

FLOOD MANAGEMENT IN SINGAPORE

FLOODS – NOW AND THEN

Singapore is no stranger to floods, with our abundant rainfall and relatively low-lying land. Back in the 60s and 70s, floods — some as high as waist-level — affecting large areas were common when heavy rains came.

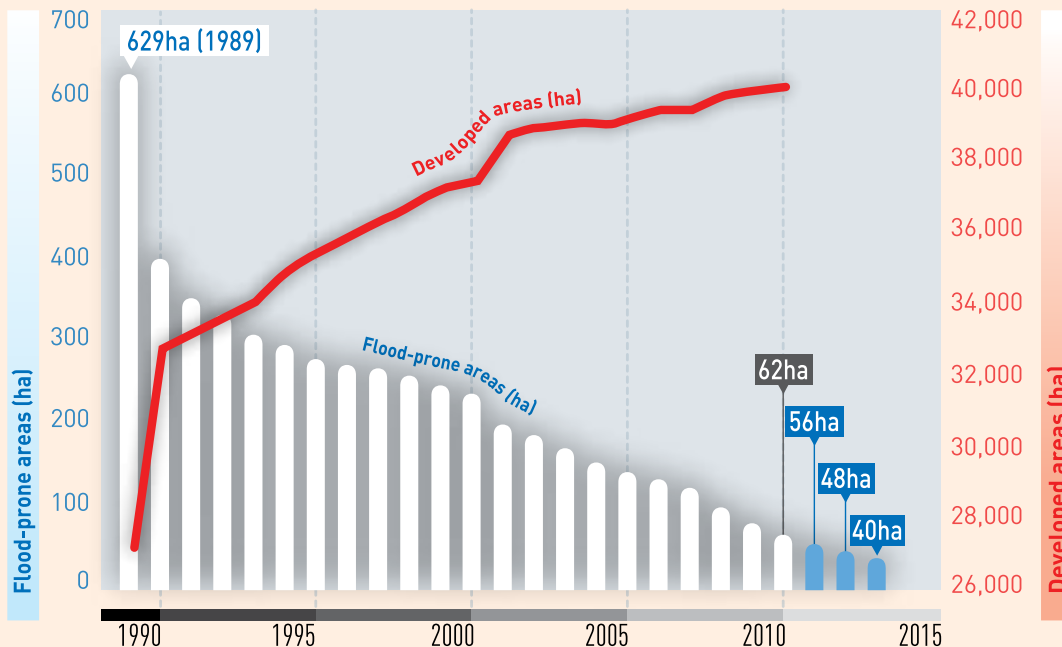
Today, the situation has improved greatly. Flood-prone areas in Singapore have reduced significantly by 98%, from 3,178 hectares in the 1970s to 62 hectares today, despite increased urbanisation which usually would have resulted in more floods. This is the result of careful planning and investments of some \$2 billion in the past 30 years toward building an extensive drainage system, about 7,000km long, and continuous improvement works.



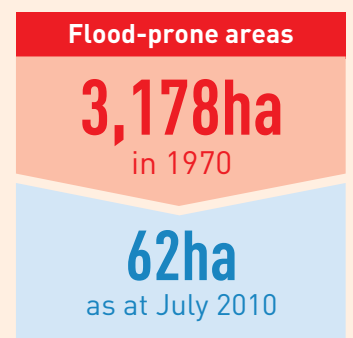
Drains and canals convey rainwater toward our reservoirs



Unlike the past (photos above), what we experience today are flash floods that are small and localised, and subside quickly



Despite the trend elsewhere of higher flooding incidence because of urbanisation, careful urban planning in Singapore has seen a reverse trend.



WHY DO FLOODS STILL HAPPEN?

Most times, our drains are able to cope with the rain that we receive. However, extremely heavy rainfall can sometimes exceed the capacity that the drains are designed for, especially in low-lying areas. That is when flash floods – small and localised floods that come and go relatively quickly – may occur.

HOW DO WE MANAGE FLOOD RISKS?

PUB manages flood risks in three ways:

1 Providing adequate drainage ahead of new developments

Planning is crucial. Prior to any new land development or before construction begins in any area, PUB works together with agencies such as URA, HDB, LTA and JTC to map out necessary drainage measures.

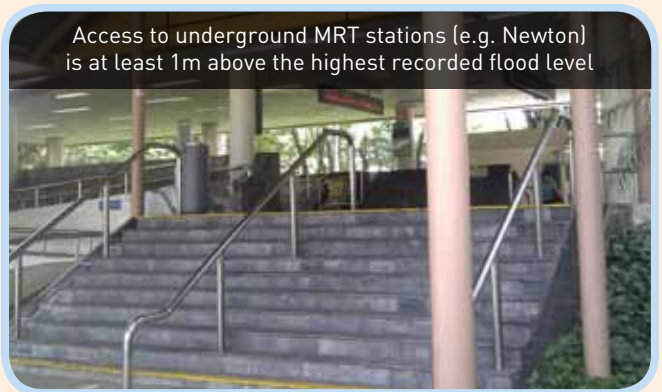
For example, to ensure that new roads are protected against flooding, PUB works closely with the relevant agencies to ensure that new roads are built to the required levels for flood protection in addition to ensuring that the drainage systems along these roads are adequate.

