SURVEYING THE UNDERGROUND

Maryland Society of Surveyors
Fall Conference
October 18, 2014

Michael T. Maguire, MA, LS
John P. Berrettini
A/I/DATA
SURVEYING THE UNDERGROUND

We are here to discuss the professional practice of locating, surveying and mapping underground utilities

• Review MD One Call (Miss Utility) law and practices; some One Call laws in adjoining States
• Review the standard known as ASCE 38-02 which describes the practice of Subsurface Utility Engineering (SUE).
• Look at some technical aspects of locating UG utilities
• Answer your questions about locating UG utilities
SURVEYING THE UNDERGROUND

Audience Q&A

- Why are you here today?
- What are your experiences with underground utility locating?
- What do you want to know about surveying and mapping underground utilities?
- What are the challenges associated with underground utilities faced by the surveying community?
- How do you deal with liability issues associated with underground utility systems?
- Do you want to locate underground utilities in-house?
  - All projects or just selected ones?
- What do you know about SUE? How about ASCE 38-02?
- What are your One Call experiences?

How should this shape our presentation today?
THE CHALLENGE

COMPLEX UTILITY LAYERS UNDERGROUND

Source: Federal Laboratory Consortium for Technology Transfer
THE CHALLENGE
INCREASING COMPLEXITY UNDERGROUND
INCREASING COMPLEXITY UNDERGROUND
TRACE WIRE NEEDED IF UTILITY MATERIAL IS NON-CONDUCTIVE
WHAT ARE TRADITIONAL METHODS TO MAP UTILITIES?

Records research

Field survey of surface features
  • Valves, hand boxes, meters, manholes, hydrants

Perhaps locate One Call marks

Fit record information to surface evidence & marks

Disclaim responsibility for underground utilities – “per plan”
TRADITIONAL METHODS MAY RESULT IN INACCURATE DEPICTIONS

Subsurface utilities are underground and all covered up

• One Call marks are not necessarily reliably accurate

Utility records:

• Not Always Available
  • Homeland Security
  • Privacy concerns
  • Lost
  • Not drawn
  • Personnel and other costs for utilities to share records

• Not Always Reliable
  • Not As-built
  • Surrounding conditions have changed
Designer Tickets

§12–131  (a)  In connection with a project that may require excavation or demolition, a designer may initiate a ticket request by notifying the one–call system serving the geographic area covering the planned project.

(b)  A designer initiating a ticket request under this section:

   (1)  may initiate only one ticket request for a single project; and

   (2)  shall, in connection with a ticket request:

       (i)  indicate that the request is for design purposes only and may not be used for the purpose of excavation or demolition;

       (ii)  notify the one–call system of any owner–members from which the designer does not require underground facilities information; and

       (iii)  on the request of an owner–member, provide the owner–member with a preliminary drawing that indicates the scope of the project.
§12–131.

(c)  (1) Within 15 business days after receiving notice from a one–call system that a designer has made a request under this section, an owner–member of an underground facility in the area of the project shall notify the designer of the type and approximate location of the underground facility.

(2) An owner–member may provide notice of the approximate location of an underground facility through the use of:

   (i) field locates; (ii) maps; (iii) surveys;

   (iv) installation records; or

   (v) other similar means.

(d)  (1) Information provided to a designer under this section is for informational purposes only.

    (2) An owner–member or agent of an owner–member may not be held liable for any inaccurate information provided to a designer under this section.
An operator, upon notification by a designer in accordance with § 56-265.17:1, shall:

1. Respond to the designer's request for underground utility line information within fifteen working days in accordance with subdivisions 2, 3, and 4 of this section;

2. Provide designers with the operator's name, the type of underground utility line, and the approximate horizontal location of the utility line. The foregoing information may be provided to the designer through the means that include, but are not limited to, field locates, maps, surveys, installation records or other means. If the designer requests field locates, the operator shall provide field locates in accordance with the accuracy set forth in subsection A of § 56-265.19 ("the operator shall mark the approximate horizontal location of the underground utility line on the ground to within two feet of either side of the underground utility line by means of stakes, paint, flags, or a combination thereof").
Marking shall be done by both paint and flags whenever possible;

3. Provide such information about the location of the utility lines to designers for informational purposes only. Operators will not be liable for any incorrect information provided or for the subsequent use of this information, nor will they be subject to civil penalties for the accuracy of the information or marks provided. Any concerns about the accuracy of information or marks should be directed to the appropriate operator; and

4. Respond to the operator-excavator information exchange system by no later than 7:00 a.m. on the sixteenth working day following the designer's notice to the notification center.
Project Owner

The Project owner is any person who or which engages an excavator for construction or any other project which requires excavation or demolition work.

