Effective Distribution and Spatial Confidence Tracking of GIS Data – One Organization's Approach

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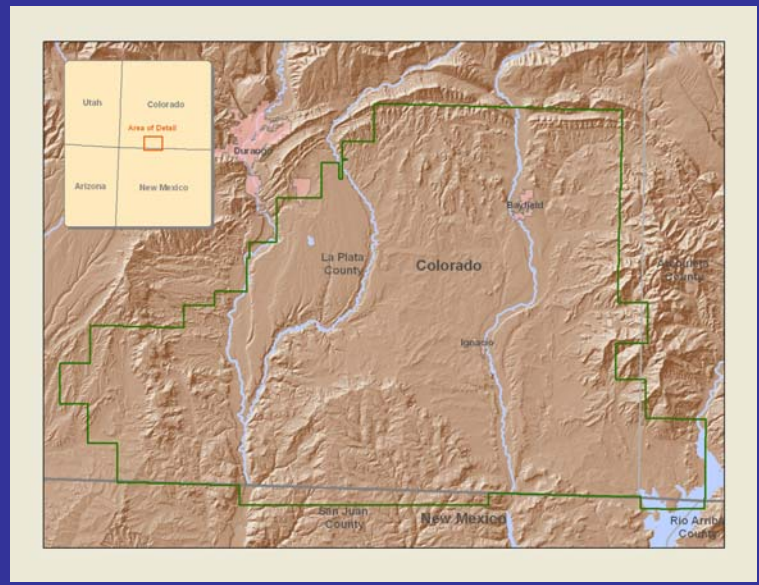
Synopsis

- BP America's North San Juan Operation
  - GIS inception in 1995
  - Continuous evolution of:
    - Data collection tools and methods
    - GIS software and its use
  - Persistent issues
    - GIS data distribution throughout a growing organization
    - Tracking spatial confidence of variable data sources
  - Solutions
    - Implemented ArcReader to widely distribute GIS data
    - Spatial data sources are tracked by source, reflecting confidence

Overview of BP America's North San Juan Operation

- Located in prolific northern tip of San Juan Basin
- In La Plata and Archuleta Counties in SW Colorado
- Field-based organization of approx 190 employees and contractors
- Approx 1100 wells; primarily coal bed methane
- Complex 1600 mile gathering system for gas and water



GIS Background

- GIS inception in 1995
  - Spawned from GPS field inventory
  - Evolved from CAD-based pseudo GIS through ArcView 2, 3.x, 8.3, to 9.2
- GIS evolution driven by:
  - Organizational change
  - Acquisitions
  - User expectations
  - Software improvements
  - Data collection methods and equipment

Part 1: Effective GIS Data Distribution and Use

GIS Data Distribution - Problem

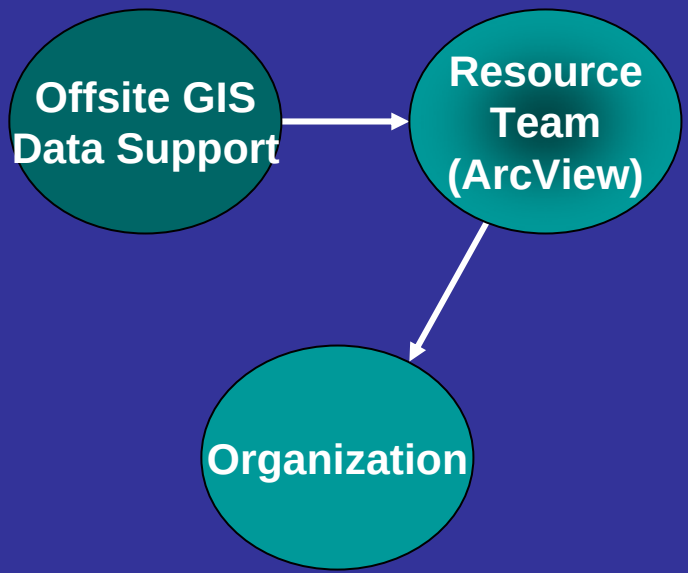
- GIS increasingly embraced throughout organization from 1995 to 2005
  - Demand for GIS data and products continuously increasing
- GIS historically centrally housed in Resource Team
  - Team's GIS capacity became insufficient for organizational demand/expectations

