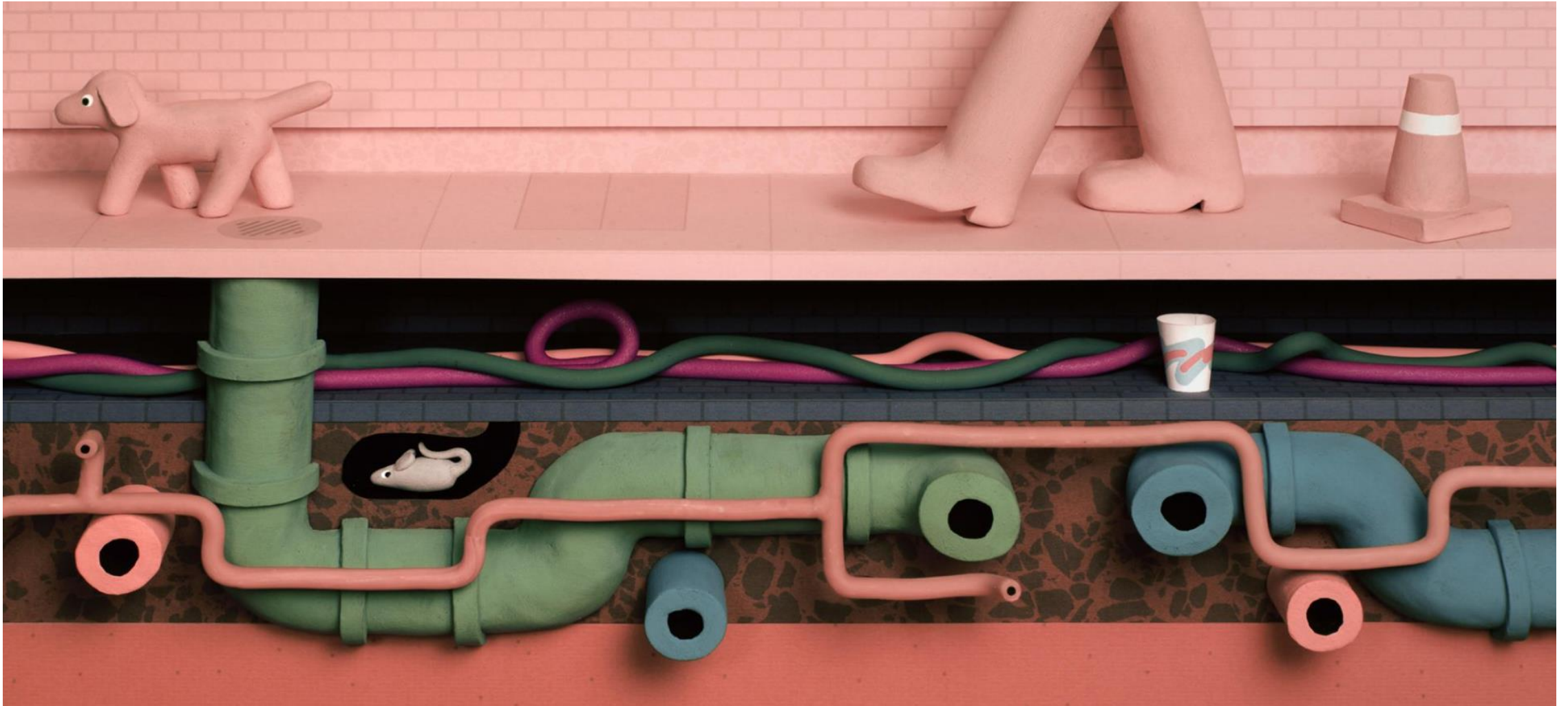


Infrastructure and the Evolution of GIS in NYC



“Nobody Knows What Lies Beneath New York City” by Greg Milner for Bloomberg Businessweek Magazine, 8.10.17

How The Municipal Underground Infrastructure Data, Analysis and Sharing (MIDAS) Project Began: 1999 - 2017

- Jim McConnell
 - Deputy Director Emergency Mapping and Data Center, 9/11
 - Assistance Commissioner for Data/GIS, NYC OEM
 - Project Manager Underground Infrastructure Initiative for Mayor's Office
- Wendy Dorf
 - Project Manager, Watermain Mapping Project
 - Senior Manager NYC Basemap Project
 - Director, Deep Infrastructure Group, EMDC, 9/11
- Alan Leidner
 - Director, NYC Basemap Project
 - NE Regional Coordinator, DHS HIFLD Infrastructure Protection Program
 - Director, Center for Geospatial Innovation, FCNY

From the 1888 Blizzard to an Underground World



I-405 Sepulveda Pass Improvements Project
Typical Infrastructure Beneath Sepulveda Bl

- 6" CHEVRON GAS
- 6" SOUTHERN CALIFORNIA GAS METHANE
- 4" AT&T TELECOM
- 6" SHELL GAS
- 6" ABANDONED SHELL GAS
- 20" SOUTHERN CALIFORNIA GAS COMPANY HIGH-PRESS GAS LINE
- 10" VERIZON BUSINESS
- 14" EXONMOBIL OIL
- 14" x 6" DEPARTMENT OF WATER AND POWER
- 14" x 6" VERIZON TELECOM
- 80" CULVERT
- 14" FRESH WATER
- 12" SEWER
- PROPOSED 14" SEWER
- 14" SEWER

M Metro

Illustration of utility sizes, their spatial relationship to one another and their depth below Sepulveda Bl.

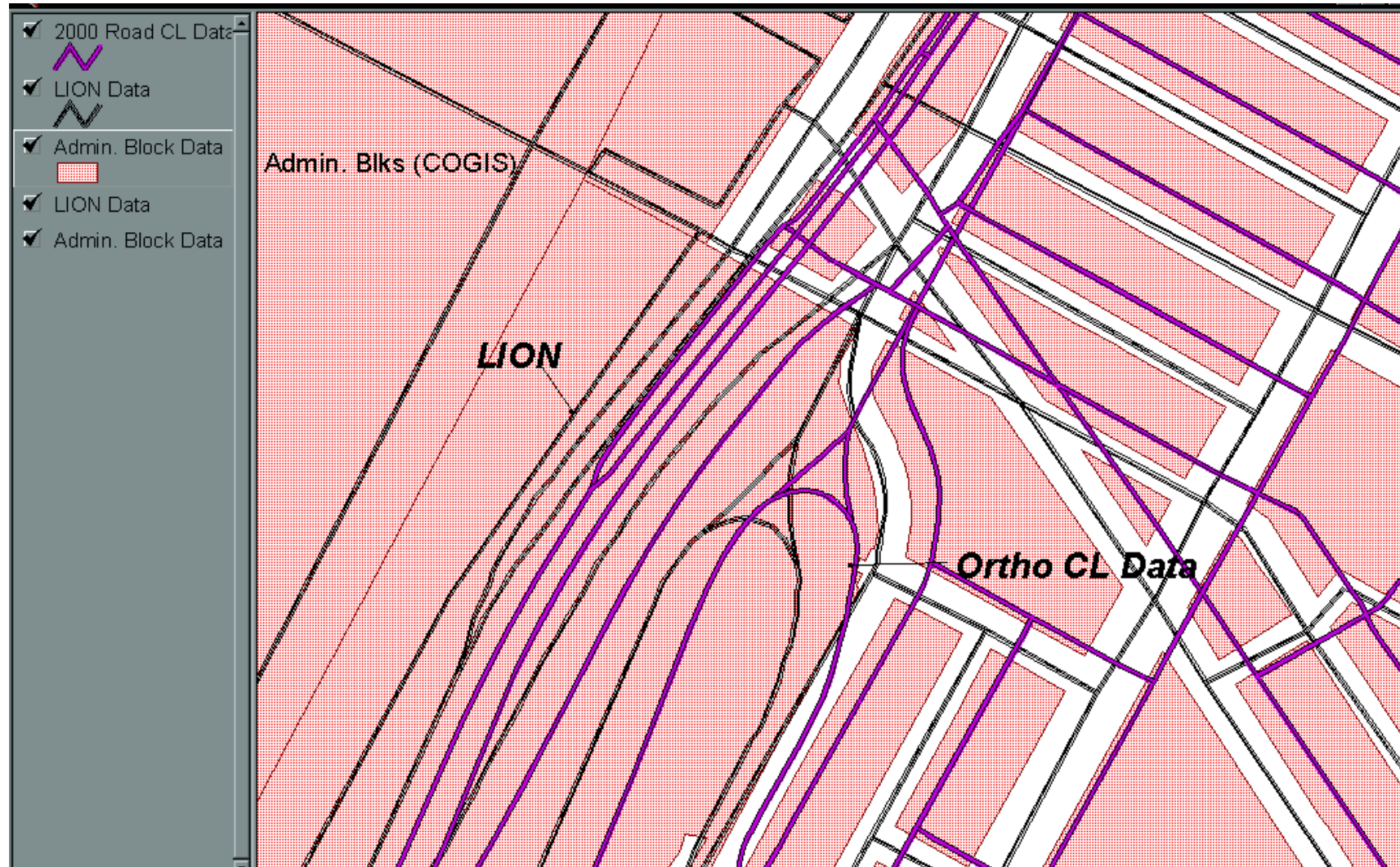
Plus: transportation tunnels, foundations of buildings, etc.

Steam Pipe Explosion Midtown Manhattan

July 18, 2007



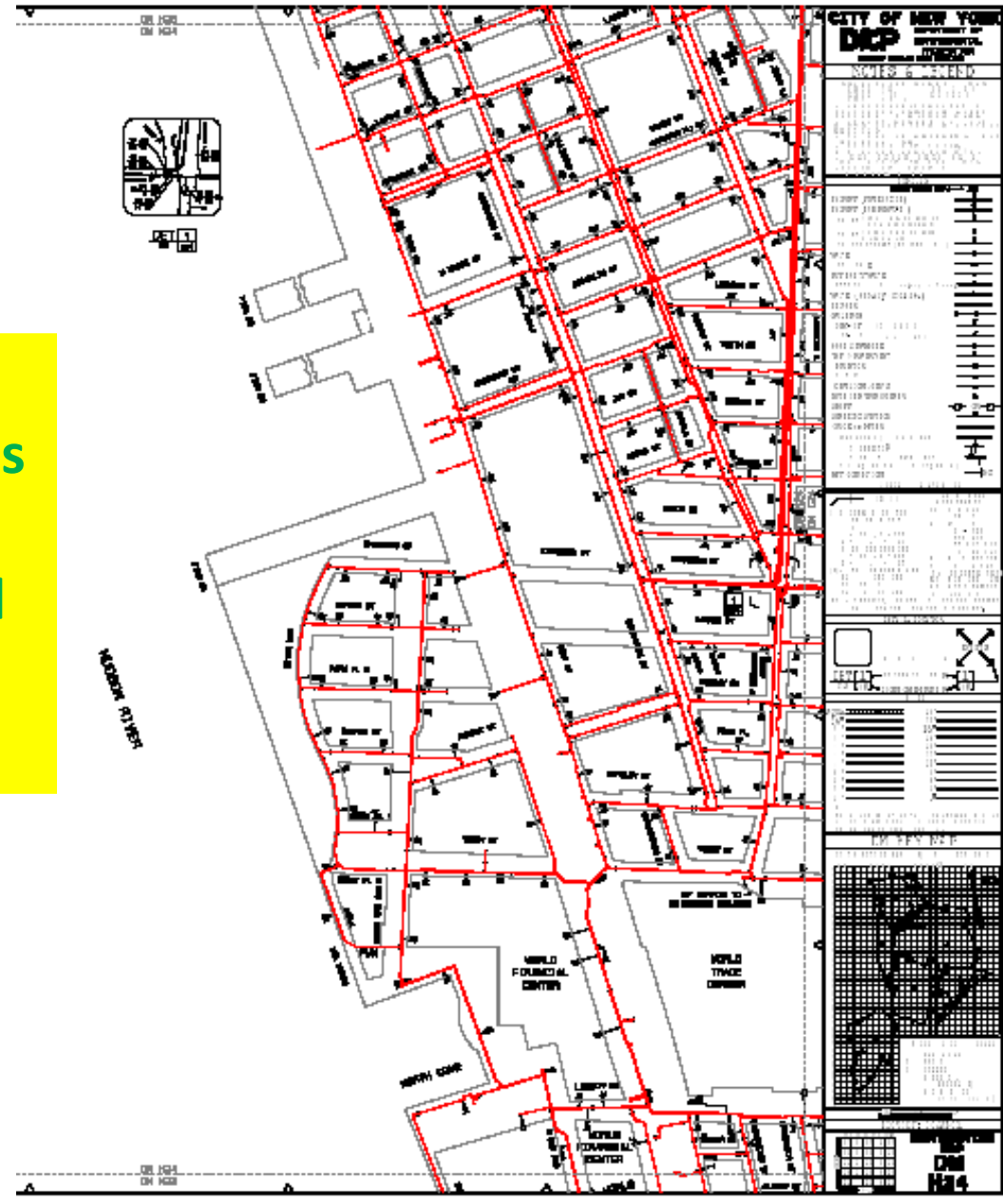
Incompatible map systems lead to data problems



- ◆ Features and data DO NOT Line- Up
- ◆ Crisscrossing LION, Administrative Blocks (COGIS), & Ortho. CL Photos.

