

CHAPTER ELEVEN: ROADS AND WET SERVICES

11.1 INTRODUCTION

This Chapter of the report presents the preliminary engineering investigation, conducted by Jaco Spies of JJ Spies Civil Engineers, regarding the bulk services and the preliminary design of the roads, stormwater, sewer, and water reticulation systems that will serve the citrus orchard development on Farm 653.

11.2 SPECIALIST TERMS OF REFERENCE

The terms of reference (ToR) for the Roads and Wet Services Report, as requested by Public Process Consultants, on behalf of the applicant, are stated below:

- Estimate the domestic water consumption requirements for personnel and indicate the source of domestic water.
- Estimate the domestic effluent load to be created by the onsite personnel and capacity of the existing effluent treatment/ storage facility.
- Determine whether existing facilities have capacity to supply domestic water and manage domestic effluent.
- Make recommendations towards the effective management of effluent and water supply systems, if upgrades are required.
- To provide flood control measures that prevent loss of life and significant damage to property from the run-off from major storms and keep excess run-off away from buildings and/or habitable units as far as practical possible.

Additionally, the services provided are in accordance with the Guidelines for Human Settlement Planning and Design compiled under the patronage of the Department of Housing by CSIR Building and Construction Technology: (2000: Revision August 2003) and other acceptable design specifications.

11.3 SCOPE OF WORK

The scope of this report deals with the collection of data on, and adjacent to Remainder of Farm 653 within the Sundays River Valley Municipal area (SRVM), Eastern Cape and analysis of this data concerning an engineering opinion regarding the availability of bulk services, identification of restraints, further approvals and studies. This report further includes the preliminary investigation and design of main roads, stormwater, sewer and water reticulation systems required to serve the facilities which will provide support to the proposed citrus development.

The above information is required for the water supply, foul sewer drainage, and stormwater management plan that will form part of the Final Environmental Impact Assessment Report.

11.4 DATA COLLECTION

11.4.1 Site Boundaries

The layout of the site boundaries as indicated on a Google Earth image has been obtained from Public Process Consultants, on 24 March 2017.

11.4.2 Citrus Plantation Logistic Facilities

The citrus development's logistical facilities will mainly consist of the **existing structures** identified in **Figure 11.1** (Drawing No. IL/2017-18/RS/01):

- House (office/ administration)
- House (permanent residence)
- Portal frame structure (store)

In accordance with the project description, ~650ha of the farm is proposed for transformation in order to establish ~586ha of citrus orchards and associated infrastructure.

The domestic water infrastructure will mainly consist of water tanks near the office/ administration building, permanent residences, and the store, as well as a small on-site water treatment plant, which will act as a back-up system during times of abnormal droughts.

11.4.3 Field Records and Observations

Access to the site can be obtained via the existing gravel road MR00470, as indicated in the Traffic Impact Assessment (Chapter Eight) which was done by Engineering and Advice Services, dated January 2017. The proposed access off the MR00470 is ~165m north-north-west from the existing office/ administration house. There are existing gravel roads to the proposed office/ administration and permanent residence facility, as well as to the store.

In accordance with the available aerial contours, the site slopes with a fairly steep slope from 143m above Mean Sea Level (MSL) near the existing store, down to 126 MSL near the office/ administration house and with a moderate to flat slope to 105m MSL near the proposed access off the MR00470 road.

11.4.4 Engineering Geological Report

A detailed geo-technical investigation of the site area is not available at present.

However, it is recommended that an Engineering Geological Investigation be conducted prior to the detailed design stage of the road upgrading, related to the proposed access to the store and office facilities.

Based on visual observations of excavations in the vicinity of the site under discussion, the soil profile in general can be described as follows:

- The topsoil mainly consists of clayey sand and/ or gravel with vegetation and roots.
- Over the majority of the site, the topsoil is underlain by loose to medium stiff sandy silty material from shallow to moderate depths.
- In isolated cases, the sandy silty layer could be underlain by a stiff to very stiff calcrete layer.
- Based on the current information at our disposal, the probability that a high water table is present in the vicinity of the development, is considered to be low.

