

New Technologies for Damage Prevention

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Presentation Overview

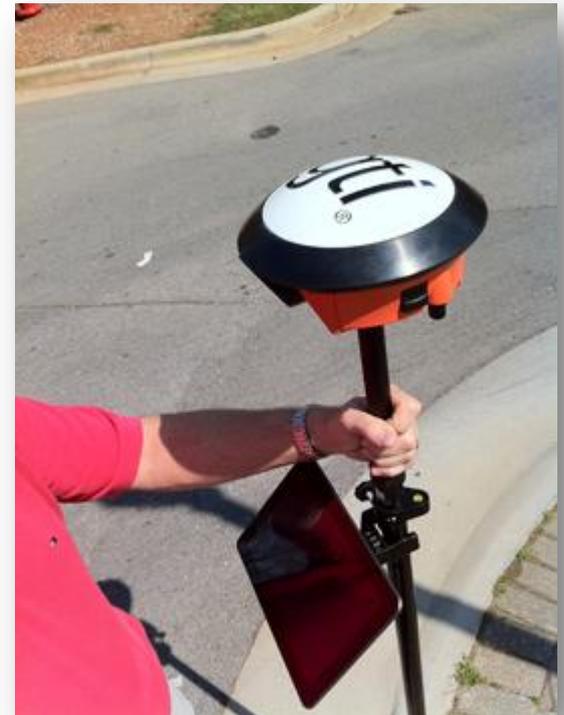
- **GTI New Technologies**
 - **Intelligent Utility Program**
 - **Asset Lifecycle Tracking and Electronic As-Building**
 - **RFID Marker Ball Mapping**
 - **GPS Excavation Monitoring**
 - **Acoustic Plastic Pipe Locator**
 - **3M Locatable Marker Tape and Rope**
- **NiSource GPS Pilot Project**
- **GTI Pilot Project Lessons Learned and Next Steps**

Intelligent Utility Program

- > Transition away from paper based data collection towards mobile, electronic data collection
- > Reduce the cost of compliance
 - Hardware and software
 - Data management labor
- > Decrease operational risk
 - Increased data quality
 - Enhanced awareness

High Accuracy GPS

- > Integrated external high accuracy GPS receivers with tablet computers
 - Sub-foot quality data in real time
 - No need for post processing or a base station
 - Field data directly inserted into the GIS (with controls)
 - Integrated receivers, so far . . .
 - > Navcom
 - > Geneq
 - > Trimble



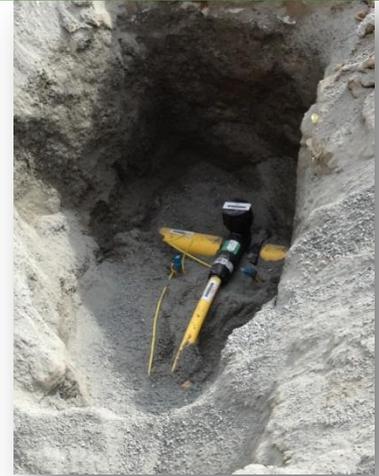
Asset Lifecycle Tracking and Electronic As-Building

> Industry Drivers

- Excavation Damage Prevention
- Pipeline Integrity Management
 - > Traceable, Verifiable and Complete
- Distribution Integrity Management
 - > Know Your System
- ASTM F2897-11a *Specification for Tracking and Traceability Encoding System of Natural Gas Distribution Components*
 - > 16 digit alpha-numeric code that standardizes manufacturer, lot number, material, size and type

Asset Lifecycle Tracking and Electronic As-Building

- > GTI's technology solution
 - Barcode scanner
 - High accuracy GPS receiver
 - Tablet device with GIS-based data collection software
 - Application to convert barcode into asset attributes to auto populate the GIS
- > Pilot projects
 - NiSource, Integrys, Avista

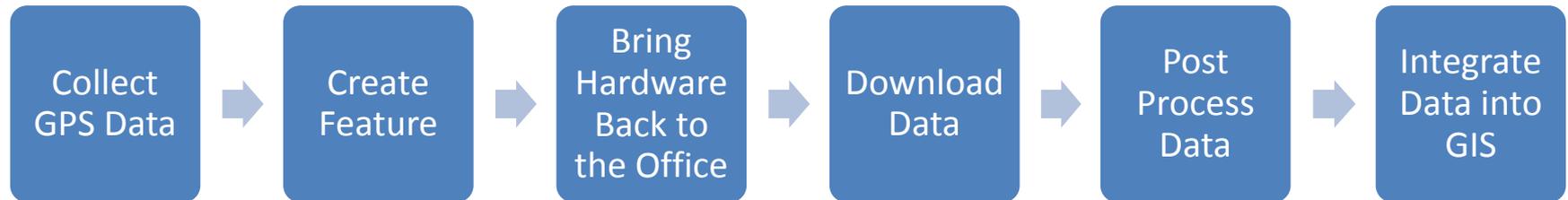


Asset Lifecycle Tracking and Electronic As-Building

- > Automates the entire data collection process for documenting new installations
- > In less than one minute . . .
 - The barcode scanner captures asset attribute information and causes a new feature to be created in the GIS
 - GIS fields are automatically populated with asset attribute information (material type, batch number, etc)
 - The location of the new asset is positioned with the sub-foot accurate GPS in real time
 - Data is available in the back office immediately

