Enterprise GIS in a Commuter Rail Environment: State-of-Practice at a Major Northeastern Carrier

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Abstract

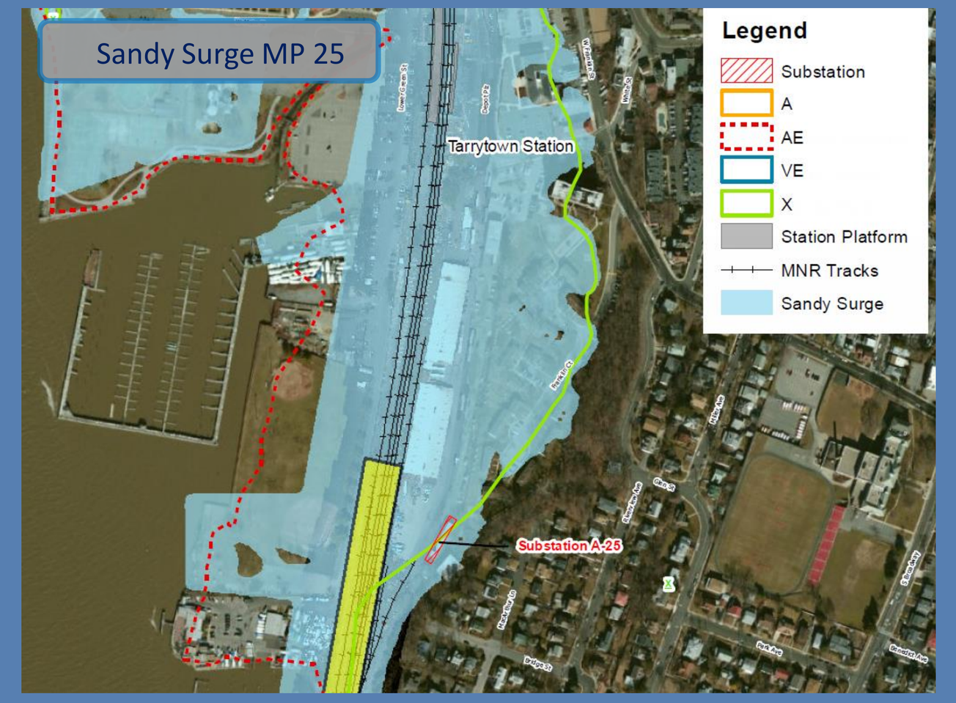
Triggered by both Superstorm Sandy's aftermath and a minor operational incident—where accurate and rapid mapping would have been tremendously helpful—Metro-North Commuter Railroad deployed its first Enterprise Geographic Information System (GIS) in 2012 by federating existing departmental systems, creating a companywide Office of GIS Coordination, promulgating GIS policies and standards, and developing and marketing a uniform set of web mapping viewers designed for all employees. This paper describes the state-of-practice and a checklist of strategies utilized to promote a new technology that, by its very nature, requires interdisciplinary collaboration and coordination within a proud organization steeped in a rich tradition of craft-based engineering excellence. This case study offers a glimpse of how incrementalism and a web-based rapid deployment strategy can overcome institutional inertia, culminating in an ongoing culture transformation where GIS became a common acronym understood by many functional groups and managerial levels within the organization. While there will always be different degrees of GIS readiness across departments, many employees at Metro-North now see the value of GIS and proactively seek it out as a resource to improve their daily workflow where circumstances warrant.

- Three states, twelve county service areas, and 2,701 square miles.
- Five lines, three branches, 384 route miles, and 775 track miles.
- 1,072 bridges, 119 grade crossings, and 77 substations.
- 124 stations, 1,258 railcars, and 711 weekday departures carrying 284k customers.
- Full service commuter railroad with engineering responsibilities for track, signals, power, structures, stations, and railcars.

