RESEARCH INTO GROUNDWATER ABSTRACTION

IN THE PORT ELIZABETH MUNICIPAL AREA

by

C R Lomberg and P N Rosewarne
Steffen Robertson and Kirsten (CAPE)

and

D A Raymer and D G Devey
Port Elizabeth Municipality

Report to the Water Research Commission
on the Project,
"Research into groundwater abstraction
in the Port Elizabeth Municipal area"

Project Leader: P N Rosewarne

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Steffen, Robertson and Kirsten
7 Heugh Road
Walmer
PORT ELIZABETH

P.O. Box 21842
PORT ELIZABETH
6000

Tel: (041) 511911
Fax: (041) 511964

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The Steering Committee responsible for the project consisted of the following persons:

Mr A G Reynders	:	Water Research Commission (Chairman)
Mr H C Chapman	:	Water Research Commission
Mr N Andersen	:	Atomic Energy Corporation (AEC)
Mr P Seward	:	Department of Water Affairs and Forestry
Mr D Coetzee	:	Department of Water Affairs and Forestry
Mr M van Zyl	:	Department of Water Affairs and Forestry
Mr F A Stoffberg	:	Department of Water Affairs and Forestry
Mr T H Proudlock	:	Port Elizabeth Municipality
Mr D A Raymer	:	Researcher Port Elizabeth Municipality
Mr D G Devey	:	Researcher Port Elizabeth Municipality
Mr P N Rosewarne	:	Researcher Steffen, Robertson and Kirsten

Mr G Nel and Mr S Meyer of the Department of Water Affairs and Forestry and Mr W Illenberger were alternate members, co-opted to represent the Department of Water Affairs and Forestry and AEC.

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CONTENTS

TABLES:

FIGURES:

APPENDICES:

EXECUTIVE SUMMARY

INTRODUCTION AND RESEARCH OBJECTIVES

The Port Elizabeth area experienced a downward trend in rainfall from 1983, culminating in water restrictions being introduced from 1989 to 1992. In response to this, a proliferation of private boreholes were drilled into the sandstone aquifer underlying the municipal area, with much attendant publicity in the local press. In early 1992, Steffen Robertson and Kirsten (SRK) held discussions with Port Elizabeth Municipality (PEM) with a view to initiating a project to investigate the extent and effects of private groundwater abstraction in the municipal area. SRK and PEM then agreed to submit a joint proposal to the Water Research Commission for funding, which was subsequently approved, and the project commenced in January 1993. Research objectives are divided into principal and secondary categories as follows :

- **Principal objectives**
  - Determine the number and distribution of boreholes in the PEM area;
  - Assess the volumes of groundwater abstracted and overall groundwater quality;
  - Assess the potential for saline water intrusion;
  - Investigate legal options for PEM to control development and use of groundwater in the municipal area.

- **Secondary objectives**
  - Determine spatial and seasonal variations in groundwater use;
  - Assess groundwater contamination from irrigation with final effluent and fertilizer application.

INVESTIGATION APPROACH

The initial priority of the investigation was to determine the number and location of boreholes by means of a census. A representative monitoring network of boreholes was then established from which data on abstraction, water levels and water quality were obtained. Originally, 50 boreholes were selected to be monitored over the study period, including for completeness, boreholes that fall outside the PEM boundary. Sites were selected to enable collection of representative data from as wide an area as possible, with a balance between private residential and higher consumption corporate and municipal boreholes. Permission was granted to equip 37 boreholes with water meters as principal monitoring points. Monitoring data to be collected included water consumption (abstraction), water levels and samples for chemical and bacteriological analysis.

Once the water meter installation programme was completed, meters were read on a monthly basis along with water levels where possible. In total some 700 meter readings were taken from 37 boreholes. About 1 000 borehole water samples were analysed from the 47 boreholes monitored.

A database was developed using Dbase 4, which was designed to accommodate information from the census forms. The PEM Engineer's Department maintained a database on Quattro Pro into which monitoring data on borehole water levels and abstraction rates, as well as records of corresponding municipal consumption, were entered. The Scientific Services Division of PEM entered all the results of the hydrochemical analyses on Excel spreadsheets.

HYDROGEOLOGY

Port Elizabeth is situated at the eastern extremity of outcrop of the Table Mountain Group sandstones (TMGS) on a northwest-southeast trending anticlinal structure, which forms part of the southern limb of the Cape Fold Belt. Along the northern boundary of the study area, the resistant sandstones form an escarpment where they dip under the Uitenhage Group, while to the south, the sandstones form an elevated wave-cut platform.

Much of the southern part of the wave-cut platform that forms the Cape Recife headland is covered by a mantle of Tertiary to Recent age deposits, such as The Nanaga Formation, a consolidated calcareous aeolian sand or dune rock. The formation is relatively resistant to weathering and forms topographic highs, e.g. Lovemore and Walmer Heights. Recent unconsolidated aeolian sand forms longitudinal sand dunes with crests trending east-northeast, west-southwest. Calcrete layers are commonly developed within the sand.

The rocks and sediments described above can be classified into two broad aquifer types. The TMGS form secondary aquifers in which groundwater flows and is stored within fractures such as joints, bedding planes and faults. The Tertiary to Recent sands are primary aquifers in which groundwater flows and is stored in interstices within the constituent sand grains. Rocks of the Uitenhage Group are not classed as aquifers within the study area due to their generally low permeability and poor water quality.

The area covered by the Tertiary to Recent deposits is large but little is known about their thickness or aquifer potential. The coastal sands underlying Summerstrand and Humewood are younger and have a greater coarse grained sand fraction, less calcretisation and compaction, and are thus likely to have higher aquifer potential. None of the boreholes recorded in the database pump water from the sands in the Walmer, Arlington and Kragga Kamma areas.
The TMGS have been intensely folded to form a series of northwest-southeast trending synclines and anticlines, and associated thrusting has resulted in a thickening of the sequence in the PEM area. Consequently, the rock mass is highly bedded and fractured, resulting in development of a network of secondary structural discontinuities.

There are two primary controls on the distribution of boreholes, the most important of which appears to be socio-economic status, while geological and hydrogeological factors are of secondary consideration. Although not all boreholes within the study area were located in the census, the borehole distribution and density recorded is considered to be representative of borehole occurrence in the area. Walmer and Summerstrand show the highest concentration of boreholes and major roads can be identified by the alignment of boreholes. Together these suburbs account for 65% of boreholes and the distribution drops-off dramatically moving away from these areas.

The data indicate that the TMGS aquifer in the PEM area is relatively low yielding with >96% of recorded boreholes having a yield of <10 m^3/h. The generally exploited depth is from 60 to 120 m. As a comparison, yields at St Francis Bay are in the range of 7 to 50 m^3/h from depths up to 90 m, while at Ceres, yields range from 20 to 45m^3/h from depths of 80 to 120 m.

In the majority of average and above average rainfall months, abstraction is minimal as groundwater quality is considered generally undesirable and municipal water relatively cheap. Records show that, for the majority of borehole owners, groundwater is used and considered as an emergency supply source only. Therefore, the proliferation of boreholes tapping the aquifer between 1989 and 1992 does not necessarily represent higher sustained abstraction rates but rather the potential for high demand pulses to be imposed on the aquifer.

Annual metered private groundwater abstraction amounts to 20 486 m^3 from which, by simple proportion, it is estimated that total private groundwater abstraction is 236 600 m^3/annum. An order of magnitude figure of total corporate abstraction is estimated to be about 150 000 m^3/annum. Combining figures for corporate and private abstraction, total annual groundwater abstraction in the PE municipal area is thus estimated to be about 387 000 m^3.This volume forms less than 1% of total municipal consumption since recent expansion of the reticulation network. The total cost of groundwater use in PEM to the municipality in terms of lost revenue, based on an annual abstraction of 370 000 m^3 at R1,80 per m^3, is therefore R666 000 at July 1995 prices.

Groundwater contours indicate a natural hydraulic gradient along geological strike from north-west to south-east, towards and across the study area. This reflects the enhanced permeability along strike, with bedding and thrust planes being the principal flow conduits. Exceptionally steep groundwater gradients are maintained across geological strike.

The contours indicate that the Baakens River intercepts and drains water from the aquifer and may play an important role in limiting the spread of high conductivity groundwater from the north-west into the Humewood and Summerstrand areas. To the north of the study area, the TMGS is covered by a thick sequence of Tertiary and Cretaceous mudstones. This has generated artesian conditions in the Uitenhage

Basin and the groundwater contours indicate that the hydraulic head in this basin pushes groundwater to the south-east and south. Groundwater levels monitored over the study period show that no significant regional fluctuations of the water table have occurred beside localised drawdown due to pumping.

HYDROGEOCHEMISTRY

Groundwater from the central and inland suburbs is all of a sodium chloride type, particularly north of the Baakens River. Groundwater from the Summerstrand area has a greater Ca/Mg HCO_3 component, which is due to the influence of the lime rich coastal sands. This could indicate that boreholes are tapping the primary aquifer directly or that a component of the secondary aquifer groundwater is derived by leakage from the sands.

Although water types are consistently within the above two categories, there is a large spatial range in electrical conductivity and individual constituents within the sodium chloride type. There are also significant time variations in water quality within individual boreholes, as shown by the high values of standard deviation for many constituents, although some are skewed by one analysis, which in many cases was the first of the monitoring period. The time variations do not appear to be seasonally related, with each borehole having its own pattern. Fluctuations also appear to be above and below a fairly constant level, with concentrations at the start and end of the monitoring period not being significantly different. The groundwaters generally comply with SABS 241-1984 upper limits for domestic water use, some exceptions including chloride, nitrate and iron.

In the context of expected TMGS groundwater chemistry, the Port Elizabeth aquifer is atypical. For example, the range in conductivity is 50 to 819 mS/m, and in chloride, 100 to 2799 mg/l. Furthermore, contour plots of these parameters and sulphate appear to indicate that they are decreasing in concentration along the groundwater flow path to the south of the Baakens River. Chemical reactions such as adsorption, precipitation and base exchange can cause natural attenuation and alteration of groundwater chemistry but, in the case of chloride, this explanation is not satisfactory, as chloride is a conservative ion.

If it is thus accepted that chloride is not being lost from the aquifer system along the flow path, then the only feasible explanation is that it is being diluted. The explanation put forward is that expanding urbanisation in the PEM area along the outcrop of the TMGS aquifer has resulted in partial replacement of diffuse recharge through the soil profile by the development of numerous point sources of contamination such as old waste tips, leaking sewers and water mains, septic tanks, fertilizer application and stormwater runoff. This would explain the frequent occurrence of groundwater with radically different chemistry from boreholes a few streets apart. Examples of such conductivity-chloride contrasts are 475mS/m-1463mg/ℓ and 151mS/m-390mg/ℓ in Walmer, and 247mS/m-559/mgℓ and 652mS/m-1591/mgℓ in Walmer Heights. Historical reports of 'brackish' water in the Walmer area in the 1920's could indicate a natural level of salts in the aquifer.

Nitrate concentrations show an opposite trend to chloride in that concentrations increase along the flow path towards the coastal suburbs. The low iron concentrations in these areas may indicate an increase in redox potentials and a decrease in denitrification potential within the aquifer. This could have long-term implications for groundwater quality, with a continuing build-up of nitrates, given the practice of irrigation with treated sewage effluent in many coastal areas and fertilizer application to gardens, sports fields and parks. There is a trend for a general increase in nitrates in the peripheral coastal areas, which possibly supports the above contention.

Activities which could result in the introduction of contaminants into the aquifer include waste disposal sites, sites irrigated with reclaimed sewage effluent, golf courses where nitrogenous fertilizers are used, and other sites where nitrogenous and other fertilizers are used. For the purpose of assessment of contamination, the major borehole water quality indicators considered were, chloride, nitrate, iron, Total Organic Carbon and bacteria. These five indicators are discussed separately as far as the monitoring boreholes are concerned.

- **Chloride**

  Most of the boreholes in the PEM area have relatively high chloride concentrations, predominantly in the form of sodium chloride. Of the 47 boreholes monitored, 37 had average chloride levels of >250 mg/l; 28 with >400 mg/l and 11 with >600 mg/l. The majority of the borehole waters fall into the medium and medium/high chloride category, i.e., 250 to 600 mg/l.

- **Nitrate**

  Out of the 44 borehole waters analysed, 21 have nitrate levels >4,0 mg/l as N, with 11 being >10,0 mg/l. The high nitrate boreholes are contained in a triangle from Newton Park towards the sea, with Central and Summerstrand being the outer corners of the triangle. Sources of nitrate include areas irrigated with treated sewage effluent, e.g PE Technikon, UPE and Humewood Golf Course and irrigated parks and golf clubs where nitrogenous fertilizers are used, e.g Walmer Country Club, Walmer and PE Golf Clubs, municipal parks. Nitrate contamination is not seen as being a serious problem as the water is used for irrigation purposes rather than drinking water.

- **Iron**

  Iron has only been found in significant levels, i.e., >1 mg/l, at 10 sites, of which four were >5,0 mg/l. The Walmer/Walmer Heights area seems to have a particular iron problem and this also applies to the Framesby, Lorraine and Kragga Kamma areas. Very high iron levels of >20 mg/l were found on occasions, particularly in Walmer. High iron concentrations are typical of TMGS groundwater, but levels > 5 mg/ℓ are probably more indicative of borehole condition, ie casing corrosion.

- **Organics**

The Total Organic Carbon test was used to evaluate the possible organic pollution of borehole waters. Only in seven out of the 47 boreholes monitored were the levels of organic carbon considered significant, i.e., >6,0 mg/l as C. Of these sites, three are situated in the Arlington area and three in Summerstrand, but others in the same areas did not have significant organic carbon levels.

- **Bacteria**

Faecal bacteria were recorded from a few samples, but most of these can be attributed to poor sampling and were not considered to be significant.

With regard to saline water intrusion, the main area of concern is the suburb of Summerstrand and, to a lesser extent, Humewood. The other coastal areas are either undeveloped or bordered by office or industrial areas. Inspection of the results from the four monitoring boreholes in Summerstrand shows no sign of any problem relating to sea water intrusion. Of all the boreholes investigated for this project, the Summerstrand boreholes were some of the most consistent in terms of water quality. On the basis of these results, sea water intrusion would not be seen as a problem, although the drought ended shortly before the commencement of this project, and the boreholes have not been used as much as they would in drought conditions.

However, recent information has come to light on boreholes in Summerstrand, very close to the sea, which the owners report change from fresh water to saline water very quickly during pumping. When the borehole is next pumped, fresh water is again obtained initially. These boreholes are within 200 m of the beach, whereas the four monitoring boreholes are further inland, with more of a buffer zone between the fresh/salt water interface.

Under drought conditions, with all boreholes being used on a regular basis, there is a risk that this transient, short-lived intrusion of saline water could be drawn further into the aquifer at Summerstrand. This is especially true under the likely scenario of borehole use, with pumps being switched on and off on a daily or otherwise frequent basis. Turbulence in fractures is a prime cause of expansion of the brackish water diffusion zone between fresh and sea water. With the northwest-southeast structural trend of the

TMGS, there is potential for direct connection between the aquifer and the sea. Ideally, boreholes should be pumped continuously at a relatively low rate to minimize turbulence.

On the basis of the yield and water quality characteristics described above, it can be concluded that the TMGS aquifer in the PEM area does not have potential for municipal water supply, unless more productive aquifers exist at depths greater than those so far exploited.

LEGAL ASPECTS

Broadly speaking, international water law can be classified into two main systems, which are often referred to as the common law and civil law systems. The common law system is the body of law built up by the courts through successive judgements, whereas civil law is codified law developed by Parliament or its equivalent in the country concerned. Both systems have their origin in Roman Water Law, the common law system developing into the riparian system primarily found in England and in countries across the world with historical ties to England. The civil law system is found in European countries where the Napoleonic Code of 1804 applied, and in other countries in Africa and the East with historical ties to the European states of France, Germany, Belgium and others.

In the United States of America, most of the eastern states have accepted the riparian system, while in the more arid western states, the appropriation system developed, which at the same time protects the rights of people who had prior rights to water. A common factor in the national systems of most countries is a tendency towards greater State control. Even in regions where water availability is not the primary issue, State intervention in order to safeguard the quality of water resources appears to be the order of the day.

South Africa's water law is contained primarily in the Water Act of 1956 but is also scattered in 33 other Acts. Most of the legislation is based on the legal system of the countries from which the European settlers came from. South Africa is one of the few countries in the world that has no legal way to restrict the use of groundwater, save through emergency regulation by the minister of Water Affairs. The Water Act of 1956 vests in the owner of land the exclusive right to use groundwater occurring on his land, with only some prohibitions on transfer of such water across boundaries of the land. The declaration of Subterranean Government Water Control Areas (SGWCA's) is the only way within the present Act (Section 26) to regulate development and use of groundwater. As of 1993, only 13 SGWCA's had been declared, covering a total area of about 5000 km^2, including the Uitenhage Artesian Basin.

On 17 January 1986 a proposed Water Amendment Bill was published in the *Government Gazette*, the main purpose of the bill being to," vest in the minister the powers to control and exploit water in subterranean sources in certain areas in the public interest." The bill does not alter the existing state of groundwater law and only confers wider powers concerning public management and use of subterranean water found in a

SGWCA. The best policy, however drastic, would be to define all groundwater as public water and to deal with such water as is presently proposed for water found inside a SGWCA.

South Africa's water legislation is unsuited to an essentially dry country and is being reviewed. It is based on Roman law which was developed in a totally different climate where water shortages were not of major concern. The shortfalls in current SA water law with regard to groundwater are recognised by the Department of Water Affairs and Foresty (DWA&F) and a draft white paper is being drawn-up in consultation with experts from the private sector, and there seems little doubt but that the status of groundwater will change from private to public water in the near future. In this respect, the DWA&F has published a booklet "You and Your Water Rights - South African Water Law Review - a call for public response". Contributions, comments, recommendations and submissions concerning the review of any aspect of the present water law were invited from individuals and interested parties, to be submitted by 19 May 1995.

From the above it can be assumed that far reaching changes can be expected in South African water law in the near future.

The current legal framework for local government in South Africa comprises National Statutes, provincial ordinances and municipal by-laws. Municipal by-laws are generally in accordance with the provisions of the relevant provincial ordinance. The PEM Water Supply by-laws were promulgated in The Province of the Cape of Good Hope Gazette No. 4672, November 1990, and contain clauses on water installations that can be related to borehole use. In terms of the existing Water Act and by-laws, PEM cannot regulate the volumes of groundwater pumped from the aquifer.

Other municipalities with known private groundwater use were contacted to obtain further insight into the *status quo* in respect of legislation. Most have no provision for control or even notification of groundwater use, eg. Somerset West, Hermanus and Graaff Reinet. Beaufort West has no general by-law concerning groundwater/boreholes but further drilling is prohibited in one particular suburb because of the large number of existing boreholes. The most detailed examples of a by-law that the researchers came across is that of Johannesburg.

Aspects that should be addressed in any by-law promulgated by PEM include:

- Compulsory employment of drilling contractors affiliated to the Borehole Water Association to assist the borehole owner to achieve a satisfactory standard of construction;
- Compulsory submission of copies of borehole completion certificates to the municipality by the owners;
- Right of access for inspection of borehole installations, groundwater sampling, installation of flow

meters and measurement of water levels;

- Compulsory submission of one water sample per year for chemical and bacterial analysis;
- The imposition of restrictions on groundwater use should declining water levels become evident, or changing water chemistry indicate pollution or saline intrusion, or should well interference be proven and a dispute between borehole owners arise;
- Possible ban on borehole use within an exclusion zone adjacent to the sea;
- Provision for restriction of use of groundwater unfit for domestic consumption.

The aim of PEM should not be just to regulate groundwater use and possibly alienate borehole owners, but also to generate an interest and awareness in the public of the need to protect the resource. However, in the light of the fairly limited use of groundwater as a percentage of municipal consumption, the low yields and moderate to poor water quality, the need for a by-law containing all of the above provisions may need to be reconsidered. It may also be prudent to wait for indications from the DWA&F as to the status of groundwater in the new water laws soon to be formulated.

CONCLUSIONS AND RECOMMENDATIONS

The main conclusions to be drawn from this study are:

- There are an estimated 300 boreholes in the PEM area, of which 239 have been located.
- Annual groundwater abstraction is estimated at 370 000 m^3;
- There are very few municipalities who have promulgated by-laws to control private groundwater use. Aspects that should be included in a by-law for PEM are:
  - employment of an affiliated drilling contractor;
  - submission of borehole completion certificates;
  - right of access for inspection and monitoring;
  - regular submission of water samples for quality analysis;
  - restrictions on groundwater use in areas with declining water levels or quality, or where mutual interference occurs;
  - restriction on groundwater use in an exclusion zone adjacent to the sea;
  - public awareness on groundwater issues.
- Over most of the study area the groundwater is a sodium chloride type. The only exception is Summerstrand where the groundwater has a greater Ca/Mg HCO_3 component;
- Groundwater quality in the PEM area is generally atypical of TMGS aquifers elsewhere in the Eastern and Western Cape;
- There is extreme spatial variation in groundwater quality, often over very short distances in the same suburb;

- There is sporadic and short-lived intrusion of saline water in those boreholes closest to the sea in the

Summerstrand area. This is a local and non-permanent phenomenon at the moment but there is potential for a deeper incursion of saline water into the aquifer under higher pumping stress, should drought conditions return;

- There is evidence of groundwater contamination in many areas on the basis of conductivity, chloride and nitrate levels, especially in the context of groundwater quality in TMGS aquifers elsewhere. The contamination is attributed to urbanisation and, specifically old waste dumps, fertilizer application, irrigation with treated effluent, leaking sewers and stormwater runoff;
- Groundwater use has had a negligible effect on municipal consumption in respect of homeowners;
- In terms of yield and water quality, the TMGS aquifer in the PEM area is not a potential source of municipal supply, unless untapped aquifers exist at greater depths than so far exploited.

The following recommendations are made for continuation of the research project:

- The results of drilling, water sampling and testing at Arlington waste site should be incorporated into the research findings;
- A reduced monitoring borehole network should be maintained in representative areas of the aquifer. These include "upstream" (Kabege Park) central (Arlington), northern (Newton Park) and coastal (Summerstrand) areas. This would equate to about six boreholes, including Arlington waste site, which will be monitored as part of a separate project;
- A more detailed study of the boreholes within the coastal rim of Summerstrand/Humewood, where saline water has been reported, should be made to quantify the threat or occurrence of sea water intrusion;
- There is a vast amount of chemical data in the database which has only been qualitatively assessed in this study. More rigorous statistical and graphical analysis should be carried out to provide further insight into the atypical hydrogeochemistry of the TMGS aquifer in Port Elizabeth.

RESEARCH INTO GROUNDWATER ABSTRACTION

IN THE PORT ELIZABETH MUNICIPAL AREA

1 INTRODUCTION AND RESEARCH OBJECTIVES

The Port Elizabeth area experienced a downward trend in rainfall from 1983 onward culminating in water restrictions being introduced from 1989 to 1992. In response to this, a proliferation of private boreholes were drilled into the sandstone aquifer underlying the municipal area, with much attendant publicity in the local press. Headlines such as "PE, boreholes can go salty, expert warns," and, "Boreholes could drain groundwater," illustrate the concerns over extensive and uncontrolled use of groundwater in the municipal area.

In early 1992, Steffen Robertson and Kirsten (SRK) held discussions with Port Elizabeth Municipality (PEM) with a view to initiating a project to investigate the extent and effects of private groundwater abstraction in the municipal area. SRK and PEM then agreed to submit a joint proposal to the Water Research Commission for funding, which was subsequently approved and the project commenced in January 1993. The original two year project duration was extended by six months in 1995 to facilitate gathering of further monitoring data.

Research objectives are divided into principal and secondary categories as follows :

- **Principal objectives**

  - Determine the number and distribution of boreholes in the PEM area;

  - Assess the volumes of groundwater abstracted and overall groundwater quality;

  - Assess the potential for sea water intrusion;

  - Investigate legal options for PEM to control development and use of groundwater in the municipal area.

- **Secondary objectives**

  - Determine spatial and seasonal variations in groundwater use;

  - Assess groundwater contamination from irrigation with final effluent and fertilizer application;

  - Assess impact of groundwater abstraction on municipal consumption and the potential for pollution of municipal supply by contaminated groundwater.

1.1 Historical groundwater development

More than a century ago, the greatest problem the settlement of Port Elizabeth had to face was the question of regular and adequate supply of fresh water for the number of inhabitants resident in the town. When the British Settlers landed in 1820 Port Elizabeth comprised Fort Frederick and very little else. From 1820 until 1880 no house in Port Elizabeth had water on tap unless the owner could afford rain water tanks or underground storage tanks.

Water was collected from the roofs of houses and stored in tanks on the land owners premises or obtained from the many creeks and streams located in the town area. A wide vlei on the site of the present Trinder Square (opposite the P E Club in Bird Street) was used chiefly by cattle, spans of oxen hauling-in produce from neighbouring farms, and by the Fingoes.

The first mention in the records of the municipality dealing with water supply for the town was the receipt of a letter from a Mr Coleman, dated 5 July 1848, submitting certain views on the subject. On 12 July 1848, the Commissioners decided to meet Mr Coleman. At the same meeting it was decided to advertise for tenders for sinking a well, 5 feet in diameter, and to hold not less than 6 feet of water. Only one tender was received, from a Mr Joseph Morton, and it was decided to sink the well near to Mr Diesel's property.

On 28 February 1849 it was decided to sink a well in the kloof (now Whites Road), between the houses of Mr Bird and Mr Adcock. In the second report of the Commissioners for the year 1849, submitted to a public meeting in the Commercial Hall on Monday, 15 April 1850, the following paragraph appears:-

"The Public Wells have been constantly attended to ... . a large one has been sunk at the bottom of Donkin Street and although at a depth of 42 feet (12,8m), no permanent spring has been found, yet it answers for a tank and a very large supply of water has been obtained there. A great portion of this well has been sunk through solid rock, but as the expenditure was becoming greater, it was thought advisable to leave off at a depth of 42 feet, having 10 feet diameter at the bottom and it is walled up from the rock to the surface. The well near Mr Diesel's property was deepened by 9 feet more, making the present depth 26 feet. A pump has been put into this well which has been found a great convenience and it is most desirable that one should be provided at each public well in the town for otherwise it is impossible to prevent the dipping in of dirty buckets and other nuisances, as well as the waste of much water."

In order that the supply of water to the town should be augmented, it was resolved at the meeting of the Commissioners held on 29 July 1852, that Messrs Doiner, Pattinson, Slater and Blaine "repair to the Duin to ascertain the level of the springs there."

The following letter was submitted at a meeting of the Board of Commissioners dated 2 January 1856:-

"I am instructed by Mr W N Coleman to inform the Municipal Commissioners through you that for some time past he has been and is engaged in opening the spring on his property in the valley and that the result so far has happily developed a very copious supply of fine water which he purports to make available to the inhabitants of Port Elizabeth.

I am therefore instructed to apply to the Commissioners for their sanction to an act of Incorporation to enable Mr Coleman and others to be associated for the purpose to perform certain essential acts in a corporate capacity. Amongst these would be liberty to lay down pipes through the streets belonging to the Municipality for which I am very respectfully to ask the license of the Commissioners.

Mr Coleman confidently predicts that these springs will afford sufficient water to supply the present population of Port Elizabeth, but should they not prove adequate, Mr Coleman and his friends will nevertheless make them available to their full extent and, as he does not ask the exclusive privilege, he ventures to claim the credit of offering the best water from the most practicable source".

The Board decided to give Mr Coleman permission to lay down pipes according to the terms proposed in his letter.

During the period 1857 to 1862 the population of Port Elizabeth rapidly increased and areas on the Hill, North End, South End and the lower regions of the town were developed, and Port Elizabeth was rapidly established as an important commercial town in the Eastern Province of the Cape Colony.

As a result of this progress, the need for water intensified and investigations to find suitable and reliable water sources in Port Elizabeth and the surrounding rural areas continued. The conditions for possible water supply schemes were that any scheme which required pumping was to be disregarded, at any rate until it was proved that gravitation schemes were impractical, either from an engineering or financial point of view; that the water was to be uncontaminated by any exposure in furrows or percolation through unwholesome soil. The water was also to be free of injurious matter, whether in suspension or in solution. Another important requirement was that the population of the town and the quantity of water required for shipping and other purposes be taken into consideration when establishing the source of water supply.

A number of sources in town and in the rural area recommended as being likely sources of water supply were dismissed by the Commissioners as unsuitable because the water was either unfit for consumption, brakish, pumping would be required or that during dry seasons the sources of supply would be completely inadequate for the town.

However, on 10 June 1857, it was decided to call for tenders for sinking wells in the following localities:

- Opposite the Commissariat Buildings;
- Opposite Mr Proudfoot's in Queen street;
- On the Hill near Bird Street, also for deepening the well in Constitution Hill;
- Opposite Mr Geard's;
- Opposite Mr Sparrow's.

In February 1860 wells were ordered to be sunk in Jetty Street and the corner of Dament Street.

(It was only a few years ago that this well was discovered again when repairs were being made to Jetty Street and one of the workmen, getting deeper than usual with an excavation, was surprised to see his spade disappear from sight. The well was then backfilled.) It was decided to sink more wells in town, and Grace Street, Britannia Street and Alice Street were the sites chosen to establish additional wells.

On 26 September 1865, owing to the scarcity of water, all the municipal wells were closed from 9 am to 4 pm daily. At this juncture it is worthy of mention that the majority of wells in town were five feet in diameter and held no less than 6 feet of water. They were all lined with stone or masonry and for protection against accidents and contamination, strong wooden frames with trap-doors covered the openings of the wells.

After the implementation of the Frames Dam in 1865 and the Van Stadens Water Scheme in 1879, the reliance on underground water decreased as surface water became the major source of supply for domestic use.

The record then continues with Annexure B, of the Mayor's report of 1928, on the underground water supply of Port Elizabeth by E D Mountain. He states that boreholes in the Table Mountain Group Sandstone (TMGS) are a fairly safe proposition but are not likely to give very large supplies, and recommended drilling a number of "coordinated" boreholes aligned in a NE-SW direction on the "plateau" (presumably this refers to the wave cut platform). He postulates that greater supplies of water are possible in the north-eastern area around Zwartkops with potential artesian conditions. The borehole information in Table 1 below is taken from his report.

TABLE 1 : HISTORICAL BOREHOLE INFORMATION

Owner	Locality	Depth (ft)	Yield (gal/day)	Comments
Patterson	Walmer	200	10 000	Brackish
Mattingly	Walmer	200	14 000	-
Holmes	Walmer	200	_	-
Roper	Walmer	200	5 000	Brackish
Parkin	Greenbushes	150	17 000	-
Richardson's	Port Elizabeth	292	52 000 (1919)	25 000 (1928)
Ohlsson's	Port Elizabeth	390	Dry	Cretaceous Blue clay
Grewer	Uitenhage	197	90 000	TMGS at 170 ft
Van Vuuren	Uitenhage	400	216 000	TMGS at 150 ft

The occurrence of brackish water in the Walmer area as far back as the 1920's is of significance when evaluating the hydrochemistry of water samples taken during the current project, with some apparently anomalous results in the context of TMGS water quality. This is discussed further in Section 5.7.

The historical record then moves to the 1950's and extracts from the City Engineer's reports for 1954, '55 and '56 concerning groundwater exploration are given below:

1954

'Drilling of a borehole into the Artesian Basin on "Wells Estate", near Coegakop commenced under contract in July. The borehole was first drilled to a depth of 555 feet and then lined with 8" casing. Drilling was then resumed to a depth of 759 feet and a small flow of water under pressure was struck at approximately 700 feet. Drilling was then suspended whilst 6" casing was inserted, after which cement grout was pumped into the borehole to anchor the casing. After the grout had set, drilling continued to a total depth of 1,220 feet which was reached on 24th November.

A meter was installed on the outlet from the borehole and, in October, a flow of 196 800 gallons per day was recorded at a depth of 800 feet. On 4th November, at a depth of 1,138 feet the flow was 440,640 gallons per day and on 24th November, at the maximum depth of 1,220 feet, it was then 421 900 gallons per day. Readings at the meter were taken from 30th November, and up to the end of the year the flow averaged 409000 gallons per day.

These results were considered to be very encouraging and in December, the City Council resolved to extend the contract and the drilling of a second borehole is now in progress on "Wells Estate" at a point approximately one mile east of the first borehole. In addition, an amount of £20,000 was placed on the Loan Schedule, which is due to be placed before the Ratepayers early in the new year, for the drilling of further boreholes.'

1955

'Borehole No. 1 on Wells Estate, which was completed in October, 1954, to a depth of 1,220 feet, was allowed to run uninterruptedly until February and daily readings were taken of the flow which stabilised at approximately 400,000 gallons per day.

Borehole Nos. 2 and 3, which are situated on the East side of the Grahamstown Road twelve miles from the City, were drilled during the year and work started in August on Borehole No 4, which is 1,000 feet North of Borehole No. 1. Borehole No. 2 was abandoned at a depth of 626 feet due to the unsatisfactory nature of the formation, while Borehole No. 3 was drilled to a depth of 1,209 feet when the flow was 59,000 gallons per day. The artesian flow was struck in Borehole No. 4 at a depth of 825 feet and the flow from this borehole, which had a depth of 920 feet when the contractor closed down for the holidays on 14th December, was 151,000 gallons per day.'

1956

'The fourth and final borehole on Wells Estate was completed in June to a depth of 1,226 feet, when the yield was 203,000 gallons per day. Tests were carried out during the period August - November to determine the individual and combined flows from Boreholes Nos. 1 and 4, which are approximately 1,000 feet apart. These give a yield from Borehole No. 4 of 195,000 gallons per day and from Borehole No. 1 of 447,000 gallons per day. The previous yield from Borehole No. 1 from tests made soon after it was completed in 1954 was 391,000 gallon per day. The combined yield with both boreholes flowing together was 617,000 gallons per day.

The analysis of the water from the boreholes showed an iron content of 4 parts per million, which would prove objectionable in the water supply. A pilot plant was, therefore, erected near Borehole No. 1 to determine what treatment would be necessary to reduce the iron content to reasonable limits, and encouraging results were obtained by the Municipal Chemist.'

Marais (1964) reports that the completion of these flowing boreholes and others on Coegakop led to a halving of the water available from the Uitenhage Springs. Bush (1986) reports that piezometric levels declined by approximately 32 m over the 71 years since boreholes were first drilled and that abstraction approximately doubled since 1963.

The Uitenhage Subterranean Water Control Area (USWCA) was proclaimed in August 1957 in order to exercise control over the drilling of boreholes and abstraction of subterranean water contained in the said area. The area under control was increased in 1964 and is partly shown on Figure 4. Despite the declaration of the Subterranean Water Control Area, the aquifer is still being overpumped (Braune *pers comm*).

In April 1989, Steffen, Robertson and Kirsten (SRK), held discussions with personnel of the City Engineer's Department on the possibility of developing emergency groundwater supplies from the TMGS and a detailed proposal was submitted. However, improved rainfall and dam levels led to the shelving of these plans.

2 INVESTIGATION APPROACH

The initial priority of the investigation was to determine the number and location of boreholes by means of a census. A representative monitoring network of boreholes was then established from which data on abstraction, water levels and water quality were obtained.

2.1 Borehole census

The majority of boreholes in Port Elizabeth are privately owned so it was realised at an early stage that public co-operation was vital to the success of the project. To this end, a press release was issued jointly by the Water Research Commission (WRC), PEM and SRK to create public awareness of the need for research prior to requesting information on boreholes. Unfortunately, for reasons outside the research teams' control, the press release did not enjoy the exposure intended.

An explanatory letter, combined with a census form was then prepared and mailed with monthly accounts by PEM to all ratepayers in suburbs where boreholes were known to exist. A total of 30 000 such forms were mailed during February and March 1993 and by the end of May, 74 completed forms had been returned. The poor response led to a second press article published in the Eastern Province Herald on 19 April, but the response to the article was negligible. After discussions between the WRC and the researchers, a final press release was published on 30 June 1993 in the Port Elizabeth Express, a newspaper distributed free of charge in all residential areas of the city. The release contained an outline of the research, the importance of the study, reassurances to the public regarding the use and ownership of private boreholes and a copy of the census form (Appendix A1). The response to the article was again poor, with only three further census forms returned. The lack of co-operation from the public is ascribed mainly to a perceived threat of intervention and ultimate control of the use of groundwater by PEM. Secondary reasons are a lack of interest and understanding of groundwater related issues.

Following the census form mailing, the two main contractors involved in borehole installations in the city were contacted and with their co-operation, installation lists were obtained. In conjunction with a chemical database already maintained by the Scientific Services Division of PEM, these lists were used to identify further borehole locations in the city. Installation inspectors from the PEM Water Division also recorded address details of properties found to have boreholes during routine inspection work. In this way a total of 259 boreholes were identified, 238 within the study area. From discussions between the researchers and borehole installation contractors it was estimated that this figure constitutes about 85% of boreholes in the study area. Even if this figure is out by 50%, the impact on the study is negligible. The co-ordinates, and ground levels were determined for each borehole from the 1:10 000 orthophoto maps of Port Elizabeth. Borehole locations are shown on Figure 1.

2.2 Borehole monitoring network

Originally, 50 boreholes were selected from the results of the census to be monitored over the study period, including for completeness, boreholes that fall outside the PEM boundary.

Sites were selected to enable collection of representative data from as wide an area as possible. A balance between private residential and higher consumption corporate and municipal boreholes, such as golf clubs, schools, parks and large office complexes was planned. The researchers contacted the relevant home owners and institutions and permission was granted to equip 37 boreholes with water meters as principal monitoring points. These sites are listed in Appendix A2 and shown on Figure 2.

The collection of monitoring data was mainly conducted by PEM staff. Monitoring activities were accommodated within normal work schedules of the relevant municipal department and, as a result, sampling could not take place on a fixed schedule as intended. Successful sampling was also often dependent on the presence of the landowner (or pump operator) at the time of the visit. For this reason, several gaps exist in the sampling database and the sampling period was extended for six months to ensure adequate data for interpretation purposes.

The monitoring of groundwater levels was also problematic as PEM staff omitted readings in boreholes out of commission or unused. In an effort to remedy the lack of groundwater level information, a two week programme of measurements was initiated in July 1995 and 45 measurements were made over the entire study area, from which a water level contour map of the study area was generated.

