



*Workshop on Urban Water within a changing Globe  
Influence of Climate Change on Water Systems in Japan and Germany*

# *Strategic urban drainage management in Japan under climate change*

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# Outline of Presentation

## ■ Introduction

Increase in torrential rainfall events

Serious urban flood disasters in Japan

## ■ Recent Policy and Plan for Urban Flood Control

## ■ Development of Inundation Hazard Map

Importance of preparation of Inundation Hazard Map

Application procedure of runoff & inundation simulation

## ■ Summary and Future Task

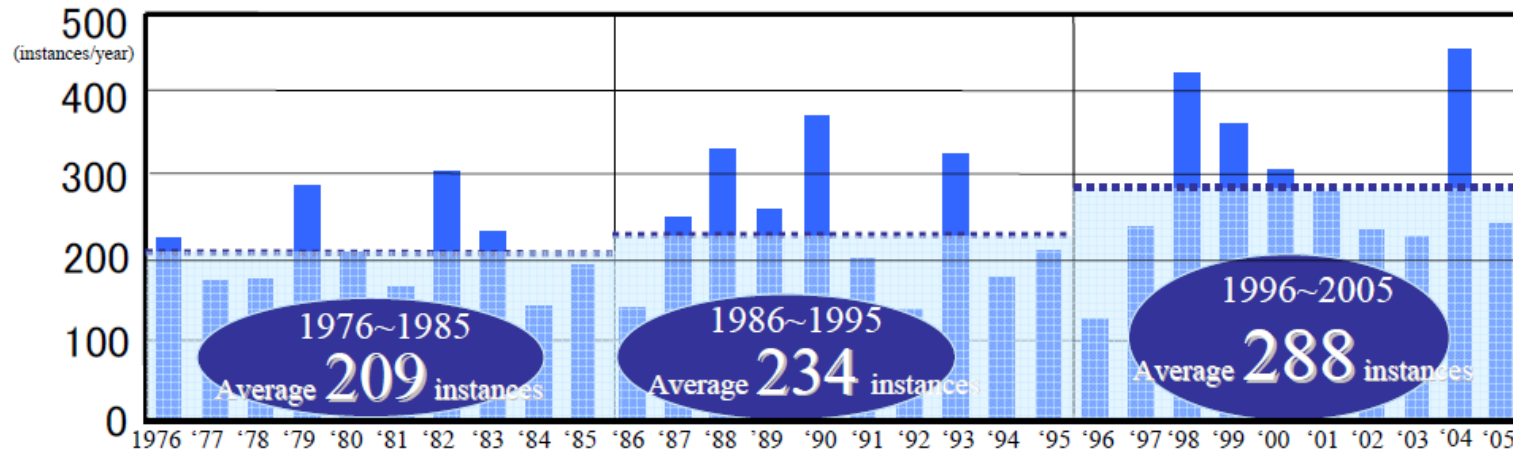


# Torrential rainfall events nationwide in Japan

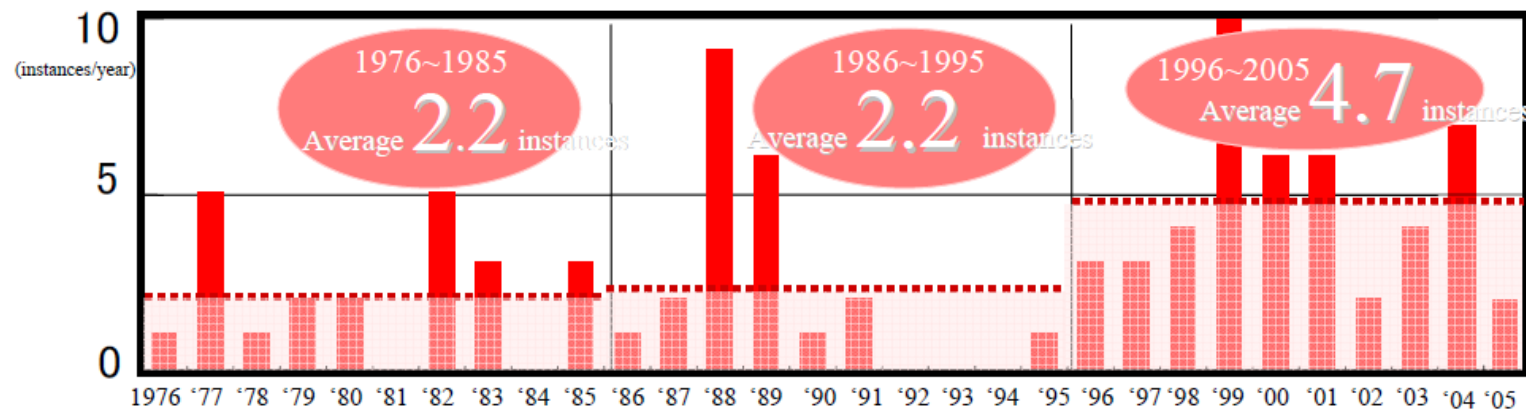
Data from Automated Meteorological Data Acquisition System (AMeDAS) at about 1300 stations

## 1. Number of instances of 50 mm or more rain in an hour

Annual total of hourly rainfall instances  
(from approx. 1,300 AMeDAS locations across Japan)



## 2. Number of instances of 100 mm or more rain in an hour



Data from the materials prepared by the Meteorological Agency

**There are several extraordinary urban floods.**



# Fukuoka Flood

June 29, 1999

12-hours rainfall height = 148 mm  
Max. hourly rainfall intensity = 79.5mm/hr



Radar information at 9:00AM



Levee Breach

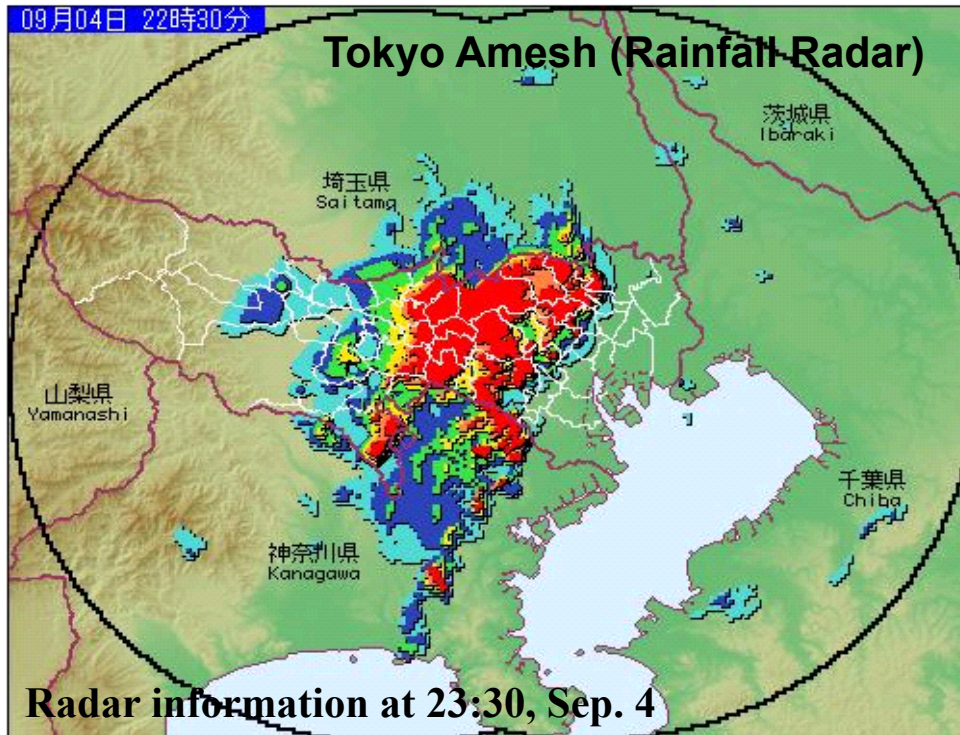
Inundated water into underground shopping mall and subway station





