GIS Mapping for Water Supply Infrastructure in Japan

JWRC Study Group for International Comparison of Water Supply Services

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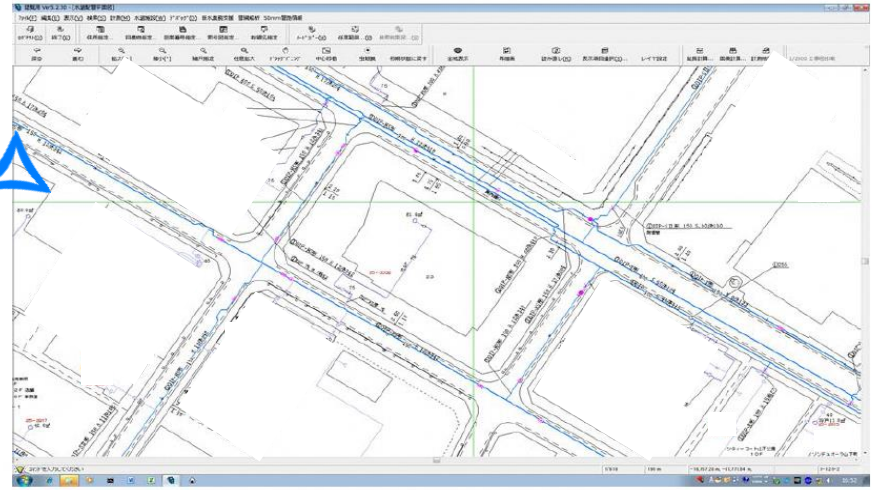
What is GIS Mapping?

- The GIS mapping enables water utilities to project positions of water mains onto a computerized map surface, along with relevant data such as pipe material, diameter, installation year, ground conditions.

Computerized 1/500 paper plane drawing

1. to manage and register drawings
2. to search data

Building up by "GIS" technology



Special system focused on Water Works Facility
This Mapping system has all data of water facilities & pipelines on topography(road , house ,etc.)

Source: Yokohama Waterworks Bureau

Characteristics of GIS Mapping

- Useful at various stages of service delivery from addresing service disruption, to mains network analysis and renewal planning, to checking various data and records of facilities, and more.
- The web-based system is easy to use and can be adopted regardless of the size of utility
- The data security function can restrict the use of, and access to the system by the user ID, password, types of data requested, data encryption, historical access record, and others.
- Highly adaptable to future system upgrades for potential service expansion and modification, including for coordination with the rates management system
- Accumulated data is easy to transfer within the utility.