NYC DEP: 6,000 Street Miles of Watermain Mapping

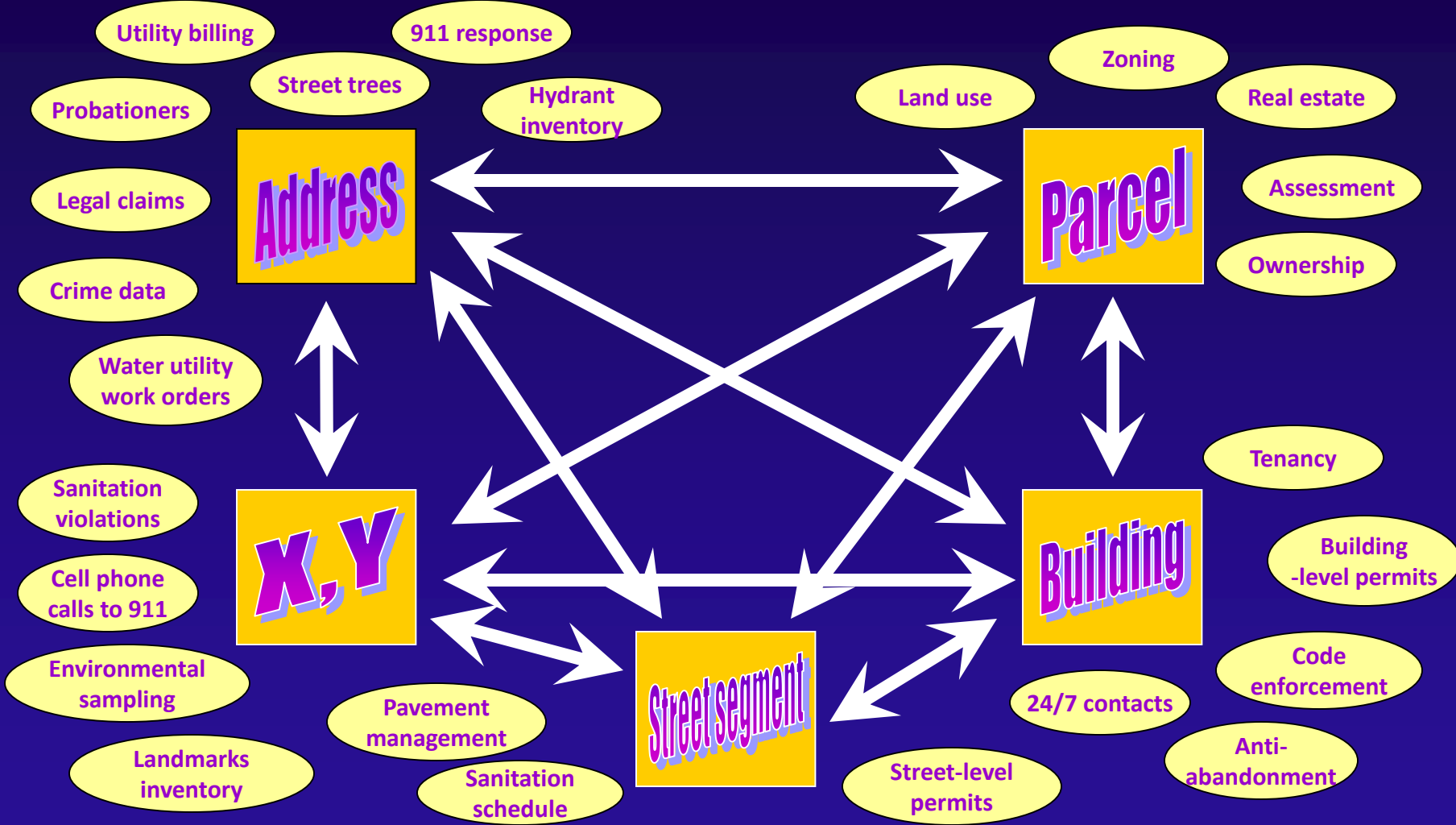
1990 – 1995: NYC
Basemap Project evolves
from a need for the
water network map and
the planned sewer map
to relate to each other.



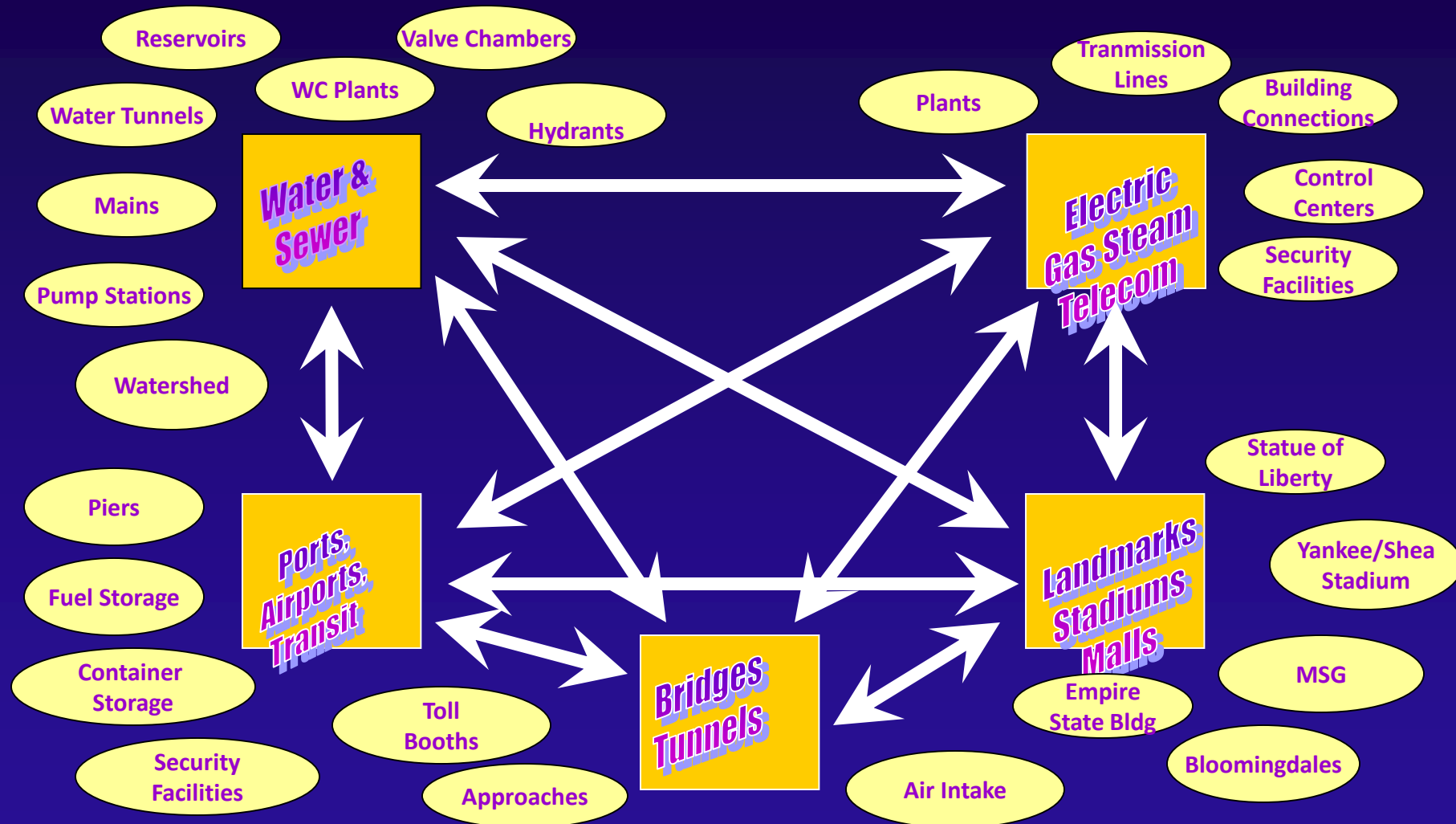
Imagery, Streets, Parcels and Buildings Overlaid: “One Map To Bind Them All”

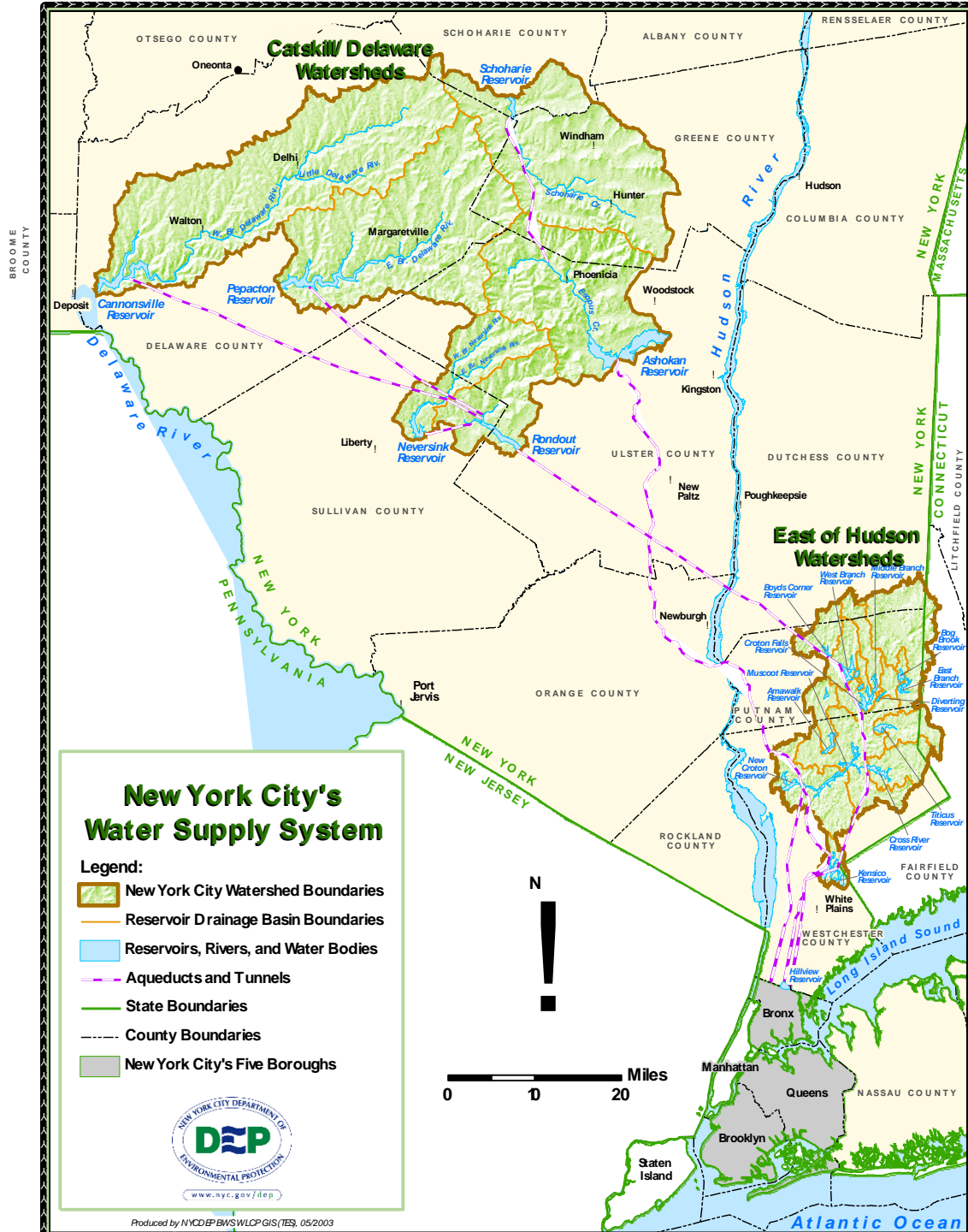


GeoSpatially Enabled Enterprise Data Integration (GEDI)



