Port of Tokyo Disaster Prevention Scheme

To protect citizens of Tokyo from flood damage by preparing for major earthquakes, tsunamis, and typhoons.

2024

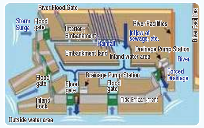
Interior Embankment of the Tatsumi Canal

Tokyo

Bureau of Port and Harbor, TOKYO METROPOLITAN GOVERNMENT

Functions and Types of Coastal Protection Facilities

Without coastal protection facilities, "zero-meter zones" and other low-lying areas would suffer from regular flood damage. Even storm surges would pose a threat of widespread inundation.



Functions of Coastal Protection Facilities

Coastal protection facilities are therefore constructed around low-lying areas to keep seawater out and protect areas farther inland.

Tide embankments, floodgates, and inland locks prevent flooding from tidal waves and storm surges, while drainage pump stations are placed to keep canal waters from rising too high in the event of heavy rainfall, for example.

The "Canal Renaissance" initiative also encourages local residents to make the most of their coastal protection facilities by getting people to visit and enjoy their canal areas.

Tide Embankment protects a city area from tsunamis and storm surges.

Interior embankment offer flood protection for reclaimed land located behind embankments or floodgates (planned crown height: A.P. +3.0 m)

Floodgates installed in canals can be closed when there is flood danger due to storm surge or other factors.

Inland locks are gates set up where there are breaks in embankments due to roads or other reasons. They can be closed when rising waters pose a flood risk.

Once the floodgates have been closed due to heavy rainfall or other threats, drainage pump stations use pumps to force water outside embankments and keep water levels from rising.

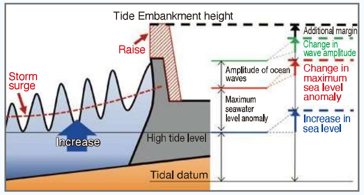
Port of Tokyo disaster preparedness centers make it possible to remotely operate floodgates and other facilities during storms or other high-risk events.

Climate Change Demands Higher Embankments

In the past, embankment heights were calculated by adding storm surge (maximum sea level anomaly plus wave amplitude) from an exceptionally intense cyclone like Typhoon Vera to the height of high tide (high water level).

However, the city is now raising embankment heights to address expected climate change impacts, among them rising sea levels from the expected 2°C rise in sea temperatures and greater storm surge and wave action from increasingly severe typhoons—plus an additional margin of 30 cm.

As expected storm surge the Port of Tokyo is far above anticipated tsunami height, it is the figure used to set the height of its embankments.



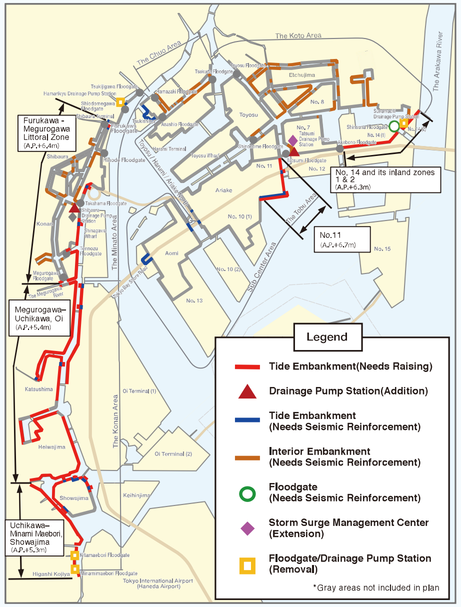
Raising embankments in response to climate change

■Crown height of tide embankment by areas

Area	Section	Planned Crown height for the year 2100
Koto	Etchujima Aioi-bashi Bridge-Toyosu	6.5
	Toyosu Littoral Zone	6.5
	Toyosu Inland	6.5
	Shinonome Littoral Zone	6.5
	Shinonome Inland	6.5
	Tatsumi	6.5
	No. 14 and its littoral zones 1 & 2	8.0
	No. 14 and its inland zones 1 & 2	6.8
Chuo	Littoral Zone	7.3
	Inland	6.5
Minato	Tsukiji–Furukawa Littoral Zone	7.4
	Tsukiji–Furukawa Inland Zone	6.5
	Furukawa - Megurogawa Littoral Zone	6.9
	Furukawa - Magurogawa Inland	6.1
Konan	Megurogawa–Uchikawa, Oi	5.9
	Uchikawa–Minami Maebori, Showajima	5.6