The hydrochemical monitoring points were planned to cover as large an area as possible with at least four boreholes in each suburb. Unfortunately, borehole distribution is heavily skewed by socio-economic factors, resulting in a clustered distribution across the city. Forty seven boreholes were finally selected for sampling on a regular basis, with the ratio between private, low usage, and "corporate" boreholes designed to be about 50/50 (Figure 2). In addition, borehole drilling and pump installation companies have submitted groundwater samples to the Scientific Services Laboratories for many years and chemical analyses from these samples have been stored in the database maintained by them.

2.3 Monitoring programme

Monitoring data to be collected included water consumption (abstraction), water levels and samples for chemical and bacteriological analysis.

Water meters were installed from April 1993 by the Water Installation Workshop of the Port Elizabeth City Engineer's Department. Three sizes of water meter were fitted depending on pump capacity and delivery volume. Due to abnormally high workloads, the PEM staff could only complete the installation programme in August 1993.

Once the water meter installation programme was completed, meters were read on a monthly basis along with water levels where possible. In total, some 700 meter readings were taken from 37 boreholes. During the monitoring period, seven boreholes became non-functional for various reasons and this incidence of borehole failure was taken into account when formulating an estimate of annual abstraction volumes from the aquifer.

Seven hundred and forty four borehole water samples were analysed from the 47 boreholes monitored. To spread the workload on the Scientific Services Division Laboratories, analyses were rotated over a cycle of three months. The aim was to get as many "full" analyses as possible during the project period, with partial indicator analyses in between, and the following schedule was established :

Month 1 - Full physical and chemical analysis for the following determinands :
Physical parameters: pH, conductivity, colour, turbidity;
Macro determinands: Total Alkalinity, Total Hardness, Total Dissolved Solids;
Cations: calcium, magnesium, sodium, potassium;

Anions:	chloride, bicarbonate, sulphate, nitrate, fluoride;
Trace elements:	iron, manganese, copper, lead, zinc;
Organics:	total organic carbon.

Month 2 - Partial analysis covering pH, conductivity, Total Dissolved Solids, chloride, sulphate and nitrate.

Month 3 - Partial analysis and bacteriological analysis for:
Total coliforms;
Faecal coliforms;
E. coli I;
Total bacterial count.

2.4 Database

A data base was developed using DBASE IV which was designed to accommodate information from the census forms. PEM City Engineer's Department maintained a database on Quattro Pro into which monitoring data on borehole water levels and abstraction rates, as well as records of corresponding municipal consumption, were entered. The Scientific Services Division of PEM entered all the results of the hydrochemical analyses on Excel spreadsheets.

The research team was offered a specialised groundwater programme and database, HYDROCOM, which could serve to amalgamate the physical and hydrochemical databases and has the facility to plot relationships between parameters such as water levels, abstraction volumes, rainfall, hydrochemistry and time. Piper and Durov plots can be easily produced to evaluate hydrochemical trends. Because of the amount of data that would have to be re-entered and the incompatibility with other spreadsheets, the research team decided against this option. Instead, all the databases were transformed to the Quattro Pro format which allows easy maintenance, updating, access and manipulation of the data-set for a wide range of interested parties.

The database is maintained in two files:

File 1: This is a physical database which contains 238 entries and lists erf numbers, names and addresses of owners, co-ordinates and information as to borehole depth, yield, abstraction volumes and rates, and water levels. Twenty one other boreholes are recorded but fall outside the perimeter of the study area.

File 2: This is a hydrochemical database with the results of all the analyses for each borehole over the study period. This can be expanded to include the results of all analyses of borehole water ever conducted by the Scientific Services Division.

At the request of PEM, the two parts of the database are correlated by erf numbers.

PEM undertook to perform the plotting and contouring of hydrogeological data on the Genesis GIS system. Borehole positions are plotted according to the erf number, and not co-ordinates, which creates problems when more than one borehole is present on an erf, the erf size is very large or the borehole does not fall on a municipal erf. As a result not all monitoring points could be plotted by the programme. The distribution of data points is clustered but groups are dispersed and large areas have no boreholes. The software was unable to grid and contour the data set and the maps were contoured manually. The extreme variation in hydrochemical values over short distances precluded a standard contour interval being used and contour values were selected to illustrate regional trends.

The complete database in Quattro Pro can be saved in a variety of compatible formats and distributed on 3.5" diskette on request.

3 RAINFALL

The rugged mountainous topography resulting from erosion of the resistant TMGS has a strong orographic influence on the rainfall patterns in the Cape Province and particularly the SE Cape coast. Some of the highest annual precipitation in South Africa occurs on these mountain ranges, with up to 2 400 mm/pa on mountain peaks. This rainfall and extensive outcrop ensures a ready supply of recharge in all but the driest years. However, Port Elizabeth's rainfall tends to be atypical and highly erratic, and references to "drought" years are frequent. The definition of "drought" varies, but is generally accepted a period in which rainfall is half the annual average over any 12 months. More specifically, drought in the Eastern Cape has been defined as rainfall below -0.5 times the standard deviation for more than nine consecutive months over a catchment area (Jury and Levey, 1993). A plot of the standard deviation from the mean monthly rainfall averages (Figure 3) shows that references to monthly and annual averages are less meaningful than the "likelihood of occurrence". The table below shows that over the last 10 years, exceptionally low rainfall has reduced the mean annual average, calculated from the records dating back to 1926, from 672mm to 611mm.

TABLE 2: SUMMARY OF PORT ELIZABETH RAINFALL STATISTICS

	YEAR	RAINFALL mm/a
Average	1926 - 1982 1926 - 1992	672 611.2
Minimum	1969	406.3
Maximum	1968	1068.9
Standard Deviation	1926 - 1992	139.9

4 GEOLOGY

The geological succession in the Port Elizabeth area comprises the following:

Tertiary to Recent {	Aeolian sand Nanaga Formation
Uitenhage Group {	Sundays River Formation Kirkwood Formation Enon Formation
Table Mountain Group {	Nardouw Subgroup Peninsula Formation Sardinia Bay Formation

The Sardinia Bay Formation is a predominantly arenaceous sequence of rocks comprising thin to medium bedded quartzitic sandstone with interbedded shale. The formation outcrops along the coast from west of Skoenmakerskop to about 1.5 km west of the Willows and has a total

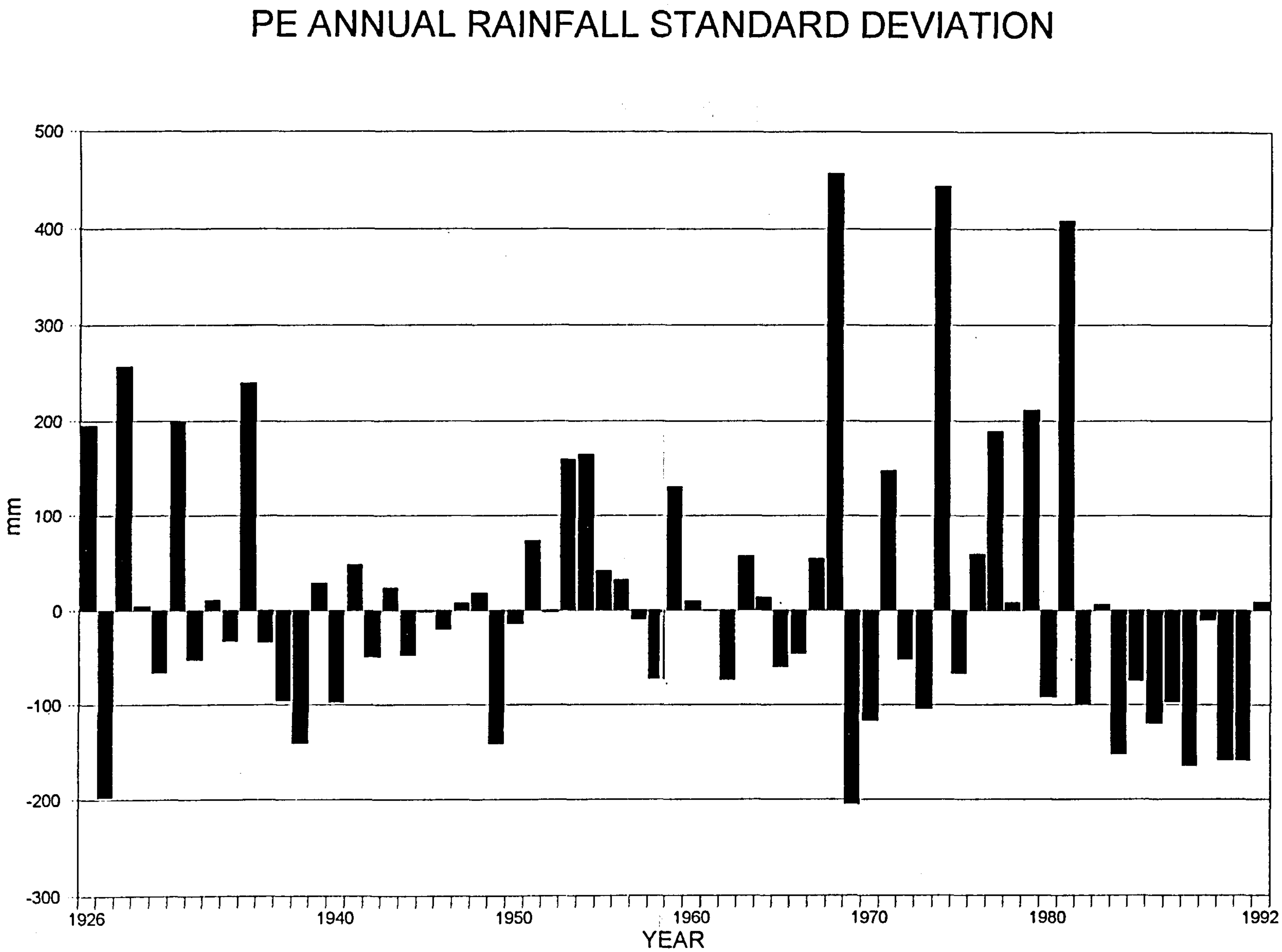

PE ANNUAL RAINFALL STANDARD DEVIATION
500
400
300
200
100
0
-100
-200
-300
mm
1926
1940
1950
1960
1970
1980
1992
YEAR

Fig. 3

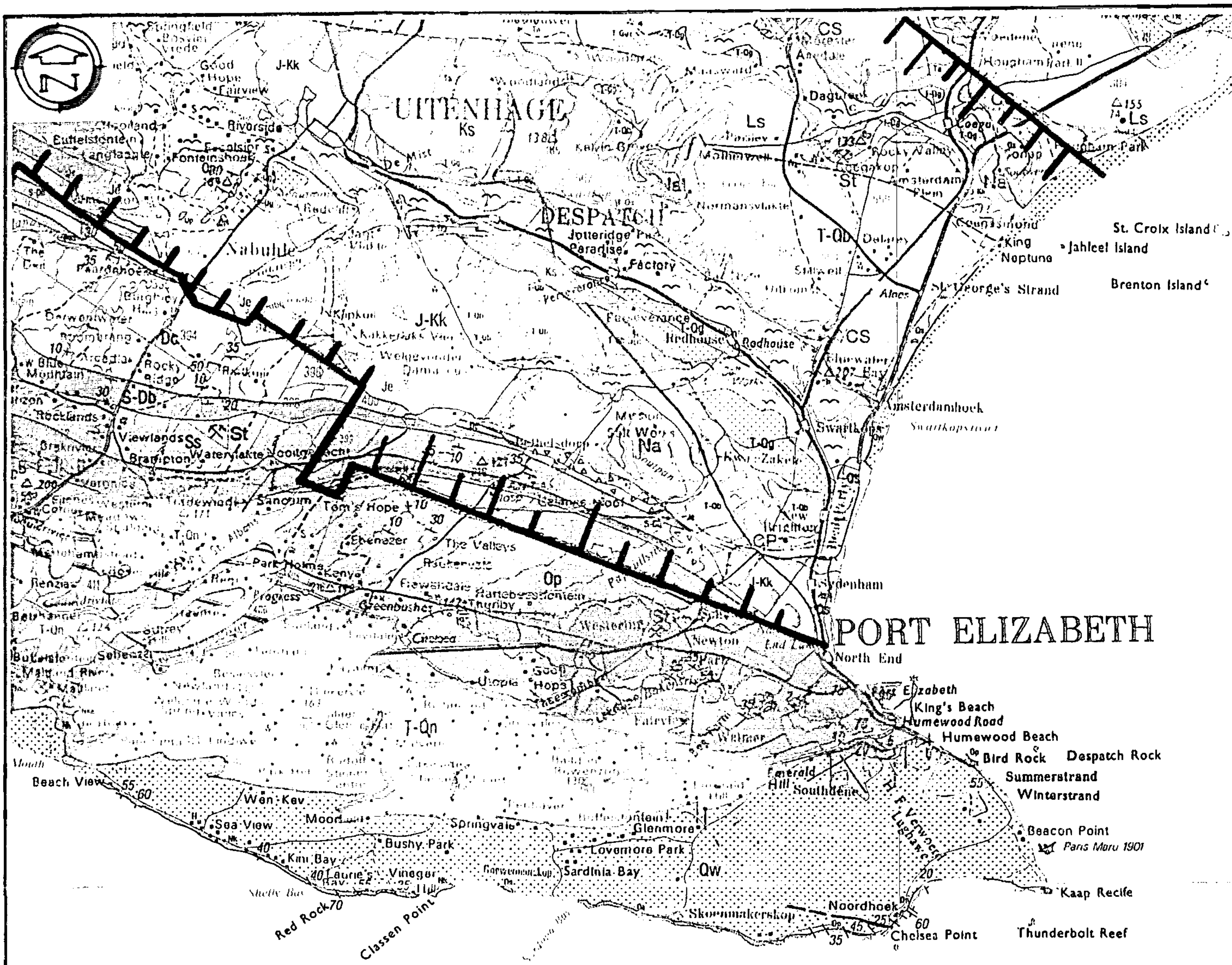
thickness of about 950 m in this area. The boundary with the overlying Peninsula Sandstone Formation is gradational, being taken where shale becomes subordinate in the sequence.

The Peninsula Sandstone Formation (PSF) is aerially, stratigraphically and topographically the most prominent member of the Table Mountain Group (TMG) and consists of medium to coarse grained, generally massive, quartzitic sandstones. The formation is exposed along the coast from the Willows to Cape Recife and in the central and northern areas of Port Elizabeth. In the Willows - Chelsea Point area the sandstones strike in a northwest-southeast direction, dipping at 25° to 45° to the north-east.

The Nardouw Subgroup comprises three sandstone formations which are limited to the northern part of the study area. Along the northern boundary of the study area the resistant sandstones form an escarpment where they dip under Cretaceous formations of the Algoa Basin, while to the south, the sandstones form an elevated wave-cut platform.

The Uitenhage Group rocks consist of mudstones, conglomerates and subordinate sandstones and outcrop to the north of the study area.

Port Elizabeth is situated at the eastern extremity of outcrop of the TMGS on a northwest-southeast trending anticlinal structure, which forms part of the southern limb of the Cape Fold Belt (Figure 4). Booth and Shone (1992) have identified two major fault zones in the TMGS, the Chelsea-Noordhoek Fault in the south and Moregrove Fault in the north. Between these faults they postulate a recumbent fold with numerous thrust planes in a graben structure to account for the excessive thickness of the PSF in the area. The inland extension and trend of the Chelsea-Noordhoek fault, as postulated by Booth and Shone, is based on field observations along the coastal outcrop. A photo-lineament trending west-northwest from the coast, which can be traced for 2 km inland, may be associated with this fault zone (SRK 1993). The Cedarberg Shale Formation, which is normally present between the PSF and Nardouw Subgroup, is absent, probably due to pinching out as a result of thrusting and folding (Shone *op cit*).



Recent	Aeolian Sands	Qw
	FORMATION	
Tertiary	Nanaga	T-Qn
Uitenhage Group	Sundays River	Ks
	Kirkwood	J-Kk
	Enon	Je
Table Mountain Group (TMGS)	Nardouw Subgroup: Baviaanskloof	S-Db
	Nardouw Subgroup: Skurweberg	Ss
	Nardouw Subgroup: Goudini	Sg
	Cedarberg	Oc
	Peninsula	Op
	Sardinia Bay	Os

- - — Chelsea / Noordhoek fault

Boundary of Uitenhage Artesian Basin

Fig. 4

GENERAL GEOLOGY

0 5 10km
SCALE

Taken From Geological Survey Sheet 3324 (P.E)

Much of the southern part of the wave-cut platform that forms the Cape Recife headland is covered by a mantle of Tertiary to Recent age deposits. The Nanaga Formation is a consolidated aeolian sand or dune rock, which is calcareous due to the presence of numerous shell fragments. The formation is relatively resistant to weathering and forms topographic highs, e.g. Lovemore and Walmer Heights. Recent unconsolidated aeolian sand forms longitudinal sand dunes with crests trending east-northeast, west-southwest. Calcrete layers are commonly developed within the sand.

5 HYDROGEOLOGY

5.1 Aquifer definition

The rocks and sediments described above can be classified into two broad aquifer types. The TMGS form secondary aquifers in which groundwater flows and is stored within fractures such as joints, bedding planes and faults. The Tertiary to Recent sands are primary aquifers in which groundwater flows and is stored in interstices within the constituent sand grains. Rocks of the Uitenhage Group are not classed as aquifers within the study area due to their generally low permeability and poor water quality.

- **Primary Aquifer**

The area covered by the Tertiary to Recent deposits is large, but little is known about their thickness or aquifer potential. At St Francis Bay, which is in an equivalent hydrogeological setting, sand thickness varies widely due to the sub-outcrop of more resistant TMGS. Softer formations have been denuded by wave action and the sand cover varies from zero to over 40 m in thickness. Shallow pit profiles at Arlington revealed a soil profile to 3.3m of medium grained aeolian sand with widespread calcrete development. No seepage was observed within these pits.

The coastal sands underlying Summerstrand and Humewood are more recent in age and contain a greater element of shelly beach sand. With a greater coarse grained sand fraction, less calcretisation and compaction, they are likely to have higher aquifer potential.

The Recent sands have high infiltration potential and internal drainage of rainfall takes precedence over surface runoff, thus reducing losses due to evaporation and enhancing recharge volumes. Most of the sand covered area is free of residential development, although the dunes have been stabilised by alien vegetation such as Rooikranz and Port Jackson, increasing losses due to evapotranspiration.

None of the boreholes recorded in the database pump water from the sands in the Walmer, Arlington and Kragga Kamma areas. Reasons for this might be that the sands are unsaturated or it is easier and cheaper to construct a borehole in the TMGS and rely on the upper sands to store groundwater and recharge the fractured rock.

- **Secondary Aquifer**

There are a number of features that contribute to the TMGS being a major aquifer within the context of the generally limited potential of the secondary 'hard rock' aquifers in South Africa. These indicators are:

- Large areal extent and great thickness;
- Extensive fracture development;
- High rainfall and therefore recharge potential;
- Good quality groundwater.

The TMGS outcrop over a large part of the Cape Province and attain great thicknesses, e.g. Peninsula Sandstone Formation 1 550 m, and Nardouw Subgroup 500 m. The TMGS form one of the major secondary aquifers occurring in South Africa and the local towns of Uitenhage, Humansdorp, Jeffrey's Bay and St Francis Bay all use groundwater from this aquifer for domestic purposes, as do other towns such as Ceres, Calitzdorp, Citrusdal and Albertinia. In the Port Elizabeth area these rocks have been intensely folded to form a series of NW-SE trending synclines and anticlines, and associated thrusting has resulted in an increased thickness of the PSF. Consequently, the rock mass is highly bedded and fractured resulting in the development of a network of secondary structural discontinuities. The secondary fractures form the conduits through which groundwater flows and is stored and give the otherwise impermeable rock its favourable aquifer characteristics.

Groundwater contained in the TMGS is usually among the best in quality in South Africa in terms of dissolved salts, as the sandstones mainly comprise silica and contain little in way of soluble salts. Problems can arise with the low pH and unbuffered water corroding steel and concrete, and deposition of iron compounds in pipes.

While groundwater is not a source of municipal water supply to Port Elizabeth at the moment, the TMGS within the surface water supply catchments of Port Elizabeth, which stretch beyond the Humansdorp area, are a strategic regional resource which should be incorporated into the City's water supply planning in the future. It has been proposed to the Municipality that boreholes drilled into TMGS aquifers, where traversed by existing surface water supply pipelines, could prove a cost effective way of augmenting the municipal water supply. Estimates of sustainable delivery of such a system range between 200 and 600 ℓ/sec. Groundwater protection within this area is therefore an important factor in land-use planning.

5.2 Present distribution of boreholes

There are two primary controls on the distribution of boreholes, the most important of which appears to be socio-economic status, while geological and hydrogeological factors are of secondary consideration. Although not all boreholes within the study area were located in the census, the borehole distribution and density recorded is considered to be representative of borehole occurrence in the area. Beyond the municipal reticulation network, in areas such as Sardinia Bay, Kragga Kamma Road and Theescombe, rainwater tanks and groundwater are the only supply options. Several boreholes are found in these areas, some of which have been included in the database. Table 3 gives a breakdown of the number of boreholes in the database by suburb.

Walmer and Summerstrand show the highest concentration of boreholes. Together these suburbs account for 65% of boreholes and the distribution drops off dramatically moving away from these areas.

It is apparent from driller's records that new boreholes are sunk primarily in response to drought conditions. Between 1983 and 1992 properties with larger gardens were suffering under both drought conditions and municipal water restrictions and there was a dramatic increase in the number of private boreholes in PE. With a depressed economic climate and escalating costs of drilling and pumping equipment, it was only the upper socio-economic groups who could afford the installation of a borehole.

TABLE 3 - BOREHOLE DISTRIBUTION BY SUBURB

SUBURB	TOTAL BOREHOLES	PERCENTAGE
Central	13	5
Fernglen	3	1
Humewood	8	4
Kabega	3	1
Lorraine	5	2
Mill Park	25	11
Newton Park	7	3
Summerstrand	60	25
Sunridge Park	3	1
Walmer	96	41
Sub Total	**223**	**94**
Others	15	6
TOTAL	**238**	**100**
Boreholes outside Municipal area	21	-

(Only suburbs with $\geq$ 3 boreholes are listed.)

Borehole water use is still considered secondary to municipal water use, which is reflected in the number of out of commission or unused boreholes. Expense on maintenance is considered unnecessary until the next drought threat materialises. In many cases, groundwater quality is so poor that people have a negative attitude to groundwater use and the ownership of boreholes is not considered desirable.

Almost all the boreholes in the study area have been drilled by two or three local contractors. However, none are dependent on local work as the demand is neither reliable nor steady. Enquiries with these contractors reveal they have not drilled a private borehole in the municipal area since 1993.

5.3 Borehole characteristics

- **Construction**

Borehole construction is usually simple, with casing through the upper sands and weathered rock, and the competent TMGS left uncased. Drilling conditions in steeply dipping TMGS can be very difficult and deep boreholes (>100m) can take weeks to complete. In many boreholes, the casing installed was insufficient resulting in collapse and loss of the borehole and pumping equipment within two years. In others, collapse has resulted from weathering of the wall rock during cycles of oxidation and saturation induced by pumping. The result is that an unacceptably high number of successful boreholes are redundant because of poor construction and collapse.

- **Depth**

Average drilling depths in all areas except Summerstrand tend to be between 60 and 120 m, implying fairly deep water strikes in the fractured rock aquifer. The depth of these water strikes indicates that the boreholes are not supplied from saturated upper sands. The majority of boreholes in the Walmer and western suburbs of the study area record a water level less than 15 m below ground level. In the Summerstrand and Humewood coastal belt, drilling between 30 and 60 m in depth results in average yields of between 1 and 5 m^3/h. Figure 5 shows the yield versus depth relationship for 91 boreholes. The minimum drilling depth of a borehole on record along the coastal belt is 20 m and the maximum, is 90 m. Borehole yield characteristics indicate a typical fractured rock distribution despite the mantle of permeable sands.

- **Yields**

In the context of water requirements for garden irrigation and other domestic uses, the success rate of boreholes drilled is high. The high density of functional boreholes in Walmer and Summerstrand indicates that, even without the benefit of geophysical borehole siting techniques, success is guaranteed. Table 4 shows individual borehole yields rarely exceed 12 m^3/h and yields of between 1 and 5 m^3/h are normal. Continuous sustainable yields have been proven up to 8 m^3/h at the PE Golf Club.

TABLE 4 : FREQUENCY OF BOREHOLE YIELDS

Yield range (m^3/h)	<1	1 to 5	5 to 10	> 10
Frequency	1	60	27	3

More than half the boreholes on the depth vs yield plot (Figure 5) are deeper than 80m. The chances of a yield above 5 m^3/h are greatest between 80 and 120 m, although the majority of boreholes only yield between 1 and 4 m^3/h. "Dry" boreholes have been reported. To the north-west outside the study area, the incidence of unsuccessful boreholes increases, as do the chances of yields in excess of 10m^3/h.

The data indicate that the TMGS aquifer in the PEM area is relatively low yielding when compared to TMGS aquifers elsewhere. Boreholes in the adjacent USWCA, which tap the TMGS at depth below the Uitenhage Formation, deliver exceptional yields in the order of 20 to 100m^3/h. Yields at St Francis Bay, Jeffreys Bay and Humansdorp are in the range 7 to 50 m^3/h from depths of 60 to 90 m, while at Ceres, yields range from 20 to 45 m^3/h, from depths of 120 to 150 m. In the latter two examples, the boreholes are tapping the Nardouw Subgroup sandstones, which appear to be more productive than the PSF.

- **Pumping equipment**

Almost all boreholes are equipped with submersible pumps and electric motors. These installations are favoured in urban areas because they can be concealed, make no noise, are entirely automated and are the cheapest to buy, install and run. They require little maintenance but are subject to excessive wear by sand or particulate matter in the water. The relatively high incidence of pump failure is unusual and attests to the indifferent attitude of borehole owners to their groundwater resources.

5.4 Groundwater abstraction and use

Much of the groundwater demand is socio-economically controlled, with the water being used for maintaining gardens and other activities where potability is not a criteria. A minor quantity is used for human consumption and only in those areas where municipal water is not available. As a result, abstraction volumes peak in dry weather and particularly when restrictions are imposed by means of tariff penalties for "excessive" municipal consumption.

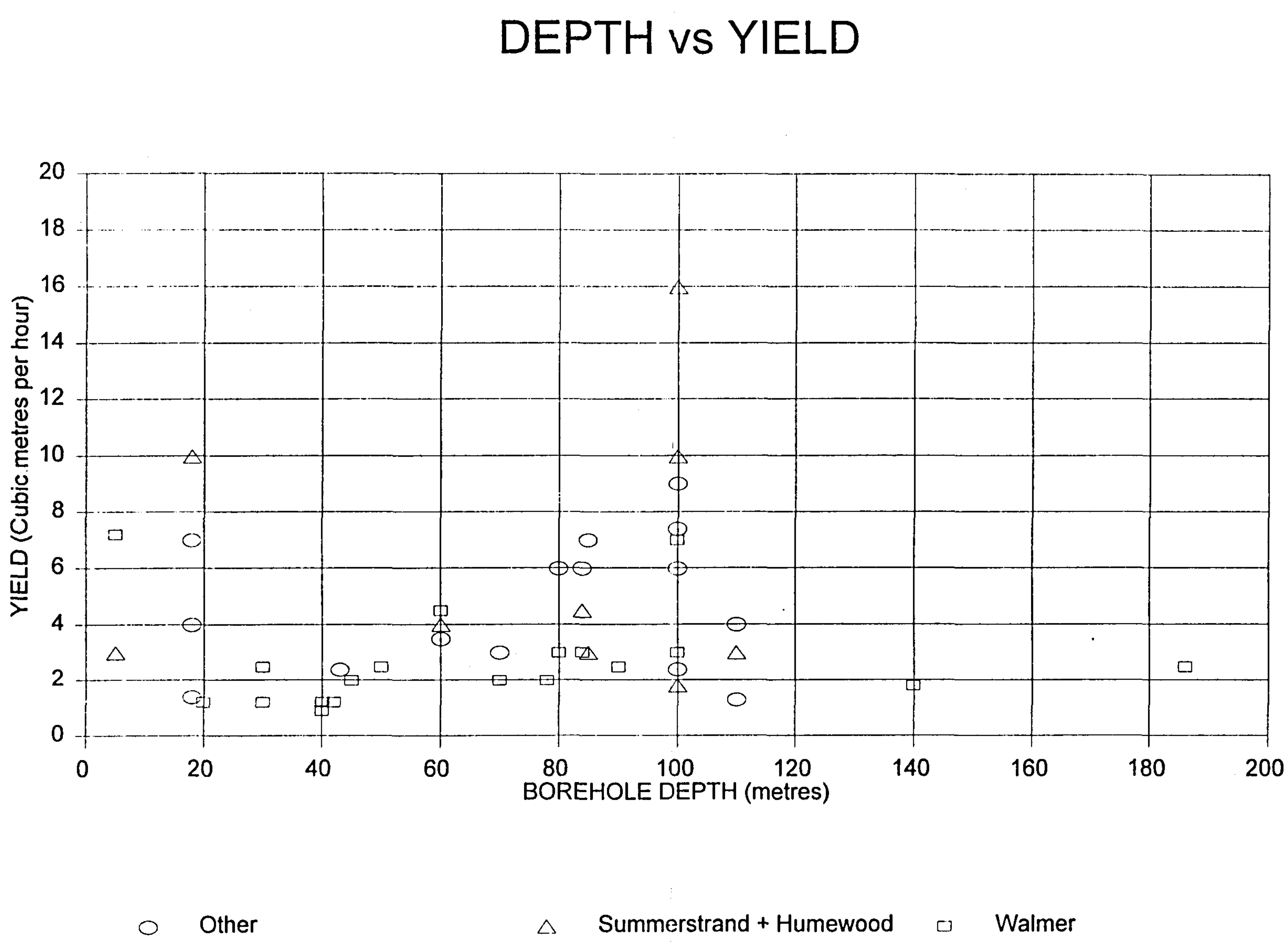

DEPTH vs YIELD
YIELD (Cubic metres per hour)
0
2
4
6
8
10
12
14
16
18
20
0
20
40
60
80
100
120
140
160
180
200
BOREHOLE DEPTH (metres)
Other
Summerstrand + Humewood
Walmer

Fig. 5

Water restrictions were first introduced on 22 February 1989. Due to good rains in the catchment areas of the supply dams in November 1989 restrictions were lifted on 22 November 1989. However, the drought continued and restrictions were again introduced on 29 April 1991. High rainfall in October and November resulted in all restrictions being lifted on 2 December 1992. It should be noted that, for this project, the rainfall figures used are those of the gauging station at Port Elizabeth airport and are not the rainfall figures of the catchment areas of the supply dams. It was the available storage capacity in the dams that determined the level of water restrictions which were implemented in stages. An analysis of the situation conducted by consultants after the drought established that it was a one in a two hundred year drought return and was one of the most severe in history.

In the majority of average and above average rainfall months, abstraction is minimal as groundwater quality is considered generally inferior and municipal water relatively cheap. Records show that, for the majority of borehole owners, groundwater is used and considered as an emergency supply source only.

The proliferation of boreholes tapping the aquifer between 1989 and 1992 does not necessarily represent higher sustained abstraction rates but rather the potential for high demand pulses to be imposed on the aquifer. The ability of the TMGS aquifer to cater for this type of demand pattern has been proven, within reason, in the coastal resort towns along the south-west Cape coast, which rely on groundwater for their water supply. Many of these towns specifically manage their groundwater resources to accommodate the skewed water demand imposed by the influx of tourists over the summer season.

- **Private boreholes**

Of the 238 boreholes in the database, 216 are located on private property. Twenty five boreholes were initially metered, but only 20 can be used to assess the representative volume of groundwater abstracted. Table 5 gives a breakdown of abstraction over the study period.

From the 20 boreholes an annual volume of 20486 m^3/annum is abstracted. With the 216 private boreholes recorded estimated to represent 85% of private boreholes in the study area, the total volume abstracted annually from private boreholes is calculated by simple proportion as:

$$\frac{216}{0{,}85 \times 20} \times 20\ 486\ m^3 = 260\ 292\ m^3/\text{annum}$$

TABLE 5 : METERED ABSTRACTION FROM PRIVATE BOREHOLES

Location	Total Abstraction (m^3)	Period (days)	Total Annual Abstraction (m^3)	Erf Size m^3
98 Verdun Road	5 547	660	3068	16184
78 Kabega Road	26	707	13	1907
5 Norland Close	155	790	72	1849
308 Kragga Kamma Road	data unreliable			3684
12 West Street	2 358	790	1089	1606
47 Wychwood Road	2 475	790	1144	1190
8 Hallack road	4 752	783	2215	4214
8 Mill Park Road	3 372	781	1575	2078
14 Thames Road	1 126	780	527	1218
3 Whitney Street	1 095	790	506	2201
12 11th Avenue	1 684	408	1506	2146
6 Club Road	1 295	761	621	1983
64 Short Road	794	765	379	3780
10 4th Avenue	502	780	235	1707
10 Idlewylde Cresent	5 519	788	2556	5788
12 Newcombe Avenue	4 156	790	1920	14182
*Sardinia Bay (Stone)	8 333	769	*3955	-
*Sardinia Bay (Danoher)	30 658	829	*13498	-
21 Admirality Way	220	765	105	1740
10 Bullbring Road	1 066	776	501	1104
68 Winchester Road	2 193	776	1031	1620
5 Kolbe Cresent	2 334	739	1153	1700
74 River Road	not operable			2911
15 Cosmos Street	111	150	270	1685
17 Victoria Park Drive	not operable			765
20 Boreholes	40780 m^3		20 486m^3	

* Denotes boreholes not considered for abstraction calculations

Including the percentage of boreholes that became inoperable as being representative of the general incidence of failure in the area, this total is modified as follows:

$$\frac{216}{0,85 \times 22} \times 20\ 486\ m^3 = 236\ 629\ m^3/annum$$

- **Corporate boreholes**

Ten percent of boreholes in the PEM area are classified as corporate. These include business premises, schools, parks, golf courses and the like. Twenty three were identified in the database of which 13 were monitored. Of these, one collapsed, one pump failed and one is disused. This incidence of failure is higher than for private boreholes and is attributed to the lack of a responsible person in charge of borehole maintenance. The sample size is relatively small and 15% is considered to be a more representative figure for incidence of failure. Table 6 overleaf, gives details of groundwater abstraction from corporate boreholes.

From Table 6 it can be seen that an average annual volume of 60 884 m^3 was abstracted from the 10 boreholes during the study period. The calculated average abstraction at PE Golf Course is conservative as metering has shown they use about 75 000 m^3 per year. Taking this into account, the volume abstracted from the metered boreholes is 92 582 m^3. If the total volume abstracted annually from corporate boreholes in the study area is calculated by simple proportion as with the private boreholes, a figure of 213 650 m^3 is obtained. This is heavily skewed as, with the exception of PE Golf Club, Telkom, Victoria Park and Crusader Club, the corporate use of groundwater is negligible. Allowing for the two other major corporate users in the area ie. Walmer CC and Arlington Race Course, an order of magnitude figure of total corporate abstraction is estimated to be no more than 150 000 m^3/annum.

TABLE 6: METERED ABSTRACTION FROM CORPORATE BOREHOLES

Location	Total Abstraction (m^3)	Period (days)	Annual Abstraction (m^3)
PE Golf Club			
No 1	38 400	763	18370
No 2	35 167	762	6845
No 3	16 907	763	8087
No 4	borehole collapsed		
Telkom	1 475	722	746
Clarendon Park School	337	748	165
Victoria Park	24 766	746	12 085
Fort Frederick	9	760	4
Donkin Reserve	15	736	7.5
St George's Park	borehole not working		
Crusaders Club	6 197	753	3004
King Edward Park	borehole not required		
Fedlife Building	241	56	1571
10 boreholes	123 514	680,9	60884

Combining figures for corporate and private abstraction, total annual groundwater abstraction in the PE municipal area is estimated to be of the order of 387 000m³.

- **Impact on municipal water use**

From the estimates given above, the annual volume of groundwater that is abstracted is approximately 387 000m³. Table 7 below shows that this volume forms less than 1% of total municipal consumption since recent incorporation of black residential areas.

TABLE 7: ANNUAL WATER CONSUMPTION

Source	1992/93	1993/94	*1994/95
Municipal (Ml)	28 915	32 336	50 114
Groundwater (Ml)	370	370	370
Percent	1.3	1.1	0.74

* Includes incorporation of the former Ibhayi, Motherwell, Kwadwesi and Kwamagxaki areas.

This low percentage is due mainly to the small proportion of properties with boreholes compared to those served by municipal reticulation. The percentage of groundwater to municipal water use where a borehole is present appears to be high from the two sites where both sets of data are available. These results are presented in graphical form in Figure 6.

At 5 Kolbe Crescent, Summerstrand, borehole water is used for irrigation and household appliances such as the dishwasher, washing machine and toilet cisterns. Once the borehole was installed in July 1993, municipal consumption dropped dramatically and has remained consistently low, on average only between 10 and 20% of total monthly consumption. A rough calculation indicates a reduction of about R2 000 per annum for this user, excluding borehole installation and running costs.