Trigger Events

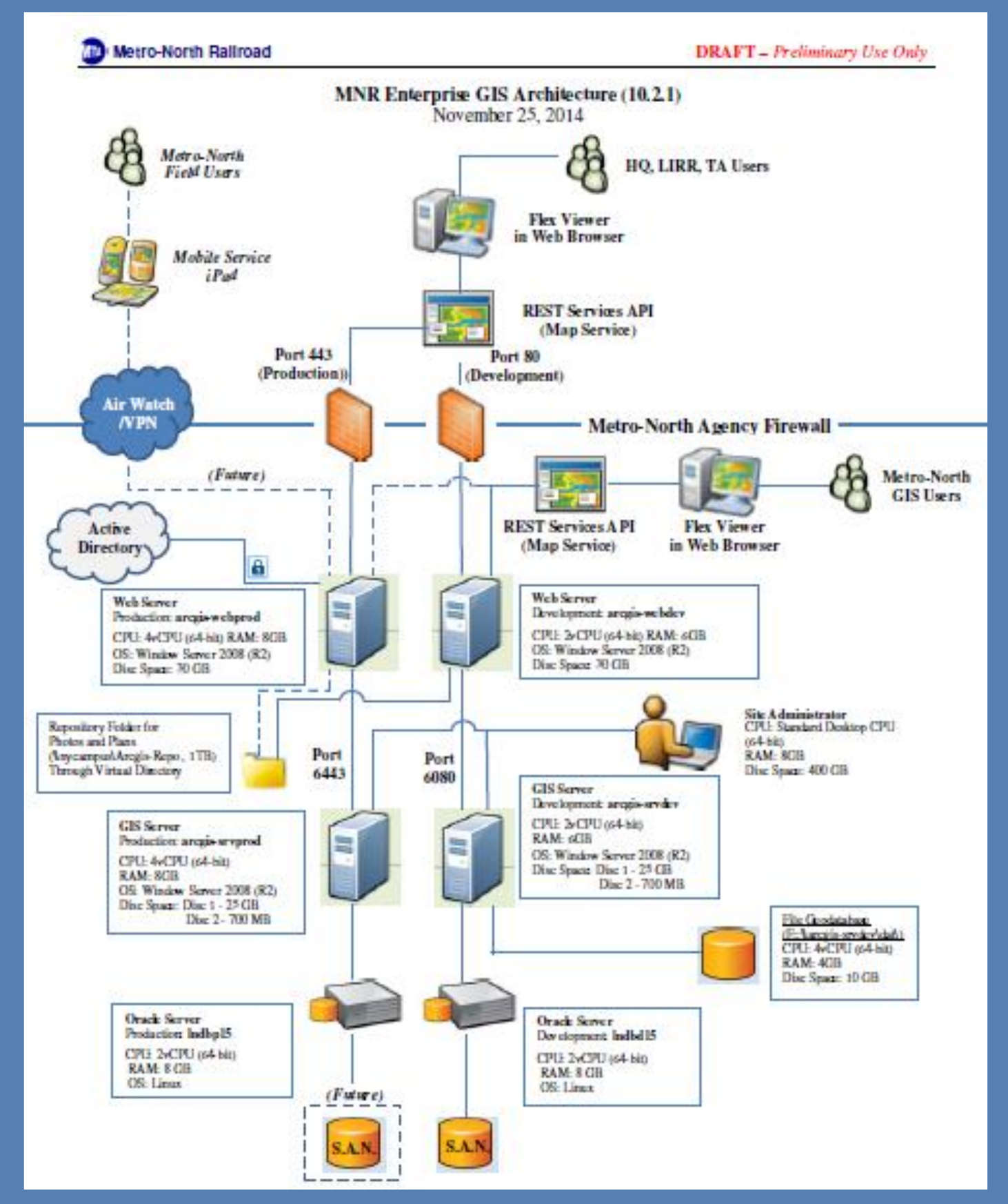
- **Westport 1532** (2011-07-22)
  - Real-time train location
  - Emergency access to ROW
  - Fire/EMS jurisdictions
- **Hurricane Sandy** (2012-10-20)
  - Real-time storm tracking
  - Elevation of key rail assets
  - Post-event insurance claims
  - Mapping recovery efforts