Data Collection Workflow

> Existing

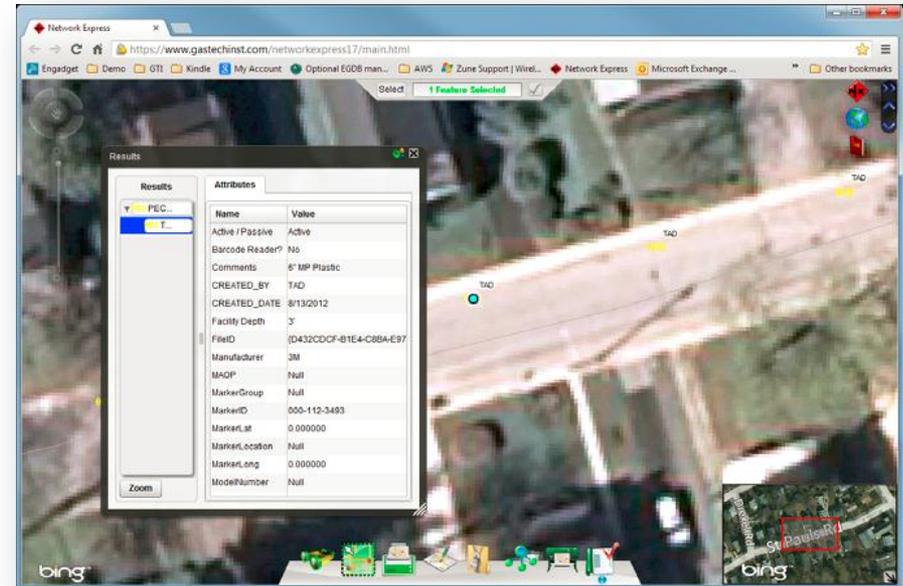


> New



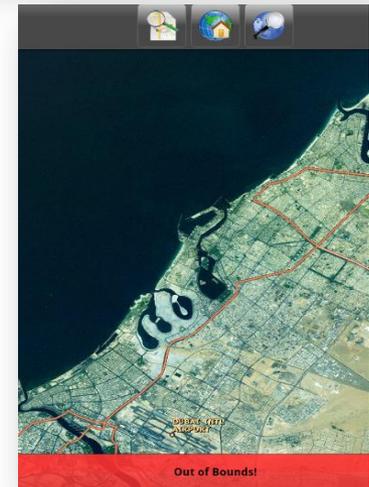
Marker Ball Mapping Pilot Project

- > GTI's marker ball mapping application
 - Create new marker ball features in the GIS from the field
- > Pilot projects
 - PECO
 - ConEd



GPS-Based Excavation Encroachment Notification

- > GPS tracks excavation activity in relation to assets and one-call tickets
- > Provide real-time notification of encroachment
- > Modifications to original system
 - GIS-based
 - Smart phone monitoring
 - Alternative GPS options
 - ROW monitoring



GPS-Based Excavation Encroachment Notification

- > New pilot project in New York
 - High accuracy GPS for excavators and pipe locations
 - Application - DOT projects
- > Developing pilot projects in California and Texas
 - Lower accuracy GPS tracking
 - ROW data in the GIS for pipe locations
- > Bring the system that Dave Thompson envisioned back to Virginia!

Acoustic Plastic Pipe Locator

- > Locates plastic pipe with no tracer wire
 - ½” pipe up to 30” deep
 - 4” pipe up to 96” deep
- > Commercialized as Ultra-Trac[®] by Sensit Technologies



