

THE DAIRY AT HILTON DEVELOPMENT



BULK AND INTERNAL SERVICES ENGINEERING REPORT REVISION 2



PO Box 68, Merrivale 3291
Phone: 033-330 8386
Fax: 086 667 9713

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1. **INTRODUCTION**

Umsunguli Project Management cc was appointed by the Developer, Gwens Stream, to investigate and prepare a report on the bulk and internal service requirements for a maximum of 83 stands on the Hilton College Estate, to be known as Dairy on Hilton Development.

This report will assess the availability of all existing infrastructure services and elaborate on the design criteria and specifications that will be applied in the detail design process.

2. **LOCATION AND ACCESS**

The proposed development is situated on the Hilton College Estate, being Portion 167 of 10, of the Farm Hilton No. 12304 located within the local uMngeni Municipality and uMgungundlovu District Municipality. The site is situated along a gravel road and will gain access off the KZN Department of Transport District Road, D494 which joins onto the main Provincial Road, P139-1, approximately 1,7km away and 3,1km from the N3.

The GPS co-ordinates at the approximate entrance of the site is 29° 30' 51.44"S and 30° 18' 46.17"E. A locality plan is provided as Annexure A of this document.

3. **ENGINEERING DEVELOPMENT PROPOSAL**

3.1 **General**

Best practise requirements require that services be designed to connect to the existing municipal services infrastructure in order to accommodate the service requirements for developments of this nature. The internal services will be according to accepted engineering specifications and principles as well as acceptable environmental requirements and specifications, as provided in the approved environmental scoping and impact assessment reports.

The following engineering design criteria will apply and assumptions made:

- (a) Where bulk services are not available, the infrastructure will be provided by the Developer.
- (b) The provision of services to the proposed development will be designed to norms and standards in accordance with the "*Guidelines for Human Settlement Planning and Design*" (Red Book).
- (c) Site Development Plan provided by FGG Architects (SK004 – Site Plan Rev 7)
- (d) Environmental Wetland Delineation and registered watercourses provided by JG Afrika

A more in-depth geotechnical investigation of the development was completed; it came highly recommended in order to gauge the availability and quality of material on site. It should be considered when determining and estimated end quantities and pipeline routes which are normally finalized during the detail design phases.

- Profiling of the soil samples with complimentary DCP standard tests. This will help quantify the amount of top soil , intermediate and hard rock found
- Confirming the bearing capacity of natural earth insitu material, a CBR (California Bearing Ratio) test conforming to ASTM Standards D1883-05, which will be applicable to road construction materials.
- Grading Analysis of insitu material
- Determining Atterberg Limits of insitu material

The report mentioned areas which contained areas of weak bearing capacity, therefore it is recommended that structural details of individual House plans and road layer works take cognizance of the information and recommendations contained within the report.

Existing Services

The following existing services were observed during the site inspection conducted on 06 June 2016:

- **Roads** The main road serving the property is a gravel district road, D494 which runs in a South Western direction along the Southern boundary of the property. An additional internal farm road on the east side of the road connects perpendicularly to the district road. The farm road is situated within an informal unregistered right of way area between the two adjacent properties.
- **Water** There are no existing bulk infrastructure services on site. However, water is sourced from the supply dams on the Hilton Estate, purified and stored.
- **Sanitation** There are no existing bulk infrastructure services on site as the surrounding neighbourhood, including the current farmhouse all function using on-site sanitation in the form of septic tanks and soakaways. The proposed development will however be linked into the existing waste water treatment facility located on the Hilton College Estate, the capacity of which is to be increased to manage this additional volume.
- **Storm water** There are no existing storm water systems in place, except for rudimentary drainage near the Farmhouse running into the existing watercourse.

3.2 Roads

3.2.1 Bulk Road Network

There is an existing farm road on the eastern boundary of the road which joins onto the district road. The farm road is situated within an informal unregistered right of way area between the two adjacent properties. This road is not fit for reuse for access for the development. Therefore, the proposed development will be accessed off the existing gravel District Road, D494 via the provincial road P139-1, refer to the Conceptual Layout Plan (Annexure B) for more detail. The intersection to the development will have to comply with the Kwa-Zulu Natal Department of Transport standards and regulations stated within the conditions of establishment and is likely to be of a Type B1 gravel standard.

