The Location of Underground Services

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The ultimate goal is to have the underground services treated as a matter of survey, either by the utility authorities or in conjunction with the surveying and engineering professions.

Too often in the past, the laying of services has been a haphazard arrangement worked out on site as the work proceeds without subsequent records or accurate plans being prepared and filed. Frequently a scheme for cable or pipe laying would be sketched on a local plan of varying age or obsolescence. Dimensioning would be roughly by scale (although the scale of the underlying basic plan may be unsuitable for this purpose), or in accordance with previous policy; for example a particular service could be assumed to be laid at a given depth at given distance from curbs. Site conditions may have forced deviations from these proposals even to the extent of running the service on the opposite side of the street or down another street in a city block layout without these "as-constructed" deviations being recorded. All too frequently no record whatever of the work can be found, this being particularly true of minor service connections to individual premises.

Available Sources of Information

In routine surveying work it is customary to contact the respective authorities and arrange for a "locate", i.e. a field representative to locate the underground services on the site wherever they are expected. Invariably in urban areas this means a call to the telephone authority with the electricity the next most frequently required followed by the gas and water services.

In conjunction with drawings and marker posts or other indicators, an electrical influence meter may be used and a shallow line located to say the nearest foot. By way of "indicators", we may include items evident in the locality which may give a rough idea of which services can be expected. The following table may be considered as a rough guide:

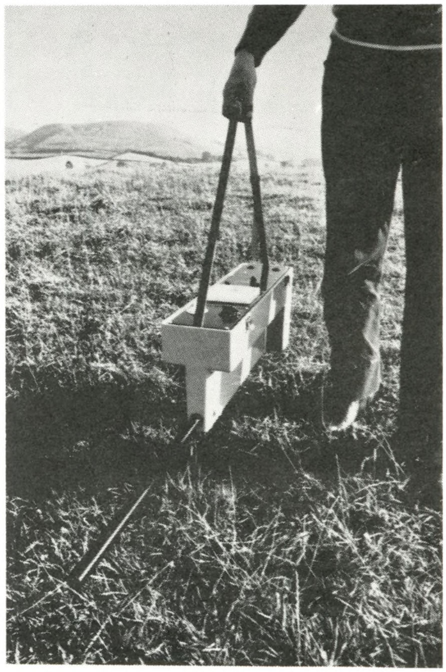

Fig. 3

Item	Service
Manhole Covers	— electricity, telephone, sewers.
Junction Box Covers	— electricity, telephone.
Poles, Masts, Overhead, Wall of Building Cable Connections	— electricity, telephone.
Valve, Stopcock and Toby Covers	— gas, water, miscellaneous pipelines.
Syphon Covers, Breather Pipes	— gas, miscellaneous pipelines.
Hydrants	— water.
Gully Gratings, Trap Covers	— sewers.
Evidence of track excavation or resurfacing	— all services.
Marker posts	— all services.

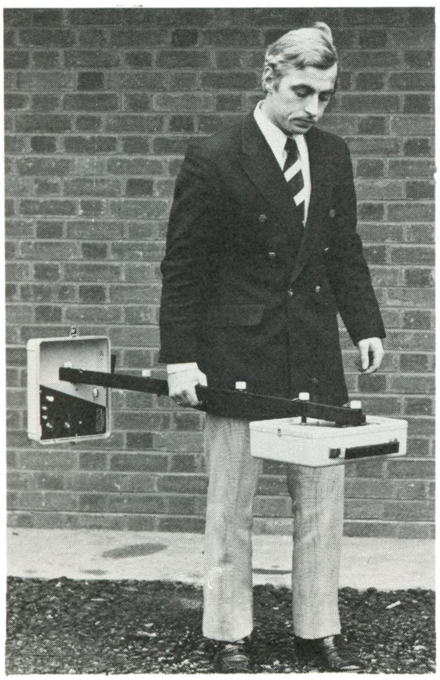

Fig. 2

Location Methods

The physical location of services when no accurate data are available falls into two general categories — electronic and excavation exploration.