GeoSpatially Enabled Infrastructure Data Integration





New York City Watershed Mapping 1997

- 9 million people use 1.3 billion gallons daily
- 1,969 square mile watershed

GIS Functions

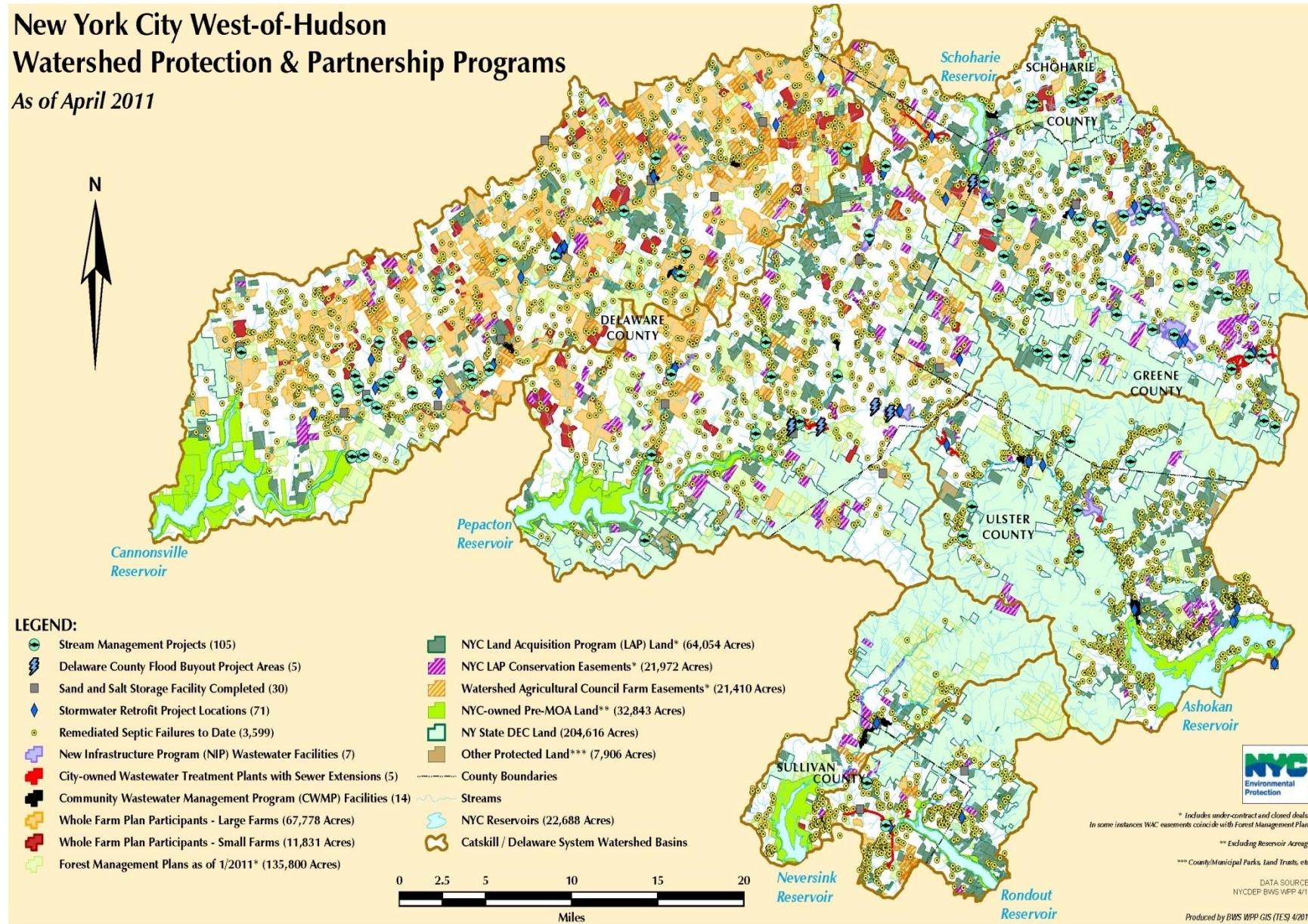
- Identify land use threatening water quality
- Identify point sources of pollution
- Support model farming program
- Model water quality patterns

NYC DEP Water Quality Program

"Filtration Avoidance" saves \$10B

New York City West-of-Hudson Watershed Protection & Partnership Programs

As of April 2011



September 10, 2001

NYC and Con Edison near agreement to share electric grid data

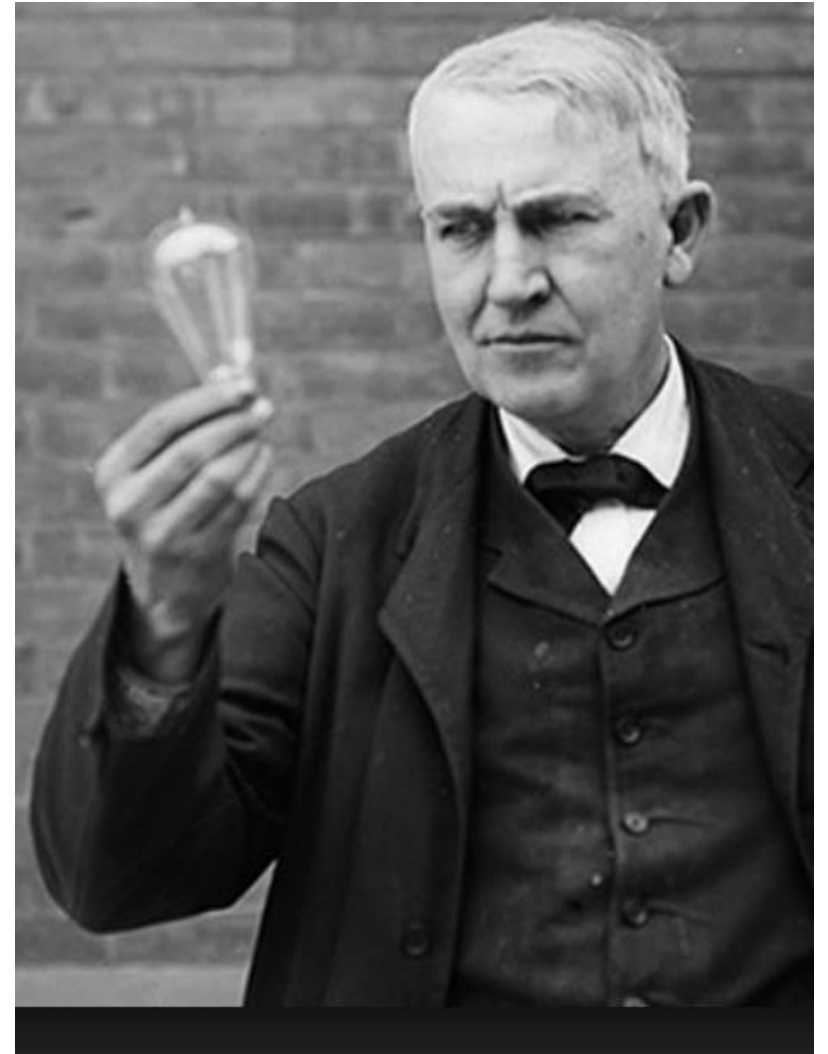
NYC invokes provisions of its franchise agreement with Con Ed

NEW YORK CITY DEPARTMENT OF INFORMATION TECHNOLOGY
& TELECOMMUNICATION AND
CON EDISON UNDERGROUND
ELECTRIC FACILITY DATA EXCHANGE STUDY—
VERSION 2.2

Prepared for:

Al Leidner, GIS Utility Manager, DoITT

**Eric Stewart, Director of Application Services
Consolidated Edison Co. of New York, Inc
4 Irving Place, New York, NY 10003
(212)460-2150, Room 875-S**







7 World Trade Center: Site of the NYC Emergency Operations Center



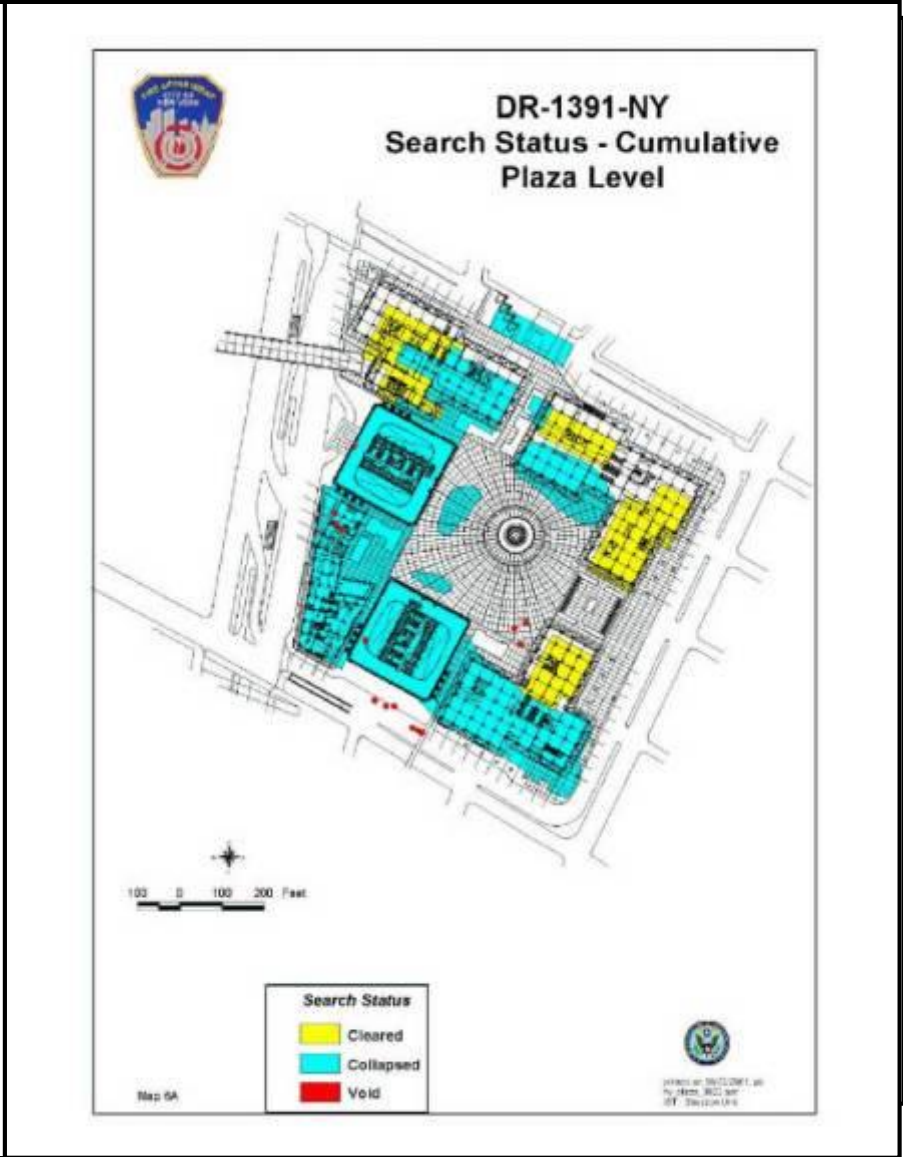
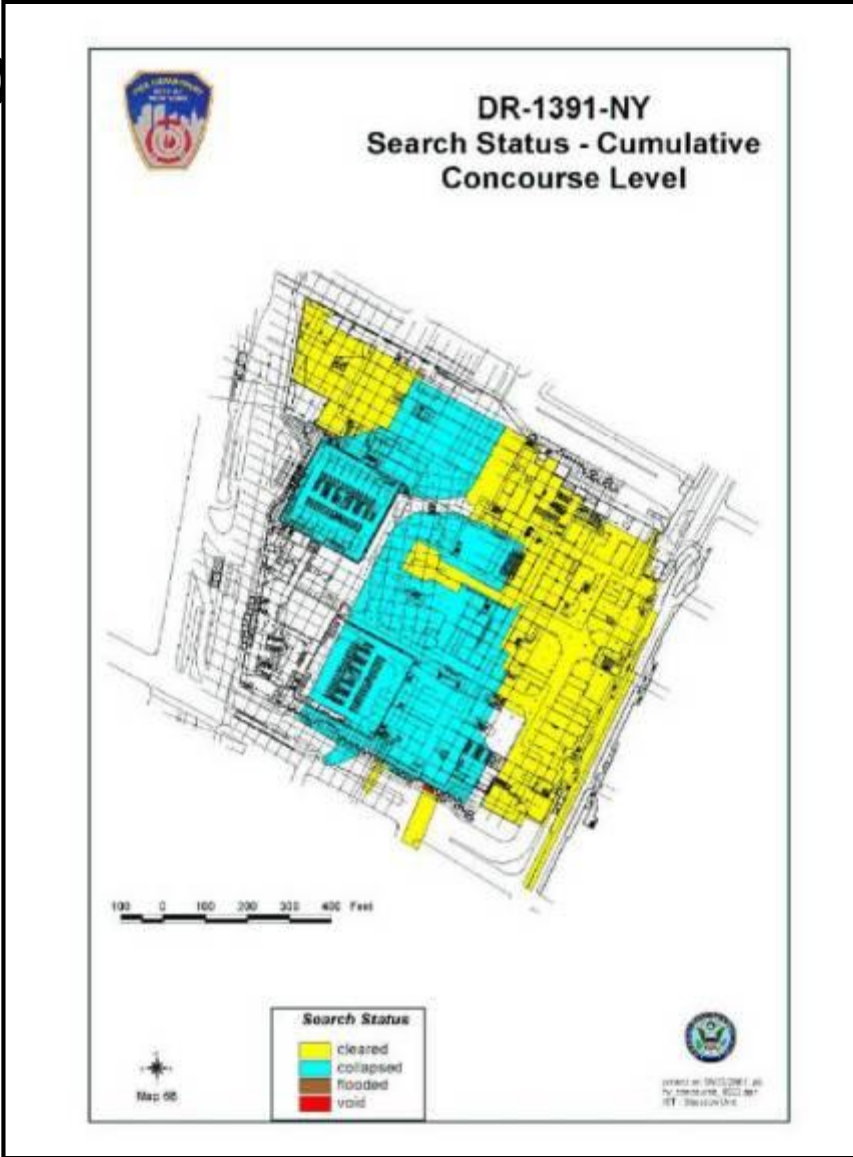
Thanks to the incredible work of NYC OEM
On Saturday 9/15 GIS operations shift to Pier 92



