A proposal of a method for planning and designing water supply and drainage facilities for buildings managed under BCP or LCP

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1. Background of the study

- In recent years, Japan has suffered large-scale disasters including the Great East Japan Earthquake in 2011 and the Kumamoto Earthquake in 2016.
- These disasters caused extensive damage to lifelines, such as water and sewage services.

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Damage reports predict that if Japan were struck by a large-scale disaster again, water and sewage services would be interrupted for as long as one or two months.

Damage of the Great East Japan Earthquake by the tsunami (Ofunato City in Iwate Prefecture)

1. Background of the study

- Nevertheless, no specific planning and designing method with consideration of BCP (Business Continuity Planning) or LCP (Life Continuity Planning) has been satisfactorily verified.

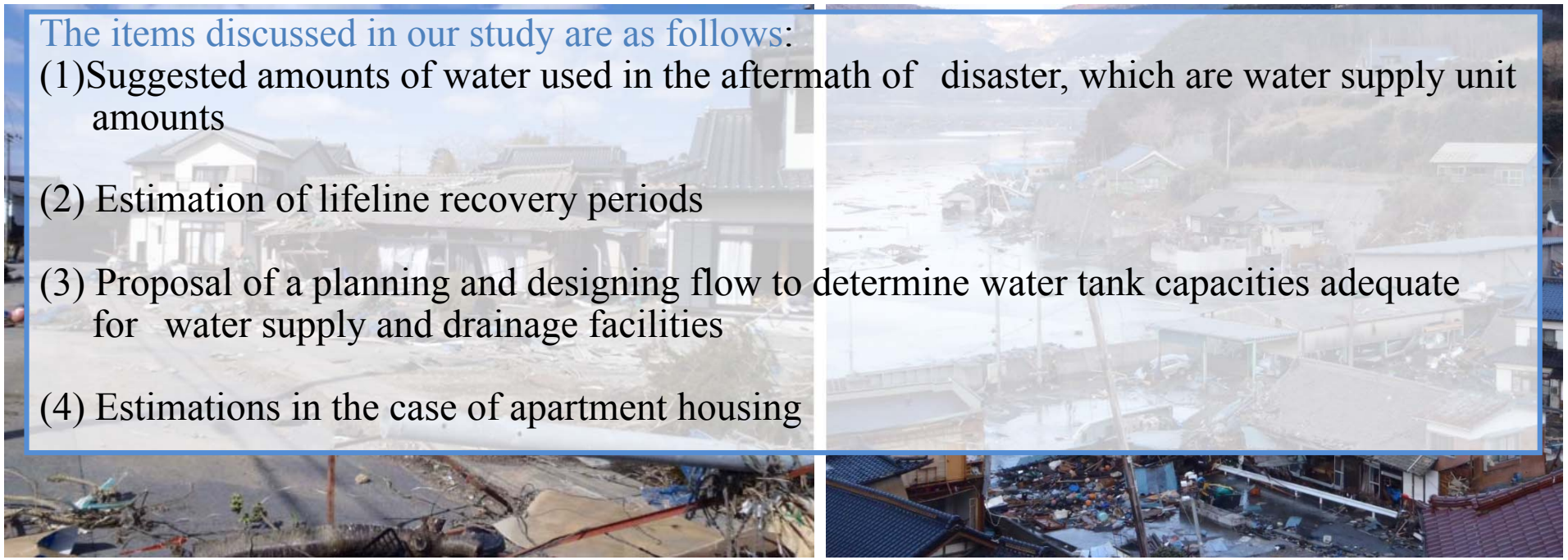
The items discussed in our study are as follows:

(1)Suggested amounts of water used in the aftermath of disaster, which are water supply unit amounts

(2) Estimation of lifeline recovery periods

(3) Proposal of a planning and designing flow to determine water tank capacities adequate for water supply and drainage facilities

(4) Estimations in the case of apartment housing



Damage of the Great East Japan Earthquake by the tsunami (Ofunato City in Iwate Prefecture)

2. Study overview

Suggested amounts of water used in the aftermath of disaster, which are water supply unit amounts

■Previous studies and disaster prevention plans by local authorities were examined to identify suggested amounts of water required for daily life in the aftermath of disaster.

