

APPENDIX A: Tool 1 – Hydraulic Design Tool

WATER RESEARCH COMMISSION SEWER MASTER
PLANNING TOOLKIT

Hydraulic Tool

A Project by Stellenbosch University in
Collaboration GLS Consulting

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2010

Note to the user

Average flow velocity

The application of the average flow velocity in hydraulics is now accepted to be out-dated and other more advanced methods are available for determining scouring and sediment transport in sewer pipes. Contrary to the theory presented here, sewers often do not flow full. Sewers typically have a free surface flow that is subject to complex phenomenon (like hydraulic jumps) that could not be addressed in a simplified manner here. For the limited application of this simplified tool it was considered necessary to use the average velocity and the assumption of pipes flowing full as a means to illustrate some essential concepts in pipe flow hydraulics.

Simplified approach versus computer modelling

Sewer system design and planning is nowadays conducted by means of computer models. The hard-copy graphs presented here should not be used for design, but could aid the user in better understanding the typical values that could be expected when an Engineer finally conducts a design.

Format of this tool

This A4 format of the tool includes 9 pages showing various graphs. Each figure number corresponds to a Water Research Commission Report from which these were drawn (www.wrc.org.za). A larger poster-format for wall mounting was also developed during this project and includes some selected graphs of the Hydraulic Tool. The following figures are included here:

- Flow rate for different pipe diameters and slopes
- The relationship between pipe diameter and minimum slope
- Relationship between number of low-income (LI) homes, pipe diameter and slope
- Relationship between number of middle-income (MI) homes, pipe diameter and slope
- Relationship between number of high-income (HI) homes, pipe diameter and slope

Warning with regards to scatter

To illustrate the amount of scatter that is found when analysing actual existing sewer systems, two additional graphs were also included in the Hydraulic Tool:

- A scatter plot showing the large variation in pipe diameter with increasing number of upstream service connections
- A scatter plot showing the large variation in total gravity pipe length with increasing number of upstream service connections.

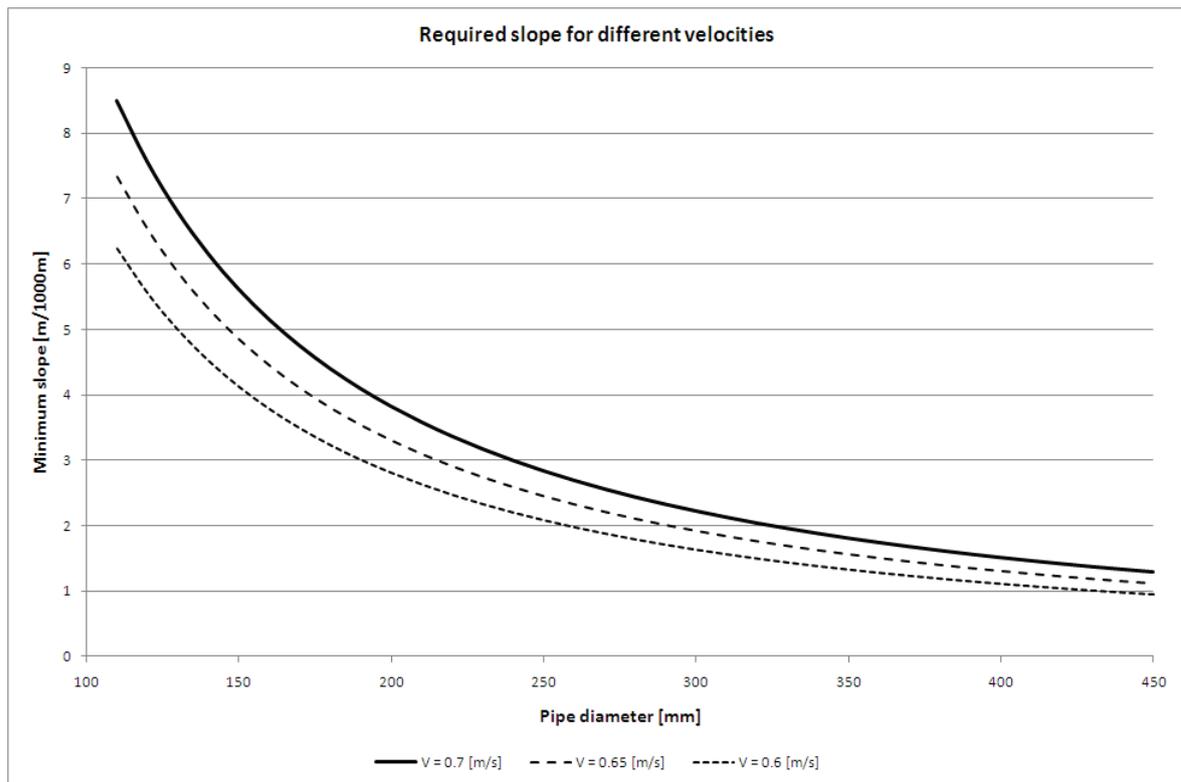


Figure 5.1: Pipe diameter, slope and different average velocities for pipes flowing full

Flow rate for different pipe sizes and slopes
 (Small diameter pipes flowing full @ 40% stormwater ingress & 15% infiltration)

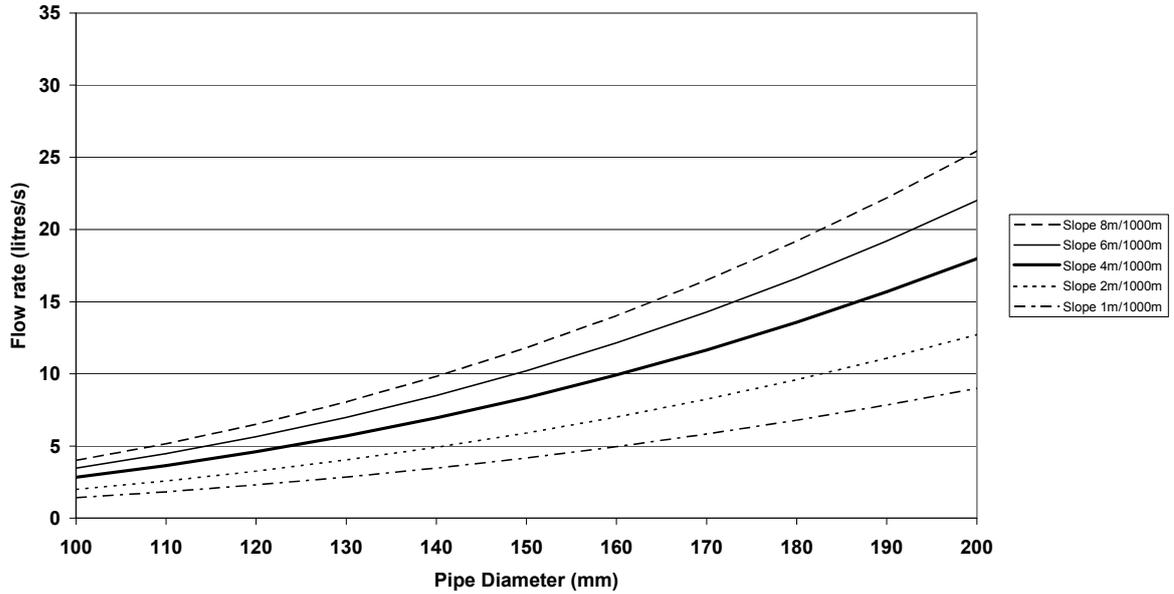


Figure 5.4: Flow rate for different pipe diameters and slopes ($D < \varnothing 200$ mm)

Flow rate for different pipe sizes and slopes
 (Large diameter pipes flowing full @ 40% stormwater ingress & 15% infiltration)

