bio-gas digester with an overflow to the constructed / artificial wetland system soak away system.
- The water from the constructed / artificial wetland system will be used for gardening purposes.
- The Bio-Gas Digester will have the following building functions
  - mixes the contents for increased gas generation efficiency
  - naturally decomposes biodegradable materials without the additional any chemicals
  - stores the biogas that is generated by this natural decomposition
  - generates an internal pressure which allows the biogas to be piped directly to the point of use
  - the digester mixing, gas storage and pressurisation are all achieved without any mechanical input at all i.e. no pumps or motors of any kind.

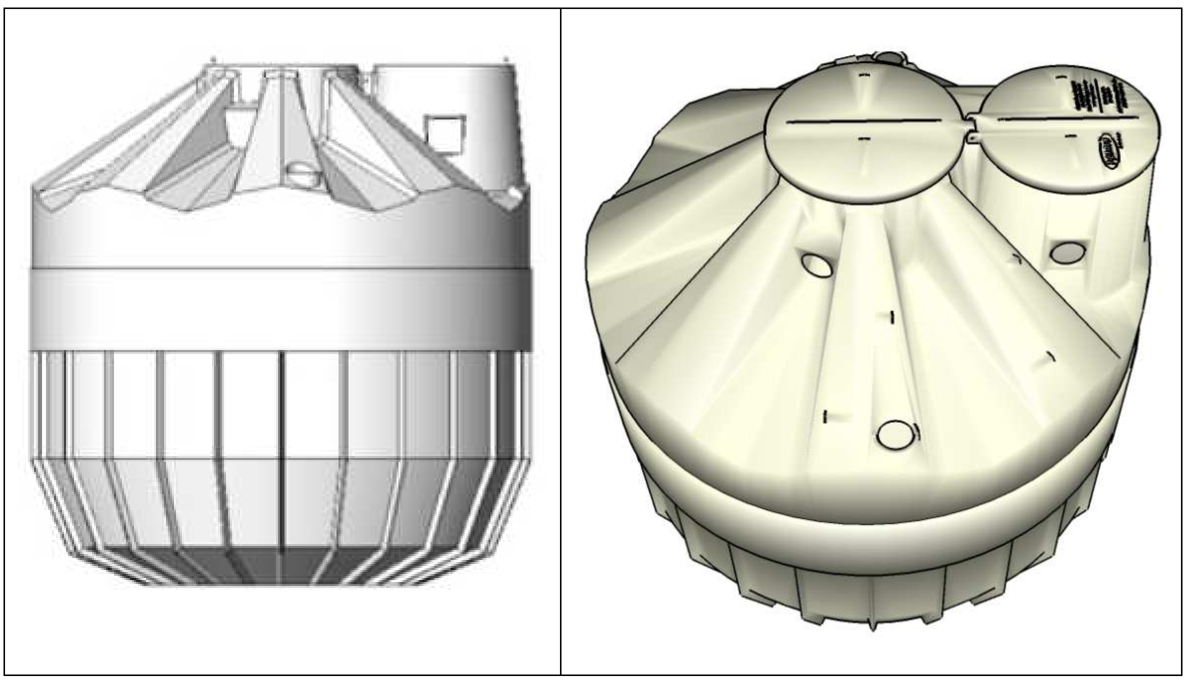

Figure A : Typical on-site Bio-Gas Digester plant

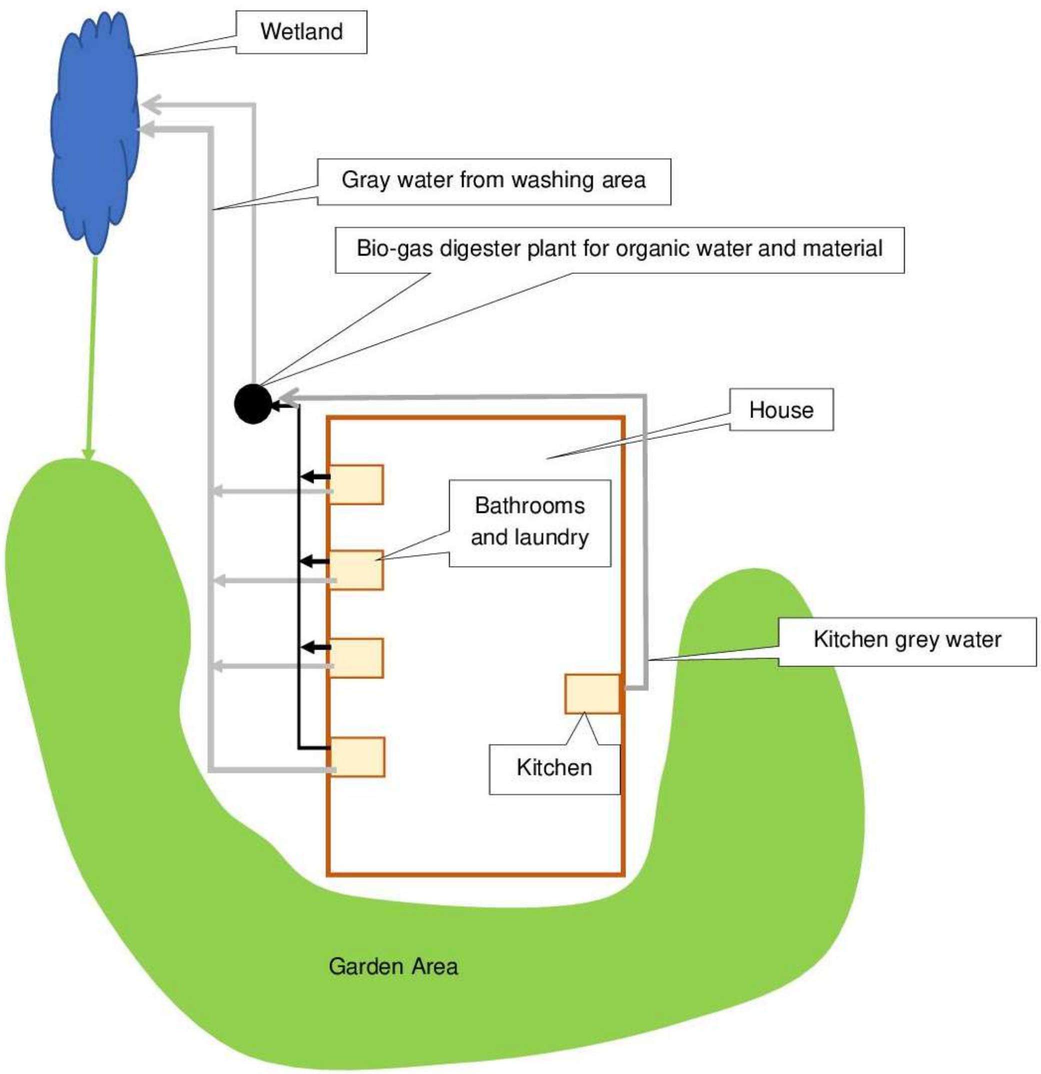

Figure B : Schematic wastewater treatment on-site

5.4 Access and Roads

Access to and from Portion 31 of the Farm Buffelsfontein 250 will be via the existing Boggomsbaai road network. An extention of the existing Bonito Street will be constructed into the proposed development.

Figure C : General layout and access to Portion 31 of the Farm Buffelsfontein 250

The new internal roads will be designed as a so called "Jeep Track" existing of 2 vehicle tracks with most of the time lower vegetation growing in between the two tracks. These tracks will all be accessible with a normal 4 x 2 vehicle.

We recommend that roads be constructed out of a combination of the materials as described below. The gradient and stormwater per position also needs to be taken into consideration in the road surface material choice.

1. Hyson Cells filled with 15MPa concrete.

2. The "Jeep Tracks" build with 20MPa concrete to form 2 concrete tracs each 300mm wide with construction joints at 2m intervals to prevent unnecessary expansion cracks.

3. Grass block in the form off :
   - Concrete pre-cast grass blocks.
   - Tensar TriAx interlocking plastic grass blocks.