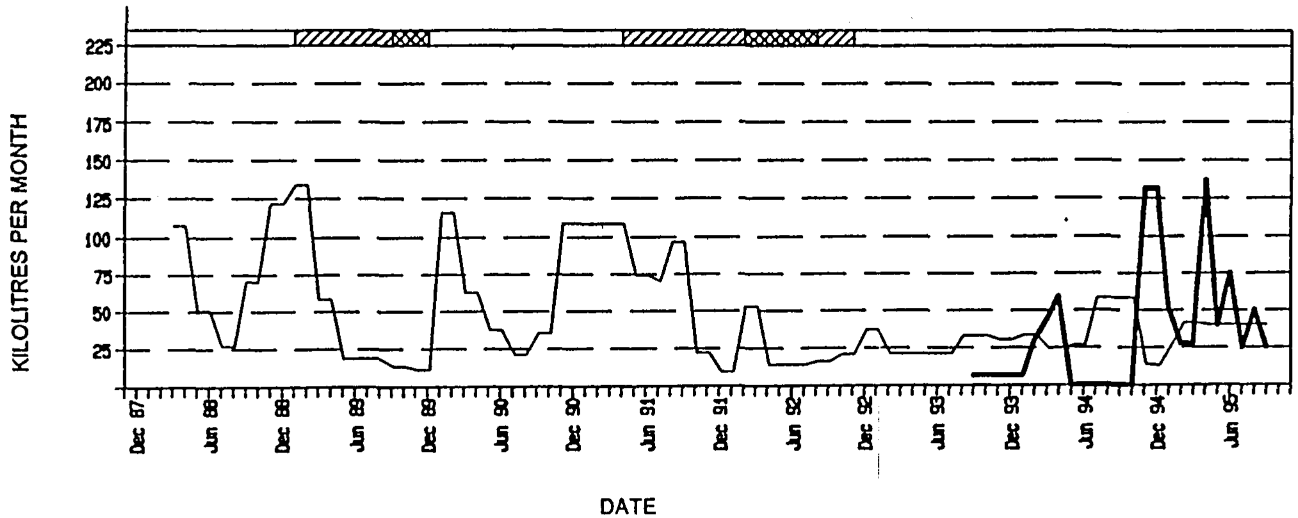
At 64 Short Road Walmer, groundwater is used solely for garden irrigation, partly due to a high iron content making it unsuitable for any household application. As a result, groundwater demand is seasonally driven with typical abstraction peaks in summer. At these times groundwater accounts for up to 75% of total consumption but typically more than 50%.The saving to this user is about R1 200 per annum at current rates but is significantly more during dry years and times of rationing.

Because the borehole distribution is socio-economically controlled, the more affluent people who have the highest per capita daily water demand have the opportunity to make the greatest savings on their water account.

Abstraction volumes have increased since the beginning of the drought in 1983 and peaked in 1992. After the drought and during the monitoring period when "normal" rainfall resumed, many borehole owners allowed their boreholes to fall into disrepair or stopped using them, as the water quality was poor and they are not solely dependent on groundwater. However, many owners do use groundwater as an ongoing part of their consumption, particularly for garden irrigation purposes.

During dry periods additional borehole owners resume abstraction principally to save money. This results in a saving of municipal water which becomes available to other users during times of drought. In this way, boreholes within PEM boundaries that are privately owned are, to a degree, an extension of PEM water resources.

WATER CONSUMPTION AT 64 SHORT ROAD - WALMER



NOTES

WATER RESTRICTIONS

WATER RATIONING

Municipal consumption

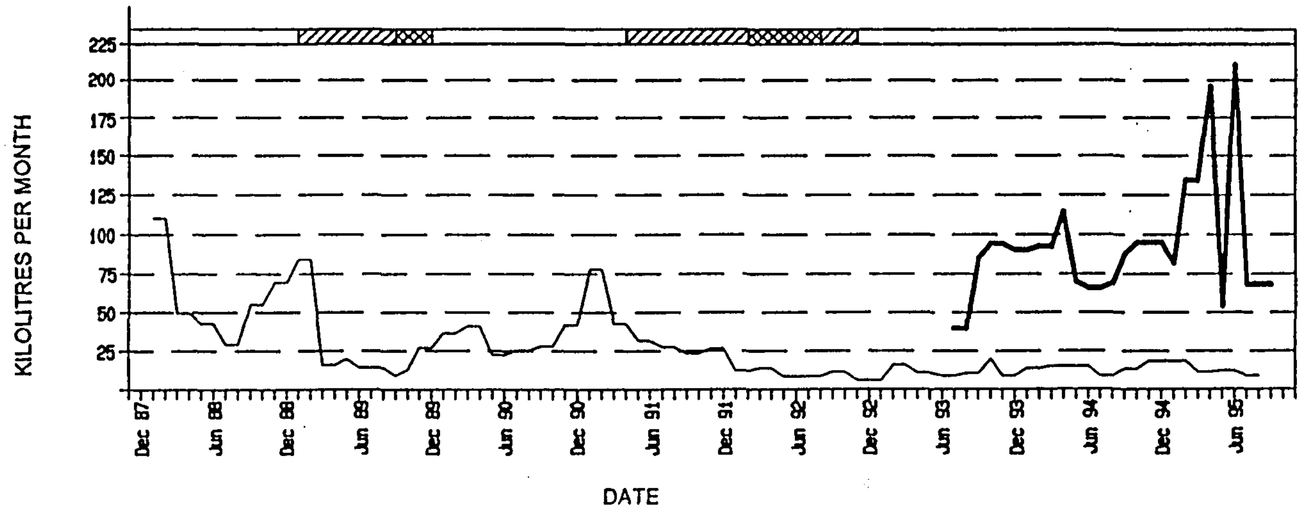
Borehole consumption

Erf Size : 3780 Square metres

Installed : March 1992

Usage : Irrigation

WATER CONSUMPTION AT 5 KOLBE CRESCENT - SUMMERSTRAND



NOTES

WATER RESTRICTIONS

WATER RATIONING

Municipal consumption

Borehole consumption

Erf Size : 1700 Square metres

Installed : July 1993

Usage : Irrigation, toilets, washing machine and dishwasher

Fig. 6

Of interest is the effect of municipal water restrictions and water rationing on the user. The Kolbe Crescent site shows that after the lifting of restrictions and rationing, and prior to the installation of a borehole, municipal consumption remained well below the previous average monthly consumption. As soon as the borehole was installed, the total consumption levels increased beyond those previously recorded outside of restriction periods. This indicates that people adapt to conservative water use when restrictions are initially imposed, but as soon as the water is perceived as "free" or strategically unimportant, consumption volumes are unimportant.

The potential impact on municipal water sales can best be illustrated by a large groundwater consumer like PE Golf Club. An annual consumption of 75 000 m^3 of groundwater for irrigation replaced a similar volume bought from the municipality. At current rates this saves the golf club about R135 000 per annum but costs approximately R11 000 to pump.

The total cost of groundwater use to the municipality in terms of lost revenue, based on an annual abstraction of 390 000 m^3 at R1.80 per m^3, is therefore R702 000 at July 1995 prices.

5.5 Groundwater levels

A groundwater contour map has been drawn-up from the water levels measured in July 1995 (Figure 7). The contours indicate a natural hydraulic gradient along geological strike from north-west to south-east, towards and across the study area. This reflects the enhanced permeability along strike, with bedding and thrust planes being the principal flow conduits. Exceptionally steep groundwater gradients are maintained across geological strike. This is typical of the TMGS aquifer and mirrors conditions at St Francis Bay and in the Hex River Valley.

The contours indicate that the Baakens River intercepts and drains water from the aquifer and may play an important role in limiting the spread of high conductivity groundwater from the north-west into the Humewood and Summerstrand areas. To the north of the study area, the TMGS is covered by a thick sequence of Tertiary and Cretaceous mudstones. This has generated artesian conditions in the Uitenhage Basin and the groundwater contours indicate that the hydraulic head in this basin pushes groundwater to the south-east and south.

Groundwater levels monitored over the study period show that no significant regional fluctuations of the water table have occurred besides localised drawdown due to pumping. There is no meaningful correlation with rainfall due to the latter's erratic pattern. In general, levels have remained remarkably stable, and without accurate water level data from 1991 and 1992, it is not possible to ascertain the effect of the 'drought' years and increased abstraction on water levels.

The largest monitored user of groundwater is PE Golf Club which uses groundwater for all its irrigation requirements. Three of the four boreholes have been pumped consistently over the last three years. Water levels monitored in the non- pumping borehole indicate that pumping water levels have reached equilibrium at around 58 m below collar and the cone of drawdown is relatively stable. Figure 8 shows water level fluctuations compared to rainfall and abstraction over the study period. Water level measurements were complicated by automated pumping systems and *ad hoc* pumping by major users, which made planning for monitoring difficult.

The presence of the overlying primary aquifer is thought to buffer the effects of both rainfall and pumping on groundwater levels. This is a result of the ability to store and release large volumes of water per unit rise or fall in the water table.

5.6 Groundwater chemistry

Groundwater chemistry is firstly discussed in terms of general water types followed by sections on contamination and seawater intrusion.

5.7 Overview of groundwater quality

The database contains over 700 chemical analyses presented in Appendix B. To simplify matters, the average analytical values for each constituent over the entire monitoring period have been used for general discussion on water quality characteristics. The average analyses from 47 boreholes representing all suburbs have been plotted on a Piper Diagram, to enable classification of groundwater types and determine evolution patterns, if any.

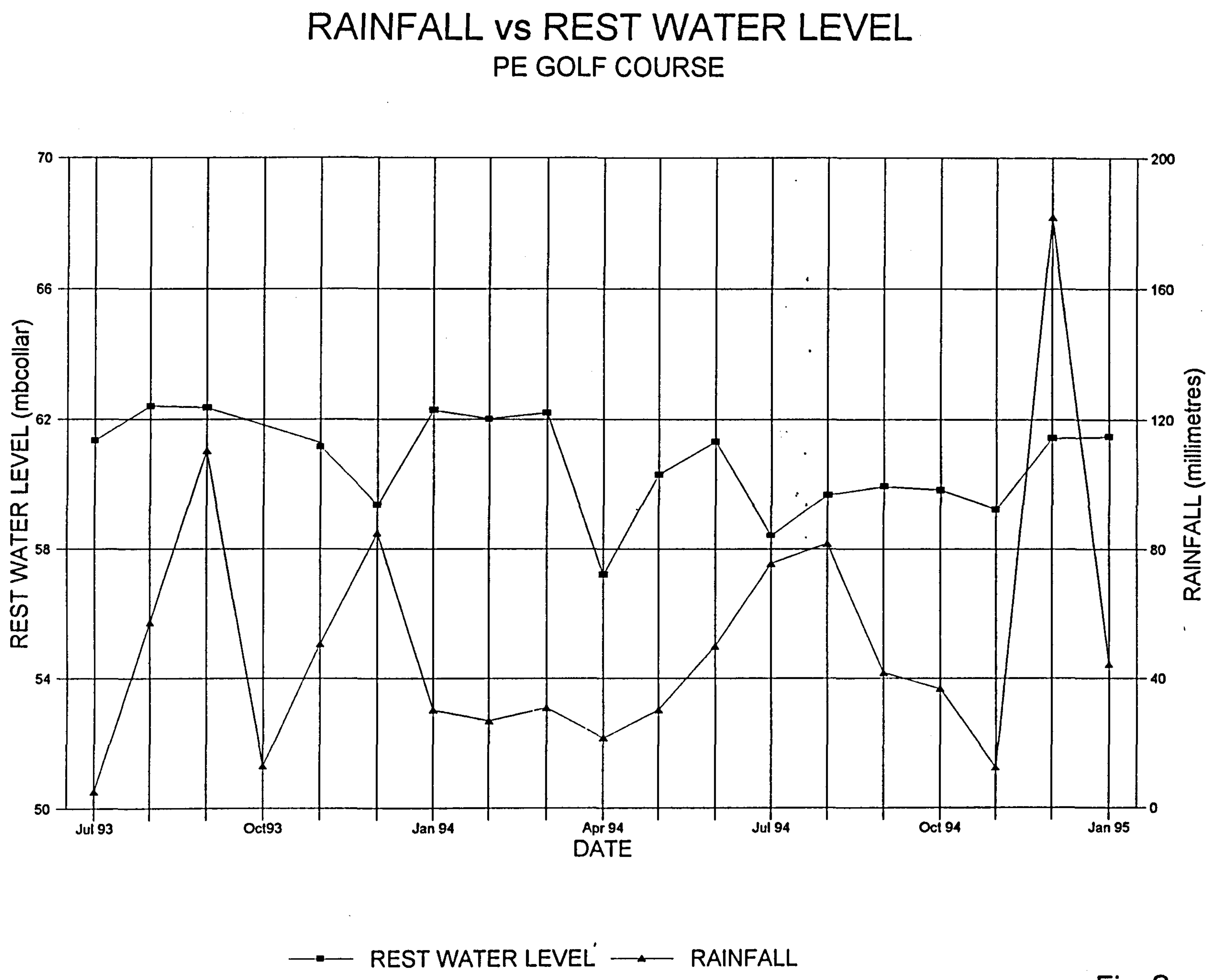

RAINFALL vs REST WATER LEVEL
PE GOLF COURSE
REST WATER LEVEL (mbcollar)
RAINFALL (millimetres)
70
66
62
58
54
50
200
160
120
80
40
0
Jul 93
Oct93
Jan 94
Apr 94
Jul 94
Oct 94
Jan 95
DATE
REST WATER LEVEL
RAINFALL

Fig. 8

With reference to the Piper Diagram (Figure 9) it can be seen that groundwater from the central and inland suburbs is all of a sodium chloride type, particularly north of the Baakens River. Groundwater from the Summerstrand area has a greater Ca/Mg HCO_3 component, which is due to the influence of the lime rich coastal sands. This could indicate that boreholes are tapping the primary aquifer directly or that a component of the secondary aquifer groundwater is derived by leakage or direct rainfall percolation from/through the sand.

Although water types are consistently within the above two categories, there is a large spatial range in electrical conductivity and individual constituents within the sodium chloride type. This is discussed further in Section 5.7.2.

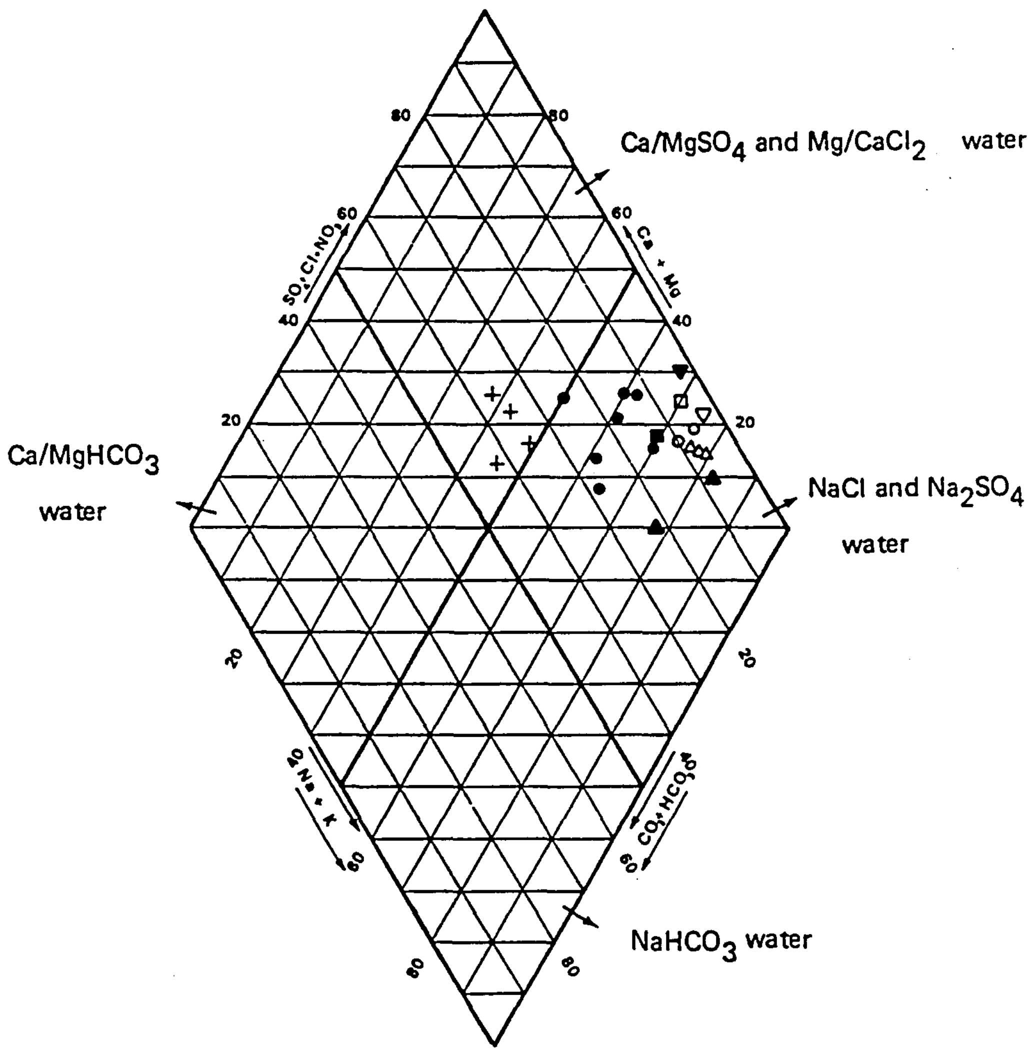
There are also significant time variations in water quality within individual boreholes, as shown by the high values of standard deviation for many constituents, although some are skewed by one analysis, which in many cases was the first of the monitoring period.

The time variations do not appear to be seasonally related, with each borehole having its own pattern. Fluctuations also appear to be above and below a fairly constant level, with concentrations at the start and end of the monitoring period not being significantly different. One exception is the Fedlife borehole, which has shown a continual increase in chloride concentration from 100 mg/ℓ in June 1993 to 500 mg/ℓ in February 1994, although this is based on a small number of samples.

The groundwater generally complies with SABS 241-1984 upper limits for domestic water use, with some exceptions, including chloride, nitrate and iron.

5.8 Groundwater contamination

Groundwater from TMGS aquifers in undeveloped mountain catchments ranks among the lowest in electrical conductivity in South Africa. In these recharge areas, conductivity of the "young" groundwater is generally <20 mS/m. Examples include the Ceres and Hex Valleys, and the Citrusdal area. In a recent drilling programme at Ceres, groundwater conductivity was <4 mS/m . Further along the flow path "older" groundwater quality is influenced by catchment land-use and longer contact with the host rock or rocks, and conductivity tends to



Borehole localities

- + Summerstrand / Schoenmakerskop
- ● Walmer
- △ Mill Park
- ▲ Newton Park
- ○ Fernglen
- □ Framesby
- ▽ Kabega
- ▼ Westering
- ■ Lorraine

MODIFIED PIPER DIAGRAM

Fig. 9

increase. Examples include St Francis Bay and Gansbaai, both coastal aquifers with similar physiographic and geological features to Port Elizabeth. In the latter aquifers, conductivity ranges between 80 to 150 mS/m. Plots of conductivity and chloride concentration in the St Francis area showed a clear increase in both parameters along the groundwater flow path (SRK 1989), ie towards the coast.

In the study area, however, this chemical evolution of the groundwater is not seen and, in the context of expected TMGS groundwater chemistry, the Port Elizabeth aquifer is atypical. For example, the range in conductivity is 50 to 819 mS/m, and in chloride, 100 to 2 799 mg/ℓ. Furthermore, contour plots of these parameters and sulphate (Figures 10, 11 and 12) appear to indicate that they are decreasing in concentration along the groundwater flow path to the south of the Baakens River. Chemical reactions such as adsorption, precipitation and base exchange can cause natural attenuation and alteration of groundwater chemistry but, in the case of chloride, this explanation is not satisfactory as chloride is a conservative ion. Two quotes from the literature illustrate this fact. Mckee and Wolfe (1963) state that "the chloride ion is probably the best tracer of groundwater flow as it is least affected by absorption-desorption lag or by other physical or chemical phenomena". Hem (1985) states "that chloride ions do not significantly enter into oxidation or reduction reactions, form no important solute complexes with other ions unless the chloride concentration is extremely high, do not form salts of low solubility, are not adsorbed on mineral surfaces and play few vital biochemical roles".

If it is thus accepted that chloride is not being lost from the aquifer system along the flow path, then the only feasible explanation is that it is being diluted. The explanation put forward is that expanding urbanisation in the PEM area (along the outcrop of the TMGS aquifer) has resulted in partial replacement of diffuse recharge through the soil profile by the development of numerous point sources of contamination such as old waste tips, leaking sewers and water mains, septic tanks, fertilizer application and stormwater runoff. For example, Walmer only converted to water-borne sewage in 1968.

This would explain the frequent occurrence of groundwater with radically different chemistry from boreholes a few streets apart. Examples of such conductivity/chloride contrasts are 475mS/m - 1463mg/ℓ and 151mS/m - 390mg/ℓ in Walmer, and 247mS/m - 559mg/ℓ and 652mS/m - 1591mg/ℓ in Walmer Heights. A contributory factor here could be the discrete nature of the secondary aquifer due to poor hydraulic connection across geological strike. The trend for lower conductivity and concentration of some ions to develop along the flow path is thus a reflection of dilution of contaminated groundwater and its tendency to approximate to background chemistry with time and distance. The main threat to groundwater quality could therefore be from inland sources rather than from seawater intrusion. The reports of 'brackish' water in the Walmer area in the 1920's could also indicate a natural level of salts in the aquifer.

Nitrate concentrations show an opposite trend to chloride in that concentrations increase along the flow path towards the coastal suburbs. The low iron concentrations in these areas may indicate an increase in redox potentials and a decrease in denitrification potential within the aquifer. This could have long-term implications for groundwater quality, with a continuing build-up of nitrates, given the practice of irrigation with treated sewage effluent in many coastal areas and fertilizer application to gardens, sports fields and parks. Figure 13 shows a trend for a general increase in nitrates in the peripheral coastal areas, which possibly supports the above contention.

In a study of the impacts of urban development on groundwater quality in a coastal aquifer near Perth, Australia (Appleyard 1995), it was concluded that significant changes had occurred. These were mainly manifested in increases in nitrate and sulphate. Chloride did not appear to be affected to the same degree.

Potential souces of contaminants into the aquifer are listed below and shown on Figure 13.

I) **Waste disposal sites**
Arlington, Victoria Drive
Historical sites at Walmer and Baakens River Valley and elsewhere.

ii) **Sites irrigated with reclaimed sewage effluent**
Port Elizabeth Technikon
University of Port Elizabeth
Humewood Golf Course

iii) **Golf courses where nitrogenous fertilizers are used**
Humewood Golf Club
Walmer Country Club
Walmer Golf Club
Port Elizabeth Golf Club, Mill Park

iv) **Other sites where nitrogenous and other fertilizers are used**

Port Elizabeth Municipal Parks
St Georges Park
Donkin Reserve
Fort Frederick
Clarendon Park
Settler's Park
Private and corporate sports clubs

For the purpose of assessment of contamination, the major ground water quality indicators considered were, chlorides, nitrates, iron, total organic carbon and bacteria. These five contaminants are discussed separately as far as the monitoring boreholes are concerned.

- **Chloride**

Most of the boreholes in the Port Elizabeth area have relatively high chloride concentrations, predominantly in the form of sodium chloride. Of the 47 boreholes monitored, 37 had average chloride levels of >250 mg/ℓ; 28 with >400 mg/ℓ and 11 with >600 mg/ℓ. The majority of the borehole waters fall into the medium and medium/high chloride category, i.e., 250 to 600 mg/ℓ.

On the basis of information available, there are not many boreholes in Port Elizabeth where the water is used for domestic/potable purposes, other than for the flushing of toilets, washing down floors and other general uses. The high chlorides have a considerable effect on the use of these waters for irrigation purposes, and in many cases special practices have to be used when irrigating plants. Many of the waters are unsuitable for spray irrigation of plants because of problems resulting from salt build-up on leaves. Certain of the boreholes are virtually unusable for irrigation purposes because of the very high total salt content. None of the very highly saline boreholes are close to the sea.

- **Nitrate**

Out of the 47 borehole waters analysed, 21 have nitrate levels >4,0 mg/ℓ as N, with 11 being >10,0 mg/ℓ. The high nitrate boreholes are contained in a triangle from

Newton Park towards the sea, with Central and Summerstrand being the outer corners of the triangle.

In a study by Tredoux (1993) on nitrates in groundwater in South Africa, it was found that out of a data base of 18827 complete analyses, the median nitrate value (as N) was 4,5 mg/ℓ. The majority of this sample base was representative of inland aquifers, with few coastal aquifers apart from the west coast. In this context, nitrate values in the study area are not excessive, although in the context of TMGS aquifers, they are excessive.

Sources of nitrate include areas irrigated with treated sewage effluent eg PE Technikon, UPE and Humewood Golf Course, irrigated parks and golf clubs where nitrogenous fertilizers are used, eg Walmer Country Club, Walmer and PE Golf Clubs, municipal parks.

Nitrate contamination is not seen as being a serious problem with the Port Elizabeth boreholes as the water is used for irrigation purposes rather than drinking water.

- **Iron**

Iron has only been found in significant levels, i.e., >1 mg/ℓ, at 10 sites, of which four were >5,0 mg/ℓ. The Walmer/Walmer Heights area seems to have a particular iron problem and this also applies to the Framesby, Lorraine and Kragga Kamma areas. Very high iron levels of >20 mg/ℓ were found on occasions, particularly in Walmer. High iron concentrations are typical of TMGS groundwater, being derived from oxidation of pyrite, but levels > 5 mg/ℓ are probably more indicative of borehole condition, ie casing corrosion.

- **Organics**

The Total Organic Carbon test was used to evaluate the possible organic pollution of borehole waters. Only in seven out of the 47 boreholes monitored were the levels of organic carbon considered significant, i.e., >6,0 mg/ℓ as C. Of these sites, three are situated in the Arlington area and three in Summerstrand, but others in the same areas did not have significant organic carbon levels. There may be some possible connection between the boreholes and the situation of the City's largest domestic waste disposal site at Arlington, but this cannot be proved from the relatively few boreholes studied in the area.

- **Bacteria**

Some samples recorded faecal bacteria during the period of study, but most of these can be attributed to bad sampling. One site had significant E. coli I counts on several occasions. This borehole is situated on a smallholding and there are several labourer's cottages with "toilets" in the vicinity of the borehole, and this is the likely cause of the contamination. After due modifications to the facilities the problem was resolved. One borehole in Walmer also had faecal contamination on the several occasions that it was sampled, but these were not significant.

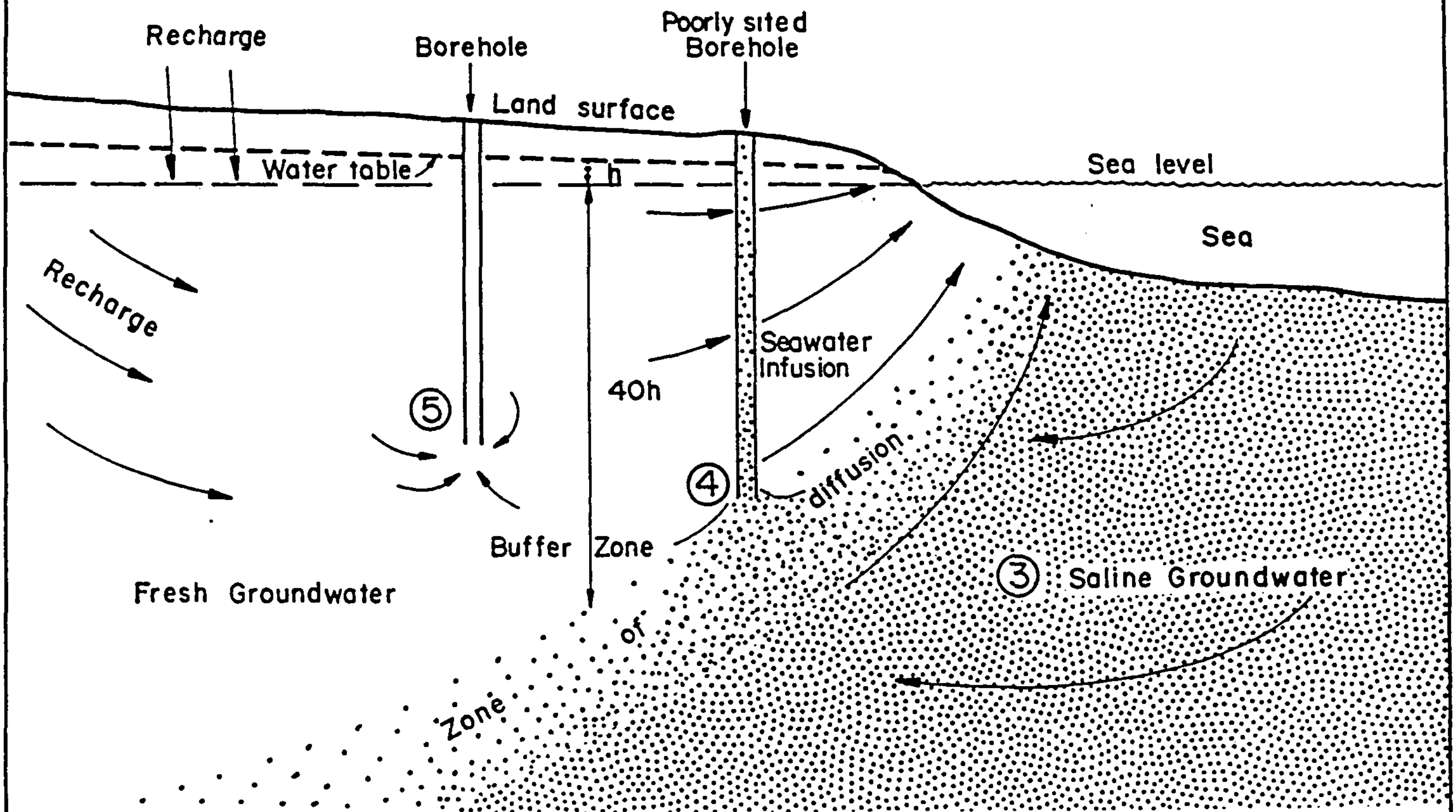
On the basis of this study bacterial contamination of borehole water is not a problem in the Port Elizabeth area. Even the situation of a low income suburb with informal housing in part of Walmer does not appear to result in pollution of the groundwater, as yet.

5.9 Sea water intrusion

The main area of concern with regard to sea water intrusion is the suburb of Summerstrand and, to a lesser extent, Humewood. The other coastal areas are either undeveloped or bordered by office or industrial areas. Inspection of the results from the four monitoring boreholes in Summerstrand shows no sign of any problem relating to sea water intrusion. Of all the boreholes investigated for this project, the Summerstrand boreholes were some of the most consistent in terms of water quality. Water levels are about 4 mamsl within 100m of the sea. This positive hydraulic head will maintain the current fresh/sea water interface position. On the basis of these results sea water intrusion would not be seen as a problem. However, the drought ended shortly before the commencement of this project, and the boreholes have not been used as much as they would during drought conditions.

Recent information has come to light on boreholes in Summerstrand, very close to the sea, which change from fresh water to saline water very quickly during pumping . The owners report that when the borehole is next pumped, fresh water is again obtained initially. These boreholes are within 200 m of the beach, whereas the four monitoring boreholes are at least 400 m from the fresh/salt water interface. A diagram illustrating the mechanics of pulsed sea water intrusion in a secondary aquifer is shown in Figure 14.

CONCEPTUAL MODEL OF FRESH WATER AND SALINE GROUNDWATER IN AN UNCONFINED COASTAL AQUIFER



GHYBEN-HERZBERG RELATION

AT A GIVEN LOCATION, THE DEPTH OF FRESH WATER ABOVE THE MEAN SEA LEVEL (h), IS 1 METRE FOR EVERY 40 METRES (40h) OF FRESH WATER BELOW SEA LEVEL.

Fig. 14

Under drought conditions, with all boreholes being used on a regular basis, there is a risk that this transient, short-lived intrusion of saline water could be drawn further into the aquifer at Summerstrand. This is especially true under the likely scenario of borehole use, with pumping frequently taking place at relatively high rates for short periods of time. Turbulence in fractures is a prime cause of expansion of the brackish water diffusion zone between fresh and sea water. With the NW-SE structural trend of the TMGS, there is potential for direct connection between the aquifer and the sea. Ideally, boreholes close to the sea should be pumped continuously at a relatively low rate to minimize turbulence.

5.10 Overview of aquifer potential

On the basis of the yield and water quality characteristics described in the preceeding sections, it can be concluded that the TMGS aquifer in the PEM area does not have potential for municipal water supply, unless more productive aquifers exist at depths greater than those exploited so far. The economics of a network of low yielding boreholes delivering variable but generally poor quality water into the system are not feasible.

It is possible that many boreholes are not being used to full capacity and the yields are generally underestimated. It appears that some areas, like Port Elizabeth Golf Club, are more favourable and the aquifer can support fairly high sustained yields of suitable quality groundwater in these areas.

The clustering of boreholes in selected areas means large parts of the aquifer remain unassessed. The extreme variability in groundwater quality is consistent over the sample areas and on this basis further reduces the aquifer potential for larger scale exploitation.

On a more regional scale, the aquifer beyond the western boundary of the study area improves in both water quality and yield potential. Boreholes forming part of the AEC/WRC investigation and drilled in the Bushy Park area on a large fault, yield between 18 and 55m^3/h of potable quality water. Smallholdings in the Kragga Kamma area use groundwater for all domestic purposes, as do the landowners stretching back toward the Lady Slipper and Van Stadens area.

The linear TMGS aquifers formed by the E - W trending folds of the Cape Fold Belt extend for hundreds of kilometers into the Western Cape. Large outcrops form the mountains of the West and South East Cape and high rainfall over the area ensures significant recharge to the aquifer. Three major parallel aquifer systems traverse the catchment feeding Port Elizabeth's water supply dams. These aquifers are being exploited on a small scale locally, but show high potential for further development for regional objectives.

Within this regional hydrogeological framework, the portion of the aquifer forming the Port Elizabeth Peninsula is atypical in terms of both groundwater quality and yield.

It appears from water level data that recharge exceeds abstraction and there is little doubt the aquifer can cope with greater abstraction volumes if they are spread over a wider area. The aquifer is suitable for the type and nature of the demand it currently fulfills and has the ability to cope with the pulses of increased abstraction in dry years.

6 LEGAL ASPECTS

6.1 The international situation

Broadly speaking, international water law can be classified into two main systems, which are often referred to as the common law and civil law systems. The common law system is the body of law built up by the courts through successive judgments, whereas civil law is codified law developed by Parliament or its equivalent in the country concerned.

Both systems had their origin in Roman Water Law, the common law system developing into the riparian system primarily found in England and in countries across the world with historical ties to England. The civil law system is found in European countries where the Napoleonic Code of 1804 applied and in other countries in Africa and the East with historical ties to the European states of France, Germany, Belgium and others.

In the United States of America, most of the eastern states have accepted the riparian system while in the more arid western states the appropriation system developed, which at the same time protects the rights of people who had prior rights to water. A common factor in the national systems of most countries is a tendency towards greater State control. Even in regions where water availability is not the primary issue, State intervention in order to safeguard the quality of water resources appears to be the order of the day. Some examples of the international situation are:

- **Botswana**: Water is publicly owned and anyone who drills a borehole must apply for a water abstraction right. All boreholes have to be registered and such registration can be refused if the information supplied is inadequate;

- **Germany**: Water belongs to the community of citizens of a state, who are represented by a government which is responsible for protection and fair distribution of the resource. Some of the basic tenets of the German Federal Water Balance Act are, no water use without a permit, which is limited in time and quantity, and protection of wells and springs for public water supply;

- **Russia**: Water is an exclusive state property and is made available only for use. It is neither bought nor sold and cannot be separated from the state property.

With the above summary of international water law as a background, section 7.1 focuses on the situation within South Africa.

6.2 South African Water Law

South Africa's water law is contained primarily in the Water Act of 1956 but is also scattered in 33 other Acts. Most of the legislation is based on the legal system of the countries from which the European settlers came from.

The Roman-Dutch Law was introduced by the first Dutch settlers in the Cape in 1652 and it was soon found to be necessary to control the use of water from rivers near the original settlement. As the Cape settlement was extended and more water was used for irrigation, disputes arose which were dealt with by the "Landdrost en Heemraden" until their abolition in 1827. These bodies, when dealing with water disputes, in effect performed the State's traditional role of regulating water use and resolving disputes. The abolition left a vacuum which could only be filled by the Cape Supreme Court. By the end of the 19th Century, however, it became clear that laws were needed to regulate competing demands on water resources and consuquently laws were developed in the Cape Colony, Natal and the Transvaal. After Union in 1910, water law was rationalised under a single Act - the Irrigation and Conservation of Waters Act, 1912. This Act largely contained the existing common law position as developed by the Courts. Because the courts dealt mainly with irrigation disputes, the Act was largely aimed at compiling these irrigation rules. After the Second World War, when industrial development was on the increase, it became necessary to update the law, which resulted in the substitution of the 1912 Act with the Water Act, 1956.

South Africa is one of the few countries in the world that has no legal way to restrict the use of groundwater, save through emergency regulation by the minister of Water Affairs. The Water Act of 1956 vests in the owner of land the exclusive right to use groundwater occurring on his land, with only some prohibitions on transfer of such water across boundaries of the land. The declaration of Subterranean Government Water Control Areas (SGWCA's) is the only way within the present Act (Section 26) to regulate development and use of groundwater. As of 1993, only 13 SGWCA's have been declared, covering a total area of about 5000 km^2, including the Uitenhage Artesian Basin.

The Water Act distinguishes between two types of groundwater, namely *subterranean water* and *underground water*. The former is defined by the Act as ,"such water naturally existing underground...as is contained within the areas proclaimed by the State President to be subterranean water control areas". It is presumed to exist or flow in defined channels. The latter category of water is not defined in the Act but it can be assumed to refer to water that also exists naturally underground but is not included in a subterranean water control area (Visser 1987).

On 17 January 1986 a proposed Water Amendment Bill was published in the *Government Gazette*, the main purpose of the bill being to, vest in the minister the powers to control and exploit water in subterranean sources in certain areas in the public interest." The bill does not alter the existing state of groundwater law and only confers wider powers concerning public management and use of subterranean water found in a SGWCA. The best policy, however drastic, would be to define all groundwater as public water and to deal with such water as is presently proposed for water found inside a SGWCA.

South Africa's water legislation is unsuited to an essentially dry country and is being reviewed. It is based on Roman law which was developed in a totally different climate where water shortages were not of major concern. The shortfalls in current SA water law with regard to groundwater are recognised by the DWA&F and a draft white paper is being drawn-up in consultation with experts from the private sector, and there seems little doubt but that the status of groundwater will change from private to public water in the near future.

In this respect, the Department of Water Affairs and Forestry has published a booklet "You and Your Water Rights - South African Water Law Review - a call for public response". The following is an extract from the section of the booklet dealing with the process of reviewing South Africa's water law and the call for public response:

"It is planned to undertake the review in three phases:

* The first phase will be to make sure that as wide a cross-section of South African society as possible has the opportunity to comment on the law and express what is important to their community. The objective is to avoid the "tyranny of the articulate". Workshops will be encouraged throughout the country, particularly in rural and poor communities.

