Concept and Viability Report – Summary Treatment options

Professional Services: Upgrade of Bulk Sewers, Replacing of Small-Bore Sanitation System at Woodlands

Prepared for: Koukamma Local Municipality
14 May 2025
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Abbreviations

Average Daily Dry Weather Flow	ADWF
Kilolitre	Kl
Local Municipality	LM
Peak Daily Dry Weather Flow	PDWF
Peak Wet Weather Flow	PWWF
Wastewater Treatment Works	WWTW

1. Introduction

1.1 Background

The Koukamma Local Municipality (LM) has commissioned SMEC South Africa for the design and implementation of the internal sewer reticulation, bulk sewer reticulation, and wastewater treatment works within the Woodlands Settlement.

This report contains a summary of the preliminary design and cost estimate of the proposed wastewater treatment works (WWTW).

2. Hydraulic Load

2.1 Future Hydraulic Load

Given that the connection points to the Bulk Main are within the designer's control, the entire development has been divided into zones based on their connection points. Please refer to Appendix B for the drainage zone layout and their respective connection points to the Bulk Main.

The future Hydraulic load indicated in **Table 3-2** below.

Table 2-1 Future Hydraulic Load

Development Type	Total Units	Average Daily Dry Weather Flow (ADWF) (Kl/day)	Peak Daily Dry Weather Flow (PDWF) (Kl/day)	Peak Wet Weather Flow (PWWF) (Kl/day)
Zone 1				
Low Income Housing	94	35.72	67.87	79.49
Business		2.47	4.20	5.18
Educational Facilities		14.55	24.73	29.38
	Sub-Total	**52.74**	**96.8**	**114.05**
Zone 2				
Low Income Housing	571	216.98	412.83	494.208
Business		4.10	6.97	8.64
Educational Facilities		23.34	39.67	47.52
	Sub-Total	**244.42**	**459.47**	**550.368**
Zone 3				
Low Income Housing	15	8.55	16.25	19.872
	Sub-Total	**8.55**	**16.25**	**19.872**
Zone 4				
Low-Cost Housing	244	109.80	208.62	250.56
Business		0.9	1.53	1.728
Educational Facilities		0.42	0.71	0.864

	Sub-Total	**111.12**	**210.86**	**253.152**
Zone 5				
Low Income Housing	114	43.24	82.16	98.496
Business		1.61	2.74	3.456
Educational Facilities		0.69	1.17	1.728
	Sub-Total	**45.24**	**85.50**	**102.816**
	Total	**462.37**	**869.45**	**1041.122**

The total ADWF is 462.37 Kl/day, the PDWF is 869.45Kl/day and the PWWF is 1041.122 Kl/day.

Refer to **Appendix A** for all hydraulic load calculations and design assumptions.

Figure 3-2 below indicates the sewer drainage zone post development.

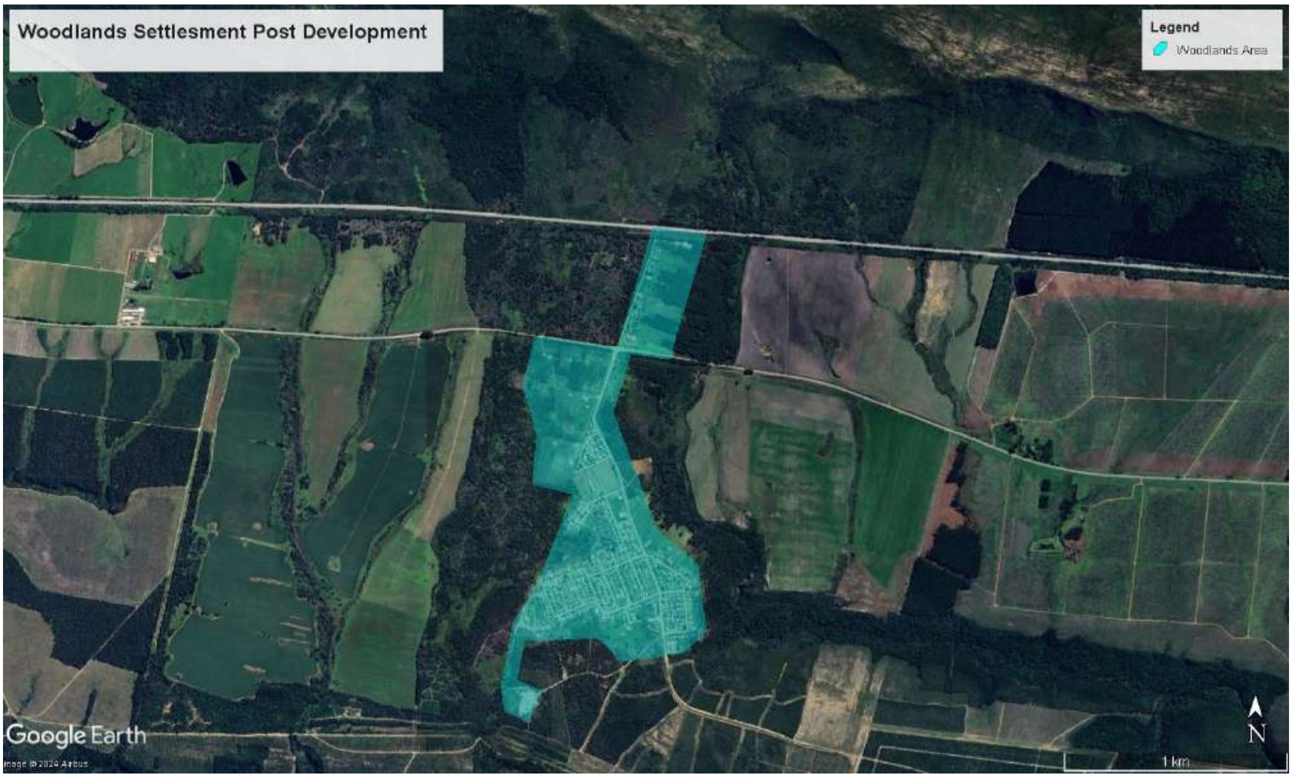


Figure 2-1: Sewer Drainage zone Post Development

3. Proposed Sewerage Infrastructure

3.1 Wastewater Treatment works

3.1.1 Wastewater Treatment Plant Design Objectives

Design Capacity

- The plant shall be designed for waterborne domestic sewage for the following flows: ADWF – 500kl/d, PDWF – 800kl/d, PWWF – 1000kl/d.
- There is an additional requirement for receiving sewage from “honey suckers”

The influent wastewater from households is expected to primarily consist of domestic sewage, containing a mixture of water, organic, and inorganic substances, both dissolved and suspended. Organic substances will include carbohydrates, proteins, fats, soap, detergents, and their decomposition products. The strength of sewage, whether high or low, can indicate patterns of water consumption: high strength may suggest low water usage for consumption, while low strength may indicate higher water consumption and potential dilution from stormwater infiltration. High sewage strength is often associated with low-income groups, whereas low sewage strength is characteristic of high-income groups.

Compared to the typical sewage strength, the sewage entering Woodlands WWTW is expected to be medium sewage strength. The proposed raw wastewater characteristics to be used is shown in **Table 5-2** below.

Table 3-1 Typical raw wastewater quality data percentiles

Parameter	Units	Assumed Influent wastewater
COD	mg/l	750
TKN	mg/l	60
TP	mg/l	10
pH		7.0 le

Design Effluent Water Quality

In accordance with the National Water Act 1998 (Act No 36 of 1998), all wastewater treatment works being operated in South Africa are required to have a valid water use license which sets out the allowable quantity and quality of the effluent that can be discharged. The Woodlands WWTW currently has a valid General Authorization in place dated 28 September 2017. The GA (Ref 27/2/2/K480/7/8) allows a volume of 1772.8 m^3/annum into the Groot River.

