



Subsurface Utility Engineering Essentials for Public Works Smarter Utility Investigations

Thursday, August 6, 2025

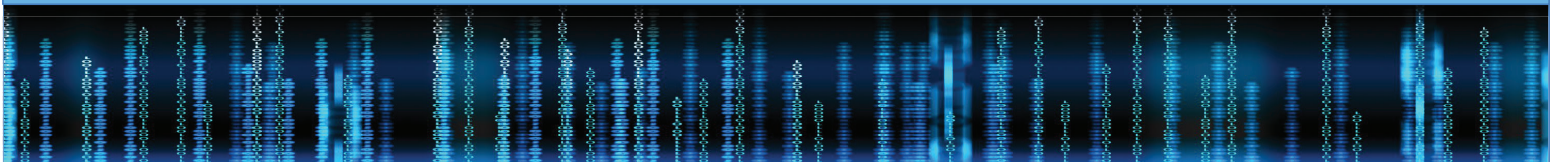
- 11:00 a.m. - 12:00 p.m. ET
- 10:00 a.m. - 11:00 p.m. CT
- 9:00 a.m. - 10:00 a.m. MT
- 8:00 a.m. - 9:00 a.m. PT

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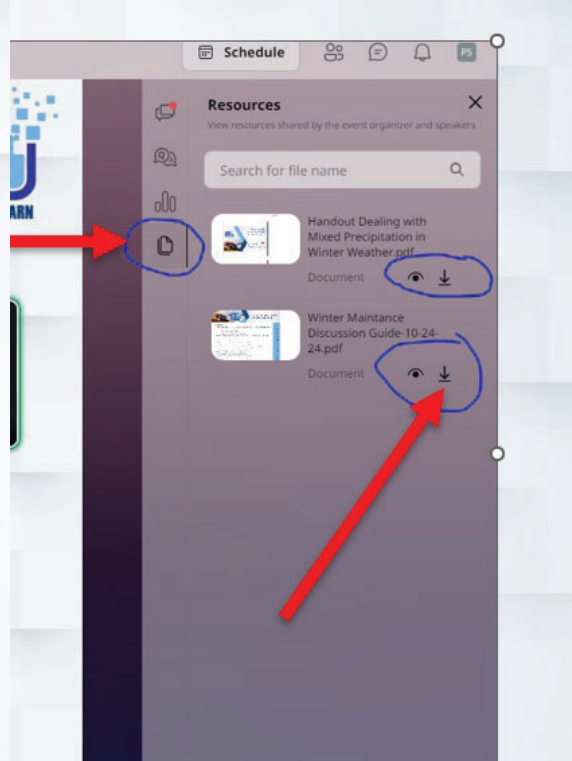
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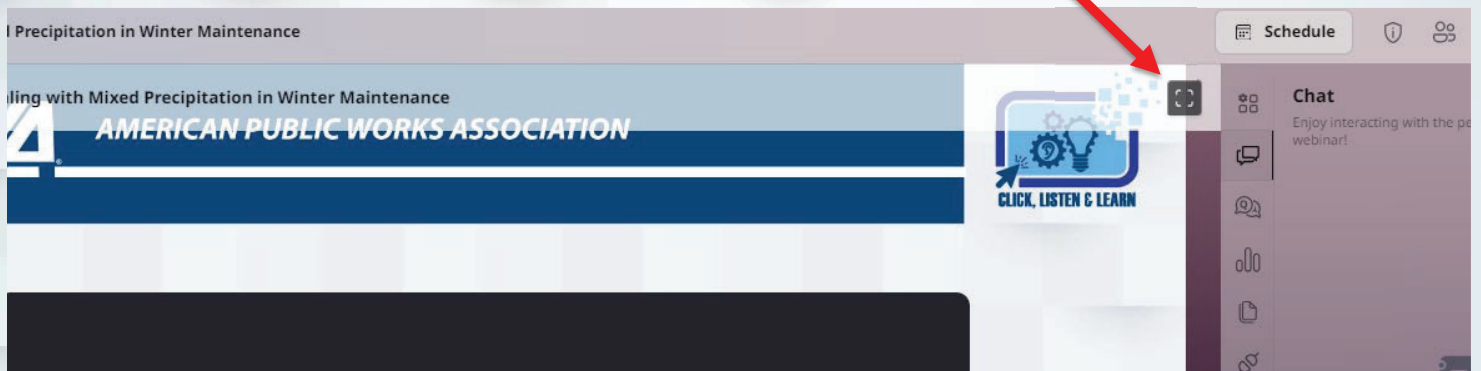
For more information go online to
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Handout for Today's Program can be download from the right-hand chat panel.