The Project owner responsibilities under the Act during design stage are as follows:

To utilize sufficient quality levels of Subsurface Utility Engineering or other similar techniques whenever practicable to properly determine the existence and positions of underground facilities when designing known complex projects having an estimated cost of four hundred thousand dollars ($400,000) or more.

"Subsurface utility engineering" or "(SUE)" means those techniques set forth in the American Society of Civil Engineers (ASCE) standard CI/ASCE38-02 or its successor document.

To not release to bid or construction any project until after final design is completed;

To participate in design and preconstruction meetings either directly or through a representative.

The designer is required to attend preconstruction meeting on complex projects.

Designers who comply with the terms of the act and not otherwise negligent not subject to liability for injury to persons or property as a result of his excavation or demolition planning work.
PRIVATE UTILITIES NOT MARKED BY ONE CALL PROCESS

- Hot & Chilled Water Systems
- Steam Systems
- Telecommunication

- MTA – Light Rail
- JHH – Steam
- UMMC
- JHU - APL
Gas line mis-mark – Carroll County – an excavator ticket
“It’s just a designer ticket” – Arcola Avenue
Designer ticket areas tend to be larger than excavation ticket areas.

- Financial disincentive (fixed fee per ticket) and lack of liability
WHAT IF RELIABLE INFORMATION IS NOT AVAILABLE?
WHAT IF RELIABLE INFORMATION IS NOT AVAILABLE?
WHAT IF RELIABLE INFORMATION IS NOT AVAILABLE?
WHAT IF RELIABLE INFORMATION IS NOT AVAILABLE?

Incomplete or inaccurate data models
Poorly informed designs
Designs that cannot be executed or constructed as planned
Construction delays
Re-designs
Change orders

Cost increases
Back charges
Lawsuits
Damages
Insurance claims
Increased operating costs
Loss of profits
Loss of client confidence, loss of client
THE NEED TO KNOW HORIZONTAL AND VERTICAL POSITIONS & TYPE, SIZE AND LOCATION OF EXISTING SUBSURFACE UTILITIES LED TO THE DEVELOPMENT OF SUBSURFACE UTILITY ENGINEERING
SUE HISTORY

1981 So-Deep, Inc. founded to dig A/V test holes
1983 – Jim Anspach adds geophysics
1984 – VDOT successful use of SUE
1995 FHWA SUE handbook developed
SUE & FHWA

1990’s – (Early) – Federal Highway Administration (US DOT)

• Aggressively promotes use of SUE
• Defines “quality level” outcomes
  • ‘D’ – records only
  • ‘C’ – adds surveyed utility features
  • ‘B’ – includes surface geophysical techniques to determine the existence and horizontal position of utilities
  • ‘A’ – excavation to determine the precise H & V position, and type, size, material and condition of underground utilities and structures

1990’s – (Late)

• FHWA funds Purdue University study published in 2000
  • $4.62 in avoided costs for every dollar spent on SUE activities
• FHWA helps fund development of national standard
CI/ ASCE 38-02

Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data
©2003 – American Society of Civil Engineers

• Increasing complexity of national subsurface infrastructure
• Subsurface “unknowns” create risks on construction projects
  – Many records are inaccurate, incomplete, out of date
• Utility Owners (One Call)— in most states a construction excavation period service
  – Post-design & after bidding
  – VA & MD have Designer Tickets – Informational only,
  – NO LIABILITY FOR INACCURATE INFORMATION
  – When conflicts arise during construction solutions are costly
  – change orders, extra work orders, insurance payouts and contingency pricing
ASCE 38-02

Scope of 38-02

- Consensus standard
- Defines quality of utility depictions
  - Associated attribute data
- Addresses implementation
  - Methods
  - Available technologies
  - Communication of data

Intent of 38-02

- Establish classification system to describe quality of data associated with existing subsurface utilities
- Facilitate Communication about the quality of utility data needed or provided for construction documents
DEFINITION

Subsurface Utility Engineering – A branch of engineering practice that involves managing certain risks associated with: utility mapping at appropriate quality levels, utility coordination, utility relocation design and coordination, utility condition assessment, communication of utility data to concerned parties, utility relocation cost estimates, implementation of utility accommodation policies, and utility design.
KEY TERMS

Designating
- Interpret the presence of subsurface utility through surface geophysical methods
- Mark its approximate horizontal position on the ground

Locating
- Expose and record the precise vertical and horizontal location of a utility.

