

WASTE AND WATER QUALITY MANAGEMENT REPORT
for
JARRAHNUP FARM PIGGERY OPERATION ON PORTIONS OF REMAINDER OF FARM 781,
CALEDON, WESTERN CAPE



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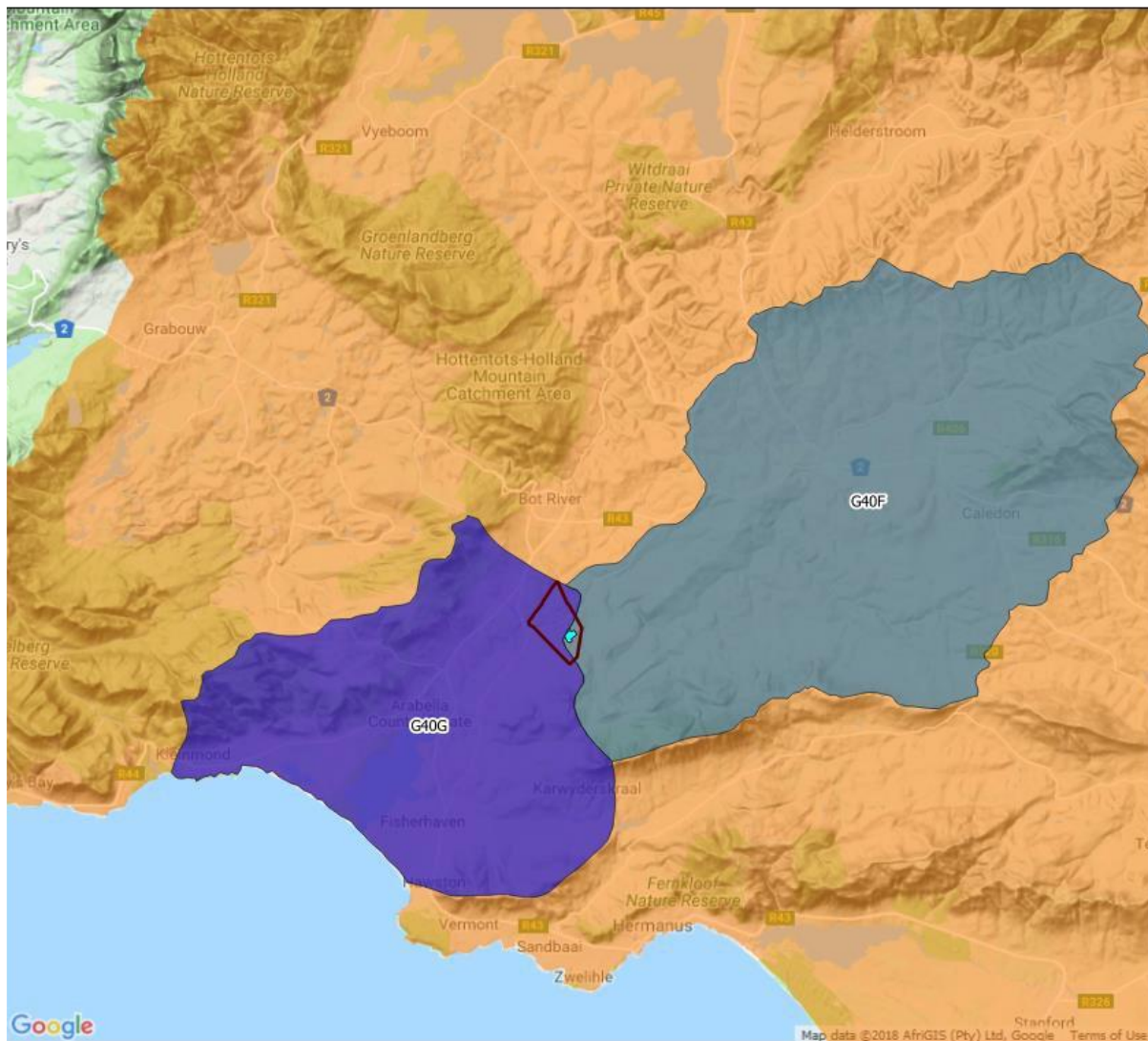