Viewing the Presentation



Communication & Engagement Opportunities

Copy of Managing Public Art in the Right-of-Way



AMERICAN PUBLIC WORKS ASSOCIATION



Chat

Session will resume shortly
Session number 2



Chat

Enjoy interacting with the people in this webinar!

NT You just now

Good Morning everyone so glad to see you!



Reactions



HOST

Natalie Tucker ▶
Education Specialist, APWA



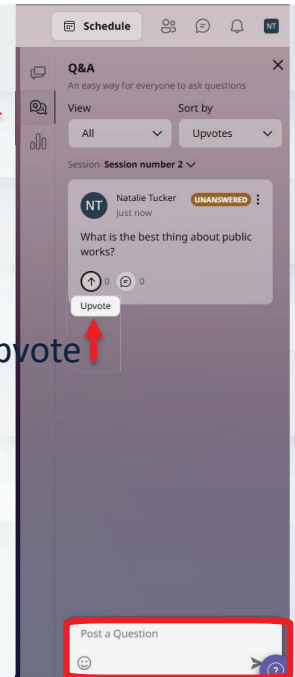


Program Questions

1. If you have questions for our speakers, you may ask them using the Q&A feature.
2. Choose to Upvote a question that is the same as your question.

Q & A →

Upvote ↑



Today's Moderator:



Tony D'Angelo
Staff Engineer
Farnsworth Group Inc.

Learning Objectives

After completing this course, participants will be better able to:

- *Explain how Subsurface utility investigations (SUE) can be integrated into project delivery.*
- *Describe the four quality levels and utility investigation methods.*
- *Describe how SUE can help to reduce project risks of delay and unanticipated costs.*



Nominations to join an APWA knowledge team or subcommittee are considered year-round. Share your interest via the QR code below.



Get Involved with APWA

Today's Speakers



Joel Koenig, PE, Env SP
UPROW Committee Vice Chair
Retired Senior Project Manager
Crawford, Murphy & Tilly



Cesar Quiroga, PhD, PE, ASCE Fellow
Founder and President
CQ Infrastructure Strategies LLC



Andrew Sylvest
Utility Engineering Practice Leader
Bolton & Menk, Inc.