Basic Function 1 : Simulation of Service Disruption and Turbidity Increase

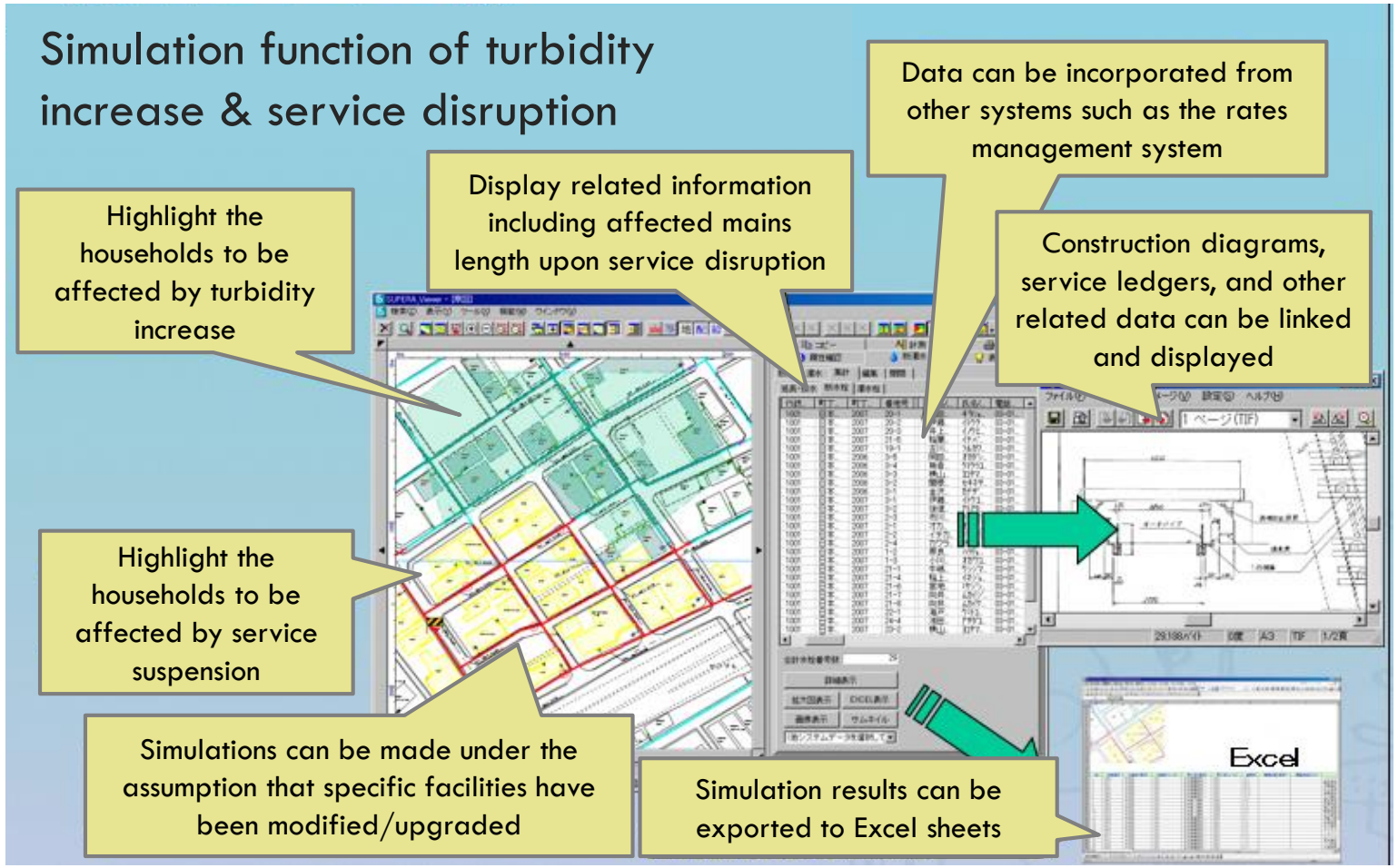
- Simulate an impact of service disruption due to scheduled construction work

Supporting Function for Water Stoppage

If you plan water stoppage point on the mapping system pipeline

(1) You can count number of water stoppage houses

(2) You can specify water stopping area



Basic Function 2 : Network Analysis

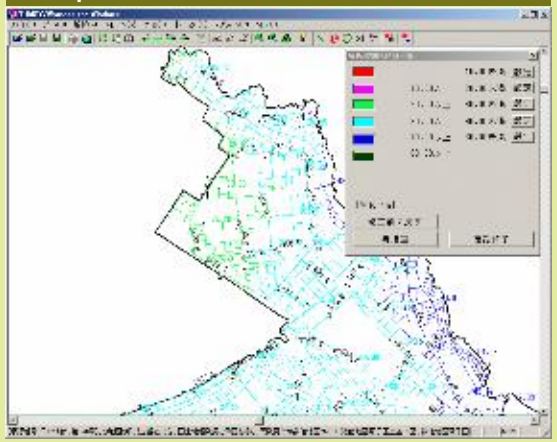
- Review the composition of mains network

Hydraulic Calculation
(Pipe Network Analysis)