GIS Data Distribution - Solution

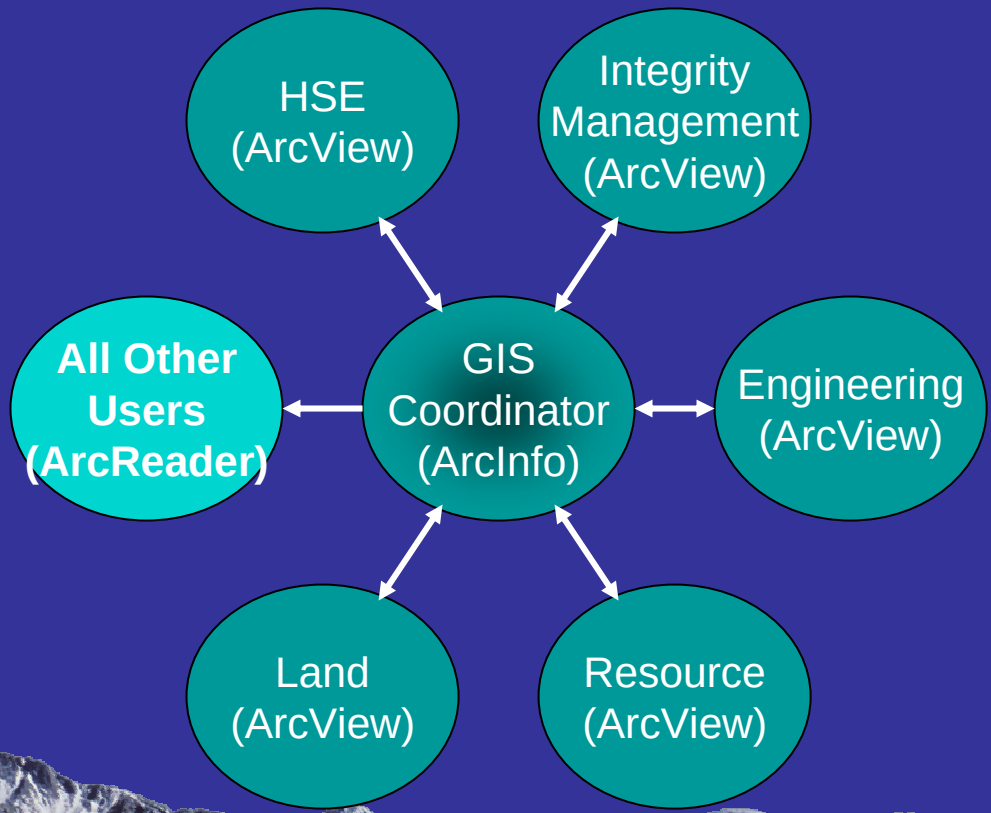
- GIS program restructured into “Semi-distributed” model
  - GIS coordinator
    - Coordinates data collection, archiving, and distribution
    - Provides central support for all GIS users
  - ArcView expertise in functional teams
    - Specialized GIS functionality within and on behalf of teams
  - ArcReader distributed throughout organization for broad access to basic GIS data

Organizational GIS Models

Older Centralized GIS Model



Newer Semi-distributed GIS Model



Benefits of Newer GIS Model

- On-site GIS Coordinator supports all GIS functionalities and acts as GIS data librarian
- Improved distribution and use of GIS data
- Functional teams perform GIS for their specialty, “in-house”
- ArcReader software effectively supports broad casual user audience, and frees GIS techs to focus on more complex tasks

ArcReader Software

- ArcReader is free ESRI GIS reader software
- Reads a “PMF” file – Published Map File created in house
  - PMF files are un-editable dynamic/interactive maps
- General Observations:
  - ArcReader is to ArcInfo as Adobe Reader is to Adobe Photoshop
  - ArcReader is the “90-90 what/where tool”
    - Satisfies 90% of people 90% of the time to answer basic “Where is it?” and “What do I know about it?” questions
  - Limitations must be understood by users

ArcReader Implementation & Assessment

- PMF file and supporting layer files posted on Citrix network or installed stand-alone on field-based computers
- One large PMF file contains 225 selectable vector and raster layers for rich data viewing options
- Created BP-specific manual with ArcReader functions, introduction to layers, GIS data set information and interpretation guidelines