3.2.2 Internal Roads

All internal roads will be constructed to suit the anticipated traffic flow through the development, with additional parking provided near the Guardhouse for visitors. The pavement design will be a conventional municipal standard Category UC road for granular bases with an anticipated design bearing capacity ES1 0,3-1,0 x 10⁶ within a wet region (Red Book Extract). This will assess in further stages of design, including the following criteria:

Internal Roads	:	6.0m wide road
Design Speed	:	30 km/hr
Cross Fall	:	2.5%
Min K-Value (Crest)	:	4
Min K-Value (Sag)	:	5
Min Vertical Length	:	80m
Min Horizontal Length	:	45m
Pavement Design	:	25mm Asphalt 150m G2 Imported Crusher Run 150mm G5 Imported Selected Layer 150mm G7 Selected Subbase 150mm G9 Insitu Layer

3.3 Sewer

There is no municipal bulk sewer available for the development to connect into and the development will connect into the existing waste water treatment works on the Hilton College Estate. The development will be provided with two sewer pumpstations transferring effluent via a rising main into a gravity main flowing into the waste water treatment facility. The details of the system are described in more detail under section 3.3.2.

The Redbook does not provide any effluent guidelines for sewage and the water engineers, Mottram and Associates recommends using 1000l/day for sewer and 1350l/day for water.

The Dairy on Hilton Development is regarded as a Residential Zone 1 with a “*very high*” development level. Average and daily flow was determined using the following inputs and confirmed by the water engineer, Mottram and Associates:

Average Erf Size	: 1800m ²
No of Erven	: 83
Average water (l/day/erf)	: 1000
Peak Flow Factor	: 2.5
Infiltration Rate	: 15%

Using the current FGG architectural layout which provides a total of 83 sites, this provides an effluent production of 83,0 m³ / day or 30,3 Ml/annum. This equates to an average flow of 0.96 l/sec with an instantaneous peak flow reaching 2.40 l/sec.

3.3.1 Internal Reticulation

The internal reticulation will operate as a gravity main conveying raw effluent to a local low point.

The standards for the internal sewer reticulation to be installed with the proposed development can be summarised as follows:

➤ Pipe Material	: uPVC
➤ Pipe class	: Class 34 (300 kPa)
➤ Pipe diameters	: Main Gravity Main : 160mm
	: Individual House Connection : 110mm
➤ Minimum Grade	: Main Gravity Main : 1:120
	: Individual House Connection : 1:60
➤ Maximum Grade	: 1:10
➤ Bedding	: Flexible (SABS1200LB)
➤ Manholes	: 1.0m Dia. Precast Concrete Manholes
➤ Manhole Spacing	: 80m (Maximum)
➤ Minimum Cover	: 600 mm (Servitudes)
	: 800 mm (Midblock)
	: 1000 mm (Road Reserve)
	: 1200 mm (Road Crossing)

The internal sewer reticulation will comprise of 160mm uPVC Class 34 sewer pipe with circular precast concrete manholes at placed at a maximum spacing of 80m or at a change in direction throughout the development. House connections will be provided for each for site either midblock or into the nearest manhole.

The detail design of the internal reticulation of the estate provides for two collection points requiring pumping; disposal methods of the effluent will be discussed within the bulk sewer section.

All internal services will be operated and maintained by the Home Owners Association responsible for the development.

3.3.2 Bulk Sewer

Sewer Pumpstations

The development will be served with two sewer pumpstations. At the lowest point in the development, pump station 1 will collect effluent from 23 sites and pump raw effluent along the registered omnibus at the lower boundary of the sites and feeds directly into the sump of Pump Station 2. Pump Station 2 will pump effluent from the entire development via a 420m long rising transferring into a 2530m gravity main in order to reach the Hilton College Waste Water Treatment Works.

