The Environmental Management Consultancy

CES

Deputy Gerard Baudains

Water Resources Review of Jersey

Final Draft Report

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INSTITUTE OF ENVIRONMENTAL MANAGEMENT & ASSESSMENT
iema
Registered Environmental Impact Assessor Member

CES
The Rotunda
150 New Street
Birmingham B2 4PA
Tel: 0121 616 1126
Fax: 0121-633 3811
e-mail: post@bir-ces.demon.co.uk

CES

The Environmental Management Consultancy

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1 INTRODUCTION

CES were commissioned by Deputy Gerard Baudains to carry out an independent review of a series of reports prepared by the British Geological Survey (BGS) relating to the availability and quality of water resources on Jersey and to review comments made on those reports by the Water Diviners and Engineers Association (WDEA) of Jersey.

This report provides a critique of the reports and compares the findings and conclusions with calculations carried out on Island water resource by CES to assess the validity of the BGS conclusions. The critique concentrates principally on the quantification of groundwater resources on the Island although aspects relating to surface water and to groundwater quality briefly are considered.

Recommendations are provided for further works considered necessary to clarify matters of uncertainty identified during the review.

1.1 Background information

BGS have been involved in the assessment of the availability of water resources on the island of Jersey since 1990 following the period from 1988 when rainfall was below average and water resources on the Island were stressed. A series of reports have been prepared and are listed in Section 1.3. Several of the reports largely are repetitive although inconsistencies are present between them. Concerns have been raised by residents of the Island, in particular the Water Diviners and Engineers Association (WDEA) that the conclusions of the reports are pessimistic in respect of the volume of water available for exploitation and are based on inaccurate or incorrect assumptions. The WDEA also consider that the reports consistently disregard their assertion that there is an additional source of groundwater to the Island originating on the French mainland.

The principal conclusions of the studies carried out by BGS are:-

- groundwater on the Island is a finite resource under considerable demand.
- approximately 50% of the long term average recharge currently is used as groundwater abstractions or provides baseflow to surface waters.
- the main island aquifer comprises a shallow zone of approximately 25m below the water table.
- all the groundwater is susceptible to diffuse and point-source surface pollutants

because the aquifer is shallow and generally unconfined.

- much of the water is polluted to some degree with concentrations of nitrate commonly significantly above the EC maximum admissible concentration for drinking water.
- the principal source of nitrate pollution of the groundwater is the application of agricultural fertilisers.
- pesticides are increasingly being detected in the groundwaters.

1.2 Information sources

The reports which were reviewed in the water resources assessment are listed below:

- Hydrogeological and Hydrogeochemical Survey of Jersey. BGS Technical Report WD/91/15. 1991.
- Jersey Groundwater – Year 2: Further Observations and Groundwater Model. BGS Technical Report WD/92/22. 1992.
- Jersey Groundwater – Year 3: Further Observations and Potential Sources of Pollution. BGS Technical Report WD/93/28. 1993.
- Jersey Groundwater – Year 4: Monitoring and Consolidation. BGS Technical Report WD/94/53. 1994.
- Groundwater Resources Degradation in Jersey: Socio-Economic Impacts and their Mitigation. BGS Technical Report WD/96/8. 1996.
- The Jersey Groundwater Study. BGS Research Report RR/98/5. 1998.
- Water Reports by WDEA. July 1999
- The Water Resources of Jersey: An Overview. BGS Report WD 00 28. 2000.

2 GROUNDWATER OCCURRENCE

2.1 Introduction

Groundwater can be defined as *water contained in underground strata below the level of the groundwater table* ie water within the saturated zone. Most rock types have the ability to hold groundwater. However, the ability of specific rock types to store and yield groundwater is dependant on the hydraulic properties of the rock in particular the permeability (or hydraulic conductivity) and the porosity.

Permeability is defined as the capacity of the rock or sediment to yield water. Major aquifers such as the Chalk and the Triassic Sandstone of the UK are characterised by a high permeability which facilitates the movement of groundwater. Rock types such as granite and other crystalline igneous and metamorphic rocks typically have a very low intergranular permeability but frequently show an enhanced secondary permeability imparted by the presence of fractures and fissures. In reality most rock types, apart from unconsolidated sediments, exhibit both types of permeability.

Porosity is a measure of the pore space in rocks and can be defined as the percentage of the rock volume occupied by voids. A more suitable term when referring to aquifer characteristics is *effective porosity*, which is a measure of the percentage of interconnected voids which facilitate transient water storage and water movement.