  Flood proofing future design

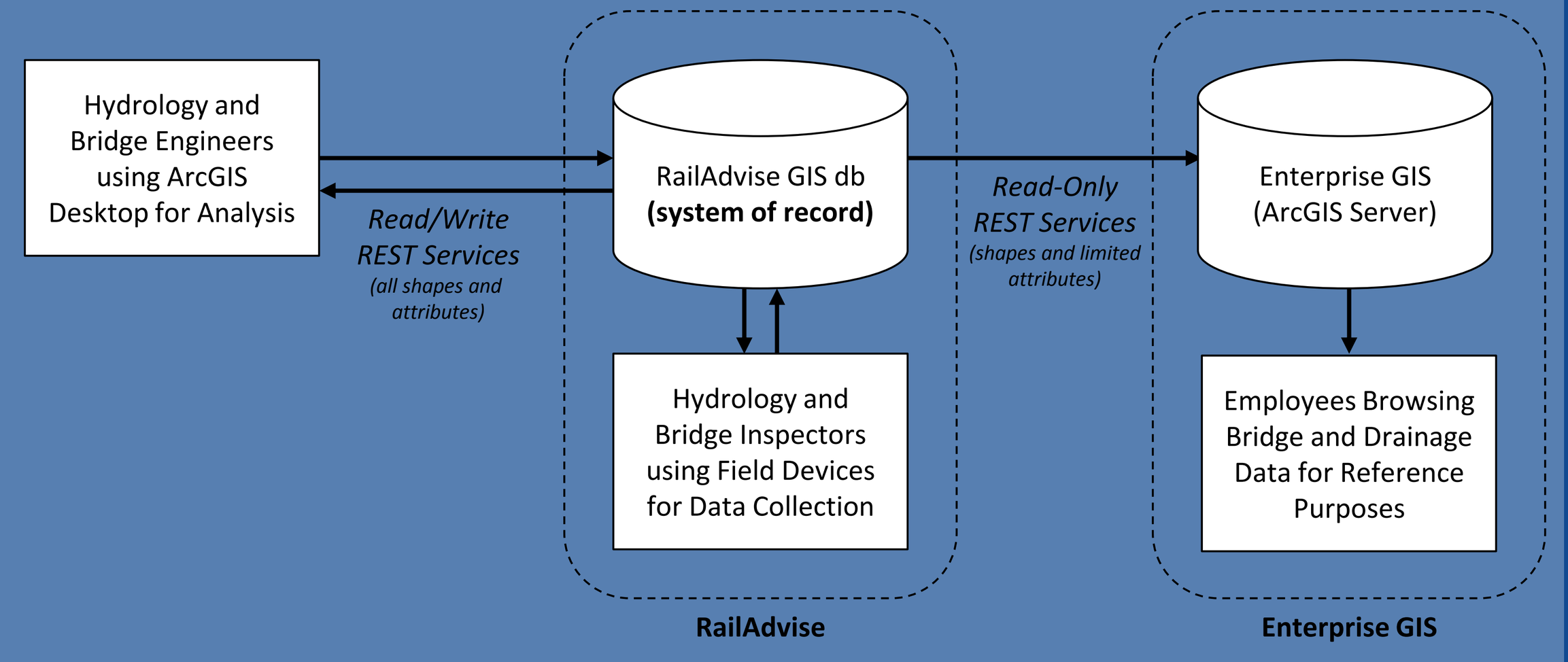


Early Strategy

- Hire GIS Specialist
- Sizing Enterprise GIS Infrastructure
  - Small-Scale but Expandable Infrastructure
  - Leverage Enterprise Virtual Servers
- Federated Approach—Sharing of Responsibilities



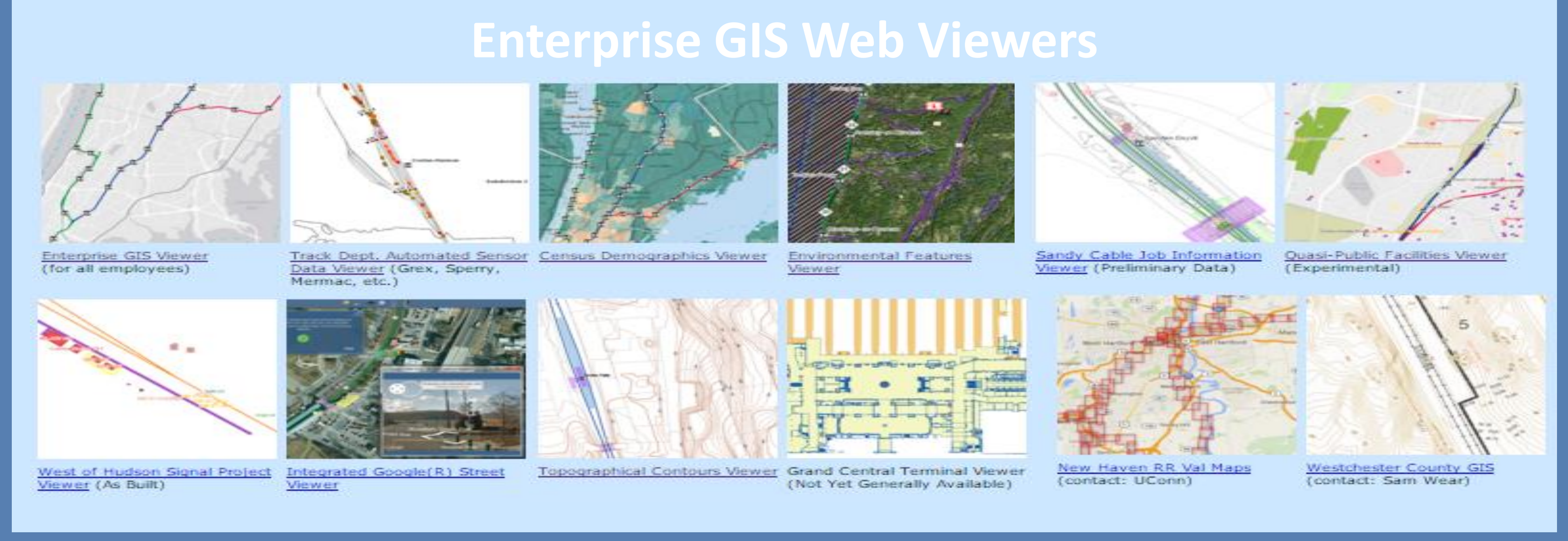
Enterprise GIS Architecture


Hydrology and Bridge Engineers using ArcGIS Desktop for Analysis
Read/Write REST Services
(all shapes and attributes)
RailAdvise GIS db (system of record)
Hydrology and Bridge Inspectors using Field Devices for Data Collection
RailAdvise
Read-Only REST Services
(shapes and limited attributes)
Enterprise GIS (ArcGIS Server)
Employees Browsing Bridge and Drainage Data for Reference Purposes
Enterprise GIS

Departmental systems would be the system of record while EGIS would fulfill a portal role with read-only access to departmental geodata.