Figure 2: Catchment Areas applicable to the Study Area

Typically, representative of a watershed, the RE of Farm 781 Caledon RD is situated across two Quaternary Catchments. These are the G40F and G40G Quaternary Catchments. As mentioned earlier four unnamed non-perennial tributaries drain the centre and western section of the farm towards the Bot River which forms its northwestern boundary. One additional unnamed non-perennial tributary drains the very most eastern section of the farm towards the Leeu River. The Leeu River flows in a northern direction into the Swart River which flows west to link up with the Bot River, which in turn continues flow in a southwestern direction towards the Botrivierlei Coastal Lagoon.

It is important to note that all physical infrastructure related to the piggery operation is situated outside of drainage lines. Numerous small instream farm dams are found throughout the property, however, none related to the Jarrahnup Piggery. No surface water will be abstracted for use in piggery activities.

2. STORM WATER MANAGEMENT

Storm water management is part of the construction design for the Jarrahnup Piggery. No storm water runoff can enter the site due to the construction design, and components of the holding and treatment stages will ensure that wastewater does not contaminate the surrounding environment or come into contact with water resources. Sufficient leachate protection barriers, holding capacities and freeboard, have already been incorporated in the

design of the holding dams to ensure compliance with the relevant Government Notices. The piggery has constructed a contour around the outside of the boundary fences of the piggery to collect any runoff of water from the piggery paddocks. The water is directed into 2 holding dams especially during the wet Winter months. These dams are emptied using a tractor and tanker and taking them to the separating plant. Internal contours have also been constructed to collect stormwater runoff from the paddocks and internal roads. 1 new manhole has been constructed to divert all of the above runoff water into the stormwater dams. This was done to ensure that dirty stormwater from the piggery does not enter surrounding environment outside the piggery. Floors are 50% solid concrete and 50% concrete slats in the gilt development shed, Artificial Insemination station, farrowing houses and weaner houses and all of the effluent is captured in channels which is covered with either concrete/ cast iron and plastic slates and is then emptied into underground concrete conservancy tanks covered with concrete. All of this waste is collected by tractor and tanker and taken to the separation plant. All paddocks outside have housing facilities and feeding facilities and again all the effluent created by the pigs on the concrete floors is collected into underground concrete conservancy tanks covered with concrete. All of this waste is collected by tractor and tanker and taken to the separation plant.

The sludge separating plant consists of a concrete holding facilities (when the tanker offloads the 10 000 liters collected from the conservancy tanks). The holding facility has an agitating propellor creating a liquid sludge. It is then pumped up into the separating machine which as a (stainless screw), which is inside a screen. This process now separates solids from the liquid. The solids fall into a three-side concrete construction and concrete floor, and the residue water flows into the plastic lined holding dam. The solids are composted.

3. WASTE/WASTEWATER MANAGEMENT

3.1. PIGGERY WASTEWATER IRRIGATION SYSTEM AND SOLIDS FRACTION MANAGEMENT

The storage dam was designed to cater for an estimated 157 days holding capacity during the winter rainfall season and planting periods during which access to the agricultural lands may be limited and provides a 22% safety margin. Due to the premixing stage the liquid fraction entering the dams is predominantly a moisture-based wastewater of >98% (thus <2% solids) and thus handled as a liquid wastewater and not a semi-solid (4-20% solids) or solid (usually >20% solids) manure.

The solids fraction is:

- Initially captured onto a cement floor and bunded area directly below the screen.
- Stacked in windrows on a quarry aggregate compacted area yielding an impervious barrier.
- Composted for 12 – 16 weeks within an area with adequate protection from storm water runoff.

