Subsurface Utility Engineering

by
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Construction Technical Group, Transportation and Urban Development Technical Group and Engineer's Club of Philadelphia
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Are you confused about SUE?

- Tonight we will work through the issues and procedures relating to Subsurface Utility Engineering (SUE)

Subsurface Utility Engineering

Today's topics include:

1. Understanding the Need for SUE
2. Understanding ASCE Standard 38-02
3. SUE Technology
4. SUE in Practice

1. Understanding the need for SUE

- **Reasons for identifying existing underground utilities**:

1. To provide adequate utility information to facilitate design projects
2. To avoid utility relocations due to conflicts
3. To avoid utility damage during construction or pre-construction geo-physical investigations

Conventional methods of locating existing utilities (w/o SUE)

1. As-built/as-constructed record documents
2. Physical visit to site and survey of visual clues of existing utilities
3. Conversations with utility companies, local municipal reps, anecdotal information
4. Design or construction ticket requests to PA One Call

So why use SUE?

1. Reduction in unforeseen utility conflicts and relocations.
2. Reduction in potential project delays.
3. Reduction in contractor claims and change orders.
4. Lower project bid results
5. Reduction or elimination of re-design costs

Studies Documenting Cost Savings In Last 12 Years

- Purdue University – 1999 (for FHWA)
- University of Toronto, 2005
- Penn State University – 2007 (for PennDOT)
- Virginia DOT
- Maryland SHA
- Society of American Value Engineers
- At least 11 other studies have been published

1999 Purdue Study – Cost Savings

- 71 state DOT highway projects from 4 different states were studied . The study documented average savings of **$4.62 for every $1.00 spent** on SUE services with one North Carolina DOT project seeing a return of $206.00 per $1.00 spent

The Purdue Study - Conclusions

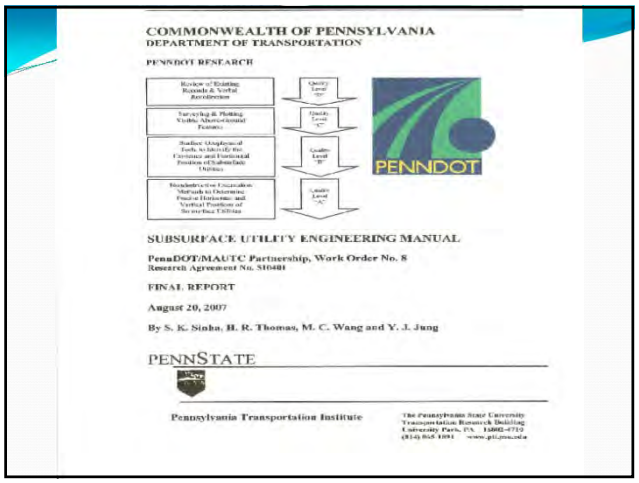
- States us a variety of methods to select projects suitable for SUE
- SUE results in the highest overall financial benefits when utilized early in the design phase of a project (30% design)
- SUE has been found to be particularly helpful in complex reconstruction or new construction in urban areas

The Purdue Study - Findings

- The reason most DOT's have utilized SUE is for the reduction of delays – not cost savings.
- States with a well-established SUE program have been pleased with the results that SUE has brought to their projects
- Many DOT's are increasing their use of SUE as the benefits are realized
- SUE has resulted in better contractor bids

Penn State University Study

- Study was of several various types PennDOT construction projects.
- The conclusion of this study was that over **$11.00** of savings were realized for every dollar spent.



COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION

PENNDOT RESEARCH

SUBSURFACE UTILITY ENGINEERING MANUAL

PennDOT/MAUTC Partnership, Work Order No. 8
Research Agreement No. 510401

FINAL REPORT

August 20, 2007

By S. K. Sinha, B. R. Thomas, M. C. Wang and Y. J. Jung

PENNSTATE

Pennsylvania Transportation Institute

University of Toronto Study

- Funded by the Ontario Sewer and Water Main Contractors Association.
- 9 projects were studied in the Province of Ontario.
- Study documented savings averaged **$3.61** per $1.00 spent

Additional Studies - Highlights

- Virginia DOT savings $7.00/1.00 spent
- Maryland SHA documented savings $18.00/$1.00 spent
- Society of American Value Engineers study - savings of $10.00/$1.00 spent

Quality Issues with Records

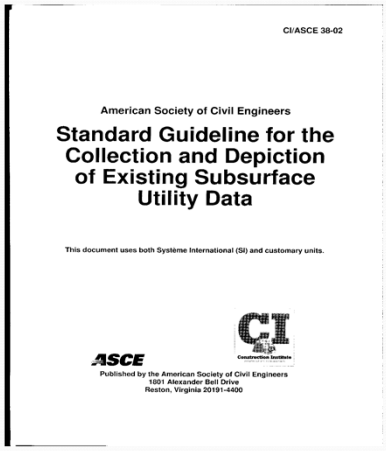
1. Inaccurate or incomplete information on record drawings.
2. Poorly scaled record drawings.
3. Inaccurate anecdotal information.
4. Record drawings with swing tie information that is no longer valid due to road widening, tree removals, house removals or additions.

Potential risks of using inaccurate utility information in design

- Inaccurate design.
- Damage to utilities (hits)during construction.
- Delays and down time costs for contractor
- Re-design costs to design engineer
- Possible legal action against designer.
- Being on the cover of Underground Focus Magazine and local/national newspapers.

SUE History - Standards

- FHWA requested ASCE to establish SUE Standards for highway projects.
- Resulted in Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data (ASCE Standard 38-02, 2003)
- Established SUE Quality Levels D, C, B, and A


CI/ASCE 38-02

American Society of Civil Engineers

Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data

This document uses both Système International (SI) and customary units.

ASCE

Published by the American Society of Civil Engineers
1801 Alexander Bell Drive
Reston, Virginia 20191-4400

History of 'SUE' – how it began

- Vacuum excavation first developed in 1958
- Millions of test holes dug on natural gas lines repairing leaking bell joints using vacuum excavation for the pipeline industry in midwestern US.
- In 1987, FHWA defined the term "Subsurface Utility Engineering" (SUE) as a service to DOT's, Utilities, Industry and Consulting firms

History of SUE – VDOT

- In 1982 Virginia DOT needed a way to save time on its highway projects.
- Saving money was not the primary concern.
- Time is money! VDOT analysis claimed savings of $8.00 for every dollar spent

Intent of the ASCE Standard

- The standard offers an organized collection of information or a series of options and does not recommend a specific course of action.

SUE as defined in the ASCE Standard

- "A convergence of new equipment and data-processing technologies now allows for the cost-effective collection, depiction and management of existing utility information. These technologies encompass surface geophysics, surveying techniques, computer-aided design and drafting and geographic information systems, and minimally intrusive excavation techniques."

Quality levels of SUE

- ***QL-D***: Information derived from existing records or oral recollections.
- ***QL-C***: Information obtained by surveying and plotting visible above ground appurtenances. Utility data from QL-D records are correlated to the appurtenances.
- ***QL-B***: Information obtained through the application of surface geophysical methods. *Designated* utilities are marked as paint marks on the ground.
- ***QL-A***: Precise horizontal and vertical *location* of utilities obtained by the actual exposure and subsequent measurement of subsurface utilities

Quality level "D" – Least Reliable

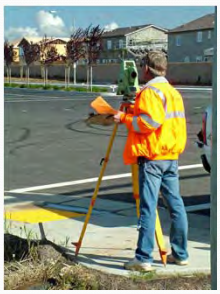
- Review old plans
- Review as-builts
- Sometimes a field visit to look for indications of utilities
- Good for project planning purposes, utility "inventories", preliminary utility relocation cost estimates.