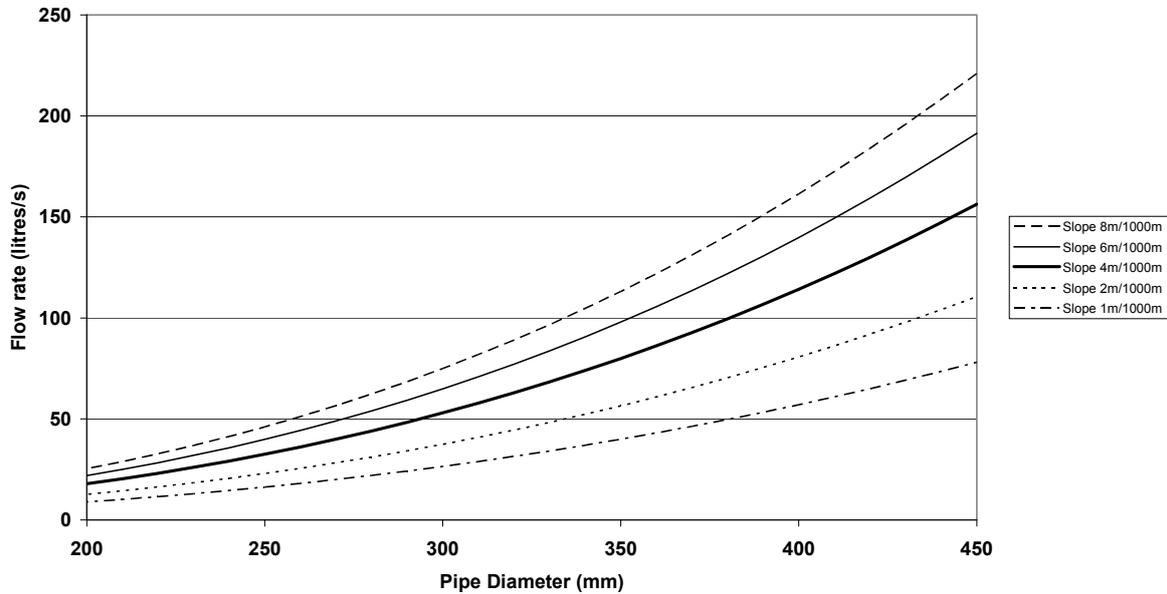


Figure 5.5: Flow rate for different pipe diameters and slopes ($D > \varnothing 200$ mm)

Number of LI-homes serviced by different pipe sizes and slopes
 (Small diameter pipes flowing full @ 40% stormwater ingress & 15% infiltration)

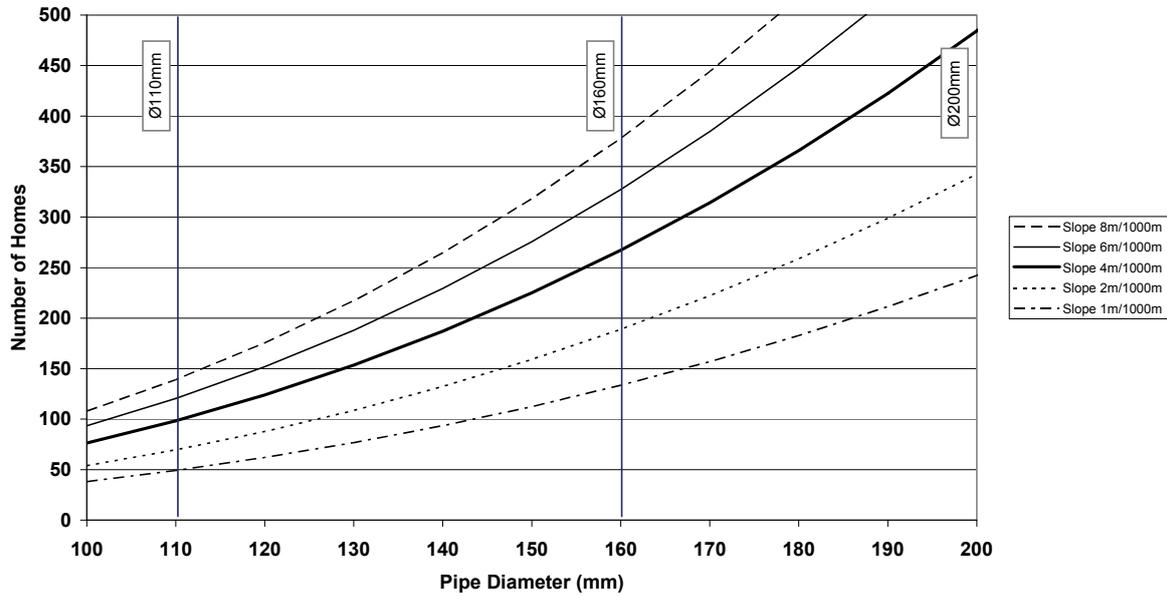


Figure 5.6a: Relationship between number of LI-homes, pipe diameter and slope ($D < \varnothing 200$ mm)

Number of LI-homes serviced by different pipe sizes and slopes
 (Large diameter pipes flowing full @ 40% stormwater ingress & 15% infiltration)

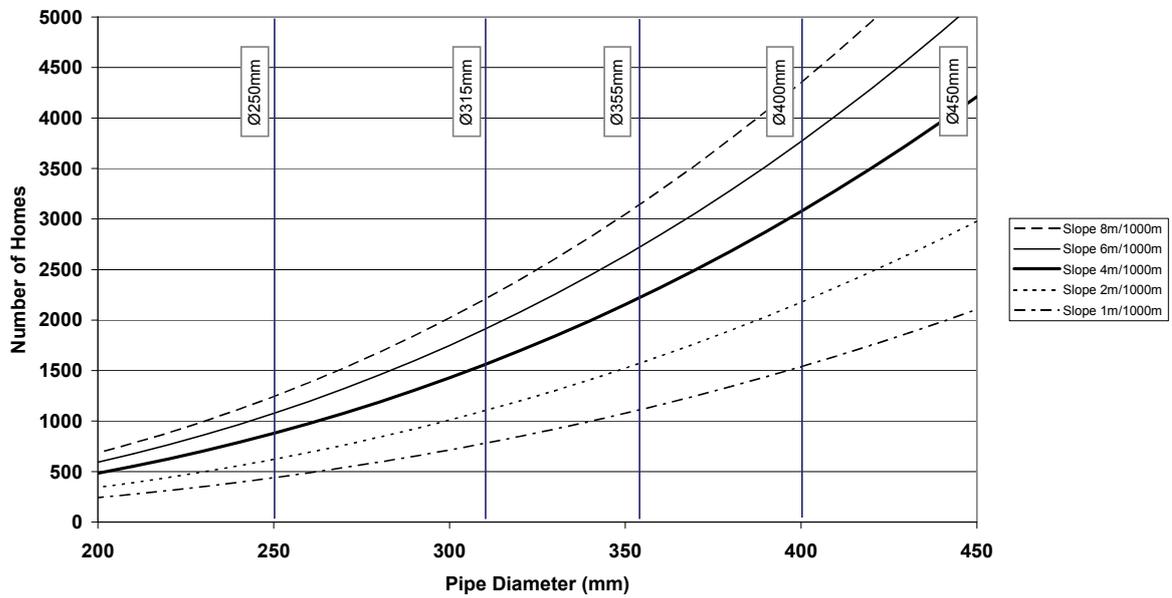


Figure 5.6b: Relationship between number of LI-homes, pipe diameter and slope ($D > \varnothing 200$ mm)