The applicable General Limits therefore are:

- pH — between 5.5 - 9.5
- EC — 5mS/m above intake of 150mS/m
- Chemical Oxygen Demand — ≤ 75 mg/l
- Nitrate as N — ≤ 15 mg/l
- Ortho phosphate as P — ≤ 10 mg/l
- Total ammonia as N — ≤ 6 mg/l

- Suspended Solids ≤ 25 mg/l
- Faecal coliforms 1 000 cfu/100 ml
- *E.coli* 1 000 cfu/100 ml

3.1.2 Proposed Wastewater Treatment Solution

3.1.2.1 Option 1 - Oxidation Ponds

Oxidation ponds, also called lagoons or stabilization ponds, are large, shallow ponds designed to treat wastewater through the interaction of sunlight, bacteria, and algae. Algae grow using energy from the sun and carbon dioxide and inorganic compounds released by bacteria in water. During the process of photosynthesis, the algae release oxygen needed by aerobic bacteria. Mechanical aerators are sometimes installed to supply yet more oxygen, thereby reducing the required size of the pond. Sludge deposits in the pond must eventually be removed by dredging. Algae remaining in the pond effluent can be removed by filtration or by a combination of chemical treatment and settling.

For purposes of the Woodlands WWTW, the utilization of ponds to treat sewerage can be considered if more land can be made available.

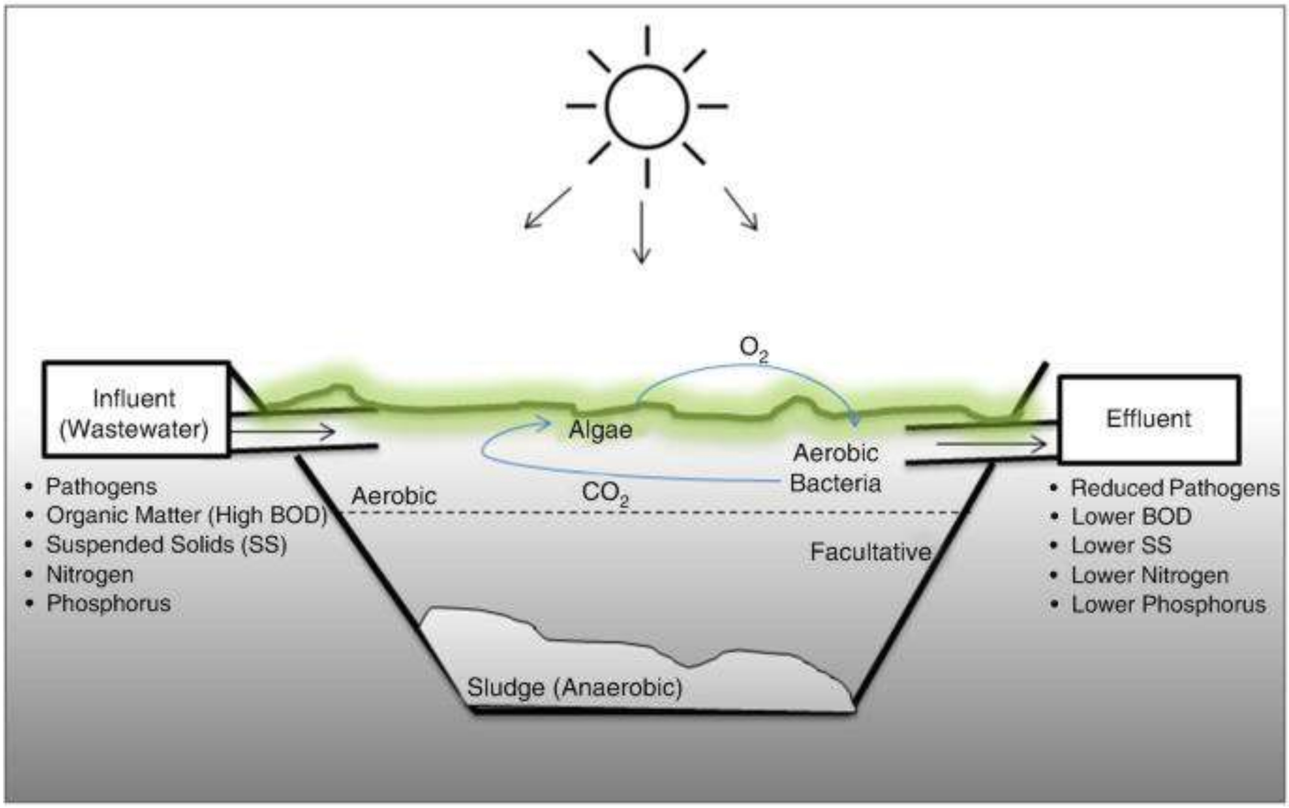


Figure 3-1 Oxidation Pond process configuration

Figure 3-2 Typical layout for oxidation ponds

3.1.2.2 Option 2 – Rotating Biological Contactors

In this treatment system a series of large plastic disks mounted on a horizontal shaft are partially submerged in primary effluent. As the shaft rotates, the disks are exposed alternately to air and wastewater, allowing a layer of bacteria to grow on the disks and to metabolize the organics in the wastewater.