◆ Amounts of emergency water according to the disaster prevention plans by local authorities
⇨ locally determined water amounts

◆ Total amount of water required for specific daily activities in the aftermath of disaster as determined by researchers
⇨ water amounts determined in previous reports

◆ The amount of water necessary to maintain lives to be secured at the time of the disaster set in this study
⇨ suggested water amounts

2. Study overview

Planning and designing method for determining water tank capacities for water supply and drainage facilities

■ In our proposed planning and designing flow, the elevated water tank system is adopted with consideration of BCP or LCP.

◆ A method for determining water tank capacities for water supply and drainage facilities under general circumstances

⇨ ordinary-time design

◆ How to calculate the capacity of water tanks that can store all the water used at the time of a disaster even under normal conditions

⇨ time-of-disaster design

2. Study overview　Apartment housing conditions considered in the estimations

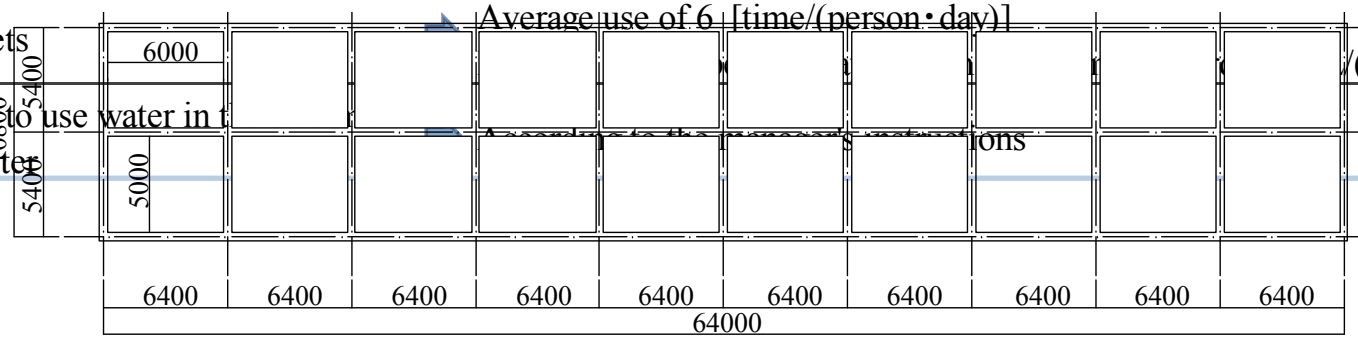
The trial conditions are as follows.

◆Effective capacity of the underground pit	300 units
◆Location	Inner area of Yokohama City, Kanagawa Prefecture in Japan
◆Water usage at normal times	250 [L/(person・day)]
◆Water supply and drainage facility	Elevated water tank system Toilets: flush water 6.0 [L/time], low-level cistern type
◆Toilets	Average use of 6 [time/(person・day)]
◆How to use water in t… of disaster	According to the proposed instructions

