MLIT's emergency response to the Great East Japan Earthquake and recent policy changes regarding tsunami disaster countermeasures

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1. Damages caused by the Great East Japan Earthquake

2. MLIT's emergency response to the Great East Japan Earthquake

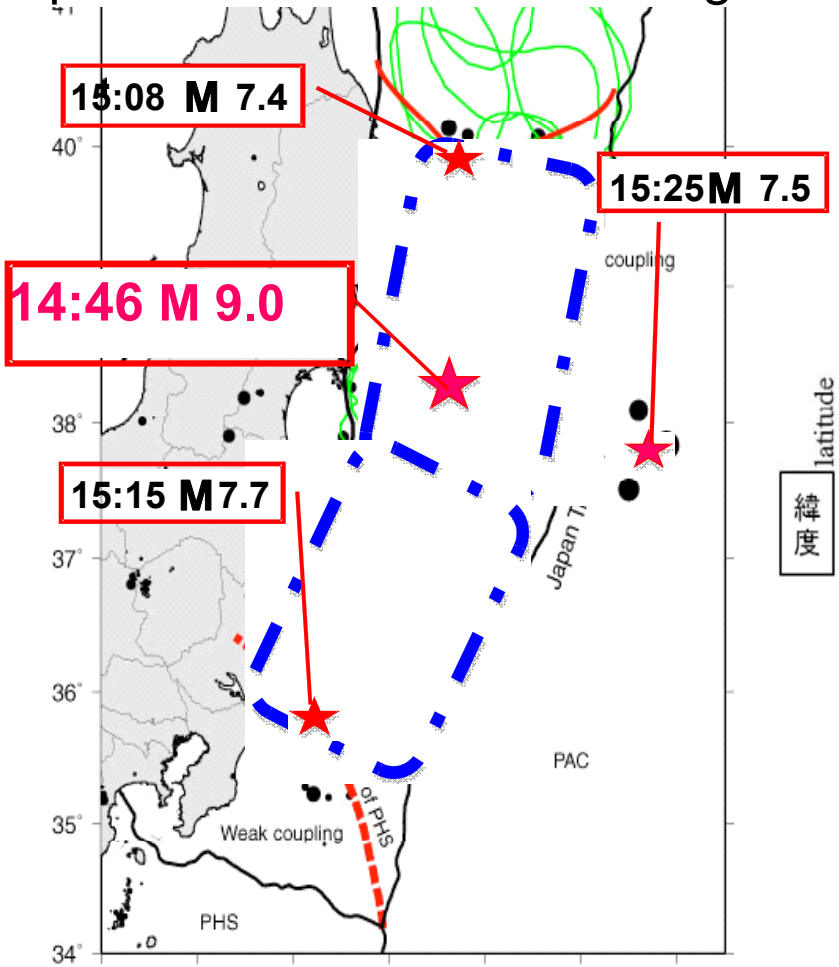
3. Recent policy changes regarding tsunami disaster countermeasures

Overview of Earthquake & Tsunami

- ○ On March 11 a massive earthquake of magnitude 9.0 occurred off Sanriku coast. Strong shocks were widely observed.
- ○ Focal region ranged over in the rectangle of around 450km long and 200km wide※.
- ○ The earthquake caused massive tsunami from Hokkaido to Kanto.
- ○ The scale of tsunami was equal to or larger than that of the Jogan Tsunami (869). The return period is estimated to be 500 to 1000 years.

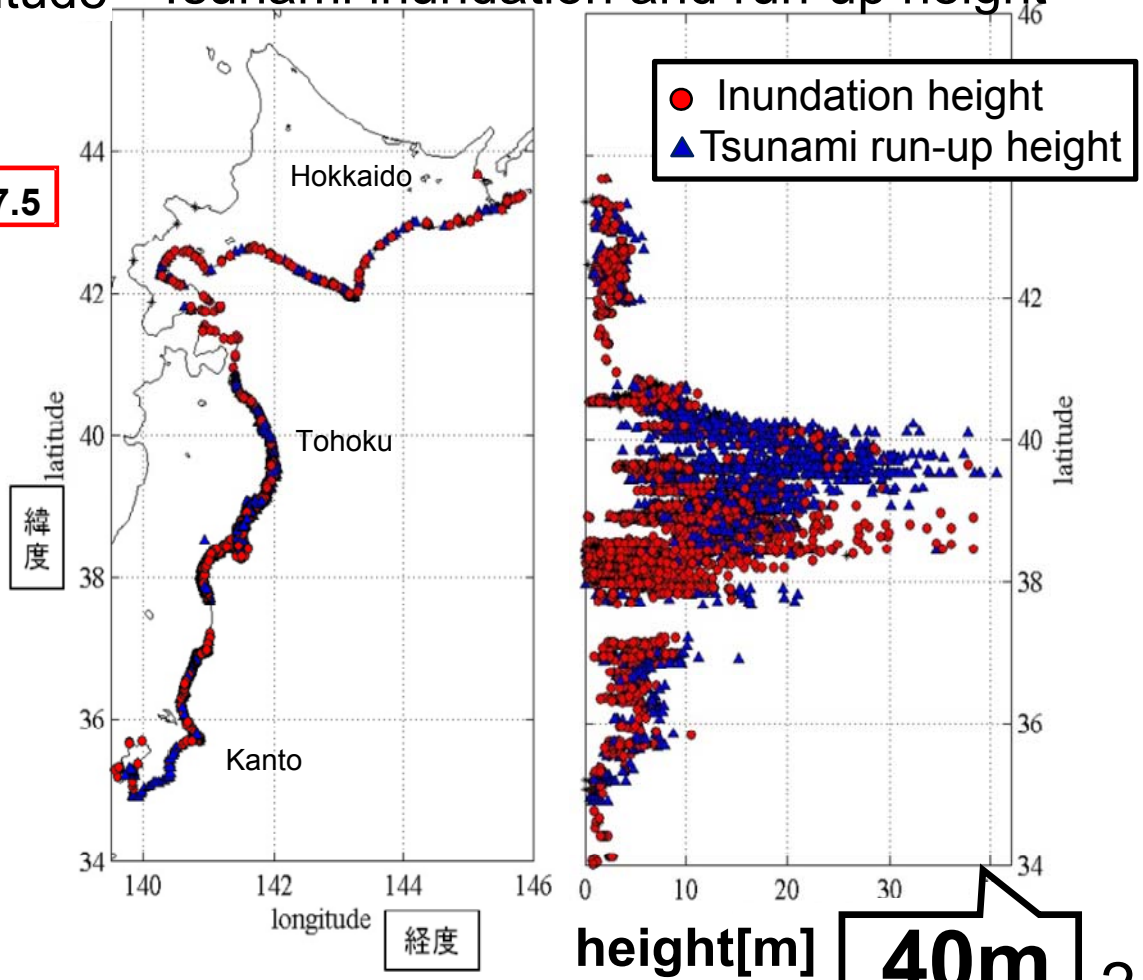
※White Paper on Disaster Management 2011, Cabinet Office, Government of Japan

Epicenter distribution and magnitude



Research Center for Prediction of Earthquakes and Volcanic Eruptions, Tohoku University
http://www.aob.geophys.tohoku.ac.jp/info/topics/20110311_news/index_html

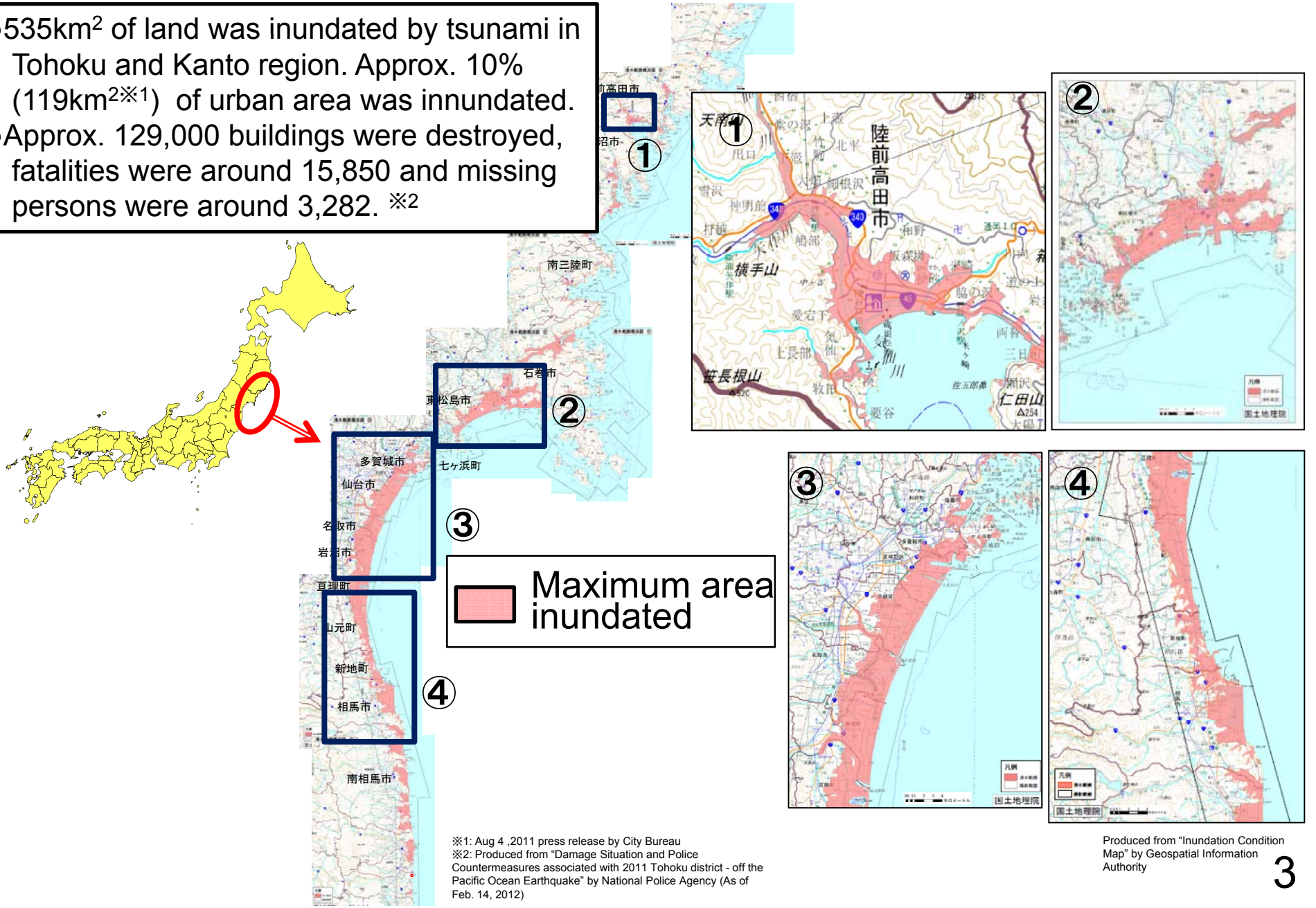
Tsunami inundation and run-up height



The 2011 Tohoku Earthquake Tsunami Joint Survey Group report (As of July 5, 2011)
http://www.coastal.jp/ttjt/

Damages caused by Tsunami (1/2)

○535km^2 of land was inundated by tsunami in Tohoku and Kanto region. Approx. 10% (119km^2※1) of urban area was innundated.
○Approx. 129,000 buildings were destroyed, fatalities were around 15,850 and missing persons were around 3,282. ※2



※1: Aug 4 ,2011 press release by City Bureau
※2: Produced from "Damage Situation and Police Countermeasures associated with 2011 Tohoku district - off the Pacific Ocean Earthquake" by National Police Agency (As of Feb. 14, 2012)

Produced from "Inundation Condition Map" by Geospatial Information Authority

Damages caused by Tsunami (2/2)

○In Rikuzentakata city 13km^2 was inundated※1.
90% of the urban area (2.9 km^2) in Rikuzentakata city was inundated※2.
○3,159 buildings were destroyed, fatalities were 1,656 and missing persons were 72※3.