# Tokyo Flood

## Sep. 4, 2005



データを10分ごとに更新しています。最新のデータを表示するには、“更新ボタン”をクリックしてください。

- 7 weather observatories recorded 100mm/hr in Tokyo Ward area
- Flooding from urban rivers
- 5,000 houses with inundation damage



<http://www.mlit.go.jp/river/saigai/kiroku/suigai2005/kanto.html>



**Damage to river bank and overflow to inland In Nakano-Ward**

<http://www.city.tokyo-nakano.lg.jp/018/01/d00500009.html>



# Policy Change and Paradigm Shift for Urban Flood Control

- Since the frequency of torrential rainfall have recently become higher, it is difficult to control urban runoff without having any state of inundation in highly urbanized regions.
- The urban flood control have been designed based on the rational runoff formula and its return period was mainly Design value in Tokyo 50mm/hr set from 5 to 10 years for far.
- The new policy was presented in 2006, aiming for the minimization of inundation damage by accepting tolerable inundation without great damage to human activities.
- The manuals for implementation of comprehensive control program and for development of inundation hazard map were also released in 2007.



# New criteria for comprehensive flood management

New criteria were set at the 3 viewpoints.

## 1) Protection of human lives

Since underground space is really dangerous for human lives at inundation situation, it is essential to protect human lives in underground space from inundation.

## 2) Conservation of city functions

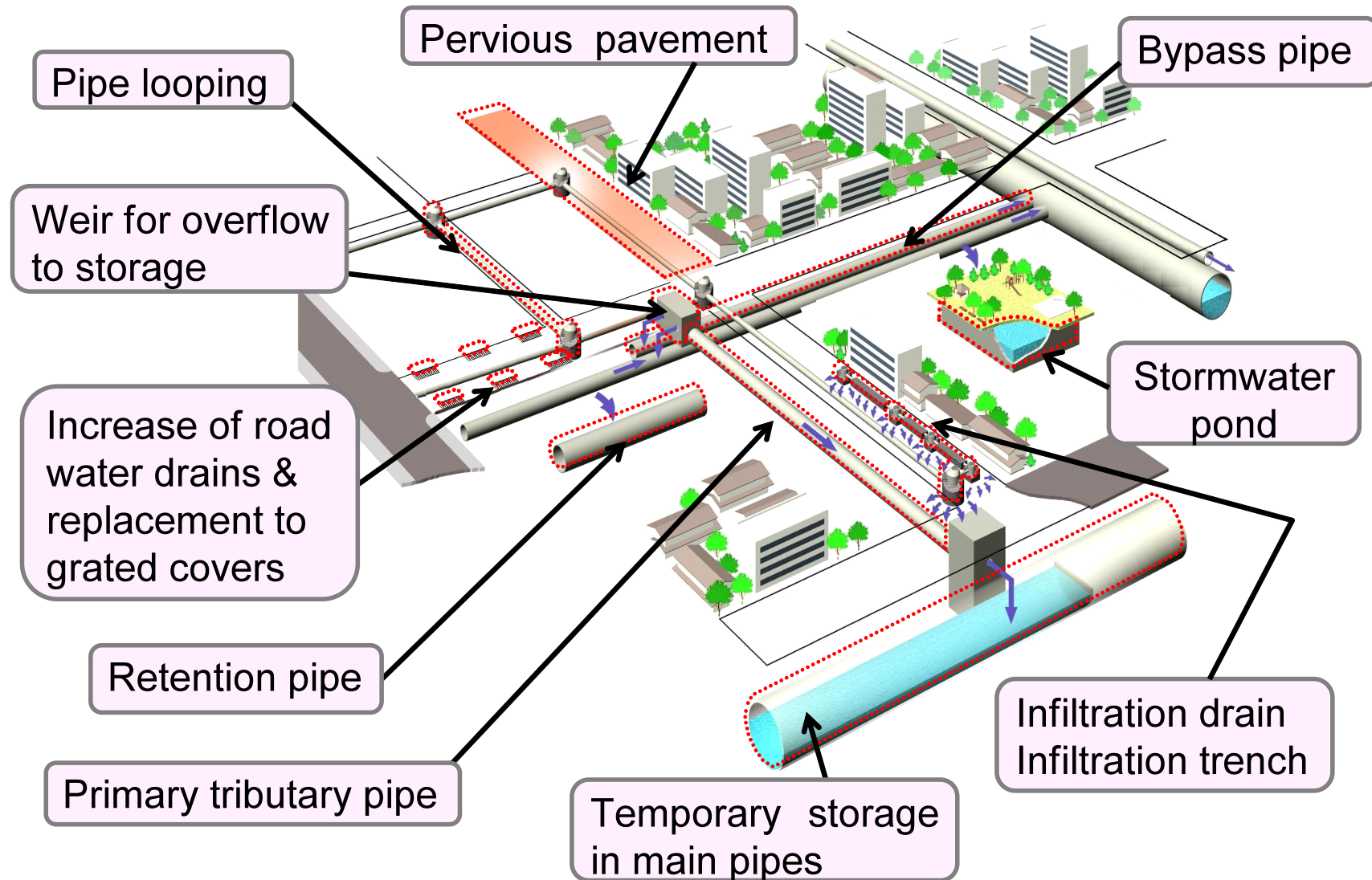
Flooding roads cause interference of car traffics. Therefore, less than 20 cm was selected as inundation depth without severe interference to traffic function.

## 3) Protection of private properties

Inundation depth of 50 cm is given as a tolerable level to damage to typical housing (floor level) in Japan.



# Examples of countermeasures for inundation control







# Stormwater storage pipes and water level monitoring system

The Wada-Yaoi trunk sewer



Interior diameter : 8.5 m  
Storage capacity: 150,000 m<sup>3</sup>  
Service area:  
573 ha area in the Kanda River Basin  
including a highly flood-prone area.