◆Excluding overflow

◆Effective capacity of the underground pit

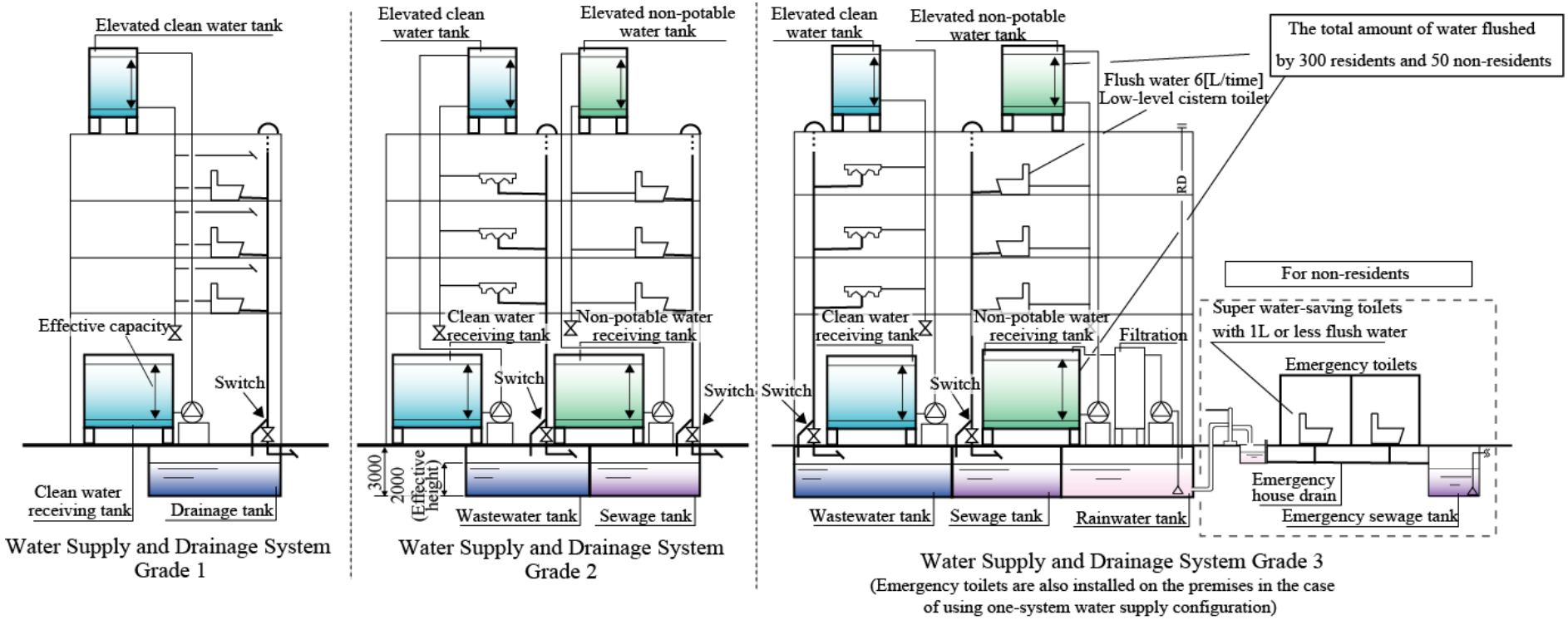
It is divided into 20 , and approximately 6m × 5m × 2m.



Plane view of the underground pit of the apartment housing (non-scale)

2. Study overview　Water supply and drainage system grades

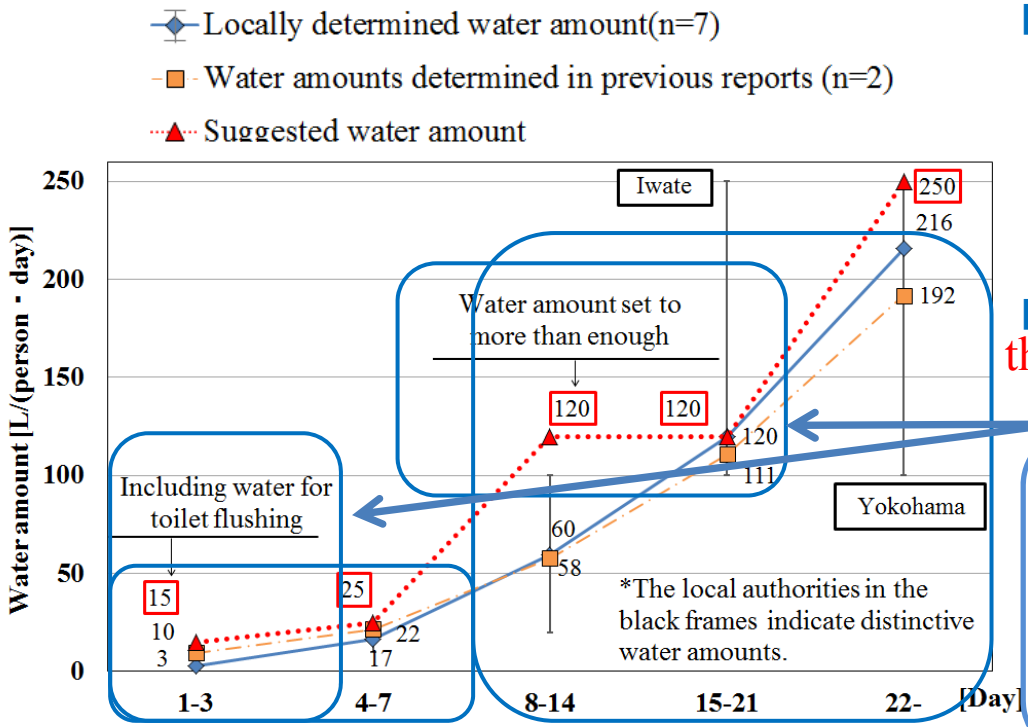
- The water supply and drainage system grades are grouped into three grades according to equipment level considering BCP or LCP.