Waste and Water Quality Management

A dam next to the separating plant which is lined with the recommended plastic sheeting measuring 75 meters long, 65 meters wide and a depth of 5 meters is used to store the sludge after solids are screened out. A fence has been erected on top of the dam walls with veldspan and barb wire with no access gate. There are signs attached to the fence stating No Entry, no drinking and no swimming. At strategic points there are escape ropes tied to the fence posts

which hangs into the dam in the case of someone falling into the dam, they will be able to get out of the dam by climbing up with the ropes.

All solid waste from the pig buildings is collected and then transferred to the composting site. At the composting site there is a banking contour on the lower side to collect run off when it rains. Any excessive run off is collected by the tractor and tanker and taken to the separating plant.

The biodegradable water from the dam is mixed with fresh water at a ratio of 70% fresh and 30% biodegradable (sludge from dam) and is used to irrigate through a centre pivot when maize or crop will be planted or irrigating the land with a tractor and tanker. The 10 000-liter tanks are filled with the same ratio of fresh and biodegradable water. This enables also the spread of water during the irrigation over the allocated 230.2 Ha.



Figure 3: Jarrahnup Piggery Biodegradable Industrial Wastewater Irrigation Areas

Table 1: Agricultural land Application Areas at the Jarrahnup Piggery

Agricultural Land Application Areas	Main Indicative Coordinates	Application Area Locality
The area of irrigation is hilly terrain and therefore does not have specific rectangular outlines		
Application Area 01 50.8 ha	▪ 34°15'56.16"S 19°12'8.84"E ▪ 34°16'5.34"S 19°11'58.62"E ▪ 34°16'10.38"S 19°11'54.53"E ▪ 34°16'16.64"S 19°11'56.85"E ▪ 34°16'13.15"S 19°11'58.78"E ▪ 34°16'15.48"S 19°12'8.07"E ▪ 34°16'22.90"S 19°12'6.66"E ▪ 34°16'21.66"S 19°12'1.52"E ▪ 34°16'29.31"S 19°12'12.94"E ▪ 34°16'30.21"S 19°12'27.36"E ▪ 34°16'31.90"S 19°12'31.62"E	 A satellite map from Google Earth showing a hilly landscape. A yellow outline highlights a specific area, and a green outline highlights another area. The terrain is uneven with various shades of brown and green.
Application Area 02 48 ha	▪ 34°16'37.92"S 19°12'21.82"E ▪ 34°16'16.60"S 19°11'45.81"E ▪ 34°16'23.27"S 19°11'41.41"E ▪ 34°16'30.68"S 19°11'45.29"E ▪ 34°16'31.66"S 19°12'0.15"E ▪ 34°16'44.55"S 19°11'58.96"E ▪ 34°16'48.47"S 19°11'43.49"E ▪ 34°16'36.77"S 19°11'30.31"E ▪ 34°16'49.68"S 19°11'16.60"E	 A satellite map from Google Earth showing a hilly landscape, similar to the one above. A yellow outline highlights a specific area, and a green outline highlights another area. The terrain is uneven with various shades of brown and green.

Agricultural Land Application Areas	Main Indicative Coordinates	Application Area Locality
The area of irrigation is hilly terrain and therefore does not have specific rectangular outlines		
Application Area 03 49.1 ha	▪ 34°16'32.44"S 19°12'33.80"E ▪ 34°16'45.66"S 19°12'10.26"E ▪ 34°16'50.08"S 19°12'12.46"E ▪ 34°16'52.18"S 19°12'17.26"E ▪ 34°17'0.25"S 19°12'18.46"E ▪ 34°16'53.65"S 19°12'22.91"E ▪ 34°16'54.63"S 19°12'28.63"E ▪ 34°16'55.20"S 19°12'34.37"E ▪ 34°17'2.84"S 19°12'39.68"E ▪ 34°17'7.89"S 19°12'29.95"E ▪ 34°17'0.47"S 19°12'45.46"E ▪ 34°16'51.61"S 19°12'46.94"E	