Water level monitoring



Water level display panel

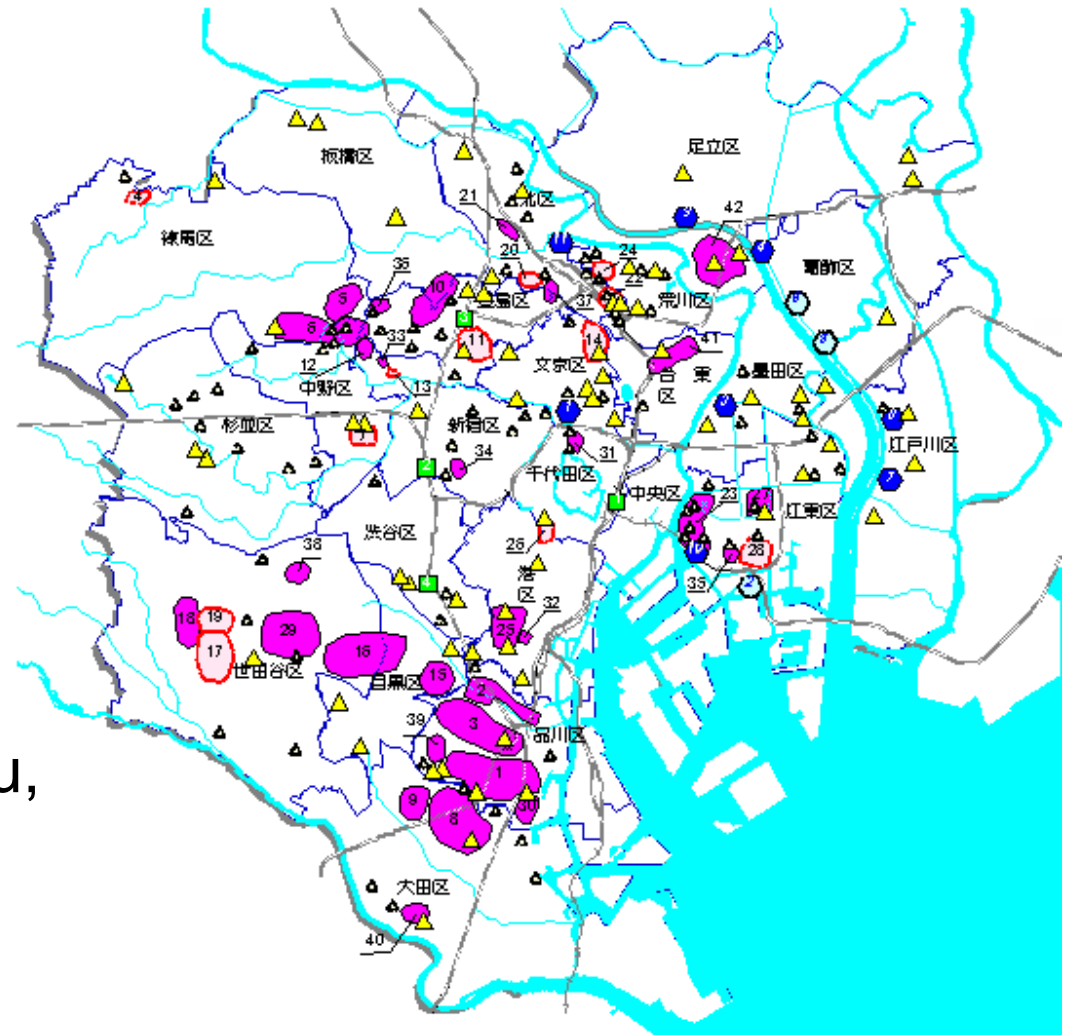




# Map of New Quick Plan for Stormwater Control

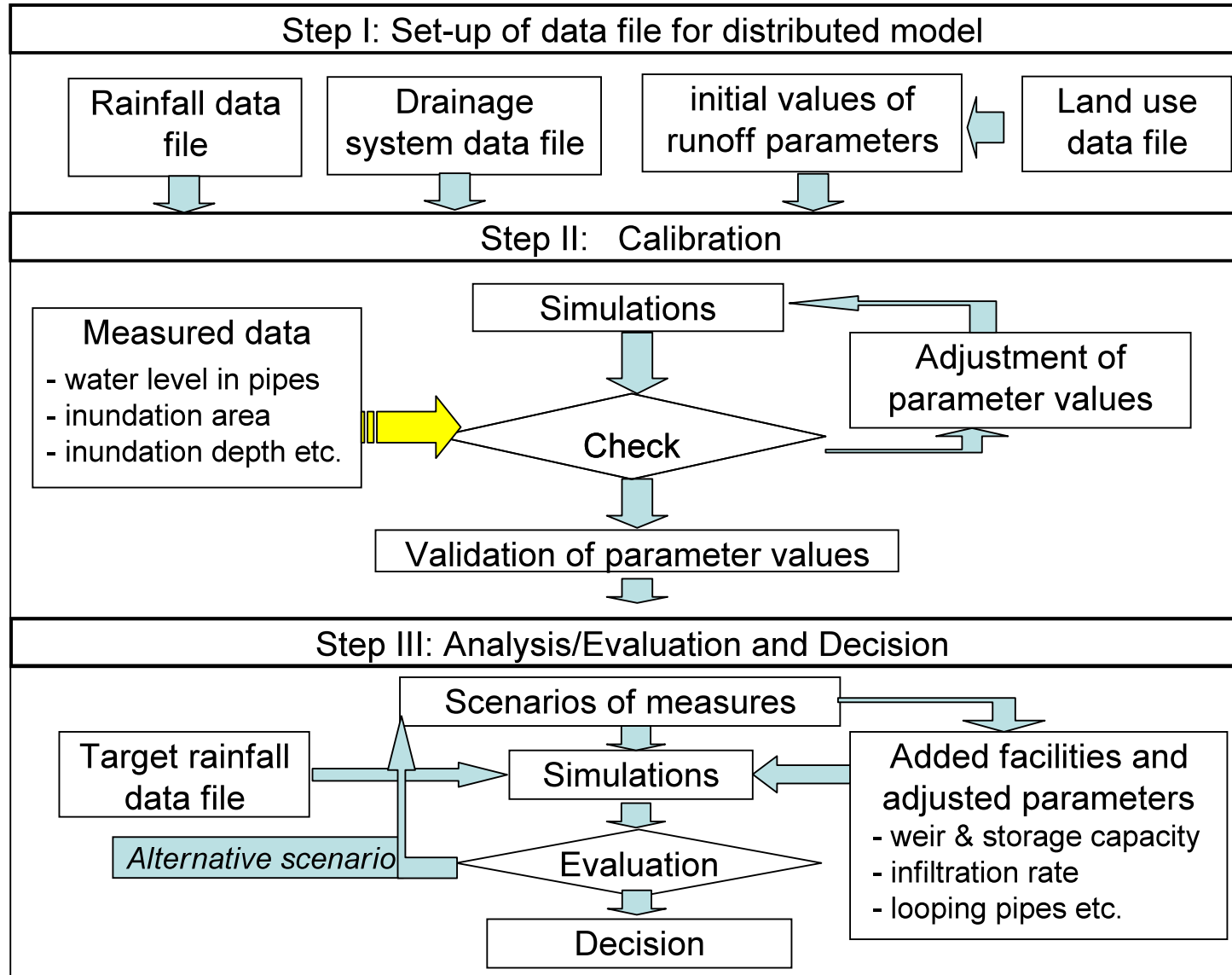
## *Selected flood-prone areas and spots in Tokyo*