Schematics of water supply and drainage system grades

3. Results and considerations

Suggested amounts of water used in the aftermath of disaster, which are water supply unit amounts



The averages of the water amounts and suggested water amounts corresponding to the assumed number of days of recovery

- Securing water for flushing toilets and sewage treatment were particularly challenging in a past earthquake disaster.

determined in previous reports.

- However, the trend reverses, the locally determined water amounts are higher than the water amounts determined in previous reports.

With these issues in mind, from the 8th day and onwards, the suggested water amounts were determined.

- With a focus on the following

・Day 3 of the disaster

⇒15[L/(person・day)] (including toilet flush water)

・Day 8-14

⇒120[L/(person・day)], similar to Day 15-21

In this study, estimate using the suggested water amounts.

3. Results and considerations　Assumed periods of lifeline recoveries

■ The recovery period of each lifeline, from the time a disaster strikes to cause interruption to the time recovery is achieved, is divided into four levels.

◆ Levels I and Ⅱ ⇨ the scale of disaster causing damage that can be repaired quickly

◆ Level Ⅲ ⇨ the same scale as that of the Kumamoto Earthquake

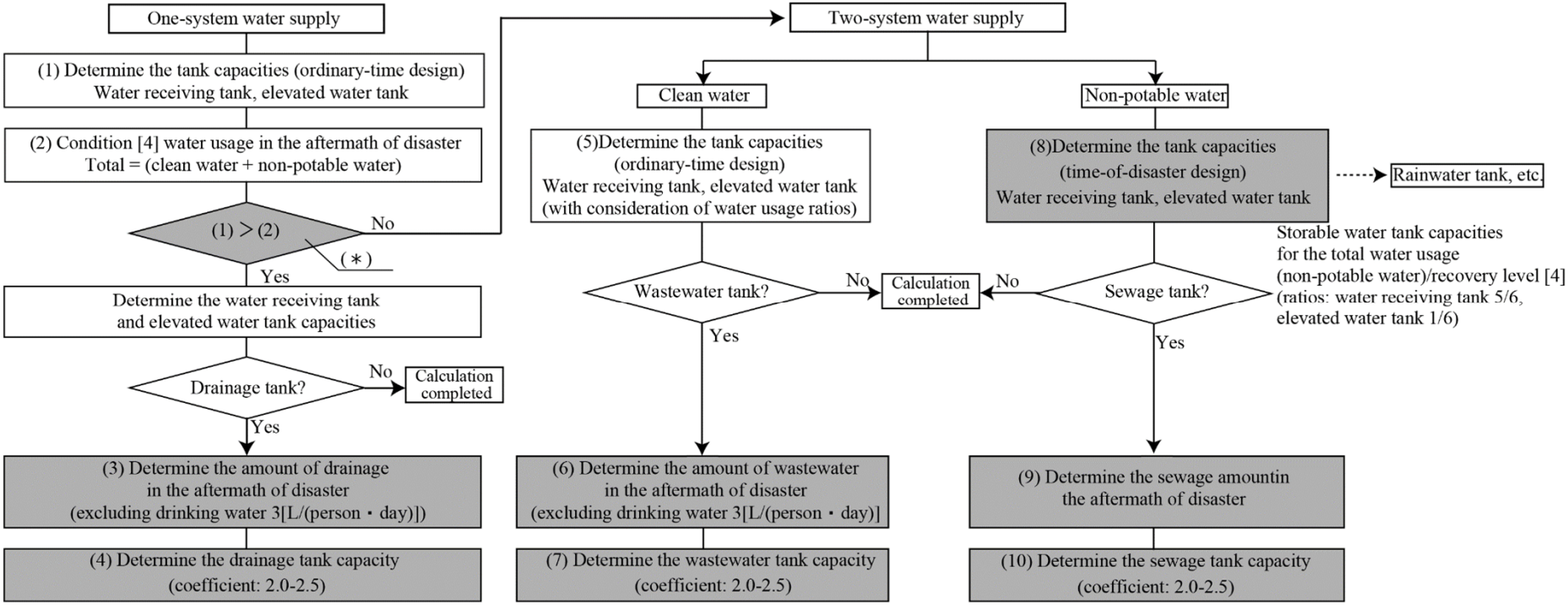
◆ Level Ⅳ ⇨ the same scale as that of the Great Hanshin Awaji Earthquake, the Great East Japan Earthquake or the Nankai Trough Megathrust Earthquake (in the future)