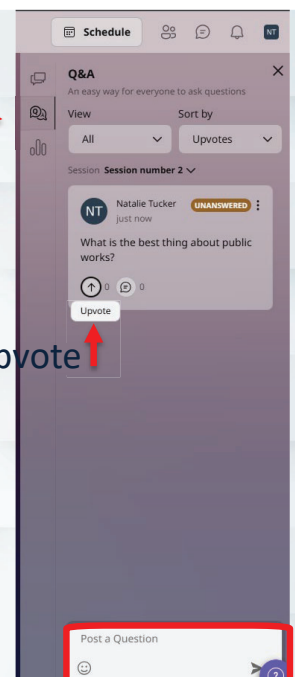
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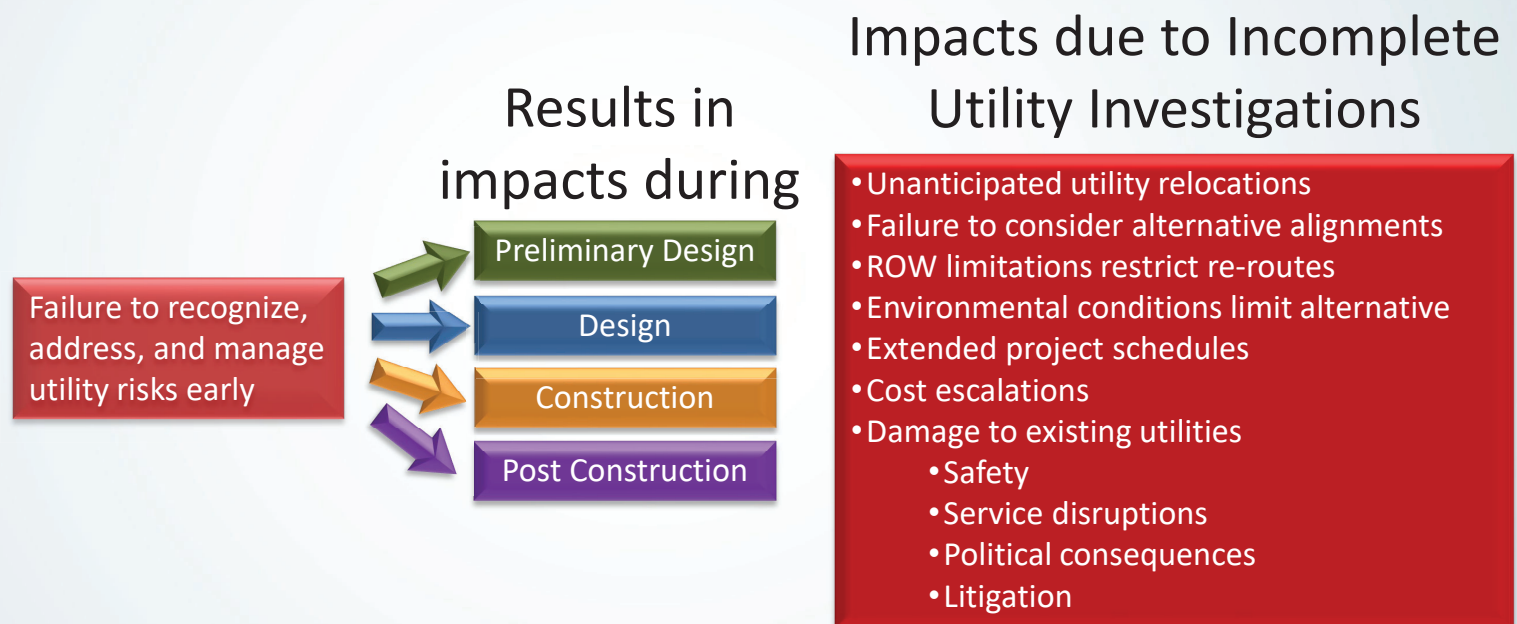
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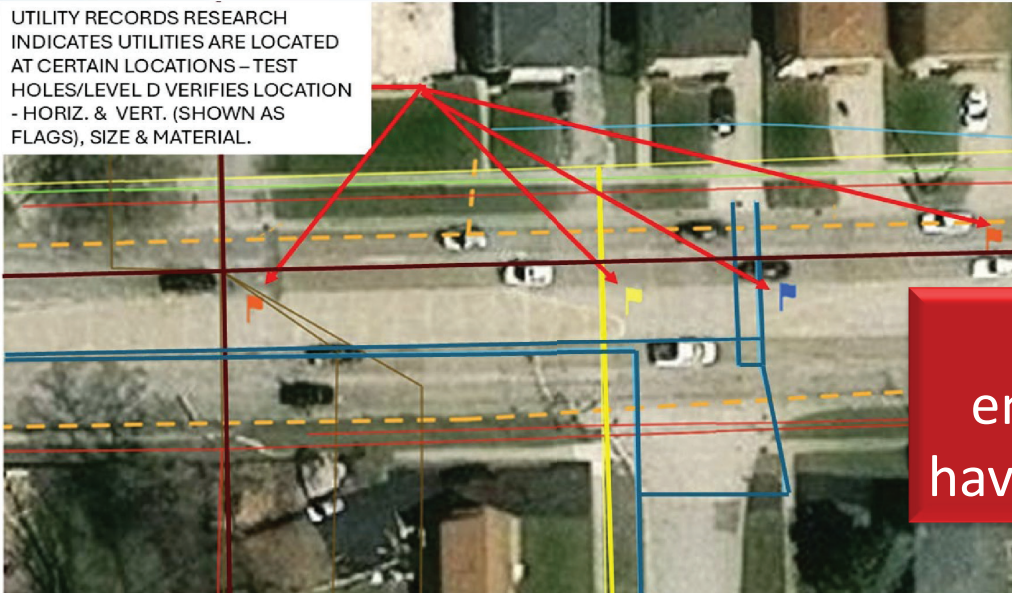
SUE Essentials for Public Works: Smarter Utility Investigations

Utility-Related Risks During Project Delivery



Need for Conducting Subsurface Utility Engineering (SUE)

UTILITY RECORDS RESEARCH INDICATES UTILITIES ARE LOCATED AT CERTAIN LOCATIONS – TEST HOLES/LEVEL D VERIFIES LOCATION - HORIZ. & VERT. (SHOWN AS FLAGS), SIZE & MATERIAL.