11.5 ANALYSIS

11.5.1 Methodology

The methodology adopted in analyzing an effective design for the wet services systems and main access road required by the proposed development , consists of the following:

- Establishing acceptable objectives for the proposed road and wet services systems.
- Determining appropriate design standards for the purpose of analysis and reporting.
- Applying these criteria to the expected post-development conditions to confirm findings and details regarding the proposed design and constructed works.

11.5.2 Acceptable Objectives

- To provide flood control measures that prevent loss of life and significant damage to property due to run-off from major storm event and to keep excess run-off away from buildings and/ or habitable units as far as practically possible.
- To provide reasonable access to buildings and/ or habitable units, effective water supply, effective domestic sewer and stormwater drainage systems for the health, safety and convenience of the community and to protect properties from damage by frequent storms.
- To provide economical facilities and find solutions to accommodate water demand, domestic sewer effluent and stormwater run-off problems compatible with the physical and ecological environment and to protect the natural environment.
- To implement procedures and practices which are consistent with the operating and maintenance standards of the accountable governing bodies and/ or local authorities.

11.5.3 Appropriate Design Standards

A balance must be achieved between the objectives, optimal land use and economic viability of the development.

- A compromise between the Guidelines for the provision of Engineering Services as published by the Department of Community Development 1983 (Blue Book), Guidelines for the Provision of Engineering Services and Amenities in Industrial Townships Development issued by The South African Housing Advisory Council 1994 ("old" Red Book) and Guidelines for Human Settlement Planning and Design compiled under the patronage of the Department of Housing by CSIR.
- Building and Construction Technology: (2000: Revision August 2003) ("new" Red Book).
- The Guidelines for the Geometric design of Urban arterial roads (UTG1, 1986), TRH4 Specifications: Structural Design of Inter-urban and Rural road pavements **and** other accepted specifications as indicated, have generally been adopted as a basis for the design of the roads, water supply, sewer and stormwater control systems
- In accordance with the recommendations from the Hydrological Research Unit (HRU) of the University of the Witwatersrand: HRU report No. 1/72 - Design Flood Determination in S.A. and HRU report No. 2/78 – Additional information and improvements to Depth - Duration - Frequency diagram the so-called Rational Method has been used to determine the run-off for the relative small catchment areas on the proposed development areas on Remainder of Farm 653 of Farm Commando Kraal No. 113.
- Intensity/ Duration/ Frequency Curves for 100; 50 down to the 5 and 2-year recurrence intervals for the area have been used in preliminary calculations.
- DWAF (2001) White Paper on basic Household Sanitation. Department of Water Affairs & Forestry, September
- Xu, Y and Braune, E (1998). A guideline for groundwater protection for the community water supply and sanitation programme. Department of Water Affairs & Forestry, Pretoria
- Gazette No. 26187, Government Notice, DWAF, No. 399, 26 March 2004: Table B1: Effluent Treatment Standards

11.6 INVESTIGATION AND PRELIMINARY DESIGN

11.6.1 Roads - Access

Access to the proposed logistical area can be obtained via the existing gravel road MR00470 as indicated in the Traffic Impact Assessment (Chapter Eight), which was done by Engineering and Advice Services, dated January 2017 (**Figure 11.1**; Drawing No. IL/2017-18/RS/01).

The new access to the proposed logistical area is proposed ~95m east of the existing access to the site, off the MR00470. The new access to the logistical area at the MR00470 has been designed with the applicable stacking distance and radii to ensure the required mobility and safety of traffic in accordance with the accepted guidelines. Refer to the new "light grey" access road as indicated in Figure 11.1.