Another important feature of the rock type to consider is the ability of rainfall to recharge the aquifer, which is a feature of the permeability of the rock.

All of these characteristics affect the volume of groundwater which is held within and, more importantly, can be abstracted from specific rock types.

2.2 The hydrological cycle

Practicality all groundwater originates as rainfall and forms part of the hydrological cycle. The hydrological cycle is the continuous circulation of water between ocean, atmosphere and land and can be simplified as a system that takes water from the sea as vapour, deposits it on land as rain and the rainfall is returned to the sea through watercourses. In addition to flow via watercourses, water infiltrates the ground and may reach the water table, thus becoming groundwater. This water moves though the underground strata at variable speeds (depending on the nature of the rock) and, where the water table intercepts the ground surface, seeps from the rock to form springs, provides baseflow to watercourses and, in the case of Jersey, discharges at the coast as seepages. In Jersey, examples of these seepages can be seen on the beach in St Ouen's Bay.

The proportion of recharge which either runs off the ground surface to the surface water system or infiltrates is determined by the nature of the rock type. For example, on low permeability materials such as clay, the majority of rainfall runs off. In contrast, on high permeability deposits such as the sands in St Ouen's Bay, the majority of the rainfall infiltrates to form groundwater.

In addition to natural variations in groundwater flow resulting from variations in rainfall recharge, the hydrological cycle is influenced by man through the abstraction of surface and groundwater for public and private water supplies and agricultural uses including stock watering and spray irrigation.

2.3 Groundwater flow and storage

The presence of groundwater is reflected in the water table, the level of which is constantly fluctuating in response to variations in recharge, changes in aquifer storage and groundwater movement. The range of natural groundwater level fluctuations is related to the hydraulic characteristics of the rock. Typically in aquifers with a high intergranular permeability, fluctuations in groundwater level are subdued compared with an aquifer in which fissure permeability dominates. Typically aquifers with a high intergranular permeability also have a high porosity (in the order of 10% to 20%) hence a high capacity for groundwater storage. In contrast, aquifers dominated by fissure flow have a low porosity (in the order of 1%) hence a limited storage to accommodate variations in recharge.

CES' experience from working on the Jersey Shale and the St Ouen's Sand aquifers in the west of the Island is consistent with this variation in behaviour of the groundwater level in different aquifer systems. Groundwater level monitoring results for 1999 and 2000 show a greater fluctuation in the groundwater level in the Jersey Shale aquifer which is a fissure storage system, compared to the St Ouen's Sand which is an intergranular system. In the Jersey Shale aquifer the water level over this period fluctucted by approximately 3.8m whereas the water table in the sand aquifer varied by approximately 2.0m.

The volume of water held in storage within the rock affects the ability of the aquifer to withstand periods of minimal or below-average rainfall. Groundwater levels respond to rainfall events. Typically the higher groundwater levels occur during late-winter or early spring following recharge over the winter period. The water level normally falls during the summer period as a result of minimal recharge reaching a low point in early autumn before rising again in response to increased reacharge during autumn and winter. The degree of fluctuation reflects the effective porosity of the aquifer with intergranular aquifers having a higher storage and a higher capacity to accommodate 'drought' events. In contrast, fissure dominated systems which are characteristic of most of the rock types on Jersey have a much lower capacity to withstand 'drought' events.

3 AN ASSESSMENT OF GROUNDWATER AVAILABILITY IN JERSEY

3.1 Introduction

As indicated previously in Section 2.1, the capacity of a rock type to store and yield groundwater depends on the hydraulic characteristics of the rock. Accordingly the hydraulic characteristics influence the volume of water present as groundwater, available for abstraction and for baseflow support to watercourses.

3.2 Geology

Considering the size of the Island, the geology of Jersey is complex. At least five major rock types can be identified. Each of these has distinctive characteristics which control its ability to act as an aquifer. The major rock types are the Jersey Shale Formation which covers much of the western and central parts of the Island; the intrusive granite and diorite which crop out in the north western, south western and south eastern parts of the Island; the Volcanic Group which are present in the central and north eastern parts; and, the Rozel Conglomerate on the north eastern coast. The superficial St Ouen's Sand covers the Jersey Shale and the granite in the west of the Island.