※1：Aug 4 2011 press release by City Bureau, MLIT
※2：Date source from City Bureau, MLIT
※3：Produced from Rikuzentakata City HP (As of Jun. 30, 2011)

Looking at Rikuzentakata from the sea side (After tsunami)

Before tsunami（Oct. 18 and 29, 2010）

After tsunami（Mar. 13, 2011）

Produced from 4th meeting of The Reconstruction Design Council in response to the Great East Japan Earthquake (Oct. 5 2001)

Levee height and Tsunami trace height

[Basic concept of levee design height]

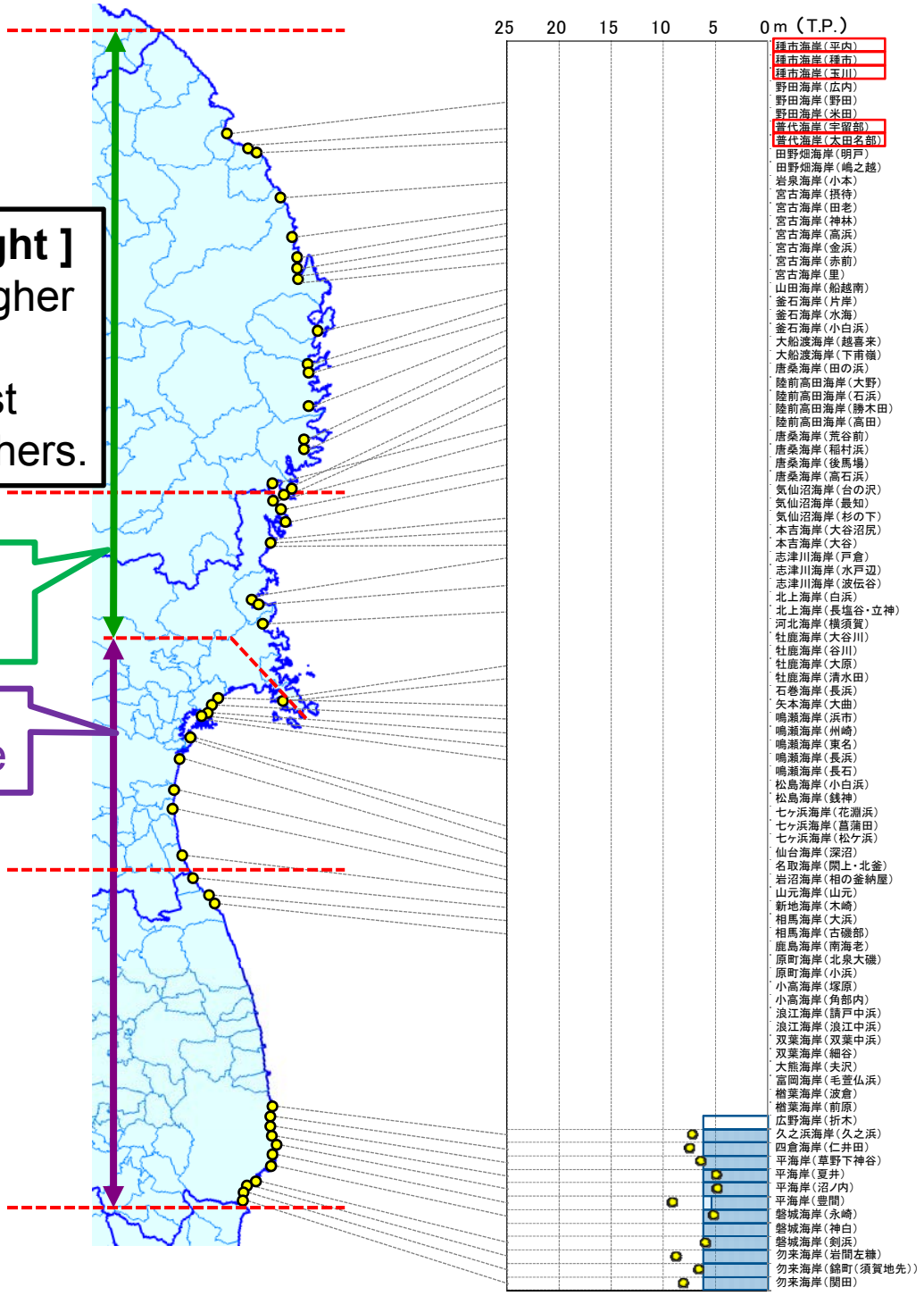
- Height of levee is decided by the higher of either storm surge or tsunami.
- Tsunami height is used for rias coast and storm surge height is used for others.

Levee design height is decided by tsunami

Levee design height is decided by storm surge

- Current levee height
- Levee design height
- Tsunami trace height
  (Plotted tsunami trace height were observed close to the coast)

little or no damages caused

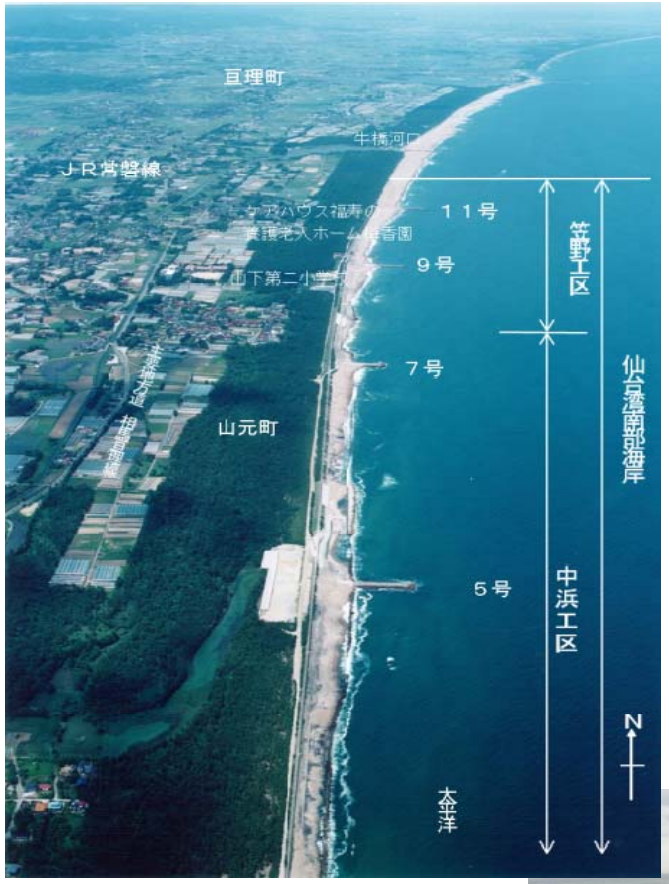


※The 2011 Tohoku Earthquake Tsunami Joint Survey Group report (As of May 3) (http://www.coastal.jp/ttjt/)

Damages to the Coastal Levees

○ Along the 1,700km coast of Iwate, Miyagi & Fukushima prefectures, there were 300km of coastal levees.
○190km of the levees were fully or half destroyed.

【Sendai Gulf Southern Coast】



Before

【Kasano District】

After

Photo on March 12, 2011

Damages to Rivers

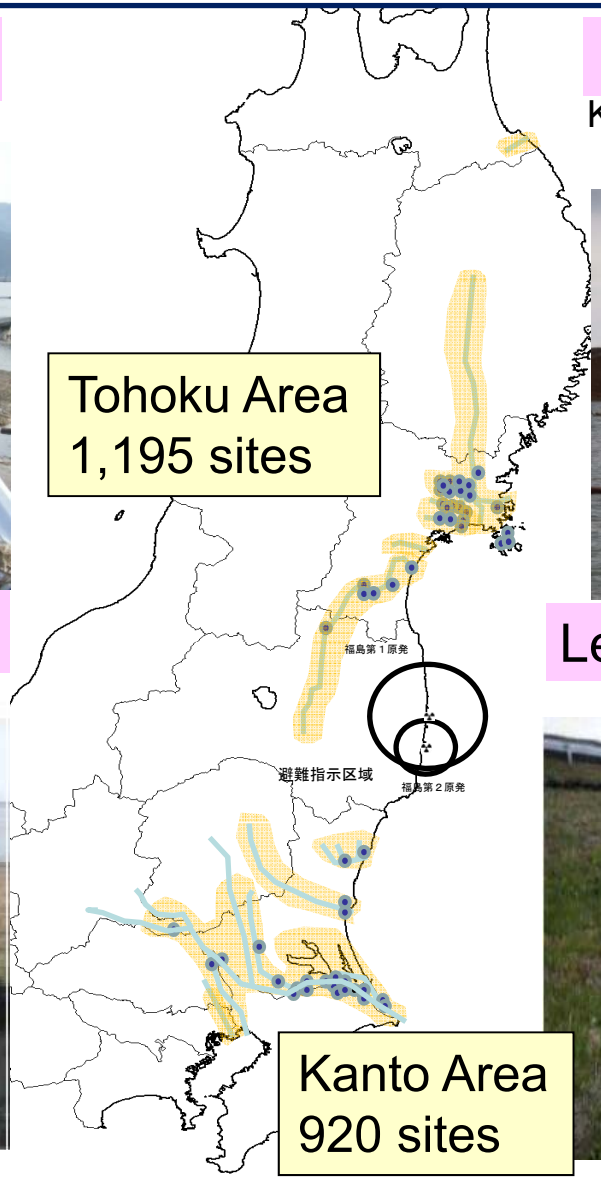
○River levees in Tohoku and Kanto regions were washout/failure, subsidence, slope failure, etc.
○2,115 sites were identified to be damaged, a little less than half were caused by liquefaction in Kanto region.