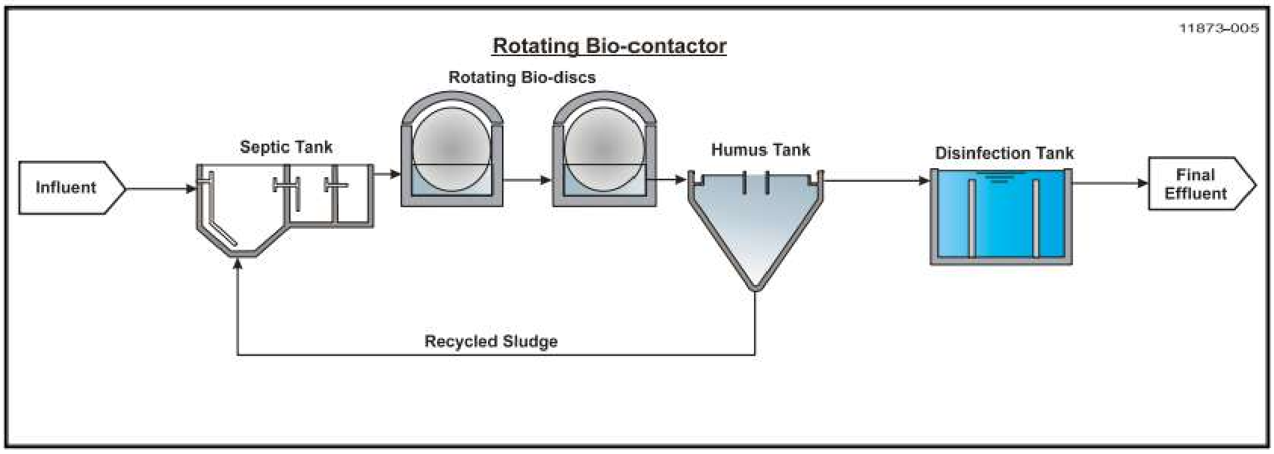


Figure 3-3 Typical rotating bio-contactor process configuration

Figure 3-4 Typical layout for RBC

3.1.2.3 Option 3 - Extended Aeration Activated Sludge

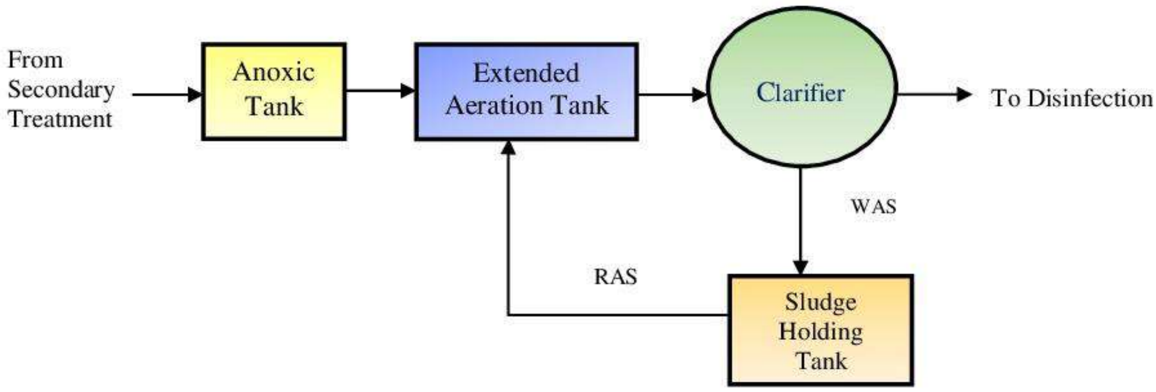
Extended aeration means that the raw sewage only undergoes screening and grit removal and is then aerated in an extended aeration plant without any primary sedimentation. Extended aeration is the simplest form of activated sludge and, if using robust aeration equipment; it provides a simple and reliable treatment option. It is capable, due to long sludge ages and long hydraulic retention times, to accommodate shock loads better than conventional activated sludge with its shorter sludge age and hydraulic retention time. The long sludge age also offers the benefit that the sludge can dry on sludge drying beds without additional sludge treatment such as anaerobic digestion.

It is also not uncommon that waste activated sludge is taken to sludge lagoons for further stabilisation due to natural fermentation and then the sludge is pumped from the lagoons to drying beds in an even more stable form which would be less prone to odour problems.
SMEC recommends that biological denitrification should form part of any form of activated sludge. The process offers the following benefits:

- The denitrification process increases and reinstates the alkalinity consumed and is destroyed during the nitrification process. This released alkalinity ensures the effluent becomes less aggressive/corrosive.
- The process reduces the energy required for treatment significantly as part of the COD would degrade through the chemical oxygen created in the nitrification process. Nitrification is the conversion of ammonia NH_4 to nitrate NO_3, and by recycling the NO_3 rich mixed liquor to an anoxic zone where no air is introduced, the bacteria are forced to utilise the O_2 bound in the NO_3 molecule for metabolic action, and in the process, N_2 gas forms for release to the atmosphere, as 80 % nitrogen.

- The biological denitrification process in a WWTW is a simple process, and it renders the effluent suitable for downstream reuse as potable water. If the effluent is not void of nitrate, it would require removal at the downstream water treatment works before using it as potable water. Potable water must have > 9.0 mg/ℓ nitrate to be safe for use, especially by infants. Processes to remove nitrate at a water treatment works are expensive and complex and involves ion exchange, reverse osmosis or adsorption processes all of which are expensive and complex. It is thus the opinion of SMEC that maximum denitrification in an activated sludge plant should be encouraged.

A typical process flow diagram for an Extended Aeration System (EA) is shown as below:



Extended Aeration System (EA)

Figure 3-5 Typical extended aeration process configuration (Onevproject.com, 2016)

3.1.3 Plant Design

During the design phase, careful consideration will be given to safety, leak and damage prevention, government regulations and environmental concerns. As far as reasonably practicable, interruption to the operations of the existing works will be avoided with minimal downtime for the cross-connection between the existing and new works.

3.1.3.1 Head of Works

The new inlet works will be designed with coarse screening (for the removal of rags, paper and large debris) and degritting channels (for the removal of sand and grit). The head of works will be provided with a means of flow measurement as required by the Department of Water and Sanitation.
The screens must be able to screen initial minimum hourly flows as well as expected PWWF for the design capacity of the Works. The head of works will include:

- A tanker dumping area
- 1x 10mm coarse mechanical screen
- 2x degritting channels.

The flow will be measured in a Parshall flow flume and an ultra-sonic level sensor. A simple mathematical equation will be used to convert the level measurements to flow data which records the total influent flow to the plant. This

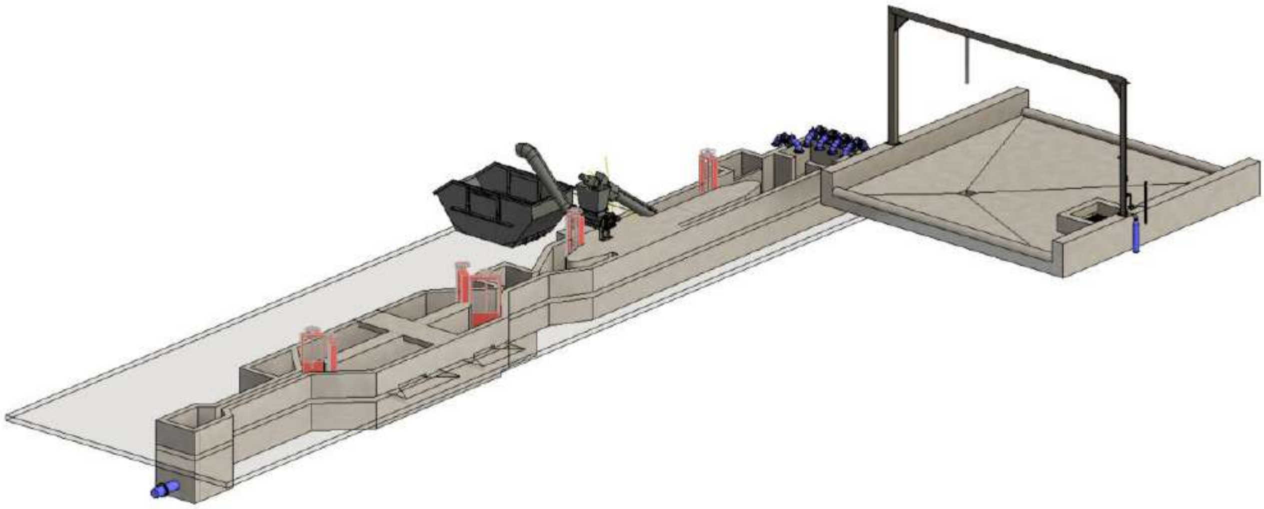


Figure 3-6 Head of Works

Option 2 – Rotating Biological Contactor

A high-level configuration and more detailed overview of the proposed proses is shown in the figures below:

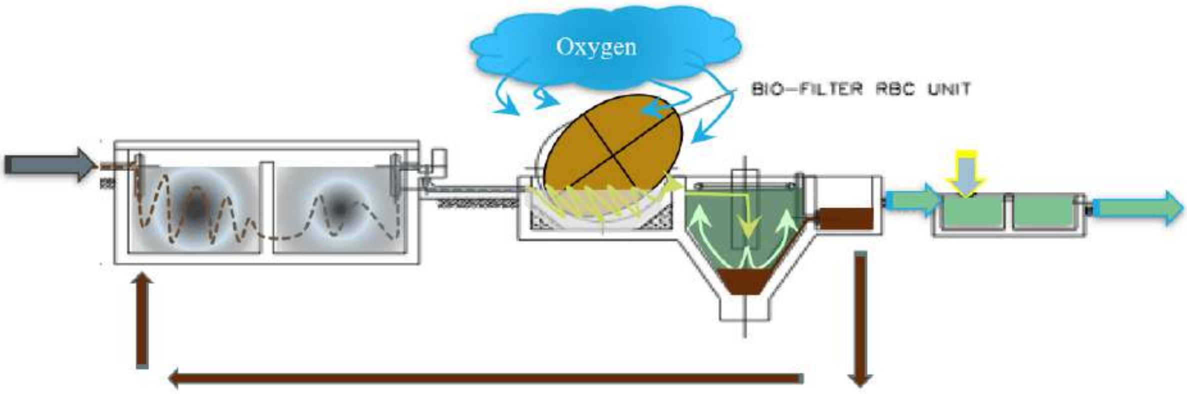


Figure 3-7 High level RBC proses

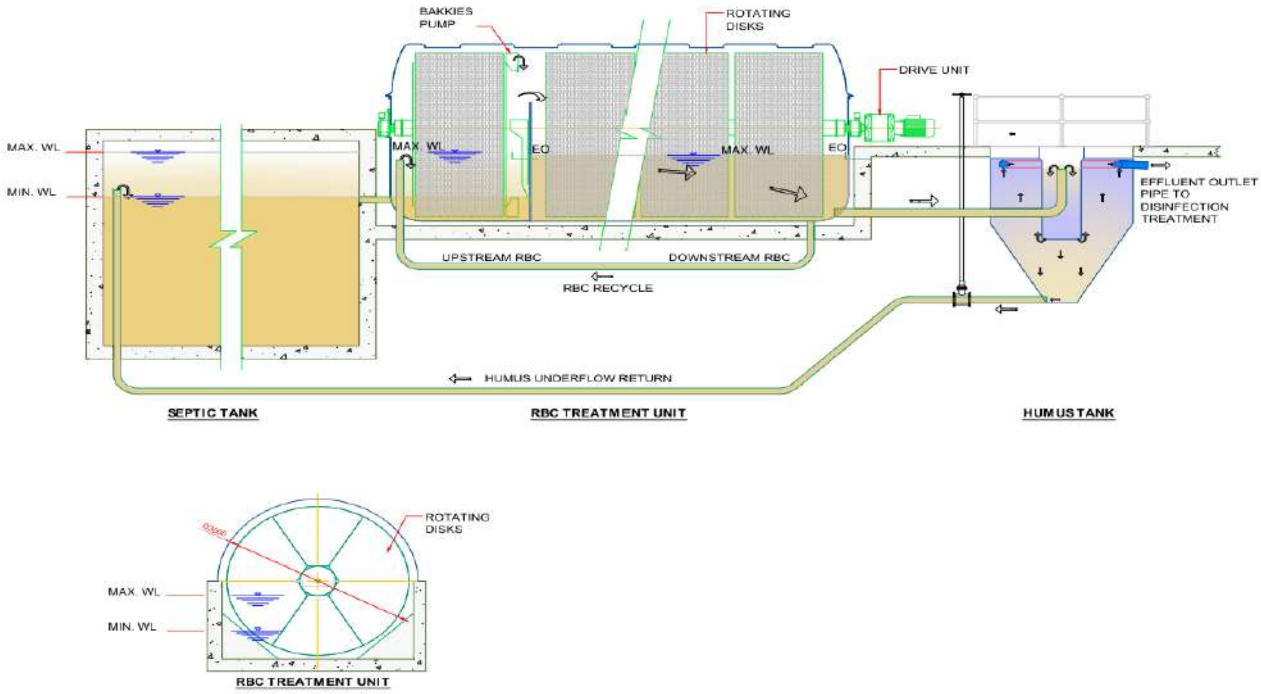


Figure 3-8 Head of Works

Primary Phase Separation

The septic tank allows for the gross removal of organic material by settlement and anaerobic oxidation. The septic tank makes provision for the accumulation of this material and has design features incorporated to ensure that this activity does not cause unnecessary blockages across the tank.
All septic tanks do require servicing and desludging at some stage since the rate of sludge accumulation exceeds the slow growth rate of the anaerobic bacteria and hence their capacity to break down organic material.
The settled sewage from the septic tank is then discharged under gravity to the RBC stage where further organic reduction and ammonia nitrification is achieved under aerobic conditions. The aerobic conditions are achieved by the rotation of the discs, on which the micro-organisms are attached and growing, at a low speed of approximately 3 to 4 RPM. The discs are 3m in diameter and 5m long with 6151m2 EBA. End bearings are provided to secure the unit to the RBC basin. The energy requirement per rotor is 2.25kW.
A secondary settling tank, or humus tank, is required for the collection and removal of surplus bacteria that is removed from the discs by the rotating action of the discs in and out of the water. The Becon Watertech design utilises the standard Dortmund type tank for this application. The collected humus is returned to the septic tank for anaerobic digestion, eliminating the need for sludge drying beds on site. A desludge pump is provided for this purpose.
Since pathogenic bacteria are not removed by the micro-organism population generated in any sewage treatment process by any adequate degree, a tertiary disinfection stage is typically deployed to eliminate the potentially disease forming bacteria. Provision has been made for disinfection (sodium hypochlorite dosage recommended).

Option 3 – Extended Aeration Activated Sludge

Balancing Tank

The common use of a balancing tank within the process train at a wastewater facility is to attenuate daily peak flow rates through the works. This will ensure that only the Average Dry Weather Flow needs to be catered for in the Biological Reactor Unit, which will reduce capital expenditure. This will ensure a constant food source for the BNR, thereby also ensuring a constant organic and hydraulic load on downstream unit processes.
Two tanks are proposed for maintenance purposes. Each tank, with a proposed volume of 125 m^3, will be equipped with one 4 kW platform-mounted mixers to keep suspended solids in suspension and prevent settling.

Additionally, a bypass weir and spilling well will be connected to a storm flow retention pond to contain any sewage during emergencies, such as maintenance or flood events.