Each of the units has different hydraulic characteristics which influence the amount of groundwater recharge. Apart from the sand aquifer, it is considered that the rock types present on the Island are characterised by fissure flow with the majority of groundwater held within and transmitted along joints and fractures within the rock. Experience of the Jersey Shale Formation in the west of the Island has shown extensive fracturing of the strata particularly in the upper weathered layer. It is considered likely that on the harder igneous and volcanic rocks, extensive fracturing is confined to a much thinner weathered zone and to discontinuities within the rock mass such as faults. Accordingly, it is considered that the amount of groundwater held within these units is limited to the joints and fractures within the rock.

The St Ouen's Sand aquifer is a typical unconsolidated aquifer with a high permeability and porosity. Accordingly the sand aquifer holds a significantly greater volume of groundwater per unit volume than the other units on the Island.

3.3 Water balance

In the report by BGS from 1998 (RR/98/5) it is stated that only half of the long-term mean renewable water resource is used indicating that water supplies are generally assured unless there is below average rainfall. However, BGS suggest that it is probable that much of the groundwater available for direct abstraction from boreholes and wells is already taken and there is little room for further development before permanent reductions in water levels occur. As a result of the significant uncertainties in the controlling factors, it is considered that there is little firm evidence to support this conclusion.

BGS reports have put forward a wide variation of estimates for groundwater recharge, which appears to have led to some inconsistency and uncertainty. The most recent published value for groundwater recharge for the Island was 132mm/a, which compares with a previous minimum value of 30mm/a and a previous maximum value of 300mm/a. It is considered that the quoted maximum estimate is incorrect as it exceeds the estimated total effective rainfall figure of 266mm/a. The value of 132mm/a is based on a catchment study of the area around Trinity which is situated on rocks comprising the Volcanic Group.

Because of the complexity of the geology of the Island it is considered that the use of a single recharge value to calculate average groundwater recharge is too simplistic. To assess the validity of the BGS conclusions regarding the amount of groundwater recharge, CES calculated the potential groundwater recharge to each of the five principal rock types on Jersey.

An estimate of the areal extent of each aquifer was made, as shown in Table 3.1. The rock types are given the same designations as in the BGS report RR/98/5 (1998) for clarity.

Table 3.1 Area of individual rock types

Aquifer	Area (km^2)
Jersey Shale Formation	27
St Ouen's Sand Aquifer	7
Granite/diorite	42
Volcanic Group	36
Rozel Conglomerate Formation	5

Average rainfall for the Island varies between 775mm/a on the west coast to 925mm/a in the north east with a long term average annual rainfall for the Island as a whole for the period 1968 to 1996 of 884mm. Effective rainfall is the amount of rainfall available for aquifer recharge once evaporation losses have been satisfied. The average annual actual evapotranspiration over this period was 618mm. This provides an average annual effective rainfall of 266mm.

Based on professional experience and knowledge of the properties of two of the aquifers on Jersey, an estimate of the amount of effective rainfall that will infiltrate to form groundwater can be made. This is called the infiltration coefficient. An assessment of the amount of groundwater recharge can be made using the following equation:

$$\text{surface area of aquifer } x \text{ (effective rainfall } x \text{ infiltration coefficient)} \\ = \text{groundwater recharge}$$

The infiltration coefficient varies depending on the properties of each rock type. An assumption of the infiltration coefficient has been made for each aquifer and is shown in Table 3.2. The Table also shows the results of the calculations to estimate the total average annual volume of groundwater recharge on the Island. This is an average value which will vary between individual years in response the variations in actual rainfall and evaporation.

The infiltration coefficients have not been modified to take account of the built up areas where percolation to the water table is impeded by hard surfaces and intercepted by storm water drainage systems. It also should be recognised that the calculations do not consider the potential for additional recharge as a result of leaking water mains and sewers.

Table 3.2 Groundwater recharge

Aquifer	Infiltration factor	Recharge (Mm^3/a)
Jersey Shale Formation	25%	1.80
St Ouen's Sand Aquifer	90%	1.68
Granite/diorite	10%	1.12
Volcanic Group	10%	0.96
Rozel Conglomerate Formation	20%	0.27
	Total	**5.81**

The estimated total groundwater recharge is 5.81Mm^3. This is equivalent to an infiltration rate over the whole Island of 50mm per year. This value is significantly lower than the groundwater recharge proposed by BGS of 132mm/annum. The calculation was repeated by varying the infiltration coefficients.