The upgrading of the existing roads and/ or intersections will have to be done in accordance with the Traffic Impact Assessment (Chapter Eight), as executed by a competent Transportation Engineer and **as approved** by applicable authorities. The detailed designs of any upgrades that could be required in the approved TIA with regards to access to the proposed development, will also have to be approved by the afore-mentioned authorities.

11.6.2 Roads - Structural

The structural design of the roads will have to be done in accordance with the TRH4 Specifications: Structural design of inter-urban and rural road pavements subject to the conditions as indicated in the Geo-technical Report.

The structural-layer works of the main internal roads have been preliminary designed to accommodate the repetitive axle loads associated with post-development commercial and heavy vehicles.

The preliminary structural-layer works consist of selected 150mm in-situ sandy-silt material, compacted to 90% Modified American Association of State Highway Traffic Officials (**MOD AASHTO**) density, 210mm to 350mm selected blasted rock G8 material compacted to 98% MOD AASHTO density where the California Bearing Ratio (**CBR**) of the in-situ material would be lower than 3% at 90% MOD AASHTO density (Classification in accordance with TRH 14: Guidelines for Road Construction Materials) and a layer of 150mm Crushed stone G7 material compacted to 93% Mod AASHTO density.

In areas where a high frequency of forklift traffic is expected, an extra layer of 150mm Crushed stone G5 Material compacted to 95% Mod AASHTO density, and stabilised with 0.5% cement and a 150mm deep 30MPa lightly reinforced concrete surfacebed, can be constructed to specifically accommodate the associated high point wheel loads.

In areas where low or no forklift traffic is expected and if preferred by the applicant, the final layer can also be upgraded to consist of an 80mm interlocking concrete paving block (40MPa crushing strength), complete with cement infill with an 80mm high mountable or sunken 35MPa concrete kerb on the sides of the road, subject to the stormwater design considerations.

11.6.3 Roads – Geometric Design

If required, the coordinated horizontal alignment of the existing intersections, directly related to the proposed development, will have to be amended and designed in accordance with the guidelines as indicated in the approved TIA report.

The preferred width of the main internal distributor area should preferably be a minimum width of 8m wide near the entrance to the site. Subject to the applicable trip generation figures, the width of the other main internal access areas should vary between 8m and 4m.

As far as practically possible, the vertical alignment of the roads will have to be done in accordance with the mentioned guidelines, as indicated earlier in this report.

The formed-gravel, paved and/ or concrete surface areas will, as far as practically possible, be designed to **accommodate the sheet flow of stormwater**.

Considering the topography of the site, the road and turning facility will have to be designed mainly to fall within the allowed minimum and maximum gradients (self-cleansing flow and maximum stormwater flow velocities) and to follow the natural contours, but with an overall fall towards the natural lower-lying overland flow routes. Based on our experience and in accordance with the available topographical data for the site, maximum and minimum longitudinal vertical gradients on the roads should vary in general between 16% and 0,5% (absolute minimum 0,4%) respectively with a cross fall gradient of 2,0% to 2,5%.

11.6.4 Stormwater System

In order to address the post-development stormwater drainage in a responsible way, including adherence to the accepted objectives, the following preliminary design proposals are recommended (**Figure 11.1**; Drawing No. IL/2017-18/RS/01).