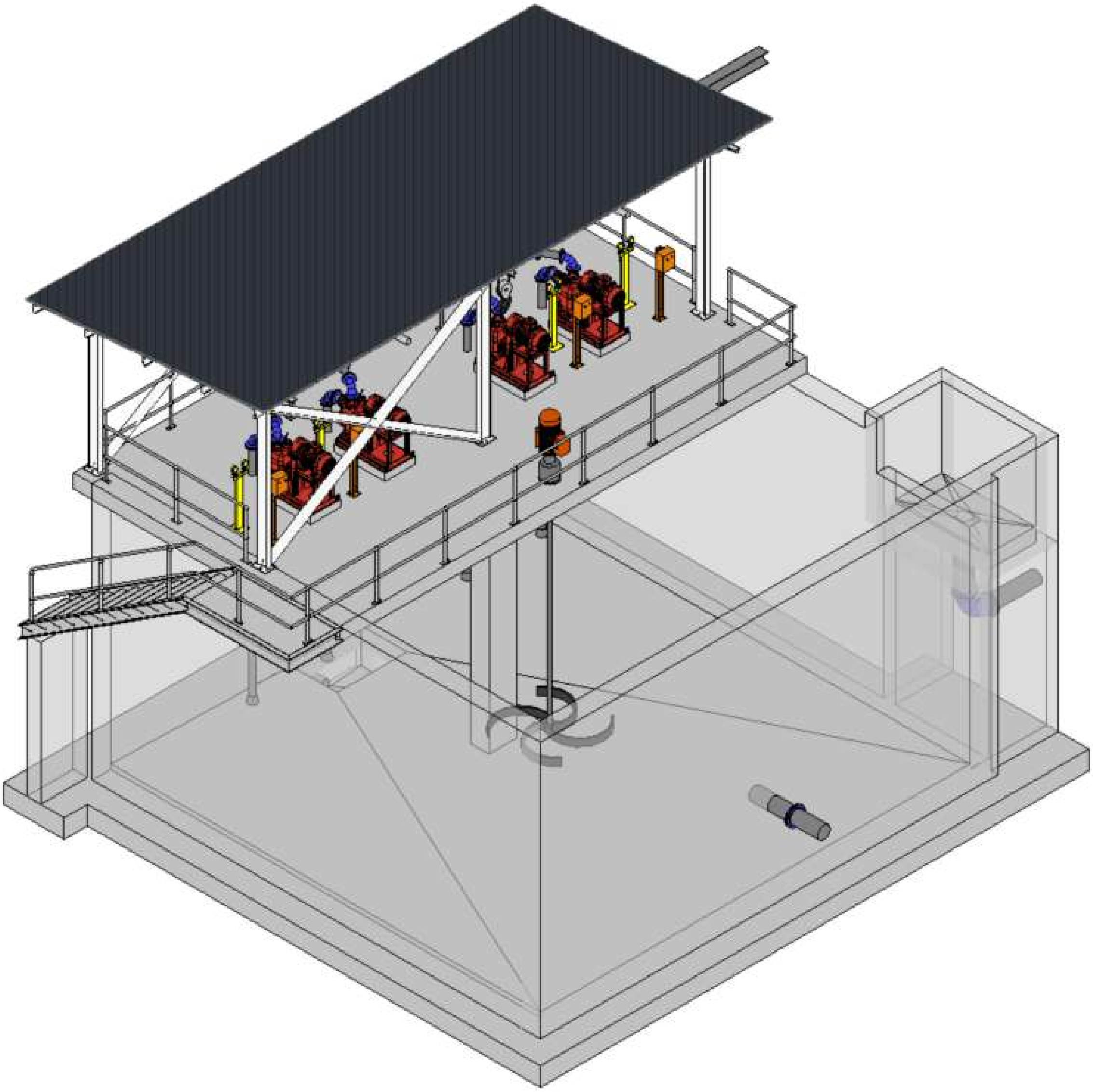


Figure 3-9 Balancing Tank

3.1.4 Biological Reactor Unit

The expected temperature for winter is 13ºC and for summer 23ºC. These temperatures are important for ensuring the effectiveness of microbial cell growth and effectiveness in the biological treatment process. The intended mixed liquor suspended solids (MLSS) for winter to be 4500 mg/ℓ and 3500 mg/ℓ for summer. The plant will be able to operate in MLE process mode.

There will be one biological nutrient reactor comprising the anoxic, and aerobic zones.

3.1.4.1 Anoxic Zone

This zone is the main denitrification reactor in the process. The main anoxic zone receives the following streams:

- Balanced flow from the balancing tank,
- The a-recycle flow from the aerobic zone. This recycle is abstracted from the end of the aerobic zones and the flow rate can be adjusted in accordance with the nitrate concentration in the effluent up to a maximum of 6 x ADWF with three axial flow pumps operational (3 duty, 1 standby).

- The return activated sludge (RAS or s-Recycle) from the Clarifier. The recycle rate may vary between 0.75 x ADWF and 1.5 x ADWF, and
- This zone will be fitted with 1 x 4kW vertical shaft mixers to facilitate the agitation of the mixed liquor. The compartment will have a volume of ± 100 m^3.

The a-Recycle rate will be adjustable by running a different number of pumps. Flow will be extracted from the aerobic zone into a suitably sized canal fitted with a flow-measuring flume and separate discharge points depending on the treatment process selection.

3.1.4.2 The Aerobic Zone

The function of this zone is to oxidise the organic matter in the sewage, to oxidise ammonia to nitrate. It employs air from environment to provide aeration for oxidation of ammonia process called nitrification. The aerobic zone receives flow from the main anoxic zone. This zone will have a total volume of approximately ± 270 m^3.

The aeration capacity is based on oxygen transfer rates under standard conditions and adjusted for site conditions. A drop between the un-aerated and aerated zones is required to prevent back mixing. If these two zones are at the same level, aeration from the aerobic zone can flow back towards the anoxic zone which needs to be prevented.

Wasted Activated Sludge (WAS) will be wasted from both the end of the aerobic zone of the biological nutrient reactor and from the sludge return flow stream. The significance of wasting sludge is to remove excess and dead microorganisms from the process to keep the biological system in balance.

3.1.4.3 Surface Aeration

The surface aeration provides air (contains oxygen) into the mixed liquor in the aerobic zone to ensure sufficient dissolved oxygen (DO) content is maintained. It oxidizes the organic matter, reduces the concentration odour, and taste caused by substances such as hydrogen sulphide and other various organic compounds.

Air will be introduced into the mixed liquor by means two surface aerators with a energy input of approximately 22 kW each.

Low dissolved oxygen concentrations have been noted more than any other cause for the production of MLSS with poor settling characteristics into what is known as bulking sludge, which defines a condition in the activated sludge clarifier that can cause high effluent suspended solids and poor treatment performance. The mechanical aeration equipment has therefore been sized to maintain a dissolved oxygen concentration of 2 mg/l in the aeration basin as higher values will constitute a wastage of energy.

The surface aerator will be equipped with timers that will switch the units on and off based on the DO levels in the reactor. In addition, an adjustable tilting weir will be provided at the outlet to control the immersion and therefore the power drawn by the aerators. The weir will be equipped with an actuator that receives a signal from one or more Dissolved Oxygen (DO) meters indicating the required oxygen demand.

