This Technical Brief looks at the key sanitation issues affecting populations in urban flood settings, including excreta disposal, vector control, waste management, major clean-ups, drainage and the disposal of dead bodies.

It is important to plan the response with an understanding of the type of flood and its impact on the affected population. Floods may last from a few days up to many months. Refer to Smith (2009) for a comprehensive list of the different types of floods.

The main challenges associated with sanitation in urban floods are:

- Floods in urban areas are often characterised by mass population displacements in a short period. Shelter and access to adequate WASH facilities are frequently inter-linked, and many public shelters are ill equipped to cope with large in-fluxes in a short time period.
- In situations of displacement, women and adolescent girls may be vulnerable to sexual violence or exploitation, especially when housed in public shelters.

The type of intervention will not be the same for all flood situations, and it may be necessary to work in a phased approach. The phases are:

- **Immediate action after the flood (1st Phase options)**, typified by instability and rapidly changing situation (0 – 2 months).
- **Short to medium-term actions (2nd Phase options)**, typified by a stabilisation of the situation (from 2 – 6 months).
- **Medium to long-term actions**, typified by the recovery & resettlement of the affected communities (6 – 12 months or longer). Medium to long-term options are not considered in this paper.

The responsible role of state actors, such as municipal authorities, armed forces and/or police forces in responding to the flood situation is critical in managing a response to the floods and in ensuring the safety of those affected.

Sufficient water, sanitation and hygiene (WASH) facilities on their own will not guarantee an optimal impact on people’s health. To achieve maximum benefit, it is imperative to ensure that those affected by floods have the tools, knowledge and understanding to prevent WASH related disease by involving them in the design and maintenance of the facilities.

**The importance of hygiene behaviour**

Sanitation, water supply, and health are directly affected by hygiene behaviour. It is important to bear this in mind when considering technical options, so that sanitation facilities provided in emergencies are acceptable to the users and can be used and maintained hygienically. **It is essential to read this briefing in conjunction with the ‘Hygiene Promotion in Flood Settings’ briefing (Sow, 2009).**
1. Excreta Disposal in an Urban Flood Setting

The priority of any immediate options is the speed of response, and it is essential that technologies to contain excreta can be installed quickly, particularly in public shelters (official or unofficial), that are cramped and overcrowded. Hygiene promotion and community mobilisation is a key element of any such activities. Refer to Sow (2009).

Typical excreta disposal options in an urban flood setting include:

- Repairs to existing sanitation facilities
- Chemical “Portaloo” toilets

- Packet latrines (with or without enzymes)
- Bucket latrines with close fitting lids
- Rapid kit (type) latrines

See Table 2 overleaf for details regarding these options.

Support may be necessary for families who stay in their homes, and for those hosting other families, as well as those relocating to shelters. Provision of traditional excreta disposal technologies, such as pit latrines, pour-flush toilets and raised urine-diversion (UD) toilets, can be slow. Urban responses may typically include a both first and second phase options (see Table 1 below).