Application Area 04 82.3 ha	▪ 34°17'0.67"S 19°12'16.23"E ▪ 34°17'4.03"S 19°12'8.41"E ▪ 34°17'15.19"S 19°12'19.60"E ▪ 34°17'16.21"S 19°12'28.17"E ▪ 34°17'32.45"S 19°12'28.17"E ▪ 34°17'34.91"S 19°12'22.09"E ▪ 34°17'33.46"S 19°12'8.78"E ▪ 34°16'56.60"S 19°11'25.20"E ▪ 34°16'57.30"S 19°11'31.78"E ▪ 34°17'3.73"S 19°11'58.15"E ▪ 34°17'16.56"S 19°12'8.79"E ▪ 34°17'23.23"S 19°12'13.06"E	
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“The irrigation of biodegradable industrial wastewater to land must comply with the following conditions stipulated in subsection 1.10 (2) in the GN 665 of 06 September 2013 for Section 21 (e) activities:

1.10: (2) Suspended solids must be removed from any wastewater, and the resulting sludge disposed of according to the requirements of any relevant law or regulation, including the document Guidelines for the Utilisation and Disposal of Wastewater Sludge, Volumes 1 – 5, Water Research Commission Reports TT 261/06, 262/06, 349/09, 350/09, 351/09, as amended from time to time.”

Variables	Limit
pH	6.5 – 9.5
Electrical conductivity	265 mS/m
Chemical Oxygen Demand (COD)	377 mg/l
Orthophosphate	3 mg/L
Suspended Solids	42 mg/l
Fats, oil or grease	36 mg/L

Disposing the sludge to land in line with these parameters and to the volumes and irrigation areas authorized and described by Dr James Meyer will not result in surface and ground water pollution.

As defined in the stipulated WRC Volume monitoring requirements extend to include wastewater, solids and liquid fractions, water resources and soil. According to Dr JA Meyer sludge disposal guideline document which is followed currently on the farm. Following extensive consultations and presentations by Dr Meyer and others to the Dept of Water & Sanitation, Dr Meyer have finally succeeded in DWS issuing a WUL amendment for wastewater irrigation that is based on typical nutrient content and not the restrictive GN 665 wastewater limit tables. This is good news as it aligns the practice of manure, slurry or the liquid fraction thereof, to be applied to land based on sustainable nutrient application rates, as opposed to having to first treat the wastewater to comply with what in effect amounted to discharge quality (section 21 f & h versus e Activities of the NWA). By implication a similar nutrient loading rate approach is implied for the solids fraction (compost). The WRC Guideline Classification for the compost solids fraction is unrestricted, enabling beneficial use thereof off-site. Classification: Pollutant Class: A: Thus: (a) Agricultural Use is an acceptable option. (b) No additional restrictions or requirement apply and (c) Could be used as a saleable product.

Typical Pig Slurry composition consists of 4.2kg/Nitrate/1000l, 41.4kg/Phosphate/1000l and 2.2kg/Potash/1000l. The raw wastewater generated on site will contain 4.2 kg N/1000L. The DWS Section 21 (e) Permitted Application Rates of 320 – 450 kg Nitrate (N)/ha/y. Therefore 128 000 l/ha/y at 320 kg N/ha/y and 180 000 l/ha/y at 450 kg N/ha/y can be irrigation. Take note that the property is bigger, but that the available area for irrigation is 230 ha due to the exclusions of the 100m buffer areas. Thus, for the 230 ha available for disposal of sludge a total of 29 46 5600 l/y at 320 kg N/ha/y and 41 436 000 l/y at 450 kg N/ha/y can be irrigation. The facility will produce 54.86 m³/day (383.15 m³/week) of biodegradable industrial wastewater with a total of 19

924m³/a or 19 924 000 l/y. At the lower limit of the DWS Section (e) disposable rate the facility will irrigate 19 924 000 l/y which is much lower than the lower rate of 29 46 5600 l/y. This is well within the range that is stipulated by DWS in the guidelines for N and the irrigation of the expanded facility biodegradable industrial wastewater will not result in the pollution of the soil from an N parameters. The use of these fractions are preferred to the use of inorganic fertilisers as the N-fraction in the inorganic fertilisers is inorganic nitrate-N which represents a greater risk of leaching towards water resources when compared to the ammonia-N fractions from the biodegradable industrial wastewater. It should be noted that the wastewater generated by the piggery is significantly of lower risk than that generated from other industry sectors and domestic wastewater, predominantly as it is controlled and does not contain pollutants or contaminants (refer to the Water Research Commission on Dialogues of Contaminants of Emerging Concern 2015).

