Consultant’s Session
Shaping the 3D Scope

Chattanooga, Tennessee
April 28–May 2, 2019
3D – The Situation

• Technology is Rising
• Clients are Progressing
• Client condensing resources and processes
• Shifting of Risk
The Opportunity

• Lead the industry
• Reduce Risk
• Reduce Confusion
• The shaping of our own future
The Challenge

- Establish standards
  - Who is leading?

- Adoption of Standards
  - Are DOTs ready?
  - Is the industry ready?

- “Enforcement” of the Standards
Project Goals

1) Quality Level B involves the use of Quality Level D and C methods of utility investigation plus the use of surface geophysical techniques to determine the existence and horizontal position of underground utilities. This activity is called "designating." The information obtained in this manner is surveyed to project control. Two-dimensional mapping information is obtained. This information is usually sufficient to accomplish preliminary engineering goals.

2) Quality Level A involves the use of Quality Level D, C and B methods of investigation plus the use of minimally intrusive excavation methods at critical points to determine the precise horizontal and vertical position of underground utilities, as well as the type, size, condition, material, and other characteristics. This activity uses test holes (sometimes called Locating). It is the highest level presently available. When surveyed and mapped, precise plan and profile information is available for making final design decisions.

3) 3D Modeling involves the use of CADD to depict the precise horizontal and vertical profile of each utility in areas of high conflict. This tool is only utilized in areas where precision locating and design of utilities is essential for project success.
Quality Level B - Designate: Underground utility facility information and documentation obtained by performing research, site examination, identification of the utility facility path using geophysical techniques, placement of markings to indicate the path of the utility facility, and survey of the markings. Also included are CADD efforts, applicable reviews, and administration as well as any other work to create and deliver the work product consistent with these specifications. The accuracy of the markings (centerline of marking) to indicate the path of the utility facility shall be within the tolerance zone less 0.30 feet. The horizontal accuracy of the surveyed markings (centerline of marking) shall be 0.07 feet. The depth of the utility facility is to be shown on the plan sheets and provided in the Underground Utility Facility Matrix from the research, site investigation, and related work performed.

Design Work is being performed based on this information!
Current Contract with 3D Modeling being performed

General Provisions for Overhead/Subsurface Utility Engineering (SUE)
X. Provide the location of the Department’s current Electronic Utility File Guidelines for the SUE Consultant’s use in preparing files in a format compatible with the Department’s current CADD systems (Microstation and/or InRoads[as applicable]) as the project requirements stipulate.
XX. Translate utility data to the appropriate CADD format (See 1.8 Data Management) for direct incorporation of SUE Consultant’s information into the Department’s or design engineer's CADD file. Utility information shall be clearly delineated as to its "Quality Level" via line codes/symbols and labeling as set forth in the Department’s Electronic Utility File Guidelines and Standard Guidelines for the Collection and Depiction of Existing Subsurface Utility Data, published by the ASCE, current edition.
1. What are the critical components in a 3D data collection scope?

- Standards regarding how vertical data is collected
- Utility specific details regarding data collected.
2. How many different variations on 3D data exist?

3. How many different ways can you populate the Z value on 3D data?
4. What is the applicable standard of care?

- Must the professional furnishing the 3d data specify where the data originated?
- Is a 3d model to be sealed or is it for reference only?
- Do 3d models decrease or increase the need for QLA?
- How does one differentiate "pure design data not yet built" from uncertain pre-existing conditions?
5. Is a written standard required to protect the industry?
6. What organization is best suited to develop a standard for 3D modeling or a guideline for a quality scope?
Subsurface Utility Engineering with GPR

Greg Johnston

April 29, 2019

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Concept of GPR for Utility-Locating
Overview

1) SUM/SUE
   • Subsurface Utility Engineering Defined
   • SUE Standards
   • SUE Cost Benefits
   • Geophysical Methods

2) GPR and SUE
   • GPR Strengths
   • GPR Roadblocks

3) GPR Features
   • GPR Compared to EM
   • GPR, GPS and Field Interpretations

4) Mapping Utilities with GPR
   • Deliverables

5) Summary
Subsurface Utility Engineering:

An engineering practice that manages select risks rising from utility coordination, utility mapping at appropriate quality levels, utility relocation, utility condition assessment, utility relocation cost estimates, and utility design.
SUE Governing Standards:

- Governing Standards:
  - American Society of Civil Engineers – Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data (ASCE 38-02)
  - CSA Standards – Mapping of underground infrastructure (S250-11)
Cost Benefit Analysis
- SUE References

• The Federal Highway Administration (FHWA) highway projects
  • Cost Savings on Highway Projects Utilizing Subsurface Utility Engineering’ (Purdue University, 1999)
    • A savings of $4.62 for every $1.00 spent¹