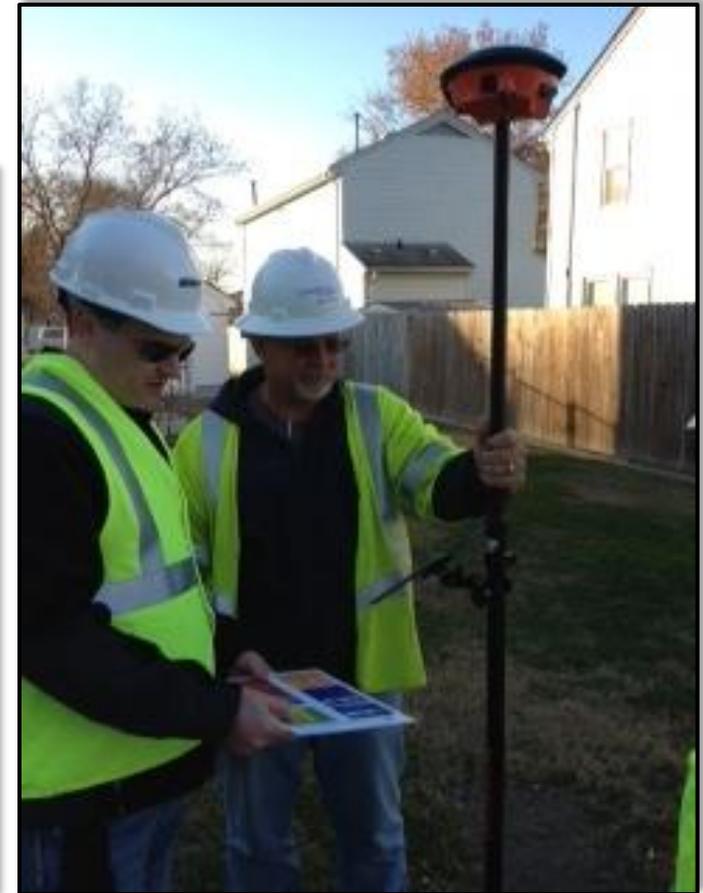
3M Locatable Marker Tape and Rope

- > 3M's solution for tracer wire issues
- > GTI testing and implementation support
- > New solution for HDD



Columbia's GPS Pilot Project

April, 2013



The Case For Change

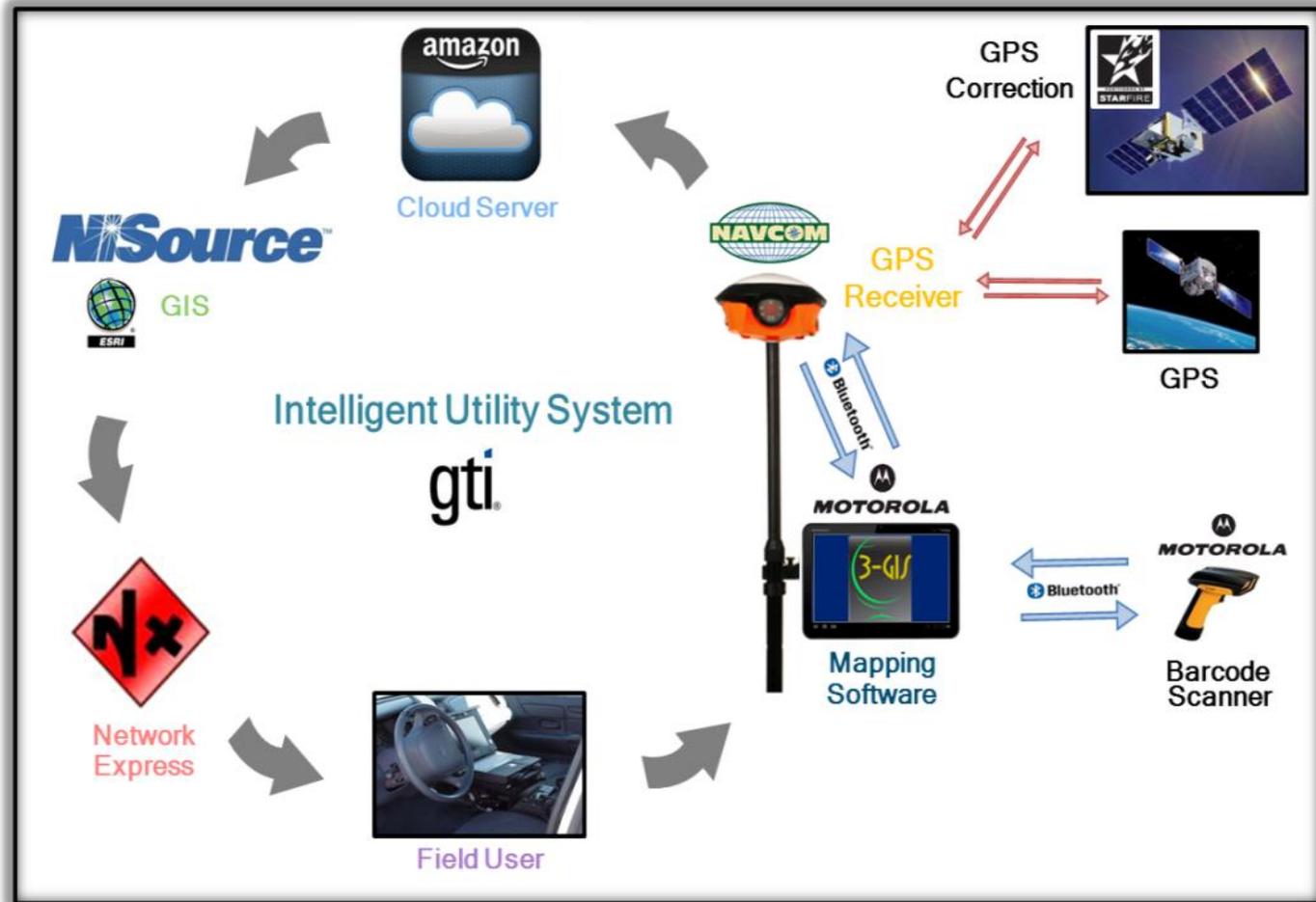
“Why fix it if it isn’t broken??”

