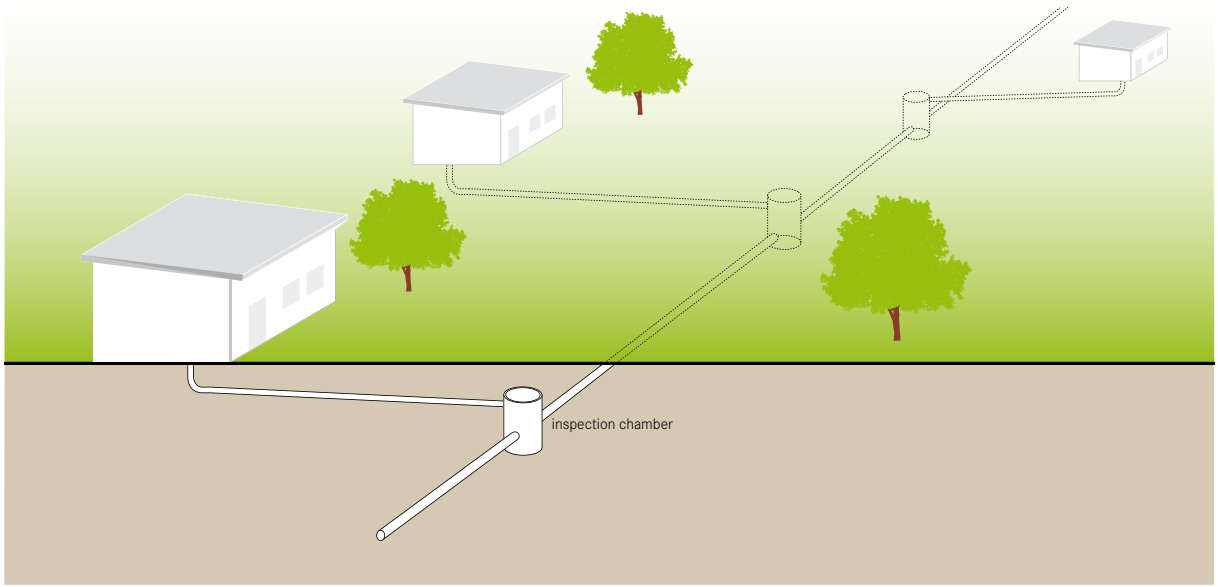
C.4 Simplified Sewer

Applicable to: **Systems 7-9**

Application Level:	Management Level:	Inputs/Outputs:
Household	Household	Blackwater, Brownwater
Neighbourhood	Shared	Greywater, Effluent
City	Public	



A simplified sewer describes a sewerage network that is constructed using smaller diameter pipes laid at a shallower depth and at a flatter gradient than Conventional Sewers (C.6). The simplified sewer allows for a more flexible design at lower costs.

Conceptually, simplified sewerage is the same as Conventional Gravity Sewerage, but without unnecessarily conservative design standards and with design features that are better adapted to the local situation. The pipes are usually laid within the property boundaries, through either the back or front yards, rather than beneath the central road, allowing for fewer and shorter pipes. Because simplified sewers are typically installed within the condominium, they are often referred to as condominial sewers. The pipes can also be routed in access ways, which are too narrow for heavy traffic, or underneath pavements (sidewalks). Since simplified sewers are installed where they are not subjected to heavy traffic loads, they can be laid at a shallow depth and little excavation is required.

Design Considerations In contrast to Conventional Sewers that are designed to ensure a minimum self-cleansing velocity, the design of simplified sewers is based on a minimum tractive tension of 1 N/m^2 (1 Pa) at peak flow. The minimum peak flow should be 1.5 L/s and a minimum sewer diameter of 100 mm is required. A gradient of 0.5% is usually sufficient. For example, a 100 mm sewer laid at a gradient of 1 m in 200 m will serve around 2,800 users with a wastewater flow of 60 L/person/day.