Lifeline recovery levels

Recovery level		Ⅰ	Ⅱ	Ⅲ	Ⅳ
Recovery period	Clean water supply	3 days	7 days	21 days	2 months(60 days)
	Sewage disposal	2 days	4 days	2 weeks(14 days)	5 weeks(39 days)
	Electric power	1 days	2 days	1 week(7 days)	2 weeks(14 days)

3. Results and considerations

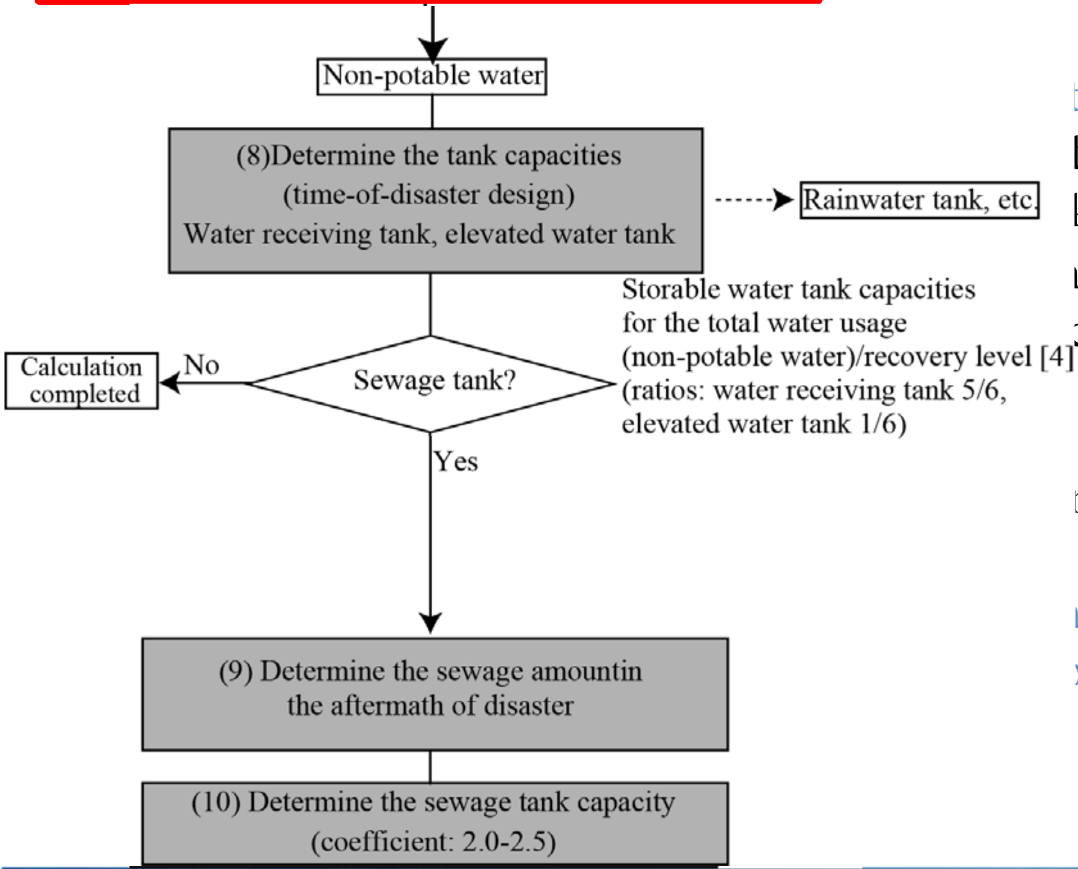
Proposal of a planning and designing flow for determining water tank capacities for water supply and drainage facilities