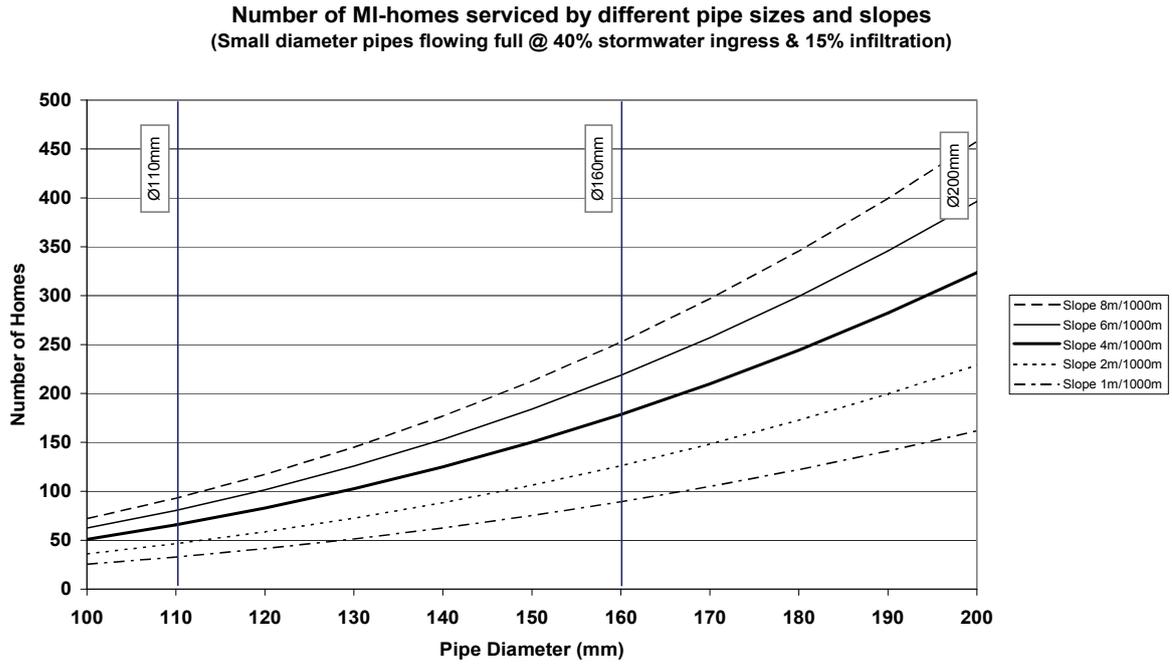


Figure 5.7a: Relationship between number of MI-homes, pipe diameter and slope ($D < \varnothing 200$ mm)

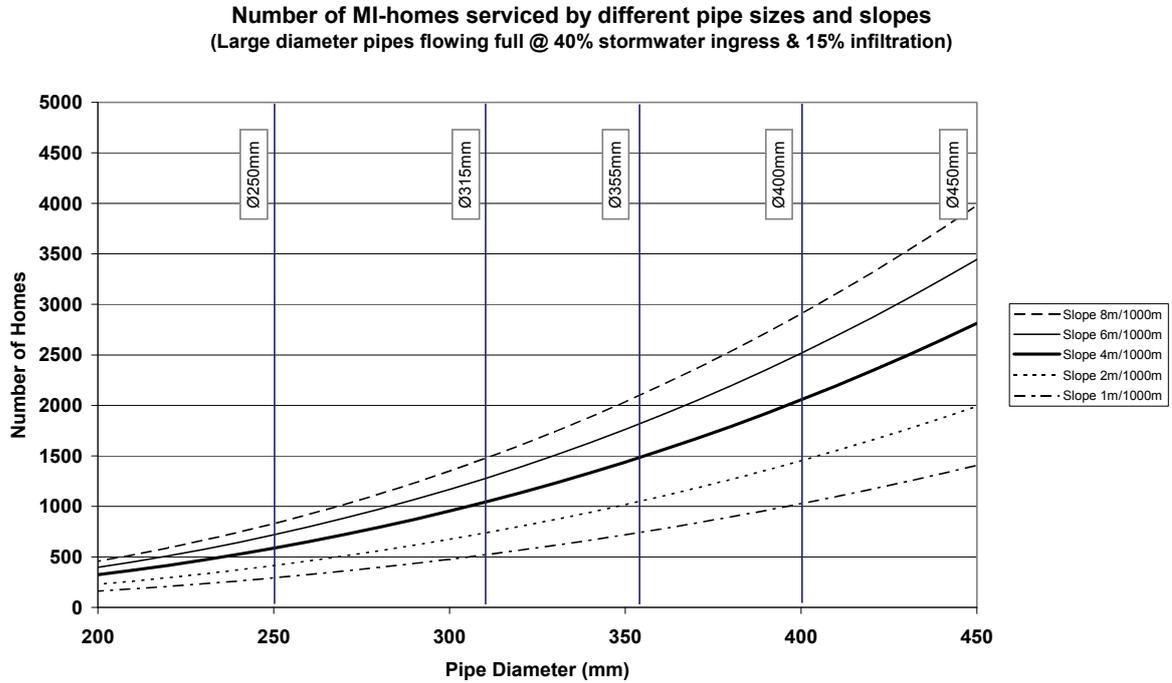


Figure 5.7b: Relationship between number of MI-homes, pipe diameter and slope ($D > \varnothing 200$ mm)

Number of HI-homes serviced by different pipe sizes and slopes
 (Small diameter pipes flowing full @ 40% stormwater ingress & 15% infiltration)

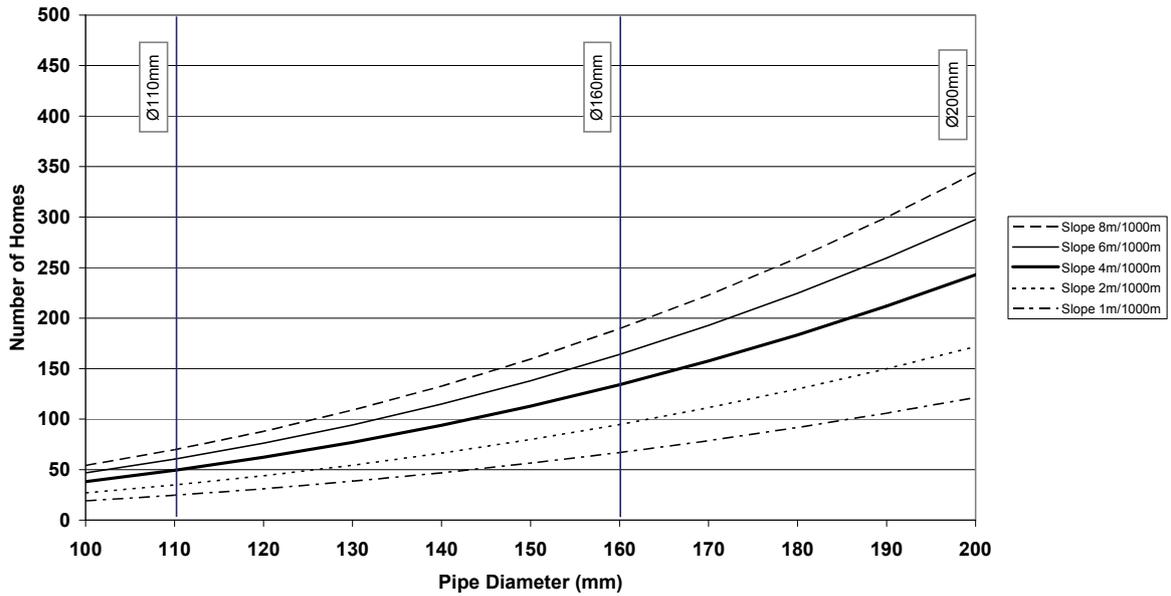


Figure 5.8a: Relationship between number of HI-homes, pipe diameter and slope ($D < \text{Ø}200 \text{ mm}$)

Number of HI-homes serviced by different pipe sizes and slopes
 (Large diameter pipes flowing full @ 40% stormwater ingress & 15% infiltration)