- **25 areas** which have suffered from serious inundation in the past
- ▲ **77 spots** to be coped by small-scale countermeasures
- **4 station areas** with underground shopping centers (Tokyo, Shinjyuku, Ikebukuro, Shibuya)





# Application procedure of runoff simulation





# Sewerage Mapping and Information System (SEMIS)

Top page

下水道台帳案内

下水道台帳案内

このページの掲載状況は、「下水道台帳」という画面に記載されています。  
 「下水道台帳」(建設平面図 縮尺:1/500)を平成17年4月1日からホームページ上に公開しています。

「下水道台帳」でわかることは、東京23区の公道の下水道管の埋設状況です。

下水道管の位置・深さ・管径・管種・公共ますの位置等を記載しています。  
 下水の排除方式(合流式・分流式)もわかります。

●印刷様式はA4、A3の縦・横です。 ●印刷画面の縮尺は1/500です。

**下水道台帳への入口**  
 こちらをクリックしてください

「下水道台帳」を直接にお調べになりたい方や、その他の画面等をお調べになりたい方は、お手数ですが、従来どおり、都庁第二本庁舎6階南側(下水道台帳閲覧室)においでください。  
 ※都庁第二本庁舎「下水道台帳閲覧室」でお調べできる画面は、下記のとおりです。  
 (手数料はかかりません。ただしコピーは、A3サイズ1枚あたり0円が必要です。)

