



DRAINAGE

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During the monsoon, flooding in urban areas is becoming more frequent. At the same time, in the dry season, the quality of water in rivers and lakes is becoming worse every year. This is due mainly to the growth of urban areas and urban population, without commensurate development of the drainage system.

Drainage is a very important part of urban infrastructure. Considerable sanitation problems have arisen in recent years because municipal drainage systems have been badly designed, carelessly built and inadequately maintained. In fact, the main reason for drain blockage is the lack of management and maintenance. The longer this situation is allowed to continue, the more serious the problems will become, and the more costly they will be to rectify.

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THE PROBLEMS

Inadequate main drainage channels

- Flooding in urban areas is caused by rivers overflowing their banks, coupled with the inadequacy of main drainage channels.
- Bad agricultural practices and deforestation reduce protective ground cover, increasing runoff and erosion.
- Increased runoff, in turn, results in siltation and erratic flow in rivers, thereby adding to the likelihood of downstream flooding.
- Stationary boats, used as living quarters, can also add to the siltation of rivers and canals.

Inadequate local drainage

- Most municipalities have drainage problems because the local drainage system does not have enough pipes and drains; or because these are not big enough.
- Drainage capacity is often reduced by houses and roads being built over natural drainage channels, without the installation of alternative channels.
- The inadequacy of local drainage capacity results in flooding in the rainy season, and in the formation of stagnant pools in dry weather.



Drain blockage

- The lack of management and maintenance is one of the major reasons for drain blockage.
- Urban drainage channels are not dredged frequently enough to clear them of blockage.
- Large drains and canals are often blocked by water hyacinth, and other water plants, when the water receives too much nutrients from agricultural runoff and urban wastewater.
- Plastic and other floating refuse can cause clogging, and present major problem at pumping stations.
- Combined sewers and storm water drains accumulate sludge very quickly if they do not have self-cleansing, smooth surface.
- Uncovered roadside channels quickly fill up with grit, fallen leaves and twigs, and blown refuse.
- These problems are often exacerbated by unevenly laid pipes.

Effects of urban development

- All forms of urban construction (buildings, roads, car parks, etc) seal the ground against rainwater absorption, increasing the volume of surface runoff during storms.
- Unfortunately, the growth of towns is often accompanied by a reduction rather than an increase in drainage capacity.
- The connection of new developments to existing drainage leads easily to the overloading of main drainage channels.

- Bridges and other structures over rivers and canals can sometimes obstruct the flow of storm water.
- Houses and other buildings encroaching on canals and other drainage channels obstruct the flow of the water.

Lack of planning

- The overloading of main drains by ongoing urban development is partly due to the lack of a coherent municipal drainage plan.
- Surface waters become polluted because wastewater is not separated from storm water and/or ornamental waters.



TAKING ACTION

GENERAL GUIDANCE

Urban drainage fulfils two functions: to remove sewage and sullage, and to take away storm water. An efficient drainage system is particularly crucial during the monsoon season, when flooding can bring urban activities to a halt, damaging property and the economy.

The legal means exist for municipalities to take strong action to combat these problems. At the same time, the national government is providing more resources and encouragement for municipalities to take action. In this respect, the Regional Cities Development Programme, financed by the Department of Local Administration through its Office of Urban Development, is showing the way. All municipalities should follow this Programme to improve their drainage provision.

- Establish rules and regulations for the prevention of drainage problems.
- Cooperate with neighbouring local authorities and the Province; and consult with relevant national government agencies.
- The Municipal Public Works Division should review the current state of drainage throughout the Municipality.
- The Municipal Public Works Division should develop a municipal sanitation strategy, to include an interceptor system that will protect ornamental waters from being contaminated by sewage.
- If it is not possible to implement the sanitation strategy all at once, it can be carried out in stages.



- Develop an overall plan for a drainage system to cover all the existing areas in the Municipality, as well as planned future developments. The plan should indicate the direction of natural drainage, and the levels and sizes of drainage pipes.
- Ensure that the drainage plan is compatible with the municipal development plan and land use plans.
- Drainage improvement programmes should also be worked out for low-income and informal housing areas. Community groups should be involved in implementing local projects.
- Public environmental education campaigns concerned with sanitation should include the subject of stopping waste dumping in drainage channels.
- Allocate sufficient resource to ensure that the drainage system will be developed.

WHAT TO DO

Rivers and Main Drainage Channels

Is flooding a serious problem in the Municipality?

- The Municipal Public Works Division should review the causes of flooding. If necessary, ask for help from the Harbour Department.

Is flooding becoming more frequent and/or more widespread?

- Establish a formal system of flood records. These records should refer to rainfall, river flows, contours and the existing drainage system, so that problem areas may be identified.