A look at current risks/problems:

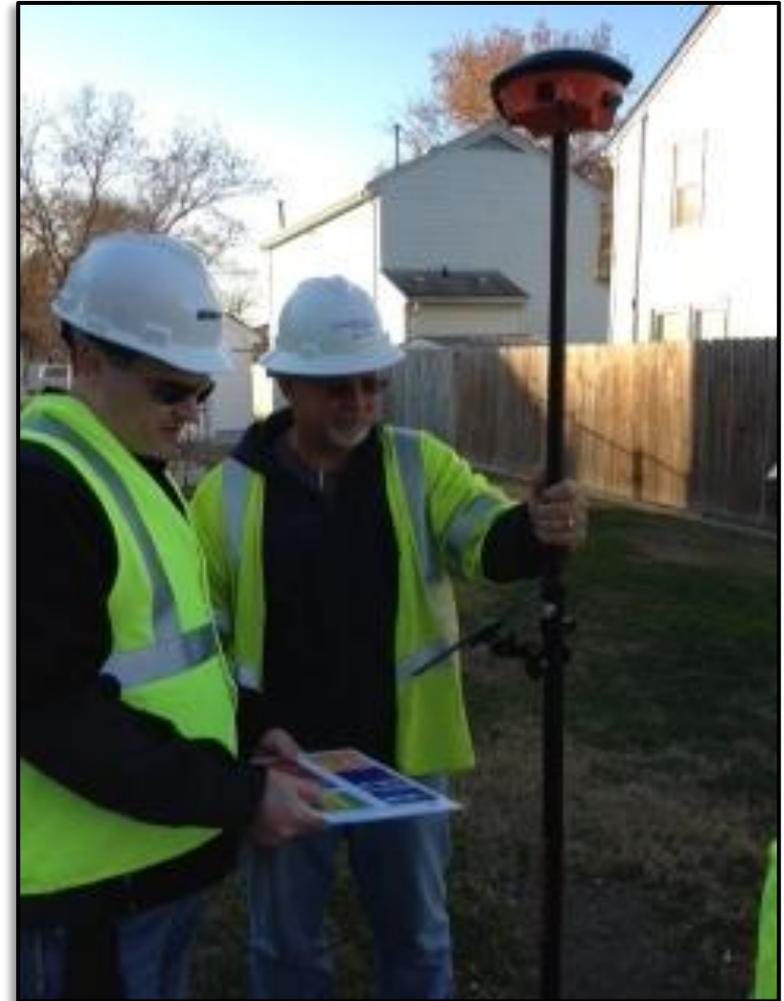
- Data
- Risk
- Requirements
- Affirmative Obligation



Project Overview



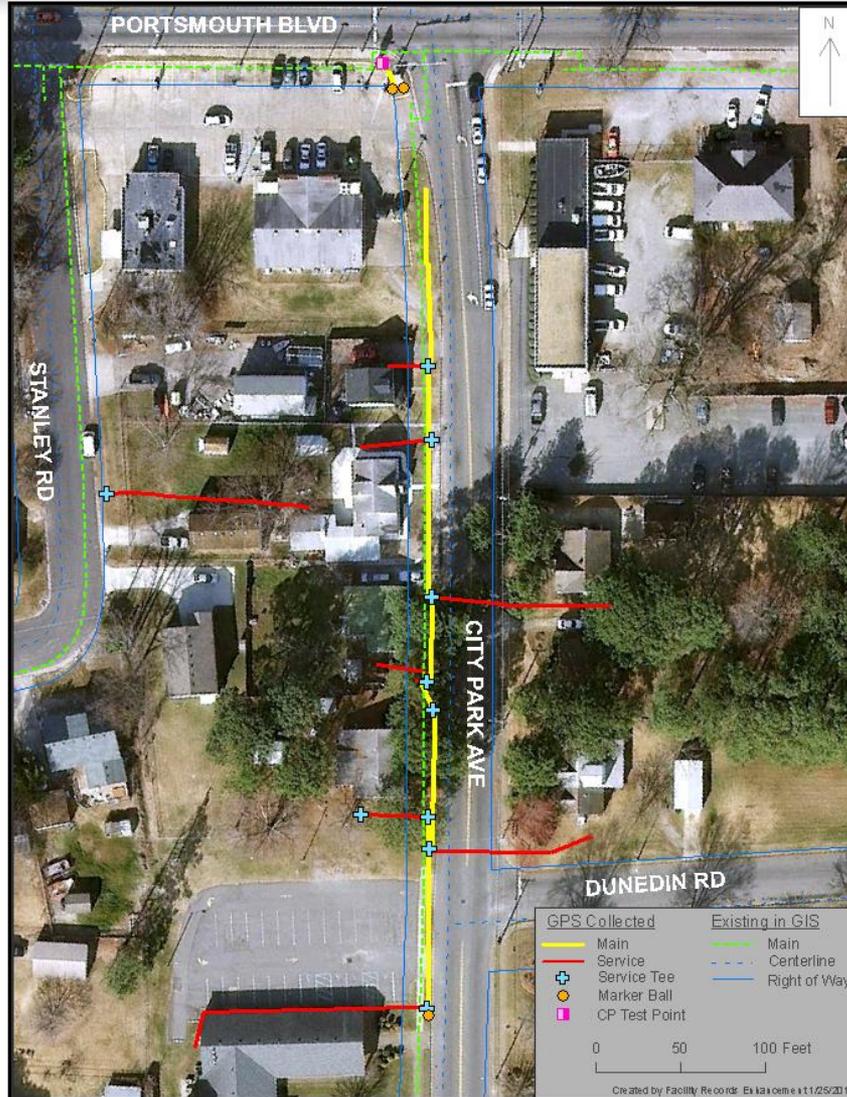
- ***Key Points:***
 - **The concept has shown to be very possible**
 - Target upgrades and modifications can realize potential for scaled deployments