ページ

下水道台帳案内 下水道のお問合せ先 東京都下水道局 東京都ホームページ

SEMISインターネット配信システム

Search page

台帳図印刷までの流れの説明  
 別ウインドウが開きます

お探しの場所を検索してください。  
 検索方法は、左下の「住所から検索」と右下の「地図から検索」があります。

**住所から検索**

区名 区を選択  
 町名  
 丁目  
 街区番号

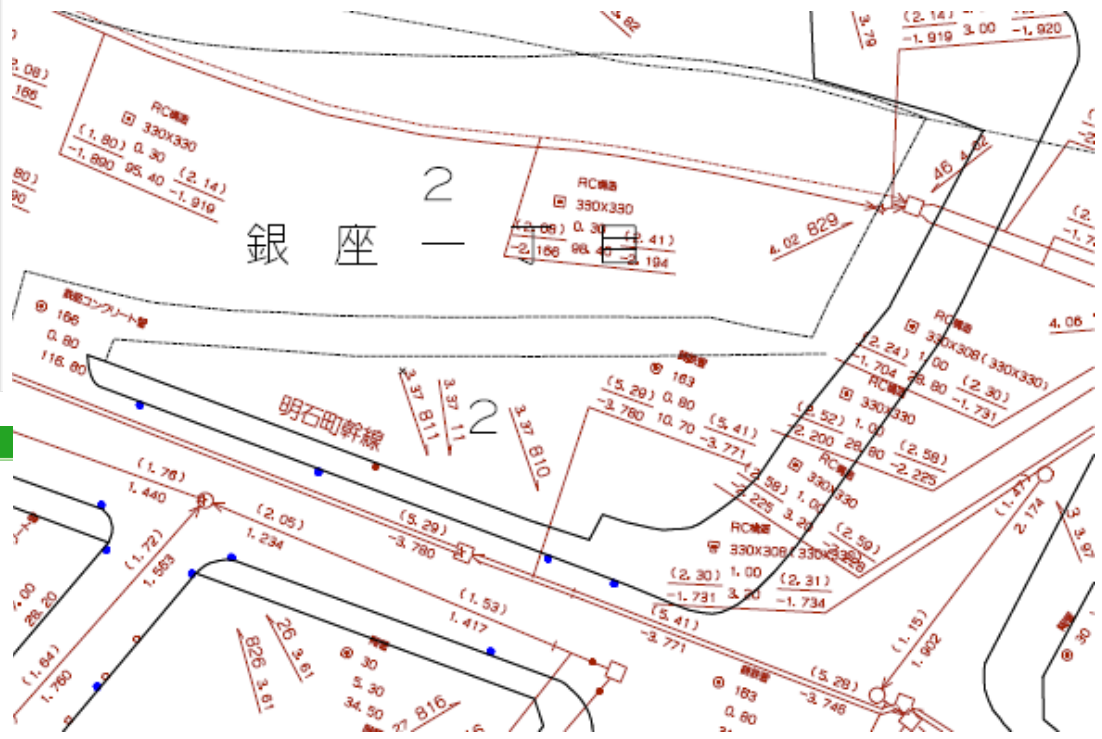
検索する

**地図から検索**(区役所を中心15kmの範囲を表示します)

凡例  
 分流域  
 合流域

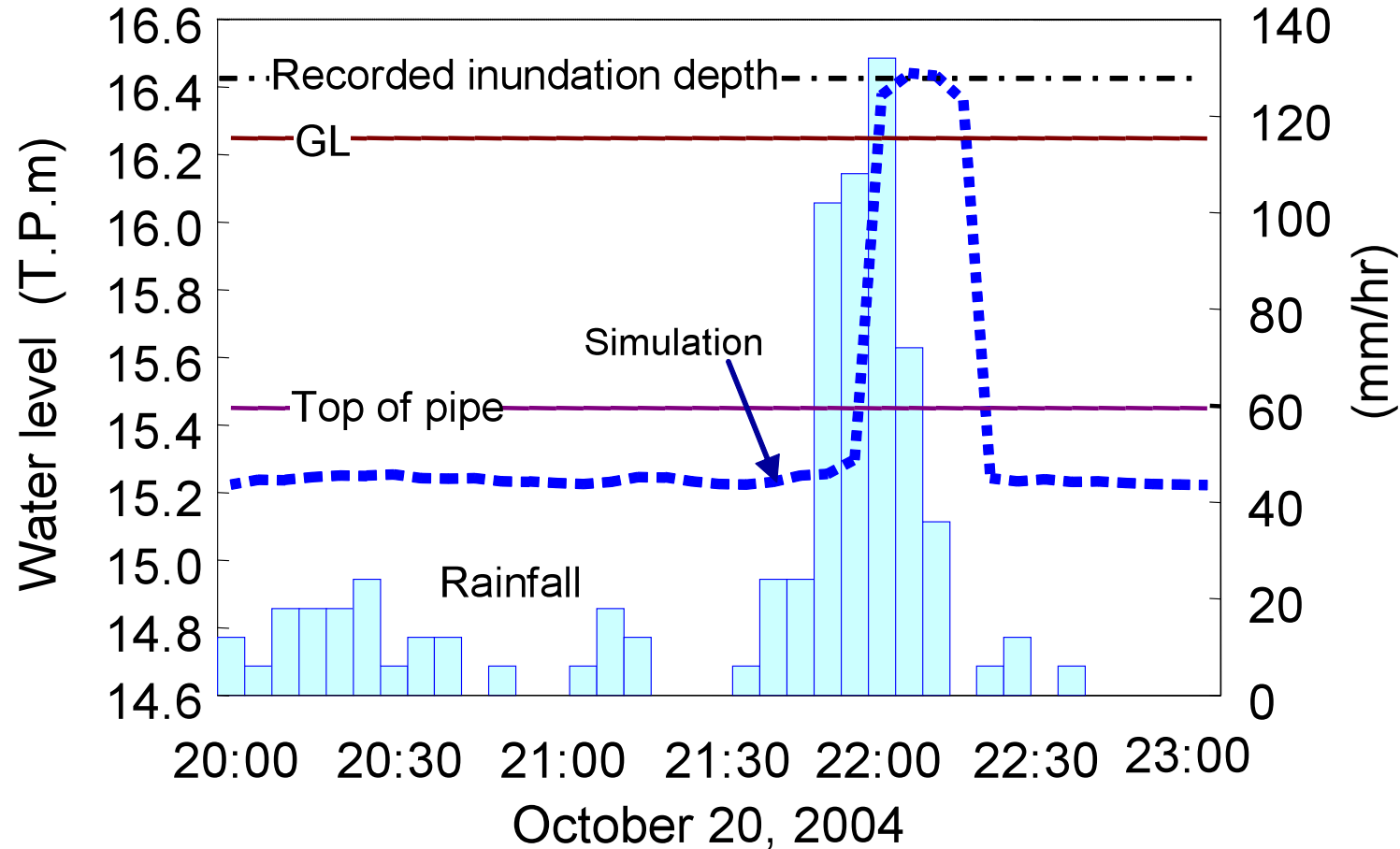
確尺1:410,000

見たい区をクリックしてね





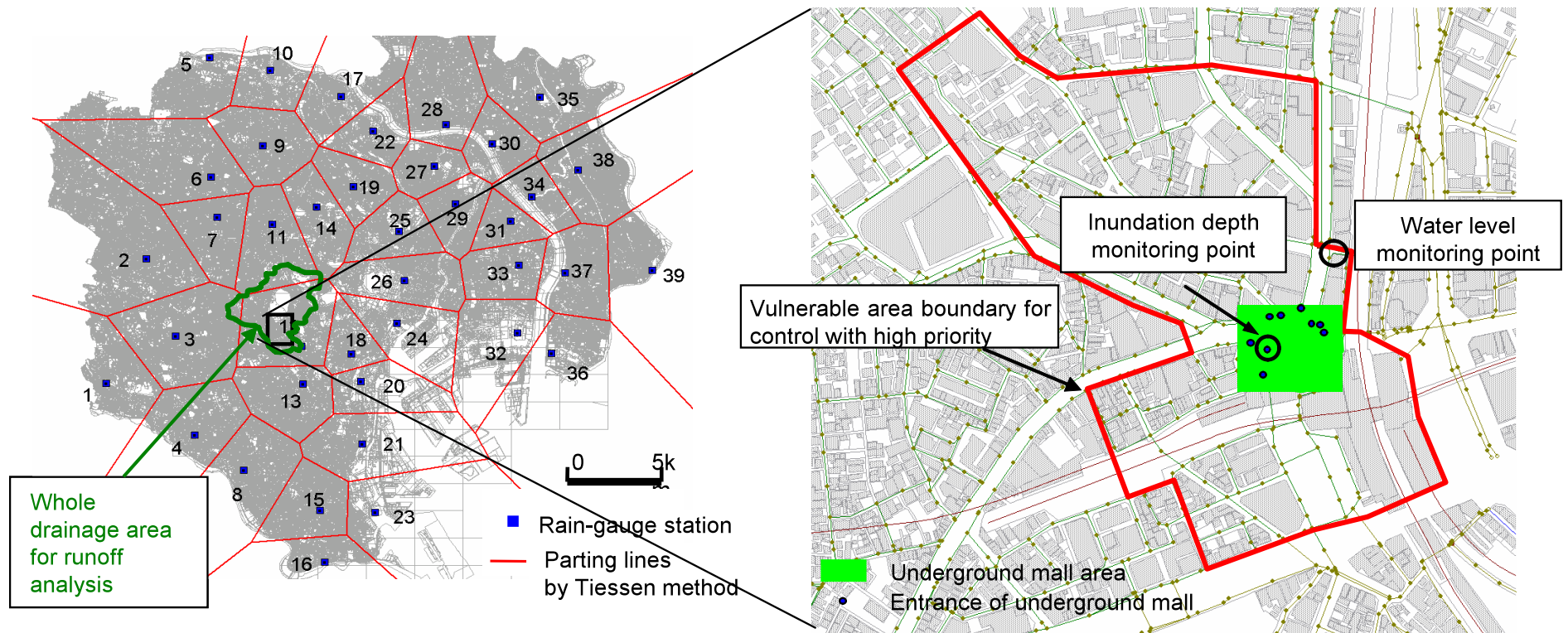
# Calibration of runoff simulation model



After obtaining the satisfactory results in calibration and validation, the simulation model is capable to quantify the damage as well as to estimate area of hazard zones for designed rainfall with and without countermeasures.