* The second phase will be the consideration of the public's response by a monitoring team to be set up by the Minister of Water Affairs and Forestry. This committee will consist of experts in various fields disciplines to the water field, including community representatives, who will recommend to the Minister the principles that should provide the basis for a new legal structure. These principles will then be published in a White Paper giving further opportunity for public involvement.

* After the Government has made a decision in principle, the third phase will be the actual drafting of new legislation under the supervision of a second monitoring committee consisting of legal experts, whereupon once again draft legislation will be widely published for comment.

Contributions, comments, recommendations and submissions concerning the review of any aspect of the present water law were invited from individuals and interested parties, to be submitted by 19 May 1995."

From the above it can be assumed that far reaching changes can be expected in South African water law in the near future.

6.3 Municipal by-law formulation

The current legal framework for local government in South Africa comprises National Statutes, provincial ordinances and municipal by-laws. Municipal by-laws are generally in accordance with the provisions of the relevant provincial ordinance. The PEM Water Supply by-laws were promulgated in The Province of the Cape of Good Hope Gazette No. 4672, November 1990, and contain the following clauses on water installations that can be related to borehole use;

- Chapter I - Section 13

  The clause provides for the right of entry to premises to request information regarding the water installation, or to inspect, examine or operate any water fitting of the water installation on the premises.

- Chapter IV - Section 52: "Persons permitted to do installation and other work".

  This clause states that only plumbers registered with the Council may carry out work on pipes and fittings on any premises.

- Chapter VI - Section 68: "Use of pipes and water fittings to be authorised by Engineer".

  Only pipes and fittings included in the Schedule of Accepted Pipes and Water Fittings, shall be installed. The schedule is drawn up by JASWIC, the Joint Acceptance Scheme for Water Installation components whose members are representatives from the municipalities of Port Elizabeth, Cape Town, Durban, Johannesburg, Pretoria, East London and Kimberley as well as the Water Research Commission and the South African Bureau of Standards.

- Chapter VI - Section 74(8): "Installation of pipes".

  The Engineer may require that different water installations on premises bear an acceptable means of identification such as colour coding.

- Chapter VIII - Section 99(4)(b): "Protection of water installation".

  The owner is to ensure that no cross connection is made between the municipal supply and an alternative supply, for example, a borehole.

- Chapter IX - Section 102: "Use of water from sources other than the water supply system".

  No person shall use an alternative source of water for domestic, industrial or commercial purposes unless the water quality conforms to the specifications of SABS 241-1984: Water for Domestic Supplies. Also, if borehole water used on a premises is discharged to the municipal sewerage system, the Engineer may install a water meter at the source of the borehole supply.

- Chapter IX - Section 103: "Notification of boreholes".

  The Engineer may, by public notice, require that owners with boreholes on their premises notify the Engineer of the boreholes and that owners intending to sink boreholes advise the Engineer of their intentions.

  The owner of a premises within a municipal area is obliged to comply with the promulgated by-laws of that authority (in this case PEM). The municipality can, by enforcing by-laws and publishing of public notices, regulate the use of groundwater in terms of installation standards , health aspects related to water quality, discharge of effluent groundwater and the registration of existing and future boreholes.

In terms of the existing Water Act and the by-laws outlined in the previous section, PEM cannot regulate the volumes of groundwater pumped from the aquifer and thereby assess the impact of abstraction on the resource in terms of available storage and groundwater quality. This highlights the need for public awarness through education as well as a need for self control.

Further potential problems that may occur and ultimately involve the municipality, include the following:

- Well interference - this can occur when a cone of drawdown formed during pumping from one borehole extends to other boreholes situated nearby. The water levels in surrounding boreholes can decline to the extent that the neighbouring boreholes cannot be used simultaneously;

- Over-pumping from an aquifer - which will occur if the total volume of water pumped from an aquifer exceeds the rate of recharge to the aquifer, resulting in a nett decrease in storage and a consequent decline in water levels;

- Groundwater pollution - Indiscriminate disposal of effluents on surface areas and the application of fertilizers can, in time, result in pollution of an aquifer and degradation of groundwater supplies in areas adjacent to the source of the contamination;

- Sea water intrusion - Port Elizabeth occupies a peninsula bounded by the ocean to the east and south. Summerstrand is a suburb situated on the coastal plain and a major proportion of the boreholes identified in Port Elizabeth are concentrated in this area. A potential exists for saline intrusion to occur if pumping in the area exceeds recharge. This potential will be aggravated by high rate, short duration, pumping and in times of drought, when recharge is diminished;

- Sub-standard borehole construction - During the drought, some owners in the city sought quick solutions and did not specify borehole construction to the drilling contractor with the result that, in some instances, borehole owners have paid dearly for remedial work to boreholes that were poorly constructed.

Other municipalities with known private groundwater use were contacted to obtain further insight into the *status quo* in respect of legislation. Most have no provision for control or even notification of groundwater use, eg. Somerset West, Hermanus and Graaff Reinet. Beaufort West has no general by-law concerning groundwater/boreholes but further drilling is prohibited in one particular suburb because of the large number of existing boreholes. The most detailed examples of a by-law that the researchers came across is that of Johannesburg, relevant sections of which are as follows:

Wells and excavations:

33.(1) Every well or excavation shall be and be kept adequately covered or fenced and everything shall be done which is necessary to prevent its being in any way dangerous to life or limb.

Construction of wells and boreholes:

35.(1) No well, tube well or borehole may be sunk or constructed, nor shall any person cause, permit or suffer it to be sunk or constructed, unless fourteen clear days' notice has first been given to the Council of the intention to carry out such work, which notice shall also state the proposed position and nature of the work and the purpose for which the water to be derived therefrom is to be used.

The Council may, in any case in which the medical officer of health deems it necessary for the protection or otherwise in the interests of the public health, to do so, by notice in writing to the owner of the premises -

(a) prohibit the use of any well, tube well or borehole permanently or for such period as he may specify in the notice;
(b) require modifications of or alterations to, including a change in the position of any well, tube well or borehole and prohibit the use thereof until such modifications or alterations have been completed and approved by the medical officer of health;
(c) prohibit the carrying out of any work the subject of a notice given to it in terms of sub-section (1) or give such directions as the medical officer of health may deem necessary with regard to the carrying out of such work.

Water supply:

No person shall use or cause, permit or suffer to be used the water from any well, tube well, borehole, spring, dam, river or other source, not being the Council's water main, for human consumption or for any other domestic purpose or for the preparation or manufacture of food or drink for human consumption or in the cleansing of vessels, utensils or appliances used in the preparation or manufacture of the aforesaid unless and until the Council's Medical Officer of Health has given a certificate under his hand stating that such water is suitable for the use which is to be made of it.

Aspects that should be addressed in any by-law promulgated by PEM include:

- Compulsory employment of drilling contractors affiliated to the Borehole Water Association to assist the borehole owner to achieve a satisfactory standard of construction;

- Compulsory submission of copies of borehole completion certificates to the municipality by the owners;

- Right of access for inspection of borehole installations, groundwater sampling, installation of flow metres and measurement of water levels;

- Compulsory submission of one water sample per year for chemical and bacterial analysis;

- The imposition of restrictions on groundwater use should declining water levels become evident or changing water chemistry indicate pollution, sea water intrusion or should well interference be proven and a dispute between borehole owners arise;

- Possible ban on borehole use within an exclusion zone adjacent to the sea;

- Provision for restriction of use of groundwater unfit for domestic consumption;

- Education and self controll.

The aim of PEM should not be just to regulate groundwater use and possibly alienate borehole owners, but also to generate an interest, awareness and self control in the public of the need to protect the resource. In parts of the USA, signposts inform the public that they are entering a protected aquifer area. Such signs placed at strategic points along main thoroughfares would create an awareness among the public and possibly generate interest and enquires.

In the light of the fairly limited use of groundwater as a percentage of municipal consumption, the low yields and moderate to poor water quality, the need for a by-law containing all of the above provisions may need to be reconsidered. It may also be prudent to wait for indications from the DWA&F as to the status of groundwater in the new water laws soon to be formulated.

7. CONCLUSIONS AND RECOMMENDATIONS

The main conclusions to be drawn from this study are listed below and follow the same order as the research objectives:

- Number and distribution of boreholes;
  There are an estimated 300 boreholes in the PEM area, of which 241 have been located on the ground;

- Volume of groundwater abstracted;

- Annual groundwater abstraction is estimated at 370 000 m^3;

- Legal aspects;
  There are very few municipalities who have promulgated by-laws to control private groundwater use. Aspects that should be included in a by-law for PEM are:
  - employment of an affiliated drilling contractor;
  - submission of borehole completion certificates;
  - right of access for inspection and monitoring;
  - regular submission of water samples for quality analysis;
  - restrictions on groundwater use in areas with declining water levels or quality, or where mutual interference occurs;
  - restriction on groundwater use in an exclusion zone adjacent to the sea;
  - create public awareness on groundwater issues.

- Groundwater Quality
  Over most of the study area the groundwater is a sodium chloride type. The only exception is Summerstrand where the groundwater has a greater Ca/Mg HCO_3 component;

  Groundwater quality in the PEM area is generally atypical of TMGS aquifers elsewhere in the Eastern and Western Cape;

  There is extreme spatial variation in groundwater quality, often over very short distances in the same suburb;

Seasonal variation in groundwater quality is not seen as the rainfall patterns are so irregular. There is no 'winter' or 'summer' period of high or low rainfall as in Cape Town, for example;

- Sea water intrusion
  There is sporadic and short-lived intrusion of sea water in boreholes closest to the sea in the Summerstrand area. This is a local and non-permanent phenomenon at the moment but there is potential for a deeper incursion of saline water into the aquifer under higher pumping stress should drought conditions return;

- Groundwater pollution
  There is evidence of groundwater contamination in many areas on the basis of conductivity, chloride and nitrate levels, especially in the context of groundwater quality in TMGS aquifers elsewhere. The contamination is attributed to urbanisation and specifically waste dumps, fertilizer application, leaking sewers and stormwater runoff;

- Effect of groundwater use
  Groundwater use has had a negligible effect on municipal consumption in respect of homeowners but in the case of the main corporate user, PE Golf Club, 75 000 m^3/annum of groundwater is used. This costs the municipality about R135 000 per annum in lost revenue from sales;

- Groundwater potential
  In terms of yield and water quality, the TMGS aquifer in the PEM area is not a potential source of municipal supply, unless untapped aquifers exist at greater depths than so far exploited.

The following recommendations are made for further attention:

- The database should be maintained, expanded and constantly updated to include all boreholes drilled into the Port Elizabeth TMGS aquifers as far as Van Stadens River;

- A reduced monitoring borehole network should be maintained in representative areas of the aquifer. These include upgradient (Kabega Park), central (Arlington), northern (Newton Park) and coastal (Summerstrand) areas. This would equate to about six boreholes, including Arlington waste site, which will be monitored as part of a separate project;
- A more detailed study of the boreholes within the coastal rim of

Summerstrand/Humewood, where sea water intrusion has been periodically reported, should be made to quantify the threat or occurrence of sea water intrusion;

- There is a vast amount of chemical data in the database which has only been qualitatively assessed in this study. More rigorous statistical and graphical analysis should be carried out to provide further insight into the atypical hydrogeochemistry of the TMGS aquifer in Port Elizabeth;

- The upgradient limits of the poor quality groundwater should be delineated to ensure that the potential groundwater resources in the TMGS to the west of Port Elizabeth remain unpolluted.

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RESEARCH INTO BOREHOLES IN THE PORT ELIZABETH MUNICIPAL AREA

THE OWNER/OCCUPIER

PLEASE READ THIS PAMPHLET IF THERE IS A BOREHOLE ON YOUR PROPERTY

The recent extended drought in the Eastern Cape has resulted in a proliferation of boreholes in Port Elizabeth with a corresponding increase in groundwater abstraction. Unless the situation is professionally assessed, the future integrity of the groundwater resource cannot be guaranteed.

Research into groundwater abstraction in Port Elizabeth has been initiated jointly by the Port Elizabeth Municipality and Steffen, Robertson and Kirsten Inc. in a two year project funded by the Water Research Commission. The research will focus on the following main aspects:

* Determination of the number of boreholes in the municipal area;

* Assessment of the volumes of groundwater abstracted;

* Monitoring of groundwater quality and assessment of the potential for contamination of the groundwater by sea-water intrusion and the disposal of effluents on the surface.

In order to gather information on boreholes a census form has been printed below this letter and, if you have a borehole on your premises, you are kindly requested to complete the form and return it to the City Treasurer's Department with your monthly municipal services payment or to the City Engineer, P.O. Box 7, Port Elizabeth 6000.

A borehole represents a considerable investment. Your co-operation will be in your best interests to ensure that the groundwater resource can be protected in the long term for all users. Any enquiries that you may have in this regard should be directed to the telephone numbers given below.

City Engineer's Department
Scientific Services Division
(041) 5062333
Enquiries: Mr G Devey

Steffen Robertson and Kirsten Inc.
(041) 323706
Enquiries: Mr C Langton

BOREHOLE CENSUS FORM

LOCALITY

OWNER/OCCUPIER:

STREET ADDRESS: .... POSTAL ADDRESS: ....

SUBURB: .... SUBURB: ....

CODE: .... CODE: ....

TELEPHONE NUMBERS:

RESIDENCE: .... BUSINESS: .... ERF NO.: .... ERF SIZE: .... (m^2)

BOREHOLE DETAILS

DATE DRILLED: .... / .... /19 .... CONTRACTOR: ....

DRILLED DEPTH: .... (m) LENGTH OF CASING: .... (m) TYPE OF CASING: PVC: .... STEEL: .... BOTH: ....

CASING PERFORATED: FROM: .... (m) TO: .... (m) REST WATER LEVEL: .... (m) BOREHOLE YIELD: ....

WAS THE YIELD OBTAINED

FROM: (a) DRILLING RESULTS?: YES ☐ NO ☐ *OR* (b) DETERMINED FROM TEST PUMPING?: YES ☐ NO ☐

TEST PUMPING CONTRACTOR: ....

PUMPING DETAILS

PUMP TYPE: SUBMERSIBLE: .... JET: .... OTHER: ....

PUMPING RATE: .... ESTIMATED DAILY USAGE: ....

DO YOU HAVE A FLOW METER INSTALLED ON YOUR BOREHOLE DELIVERY LINE? YES ☐ NO ☐

WOULD YOU BE PREPARED TO HAVE A METER INSTALLED AT NO COST TO YOU FOR THE DURATION OF THE RESEARCH? YES ☐ NO ☐

GROUNDWATER QUALITY

HAS A SAMPLE OF YOUR BOREHOLE WATER BEEN SUBMITTED FOR:

CHEMICAL ANALYSIS: YES ☐ NO ☐ MICROBIOLOGICAL ANALYSIS: YES ☐ NO ☐

SAMPLES ANALYSED BY: ....

GENERAL

ARE YOU PREPARED TO PERMIT ACCESS TO YOUR PROPERTY ON A CONTROLLED BASIS FOR BOREHOLE MONITORING DURING THE PROJECT?
YES ☐ NO ☐

NAVORSING OOR BOORGATE BINNE DIE MUNISIPALE GEBIED VAN PORT ELIZABETH

DIE EIENAAR/HUURDER

LEES ASSEBLIEF HIERDIE PAMFLET INDIEN DAAR 'N BOORGAT OP U EIENDOM IS

Die onlangse langdurige droogte in Oos-Kaapland het tot 'n groot toename in die getal boorgate in Port Elizabeth gelei, met 'n ooreenstemmende toename in grondwateronttrekking. Tensy die situasie professioneel geëvalueer word, kan die voortgesette beskikbaarheid van die grondwater nie gewaarborg word nie.

Die Port Elizabethse Munisipaliteit het tesame met Steffen, Robertson en Kirsten Ing. 'n navorsingsprojek oor grondwateronttrekking van stapel gestuur. Dié projek sal oor twee jaar strek en deur die Waternavorsingskommissie gefinansier word. Die navorsing sal hoofsaaklik die volgende aspekte dek:

* Bepaling van die aantal boorgate in die munisipale gebied;
* Evaluering van die volume grondwater wat onttrek is;
* Monitering van die grondwatergehalte en evaluering van die moontlikheid dat die grondwater deur seewaterindringing en die wegdoening van afvloeistowwe op die oppervlak besmet kan word.

Ten einde inligting oor boorgate in te samel, is 'n sensusvorm hieronder gedruk. Indien daar 'n boorgat op u eiendom is, word u vriendelik versoek om die vorm in te vul en dit saam met die betaling van u maandelikse rekening vir munisipale dienste aan die Departement van die Stadstesourier te stuur of aan die Stadsingenieur, Posbus 7, Port Elizabeth 6000 te pos.

'n Boorgat verteenwoordig 'n aansienlike belegging. Dit is in u eie belang om u samewerking in dié verband te verleen sodat die langtermynbeskikbaarheid van grondwater vir alle verbruikers verseker kan word. Skakel asseblief onderstaande telefoonnommers indien u enige navrae oor die aangeleentheid het.

Departement van die Stadsingenieur
Wetenskaplikediensteafdeling
(041) 5062333
Navrae: Mnr G Devey

Steffen Robertson en Kirsten Ing.
(041) 323706
Navrae: Mnr C Langton

BOORGATSENSUSVORM

LIGGING

EIENAAR/HUURDER:

STRAATADRES: .... POSADRES: ....

VOORSTAD: .... VOORSTAD: ....

KODE: .... KODE: ....

TELEFOONNOMMERS:

HUIS .... KANTOOR: .... ERFNO.: .... ERFGROOTTE .... (m^2)

BESONDERHEDE VAN BOORGAT

DATUM GEBOOR: .... / .... /19 .... KONTRAKTEUR: ....

BOORDIEPTE: .... (m) LENGTE VAN VOERING: .... (m) TIPE VOERING: PVC: .... STAAL: .... BEIDE: ....

VOERING GEPERFOREER: VAN: .... (m) TOT: .... (m) RUSWATERVLAK: .... (m) BOORGATVLOEI: ....

IS DIE VLOEI VERKRY

VAN: (a) BOORRESULTATE?: JA ☐ NEE ☐ *OF* (b) BEPAAL UIT TOETSPOMPRESULTATE?: JA ☐ NEE ☐

TOETSPOMPKONTRAKTEUR: ....

BESONDERHEDE VAN POMP

TIPE POMP: DOMPELPOMP: .... STRAAL: .... ANDER: ....

POMPTEMPO: .... GERAAMDE DAAGLIKSE VERBRUIK: ....

IS 'N VLOEIMETER IN U BOORGAT SE TOEVOERPYP GEÏNSTALLEER? JA ☐ NEE ☐

SAL U INSTEM DAT 'N METER VIR DIE DUUR VAN DIE NAVORSINGSPROJEK KOSTELOOS GEÏNSTALLEER WORD? JA ☐ NEE ☐

GRONDWATERGEHALTE

IS 'N MONSTER VAN U BOORGATWATER VOORGELÊ VIR:

CHEMIESE ONTLEDING: JA ☐ NEE ☐ MIKROBIOLOGIESE ONTLEDING: JA ☐ NEE ☐

MONSTER(S) ONTLEED DEUR: ....

ALGEMEEN

IS U BEREID OM VIR DIE DUUR VAN DIE PROJEK TOEGANG TOT U EIENDOM OP 'N BEHEERDE GRONDSLAG TOE TE LAAT SODAT DIE BOORGAT GEMONITOR KAN WORD?

JA ☐ NEE ☐

ERFNO	NAME OF OWNER	STREET ADDRESS	SUBURB	-Y CO-ORD	X CO-ORD
14001480000	PE GOLF CLUB NO.1	WESTVIEW DRIVE	MILL PARK	54285.000	3758980.000
14001480000	PE GOLF CLUB NO. 2	WESTVIEW DRIVE	MILL PARK	53965.000	3759040.000
14001480000	PE GOLF CLUB NO.3	WESTVIEW DRIVE	MILL PARK	53995.000	3758865.000
14001480000	PE GOLF CLUB NO.4	WESTVIEW DRIVE	MILL PARK	54000.000	3758635.000
17030090000	METROPOLITAN LIFE LTD	281 CAPE ROAD	NEWTON PARK	52965.350	3757956.920
04031820000	PE MUNICIPALITY	CRUSADERS CLUB	CENTRAL	56380.000	3759900.000
32019350000	PE MUNICIPALITY	KING EDWARD PARK	WALMER	53690.810	3762029.400
32019480000	TELKOM CLUB	VICTORIA DRIVE	WALMER	52540.000	3764120.000
32000470000	CLARENDON PARK SCHOOL	50 SEVENTH AVENUE	WALMER	54350.000	3760570.000
22005270000	VICTORIA PARK SCHOOL	VICTORIA PARK DRIVE	CENTRAL	57035.000	3760815.000
04035960000	PE MUNICIPALITY	FORT FREDERICK	CENTRAL	57435.000	3759820.000
04019000000	PE MUNICIPALITY	DONKIN	CENTRAL	57290.000	3759405.000
04031820000	PE MUNICIPALITY	ST GEORGES PARK	CENTRAL	56240.000	3759375.000
22006240000	BUYS, ISC	17 VICTORIA PARK DRIVE	SOUTH END	57326.570	3760716.770
32026390000	KEMP, ES	10 4TH AVENUE	WALMER	55800.000	3761360.000
32001790000	EXLEY, FR	12 11TH AVENUE	WALMER	53190.000	3761589.000
32025500000	VAN DER WALT, A	74 RIVER ROAD	WALMER	53623.000	3760684.000
32004980000	CORNISH, C	64SHORT ROAD	WALMER	53010.000	3761117.000
32028810000	MILLER, P	6 CLUB ROAD	WALMER	52288.000	3760925.000
14002420000	DEWAR, BN	8 MILL PARK ROAD	MILL PARK	54785.000	3759026.000
04034050000	DASHWOOD, HA	8 HALLACK ROAD	CENTRAL	55569.000	3760077.000
14009890000	LAPINER	47 WYCHWOOD AVENUE	MILL PARK	53145.000	3759304.000
17016790000	LANDMAN	12 WEST STREET	NEWTON PARK	52765.000	3758016.000
06000560000	ENGELBRECHT	3 WHITNEY STREET	FERNGLEN	50952.464	3757754.59
36000930000	DU TOIT, LM	98 VERDUN ROAD	LORRAINE	46923.000	3760663.000
06002980000	LOFTIE-EATON, GA	14 THAMES ROAD	FERNGLEN	50660.000	3757926.000
12000720000	MICHEALS	78 KABEGA ROAD	KABEGA	46808.230	3758480.000
32019810000	HARTY, JP	12 NEWCOMBE AVENUE	WALMER	50109.560	3763293.540
07008590000	LANGER	5 NORLAND CLOSE	FRAMESBY	47300.000	3758698.000
27006880000	PEINKE	15 COSMOS STREET	WESTERING	47812.790	3756403.070
32040170000	PEDERSEN, C	10 IDYLWYLDE CRESCENT	WALMER HEIGHTS	51150.000	3763310.000
99003510000	DANHOER	SCOTSAM	LOVEMORE PARK	47018.087	3765034.779
99007400000	STONE, TC	STONE'S THROW	LOVEMORE PARK	48140.731	3764679.926
23006160000	GRAHAM, RC	21 ADMIRALTY WAY	SUMMERSTRAND	62141.000	3762843.000
23014100000	CHURCH, KA	5 KOLBE CRESCENT	SUMMERSTRAND	60364.000	3762682.000
23017360000	BOSCH, JK	68 WINCHESTER ROAD	SUMMERSTRAND	60270.000	3762750.000
23016930000	VAN RENSBERG	10 BULBRING ROAD	SUMMERSTRAND	59912.000	3762833.000

APPENDIX B

PHYSICAL DATA BASE

CHEMICAL DATA BASE

No.	ERFNO	NAME	STREET ADDRESS	SUBURB	-Y CO-ORD	X CO-ORD	ELEVATION(m)	BH_DEPTH(m)	YIELD(m3/hr)	WLMBGL(m)	WLAMSL(m)
1	04005270000	VICTORIA PARK SCHOOL	VICTORIA PARK DRIVE	CENTRAL	57035.000	3760815.000	61.500			33.25	28.75
2	04019000000	PE MUNICIPALITY	DONKIN	CENTRAL	57290.000	3759405.000	56.000			36.53	19.47
3	04028630000	PE MUNICIPALITY	OVAL TRACK	CENTRAL	56410.000	3759200.000	71.500				
4	04031820000	PE MUNICIPALITY	ST GEORGES PARK	CENTRAL	56240.000	3759375.000	71.500			46.65	26.35
5	04031820000	PE MUNICIPALITY	CRUSADERS CLUB	CENTRAL	56380.000	3759900.000	72.500	100.0	6.0		
6	04032120000	NAZARETH HOUSE	10 PARK LANE	CENTRAL	55749.000	3759355.000	84.000	100.0	7.4	53.94	30.06
7	04034020000	TRUSTEES OF HALLACK RD.	2 HALLACK ROAD	CENTRAL	55679.000	3760135.000	72.000				
8	04034030000	DALLA-VECCHIA, E	4 HALLACK ROAD	CENTRAL	55641.000	3760116.000	76.000				
9	04034040000	POUROULLIS, AI	6 HALLACK ROAD	CENTRAL	55607.000	3760096.000	76.000				
10	04034050000	DASHWOOD, HA	8 HALLACK ROAD	CENTRAL	55569.000	3760077.000	76.000			52.3	23.7
11	04034300000	VAN DER SPUY, S	1 BRIAN CLOSE	CENTRAL	55622.000	3759857.000	76.500				
12	04034370000	GREYLING, JGB	11 HALLACK ROAD	CENTRAL	55609.000	3760003.000	76.000				
13	04035960000	PE MUNICIPALITY	FORT FREDERICK	CENTRAL	57435.000	3759820.000	57.000	100	6	27.7	51
14	05004000000	FERREIRA, TIR	8 LEWERKIESTRAAT	COTSWOLD	50189.000	3757019.000	131.000	5.0		2.2	128.8
15	06000560000	ENGELBRECHT	3 WHITNEY STREET	FERNGLEN	50952.464	3757754.590	116.000				
16	06002720000	STRECKER, H	32 STELLA LONDT DRIVE	FERNGLEN	49993.000	3758026.000	118.000	100.0	6.0	58.87	31.13
17	06002980000	LOFTIE-EATON, GA	14 THAMES ROAD	FERNGLEN	50660.000	3757926.000	113.000	110.0	1.3	45	68
18	07008590000	LANGER	5 NORLAND CLOSE	FRAMESBY	47300.000	3758698.000	125.000			2.7	122.3
19	09000750000	VAN DER VYWER	15 GLENGARRY CRESCENT	HUMEWOOD	58795.000	3761150.000	43.500	84.0	2.4	21.33	22.17
20	09001160000	LEVINTHAL	13 KILLARNEY ROAD	HUMEWOOD	59206.000	3760809.000	23.500				
21	09001170000	DE BEER,AS	15 KILLARNEY ROAD	HUMEWOOD	59234.000	3760841.000	22.000			22	14.9
22	09001540000	MUKHEIBER, E	14 GLENGARRY CRESCENT	HUMEWOOD	58850.000	3766115.000	43.000	80.0	1.5	20.35	22.65
23	09001780000	BRITO, MM	27 MARSHALL ROAD	HUMEWOOD	59428.000	3761039.000	35.000				
24	09003920000	HUMEWOOD HOTEL	33 BEACH ROAD	HUMEWOOD	59751.000	3760896.000	8.500	60.0	3.0	4.13	4.37
25	09004830000	CROSS, JH	8 LA ROCHE DRIVE	HUMEWOOD	59617.390	3761160.000	31.000	43.0	1.4		
26	09012560000	PE MUNICIPALITY	HAPPY VALLEY	HUMEWOOD	59405.000	3761695.000	40.000				
27	10020470000	GOLIGHTLY, GA	10 KLEINEMOND STREET	HUNTERS RETREAT	44426.000	3758285.000	160.000				
28	12000720000	MICHEALS	78 KABEGA ROAD	KABEGA	46808.230	3758480.000	132.000			5.1	126.9
29	12009620000	LOURENS	21 TULBAGH STREET	KABEGA	45220.660	3757160.000	174.000			3.2	170.8
30	12009920000	STRYDOM	18 TULBACH STREET	KABEGA	45224.640	3757214.270	171.000				
31	14001480000	PE GOLF CLUB NO. 2	WESTVIEW DRIVE	MILL PARK	53965.000	3759040.000	95.000			62.31	35.69
32	14001480000	PE GOLF CLUB NO.1	WESTVIEW DRIVE	MILL PARK	54285.000	3758980.000	93.000	150	7.0	62.95	35.05
33	14001480000	PE GOLF CLUB NO.3	WESTVIEW DRIVE	MILL PARK	53995.000	3758865.000	95.000				
34	14001480000	PE GOLF CLUB NO.4	WESTVIEW DRIVE	MILL PARK	54000.000	3758635.000	97.000	COLLAPSED			
35	14001480000	PE GOLF CLUB NO.5	WESTVIEW DRIVE	MILL PARK	54300.000	3758800.000	98.000				
36	14002240000	SIMPSON, KA	25 MILL PARK ROAD	MILL PARK	54602.000	3759238.000	88.000	110.0	4.5		
37	14002310000	MEYBURG, JM	11 MILL PARK ROAD	MILL PARK	54705.000	3758991.000	90.600	104.0	9.0		
38	14002320000	MOORCROFT, CF	9 MILL PARK ROAD	MILL PARK	54717.000	3758963.000	91.500			60.2	31.3
39	14002370000	ROUX,VJ	2 MILL PARK ROAD	MILL PARK	54821.000	3758940.000	91.600				
40	14002400000	ALAN ORCHARD FAMILY TRUST	5 MC LEAN ROAD	MILL PARK	54855.000	3759023.000	90.000			65	25.5
41	14002400000	ORCHARD, NA	3 MCLEAN ROAD	MILL PARK	54840.000	3759020.000	90.500	96.0	3.5		
42	14002420000	DEWAR, BN	8 MILL PARK ROAD	MILL PARK	54785.000	3759026.000	91.000				
43	14002450000	JONES, IA	10 MILL PARK ROAD	MILL PARK	54757.000	3759087.000	91.000	110.0	4.0		
44	14002600000	VAN ZYL RUDD & ASS, PTY,LTD	18 MILL PARK ROAD	MILL PARK	54716.000	3759191.000	90.000				
45	14002650000	EDUCATIONAL TRUSTEES	GREY HIGH SCHOOL	MILL PARK	55080.000	3759275.000	86.000	125.0	6.0		
46	14003560000	MCCALL, I	10 SALISBURY AVENUE	MILL PARK	55312.790	3759343.680	81.000	110.0	3.0		
47	14003690000	HOPEWELL, EC	5 WAVERLEY DRIVE	MILL PARK	55128.000	3759609.000	76.000	80.0	2.4		
48	14004410000	FORSDICK, AE	1 YOUNG LANE	MILL PARK	54797.000	3759947.000	70.000				
49	14005300000	GOWAR, GB	11 REITZ ROAD	MILL PARK	54862.000	3759715.000	80.000	100.0	3.0		
50	14005610000	OLIVETO	1 LINTON ROAD	MILL PARK	55009.000	3759552.000	78.000				
51	14006200000	GREYVENSTEIN PRIMARY TRUS	2 WOODVILLE ROAD	MILL PARK	55079.000	3759750.000	79.000				
52	14009680000	VIANELLO	10 FAIRFORD AVENUE	MILL PARK	54250.000	3759520.000	80.000	60.0	2.2		
53	14009890000	LAPINER	47 WYCHWOOD AVENUE	MILL PARK	53145.000	3759304.000	87.000	100.0	4.5		
54	14010030000	MORIS, DH	21 WYCHWOOD AVENUE	MILL PARK	53549.000	3759356.000	92.000		6.0		
55	14010260000	MEYER, G	4 CAMDEN ROAD	MILL PARK	53230.000	3759452.000	80.000		2.6	34.1	45.9
56	17001500000	MARAIS	52 KING EDWARD STREET	NEWTON PARK	51991.000	3756937.000	106.000	80.0	2.0	50.7	55.3
57	17002840000	ERASMUS, LB	92 PICKERING STREET	NEWTON PARK	51165.910	3757250.193	122.000	70.0			
58	17008720000	FEDLIFE	GREENACRES	NEWTON PARK	53170.000	3758100.000	106.000	140.0	7.4	57.45	48.55
59	17016790000	LANDMAN	12 WEST STREET	NEWTON PARK	52765.000	3758016.000	108.000	126.0	3.0	56.48	54.7

No.	ERFNO	NAME	STREET ADDRESS	SUBURB	-Y CO-ORD	X CO-ORD	ELEVATION(m)	BH_DEPTH(m)	YIELD(m3/hr)	WLMBGL(m)	WLAMSL(m)
60	17017220000	BRERETON, DN	20 MANGOLD STREET	NEWTON PARK	52880.000	3757619.000	106.000	100.0	2.4		
61	17030090000	METROPOLITAN LIFE LTD	281 CAPE ROAD	NEWTON PARK	52965.350	3757956.920	107.000				
62	17030500000	OLD MUTUAL	GREENACRES	NEWTON PARK	53130.000	3758030.000	106.000		3.0		
63	21000690000	SHEPHERD, SB	108 MARINE DRIVE	SCHOENMAKERSKOP	59727.000	3768115.000	19.000				
64	21001090000	ALGOA REGIONAL SERVICES	"VITAL LINK" FAITH MISSION	SCHOENMAKERSKOP	54150.000	3768830.000	11.000	30.0	1.8	4.6	6.4
65	22006240000	BUYS, ISC	17 VICTORIA PARK DRIVE	SOUTH END	57326.570	3760716.770	59.000			22.07	36.93
66	23000250000		8 BRIGHTON DRIVE	SUMMERSTRAND	61229.000	3761888.000	9.000				
67	23000160000	MOOLMAN, CH	1 3RD AVENUE	SUMMERSTRAND	61242.000	3761731.000	6.000			1.85	4.15
68	23000170000	BLUMBERG, JM	3 3RD AVENUE	SUMMERSTRAND	61233.000	3761757.000	7.000				
69	23000230000	ZONIA PROPERTY TRUST	4 3RD AVENUE	SUMMERSTRAND	61306.000	3761763.000	6.000				
70	23000250000	WEPENER, EP	8 3RD AVENUE	SUMMERSTRAND	61285.000	3761826.000	7.000	30.0	10.0		
71	23000450000	HARTZENBERG, FA	8 2ND AVENUE	SUMMERSTRAND	61170.000	3761857.000	10.000			3.4	6.6
72	23000470000	ALBERTYN, ML	7 BRIGHTON DRIVE	SUMMERSTRAND	61229.470	3761888.090	9.000	13.0	10.0	2.35	6.65
73	23001310000	VAN HEERDEN, PS	34 BRIGHTON DRIVE	SUMMERSTRAND	61637.000	3762184.000	10.000	45.0	4.0		
74	23001480000	ROTHERAY, B	7 9TH AVENUE	SUMMERSTRAND	61953.000	3762182.000	6.000				
75	23001610000	HUISAMEN, GG	2 BOGNOR STREET	SUMMERSTRAND	61767.000	3762285.000	12.000				
76	23001980000	KRUGER, M	17 SCARBOROUGH STREET	SUMMERSTRAND	62015.000	3762370.000	6.000	40.0			
77	23002220000	SPIES, AJ	70 BRIGHTON DRIVE	SUMMERSTRAND	62139.000	3762602.000	7.000				
78	23002330000	DEMAY, JRC	77 BRIGHTON DRIVE	SUMMERSTRAND	62096.000	3762648.000	8.000				
79	23002500000	LONGWORTHY, T	5 ADMIRALITY WAY	SUMMERSTRAND	62356.000	3762640.000	5.300	16.0	4.0	0.66	4.64
80	23002530000	BYRAM, AG	9 ADMIRALTY ROAD	SUMMERSTRAND	62314.000	3762675.000	6.000	20.0	3.0		
81	23005060000	FOURIE, AB	22 BOGNOR ROAD	SUMMERSTRAND	61468.000	3762614.000	20.000	40.0	3.0		
82	23005080000	EDWARDS, JP	18 BOGNOR STREET	SUMMERSTRAND	61520.000	3762584.000	19.000				
83	23005290000	KOORTS, EM	19 NOBBS STREET	SUMMERSTRAND	61328.110	3762723.210	23.000				
84	23005310000	READ, M	28 7TH AVENUE	SUMMERSTRAND	61326.000	3762660.000	23.000	26.0			
85	23005330000	REEDERS, AJ	24 7TH AVENUE	SUMMERSTRAND	61332.000	3762602.000	22.000				
86	23005400000	PLACKETT, CK	15 JENVEY STREET	SUMMERSTRAND	61964.000	3762597.000	10.000				
87	23005790000	CONNACHER, KH	21 BRADLEY ROAD	SUMMERSTRAND	61749.000	3763009.000	21.800	32.0	4.5	2.04	19.76
88	23006160000	GRAHAM, RC	21 ADMIRALTY WAY	SUMMERSTRAND	62141.000	3762843.000	11.000				
89	23006930000	DITSHOFF, IT	8 ERASMUS AVENUE	SUMMERSTRAND	61353.000	3763092.000	27.000				
90	23006950000	SCHONEGEVEL,NC	4 ERASMUS AVENUE	SUMMERSTRAND	61368.000	3763154.000	28.000				
91	23007650000	BEETTIGER, MA	8 SHERINGHAM STREET	SUMMERSTRAND	61213.000	3762422.000	22.000	30.0	7.0		
92	23007840000	LUDERS, FW	41 ERASMUS AVENUE	SUMMERSTRAND	61072.000	3762723.000	26.000	43.0			
93	23007890000	TRUSTEES OF MARCLA TRUST	44 ERASMUS AVENUE	SUMMERSTRAND	60957.000	3762768.000	28.000				
94	23008120000	MICHAEL, H	33 SOUTH PORT ROAD	SUMMERSTRAND	61000.000	3762555.000	27.000				
95	23008620000	PELLE, PJW	13 AVONMOUTH CRESCENT	SUMMERSTRAND	60704.000	3762512.000	30.000				
96	23008840000	CHERRY, HT	30 AVONMOUTH CRESCENT	SUMMERSTRAND	60555.000	3762544.000	30.000				
97	23012710000	GOUDBERG, VE	11 7TH AVENUE	SUMMERSTRAND	61575.630	3762095.170	8.000	30.0			
98	23014100000	CHURCH, KA	5 KOLBE CRESCENT	SUMMERSTRAND	60364.000	3762682.000	32.000			27.5	4.5
99	23014160000	SCHNETLER, ES	17 KOLBE CRESCENT	SUMMERSTRAND	60403.000	3762815.000	34.000	50.0	16.0		
100	23014350000	BRADSHAW, JH	64 WINCHESTER WAY	SUMMERSTRAND	60310.000	3762684.000	38.000	32.0	8.0		
101	23014400000	SCEMMER, F	31 KOLBE CRESCENT	SUMMERSTRAND	60474.000	3762683.000	32.000				
102	23014550000	GROBLER, LC	14 LOUIS BOTHA CRESCEN	SUMMERSTRAND	60817.000	3762831.000	30.000				
103	23014660000	DELPORT, HJ	1 BURGER STREET	SUMMERSTRAND	61200.000	3762861.000	26.000	40.0	3.0		
104	23014670000	HOLANI, AP	3 BURGER STREET	SUMMERSTRAND	61180.000	3762897.000	26.500	40.0	3.0		
105	23014690000	HATTINGH, DJH	34 LOUIS BOTHA CRESCEN	SUMMERSTRAND	61131.000	3762864.000	26.500				
106	23014720000	BLUMBERG, AV	44 LOUIS BOTHA CRESCEN	SUMMERSTRAND	61260.000	3762983.000	28.000				
107	23015000000	TUTTON, CW	2 MARITZ STREET	SUMMERSTRAND	60553.000	3763040.000	34.000			5.45	28.55
108	23015010000	ROBEY, BD	23 BEYERS ROAD	SUMMERSTRAND	60567.000	3763075.000	34.000	78.0	16.0		
109	23015100000	DIPPENAAR, MJ	90 LOUIS BOTHA AVENUE	SUMMERSTRAND	60735.420	3763254.540	33.000				
110	23015190000	MARSHALL, A	89 ADMIRALTY ROAD	SUMMERSTRAND	60867.000	3763276.000	31.500	30.0	4.8		
111	23015680000	SNYDERS, PJ	10 HATTINGH ROAD	SUMMERSTRAND	60925.000	3762988.000	29.800				
112	23016570000	PETROV, S	28 VIGNE ROAD	SUMMERSTRAND	60252.000	3762902.000	37.000				
113	23016760000	KRIGE, IA	11 VIGNE ROAD	SUMMERSTRAND	59975.000	3762815.000	40.000	50.0	10.0		
114	23016800000	HENDRIN PROPERTIES CC	19 VIGNE ROAD	SUMMERSTRAND	60055.000	3762860.000	37.000				
115	23016880000	DORFLING, NJ	20 BULBRING ROAD	SUMMERSTRAND	60012.000	3762890.000	40.000				
116	23016930000	VAN RENSBERG	10 BULBRING ROAD	SUMMERSTRAND	59912.000	3762833.000	38.500	70.0		6.58	32.42
117	23016940000	GREYVENSTEIN, R	8 BULBRING ROAD	SUMMERSTRAND	59892.000	3762821.000	38.500	42.0			
118	23016950000	BERNADE, AJ	6 BULBRING ROAD	SUMMERSTRAND	59871.000	3762810.000	38.500				