The infiltration coefficient was doubled for each aquifer apart from the St Ouen's Sand for which the coefficient was increased to 100% ie all effective recharge infiltrates to form groundwater. Using the revised infiltration coefficients gives a total annual recharge of 10.13Mm^3, equivalent to an infiltration rate of 87mm/a. Based on our experience of assessing aquifer recharge, it is considered highly unlikely that infiltration coefficients exceed those used in the revised calculation. Accordingly, it is considered that average annual groundwater recharge does not exceed approximately 10Mm^3 (86mm/a), a value within the range quoted by BGS.

Based on the recharge calculations, it is considered that the average annual recharge to groundwater on the Island is in the range 6Mm^3 to 10Mm^3. This volume of groundwater is available for abstraction and baseflow support to watercourses on the Island.

Apart from information provided by Jersey New Waterworks Company Limited, presented in Appendix 1, there is no accurate information on the volume of water abstracted on the Island. For the period 1986 to 1997, the total annual volume of water supplied by the Company varied between 5.747Mm^3 in 1990 and 6.994Mm^3 in 1997. Of this total, direct abstraction from groundwater sources varied between 0.082Mm^3 (1.2%) in 1994 and 0.436Mm^3 (6.4%) in 1996. In the BGS reports, it is estimated that the demand on groundwater as baseflow to support surface water abstractions for public supplies is approximately 3.5Mm^3 per annum.

Based on information contained in the BGS reports, it is understood that there are between 4000 and 4500 private wells and boreholes in use on the island principally for agricultural and domestic uses. There is little information on the volume of water abstracted from these sources. An estimate on the likely volume abstracted has been based on a small sample (1.7%) of the sources, which were equipped with water meters during the 1989 drought. This data has been extrapolated to provide an estimated private annual groundwater use of 3.6Mm^3. Considerable caution should be exercised when using this estimate. However, currently no alternative information is available.

Using the available information, it is calculated that on average approximately 7.5Mm^3 of groundwater is abstracted for public water and private use. If this figure is accurate, it implies that abstraction exceeds the lower end of the estimated volume of groundwater recharge (Table 3.1) hence there should be a trend of declining water levels and instances of sources failing. We are not aware of any evidence or reports of sources failing as a result of declining water levels. Such instances strongly are denied by WDEA who, it is considered, have extensive local knowledge on these matters as the body includes the main water well driller on the Island.

Accordingly, if the total groundwater abstraction volume of 7.5Mm^3 is accurate, it is concluded that the average annual groundwater recharge is in excess of this figure and that the average annual groundwater recharge is in the range 7.5Mm^3 to 10Mm^3. Recharge in excess of 7.5Mm^3 provides baseflow to other surface watercourses on the Island or discharges at the coast. A more detailed appraisal of the water balance is not possible due to the absence of accurate figures on private groundwater abstraction and of information on long term variations in groundwater levels for the main aquifers on the Island.

3.4 Groundwater inflow from France

Strong suggestions have been made by the WDEA of Jersey that there is additional groundwater recharge to the Island by deep-seated flow from France approximately 25km east of the Island. These suggestions have in part been based on the identification by divining of east-west trending lines of groundwater flow in the Fort Regent area and in the southern part of St Clement. Both areas are underlain by igneous rocks in which groundwater movement is principally through fissures hence the identification of preferential linear groundwater flowpaths is not unexpected.

Classical island hydrogeology suggests that fresh groundwater, recharged by incident rainfall, is present as a lens sitting above the more dense saline groundwater. Based on our knowledge of the geology and hydrogeology of Jersey, it is considered that there is no evidence to suggest a different hydrogeological situation.

There are many instances of extensive groundwater flow, including the movement of fresh groundwaters beneath the sea. However, these examples refer to specific hydrogeological conditions in particular where an aquifer dips beneath the sea from a recharge area on the mainland and where the aquifer is present beneath a cover of low permeabilty deposits. The groundwater is confined which restricts the ingress of saline water to the aquifer. However, it is likely that over time diffusion of the saline water will result in the deterioration in groundwater quality.

There is no confined aquifer present on Jersey or in the immediate vicinity which could provide a flowpath for groundwater flow from France. However there is a remote possibility of a fissure connection between the Island and the mainland. In this event and with a driving head of water from the point of recharge on the mainland there is potential for water movement. However, it is considered that any water moving along this route will be in contact with the sea hence will be saline and will not provide an additional source of fresh groundwater recharge to the Island.