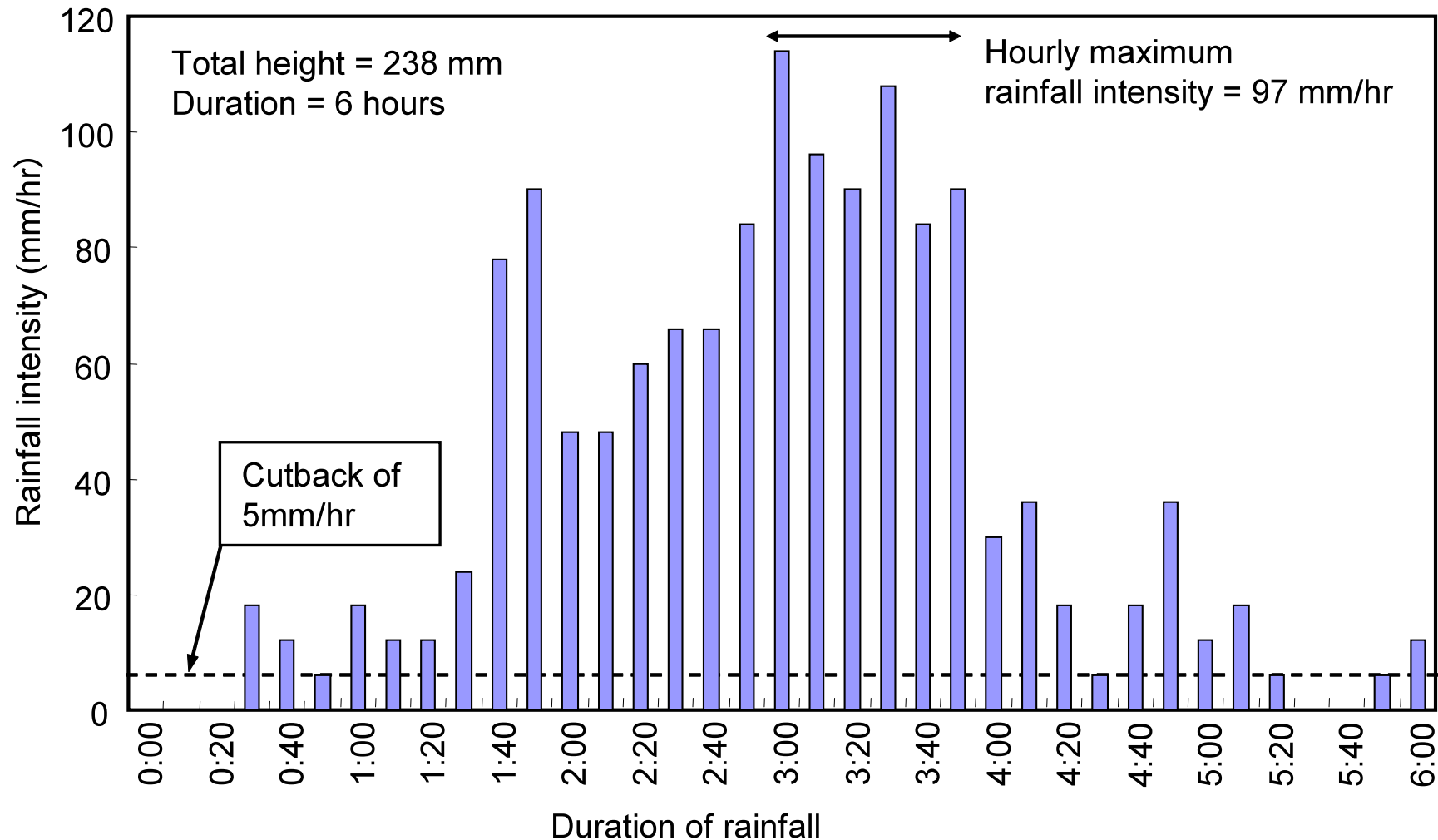


# Example location of whole drainage and target vulnerable area at Shibuya district





# Heaviest rainfall event in Tokyo used for making the hazard map





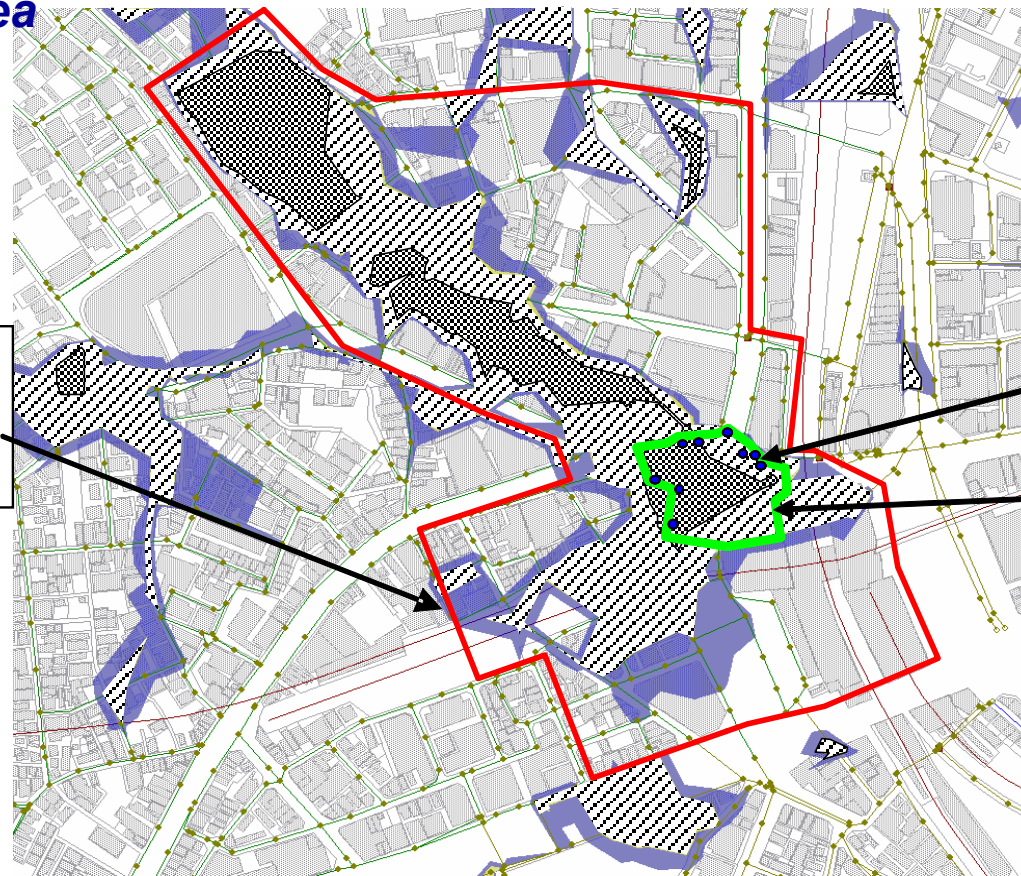
# Inundation hazard map containing vulnerable area for control with high priority