<table>
<thead>
<tr>
<th>Category</th>
<th>First phase Response</th>
<th>Second Phase Response</th>
<th>General</th>
</tr>
</thead>
<tbody>
<tr>
<td>Those who stay in their own homes</td>
<td>Use of existing latrines or toilets.</td>
<td>Repair and clean existing facilities.</td>
<td>Chemical, packet or bucket latrines will require a collection and disposal service to dispose of sludge safely.</td>
</tr>
<tr>
<td></td>
<td>Packet latrines.</td>
<td>Repair and clean existing facilities.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bucket latrines.</td>
<td>Repair and clean existing facilities.</td>
<td></td>
</tr>
<tr>
<td>Those who stay with host families</td>
<td>Use of existing latrines or toilets.</td>
<td>Repair and clean existing facilities.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Packet latrines.</td>
<td>Repair and clean existing facilities.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bucket latrines with lids.</td>
<td>Repair and clean existing facilities.</td>
<td></td>
</tr>
<tr>
<td>Those who relocate to official shelters</td>
<td>Excreta clean up campaigns.</td>
<td>Repair and clean existing facilities.</td>
<td>Keep facilities clean and well maintained. Sludge from chemical, packet or bucket latrines will require a safe collection and disposal service.</td>
</tr>
<tr>
<td></td>
<td>Repair existing facilities.</td>
<td>Repair and clean existing facilities.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rapid kit latrines.</td>
<td>Repair and clean existing facilities.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chemical toilets.</td>
<td>Repair and clean existing facilities.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Packet latrines.</td>
<td>Repair and clean existing facilities.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bucket latrines.</td>
<td>Repair and clean existing facilities.</td>
<td></td>
</tr>
<tr>
<td>Those who relocate to unofficial shelters</td>
<td>Excreta clean up campaigns.</td>
<td>Repair and clean existing facilities.</td>
<td>Keep facilities clean and well maintained. Sludge from chemical, packet or bucket latrines will require a safe collection and disposal service.</td>
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<td></td>
<td>Repair existing facilities.</td>
<td>Repair and clean existing facilities.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rapid kit latrines.</td>
<td>Repair and clean existing facilities.</td>
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<tr>
<td></td>
<td>Chemical toilets.</td>
<td>Repair and clean existing facilities.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Packet latrines.</td>
<td>Repair and clean existing facilities.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bucket latrines.</td>
<td>Repair and clean existing facilities.</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Priority sanitation responses for those affected by urban flooding (adapted from Smith, 2009)
### Table 2: Advantages and Disadvantages of 1st Phase Excreta Disposal Options
(adapted from Emergency Sanitation, 2002)

<table>
<thead>
<tr>
<th>Description</th>
<th>Advantages/Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chemical &quot;Portaloo&quot; Toilets</strong></td>
<td><strong>Advantages</strong>&lt;br&gt;- Hygienic and odour is minimised</td>
</tr>
<tr>
<td><strong>Packet latrine</strong></td>
<td><strong>Advantages</strong>&lt;br&gt;- Packets are lightweight and easy to transport  &lt;br&gt;- Appropriate for flooded areas or where space is limited</td>
</tr>
<tr>
<td><strong>Bucket latrine</strong></td>
<td><strong>Advantages</strong>&lt;br&gt;- Defecation containers can be procured easily and transported  &lt;br&gt;- Once containers are provided only final disposal system needs to be established</td>
</tr>
<tr>
<td><strong>Kit latrines</strong></td>
<td><strong>Advantages</strong>&lt;br&gt;- Rapid to implement on site  &lt;br&gt;- Quality hardware designed for easy transport</td>
</tr>
<tr>
<td><strong>Existing urban sewer systems – temporary latrines</strong></td>
<td><strong>Advantages</strong>&lt;br&gt;- Can be quick to install in an emergency</td>
</tr>
<tr>
<td><strong>Repair of existing excreta disposal facilities</strong></td>
<td><strong>Advantages</strong>&lt;br&gt;- Repairs to existing facilities may provide a quick solution</td>
</tr>
<tr>
<td><strong>Desludging existing excreta disposal facilities</strong></td>
<td><strong>Advantages</strong>&lt;br&gt;- A quick solution to making existing facilities serviceable again.</td>
</tr>
</tbody>
</table>
**Health & Safety Issues - Desludging**

If manual latrine emptying is the only method available, care must be exercised during the emptying process. The removal of pit/Septic tank contents is extremely hazardous to health (and safety). Workers involved in emptying should never enter the pit, and should wear protective clothing such as rubber boots, overalls, rubber gloves and facemasks. On completing the work, hands must be washed thoroughly with soap, and the protective clothing should also be washed and disinfected.