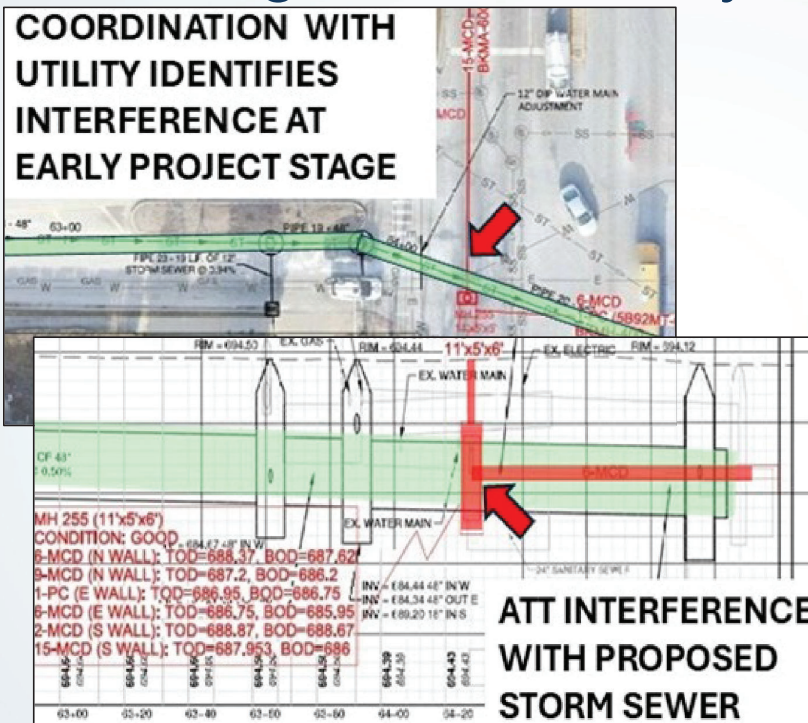


Graphic courtesy of Crawford, Murphy & Tilly, Inc.

Owners and engineers don't have X-ray vision!!!

Management of Utility Conflicts (Interferences)

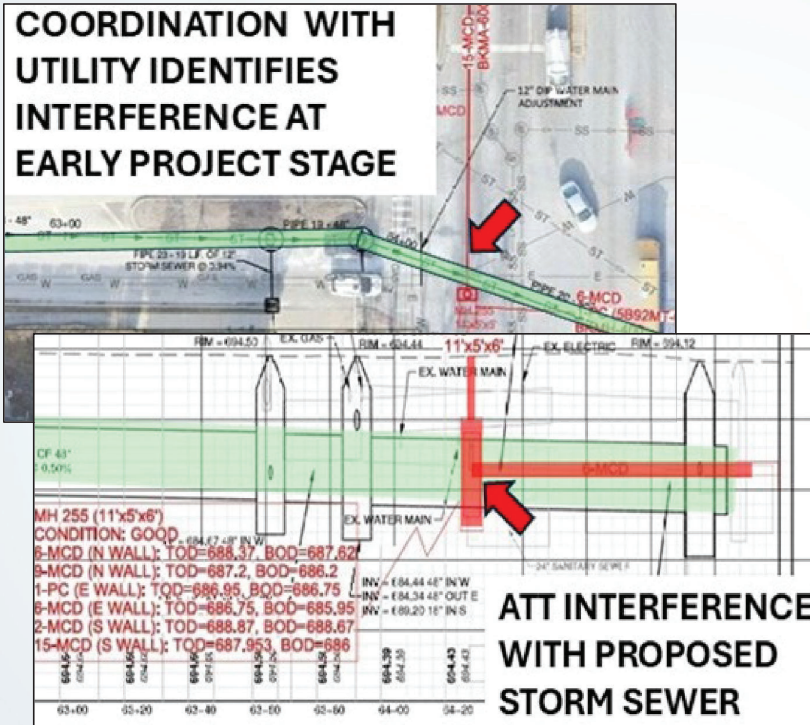
COORDINATION WITH UTILITY IDENTIFIES INTERFERENCE AT EARLY PROJECT STAGE



- Identifying utility conflicts (interferences)
 - Identify utility owners
 - Field visits
 - Historical permits
 - One-Call systems
 - Google Earth – Street Views
 - Outreach to utility owners
 - Initial routing – Atlases/as-builts
 - Preliminary plans – Alignment
 - Design stage (60-90%)

Include SUE in Project Scope and Budget

COORDINATION WITH UTILITY IDENTIFIES INTERFERENCE AT EARLY PROJECT STAGE



- Account for SUE in project scope
 - Costs
 - Data gathering
 - Surveys
 - Geophysics and test holes
 - Time
 - Field work
 - Data processing
 - Permissions
 - Right of access
 - Permits (hwy, RR, etc.)
 - Safety
 - Maintenance of traffic
 - Restoration