Area	Section	Planned Crown height for the year 2100
Tokyo Waterfront City	Aomi (West/ South)	8.0
	Aomi(East)	6.7
	Daiba	7.2
	Daiba (Tokyo International Cruise Terminal) Littoral Zone	8.0
	Daiba (Tokyo International Cruise Terminal) Inland	6.5
	Ariake(Kokusai tenjijomae East Side)	7.5
	Ariakeminami	6.7
Toyosu / Harumi / Ariakekita	Ariakekita	6.8
	Toyosu	7.1
	Harumi	7.3
Tobu	No.11	7.4

Facilities Outlined in "Port of Tokyo Coastal Protection Facility Preparation Plan"



*Drainage pump station installation and positioning in the Koto area TBD

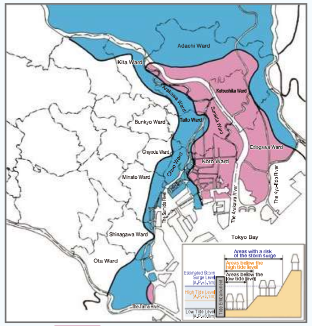
A Vast Lowland / Major Flood Damages

The Port of Tokyo is an international port that supports the lives of 40 million citizens in the Metropolitan area and the business of various industries. Behind it lies a high concentration of municipal functions including core metropolitan functions and a variety of commercial activities. In the eastern side of Tokyo, there is a vast area called the "zero meter zone" where the ground is below the high water level.

It is said that the storm surge reached about 5 meters above the low tide level when the Ise Bay Typhoon hit the Ise Bay in 1959.

Areas below 5 meters at the time of the low tide level in the Port of Tokyo are shown on the map on the right (in blue and pink color). They are equivalent to roughly 40 % of the size of the entire Tokyo's 23 wards where about 3 million people reside.

A so-called "zero meter zone" where the ground is below the high tide level (indicated in pink color) covers about 20 % of the size of the entire Tokyo's 23 wards. There are approximately 1.5 million residents in this zone.



Areas below the high tide level

Areas 5 meters below the low tide level

■Major Flood History

Classification \ Year	Oct. 1917	Aug - Sep. 1949	Sep. 1958	Oct. 1979
Types	Storm (Storm Surge)	Typhoon Kitty (Storm Surge)	Typhoon Ida (Flood)	Typhoon Tip (Flood)
Atmospheric pressure (mb)	952.7	985.9	970.7	976.1
One-hour precipitation (mm)	16.5	12.6	76.0	47.0
Total precipitation (mm)	161.6 (Sep 28–Oct 1)	64.9 (Aug 31–Sep 1)	444.1 (Sep 22–Sep 27)	120.0 (Oct 17–Oct 19)
Wind direction / Highest wind speed (m/S)	S39.6	ESE24.9	WNW20.5	S17.5
Seawater level (A.P.m)	4.21	3.15	2.91	3.55
Wetted surface area (km^2)	86.60	92.01	211.03	1.47
Houses flooded above floor level	131,334	73,751	142,802	180
Houses flooded below floor level	49,004	64,127	337,731	1,550
Casualties / Missing (Persons)	1,524	122	203	99

Note: The storm surge reached about 5 meters above the low tide level when Ise Bay Typhoon hit the Ise Bay in 1959.

■Major Earthquakes Causing Damage in Tokyo (1703 – 2011)

*Earthquakes of magnitude 7 and above.