**Figure 1:** Health and Safety Requirements for desludging existing excreta disposal facilities

**Criteria for Selection**

In an emergency setting, a number of factors must be fully considered before introducing the chosen solution. The choice of technology should be based on a solid assessment of the situation. Refer to Harvey (2007). Consultation with the affected community is an essential part of the assessment, and a number of parameters should also be considered, including:

- Existing sanitation facilities in the public shelters that could be either cleaned or rehabilitated for use by the displaced population.
- The physical constraints (rocky ground, high water table, flood plain, etc.) existing in the target community.
- The community’s preferences regarding excreta disposal practices and facilities. Are there any strongly held beliefs or taboos about urine or faeces?
- Existing local knowledge and local organisations involved in promoting sanitation.
- The different requirements of men, women, children and those with special needs.
- The logistics of supplying latrine materials and the availability of hardware and moulds also needs careful consideration.
- The expected timescale for communities to remain in public shelters.

**Assisting the return home**

Support should be provided for families returning to their own homes, through the provision of materials for repairs or by providing assistance to empty flooded latrines.

**Figure 2:** A biodegradable packet latrine (Peepoople, undated)

**Figure 3:** Latrines installed over an existing sewer (Harvey et al, 2002)
Disaster Risk Reduction (DRR)

In areas at risk of recurrent flood emergencies, it is important to incorporate DRR activities into the response, for example ensuring that rehabilitated and newly constructed facilities are (more) disaster proof and making local staff aware of immediate actions to take in the event of a flood.

Note: The following sections are also largely applicable in rural contexts and are referred to in the ‘Sanitation in Rural Flood Settings’ briefing (Forster, 2009). Some sections have been these sections have been tailored, as appropriate for urban settings.

2. Vector Control in an Urban Flood Setting

Vectors can carry disease-producing parasites from one host to another. These potential disease carriers are capable of rapidly reproducing and dispersing within favourable environments. Floods often provide conditions for proliferation, with flies and mosquitoes posing the greatest risk. Vectors of significance include mosquitoes, flies, rats and mice, cockroaches, ticks, fleas, lice and mites. The principal vector transmitted diseases include:

<table>
<thead>
<tr>
<th>Vector</th>
<th>Disease/Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mosquitoes</td>
<td>Dengue, Malaria, Yellow Fever, West Nile Fever, Filariasis, etc.</td>
</tr>
<tr>
<td>Rats</td>
<td>Leptospirosis, Hanta virus, Bubonic plague, Typhus, etc.</td>
</tr>
<tr>
<td>Flies &amp; Cockroaches</td>
<td>Diarrhoeal diseases</td>
</tr>
<tr>
<td>Ticks, Fleas, Lice</td>
<td>Typhus</td>
</tr>
</tbody>
</table>

Table 3: Vector transmitted diseases & conditions (Wisner et al, 2003)

Floods do not cause new diseases or automatically result in outbreaks of vector-borne diseases, but alter the environment, and encourage the proliferation of vectors. Some flood-associated diseases may appear several weeks or months after the event.

In the post-flood period, the first priority is to assess the risk of vector-borne disease transmission, as quickly as possible. If an intervention is required, major vector control activity should take place as soon as possible.

The necessary resources must be mobilised rapidly, and an operational management framework put in place swiftly to allow vector-control activities to be implemented. Refer to Wisner et al, 2003.

Vector control responses

In a post-flood situation, flood-affected people need to have the knowledge and the means to protect themselves from disease and nuisance vectors that are likely to represent a significant risk to health and/or well-being. Risks must be kept to an acceptable level and can be controlled by:

- Medical diagnosis and treatment
- Chemical/ biological means
- Environmental sanitation
- Promoting personal protection

Medical diagnosis and treatment: are outside the scope of this paper, and should be undertaken by the competent authorities.