Utility Damage during Excavation

Damage Cause	%
Locating practices	34%
Excavation practices	35%
No locate request	25%

Source: 2024 CGA DIRT Report



Courtesy of Cesar Quiroga



Utility-Related Change Orders

Disaggregated Change Order Reason	Average
Errors and omissions in PS&E	33%
Inaccurate or incomplete data about existing or relocated utility facilities	23%
Changes initiated by project owner, contractor, or utility owner	12%
Delays getting utility owners to schedule utility relocations	11%
Differing site conditions	4%
Difficult or inadequate constructability of highway work or utility relocation	4%
Inaccurate or deficient utility relocation work	2%
Delays acquiring or clearing right-of-way or utility relocation sites	2%
Other	9%
Total	100%



Source: NCHRP Project 15-69, Final Report

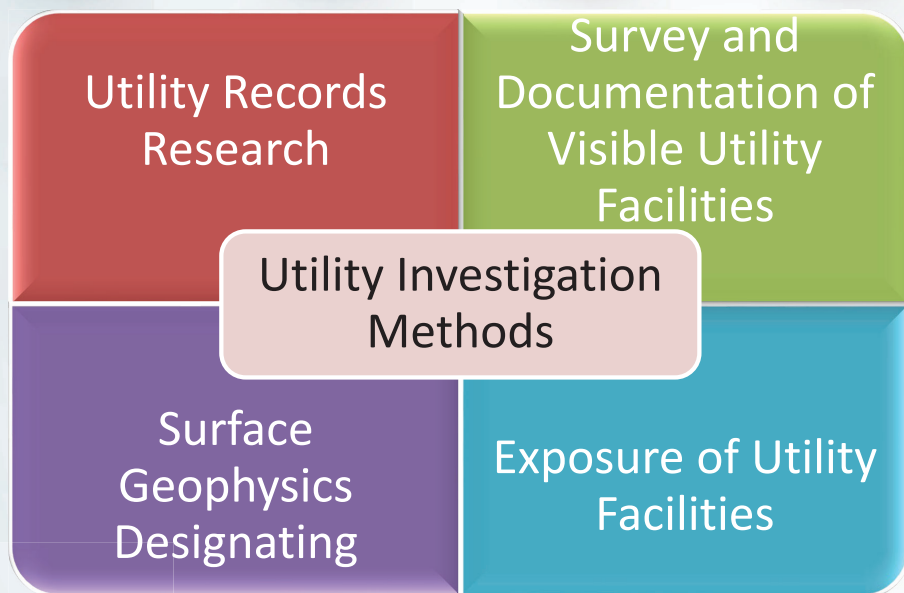


Learning Objectives

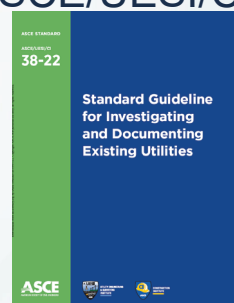
- Explain how utility investigations (SUE) can be integrated into project delivery
- ➔ • **Describe the four quality levels and utility investigation methods**
- Describe how SUE can help to reduce project risks of delay and unanticipated costs



Utility Investigation Methods



- Quality levels:
 - QLD, QLC, QLB, QLA
- Standard Guideline for Investigating and Documenting Existing Utilities
 - ASCE/UESI/CI 38-22



Utility Records Research

Data Sources	Uses	Challenges/Limitations
• Drawings • GIS databases • Oral recollections • 811 marks • Existence of service • "Private" locates • Previous designs/survey/SUE by others	• Preliminary assessment of utility facilities • Utility owner contacts • Major constraints affecting project alignment and footprint • Low cost • Best done as early as possible (preliminary engineering phase) • Send notifications before conducting utility records research	• 50-60% of underground utility facilities identified • Low positional accuracy • Data not sufficient for design
Outcomes		
• X-Y locations • Attribute • Metadata • QLD (if done according to ASCE 38-22)		



Utility Records Research



Survey & Documentation of Visible Utility Facilities

Data Sources

- Manhole pipe inverts
- Valves
- Vaults
- Hydrants
- Curb stops
- All features must be opened, if possible, to obtain anchor points

Outcomes

- X-Y locations
- Attribute
- Metadata
- Overhead details
- QLC, QLD (if done according to ASCE 38-22)