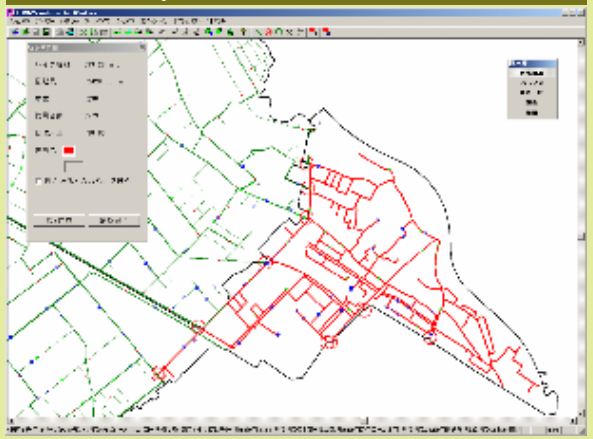
You can calculate

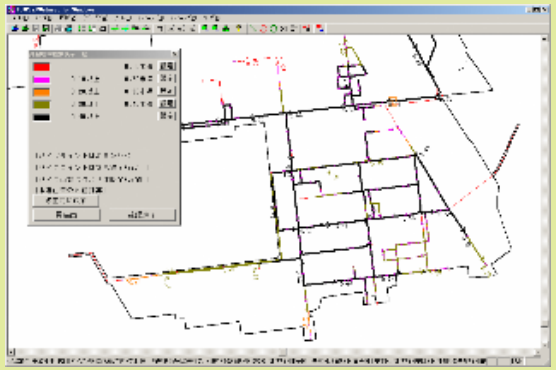
(1) Water pressure
(2) Velocity
(3) Volume
(4) Arrival Time
(5) Flow Direction
(6) Residual Chlorine

Highlight the range of water pressures in different colors



Highlight the areas of service disruption in different colors





Highlight the estimated range of residual chlorine concentrations in different colors

Source: Public Enterprises Agency, Kanagawa Prefectural Government

Option 1 : Mobile Device to Check Mapping Data

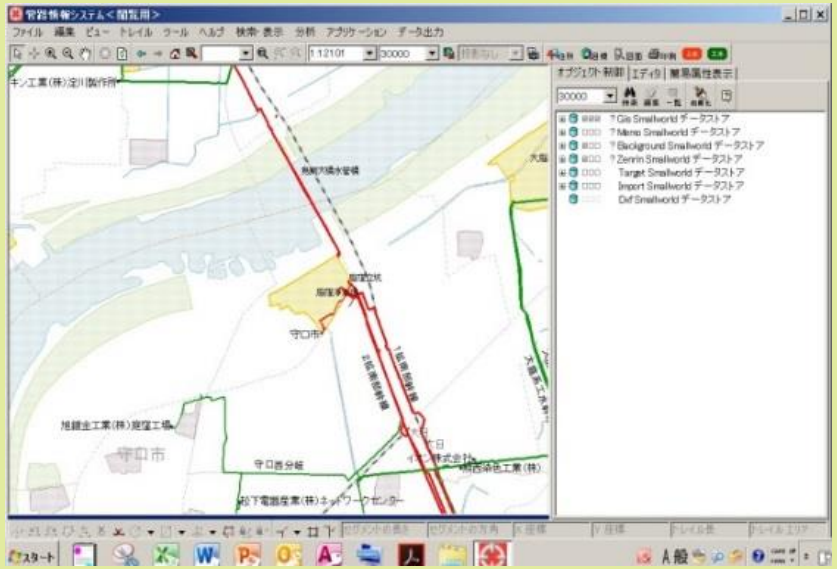
- Operable even when the server is down.
- Portability in the field can facilitate emergency response
- Work like a tablet computer with a rotatable, touch screen