Chemical vector control measures: should be undertaken in a way, which ensures the staff, those affected by floods and the local environment, are all adequately protected. The use of chemicals should be done in a way that avoids creating resistance to that particular substance. The “toxicity grade” of the chemicals being used should be verified prior to use, and the use of DDT should be avoided. All staff
involved in spraying must be given adequate personal protection. Refer to Wisner et al, 2003). Possible application methods include:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Application method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dusting</td>
<td>Hand-held dusters manually operated or mechanised.</td>
</tr>
<tr>
<td>Residual Insecticide Spraying</td>
<td>Knapsack sprayers with special nozzles.</td>
</tr>
<tr>
<td>Ultra-low volume spraying</td>
<td>Low-dosage applications to large areas from fixed-wing aircraft or helicopters.</td>
</tr>
<tr>
<td>Space spraying</td>
<td>Interior or exterior applications with pesticide aerosols dispersed under pressure from vaporizers.</td>
</tr>
<tr>
<td>Impregnation</td>
<td>The treatment of materials such as bedding, clothing and mosquito nets with pesticides in emulsion or solution (by dipping and drying, or by spraying with knapsack sprayers).</td>
</tr>
</tbody>
</table>

Table 4: Pesticide application methods and equipment (Wisner et al, 2003)

Where possible, the vector control activities should be coordinated with the local authorities and the relevant public health body.

Environmental sanitation measures: draining standing bodies of water, removing vector breeding sites (such as piles of rubbish, old tyres, water jars, bamboo poles, etc.), protecting water storage containers, setting traps (rats & flies) etc.

Personnel protection measures: includes distribution of insect/mosquito repellent, promoting use of long sleeves & trousers, fitting houses/shelters with mosquito/fly netting on windows & doors, distribution of insecticide treated bed nets (ITNs), wearing rubber boots etc.

In an urban context, a combination of good environmental sanitation (good drainage and waste management), residual insecticide spraying, distributing insecticide treated bed nets (ITNs) and insect repellent are amongst the most effective ways of controlling vector problems in public shelters.

3. Waste Management in Urban Flood Settings

When large numbers of people have sought refuge in public shelters, waste management will quickly become a major issue. The first priority is to analyze the emergency context and the nature of waste being generated. Following this, a system of managing the waste, in a safe and environmentally friendly manner, should be put into place. A decision must be taken as to whether the waste will be dealt with on-site (burial), or whether it is necessary to transfer the waste to a remote disposal site. The key steps in waste management are:

- Collection, containment & storage
- Waste transfer
- Final waste disposal

For waste disposal on-site (burial in communal pits), waste transfer will not be necessary. If disposal is off-site, a means of collection, transportation and a final disposal site must be identified. The municipal and other relevant authorities should be consulted. The agency in charge may have to provide the vehicles and manpower to operate the service. Sphere guidelines should be kept in mind for the operation of waste management services (see Table 5).

Table 5: Key Waste Management Indicators (SPHERE, 2004)

Sphere: Key indicators

- People from the affected population are involved in the design and implementation of the solid waste programme.
- Household waste is put in containers daily for regular collection, burnt or buried in a specified refuse pit.
- All households have access to a refuse container and/or are no more than 100 meters from a communal refuse pit.
- At least one 100-litre container is available per 10 families where domestic refuse is not buried on site.
- Refuse is removed from the settlement before it becomes a nuisance or a health risk.
All personnel working in the collection and handling of waste should be provided with protective clothing and given training. The communities themselves should be consulted about the location of communal waste collection points and how they will be managed.

Waste Reduction

It may be possible to reduce waste and to identify opportunities for re-use and recycling by raising awareness and influencing the behaviour of those living in public shelters. Beneficiaries should be engaged and take a lead in the process. Messages need to be developed so that people are aware of how they can reduce waste generation, and be involved in recycling. Opportunities for creating livelihood activities through recycling should be identified.

Refer to the ‘Hygiene Promotion in Flood Settings’ briefing (Sow, 2009).

4. Drainage in an Urban Flood Setting

Surface water in or near public shelters will invariably be contaminated by wastewater from septic tanks, toilets and/or latrines. The main health risks are contamination of water supplies; damage to dwellings; vector breeding; and drowning. People should live in an environment where health and other risks are minimised.

To reduce potential health risks to the population, it will be necessary to unblock existing drainage to help drain the site. People should have an environment in which health risks (and other risks) posed by water erosion and standing water, including storm water, floodwater, domestic wastewater and wastewater from medical facilities, are minimised. Communities can be mobilised to clear drainage channels and to repair small breaches in flood defences using a “Cash-for-Work” (CFW) approach.