Levee washout/failure

Kitakami River【Ishinomaki City】

Levee Sinkage

Kasumigaura Lake 【Inashiki City】



Damaged Gates

Kitakami River (Kamaishi Gate)
【Ishinomaki City】

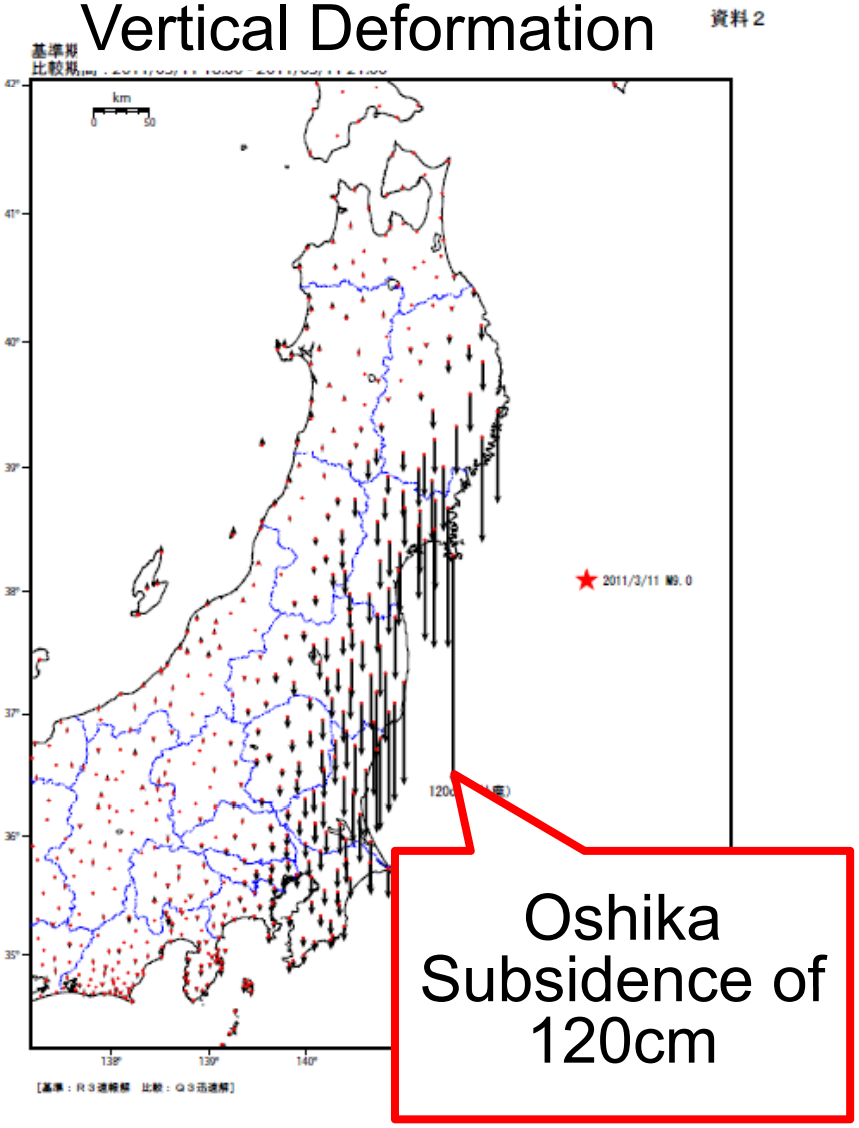
Levee slope failure

Edo River 【Satte City】

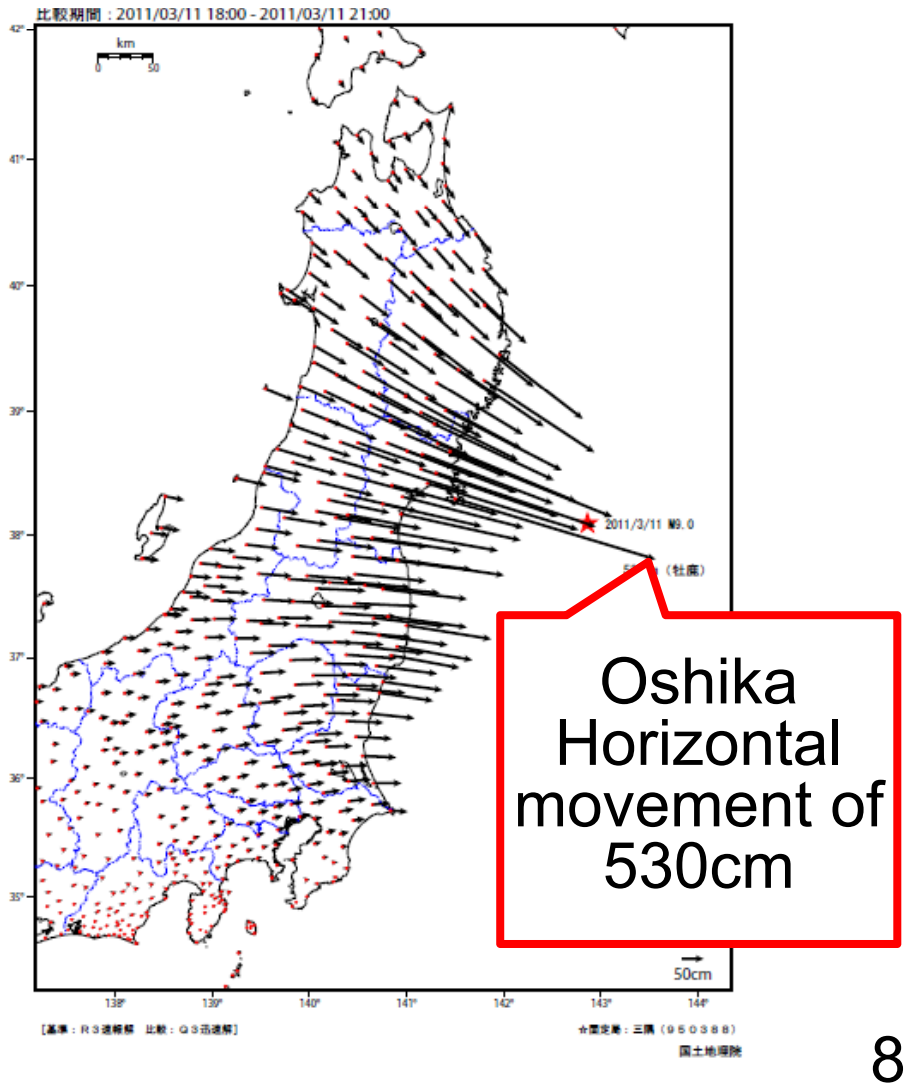
Deformation caused by the Earthquake

Deformation occurred over a large area due to the Tohoku Earthquake.

Vertical Deformation

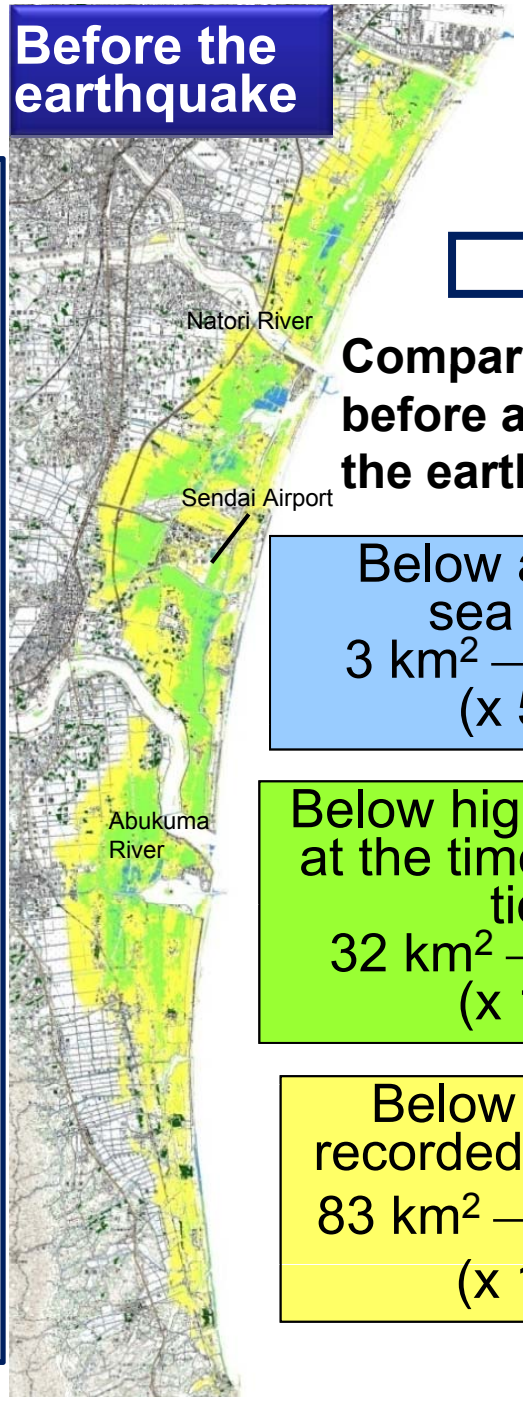


Horizontal Deformation



Subsidence

- Earthquake deformation caused extensive subsidence in the Sendai plain.
- Announced the status of subsidence based on the Laser Profiling (LP) surveys.
- The extent of the area below the mean sea level increased by 5.3 times.
- Tsunami destructed coastal levees along the entire coastline.
- Sendai plain's safety level against storm surges have been reduced significantly.
- The flood forecast warning standards have been lowered accordingly.