- Used successfully for 2 years without surprises or disruptions
- More than 100 active users; hands-on derivation of immediate results
- Significantly enhanced how some employees do their jobs
- Paper map production decreased
- Superior value – low cost, high functionality

Part 2: Tracking Pipeline Spatial Confidence in a GIS

Tracking Pipeline Spatial Confidence

- An ideal GIS is:
  - Accurate
  - Complete
  - Consistent
  - Timely
  - Useful

- Difficult to achieve in continuously evolving, yet mature GIS data set
- Consideration: mapped underground pipelines may always be displayed in GIS within ROW, but…
  - How accurately within the ROW is the pipe rendered?
- Smart GPS data collection and effective attributing allows users to reliably interpret pipeline spatial confidence

GIS Pipeline Data Sources

- Some possible ways to acquire pipeline data:
  - Best - As-built survey data
  - Very Good - GPS positions from visual reconciliations
  - Good - GPS positions from pipeline locate
  - Fair to Poor – Inferred GPS positions or digitizing
    - Ground disturbances or other unreliable sources
    - Digitize pipeline from aerial photo

Good GPS Practices in the Field Are the Foundation of Good Facilities GIS Data

- GPS points are as accurate as the source
  - Can collect an accurate position of a bad source
- GPS underground pipeline mapping is inherently inferential, except where pipe is exposed
- Before mapping underground pipelines, define in the GPS the domain of PI source types available
- In the field, note the source of a GPSd pipeline PI to reflect inherent confidence in the position (Journalistic approach)
- Do not use qualifiers such as Good, Fair, Poor

GPS Techniques - Example

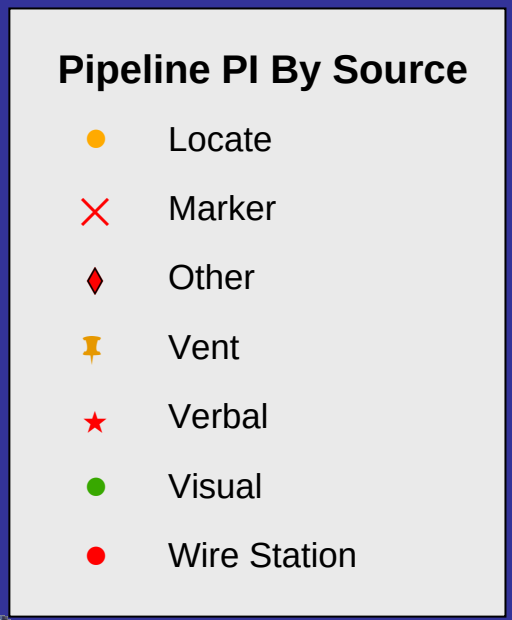
- Pipeline spatial confidence can be noted in pipeline attribute table (OK), or reflected in GPSd PIs (better)
- Hypothetical domain of GPSd underground pipeline PI sources:
  - Locate – Pipe located with a pipeline locator
  - Marker – Pipeline surface marker
  - Other – Other type of indicator, needs comment
  - Vent – Bored ROW/cased road crossing vent
  - Verbal – Verbal instruction of pipe location
  - Visual – Visual reconciliation of pipe from open ditch or pothole
  - Wire Station – Cathodic test lead station

Possible Confidence Values for Hypothetical GPSd Underground Pipeline PI Sources

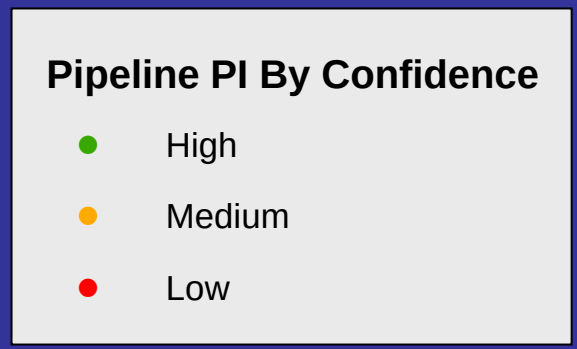
- Visual: High Conf - unarguable reconciliation
- Locate: Medium Conf - pipe located, but not visually verified. Reliability of locate may vary with corridor congestion and pipe material/traceability.
- Vent: Medium Conf - indicates presence of pipe, though vent may not be directly over pipe.
- Wire Station: Low Conf - may not be directly over pipe.
- Marker: Low Conf - pipe marking is only as good as the reason supporting or constraint affecting the placement.
- Verbal: Low Conf - people's spatial recollections of buried pipe are typically not as good as they think.
- Other: Low Conf - likely to contain uncertainty