The necessary drainage is designed based on:

- rainfall intensity from past records
- size of the catchment area
- surface runoff

2 Adopting flood protection measures

It is not possible to prevent flooding entirely through the drainage system. To provide for additional flood protection, PUB has put in place a Code of Practice that stipulates drainage requirements. This includes minimum platform and crest levels for buildings and entrances to underground facilities (e.g. basement car parks, underground MRT stations, etc.). In the case of older buildings, PUB will provide advice on appropriate protection measures should these buildings be affected by flash floods.



Building owners can install measures such as flood gates to protect their premises against floods

3 Making continual drainage improvement


Continual drainage improvement works, which could include widening and deepening of drains and canals, are carried out to ensure the adequacy of the drainage system.



In low-lying areas, however, drainage improvement projects are effective only if the surrounding ground level is also raised. Such projects will be carried out when the area is redeveloped.

For existing older roads which are relatively low-lying and flood-prone, the road levels would be raised either in conjunction with drainage upgrading works or LTA's road upgrading works as part of PUB's plan to reduce flood-prone areas wherever possible. One example is the raising of Orchard Road. Raising Orchard Road by an average of 30cm will give it an additional flood protection against storms like those experienced on 16 June 2010. When an area is earmarked for redevelopment, PUB will review the drainage system in that area and raise the building and road levels to increase flood protection.

PUB has scheduled works in most of the areas affected by the recent floods. These areas include Bukit Timah, Thomson, Syed Alwi, Rochor Canal, Bedok and Telok Kurau. For a list of the projects, please refer to:

 [www.pub.gov.sg/
managingflashfloods/reducingfloods/
Pages/ImprovementWorks.aspx](http://www.pub.gov.sg/managingflashfloods/reducingfloods/Pages/ImprovementWorks.aspx)

MARINA BARRAGE

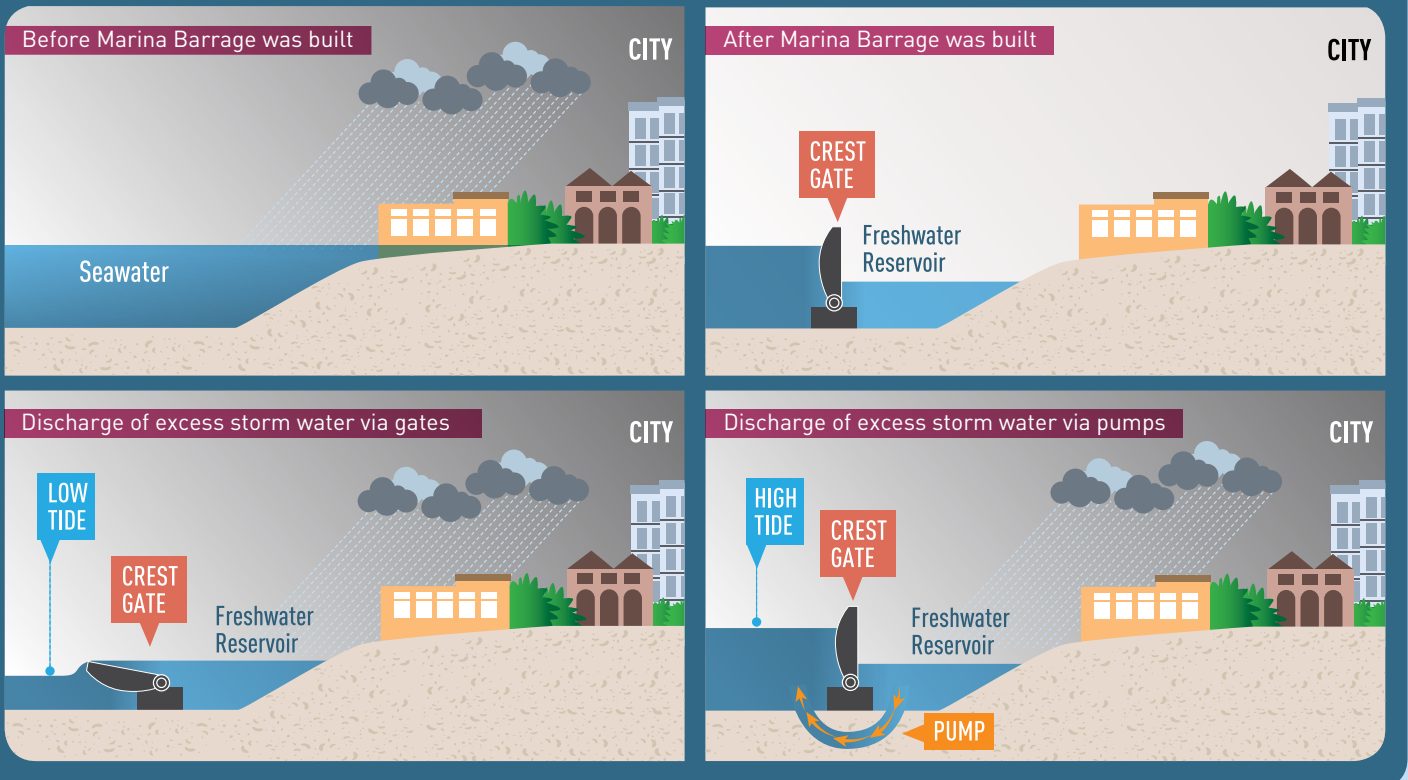
Marina Barrage helps reduce flood risks in low-lying areas of the city such as Chinatown, Jalan Besar, Geylang, Boat Quay and Little India as it removes tidal influence from the Marina Reservoir. During heavy storms, when the reservoir water level is higher than the sea level, up to nine gates can be opened to discharge water from the reservoir into the sea. If the sea level is higher, up to six pumps can be activated to discharge excess storm water.