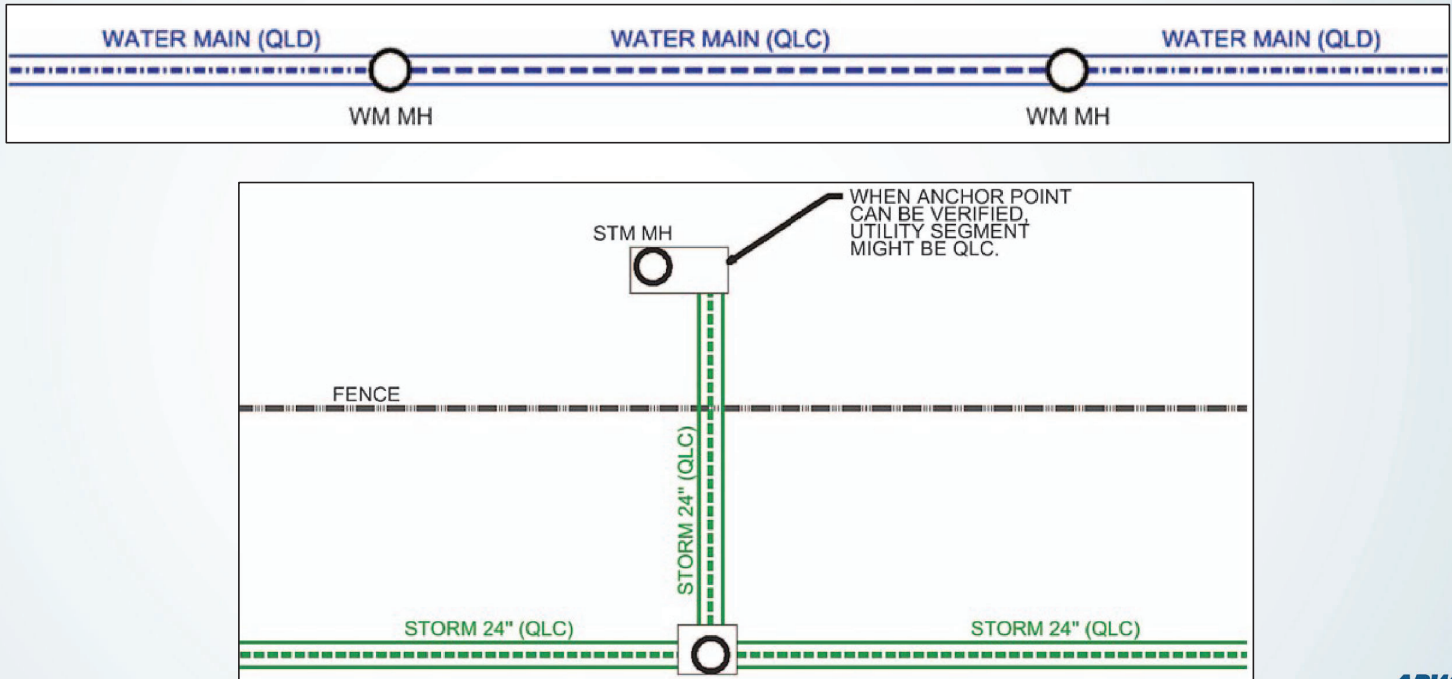
Uses

- Improved reliability of existing utility data
- Tight integration of utility data with project survey control
- Pole attachments (no QL):
 - Increasingly important
 - Ignored in utility records research
 - Need to coordinate with each utility pole tenant

Challenges/Limitations

- Not helpful for flexible utilities
- Surface features paved over or filled with dirt
- Difficult to access manholes and vaults
- Difficult to measure top of pipe inside tight valve boxes
- Information at one location
- Pole attachments not documented

Survey & Documentation of Visible Utility Facilities



Surface Geophysical Designating

Data Sources

- Electromagnetic induction (EMI)
- Ground penetrating radar (GPR)
- Acoustic sensor
- Sonde/rodder

Uses

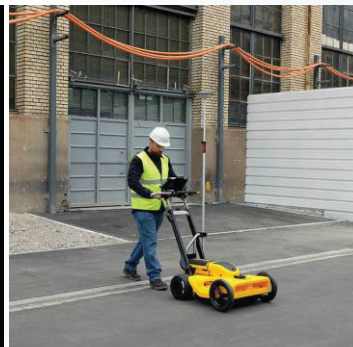
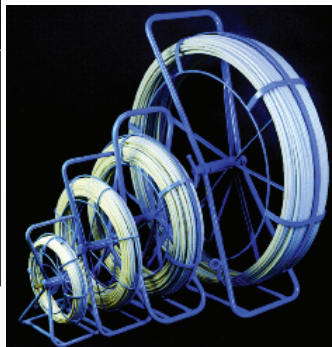
- Improved utility data completeness and reliability
- Up to 80-90% of underground utility installations located