4 CONCLUSIONS

- Water resources on Jersey are finite as a result of the size of the island. The volume and availability of groundwater resources on the island of Jersey are dependant on the relationship between recharge to groundwater from rainfall and abstraction for public and private supplies.

- Several studies undertaken by BGS have provided variable and inconsistent estimates of the volume of groundwater resources. Published estimates of annual recharge vary from 30mm (3.5Mm^3) to 300mm (34.8Mm^3).

- As a result of the complexity and differences in the hydraulic characteristics of the rocks on the Island, it is considered that use of a single recharge value is inappropriate. Calculations based on recharge to the five main rock units on the Island give a range of annual average values for groundwater recharge between approximately 6Mm^3 and 10Mm^3, between 50mm and 87mm per annum. It is considered unlikely that average groundwater recharge exceeds 10Mm^3 per annum.

- There is very limited information available on the volume of groundwater abstracted from the Island's aquifers. The only reliable information is provided by Jersey New Waterworks Company for their borehole abstractions which comprise less than 7%, approximately 0.4Mm^3 of the water abstracted for public water supply. It is estimated that approximately 3.5Mm^3/a of water abstracted for public water supply from surface water sources is groundwater inflow to the watercourses. In addition, there is no reliable data on the volume of water abstracted from up to 4500 private wells and boreholes on the Island. A value of 3.6Mm^3 per annum has been used by BGS in their assessments.

- If the two values for groundwater support to surface waters and for private abstractions are accurate, the total volume of groundwater abstracted for public and private use (7.5Mm^3) exceeds the lower limit of the estimated range of recharge, implying that there should be a trend of declining water levels and possible instances of failing water supplies. As there appears to be no evidence for such events, it is concluded that the average annual groundwater recharge is in excess of 7.5Mm^3. Alternatively, if the figures for baseflow support and private groundwater abstraction are significant over estimates, the lower estimated recharge value may be realistic.

- In the absence of information on variations in groundwater levels over a long period of time it is not possible to confirm whether there is a trend of declining groundwater levels on the Island.

- It is considered unlikely that there is an additional source of fresh groundwater recharge to the Island from the French mainland.

- In summary, it is concluded that currently there is no evidence of stress on the groundwater resources of the Island. However, it is not possible to state with any degree of certainty that there is a surplus of groundwater resources which is adequate to meet the effects of any prolonged period of reduced recharge. It is concluded that the comments made by BGS in their 1996 report (WD/96/8) represent the best summary of the current situation:-

  'In summary, there appears to be no deficit in the water-balance at present. Current discharges from the groundwater system amount to between 50% and 100% of the estimated annual renewable resource. Although the margins of uncertainty in the estimation of abstraction and recharge are large, problems of physically unsustainable use, that is where abstraction exceeds recharge, are probably only significant in the short run during periods of 'drought' and in particular localities, rather than posing a longer term threat for the Island as a whole.'

5 RECOMMENDATIONS

(1) Because of the finite nature of water resources on the Island, it is considered important that sufficient baseline information on groundwater levels is available to facilitate long term planning in respect of water resources. It is recommended that a network of monitoring boreholes is commissioned on each of the main aquifers of the Island to allow trends in groundwater levels to be identified. To reduce costs, wherever possible existing disused or geotechnical boreholes should be used.

(2) The long term management of water resources on the Island will be enhanced if reliable information on the volume of private water abstraction is obtained. It is recommended that additional information on water usage is collected from the larger private industrial, leisure and agricultural abstractions to facilitate a more rigorous water balance calculation.

APPENDIX 1

PUBLIC WATER SUPPLIED BY JERSEY NEW WATERWORKS COMPANY

The Jersey New Waterworks Company Limited

STATISTICS (METRIC)