No.	ERFNO	NAME	STREET ADDRESS	SUBURB	-Y CO-ORD	X CO-ORD	ELEVATION(m)	BH_DEPTH(m)	YIELD(m3/hr)	WLMBGL(m)	WLAMSL(m)
119	23016970000	SCHULTZ, SP	27 VIGNE AVENUE	SUMMERSTRAND	60163.510	3762922.490	40.000	60.0			
120	23017170000	TEMPLER, BM	30 BULBRING ROAD	SUMMERSTRAND	60140.000	3762962.000	41.000	42.0	3.0		
121	23017360000	BOSCH, JK	68 WINCHESTER ROAD	SUMMERSTRAND	60270.000	3762750.000	33.000	60.0	3.0	13	20
122	23019050000	WIESE, TG	9 KOLBE CRESCENT	SUMMERSTRAND	60329.800	3762739.370	34.000	40.0	10.0		
123	23021100000	PIENAAR, DR	24 HARVEY STREET	SUMMERSTRAND	59832.000	3763164.000	46.000			7.1	38.9
124	23021610000	CROSS, MA	5 SOLOMON CLOSE	SUMMERSTRAND	60160.380	3762072.150	30.000	96.0			
125	23021830000	HART, EE	4 MILLER STREET	SUMMERSTRAND	60095.000	3762201.000	33.000	90.0	6.0		
126	24000960000	MILLER, IJW	18 CAMELIA CRESCENT	SUNDRIDGE PARK	49097.000	3757911.000	132.000	50.0	4.0		
127	24003020000	BUWALDA, CM	58 HONEYSUCKLE AVENUE	SUNDRIDGE PARK	48618.000	3758639.000	138.000	60.0	4.5		
128	24004620000	CROUSE, E	7 SUNRIDGEPARK AVENUE	SUNRIDGEPARK	49448.000	3757651.000	123.000				
129	27000200000	WILLIAMS, A	4 BOSHOFF STREET	WESTERING	48358.000	3757368.000	143.000			0.9	142.1
130	27006880000	PEINKE	15 COSMOS STREET	WESTERING	47812.790	3756403.070	140.000	105.0	2.0	108.28	31.72
131	30012220000	SCHEEPERS, G	2 FILIPPUS	THEESCOMBE	45646.970	376096.709	3.000				
132	32000170000	HOUZE, AAP	87/89 9TH AVENUE	WALMER	53600.000	3760460.000	60.000				
133	32000300000	PEARSON, NP	20 ALCOCK ROAD	WALMER	54316.000	3760188.000	64.000	100.0	1.2		
134	32000470000	CLARENDON PARK SCHOOL	50 SEVENTH AVENUE	WALMER	54350.000	3760570.000	70.500	100.0	7.2		
135	32000570000	BENADE, W	29 SHORT ROAD	WALMER	53304.000	3760872.000	81.000	100.0	1.2		
136	*32000620000*	*RUBIN*	*197 CHURCH ROAD*	*WALMER*	*52256.000*	*3761129.000*	*90.000*	*100.0*	*3.0*		
137	32001060000	DAKIN	132 CHURCH ROAD	WALMER	53425.000	3761147.000	68.000				
138	32001090000	DIX-PEEK, BM	27 11TH AVENUE	WALMER	53199.000	3761323.000	72.000			11	6.4
139	32001790000	EXLEY, FR	12 11TH AVENUE	WALMER	53190.000	3761589.000	80.000	93.0	10.0	5.73	74.27
140	32002890000	VOSLOO, PW	56 ALBERT ROAD	WALMER	56041.000	3761235.000	59.000	45.0			
141	32003400000	MOLYNEAUX, JA	20 THOMAS ROAD	WALMER	54220.000	3760005.000	46.000				
142	32004660000	SNIJMAN, CJA	69 9TH AVENUE	WALMER	53743.050	3760706.600	70.000	90.0	6.0		
143	*32004730000*	*ROGERS, AC*	*9 SHORT ROAD*	*WALMER*	*53565.000*	*3760790.000*	*77.000*				
144	32004820000	RAYNER, HM	110 RIVER ROAD	WALMER	53172.000	3760888.000	81.000	110.0	1.2		
145	32004870000	LANE, BA	98 SHORT ROAD	WALMER	52550.000	3761098.000	86.000				
146	32004960000	ADLER, AJ	68 SHORT ROAD	WALMER	52963.000	3761118.000	79.000	110.0	2.0		
147	32004980000	CORNISH, C	64SHORT ROAD	WALMER	53010.000	3761117.000	79.000	102.0	3.0	4.3	74.4
148	32005700000	TWL INVESTMENT TRUST	6 SHORT ROAD	WALMER	53675.000	3760839.000	74.000				
149	32006560000	JUDD, BJ	104 CHURCH ROAD	WALMER	53763.000	3760991.910	66.000				
150	*32006640000*	*PUTTER, J*	*160 CHURCH ROAD*	*WALMER*	*53174.000*	*3761256.000*	*73.000*	*110.0*	*2.5*		
151	32006910000	LUWMI TRUST	230 CHURCH ROAD	WALMER	52325.000	3761247.000	89.000				
152	32007270000	SEAMAN, VN	236 WATER ROAD	WALMER	52539.000	3761410.000	85.000	100.0	3.0		
153	32007600000	SCHECKTER, SB	17 11TH AVENUE	WALMER	53237.170	3761498.260	77.000	110.0	2.5		
154	32007990000	DIAS, LC	112 WATER ROAD	WALMER	53817.000	3761184.000	64.000				
155	32008000000	BOOYSEN FAMILY TRUST	110 WATER ROAD	WALMER	53827.740	3761129.050	62.000				
156	32008670000	BENNETT, AC	41 MAIN ROAD	WALMER	54981.150	3760682.440	70.000			35.38	34.62
157	32010100000	MENZIES, P	192 MAIN ROAD	WALMER	53312.000	3761559.000	78.000				
158	32010120000	MARKRAM, A	194 MAIN ROAD	WALMER	53286.000	3761568.000	79.000	100.0		5	74
159	32010740000	WIEGAND, H	287 VILLIERS ROAD	WALMER	52336.000	3761645.000	100.000				
160	32010770000	PARK, TR	281 VILLIERS ROAD	WALMER	52430.000	3761654.000	100.000				
161	32010820000	ROBERTSON, HBD	158 PROSPECT ROAD	WALMER	53556.730	3761637.390	79.000				
162	32010840000	REID, GE	227 VILLIERS ROAD	WALMER	53606.000	3761654.000	79.000	70.0	2.0		
163	32011070000	KNUTH, RB	185 FORDYCE ROAD	WALMER	54142.000	3761436.000	72.000	109.0			
164	32012980000	VAN STADEN, PJ	52 FORDYCE ROAD	WALMER	55876.000	3760762.000	66.000				
165	32015600000	VAN DER MERWE, AG	95 HEUGH ROAD	WALMER	55580.370	3761152.590	65.000	103.0	8.0		
166	32015850000	FERREIRA, SG	74 VILLIERS ROAD	WALMER	55850.000	3760951.000	66.000				
167	32017500000	CADLE, B	67 ALBERT ROAD	WALMER	55931.000	3761198.000	60.000	110.0			
168	32017630000	ELLIS,SS	94 HEUGH ROAD	WALMER	55641.000	3761234.000	62.000	75.0	8.0		
169	32018840000	COLESKE, WJ	5 3RD AVENUE	WALMER	56232.000	3761201.000	59.000	86.0			
170	32019340000	PE MUNICIPALITY	EIGHTH AVENUE	WALMER	54130.640	3761045.190					
171	32019350000	PE MUNICIPALITY	KING EDWARD PARK	WALMER	53690.810	3762029.400	90.000	58	10	11.5	82
172	32019350000	WALMER COUNTRY CLUB NO.1	BUFFELSFONTEIN ROAD	WALMER	52495.000	3762895.000	107.000			12.5	78.5
173	32019350000	WALMER COUNTRY CLUB NO.2	BUFFELSFONTEIN ROAD	WALMER	52925.000	3762555.000	101.000				
174	32019350000	WALMER COUNTRY CLUB NO.3	BUFFELSFONTEIN ROAD	WALMER	53460.000	3762645.000	96.000				
175	32019350000	WALMER COUNTRY CLUB NO.4	BUFFELSFONTEIN ROAD	WALMER	52932.000	3762216.000	103.000				
176	32019480000	PE KENNEL CLUB	VICTORIA DRIVE	WALMER	55654.200	3763403.950	103.000	50.0	3.0		

No.	ERFNO	NAME	STREET ADDRESS	SUBURB	-Y CO-ORD	X CO-ORD	ELEVATION(m)	BH_DEPTH(m)	YIELD(m3/hr)	WLMBGL(m)	WLAMSL(m)
177	32019480000	TELKOM CLUB	VICTORIA DRIVE	WALMER	52540.000	3764120.000	110.000				
178	32019810000	HARTY, JP	12 NEWCOMBE AVENUE	WALMER	50109.560	3763293.540	144.000			31.5	112.5
179	32019820000	HOGG, BK	10 IDYLWYDE CRESCENT	WALMER	51139.000	3763234.000	140.000				
180	32020080000	SOFOKLEOUS, V	187 HEUGH ROAD	WALMER	54548.000	3761598.000	62.200				
181	32020350000	REPTON, PJ	132 PROSPECT ROAD	WALMER	53644.000	3761632.000	78.000				
182	32020440000	GRAHAM, SJ	15 ST JOHNS AVENUE	WALMER	53841.000	3760607.000	54.000				
183	32025500000	VAN DER WALT, A	74 RIVER ROAD	WALMER	53623.000	3760684.000	70.000			19.53	50.47
184	32025850000	MALHERBE, AL	231 WATER ROAD	WALMER	53202.000	3761314.000	89.000	72.0	3.0		
185	32025980000	MATTHEWS, PD	113 WATER ROAD	WALMER	53600.450	3761161.060	64.000				
186	32026390000	KEMP, ES	10 4TH AVENUE	WALMER	55800.000	3761360.000	59.000	60.0			
187	32026450000	TAVERNER, SM	125 CHURCH ROAD	WALMER	53197.000	3761143.000	74.000	100.0	3.0		
188	32026570000	CHURCH, SM	186 CHURCH ROAD	WALMER	52871.000	3761272.000	80.000	90.0	3.0		
189	32026890000	BEYLEVELD, HJJ	34 SHORT ROAD	WALMER	53301.000	3761021.400	76.000	100.0	2.0		
190	32026920000	HOFMEYER, ALC	99 CHURCH ROAD	WALMER	53470.000	3761035.000	76.000	140.0	1.2		
191	32027230000	CONNELLAN, PM	54 THOMAS ROAD	WALMER	53908.000	3760186.000	75.000	100.0	1.8		
192	32027530000	EASTWOOD, JC	159 PROSPECT ROAD	WALMER	53730.000	3761460.000	72.000			5.75	72.25
193	32028030000	COOK, RP	30 12TH AVENUE	WALMER	53752.000	3760600.000	81.000	18.0	12.0		
194	32028050000	KOHLER, LE	70 RIVER ROAD	WALMER	53752.000	3760600.000	64.000	108.0	7.0		
195	32028230000	MC WILLIAMS, PJ	41 10TH AVENUE	WALMER	53510.000	3761020.000	74.000	112.0	9.0		
196	32028350000	PERROTT, JR	49 SHORT ROAD	WALMER	53130.000	3761000.000	79.000	38.0			
197	32028600000	BLUMBERG, SA	12 DORMY PLACE	WALMER	51982.000	3760923.000	90.000			1	89
198	32028810000	MILLER, P	6 CLUB ROAD	WALMER	52288.000	3760925.000	88.000			2.73	77.27
199	32028890000	RUDMAN, LV	32 GOLF ROAD	WALMER	52508.000	3760794.000	84.000	80.0	1.2		
200	32028970000	STRYDOM, CJ	10 CLUB ROAD	WALMER	52470.000	3760849.000	85.000				
201	32029000000	VISSER, FC	1 CLUB ROAD	WALMER	52359.000	3760974.000	87.000	110.0			
202	32029010000	HILL, ER	3 CLUB ROAD	WALMER	52363.000	3760931.000	87.000	72.0	2.5	1.5	86.5
203	32029050000	KEHL, HJ	140 RIVER ROAD	WALMER	52491.000	3760932.000	86.000	30.0			
204	32029070000	LEVIN, R	77 SHORT ROAD	WALMER	52515.000	3760998.000	86.000	85.0	2.5		
205	32030330000	VAN AARDE, FJ	10 ALCOCK ROAD	WALMER	54439.000	3760128.000	36.000				
206	32030480000	BALL, BS	15 WATER ROAD	WALMER	54896.000	3760549.000	70.000				
207	32030630000	SCOTT, PA	5 HILLBROW PLACE	WALMER	54900.000	3760471.000	69.000				
208	32033330000	DU PLESSIS, YS	16 11TH AVENUE	WALMER	53158.000	3761483.000	77.000	114.0	3.6	3	74
209	32036260000	SKINNER, DHG	166 WATER ROAD	WALMER	53243.000	3761410.000	73.000				
210	32036490000	BRETT, ES	146 CHURCH ROAD	WALMER	53327.000	3761195.000	70.000				
211	32038800000	HERMAN,GS	17 13TH AVENUE	WALMER	52535.000	3761281.000	85.000	100.0	4.5		
212	32038810000	WILLIAMS, MA	214 CHURCH ROAD	WALMER	52537.000	3761248.000	85.000				
213	32038820000	BOOYSEN, L	38 CHURCH ROAD	WALMER	54540.000	3760606.950	72.000	110.0	3.0		
214	32039640000	PLEKKER	152 PROSPECT ROAD	WALMER	53620.000	3761610.000	78.000				
215	32039860000	MILLWOOD CORNER BODY	162 MAIN ROAD	WALMER	53703.000	3761398.000	71.000				
216	32040170000	PEDERSEN, C	10 IDYLWYLDE CRESCENT	WALMER HEIGHTS	51150.000	3763310.000	143.000	69.0	2.0	29.7	110.3
217	32040180000	GAIL TAVERNER TRUST	86 SHORT ROAD	WALMER	52699.000	3761111.000	83.000				
218	32040370000	SPEYERS, SA	135 CHURCH ROAD	WALMER	53042.240	3761146.060	78.000				
219	32040730000	ROBERTSON, B	6 LIONEL ROAD	WALMER	51737.000	3759846.000	105.000			1.2	103.8
220	32041360000	EHINGER, L	75 SHORT ROAD	WALMER	52591.000	3761012.000	85.000				
221	32041370000	MOLLER, JJ	75 SHORT ROAD	WALMER	52571.370	3760967.330	85.000	100.0	3.0		
222	32041510000	VERNON GRAMANDA SCHOOL	HEUGH ROAD	WALMER	54430.000	3761940.000	70.000				
223	32041520000	BRICKNELL, NW	141 PROSPECT ROAD	WALMER	53892.870	3761400.880	70.000				
224	32041730000	SUNDE, HP	53 SHORT ROAD	WALMER	53033.060	3761030.000	79.000	30.0	0.9		
225	32041990000	ADLER, VJ	49 10TH AVENUE	WALMER	53427.000	3760801.000	80.000				
226	32048010000	LLOYD, CPA	52 SHORT ROAD	WALMER	53101.860	3761069.680	75.000				
227	32050150000	FOGARTY, TG	43 CHURCH ROAD	WALMER	54500.440	3760530.980	71.000				
228	32050160000	DATMAN	39 CHURCH ROAD	WALMER	54790.281	3761103.062	72.000			33.2	38.8
229	33000760000	COOK, RA	19 KITCHING ROAD	CHARLO	50752.000	3762275.000	125.000				
230	33014730000	KUSTERER, WE	14 MARTIN ROAD	CHARLO	50869.250	3761780.502	118.000	85.0	7.0		
231	360 0000	DOUGLAS-JONES, AJ	12 WOODLANDS AVE	LORRAINE				80	2.5	12	116
232	36000850000	VAN DER MERWE, SD	66 VERDUN ROAD	LORRAINE	46612.000	3760608.000	156.000				
233	36000930000	DU TOIT, LM	98 VERDUN ROAD	LORRAINE	46923.000	3760663.000	156.000	70.0		5.7	150.3
234	36017550000	SEAMAN, D	262 KRAGGA KAMMA ROAD	LORRAINE	46615.760	3759561.900		100.0		1.5	
235	36019180000	SAMUELS, DA	29 LOURDES AVE	LORRAINE	47265.000	3759864.000	137.000			0.67	136.33

No.	ERFNO	NAME	STREET ADDRESS	SUBURB	-Y CO-ORD	X CO-ORD	ELEVATION(m)	BH_DEPTH(m)	YIELD(m3/hr)	WLMBGL(m)	WLAMSL(m)
236	36054090000	PARKER, AH	ASCOT STUD	THEESCOMBE	47611.956	3761750.750	94.500	68		58	36.5
237	99002980000	MACKAY	MELLOWMEAD	LOVEMORE PARK	46745.593	3765654.594	53.000			7	46
238	99002860000	MAHLERT	ALTMARK	LOVEMORE PARK	46724.533	3765554.660	58.200			33.6	24.6

Boreholes outside of the PE municipal area

No.	ERFNO	NAME	STREET ADDRESS	SUBURB	-Y CO-ORD	X CO-ORD	ELEVATION(m)	BH_DEPTH(m)	YIELD(m3/hr)	WLMBGL(m)	WLAMSL(m)
239	990 0000	GREEF W.	GLENDORE ROAD	THEESCOMBE	51423.971	3746261.871	114.000			10	104
240	990 0000	WADE T.	GLENDORE ROAD	THEESCOMBE	51424.922	3746443.627	125.000			11	114
241	99000180000	CILLIE, H	KRAGGA KAMMA ROAD	THEESCOMBE	42312.792	3760845.005	195.000			1.7	178.3
242	99000460000	THEOPHILUS, AJ	GREENBUSHES	THEESCOMBE	39775.920	3761278.550	180.000	186.0	4.0	29.7	113.3
243	99002850000	ELIOT	CROSSWINDS	LOVEMORE PARK	46382.658	3765575.162	50.500			23.7	26.6
244	99002860000	FUGARD	ASHRAM	LOVEMORE PARK	46582.937	3765546.567	56.100			5.65	50.45
245	99003050000	PUFFETT, R	843 SARDINIA BAY ROAD	LOVEMORE PARK	48491.871	3765262.214	91.000	94		10.45	80.55
246	99003410000	NICKELSON	OVER-THE-MOON	LOVEMORE PARK	47674.276	3765583.432	76.100			7.6	68.5
247	99003450000	BARTLETT		LOVEMORE PARK	47354.776	3765439.476	72.900			43	29.9
248	99003510000	DANHOER	SCOTSAM	LOVEMORE PARK	47018.087	3765034.779	81.900	220		9.17	72.73
249	99003510000	LONG, S	SCOTSAM	LOVEMORE PARK				220		9.2	70.8
250	99004090000	PUFFETT, R	843 SARDINIA BAY ROAD	LOVEMORE PARK							
251	99007400000	STONE, TC	STONE'S THROW	LOVEMORE PARK	48140.731	3764679.926	103.800			10.7	84.3
252	99007780000	ONVLEE, C	250 KRAGGA KAMMA ROAD	KRAGGA KAMMA	46815.000	3759360.000	127.000				
253	99019350000	PE TURF CLUB	ARLINGTON R. COURSE NO.	ARLINGTON	51535.000	3763685.000	113.000	18	7	20	94
254	99019480000	ROVER MOTORCROSS	VICTORIA DRIVE	THEESCOMBE	51375.000	3765620.000	97.000				
255	99019520000	WELLS J.	GLENDORE ROAD NO2	THEESCOMBE	51330.000	3764420.000	112.000				
256	99019520000	WELLS J.	GLENDORE ROAD NO3	THEESCOMBE	51500.000	3764436.000	115.000				
257	99019520000	WELLS J.	GLENDORE ROAD NO4	THEESCOMBE	51480.000	3764410.000	115.000				
258	99019520000	WELLS J.	GLENDORE ROAD NO1	THEESCOMBE	51290.000	3764440.000	112.000				
259	99040340000	PE TURF CLUB	ARLINGTON R. COURSE NO.	ARLINGTON	51915.000	3763632.000	110.000		7	4	106

Erf. No.	Bh.No.	Date	Address	-Y-Co-ord	-X-Co-ord	EC	Turb.	TDS	TA	BCA	CH	NCH	TH	Ca	Mg	Cl	Fe(t)	Na	K	SO4	NO3-N	F	N
									CaCO3	CaCO3	CaCO3	CaCO3	CaCO3	CaCO3	CaCO3								
04019000000	37	21-Jul-93	Donkin Reserve	57290.000	3759405.000	91										112							
04019000000	37	10-Aug-93	Donkin Reserve	57290.000	3759405.000	91										132				73	26.0		115.092
04019000000	37	12-Jun-95	Donkin Reserve	57290.000	3759405.000	104		694								153				75	31.0		137.225
04031820000	24	18-Jun-93	Crusaders Club	56380.000	3759900.000	301	4.9	2210	379	379	379	210	589	356	233	277	0.15	186	345.0	263	152.0	0.19	672.843
04031820000	24	17-Jul-93	Crusaders Club	56380.000	3759900.000	135										266							
04031820000	24	10-Aug-93	Crusaders Club	56380.000	3759900.000	118	2.1	666	85	85	85	48	133	39	94	216	0.06	176	7.0	102	7.4	0.17	32.7568
04031820000	24	25-Oct-93	Crusaders Club	56380.000	3759900.000	102										203				78	8.5		37.6261
04031820000	24	20-Nov-93	Crusaders Club	56380.000	3759900.000	104										193				74	0.4		1.77064
04031820000	24	14-Dec-93	Crusaders Club	56380.000	3759900.000	103										178				64	0.3		1.28371
04031820000	24	24-Feb-94	Crusaders Club	56380.000	3759900.000	92	0.7		44	44	44	69	113	37	76	242		162	11.0		9.3		41.1674
04031820000	24	17-Mar-94	Crusaders Club	56380.000	3759900.000	93	0.6		53	53						181				65	8.9		39.3967
04031820000	24	21-Apr-94	Crusaders Club	56380.000	3759900.000	94	0.2	544	47	47	47	70	117	42	75	186	0.05	167	6.0	84	3.5	0.10	15.4931
04031820000	24	20-May-94	Crusaders Club	56380.000	3759900.000	112	0.4	654								221				81	6.5		28.7729
04031820000	24	21-Jun-94	Crusaders Club	56380.000	3759900.000	95	0.2	562	54	54	54	45	99	30	69	181	0.04	151	5.0	68	7.1	0.12	31.4289
04031820000	24	07-Jul-94	Crusaders Club	56380.000	3759900.000	94	0.4	546	52	52	52	29	81	22	59	197	0.11	142	3.0	69	8.4	0.11	37.1834
04031820000	24	31-Aug-94	Crusaders Club	56380.000	3759900.000	102		644								180				73	0.1		0.61972
04031820000	24	21-Sep-94	Crusaders Club	56380.000	3759900.000	111		710								219				86	7.6		33.6422
04031820000	24	26-Sep-94	Crusaders Club	56380.000	3759900.000	97		572								188				73	8.7		38.5114
04031820000	24	12-Oct-94	Crusaders Club	56380.000	3759900.000	123	0.7	698	102	102	102	61	163	62	101	239	0.01	177	12.0	95	7.7	0.21	34.0848
04031820000	24	10-Nov-94	Crusaders Club	56380.000	3759900.000	127		812								269				107	6.8		30.1009
04031820000	24	08-Dec-94	Crusaders Club	56380.000	3759900.000	94		600								212				81	8.7		38.5114
04031820000	24	05-Jan-95	Crusaders Club	56380.000	3759900.000	149	0.9	1076	83	83	83	148	231	125	106	216	0.04	167	45.0	136	31.0	0.11	137.225
04031820000	24	15-Mar-95	Crusaders Club	56380.000	3759900.000	126		748								244				101	6.9		30.5435
04031820000	24	16-Mar-95	Crusaders Club	56380.000	3759900.000	123		804								238				101	7.0		30.9862
04031820000	24	05-May-95	Crusaders Club	56380.000	3759900.000	97	0.7	646	62	62	62	46	108	33	75	181	0.05	153	6.0	77	1.8	0.09	7.96788
04031820000	24	09-May-95	Crusaders Club	56380.000	3759900.000	109		696								201				78	6.6		29.2156
04031820000	24	01-Jun-95	Crusaders Club	56380.000	3759900.000	110		778								215				88	5.3		23.461
04031820000	24	12-Jun-95	Crusaders Club	56380.000	3759900.000	116		746								242				102	5.7		25.2316
04031820000	43	17-Nov-93	PEM St.Georges Park	56240.000	3759375.000	180										437				85	0.1		0.22133
04034050000	16	07-Jun-93	8 Hallack Road	55569.000	3760077.000	183	0.3	1056	48	48	48	147	195	75	120	511	0.02	286	5.0	135	4.4	0.12	19.477
04034050000	16	17-Jul-93	8 Hallack Road	55569.000	3760077.000	180										490							
04034050000	16	10-Aug-93	8 Hallack Road	55569.000	3760077.000	174										483				97	3.6		15.9358
04034050000	16	14-Sep-93	8 Hallack Road	55569.000	3760077.000	177	2.5	1012	41	41	41	185	226	85	141	462	0.44	291	5.0	73	3.6	0.12	15.9358
04034050000	16	16-Nov-93	8 Hallack Road	55569.000	3760077.000	177										356				140	3.5		15.4931
04034050000	16	12-Jan-94	8 Hallack Road	55569.000	3760077.000	164	0.2	982	42	42	42	148	190	69	121	490	0.01	254	4.5	86	2.8	0.12	12.3945
04034050000	16	08-Feb-94	8 Hallack Road	55569.000	3760077.000	174	2.5		41	41	41	195	236	88	148	437		284	10.0	86	3.6		15.9358
04034050000	16	10-Feb-94	8 Hallack Road	55569.000	3760077.000																		
04034050000	16	09-Mar-94	8 Hallack Road	55569.000	3760077.000	181	0.8		43	43						462				80	4.4		19.477
04034050000	16	14-Apr-94	8 Hallack Road	55569.000	3760077.000	183	0.6	976	41	41	41	224	265	104	161	460	0.01	316	8.0	85	4.9	0.35	21.6903
04034050000	16	09-May-94	8 Hallack Road	55569.000	3760077.000	173	0.3	966	41	41						490				93	4.1		18.1491
04034050000	16	09-Jun-94	8 Hallack Road	55569.000	3760077.000	182		1014								460				103	4.3		19.0344
04034050000	16	13-Jul-94	8 Hallack Road	55569.000	3760077.000	185	0.3	1006	49	49	49	153	202	78	124	501	0.36	318	4.0	83	4.8	0.05	21.2477
04034050000	16	10-Aug-94	8 Hallack Road	55569.000	3760077.000	182		1010								422				83	5.1		22.5757
04034050000	16	14-Sep-94	8 Hallack Road	55569.000	3760077.000	181		1044								465				86	4.9		21.6903
04034050000	16	12-Oct-94	8 Hallack Road	55569.000	3760077.000	183	2.5	1150	57	57	57	156	213	82	131	472	0.26	270	9.0	92	4.3	0.21	19.0344
04034050000	16	12-Dec-94	8 Hallack Road	55569.000	3760077.000	177		1012								316				93	5.0		22.133
04034050000	16	10-Jan-95	8 Hallack Road	55569.000	3760077.000	184	0.4	1110	45	45	45	168	213	82	131	419	0.01	273	8.0	91	4.7	0.05	20.805
04034050000	16	09-Feb-95	8 Hallack Road	55569.000	3760077.000	183		986								446				97	5.0		22.133
04034050000	16	10-Mar-95	8 Hallack Road	55569.000	3760077.000	182		1156								371				94	4.6		20.3624
04034050000	16	11-Apr-95	8 Hallack Road	55569.000	3760077.000	181	1.7	1028	46	46	46	152	198	75	123	432	0.02	278	8.0	94	4.0	0.05	17.7064
04034050000	16	09-May-95	8 Hallack Road	55569.000	3760077.000	182		1012								428				80	4.5		19.9197
04034050000	16	12-Jun-95	8 Hallack Road	55569.000	3760077.000	181.9		972								389				100	4.3		19.0344
04035960000	38	21-Jul-93	Fort Frederick	57435.000	3759820.000	77										92							
04035960000	38	10-Aug-93	Fort Frederick	57435.000	3759820.000	74										94				70	9.7		42.938
04035960000	38	09-May-94	Fort Frederick	57435.000	3759820.000	77	45.0	508	99	99						101				85	10.3		45.594
04035960000	38	14-Jul-94	Fort Frederick	57435.000	3759820.000	85	19.0	620	116	116	116	22	138	62	76	114	0.25	104	5.0	83	13.1	0.23	57.9885
06000560000	2	03-Jun-93	3 Whitney Street	50952.464	3757754.59	75	1.5	422	26	26	26	45	71	23	48	152	0.08	105	3.0	60	3.9	0.10	17.2637
06000560000	2	10-Aug-93	3 Whitney Street	50952.464	3757754.59	87										199				63	3.0		13.2798
06000560000	2	14-Sep-93	3 Whitney Street	50952.464	3757754.59	98	1.1	520	17	17	17	103	120	43	77	239	0.03	160	4.0	46	1.5	0.11	6.6399
06000560000	2	16-Nov-93	3 Whitney Street	50952.464	3757754.59	90										241				44	1.8		7.96788
06000560000	2	12-Jan-94	3 Whitney Street	50952.464	3757754.59	93	0.5	488	16	16	16	71	87	29	58	230	0.02	134	1.6	38	1.7	0.05	7.52522
06000560000	2	08-Feb-94	3 Whitney Street	50952.464	3757754.59	100	0.9		24	24	24	85	109	36	73	256		156	6.0	40	1.4		6.19724
06000560000	2	10-Feb-94	3 Whitney Street	50952.464	3757754.59																		
06000560000	2	09-Mar-94	3 Whitney Street	50952.464	3757754.59	80	4.6		69	69						151				53	1.9		8.41054
06000560000	2	14-Apr-94	3 Whitney Street	50952.464	3757754.59	93	0.6	488	17	17	17	97	114	46	68	245	0.03	158	4.0	45	1.9	0.05	8.27774
06000560000	2	09-May-94	3 Whitney Street	50952.464	3757754.59	90	0.4	490	15	15						226				47	2.3		10.1812