Is the increasing frequency and severity of flooding caused partly by siltation of rivers and erratic river flow?

- The Municipal Public Works Division should cooperate with the provincial authority and other relevant government departments to find the sources of siltation and erratic flow.
- If siltation is caused by mining, deforestation or bad agricultural practices in upstream areas, the Municipality should approach those responsible for these activities with a view to improving their practices; or, if these activities take place in a neighbouring municipality, ask that municipality for cooperation in overcoming the problem.





Is local siltation caused by activities along river banks, such as permanently moored boats?

- The Municipal Public Works Division should investigate local causes of siltation. If necessary, promulgate local regulations to control these activities.

Is the existing surface drainage inadequate for flood control and wastewater removal?

- It is difficult to accommodate both the relatively small but steady flow of domestic wastewater and the erratic flow of storm water in the same drains. The municipal drainage strategy should therefore try to separate sewerage from storm water drainage.

Local Drainage

Is there frequent local flooding in new developments?

- In issuing licences for new building developments and inspecting the completed schemes, the officers in charge must ensure that there is adequate local sewerage and drainage.

Has any of the natural drainage in the Municipality been cut off by roads or buildings, resulting in periodic flooding?

- The drainage strategy and plan produced by the Municipal Public Works Division should show the direction and location of natural drainage channels throughout the Municipality and surrounding areas.
- The Municipal Public Works Division should ensure that no roads or other structures are built without redirecting existing drainage flows to new drains.

Are there places in the Municipality where stagnant water stands around for a long time after rains?

- The drainage strategy should include the prevention of stagnant water by constructing adequate drainage in areas which are cut off from natural water flows.
- The Municipality should initiate an active campaign involving the community in clearing stagnant water. This should be part of the public health campaigns designed to eradicate malaria and dengue (see *Environmental Health*).

Are local drains deteriorating rapidly?

- The officers in charge of issuing building licences should ensure that the materials and design of drains, proposed by developers for new developments, are of high quality and reasonably maintenance-free.
- The Municipality must, however, allocate sufficient resources to ensure that drainage channels are maintained in good condition.

Drain Blockage

Are roadside drains often blocked and foul smelling?

- Roadside drains should be covered and built with self-flushing, smooth-surfaced material. Although this would mean higher initial cost, it would reduce maintenance costs substantially.
- Ensure that drains are regularly cleared. Drain-clearing programmes must involve local communities so as to obtain their commitment to stop dumping in drains.

Is solid waste a major cause of the blockage of main drains, the fouling of canals and/or the clogging of drainage pumps and other machinery?

- The Municipality should clear drainage channels of floating garbage, but this should not be the main measure.
- More importantly, the Municipal Solid Waste Management Service should seek out the sources of solid waste in the drainage system, and find ways to eliminate it at source. These might include:

- improving the waste management system (see *Solid Waste Management*) and the clearing of litter from the streets;
- running community campaigns to improve community responsibility in reducing littering and dumping;
- imposing fines on businesses or people dumping their rubbish in the open.

Do open drains and canals fill up with foul-smelling sludge?

- Separating sewerage from main drainage and installing self-cleansing, smooth-surfaced sewers will eliminate foul smells and reduce the need for dredging.

Is the clogging of rivers, canals and drains partly due to the rapid growth of water hyacinth and other water plants?

- The growth of water plants, and consequently the build-up of sludge, is accelerated by increased nutrients in the water. Part of the solution is to separate sewerage from storm water drainage.
- Meanwhile, water plants in waterways must be regularly removed. As long as the water has not been polluted by heavy metals, the removed plants can be composted and sold as fertiliser.



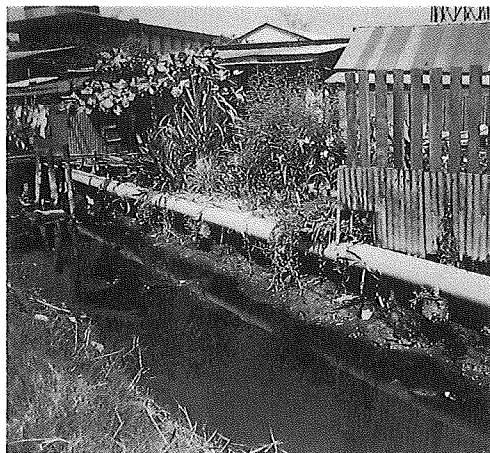
Effects of Urban Development

Do drainage channels overflow following sudden storms? Is this becoming more frequent?