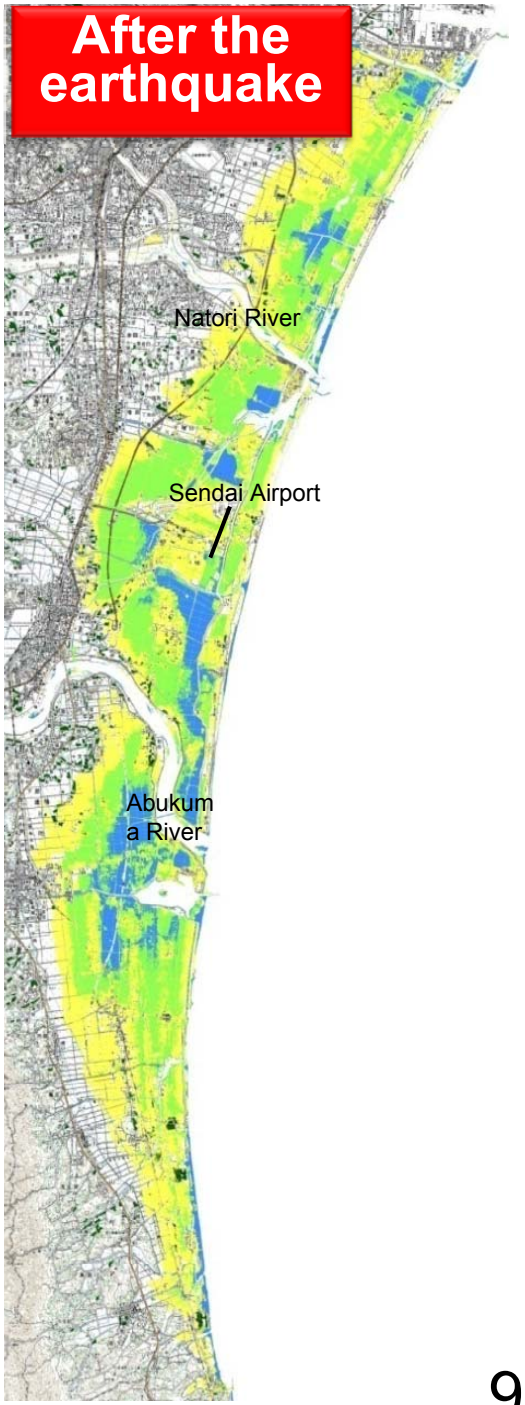


Comparing areas before and after the earthquake

Below average sea level
3 km^2 → 16 km^2
(x 5.3)

Below high tide level at the time of spring tide
32 km^2 → 56 km^2
(x 1.8)

Below largest recorded sea level
83 km^2 → 111 km^2
(x 1.3)



Surveyed in 2005 and 2008

Surveyed in 2011

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Basic Principles for MLIT's Emergency Response

- Give primacy to saving lives, and exert every possible effort in rescue and relief operations and securing of emergency transportation routes by land, air or sea.

- Vigorously pursue such measures as livelihood assistance to affected persons, sustaining of logistics operations, rehabilitation of facilities under the jurisdiction of MLIT such as roads, ports, airports, railways and rivers, securing of housings for victims and assistance to disaster-affected municipalities.

Establishment of MLIT's Emergency Headquarters

- ○ Established MLIT's Emergency Headquarters at 15:15 (approx. 30 minutes after the quake)
  Chief of headquarters: Minister of MLIT , Members of headquarters：Director-Generals of MLIT's Bureaus
- ○ The first meeting was held from 15:45, March 11. Meetings were held three to four times a day in the period immediately after the earthquake. 49 meetings have been held since.
- ○ Information is shared simultaneously with regional development bureaus nationwide by utilizing the TV conference system.
- ○ Prompt information sharing, quick decision-making and implementation of measurements could be achieved.

MLIT's Emergency Headquarters

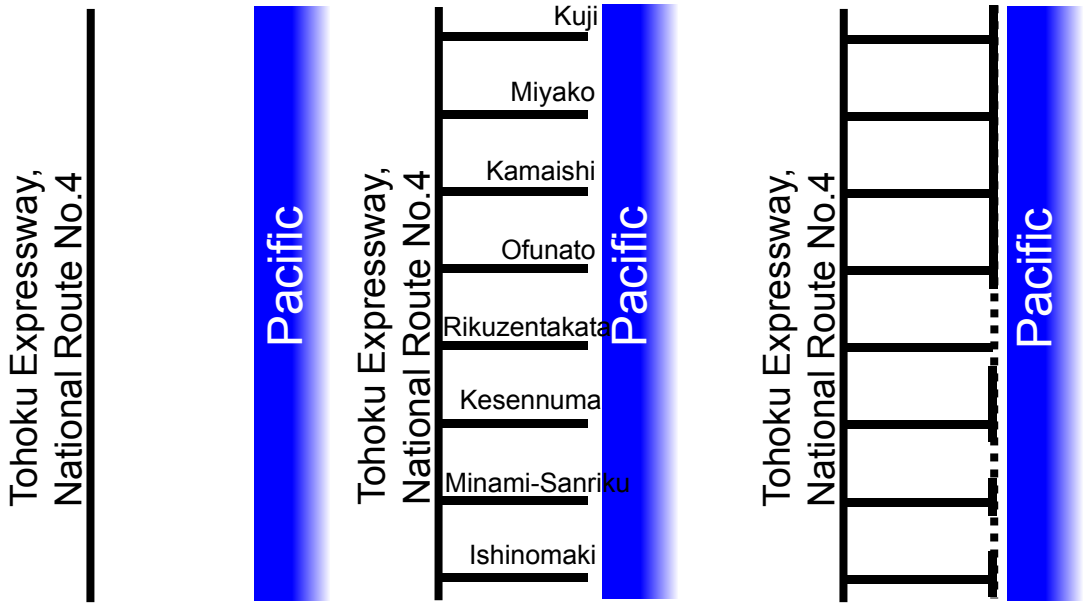
Restoration of Roads （Operation “Toothcomb”）

Mar. 11: Earthquake occured

<First Step>
Establish the vertical artery

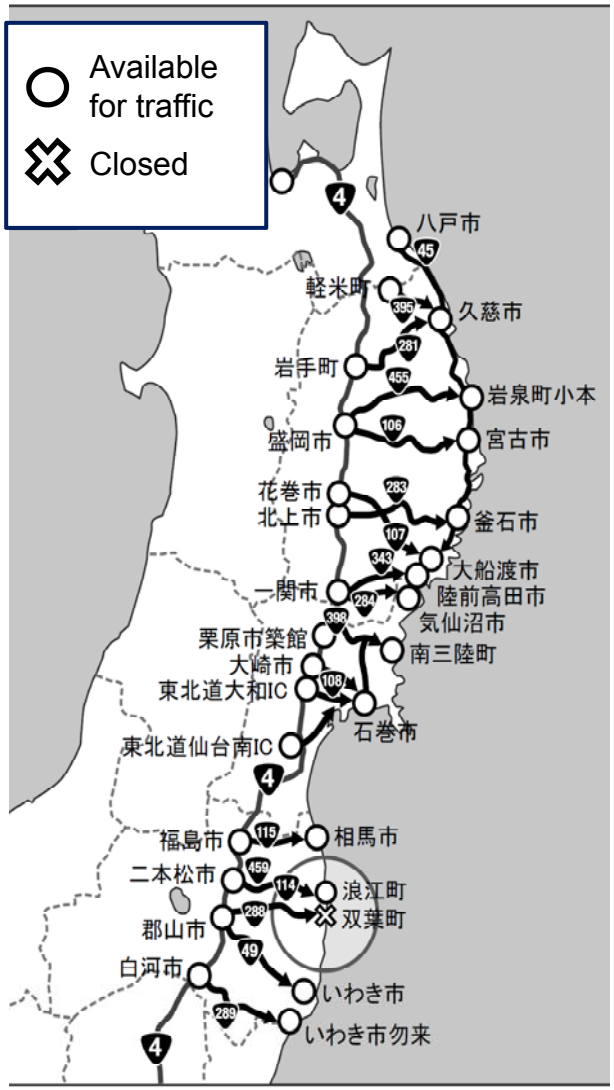
<Second Step>
Mar. 15: Establish the horizontal lines

<Third Step>
Mar.18： National Route No.45 & 6 were 97% rehabilitated (operation completed)



<Reasons for the fast restoration of roads>
①Damages of bridges were reduced by antiseismic reinforcement.
②Concentrated efforts on clearing the “16 routes” under the “Toothcomb Operation”.
③Cooperation of local construction companies based on the disaster agreement.

Toothcomb Operation



Restoration of Roads

Rikuzentakata City, Iwate Prefecture

Before Road Restoration
（March 16, 2011）

During Road Restoration
（March 16, 2011）

Emergency Rehabilitation of Roads

Kesen Ohashi Bridge, Rikuzentakata City, Iwate Pref.

Superstructure of the bridge washed away by tsunami (March 19, 2011)

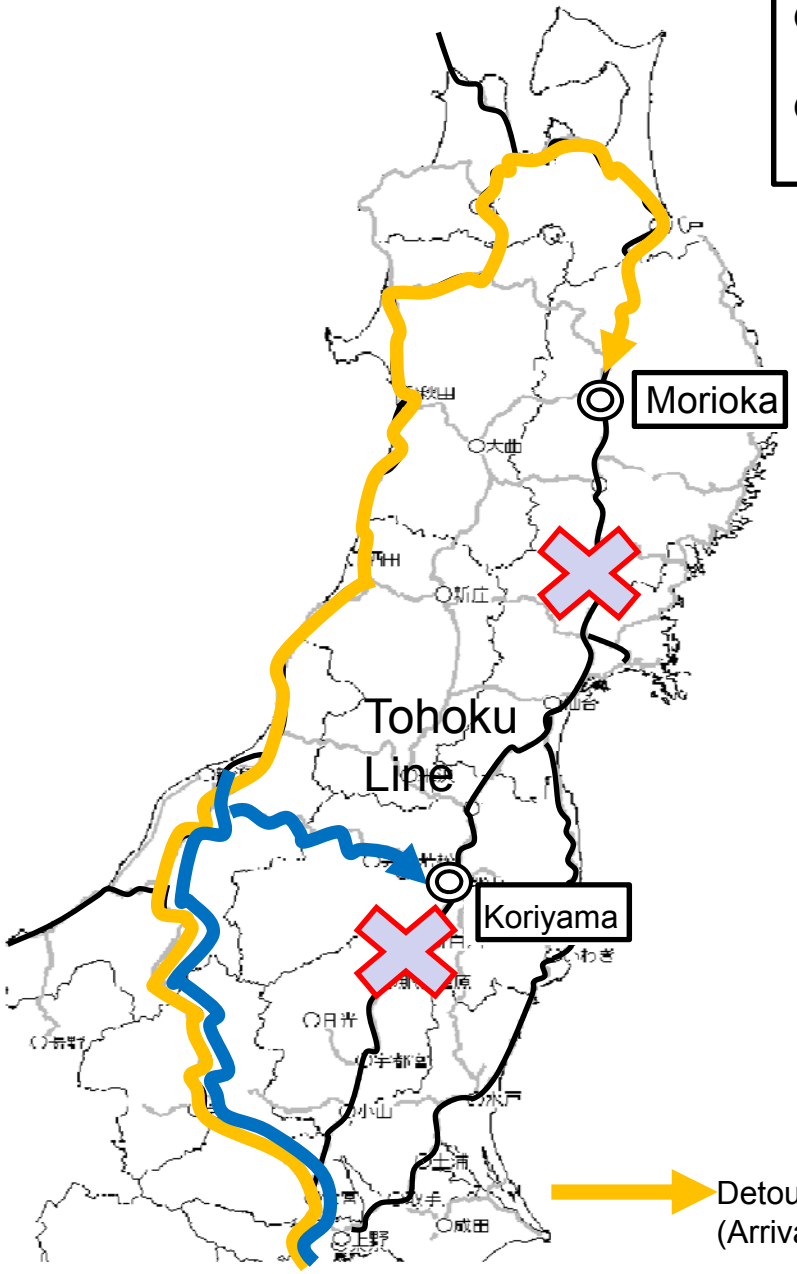
Temporary bridge was built to secure transportation route (July 12, 2011)