PVC pipes are recommended to use. The depth at which they should be laid depends mainly on the amount of traffic. Below sidewalks, covers of 40 to 65 cm are typical. The simplified design can also be applied to sewer mains; they can also be laid at a shallow depth, provided that they are placed away from traffic.

Expensive manholes are normally not needed. At each junction or change in direction, simple inspection chambers (or cleanouts) are sufficient. Inspection boxes are also used at each house connection. Where kitchen greywater contains an appreciable amount of oil and grease, the installation of grease traps (see PRE, p. 100) is recommended to prevent clogging.

Greywater should be discharged into the sewer to ensure adequate hydraulic loading, but stormwater connections should be discouraged. However, in practice

it is difficult to exclude all stormwater flows, especially where there is no alternative for storm drainage. The design of the sewers (and treatment plant) should, therefore, take into account the extra flow that may result from stormwater inflow.

Appropriateness Simplified sewers can be installed in almost all types of settlements and are especially appropriate for dense urban areas where space for onsite technologies is limited. They should be considered as an option where there is a sufficient population density (about 150 people per hectare) and a reliable water supply (at least 60 L/person/day).
Where the ground is rocky or the groundwater table high, excavation may be difficult. Under these circumstances, the cost of installing sewers is significantly higher than in favourable conditions. Regardless, simplified sewerage is between 20 and 50% less expensive than Conventional Sewerage.

Health Aspects/Acceptance If well constructed and maintained, sewers are a safe and hygienic means of transporting wastewater. Users must be well trained regarding the health risks associated with removing blockages and maintaining inspection chambers.

Operation & Maintenance Trained and responsible users are essential to ensure that the flow is undisturbed and to avoid clogging by trash and other solids. Occasional flushing of the pipes is recommended to insure against blockages. Blockages can usually be removed by opening the cleanouts and forcing a rigid wire through the pipe. Inspection chambers must be periodically emptied to prevent grit overflowing into the system. The operation of the system depends on clearly defined responsibilities between the sewerage authority and the community. Ideally, households will be responsible for the maintenance of pre-treatment units and the condominial part of the sewer. However, in practice this may not be feasible because users may not detect problems before they become severe and costly to repair. Alternatively, a private contractor or users committee can be hired to do the maintenance.

Pros & Cons

+ Can be laid at a shallower depth and flatter gradient than Conventional Sewers
+ Lower capital costs than Conventional Sewers; low operating costs
+ Can be extended as a community grows
+ Greywater can be managed concurrently
+ Does not require onsite primary treatment units
- Requires repairs and removals of blockages more frequently than a Conventional Gravity Sewer
- Requires expert design and construction
- Leakages pose a risk of wastewater exfiltration and groundwater infiltration and are difficult to identify

References & Further Reading

_ Bakalian, A., Wright, A., Otis, R. and Azevedo Netto, J. (1994). *Simplified Sewerage: Design Guidelines.* UNDP-World Bank Water and Sanitation Program, Washington, D.C., US. Available at: documents.worldbank.org/curated/en/home (Design guidelines for manual calculations)

_ Mara, D. D. (1996a). *Low-Cost Sewerage.* Wiley, Chichester, UK. (Assessment of different low-cost systems and case studies)

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_ Mara, D. D. (2005). *Sanitation for All in Periurban Areas? Only If We Use Simplified Sewerage.* Water Science & Technology: Water Supply 5 (6): 57-65. (An article summarizing the technology and its potential role in urban sanitation)

_ Mara, D. D., Sleigh, A. and Tayler, K. (2001). *PC-Based Simplified Sewer Design.* University of Leeds, Leeds, UK. Available at: www.efm.leeds.ac.uk/CIVE/Sewerage/ (Comprehensive coverage of theory and design including a program to be used as a design aid)

_ Watson, G. (1995). *Good Sewers Cheap? Agency-Customer Interactions in Low-Cost Urban Sanitation in Brazil.* Water and Sanitation Division, The World Bank, Washington, D.C., US. Available at: www.wsp.org (A summary of large-scale projects in Brazil)