5. Post-flood Clean ups

A number of post flood problems will need to be solved by collective action between the affected communities and the local authorities. Typical problems include:

- Blocked urban drainage systems, which prevent the evacuation of flood waters and pose a risk in the event of new rainfall events.
- The accumulation of mud and flood related debris in the streets, which block access and prevent effective clean-up activities.
- Flooded homes containing silt and flood related debris, which may have been contaminated with biological matter.
- Household possessions (mattresses, fridges and household appliances, etc.), which have been damaged or destroyed, and require collection & safe disposal.

Direct contact with floodwater in itself may not pose a serious health risk, but there may be some risks of disease if floodwater contaminated food items are consumed. People may become infected with diseases such as leptospirosis if cuts, sores or wounds come directly into contact with floodwater, and it may also cause skin diseases. During the emergency period, it is critical to encourage people not to spend too much time in floodwater and to practice basic hygiene. Hand washing with soap and clean water is one of the most effective ways of protecting against disease. Children should be prevented from playing in floodwater and their toys and possessions should be disinfected. Effective hygiene promotion messages will need to be developed. Refer to the ‘Hygiene Promotion in Flood Settings’ briefing (Sow, 2009).

Mass Clean up Campaigns

In urban floods, flood-related debris such as sediment, silt, and organic material will have affected drainage channels, public roads, public thoroughfares and houses. In some instances, cars, lorries and industrial equipment will be transported and deposited by the floods. In
such circumstances, it will be necessary to organise a mass clean up campaign, not only to assist with draining floodwaters, but also to open up access and to assist the community to return home. The use of “Cash-for-Work (CFW)” campaigns, in conjunction with local authority rehabilitation plans, offers an effective mechanism for collective action.

An initial assessment will assist in highlighting the volume of waste to be dealt with, options for removal, transport needs, possible temporary storage needs, pre-treatment requirements and final disposal options.

Community Mobilisation

Communities can be alerted by loudspeaker vehicles passing through the target areas, prior to Cash-for-Work (CFW) teams going into an area. In the event of vulnerable groups being identified (elderly, disabled and women headed households), CFW teams can be instructed to assist such people by removing flood debris directly from their properties. Permission to undertake such measures must be obtained from the beneficiaries prior to the physical removal happening.

Community based activities are best coordinated by area coordinators, trained in the waste management process and with knowledge of the areas to be cleaned. CFW teams will in general be selected from the target communities, based on specific criteria. Typically, one supervisor may coordinate around 10 – 15 people. CFW teams should be rotated on a periodic basis to provide an opportunity for a number of different people to participate in the scheme. Typically, CFW teams may be employed for a maximum of two weeks in one area, then standing down to give others an opportunity to continue the work.

The provision of tools, such as picks, shovels and wheelbarrows will be essential, and it may be necessary to organise trucks and mechanical diggers to evacuate the debris, depending on the volume that has been deposited. Protective clothing such as boots, overalls and gloves should be provided to all those involved in mass clean up campaigns. For further information on community mobilisation, refer to the ‘Hygiene Promotion in Flood Settings’ briefing (Sow, 2009).

Re-entering a flooded home

Flooded homes may have been contaminated with sewerage or other biological matter, and if the house has been closed for several days, there may be a risk of mould. In both cases, ensure doors and windows are fully open when entering the house for the first time. Open doors and windows at least 30 minutes before starting cleaning activities, and stop Floodwater outside the house from re-entering. Good practice includes:

- Wearing rubber boots, gloves & goggles
- Wearing face masks to avoid inhaling fungal spores
- Cleaning all hard surfaces with clean water and a disinfectant
- Washing hands with soap & clean water after the clean up activities.
- Disinfecting cuts and wounds coming into contact with floodwater. Seek medical help if people become ill.
- Washing and disinfecting clothes worn for clean up campaigns. Clothes salvaged from the flooded home should also be washed and disinfected.
- Items such as mattresses, cushions and other such items that cannot be cleaned should be disposed of.
- Ensuring the house is fully dried before resettling