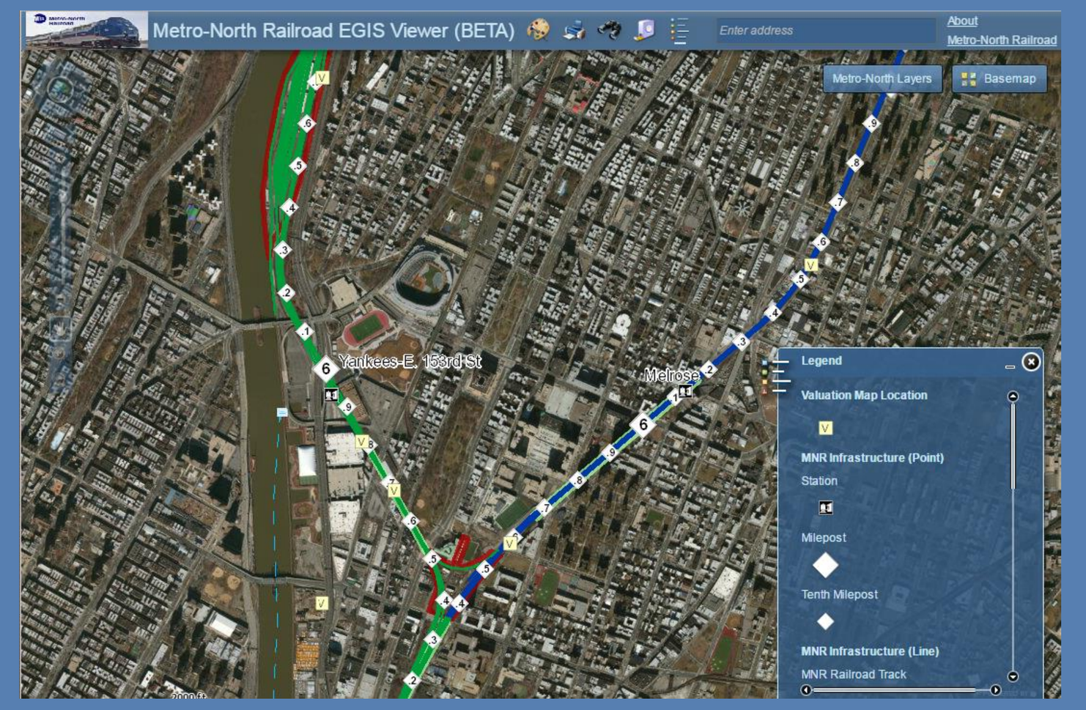
Enterprise GIS Web Viewers

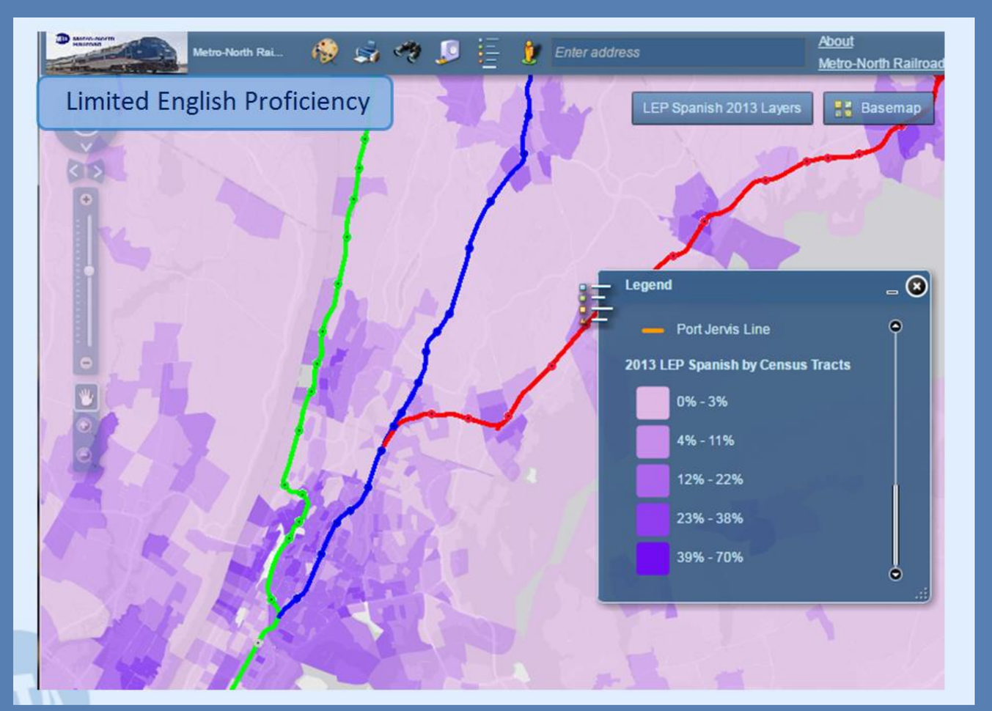
- Enterprise GIS Viewer
- Track Department Automated Sensor Data
- Census Demographics
- Environmental Features
- Superstorm Sandy Cable Job
- Quasi-Public Facilities
- West-of-Hudson Signal Project As-Built
- Integrated Google(R) Street View
- Topographical Contours
- Grand Central Terminal Floorplan
- New Haven Railroad Val Maps
- Westchester County GIS

