

Sewerage systems

Sewerage system planning made simple

A new sewer system planning tool developed with WRC funding will greatly assist local authorities.

Sewer system planning: the need for support tools

Over the last decade there has been a government drive to provide basic services, sewer systems included, to all residents. In many instances the preferred sewer systems are waterborne systems (also called conventional sewer systems) consisting of a system of sewer pipes, pumps and other infrastructure needed to transport the waterborne sewage from the point of entry to the point of outfall. Waterborne sewer planning is inherently complex and the planning process is not readily amenable to a low technology approach.

There is, however, a need for simple tools to assist staff at all local and regional authority levels to complete a basic assessment of sewer systems, give structure to the sewer system (SS) planning process and provide a methodology for compilation of a SS plan. The need for simplicity is dictated by the frequent lack of resources (e.g., computing facilities and staff with sufficient computer knowledge to apply more advanced tools), especially at the level of the smaller, poorer local authorities.

To satisfy this need, a project was undertaken to develop a product that would be simple enough to provide immediate benefits to the local authority, yet be based on the vast and advanced pool of knowledge available to specialists in the field. The product was intended to acquaint sewer managers with fundamental principles relating to sewer planning and provide them with a set of usable tools, in contrast to directing their attention to advanced software suites currently available. Lower-technology tools and guidelines would be more effective in aiding relatively small local authorities to expeditiously move towards a sewer system plan that would contribute to improved service delivery.

Approaches to developing planning tools

Knowledge review

The first step was to make an assessment of existing knowledge contained not only in academic publications and key international sources, but more especially also in the so-called 'grey literature', including locally available design guidelines and consultants' reports – even though relatively few consultants were found to operate specifically in the field of SS planning.

Three-tiered design philosophy

In recognition, on the one hand, of the potential complexity of SS planning (with regard to both the system itself and the sewage flow and load to be transported) and, on the other hand, the need to arrive at simple procedures for routine use in areas with low service levels, provision was made for the following three-tiered approach:

Level 1: The Level 1 approach comprises the application of the most basic design rules and is intended for use in cases where limited technical skill is available, or the scope of work is relatively small with negligible risk. This approach is adequate only in smaller municipalities and small towns with limited sewer infrastructure. Quite often Level 1 is dominated by factors other than hydraulic considerations (e.g. where the minimum pipe diameter is driven by that needed for rodding and prevention of clogging).

Level 2: The second tier entails a more sophisticated approach incorporating design theories that take into account the hydraulics of system elements, requiring a basic analysis of the system or parts thereof. The analysis of a single main sewer, or pump station and rising main, are examples of the Level 2 approach. This would typically be the level needed by a medium-sized town.

Level 3: Level 3 essentially requires advanced skills and software tools needed to conduct planning of extensive sewer systems for cities and large metros.

Compilation and presentation of planning tools

Draft sewer system planning tools were developed on the basis of existing knowledge and the chosen design philosophy. These were subsequently workshopped in order to gain feedback and improve concepts prior to arriving at tools that could be delivered to local authorities as being immediately suitable for practical application.

A detailed account of the tool compilation process and its outcomes, geared mainly to academic readership, has been provided in a descriptive text. However, the importance of also making the results of the project available in wall-mounted poster form was recognised.

A poster-output was consequently produced as the key means of facilitating the application of project outcomes at local authority level. The individual planning tools, components of which have been incorporated in the poster, have also been documented in detail for those requiring more information on any one particular tool.

Workshops

Workshops were held in various centres with stakeholders from a wide range of municipalities, the focus being on local authorities and other stakeholders involved with SS planning where resources limit the application of expensive, high technology interventions such as the use of specialist consultants or advanced software applications. Through these workshops, needs of stakeholders with regard to low-technology tools and guidelines for SS planning were established.

Basic tools

The eventual set of basic, hard copy, tools comprised relatively simple check-lists, tables, graphs and diagrams to aid in the critical steps of the planning process. The final toolkit comprised the following components:

Hydraulic design tool – an aid to understanding the relationships between critical parameters used in characterising the basic hydraulics of sewer pipes, and a useful way of obtaining a feeling for the required pipe size;

Infrastructure costing tool – a mechanism to estimate the fixed capital cost of sewer infrastructure;

Sewer system planning checklist tool – a method to record progress and provide guidance towards a comprehensive sewer system plan;

Master planning process tool – a schematic description of the SS planning process;

Sewer terms tool – a glossary of sewer terms (or mini sewer-dictionary);

Water services development plan (WSDP) tool – a means of simplifying the transfer of information from the sewer system plan to the WSDP.

The Sanitown sewer system model

In addition to the basic tools described above, a conceptual, hypothetical hydraulic model for SS named 'Sanitown', analogous to the 'Anytown' model used in water distribution system analysis, was developed and tested to allow for increasing levels of complexity in SS planning. The Sanitown model fulfils the need for a benchmark model to be used for waterborne sewer system analysis and investigations into optimisation techniques and software performance. This is particularly applicable to South Africa with its unique mix of service delivery challenges involving customers at both the upper and lower ends of the delivery ladder.

Benefits of SS planning tools

The value of the simple, basic tools that have been provided does not merely lie in their usefulness for sewer system planning, but also in their value as training tools. Personnel at ground level, responsible for service delivery in many smaller local authorities, are often limited in terms of their basic knowledge regarding the sewer system, its planning and its operation. The tools will assist them in gaining the necessary understanding by illustrating critical relationships between key parameters typically used in sewer system planning.

No matter how extensively and how well the simple planning tools provided by this project are applied in practice, a computer model of the sewer system would, with growth in the system, ultimately be required to correctly assess the system's hydraulic capacity. Such increase in analytical complexity to the level at which modelling is required immediately creates the need for a benchmark model to allow different approaches to the sewer system design problem to be investigated – a need satisfied through the provision of the Sanitown model.

Use of the basic SS planning tools and the Sanitown model delivered by this project would greatly assist a municipality in better understanding the working, modelling and planning of a sewer system, and its optimisation in terms of hydraulics and cost.

Further reading:

To obtain the report, *Sewer system planning made simple – for small local authorities* (Report No: 1828/1/11) contact Publications at Tel: (012) 330-0340; Fax: (012) 331-2565; E-mail: orders@wrc.org.za; or Visit: www.wrc.org.za