EMDC Map Request Intake and Pickup Station



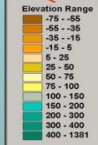
Resp



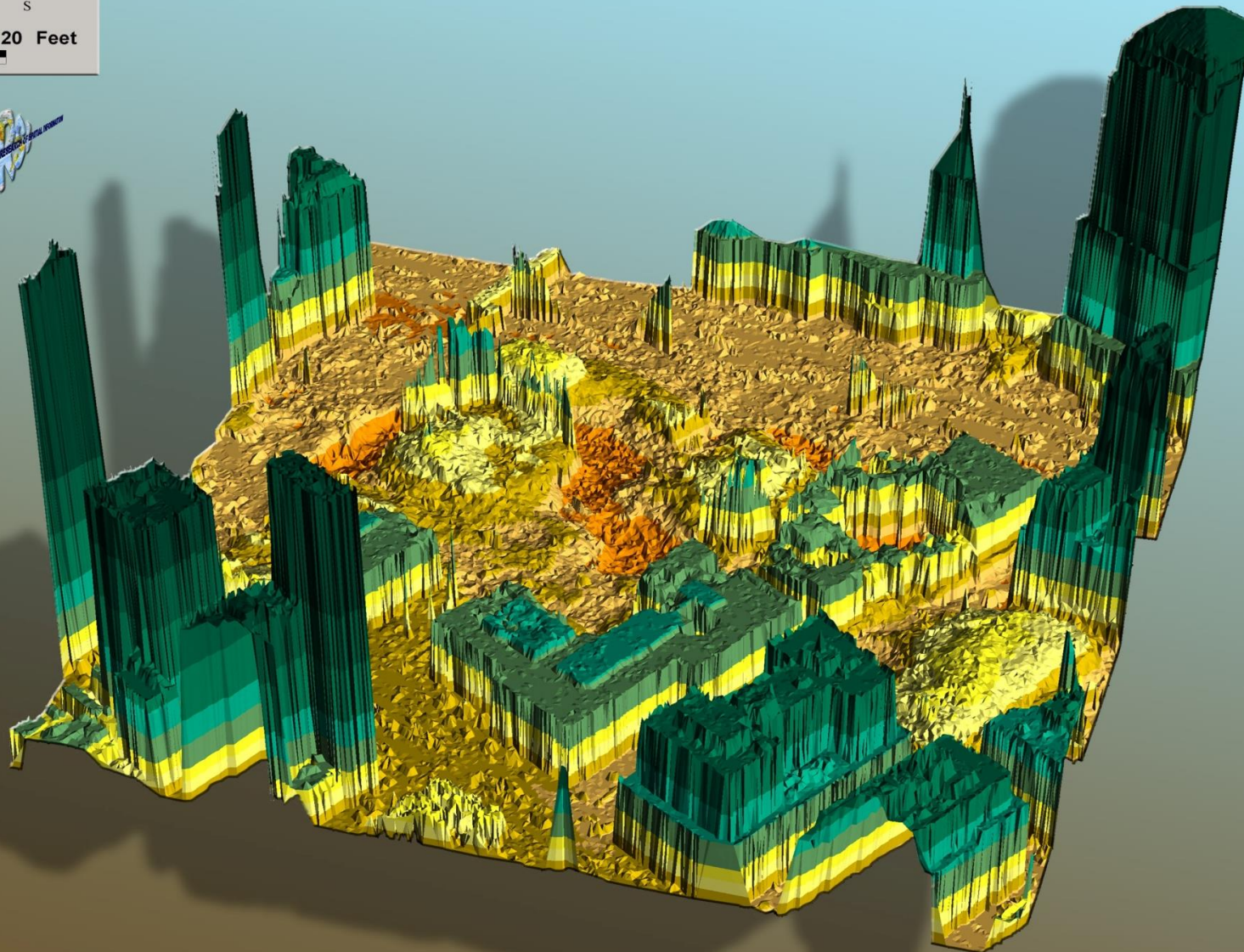
3D Model Rendered from TIN. September 19, 2001 LIDAR data