Year	Magnitude	Intensity	Description
Dec 31, 1703	7.9~8.2	5~6	It shook the Kanto regions and killed 2,327 people, causing severe damage especially in Odawara.
Oct 28, 1707	8.4		This earthquake struck the Tokai region. It resulted in a tsunami that hit the Pacific coastal areas.
Aug 23, 1782	7.0	4~5	Odawara Castle and 800 houses were destroyed by this earthquake. A tsunami also hit the region. House destruction and related deaths were reported in the Edo region.
Dec 23, 1854	8.4		Damage was reported in the Tokai, Higashiyama, and Nankaido regions. A tsunami hit the coastal areas. A stone wall at Edo Castle and residences collapsed in Edo.
Jun 20, 1894	7.0	5~6	24 people were killed, 157 were injured, 90 houses collapsed, and 4,922 houses were damaged in Tokyo. Damage was particularly severe in downtown Tokyo.
Jan 18, 1895	7.2	4	This earthquake caused extensive damage around the Kanto region, especially in Ibaraki Prefecture and downtown Tokyo.
Sep 1, 1923	7.9	6	Great Kanto Earthquake killed 99,331 people and injured 103,733. 43,476 people were missing. 700,000 houses were damaged. Major diastrophism was reported.
Jan 15, 1924	7.3	4	This earthquake caused major damage in the central area of Kanagawa Prefecture.
Oct 12, 1993	7.1	4	The earthquake occurred far out at sea from the Tokai region, causing 1 death, 2 severe injuries, and 2 slight injuries.
Mar 11, 2011	9.0	7	The earthquake occurred far out at sea from the Sanriku region. 7 deaths, 18 severe injuries, and 97 slight injuries were reported in Tokyo.

Reference: Tokyo Metropolitan Government (2002) Tokyo Disaster Prevention Plan, Tokyo Metropolitan Government (2011) Disaster Preparedness Tokyo.

Readying the Port of Tokyo for Storms and Tsunamis

■Comprehensive Program for Storm-surge Protection (1934)

The Tokyo Metropolitan Government started implementing measures against storm surges at the Port of Tokyo.

■Special Program for Storm-surge Protection Works of the Port of Tokyo (1960)

Based on lessons learned from Typhoon Kitty in August 1949 and the Ise Bay Typhoon in September 1959, a new initiative began in 1960 to expand the storm surge protection area to the whole area of the Port of Tokyo. Under this program, the metropolitan government built tide embankments in the most hazardous areas including the Koto and Chuo areas in 1965, in a part of the Konan area in 1966, and in the Minato area in 1979.

■Tokyo Bay Coastal Protection Master Plan (August, 2004)

When the Coast Act was amended in May 1999, its aims were expanded beyond protecting coastal areas from disasters to include development and protection of coastal environments as well as the proper public use of coastal areas. The goal was to comprehensively manage coastal areas to target all three of these aims in a balanced way. The Coast Act also sets forth a basic plan for prefectural governors to protect coastal conservation zones on the nationally-issued Basic Policy on Coastal Protection.

The Tokyo Metropolitan Government, Kanagawa Prefecture, and Chiba Prefecture responded by jointly formulating a master plan for the coastlines in Tokyo Bay.

■Basic Policy of Tokyo Metropolitan Government against Earthquake and Tsunami Disasters (August, 2012)

In the aftermath of the Great East Japan Earthquake, the Tokyo Metropolitan Government decided to take measures to maintain functions of facilities in order to prevent flooding from tsunamis when the largest projected earthquake occurs.

■Revised Tokyo Bay Coastal Protection Master Plan (Tokyo Section) (March 2023)

Japan changed its Basic Policy on Coastal Protection in November 2020 based on the Coastal Protection Considering Climate Change proposal issued in July of that same year. Tokyo responded by setting up an expert advisory committee to figure out how it should set up its coastal protection facilities in light of climate change, revising its Basic Plan for Coastal Protection in Tokyo Bay (Tokyo Section) in March 2023.

■Port of Tokyo Coastal Protection Facility Preparation Plan (March 2023)

This plan outlines ten years of initiatives starting in fiscal 2022, detailing the development of coastal protection infrastructure in the Port of Tokyo. We aim to strengthen the port's resilience to earthquakes and typhoons by steadily moving forward with the plan.