- The proposed private road to the logistical area has been designed to ensure **minimum interference with the natural stormwater flow conditions and not to concentrate stormwater as far as practically possible**.
- The low-level road crossing at the non-perennial water course will consist of a 1m deep non-rigid gabion structure complete with a geotextile filter cloth. Refer to IL/2017-18/DT/01. The top of the gabion crossing will as far as possible follow the natural contours of the site. The gabion structure road crossing will allow the natural flow and seepage of water during and after rain conditions but will limit the transport of sediment (**Figure 11.4**; Drawing No. IL/2017-18/DT/01).
- However, in areas where vertical road gradients are steeper than 1:10 or where the road lends itself to intercept the natural flow of stormwater, it is advisable to construct earthen berms. The earthen berms will divert and limit the concentration of the intercepted run-off on the road. The mentioned berms will distribute the run-off on the road to the lower-lying area to prevent the risk of excessive erosion. The earthen berms can consist of sub-base quality material. The mentioned berm should be 100mm to 200mm higher than the final formation level of the upgraded road surface to divert the intercepted flow effectively off the road to the natural lower-lying area adjacent to the road.
- The turning facility for the heavy vehicles near the store has also been designed to distribute stormwater in a sheet flow manner.
- It is recommended that **indigenous drought-resistant ground cover (or grasses) be established, as dictated by the Vegetation Specialist Assessment (Chapter Six), on the disturbed cut and fill areas, as well as the verges and berm outlets** of the constructed road and turning facility, to limit the transport of sediment in these affected areas by water and/ or wind and resultant erosion.
- The gradient of the constructed embankments will not be steeper than 1 in 3 (preferable 1 in 4) to enhance the establishment of vegetation and soil stability under wet conditions as far as possible.
- Where the embankments would be steeper than 1:3, it is recommended to design and construct non-rigid retaining structures which will consist of gabions and/ or Reno mattresses complete with filter cloth to effectively stabilize the retained soil and also limit the transport of sediment by water and/ or wind on and near the affected cut and fill areas.

11.6.5 Water Supply System

The water supply system has been designed to accommodate the peak **domestic demand (Figure 11.2; Drawing No. IL/2017-18/WL/01)**.

The office/ administration facility will accommodate 10 personnel members. The permanent dwelling will have a maximum of 5 persons. The total **domestic water demand** for the logistical area will be **1.7m³ per day. In accordance with our design calculations the 1.7m³ per day is less than the 1.8m³ per day for the 9 permanent persons who occupied the farm before.**

The water supply will mainly consist of roof rainwater harvesting for the office/ administration facility and permanent residence. Treated canal irrigation water will serve as a backup supply.

The bulk irrigation supply to the development (to irrigate the citrus), from the Lower Sundays River Water Users Association (LSRWUA), will be via two (2) 450mm diameter pipelines. The irrigation water will be stored in four () dams with a capacity of ~45000m³ each.

If the LSRWUA norm of the irrigation quota of 900mm/ha would apply, an average irrigation supply of 122 538m³ per week is permitted. **This will give an average daily irrigation supply of 17505m³ per day.**

Given the afore-mentioned irrigation supply and also the **approval of the LSRWUA to use 2m³ per day irrigation water for domestic purposes**, the irrigation supply can effectively serve as a backup to the rainwater supply.

Based on available rainfall figures from 1990 to 2014, one can assume an average rainfall of 474mm per year on and near the area under assessment.

It is recommended to upgrade the gutter system of the existing store roof, administration house and permanent residence, in order to effectively intercept and convey the surface run-off of the rainwater to the proposed rainwater storage tanks to be erected adjacent to the buildings.

If only 70% (assume 30% losses) of the normal rainwater from the aforementioned roofs could be effectively intercepted and conveyed to the water tanks, it should on average contribute 1.2m³ per day which is more than 70% of the calculated domestic demand of 1.7m³ per day.

It will be the prerogative of the applicant to install a tank/ pressure pump system near the office/ administration house and permanent residence to ensure adequate pressure and water supply from the proposed tanks. Considering totally unforeseen emergency conditions, it is recommended that the size of each of the storage tanks at the afore-mentioned units not be smaller than **10 000 litres**.

It is further recommended that the water treatment plant which will treat the irrigation water for domestic purposes, be located near the store building. The treated irrigation water and the water from the rainwater tanks near the store can be connected directly to the administration/ office and permanent residence buildings. That will ensure a positive static pressure of at least 100kPa.

It is recommended that the water treatment plant be designed by a specialist. Based on our experience, the water treatment plant should be designed to treat at least 2000 litres of irrigation water per day (**Figure 11.3; Drawing No. IL/2017-18/WT/01**).

