EXECUTIVE SUMMARY

The work described in this report is a follow-up to an earlier Water Research Commission (WRC) funded project. This earlier project dealt with the construction and commissioning of four field test cells at the Weltevreden landfill. One cell (Cell 1) was filled with refuse from a typical middle class suburb and contained a large proportion of paper and putrescibles. Another cell (Cell 4) was filled with refuse from an informal settlement and consisted primarily of ash and dust, while the remaining two cells (Cells 2 and 3) were filled with blends of these two waste streams. The project ended in December 1998 and by that time only 14 months of data had been collected. These results indicated very little generation of leachate had occurred and in order to maximise the benefit of the money spent on constructing the cells a proposal was submitted to the WRC to continue monitoring the cells for a further two years. This proposal was accepted by the WRC and this report describes the results of this extended period of monitoring.

The intention had been to monitor quantity and quality of both leachate and biogas emissions. A static accumulation chamber was used to attempt to detect biogas emissions through the covers of the test cells but negligible emissions were detected on all testing occasions. The bulk of the useful data collected was thus the leachate data. For the first 2 years of monitoring, the quantities of leachate produced by all four cells were minimal, being less than 3% of the precipitation.

After approximately 930 days however, a significant change in the quantity of leachate generated by Cell 1 occurred. Substantially larger volumes of leachate began to be collected and the total leachate volume from Cell 1 soon overtook the other 3 cells. By the end of the study, Cell 1 had been subjected to about 0.05 pore volumes of flow, while for the remaining cells only about 0.015 pore volumes of flushing had occurred. While the volume of leachate generated by Cell 1 increased dramatically, the generation rates from the remaining 3 cells remained fairly constant. The reasons for the differences in behaviour are attributed to preferential flow occurring within Cell 1, whereas the presence of ash in the other cells tends to prevent this occurring and also improves the moisture retention capacity of the waste. The implication for the practice of landfilling in South Africa is that by blending ash-rich waste with the remainder of the waste stream, the hydraulic characteristics of the waste can be improved, ultimately resulting in reduced leachate volumes.

By the end of the study the quality of the leachate being generated by all cells still showed no sign of reaching an acceptable quality. The concentration of chloride in the leachate from all cells showed a gradual decline in concentration with increasing proportions of pore volumes flushed, but still appeared to be a long way from reaching acceptable concentrations. Chloride, being non-degradable, is often considered to constitute an ideal tracer in ground water and an extremely useful indicator of the changing strength of landfill leachate. In the present study it was estimated that approximately 28 years would be needed to flush the waste in Cell 1 to an acceptable state of degradation. Considering that the height of waste in Cell 1 started off as slightly greater than 1m (and has inevitably decreased with time), it is suggested that a conservative estimate of the time needed to bring a full-scale landfill in a semi-arid climate to an acceptable stage of degradation would be given by assuming that 28 years were needed for every 1m thickness of waste deposited. For many of our urban landfills, that have 20m or more of stored waste, this is clearly an unacceptable condition. We cannot condone the establishment of a source of potential contamination that may be expected to constitute an environmental and health hazard for up to 600 years after closure. Concentrations of ammonia in the leachate from all four cells indicates an even more severe problem. In Cell 1for example, even after 0.05 pore volumes of flushing, the ammonia concentration was still increasing. The estimate of 28 years to achieve acceptable leachate quality that was derived from changes in chloride concentrations measured to date is unlikely to be sufficient to ensure the same goal is achieved for ammonia concentrations.

The primary, and most useful outcome of the work performed in this study is thus to raise concerns about the long-term viability of our current approach to landfilling in semi-arid parts of the country. By encapsulating the waste and maintaining it at a relatively low moisture content, the effect is to retard biological degradation processes and thus effectively retain the polluting potential of the stored waste.

However, the waste cannot be isolated from the ingress of moisture in perpetuity and once moisture begins infiltrating into the stored waste (eg through a damaged or poorly maintained cover system), the process of biological degradation, with associated generation of highly contaminated leachate, will begin again. Current legislation in South Africa requires that a landfill and its surrounding environment (eg adjacent groundwater) be monitored for a period of 30 years after closure, to ensure the environmental and health risks posed by the landfill are not unacceptable. The problem with this approach in a semi-arid climate appears to be that even after this period of aftercare the landfill may in fact be many years from achieving a stable and acceptable state. In short, it may still have a very large proportion of its initial contaminating potential.

The major conclusion to be drawn from this ongoing study is that an urgent re-think is required on current provisions for post-closure monitoring of municipal solid waste landfills in South Africa. In addition, we should be investigating techniques of accelerating the decomposition of refuse within the landfill in order that the contaminating potential of the stored refuse can be reduced to acceptable values within the operational and reasonable post-closure period. If this issue is not addressed now, it is suggested that we will inevitably be forced to revisit it sometime in the future when today's landfills become tomorrow's sources of environmental contamination.