World Trade Center, New York, NY

Road Centerlines

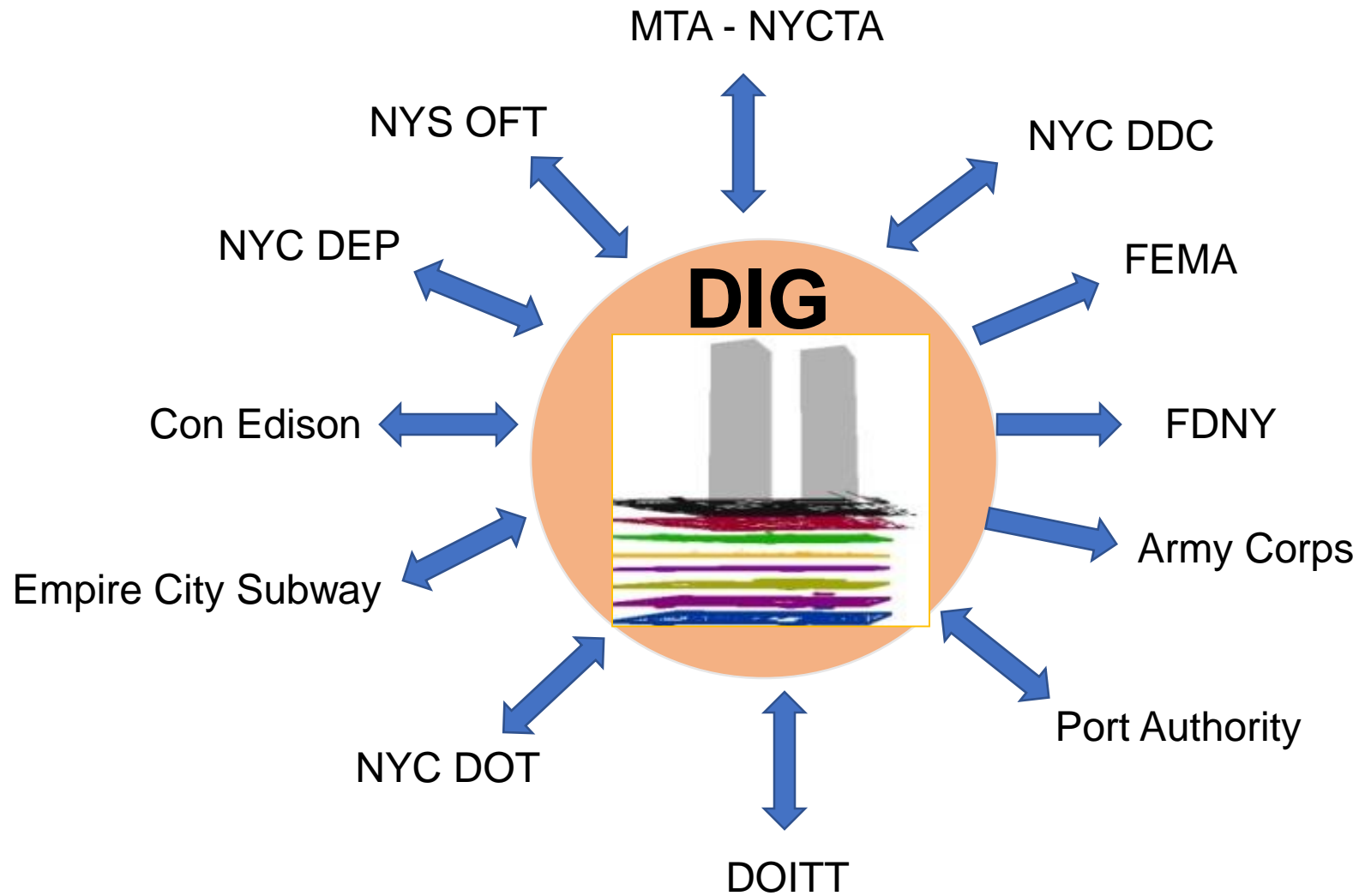


0 40 80 120 Feet



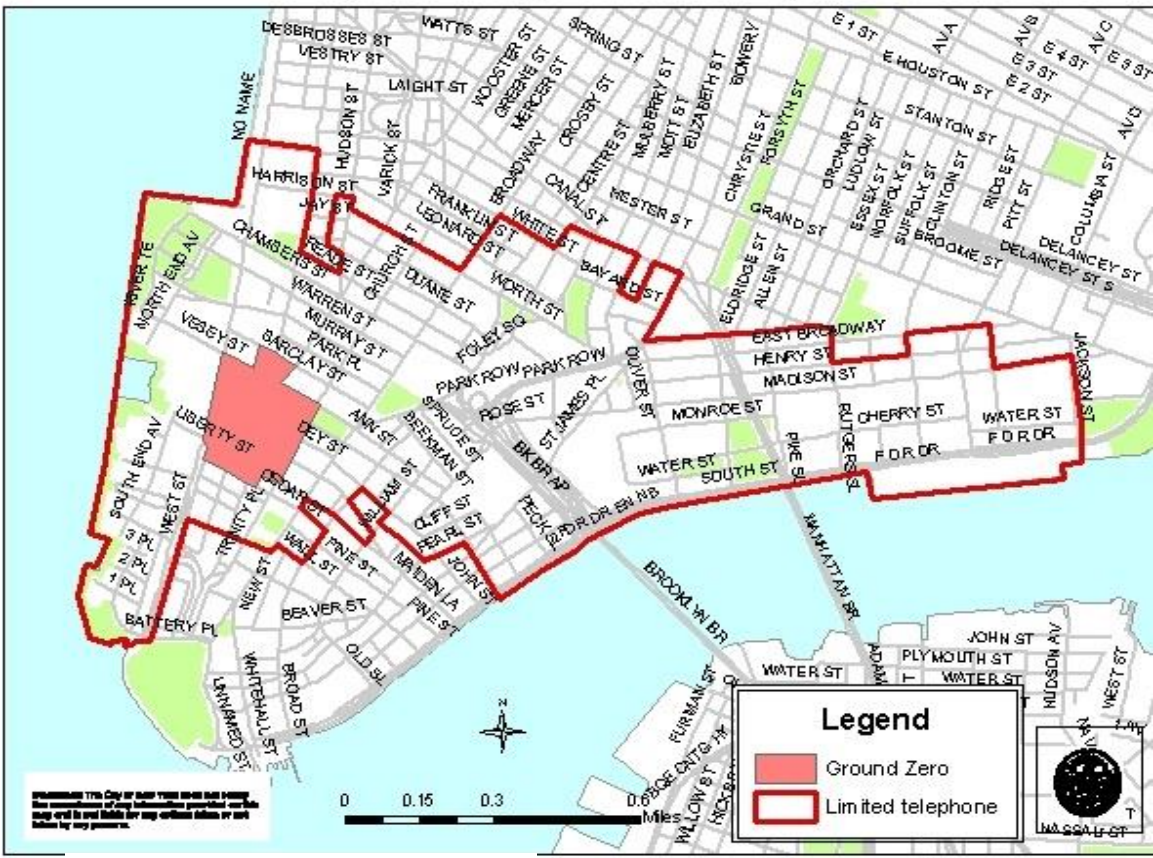
NEW YORK CENTER FOR THE ANALYSIS AND DESIGN OF CIVIL ENGINEERING

Deep Infrastructure Group: 9/11 Data Exchange Broker



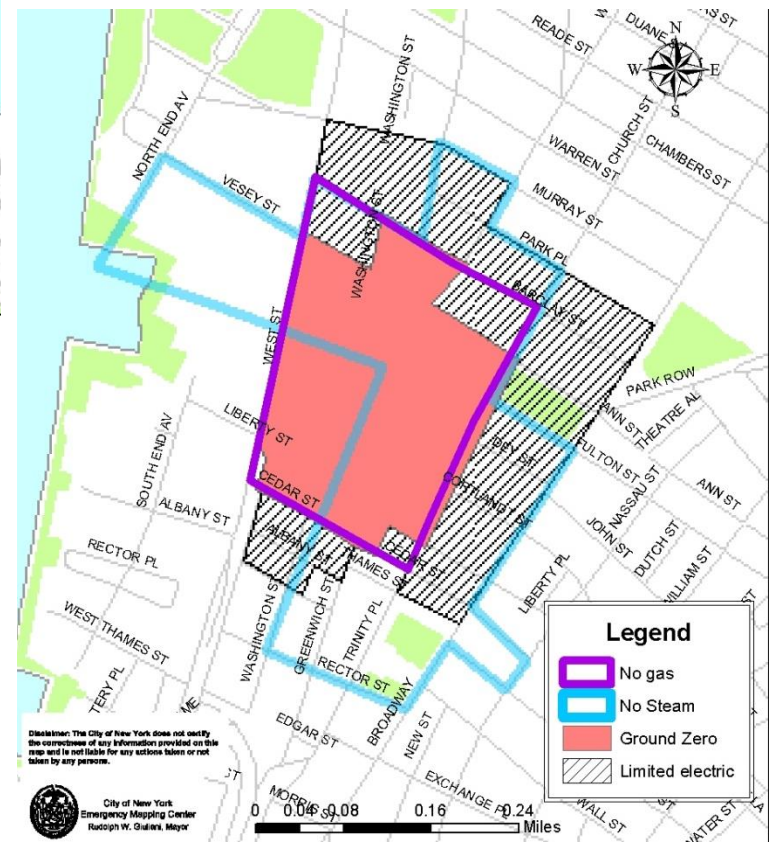
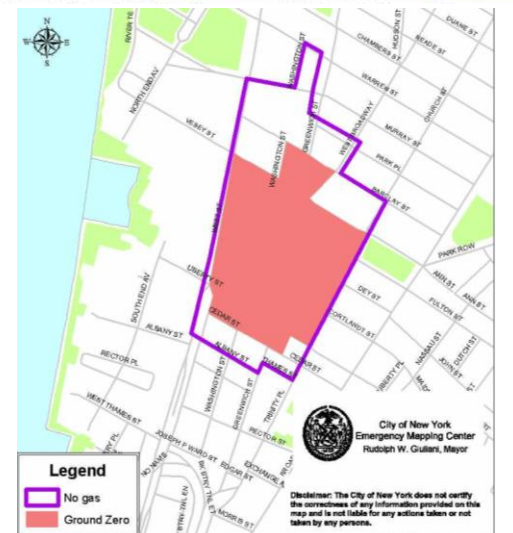
DIG Information Flows

Telephone Outages as of 8:00 AM, 9/22/01



Daily Utility Outage Map Changes for Posting to the Internet

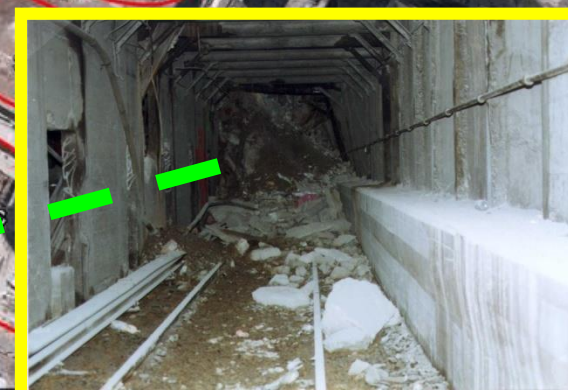
Water Outages as of 6:00 PM, 9/22/01



No loss of transit passengers or employees

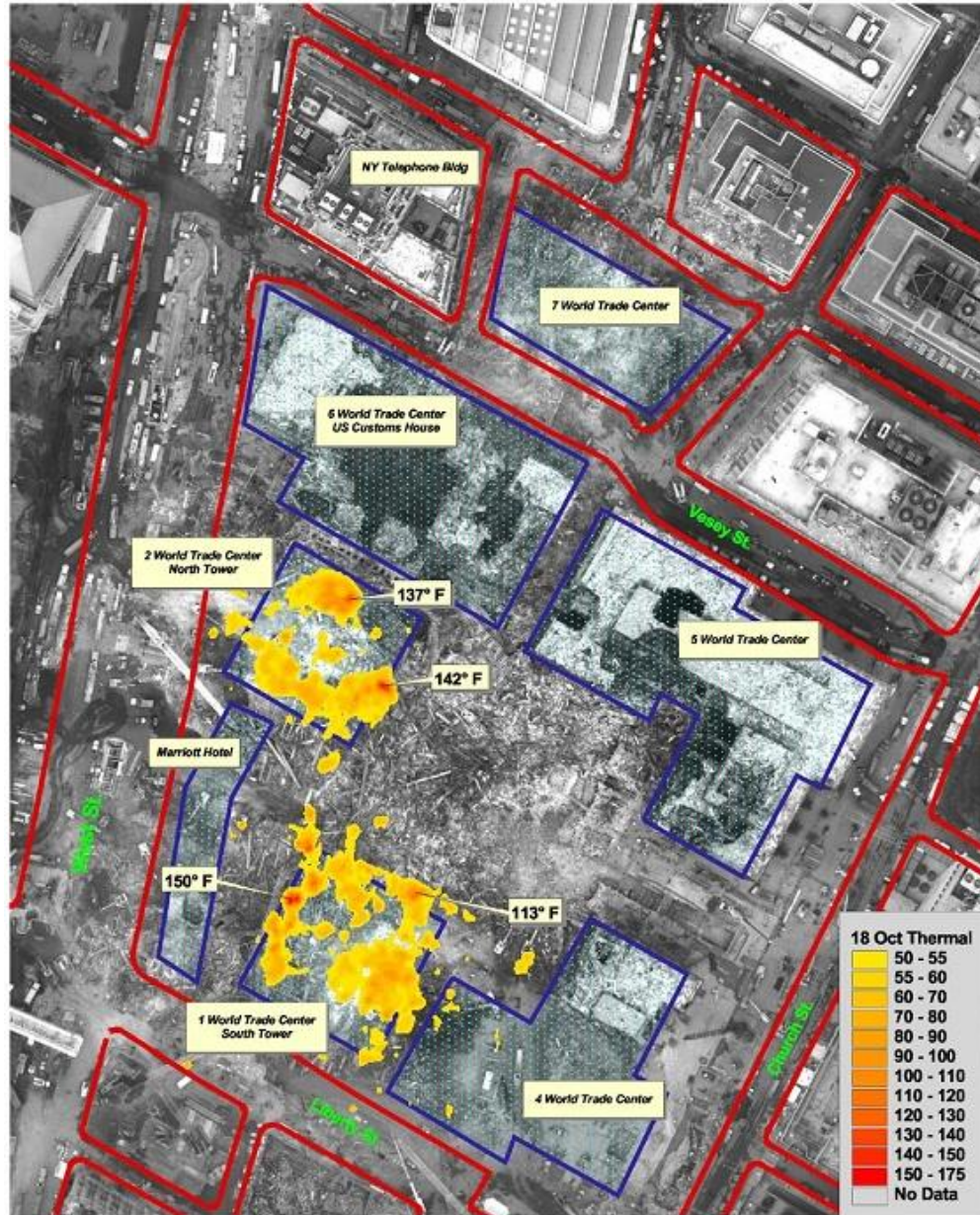
Due to rapid, decisive response by NYCT Rapid Transit Operations Command Center, and personnel at the scene

IRT
Cortlandt
St / WTC
Station –
Looking
South



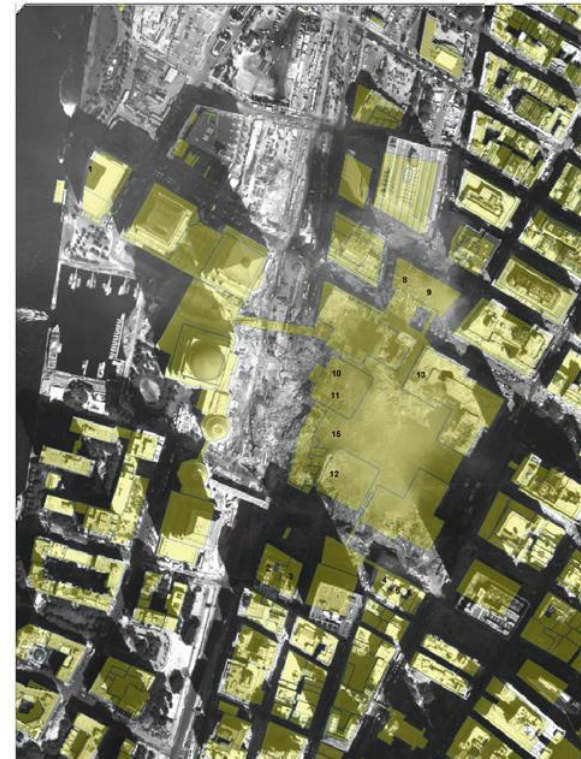
IRT
Broadway
-7th Ave
Line
Tunnel –
Looking
North
from
Liberty St

Fuel tanks + Freon + Fires = Trouble



Fuel Tanks Near the World Trade Center Within Secured Area

- | | | |
|---|--|---|
| 1) PBS# 2-601825
250 Vesey Street
400 gallons
Fuels: #1, 2, or 4
Steel Storage Tank, Above Ground | 3) PBS# 2-511536
130 Cedar Street
9,500 gallons, #5 or 6,
Underground, Vaulted Access
3,000 gallons, #1, 2, or 4
Steel Tank | 5) PBS# 2-604662
120 Liberty Street
4,000 gallons
Fuels: #1, 2, or 4
Steel Tank, Above ground |
| 2) PBS# 2-200212
90 West Street
2 x 10,000 gallons
Fuels: #5 or 6
Steel Tanks, Above Ground | 4) PBS# 2-357685
124 Liberty Street
330 gallons, Above ground, Steel tank
1,000 gallons
Below ground, Fiberglass reinforced plastic
Diesel Fuel | 6) PBS# 2-332941
114 Liberty Street
5,000 gallons
Fuels: #5 or 6
Steel Tank, Above Ground |
| | | 7) PBS#2-258822
47 West Street
3,000 gallons
Fuels: #5 or 6
Steel Storage Tank, Above Ground |
| | | 8) PBS# 2-601553
7 World Trade Center
2 x 6,000 gallons
Diesel Fuel
Underground Storage Tank |
| | | 9) PBS# 2-602283
7 World Trade Center
2 x 11,690 gallons
Fuels: 1, 2, or 4
Fiberglass reinforced plastic tanks, Underground |
| | | 10) PBS# 2-602234
1 World Trade Center
10,000, 3 x 275, & 100 gallons
Fuels: #1, 2, or 4
Steel Storage Tank |
| | | 11) PBS# 2-293563
1 WORLD TRADE CENTER
10,000, 5,000, 1,800, & 3 x 275 gallons
Fuels: 1, 2, or 4
Above Ground, Stainless Steel Tanks |
| | | 12) PBS# 2-344737
2 World Trade Center
2 x 2,500 gallons
Fuels: #1, 2, or 4
Steel Storage Tanks, Above Ground |
| | | 13) PBS# 2-604231
5 World Trade Center
2 x 10,000 gallons
Fuels: #1, 2, or 4
Steel Storage Tanks, Above Ground, Level B2 |
| | | 14) PBS# 2-000204
River Water Pump Station
(Actual Location Unknown)
2 x 4000 gallons
Sodium Hypochlorite
Fiberglass Reinforced Plastic Tank |
| | | 15) Large Freon Tank |



Disclaimer: The City of New York does not certify the correctness of any information provided on this map and is not liable for any actions taken or not taken by any persons.