Erf. No.	Bh.No.	Date	Address	-Y-Co-ord	-X-Co-ord	EC	Turb.	TDS	TA	BCA	CH	NCH	TH	Ca	Mg	Cl	Fe(t)	Na	K	SO4	NO3-N	F	N
									CaCO3	CaCO3	CaCO3	CaCO3	CaCO3	CaCO3	CaCO3								
04019000000	37	21-Jul-93	Donkin Reserve	57290.000	3759405.000	91										112							
04019000000	37	10-Aug-93	Donkin Reserve	57290.000	3759405.000	91										132				73	26.0		115.092
04019000000	37	12-Jun-95	Donkin Reserve	57290.000	3759405.000	104		694								153				75	31.0		137.225
04031820000	24	18-Jun-93	Crusaders Club	56380.000	3759900.000	301	4.9	2210	379	379	379	210	589	356	233	277	0.15	186	345.0	263	152.0	0.19	672.843
04031820000	24	17-Jul-93	Crusaders Club	56380.000	3759900.000	135										266							
04031820000	24	10-Aug-93	Crusaders Club	56380.000	3759900.000	118	2.1	666	85	85	85	48	133	39	94	216	0.06	176	7.0	102	7.4	0.17	32.7568
04031820000	24	25-Oct-93	Crusaders Club	56380.000	3759900.000	102										203				78	8.5		37.6261
04031820000	24	20-Nov-93	Crusaders Club	56380.000	3759900.000	104										193				74	0.4		1.77064
04031820000	24	14-Dec-93	Crusaders Club	56380.000	3759900.000	103										178				64	0.3		1.28371
04031820000	24	24-Feb-94	Crusaders Club	56380.000	3759900.000	92	0.7		44	44	44	69	113	37	76	242		162	11.0		9.3		41.1674
04031820000	24	17-Mar-94	Crusaders Club	56380.000	3759900.000	93	0.6		53	53						181				65	8.9		39.3967
04031820000	24	21-Apr-94	Crusaders Club	56380.000	3759900.000	94	0.2	544	47	47	47	70	117	42	75	186	0.05	167	6.0	84	3.5	0.10	15.4931
04031820000	24	20-May-94	Crusaders Club	56380.000	3759900.000	112	0.4	654								221				81	6.5		28.7729
04031820000	24	21-Jun-94	Crusaders Club	56380.000	3759900.000	95	0.2	562	54	54	54	45	99	30	69	181	0.04	151	5.0	68	7.1	0.12	31.4289
04031820000	24	07-Jul-94	Crusaders Club	56380.000	3759900.000	94	0.4	546	52	52	52	29	81	22	59	197	0.11	142	3.0	69	8.4	0.11	37.1834
04031820000	24	31-Aug-94	Crusaders Club	56380.000	3759900.000	102		644								180				73	0.1		0.61972
04031820000	24	21-Sep-94	Crusaders Club	56380.000	3759900.000	111		710								219				86	7.6		33.6422
04031820000	24	26-Sep-94	Crusaders Club	56380.000	3759900.000	97		572								188				73	8.7		38.5114
04031820000	24	12-Oct-94	Crusaders Club	56380.000	3759900.000	123	0.7	698	102	102	102	61	163	62	101	239	0.01	177	12.0	95	7.7	0.21	34.0848
04031820000	24	10-Nov-94	Crusaders Club	56380.000	3759900.000	127		812								269				107	6.8		30.1009
04031820000	24	08-Dec-94	Crusaders Club	56380.000	3759900.000	94		600								212				81	8.7		38.5114
04031820000	24	05-Jan-95	Crusaders Club	56380.000	3759900.000	149	0.9	1076	83	83	83	148	231	125	106	216	0.04	167	45.0	136	31.0	0.11	137.225
04031820000	24	15-Mar-95	Crusaders Club	56380.000	3759900.000	126		748								244				101	6.9		30.5435
04031820000	24	16-Mar-95	Crusaders Club	56380.000	3759900.000	123		804								238				101	7.0		30.9862
04031820000	24	05-May-95	Crusaders Club	56380.000	3759900.000	97	0.7	646	62	62	62	46	108	33	75	181	0.05	153	6.0	77	1.8	0.09	7.96788
04031820000	24	09-May-95	Crusaders Club	56380.000	3759900.000	109		696								201				78	6.6		29.2156
04031820000	24	01-Jun-95	Crusaders Club	56380.000	3759900.000	110		778								215				88	5.3		23.461
04031820000	24	12-Jun-95	Crusaders Club	56380.000	3759900.000	116		746								242				102	5.7		25.2316
04031820000	43	17-Nov-93	PEM St.Georges Park	56240.000	3759375.000	180										437				85	0.1		0.22133
04034050000	16	07-Jun-93	8 Hallack Road	55569.000	3760077.000	183	0.3	1056	48	48	48	147	195	75	120	511	0.02	286	5.0	135	4.4	0.12	19.477
04034050000	16	17-Jul-93	8 Hallack Road	55569.000	3760077.000	180										490							
04034050000	16	10-Aug-93	8 Hallack Road	55569.000	3760077.000	174										483				97	3.6		15.9358
04034050000	16	14-Sep-93	8 Hallack Road	55569.000	3760077.000	177	2.5	1012	41	41	41	185	226	85	141	462	0.44	291	5.0	73	3.6	0.12	15.9358
04034050000	16	16-Nov-93	8 Hallack Road	55569.000	3760077.000	177										356				140	3.5		15.4931
04034050000	16	12-Jan-94	8 Hallack Road	55569.000	3760077.000	164	0.2	982	42	42	42	148	190	69	121	490	0.01	254	4.5	86	2.8	0.12	12.3945
04034050000	16	08-Feb-94	8 Hallack Road	55569.000	3760077.000	174	2.5		41	41	41	195	236	88	148	437		284	10.0	86	3.6		15.9358
04034050000	16	10-Feb-94	8 Hallack Road	55569.000	3760077.000																		
04034050000	16	09-Mar-94	8 Hallack Road	55569.000	3760077.000	181	0.8		43	43						462				80	4.4		19.477
04034050000	16	14-Apr-94	8 Hallack Road	55569.000	3760077.000	183	0.6	976	41	41	41	224	265	104	161	460	0.01	316	8.0	85	4.9	0.35	21.6903
04034050000	16	09-May-94	8 Hallack Road	55569.000	3760077.000	173	0.3	966	41	41						490				93	4.1		18.1491
04034050000	16	09-Jun-94	8 Hallack Road	55569.000	3760077.000	182		1014								460				103	4.3		19.0344
04034050000	16	13-Jul-94	8 Hallack Road	55569.000	3760077.000	185	0.3	1006	49	49	49	153	202	78	124	501	0.36	318	4.0	83	4.8	0.05	21.2477
04034050000	16	10-Aug-94	8 Hallack Road	55569.000	3760077.000	182		1010								422				83	5.1		22.5757
04034050000	16	14-Sep-94	8 Hallack Road	55569.000	3760077.000	181		1044								465				86	4.9		21.6903
04034050000	16	12-Oct-94	8 Hallack Road	55569.000	3760077.000	183	2.5	1150	57	57	57	156	213	82	131	472	0.26	270	9.0	92	4.3	0.21	19.0344
04034050000	16	12-Dec-94	8 Hallack Road	55569.000	3760077.000	177		1012								316				93	5.0		22.133
04034050000	16	10-Jan-95	8 Hallack Road	55569.000	3760077.000	184	0.4	1110	45	45	45	168	213	82	131	419	0.01	273	8.0	91	4.7	0.05	20.805
04034050000	16	09-Feb-95	8 Hallack Road	55569.000	3760077.000	183		986								446				97	5.0		22.133
04034050000	16	10-Mar-95	8 Hallack Road	55569.000	3760077.000	182		1156								371				94	4.6		20.3624
04034050000	16	11-Apr-95	8 Hallack Road	55569.000	3760077.000	181	1.7	1028	46	46	46	152	198	75	123	432	0.02	278	8.0	94	4.0	0.05	17.7064
04034050000	16	09-May-95	8 Hallack Road	55569.000	3760077.000	182		1012								428				80	4.5		19.9197
04034050000	16	12-Jun-95	8 Hallack Road	55569.000	3760077.000	181.9		972								389				100	4.3		19.0344
04035960000	38	21-Jul-93	Fort Frederick	57435.000	3759820.000	77										92							
04035960000	38	10-Aug-93	Fort Frederick	57435.000	3759820.000	74										94				70	9.7		42.938
04035960000	38	09-May-94	Fort Frederick	57435.000	3759820.000	77	45.0	508	99	99						101				85	10.3		45.594
04035960000	38	14-Jul-94	Fort Frederick	57435.000	3759820.000	85	19.0	620	116	116	116	22	138	62	76	114	0.25	104	5.0	83	13.1	0.23	57.9885
06000560000	2	03-Jun-93	3 Whitney Street	50952.464	3757754.59	75	1.5	422	26	26	26	45	71	23	48	152	0.08	105	3.0	60	3.9	0.10	17.2637
06000560000	2	10-Aug-93	3 Whitney Street	50952.464	3757754.59	87										199				63	3.0		13.2798
06000560000	2	14-Sep-93	3 Whitney Street	50952.464	3757754.59	98	1.1	520	17	17	17	103	120	43	77	239	0.03	160	4.0	46	1.5	0.11	6.6399
06000560000	2	16-Nov-93	3 Whitney Street	50952.464	3757754.59	90										241				44	1.8		7.96788
06000560000	2	12-Jan-94	3 Whitney Street	50952.464	3757754.59	93	0.5	488	16	16	16	71	87	29	58	230	0.02	134	1.6	38	1.7	0.05	7.52522
06000560000	2	08-Feb-94	3 Whitney Street	50952.464	3757754.59	100	0.9		24	24	24	85	109	36	73	256		156	6.0	40	1.4		6.19724
06000560000	2	10-Feb-94	3 Whitney Street	50952.464	3757754.59																		
06000560000	2	09-Mar-94	3 Whitney Street	50952.464	3757754.59	80	4.6		69	69						151				53	1.9		8.41054
06000560000	2	14-Apr-94	3 Whitney Street	50952.464	3757754.59	93	0.6	488	17	17	17	97	114	46	68	245	0.03	158	4.0	45	1.9	0.05	8.27774
06000560000	2	09-May-94	3 Whitney Street	50952.464	3757754.59	90	0.4	490	15	15						226				47	2.3		10.1812

Erf. No.	Bh.No.	Date	Address	-Y-Co-ord	-X-Co-ord	EC	Turb.	TDS	TA	BCA	CH	NCH	TH	Ca	Mg	Cl	Fe(t)	Na	K	SO4	NO3-N	F	N
									CaCO3	CaCO3	CaCO3	CaCO3	CaCO3	CaCO3	CaCO3								
06000560000	2	13-Jul-94	3 Whitney Street	50952.464	3757754.59	82	2.3	564	59	59	59	55	114	40	74	170	0.09	93	3.0	66	3.7	0.10	16.3784
06000560000	2	14-Sep-94	3 Whitney Street	50952.464	3757754.59	78		482								153				61	0.1		0.22133
06000560000	2	12-Oct-94	3 Whitney Street	50952.464	3757754.59	77	3.2	628	89	89	89	48	137	83	54	141	0.19	91	4.0	57	2.1	0.06	9.29586
06000560000	2	15-Mar-95	3 Whitney Street	50952.464	3757754.59	87		564								174				65	4.4		19.477
06000560000	2	21-Jun-95	3 Whitney Street	50952.464	3757754.59																		
06002980000	13	04-Jun-93	14 Thames Road	50660.000	3757926.000	509	3.7	3110	157	157	157	429	586	210	376	1689	0.74	860	14.0	170	0.2	0.36	0.75252
06002980000	13	10-Aug-93	14 Thames Road	50660.000	3757926.000	498										1386				237	0.1		0.44266
06002980000	13	14-Sep-93	14 Thames Road	50660.000	3757926.000	496	2.6	2982	158	158	158	560	718	285	433	1632	0.10	847	17.0	147	0.1	0.40	0.22133
06002980000	13	18-Nov-93	14 Thames Road	50660.000	3757926.000	486										1299				184	0.1		0.22133
06002980000	13	12-Jan-94	14 Thames Road	50660.000	3757926.000	469	1.7	2966	154	154	154	468	622	233	389	1541	0.06	799	13.0	143	0.1	0.44	0.22133
06002980000	13	08-Feb-94	14 Thames Road	50660.000	3757926.000	497	0.8		152	152	152	518	670	246	424	1343		825	30.0	183	0.1		0.44266
06002980000	13	09-Mar-94	14 Thames Road	50660.000	3757926.000	506	0.7		161	161						1488				120	0.1		0.22133
06002980000	13	14-Apr-94	14 Thames Road	50660.000	3757926.000	504	0.5	2850	155	155	155	638	793	325	468	1620	0.11	923	23.0	164	0.1	0.43	0.57546
06002980000	13	09-Jun-94	14 Thames Road	50660.000	3757926.000	509		3060								1461				159	0.1		0.22133
06002980000	13	13-Jul-94	14 Thames Road	50660.000	3757926.000	512	1.2	2828	158	158	158	416	574	200	374	1499	0.45	804	11.0	153	0.1	0.05	0.22133
06002980000	13	10-Aug-94	14 Thames Road	50660.000	3757926.000	504		3062								1364				172	0.2		0.66399
06002980000	13	15-Sep-94	14 Thames Road	50660.000	3757926.000	502		2920								1490				148	0.0		0.17706
06002980000	13	13-Dec-94	14 Thames Road	50660.000	3757926.000	494		2920								1533				161	0.2		0.79679
06002980000	13	10-Jan-95	14 Thames Road	50660.000	3757926.000	509	1.1	3010	161	161	161	534	695	275	420	1380	0.01	821	23.0	164	0.2	0.37	0.84105
07008590000	8	03-Jun-93	5 Norland Crescent	47300.000	3758698.000	815	30.0	4866	192	192	192	916	1108	394	714	2455	2.65	1340	17.0	306	0.1	0.64	0.22133
07008590000	8	10-Aug-93	5 Norland Crescent	47300.000	3758698.000	790										2471				363	0.1		0.22133
07008590000	8	14-Sep-93	5 Norland Crescent	47300.000	3758698.000	812	42.0	4836	200	200	200	1042	1242	514	728	2633	3.64	1345	19.0	293	0.1	0.70	0.22133
07008590000	8	11-Nov-93	5 Norland Crescent	47300.000	3758698.000	807										2542				288	0.1		0.22133
07008590000	8	12-Jan-94	5 Norland Crescent	47300.000	3758698.000	774	51.0	4848	185	185	185	933	1118	427	691	2619	3.60	1235	20.0	280	0.1	0.80	0.22133
07008590000	8	08-Feb-94	5 Norland Crescent	47300.000	3758698.000	798	22.0		182	182	182	1198	1380	545	835	2512		1355	31.0	394			
07008590000	8	14-Apr-94	5 Norland Crescent	47300.000	3758698.000	815	47.0	5412	193	193	193	1213	1406	562	844	2466	3.36	1399	31.0	374	0.1	0.70	0.22133
07008590000	8	09-Jun-94	5 Norland Crescent	47300.000	3758698.000	810		4840								2446				300	0.1		0.22133
07008590000	8	13-Jul-94	5 Norland Crescent	47300.000	3758698.000	793	60.0	4748	190	190	190	895	1085	386	699	2533	4.49	1290	12.0	272	0.1		0.22133
07008590000	8	10-Aug-94	5 Norland Crescent	47300.000	3758698.000	799		4940								2242				288	0.1		0.22133
07008590000	8	14-Sep-94	5 Norland Crescent	47300.000	3758698.000	798		4668								2312				289	0.1		0.22133
07008590000	8	12-Oct-94	5 Norland Crescent	47300.000	3758698.000	813	41.0	4884	197	197	197	999	1196	461	735	2517	0.03	1293	34.0	305	0.1	0.41	0.22133
07008590000	8	12-Dec-94	5 Norland Crescent	47300.000	3758698.000	778		4930								2379				289	0.1		0.22133
07008590000	8	10-Jan-95	5 Norland Crescent	47300.000	3758698.000	809	42.0	4912	196	196	196	998	1194	478	716	2276	3.94	1273	26.0	299	0.1	0.05	0.22133
07008590000	8	13-Feb-95	5 Norland Crescent	47300.000	3758698.000	799		4868								2402				323	0.0		0.04427
07008590000	8	10-Mar-95	5 Norland Crescent	47300.000	3758698.000	786		4892								2142				305	0.0		0.04427
07008590000	8	20-Apr-95	5 Norland Crescent	47300.000	3758698.000	819	53.0	5090	198	198	198	937	1135	457	678	2101	0.28	1244	32.0	300	0.0	0.05	0.02213
07008590000	8	11-May-95	5 Norland Crescent	47300.000	3758698.000	728		4804								2038				281	0.1		0.22133
07008590000	8	28-Jun-95	5 Norland Crescent	47300.000	3758698.000	793		4544								2799				294	0.2		0.88532
12000720000	42	10-Aug-93	78 Kabega Road	46808.230	3758480.000	320										1006				86	0.1		0.22133
12000720000	42	14-Sep-93	78 Kabega Road	46808.230	3758480.000	325	20.0	1952	44	44	44	342	386	150	236	948	2.28	511	7.0	50	0.1	0.19	0.22133
12000720000	42	12-Jan-94	78 Kabega Road	46808.230	3758480.000	321	2.0	2038	52	52	52	331	383	142	241	1070	0.12	519	8.3	64	0.1	0.25	0.22133
12000720000	42	09-Mar-94	78 Kabega Road	46808.230	3758480.000	340	8.1		76	76						955				82	0.1		0.22133
12000720000	42	14-Apr-94	78 Kabega Road	46808.230	3758480.000	344	48.0	2234	83	83	83	354	437	177	260	1042	43.80	542	7.0	115	0.1	0.24	0.22133
12000720000	42	09-May-94	78 Kabega Road	46808.230	3758480.000	323	60.0	1884	65	65						950				93	0.1		0.22133
12000720000	42	09-Jun-94	78 Kabega Road	46808.230	3758480.000	337		2006								998				73	0.1		0.22133
12000720000	42	13-Jul-94	78 Kabega Road	46808.230	3758480.000	339	27.5	1926	44	44	44	309	353	125	223	897	5.71	504	5.0	95	0.1	0.05	0.22133
12000720000	42	14-Sep-94	78 Kabega Road	46808.230	3758480.000	338		2016								1056				67	0.1		0.22133
12000720000	42	12-Oct-94	78 Kabega Road	46808.230	3758480.000	339	1.6	2074	42	42	42	360	402	152	250	1027	1.08	533	12.0	72	0.1	0.39	0.22133
12000720000	42	10-Jan-95	78 Kabega Road	46808.230	3758480.000	341	17.0	1990	41	41	41	338	379	146	233	921	3.07	512	11.0	70	0.1	0.05	0.22133
12000720000	42	13-Feb-95	78 Kabega Road	46808.230	3758480.000	335		2120								946				71	0.0		0.04427
12000720000	42	08-Mar-95	78 Kabega Road	46808.230	3758480.000	342		2044								999				74	0.0		0.04427
12000720000	42	20-Apr-95	78 Kabega Road	46808.230	3758480.000	342	12.0	1994	45	45	45	341	386	153	233	1046	4.71	521	12.0	64	0.0	0.23	0.02213
12000720000	42	11-May-95	78 Kabega Road	46808.230	3758480.000	323		2064								1005				64	0.1		0.22133
12000720000	42	28-Jun-95	78 Kabega Road	46808.230	3758480.000	338		1844								1118				68	0.1		0.22133
14001480000	30	18-Jun-93	P.E. Golf Club	53965.000	3759040.000	150	1.3	952	230	230	191	0	191	87	104	316	0.25	223	5.0	77	1.7	0.31	7.43669
14001480000	30	17-Jul-93	P.E. Golf Club	53965.000	3759040.000	163										352							
14001480000	30	10-Aug-93	P.E. Golf Club	53965.000	3759040.000	130										313				77	2.5		11.0665
14001480000	30	19-Jan-94	P.E. Golf Club	53965.000	3759040.000	153	3.0	868	56	56	56	93	149	46	103	360		267	1.9	90	2.8		12.3945
14001480000	30	22-Feb-94	P.E. Golf Club	53965.000	3759040.000	139	0.2		32	32	32	111	143	48	95	349		257	6.6		2.2		9.73852
14001480000	30	17-Mar-94	P.E. Golf Club	53965.000	3759040.000	143	0.6		35	35						334				62	2.5		11.0665
14001480000	30	21-Apr-94	P.E. Golf Club	53965.000	3759040.000	143	0.8	764	36	36	36	161	197	93	104	360	0.01	258	4.0	71	2.5	0.05	11.0665
14001480000	30	20-May-94	P.E. Golf Club	53965.000	3759040.000	147	0.7	800								362				66	2.3		10.1812
14001480000	30	21-Jun-94	P.E. Golf Club	53965.000	3759040.000	145	0.4	808	40	40	40	108	148	50	98	370	0.03	237	7.0	66	2.5	0.15	11.0665
14001480000	30	21-Sep-94	P.E. Golf Club	53965.000	3759040.000	146		842								359				66	2.4		10.6238
14001480000	30	12-Oct-94	P.E. Golf Club	53965.000	3759040.000	147	0.5	838	43	43	43	94	137	47	90	375	0.02	231	7.0	67	2.6	0.22	11.5092
14001480000	30	10-Nov-94	P.E. Golf Club	53965.000	3759040.000	147		836								379				68	2.3		10.1812

Erf. No.	Bh.No.	Date	Address	-Y-Co-ord	-X-Co-ord	EC	Turb.	TDS	TA	BCA	CH	NCH	TH	Ca	Mg	Cl	Fe(t)	Na	K	SO4	NO3-N	F	N
									CaCO3	CaCO3	CaCO3	CaCO3	CaCO3	CaCO3	CaCO3								
14001480000	30	08-Dec-94	P.E. Golf Club	53965.000	3759040.000	171		1082								397				96	0.5		2.2133
14001480000	30	05-Jan-95	P.E. Golf Club	53965.000	3759040.000	145	0.5	928	84	84	84	75	159	62	97	297	0.02	217	7.0	74	2.6	0.21	11.5092
14001480000	30	16-Mar-95	P.E. Golf Club	53965.000	3759040.000	145		808								342				69	2.4		10.6238
14001480000	30	05-May-95	P.E. Golf Club	53965.000	3759040.000	144	0.5	792	67	67	67	84	151	57	94	340	0.01	217	6.0	72	2.9	0.24	12.8371
14001480000	30	01-Jun-95	P.E. Golf Club	53965.000	3759040.000	141		786								370				74	2.7		11.9518
14001480000	30a	21-Jun-94	P.E. Golf Club	54285.000	3758980.000	225	11.0	1250	52	52	52	233	285	120	165	606	0.20	363	10.0	79	1.3	0.05	5.75458
14001480000	30a	10-Aug-94	P.E. Golf Club	54285.000	3758980.000	225		1310								650				80	1.0		4.4266
14001480000	30a	21-Sep-94	P.E. Golf Club	54285.000	3758980.000	187		1104								490				73	1.7		7.52522
14001480000	30a	12-Oct-94	P.E. Golf Club	54285.000	3758980.000	186	0.2	1076	29	29	29	143	172	56	116	508	0.45	294	9.0	73	1.7	0.31	7.52522
14001480000	30a	10-Nov-94	P.E. Golf Club	54285.000	3758980.000	186		1020								521				75	2.0		8.8532
14001480000	30a	08-Dec-94	P.E. Golf Club	54285.000	3758980.000	184		1008								564				83	2.1		9.29586
14001480000	30a	05-Jan-95	P.E. Golf Club	54285.000	3758980.000	187	0.3	1034	34	34	34	142	176	58	118	451	0.02	288	8.0	76	1.9	0.05	8.41054
14001480000	30a	16-Mar-95	P.E. Golf Club	54285.000	3758980.000	185		992								498				75	2.1		9.29586
14001480000	30a	01-Jun-95	P.E. Golf Club	54285.000	3758980.000	180		990								488				73	2.0		8.8532
14001480000	31	18-Jun-93	P.E. Golf Club	53995.000	3758865.000	140	37.0	932	215	215	192	0	192	92	100	305	0.93	200	7.0	70	0.8	0.29	3.31995
14001480000	31	17-Jul-93	P.E. Golf Club	53995.000	3758865.000	167										463							
14001480000	31	10-Aug-93	P.E. Golf Club	53995.000	3758865.000	157										378				91	5.6		24.789
14001480000	31	26-Oct-93	P.E. Golf Club	53995.000	3758865.000	165										401				86	6.6		29.2156
14001480000	31	16-Nov-93	P.E. Golf Club	53995.000	3758865.000	175										511				88	3.8		16.8211
14001480000	31	22-Feb-94	P.E. Golf Club	53995.000	3758865.000	173	0.5		23	23	23	188	211	76	135	555		326	7.9		4.5		19.9197
14001480000	31	17-Mar-94	P.E. Golf Club	53995.000	3758865.000	173	1.2		25	25						398				78	5.3		23.461
14001480000	31	21-Apr-94	P.E. Golf Club	53995.000	3758865.000	167	0.6	1020	24	24	24	195	219	88	131	436	0.00	305	7.0	89	5.0	0.05	22.133
14001480000	31	20-May-94	P.E. Golf Club	53995.000	3758865.000	171	0.3	1004								457				87	5.9		26.1169
14001480000	31	21-Jun-94	P.E. Golf Club	53995.000	3758865.000	169	3.9	980	81	81	81	99	180	67	113	390	0.10	287	8.0	94	5.2	0.12	23.0183
14001480000	31	10-Aug-94	P.E. Golf Club	53995.000	3758865.000	172		1154								335				93	0.1		0.44266
14001480000	31	21-Sep-94	P.E. Golf Club	53995.000	3758865.000	177		1020								462				79	5.1		22.5757
14001480000	31	12-Oct-94	P.E. Golf Club	53995.000	3758865.000	160	1.1	854	36	36	36	105	141	43	98	392	0.02	260	8.0	97	7.5	0.24	33.1995
14001480000	31	10-Nov-94	P.E. Golf Club	53995.000	3758865.000	175		978								472				87	5.0		22.133
14001480000	32	18-Jun-93	P.E. Golf Club	54000.000	3758635.000	120	2.6	680	76	76	76	52	128	51	77	287	0.01	188	4.0	69	4.2	0.18	18.636
14001480000	32	17-Jul-93	P.E. Golf Club	54000.000	3758635.000	129										301							
14001480000	32	10-Aug-93	P.E. Golf Club	54000.000	3758635.000	120										270				81	4.4		19.477
14001480000	32	26-Oct-93	P.E. Golf Club	54000.000	3758635.000	118										519				75	4.3		19.0344
14001480000	32	16-Nov-93	P.E. Golf Club	54000.000	3758635.000	125										300				42	4.1		18.1491
14001480000	32	19-Jan-94	P.E. Golf Club	54000.000	3758635.000	127	0.4	670	25	25	25	114	139	46	93	305		226	5.6	65	4.4		19.477
14001480000	32	22-Feb-94	P.E. Golf Club	54000.000	3758635.000	128	0.3		29	29	29	102	131	43	88	307		232	6.5		4.8		21.2477
14001480000	32	17-Mar-94	P.E. Golf Club	54000.000	3758635.000	132	0.3		25	25						306				62	4.2		18.5917
14001480000	32	21-Apr-94	P.E. Golf Club	54000.000	3758635.000	134	0.2	706	24	24	24	177	201	79	122	331	0.00	289	10.0	108	4.4	0.05	19.477
14001480000	32	20-May-94	P.E. Golf Club	54000.000	3758635.000	130	2.5	712								306				72	4.6		20.3624
14001480000	32	21-Jun-94	P.E. Golf Club	54000.000	3758635.000	132	2.1	700	26	26	26	106	132	45	87	315	0.04	218	6.0	71	5.1	0.05	22.5757
14001480000	32	10-Aug-94	P.E. Golf Club	54000.000	3758635.000	139		762								282				73	4.6		20.3624
14001480000	32	21-Sep-94	P.E. Golf Club	54000.000	3758635.000	135		786								324				64			
14001480000	32	12-Oct-94	P.E. Golf Club	54000.000	3758635.000	131	0.1	726	26	26	26	90	116	38	78	321	0.00	210	6.0	74	5.1	0.18	22.5757
14001480000	32	10-Nov-94	P.E. Golf Club	54000.000	3758635.000	133		724								327				76	5.1		22.5757
14001480000	32	08-Dec-94	P.E. Golf Club	54000.000	3758635.000	133		738								367				79	4.9		21.6903
14001480000	32	05-Jan-95	P.E. Golf Club	54000.000	3758635.000	138	1.4	758	25	25	25	96	121	39	82	297	0.02	216	7.0	73	4.7	0.11	20.805
14001480000	32	16-Mar-95	P.E. Golf Club	54000.000	3758635.000	135		744								314				75	4.6		20.3624
14001480000	32	05-May-95	P.E. Golf Club	54000.000	3758635.000	137	0.4	722	27	27	27	98	125	40	85	329	0.01	216	6.0	75	5.1	0.13	22.5757
14001480000	32	21-Jun-94	P.E. Golf Club	54000.000	3758635.000	134	2.0	700	22	22	22	99	121	45	76	320	0.02	227	6.0	65	8.6	0.05	38.0688
14001480000	32a	10-Aug-94	P.E. Golf Club	54300.000	3758800.000	134		716								320				61	8.1		35.8555
14001480000	32a	21-Sep-94	P.E. Golf Club	54300.000	3758800.000	132		756								314				72	5.2		23.0183
14001480000	32a	12-Oct-94	P.E. Golf Club	54300.000	3758800.000	132	0.4	722	21	21	21	85	106	38	68	326	0.03	217	6.0	64	8.9	0.07	39.3967
14001480000	32a	10-Nov-94	P.E. Golf Club	54300.000	3758800.000	114		622								288				65	6.9		30.5435
14001480000	32a	08-Dec-94	P.E. Golf Club	54300.000	3758800.000	112		642								277				71	6.6		29.2156
14001480000	32a	05-Jan-95	P.E. Golf Club	54300.000	3758800.000	118	0.4	724	32	32	32	70	102	42	60	274	0.02	189	6.0	64	6.9	0.05	30.5435
14001480000	32a	01-Jun-95	P.E. Golf Club	54300.000	3758800.000	134		752								348				80	3.7		16.3784
14002420000	19	08-Jun-93	8 Mill Park Road	54785.000	3759026.000	84	0.5	502	30	30	30	63	93	18	75	152	0.04	116	3.0	92	5.2	0.10	23.0183
14002420000	19	17-Jul-93	8 Mill Park Road	54785.000	3759026.000	105										198							
14002420000	19	10-Aug-93	8 Mill Park Road	54785.000	3759026.000	89										178				88	5.6		24.789
14002420000	19	14-Sep-93	8 Mill Park Road	54785.000	3759026.000	100	0.7	692	32	32	32	78	110	31	79	202	0.04	167	5.0	81	6.4	0.19	28.3302
14002420000	19	11-Nov-93	8 Mill Park Road	54785.000	3759026.000	101										204				72	6.2		27.4449
14002420000	19	12-Jan-94	8 Mill Park Road	54785.000	3759026.000	100	0.7	572	26	26	26	59	85	23	62	218	0.03	158	4.2	73		0.12	
14002420000	19	08-Feb-94	8 Mill Park Road	54785.000	3759026.000	98	1.3		24	24	24	71	95	23	72	204		167	7.0	77	5.0		22.133
14002420000	19	09-Mar-94	8 Mill Park Road	54785.000	3759026.000	99	0.7		25	25						138				39	7.1		31.4289
14002420000	19	14-Apr-94	8 Mill Park Road	54785.000	3759026.000	101	0.8	520	26	26	26	59	85	21	64	210	0.04	162	6.0	75	6.6	0.20	29.2156
14002420000	19	09-May-94	8 Mill Park Road	54785.000	3759026.000	98	0.5	566	27	27						217				76	5.8		25.6743

Erf. No.	Bh.No.	Date	Address	-Y-Co-ord	-X-Co-ord	EC	Turb.	TDS	TA	BCA	CH	NCH	TH	Ca	Mg	Cl	Fe(t)	Na	K	SO4	NO3-N	F	N
									CaCO3	CaCO3	CaCO3	CaCO3	CaCO3	CaCO3	CaCO3								
14002420000	19	09-Jun-94	8 Mill Park Road	54785.000	3759026.000	97		546								206				84	6.5		28.7729
14002420000	19	13-Jul-94	8 Mill Park Road	54785.000	3759026.000	82	1.3	492	37	37	37	61	98	21	77	172	0.06	107	3.0	93	5.7	0.12	25.2316
14002420000	19	10-Aug-94	8 Mill Park Road	54785.000	3759026.000	89		528								164				77	6.4		28.3302
14002420000	19	14-Sep-94	8 Mill Park Road	54785.000	3759026.000	90		542								188				80	6.6		29.2156
14002420000	19	12-Oct-94	8 Mill Park Road	54785.000	3759026.000	93	0.4	572	28	28	28	60	88	21	67	193	0.02	147	5.0	81	6.0	0.05	26.5596
14002420000	19	12-Dec-94	8 Mill Park Road	54785.000	3759026.000	99		590								229				81	6.3		27.8876
14002420000	19	10-Jan-95	8 Mill Park Road	54785.000	3759026.000	101	0.4	588	27	27	27	57	84	23	61	192	0.01	165	5.0	80	6.7	0.09	29.6582
14002420000	19	09-Feb-95	8 Mill Park Road	54785.000	3759026.000	102		584								212				84	6.3		27.8876
14002420000	19	10-Mar-95	8 Mill Park Road	54785.000	3759026.000	101		456								214				82	7.3		32.3142
14002420000	19	11-Apr-95	8 Mill Park Road	54785.000	3759026.000	101	0.6	538	34	34	34	57	91	26	65	212	0.49	161	6.0	79	6.1	0.05	27.0023
14002420000	19	09-May-95	8 Mill Park Road	54785.000	3759026.000	94		544								187				77	6.2		27.4449
14002420000	19	12-Jun-95	8 Mill Park Road	54785.000	3759026.000	98		568								208				80	6.3		27.8876
14002650000	25	18-Jun-93	Grey High School	55080.000	3759275.000	117	6.0	660	50	50	50	59	109	33	76	296	0.65	189	3.0	76	3.0	0.10	13.1913
14002650000	25	10-Aug-93	Grey High School	55080.000	3759275.000	85										157				87	4.2		18.5917
14002650000	25	29-Sep-93	Grey High School	55080.000	3759275.000	82	4.1	442	25	25	25	63	88	26	62	175	1.18	134	5.0	80	2.0	0.20	8.8532
14002650000	25	16-Nov-93	Grey High School	55080.000	3759275.000																		
14002650000	25	14-Dec-93	Grey High School	55080.000	3759275.000	89	0.7									161				61	3.9		17.2637
14002650000	25	19-Jan-94	Grey High School	55080.000	3759275.000	76	3.5	456	24	24	24	45	69	20	49	152		106	4.2	71	2.1		9.29586
14002650000	25	22-Feb-94	Grey High School	55080.000	3759275.000	77	1.6		22	22	22	57	79	22	57	168		130	4.1		4.1		18.1491
14002650000	25	17-Mar-94	Grey High School	55080.000	3759275.000	78	1.4		23	23						160				72	4.5		19.9197
14002650000	25	21-Apr-94	Grey High School	55080.000	3759275.000	77	1.6	420	23	23	23	59	82	28	54	153	0.04	118	4.0	73	4.3	0.05	19.0344
14002650000	25	20-May-94	Grey High School	55080.000	3759275.000	80	2.5	450								156				73	4.5		19.9197
14002650000	25	21-Jun-94	Grey High School	55080.000	3759275.000	83	1.7	542	52	52	52	70	122	64	58	165	0.27	129	3.0	74	4.1	0.07	18.1491
14002650000	25	07-Jul-94	Grey High School	55080.000	3759275.000	79	1.1	444	23	23	23	46	69	15	54	176	0.38	117	3.0	82	4.1	0.09	18.1491
14002650000	25	10-Aug-94	Grey High School	55080.000	3759275.000	96		558								212				75	3.4		15.0504
14002650000	25	26-Sep-94	Grey High School	55080.000	3759275.000	77		442								156				74	4.2		18.5917
14002650000	25	12-Oct-94	Grey High School	55080.000	3759275.000	79	1.2	420	23	23	23	50	73	18	55	160	0.20	124	5.0	79	4.4	0.22	19.477
14002650000	25	10-Nov-94	Grey High School	55080.000	3759275.000	121		664								292				78	3.3		14.6078
14002650000	25	08-Dec-94	Grey High School	55080.000	3759275.000	133		742								363				86	3.1		13.7225
14002650000	25	05-Jan-95	Grey High School	55080.000	3759275.000	146	0.3	802	22	22	22	101	123	34	89	326	0.02	113	6.0	80	2.2	0.07	9.73852
14002650000	25	16-Mar-95	Grey High School	55080.000	3759275.000	122		820								231				78	3.3		14.6078
14002650000	25	05-May-95	Grey High School	55080.000	3759275.000	112	2.4	728	67	67	67	62	129	61	68	226	0.13	166	5.0	78	3.7	0.04	16.3784
14002650000	25	01-Jun-95	Grey High School	55080.000	3759275.000	180		752								364				85	2.9		12.8371
14009890000	18	08-Jun-93	47 Wychwood Avenue	53145.000	3759304.000	150	1.6	884	16	16	16	142	158	50	108	434	0.11	218	3.0	58	0.5	0.05	2.0805
14009890000	18	10-Aug-93	47 Wychwood Avenue	53145.000	3759304.000	139										411				56	0.4		1.72637
14009890000	18	14-Sep-93	47 Wychwood Avenue	53145.000	3759304.000	147	0.7	784	17	17	17	161	178	65	113	387	0.08	221	3.0	58	1.1	0.05	4.86926
14009890000	18	11-Nov-93	47 Wychwood Avenue	53145.000	3759304.000	149										405				50	1.0		4.33807
14009890000	18	12-Jan-94	47 Wychwood Avenue	53145.000	3759304.000	150	1.1	846	20	20	20	137	157	54	103	423	0.10	200	3.2	47		0.07	
14009890000	18	08-Feb-94	47 Wychwood Avenue	53145.000	3759304.000	146	0.5		17	171	17	180	197	70	127	384		239	9.0	53	1.3		5.53325
14009890000	18	09-Mar-94	47 Wychwood Avenue	53145.000	3759304.000	154	0.9		17	17						409				44	0.7		3.09862
14009890000	18	14-Apr-94	47 Wychwood Avenue	53145.000	3759304.000	157	0.3		17	17	17	218	235	91	144	437	0.03	266	6.0	51	0.7	0.05	3.05435
14009890000	18	09-Jun-94	47 Wychwood Avenue	53145.000	3759304.000	145		810								388				47	1.0		4.2938
14009890000	18	13-Jul-94	47 Wychwood Avenue	53145.000	3759304.000	148	1.4	838	19	19	19	134	153	48	105	415	0.12	185	3.0	49	1.3	0.05	5.75458
14009890000	18	14-Sep-94	47 Wychwood Avenue	53145.000	3759304.000	152		850								415				48	0.9		3.98394
14009890000	18	12-Oct-94	47 Wychwood Avenue	53145.000	3759304.000	152	0.5	846	24	24	24	143	167	56	111	422	0.08	220	6.0	52	1.1	0.10	4.86926
14009890000	18	12-Dec-94	47 Wychwood Avenue	53145.000	3759304.000	135		814								400				52	0.9		3.98394
14009890000	18	10-Jan-95	47 Wychwood Avenue	53145.000	3759304.000	155	0.8	830	28	28	28	148	176	63	113	376	0.02	225	6.0	52	1.1	0.06	4.86926
14009890000	18	11-May-95	47 Wychwood Avenue	53145.000	3759304.000	141		840								366				48	2.2		9.73852
14009890000	18	12-Jun-95	47 Wychwood Avenue	53145.000	3759304.000	128		746								339				58	3.6		15.9358
15028720000	20	14-Jun-93	Fedlife Building	53170.000	3758100.000	62	7.1	356	81	81	69	0	69	38	31	108	0.22	94	7.0	47	2.6	0.19	11.5092
15028720000	20	17-Jul-93	Fedlife Building	53170.000	3758100.000	141										264							
15028720000	20	10-Aug-93	Fedlife Building	53170.000	3758100.000	153										282				98	9.2		40.7247
15028720000	20	29-Sep-93	Fedlife Building	53170.000	3758100.000	135	7.6	954	121	121	121	16	137	63	74	259	0.21	234	9.0	112	1.0	0.20	4.2938
15028720000	20	25-Oct-93	Fedlife Building	53170.000	3758100.000	135										289				84	9.6		42.4954
15028720000	20	16-Nov-93	Fedlife Building	53170.000	3758100.000	140										318				90	11.0		48.6926
15028720000	20	24-Feb-94	Fedlife Building	53170.000	3758100.000	259	7.2		255	255	255	46	301	116	185	505		462	19.0		8.7		38.5114
17016790000	1	03-Jun-93	12 West Street	52765.000	3758016.000		0.9	500	23	23	23	29	52	19	33	171	0.09	147	2.0	60	16.0	0.05	70.8256
17016790000	1	10-Aug-93	12 West Street	52765.000	3758016.000	50										61				53	11.0		48.6926
17016790000	1	14-Sep-93	12 West Street	52765.000	3758016.000	81	0.7	622	27	27	27	51	78	31	47	125	0.40	149	3.0	57	15.0	0.17	66.399
17016790000	1	16-Nov-93	12 West Street	52765.000	3758016.000	76										177				70	14.0		61.9724
17016790000	1	12-Jan-94	12 West Street	52765.000	3758016.000	67	0.9	396	28	28	28	8	36	12	24	109	0.10	111	1.7	52	0.3	0.10	1.32798
17016790000	1	08-Feb-94	12 West Street	52765.000	3758016.000	83	4.5		28	28	28	36	64	27	37	153		145	2.0	59	13.8		61.0871
17016790000	1	10-Feb-94	12 West Street	52765.000	3758016.000																		
17016790000	1	09-Mar-94	12 West Street	52765.000	3758016.000	77	0.6		24	24						128				43	14.7		65.071
17016790000	1	14-Apr-94	12 West Street	52765.000	3758016.000	66	0.3	386	23	23	23	22	45	17	28	107	0.03	119	24.0	50	11.5	0.05	50.9059