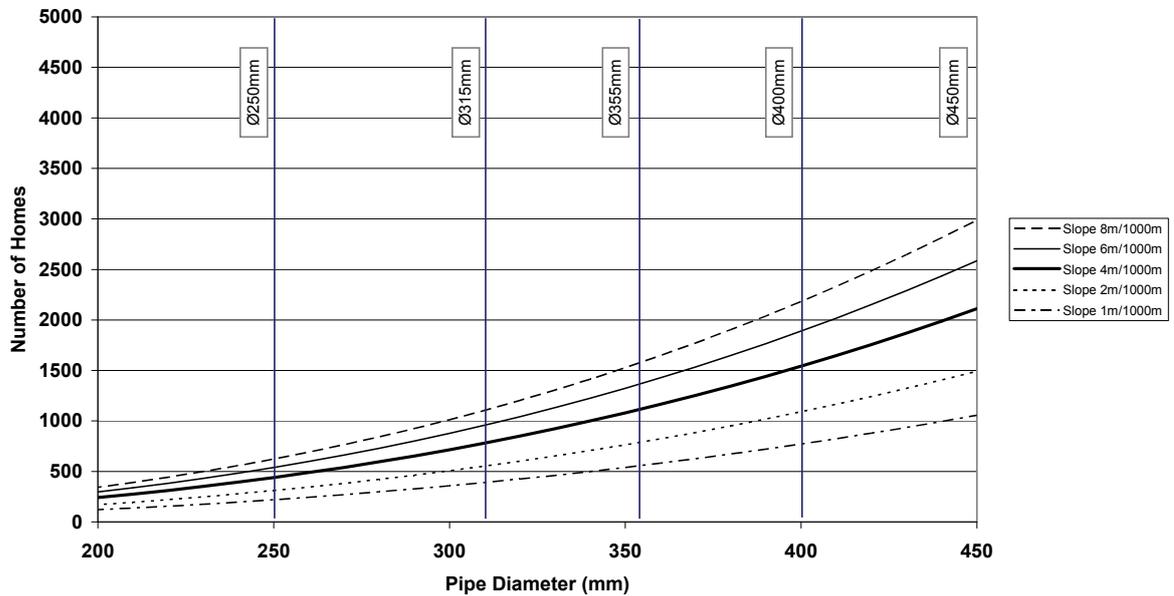
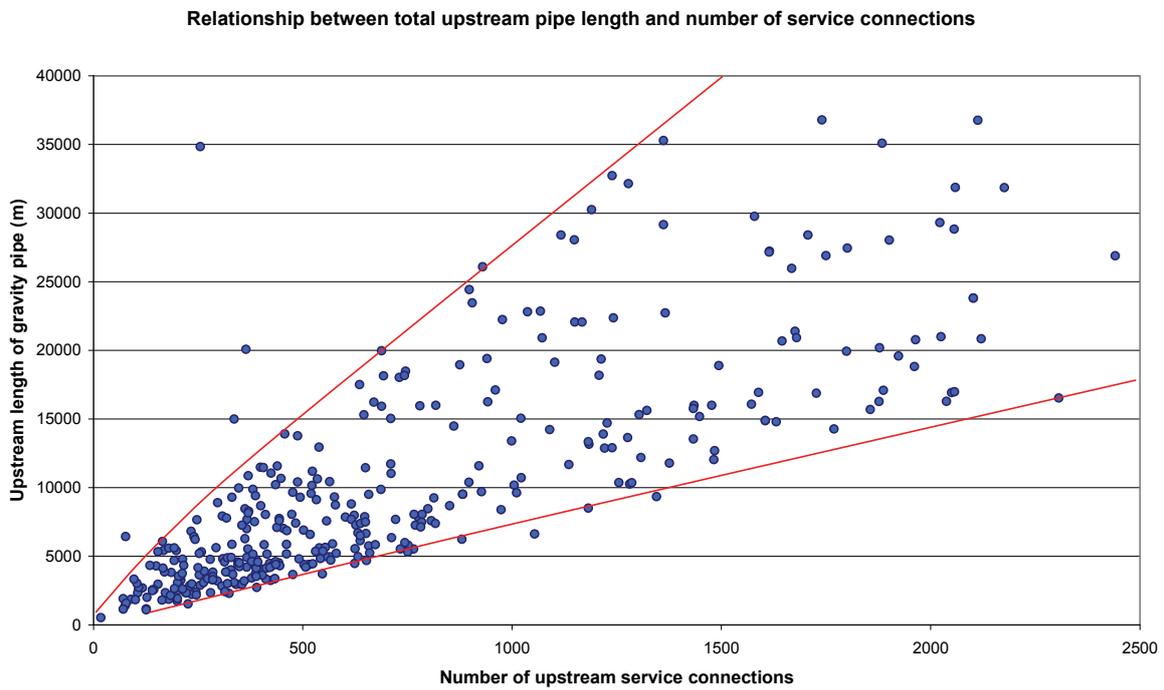
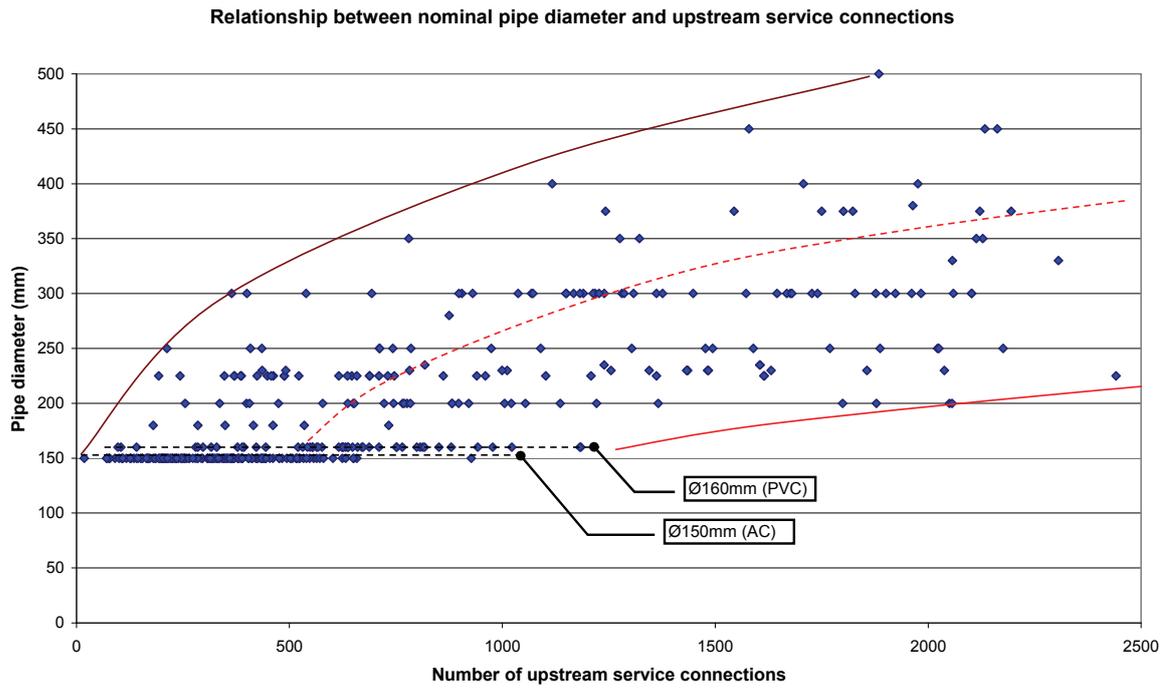


Figure 5.8b: Relationship between number of HI-homes, pipe diameter and slope ($D > \text{Ø}200 \text{ mm}$)



APPENDIX B: Tool 2 – Infrastructure Costing Tool

WATER RESEARCH COMMISSION SEWER MASTER
PLANNING TOOLKIT

Infrastructure Cost Tool

A Project by Stellenbosch University in
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2010

Note to the user

Format of this tool

This tool was developed as an A1 size poster-format for wall mounting, with graphs drawn from a Water Research Commission Report (www.wrc.org.za). A publication with detail on this topic was presented at the WISA2010 conference and the full paper, including all graphs, is available for free download via the internet from www.ewisa.co.za.

