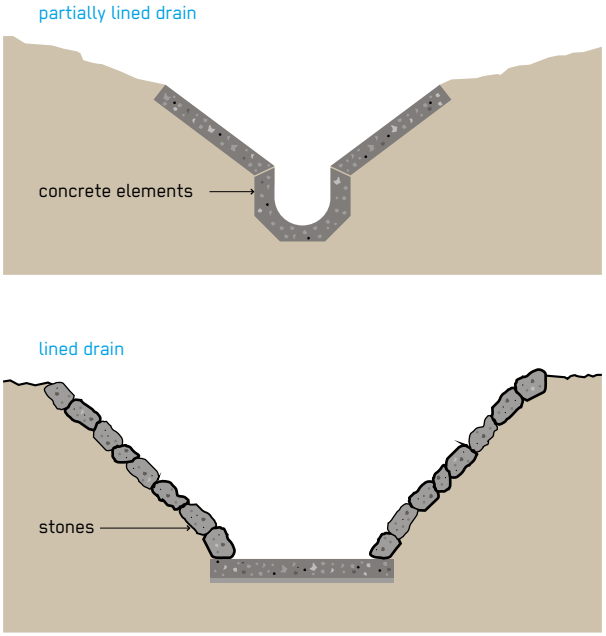
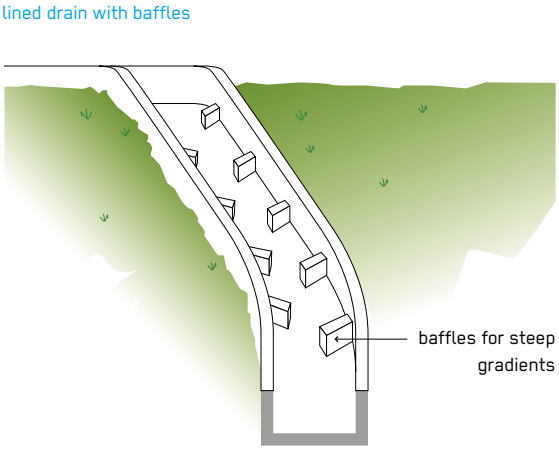
Stormwater Drainage

Phase of Emergency	Application Level / Scale	Management Level	Objectives / Key Features
Acute Response * Stabilisation ** Recovery	* Household ** Neighbourhood ** City	* Household * Shared ** Public	Conveyance of stormwater
Space Required	**Technical Complexity**	**Inputs / Outputs**	
** Medium	** Medium	● Greywater, ● Stormwater	





By draining residential and other populated areas, Stormwater Drainage helps to prevent flooding and pooling of water. Avoiding stagnant water can help prevent the spread of disease and prevent the creation of a muddy environment.

Standing water, erosion and muddy conditions can pose public health risks, especially during humanitarian emergencies. This water can come from rainfall run-off, called stormwater, or from settlements and households, called greywater. Where stormwater is not drained from urban areas by a Conventional Gravity Sewer **(C.4)**, other means of management are needed. Stormwater Drainage is of special importance in camps and urban areas, where natural run-off of water is reduced due to surfaces sealed by roads, houses and other paved areas. Constructing stormwater channels for drainage can be challenging in areas with flat terrain due to the lack of gradient, as well as in steep areas , where run-off velocities become high and difficult to control. Stormwater channels can drain directly into a receiving water body, such as a river or a lake. The minimum implementation of Stormwater Drainage in the acute phase of an emergency should be to protect wells, latrines and other water, sanitation and hygiene facilities of primary interest from flooding. Although this chapter focuses on stormwater channels, there are other means to prevent standing water, e.g. by minimising impervious cover and by using natural or constructed systems to filter and recharge stormwater into the ground. Such systems include designated flooding areas, local infiltration surfaces, such as infiltration trenches, grass filters, retention ponds and others, as well as careful land use management plans. Wherever ground conditions allow, drainage can be done on-site, where greywater is produced.

Design Considerations: Design of Stormwater Drainage needs to be done by a skilled and experienced engineer. Detailed information on terrain, land use, slope and rain events is needed. To design stormwater channels, the runoff coefficient of an area needs to be known, indicating the percentage of rainwater that actually runs off and does not infiltrate locally or evaporate. This coefficient depends mainly on soil conditions, land use and terrain. The slope will indicate how fast water will runoff. If possible streets and access roads need to be planned to have stormwater channels along them. Stormwater channels should always be constructed below the housing level, to reduce the risk of residential flooding. To control water on steep slopes (with more than 5 % gradient), different systems such as baffles, steps or check walls can be implemented in the stormwater channels. Stormwater channels can be covered or open. Closed channels have the advantages that the space above them can be used and solid waste is prevented from entering from above. Disadvantages of closed channels include more failures due to more difficult operation and maintenance, for example removal of blockages, as well as being more costly. Channels can be built lined or unlined depending on the requirements and size of the channel.

Materials: For lined stormwater channels, lining materials are needed. These can be prefabricated drain elements, cement or local materials such as wood. For unlined channels the ground can be reinforced with chicken wire and plants. Basic tools are needed for cleaning secondary channels, such as shovels and rakes.

Applicability: Stormwater drainage can be implemented in areas with regular flooding and/or greywater production and where there is no conventional sewerage. Informal settlements and camps are often built in unfavourable geographical settings and may be particularly susceptible to risks associated with stormwater (i.e. flooding). If an area can be developed before residents move in, proper stormwater management should be planned beforehand.

Operation and Maintenance: Solid waste must be removed from stormwater channels on a regular basis and particularly before the start of a rainy season or expected rainfall events to assure proper functioning. After the rains it may be necessary to empty sediments from a channel, after the water flow has decreased below the self-cleansing velocity. Structural damages also need to be tended to on a regular basis. These can occur especially in channels with high gradients and runoff velocities.

Costs: Channel construction requires labour-intensive excavation work and subsequent transport of soil. For small neighbourhood channels this can be done by the community. Channel lining material is another high-cost item. Secondary channels can often be built with local materials and the help of communities, while bigger primary channels require lining materials and often machines for excavation.

Social Considerations: One of the main challenges for Stormwater Drainage is that it is open to abuse by people, for example by throwing solid waste into the channels or by disposing of faecally contaminated water into the drain. To prevent this, the correct use of a Stormwater Drainage system needs to be part of community hygiene behaviour promotion activities **(X.12)**. Also necessary are a functioning solid waste management system **(X.8)** and measures to ensure complete toilet disconnection from the Stormwater Drainage system.

Strengths and Weaknesses:

⊕ Can be built with local materials
⊕ Allows safe drainage of stormwater
⊕ Reduces risk of flooding

⊖ Requires appropriate terrain and land management
⊖ Prone to failure due to misuse
⊖ Source of mosquito breeding if mismanaged

→ **References and further reading material for this technology can be found on page 193**