- ***Key Points:***

- **Appears to maintain a baseline visual spatial accuracy**
- Closer inspection shows position discrepancies, overshoots, undershoots, gaps and junk records
- Will need validation of accuracy of points collected in future pilots while considering alternate means when coordinate cannot be collected.

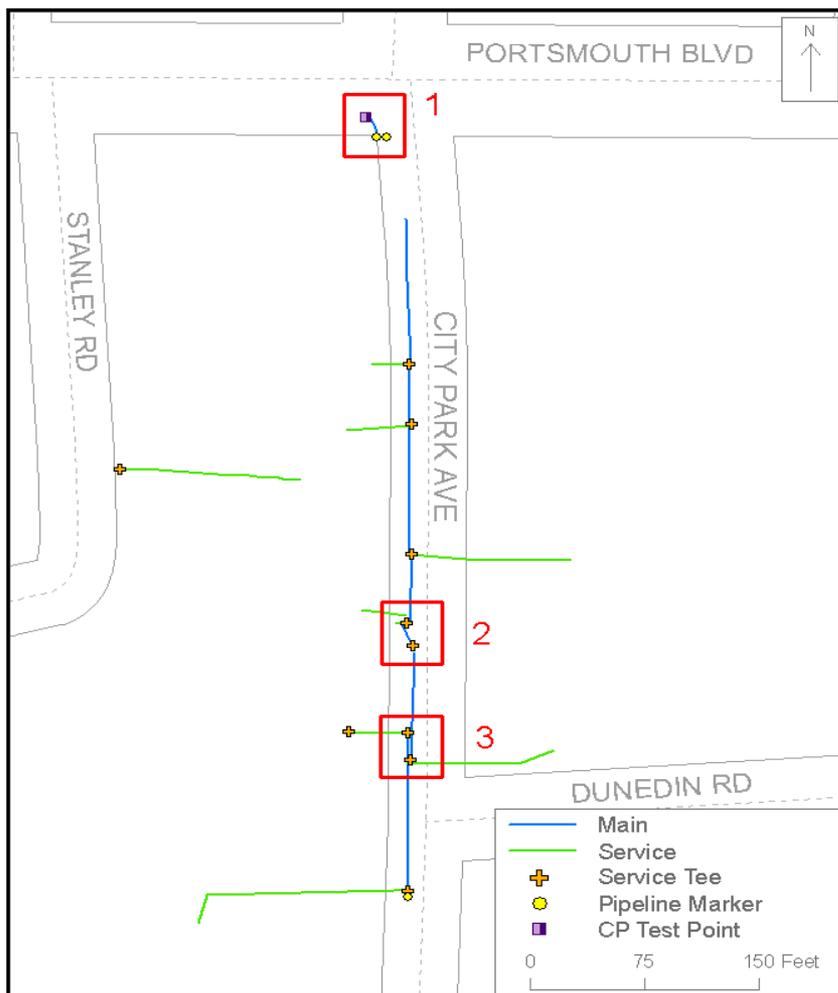




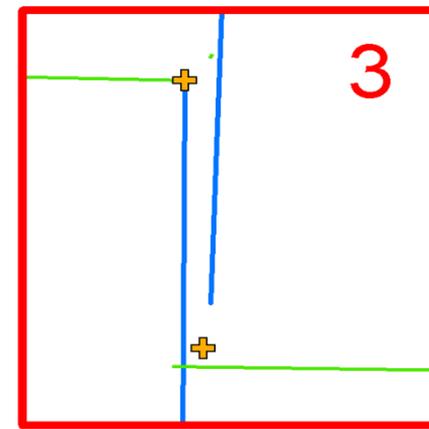
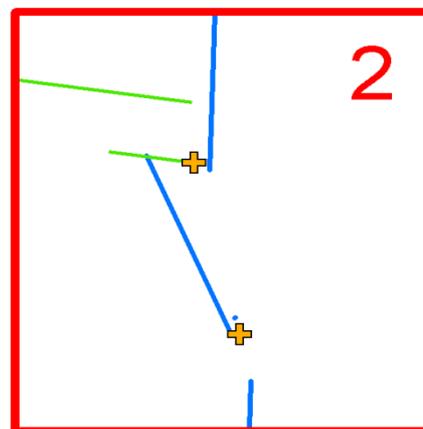
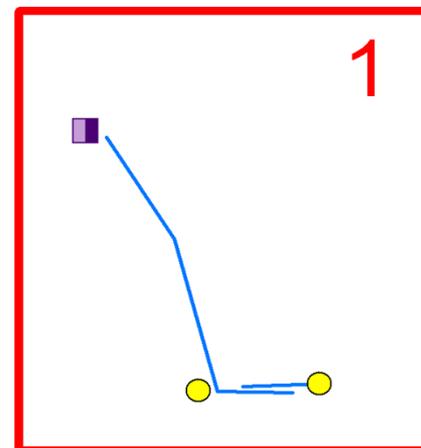
Spatial Quality Assessment

