

Highway Closure Restriction before Disaster with Considering Intensity and Cumulative Volume of Rainfall

6th March 2025

MITSUISHI Akira

East Nippon Expressway Co., Ltd. (NEXCO East)

あな た に、ベ ス ト・ウ ェ イ。



➡ Why is O&M important?

Lessons Learned from Failures

➡ Early Warning System

History in Japan

What is Early Warning?
System

Weather Station Installation

Methods/Criteria

Operation

➡ Why is O&M important?

Lessons Learned from Failures

➡ Early Warning System

History in Japan

What is Early Warning?
System

Weather Station Installation

Methods/Criteria

Operation

Lessons Learned from Failures (Road Operation, Landslide)

NEXCO



► Why is O&M important?

Lessons Learned from Failures

► Early Warning System

History in Japan

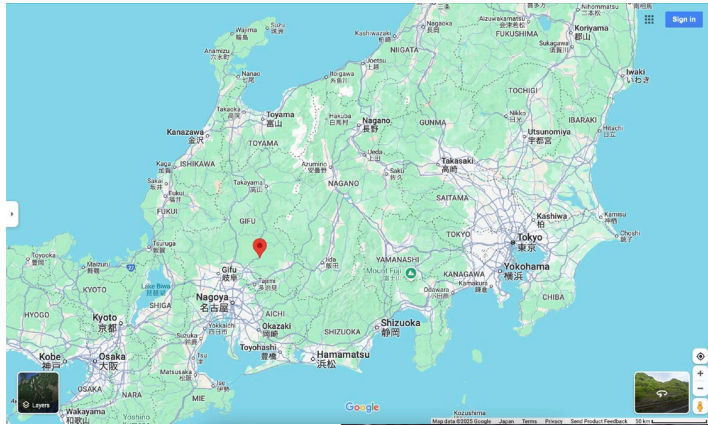
What is Early Warning?
System

Weather Station Installation

Methods/Criteria

Operation

1.1 History of Early Warning in Japan



1.2 History of Early Warning in Japan



- In 1968, two tourist buses were involved in a mud slide on NH41 in Central Japan because of extraordinary heavy rain.
- The buses dropped into the river next to the NH, which caused the fatalities of 104 passengers.
- Historically, it was common to close section(s) of highways **after** being hit by a landslide or other disaster.
- Based on this tragedy, the concept of early warning was introduced to national highways.
- Expressways also introduced early warning from 1973.

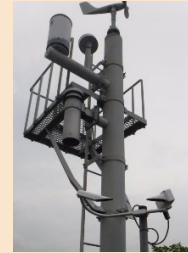
2. What is Early Warning in Japan?



- Early Warning aims to proactively regulate and close road section before a disaster occurs in order to secure the safety of road users, together with adequate slope protection work.
- In sections with mountainous/steep terrain, road operators set a threshold (criteria value) to conduct patrol and road closure, based on the history of rainfall and disasters.
- This does not mean that slope protection is not necessary.
- Weather stations are installed along roadway in order to monitor real-time weather conditions so that road operators can perform patrolling and road closure at the right time and place.

3. System of Early Warning

Collection of Weather Data



Weather Station (Rain, Wind, Temp., etc.)

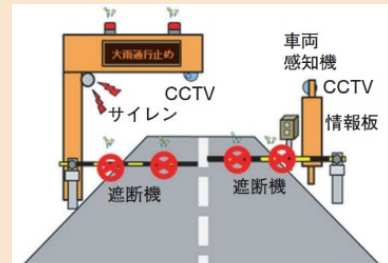
Monitoring at Office

Threshold Value (Example)

- Road Closure: Accumulated rainfall amount: 340mm
- Caution(Patrolling): Accumulated rainfall amount: 180mm
Hourly rainfall: 30mm/hr*