YEAR		1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
TOTAL WATER SUPPLIED	MI	6138.8	6433.0	6188.1	5913.2	5747.2	6109.8	6066.4	6560.6	6681.7	6626.1	6834.1	6994.5
HANDOIS OUTPUT	MI	3368.2	3236.0	2618.3	2677.3	2371.4	2652.7	2762.9	2845.2	2872.8	2530.9	3495.8	3436.1
AUGRÈS OUTPUT	MI	2357.5	2728.9	2989.8	2676.3	2790.5	2931.9	2731.3	3318.1	3287.9	3484.4	2573.9	3445.0
MILLBROOK OUTPUT	MI	414.0	468.2	578.1	576.5	585.3	525.8	571.5	397.3	522.0	613.9	763.0	114.1
ST. OUEN'S BOREHOLES	MI	46.0	143.7	233.4	221.8	223.6	138.4	159.6	111.7	82.2	163.2	210.6	141.7
OTHER BOREHOLES	MI	37.8	82.1	102.8	142.7	183.7	112.0	130.5	108.6	nil	94.8	225.5	78.3
LA ROSIÈRE	MI	16.8	nil	306.8	878.7	1018.,2	250.3	219.2	nil	nil	nil	365.9	nil
GRANDS VAUX	MI	2808.3	3107.3	2920.7	2309.0	1964.5	2604.5	2282.0	2228.0	2520.7	1829.9	2287.2	2439.2
QUEENS VALLEY	MI	332.0	329.9	448.6	289.1	197.6	120.2	914.5	1594.4	2346.4	2790.8	1357.8	1275.3
VAL DE LA MARE	MI	875.7	869.3	1369.4	1780.6	1910.4	1740.1	1672.4	1150.8	807.8	1014.6	1863.3	1629.6
LA HAGUE	MI	1471.9	1499.9	1175.1	1163.9	1246.5	1432.0	1148.7	1042.0	451.8	403.6	1201.2	1559.3
MAXIMUM DAY'S DEMAND	MI	22.0 30th July	26.1 15th Jan.	23.6 7th Aug.	24.0 20th June	21.0 3rd May	22.4 10th Feb.	22.5 28th June	23.9 18th Aug.	27.5 7th July	26.9 10th Aug.	27.0 21st July	25.7 20th Aug.
MAXIMUM MONTH'S DEMAND	MI	631.8 August	670.4 August	636.5 August	641.3 May	559.8 May	633.4 August	590.1 July	665.4 August	738.5 July	710.2 August	728.2 July	705.3 August
LIGHT INDUSTRY	MI	128.4	126.2	118.2	105.1	97.6	95.9	95.4	84.6	91.7	83.0	89.5	95.9
AGRICULTURE	MI	16.2	19.3	21.8	23.4	14.3	13.5	17.9	17.8	20.7	18.9	24.8	28.4
HOTELS AND GUEST HOUSES	MI	910.0	957.7	1007.0	968.0	938.7	931.5	890.0	908.5	933.8	911.8	935.2	951.6
ESSENTIAL SERVICES	MI	419.2	414.8	396.9	306.5	308.1	341.7	333.4	333.5	346.8	347.6	362.7	374.2
MISCELLANEOUS	MI	497.7	558.4	636.3	567.0	526.6	609.5	681.3	713.5	797.2	859.1	931.2	982.7
TOTAL METER DEMAND	MI	1972.7	2076.3	2180.3	1970.3	1885.3	1992.1	2018.9	2057.8	2190.2	2220.6	2343.4	2432.9
DOMESTIC AND UNACCOUNTED FOR	MI	4166.0	4356.6	4007.8	3942.9	3862.1	4118.2	4047.5	4521.6	4491.5	4405.5	4490.7	4561.6
ANNUAL RAINFALL (133 year average 847.4mm)		955.6	761.5	874.1	563.1	726.1	670.0	888.9	821.4	1005.1	874.7	697.4	757.5
ADDITIONAL DWELLING UNITS CONNECTED	No.	522	491	483	659	385	568	542	506	581	493	549	459
TOTAL DWELLING UNITS ON SUPPLY	No.	24,178	24,669	25,152	25,811	26,196	26,764	27,306	27,812	28,594	30,229	30,764	31,223
NEW SERVICES LAID	No.	267	318	382	355	348	568	512	523	602	523	623	563
SERVICE MAINS LAID	km	2.886	3.668	8.623	6,401	6.024	8.196	9.973	6.729	7.691	6.152	11.065	8.553
SERVICE MAINS RELAID	km	1.060	0.396	0.687	0.429	0.310	0.258	0.037	0.160	0.105	0.242	0.466	0.738
TOTAL LENGTH OF SERVICE MAINS	km	302.07	305.74	314.35	320.74	326.76	334.95	344.91	351.64	359.33	365.48	376.55	385.10
TRUNK MAINS LAID	km	nil	0.690	0.529	0.914	4.254	3.315	0.019	0.153	0.283	1.105	1.526	2.164
TOTAL LENGTH OF TRUNK MAINS	km	41.83	42.52	43.05	43.97	48.22	51.53	51.55	51.69	51.98	53.08	54.61	56.77