- Independent visual reference sources:
 - NiSource GIS landbase
 - ROW
 - Road Centerline
 - Gas Main Line
 - VGIN 2008 statewide orthoimagery

Over time, may necessitate an upgrade of our landbase maps



Spatial Quality Assessment



Database Quality Assessment

Mains **Attributes with null values

	A	B	C	D	E	F	I	J	L	N
1	OBJECT ID	Enabled	Creation User	DateCreated	Status	Diameter	Material	Barcode eID	GlobalID	SHAPE_Length
2	1	1	3gis	11/16/2012 0:00	Active	2	Plastic PE	200020	{EB9FFB5E}	0
3	2	1	3gis	11/27/2012 0:00	Active	2	Plastic PE	200020	{92CE223E}	156.264
4	3	1	3gis	11/27/2012 0:00	Active	2	Plastic PE	200020	{A673183E}	42.27665
5	4	1	3gis	11/27/2012 0:00	Active	2	Plastic PE	200020	{343FD07E}	57.56238
6	5	1	akondas	11/28/2012 0:00	Active	2	Plastic PE	200020	{BBF56E0E}	0
7	6	1	akondas	11/28/2012 0:00	Active	2	Plastic PE	200020	{160E873F}	4.010797
8	7	1	akondas	11/28/2012 0:00	Active	2	Plastic PE	200020	{758D418E}	6.897427
9	8	1	akondas	11/29/2012 0:00	Active	2	Plastic PE	200020	{04F6A303}	117.5213
10	9	1	bsementel	11/29/2012 0:00	Active	2	Plastic PE	200020	{03CAADB}	0
11	10	1	akondas	11/28/2012 0:00	Active	2	Plastic PE	200020	{A58B1C5}	0
12	11	1	akondas	11/28/2012 0:00	Active	2	Plastic PE	200020	{1D12C42}	9.018225
13	12	1	bsementel	11/30/2012 0:00	Active	2	Plastic PE	200020	{01EFD1C}	59.78271
14	13	1	bsementel	11/30/2012 0:00	Active	2	Plastic PE	200020	{B76B4CA}	45.0571
15	14	1	rmarros	12/3/2012 0:00	Active	2	Plastic PE	200020	{0772FFC2}	0
16	15	1	rmarros	12/3/2012 0:00	Active	2	Plastic PE	200020	{7A1C925}	0
17	16	1	bsementel	12/13/2012 0:00	Active	2	Plastic PE	200020	{0D4E7071}	137.3111
18	17	1	bsementel	12/13/2012 0:00	Active	2	Plastic PE	200020	{6F11821B}	75.15929
19	18	1	bsementel	12/14/2012 0:00	Active	2	Plastic PE	200020	{18CA328E}	52.28239
20	19	1	bsementel	12/14/2012 0:00	Active	2	Plastic PE	200020	{2A33987E}	0.092195
21	20	1	bsementel	12/14/2012 0:00	Active	2	Plastic PE	200020	{BD1828FF}	18.20385
22	21	1	akondas	12/4/2012 0:00	Active	2	Plastic PE	200020	{9948172F}	4.102742