Simplified approach versus computer modelling

Sewer system design and planning is nowadays conducted by means of computer models. The hard-copy graphs presented in the poster should not be used for design, but could aid the user in better understanding the typical values that could be expected when a detailed costing of the system is done by an expert.

Warning with regards to types of cost

Capital cost is the only type of cost that is amenable to simplified hard-copy presentation, and it is relatively easy to understand. Operations and maintenance costs vary greatly from one installation to the next and are a function of various complex parameters. The cost functions are useful for estimating existing system replacement value, but have limited application when it comes to optimising pump and rising main costs for future developments

APPENDIX C: Tool 3 – Checklist Tool

WATER RESEARCH COMMISSION SEWER MASTER
PLANNING TOOLKIT

Sewer System Planning Checklist Tool

A Project by Stellenbosch University in
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2010

Note to the user

Format of this tool

This tool was developed as an A1 size poster-format for wall mounting, with the information contained drawn from a Water Research Commission Report (www.wrc.org.za). A reduced single-page A4 version of the poster is included here for optional printing and use in cases where this text is available, but the A1 project poster was not accessible.

Simplified approach versus computer modelling

Sewer system design and planning is nowadays conducted by means of computer models. The hard-copy checklist presented in the poster is an ideal method to record the type and level of information that would be needed by an expert to conduct a detailed planning study by means of computer.

Use of the Checklist Tool

The idea is to mark (e.g. tick with a pen) each level of completeness for each step in the progress (each row down the table). The levels of completeness, in increasing order of desirability, are:

- "No / Not available" = the person completing the checklist knows that the information is not available or has not been recorded
- "I do not know" = the person completing the checklist is not sure whether the information is available or not
- "Available from consultant" = the information is available, but not from the Municipality; it could for example be obtained by contacting the Municipality's engineering consultant/s
- "At Municipality, but out-dated or incomplete" = the information (say a CAD drawing) is available in the Municipal office, but the recorded data is either incomplete or out-dated.

"At Municipality – Yes" = the information is available in the Municipal office.



SEWER MASTER PLANNING PROGRESS CHECKLIST TOOL

Completeness ➔

No Not available	I don't know	Available from Consultant	At Municipality	
			Out-dated Incomplete	Yes

SEWER SYSTEM PLANNING PROGRESS ↓

1 Basic information and data integrity

1.1	As-built drawings of sewer system
1.2	Site survey data of manhole positions (x,y,z - coordinates)
1.3	CCTV-survey or other accurate GIS information of manholes
1.4	Pump station location and capacity
1.5	Existing hydraulic model(s) of the sewer system
1.6	Drainage zone information (drainage basin boundaries etc)
1.7	Cadastral and land use (GIS; number of properties etc)
1.8	Basic flow measurements at treatment plant (e.g. monthly)
1.9	General sewer flow logging and/or daily measurements

2 Hydraulic (computer) model of existing system

2.1	Data capturing from CAD/GIS/Existing models
2.2	Electronic survey data of manholes
2.3	Detailed modelling of pump stations, diversions, etc.
2.4	Non-hydraulic info, e.g. pipe material/installation year
2.5	Discrepancies/field inspections

3 Plan books or wall maps

3.1	Title blocks and grids established
3.2	Background drawings, images and text
3.3	Printed maps/plan books of sewer system

4 Water balance and sewer flow estimates

4.1	Bulk sewer flow measurements (e.g. at WCV's)
4.2	Water demand records per property (AADD)
4.3	Sewer flow measurements at pump stations
4.4	Unit hydrographs and estimates of sewer flows

5 Link between flow data and model topology

5.1	Detail drawings and knowledge of sewer connections
5.2	Property to manhole cross referencing (in model)
5.3	Drainage zone-by-zone sewer flow profile (in model)

6 Hydraulic calibration of model

6.1	Flow logging at selected manholes and rainfall data
6.2	Records of monthly rainfall
6.3	Analysis of flow measurement data (infiltration/ingress)
6.4	Discrepancies and topological corrections
6.5	Field records and inspections (e.g. record of sewer spills)
6.6	Adjustments (pipe roughness coefficients, etc)

7 Evaluation of existing system

7.1	Design criteria (minimum slopes/velocities, etc.)
7.2	Groundwater infiltration/stormwater ingress analysis
7.3	Existing system hydraulic analysis
7.4	Existing system interpretation of results
7.5	Identification of problems based on modelled results

8 Future land use and sewer flow analysis

8.1	Spatial Development Framework (SDF)
8.2	Future occupation of vacant land / densification
8.3	Re-zoning of existing developments
8.4	Potential upgrading of service levels
8.5	Growth scenario and planning horizon

9 Master plan for sewer system

9.1	Extend model to cover future land developments
9.2	Modelling of future sewer flows
9.3	Plan future system (size future infrastructure)
9.4	Phasing in of future master plan items
9.5	Cost estimates for future capital projects
9.6	Optimise cost to identify best solutions
9.7	Capital budget summary (prioritised project list)
9.8	Software purchase or contract

10 Reports / Documents

10.1	Existing system status quo
10.2	Spatial Development Framework (SDF)
10.3	Sewer Master Plan (SMP)
10.3	SMP results incorporated in WSDP

APPENDIX D: Tool 4 – SS Planning Process Description Tool

WATER RESEARCH COMMISSION SEWER MASTER
PLANNING TOOLKIT

Sewer System Planning Process Tool

A Project by Stellenbosch University in
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2010

Note to the user

Format of this tool

This tool comprises a flow chart that describes the sewer system planning process in two levels of detail:

- first a reduced level of complexity as a schematic diagram of the simplified approach; it also includes a column on the right showing the link between each sewer system planning tool and the corresponding step in the process
- a more comprehensive viewpoint of the process.