Cleaning up after Floods

Houses that have been filled with flood related debris, such as sediment and silt, may need to be cleaned by organising mass clean up campaigns. The use of a “Cash-for-Work”, approach is an appropriate way of mobilising the affected communities. Tools, such as picks, shovels and wheelbarrows will be essential. It may be necessary to organise trucks and mechanical diggers to evacuate the debris, depending on the volume deposited. Protective clothing such as rubber boots, overalls and
gloves should be provided to all those involved in clean up campaigns.

Cleaning and disinfecting with bleach: An unscented proprietary liquid bleach (Sodium Hypochlorite), between 4 – 6 % should be used. The safety instructions on the container must be carefully read and closely followed. rubber boots, gloves and goggles should be used to handle the solution and it should never be used in a closed space.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Application method</th>
</tr>
</thead>
</table>
| Cleaning water storage containers | - Mix soap and clean water in container  
- Shake to clean inside of container  
- Rinse container  
- Mix 20ml bleach per litre water and pour into container  
- Shake the container so solution touches all surfaces  
- Cover and leave for 30 minutes  
Rinse with clean water |
| Food contact surfaces          | - Wash with soap and clean water  
- Rinse with clean water  
- Mix 5ml bleach per litre water and clean the surface  
- Allow to air dry |
| Hard surfaces and other household items | - Wash with soap and clean water  
- Mix 5ml bleach per litre water and clean the surface  
- Allow to air dry |
| Cleaning mould growth         | - Mix 50ml bleach per litre water and clean/wash the item/surface with the solution  
- Scrub rough surfaces with a brush  
- Rinse with clean water  
- Dry the item/surface or leave it to air dry |

Table 6: Cleaning & sanitising with bleach after an emergency (CDC, 2008)

6. Disposal of Dead Bodies in Urban Flood Settings

Health risks

There is a widespread belief that corpses pose a risk of communicable diseases after a flood. Such beliefs are frequently mistaken, especially if death has been caused by trauma or drowning. Dead bodies are unlikely to cause outbreaks of diseases such as typhoid fever, cholera or plague, though there may be a risk of water sources becoming contaminated.

Recovering Dead Bodies

In the event of human deaths in an urban flood, the local authorities will undoubtedly be responsible for recovering dead bodies.

Further information

CDC (2008). Re-entering your flooded home (Emergency Preparedness & Response)  
www.bt.cdc.gov/disasters/mold/reenter.asp

CDC (2008). Cleaning & sanitizing with bleach after an emergency (Emergency Preparedness & Response)  
www.bt.cdc.gov/disasters/bleach.asp

CDC (2008). After a hurricane or flood: cleanup of flood water (Emergency Preparedness & Response)  
www.bt.cdc.gov/disasters/floods/cleanupwater.asp

www.who.int/water_sanitation_health/hygiene/emergencies/deadbodies.pdf

Forster T (2009)

Harvey P (2007) Excreta Disposal in Emergencies, a field manual – An Inter-agency publication, WEDC, Loughborough University, UK.

Further information cont.

OxFAM TBN 7 (2009) - UD Toilets and Composting Toilets in Emergency Settings  
www.oxfam.org.uk/resources/learning/humanitarian/tbn_drafts.html#eco

Oxfam TBN 8 – Low cost drainage for emergencies  


OXFAM TBN 16 (2008) – Composting of Organic Materials and Recycling  

OXFAM TBN 17 (2008) – Large Scale Environmental Clean up Campaigns  

Parry-Jones, Sarah (1999) WELL FACTSHEET: On-site sanitation in areas with a high groundwater table  
Author: Reviewed and Updated: Rebecca Scott, September 2005. WEDC, Loughborough University, UK.

Peepoople (2009) The Peepoo bag  
www.peepoople.com/

www.who.int/water_sanitation_health/hygiene/emergencies/solidwaste.pdf


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