*after 180mm accumulated rainfall

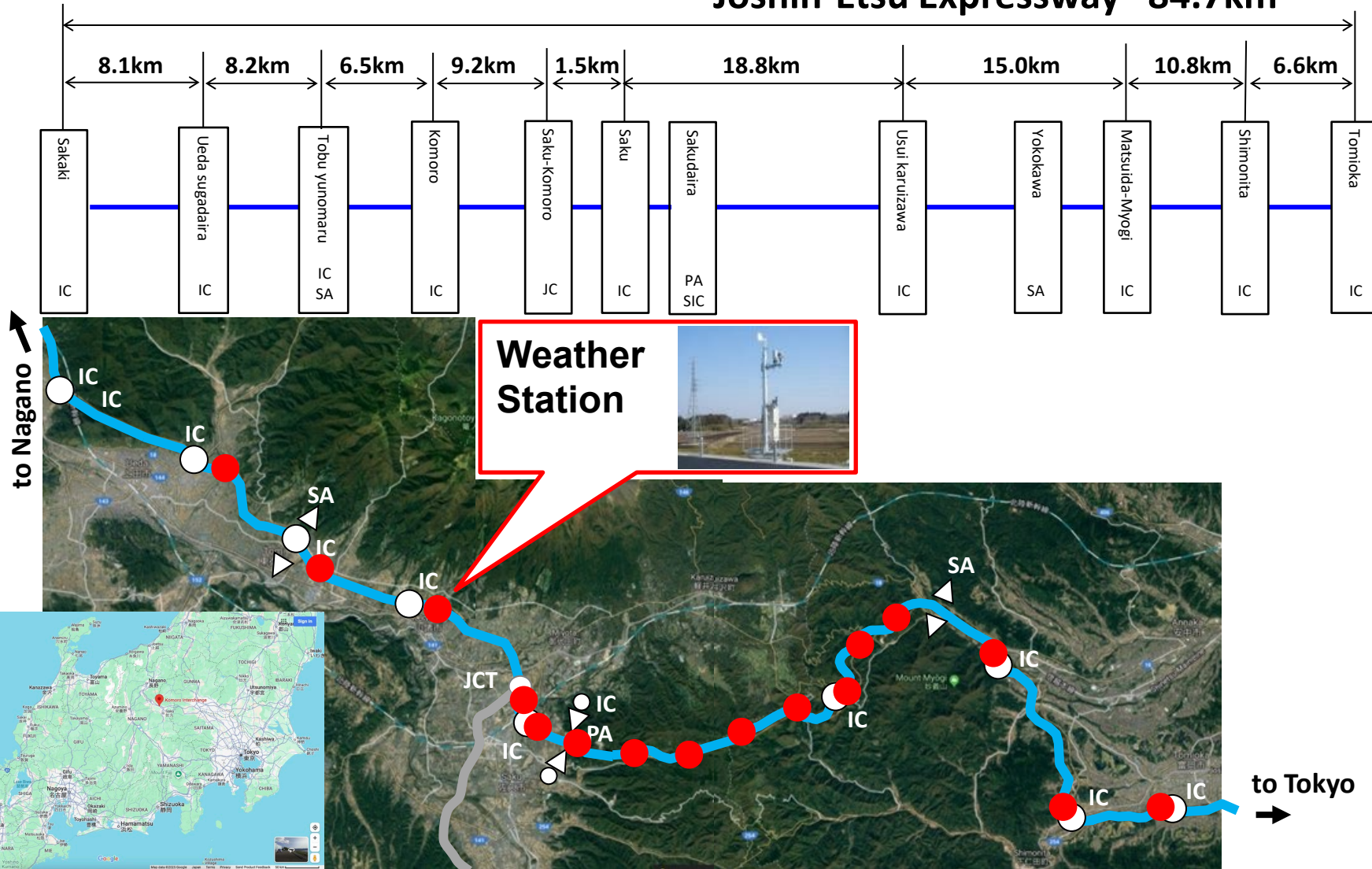
- Patrolling
- Road Closure
- Information Provision to Road Users



4. Weather Station Installation (Example)

NEXCO

Joshin-Etsu Expressway 84.7km



Weather Station



NEXCO
東日本

IC: Interchange, JCT: Junction, SA: Service Area, PA: Parking Area, PA: Parking Area, SIC: Smart Interchange only for ETC cars

5. Method

Two methods are widely being used in Japan;