The preliminary design of the internal gravity main indicates two local low spots where two separate pump stations will be built, necessitated because of the topography. Aesthetically, the pumpstation will align with the architect's requirements, but will be primarily underground for screening purposes and to minimise the visual impact. Please refer to the locality plan provided in the appendices for their location.

Both pump stations have been sized according to the number of sites that gravitate into either conservancy tank for a time period of 24 hours. An additional pump sump of 10 minutes at the pump station's duty point will also be included the design of the conservancy volume.

The sizes of the pump station conservancy volumes will be as follows:

Pump Station 1:

PUMP STATION 1	
No of Sites	23
Average Daily Flow Per Site (l/day)	1000
Average Flow (m ³ / day)	23
Average Flow (m ³ / hour)	0.96
PFF	2.5
Infiltration (15%)	15
Peak Flow (m ³ / hour)	2.76
Min Pump Conservancy Volume (24 Hours Average Flow) (m ³)	23.00
Min Pump Sump Volume (10 minutes Peak Flow) (m ³)	0.40

Pump Station 2:

PUMP STATION 2	
No of Sites	60
Average Daily Flow Per Site (l/day)	1000
Average Flow (m ³ / day)	60
Average Flow (m ³ / hour)	2.5
PFF	2.5
Infiltration (15%)	15
Peak Flow (m ³ / hour)	7.19
Min Pump Conservancy Volume (24 Hours Average Flow) (m ³)	60.00
Min Pump Sump Volume (10 minutes Peak Flow) (m ³)	1.04

Rising Mains

The development will have two separate sewer rising mains.

Rising Main 1

Rising main 1 is a 860m long rising main transferring effluent from Sewer Pumpstation 1 into the sump of Sewer Pumpstation 2.

Rising Main 2

Rising main 2 comprise the transfer of the developments effluent from sewer pumpstation 2 to the waste water treatment works. Two possible routes were investigated, being

- Route 1 (2680m)
This route follows a shorter route, but through a lowpoint, bufferzones and drainage lines, that may require a pipe bridge and additional environmental triggers, including more onerous water use licence requirements.
- Route 2 (2950m)
This route is 270m longer, but does not cross any wetlands, buffer zones or require pipe bridges. Once the effluent is pumped 420m to the highest point, it will gravitate into the waste water treatment works.

The horizontal alignment of the rising main was set using the following considerations:

- Avoiding crossing all watercourse buffers
- Avoiding crossing delineated wetlands and dams
- Avoiding trees and existing structures
- Avoiding acute angles
- Perpendicular crossing of existing roads and road servitudes
- Avoiding local high spots to avoid the placement of air valves

The vertical alignment of the rising main was set using the following considerations:

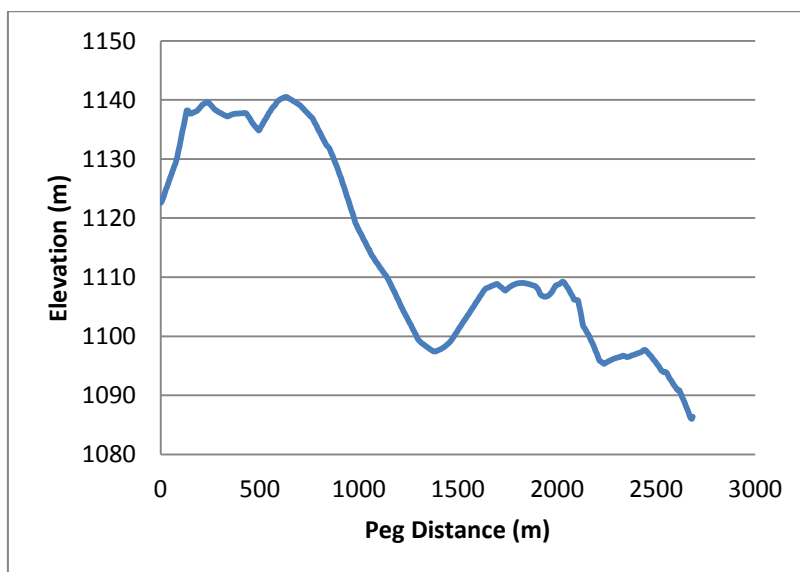
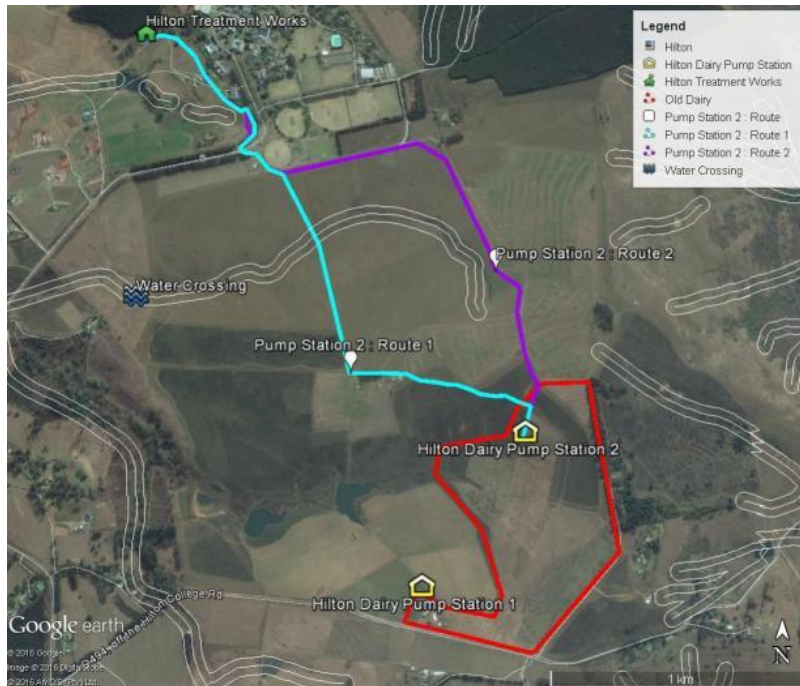
- Avoiding local high spots to avoid the placement of air valves
- Avoiding local low spots to avoid the placement of scour valves

Route selection of the rising main from Sewer Pumpstation 2 to the WWTW will also take cognisance of minimising friction head, as this will reduce the size of the pumps required to transfer the effluent, not only reducing the capital costs but the overall energy costs of running the pump station. The route will therefore be established with the intent of reaching a high point in the vertical alignment in the shortest feasible distance, thereafter the pipeline can be exposed to atmospheric pressure and operate as a conventional gravity main as designed within internal reticulation section 3.3.1.

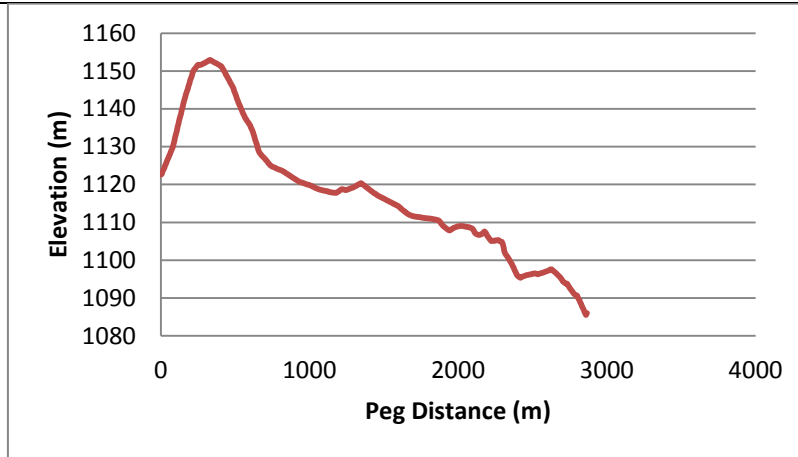
The standards for the bulk sewer reticulation will operate as a combination of both a rising main and a gravity main. The gravity main will have standards identical the internal reticulation while the rising main will be as follows:

- Pipe Material : HDPE
- Pipe class : PN16 PE100
- Pipe diameter : 110mm
- Minimum Radius : 30m
- Minimum Cover : 600 mm (Servitudes)
: 800 mm (Midblock)
: 1000 mm (Road Reserve)
: 1200 mm (Road Crossing)

See the two route options in the figures below.