Source: Saitama City Waterworks Bureau

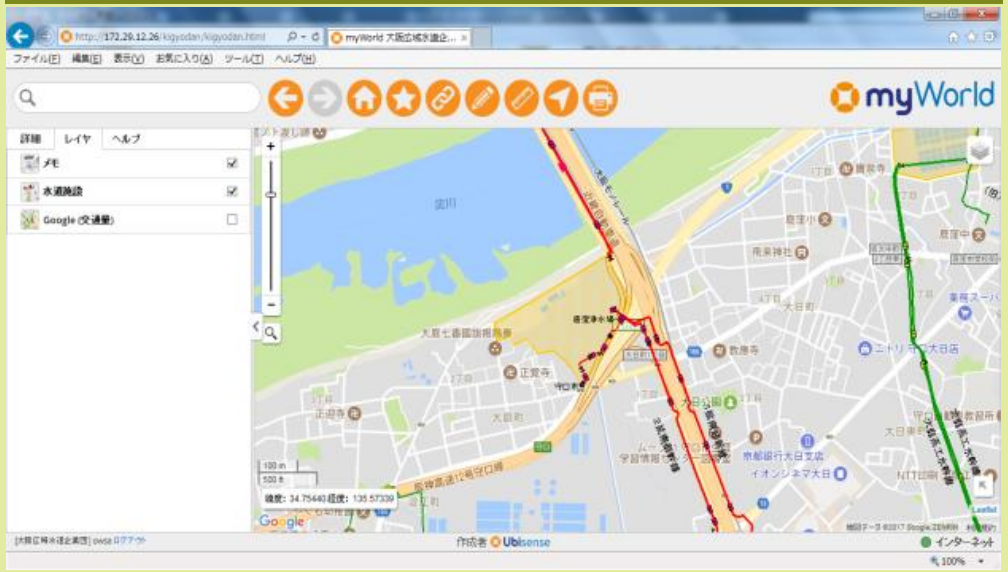
Option 2 : Two Types of Interfaces

- Two types of interfaces are available according to the needs of the utility

1. Interface with detailed information and more advanced functions



2. Interface with simplified information and functions to maximize day to day operation

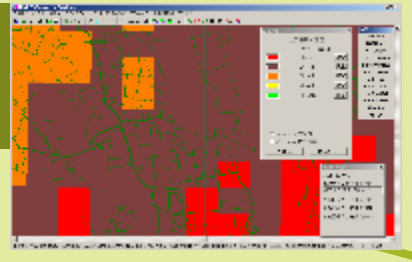


Source: Osaka Water Supply Authority

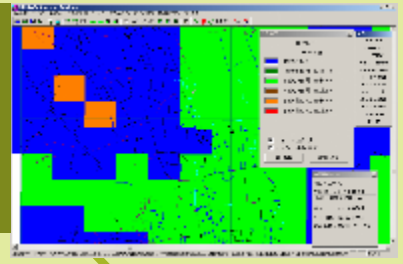
Option 3-1 : Seismic Damage Estimation to Water Mains

- Serve the development of mains renewal plans for enhanced seismic resistance
- Estimate seismic damage to mains using the pipe material and diameter data as GIS parameters and the data of estimated seismic intensity, ground conditions, and liquefaction probability as mapping data

Estimated seismic intensity

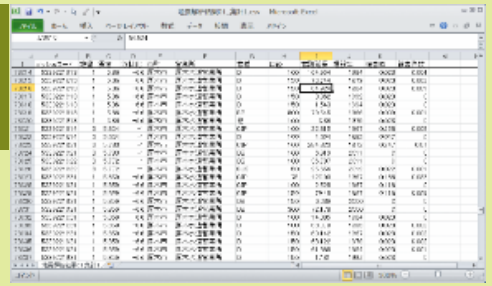


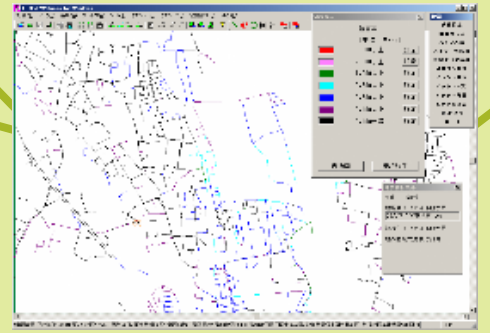
Grouping by ground conditions and liquefaction probability



Mains data (material, diameter, installation year)