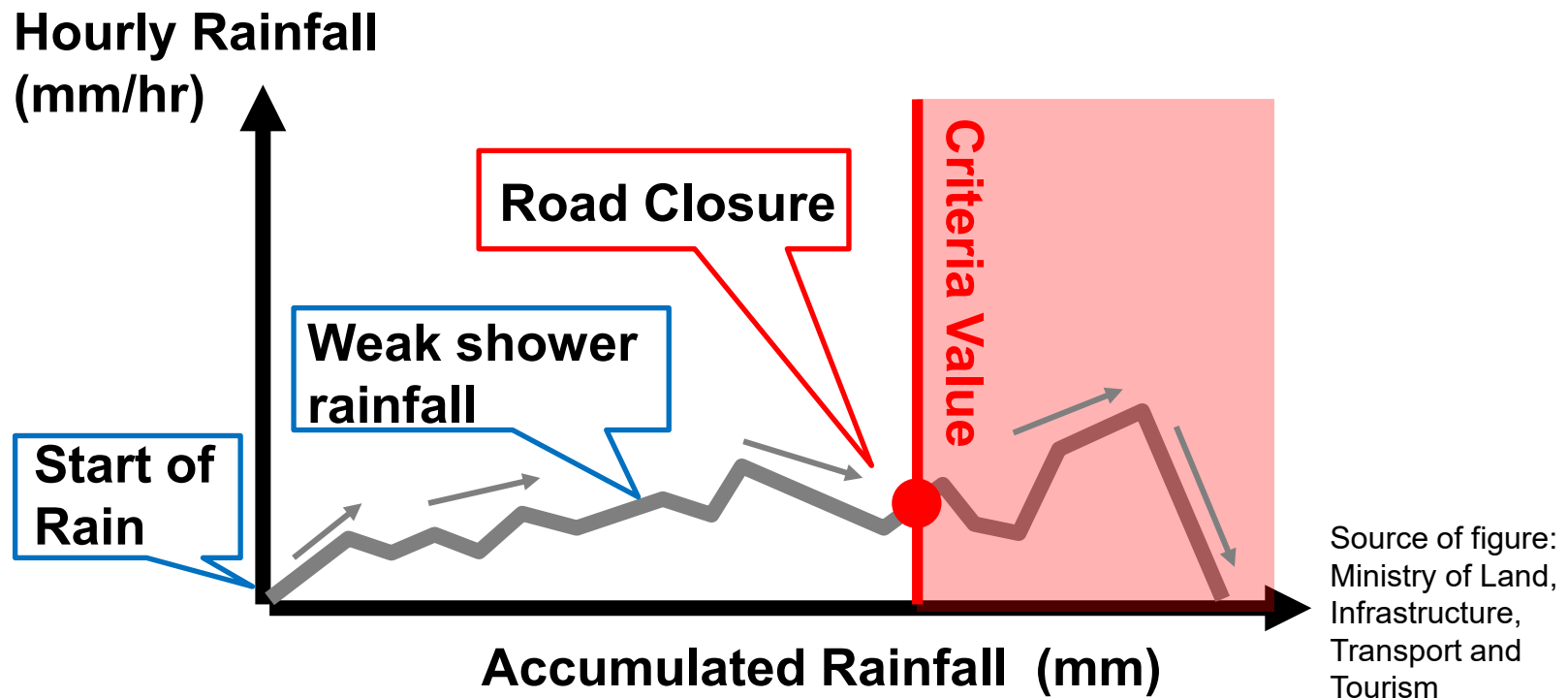
(1) Accumulated rainfall

(2) Combination of accumulated rainfall and hourly rainfall

Method	(1) Accumulated Rainfall	(2) Combination of Accumulated Rainfall and Hourly Rainfall
Road Category	National Highway	Expressway/some NHs in trial
Threshold (Criteria)	- Accumulated Rainfall only	- Accumulated Rainfall - Hourly Rainfall
Advantage	- Easiness of operation (arrange of workers and equipment)	- More reliable method (both accumulated rainfall and rain intensity are taken into account)
Disadvantage	- Heavy rainfall in a short period of time is not taken into account	- Appropriate monitoring system and human resources are necessary