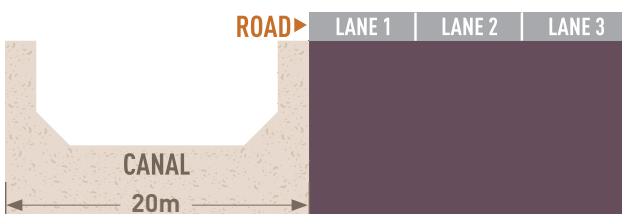
Marina Barrage helps in flood control by discharging excess storm water into the sea

Flood Control

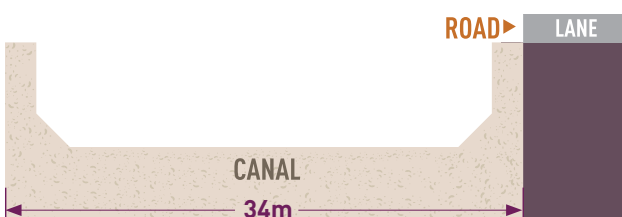
Keeps out seawater, acting as a tidal barrier to alleviate flooding in the low-lying areas in the city.



BEFORE



AFTER



A trade-off of widening the canal is a reduction in the number of road lanes

Can we solve the flood problem by widening and deepening drains?

While having larger drains helps, there is a limit to how wide drains can be as land is also needed for other uses such as housing and roads. There is also a limit to digging deeper drains as a minimum gradient is required for effective conveyance of storm water to the reservoirs.

Did poor maintenance contribute to flooding?

PUB has a stringent maintenance regime and works closely with its contractors to ensure that drains are checked and cleared regularly. Moving forward, PUB and its contractors will continue to do so to minimise blockage of drains.

Is flooding a result of climate change?

While June and July 2010 had heavier than normal rainfalls, it is too early to conclude that the recent intense rainfall events were a result of climate change. There is a large natural variability in our annual rainfall from year to year and long-term analysis of Singapore's historical rainfall patterns does not indicate any significant change. NEA will continue to monitor long-term rainfall trends. If necessary we will tighten the drainage design standards to allow us to cope with more intense rainfall.

DO YOUR PART

1 Keep our drains litter-free

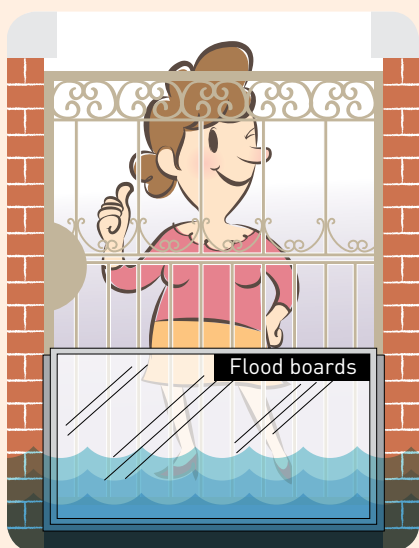
Help to keep our drains litter-free so that water can flow easily. Residents can report obstructions in drains at 1800-284-6600.



Keep our drains free from litter

2 If you live in a flood-prone area...

Flood boards and sandbags are useful in preventing rainwater from flowing into houses and buildings. These are mostly products available in the market.



Flood boards help prevent rainwater from flowing into houses

IN TIMES OF FLOOD...

- Move to higher ground and stay put until the flood subsides.
- Avoid open drains.
- If you are at home/office, turn off and avoid touching electrical equipment.
- Essential items should be moved to a higher level.



TO FIND OUT MORE...

Currently, there are 32 sensors (these will be increased to 90 by end of the year) in the canals that monitor the water level in key canals and drains. You can access the information at www.pub.gov.sg/managingflashfloods. Such information will also be available via an SMS alert subscription service to be rolled out by mid 2011.

Websites

- Find out more about managing flash floods and a list of drainage improvement works in the pipeline: PUB, the national water agency www.pub.gov.sg/managingflashfloods
- For weather information: National Environment Agency www.nea.gov.sg Weather@SG at weather.nea.gov.sg Twitter at twitter.com/nea_sg

Hotlines

- **6542-7788**
NEA's weather forecast hotline
- **1800-284-6600**
PUB's 24-hour Call Centre - to report obstructions in drains or check on the flood situation

Radio

- Tune in to radio broadcasts for heavy rain warnings