Restoration of Sendai Airport

○Sendai Airport was severely damaged by inundation caused by massive tsunami.
○Early recovery efforts were performed to clear the runway for rescue planes.
○Water draining began on March 17 by water drainage pump vehicles.
March 29: 3,000m-runway usable day and night.
April 13: Operation of civilian airplanes resumed.

Water drainage at Sendai Airport started on March 17.

Transportation of Petroleum by Freight Train



- Due to disruption of Tohoku JR Line, transportation of petroleum to Morioka and Koriyama became unable.
- Instead of the Tohoku Line, the freight trains carrying petroleum were operated through the Japan Sea side.

Approx. 57,000kl (about 2,850 20kl-tanker trucks) of petroleum was transported in about one month period before the Tohoku Line resumed.
The operation contributed to easing of fuel shortage in the disaster affected areas.

→ Detour route for Morioka (Arrival at Morioka Mar. 19 – Apr. 20)

→ Detour route for Koriyama (Arrival at Koriyama Mar. 26 – Apr. 16)

TEC-FORCE Dispatch

○TEC-FORCE (Technical Emergency Control Force)
Specialist group that provides technical assistance for fast rehabilitation in the affected areas at the time of large scale natural disasters. (consists of MLIT staff)

○62 staff were dispatched on the day of the disaster, 397 staff the next day and there were more than 500 staff by three days later. (18,115 person-day as of Jan 9, 2012)

18,115 person-day as of Jan 9, 2012

Survey of disaster affected areas

Supporting affected municipalities (technical assistance)

Information & communication team (satellite communication vehicle)

Survey of disaster affected rivers

local needs survey

Disaster emergency response (emergency flood removal)

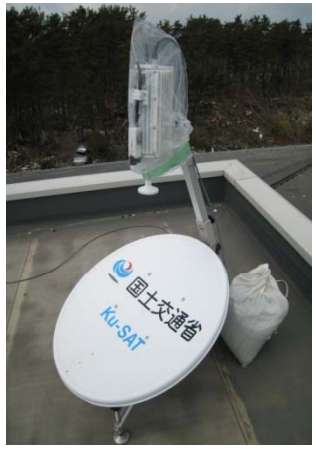
TEC-FORCE Dispatch (Disaster response equipment)

■Drainage pump vehicles (30m^3/min)

■Satellite phones

■Movable task force HQ

■Ku-SAT
(Small satellite aperture terminal)



■Lighting vehicle

Assisting disaster affected municipalities (liaison officers)

○ Municipalities in coastal areas suffered severe damages to their buildings and to their staff, and their self-governing functions were paralyzed. MLIT officials (directors of regional bureaus or deputy general managers of local offices) who know well about disaster response were dispatched to afflicted municipalities from the day after the disaster (for about 80 days).

○ Promptly implemented information sharing, field surveys, and needs assessment of municipalities.

Attending the headquarters meeting (Kuji City, Iwate Pref.)

Attending the headquarters meeting (Tanohata Village, Iwate Pref.)

On-site investigation (Yamada Town, Iwate Pref.)

Inspection of temporary housing (Yamada Town, Iwate Pref.)

Assisting disaster affected municipalities (restoration of telecommunications)

- ○ Dispatched satellite communication vehicles to municipalities with paralyzed telecommunication systems where phone lines and mobile phone base stations were severely damaged by the earthquake and tsunami.
- ○ Restored communication between Regional Development Bureaus and municipalities and between the headquarters and branch offices of those municipalities.
- ○ Quick recovery of telecommunications enabled MLIT to gather information on the extent of damages and to understand the needs of municipalities, and to deliver appropriate support for municipalities.

Allocation of satellite communications vehicles
(Ofunato City, Iwate Pref.)

Installation of Ku-SAT
(Tanohata Village, Iwate Pref.)

Assisting disaster affected municipalities (Procurement of relief supplies)

- ○ Based on the needs of the municipalities, the relief supply procurement team was organized on March 13. (with cooperation of Japan Civil Engineering Contractors Association, Inc., etc)
- ○ Responded until March 31 when transportation and telecommunications started to normalize.
- ○ Delivered requested relief supplies in 3 days on average and with over 90 % achievement rate.

Relief supply procurement team（Tohoku Regional Development Bureau）

Temporary housing（Minamisanriku Town ）

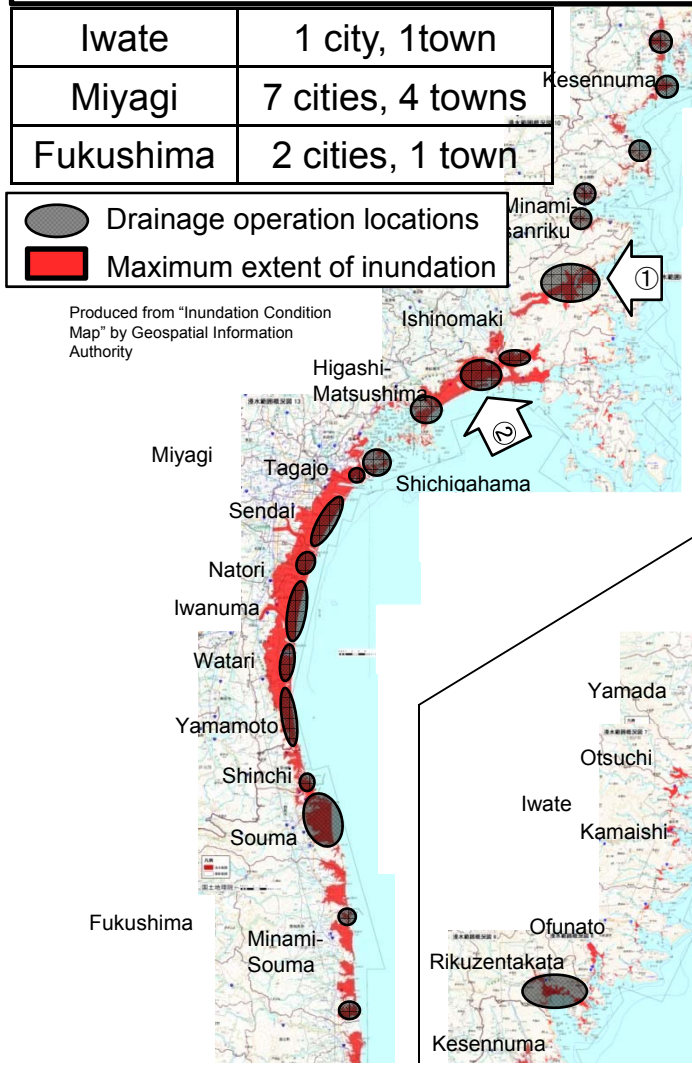
Washing machines

Temporary lavatories

Emergency Water Drainage Measures

- ○ Pacific coastal regions were widely inundated due to tsunami.
- ○ In areas where natural drainage was difficult due to the large extent and depth of inundation, drainage pump vehicles of MLIT gathered from around the country were utilized to conduct intensive drainage operation.
- ○ 3,945 vehicle-day of drainage pump vehicles operated in 10 cities and 6 towns.

Iwate	1 city, 1town
Miyagi	7 cities, 4 towns
Fukushima	2 cities, 1 town



① Kanaya, Ishinomaki City

② Oomagari, Higashi-Matsushima City

Emergency Rehabilitation of Coastal Levees

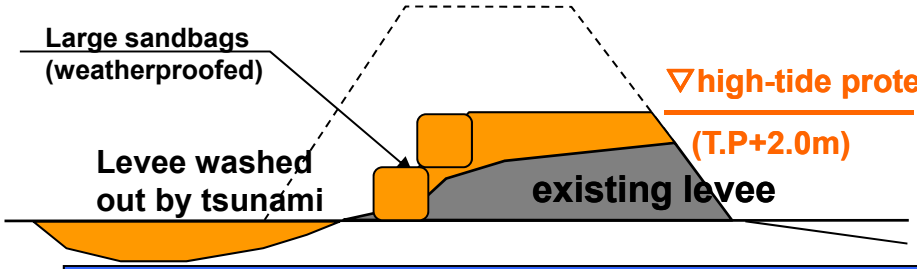
Sendai Bay Southern Coast (Kabasaki Coast) (Iwanuma City, Miyagi Pref.)