Sample Pipeline PI Symbology

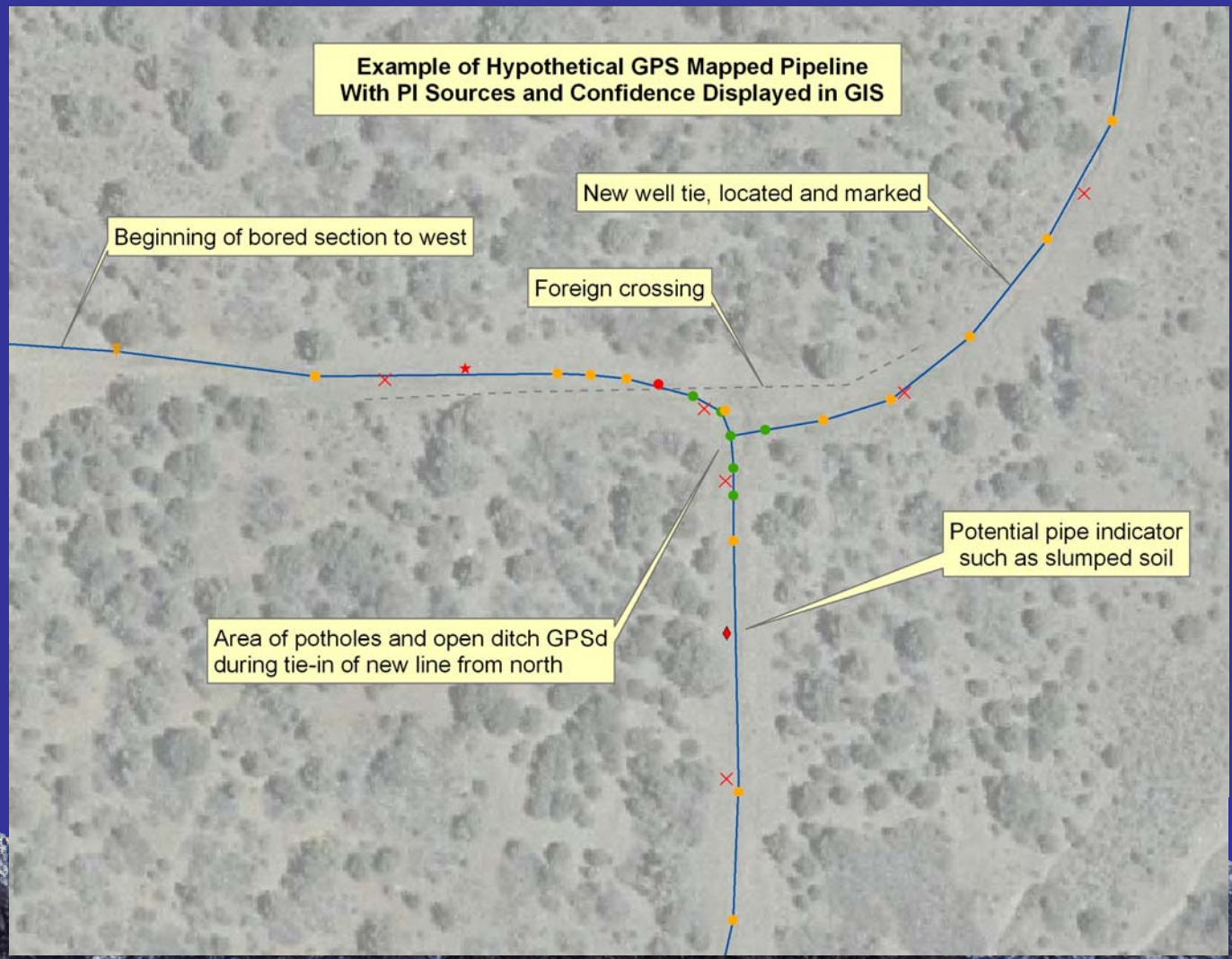
Hypothetical Source and Confidence Symbols