Quality Level "C"-Traditional

- Visit site
- Review information on plans from QL-D and correlate to the appurtenances

Quality Level "C"

- Survey Surface Utility features such as; fire hydrants, valve boxes, utility boxes, pull boxes and other utility objects seen in the field



Designation & Location

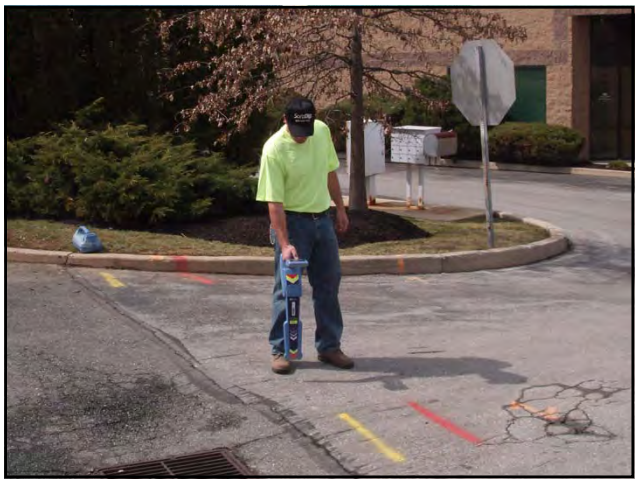
- ***Designating***: The process of using a surface geophysical method or methods to interpret the presence of a subsurface utility and to mark its approximate horizontal position (its designation) on the ground surface. (Quality Level B)
- ***Locating***: The process of exposing and recording the precise vertical and horizontal location of a utility. (Quality Level A)

Quality Level "B" – Significant Upgrade in Quality

- Designate all buried utilities within project limits
- In some cases designation of only some of the utilities may occur because some may be replaced during construction

Quality Level "B"-Designating

- Use of surface geophysical methods used to search for and trace existing utilities.
- Survey all designation marks and CAD plot.
- Non-recorded utilities identified if found.
- Typically used in early preliminary design phase



Designating basics

- Transmitters and Receivers
- Inducing a radio signal
- Direct connect
- Drop boxes
- The clamp
- Sonde's

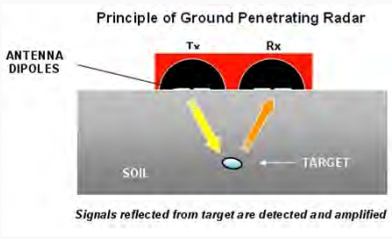
Ground Penetrating Radar (GPR)

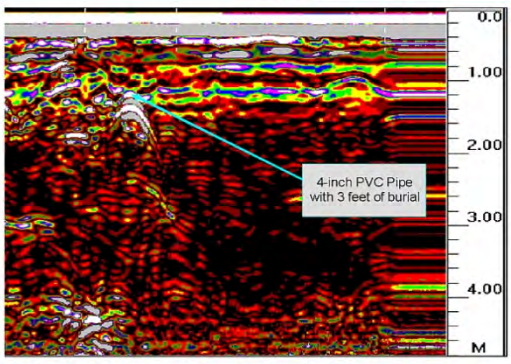
- Geophysical system using radar reflections off utilities
- It can locate utilities
- Useful for non-metallic lines made of PVC and terra-cotta

Ground Penetrating Radar

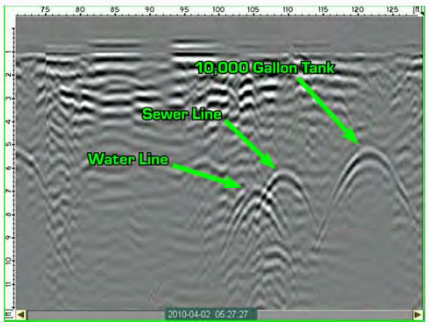
- This is what clients think is seen when (GPR) Ground Penetrating Radar is used.