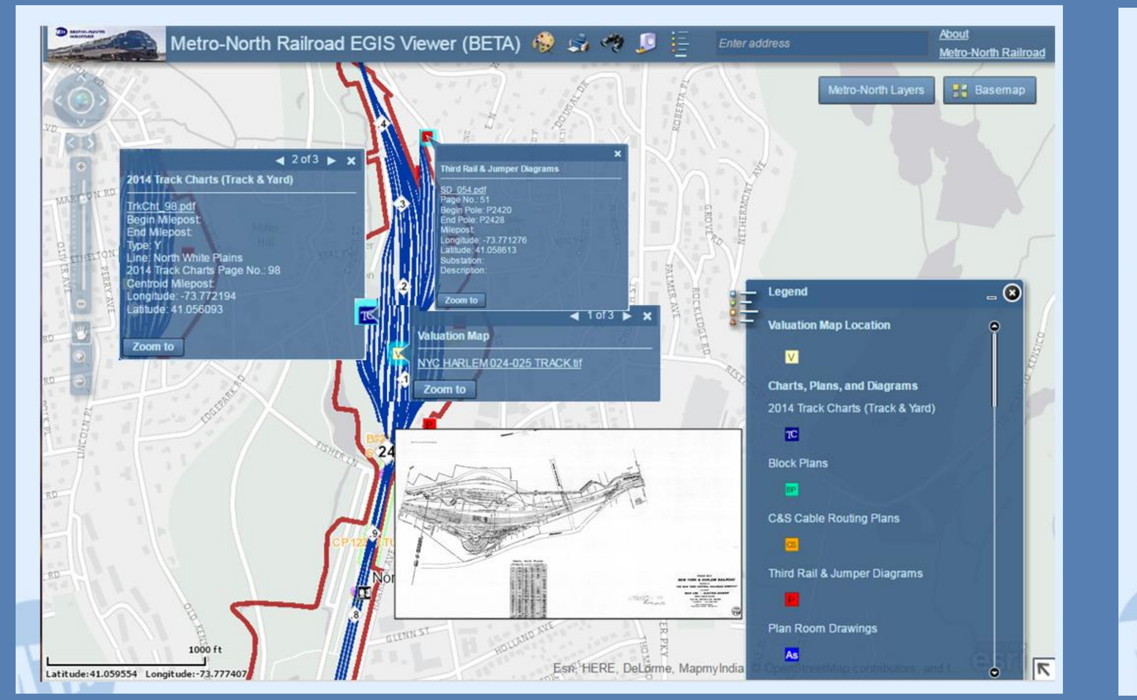


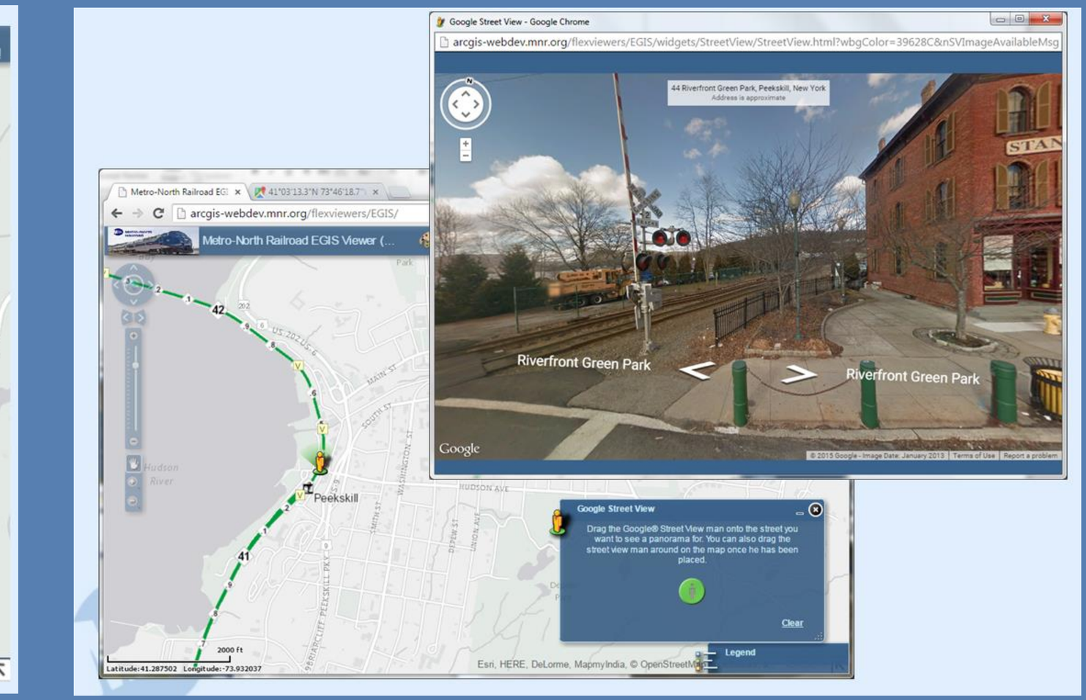
GIS Data Layers

- Map railroad features on web application
- Publicly available GIS layers overlaid with railroad locations
- Link existing PDF maps into viewer as repository of drawings
  - Signal block plans, Power sectionalizing diagrams, Val maps, etc.
  - Avoids labor intensive Georeferencing for now
- Google Maps and Street View Integration at critical points

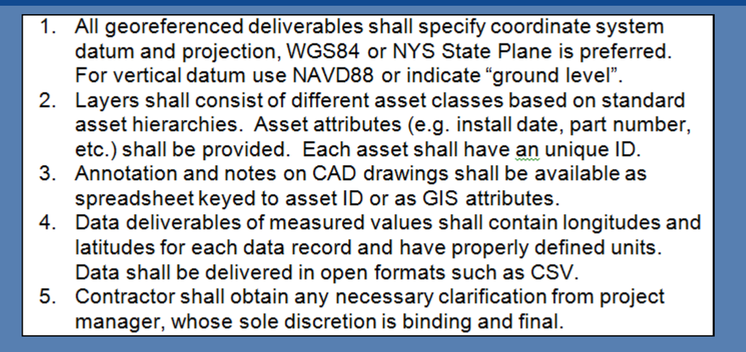






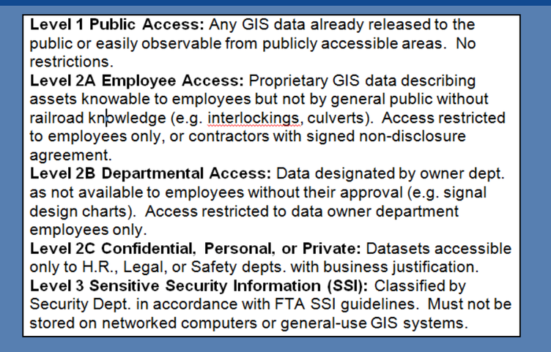


- **GIS Policies and Standards**
  - Software
  - GIS Boilerplate
  - Data Security
  - Data Hygiene Procedures
  - Human Capital
  - Establish Data Ownership and Update Responsibilities



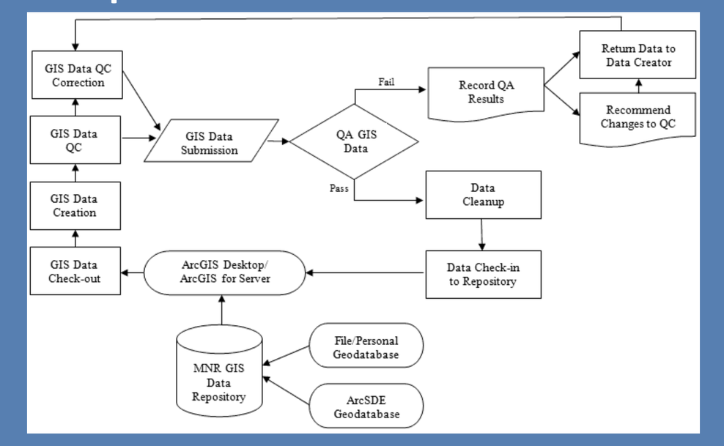
1. All georeferenced deliverables shall specify coordinate system datum and projection, WGS84 or NYS State Plane is preferred. For vertical datum use NAVD88 or indicate "ground level".
2. Layers shall consist of different asset classes based on standard asset hierarchies. Asset attributes (e.g. install date, part number, etc.) shall be provided. Each asset shall have an unique ID.
3. Annotation and notes on CAD drawings shall be available as spreadsheet keyed to asset ID or as GIS attributes.
4. Data deliverables of measured values shall contain longitudes and latitudes for each data record and have properly defined units. Data shall be delivered in open formats such as CSV.
5. Contractor shall obtain any necessary clarification from project manager, whose sole discretion is binding and final.