• University of Toronto
  • Evaluating the use of Subsurface Utility Engineering in Canada’ (University of Toronto, 2006)
    • A savings of $2.05 to $6.59 for every $1.00 spent²

• Pennsylvania DOT
  • Subsurface Utility Engineering Manual’ (Pennsylvania State University, 2007)
    • A savings of $22.21 for every $1.00 spent³
Subsurface Utility Engineering:

An engineering practice that manages select risks rising from utility coordination, utility mapping at appropriate quality levels, utility relocation, utility condition assessment, utility relocation cost estimates, and utility design.
ASCE Quality Level Designations

• Four quality 4 levels:
  • Level D – existing records/drawings ($)
  • Level C – visible above-ground features ($$)
  • Level B – geophysical methods ($$$)
  • Level A – exposing utility (“daylighting”) ($$$$$)

Note: Level D, C, and B may not be performed in sequence depending on feasibility.
Geophysical Methods

• Level B
  • “Select an appropriate suite of surface **geophysical methods** to search for utilities within the project limits...”
Geophysical Methods

• Most common “geophysical method” is EM or EMI
• 95+% of locates are done with EM
Where does GPR fit into SUE?

- GPR complements EM
- GPR included in many best practices for utility locating (CGA, Nulca, CCGA)
GPR Strength: Non–conductive utilities

Locate non-conductive utilities that don’t have tracer wire
GPR Strength: Close Proximity Utilities

Locating utilities that are close to each other
GPR Strength: Locating Utilities with damaged tracer wires

Wire snaps during installation, corrodes, broken during repair or never installed
GPR Strength: Buried USTs

Find position and depth of the tanks
GPR Strength: Duct Banks

Identifying large concrete obstructions
GPR Strength: Unexpected Obstacles

Abandoned Infrastructure such as Old foundation walls
GPR Strength: Accurate Depths to Targets

- Calibrate for depth by fitting the red system hyperbola to the target hyperbola
- Depth estimate is usually within 10% of the actual target depth
GPR – Complementary to EM

GPR should be used to ensure due diligence
Why isn’t GPR More Widely Used?

1) GPR cannot see deep in all soil conditions, i.e. clay
   True but it can often see at least 3-4 feet where many utilities are located

2) GPR is pricier than EM
   Yes, but not significantly
Why isn’t GPR More Widely Used?

3) GPR is difficult to become proficient at using

We always hear that GPR training takes MUCH longer than EM training
Why isn’t GPR More Widely Used?

The new capabilities of GPR are closing the gaps on learning to use GPR effectively.
No Settings – Just Start Collecting
Collect Data Once and Optimize the Image

Change Gain to reveal targets
Collect Data Once and Optimize the Image

Apply Filter to emphasize targets
Pinpoint a Utility by Backing Up
Add Interpretations in the Field
Collect Grid Scan around Obstacles
“EM-like” GPR System
The product failed (for various reasons) but the idea is a good one:

Make GPR more “EM-like” because EM is the standard technology for utility-locating
EM, using an EM transmitter, “excites” one or more metallic utilities so an operator, by sweeping a wand back and forth on the surface, can track one utility, using a tone (sound).
EM, using an EM transmitter, “excites” one or more metallic utilities so an operator, by **sweeping a wand back and forth** on the surface, can track one utility, using a tone (sound).
Positioning

Collecting GPR data with GPS
EM, using an EM transmitter, “excites” one or more metallic utilities so an operator, by sweeping a wand back and forth on the surface, can track one utility, using a tone (sound).
Sensing

GPR is a visual technology (for now)
GPR “excites” all utilities using a radio wave transmitter so an operator, using a GPR with GPS on the surface, can track one utility, using an image (visual).
Real-time Cross-Section & Plan Map

Last 25 feet of data (orange line)

GPR Survey Path and current location (blue dot)
Real-time Cross-Section & Plan Map

Add interpretation by touching the hyperbola
Multiple, linear interpretations builds confidence you are tracking a utility.

The pattern suggests one target was missed because the hyperbola was very weak.
2 Targets - Now What?

GPR sees more targets than just the one you are looking for
Likely the Wrong Target

The right target does not line up with the other interpretations
Erase that one and select the other

Erase a target by touching it on the screen
More Likely

See in real time that the left target lines up with the other interpretations
Case Study: Data Collection GPS Path

GPR data covering 16,000 sq. ft
Case Study: Depth Slice showing Linear Utilities
Case Study: Depth Slice Animation Showing Utilities at Different Depths

Depth slices from the surface to 5.5 feet in 4 inch thick increments

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However, if a target has a weak or subtle response, it is difficult to see it in depth slices.
Case Study: Adding Interpretations to All Hyperbolas
Case Study: Depth Slice and Interpretations

Adding interpretations confirms the location of utilities and reveals a few more that might have been missed.
### Typical Utility-Locating Deliverables