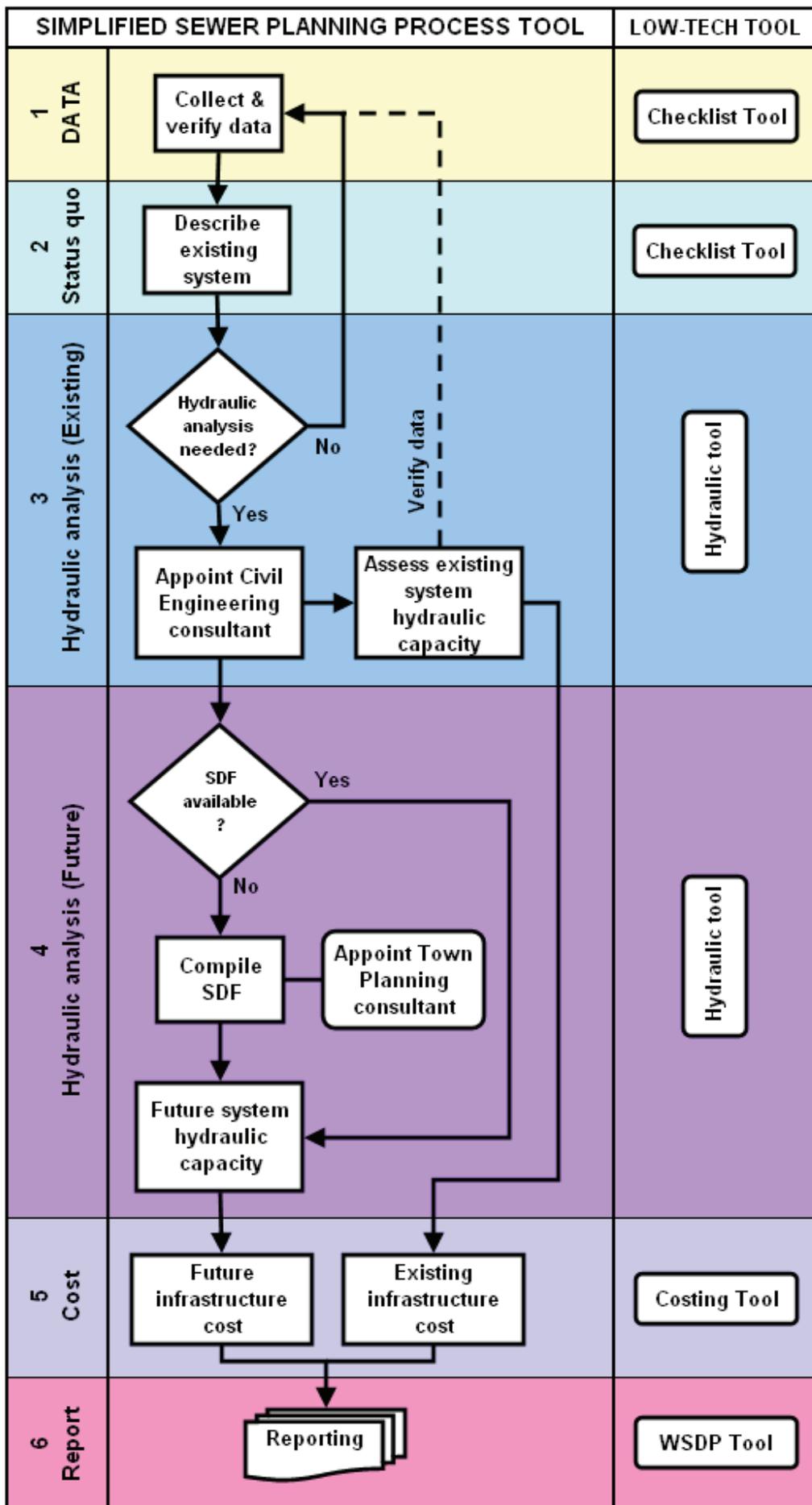
This tool was developed to fit on an A4 size page and the flow was included in the project poster-format for wall mounting, where it is linked to other tools. The information contained was drawn from a Water Research Commission Report (www.wrc.org.za).

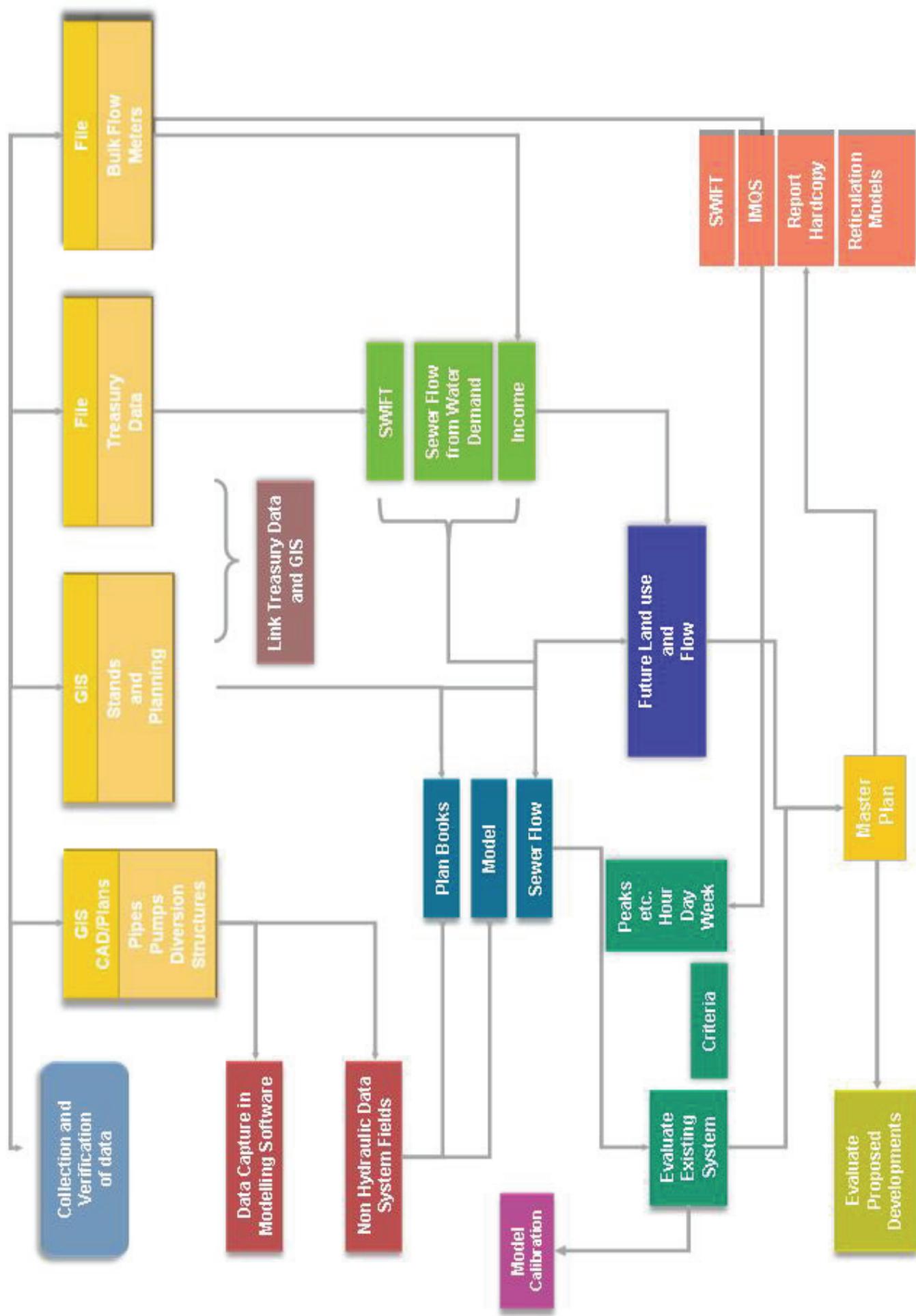
Simplified approach versus computer modelling

Sewer system design and planning is nowadays conducted by means of computer models. The checklist presented here is aimed at explaining the relatively simple approach of sewer system planning. A more comprehensive description is available to describe the dynamic sewer master planning process and how it integrates to the water master plan; that work is not included here.

Use of the Process Tool

The idea of this tool is to illustrate the process by means of a simple flow chart, with actions and warnings where appropriate as they relate to each step.





APPENDIX E: Tool 5 – Sewer Terms Tool

WATER RESEARCH COMMISSION SEWER MASTER
PLANNING TOOLKIT

Sewer Terms Tool

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2010

PART A. SEWER SPECIFIC- The following list of definitions and terms relate to sewers.

Attenuation

The reduction in magnitude/intensity/concentration of a substance dispersed in a liquid medium.

Average dry weather flow

The average non-storm flow over 24 hours during the dry months of the year. It is composed of the average sewage flow and the average dry weather inflow/infiltration.

Average wet weather flow

The average flow over 24 hours during the wet months of the year on days when no rainfall occurred on that or the preceding day.

Base flow

That portion of the wastewater flow, including inflow and infiltration, that corresponds to the minimum flow recorded in a sewer. It typically equates to the "minimum night flow" concept in water distribution systems.

Bulk main

See Collector main.

Blockage

A deposit in a sewer resulting in restriction or stopping of flow.

Cesspool

A covered watertight tank used for receiving and storing sewage from premises which cannot be connected to the public sewer and where conditions prevent the use of a small sewage treatment works, including a septic tank.