Hypothetical Confidence-only Symbols



Sample With Pipeline & Symbology



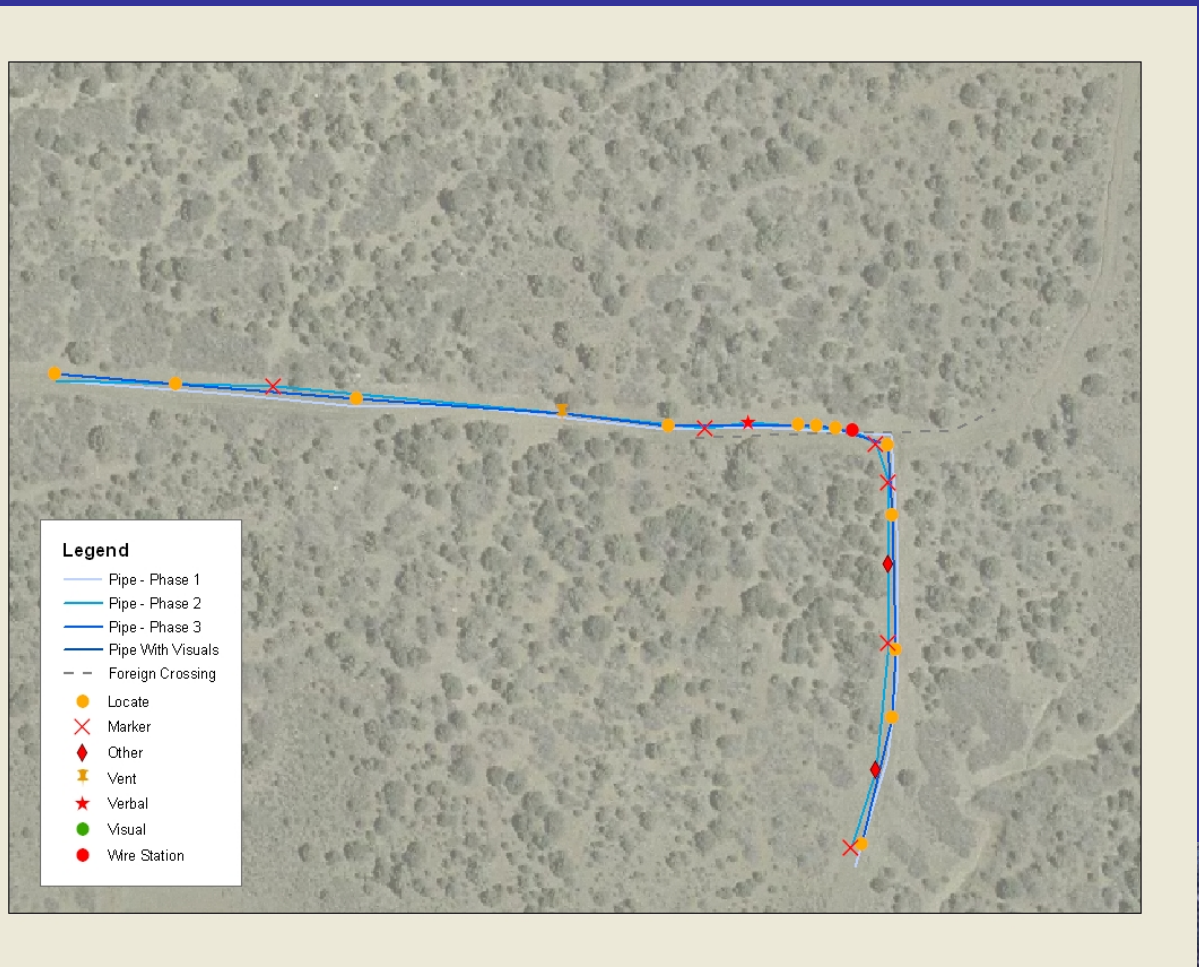
Sample: Hypothetical Scenario - Evolution of Pipeline Mapping

- Hypothetical Mapping Scenario - Operator buys gathering system in acquisition. No accurate map data provided.
  - Phase 1: Digitize pipeline on aerial photo for immediate rendering
  - Phase 2: GPS immediately available Marker, Other, Vent, Verbal, and Wire Station points
  - Phase 3: Locate pipe and GPS located PIs
  - Phase 4: Subsequent pipe tie-in requires local excavation. Collect visual GPS points to unequivocally resolve pipe location.

