GREATER HERMANUS SETTLED SEWERAGE PROJECT

by

JA van der Linde (Hermanus Town Engineer)

and JE du Pisani (CSIR Division of Building Technology) 1997

Pretoria, South Africa

This paper discusses the provision of settled sewerage systems to three areas of Greater Hermanus, namely Voëlklip, Sandbaai and Onrus River / Vermont.

Greater Hermanus local authority, located about 100km east of Cape Town, South Africa, was established in January 1994 and stretches for 15 km along the coastline. The local authority comprises seven formerly independent towns and municipalities, as listed in Table 1, with a total of 11 580 erven and a permanent population of about 19 000 people. During the summer peak season the total population of the area increases to about 50 to 60 000.

Table 1 : Towns included in the Greater Hermanus Local Authority

Town	Hermanus	Fisherhaven	Hawston	Vermont	Sandbaai	Onrus River	Zwelihle
Erven	4465	780	1145	1115	1470	1425	1180

In 1990 only 1 660 erven (all located in Hermanus) were serviced by a raw sewage conveyance system (RSCS), while the balance of the developed erven were serviced either by conservancy or septic tank systems. Due to

- a very high growth rate in Hermanus during the early 1990's,
- signs of groundwater pollution due to the septic tank drainfields, and
- the high cost of emptying conservancy tanks, particularly during the holiday peak season when the time required to empty one septic tank and discharge the sludge at the treatment works increased from 25 minutes to 40 minutes per round trip,

the decision to install a sewerage network in Voëlklip, an area of 1830 erven within Hermanus proper, was taken in March 1992.

An initial estimate for a raw sewage conveyance system was R15,5 million. The town engineer then requested a comparison with the cost of a settled sewerage (SS) system. The cost of the latter was estimated to be between 25% and 34% less than that of the raw sewage conveyance (RSC) system. The other advantages and disadvantages of the proposed settled sewerage system, which were considered at the time, are listed in Table 2. As a result of the perceived disadvantages of the SS system it was decided to service only a small area with the settled sewerage technology initially, and to evaluate this before servicing the whole of Voëlklip. The three phases of construction eventually adopted are indicated in Table 3. The design parameters adopted, and the modifications during or after construction are listed in Table 4.

Table 2 : Advantages and disadvantages of the proposed settled sewerage scheme at Voëlklip, as at 1992.

Advantages	Disadvantages
1. Existing septic tanks could be utilized to settle sewage. Only 2% of erven had no septic tanks. 18% had tanks greater than 2400 ℓ and 80% had tanks of 10 000 ℓ	1. There was no comparable SS scheme in South Africa to model the system on.
2. Existing tanks could provide primary digestion. A BOD reduction of 50% was estimated, thus reducing the loading on the treatment works.	2. Apart from the literature surveys, and inspections of two existing South African schemes, the town engineer and the consultants were not familiar with the technology.
3. Because most existing tanks were conservancy tanks they were already located at the street frontage of the erf. Connecting from sewers laid in the street reserve would therefore be less costly.	3. There was little information available on the operation and maintenance requirements of the SS systems.
4. The majority of Voëlklip erven, with a size of 495 m^2, were developed with outbuildings, paving and sensitive gardens. This favoured the narrow, shallow trenching of the SS System.	4. The desludging frequency was not known, since the standard predictions of 5 - 7 years would probably not be applicable to a resort town like Hermanus.
5. Shallow rock was anticipated, particularly close to the shore. The narrow, shallow, trenches and shallower pump stations of the SS system would reduce excavation, and consequently spoil of rock as well as importation of suitable backfill materials.	5. The magnitude of possible infiltration was unknown.
6. Conflict with existing services in the built up town would be reduced due to the shallower depth and horizontal flexibility of SS systems.	6. Public opinion, including that of qualified engineers, did not favour the SS system, considering it "sub-standard".

Table 3 : Three phases of the Voëlklip sewerage project

Phase 1	Phase 2	Phase 3
1. Install main Voëlklip pump station 2. Install rising main to treatment works 3. Reticulate 275 *erven* with SS system	1. Install main outfall sewers 2. Reticulate a further 380 erven with SS system	1. Install 6 local pump stations and rising mains 2. Reticulate caravan park and chalets with raw sewage conveyance system 3. Reticulate 1 175 erven with SS system

Table 4 : Design Parameters - Voëlklip Settled Sewerage System

Design Parameters
Curvilinear alignment only in horizontal plane
Vertical alignment to be straight and no flow (excepting pump rising mains) to be under hydraulic pressure.
Minimum velocity of 0,3m/s, based on that of grit channels. The intention was that digested flocs entering the system should remain in suspension.
Maximum flow in pipes to 80% of full flow.
Minimum diameter of service laterals to be 63mm, and the minimum size of the network sewers to be 75mm.
Average Daily Dry Weather Flow (ADWF) assumed at 1000l/erf. Peak Wet Weather Flow (PWWF) = 2 x ADWF.
Pump stations designed as for raw sewage pump stations.
Manholes on the sewer network were to be excluded as far as possible, and where used were constructed of hard burnt clay bricks. Rodding eyes were to be installed at 100m intervals. Since the first phase had low maintenance requirements, this distance was later extended to 200 - 250m intervals.
Only uPVC and bitumen-dipped fibre-cement pipework was used in the network and rising mains. uPVC y-junctions were specially made up for the project.
All pump stations were lined with 3mm plastic lining.
Minimum septic tank size of 5000 ℓ
Tank inlet to outlet height difference of 50mm
The tee-piece was designed as a 150mm upright with a 63mm outlet pipe. Both ends were closed, with 15 x 15mm holes drilled in each end cap. This design proved too bulky and the upright was replaced by a 110mm section. After a few blockages at the outlet, caused by floating matter sealing the bottom of the outlet tee-piece, four additional 15mm diameter holes were drilled in the upright section of the tee-piece.