- The land along river flood plains should be reserved to act as flood retention areas, where flood water can be held back. Such areas can facilitate ground water recharge. Building should be prohibited in these areas. This is partly a question of land management (see *Land Use Planning*).
- Flood retention areas can also serve as public parks (see *City Greening*).

Is the connection of new housing, commercial or other developments to the main drainage system resulting in local flooding?

- The main drainage system must be designed and built to cater not only for present peak storm water flows, but also to take account of future flows resulting from expected developments.



- In developing a flood control strategy, the Municipal Public Works Division must have a good understanding of the way in which the Municipality and surrounding areas are growing. This means that the Public Works Division must coordinate with the municipal staff responsible for land use planning (see *Land Use Planning*).

Can local flooding be attributed to restriction of flow in rivers or canals by bridges or other structures?

- It is essential that the provision of urban infrastructure be properly coordinated locally, and not just left to the provincial authorities and national government agencies to design and build. The Municipal Public Works Division must play a very active role in this matter.

Is flooding exacerbated by encroachment of houses and other structures on canals and other drainage channels?

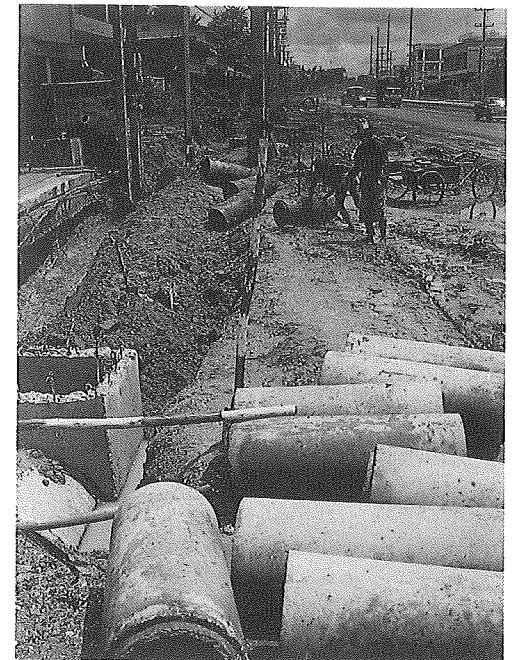
- For main drainage (and any urban infrastructure) to function properly, it is essential that it is not encroached upon. The licensing and control of building must be used to ensure that drainage channels are free from encroachment.
- If canal banks and drainage channels are encroached upon by squatter settlements, the Municipality should recognise the needs of the squatters and find alternative sites for them (see *Slum Improvement*).
- The Municipality must inform the public of the importance of the flood control system and its maintenance.

LEGAL GUIDANCE

- Under the **Drinking Water Conservation Act 2526 (1983)**, no sewage or drainage may be discharged into places or watercourses used for supplying drinking water. Violators of this Law may be imprisoned for up to one month and fined up to 2,000 baht.
- Under the **Royal Irrigation Act 2485 (1942), Section 28**, anyone who discharges wastewater and pollutes water sources, or discharges chemicals into irrigation canals, thereby causing damage to agriculture, water quality or human health, may be imprisoned for up to two years and fined up to 100,000 baht.

The same Law, **Section 37**, prohibits the discharge of wastewater into wells in protected areas, except where a licence has been granted by the Director-General of the Department of Natural Resources, subject to compliance with criteria set in the Notification of the Minister of Industry, Volume 5, dated 30 May 1978.

- Discharge of turbid wastewater from mining operations is prohibited. Mine owners/operators are required to take preventive measures to ensure that public watercourses are not silted up, or reduced in their use as waterways.
- The **Building Control Act 2522 (1979)** empowers the Minister of the Interior to issue Ministerial Regulations on drainage, in consultation with the Building Control Committee. Municipalities are required to promulgate detailed municipal regulations relating to drainage in compliance with these Ministerial Regulations. If, owing to special circumstances, a municipality cannot comply with the Ministerial Regulations, municipal regulations con-



trary to the Ministerial Regulations may be issued subject to approval by the Building Control Committee and authorisation from the Minister of the Interior.

Under the same Law, Volume 33, dated 2535 (1992), storm water from large buildings may be drained directly into open waters, provided that it will not cause any harm to human health or to property, nor affect the environment. However, wastewater must be treated to standards set by the National Environmental Board before discharging into open waters.



USEFUL EXAMPLES

Integrating flood control with wastewater treatment

The Makkasan Pond in the north of Bangkok, 2 kilometres long and 15 metres deep, was dug in 1931, by the Railway Authority of Thailand, to receive the wastewater from its engine assembly and maintenance workshops. Within a very short time, it became stagnant and polluted for lack of maintenance. Subsequently, the land surrounding it was occupied by more than 100 households, and its environment deteriorated further.