Cleaning eye

An access opening to the interior of the discharge pipe or of a trap, provided for the purpose of internal cleaning, and which remains permanently accessible after completion of the drainage installation.

Collector main

In collection systems, this is a larger pipe in which smaller branch and sub main sewers are connected.

Collector sewer

The intermediate sized pipelines that convey the effluent from the reticulation to the main outfall sewers. These are usually in sizes ranging from 150 to 450 mm in diameter (Goyns, 2007).

Collection system

In a wastewater system, a collection system is a system of pipes which receives and conveys sewage and/or storm water.

Combined sewer system

A wastewater collection and treatment system where domestic and industrial wastewater is combined with storm runoff.

Combined sewers

A sewer that carries both sewage and stormwater runoff.

Conservancy tank

A covered tank that is used for the reception and temporary retention of sewage and that requires emptying at intervals.

Conventional sewer system

Refer to waterborne sewer system

Detention

The process of collecting and holding back stormwater or combined sewage for delayed release to receiving waters.

Discharge

The release of wastewater or contaminants to the environment. A direct discharge of wastewater flows from a land surface directly into surface waters, while an indirect discharge of wastewater flows into surface waters by way of a wastewater treatment system.

Diversion structure

A type of regulator that diverts flow from one pipe to another.

Drain

A pipeline, generally underground, designed to carry wastewater and/or surface water from a source to a sewer; the drain is the plumbing within the boundary of the water consumer (it could also be interpreted as a pipeline carrying land drainage flow or surface water from roads, Stephenson and Barta, 2005).

Domestic wastewater

Human-generated sewage that flows from homes and businesses.

Effluent

Treated water, wastewater or other liquid flowing out of a treatment facility.

Extraneous flow

Water entering the sewer from sources other than intended water used and wasted, or leaking, at source (e.g. stormwater and groundwater infiltration). Extraneous flows make up most of the base flow in most sewers.

French drain

A conventional absorption field that comprises a trench that is filled with suitable material and that is used for the disposal of liquid effluent from a septic tank or waste water.

Grease trap

A device that is designed to cool down incoming hot waste water to below 30°C, to enable grease and fat to separate from the water and to solidify at the surface level of the waste water, and that prevents grease and fat from entering the sewer (also referred to as a grease interceptor).

Greywater

Wastewater from the bath, shower and possibly the washing machine that is "less polluted" than waste from the other sources (e.g. the toilet and kitchen sink).

Groundwater infiltration

Infiltration of groundwater (that typically enters the sewer system through pipe defects located below the normal groundwater table).

Gully

A pipe fitting that incorporates a trap into which waste water is discharged and that is normally connected to a drain.

Infiltration

The ingress of water into a drain or sewer through defects in pipes, joints or manholes (Stephenson and Barta, 2005).

Inflow

Flows of extraneous water into a wastewater conveyance system from sources other than a sanitary sewer connections, such as roof leaders, basement drains, manhole covers, and cross-connections from storm sewers.

Influent

Water, wastewater or other liquid flowing into a reservoir, basin or treatment plant.

Influent pump station

A pump station that pumps flow from an interceptor sewer into a treatment plant.

Inspection chamber

A chamber not deeper than 1 m and of such dimensions that permanent access may be obtained to a drain without a person being required to enter into such a chamber.

Invert

The bottom of the inside of a pipe.

Lateral sewer

A sewer that discharges into a branch or other sewer and has no other common sewer tributary to it.

Lag

An interval of time before additional flow enters the system.

Load

Any matter transported by the flow in sewers (typically this would be sewage).

Main sewer

This is a relatively larger pipe into which smaller branch and submain sewers are connected. It may also be called a trunk sewer.

Manhole

Chamber of depth exceeding 750 mm and of such dimensions that a person can enter such chamber to obtain access to a drain.

Network pipe

See reticulation pipe.

Nonpoint source pollution

Pollution that enters water from dispersed and uncontrolled sources (such as surface runoff) rather than through pipes. Nonpoint sources (for example, stormwater runoff from agricultural or forest operations, on-site sewage disposal systems, and discharge from boats) may contribute pathogens, suspended solids, and toxicants.

Outfall

The point, location, or structure where wastewater or drainage discharges from a sewer, drain or other conduit.

Outfall sewer

A sewer that receives wastewater from a collecting system or from a treatment plant and carries it to a point of final discharge. These are usually from 450 mm in diameter and larger.

Peak dry weather flow (PDWF)

The peak non-storm flow during the dry months of the year. It is composed of the peak sewage flow and the peak dry weather inflow/infiltration.

Peak wet weather flow (PWWF)

The peak flow during the wet months of the year on days when no rainfall occurred on that preceding day.

Plumbing

The system of pipes and fittings required for the sanitation of a building (to the stand boundary where the plumbing joins the sewer).

Pump station (also pumping station)

A pump station comprises at least a motor, pump and some type of sump. A pump station may contain more than one of the former elements. This is usually an underground structure that the sewage is discharged into. The types vary but in smaller systems these comprise of a wet well, into which the sewage is discharged, and the wet well also houses submersible pumps which pump the sewage to its destination via a rising main (pipe). In a larger pump stations there may be a separate dry well, adjacent to the wet well, where the pumps are housed. On some pump stations the pumps may be housed above ground near the wet well.

Raw sewage

Untreated waste water.

Regulator

A structure that controls the flow of wastewater from two or more input pipes (trunk lines) to a single output (usually a larger interceptor line). Regulators can be used to restrict or halt flow, thus causing wastewater to be stored in the conveyance system until it can be handled by the treatment plant.

Relief sewer

A sewer built to carry flows in excess of the capacity of an existing sewer.

Reticulation pipe

Also called a network pipe. This is the smallest element of a sanitation system and consists of the small diameter pipelines that convey the effluent from the individual properties and along streets. They are usually in sizes ranging from 110 to 225 mm in diameter (Goyns, 2007).

Rising main

A pipeline leading from a pump station that transports wastewater under pressure to its destination at higher elevation.

Runoff

That part of precipitation, snow melt, or irrigation water that runs off of the land surface into streams or other surface water instead of infiltrating the land surface. Runoff could infiltrate sewers.

Rodding eye

A permanent access opening to the interior of a drainage installation that permits full-bore access to the interior of a drain for internal cleaning, but does not include an inspection eye or manhole.

Sand trap

A large construction (typically of concrete) to trap load in sewage. To be completed.

Sanitation

Conditions relating to public health. The term would thus include the provision of waterborne sewerage as a service in the wider definition

Sanitation system

N/a

Screen

A large sieve used for the purpose of trapping the load in sewage.

Secondary treatment

Biochemical treatment of wastewater after the primary stage, using bacteria to consume the organic wastes. The secondary treatment step includes aeration, settling, disinfection and discharge through an outfall. Secondary treatment in conjunction with primary treatment removes about 85 to 90 percent of suspended solids in wastewater.

Sediment

Once-suspended material which has settled to the bottom of a liquid, such as the sand and mud.

Sedimentation tanks

Tanks or tunnels for holding wastewater where floating wastes are skimmed off and solids settle by gravity. Settled solids, called "sludge," are pumped out for further treatment. Sedimentation tanks are also referred to as clarifiers.

Septic tank

An underground tank used for the deposition of domestic wastes. Bacteria in the wastes decompose the organic matter, and the sludge settles to the bottom. The effluent flows through drains into the ground. Sludge is pumped out at regular intervals.

Sewage

Wastewater and excrement conveyed in sewers. It could include infiltrated soil water, industrial effluent and other liquid waste, either separately or in combination, but excludes stormwater by design. Sewage is usually classified as wastewater derived from human communities – toilet, bathroom, laundry and kitchen waste.