*Large and wide inundation area of IH > 50 cm*




*No countermeasure*

*Present situation*

Vulnerable area for control with high priority



Entrance of Underground mall  
Underground mall area

Inundation height (IH)	
	: IH > 50cm
	: 20cm < IH < 50cm
	: IH < 20cm





# Simulation result with storage pipe installation

## Single countermeasure

*Insufficient elimination of inundation area of  $IH > 50$  cm*

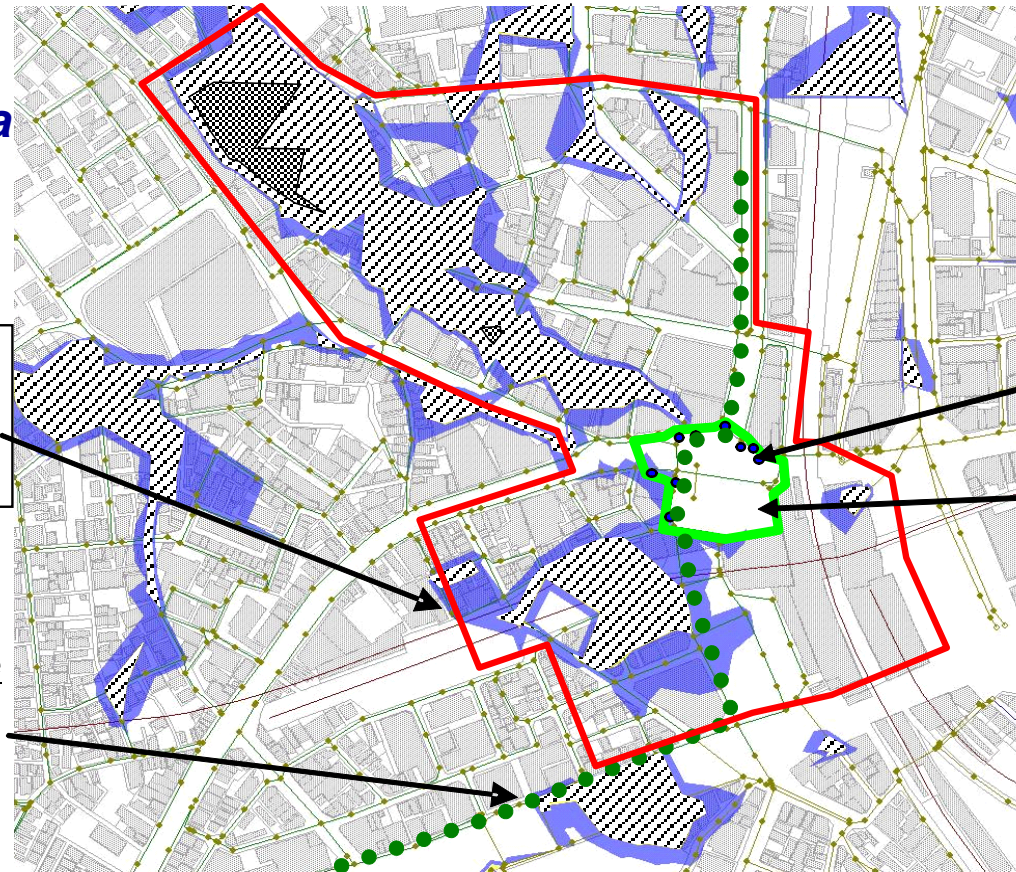
*Lowered risk at entrance of underground mall*

Vulnerable area for control with high priority

Entrance of Underground mall

Underground mall area

**Storage pipe**  
Countermeasure  
Construction of storage pipe



Inundation height (IH)

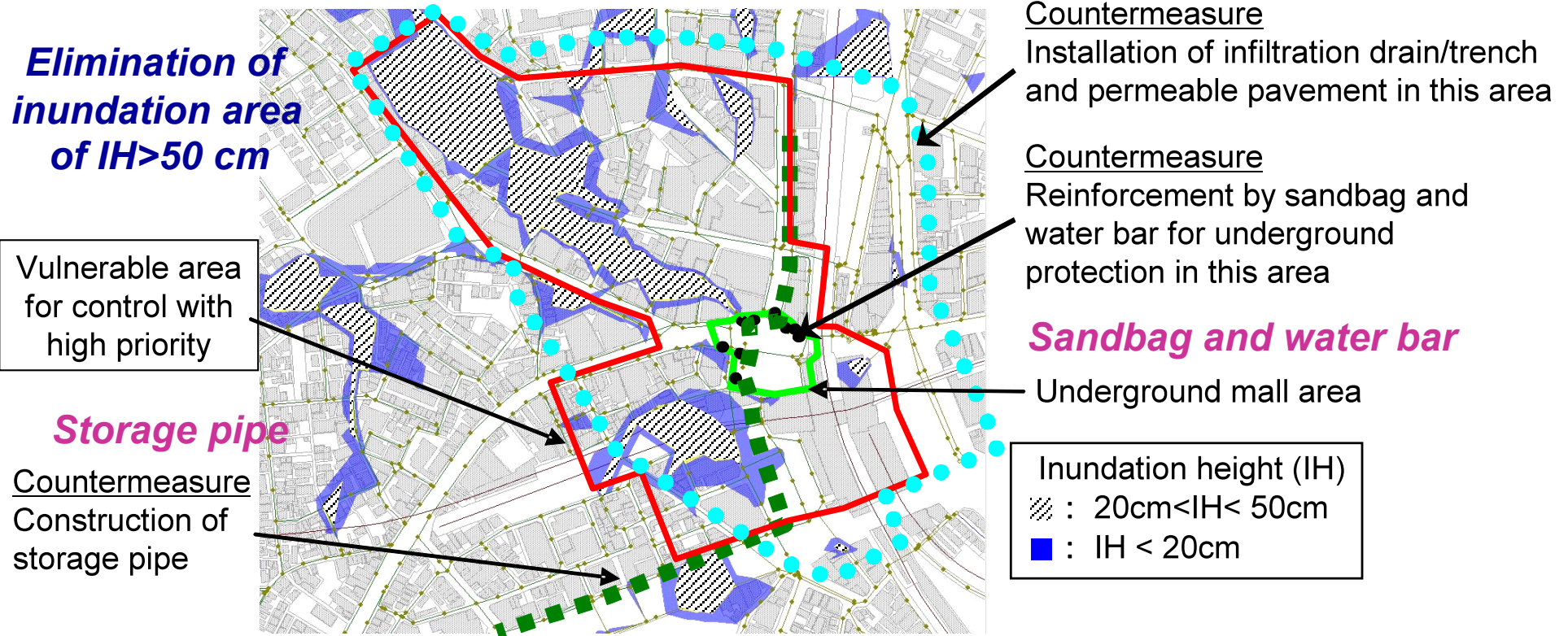
- :  $IH > 50\text{cm}$
- ▨ :  $20\text{cm} < IH < 50\text{cm}$
- :  $IH < 20\text{cm}$

Storage pipes:  $D=4.0\text{m}$ ,  $L=1,400\text{m}$



# Simulation result with integrated flood control measures

## Integration of countermeasures





# Summary and Future tasks

- Strategic countermeasures are strongly evaluated in the inundation simulations by urban runoff models with different scenarios. However, the following points has to be incorporated in the model application for any decision or conclusion.
  - i) Advancement of model can be made with all the important data of drainage system, land use and rainfall. Model calibration is a most important part and requires monitoring data of inundation.
  - ii) Inundation hazard maps can be strengthen with showing the possible countermeasure and its possible effect. The hazard map with the estimated inundation situation is a strong incentive for relevant stakeholders to cooperate for exploring better comprehensive inundation control.



# Map showing areas of potential flooding



Tokyo Metropolitan Government (TMG) provides Flood/Inundation Hazard Maps which show areas of potential flooding in order to assist residents in preparing against water damage and evacuating quickly.



# Tokyo Amesh (rainfall data system)

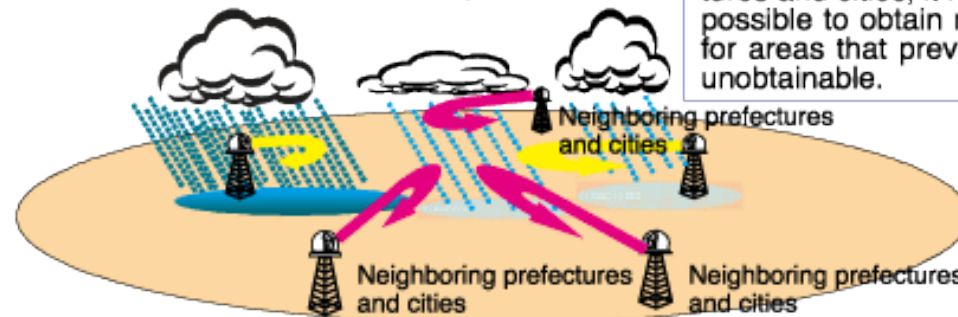
Before Improvement

There were rainfall areas that could not be monitored accurately by the two radars located in Tokyo only during heavy rainfall.