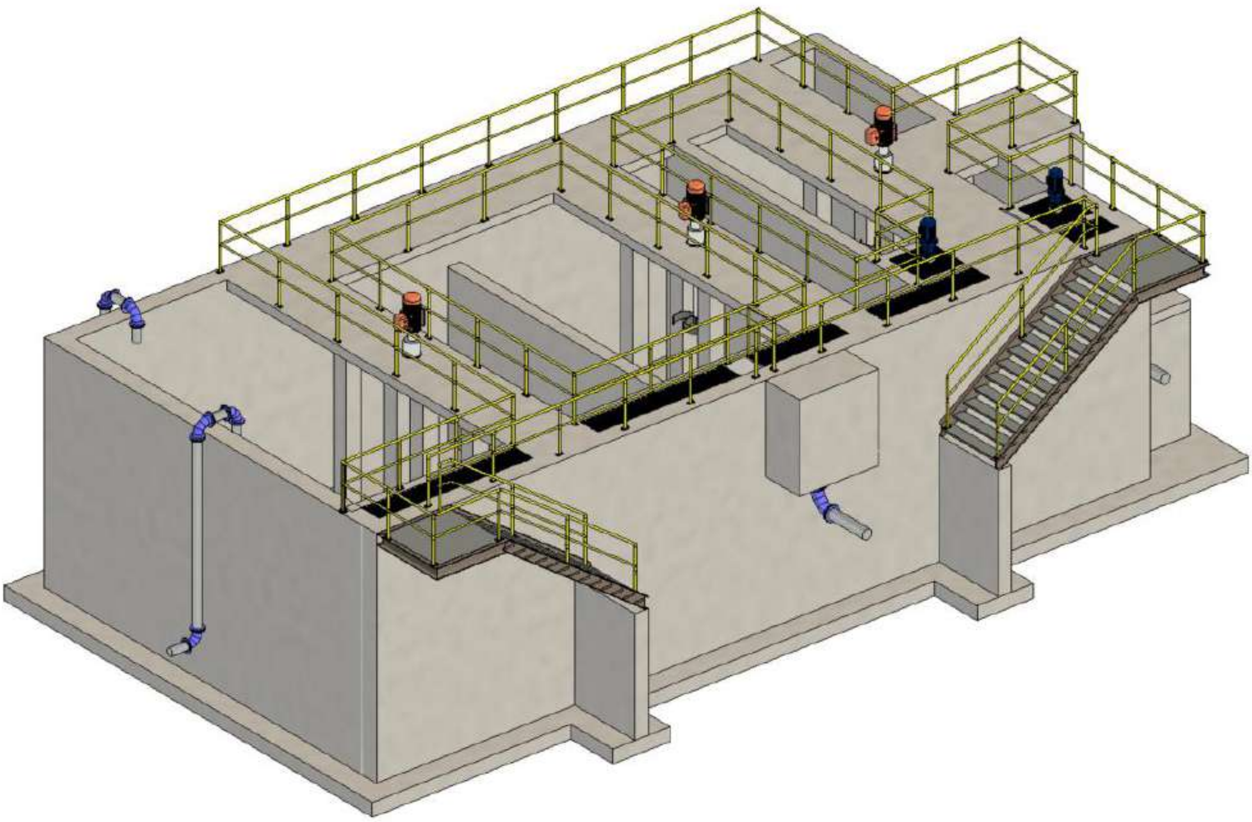


Figure 3-10: Biological Nutrient Removal

3.1.5 Clarifier

Clarification is the process of separating solids by settling of activated sludge to produce clear effluent for downstream processes. There will be one 7m diameter clarifier with a 3m side wall depth will be provided to separate the return-activated sludge (RAS) from the effluent. An upward velocity of 0.7 m/h will be maintained peaking at 0.8 m/h. Flux loading in summer can be expected to be 50 kg TS/m^2/day and 65kg/m^2/day in winter.

The tanks will be designed with sloping floors and sludge will be scraped towards a central sludge collecting hopper with a logarithmic spiral-type scraper assembly suspended from a peripherally driven bridge. Sludge will be withdrawn to the sludge pump station, either by telescopic bellmouths discharging into a sump or alternatively the sludge lines will be directly coupled to the pumps. The typical return-activated sludge concentration will be 0.6 to 1.5% peaking at 2.0 to 3.0%.

The treated effluent will flow over V-notch weirs into a peripheral launder. It will then be collected in a common effluent channel which gravitates to the chlorine contact tank. At the end of the channel, the flow is measured in a venturi flume. Figure 3-11 depicts the Secondary Settling Tank model developed using a 3D Revit.

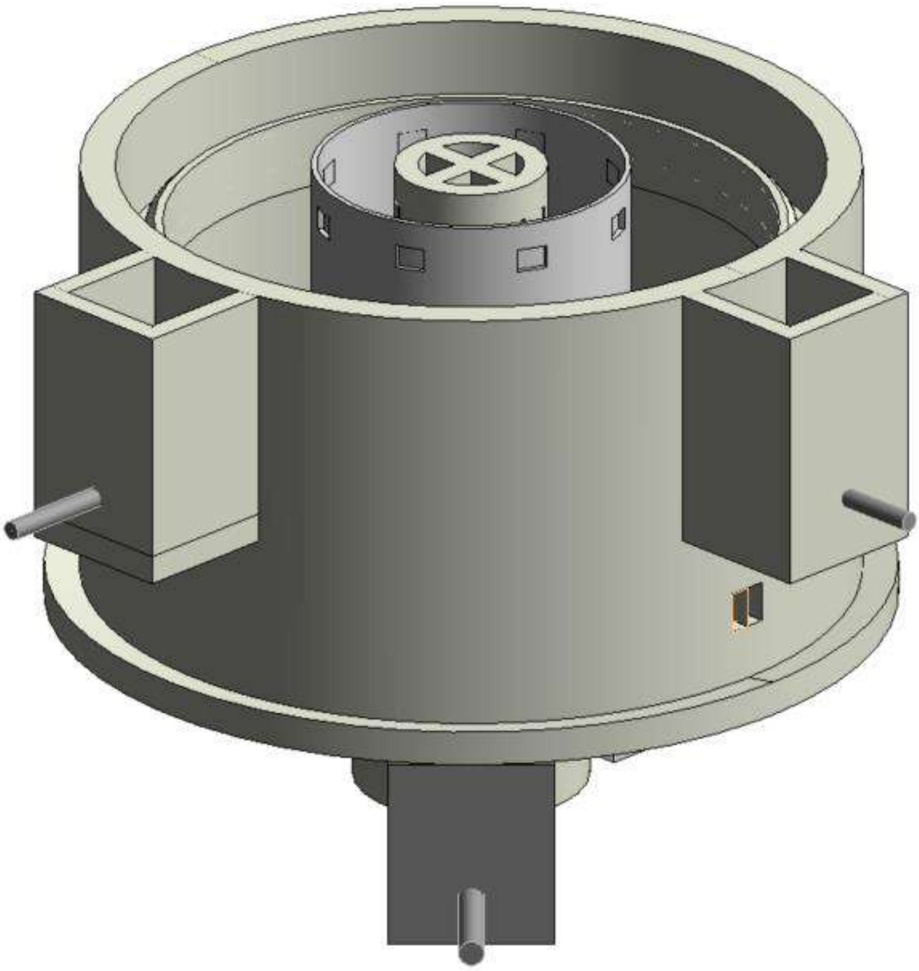


Figure 3-11: Clarifier

3.1.6 Chlorination

The process of reducing pathogenic microorganisms in wastewater to mitigate potential health risks by using physical or chemical methods is called disinfection. Chlorine disinfection was employed to ensure the removal of pathogens in the effluent from the clarifier. There will be two chlorine contact tanks for the new Woodlands WWTW and each train of treatment will have its chlorine contact tank.

The effluent from the clarifiers is collected in a common sump and then distributed into a 15m^3 chlorine contact tank. Chlorine will be dosed at the inlet weir or in the pipe upstream of the inlet to the chlorine contact tanks. The chlorine contact tank provides 20-30 minutes of contact time at PWWF. An auto-flow metering system will be installed to ensure that a chlorine dosing rate of 5mg/l is maintained.