Following the concern of His Majesty the King, a programme for the rehabilitation of this pond was initiated. The heavily polluted pond was dredged and the floating grease was removed. An investigation was launched into the possibility of using water plants to cleanse the water of heavy metals and organic waste. The investigation revealed that water hyacinth can do this very efficiently. The pond was then planted with water hyacinth, morning glory and watercress.



The rehabilitation of the pond has greatly improved the water quality of the Samsen Canal, to which it is connected. The pond is now used for treating domestic wastewater from households in the surrounding area; it also acts as a storm water retention basin to prevent flooding. Currently, the pond is managed by the Bangkok Metropolitan Authority.

Realising the role played by the pond in flood prevention, the Cabinet passed a Resolution, on 29 August 1989, that all public ponds, swamps and reservoirs under the Bangkok Metropolitan Authority should be kept for flood prevention purposes. Any construction activity likely to decrease the water-holding capacity of these areas must provide equivalent capacity somewhere else.

Contact:

Department of Public Cleansing
Bangkok Metropolitan Authority
City Hall 2
Mitmaitri Road
Dindaeng, Huaykwang
Bangkok 10400
Tel (02) 246-0034/6



Managing wastewater and drainage at Patong Beach

Assigned by the Ministry of the Interior, the Department of Civil Engineering has constructed a drainage and wastewater treatment system to collect and treat wastewater in Patong Beach, Phuket. The system started in 1990 with a treatment capacity of 2,500 cubic metres per day. In 1993, it was enlarged to treat an average of 4,500 cubic metres per day.

In order to collect wastewater from an area of around 450 rai into the treatment plant, a network of pipes was constructed, separate from storm water drainage. Unfortunately, owing to a lack of communication and appropriate instructions on how to connect residential wastewater pipes to the network correctly, household wastewater drains were connected to the storm water drainage, which

drains directly into the sea at Patong Beach. Consequently, the water along the beach has become polluted and is no longer safe for swimming.

The Patong Beach Sanitation Office is currently trying to overcome the problem by improving the information given out to the public on how to carry out appropriate connection, and how to rectify a wrong connection. Meanwhile, an improved storm water drainage interceptor is being constructed along the beach front.

Contact:

Patong Beach Sanitation Office
Kratoo District
Phuket
Tel (076) 321-266, 321-321



WHERE TO FIND HELP

GOVERNMENT INSTITUTIONS

Department of Public Works Ministry of the Interior

This Department provides technical assistance in the design and construction of drainage systems.

Department of Public Works
218/1 Rama VI Road
Samsen Nai, Phayathai
Bangkok 10400

Tel (02) 273-0860/78
Fax (02) 273-0879

Office of Urban Development

Department of Local Administration, Ministry of the Interior

This Office coordinates urban development, provides technical support to local organisations, and appraises applications for special funding for projects implementing government policies on urban development.

Office of Urban Development
Wang Sunantha
Rachasima Road
Dusit
Bangkok 10300

Tel (02) 243-2282, 243-2226
Fax (02) 243-1812

Harbour Department

Ministry of Transport and Communications

This Department is responsible for the maintenance of rivers and the control of construction works in harbour areas.

Harbour Department
Yotha Road
Bangrak
Bangkok 10500

Tel (02) 233-5087, 233-9167
233-131

EDUCATIONAL AND RESEARCH INSTITUTIONS

The following institutions can give technical assistance in the design and construction of wastewater treatment and drainage systems. Apart from these, there are also regional research institutions and universities which can advise on drainage systems. Enquiries should be addressed to their Faculty of Engineering or Faculty of Health Sciences.

Chulalongkorn University
Institute of Environmental Research
Phyathai Road
Patumwan
Bangkok 10500

Tel (02) 251-4426/7
Fax (02) 252-5929

Mahidol University
Department of Sanitary Engineering
Faculty of Public Health
Rajvithi Road
Phyathai
Bangkok 10400

Tel (02) 245-9509
Fax (02) 245-9509

Thailand Institute of Scientific and Technological Research
Environmental and Resources Management Department
196 Phaholyothin Road
Bangkhen
Bangkok 10900

Tel (02) 579-1121/30
Fax (02) 579-4940

Thai Environmental Engineering Association
Faculty of Engineering Sciences
Chulalongkorn University
Phyathai Road
Patumwan
Bangkok 10500

Tel (02) 218-6669
Fax (02) 252-7510

There are various consultancies which can provide technical services related to wastewater treatment systems and drainage. The Department of Pollution Control (Tel (02) 245-3122, 245-3127, 245-3143) has a list of registered consultancies.





Urban Environmental Guidelines Project

Local Government Development Division
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