Estimated mains damage upon earthquakes

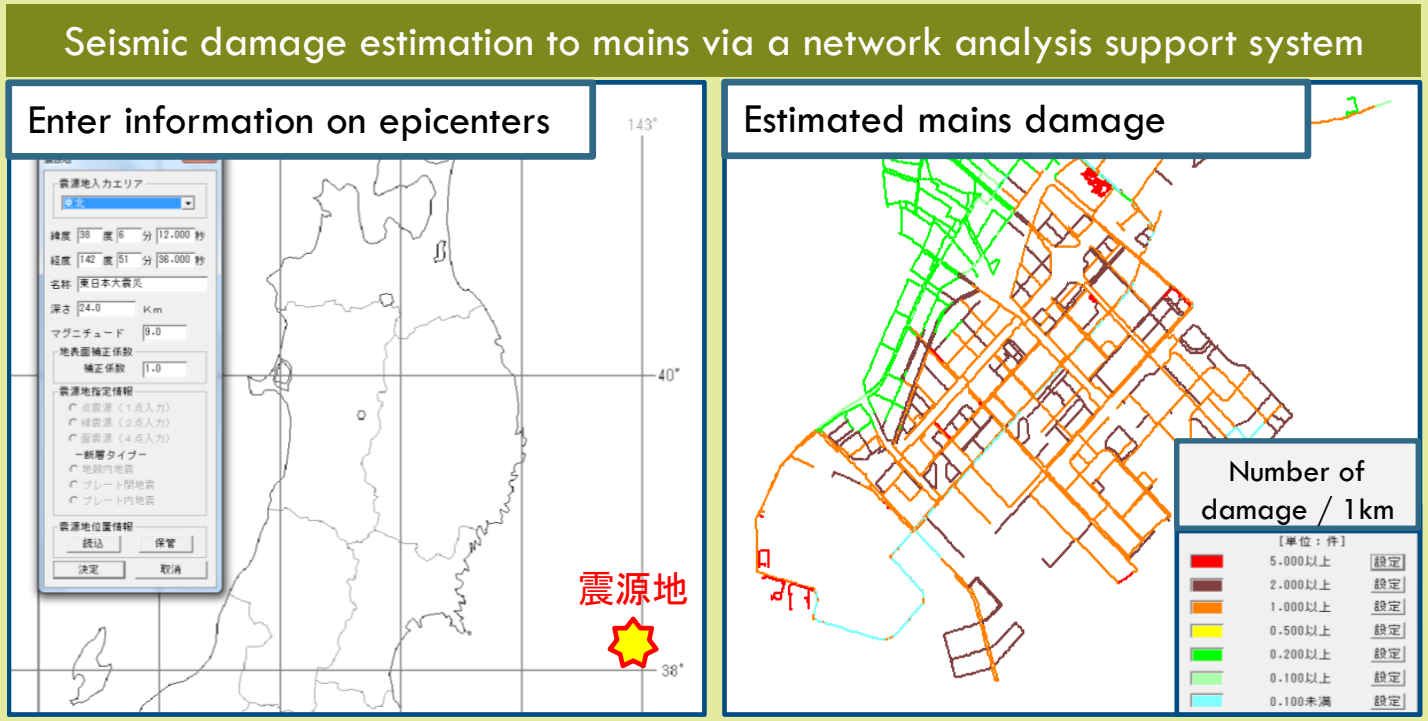




Source: Public Enterprises Agency, Kanagawa Prefectural Government

Option 3-2 : Seismic Damage Estimation to Water Mains

- Estimate seismic damage to mains by feeding the information on the epicenters of potential earthquakes



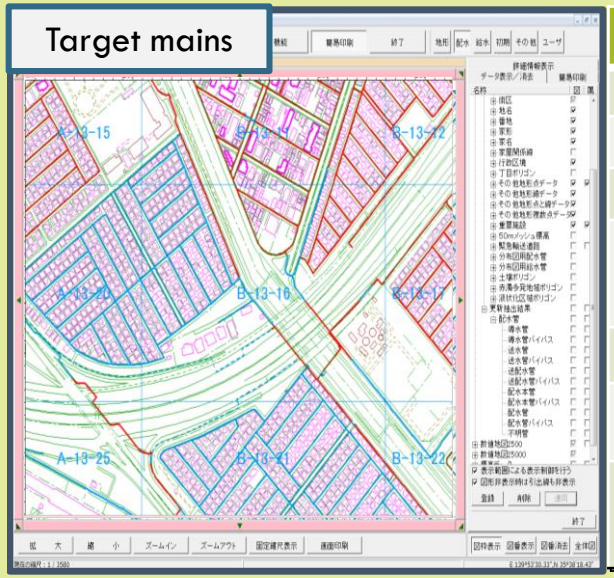
Source: Chiba Prefectural Waterworks Bureau

Option 4 : Mains Renewal Decision Support System

- The utility can select mains with a high renewal priority from the information such as the mains corrosion level and estimated areas to be affected by discolored tap water. This would support the utility's decision making in terms of mains renewal planning.