SEWER RISING MAIN: ROUTE 1



SEWER RISING MAIN: ROUTE 2

Route 2 was aligned to avoid all major water courses and only has one high at 420m (12%) of the total length of the pipeline. Thereafter, the pipe can function as gravity main.

Route 1 was aligned using the most direct route. It will therefore cross a watercourse; and additionally pass through multiple local high & low points which results in the line being pumped through 76% of its total length, thereafter only functioning as a gravity main. This increases the complexity and cost of infrastructure, as there will be a larger resultant friction head requiring larger pumps as well as additional specialised valves. The crossing of the watercourse has its own challenges, not only in the environmental triggers of crossing a registered water course but also the structural reinforcing of the rising main via a pipe bridge at the stream crossing in a flood event.

Route 2 is the recommended and chosen path, although longer in length, the complexity and cost of infrastructure to pump effluent through Route 1 overrides the overall length of Route 2.

3.4 Water

All provision and design for water infrastructure will be handled by Mottram and Associates, which will include the water licensing application to the Department of Water and Sanitation. Water consumption is based on 1350l/day per household and will be provided from the Hilton College potable water system.

3.5 Storm water

3.5.1 Internal Storm Water System

The storm water management strategy will be to manage and collect all surface runoff in a conventional storm water system that will discharge into the natural drainage systems on site and gravitate towards the existing stream, dam and wetlands below the site.

The standards for the storm water infrastructure to be installed with the proposed development can be summarised as follows:

- Flood recurrence interval : 5 years and critical points 10 years
- Attenuation structures : 50 years
- Pipe material : Concrete
- Pipe Class : 100D in traffic areas, 75D in other
- Pipe diameters : 300mm Ø (minimum)
- Bedding : Class C
- Inlets : Splayed Catchpits/Steel Grid inlets
- Outlets : Headwalls and energy dissipaters
- Junctions : Points of deflection on pipelines

The storm water infrastructures will be constructed in accordance with the “*Guidelines for Human Settlement Planning and Designs*”, but will include service agreements concluded or departmental guidelines, where applicable.

3.5.2 Storm Water Management

The traditional design for storm water drainage systems has been to collect and convey storm water runoff as rapidly as possible to a suitable location where it can be discharged accordingly.

The objective of a storm water management plan should be to manage the storm water resources of the collective watersheds to:

- Prevent Flood Damage
- Preserve the natural and beneficial functions of the natural drainage system
- Preserve and enhance storm water quality

Storm water from parking areas, internal roads and roofs will be collected and retained on site through the installation of storm water attenuation measures, which will be done as part of a separate Storm Water Management Plan (SWMP). Outlets and overflows must be constructed to prevent scouring and erosion and release runoff into the natural stream located at the lower end of the site.

Storm water harvesting is advised for all roofed areas as the harvested rainwater could be used for the irrigation of the gardens and landscaped areas. The SWMP will discuss the introduction of attenuation and retention ponds incorporated into the civil engineering design and landscaping plan to create focal points within the development, but also to manage the increase in runoff between the pre and post development flows.

3.6 Refuse

The Home Owner's Association will be responsible for the collection and disposal of refuse.

It is essential that the internal measures ensure that recyclable material is separated from general refuse and The Home Owners Association will be responsible to contract with a recycling company to collect the recyclable material or deliver it to the Wildlands depot in Hilton.

3.7 Electricity

The proposed development will connect to the existing infrastructure, subject to an application to Eskom for an increase in supply. Application for an increase in supply should be made after development approval. Further design and municipal approval, construction phases and service level agreements for provision of electricity will be handled by the electrical engineer, EG Africa (Pty) Ltd.

