Introduction on adaptation measures in Tsurumi river
Outline of Tsurumi River (Geography)

Hill / tableland 70%
Alluvial lowland 30%

Riverbed gradient: 1/250

8. Adaptation measures in Tsurumi River

Tokyo
Chiba Pref.
Kanagawa Pref.

Densely populated downstream section

Middle section with stepped cross section

Upstream section below grand level

Riverbed gradient: 1/1,000
Urbanization ration has increased by **75%** in 50 years

Rapid economic growth has turned natural area into urban area.

Outline of Tsurumi River (Urbanization and population increase)

- **1958 10%**
  - 450,000
  - Typhoon Karinogawa in Sep 1958

- **1966 20%**
  - 700,000

- **1975 60%**
  - 1,200,000
  - Typhoon No.17 in Sep 1976

- **Present 85%**
  - 1,880,000

**Urbanization**

**Population**
Function of keeping and retarding water became weakened

As a result

- Population increased by 1.4 million in 50 years
- 85% of river basin area urbanized
- Typical urban river

Discharge into river has become faster
Peak runoff has become bigger

Before development
Slight urbanization

- Peak runoff reaches its peak in 2~3 hours
- Discharge into river 1,300 m³/s

After development
Significant urbanization

- Peak runoff reaches its peak in 1/3 of time
- Discharge into river 770 m³/s
- Volume Doubles

Outline of Tsurumi River (Effect of urbanization)
### Basic strategy for controlling inundation damage

(Runoff allocation)

#### Runoff allocation by target rainfall

**Peak runoff without discharge control**: 2,110 m³/s

- **Allocation in river basin**: 250 m³/s
  - Existing and newly developed rainfall storage and infiltration facilities: 205 m³/s
  - Rainfall storage and infiltration measures by municipalities: 15 m³/s
  - Rainfall storage tubes by sewerage administrators: 30 m³/s

- **Allocation in river**: 1,860 m³/s
  - Controlled by rivers: 1,500 m³/s
  - Storage in flood control facilities and in retarding basins: 360 m³/s

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Under the future land use, runoff is estimated at Sueyoshibashi point based on the largest rainfall after 1945.
River related projects in Tsurumi River Basin inundation control plan

Future flood control

Existing retarding basin

【Administrator】
MLIT
Tokyo Metropolitan
Kanagawa Prefecture
Yokohama City

8. Adaptation measures in Tsurumi River
Sewerage projects in Tsurumi River Basin inundation control plan

8. Adaptation measures in Tsurumi River

Natural drainage area

Pump drainage area (Name)

Rainwater storage tube (Name)
### Development of facilities for target rainfall

#### Planned discharge in pump drainage areas

<table>
<thead>
<tr>
<th>City</th>
<th>Discharge area</th>
<th>Planned discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yokohama</td>
<td>Tsuzuki</td>
<td>17 m³/s</td>
</tr>
<tr>
<td></td>
<td>Kouhoku</td>
<td>142 m³/s</td>
</tr>
<tr>
<td></td>
<td>Hokubu</td>
<td>189 m³/s</td>
</tr>
<tr>
<td>Kawasaki</td>
<td>Kase</td>
<td>55 m³/s</td>
</tr>
<tr>
<td>Total</td>
<td>402 m³/s</td>
<td></td>
</tr>
</tbody>
</table>

#### Planned storage of major facilities

<table>
<thead>
<tr>
<th>City</th>
<th>Storage facility</th>
<th>Planned Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yokohama</td>
<td>Shin hasue trunk line</td>
<td>410,000 m³³</td>
</tr>
<tr>
<td></td>
<td>Kozukue chiwaka trunk line</td>
<td>256,000 m³³</td>
</tr>
<tr>
<td>Kawasaki</td>
<td>Shibukawa rainwater storage tube</td>
<td>144,000 m³³</td>
</tr>
<tr>
<td></td>
<td>Egawa rainwater storage tube</td>
<td>81,000 m³³</td>
</tr>
</tbody>
</table>

*8. Adaptation measures in Tsurumi River*
Storage, infiltration and forest conservation

8. Adaptation measures in Tsurumi River

- Development of rainwater storage and infiltration facilities, conservation of forested areas (Total effect by municipalities: 0.3 million m³)

- Infiltration trench

- Infiltration by permeable pavement

- Storage facilities in schools, parks and public houses

- Purchase and conservation of forest in developing area
Preparation of basic operation rules, communication, command and control, information sharing and public announcement

**Basic rules of restricted pump operation**

-River and sewerage administrators make basic rules of restricted pump operation to effectively decrease urban flood and inundation caused by heavy rainfall that exceeds the current project design target.

**Communication and information sharing**

-Related organizations jointly establish communication system for effective and efficient pump operation.

-The administrators provide hazard information beforehand and ask for cooperation from residents. When pump operation is restricted, the administrators supply necessary information for residents’ smooth evacuation.
To organize local meetings and raise public awareness on preparedness on disaster

**Education for pupils**

- Annual educational course for pupils on disaster preparedness at the Center

**Disaster preparedness caravan**

- To visit local meetings and explain to residents

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**Public awareness to mitigate damages**

(Public awareness and education on disaster preparedness)

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**Tsurumi River Administration Center**
Public awareness on flood damages

(Advance dissemination of flood and inundation prone information)

By simulating urban flood and inundation, municipalities prepare “Hazard Maps”

<table>
<thead>
<tr>
<th>Urban flood prone area</th>
<th>Urban inundation prone area</th>
</tr>
</thead>
<tbody>
<tr>
<td>(River administrator)</td>
<td>(Sewerage administrator)</td>
</tr>
<tr>
<td>Flood is estimated by levee break or overtopping.</td>
<td>Inundation by insufficient drainage capacity is estimated.</td>
</tr>
</tbody>
</table>

“Hazard Map” released by Yokohama City
Implementation, monitoring, evaluation and modification of the plan

**Progress of major projects**
- Implementation of river and sewage project

**Installation of rainwater storage and infiltration facilities**
- Installation of rainwater storage and infiltration facilities
- Countermeasures against blocking rainwater infiltration
- Progress of rainwater storage and infiltration facilities constructed for development based on regulations and guidelines

**Changes of river basin**
- Re-evaluation of latest development (area, location, type etc.)

**Modification of the plan**