After Improvement

Using data provided by neighboring prefectures and cities, it has become possible to obtain rainfall data for areas that previously were unobtainable.



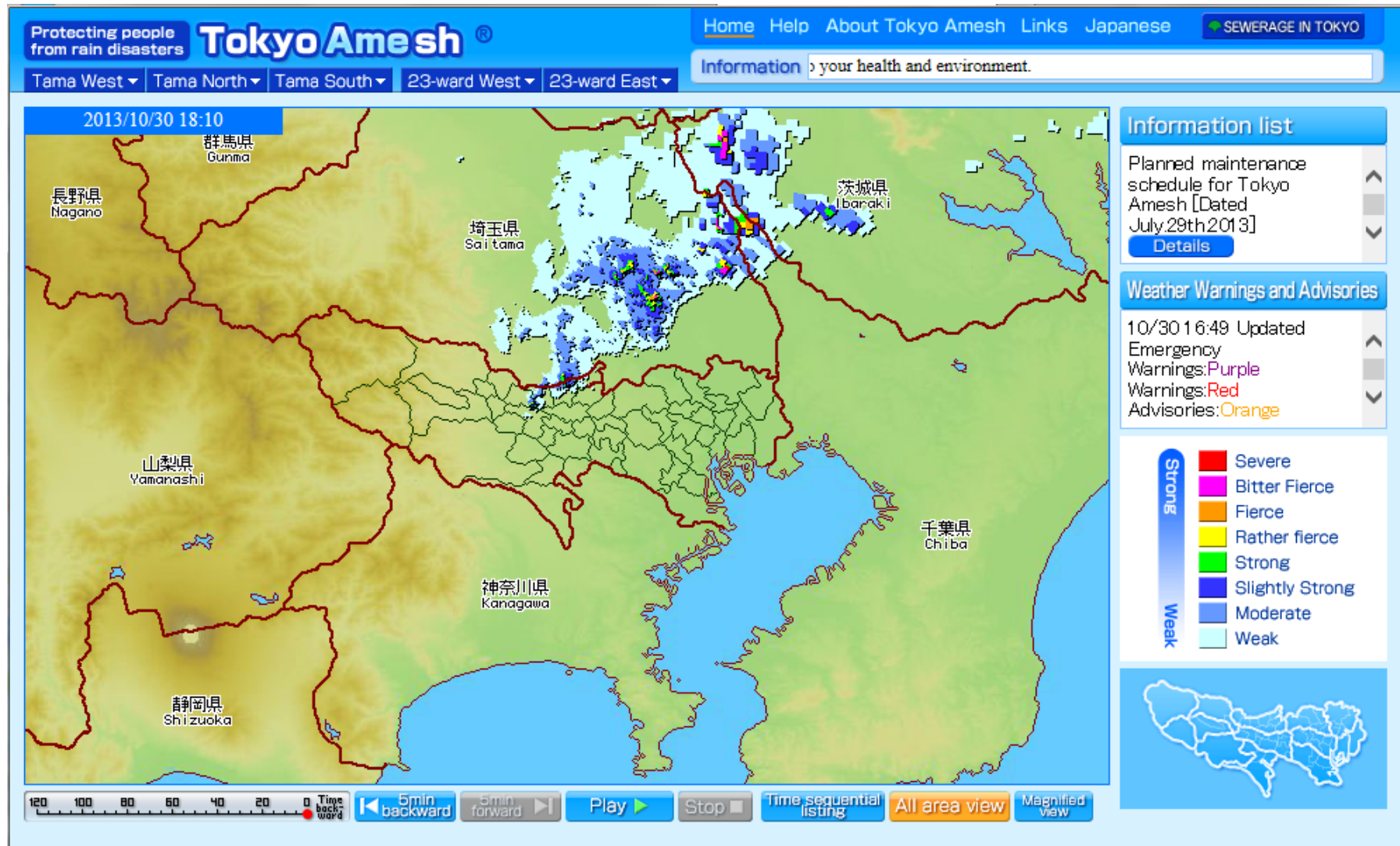
## Improving the accuracy of Tokyo Amesh

Tokyo Amesh has 5 radar stations, 2 in Tokyo (Inagi and Minato) and 3 in adjoining municipalities, and some 150 ground gauges to measure rainfall in Tokyo region. The radar data is used to prepare for and to determine proper and timely pumping operation.

<http://tokyo-ame.jwa.or.jp/en/index.html>



# Tokyo Amesh (rainfall data system)



<http://tokyo-ame.jwa.or.jp/en/index.html>



## *What are needed for sustainable urban flood/ inundation management?*

- Urban inundation control policy should emphasize the utilization of urban runoff and flood simulation for identifying inundation hazard zones.
- Publicizing the inundation hazard map and giving rainfall radar data is useful for citizens to understand possible inundation situation and to prepare for evacuation.
- Shared knowledge on estimated inundation situation is a strong incentive for relevant stakeholders to cooperate for exploring better comprehensive inundation control.

*Need of integration of countermeasures (public-, community- and self-helps) with the shared knowledge on estimated inundation situation considering climate change*



# Thank for your attention

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[Department of Urban Engineering :http://www.env.t.u-tokyo.ac.jp/index.html](http://www.env.t.u-tokyo.ac.jp/index.html)



Research Center for Water Environment Technology  
School of Engineering, the University of Tokyo

SiteMap Japanese THE UNIVERSITY OF TOKYO

Attached to Graduate School of Engineering, the University of Tokyo

## Research Center for Water Environment Technology

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- Members
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- Research
- Publication
- Satellite
- Books & Reports
- Link

### Outline



Detail information is in the REC WET booklet.

RECWET was established in April 2000 as the first education and research center attached to the Graduate School of Engineering, the University of Tokyo. Our primary mission is R&D of an advanced water-environment control system, and we strive to be a core research organization that conducts practical as well as pioneering research. To this end, we are establishing innovative systematized techniques by integrating basic sciences, such as microbial ecology, with practical sciences, such as water process engineering. Furthermore, through collaborations with researchers who are responsible for administrative action and process management at other institutions and organizations, we are pursuing academic and practical research to meet social demands.

[http://www.recwet.t.u-tokyo.ac.jp/e/index\\_e.html](http://www.recwet.t.u-tokyo.ac.jp/e/index_e.html)

Research Center for Water Environment/Department of Urban Engineering,  
Graduate School of Engineering, The University of Tokyo

## Water Environment Technology Laboratory

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Welcome To Water Environment Technology Laboratory



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