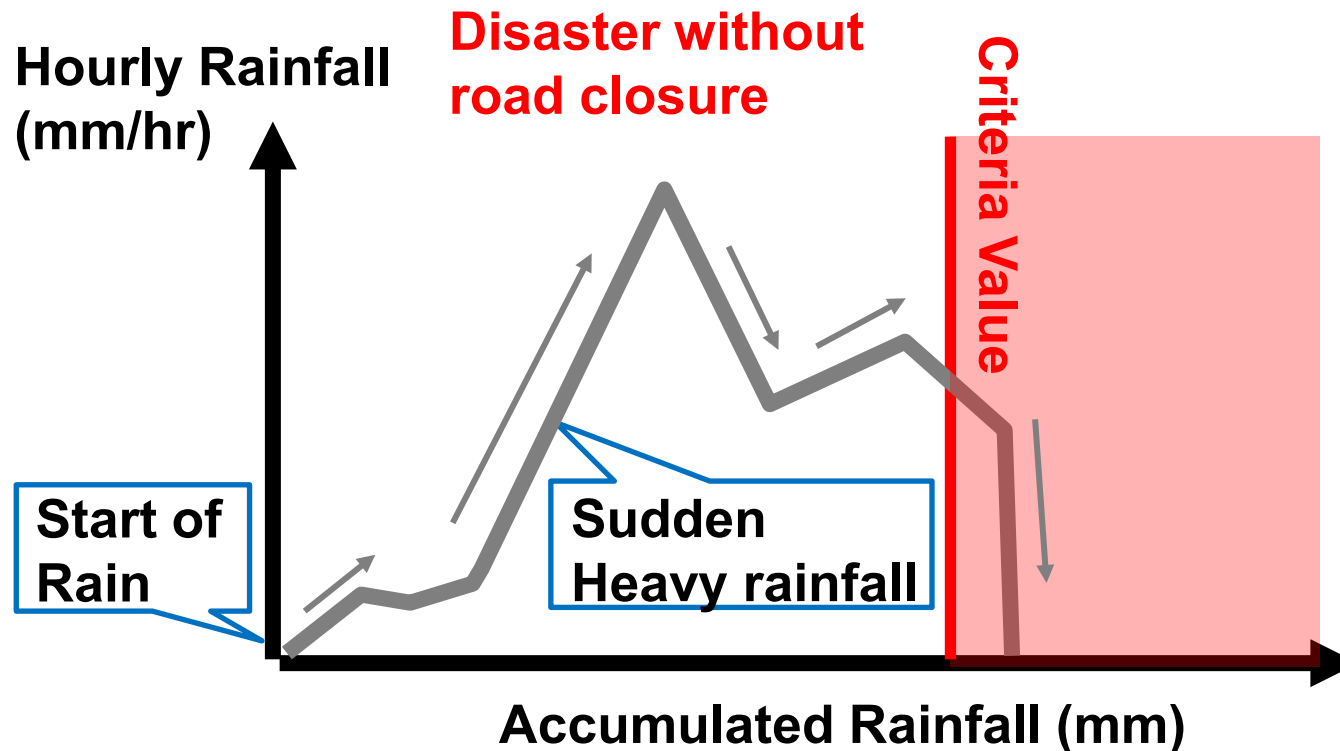
5.1.1 Accumulated Rainfall Method

- Only count **Accumulated Rainfall**, NOT count Hourly Rainfall.
- Easy to predict traffic regulations and arrange resources.
- Risk of disaster caused by local heavy rainfall remains.



5.1.2 Accumulated Rainfall Method

- Only count **Accumulated Rainfall**, NOT count Hourly Rainfall.
- Easy to predict traffic regulations and arrange resources.
- **Risk of disaster caused by local heavy rainfall remains.**