Mala GPR



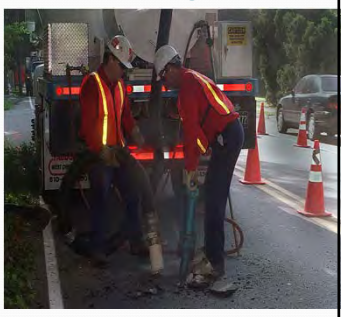


GPR Typical Display



Quality Level A - Locating

- Utilities exposed via non-destructive air or water vacuum excavation
- Exposed utilities are then surveyed and plotted on site plan
- Locating typically used in final design stages or during construction.



REDUCTION

RESTORATION

Airports

Industry

Highways

Chemical/Pharma Plants

Inside Facilities

Nuclear Plants

Heavy Construction

Trenching ($$$)

State One-Call Centers

- It's FREE! It's generally accurate.
- Then why do you need SUE?
- It worked in the past---- Then why 175,000 hits in 2009?
- Isn't it all I need to comply with the law? (not in PA if project > $400,000)

811 Know what's below. Call before you dig.

Common Ground Alliance(CGA)analysis on data submitted to DIRT

- DIRT = Damage Information Reporting Tool
- Approximately 256,000 "hits" occurred in the United States in 2007
- Approximately 175,000 "hits" occurred in 2009 – decrease is good, but mostly due to economy
- 48% of "hits" were on Natural Gas lines
- 38% were on Telecommunications Lines
- 70% of the damages caused by backhoes and trenchers

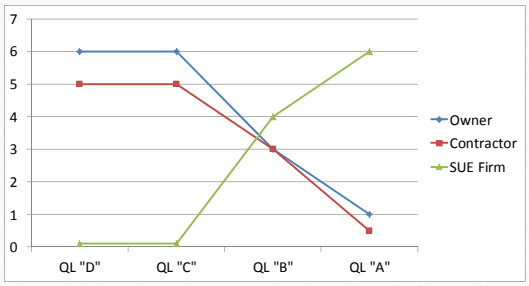
Project Owner Responsibilities

- SUE levels 'D' & 'C' - Required by PA legislation since 1975
- SUE levels 'A' & 'B' - Strongly recommended by PA One Call and CGA
- Required by law in PA for projects greater than $400,000