Challenges/Limitations

- Higher costs than for previous utility investigation phases
- More certainty for horizontal locations than vertical locations

Outcomes

- X-Y locations
- Z data (technique dependent)
- Attribute
- Metadata
- QLB, QLC, QLD (if done according to ASCE 38-22)



Exposure of Utility Facilities

Data Sources

- Survey of exposed utility facilities
- Pictures/video

Outcomes

- X-Y-Z coordinates
- Grade elevation
- Picture of utility facility
- Outside diameter
- Conduit configuration
- Material
- Condition
- Pavement thickness and type
- Soil type and conditions
- Metadata
- QLA (if done according to ASCE 38-22)

Uses

- Improved level of confidence about utility locations at point locations
- Reduced level of risk
- Size and material verification for tie-ins or relocation estimates
- Potential for clarity on unknowns



Challenges/Limitations

- X-Y-Z data limited to test hole locations
- Risk of utility damage
- Traffic disruptions at test hole locations
- Risk to road surface integrity (hydrovac)
- Difficulty in confirming exact utility and owner
- Dry holes on QLD
- Who covers the costs?



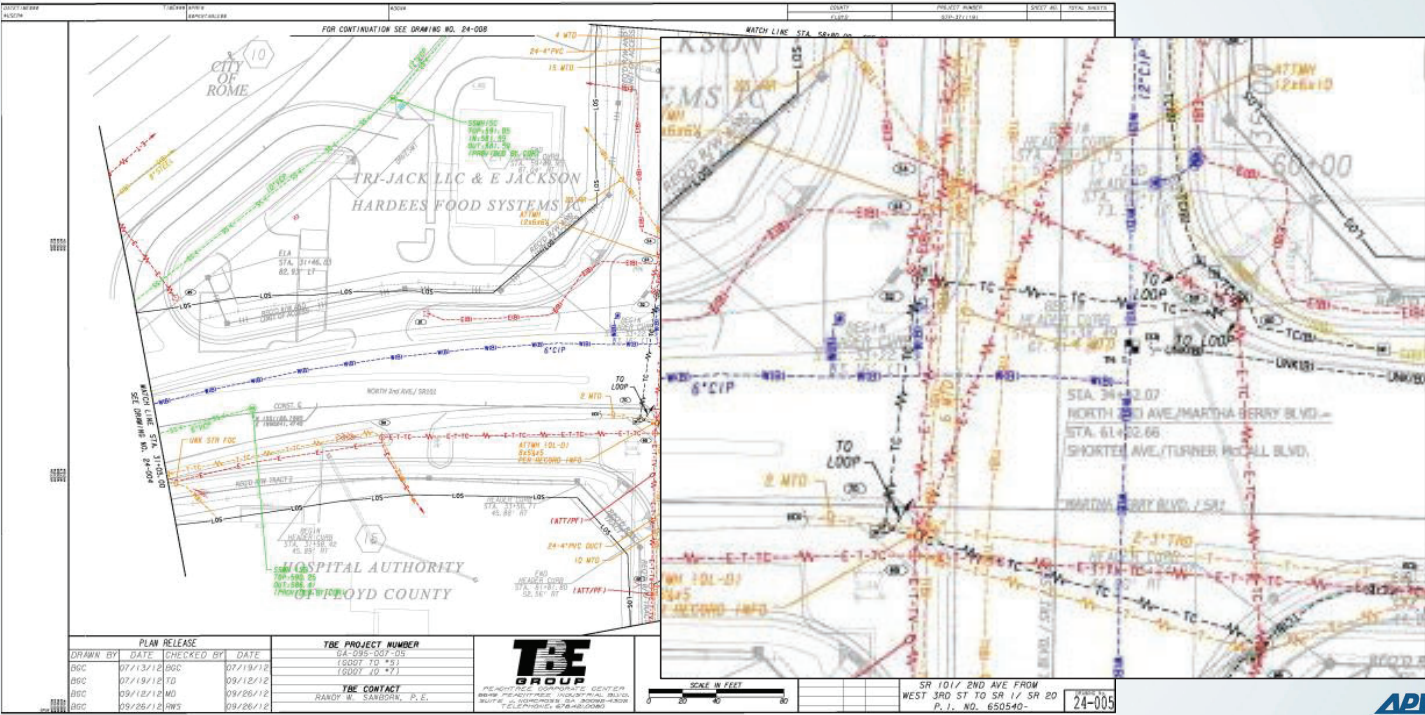
Utility Investigation Deliverables

- Plans
- Test hole sheets/Summary table
- Utility investigation report
 - Project description
 - Methods and equipment used
 - Software used to process and depict utility data
 - Description of utilities located and depicted
 - Problems encountered and resolutions