NOTE: Interpretations and clarifications can be obtained through Thomas Palanski at the NYSDCE WTC Operations Command Center at 518.402.2993 or 518.402.8813

Underground tanks held more than 200,000 pounds of freon

- Threat of explosion from fires
- Fear that leaks would suffocate workers



Eventually tanks were emptied and safely removed

Looking Back

- The collection and integration of underground infrastructure data was an essential part of the 9/11 GIS response
- The NYC/Con Edison draft agreement was “iced” for 15+ years
- **Despite continued resistance by private utilities, city government infrastructure layers continued to be digitized – but not fully integrated and shared**

Major Electric Power Blackouts

Citywide: 1965, 1977, 2003 Queens: 2006



*July 30st, 2004 Gas Main Explosion in Flanders
24 Dead, 132 Injured*



2004 – 2007: Geo-referencing All Underground Subway Stations to support 2004 RNC at MSG

Existing Microstation drawings of transportation infrastructure system are georeferenced using an NYC GIS base map (NYC MAP).



NYC DEP Sewer Map: 2005 - 2012



Wastewater Treatment Plants	Capacity (MGD)
North River	170
Wards Island	275
Hunts Point	200
Newtown Creek	310
Red Hook	60
26th Ward	85
Owls Head	120
Coney Island	110
Bowery Bay	150
Tallmans Island	80
Jamaica	100
Rockaway	45
Port Richmond	60
Oakwood Beach	40

- Wastewater Treatment Plant Location
- Plant Has Dewatering
- Collections Facility
- Community Board District



Steam Pipe Explosion Midtown Manhattan

July 18, 2007




The Geospatial Response To Sandy


October 29, 2012






NOAA Predicted Storm Track and Surge Heights for Superstorm Sandy

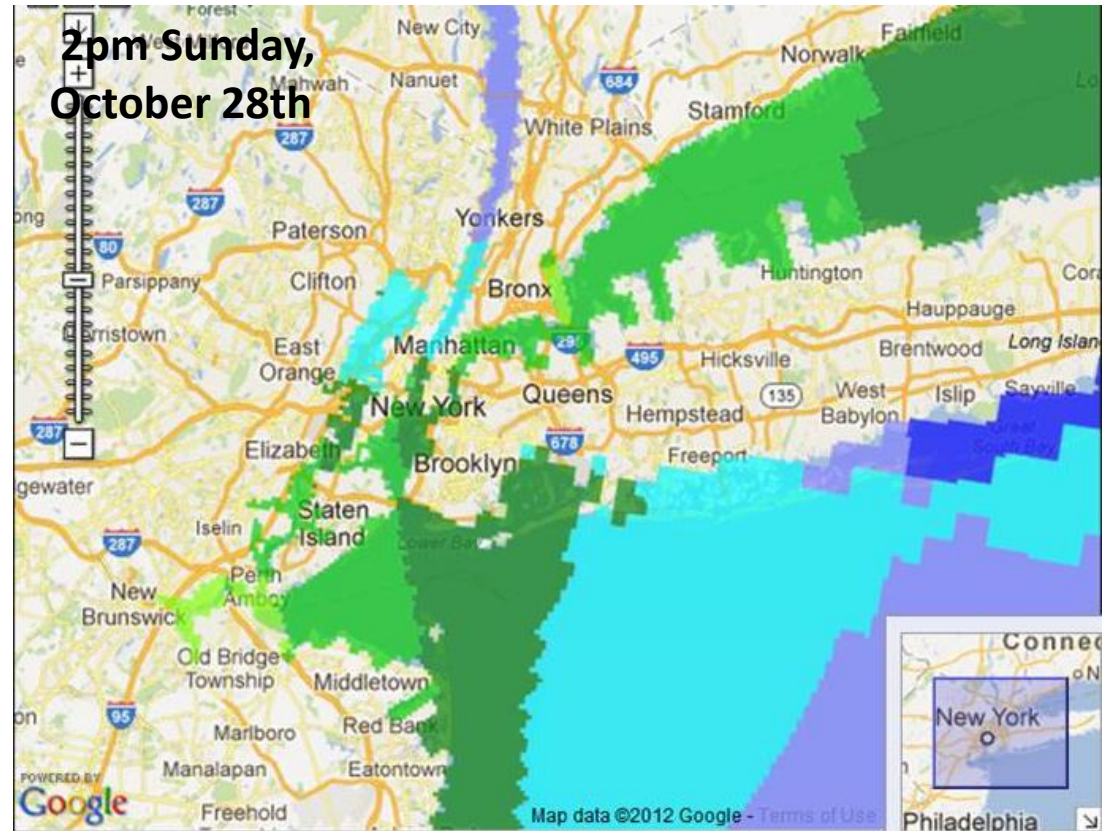


Current Information: 
 Center Location 27.1 N 77.1 W
 Max Sustained Wind 75 mph
 Movement N at 7 mph

Forecast Position: 
 Sustained Winds:
 S 39-73 mph H 7-

Watches:
 Hurricane  Trop. Storm

Warnings:
 Hurricane



Lat: 40.5848 Lon: -73.3749

Legend

Height above NGVD-29 (feet)

0 to < 2	11 to < 13	23 to < 25
2 to < 3	13 to < 15	25 to < 27
3 to < 5	15 to < 17	27 to < 29
5 to < 7	17 to < 19	29 to < 36
7 to < 9	19 to < 21	
9 to < 11	21 to < 23	

Disclaimer



Historical Data:
 NHC this storm
 NHC all storms
 MDL

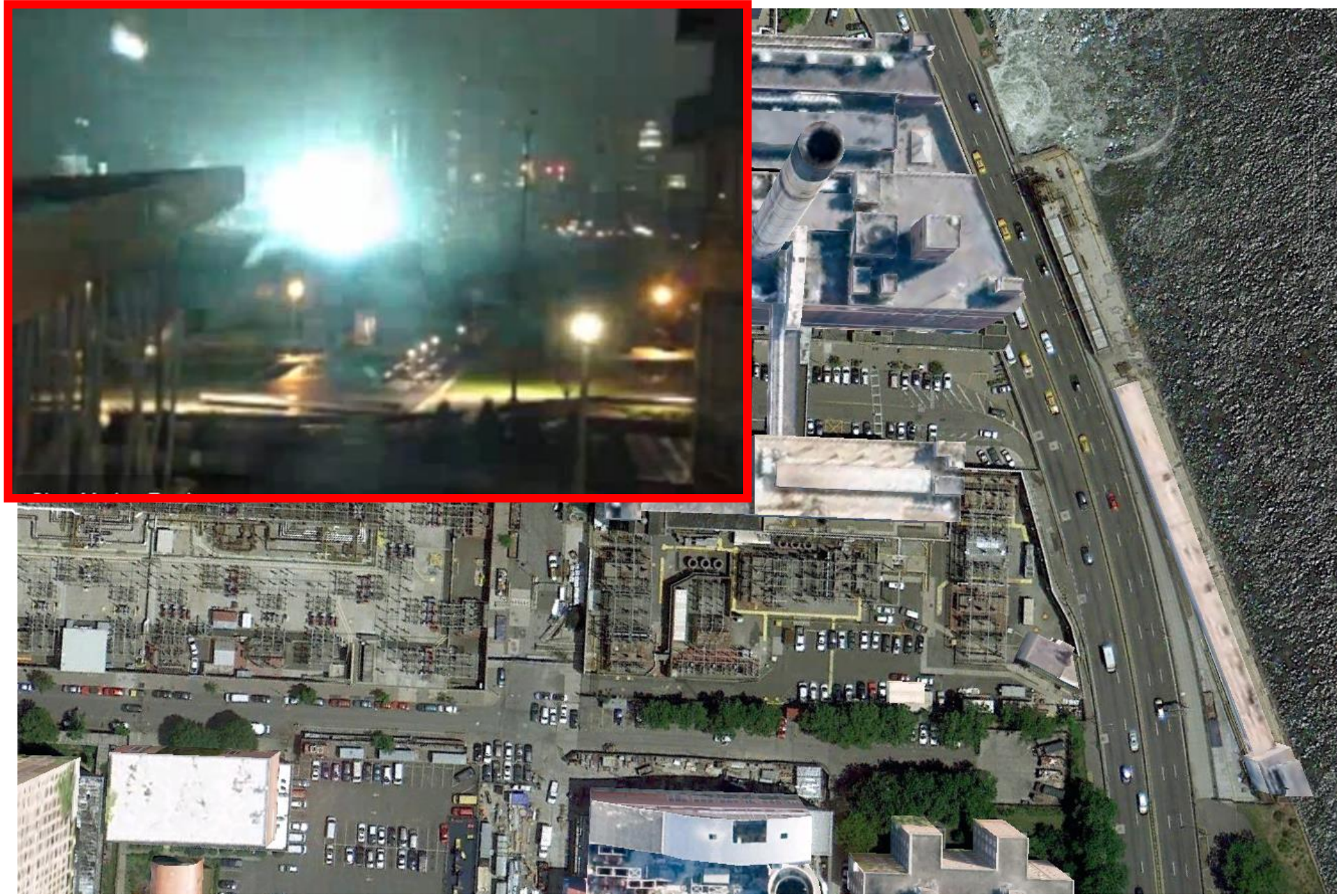
NW corner of FDR Drive and East 13th Street showing variable height in sea wall and discontinuity in the façade 1/13



Bing Oblique Imagery from 2012: Showing apparent vulnerabilities to surge waters



Super Storm Sandy Shuts Down East 13th Street Substation



Midtown to Downtown Manhattan Blackout: Oct 29th 8:50PM



NYU Medical Center at E. 32nd Street

An excellent example of a cascading effect



NYU Medical Center/Bellevue Hospital and Predicted Flood Zone



Backup Generator Fails; NYU Medical Center Evacuated



Superstorm Sandy: NYU Hospital Evacuated in New York

abc WORLD NEWS with DIANE SAWYER
By RICHARD ESPOSITO and DAN CHILDS (@DanChildsABC)
Oct. 30, 2012

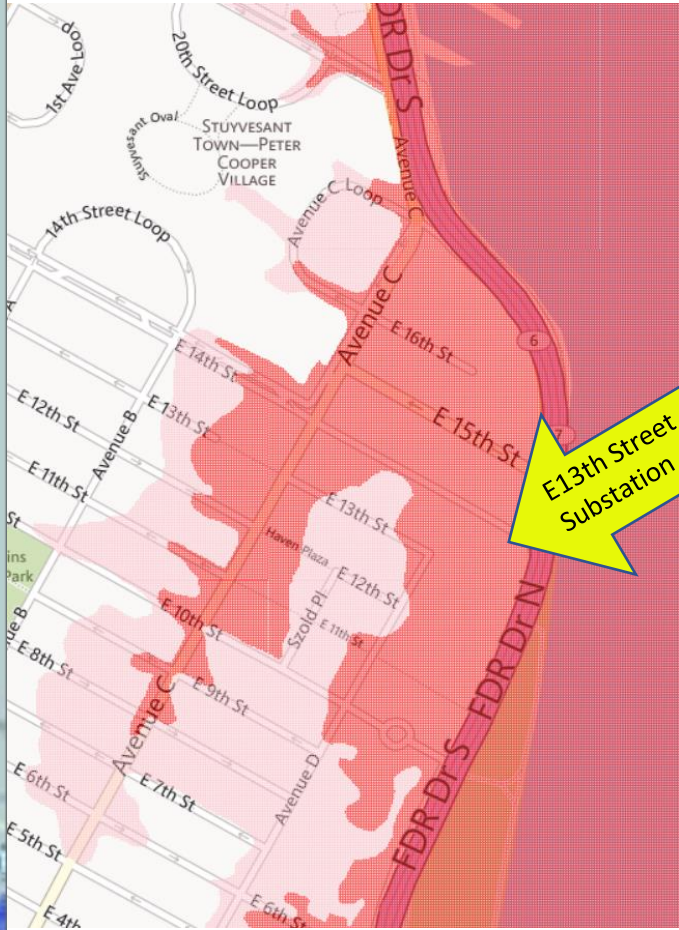
Paramedics and other medical workers began to evacuate patients from New York University Langone Medical Center due to a power outage caused by Tropical Storm Sandy, followed by a failure of backup generators at the hospital, New York City officials said Monday night.