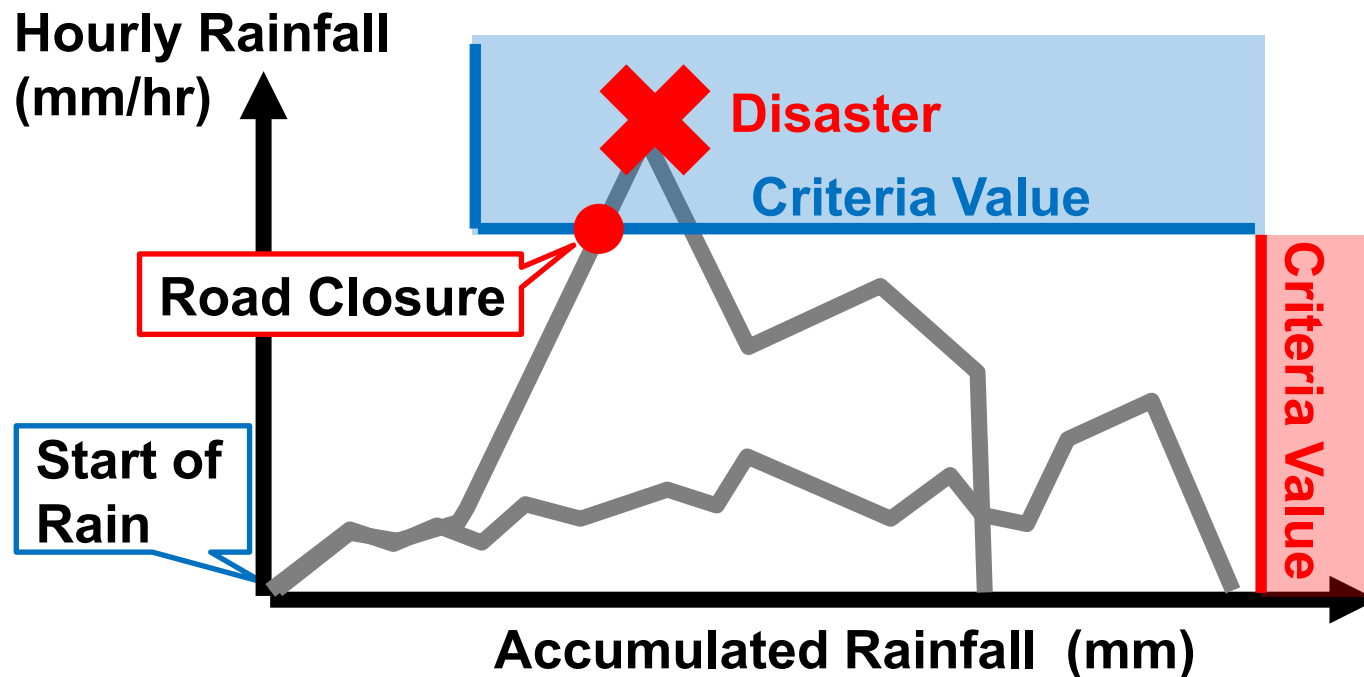


Source of figure:
Ministry of Land,
Infrastructure,
Transport and
Tourism

5.2 Combination of Accumulated Rainfall and Hourly Rainfall

NEXCO

- **Accumulated Rainfall** and **Hourly Rainfall** are counted.
- More reliable method (taking account of local heavy rainfall).
- However, appropriate monitoring system and human resources are necessary.



Source of figure:
Ministry of Land,
Infrastructure,
Transport and
Tourism

6. Operation by Early Warning (Example)



Operation Level	Caution	Warning	Emergency	Urgent
Criteria	<ul style="list-style-type: none"> - Heavy rainfall warning announced by meteorological agency 	<ul style="list-style-type: none"> - Hourly rainfall e.g. 30mm/hr - Accumulated rainfall e.g. 180mm 	<ul style="list-style-type: none"> - Hourly rainfall e.g. 50mm/hr - Accumulated rainfall e.g. 340mm 	<ul style="list-style-type: none"> - In case disaster happens and extensive influence is expected to society
Action	<ul style="list-style-type: none"> - Arrange necessary staff to collect info. and monitor them - Conduct Patrolling 	<ul style="list-style-type: none"> - <u>Collect info. and monitor them 24/7</u> - <u>Conduct Patrolling</u> - <u>Regulation of speed limit</u> - Coordination with traffic police 	<ul style="list-style-type: none"> - <u>Collect info. and monitor them 24/7</u> - <u>Conduct Patrolling</u> - <u>Road Closure</u> - Coordination with traffic police 	<ul style="list-style-type: none"> - Collect info. and monitor them 24/7 - Conduct Patrolling - Road Closure - Coordination with traffic police - <u>Arrange resources to recover disaster</u>

7.1 Operation according to Weather Information (Example of Highway)

NEXCO

Fixed sign board
indicating
road
closure
criteria



Temporary sign board
indicating road
closure



VMS indicating
road closure and
closed section



Closure gate

通行止
Road closed

Source:
Ministry of
Land,
Infrastructure,
Transport
and Tourism

7.2 Operation according to Weather Information (Example of Expressway)

NEXCO



VMS indicating road closure by heavy rain and directing drivers to exit

- To save human lives from landslides caused by heavy rain, Early Warning is a reasonable/feasible way.
- Countermeasures only consisting of adequate slope protection cannot be recommended as it must cost too much.
- It is important for a road operator to know how to fulfill his/her duty.

Thank you for your kind attention.

a.mitsuishi.aa@e-nexco.co.jp