Planning and design flow for determining water tank capacities for water supply and drainage facilities

One-system water supply configuration

The time-of-disaster design



- Set the effective capacity ratio to 5/6, 1/6 ... potable water required in the event of a disaster is regularly stored.
- When installing the sewage tank, calculate capacity.

...mpare the sum of (1) and (2).

...en the total of (1) is smaller, adopt the ...-system water supply.

Estimation conditions for water tank capacities for grade 3 water supply and drainage facilities

■ Considerations of the Grade 3 system is as follows.

◆ The amount of water for flushing emergency toilets

◆ Total water usage (non-potable water) per recovery level

◆ Water for cleaning the emergency house drain ➡ Rainwater is used.

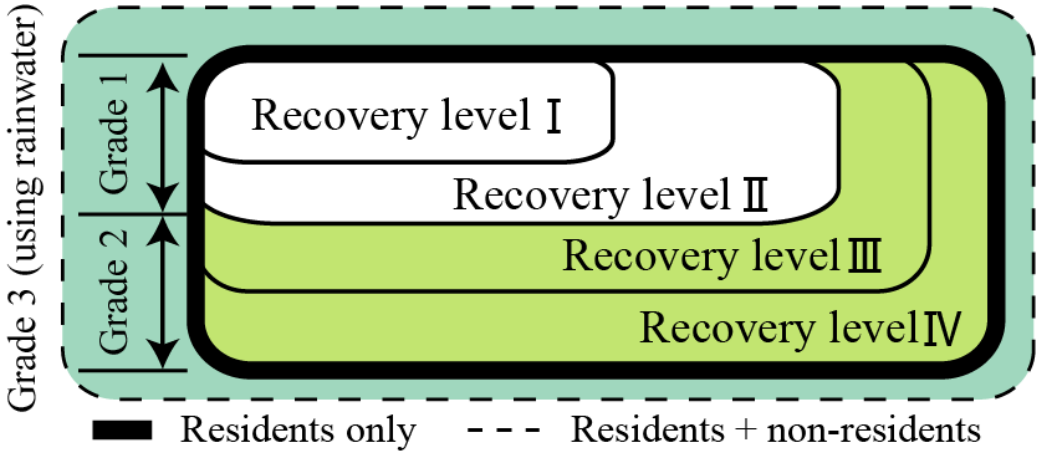
◆ The period during which the emergency toilets are used is from the day a disaster strikes to the day the sewage system is restored.

3. Results and considerations　Example results of the estimations performed on apartment housing

■ As a result of calculating estimated water tank capacities by using the planning and designing flow:

◆ Recovery levels I and Ⅱ should use the one-system water supply configuration.

◆ Recovery levels Ⅲ and Ⅳ should use the two-system water supply configuration.



Relationship between the recovery level and the water supply/drainage system grade

4. Summary

- In this report, amounts of water to be secured for daily life in the aftermath of disaster were determined with ample water in mind.
- In addition, a planning and designing flow to determine water tank capacities adequate for water supply and drainage facilities was proposed, with BCP and LCP in mind.

(1)Non-potable water should be introduced when considering BCP or LCP.

(2)It would also be necessary to consider resilience improvement in system construction to ensure flexible handling of situations, such as urgent water usage restriction, supply and aid from outside, and the use of alternative means.

◆ Further study will be carried out with a focus on coastal areas and on the planning of an emergency toilet system.

Thank you for
your attention!

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