Erf. No.	Bh.No.	Date	Address	-Y-Co-ord	-X-Co-ord	EC	Turb.	TDS	TA	BCA	CH	NCH	TH	Ca	Mg	Cl	Fe(t)	Na	K	SO4	NO3-N	F	N
									CaCO3	CaCO3	CaCO3	CaCO3	CaCO3	CaCO3	CaCO3								
17016790000	1	09-May-94	12 West Street	52765.000	3758016.000	76	3.9	464	29	29						134				77	12.8		56.6605
17016790000	1	09-Jun-94	12 West Street	52765.000	3758016.000	77		504								144				68	7.0		30.9862
17016790000	1	13-Jul-94	12 West Street	52765.000	3758016.000	80	2.3	464	28	28	28	16	44	15	29	164	0.41	107	1.0	62	12.2	0.10	54.0045
17016790000	1	10-Aug-94	12 West Street	52765.000	3758016.000	50		318								69				46	10.0		44.266
17016790000	1	14-Sep-94	12 West Street	52765.000	3758016.000	50		318								77				47	9.4		41.61
17016790000	1	12-Oct-94	12 West Street	52765.000	3758016.000	91	0.7	536	38	38	38	36	74	34	40	171	0.01	149	4.0	60	16.2	0.04	71.7109
17016790000	1	12-Dec-94	12 West Street	52765.000	3758016.000	71		462								203				24	14.0		61.9724
17016790000	1	10-Jan-95	12 West Street	52765.000	3758016.000	74	135.0	444	29	29	29	19	48	17	31	133	0.20	127	4.0	58	12.2	0.10	54.0045
17016790000	1	13-Feb-95	12 West Street	52765.000	3758016.000	72		374								123				56	14.0		61.9724
17016790000	1	10-Mar-95	12 West Street	52765.000	3758016.000	73		492								132				58	12.0		53.1192
17016790000	1	11-Apr-95	12 West Street	52765.000	3758016.000	73	5.6	434	33	33	33	13	46	17	29	135	0.35	125	4.0	58	12.0	0.07	53.1192
17016790000	1	09-May-95	12 West Street	52765.000	3758016.000	80		488								139				53	14.0		61.9724
17016790000	1	12-Jun-95	12 West Street	52765.000	3758016.000	72.7		466								132				60	14.0		61.9724
21001090000	34	07-Jul-93	Vital Link	54150.000	3768830.000	160	9.7	1026	279	279	279	178	457	388	69	344	0.33	151	2.9	49	0.2	0.34	0.88532
21001090000	34	11-Nov-93	Vital Link	54150.000	3768830.000	173										337				46	0.2		0.75252
21001090000	34	17-Mar-94	Vital Link	54150.000	3768830.000	165	0.6		277	277						336				42	0.1		0.22133
21001090000	34	21-Apr-94	Vital Link	54150.000	3768830.000	153	0.6	960	267	267	267	248	515	433	82	308	0.02	159	4.0	48	0.1	0.35	0.22133
21001090000	34	20-May-94	Vital Link	54150.000	3768830.000	153	0.7	942								292				42	0.1		0.22133
21001090000	34	21-Jun-94	Vital Link	54150.000	3768830.000	156	5.3	1012	269	269	269	190	459	386	73	307	0.49	145	3.0	41	0.4	0.21	1.85917
21001090000	34	07-Jul-94	Vital Link	54150.000	3768830.000	157	6.4	1054	271	271	271	125	396	326	70	339	2.43	136	3.0	37	0.1	0.18	0.48693
21001090000	34	10-Aug-94	Vital Link	54150.000	3768830.000	163		1062								312				39	0.1		0.53119
21001090000	34	22-Sep-94	Vital Link	54150.000	3768830.000	165		1094								338				35	0.1		0.22133
21001090000	34	12-Oct-94	Vital Link	54150.000	3768830.000	163	42.0	1082	283	283	283	130	413	345	68	339	21.80	150	3.0	31	0.1	0.42	0.22133
21001090000	34	10-Nov-94	Vital Link	54150.000	3768830.000	165		1122								357				43	0.1		0.22133
21001090000	34	13-Dec-94	Vital Link	54150.000	3768830.000	157		1066								345				42	0.1		0.44266
21001090000	34	05-Jan-95	Vital Link	54150.000	3768830.000	160	3.5	1076	279	279	279	108	387	323	64	322	0.03	141	2.0	46	0.2	0.32	0.70826
21001090000	34	16-Mar-95	Vital Link	54150.000	3768830.000	165		1072								317				43	0.2		0.88532
21001090000	34	05-May-95	Vital Link	54150.000	3768830.000	155	2.6	962	276	276	276	184	450	398	52	317	0.33	139	2.0	44	0.1	0.25	0.44266
21001090000	34	01-Jun-95	Vital Link	54150.000	3768830.000	157		948								354				45	0.1		0.22133
22006240000	11	02-Apr-92	17 Victoria Park	57326.570	3760716.770	160		1222	264	264	235	0	235	148	87	264				87	8.7		38.5114
22006240000	11	03-Jun-93	17 Victoria Park	57326.570	3760716.770	78	0.3	558	96	96	96	28	124	80	44	133	0.07	96	2.0	59	2.6	0.17	11.5092
22006240000	11	10-Aug-93	17 Victoria Park	57326.570	3760716.770	161										229				122	13.0		57.5458
22006240000	11	14-Sep-93	17 Victoria Park	57326.570	3760716.770	161	1.2	1168	270	270	269	0	269	163	106	252	0.05	245	3.0	112	14.0	0.32	61.9724
23006160000	5	03-Jun-93	21 Admiralty Way	62141.000	3762843.000	236	2.7	1394	397	397	397	178	575	419	156	478	0.11	239	4.0	47	0.4	0.48	1.72637
23006160000	5	10-Aug-93	21 Admiralty Way	62141.000	3762843.000	225										480				62	0.7		3.09862
23006160000	5	14-Sep-93	21 Admiralty Way	62141.000	3762843.000	229	0.6	1360	410	410	410	185	595	412	183	483	1.29	221	4.0	49	0.1	0.59	0.22133
23006160000	5	16-Nov-93	21 Admiralty Way	62141.000	3762843.000	224										348				65	0.7		3.01009
23006160000	5	08-Feb-94	21 Admiralty Way	62141.000	3762843.000	219	0.4		394	394	394	198	592	434	158	449		249	4.0	56	0.4		1.77064
23006160000	5	09-Mar-94	21 Admiralty Way	62141.000	3762843.000	228	0.7		393	393						472				42	0.1		0.22133
23006160000	5	14-Apr-94	21 Admiralty Way	62141.000	3762843.000	229	3.1	1366	407	407	407	179	586	415	171	473	0.05	283	2.3	54	0.1	0.66	0.22133
23006160000	5	09-Jun-94	21 Admiralty Way	62141.000	3762843.000	232		1486								480				70	0.2		0.88532
23006160000	5	14-Jul-94	21 Admiralty Way	62141.000	3762843.000	230	0.8	1478	416	416	416	138	554	399	155	492	0.05	250	3.0	52	0.1	0.47	0.22133
23006160000	5	10-Aug-94	21 Admiralty Way	62141.000	3762843.000	232		1550								465				57	0.7		3.05435
23006160000	5	21-Sep-94	21 Admiralty Way	62141.000	3762843.000	232		1448								472				57	0.1		0.22133
23006160000	5	12-Oct-94	21 Admiralty Way	62141.000	3762843.000	229	0.4	1546	419	419	419	151	570	417	153	480	0.00	260	3.0	56	0.7	0.40	2.87729
23006160000	5	20-Dec-94	21 Admiralty Way	62141.000	3762843.000	227		1460								355				85	0.1		0.22133
23006160000	5	10-Jan-95	21 Admiralty Way	62141.000	3762843.000	232	0.3	1480	412	412	412	132	544	400	144	486	0.02	251	2.0	56	0.5	0.71	2.3461
23006160000	5	13-Feb-95	21 Admiralty Way	62141.000	3762843.000	227		1410								455				57	0.3		1.46078
23006160000	5	27-Mar-95	21 Admiralty Way	62141.000	3762843.000	231		1412								480				61	0.5		2.16903
23006160000	5	20-Apr-95	21 Admiralty Way	62141.000	3762843.000	231	1.1	1406	395	395	395	176	571	421	150	480	0.10	262	5.0	84		0.19	0
23006160000	5	09-May-95	21 Admiralty Way	62141.000	3762843.000	229		1428								457				43	0.1		0.22133
23006160000	5	12-Jun-95	21 Admiralty Way	62141.000	3762843.000	227		1458								480				50	0.1		0.44266
23014100000	6	03-Jun-93	5 Kolbe Crescent	60364.000	3762682.000	196	0.2	1154	384	384	384	152	536	438	98	306	0.01	193	4.0	73	18.0	0.44	79.6788
23014100000	6	10-Aug-93	5 Kolbe Crescent	60364.000	3762682.000	188										262				82	18.0		79.6788
23014100000	6	14-Sep-93	5 Kolbe Crescent	60364.000	3762682.000	189	0.8	1240	389	389	389	140	529	406	123	285	0.09	218	6.0	87	16.0	0.58	70.8256
23014100000	6	16-Nov-93	5 Kolbe Crescent	60364.000	3762682.000	184										285				99	20.0		88.532
23014100000	6	12-Jan-94	5 Kolbe Crescent	60364.000	3762682.000	182	0.3	1164	382	382	382	91	473	378	95	278	0.04	169	3.5	75		0.46	0
23014100000	6	09-Mar-94	5 Kolbe Crescent	60364.000	3762682.000	187	0.4		366	366						304				79	19.3		85.4334
23014100000	6	14-Apr-94	5 Kolbe Crescent	60364.000	3762682.000	189	0.3	1136	376	376	376	196	572	449	123	280	0.02	220	4.0	84	18.7	0.43	82.7774
23014100000	6	09-May-94	5 Kolbe Crescent	60364.000	3762682.000	186	0.2	1172	379	379						304				89	7.0		30.9862
23014100000	6	09-Jun-94	5 Kolbe Crescent	60364.000	3762682.000	188		1220								287				86	17.0		75.2522
23014100000	6	14-Jul-94	5 Kolbe Crescent	60364.000	3762682.000	188	0.4	1198	383	383	383	120	503	398	105	288	0.03	179	3.0	78	21.0	0.39	92.9586
23014100000	6	10-Aug-94	5 Kolbe Crescent	60364.000	3762682.000	187		1260								265				76	21.0		92.9586
23014100000	6	21-Sep-94	5 Kolbe Crescent	60364.000	3762682.000	186		1206								280				81	19.0		84.1054
23014100000	6	12-Oct-94	5 Kolbe Crescent	60364.000	3762682.000	186	0.2	1232	384	384	384	114	498	400	98	283	0.37	178	4.0	88	19.0	0.64	84.1054

Erf. No.	Bh.No.	Date	Address	-Y-Co-ord	-X-Co-ord	EC	Turb.	TDS	TA	BCA	CH	NCH	TH	Ca	Mg	Cl	Fe(t)	Na	K	SO4	NO3-N	F	N
									CaCO3	CaCO3	CaCO3	CaCO3	CaCO3	CaCO3	CaCO3								
23014100000	6	20-Dec-94	5 Kolbe Crescent	60364.000	3762682.000	188		1162								322				91	21.0		92.9586
23014100000	6	10-Jan-95	5 Kolbe Crescent	60364.000	3762682.000	188	0.3	1238	388	388	388	144	532	431	101	281	0.05	177	4.0	84	19.9	0.56	88.0893
23014100000	6	13-Feb-95	5 Kolbe Crescent	60364.000	3762682.000	186		1354								272				86	19.0		84.1054
23014100000	6	10-Mar-95	5 Kolbe Crescent	60364.000	3762682.000	185		1180								288				90	22.0		97.3852
23014100000	6	20-Apr-95	5 Kolbe Crescent	60364.000	3762682.000	193	0.4	1146	366	366	366	182	548	444	104	280	0.62	181	5.0	82	21.0	0.14	92.9586
23014100000	6	09-May-95	5 Kolbe Crescent	60364.000	3762682.000	188		1136								245				69	20.0		88.532
23014100000	6	12-Jun-95	5 Kolbe Crescent	60364.000	3762682.000	187		1200								301				91	21.0		92.9586
23016930000	15	07-Jun-93	10 Bulbring Road	59912.000	3762833.000	211	0.4	1378	360	360	360	227	587	478	109	504	0.12	204	3.0	95	12.0	0.46	53.1192
23016930000	15	10-Aug-93	10 Bulbring Road	59912.000	3762833.000	197										351				84	12.0		53.1192
23016930000	15	16-Nov-93	10 Bulbring Road	59912.000	3762833.000	192										424				87	12.0		53.1192
23016930000	15	12-Jan-94	10 Bulbring Road	59912.000	3762833.000	194	0.4	1118	351	351	351	195	546	442	104	324	0.02	172	2.2	66		0.45	
23016930000	15	21-Sep-94	10 Bulbring Road	59912.000	3762833.000	205		1270								363				80	13.0		57.5458
23016930000	15	20-Dec-94	10 Bulbring Road	59912.000	3762833.000	200		1296								363				78	15.0		66.399
23016930000	15	10-Jan-95	10 Bulbring Road	59912.000	3762833.000	199	0.4	1370	360	360	360	196	556	459	97	359	0.01	185	3.0	81	14.2	0.54	62.8577
23016930000	15	10-Mar-95	10 Bulbring Road	59912.000	3762833.000	203		1344								344				83	14.0		61.9724
23016930000	15	12-Jun-95	10 Bulbring Road	59912.000	3762833.000	200		1280								349				76	14.0		61.9724
23017360000	7	03-Jun-93	68 Winchester Way	60270.000	3762750.000	239	0.4	1512	410	410	410	310	720	583	137	411	0.02	210	7.0	87	25.0	0.51	110.665
23017360000	7	10-Aug-93	68 Winchester Way	60270.000	3762750.000	235										398				76	29.0		128.371
23017360000	7	14-Sep-93	68 Winchester Way	60270.000	3762750.000	239	0.6	1548	417	417	417	260	737	591	146	379	0.06	136	4.0	85	31.0	0.64	137.225
23017360000	7	16-Nov-93	68 Winchester Way	60270.000	3762750.000	243										440				123	30.0		132.798
23017360000	7	12-Jan-94	68 Winchester Way	60270.000	3762750.000	253	0.9	1652	403	403	403	296	699	572	127	472	0.03	198	7.9	102		0.64	
23017360000	7	08-Feb-94	68 Winchester Way	60270.000	3762750.000	234	0.7		398	398	398	335	733	598	135	408		219	11.0	96	25.0		110.665
23017360000	7	09-Mar-94	68 Winchester Way	60270.000	3762750.000	254	0.8		398	398						429				74	32.0		141.651
23017360000	7	14-Apr-94	68 Winchester Way	60270.000	3762750.000	251	1.4	1628	404	404	404	417	821	673	148	476	0.04	247	9.0	108	26.3	0.76	116.42
23017360000	7	09-May-94	68 Winchester Way	60270.000	3762750.000	248	0.5	1648	409	409						464				116	21.7		96.0572
23017360000	7	09-Jun-94	68 Winchester Way	60270.000	3762750.000	249		1690								454				97	25.0		110.665
23017360000	7	14-Jul-94	68 Winchester Way	60270.000	3762750.000	249	1.9	1598	412	412	412	319	731	589	142	467	0.05	223	6.0	89	26.0	0.47	115.092
23017360000	7	10-Aug-94	68 Winchester Way	60270.000	3762750.000	256		1664								441				91	28.0		123.945
23017360000	7	21-Sep-94	68 Winchester Way	60270.000	3762750.000	260		1644								470				101	28.0		123.945
23017360000	7	12-Oct-94	68 Winchester Way	60270.000	3762750.000	258	0.3	1758	424	424	424	316	740	607	133	485	0.00	235	9.0	105	28.0	0.63	123.945
23017360000	7	20-Dec-94	68 Winchester Way	60270.000	3762750.000	253		1744								381				74	24.0		106.238
23017360000	7	13-Feb-95	68 Winchester Way	60270.000	3762750.000	264		1938								485				111	25.0		110.665
23017360000	7	10-Mar-95	68 Winchester Way	60270.000	3762750.000	266		1840								503				104	27.0		119.518
23017360000	7	20-Apr-95	68 Winchester Way	60270.000	3762750.000	272	0.5	1830	403	403	403	340	743	614	129	535	0.10	251	10.0	98	25.0	0.30	110.665
23017360000	7	09-May-95	68 Winchester Way	60270.000	3762750.000	271		1870								433				76	24.0		106.238
23017360000	7	12-Jun-95	68 Winchester Way	60270.000	3762750.000	266		1734								511				97	24.0		106.238
27006880000	40	10-Aug-93	15 Cosmos Street	47812.79	3756403.07	332										1006				126	0.2		0.88532
27006880000	40	14-Sep-93	15 Cosmos Street	47812.79	3756403.07	335	5.9	2132	54	54	54	471	525	190	335	961	0.25	515	8.0	102	0.2	0.37	0.92959
27006880000	40	16-Nov-93	15 Cosmos Street	47812.79	3756403.07	328										961				125	0.2		0.88532
32000470000	23	18-Jun-93	Clarendon Park	54350	3760570	287	3.4	1722	61	61	61	306	367	135	232	828	0.30	420	6.0	116	0.4	0.10	1.9477
32000470000	23	10-Aug-93	Clarendon Park	54350	3760570	274										763				110	0.4		1.77064
32000470000	23	10-Aug-93	Clarendon Park	54350	3760570	290										802				120	0.6		2.65596
32000470000	23	14-Sep-93	Clarendon Park	54350	3760570	288	4.5	1842	33	33	33	395	428	168	260	823	0.23	465	8.0	118	0.3	0.17	1.41651
32000470000	23	29-Sep-93	Clarendon Park	54350	3760570	291	5.5	1710	33	33	33	393	426	175	251	836	0.33	439	10.0	150	0.4	0.05	1.77064
32000470000	23	25-Oct-93	Clarendon Park	54350	3760570	274										757				123	0.3		1.32798
32000470000	23	16-Nov-93	Clarendon Park	54350	3760570	284										809				103	0.3		1.46078
32000470000	23	16-Nov-93	Clarendon Park	54350	3760570	275										696				106			
32000470000	23	14-Dec-93	Clarendon Park	54350	3760570	286										871				93	0.1		0.22133
32000470000	23	12-Jan-94	Clarendon Park	54350	3760570	285	17.0	1560	31	31	31	314	345	116	229	883	1.04	431	3.3	86	0.1	0.16	0.22133
32000470000	23	19-Jan-94	Clarendon Park	54350	3760570	294	9.4	1538	30	30	30	363	393	141	252	847		520	6.6	86	0.3		1.32798
32000470000	23	08-Feb-94	Clarendon Park	54350	3760570	299	4.0		27	27	27	399	426	149	277	829		475	13.0	105	0.4		1.59358
32000470000	23	10-Feb-94	Clarendon Park	54350	3760570																		
32000470000	23	17-Mar-94	Clarendon Park	54350	3760570	285	28.0		32	32						803				93	0.5		1.99197
32000470000	23	09-Jun-94	Clarendon Park	54350	3760570	286		1680								817				103	0.3		1.46078
32000470000	23	21-Jun-94	Clarendon Park	54350	3760570	304	5.5	1708	30	30	30	435	465	185	280	856	0.11	483	13.0	109	0.4	0.05	1.81491
32000470000	23	07-Jul-94	Clarendon Park	54350	3760570	304	1.5	1708	30	30	30	310	340	105	235	917	0.16	476	5.0	94	0.5	0.05	2.39036
32000470000	23	13-Jul-94	Clarendon Park	54350	3760570	308	26.0	1810	48	48	48	331	379	139	240	987	0.13	440	5.0	89	0.5	0.20	2.39036
32000470000	23	10-Aug-94	Clarendon Park	54350	3760570	295		1834								837				101	0.5		1.99197
32000470000	23	12-Aug-94	Clarendon Park	54350	3760570	301		1806								795				121	0.5		2.03624
32000470000	23	14-Sep-94	Clarendon Park	54350	3760570	303		1814								907				131	0.3		1.23945
32000470000	23	22-Sep-94	Clarendon Park	54350	3760570	318		1946								916				130	0.4		1.81491
32000470000	23	12-Oct-94	Clarendon Park	54350	3760570	312	7.5	1918	31	31	31	369	400	134	266	905	0.89	476	11.0	110	0.4	0.24	1.81491
32000470000	23	13-Oct-94	Clarendon Park	54350	3760570	314	2.2	1930	28	28	28	373	401	143	258	919	0.03	472	11.0	115	0.5	0.23	2.2133
32000470000	23	10-Nov-94	Clarendon Park	54350	3760570	326		1916								974				108	0.3		1.50504
32000470000	23	08-Dec-94	Clarendon Park	54350	3760570	314		1964								1016				113	0.5		2.2133
32000470000	23	12-Dec-94	Clarendon Park	54350	3760570	300		1782								929				105	0.5		2.2133

Erf. No.	Bh.No.	Date	Address	-Y-Co-ord	-X-Co-ord	EC	Turb.	TDS	TA	BCA	CH	NCH	TH	Ca	Mg	Cl	Fe(t)	Na	K	SO4	NO3-N	F	N
									CaCO3	CaCO3	CaCO3	CaCO3	CaCO3	CaCO3	CaCO3								
32000470000	23	10-Jan-95	Clarendon Park	54350	3760570	315	2.7	1806	35	35	35	341	378	130	248	825	0.04	462	9.0	104	0.5	0.05	1.99197
32000470000	23	09-Feb-95	Clarendon Park	54350	3760570	306		1790								807				113	0.5		2.16903
32000470000	23	10-Mar-95	Clarendon Park	54350	3760570	308		1892								758				123	0.6		2.61169
32000470000	23	16-Mar-95	Clarendon Park	54350	3760570	309		1828								859				106	0.6		2.65596
32000470000	23	10-Apr-95	Clarendon Park	54350	3760570	325	0.7	1940	55	55	55	362	417	172	245	987	0.06	479	11.0	112	0.6	0.05	2.52316
32000470000	23	11-Apr-95	Clarendon Park	54350	3760570	314	0.6	1694	34	34	34	345	379	133	246	949	0.03	475	12.0	102	0.5	0.05	2.03624
32000470000	23	11-May-95	Clarendon Park	54350	3760570	282		1814								877				107	0.6		2.43463
32000470000	23	01-Jun-95	Clarendon Park	54350	3760570	311		1734								967				103	0.3		1.50504
32000470000	23	12-Jun-95	Clarendon Park	54350	3760570	320		1754								947				105	0.5		2.39036
32001790000	14	07-Jun-93	12 11th Avenue	53190.000	3761589.000	171	13.0	1182	145	145	145	148	293	151	142	515	0.61	209	19.0	74	0.1	0.27	0.22133
32001790000	14	17-Jul-93	12 11th Avenue	53190.000	3761589.000	169										406							
32001790000	14	10-Aug-93	12 11th Avenue	53190.000	3761589.000	160										369				41	0.1		0.22133
32001790000	14	14-Sep-93	12 11th Avenue	53190.000	3761589.000	176	2.6	1156	146	146	146	239	385	211	174	452	0.61	239	25.0	48	0.1	0.36	0.22133
32001790000	14	16-Nov-93	12 11th Avenue	53190.000	3761589.000	174										436				45	0.1		0.22133
32001790000	14	12-Jan-94	12 11th Avenue	53190.000	3761589.000	170	3.7	1108	148	148	148	140	288	155	133	442	0.06	188	18.0	34	0.1	0.21	0.22133
32001790000	14	08-Feb-94	12 11th Avenue	53190.000	3761589.000	171	4.2		144	144	144	212	356	196	160	429		215	20.0	36	0.1		0.22133
32001790000	14	09-Mar-94	12 11th Avenue	53190.000	3761589.000	177	10.0		143	143						479				30	0.1		0.22133
32001790000	14	14-Jul-94	12 11th Avenue	53190.000	3761589.000	174	25.0	1114	162	162	162	145	307	160	147	429	8.73	198	14.0	38	0.1	0.19	0.22133
32001790000	14	10-Aug-94	12 11th Avenue	53190.000	3761589.000	169		1150								386				35	0.1		0.22133
32001790000	14	15-Sep-94	12 11th Avenue	53190.000	3761589.000	175		1214								406				40	0.1		0.22133
32001790000	14	12-Oct-94	12 11th Avenue	53190.000	3761589.000	177	5.2	1178	153	153	153	158	311	165	146	442	0.66	209	23.0	38	0.1	0.29	0.22133
32001790000	14	13-Dec-94	12 11th Avenue	53190.000	3761589.000	184		1158								501				44	0.1		0.22133
32001790000	14	10-Jan-95	12 11th Avenue	53190.000	3761589.000	173	7.0	1178	152	152	152	160	312	170	142	438	0.02	205	23.0	40	0.1	0.19	0.22133
32001790000	14	09-Feb-95	12 11th Avenue	53190.000	3761589.000	189		1056								446				46	0.0		0.04427
32001790000	14	10-Mar-95	12 11th Avenue	53190.000	3761589.000	184		1264								468				40	0.0		0.04427
32001790000	14	11-Apr-95	12 11th Avenue	53190.000	3761589.000	192	4.2	1232	171	171	171	143	314	173	141	533	0.03	225	21.0	41	0.0	0.05	0.02213
32001790000	14	11-May-95	12 11th Avenue	53190.000	3761589.000	169		1146								490				42	0.1		0.22133
32001790000	14	12-Jun-95	12 11th Avenue	53190.000	3761589.000	185		1208								480				42	0.1		0.22133
32004980000	33	28-Jun-93	64 Short Road	53010.000	3761117.000	414	68.0	2558	195	195	195	502	697	283	414	1437	29.00	638	5.4	163	0.1	0.27	0.22133
32004980000	33	17-Jul-93	64 Short Road	53010.000	3761117.000	404										1144							
32004980000	33	10-Aug-93	64 Short Road	53010.000	3761117.000	429										1230				232	0.1		0.22133
32004980000	33	16-Nov-93	64 Short Road	53010.000	3761117.000	345										1246				159	0.1		0.22133
32004980000	33	12-Jan-94	64 Short Road	53010.000	3761117.000	353	56.0	2066	178	178	178	334	512	236	276	1057	4.89	518	6.1	125	0.1	0.29	0.22133
32004980000	33	08-Feb-94	64 Short Road	53010.000	3761117.000	349	43.0		164	164	164	414	578	272	306	938		547	16.0	130	0.1		0.22133
32004980000	33	10-Feb-94	64 Short Road	53010.000	3761117.000																		
32004980000	33	09-Mar-94	64 Short Road	53010.000	3761117.000	356	40.0		178	178						957				126	0.1		0.22133
32004980000	33	14-Apr-94	64 Short Road	53010.000	3761117.000	356	79.0	2318	178	178	178	411	589	279	310	966	69.50	579	9.0	122	0.1	0.31	0.22133
32004980000	33	09-May-94	64 Short Road	53010.000	3761117.000	348	80.0	2180	184	184						956				128	0.1		0.22133
32004980000	33	09-Jun-94	64 Short Road	53010.000	3761117.000	361		2166								958				127	0.1		0.22133
32004980000	33	14-Jul-94	64 Short Road	53010.000	3761117.000	359	145.0	2162	206	206	206	272	478	205	273	987	7.90	548	3.0	104	0.1	0.05	0.22133
32004980000	33	10-Aug-94	64 Short Road	53010.000	3761117.000	360		2234								918				118	0.1		0.22133
32004980000	33	15-Sep-94	64 Short Road	53010.000	3761117.000	360		2226								893				113	0.1		0.22133
32004980000	33	12-Oct-94	64 Short Road	53010.000	3761117.000	357	31.0	2202	179	179	179	345	524	240	284	975	5.60	542	11.0	133	0.1	0.53	0.22133
32004980000	33	12-Dec-94	64 Short Road	53010.000	3761117.000	341		2238								1021				122	0.1		0.22133
32004980000	33	10-Jan-95	64 Short Road	53010.000	3761117.000	353	77.0	2266	187	187	187	310	497	241	256	867	9.34	509	9.0	107	0.1	0.05	0.53119
32004980000	33	09-Feb-95	64 Short Road	53010.000	3761117.000	356		2068								932				132			
32004980000	33	10-Mar-95	64 Short Road	53010.000	3761117.000	346		2128								935				135	0.0		0.04427
32004980000	33	11-Apr-95	64 Short Road	53010.000	3761117.000	361	77.0	2218	211	211	211	276	487	225	262	1024	15.34	541	10.0	109	0.0	0.22	0.02213
32004980000	33	11-May-95	64 Short Road	53010.000	3761117.000	344		2282								1020				110	0.1		0.22133
32004980000	33	12-Jun-95	64 Short Road	53010.000	3761117.000	360		2138								991				107	0.1		0.22133
32019350000	28	18-Jun-93	Walmer Country Club	52495.000	3762895.000	226	12.0	1356	455	455	392	0	392	268	124	528	6.18	292	6.0	65	0.1	0.31	0.22133
32019350000	28	31-Aug-93	Walmer Country Club	52495.000	3762895.000	209										505				64	0.1		0.22133
32019350000	28	29-Sep-93	Walmer Country Club	52495.000	3762895.000	281	28.0	1758	210	210	210	248	458	299	159	784	14.50	395	13.0	60	0.1	0.24	0.22133
32019350000	28	26-Oct-93	Walmer Country Club	52495.000	3762895.000	205										459				59	0.1		0.22133
32019350000	28	16-Nov-93	Walmer Country Club	52495.000	3762895.000	219														65	0.1		0.22133
32019350000	28	20-Dec-93	Walmer Country Club	52495.000	3762895.000	206										458				56	0.1		0.22133
32019350000	28	19-Jan-94	Walmer Country Club	52495.000	3762895.000	201	8.1	1206	131	131	131	236	367	243	124	501		288		49	0.1		0.22133
32019350000	28	22-Feb-94	Walmer Country Club	52495.000	3762895.000	202	17.0		241	241	241	102	343	211	132	428		294	7.8		0.1		0.22133
32019350000	28	17-Mar-94	Walmer Country Club	52495.000	3762895.000	219	45.0		233	233						479				58	0.1		0.22133
32019350000	28	21-Apr-94	Walmer Country Club	52495.000	3762895.000	204	24.0	1292	140	140	140	273	413	267	146	480	1.76	320	6.0	60	0.1	0.20	0.22133
32019350000	28	20-May-94	Walmer Country Club	52495.000	3762895.000	245	26.0	1482								586				76	0.1		0.22133
32019350000	28	21-Jun-94	Walmer Country Club	52495.000	3762895.000	200	7.0	1298	242	242	242	193	435	309	126	447	0.47	265	6.0	62	0.1	0.01	0.22133
32019350000	28	07-Jul-94	Walmer Country Club	52495.000	3762895.000	237	5.0	1518	226	226	226	157	383	247	136	618	4.10	322	5.0	61	0.1	0.34	0.22133
32019350000	28	10-Aug-94	Walmer Country Club	52495.000	3762895.000	218		1452								552				58	0.1		0.22133
32019350000	28	22-Sep-94	Walmer Country Club	52495.000	3762895.000	205		1364								457				65	0.1		0.22133
32019350000	28	12-Oct-94	Walmer Country Club	52495.000	3762895.000	220	33.0	1336	243	243	243	155	398	274	124	528	19.80	295	7.0	64	0.1	0.41	0.22133

Erf. No.	Bh.No.	Date	Address	-Y-Co-ord	-X-Co-ord	EC	Turb.	TDS	TA	BCA	CH	NCH	TH	Ca	Mg	Cl	Fe(t)	Na	K	SO4	NO3-N	F	N
									CaCO3	CaCO3	CaCO3	CaCO3	CaCO3	CaCO3	CaCO3								
32019350000	28	10-Nov-94	Walmer Country Club	52495.000	3762895.000	223		1414								540				64	0.1		0.22133
32019350000	28	13-Dec-94	Walmer Country Club	52495.000	3762895.000	237		1464								486				61	4.2		18.5917
32019350000	28	05-Jan-95	Walmer Country Club	52495.000	3762895.000	236	0.8	1526	372	372	372	138	510	394	116	480	0.04	279	3.0	121	40.0	0.46	177.064
32019350000	28	16-Mar-95	Walmer Country Club	52495.000	3762895.000	210		1232								497				63	0.1		0.44266
32019350000	28	06-Apr-95	Walmer Country Club	52495.000	3762895.000	223	1.4	1328	293	293	293	126	419	309	110	432	0.10	264	4.0	98	4.0	0.05	17.7064
32019350000	29	18-Jun-93	Walmer Country Club	52925.000	3762555.000	212	13.0	1352	472	472	386	0	386	272	114	480	3.50	265	5.0	68	0.1	0.33	0.22133
32019350000	29	31-Aug-93	Walmer Country Club	52925.000	3762555.000	214										526				70	0.1		0.22133
32019350000	29	29-Sep-93	Walmer Country Club	52925.000	3762555.000	262	22.0	1654	221	221	221	182	443	293	150	720	11.70	370	11.0	55	0.1	0.24	0.22133
32019350000	29	16-Nov-93	Walmer Country Club	52925.000	3762555.000	217										521				64	0.1		0.22133
32019350000	29	20-Dec-93	Walmer Country Club	52925.000	3762555.000	200										453				56	0.1		0.22133
32019350000	29	19-Jan-94	Walmer Country Club	52925.000	3762555.000	199	22.0	1234	131	131	131	268	399	257	142	489		311	6.6	49	0.1		0.22133
32019350000	29	22-Feb-94	Walmer Country Club	52925.000	3762555.000	242	28.0		216	216	216	228	444	283	161	675		388	10.0				
32019350000	29	17-Mar-94	Walmer Country Club	52925.000	3762555.000	220	37.0		213	213						511				52	0.1		0.22133
32019350000	29	21-Apr-94	Walmer Country Club	52925.000	3762555.000	201	20.0	1292	140	140	140	312	452	297	155	540	2.18	336	7.0	69	0.1	0.10	0.22133
32019350000	29	20-May-94	Walmer Country Club	52925.000	3762555.000	247	32.0	1474								585				74	0.1		0.22133
32019350000	29	21-Jun-94	Walmer Country Club	52925.000	3762555.000	208	7.5	1322	245	245	245	191	436	311	125	480	0.01	279	6.0	62	0.1	0.24	0.44266
32019350000	29	07-Jul-94	Walmer Country Club	52925.000	3762555.000	253	7.1	1628	217	217	217	166	383	236	147	696	6.56	342	6.0	62	0.1	0.23	0.22133
32019350000	29	10-Aug-94	Walmer Country Club	52925.000	3762555.000	231		1442								347				57	0.1		0.22133
32019350000	29	22-Sep-94	Walmer Country Club	52925.000	3762555.000	205		1362								460				63	0.1		0.22133
32019350000	29	12-Oct-94	Walmer Country Club	52925.000	3762555.000	243	0.4	1422	362	362	362	213	575	439	136	497	0.03	292	3.0	61	0.1	0.29	0.22133
32019350000	29	13-Dec-94	Walmer Country Club	52925.000	3762555.000	202		1292								502				65	0.1		0.22133
32019350000	29	05-Jan-95	Walmer Country Club	52925.000	3762555.000	223	18.0	1498	238	238	238	118	356	245	111	487	0.16	289	5.0	65	0.1	0.47	0.22133
32019350000	29	16-Mar-95	Walmer Country Club	52925.000	3762555.000	206		1236								447				63	0.1		0.22133
32019350000	29	06-Apr-95	Walmer Country Club	52925.000	3762555.000	218	1.5	1348	287	287	287	128	415	308	107	432	0.08	260	3.0	100	3.9	0.05	17.2637
32019350000	29a	20-May-94	Walmer Country Club	53460.000	3762645.000	252	6.4	1476								480				179	0.1		0.22133
32019350000	29a	21-Jun-94	Walmer Country Club	53460.000	3762645.000	251	0.3	1524	397	397	397	293	690	528	162	478	0.08	320	3.0	121	5.2	0.01	23.0183
32019350000	29a	07-Jul-94	Walmer Country Club	53460.000	3762645.000	249	13.0	1490	406	406	406	148	554	435	119	511	1.61	278	3.0	140	0.1	0.44	0.22133
32019350000	29a	10-Aug-94	Walmer Country Club	53460.000	3762645.000	245										436				114	2.3		10.1812
32019350000	29a	21-Sep-94	Walmer Country Club	53460.000	3762645.000	246		1590								483				125	6.6		29.2156
32019350000	29a	10-Nov-94	Walmer Country Club	53460.000	3762645.000	242		1434								482				122	5.6		24.789
32019350000	29a	16-Mar-95	Walmer Country Club	53460.000	3762645.000	226		1328								413				119	0.7		3.09862
32019350000	29a	06-Apr-95	Walmer Country Club	53460.000	3762645.000	232	0.3	1350	381	381	381	114	495	402	93	427	0.01	270	2.0	119	4.7	0.05	20.805
32019350000	44	15-Sep-94	PEM King Edward Pk.	53690.810	3762029.400	275		1674								719				82	0.1		0.22133
32019350000	44	12-Oct-94	PEM King Edward Pk.	53690.810	3762029.400	290	45.0	1886	64	64	64	373	437	195	242	834	0.01	411	10.0	117	0.1	0.05	0.22133
32019350000	44	13-Dec-94	PEM King Edward Pk.	53690.810	3762029.400	271		1760								803				102	0.1		0.22133
32019480000	27	18-Jun-93	Telkom Club	52540.000	3764120.000	405	0.6	2560	395	395	395	380	775	575	200	986	0.00	524	3.0	245	12.7	0.29	56.2178
32019480000	27	23-Jun-93	Telkom Club	52540.000	3764120.000	398	0.4	2388	371	371	371	217	588	452	136	1090	0.03	492	2.0	220	14.9	0.27	65.9563
32019480000	27	17-Jul-93	Telkom Club	52540.000	3764120.000	395										959							
32019480000	27	10-Aug-93	Telkom Club	52540.000	3764120.000	392										923				233	16.0		70.8256
32019480000	27	29-Sep-93	Telkom Club	52540.000	3764120.000	396	0.5	2250	391	391	391	457	848	640	208	922	0.01	544	9.0	268	1.5	0.23	6.6399
32019480000	27	25-Oct-93	Telkom Club	52540.000	3764120.000	376										841				20	16.0		70.8256
32019480000	27	16-Nov-93	Telkom Club	52540.000	3764120.000	393										789				109	17.0		75.2522
32019480000	27	14-Dec-93	Telkom Club	52540.000	3764120.000	375										912				205			
32019480000	27	19-Jan-94	Telkom Club	52540.000	3764120.000	383	0.4	2278	390	390	390	453	843	615	228	901		576	6.8	197			
32019480000	27	22-Feb-94	Telkom Club	52540.000	3764120.000	390	0.8		380	380	380	443	823	595	228	907		580	8.9		18.0		79.6788
32019480000	27	17-Mar-94	Telkom Club	52540.000	3764120.000	384	5.0		419	419						860				203	16.4		72.5962
32019480000	27	21-Apr-94	Telkom Club	52540.000	3764120.000	397	0.7	2392	398	398	398	593	991	732	259	903	0.01	611	3.0	234	9.6	0.37	42.4954
32019480000	27	20-May-94	Telkom Club	52540.000	3764120.000	398	0.4	2296								864				203	13.5		59.7591
32019480000	27	21-Jun-94	Telkom Club	52540.000	3764120.000	400	0.4	2416	399	399	399	446	845	620	225	892	0.05	554	7.0	214	16.0	0.05	70.8256
32019480000	27	07-Jul-94	Telkom Club	52540.000	3764120.000	400	0.2	2420	393	393	393	406	799	586	213	995	0.04	544	3.0	220	16.0	0.55	70.8256
32019480000	27	10-Aug-94	Telkom Club	52540.000	3764120.000	402		2466								851				210	14.0		61.9724
32019480000	27	20-Sep-94	Telkom Club	52540.000	3764120.000	383		2404								908				203	13.0		57.5458
32019480000	27	22-Sep-94	Telkom Club	52540.000	3764120.000	402		2576								940				214	13.0		57.5458
32019480000	27	12-Oct-94	Telkom Club	52540.000	3764120.000	394	2.1	2420	396	396	396	378	774	575	199	930	0.12	527	6.0	214	15.6	0.49	69.055
32019480000	27	10-Nov-94	Telkom Club	52540.000	3764120.000	407		2452								977				231	15.4		68.1696
32019480000	27	13-Dec-94	Telkom Club	52540.000	3764120.000	394		2440								978				230	13.0		57.5458
32019480000	27	05-Jan-95	Telkom Club	52540.000	3764120.000	391	1.2	2498	392	392	392	334	726	545	181	984	0.03	524	5.0	217	14.3	0.05	63.3004
32019480000	27	10-Jan-95	Telkom Club	52540.000	3764120.000	403	0.4	2526	412	412	412	409	821	608	213	896	0.01	540	5.0	213	15.8	0.05	69.9403
32019480000	27	09-Feb-95	Telkom Club	52540.000	3764120.000	384		2350								898				143	17.0		75.2522
32019480000	27	13-Mar-95	Telkom Club	52540.000	3764120.000	384		2296								871				221	16.0		70.8256
32019480000	27	16-Mar-95	Telkom Club	52540.000	3764120.000	394		2312								870				221	15.0		66.399
32019480000	27	10-Apr-95	Telkom Club	52540.000	3764120.000	392	1.2	2432	422	422	422	282	704	530	174	893	0.21	495	3.0	221	18.0	0.05	79.6788
32019480000	27	11-May-95	Telkom Club	52540.000	3764120.000	336		2406								843				207	17.0		75.2522
32019480000	27	01-Jun-95	Telkom Club	52540.000	3764120.000	380		2256								889				229	9.0		39.8394
32019480000	27	21-Jun-95	Telkom Club	52540.000	3764120.000																		
32019480000	26	18-Jun-93	P.E. Kennel Club	55654.200	3763403.950	225	1.2	1518	493	493	493	27	520	448	72	516	0.13	231	0.8	68	2.3	0.29	10.0041