Destroyed Levees
(April 26, 2011)

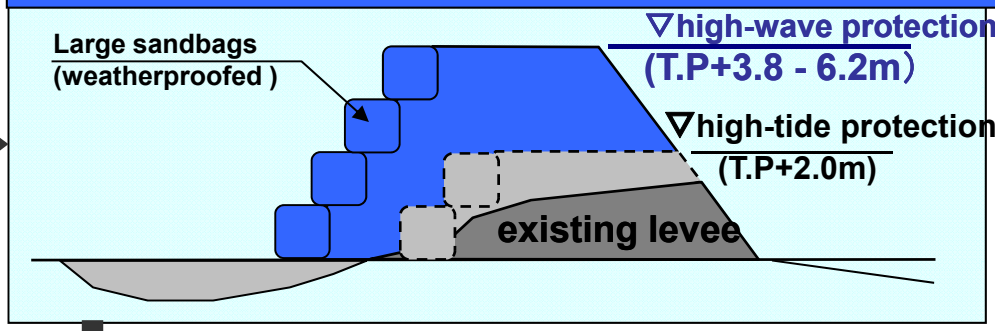
Rehabilitation work (August 31, 2011)

Reconstruction of Coastal Levees

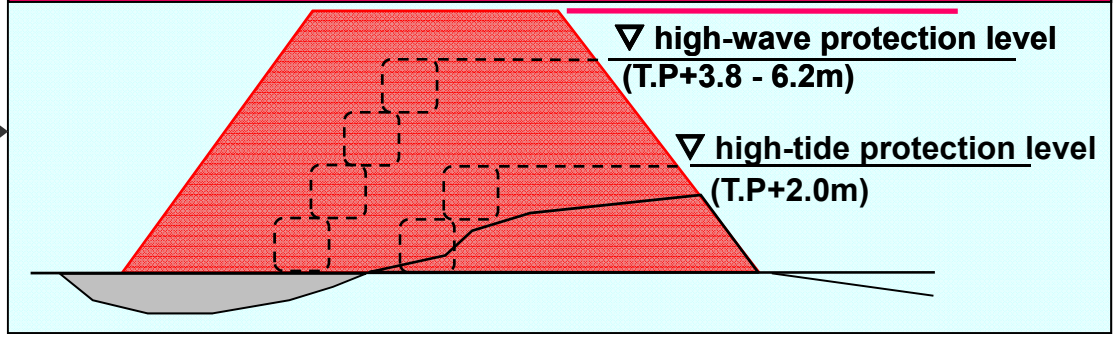
Step 1 (Emergency rehabilitation 1) - completed by flood season



Step 2 (Emergency rehabilitation 2) - completed by the typhoon season -



Step 3 (full rehabilitation) - to be completed in about 5 years -



▲ Yamamoto Coast
Miyagki Pref.

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Fundamental Strategy for Tsunami Disaster Measures

Reducing human and economic damages by “disaster mitigation” is the fundamental for all levels of tsunami.

Comparatively Frequent Tsunami

- ○Aim to ensure protection of human lives, assets and national land (coastal line), etc against comparatively frequent tsunami (once every several tens of year to a hundred year and several tens of year) on the basis of constructing coastal protection facilities.
- ○Conduct technical development and improvement of structures so that they cannot be easily broken even when the tsunami height exceeds the design level.

Largest Scale Tsunami

- ○Aim to prevent as much human damages as possible against largest scale tsunami by “Integrated Prevention” combining structural and non-structural measures such as land use regulation, building code and emergency/evacuation procedures.

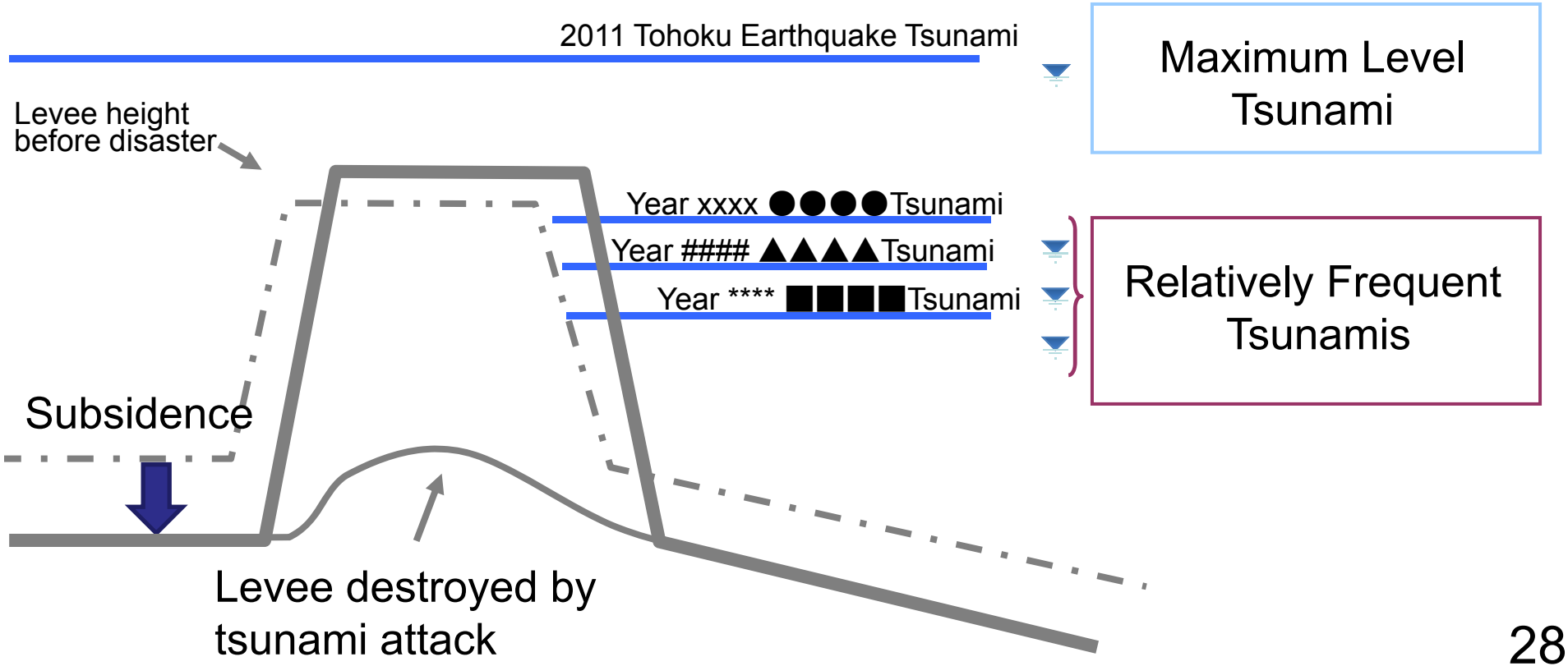
Determining the Height of Coastal Levees (1/2)

Determining Design Tsunami Level, the basis for Coastal Levee Height

For the series of coastlines and ports:

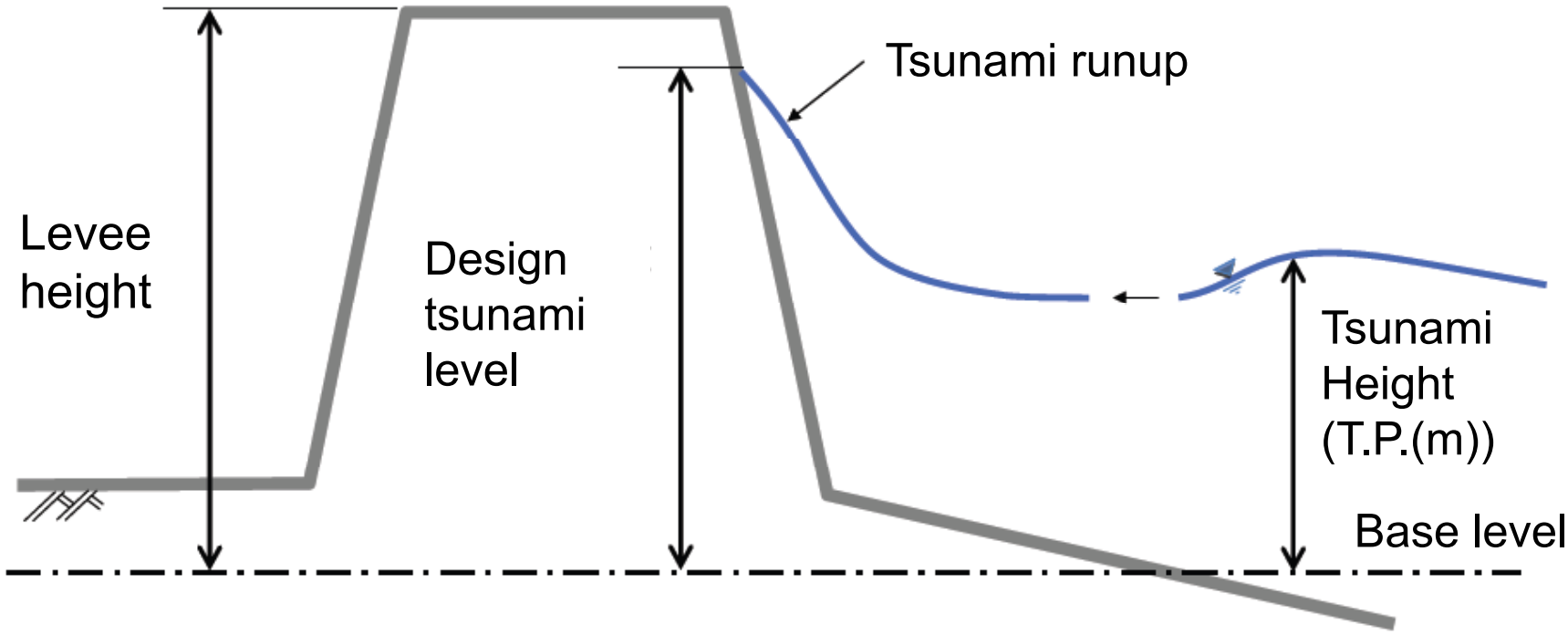
- Historical tsunami trace height records are investigated
- Conduct tsunami simulation for earthquakes with high probability of occurrence

➡ Design tsunami level is set by tsunamis occurring every several tens of years to a hundred and several tens of years



Determining the Height of Coastal Levees (2/2)

○ Levee height is set by considering the environmental aspects, economic efficiency and manageability.



Preparedness for Largest Scale Tsunami (Tsunami-Resistant City)

Outline of the Act for Tsunami-Resilient City

○In order to prevent/reduce tsunami disasters in the future, develop a standard institutional system to be utilized nationally and promote “tsunami resilient city” through “integrated prevention” incorporating structural and non-structural measures.

1. Basic Guidelines to be set by Minister for Land, Infrastructure, Transport and Tourism.
2. Tsunami Inundation Assumption to be set by Governors.
3. Promotion Plan (a plan to comprehensively promote tsunami resilient city) to be prepared by municipalities.
4. Development of tsunami adaptation structures

   Prevent expansion of inundation
5. “Tsunami Disaster Security Zones” to be designated by Governors.