Since the liquid fraction should contain no solids/fibre, thus less crust should form (crusts contribute to anaerobic conditions and further purification of liquid and consequently odour issues). Several researchers have observed that NPK values for pig manure were similar between different countries (Conn et al., 2007; Moore et al., 2005; and Sanchez and Gonzalez, 2005). Fertilizer values for liquid and solid fractions are also viewed as similar. Differences are observed between various livestock types regarding manure composition.

Ruminant manure tends to have lower P compared to poultry and pig manure due to a better plant-bound P extraction ability (Bailey and Buckley, 1998). As reported by the authors pig manure, although subject to variation from production system factors, is regarded as generally having the following composition:

- 50 % N in the ammonium (inorganic) form
- 50% in the organic form (microbial, labile organic, stable

In terms of land application the considerations are a combination of benefits and potential concerns, thus balancing crop requirements with potential adverse environmental impacts. During the growing season 20% of the organic N form is reported to mineralize and thus be available for plant uptake. Of the inorganic fraction 25% of the ammoniacal N may be lost due to volatilization. Collectively this implies a net availability of ca. 50% of the applied N for crop production. NH₄-N losses may also vary largely, with 10 – 99% ranges recorded. Losses were the highest from anaerobic lagoons. Whilst P & K were viewed to be relatively stable with 5 – 15% losses reported, the highest potential loss was that of P (up to 50%) due to runoff and/or leaching. Kachanoski et al. (1997) reported that the ammonium form may be increased to 60 – 90% organic). This is one of the reasons why Water resource quality monitoring emphasizes demonstrating that the storage of wastewater does not enter or cause impact on existing water resources, and why lagoons should be lined. According to Sutton et al. (1984) other concerns relate to dietary composition and potential increases to applied areas in NaCl and trace elements (As, Se, Cu, etc.). Similar concerns are noted by Lukehurst et al. (2010) and dealt with by the WRC TT Guidelines referred under the relevant sections of the NWA.

All water that is used for irrigation is documented and recorded by the water meters which has been installed. The piggery has its own reservoir and boreholes supplies the water for the piggery with a new meter installed and monitored monthly. The irrigation water used for the centre pivot is supplied from the boreholes with its own meter which is separately licensed. The total amount of water used for the piggery and for irrigation is captured monthly and the total amount of biodegradable mixed with fresh water is monitored with a water meter.

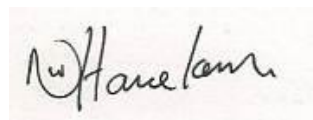
When spreading biodegradable water onto the paddocks it is demarcated by GPS coordinates and given to the Piggery manager. The yearly soil tests indicate where spreading needs to take place (precision farming).

3.2. OTHER ANIMAL WASTE

The dry waste (straw from pig shelters) from the facility as well as mortalities from the farm are composted in a compost heap within the footprint area. The compost heap has been bunded by the installation of a clay layer beneath the area prior to the commencement of the composting activity. A maximum amount of 124.6933 tons of compost is produced from this compost heap per year which is either made available to other farmers for collection as a soil conditioning measure or used on the Jarrahnup Farm for the same purpose.

3.3. SEWAGE

The small volume of sewage and other wastewater generated by the ablution facility is captured in a 15 m³ containment facility which is periodically pumped out by the Theewaterskloof Municipality and appropriately disposed of.

A handwritten signature in black ink, appearing to read 'N Hanekom', is written on a light-colored rectangular background.

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