Facility	Addresses	Target
Tide Embankment	Climate change	approx. 24 km
	Earthquakes	approx. 4 km
Interior Embankment	Earthquakes	approx. 15 km
Floodgate	Earthquakes	1
	Flooding	
Drainage Pump Station	Climate change	2
	Earthquakes	
	Flooding	

*Overlaps climate change facilities

○Additional measures

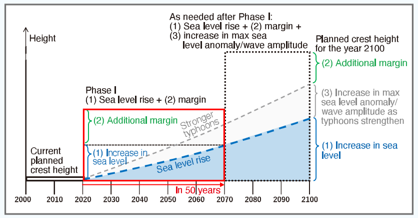
- Extension Storm Surge Management Center
- Decommission inland locks and move to remote operation
- Planned maintenance (e.g. floodgate repair)
- Nonstructural measures

Gradually Raising Tide Embankments

We are fairly certain that sea levels will rise, as we are already able to measure increases. We are less certain that maximum sea level anomalies will increase in Tokyo Bay, and even less certain that the Japan coast will see increasing extreme wave heights*.

We have therefore decided on a phased plan for raising tide embankments to account for climate change uncertainties. Development during Phase I of the plan uses the service life of each facility (50 years for concrete structures, for example) as the forecast period, calculating sea level rise ((1) below) plus margin ((2) below) during that timeframe.

*From "Special Report on the Ocean and Cryosphere in a Changing Climate" and "Climate Change in Japan 2020"



Phased embankment development (graphic)

During the implementation period, each area will consider rising sea levels over time along with differences in embankment height among different Tokyo metro cities, prioritizing specific embankments before their heights become insufficient.

■Areas that will begin raising embankments in the 2020s

Area	Section	Raised crown height* (A.P. + X m)
Koto	No. 14 and its inland zones 1 & 2	6.3
Minato	Furukawa–Megurogawa Littoral Zone	6.4
Konan	Megurogawa–Uchikawa, Oi	5.4

*Crown height of embankments raised during Phase I

■Areas that will begin raising embankments in the 2030s

Area	Section	Raised crown height* (A.P. + X m)
Konan	Uchikawa–Minami Maebori, Showajima	5.3
Tobu	No.11	6.7

*Crown height of embankments raised during Phase I

Current Status of Development for Coastal Protection Facilities (As of March, 2024)

Tide Embankment / Interior Embankment

❶Status of Development (Unit: km)

Type	Coastal Protection Area ①	Already Built ②	Needs Construction ③	Status ② / ①
Tide Embankment	60.4	58.1	2.4	96%
Outside Tide Embankment	39.8	39.3	0.5	99%
Waterside Land Tide Embankment	20.6	18.8	1.8	91%
Interior Embankment	47.9	39.7	8.1	83%

❷Seismic Reinforcement (Unit: km)

Type	Coastal Protection Area ①	Reinforced ②	Needs Reinforcement ③	Status ② / ①
Tide Embankment	60.4	57.3	3.1	95%
Outside Tide Embankment	39.8	38.5	1.3	97%
Waterside Land Tide Embankment	20.6	18.8	1.8	91%
Interior Embankment	47.9	35.5	12.4	74%

* Length of embankments is rounded off so it may not correspond to the total length.

❸Status of Climate Change Measures

Sequentially, we will carry out the raising of embankment heights.

Floodgate / Drainage Pump Station / Inland Lock

Floodgate	15
Drainage Pump Station	2
Inland Lock	21
Storm Surge Management Center	2

Port Planning and Construction, Division Bureau of Port and Harbor, Tokyo Metropolitan Government

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http://www.kouwan.metro.tokyo.jp/en/