4. Combination of Hyson Cells filled with concrete, concrete strips, concrete or plastic grass blocks. Each area will be evaluated to determine the most workable option and to protect the sides next to the roads.

5. Imported G7 material (no sand) compacted to 95% Mod Aashto density.

 Unfilled Hyson Cells	 Dirt road build wit Hyson Cells. No-concrete

Hyson Cells being filled with concrete

Completed cement surfaced road build with Hyson Cells

Tensar TriAx Plastix interlocking grass blocks

Pre-cast concrete grass blocks

The areas currently accessible with a normal 4 x 2 vehicle could be covered with wood chips harvested from the removal of alien vegetation. This is a non-official way of increasing the driving ability of roads in heavy sandy areas.

5.5 Storm water

The storm water system forms an integral part of the structure plan. The system rest on three legs, the minor system, the major system and an emergency system. The minor storms are catered for in the road design by creating stormwater management structures for the minor floods while the major storms are routed through a linked system of road and public open spaces using attenuation techniques. The emergency system recognizes failure of the minor system by storms greater than provided for in the major system or in the event or malfunction of the minor system providing continuous overland flow routes as part of the major system to minimize flooding of buildings.

The natural slope of the proposed development is in a Southern direction.

- The minor disposal system will consist of a number of stormwater management structures build into the road design at the Hyson Cells sections. The rest of the roads will consist of the in-situ soil with good permeability abilities and limited to no disruption of the natural vegetation who act as a superb natural stormwater management entity.

- The major system will make use of the natural low points in the area where water will accumulate, drain and evaporate over time.

- The emergency system will flow overland in a Southern direction.