Surface Geophysical Method
- Any of a number of methods designed to utilize and interpret ambient or applied energy fields for the purpose of identifying properties of, and structure within, the earth. Such methods typically include variants of electromagnetic, magnetic, elastic wave, gravitational, and chemical energies.

Utility Depiction
- A visual image of existing utility information in a computer-aided design and drafting system (CADD) or on project plan sheets.

Utility Quality Level
- A professional opinion of the quality and reliability of utility information.
QUALITY LEVEL ‘D’

QL D

• Information derived from existing records

Sources
• State and local utility departments
• One Call Center
• Landowners
• Internet
• Utility companies

• Types of Records
• Construction Drawings
• Conduit, Distribution and Transmission Maps
• As-builts
• Oral Histories

• May include a field visit to look for visual cues to utility systems
• Composite drawing plotted for schematic representation without registration to ground features – all representation are at QL D
• May be adequate for preliminary planning purposes
QUALITY LEVEL ‘C’

QL C

- Perform QL D tasks
- Identify and field survey, process and plot utility surface features
- Correlate applicable utility records to surveyed features considering record utility system geometries
- Determine conflicts between records and surface features and attempt to resolve discrepancies, if possible
- The Information obtained by surveying and plotting visible above-ground utility features and by using professional judgment in correlating this information to QL D
- May result in a combination of QL C and QL D depictions
QUALITY LEVEL ‘B’

QL B

- Perform QL C Tasks
  - May be done in conjunction with QL B activities
- Select an appropriate suite of surface geophysical methods
- Apply surface geophysics to search for utilities
- Interpret the geophysics in the field or office depending on method
- Mark and survey indications of subsurface utilities
- Depict approximate horizontal positions of all detected utilities
  - *Surveys of depicted positions must be merged with field records & historic documentation through professional analysis and judgment to produce final mapping.*
- QLB data to be reproducible by surface geophysics at any point of depiction
- Positions surveyed to applicable project standards
- Recommend to project owner when additional methods such as test holes may be needed to determine positions
QUALITY LEVEL ‘A’

QL A

- Perform QL B tasks at appropriate project locations
- Excavate test holes to expose the utility to be measured
- Minimally intrusive excavation
  - Air-vacuum & sometimes hydro-vacuum extraction
  - Hand dig
  - Sometimes as built measurements during construction
- Actual exposure or verification of previously exposed and surveyed utilities and subsequent measurement of subsurface utilities, usually at a specific point
- Horizontal and vertical position, existing grade at ground surface, size and configuration of utility, material type, general condition, ground condition encountered
- Precise horizontal and vertical positions reported
  - Accuracy is typically set to 15-mm (0.05 feet) vertical and to the specified horizontal survey and mapping accuracy of the project
Advise owner of potential utility impacts on project
Inform and educate the project owner about quality levels
• costs and benefits of each
**Recommend QL, scope, depiction**
• required quality level may vary across project
• Recommend formatting of deliverables to be maintained across the project team and throughout the project life
Discuss sequence of acquiring appropriate quality level data
**Recommend quality level upgrades as indicated by design needs**

Follow one-call statutes, if any apply; e.g. designer ticket number in VA.
OWNER’S RESPONSIBILITIES

Review scope with engineer; amend or approve as appropriate

Assist in contact with existing utility owners; may improve access to records

Review quality levels with project team; approve format of deliverables for all team members

Notify the engineer of suspected deficiencies in the utility depiction if familiar with site and utility systems in place

Furnish utility information to utility owners for utility marking for construction (one-call systems)
Subsurface Utility Engineering is not confined to highways. It can be used with good results on airport, railroad, transit, building construction, military, sanitation, nuclear, and any other public works project where underground utilities may be encountered. It can also be used for environmental purposes, such as detecting and mapping underground storage tanks, septic fields, and even contaminants. SUE adds value, quality, and accountability to any project.

Testimonials

"The Federal Highway Administration has been encouraging the use of Subsurface Utility Engineering on Federal-aid highway projects since 1991. Proper use of this cost-effective professional engineering service will eliminate many of the utility problems typically encountered on highway projects. Using this technology, it will be possible to avoid many utility relocations before construction and many unexpected encounters during construction, thereby eliminating many costly, time-consuming project delays.