Recommend 7.1k
Tweet 699

Hurricane Sandy Inundation Map



FEMA Flood Map



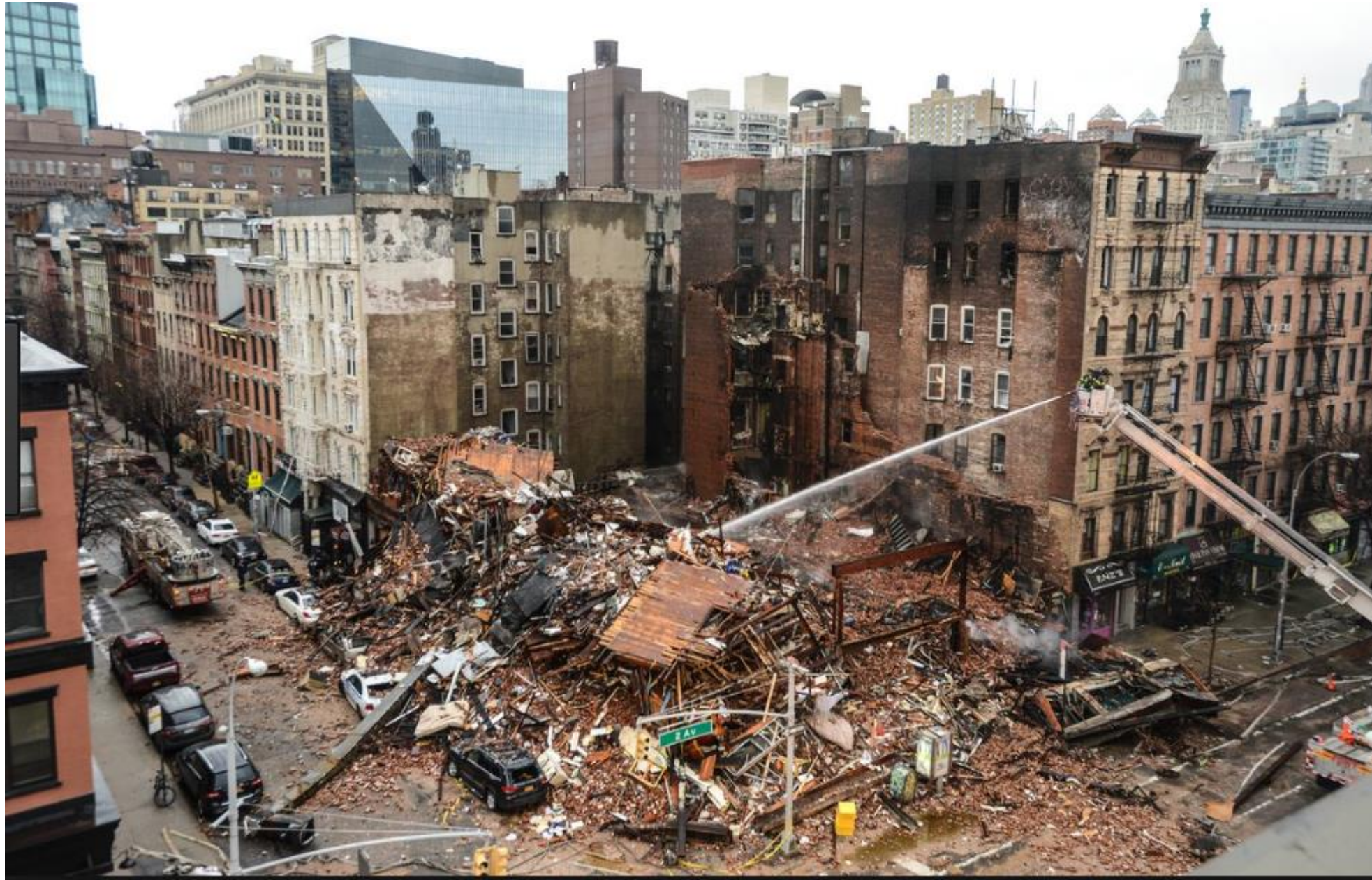
E13th Street Substation

E13th Street Substation

East Harlem Gas Explosion, March 12, 2014



East Village Gas Explosion March 25, 2015



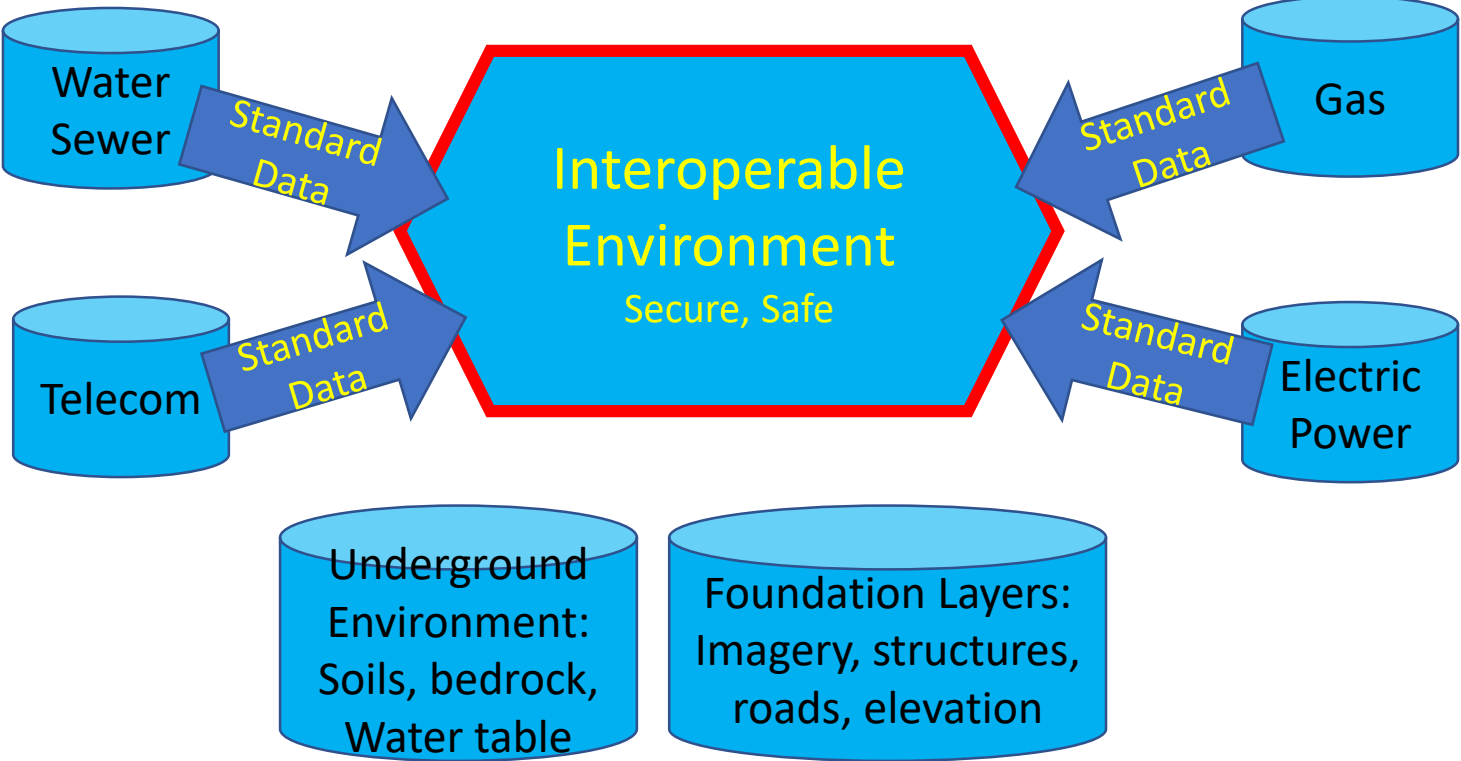
2016: The Underground Infrastructure Data Interoperability Project to Create Utility and Soil Data Models

- Mayors Office of Operations
- Fund for the City of New York: Mary McCormick
- Open Geospatial Consortium: George Percival
- Columbia University: George Deodatis, Albert Boulanger, Roger Anderson
- OGC Project Sponsors
 - FCNY, Singapore, Ordnance Survey
- OGC Participants
 - NYC, Chicago, England, Singapore, Belgium, Netherlands, France, Italy

Societal Benefits: Model the Total Built and Natural Environment

Use Cases for Interoperable Underground Infrastructure Data

- *Street Openings For Utility Work
- *Construction Design and Operations
- *Emergency Preparedness and Response
- *Smart Cities



OGC Underground Infrastructure Workshop at the HQ of the Fund for the City of New York



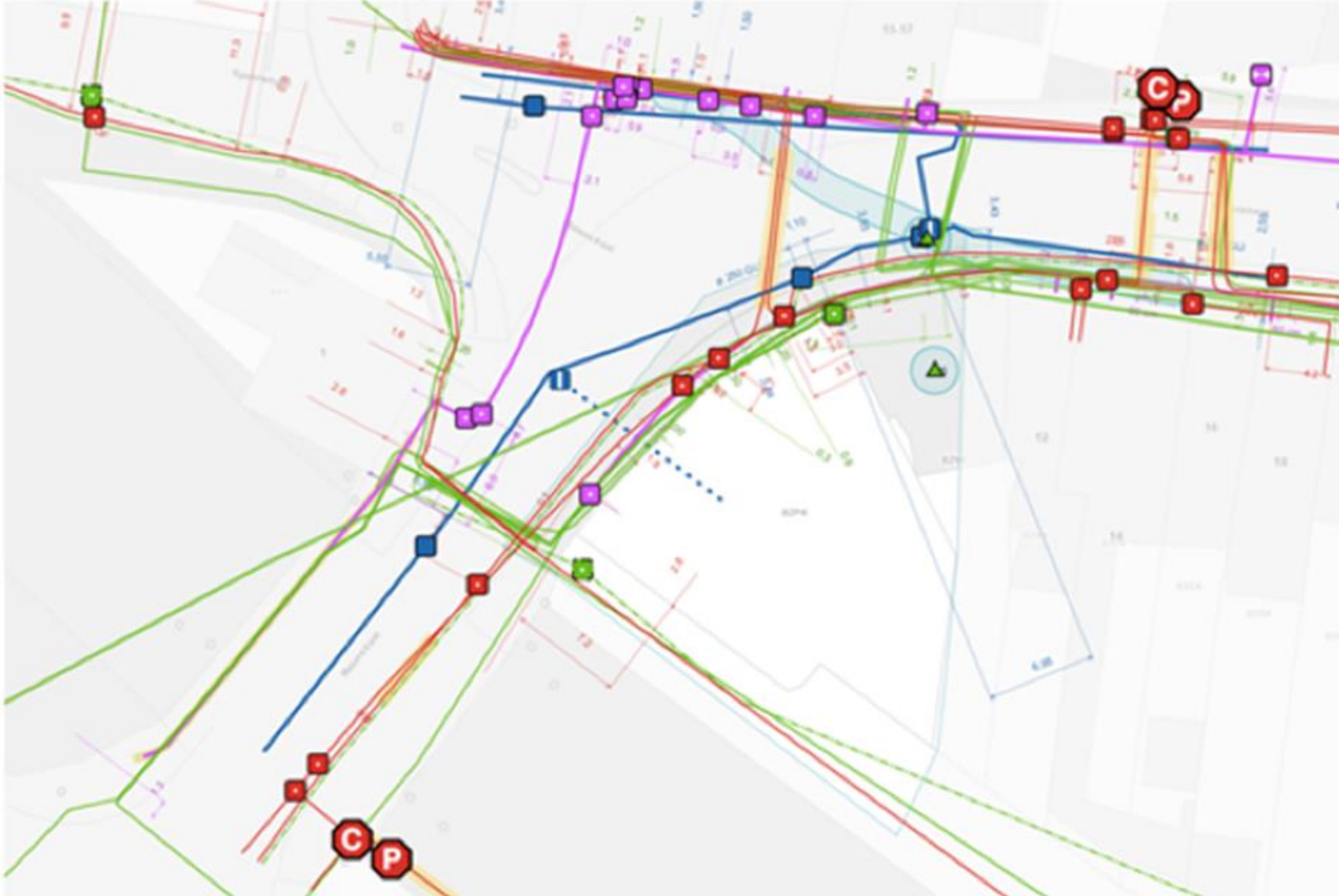
Use of Panoramic Photo Arrays To ID Infrastructure at Excavation Sites