GIS Boilerplate



Level 1 Public Access: Any GIS data already released to the public or easily observable from publicly accessible areas. No restrictions.
Level 2A Employee Access: Proprietary GIS data describing assets knowable to employees but not by general public without railroad knowledge (e.g. interlockings, culverts). Access restricted to employees only, or contractors with signed non-disclosure agreement.
Level 2B Departmental Access: Data designated by owner dept. as not available to employees without their approval (e.g. signal design charts). Access restricted to data owner department employees only.
Level 2C Confidential, Personal, or Private: Datasets accessible only to H.R., Legal, or Safety depts. with business justification.
Level 3 Sensitive Security Information (SSI): Classified by Security Dept. in accordance with FTA SSI guidelines. Must not be stored on networked computers or general-use GIS systems.

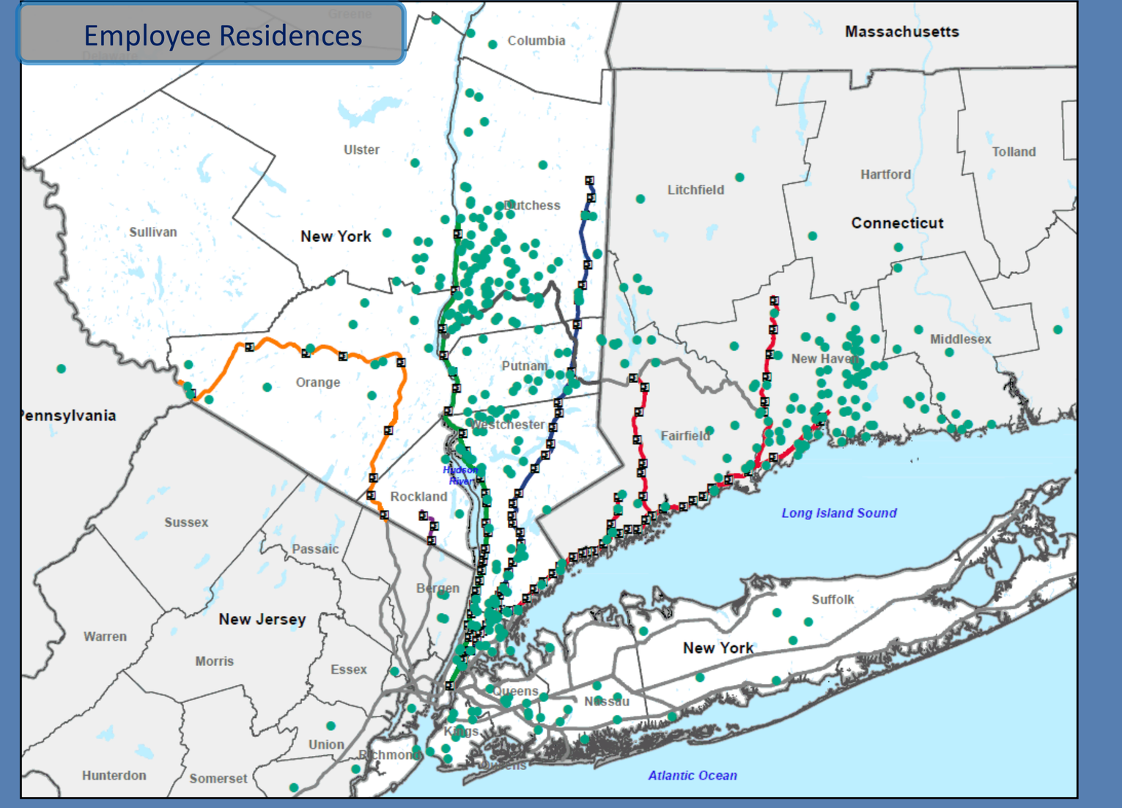
Data Security

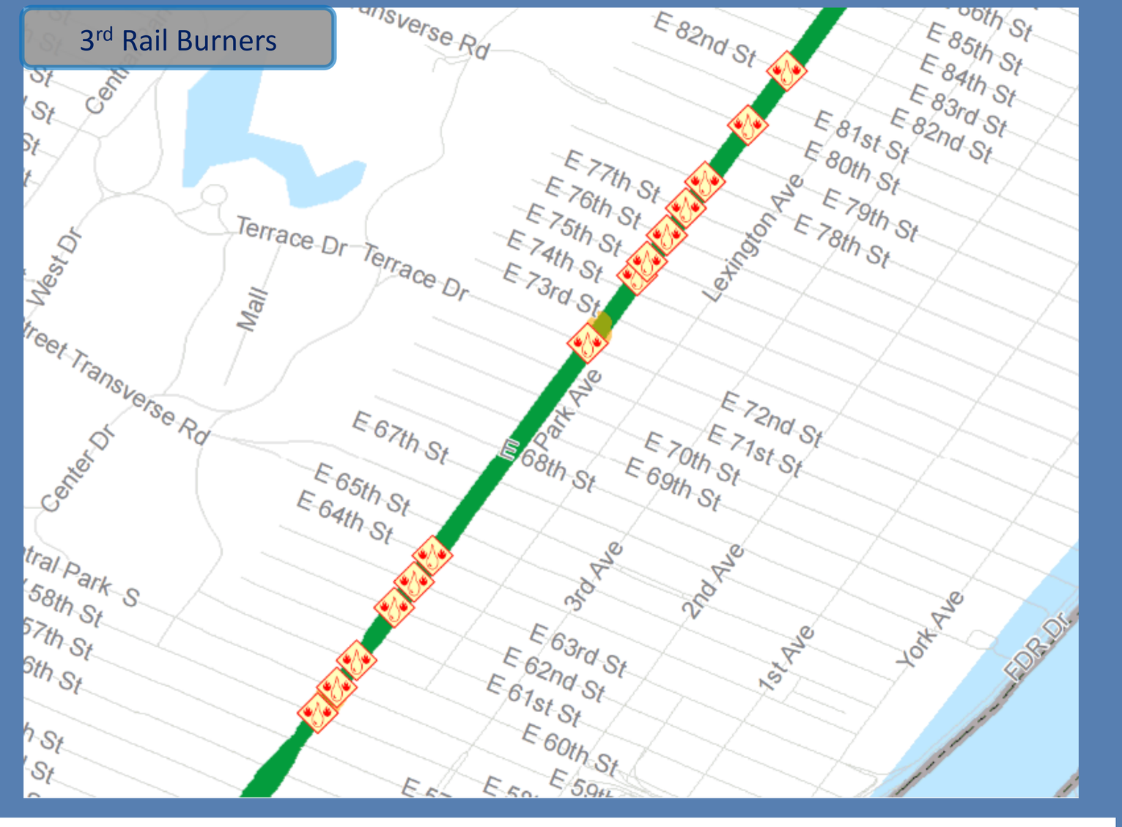


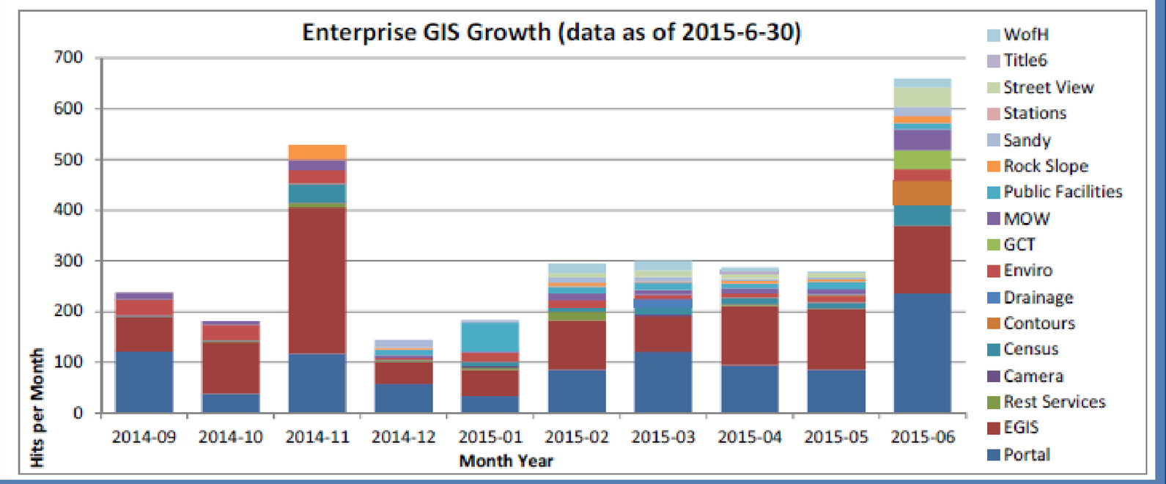
Data Check In/out Procedure

Internal GIS Marketing

- **Portal:** "at a glance" GIS resources webpage
- **Open REST Services Directory**
- **Ask Project Manager to Approve:** when receiving data, always circle back to PM (more for education than for review)
- **Early Products:** use 3D visualization, heat maps, BigData, etc., and circulate example map to generate interest
- **"Infomercial" Videos:** like home shopping…
- **Email Blasts:** exec. Level "this is what GIS can do"
- **Roadshows:** visit regular departmental meetings or set up special targeted sessions
- **Employee Newsletter Article:** provided needed buzz to encourage conversation and prompt folks to try the web applications.
- **Software Training**
- **Monitor Enterprise GIS Usage**







Monitoring Enterprise GIS Usage

Concluding Observations

As Metro-North's Enterprise GIS program enters its third year, GIS is becoming a common acronym on the railroad. Software was purchased and installed, staffing is in place, policy and procedures were promulgated, and employees were trained. Data was acquired and for the most part, web strategy was successful as more departments are requesting features they need and contributing GIS data to the crowd-sourced and federated companywide effort.