To deal first with the electronic or geophysical methods; the equipment varies greatly in type and degree or sophistication. At one extreme we have dip needles and small electromagnetic impulse indicators carried by hand or strap; at the other, the electromagnetic current path prospectors.

The latter may take the form of self-contained ground reflection meters or generators passing a low frequency alternating current between electrodes. There are also radio probes which can be introduced into sewers, tunnels, pipelines, etc. and tracked with V.L.F. receiver equipment.

The most complex instruments have both current or wave receivers and aerial arrays mounted on theodolites. The orientation of the resultant magnetic fields can be plotted and related to ground traverses. A further step is the coupling of digital plotting techniques with co-ordinated output data capable of being integrated and banked if required. Figures 1 and 2 show a portable 'Detectron 505-T' locator supplied by Metal and Pipeline Endurance Ltd. of London, England. This instrument is capable of either visual meter or audible headphone signal for both plan and depth readings. Figure 3 is a similar ground reflection meter 'GRM 501', Figure 4 a current path detector linked to a theodolite. The latter two instruments are supplied by Electrolocation Ltd. of Bristol, England.

Survey Progress

Using the latter type of equipment a typical rate of survey progress is about one acre of coverage per four days of field work. In certain complex areas, secondary observations may be taken for increased precision and discrimination. Under ideal conditions for example, the positions of pipe joints on a main, can be established for location and level to

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within 375 mm (15").

For typical legal or route survey purposes, elaborate service detection equipment will be of little more than academic interest. The small portable meters, etc. are more suitable for locating shallow service connections which are not usually recorded on any plans. The same instruments can be used for bar searching.

Electronic Problems

Electronic detection equipment whatever the type, requires an experienced operator and even when the utmost precautions are taken, observed current anomalies can be misconstrued. The systems operate on the principle of variable resistivity of the conducting materials encountered and are therefore responsive to sizeable air voids, metallic material and water or other fluids in addition to general patterns of geological formation.

An accumulation of anomalies which are impossible to decipher satisfactorily can easily be encountered in developed urban areas. These conditions are becoming more and more common with the increase in service facilities. In addition, there is a tendency for the utility authorities to use pipes, ducts or conduits of non-metallic materials such as P.V.C., propylene, asbestos cement, pitch fibre or fireclay.

Insulation to cables has also tended to be of an increasingly impervious nature. Concrete or steel reinforced road beds present similar difficulties to detection. These problems tend to offset to a certain extent the advances being made in electronic equipment.

Evacuation Method

We come now to the excavation method, and here it may be concluded by many that there is no substitute for the open exploration trench or pit where the services can be visibly seen and surveyed, (Figure 5). For small areas

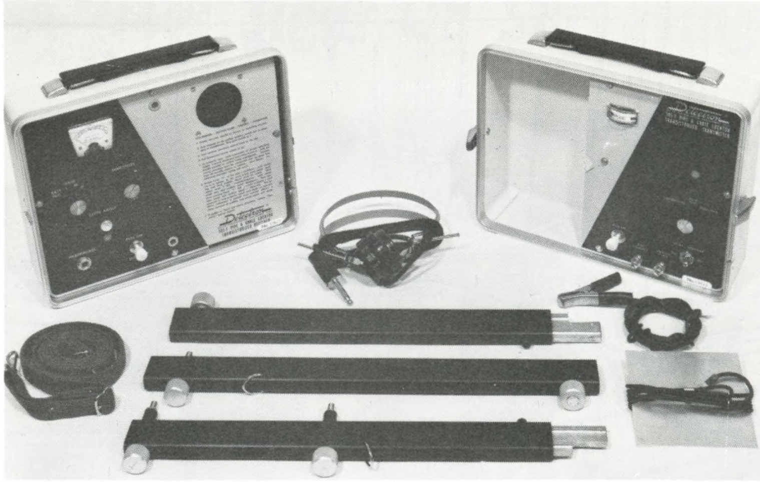

Fig. 1

Fig. 5

where the planting of single bar may be involved, spade or pick and shovel work are called for while on large scale projects, a mechanical digger may be employed. Machinery must be supplemented with hand digging when approaching depths where services may be expected. The man with the shovel will have to exercise caution in uncovering the cables and mains to avoid serious accident. For example, gas seepage from a faulty main can accumulate and be contained by the surrounding earth or electric current can arc from a point of faulty or chipped cable insulation with disastrous effect.