Sewer

A pipe or conduit used for the conveyance of sewage (the sewer is typically the property of the local authority and excludes on-site plumbing and drains). The term is often defined in dictionaries as "an underground conduit for carrying of drainage water and waste matter", but this definition is technically incorrect in instances such as South Africa where waste matter (e.g. sewage) and drainage water (e.g. storm water) are typically conveyed in separate conduit systems; the term "sewer" is used in this study as it pertains to conduits conveying wastewater.

Sewerage

The provision of drainage by sewers.

Sewer system

A system of sewer pipes and other infrastructure (e.g. pumps) needed to transport the sewage from the point of entry to the point of outfall. It includes wastewater pipes, pumping stations, treatment plants, etc. A sewer system may also be called a sewerage system, sanitation system or wastewater system, but these terms are not used in this study.

Sludge

The suspended matter in industrial effluent or sewage remaining after partial drying.

Sludge removal

This is the process of removing sludge from treatment systems or tanks and can be carried out manually or automatically.

Soffit

The top of the inside of a pipe.

Storage

A method for controlling combined sewer overflows by storing the combined sewage until the rainstorm subsides, then releasing it back into the conveyance system to be treated at the usual treatment plant.

Storm drain

A system of gutters, pipes, or ditches used to collect and carry stormwater from buildings or land surfaces to streams, lakes, or other receiving waters. In practice storm drains carry a variety of substances such as sediments, metals, bacteria, oil, and antifreeze which enter the system through runoff, deliberate dumping, or spills. This term also refers to the end of the pipe where the stormwater is discharged.

Storm sewer

A system of pipes (separate from sanitary sewers) that carry only water runoff from building and land surfaces.

Stormwater

Water that is generated by rainfall and is often routed into drain systems in order to prevent flooding.

Sullage

See greywater.

Suspended solids

Small particles of organic or inorganic materials that float on the surface of, or are suspended in, sewage or other liquids and which cloud the water. The term may include sand, mud, and clay particles as well as waste materials.

Treatment

Chemical, biological, or mechanical procedures applied to industrial or municipal wastewater or to other sources of contamination to remove, reduce, or neutralize contaminants.

Trunk main

See collector main.

Trunk sewer

See main sewer.

Wastewater flow

Total flow within a sewer system. In separated systems, it includes sewage and infiltration/inflow (thus unintended storm water ingress would be included). In combined systems, it also includes stormwater.

Wastewater system

See sewer system.

Waterborne

Transported by water.

Waterborne sewer system

A sewer system that uses water as the mode of transport for excrement and other waste.

APPENDIX F: Tool 6 – WSDP Tool

WATER RESEARCH COMMISSION SEWER MASTER PLANNING TOOLKIT

WSDP Tool

A Project by Stellenbosch University in
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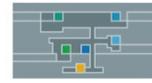
2010



WRC Project K5-1828

by Stellenbosch University in collaboration with GLS Engineers

with credit to KV3 Engineers for this WSDP-input tool.



Sewer Master Planning – WSDP TOOL SEWER-RELATED INFORMATION REQUIRED FOR WSDP INPUT <i>Based mainly on KV3 Engineers Agenda Documentation (www.kv3.co.za)</i>	
<p>4.1 GENERAL</p> <p>List of Towns and water balance models (see Sewer Master Plan Tool)</p> <p>Integrated Development Plan (IDP)</p> <p>Spatial Development Framework (SDF)</p> <p>Operational and Capital Budgets for previous two financial years</p> <p>Key Performance Management System and KPIs</p>	
<p>4.2 ADMINISTRATION</p> <p>4.2.1 Verify WSDP Drafting Team</p> <p>4.2.2 2008/2009 Process Plan (IDP program)</p> <p>4.2.3 Sanitation Service Level Policies</p> <p>4.2.4 Community Participation Plan for selection of service levels</p>	
<p>4.3 IDP AND WSDP GOALS</p> <p>4.3.1 Priority ward needs</p> <p>4.3.2 Vision / Targets / Goals / Strategies</p> <p>4.3.3 Identify sanitation sub-goals</p>	
<p>4.4 PHYSICAL AND SOCIO ECONOMIC PROFILE</p> <p>4.4.1 Population and growth rates (Census / IDP / SDF)</p> <p>4.4.2 Age and gender, household income (Census / IDP / SDF)</p> <p>4.4.3 Consumer units and their categories (HH, dry&wet industries, commercial) – Financial System</p> <p>4.4.4 Migration information</p> <p>4.4.5 Health information</p> <p>4.4.6 Poor household definition</p> <p>4.4.7 Economic Information (LED Strategy)</p>	
<p>4.5 SERVICE LEVEL PROFILE</p> <p>4.5.1 Service levels for each system (town)</p> <p>Sanitation: None or inadequate, bucket, on site dry, wet, intermediate or full waterborne.</p> <p>4.5.2 Grey water management / pit emptying and sludge disposal / Types of sanitation technology options</p> <p>4.5.3 Detail on any "Wet industries"</p> <p>4.5.5 Industrial consumer units (Monthly sewage & waste water) and permitted effluent releases</p>	

<p>4.6 WATER RESOURCE PROFILE</p> <p>4.6.1 Water Balances</p> <p>4.6.4 Water returned to resources (Flow from waste water treatment works)</p> <p>4.6.5 Quality of water taken from source and returned to the source (WQ & treated effluent monitoring, test results)</p> <p>4.6.6 Pollution Contingency measures</p>	
<p>4.7 WC/WDM</p> <p>This section is not directly applicable to sewer</p>	
<p>4.8 WATER SERVICES INFRASTRUCTURE PROFILE</p> <p>4.8.1 Existing groundwater and surface water infrastructure</p> <p>4.8.2 Existing WTWs</p> <p>4.8.3 Existing pump stations</p> <p>4.8.4 Existing bulk pipelines</p> <p>4.8.5 Existing reservoirs</p> <p>4.8.6 Existing reticulation</p> <p>4.8.7 Existing WWTWs</p> <p>4.8.8 Asset Register and AMPs (Assessments)</p> <p>4.8.9 Sewer Master Plans</p>	
<p>4.9 WATER BALANCE</p> <p>4.9.1 Commercial, industrial and residential sales, raw water and treated water meter readings, treated effluent and recycled.</p>	
<p>4.10 WATER SERVICES INSTITUTIONAL ARRANGEMENTS PROFILE</p> <p>4.10.1 WSA Capacity development program</p> <p>4.10.2 Organogram</p> <p>4.10.3 Water Services By-laws</p> <p>4.10.4 Water services providers (Water & Sanitation, current + over 5 years)</p> <p>4.10.5 Water services providers (Bulk water & sanitation, current + over 5 years)</p> <p>4.10.6 Sanitation promotion agent (Current + over 5 years)</p> <p>4.10.7 Support service contract</p>	
<p>4.11 CUSTOMER SERVICES PROFILE</p> <p>4.11.1 Number of queries/complaints, % responded to within 24hours, number of leaks and blockages, number of tanks, number of calls received for emptying (Also emergency).</p> <p>4.11.2 Health and Hygiene education</p> <p>4.11.3 Water education</p> <p>4.11.4 Pollution awareness program</p>	

<p>4.12 FINANCIAL PROFILE</p> <p>4.12.1 Capital and Operational budgets (Sources of funding)</p> <p>4.12.2 % Equitable share allocated to basic water and sanitation services</p> <p>4.12.3 Non payment per residential, commercial and industrial category</p> <p>4.12.4 Tariffs for current and two previous financial years</p> <p>4.12.5 Subsidy targeting approach for free basic water</p> <p>4.12.6 Water metering and billing (No of meter installations, meters tested and replaced)</p> <p>4.12.7 Free basic sanitation</p> <p>4.12.8 Credit Control and Debt Collection Policy, Indigent Policy</p> <p>4.12.9 Typical bill</p> <p>4.13 LIST OF PROJECTS (SMP MASTER PLAN ITEMS)</p>	
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