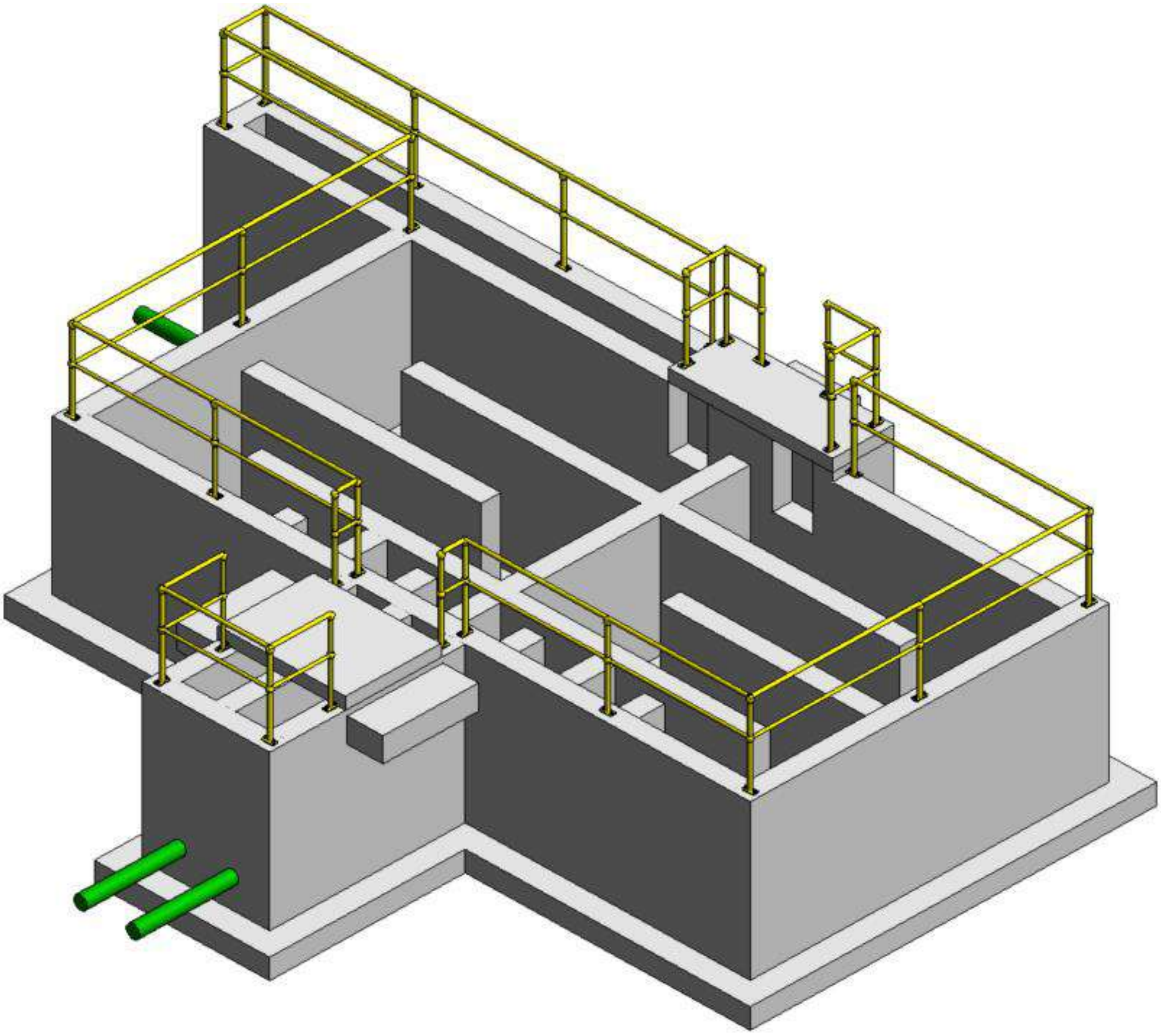


Figure 3-12 Chlorine Contact Tank

3.2 Storm Water Management

There currently is currently no Stormwater Management. A stormwater dam whereby the excess flow overflows at the Inlet works and gravitates to a stormwater dam is recommended. After the storm event the contents can be pumped back to the inlet works at a slow rate to ensure the microorganisms are not washed out. However, the available land needs to be investigated to make this feasible.

3.3 Sludge Management System

Drying

Sludge drying is typically used after stabilization to produce which are used on parks, golf courses, and general turf applications. Heat drying will reduce pathogenic viruses, bacteria, and helminth ova to below detectible levels, and also reduce the water content of the biosolids. Two basic types of sludge drying processes are used: indirect (auger screw, paddle), and direct (belt dryers, rotary drum dryers).

Numerous manufacturers use these methods to increase the percent solids to at least 90%. Thus, the volume of biosolids produced by drying is much lower than any other sludge treatment methods. Sludge drying is a proven technology that requires moderate to high operator attention. Drying requires no chemical addition; however, there are increased power and natural gas requirements. Due to the degree of dryness, there is limited odour in the end product. Dried biosolids are desirable for turf application if not too dusty, among other uses. Table 5-6 summarizes the advantages and disadvantages of drying.

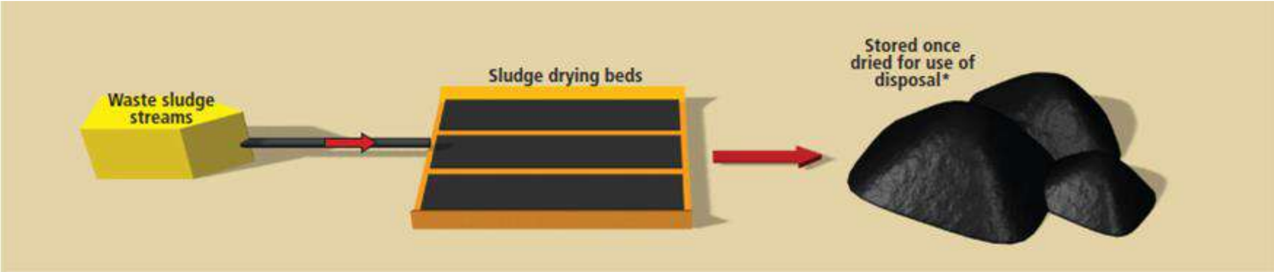


Figure 3-13 Solar Drying Bed

Figure 3-14 Sludge drying beds

The volume of sludge wasted per day will be adjusted from the control room, however, should telemetry failure occur a backup manually operated valve will also be provided. It expected that around 24.4m3/d will be wasted.

To size sludge drying beds for a 25 m^3/day sludge generation rate factors like sludge type, drying depth, and desired drying time need to be considered. A typical conventional sand drying bed (SDB) is about 6-8 meters wide and 30 meters long. The sand layer should be 230-300 mm deep.

Assuming a 25% solids concentration (a common range for wastewater treatment), the daily solids production is approximately 6.25 m^3. Converting this to dry weight using a typical sludge density (e.g., 1000 kg/m^3 for solids) one gets approximately 6250 kg of dry solids per day.

A general guideline for uncovered beds is a sludge loading rate of 100-300 kg dry solids per m^2/year. To determine the required surface area, divide the annual dry solids production by the desired loading rate. For a 250 kg/m^2/year loading rate, you'd need approximately 25 m^2 of surface area per day.

To accommodate the daily solids production, you'll need to determine how many drying beds are required based on their individual surface area and a drying time that suits your needs. A 6-8 m wide and 30 m long bed has a surface area of 180-240 m^2.

Sludge drying beds typically have a 0.5% bed slope to aid in drainage.

Studies have shown that drying at 15 cm was effective in winter, while 20-25 cm was favorable in spring, according to a study at the University of Pretoria.

It is accepted that the scope of work is to produce waste sludge suitable for general landfill disposal or an A1a sludge that can be used for beneficiation.

Supernatant from the sludge management system will be returned to the inlet works.