The system allows the selection and display of the mains that fit specific conditions

Target mains

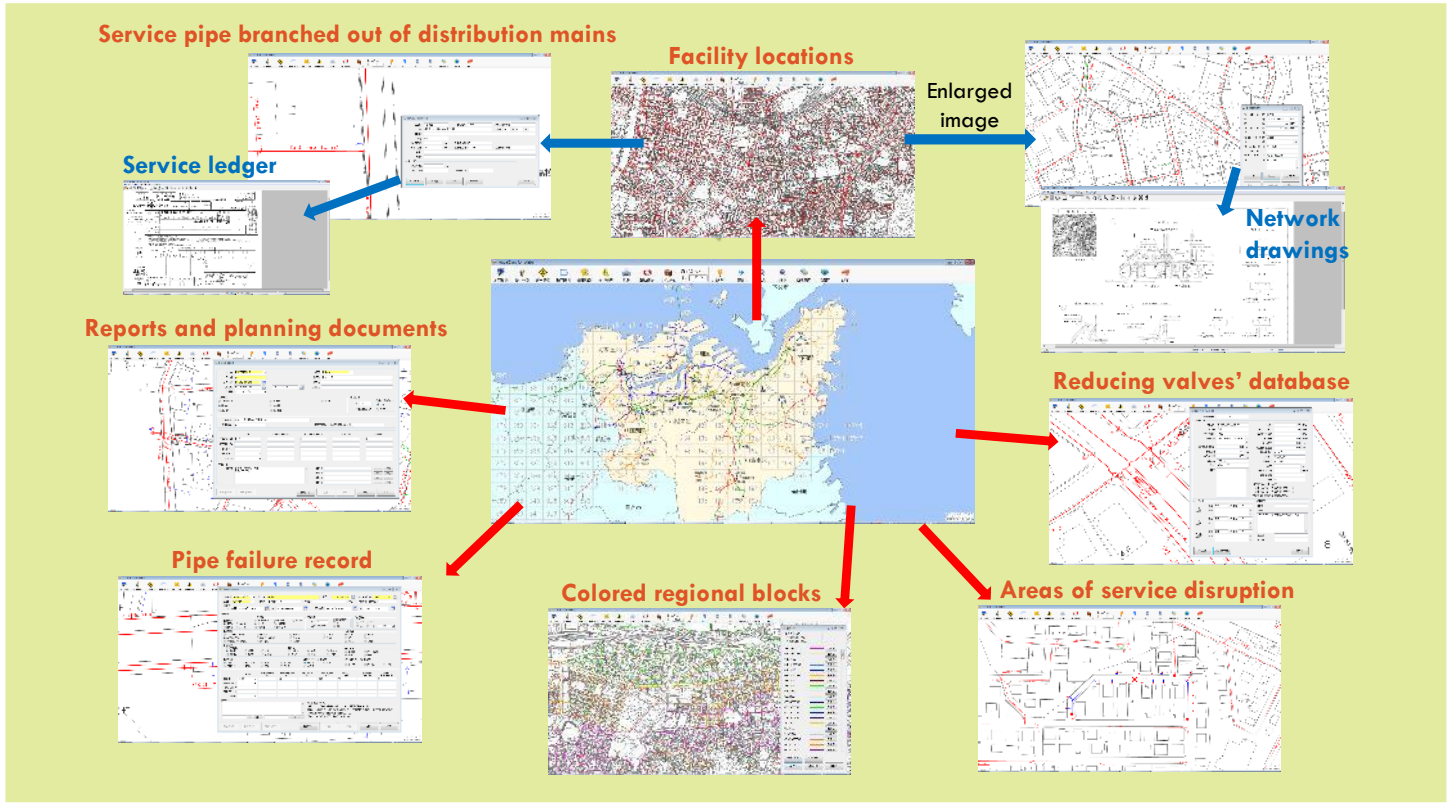


Conditions that can be specified	
Usage	Administrative area
Material	Liquefaction
Diameter	Ground condition
Year of installation	Road for emergency transportation
Degradation level	Historic leakage
Renewal priority	Corrosion level
Yes/No of polyethylene sleeves	Frequency of discolored water

Source: Chiba Prefectural Waterworks Bureau

Option 5 : Emergency Response Support

- Upon a major pipe failure, relevant departments feed the mapping system related information such as the incident's location and causes, the main's current condition, number of affected households, and the progress of restoration efforts and emergency water supply. This way, relevant utility personnel can check the necessary information in real-time.