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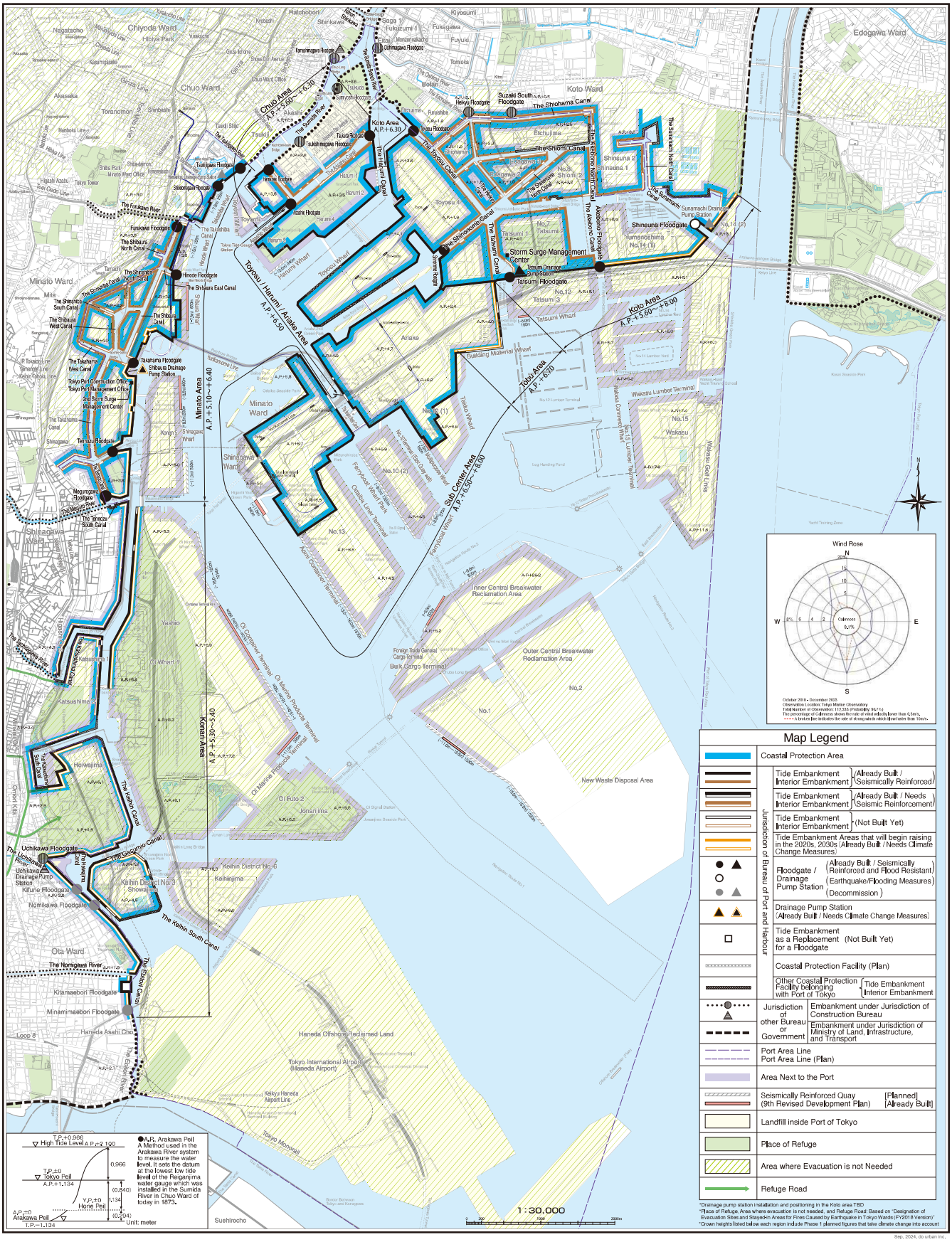
Disaster Prevention Scheme Map of the Port of Tokyo

2024



*Drainage pump station installation and positioning in the Koto area TBD
*"Place of Refuge Area where evacuation is not needed, and Refuge Road: Based on "Designation of Evacuation Sites and Stayed-in Areas for Fires Caused by Earthquake in Tokyo's Wards (FY2018 Version)"
*Crown heights listed below each region include Phase 1 planned figures that take climate change into account

Sep. 2024, do urban inc.

Bureau of Port and Harbor, Tokyo Metropolitan Government, 2024, Registration no (9) 3

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