Services **Attributes with null values

	A	B	C	D	F	I	J	K	M	O
1	OBJECT ID	Creation User	DateCreated	Status	Diameter	Material	Enabled	Barcode D	GlobalID	SHAPE_Length
2	1	akondas	11/28/2012 0:00	Active	1	Plastic PE	1	710022	{3C67280-4}	0.336154
3	2	akondas	11/29/2012 0:00	Active	1	Plastic PE	1	710022	{451AA785-5}	39.08107
4	3	bsementel	11/30/2012 0:00	Active	0.5	Plastic PE	1	720022	{508FABF8-0}	72.98859
5	4	bsementel	11/30/2012 0:00	Active	0.5	Plastic PE	1	720022	{83566288-F}	25.18997
6	5	akondas	12/3/2012 0:00	Active	1	Plastic PE	1	710022	{0F82B165-6}	7.342601
7	6	bsementel	12/4/2012 0:00	Active	1	Plastic PE	1	710022	{EDF08D4F-A}	0
8	7	bsementel	12/4/2012 0:00	Active	1	Plastic PE	1	710022	{01C023EF-3}	0
9	8	bsementel	12/7/2012 0:00	Active	1	Plastic PE	1	710022	{7E6B5CC9-6}	0
10	9	bsementel	12/7/2012 0:00	Active	1	Plastic PE	1	710022	{5AFA0D04-7}	0
11	10	bsementel	12/7/2012 0:00	Active	1	Plastic PE	1	710022	{61EFDDBA-2}	0
12	11	bsementel	12/7/2012 0:00	Active	1	Plastic PE	1	710022	{6848E627-8}	0
13	12	bsementel	12/13/2012 0:00	Active	1	Plastic PE	1	710022	{53874D22-B}	24.62963
14	13	bsementel	12/13/2012 0:00	Active	1	Plastic PE	1	710022	{BCC1A490-C}	43.03579
15	14	bsementel	12/13/2012 0:00	Active	1	Plastic PE	1	710022	{679AACB9-2}	91.43005
16	15	bsementel	12/13/2012 0:00	Active	1	Plastic PE	1	710022	{297C8DE9-4}	29.70274
17	16	bsementel	12/13/2012 0:00	Active	1	Plastic PE	1	710022	{AD9EFAAB-E}	0
18	17	akondas	12/3/2012 0:00	Active	1	Plastic PE	1	710022	{12412184-6}	93.65078
19	18	akondas	12/4/2012 0:00	Active	1	Plastic PE	1	710022	{7174E697-A}	13.3411
20	19	akondas	12/4/2012 0:00	Active	1	Plastic PE	1	710022	{88BA8C33-8}	12.11587
21	20	swallace	12/5/2012 0:00	Active	1	Plastic PE	1	710022	{7AAF59D4-6}	8.753862
22	21	swallace	12/5/2012 0:00	Active	1	Plastic PE	1	710022	{D11B940B-F}	123.077
23	22	swallace	12/5/2012 0:00	Active	1	Plastic PE	1	710022	{E99A3B24-3}	21.35773
24	23				0		0		{55C60F0B-0}	0
25	24	bsementel	12/13/2012 0:00	Active	1	Plastic PE	1	710022	{358DEB15-9}	44.27119
26	25	bsementel	12/13/2012 0:00	Active	1	Plastic PE	1	710022	{E1C31325-7}	0

- Database maintains uniformity and completion
- Valuable information
- Evidence of automation success

- 15 total records with a Shape_Length of '0' (zero)
- One totally empty record

- ***Key Points:***

- ***9 targets for potential mitigation:***

- GPS lock
- Satellite correction service connection
- Wireless connection
- Barcode scanner connection
- Software performance
- Mapping workflow
- Environmental conditions
- Power management
- Ergonomics



- **GPS Lock**

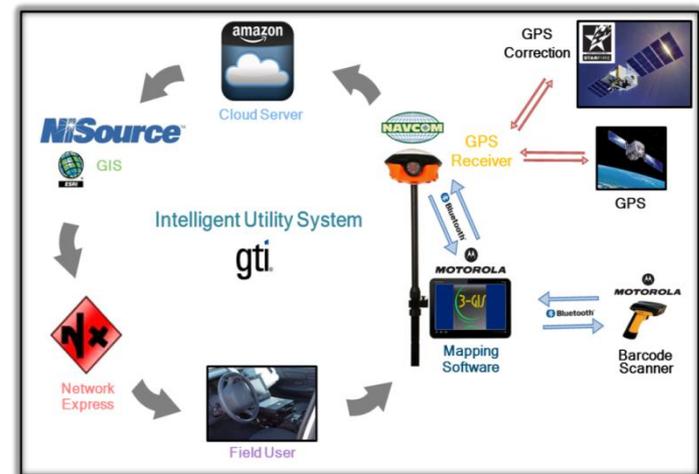
- Buildings, tree canopy, other obstruction
- Frequently experienced
- Software freeze/crash

- * ***Higher sensitivity antennae***

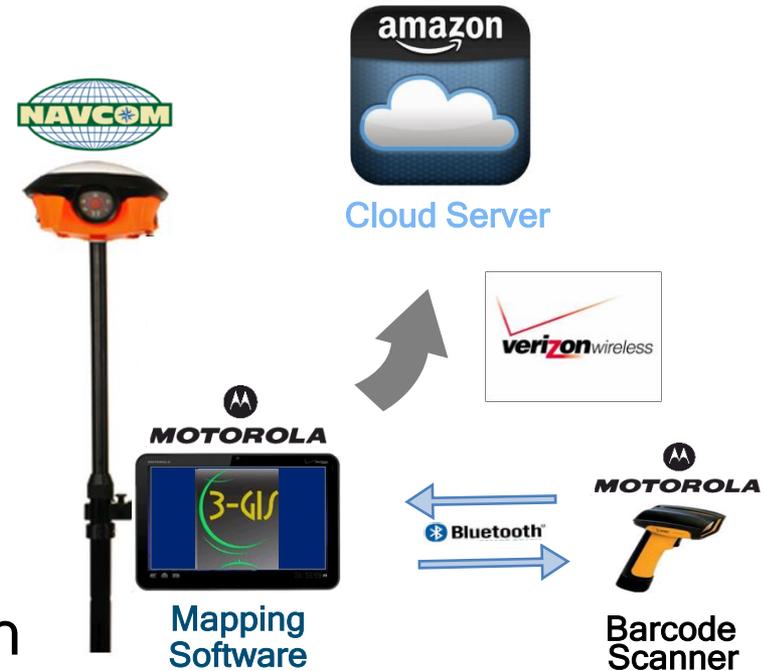
- **StarFire Connection**

- Same vulnerabilities as GPS
- Same performance results
- * ***Re-examine cost/benefit of satellite correction***