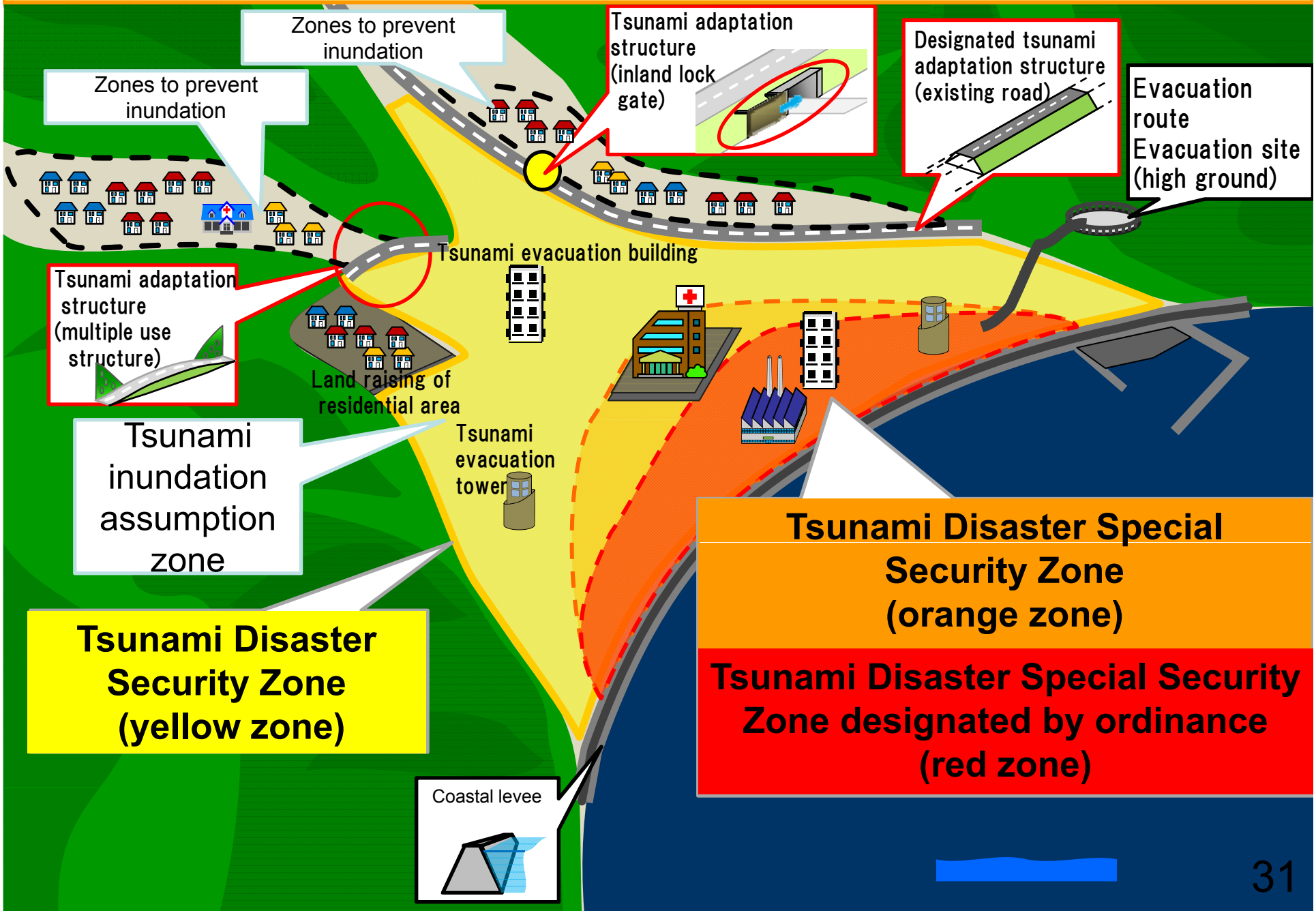
   Escape from tsunami

   (Yellow zone: development of preparedness and evacuation procedures)
6. “Tsunami Disaster Special Security Zones” to be designated by Governors.

   Avoid tsunami

   (Orange and Red zone: land use regulation)

Image of Tsunami-Resilient City



Yellow Zone (Tsunami Disaster Security Zone)

Zones where residents or others have possibilities of loosing their lives or being injured by tsunamis.

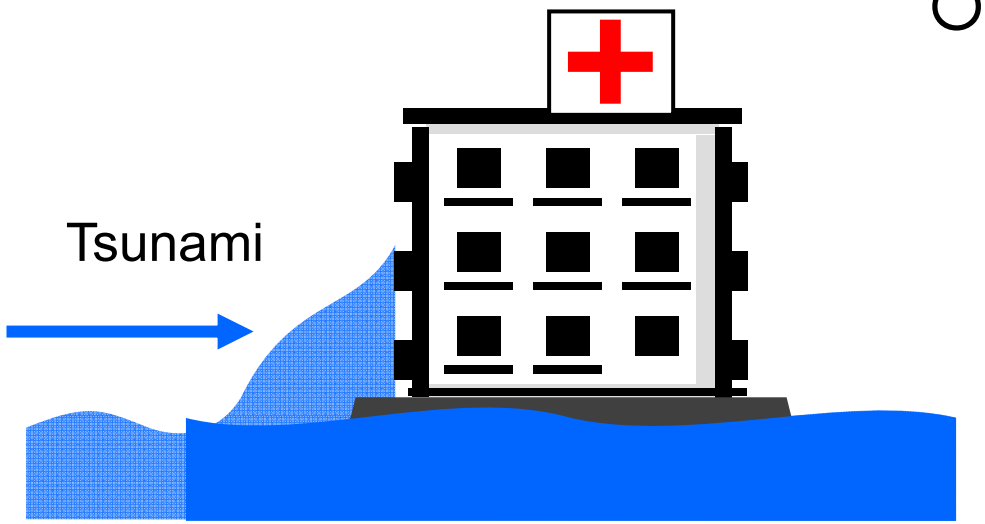
➡ Development of preparedness and evacuation procedures (Escape from tsunami)

- ○ Inclusion of tsunami preparedness/evacuation procedures (evacuation facilities/routes, tsunami evacuation drills, information delivery, etc) in the local disaster management plans for municipalities
- ○ Preparation of tsunami hazard maps by municipalities
- ○ Designation of evacuation facilities and execution of management agreements (succession effective) by municipalities
- ○ Preparation of evacuation plans or implementation of tsunami evacuation drills in underground facilities or facilities used by people who need assistance for evacuation

Orange Zone (Tsunami Disaster Special Security Zone)

Zones included in the Yellow Zone where residents or others have high possibilities of loosing lives or being injured by tsunami.

➡ Land Use Regulations (Avoid Tsunami)



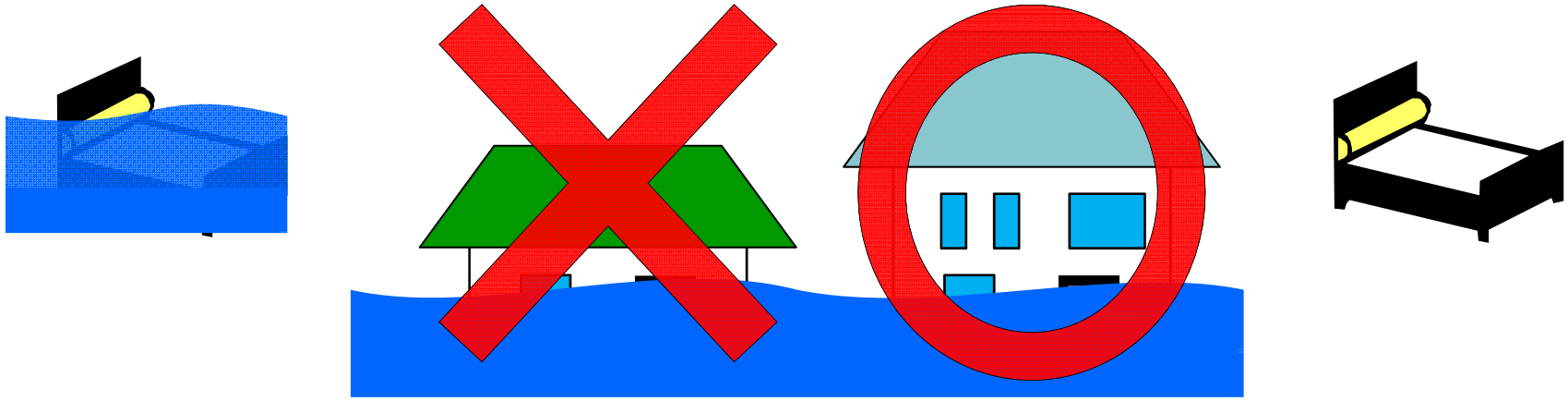
○ Hospitals and social welfare facilities

- Building or embankment structures to be safe against tsunamis
- Floor level of rooms to be above the tsunami water level

Red Zone (Tsunami Disaster Special Security Zone designated by ordinance)

Zones included in the Orange Zone where persons can not evacuate smoothly or promptly when tsunami occurs.

➡ Land Use Regulations (Avoid Tsunami)



○ Residential houses

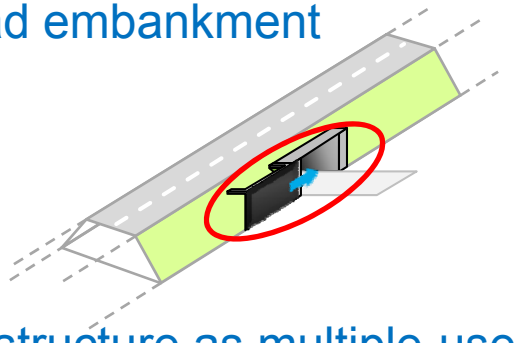
- Building or embankment structures to be safe against tsunamis
- Floor level of rooms or rooftop where persons can evacuate to be above the tsunami water level

Development of Tsunami Adaptation Structures
(Prevent inundation expansion)

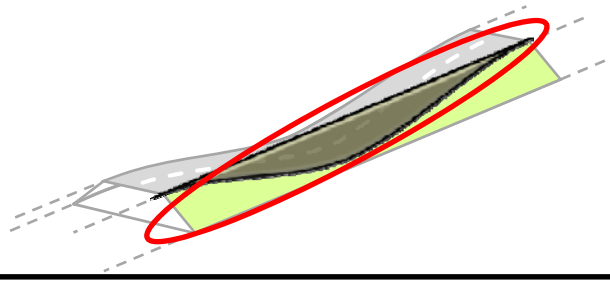
○ Tsunami Adaptation Structures
Such structures as embankment structures, inland lock gates, protective walls or breast-walls built and managed by governors or mayors based on the tsunami inundation assumptions in order to prevent or mitigate human damages caused by tsunami disaster.