Source: Water and Sewer Bureau of the City of Kitakyushu

Option 6 : Identification of Properties of Other Entities

- Function to identify and project on the map the buried properties of other entities

Source: Bureau of Waterworks, Tokyo Metropolitan Government

For Better Data Management 1 : Saving Changes

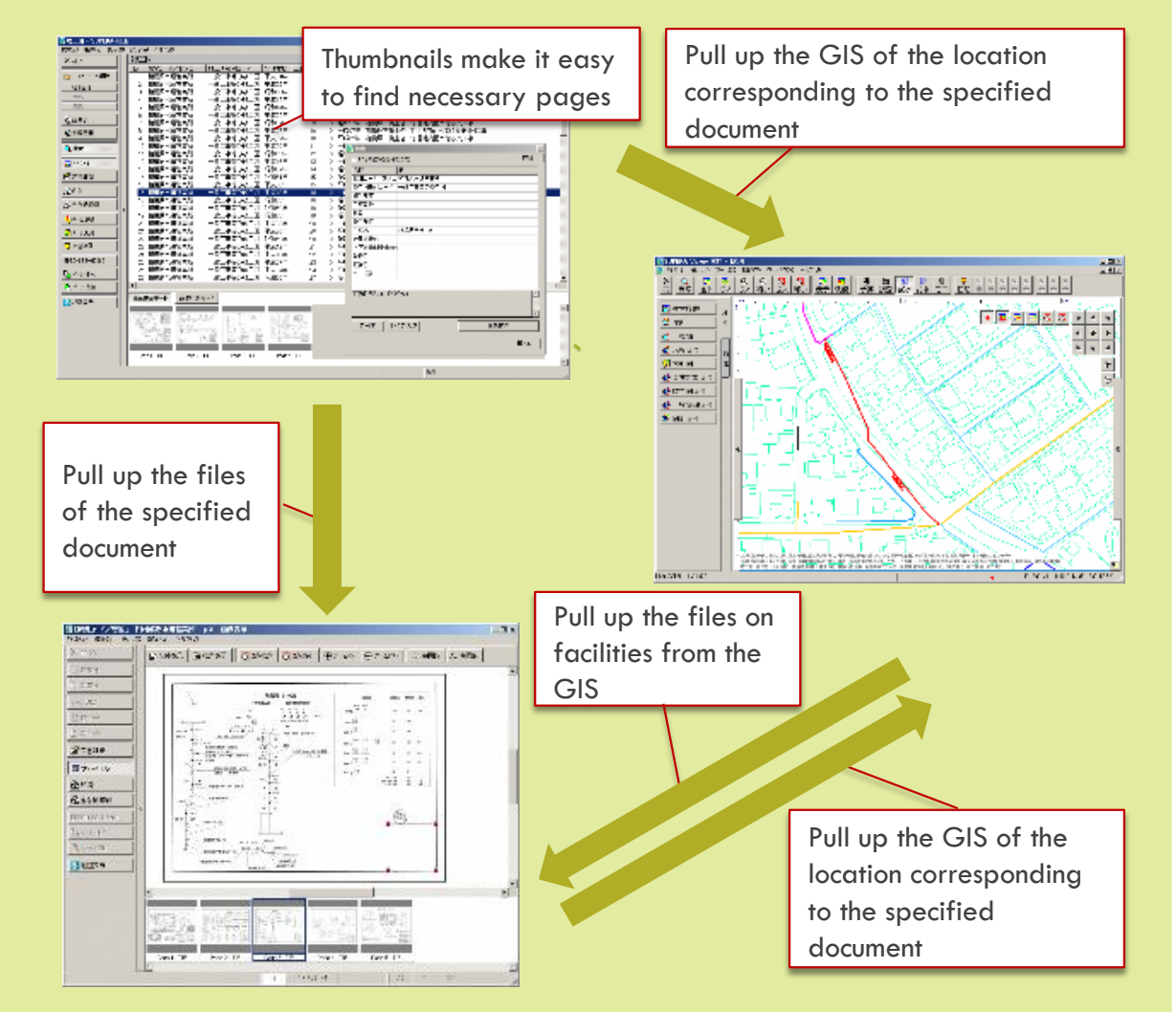
- Register facility modification record
  - Saving changes on facility upgrades/renewal enables reference to the historic modification record.
- Save the entire registry upon each update
  - Saving the entire registry upon every update enables reference to the whole pipeline condition at certain points in the past.