4. CONCLUSION

This report has been prepared to assess the availability and access to bulk infrastructures services for the proposed development, whilst confirming the level of service for all internal services. The conclusion is that the development can proceed, subject to the following conditions:

- Conclusion of a Service Level Agreement with Umgungundlovu District Municipality.
- A Service Level Agreement has been concluded with uMngeni Municipality.
- Assessment of the bulk water abstraction, purification and storage facilities by Mottram and Associates.
- Assessment of the Waste Water Treatment Works by Hilton College or their appointed consulting engineers.
- A strip survey is needed for the sewer rising main Route 2, before the final route and detail design can be completed.
- Application to Eskom for an increase supply by the Electrical Consultants.
- Preparation of a Storm Water Management Plan.

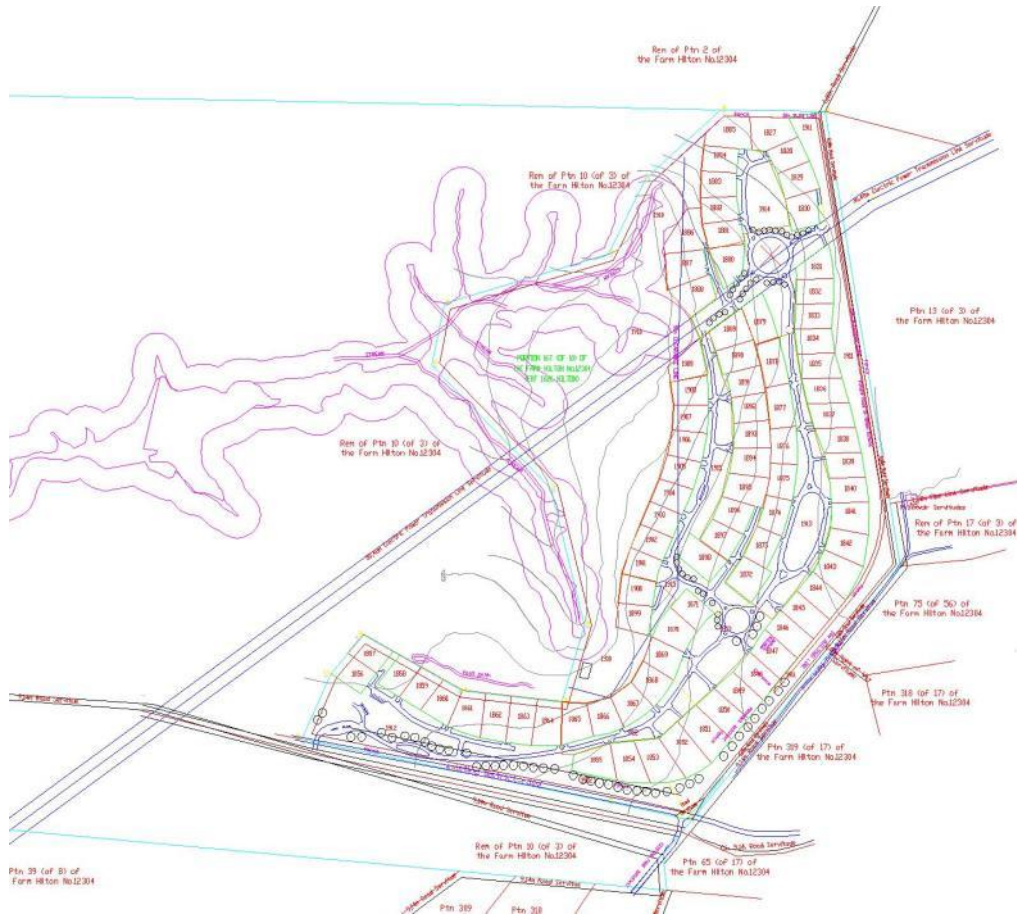
ANNEXURE A

LOCALITY PLAN



ANNEXURE B

CONCEPTUAL LAYOUT PLAN



ANNEXURE C

SITE PHOTOGRAPHS



This photo overlooks the development area and shows the general slope of the land.



This photo shows the dam and wetland downstream of the land development area.



This photo shows the route of the sewer rising main along the existing road.



This photo shows the drainage line leading to the wetlands below the development area.