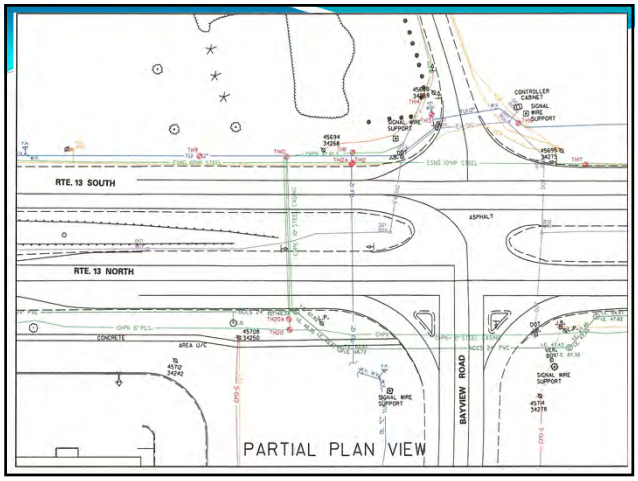
Project owner Responsibilities

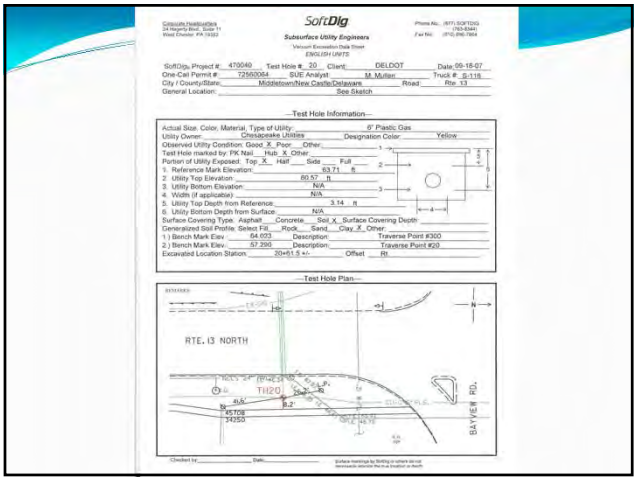
- The Design Engineer is staking his/her reputation on the final design and drawing. When the utility location is determined only from paper plans, as-builts or maintenance records, the final design is incorporating existing utility line locations of unknown reliability
- SUE level 'A' addresses this uncertainty by shifting risk onto the SUE provider.

Risk Management

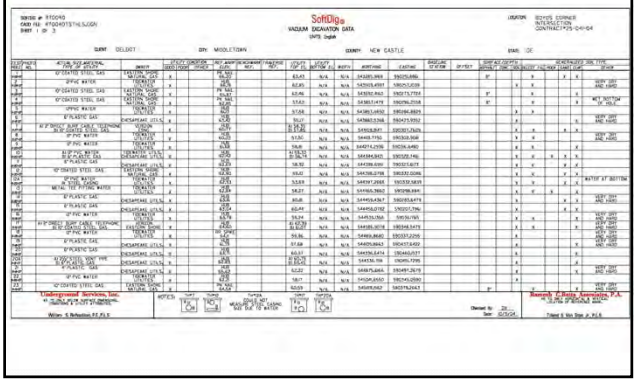


SUE – Typical Deliverables





Tabular Format – Test Hole Reports



You're not going to have

- Backhoes damaging utilities when looking for utilities because: Air/water vacuum excavation has been proven safe for many years

Your not going to have

- work stoppages because of unknown utilities in the way

GIS

- GIS mapping can be a store house for various forms of information, including:
- Storm Water Pipes
- Road Signs
- Street Trees
- Parking Meters
- School, Park, Police & Fire information
- Utilities

GIS

- GIS is used by various state agencies, counties, regional commissions, municipalities, universities and utility companies to inventory their facilities.
- Use of the public agency GIS systems are typically by subscription only.
- Private utilities typically do not provide access to their GIS systems.

Resolving Utility Conflicts

- SUE providers work with DOT and utility owners to determine conflict points between planned construction and existing or planned utility facilities
- SUE providers can develop and make recommendations to owners and designers on relocation alternatives
- Develop or facilitate comparative cost estimates

SUE has become universally accepted

- SUE can reduce unforeseen conflicts between construction activities and underground utilities.
- It provides accurate information on the XYZ location of utilities and structures in the early development of projects.
- Designers can identify conflict points and design to accommodate them ahead of time. They can avoid delays and/or redesign during construction.
- Projects avoid costly change orders and more likely to come in under budget.

References

- ASCE Standard CI/ASCE 38-02
- Common Ground Alliance, Damage Information Reporting Tool (DIRT)
- Cost Savings on Highway Projects Utilizing SUE, Publication No. FHWA-IF-00-014
- PA One Call
- Avoiding Utility Relocations FHWA DTFH61-01-C-00024

References continued

- Utility Relocation and Accommodation On Federal-Aid Highway Projects FHWA-IF-03-014
- Common Ground Alliance, Best Practices Handbook

TEST

- 1. Notifying 'One Call Center' with intent to excavate satisfies ASCE guidelines. T-F
- 2. Defining X,Y,Z position of utility is defined as Quality Level 'B'. T-F
- 3. Data Obtained from utility companies is Quality Level 'D' . T-F
- 4. Purdue study concludes $ 1.00 spent on SUE equals $ 7.00 saved. T-F