It goes without saying that adequate employee insurance cover is essential. To assist in the protection of their mains many authorities now use buried cover tiles or fluorescent marker tape.

Most services are commonly within potential reach of a standard four foot survey bar. Typical cover depths for various services are as follows:

	Below Footpaths	Below Roads
Electric Cables or Ducts	1' 2" - 1' 6"	2' 0" - 4' 6"
Telephone Cables or Ducts	1' 2" - 1' 6"	2' 0" - 2' 9"
Gas Mains	1' 6" - 3' 0"	2' 6" - 3' 6"
Water Mains	1' 6" - 3' 0"	2' 6" - 4' 0"
Sewers	variable	variable

Common Services Duct

A development now receiving more acceptance in utility circles is the common services duct in which one or more services are contained within a common reinforced concrete duct or pipe laid underground with liftable slab covers or access manholes along the route. Such structures provide excellent protection and accessibility for maintenance of the services although they are restricted in use to major trunk mains and services where there are few local connections.

In backfilling the pit or trench, the soil must be compacted in four or six inch minimum layers and the bar planted in the remade ground. Failure to compact may result in uneven settlement of the ground with consequent serious shift of the bar over a period of time.

I have described in detail what must seem, to most members, a scale of conditions far removed from the requirements of a typical survey job. The point I wish to emphasize is that the location of existing underground services and their mapping and recording is a field which can well be developed by the surveying profession itself.

Surveyors can further improve the situation by becoming involved whenever possible in the setting out of new services and selling the idea of accurate survey records to both service authorities and municipal governments. With increasing population densities such service details are bound to become either a serious business item or a serious problem in the not too distant future.