4. Cost Estimates

4.1 WWTW

4.1.1 Refurbishment Cost Estimate

The estimated cost of refurbishment is given below:

Table 4-1 Refurbishment cost

Woodlands WWTW Refurbishment	
Civil Works	
SECTION 1 : PRELIMINARY AND GENERAL	R477 702.14
SECTION 2 : HEAD OF WORKS	R136 023.38
SECTION 3: CHLORINATION CONTACT CHANNELS	R75 400.57
SECTION 4: CHLORINE BUILDING	R48 042.76
SECTION 5: SLUDGE HANDLING	R909 186.43
SECTION 6: STORMWATER DAM INFRASTRUCTURE	R203 752.76
SECTION 7: ROAD WORKS	R260 183.34
SECTION 8: SUNDRIES	R91 638.30
SECTION 9: ADMIN	R186 581.05
CONTINGENCIES (10%)	R191 080.86
CPA (10%)	R191 080.86
Sub total	R2 770 672.44
Mechanical Works	
SECTION 1 : PRELIMINARY AND GENERAL	R388 125.00
SECTION 2 : SUPPLY AND DELIVERY	R2 250 000.00
SECTION 3 : INSTALL, TEST AND COMMISSION	R337 500.00
CONTINGENCIES (10%)	R258 750.00
CPA (10%)	R258 750.00
Sub total	R3 493 125.00
Electrical Works	
SECTION 1 : PRELIMINARY AND GENERAL	R129 375.00
SECTION 2 : SUPPLY AND DELIVERY (Electrical)	R750 000.00
SECTION 3 : INSTALL, TEST AND COMMISSION	R112 500.00
SECTION 4 : SUPPLY AND DELIVERY (C & I)	R0.00
SECTION 5 : INSTALL, TEST AND COMMISSION (C & I)	R0.00
CONTINGENCIES (10%)	R86 250.00
CPA (10%)	R86 250.00
Sub total	R1 164 375.00
TOTAL	R7 428 172.44
VAT (15%)	R1 071 582.68

GRANDTOTAL	**R8 499 755.12**

4.1.2 New WWTW Cost Estimate

Capital Cost Estimation

WWTW – Option 2 Rotating Biological Contactor
The estimated cost of Option 2 is given below:

Table 4-2 Capital cost RBC

Woodlands WWTW - RBC	
Civil Works	
SECTION 1 : PRELIMINARY AND GENERAL	R1 458 701.28
SECTION 2 : HEAD OF WORKS	R136 023.38
SECTION 3 : SEPTIC TANK	R2 076 556.67
SECTION 4 : RBC BASINS	R1 500 000.00
SECTION 5: HUMUS TANKS	R713 516.00
SECTION 6: FERRIC CHLORIDE DOSING	R22 502.94
SECTION 7: CHLORINATION CONTACT CHANNELS	R75 400.57
SECTION 8: CHLORINE BUILDING	R48 042.76
SECTION 9: OUTFALL	R92 697.00
SECTION 10: SLUDGE HANDLING (to septic tank)	R0.00
SECTION 11: STORMWATER DAM INFRASTRUCTURE	R203 752.76
SECTION 12: SITE PIPELINES	R427 910.35
SECTION 13: ROAD WORKS	R260 183.34
SECTION 14: SUNDRIES	R91 638.30
SECTION 15: ADMIN	R186 581.05
CONTINGENCIES (10%)	R583 480.51
CPA (10%)	R583 480.51
SUB TOTAL	R8 460 467.42
Mechanical Works	
SECTION 1 : PRELIMINARY AND GENERAL	R755 493.60
SECTION 2 : SUPPLY AND DELIVERY	R5 036 624.00
SECTION 3 : INSTALL, TEST AND COMMISSION	R58 500.00
CONTINGENCIES (10%)	R509 512.40
CPA (10%)	R509 512.40
SUB TOTAL	R6 869 642.40
Electrical Works	
SECTION 1 : PRELIMINARY AND GENERAL	incl
SECTION 2 : SUPPLY AND DELIVERY (Electrical)	incl
SECTION 3 : INSTALL, TEST AND COMMISSION	incl
SECTION 4 : SUPPLY AND DELIVERY (C & I)	incl

SECTION 5 : INSTALL, TEST AND COMMISSION (C & I)	incl
CONTINGENCIES (10%)	R0.00
CPA (10%)	R0.00
SUB TOTAL	R0.00
GRAND TOTAL	R15 330 109.82
VAT (15%)	R1 594 996.73
TOTAL	**R16 925 106.55**

WWTW – Option 3 Biological Nutrient Removal

The estimated cost of Option 3 is given below:

Table 4-3 Biological Nutrient Removal Cost Estimate

Woodlands WWTW - BNR	
Civil Works	
SECTION 1 : PRELIMINARY AND GENERAL	R1 322 846.83
SECTION 2 : HEAD OF WORKS	R136 023.38
SECTION 3 : BALANCING TANK	R457 826.88
SECTION 3 : FLOW DIVISION	R53 544.13
SECTION 4: PROCESS TANK	R2 218 602.65
SECTION 4: FERRIC CHLORIDE DOSING	R22 502.94
SECTION 5: CLARIFIER	R375 573.76
SECTION 6: RAS AND WAS PUMPING STATION	R34 983.17
SECTION 7: CHLORINATION CONTACT CHANNELS	R75 400.57
SECTION 8: CHLORINE BUILDING	R48 042.76
SECTION 8: OUTFALL	R92 697.00
SECTION 9: SLUDGE HANDLING	R606 124.29
SECTION 10: STORMWATER DAM INFRASTRUCTURE	R203 752.76
SECTION 11: SITE PIPELINES	R427 910.35
SECTION 12: ROAD WORKS	R260 183.34
SECTION 13: SUNDRIES	R91 638.30
SECTION 14: ADMIN	R186 581.05
CONTINGENCIES (10%)	R529 138.73
CPA (10%)	R529 138.73
SUB TOTAL	**R7 672 511.63**
Mechanical Works	
SECTION 1 : PRELIMINARY AND GENERAL	R202 855.39
SECTION 2 : SUPPLY AND DELIVERY	R1 305 992.17
SECTION 3 : INSTALL, TEST AND COMMISSION	R46 377.09
CONTINGENCIES (10%)	R135 236.93
CPA (10%)	R135 236.93
SUB TOTAL	**R1 825 698.50**
Electrical Works	
SECTION 1 : PRELIMINARY AND GENERAL	R193 397.39
SECTION 2 : SUPPLY AND DELIVERY (Electrical)	R998 497.03
SECTION 3 : INSTALL, TEST AND COMMISSION	R105 805.10
SECTION 4 : SUPPLY AND DELIVERY (C & I)	R166 615.80
SECTION 5 : INSTALL, TEST AND COMMISSION (C & I)	R18 398.00
CONTINGENCIES (10%)	R128 931.59
CPA (10%)	R128 931.59

SUB TOTAL	R1 740 576.51
TOTAL EXCL VAT	R11 238 786.64
VAT (15%)	R1 685 818.00
TOTAL	**R12 924 604.63**

4.1.3 O&M Cost Estimation

WWTW – Option 2 Rotating Biological Contactor

The estimated O&M cost of Option 2 is given below:

Table 4-4 O&M cost RBC

Period/Term	Expected Operating Cost (1)	Expected Maintenance Cost (2)	Total O & M Cost (3=1+2)
Year1	R 649 733	R 162 433	R 812 166
Year2	R 658 829	R 164 707	R 823 536
Year3	R 668 052	R 167 013	R 835 065
Year4	R 677 405	R 169 351	R 846 756
Year5	R 686 889	R 171 722	R 858 611
Total	R 2 654 019	R 663 505	R 3 317 523

WWTW – Option 3 Biological Nutrient Removal

The estimated O&M cost of Option 3 is given below:

Table 4-5 O&M cost BNR:

Period/Term	Expected Operating Cost (1)	Expected Maintenance Cost (2)	Total O & M Cost (3=1+2)
Year1	R 516 984	R 129 246	R 646 230
Year2	R 524 222	R 131 055	R 655 277
Year3	R 531 561	R 132 890	R 664 451
Year4	R 539 003	R 134 751	R 673 754
Year5	R 546 549	R 136 637	R 683 186
Total	**R 2 111 770**	**R 527 943**	**R 2 639 713**

5. Recommendations

Wastewater Treatment Works

After consideration the client decided on Option 3 – Activated sludge.

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