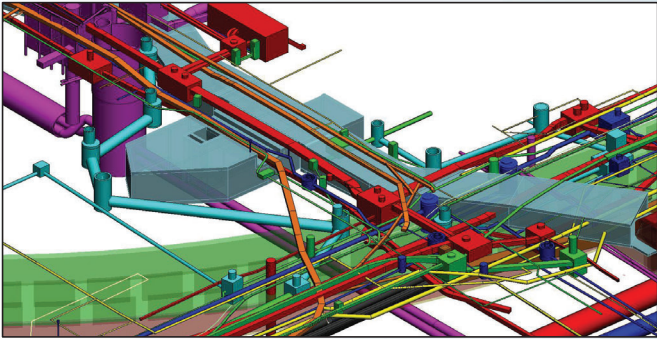
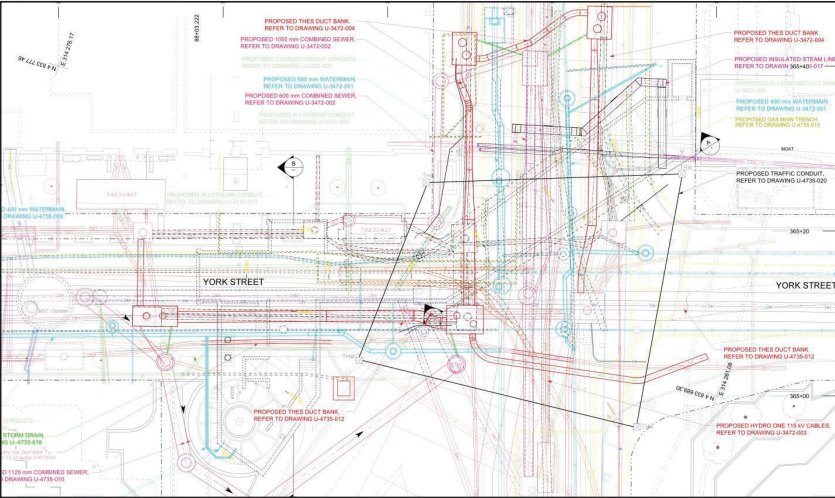


3D models

Utility Investigation Deliverables



Utility Investigation Deliverables



Best Practices

- Include active and passive methods
- Document all utilities, public and private, regardless of operational status
- Set up limits of investigation based on potential utility conflicts and risks
- Make sure a licensed Engineer or Surveyor (depending on jurisdiction) is in responsible charge



What is NOT a Quality Level

- QLD is not records
- QLC is not surveyed manhole lids
- QLB is not paint on the ground
- QLA is not a pothole
- Documented investigation activities produce data, the data is reviewed by the professional of record, and quality levels are assigned by the professional



Learning Objectives

- Explain how utility investigations (SUE) can be integrated into project delivery
- Describe the four quality levels and utility investigation methods
- ➔ • **Describe how SUE can help to reduce project risks of delay and unanticipated costs**

Benefits of Effective Utility Investigations

- Earlier identification of existing utility facilities and conflicts
- Fewer unnecessary utility relocations
- Fewer disruptions and utility damages during construction
- Fewer utility-related change orders and claims

Disaggregated Change Order Reason	Average
Errors and omissions in PS&E	33%
Inaccurate or incomplete data about existing or relocated utility facilities	23%

Return on Investment (ROI) of SUE

- FHWA study (2000)
 - Purdue University
 - \$4.62 in savings for every dollar spent on SUE
- Ontario Sewer & Watermain Contractors Association (2005)
 - University of Toronto
 - \$3.41 for each \$1 spent on SUE, with a range from \$1.98–\$6.59
- PennDOT study (2007)
 - Pennsylvania State University
 - \$22 for every dollar spent on SUE (range: \$3.25–\$33)



Utility Investigation Costs

- Pricing varies by quality level and job conditions:
 - QLD: Time or area; % of QLB cost
 - QLC: Included in QLB
 - QLB: Linear ft of anticipated underground lines
 - QLA: Test hole
- Challenge: Uncertainty about actual/measured utilities
- Planning: 0.5-1.5% of estimated construction cost



Utility Investigation Costs



Thank You!!!

- For additional information, please contact:
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