Form of Records

The concept which must be accepted

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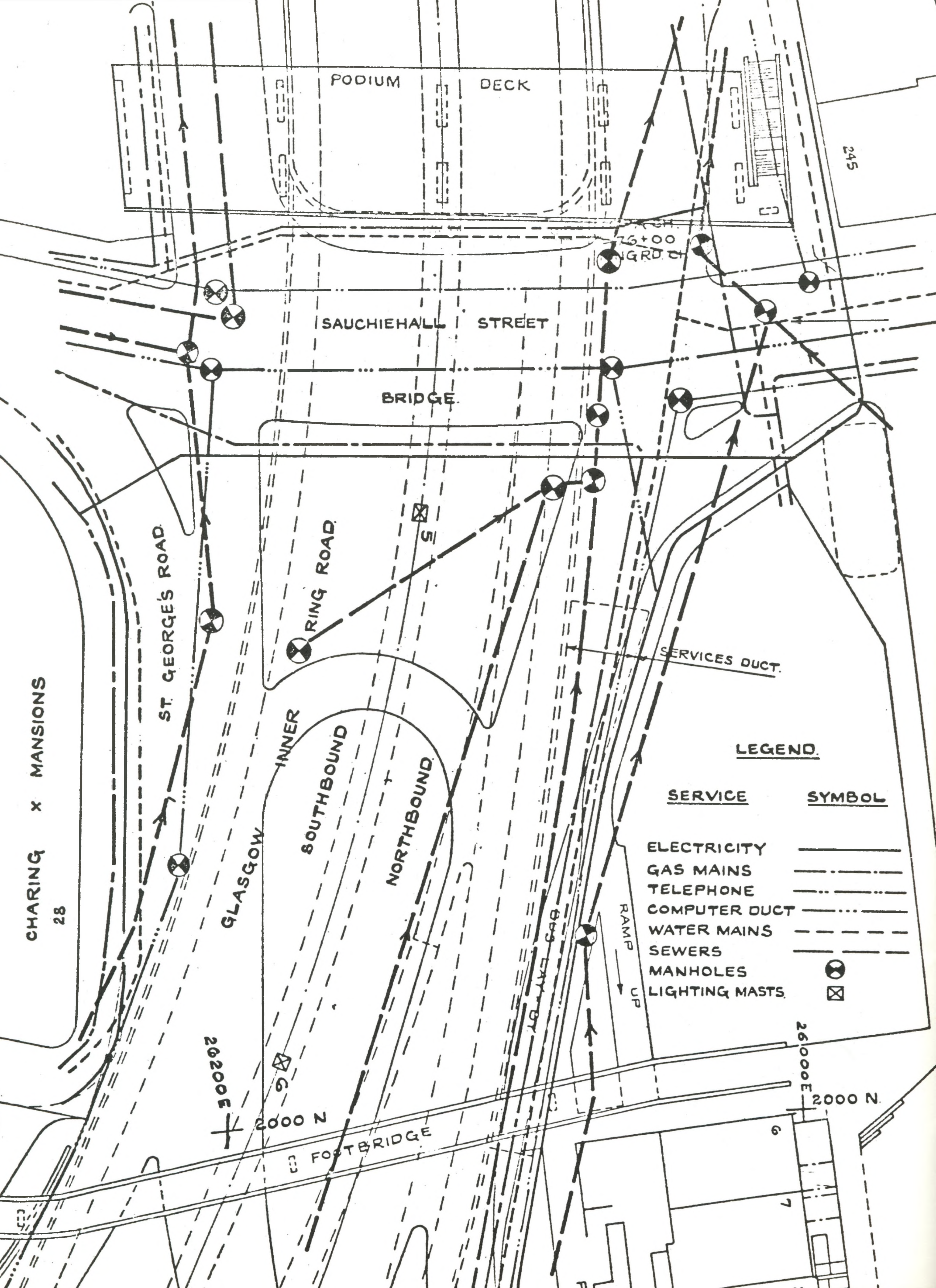
Fig. 4


PODIUM DECK
245
76+00
SAUCHIEHALL STREET
BRIDGE
ST. GEORGE'S ROAD
RING ROAD
5
SERVICES DUCT
CHARING X MANSIONS
28
GLASGOW INNER SOUTHBOUND NORTHBOUND
LEGEND
SERVICE
SYMBOL
ELECTRICITY
GAS MAINS
TELEPHONE
COMPUTER DUCT
WATER MAINS
SEWERS
MANHOLES
LIGHTING MASTS
RAMP UP
26200E
2000 N
26000E
2000 N
6
FOOTBRIDGE
9
7

Australia Survey

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crazy," he says.

"Like all simple idea, people are prone to be hypercritical."

His prototype was an old machine which bucked and spluttered its way across the vast open plains much to the merriment of local farmers.

Got Approval

Eventually, as Carel Hart and a lone assistant began eating up the survey miles at an unprecedented rate, officialdom had a closer look at his weird contraption.

"It took a lot of memo writing but eventually we obtained State Government approval to buy the right equipment," he said.

With a grant of $A530 he bought an agricultural motor cycle, two transceivers, a home-made odometer (from aircraft parts) and a steel frame to support the detachable aluminium surveyor's staff.

The motor cycle is loaded into a bright yellow van (for better visibility) together with the usual survey equipment, and driven to the area under survey.

The survey staff is bolted on to a fixed rear frame section of the cycle and the level-man's table erected.

To enable the level-man to increase the range of his observations (up to a mile) a cylindrical 1 ft. wide orange and white blocked target is fixed to the staff in the required position.

Bright yellow vests for both rider and level-man further improve visibility.

How It Works

The rider, wearing headphones and carrying a small transceiver, moves off on a predetermined track.