Chicago – Proof of Concept

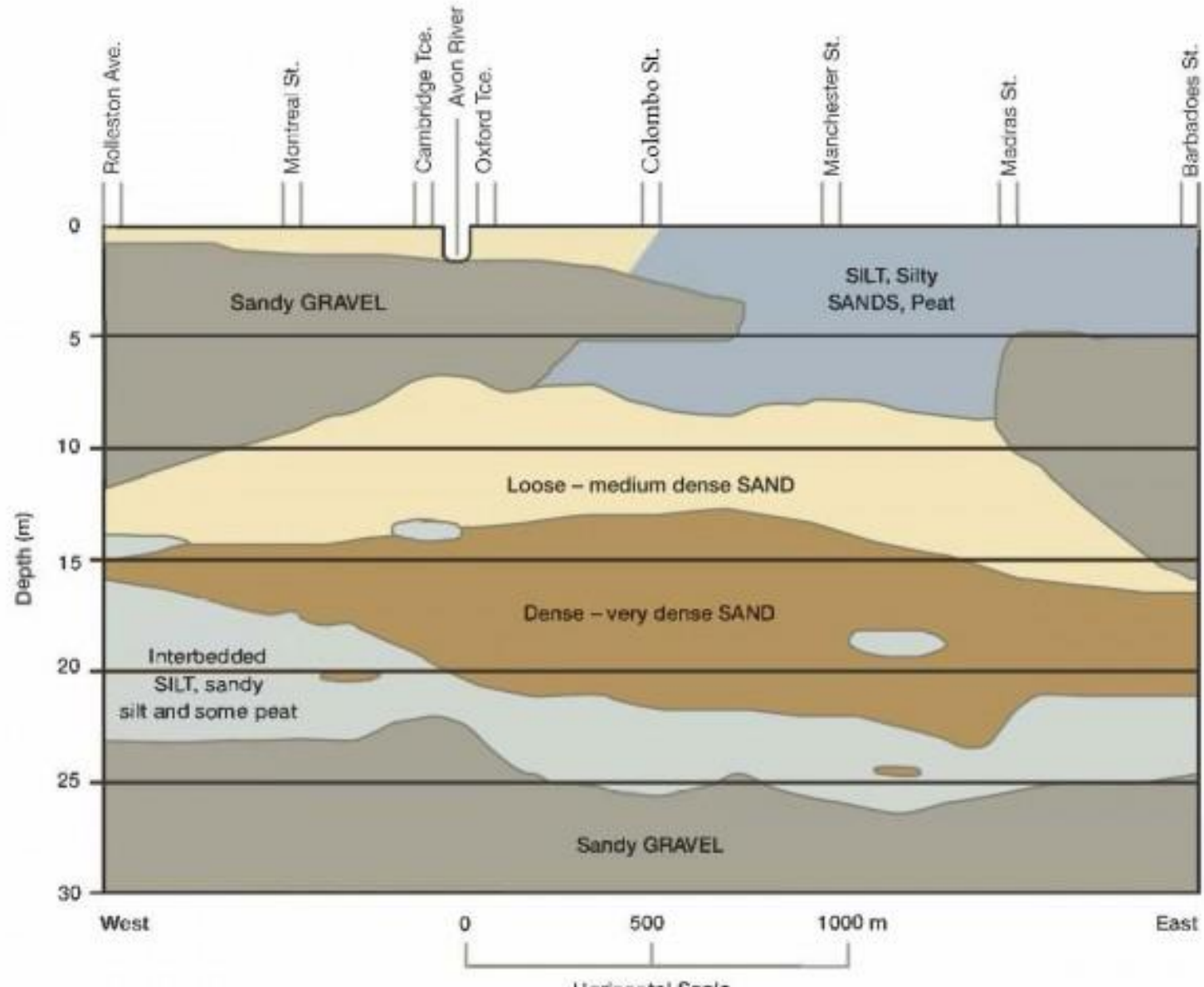


[Video Link](#)

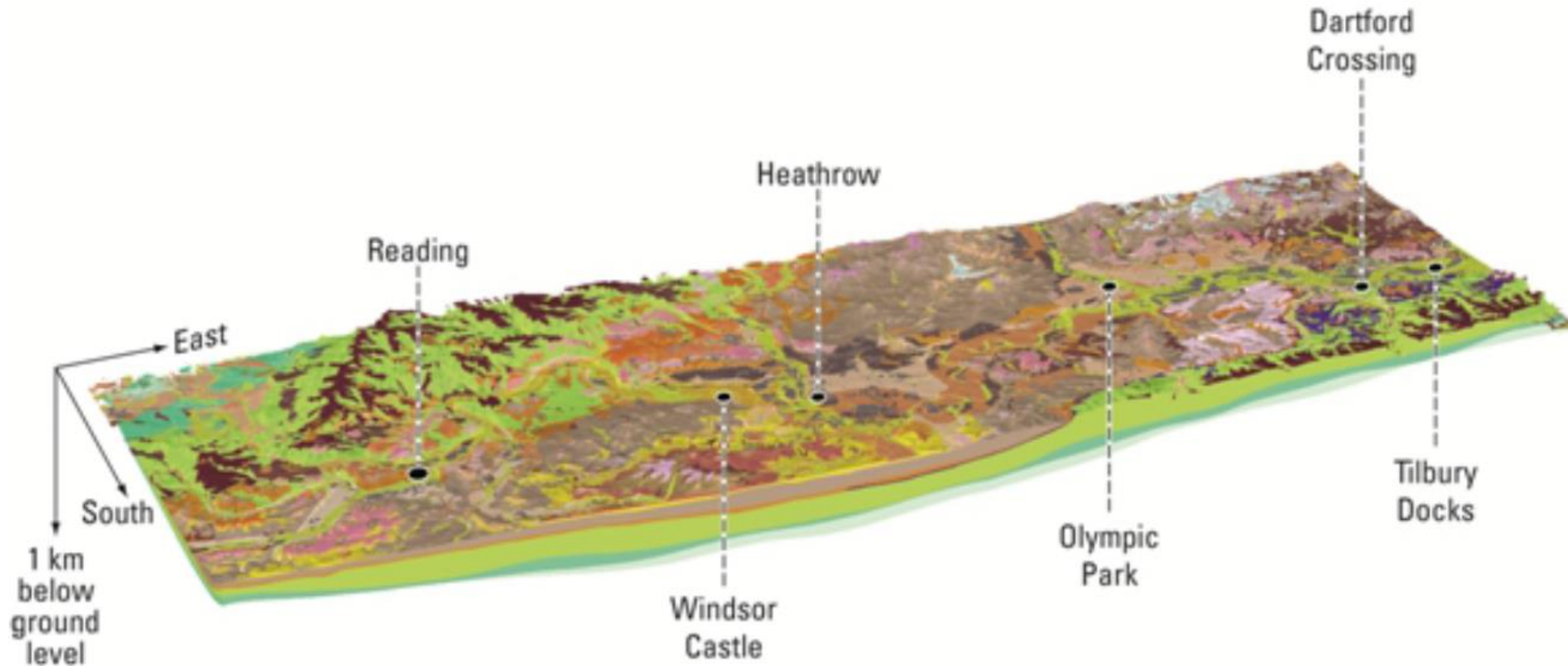
Using Euro INSPIRE data models, Flanders implements digital excavation alert system



Soil Heterogeneity in 2D



Geological Model of London and the Thames Valley Using > 7,000 core samples



Status: OGC Underground Infrastructure Interoperability Initiative

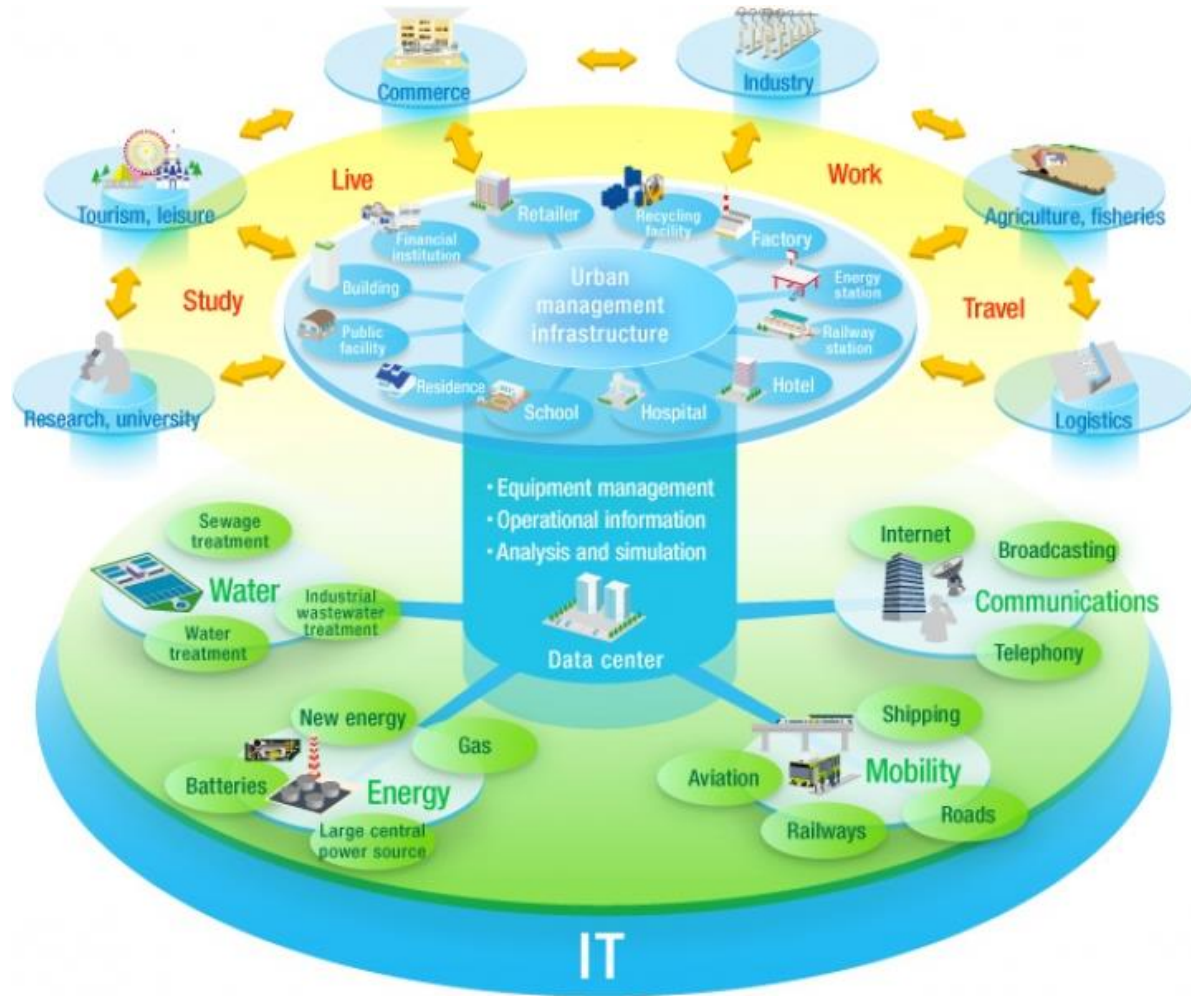
- Development and issuance of RFI: Completed
- Writing and issuance of Concept Development Study: Completed
- Development of draft infrastructure data models: Funded, Ongoing
- RFP to be Issued for pilot projects 12/17: Funding Sought
Participants Sought
- Consensus Underground Infrastructure Data Models To Be Issued
 - Also guidance on architecture, security, financing, ROI, data building methods
 - Implementation determined by each government

Interoperable Data Models Now Being Designed

- **Focus on excavations: reduced delay and fewer utility strikes**
 - Data can remain in hands of utilities
 - Planned excavations require small cut outs from each utility assembled centrally
- **Focus on large scale projects**
 - Data can remain in hands of utilities but must be available for examination
 - Larger areas must be shared centrally
 - Additional security required
- **Focus on Emergency and Disaster Planning, Preparedness and Response**
 - Generation, receiving and transmission features must be centralized
 - Large areas must be shared centrally
 - Strict security required

Integration of the Complete Natural and Built Environment

CityGML Above Ground + CityGML Below Ground



**Alan Leidner, Director
Center for Geospatial Innovation
Fund for the City of New York**

**President, NYC GISMO (Geospatial Information
Systems and Mapping Organization)**

917-455-2834

aleidner@fcny.org

OGC Project Page

<http://www.opengeospatial.org/projects/initiatives/undergroundcdfs>