**Paint on the Ground**

**Sketch**
In-Field Map Creation

The data collected in the field to locate utilities can easily be made into a map.
Every interpretation has a GPS position

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Digital Sketch – Google Earth

GPR Survey Path

Interpretations

Grid Depth Slice
Digital Sketch – Google Earth
Using the same points that are placed during data collection CAD and GIS files can be output.
Benefits of GPR

• Immediate results, real time verification
• Locate non-metallic as well as metallic utilities
• Accurate depths to utilities
• Easy intuitive user interface “Locate & Mark”
• Another tool in the tool kit, ready when you are
• Nulca-certified training
Benefits of SUM/SUE with GPR

• Decreased costs, less use of daylighting
• Fewer damages
• Fewer change requests
• Ability to better plan, excavate and implement projects
• Greater worker safety, locating non-metallic lines without tracer wire.
The Subsurface Utility Engineering Association
A Voice for the Profession

LAWRENCE ARCAND AND ANDREW SYLVEST
APRIL 29, 2019
SUE Association is there to strengthen the business environment for member firms through government advocacy, political action, and business education.
History

- Dinner Meeting, Bethesda, MD, March 4, 2015
- Consultant Study, 2017-2018
- LinkedIn Group Comments, SurveyMonkey Poll, 2017-2018
- Kick-Off Conference, Washington, DC, July 26, 2018
Poll Questions

• Is a new association needed?
• State, regional, national or international?
• Individual members or companies?
• Include government, academia, vendors/suppliers, other stakeholders?
Poll Results

• National Association
• SUE Service Firms as Core
  • Blended Membership including Related Interests
• 501(c)(6) association
• Kick-Off Conference
  • Washington, DC, July 26, 2018
  • Over 50 attendees representing 38 companies
Conference Speakers

- Jim Anspach on UESI, ASCE 38
- Congressman Randy Weber (R-TX), US Infrastructure
- US DOT Deputy Assistant Secretary Anthony Bedell
- PHMSA Office of Governmental, International, and Public Affairs Director Bobby Fraser
- Justin Klein – Insurance Issues Related to SUE
Kickoff Actions

• Adopted Bylaws
• Approved Dues Structure
• Elected Board of Directors
Leadership

John Berrettini – President and Chairman
A/I/Data, Inc., Baltimore, MD

Art Worthman – President-Elect
A. Morton Thomas and Associates, Rockville, MD

Lawrence Arcand – Treasurer
CARDNO, Ontario, Canada

Andrew Sylvest – Secretary
Surveying And Mapping (SAM) LLC, Lakewood, CO

Nadia Pimental – Director
KCI Technologies, Inc., Sparks, MD

Greg Jeffries – Director
Maser Consulting, Bryan, Texas

Daniel Checchia - Director
KEITH & Associates, Pompano Beach, FL

Craig Martin - Director
Accumark, Inc., Ashland, VA

Donald Haines – Director
Utility Mapping Services, Inc., Shoreline, WA

Nicholas Zembillas – Director
Subsurface Utility Engineering LLC, Tarpon Springs, FL
Additional Actions

- Retained Association Management Firm
- Filed as a 501(c)(6) trade association
- Established [www.sueassociation.com](http://www.sueassociation.com) website
- Created LinkedIn, Facebook and Twitter accounts
Additional Actions

• Board Drafted Strategic Plan
• Draft SUE Association / UESI MOU
• Committees formed:
  • Legislative/Government Affairs
  • Communications
  • Membership
  • Education/Conference Program
Activities

- Networking
- Continuing Education
- Standards Promotion and Certification
- Advocacy, Marketing, Public Relations
- Risk Management, Insurance
Activities

• Promote ASCE 38
• Work with but avoid duplicating or competing with existing associations and societies
Membership

• Dues:
  • Regular Member scaled based on number of employees engaged in SUE
  • Associate scaled based on revenue
  • Affiliate, Independent is flat rate
  • Sustaining Member scaled based on revenue
Membership

• Voting:
  • Each Regular Member firm has one vote
  • All other categories are non-voting
  • Board comprised of representatives from Regular Member firms
Membership

• Regular Member Dues
  • 1-10 SUE Employees $750
  • 11-50 SUE Employees $1,250
  • 51-100 SUE Employees $2,000
  • 101-150 SUE Employees $3,500
  • 151-250 SUE Employees $5,000
  • 250+ SUE Employees $7,500
Membership

• Associate Member Dues
  • Gross Annual Revenue < $1 million  $ 1,500
  • Gross Annual Revenue $1 to 10 million  $ 3,500
  • Gross Annual Revenue > $10 million  $ 7,500
Membership

• Affiliate Member Dues
  • $ 2,500
Membership

• Independent Consultant Dues
  • $500
Membership

• Current Association Makeup
  • 17 Regular Member Firms
  • 1 Associate Member Firm
Membership

• Join
• www.sueassociation.com
Questions?

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