Schematics of Tsunami Adaptation Structure

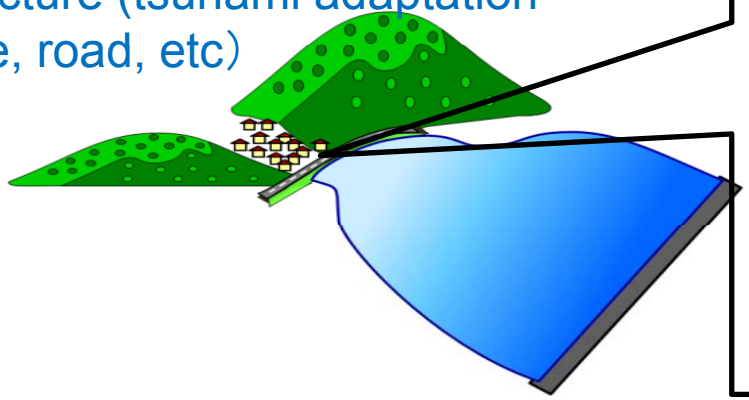
○ Installation of inland lock gate to existing road embankment

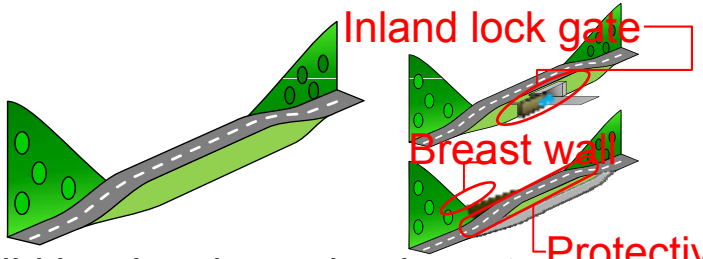


○ Installation of breast-wall to existing road embankment



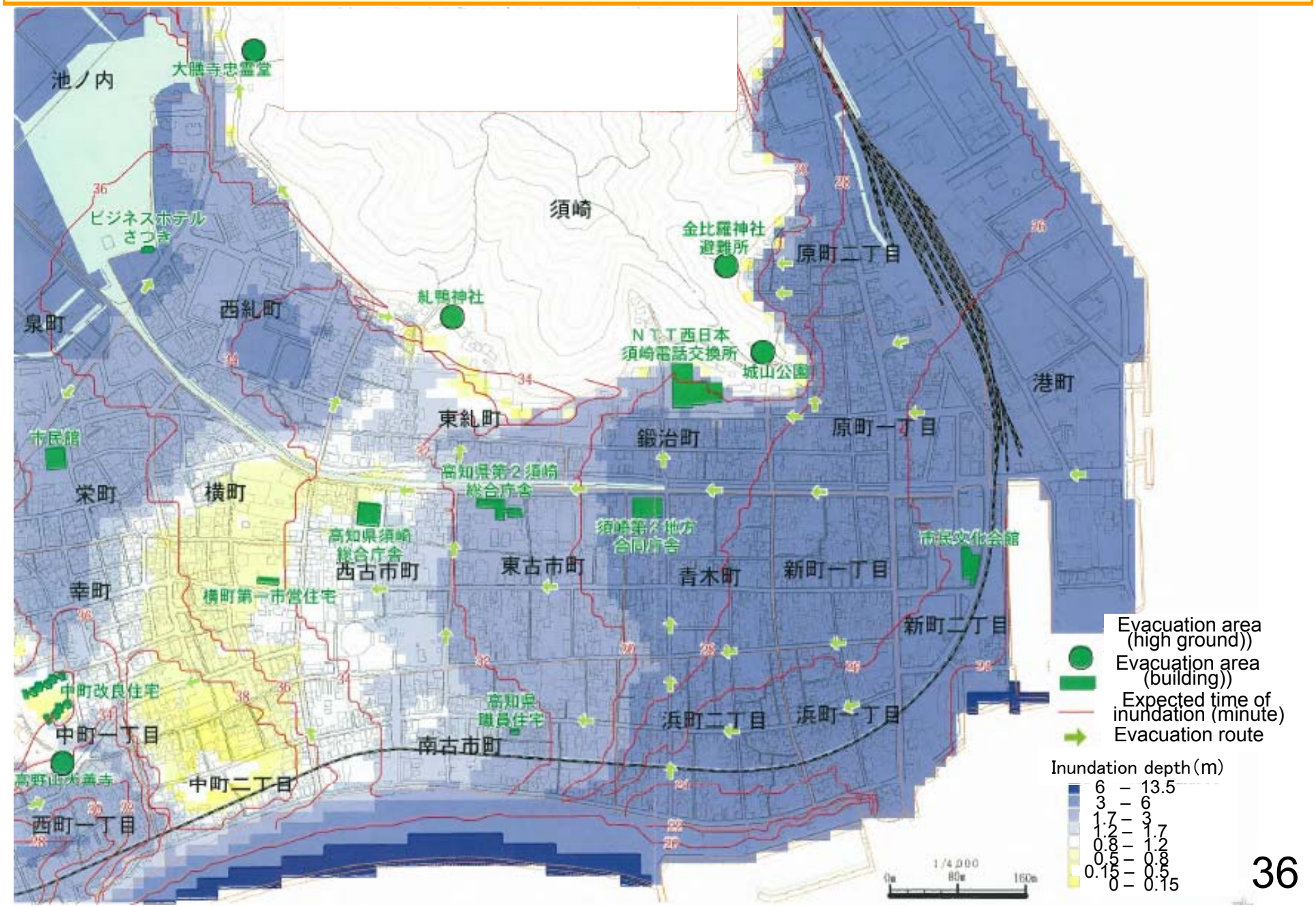
○Embankment structure as multiple-use infrastructure (tsunami adaptation structure, road, etc)





* Build barriers by embankment
* Install lock gate or protective walls as necessary

Making and publishing Hazard Map



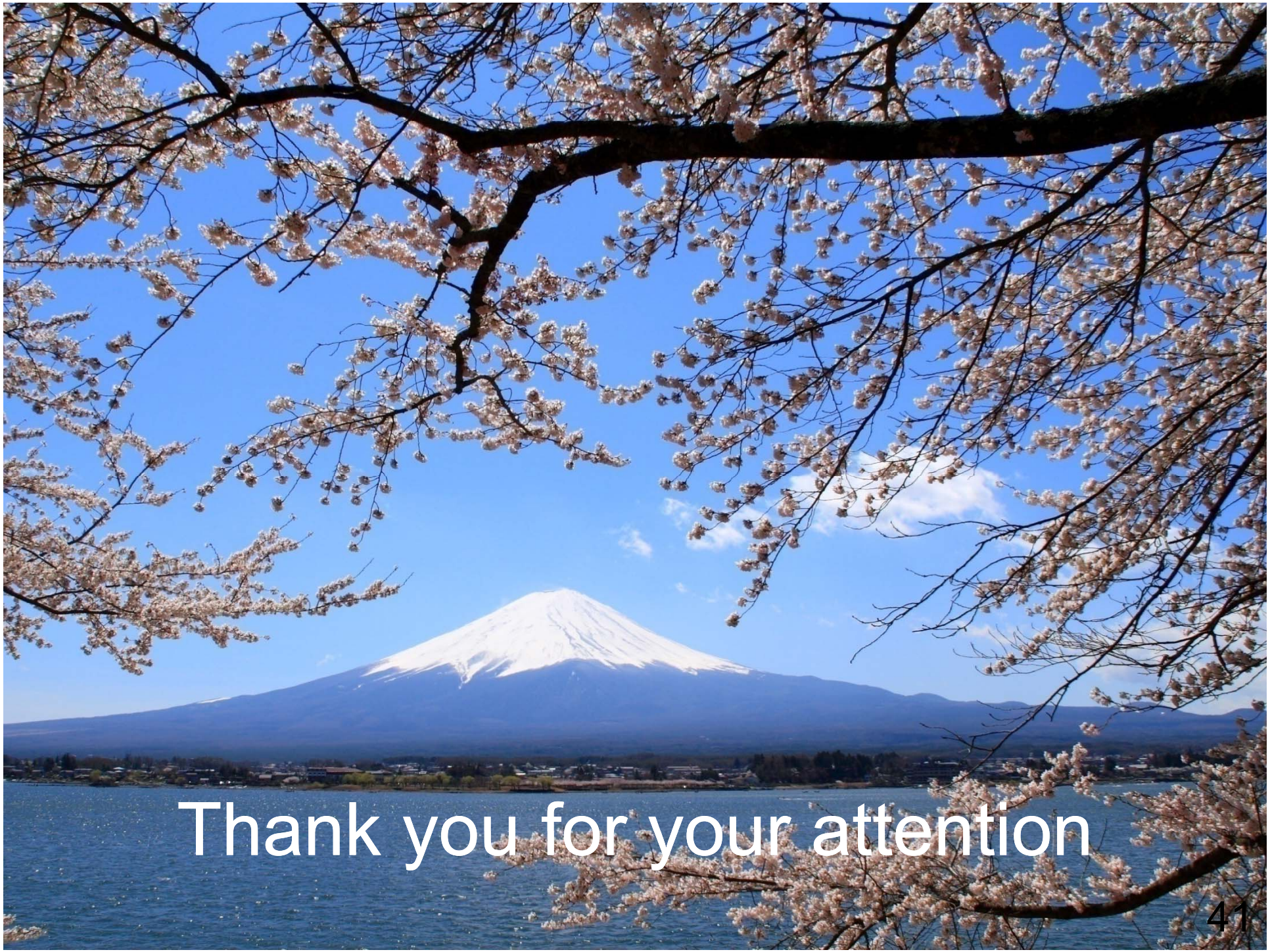
Designating Tsunami Evacuation Building

Constructing Evacuation Route

Conducting Evacuation Drill

Conclusion

- Immediately after the earthquake, lifesaving operation was the top priority. MLIT implement the following measures by utilizing its human resources and materials & equipment deployed nationwide.
  - Restoration of roads
  - Assisting disaster affected municipalities
  - Securing of emergency transportation routes
  - Emergency rehabilitation of social infrastructure etc.
- Based on the recent policy changes regarding tsunami disaster countermeasures, human and economic damage will be mitigated for tsunamis of all scales through the principle of “disaster reduction”.
  - For comparatively frequent tsunami, prevent damage in principle by construction of coastal levees
  - For largest scale tsunami, aim to prevent human damage as much as possible by “integrated prevention”, combining such measures as development of tsunami resilient city and establishment of emergency evacuation procedures


Thank you for your attention