During construction all tanks were emptied and tested for structural soundness, leakages and adequate capacity. Sub-standard tanks were modified at the expense of the owners. Manholes were installed adjacent to some existing tanks to allow for installation and maintenance of the outlet tee-pieces. Quality control of the sewers was done by means of flushing out all lines and the by washing hollow, coloured, plastic balls through the sewers to ensure that all sections were connected, that no stagnant sections occurred in the system and that there were no obstacles in the network.

There were initially complaints of bad odour relating to the system. This was traced to a sump where septage from conservancy tanks was dumped so that it could drain to the treatment works via the main outfall. The installation of waterseals at the junctions of the SS system with the main outfall resolved the problem.

The SS system for the 275 erven serviced under Phase 1 proved to have both lower capital costs and lower maintenance costs. Furthermore, a reduction of 45% in the COD was measured after four months of operation. The second phase of the SS systems was therefore approved in September 1993 and completed in May 1994. After completion of the second phase the town engineer was convinced of the benefits of the SS system technology, and the balance of the project was implemented in 1994.

During the implementation of the Voëlklip settled sewerage scheme the towns of Sandbaai and Onrus / Vermont, which were served by septic and conservancy tank systems, also took the decision to install sewerage systems. The design parameters used for the Voëlklip system, as modified during implementation, were adopted for both Sandbaai and Onrus / Vermont. Information on the elements comprising the three systems is given in Table 5.

Sandbaai adopted the settled sewerage option after a cost estimate indicated that a raw sewage conveyance system would cost an estimated R9,1 million, while a settled sewerage system was estimated to be 40 - 50% less costly. The SS technology is particularly suited to the flat gradients and the occurrence of shallow rock in Sandbaai, and the fact that there were already septic tanks on the erven. Design parameters adopted were as for Voëlklip. Due to the greater than predicted rock volume, eventually measured at 40% of total excavation, the project cost was eventually only 26% less than the estimated cost for the raw sewage conveyance system.

In Onrus / Vermont the settled sewerage system was adopted, primarily because it was less costly than a raw sewerage conveyance system, after a referendum of ratepayers. The settled sewerage technology was also favoured due to the built up state of the area. the existence of services of which the positions were not known, rock excavation in restricted areas and close to homes, the reduction in required reinstatement of erven and the fact that there were already septic tanks on the erven. High groundwater was encountered during construction, so that septic tank overflows had to be blocked off, whereas in Voëlklip these had been retained as emergency overflows.

Table 5 : Elements of settled sewerage schemes in Hermanus

Element	Voëlklip	Sandbaai	Onrus / Vermont
Main pump station (No)	1	1	1
Rising main	5 800m @ 250mm diameter	2000 m @ 200mm diameter	3500m @ 300mm diameter
Local pump stations (No)	6	1	4
Service Laterals	28 773 m @ 63mm diameter	19 281m @ 63mm diameter	24 500m @ 63mm diameter
Network Sewers	30 881m (75mm to 160mm diameter)	25 839m (75mm to 160mm diameter)	43 339m (75mm to 160mm diameter)
Outfall sewer	1 529m (greater than 160mm diameter)	1 395m (greater than 160mm diameter)	7 044m (greater than 160mm diameter)
Number of erven served	1 469 of 1 830 (balance undeveloped)	850 of 1 470 (balance undeveloped)	1 450 of 2 540 (balance undeveloped)
Project cost *	R11,1 million	R6,72 million	R13,42 million
Percentage rock	12	40	20
Cost per erf	R6 070	R4 576	R5 285

* (including mechanical and electrical)

OPERATION AND MAINTENANCE OF THE GREATER HERMANUS SEWERAGE SYSTEM

The operation and maintenance team comprise a supervisor, two labourers and an LDV. Their duties include daily inspection of the 20 pump stations in Greater Hermanus, as well as attending to complaints and problems on both the raw sewage and settled sewage networks. The local authority owns one tanker, as well as a high pressure water jet for clearing blockages.

Odours were initially experience at manholes, primarily at those adjacent to the septic tanks. The problem was resolved by sealing the manhole with vehicle lubrication grease.

Blockages were commonly reported in the first year of operation, but it was found that 70-80% of these reports were in fact not for blockages, but because the water level in the tank was high, ie: the users did not understand that this was the normal operating condition of the septic tank. A summary of odours and blockages recorded is given in Table 6.

Table 6 : Summary of problems encountered on Greater Hermanus settled sewerage scheme in relation to the raw sewage conveyance system

Year	Odours on SSS	Blockages* on SSS	Call-outs for RSCS
1994	40	10	110
1995	86	36	132
1996	37	71	134

* 70-80% unnecessary.

The charges currently applicable for sanitation provision in Greater Hermanus are given in Table 7.

Table 7 : Charges for operation and maintenance in Greater Hermanus (1997)

System	Basic monthly rate	Additional charges
Raw sewage conveyance system	R37	R33 per additional toilet pan
Settled sewerage system	R14	R33 per additional toilet pan
Conservancy tanks	R70* (tanks emptied twice a month)	R110 per additional time

* This service runs at a loss since the actual cost of emptying a tank is R184.