Erf. No.	Bh.No.	Date	Address	-Y-Co-ord	-X-Co-ord	EC	Turb.	TDS	TA	BCA	CH	NCH	TH	Ca	Mg	Cl	Fe(t)	Na	K	SO4	NO3-N	F	N
									CaCO3	CaCO3	CaCO3	CaCO3	CaCO3	CaCO3	CaCO3								
32019480000	26	30-Aug-93	P.E. Kennel Club	55654.200	3763403.950	216	0.3	1480					517	431	86	510	0.04	228	3.0	100	2.2	0.17	9.73852
32019480000	26	29-Sep-93	P.E. Kennel Club	55654.200	3763403.950	234	0.5	1574	246	246	246	312	558	470	88	603	0.02	256	2.0	67	2.5	0.20	11.0665
32019480000	26	01-Nov-93	P.E. Kennel Club	55654.200	3763403.950	229										646				93	2.1		9.29586
32019480000	26	16-Nov-93	P.E. Kennel Club	55654.200	3763403.950	235										691				104	1.7		7.52522
32019480000	26	14-Dec-93	P.E. Kennel Club	55654.200	3763403.950	233										580				91			
32019480000	26	17-Mar-94	P.E. Kennel Club	55654.200	3763403.950	238	0.3		223	223						535				99	2.6		11.5092
32019480000	26	07-Jul-94	P.E. Kennel Club	55654.200	3763403.950	241	0.2	1560	226	226	226	302	528	412	116	609	0.06	272	1.0	92	2.8	0.22	12.3945
32019480000	26	31-Aug-94	P.E. Kennel Club	55654.200	3763403.950	218	0.6									479				70	2.7	0.27	11.9518
32019480000	26	22-Sep-94	P.E. Kennel Club	55654.200	3763403.950	215		1380								477				74	2.8		12.3945
32019480000	26	10-Nov-94	P.E. Kennel Club	55654.200	3763403.950	210		1414								487				73	2.5		11.0665
32019480000	26	13-Dec-94	P.E. Kennel Club	55654.200	3763403.950	241		1612								592				99	1.8		7.96788
32019480000	26	05-Jan-95	P.E. Kennel Club	55654.200	3763403.950	220	0.4	1482	256	256	256	230	486	421	65	511	0.03	230	0.7	79	2.1	0.50	9.29586
32019480000	39	21-Jul-93	Victoria Park	57035.000	3760815.000	274										548							0
32019480000	39	10-Aug-93	Victoria Park	57035.000	3760815.000	283										525				173	24.0		106.238
32019480000	39	14-Sep-93	Victoria Park	57035.000	3760815.000	275	0.4	1792	327	327	327	374	701	526	175	560	0.11	328	6.0	158	14.0	0.59	61.9724
32019480000	39	09-Mar-94	Victoria Park	57035.000	3760815.000	180	1.1		193	193						372				65	9.1		40.2821
32019480000	39	12-Oct-94	Victoria Park	57035.000	3760815.000	279	0.3	1764	343	343	343	343	686	531	155	596	0.02	314	4.0	160	15.0	0.25	66.399
32019480000	39	09-Feb-95	Victoria Park	57035.000	3760815.000	277		1552								336				153	15.8		69.9403
32019480000	39	10-Mar-95	Victoria Park	57035.000	3760815.000	281		1796								549				162	20.0		88.532
32019480000	39	11-Apr-95	Victoria Park	57035.000	3760815.000	290	0.4	1882	372	372	372	253	625	490	135	602	0.21	333	3.0	162	18.0	0.17	79.6788
32019480000	39	09-May-95	Victoria Park	57035.000	3760815.000	277		1682								539				133	7.4		32.7568
32019480000	39	12-Jun-95	Victoria Park	57035.000	3760815.000	277		1828								579				157	15.0		66.399
32019810000	3	03-Jun-93	12 Newcombe Avenue	50109.560	3763293.540	165	0.2	900	197	197	197	83	280	206	74	339	0.04	215	4.0	57	4.8	0.17	21.2477
32019810000	3	10-Aug-93	12 Newcombe Avenue	50109.560	3763293.540	163										324				64	4.3		19.0344
32019810000	3	14-Sep-93	12 Newcombe Avenue	50109.560	3763293.540	167	3.6	904	209	209	209	81	290	207	83	354	2.60	243	3.0	67	3.4	0.26	15.0504
32019810000	3	11-Nov-93	12 Newcombe Avenue	50109.560	3763293.540	168										349				59	4.0		17.7064
32019810000	3	14-Jan-94	12 Newcombe Avenue	50109.560	3763293.540	162	0.3	936	206	206	206	58	264	194	70	277	0.39	212	3.0	63	4.4	0.25	19.477
32019810000	3	08-Feb-94	12 Newcombe Avenue	50109.560	3763293.540	162	0.4		203	203	203	113	316	234	82	334		238	6.0	63	4.1		18.1491
32019810000	3	09-Mar-94	12 Newcombe Avenue	50109.560	3763293.540	165	3.4		204	204						353				35	4.5		19.9197
32019810000	3	14-Apr-94	12 Newcombe Avenue	50109.560	3763293.540	175	0.5	926	224	224	224	143	367	276	91	417	0.04	276	5.0	74	3.4	0.40	15.0504
32019810000	3	09-May-94	12 Newcombe Avenue	50109.560	3763293.540	167	0.3	942	208	208						344				62	4.4		19.477
32019810000	3	14-Jun-94	12 Newcombe Avenue	50109.560	3763293.540	166										345				70	4.3		19.0344
32019810000	3	14-Jul-94	12 Newcombe Avenue	50109.560	3763293.540	169	0.2	930	213	213	213	70	283	205	78	375	0.05	223	3.0	60	4.7	0.19	20.805
32019810000	3	21-Sep-94	12 Newcombe Avenue	50109.560	3763293.540	172		960								359				62	4.4		19.477
32019810000	3	12-Oct-94	12 Newcombe Avenue	50109.560	3763293.540	168	0.2	972	216	216	216	79	295	216	78	355	0.05	224	5.0	66	4.6	0.24	20.3624
32019810000	3	10-Jan-95	12 Newcombe Avenue	50109.560	3763293.540	132	27.0	952	163	163	163	65	228	169	59	269	3.26	175	3.0	48	3.3	0.11	14.6078
32019810000	3	09-Feb-95	12 Newcombe Avenue	50109.560	3763293.540	170		906								344				70	5.0		22.133
32019810000	3	13-Mar-95	12 Newcombe Avenue	50109.560	3763293.540	171		984								358				66	4.7		20.805
32019810000	3	28-Jun-95	12 Newcombe Avenue	50109.560	3763293.540	170		996								406				66	4.5		19.9197
32019820000	4	03-Jun-93	10 Idylwylde Crescent	51139.000	3763234.000	275	0.7	1642	156	156	156	343	499	353	146	686	0.10	308	7.0	118	4.6	0.14	20.3624
32019820000	4	10-Aug-93	10 Idylwylde Crescent	51139.000	3763234.000	267										712				130	4.6		20.3624
32019820000	4	14-Sep-93	10 Idylwylde Crescent	51139.000	3763234.000	265	0.5	1644	156	156	156	360	516	350	166	704	0.03	373	9.0	123	3.3	0.16	14.6078
32019820000	4	11-Nov-93	10 Idylwylde Crescent	51139.000	3763234.000	269										635				120	3.1		13.7225
32019820000	4	12-Jan-94	10 Idylwylde Crescent	51139.000	3763234.000	265	0.3	1506	150	150	150	280	430	304	126	491	0.01	302	5.0	122		0.23	
32019820000	4	08-Feb-94	10 Idylwylde Crescent	51139.000	3763234.000	260	1.8		149	149	149	356	505	359	146	643		359	6.0	117	3.1		13.7225
32019820000	4	09-Mar-94	10 Idylwylde Crescent	51139.000	3763234.000	266	12.0		148	148						644				107	4.1		18.1491
32019820000	4	09-May-94	10 Idylwylde Crescent	51139.000	3763234.000	263	3.5	1672	151	151						705				130	3.4		15.0504
32019820000	4	14-Jun-94	10 Idylwylde Crescent	51139.000	3763234.000	263										645				130	4.1		18.1491
32019820000	4	21-Sep-94	10 Idylwylde Crescent	51139.000	3763234.000	258		1644								630				115	4.4		19.477
32019820000	4	20-Dec-94	10 Idylwylde Crescent	51139.000	3763234.000	258		1564													4.5		19.9197
32019820000	4	10-Jan-95	10 Idylwylde Crescent	51139.000	3763234.000	261	3.0	1630	158	158	158	303	461	334	127	605	0.23	331	7.0	117	3.7	0.05	16.3784
32019820000	4	09-Feb-95	10 Idylwylde Crescent	51139.000	3763234.000	253		1466								525				122	4.8		21.2477
32019820000	4	13-Mar-95	10 Idylwylde Crescent	51139.000	3763234.000	247		1432								642				120	4.3		19.0344
32019820000	4	11-Apr-95	10 Idylwylde Crescent	51139.000	3763234.000	253	19.0	1494	162	162	162	245	407	293	114	644	5.30	336	6.0	108	2.9	0.05	12.8371
32019820000	4	09-May-95	10 Idylwylde Crescent	51139.000	3763234.000	252		1504								579				95	3.4		15.0504
32019820000	4	28-Jun-95	10 Idylwylde Crescent	51139.000	3763234.000	249		1400								667				112	4.6		20.3624
32025500000	36	15-Jul-93	74 River Road	53623.000	3760684.000	348	12.0	2270	164	164	164	357	521	268	253	1149	1.40	467	2.6	125	9.8	0.41	43.3807
32025500000	36	17-Jul-93	74 River Road	53623.000	3760684.000	365										992							
32025500000	36	10-Aug-93	74 River Road	53623.000	3760684.000	362										972				151	9.2		40.7247
32025500000	36	14-Sep-93	74 River Road	53623.000	3760684.000	364	4.8	2298	174	174	174	391	565	284	281	1049	0.18	535	5.0	141	9.2	0.35	40.7247
32025500000	36	16-Nov-93	74 River Road	53623.000	3760684.000	351										1245				161	10.0		44.266
32025500000	36	12-Jan-94	74 River Road	53623.000	3760684.000	347	54.0	2156	147	147	147	371	513	250	263	1018	4.35	508	1.3	129		0.26	
32025500000	36	08-Feb-94	74 River Road	53623.000	3760684.000	340	21.0		139	139	139	433	572	283	289	873		535	2.0	132	5.4		23.9036
32025500000	36	09-Mar-94	74 River Road	53623.000	3760684.000	349	16.0		149	149						922					10.4		46.0366
32025500000	36	14-Apr-94	74 River Road	53623.000	3760684.000	347	65.0	2244	146	146	146	442	588	294	294	932	13.70	516	2.0	132	11.1	0.30	49.1353

Erf. No.	Bh.No.	Date	Address	-Y-Co-ord	-X-Co-ord	EC	Turb.	TDS	TA	BCA	CH	NCH	TH	Ca	Mg	Cl	Fe(t)	Na	K	SO4	NO3-N	F	N
									CaCO3	CaCO3	CaCO3	CaCO3	CaCO3	CaCO3	CaCO3								
32025500000	36	09-May-94	74 River Road	53623.000	3760684.000	352	25.0	2218	157	157						939				167	5.5		24.3463
32025500000	36	15-Sep-94	74 River Road	53623.000	3760684.000	348		2120								873				130	11.0		48.6926
32025500000	36	12-Oct-94	74 River Road	53623.000	3760684.000	379	15.0	2779	162	162	162	624	786	585	201	1078	0.02	453	13.0	119		0.21	
32026390000	17	07-Jun-93	10 4th Avenue	55800.000	3761360.000	126	0.4	878	334	334	334	30	364	295	69	156	0.01	124	2.0	86	11.0	0.17	48.7811
32026390000	17	17-Jul-93	10 4th Avenue	55800.000	3761360.000	124										118							
32026390000	17	10-Aug-93	10 4th Avenue	55800.000	3761360.000	121										117				62	13.0		57.5458
32026390000	17	14-Sep-93	10 4th Avenue	55800.000	3761360.000	127	0.2	966	346	346	346	31	377	296	81	174	0.13	137	3.0	41	12.0	0.28	53.1192
32026390000	17	16-Nov-93	10 4th Avenue	55800.000	3761360.000	123										178				73	14.0		61.9724
32026390000	17	12-Jan-94	10 4th Avenue	55800.000	3761360.000	118	0.4	840	330	330	330	3	333	266	67	117	0.04	113	1.9	47		0.15	
32026390000	17	08-Feb-94	10 4th Avenue	55800.000	3761360.000	115	1.2		325	325	325	41	366	296	70	115		113	2.0	56	9.3		41.1674
32026390000	17	09-Mar-94	10 4th Avenue	55800.000	3761360.000	120	0.9		324	324						130				41	11.0		48.6926
32026390000	17	14-Apr-94	10 4th Avenue	55800.000	3761360.000	116	0.2	786	324	324	324	67	391	314	77	120	0.01	129	1.4	52	8.6	0.25	38.0688
32026390000	17	09-May-94	10 4th Avenue	55800.000	3761360.000	119	0.3	778	328	328						128				56	10.2		45.1513
32026390000	17	09-Jun-94	10 4th Avenue	55800.000	3761360.000	125		828								138				58	12.4		54.8898
32026390000	17	10-Aug-94	10 4th Avenue	55800.000	3761360.000	123		896								130				52	13.0		57.5458
32026390000	17	15-Sep-94	10 4th Avenue	55800.000	3761360.000	122		840								122				53	12.0		53.1192
32026390000	17	13-Dec-94	10 4th Avenue	55800.000	3761360.000	117		802								121				52	7.4		32.7568
32026390000	17	10-Jan-95	10 4th Avenue	55800.000	3761360.000	118	0.2	828	338	338	338	12	350	287	63	118	0.04	115	2.0	53	10.5	0.12	46.4793
32026390000	17	09-Feb-95	10 4th Avenue	55800.000	3761360.000	123		838								119				56	11.8		52.2339
32026390000	17	10-Mar-95	10 4th Avenue	55800.000	3761360.000	116		788								121				57	11.0		48.6926
32026390000	17	12-Jun-95	10 4th Avenue	55800.000	3761360.000	121		862								127				56	11.0		48.6926
32029010000	12	04-Jun-93	6 Club Road	52363.000	3760931.000	251	110.0	1634	173	173	173	207	380	184	196	634	23.10	336	3.0	80	0.1	0.27	0.22133
32029010000	12	17-Jul-93	6 Club Road	52363.000	3760931.000	260										636							
32029010000	12	10-Aug-93	6 Club Road	52363.000	3760931.000	233										564				80	0.1		0.44266
32029010000	12	16-Nov-93	6 Club Road	52363.000	3760931.000	223										444				59	0.1		0.22133
32029010000	12	12-Jan-94	6 Club Road	52363.000	3760931.000	219	49.0	1426	141	141	141	119	260	138	122	408	2.70	306	2.0	48	0.1	0.25	0.22133
32029010000	12	08-Feb-94	6 Club Road	52363.000	3760931.000	221	25.0		133	133	133	188	321	170	151	583		358	8.0	56	0.1		0.22133
32029010000	12	09-Mar-94	6 Club Road	52363.000	3760931.000	223	13.0		125	125						543				53	0.1		0.22133
32029010000	12	14-Apr-94	6 Club Road	52363.000	3760931.000	227	32.0	1366	145	145	145	207	352	194	158	611	4.76	382	6.0	53	0.1	0.14	0.22133
32029010000	12	09-May-94	6 Club Road	52363.000	3760931.000	225	52.0	1358	145	145						590				84	0.1		0.22133
32029010000	12	09-Jun-94	6 Club Road	52363.000	3760931.000	227		1310								586				58	0.1		0.22133
32029010000	12	14-Jul-94	6 Club Road	52363.000	3760931.000	258	16.5	1608	197	197	197	200	397	213	184	694	2.12	376	3.0	70	0.1	0.27	0.22133
32029010000	12	10-Aug-94	6 Club Road	52363.000	3760931.000	247		1568								522				82			
32029010000	12	15-Sep-94	6 Club Road	52363.000	3760931.000	232		1468								572				58	0.1		0.22133
32029010000	12	12-Oct-94	6 Club Road	52363.000	3760931.000	242	22.0	1618	193	193	193	159	352	189	163	619	0.78	360	7.0	60	0.1	0.19	0.22133
32029010000	12	12-Dec-94	6 Club Road	52363.000	3760931.000	222		1428								603				53	0.1		0.22133
32029010000	12	10-Jan-95	6 Club Road	52363.000	3760931.000	228	6.6	1484	154	154	154	137	291	160	131	545	0.09	336	6.0	54	0.1	0.05	0.22133
32029010000	12	09-Feb-95	6 Club Road	52363.000	3760931.000	225		1412								554				66	0.0		0.04427
32029010000	12	10-Mar-95	6 Club Road	52363.000	3760931.000	227		1536								584				63	0.0		0.04427
32029010000	12	13-Mar-95	6 Club Road	52363.000	3760931.000	227		1276								538				61	0.2		0.66399
32029010000	12	11-Apr-95	6 Club Road	52363.000	3760931.000	227	25.0	1390	160	160	160	124	284	151	133	600	3.39	350	8.0	49	0.0	0.18	0.02213
32029010000	12	11-May-95	6 Club Road	52363.000	3760931.000	214		1452								618				56	0.1		0.22133
32029010000	12	12-Jun-95	6 Club Road	52363.000	3760931.000	259		1592								679				66	0.1		0.44266
32029010000	35	15-Jul-93	98 Verdun Road	46923.000	3760663.000	101	25.0	659	59	59	59	60	119	54	65	258	7.78	128	0.7	3	0.0	0.22	0.08853
32029010000	35	10-Aug-93	98 Verdun Road	46923.000	3760663.000	96										248				10	0.1		0.22133
32029010000	35	14-Sep-93	98 Verdun Road	46923.000	3760663.000	102	24.0	720	52	52	52	93	145	61	84	268	6.57	161	1.0	20	0.1	0.17	0.22133
32029010000	35	11-Nov-93	98 Verdun Road	46923.000	3760663.000	98										249				20	0.1		0.22133
32029010000	35	12-Jan-94	98 Verdun Road	46923.000	3760663.000	97	64.0	682	57	57	57	65	122	53	69	246	4.72	137	1.2	12	0.1	0.14	0.22133
32029010000	35	08-Feb-94	98 Verdun Road	46923.000	3760663.000	102	36.0		65	65	65	99	164	73	91	247		158	6.0	25	0.1		0.22133
32029010000	35	09-Mar-94	98 Verdun Road	46923.000	3760663.000	101	14.0		63	63						248				19	0.1		0.22133
32029010000	35	14-Apr-94	98 Verdun Road	46923.000	3760663.000	103	51.0	696	55	55	55	85	140	55	85	265	16.60	159	2.0	24	0.1	0.16	0.22133
32029010000	35	09-May-94	98 Verdun Road	46923.000	3760663.000	106	23.0	602	72	72						278				29	0.1		0.22133
32029010000	35	09-Jun-94	98 Verdun Road	46923.000	3760663.000	103		618								259				22	0.1		0.22133
32029010000	35	07-Jul-94	98 Verdun Road	46923.000	3760663.000	96	75.0	662	57	57	57	59	116	46	70	263	12.30	124	1.0	29	0.1	0.08	0.22133
32029010000	35	21-Sep-94	98 Verdun Road	46923.000	3760663.000	96		620								251				14	0.1		0.22133
32029010000	35	13-Dec-94	98 Verdun Road	46923.000	3760663.000	100		628								268				21	0.1		0.22133
32029010000	35	09-Feb-95	98 Verdun Road	46923.000	3760663.000	105		728								260				25	0.0		0.04427
36000930000	35	28-Jun-95	98 Verdun Road	46923.000	3760663.000	105		586								322				28	0.1		0.22133
36011250000	41	10-Aug-93	308 Kragga Kamma	39775.92	3761278.55	334										958				94	0.1		0.22133
36011250000	41	14-Sep-93	308 Kragga Kamma	39775.92	3761278.55	356	49.0	2208	170	170	170	367	537	264	273	1082	6.91	592	12.0	73	0.1	0.46	0.22133
36011250000	41	11-Nov-93	308 Kragga Kamma	39775.92	3761278.55	341										891				110	0.1		0.22133
36011250000	41	08-Feb-94	308 Kragga Kamma	39775.92	3761278.55	358	23.0		164	164	164	378	542	274	268	986		587	16.0	94	0.1		0.22133
36011250000	41	09-Mar-94	308 Kragga Kamma	39775.92	3761278.55	363	55.0		171	171						958				82	0.1		0.22133
36011250000	41	14-Apr-94	308 Kragga Kamma	39775.92	3761278.55	311	40.0	1518	170	170	170	294	464	237	227	872	5.36	508	10.0	93	0.1	0.40	0.22133
36011250000	41	09-Jun-94	308 Kragga Kamma	39775.92	3761278.55	305		1824								824				85	0.1		0.22133

Erf. No.	Bh.No.	Date	Address	-Y-Co-ord	-X-Co-ord	EC	Turb.	TDS	TA	BCA	CH	NCH	TH	Ca	Mg	Cl	Fe(t)	Na	K	SO4	NO3-N	F	N
									CaCO3	CaCO3	CaCO3	CaCO3	CaCO3	CaCO3	CaCO3								
36011250000	41	13-Jul-94	308 Kragga Kamma	39775.92	3761278.55	370	21.0	2244	180	180	180	258	438	206	232	1076	2.61	548	5.0	79	0.1	0.47	0.22133
36011250000	41	10-Aug-94	308 Kragga Kamma	39775.92	3761278.55	262		1654								695				64	0.1		0.22133
36011250000	41	14-Sep-94	308 Kragga Kamma	39775.92	3761278.55	340		2132								983				84	0.3		1.32798
36011250000	41	12-Oct-94	308 Kragga Kamma	39775.92	3761278.55	366	51.0	2320	184	184	184	295	479	247	232	1035	0.24	572	13.0	86	0.1	0.53	0.22133
36011250000	41	12-Dec-94	308 Kragga Kamma	39775.92	3761278.55	364		2284								1104				86	0.1		0.22133
36011250000	41	10-Jan-95	308 Kragga Kamma	39775.92	3761278.55	375	5.4	2324	151	151	151	296	447	218	229	951	0.15	558	12.0	91	0.1	0.05	0.22133
36011250000	41	09-Feb-95	308 Kragga Kamma	39775.92	3761278.55	325		1850								835				89	0.0		0.04427
36011250000	41	10-Mar-95	308 Kragga Kamma	39775.92	3761278.55	195		1452								458				81	0.0		0.04427
36011250000	41	20-Apr-95	308 Kragga Kamma	39775.92	3761278.55	279	34.0	1676	132	132	132	231	363	175	188	803	9.05	420	9.0	79	0.0	0.19	0.02213
36011250000	41	11-May-95	308 Kragga Kamma	39775.92	3761278.55	223		1374								600				82	0.1		0.22133
36011250000	41	28-Jun-95	308 Kragga Kamma	39775.92	3761278.55	278		1600								716				74	0.1		0.22133
99003510000	10	03-Jun-93	Scotsam	47018.779	3765034.790	279	0.2	1580	251	251	251	109	360	276	84	626	0.11	412	3.0	179	2.1	0.22	9.29586
99003510000	10	10-Aug-93	Scotsam	47018.779	3765034.790	223										500				128	2.3		10.1812
99003510000	10	11-Nov-93	Scotsam	47018.779	3765034.790	245										517				90	2.0		8.8532
99003510000	10	12-Jan-94	Scotsam	47018.779	3765034.790	230	0.2	1346	235	235	235	53	288	220	68	557	0.02	332	2.2	135	2.5	0.19	11.0665
99003510000	10	08-Feb-94	Scotsam	47018.779	3765034.790	248	0.7		229	229	229	151	380	287	93	560		412	6.0	147	2.2		9.73852
99003510000	10	14-Apr-94	Scotsam	47018.779	3765034.790	246	0.2	1358	245	245	245	60	305	233	72	550	1.86	373	5.0	139	2.3	0.18	10.1812
99003510000	10	09-May-94	Scotsam	47018.779	3765034.790	248	0.4	1382	244	244						511				153	2.5		11.0665
99003510000	10	14-Jun-94	Scotsam	47018.779	3765034.790	225										480				126	2.4		10.6238
99003510000	10	14-Jul-94	Scotsam	47018.779	3765034.790	244	0.2	1382	251	251	251	44	295	222	73	551	0.02	416	2.0	132	2.6	0.20	11.5092
99003510000	10	10-Aug-94	Scotsam	47018.779	3765034.790	246		1506								499				130	3.0		13.2798
99003510000	10	21-Sep-94	Scotsam	47018.779	3765034.790	242		1414								524				132	2.9		12.8371
99003510000	10	20-Dec-94	Scotsam	47018.779	3765034.790	225		1314								489				127	2.4		10.6238
99003510000	10	10-Jan-95	Scotsam	47018.779	3765034.790	247	0.2	1428	257	257	257	62	319	245	74	500	0.02	388	6.0	140	3.3	0.42	14.6078
99003510000	10	13-Feb-95	Scotsam	47018.779	3765034.790	243		1552								528				151	3.0		13.2798
99003510000	10	13-Mar-95	Scotsam	47018.779	3765034.790	247		1384								518				135	3.1		13.7225
99003510000	10	20-Apr-95	Scotsam	47018.779	3765034.790	251	0.3	1370	251	251	251	70	321	247	74	553	0.00	399	6.0	162	3.1	0.16	13.7225
99003510000	10	11-May-95	Scotsam	47018.779	3765034.790	241		1324								517				141	3.6		15.9358
99003510000	10	21-Jun-95	Scotsam	47018.779	3765034.790																		
99007400000	9	03-Jun-93	Sardinia Bay	48140.731	3764679.926	109	0.2	646	203	203	203	78	281	223	58	176	0.07	91	3.0	37	5.3	0.24	23.461
99007400000	9	10-Aug-93	Sardinia Bay	48140.731	3764679.926	103										145				82	4.4		19.477
99007400000	9	14-Sep-93	Sardinia Bay	48140.731	3764679.926	105	0.2	658	209	209	209	82	291	220	71	148	0.34	109	4.0	43	3.6	0.36	15.9358
99007400000	9	20-Sep-93	Sardinia Bay	48140.731	3764679.926																		
99007400000	9	11-Nov-93	Sardinia Bay	48140.731	3764679.926	107										161				33	4.7		20.805
99007400000	9	12-Jan-94	Sardinia Bay	48140.731	3764679.926	102	0.2	590	208	208	208	75	283	222	61	181	0.01	99	2.8	33	2.2	0.22	9.73852
99007400000	9	08-Feb-94	Sardinia Bay	48140.731	3764679.926	101	0.4		196	196	196	122	318	247	71	155		109	7.0	38	3.8		16.8211
99007400000	9	09-Mar-94	Sardinia Bay	48140.731	3764679.926	104	0.5		201	201						167				18	3.9		17.2637
99007400000	9	14-Apr-94	Sardinia Bay	48140.731	3764679.926	107	0.4	586	204	204	204	103	307	240	67	166	0.01	115	3.0	34	4.6	0.18	20.3624
99007400000	9	09-May-94	Sardinia Bay	48140.731	3764679.926	102	0.3	594	208	208						159				38	5.4		23.9036
99007400000	9	14-Jun-94	Sardinia Bay	48140.731	3764679.926	105										165				40	4.9		21.6903
99007400000	9	16-Jun-94	Sardinia Bay	48140.731	3764679.926																		
99007400000	9	14-Jul-94	Sardinia Bay	48140.731	3764679.926	104	0.2	606	212	212	212	63	275	213	62	165	0.23	99	3.0	31	5.4	0.14	23.9036
99007400000	9	10-Aug-94	Sardinia Bay	48140.731	3764679.926	105		714								161				34	5.4		23.9036
99007400000	9	21-Sep-94	Sardinia Bay	48140.731	3764679.926	103		688								166				31	5.8		25.6743
99007400000	9	12-Oct-94	Sardinia Bay	48140.731	3764679.926	104	0.2	660	212	212	212	55	267	209	58	168	0.00	98	2.0	34	5.1	0.17	22.5757
99007400000	9	20-Dec-94	Sardinia Bay	48140.731	3764679.926	104		622								172				37	5.3		23.461
99007400000	9	10-Jan-95	Sardinia Bay	48140.731	3764679.926	103	0.2	606	213	213	213	63	276	219	57	166	0.04	98	3.0	31	5.6	0.23	24.789
99007400000	9	13-Feb-95	Sardinia Bay	48140.731	3764679.926	103		720								157				33	5.2		23.0183
99007400000	9	13-Mar-95	Sardinia Bay	48140.731	3764679.926	103		616								158				36	5.6		24.789
99007400000	9	20-Apr-95	Sardinia Bay	48140.731	3764679.926	105	0.2	658	211	211	211	61	272	215	67	163	0.00	99	3.0	31	5.7	0.05	25.2316
99007400000	9	21-Jun-95	Sardinia Bay	48140.731	3764679.926																		0
99040340000	21	18-Jun-93	Arlington	51915.000	3763632.000	195	4.5	1262	372	372	372	26	398	304	94	454	0.21	223	2.0	77	3.7	0.16	16.5555
99040340000	21	10-Aug-93	Arlington	51915.000	3763632.000	275										465				138	16.0		70.8256
99040340000	21	25-Oct-93	Arlington	51915.000	3763632.000	269										556				107	15.0		66.399
99040340000	21	16-Nov-93	Arlington	51915.000	3763632.000	304										702				147	15.0		66.399
99040340000	21	14-Dec-93	Arlington	51915.000	3763632.000	277	0.5									519				118	7.1		31.4289
99040340000	21	19-Jan-94	Arlington	51915.000	3763632.000	282	0.5	1694	475	475	475	184	659	418	241	524		432	20.0	118	8.7		38.5114
99040340000	21	22-Feb-94	Arlington	51915.000	3763632.000	265	1.2		466	466	367	0	367	155	212	458		407	20.0		12.0		53.1192
99040340000	21	17-Mar-94	Arlington	51915.000	3763632.000	294	0.9		492	492						585				127	13.4		59.3164
99040340000	21	21-Jun-94	Arlington	51915.000	3763632.000	262	2.2	1562	495	495	495	88	583	368	215	453	0.06	376	21.0	112	12.2	0.27	54.0045
99040340000	21	07-Jul-94	Arlington	51915.000	3763632.000	311	0.2	1880	485	485	485	125	610	397	213	654	0.03	424	10.0	138	14.0	0.40	61.9724
99040340000	21	10-Aug-94	Arlington	51915.000	3763632.000	297		1754								538				123	9.3		41.1674
99040340000	21	22-Sep-94	Arlington	51915.000	3763632.000																		
99040340000	21	12-Oct-94	Arlington	51915.000	3763632.000	269	0.4	1652	510	510	510	23	533	339	197	500	0.03	379	20.0	115	15.0	0.51	66.399
99040340000	21	10-Nov-94	Arlington	51915.000	3763632.000	317		1872								670				142	14.0		61.9724

Erf. No.	Bh.No.	Date	Address	-Y-Co-ord	-X-Co-ord	EC	Turb.	TDS	TA	ECA	CH	NCH	TH	Ca	Mg	Cl	Fe(t)	Na	K	SO4	NO3-N	F	N
									CaCO3	CaCO3	CaCO3	CaCO3	CaCO3	CaCO3	CaCO3								
99040340000	21	13-Dec-94	Arlington	51915.000	3763632.000	303		1832								637				137	11.0		48.6926
99040340000	21	05-Jan-95	Arlington	51915.000	3763632.000	267	1.2	1788	494	494	489	0	489	305	184	492	0.03	371	17.0	119	12.9	0.68	57.1031
99040340000	21	16-Mar-95	Arlington	51915.000	3763632.000	314		1916								592				128	13.0		57.5458
99040340000	21	10-Apr-95	Arlington	51915.000	3763632.000	261	0.7	1708	485	485	482	0	482	298	184	467	0.11	369	17.0	118	14.0	0.16	61.9724
99040340000	21	01-Jun-95	Arlington	51915.000	3763632.000	225		1602								472				127	13.0		57.5458
99040340000	22	18-Jun-93	Arlington	51915.000	3763632.000	298	1.4	1798	492	492	492	107	599	384	215	589	0.03	412	13.0	141	17.5	0.38	77.4212
99040340000	22	10-Aug-93	Arlington	51915.000	3763632.000	246										507				122	9.1		40.2821
99040340000	22	25-Oct-93	Arlington	51915.000	3763632.000	236										528				92	9.8		43.3807
99040340000	22	16-Nov-93	Arlington	51915.000	3763632.000	205										522				76	3.4		15.0504
99040340000	22	14-Dec-93	Arlington	51915.000	3763632.000	200	0.4									440				67	3.1		13.7225
99040340000	22	19-Jan-94	Arlington	51915.000	3763632.000	191	0.3	1198	195	195	195	256	451	341	110	457		239		62	3.4		15.0504
99040340000	22	22-Feb-94	Arlington	51915.000	3763632.000	162	0.7		129	129	129	236	365	263	102	372		222	3.6		1.3		5.75458
99040340000	22	17-Mar-94	Arlington	51915.000	3763632.000	165	0.6		124	124						391				37	1.4		6.19724
99040340000	22	21-Apr-94	Arlington	51915.000	3763632.000	191	0.2	1146	204	204	204	328	532	399	133	395	0.00	252	3.0	78	4.9	0.14	21.6903
99040340000	22	20-May-94	Arlington	51915.000	3763632.000	191	0.4	1140								424				64	5.6		24.789
99040340000	22	07-Jul-94	Arlington	51915.000	3763632.000	196	0.2	1202	207	207	207	203	410	299	111	450	0.06	218	2.0	67	5.6	0.23	24.789
99040340000	22	10-Aug-94	Arlington	51915.000	3763632.000	169		1250								416				64	4.2		18.5917
99040340000	22	22-Sep-94	Arlington	51915.000	3763632.000																		
99040340000	22	12-Oct-94	Arlington	51915.000	3763632.000	243	3.5	1476	312	312	312	250	562	443	119	518	0.72	284	2.0	114	12.0	0.35	53.1192
99040340000	22	10-Nov-94	Arlington	51915.000	3763632.000	198		1214								446				75	5.6		24.789
99040340000	22	13-Dec-94	Arlington	51915.000	3763632.000	167		1148								442				44	2.0		8.8532
99040340000	22	05-Jan-95	Arlington	51915.000	3763632.000	228	0.4	1398	267	267	267	192	459	359	100	500	0.03	266	3.0	100	8.5	0.42	37.6261
99040340000	22	16-Mar-95	Arlington	51915.000	3763632.000	203		1224								418				73	6.1		27.0023
99040340000	22	10-Apr-95	Arlington	51915.000	3763632.000	203	0.5	1258	228	228	220	177	397	605	92	425	0.17	232	3.0	77	6.0	0.05	26.5596
99040340000	22	01-Jun-95	Arlington	51915.000	3763632.000	198		1170								460				90	4.6		20.3624