Source: Osaka Water Supply Authority

For Better Data Management 2 : Easy Access to Linked Files

- Features

1. Finding related documents becomes easy by putting together various diagrams and linking them to the GIS mapping.
2. Many kinds of diagrams data can be filed efficiently.
3. Confidential information can be safely stored via data masking and access restrictions.



Source: Public Enterprises Agency, Kanagawa Prefectural Government

For Better Data Management 3 : Online Access to Mains Network Diagram

- Function to enable online access to the information on distribution mains, service pipe, water meters and other equipment

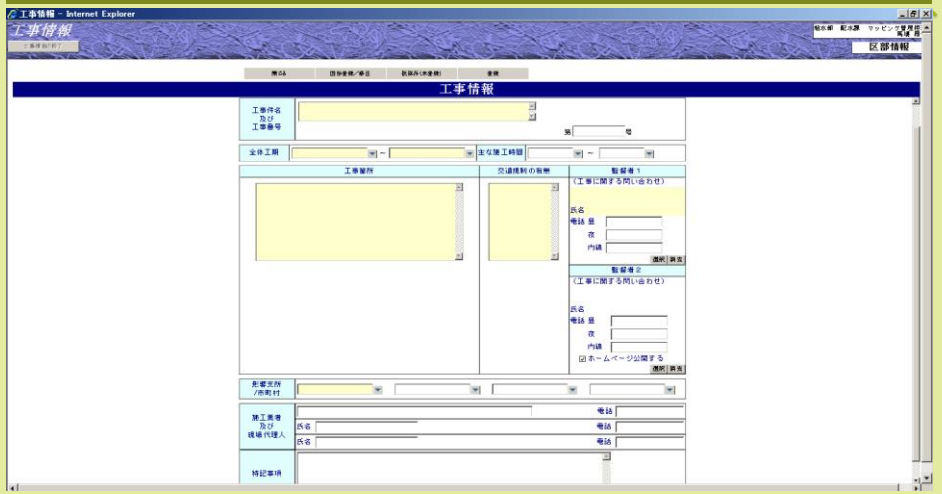
  * Access is limited to specific contractors and developers with the ID and password.
  * Information on the customers and primary facilities cannot be viewed.

Source: Bureau of Waterworks, Tokyo Metropolitan Government

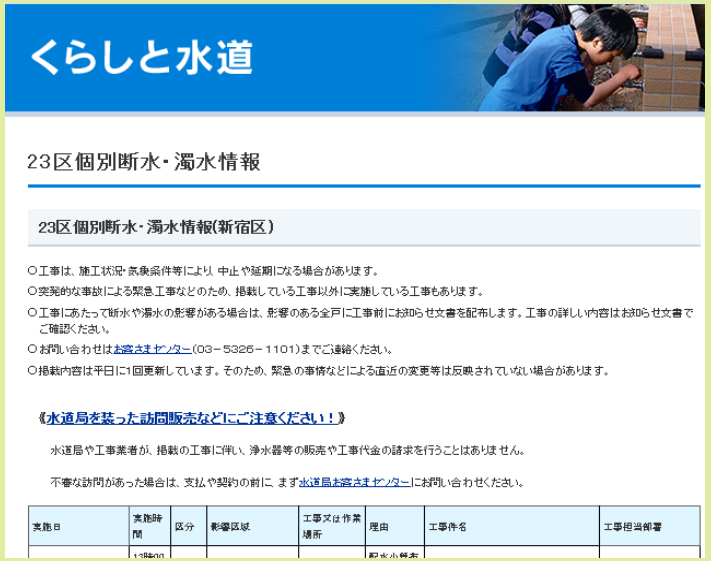
For Better Data Management 4 : Online Access to Construction Schedules

- Publish on the website of the utility the information on the construction date, location, name of the work, responsible department, and the contractor.

Entering construction information



Publish online information on service disruption, reduced supply or an increase in turbidity



Source: Bureau of Waterworks, Tokyo Metropolitan Government

Effects of Introducing GIS Mapping System

- All the related diagrams and drawings can be viewed now in electronic format regardless of which department you are in, while in the past only the department-specific material could be viewed in paper format.
- Mains network modeling and analysis have become much easier as there is no need now to make the models manually. More detailed network analysis has also become possible.
- Related work efficiency has improved.
- Faster response has become possible upon emergency.
- Calculating the ratio of seismic damage to mains has become possible, which used to be difficult to do in the past.

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