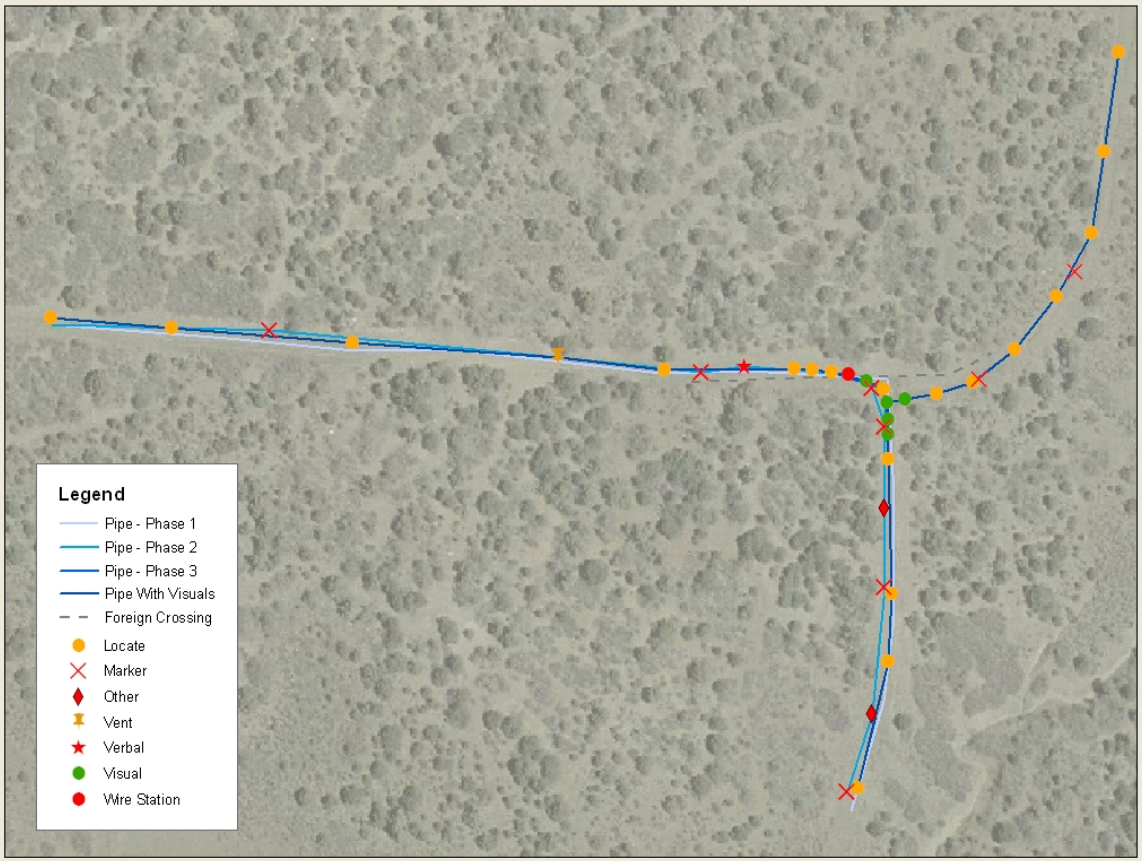
Sample Progression, Phase 1: Digitize Pipeline on Aerial Photo

Sample Progression, Phase 2: GPS Immediately Available Points

Sample Progression, Phase 3: Locate Pipe and GPS Located PIs



Sample Progression, Phase 4: GPS Visual Points at Tie-in Excavation



Sample Progression, Phase 4: Detail of New Tie-in GPS Points

Conclusion

- There are many ways to manage and deploy GIS data within an organization
  - Semi-distributed model has worked well for higher level GIS functionality
  - ArcReader has proven to be an inexpensive, simple, and effective tool for simple data distribution to a large user audience
- GIS pipeline data spatial confidence can be methodically tracked and displayed to clarify questions arising from data inconsistency