The level-man keeps him on-line by sighting at the cylindrical target and "talking" his path by radio.

Hart takes sight through a telescopic alidade while Eacott moves away on his bike.

The rider comes to a halt on command, and sits straddling his machine while the staff remains in a vertical position and the level-man takes a reading.

The motor cycle has low and high gear ratios, and can cover almost any reasonable terrain including rocky creek beds and steep hills.

Unlike a truck, or four-wheel drive vehicle, the motor cycle does not damage crops.

Put Up Barriers

The major result of the contour surveys has been to show that the only way to slow the flow rate of flood water in the area, is to erect strategically placed barriers by strip cropping.

By this method of planting, crops provide a brake for the water, allowing it to flow slowly and giving the soil time to take a deeper soaking.

The 1 ft. contour survey maps are able to pinpoint precisely the direction and level of water flow, and so provide growers with a master plan for planting.

Most growers are now converting to strip cropping in symmetrical rows 1¼ chains wide.

The basic idea is that there will always be either standing crop, or crop stubble, in alternate strips so that the water can not build up too much speed.

Carel Hart says his mobile survey unit could be used to great advantage in countries with wide open plains, such as Canada, the United States and Russia.

He expects to complete his current contour assignment early this year.

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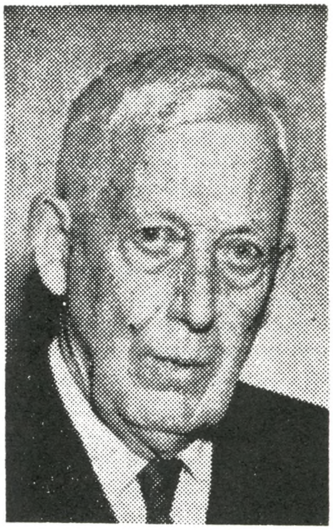
and understood is that underground strata will become an increasingly important subject for surveys and plans, in somewhat the same way condominium has focused our attention on the idea of surveying spatial volumes.

The accompanying illustration (on page 30) at reduced scale is a plan of future underground services in the Charing Cross area of Glasgow made in connection with the Glasgow Inner Ring Road project. The layout is completely referenced to national grid co-ordinates. Plans of the area are marked with grid blocks so that any service can be accurately scaled and its co-ordinates interpolated. The grip block provides a ready made index system. The co-ordinates will ensure that the services can be located accurately and their position known at all times regardless of change to surface buildings and roadworks. Each service is further detailed on profile drawings recording the levels of the various mains.

The maintenance of records of buried services could be centralised at the municipal engineer's office in each incorporated municipality or with each of a maximum of five or six names local service authorities.

The latter policy is generally practised in Britain and Europe at the moment. Dual schemes are also used in some cities with the municipal authorities compiling data from each utility record. The maintenance of such records is fairly straightforward once each authority has agreed to implement a competent system.

Veteran Surveyor Wm. G. McGeorge Dies In Accident



William G. McGeorge, 85, a Chatham land surveyor, and honorary vice-president of the Association, died May 18 in hospital after being struck by a truck while crossing a street.

Mr. McGeorge, a professional engineer, was instrumental in draining Kent County's marsh lands for conversion to some of Canada's richest farming land. He retired in 1968 after more than 50 years of elected service for the city of Chatham. He served without interruption on the municipal water board from 1922 until his retirement, and was chairman of the board for 27 of those 46 years. He also served previously on the board of education.

He served as engineer for both Dover and Chatham Townships for half a century and specialized in drainage schemes that turned soggy soil into top quality crop growing land. Many of his methods won him recognition across Ontario and were emulated by others in the rural engineering field.

He is survived by his wife, four sons and four daughters, as well as 20 grandchildren, a great grandson and a sister. Two of his sons, David G. and Donald D., both of Chatham, are Ontario land surveyors and professional engineers.

The late Mr. McGeorge had been an Ontario land surveyor since 1911.