The following design criteria will be used

Minor System: 2 Year return period conveyed in the road design by providing stormwater management structures to prevent road erosion by enabling as much as possible water to naturally soak away.

Major System: 20 Year return period. The difference be-tween the 2 year and 20 year to be conveyed in the natural low points on the property. These low points will act as natural detention ponds from which water will drain and evaporate over time feeding the underground water source.

5.5.1 STORMWATER MANAGEMENT PLAN

SUSTAINABLE URBAN DRAINAGE SYSTEMS

General

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

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

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

SUDS PROCESSES

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

i) Water quantity;
ii) Water quality; and
iii) Biodiversity

Water quantity management

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

- Capturing rainwater for supplementary water uses on site;
- Detaining stormwater before subsequent release;
- Conveyance of stormwater (transfer from one location to another);
- Long-term storage in a specified infiltrating area in the form of a wetland which will drain slowly and
- Stormwater outlet structures to act as energy dissipation structures to protect receiving watercourses in the event of flooding.

Water quality management

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

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

Biodiversity management

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

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

SUDS SELECTION

Selection basics

To successfully manage stormwater a number of treatment processes may be required. This multiple process treatment is referred to in the SUDS guideline as a treatment train. A variety of options or combinations of options may be necessary according to the individual requirements of the site. The three key points where intervention is required are as follows:

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

a) Source controls

Source control alternatives that were considered include:

- Green roofs;
- Sand filters;
- Soakaways; and
- Stormwater collection and reuse.

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

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

Soakaways are excavated pits filled with a porous medium, like course aggregate. Soakaways are used for temporary storage of stormwater, which is then allowed to infiltrate into the ground. Soakaways are suitable in most climatic conditions; significantly reduces runoff volume; and has design lives of up to 20 years if maintained correctly. This control is only suitable to small areas where infiltrating water will not adversely affect foundations of adjacent structures.

There is also a need for regular maintenance. **The overflow water collected from the roofs of the buildings need to be piped to a soakaway chamber system not negatively influence the foundation structure of the residential houses.**

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

b) Local controls

Local control alternatives that were considered inter alia include:

- Stormwater management structures as part of the hardened road construction sections.
- Make use of the natural vegetation and low points on the premises to act as natural energy dissipating structures and an
- Artificial wetland / detention pond being created on site.

Outlet structures from pipe- or channel stormwater systems will be designed in such a way to act as energy dissipating structures as well as a litter and sediment trap before water is been released into the ocean in the case of a major flood. This will only be applicable for runoff water from hardened surfaces around the primary house.

c) **Regional controls** (Not applicable to this area since the final run-off is discharged directly into the ocean and no regional controls are available downstream of the site.)

ANALYSIS OF THE PROPOSED STORMWATER DRAINAGE SYSTEM, IDENTIFICATION OF PROBLEM AREAS AND PROPOSED MANAGEMENT PLAN FOR WATER QUANTITY AND WATER QUALITY

WATER QUANTITY MANAGEMENT

Individual buildings

In order to create a more sustainable stormwater management system, a source control in the form of stormwater collection tanks at the buildings, will be used on site in order for stormwater to be reused for irrigation and domestic purposes. These tanks will be placed “in-line” on the building’s gutter system. The tanks will make use of an inlet by-pass system which ensures that the initial roof runoff is not collected in the tanks. This ensures that any pollutant build up on roofs will not be flushed into the collection tanks by the first rains, the so-called first flush phenomenon.

The buildings will be equipped with a surrounding pipe network to accommodate downpipes. The remainder of the stormwater on site will be accumulated and disposed into the artificial wetland.

WATER QUALITY MANAGEMENT

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

Utilising the concept of a treatment train, water quality will first be addressed by parking cleansing for removal of litter and sand sized particles.

Secondly a proper designed outlet structure will control pollution as well as flooding by causing energy loss of the water and the settlement of solids.

In addition to the above, the treatment train proposed for the building area will consist of stormwater collection and re-use tanks.

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

5.6 Solid Waste

The refuse generated will not consist of any chemical nature at all.

Two types of refuse will be generated

- Normal household refuse
  Non-recyclable } 1.56m³/Week
  Recyclable }
- Garden refuse

The following options for disposing of the refuse will be followed.

Normal Household refuse	- Distinction will be made on the premises between recyclable and non-recyclable refuse. Both these types of refuse will be delivered to the refuse collection point outside Boggoms Bay manage by Mossel Bay Municipality.
Garden refuse	- Will be managed on-site by the resident of the home through a composting facility in such a way that it does not pose a fire hazard to the environment.

6. GENERAL

This development will have an insignificant effect on the existing infrastructure of the Mossel Bay Municipality due to the off-the-grid principles of the Developer.

For any further queries, do not hesitate to phone Mr. Louw at 072 4233 208.

Yours truly,

JL LOUW Pr. Eng