Connection Issues



- **Wireless connection**
 - Availability
 - Software freeze/crash
 - * ***Disconnected version***
- **Barcode Scanner Connection**
 - Variable success depending on tablet configurations
 - Reconnect button create crash
 - * ***Stabilize and explore alternatives***



- **Key Points:**

- Initial challenges included instability and connections.
- **3-GIS *Field Express* product undergoing second round of improvements**
- Vendor for NiSource's NX
- Upgrades expected to address issues



Workflow Assessment

- The workflow makes assumptions about:
 - Construction practices
 - Availability to exposed facility
 - Technical reliability
- Myriad variables working against the workflow
 - Weather
 - Certified labor availability
 - Change in tie-in locations
 - Competing construction projects
 - Personnel scheduling
 - Technical issues
 - * ***Flexible functionality adjustments***



Environmental Conditions

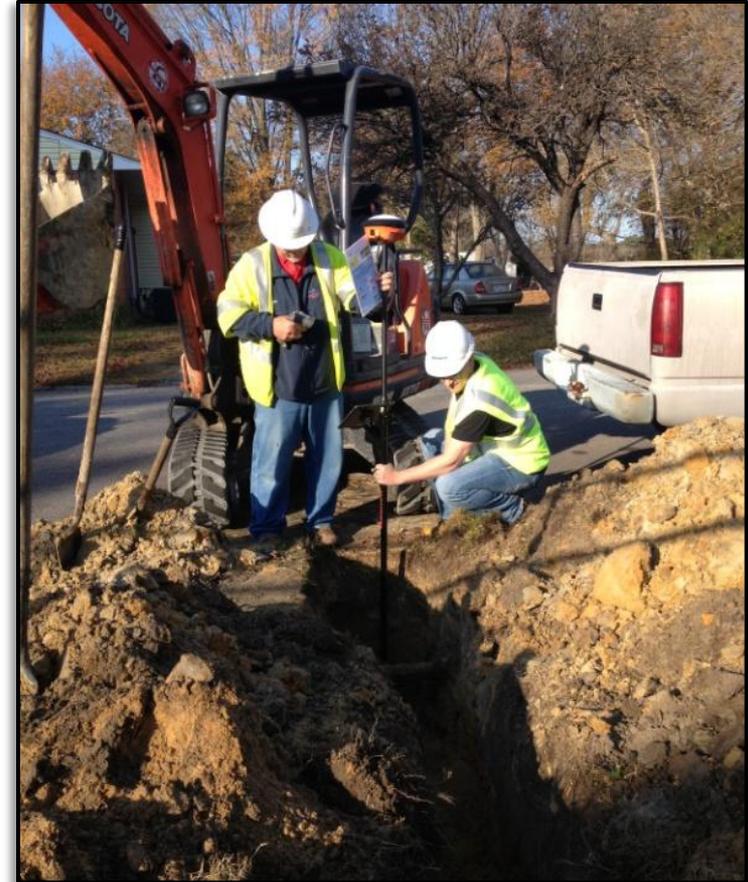
- Environmental conditions were observed to be a factor in performance:
 - Precipitation
 - Extreme cold
 - Extreme heat
 - * ***Try to mitigate as best possible; realize that weather will at times prevent collection***

Power Management

- Requirements:
 - Remote charging limitations
 - Time to charge
 - * ***Performance management plan, other mitigating options.***



- **Key Points:**
 - Both non-operational and operational challenges
 - **Exploring solutions like ground stabilization, receiver options, weight, etc.**



Conclusions

- Overall, the Virginia pilot was a **success** in proving that the concept of GPS-based gas facility mapping is very possible **BUT GPS currently should not be a single source** (Marker tape)
- Many **valuable lessons were learned** that can increase the possibility of success with future NiSource deployments as well as help realize the potential for the gas industry

- **Prior to further pilot deployment commitments have been made to:**
 - **Examine the possibility of integrating a higher sensitivity GPS antennae**
 - **Implement a disconnected version of the software**
 - **Address barcode scanner connection issues, alternative methods**
 - **Significantly stabilize the GIS performance, support workflow flexibility and increase usability**
 - **Modify the workflow for increased flexibility**
 - **Attempt solutions to mitigate adverse environmental conditions**
 - **Develop process management and options for power management**
 - **Attempt solutions and options to improve ergonomics**

GTI Pilot Project Lessons Learned

- > Tablet computers
 - Ruggedized?
 - Stability
 - Integration with external sensors

- > Cloud computing
 - More or less secure?

- > GPS experience
 - Simplicity vs high quality data

GTI Pilot Project Lessons Learned

> Software

- Simple, simple, simple
- The end-user defines simple, not the software engineer
- Must allow flexible workflows

> Ergonomics

- Don't underestimate the importance of comfort and routine
- Remove barriers to user-acceptance

> Training

- Interns vs “experienced” workers
- No such thing as too much training

Next Steps

- > Software modifications
 - Disconnected editing
 - Stability and flexibility
- > Hardware options
 - GPS, tablets, barcode scanners
- > GPS
 - Options for signal blockage
- > Ergonomics