The water treatment plant can consist of a 5000 litre chemical tank which will act as a sedimentation/flocculation facility. The clear overflow from the afore-mentioned tank can be filtered by a dual media sand filter. The filter media can consist of silica sand and activated carbon particles to also remove odours if needed. The filtered water should pass through a chlorinator before it is discharged to the 5000 litre storage tank which will feed the administration/ office and permanent residence buildings.

The **use of water** can also be **saved** by using water saving products listed as follows:

- Water saving toilets (capacity 6 litres and less) with a dual-flush valve
- Water saving taps with spray cartridges
- Water-saver shower heads with a flow rate of 4 to 9 litres per minute, by generating finer droplets
- Timed turn-off taps

Ornamental gardens could also be merged with natural and indigenous vegetation (with relative low water consumption if possible) subject to investigation by a vegetation specialist.

11.6.6 Domestic Effluent System

The Average Dry Weather Flow (**ADWF**) of the logistical area has been calculated as **1.6m³ per day**, for the 10 administration personnel and 5 permanent residents. The 2 x farm houses which will be used for the administration and 5 permanent residents were occupied earlier by 9 permanent residents. In accordance with our design calculations, the ADWF generated by the 9 permanent residents was 1.69m³ per day which is more than the future ADWF of 1.60m³ per day.

The design proposal to treat and accommodate the foul sewer effluent generated under post-development conditions should be economically viable, will prevent the pollution of ground or surface water and save water as far as possible.

The aquatic specialist visited the site while the previous 9 permanent residents were still living there. Based on the comments of the aquatic specialist, no signs of pollution of the watercourses could be found as the result of the operation of the existing septic tanks.

Given the afore-mentioned comments and design calculations, we are confident that the existing septic tank system can treat the future domestic effluent effectively subject to the following conditions.

- Once a year a competent person shall execute testing to evaluate the probability of contamination of the watercourses as the result of the septic tank system when the proposed logistical area is in full operation.
- If the tests would show that contamination can be a problem, then the existing septic tanks shall be upgraded to conservancy tanks as designed by a specialist.
- The domestic effluent of the proposed mixed development will mainly be treated by the Addo Waste Water Treatment Works as confirmed with the Acting Technical Director: Technical Services: Mr R.J. Herholdt of the Sundays River Valley Municipality on 11 September 2017.

The Governing Body of Ikamva Lethu Farms (Pty) Ltd will be liable for the effective maintenance and/or emptying of the septic tanks (once every 5 years or at regular intervals as deemed necessary) serving the logistical area under discussion. Further, the Governing Body of Ikamvu Lethu Farms (Pty) Ltd will enter into an agreement (as approved by the local authority) with a competent registered Contractor for the applicable emptying of the septic tanks when needed and discharge of the mentioned raw effluent to the registered Addo Waste Water Treatment Works in Addo.

In case of the upgrade of the sewer system in future, all sewer structures including main internal sewers and/or manholes will have to be constructed in accordance with SANS 1200 LD, SANS 1200 LB and Municipal Standards and Specifications.

11.7 RESOURCE PROTECTION AND WATER USE AUTHORISATION

In accordance with our best knowledge, it is essential to obtain the permission from The Department of Water and Sanitation (DWS) and/ or the LSRWUA regarding the following activities:

- On-site treatment of irrigation water for domestic purposes
- Rain water collection activities e.g. roof-collected water tanks

11.8 CONCLUSION

A cautious approach was adopted in the conceptual design of the roads and stormwater, domestic sewer and water systems.

In strict adherence to the detailed design and execution of earthworks, roads and wet services systems as indicated in this report, we are convinced that the proposed development of the logistical area on the Remainder of Farm 653 within the Sundays River Valley Municipal area, Eastern Cape could be serviced effectively from a civil engineering perspective.

11.9 APPENDIX

11.9.1 Layout Drawings





Figure 11.2: Drawing no. IL/2017-18/WL/01.