Dwight A. Home
Director, Office of Program Administration
Federal Highway Administration

"The SUE process, specifically the assignment of “Quality Levels” to the utility data collected, provides valuable engineering information from which to make risk-based decisions that characterize the delivery of transportation projects. At TXDOT the use of SUE in project planning and design allows us to avoid unnecessary impacts to existing utilities and to save the inestimable costs of adjustments not required and delays never imposed on the progress of a transportation project’s construction.

John P. Campbell, P.E.
Chair, AASHTO Subcommittee on ROW & Utilities
Director of Right of Way, Texas DOT

FHWA REMAINS AN ADVOCATE
SUBSURFACE UTILITY ENGINEERING

Over the decades, highway designers have had a difficult time obtaining reliable subsurface utility information. Now, this information is available through the use of an engineering process called Subsurface Utility Engineering.

MAJOR SUE ACTIVITIES:

**Scope of Work** – The process of developing a written project-specific work plan package that consists of scope of work, levels of service vs. risk allocation, project schedule and desired project delivery method. This SUE work plan package is agreed upon by the SUE provider and the client, describing the SUE work to be performed.

**Designating** – The process of using a surface geophysical method or methods to interpret the presence of a subsurface utility and mark its horizontal position on the ground surface or on above-ground surface markers.

**Locating** – The process of exposing and recording the precise vertical and horizontal location and providing utility size and configuration of a utility.

**Data Management** – The process of surveying, designating, and locating information to project control and transferring it into the client’s CADD system, GIS files, or project plans.

**Conflicts Analysis** – The engineering process of using a conflict matrix to evaluate and compare depicted designating information with proposed plans (highway, bridge, drainage, and other) in order to inform all stakeholders of potential conflicts, potential resolutions and costs to cure.

Project Application

[Diagram showing Quality Levels D, B, and A]

SUE EXPERTISE

**Competence.** SUE providers should be able to demonstrate a thorough knowledge and understanding of the major SUE activities and should be able to provide these services to the extent desired by the contracting agency.

**Experience.** Individuals assigned by the SUE provider to carry out the work should be well-trained, experienced, and capable. Those in responsible charge of the work and responsible for certifying deliverables should be engineers, geologists, and land surveyors employed by the SUE provider in accordance with state professional registration requirements.

**Equipment.** A wide range of equipment is necessary to detect the variety of subsurface utilities that may be present. Equipment available for utilization by the provider should include, but not be limited to, state-of-the-art designating equipment; vacuum excavation or comparable non-destructive locating equipment; state-of-the-art surveying and data recording equipment; and software systems compatible with those of the contracting agency.

**Timeliness.** Resources of the provider should be adequate to carry out the SUE work in a timely manner, considering other possible commitments of work and the contracting agency’s anticipated needs.

**Financial Capacity.** SUE providers should have the financial capacity to provide the required services.

**Insurance.** SUE providers should have adequate insurance covering all aspects of work. Minimum amounts should be in accordance with the contracting agency’s requirements.

The American Society of Civil Engineers (ASCE) has developed an important standard of care guideline, Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, G/ASCE 38-02. This standard guideline describes four quality levels of utility depiction:

**Quality Level D** – Information derived from existing records or oral recollections.

**Quality Level C** – Information obtained by surveying and plotting visible above-ground utility features and by using professional judgment in correlating this information to Quality Level D.

**Quality Level B** – Information obtained through the application of appropriate surface geophysical methods to determine the existence and approximate horizontal position of subsurface utilities.

**Quality Level A** – Precise horizontal and vertical location of utilities obtained by the actual exposure and subsequent measurement of subsurface utilities, usually at a specific point.

To order a copy of ASCE Standard 38-02, please go to the ASCE Bookstore: [http://www.pubs.asce.org](http://www.pubs.asce.org) or call 1-800-548-2723.
ASCE 38-02

Originally established for transportation (highway) projects

- Generally public utilities (with records) involved

Can be applied to site specific design projects

- Shortage of available (private) utility records add to challenges on site specific projects
- Patterns of utility configurations are often less regular (and predictable) than in or through transportation corridors
SURVEYING THE UNDERGROUND

Professional SUE providers use ASCE 38-02 as their professional framework for methods and procedures to achieve standard of professional care

SUE is distinctly different from One Call

- Meticulous care in research, field investigation – from mains to mechanical room, search & trace unknowns, all conductors, active & abandoned, survey, map, correlate with records
- Comprehensive consideration of all utilities; known and unknown; public & private, active & abandoned
- QL labels inform designer about the reliability of utility
- Test holes are excavated to validate utility designating
- Comprehensive investigation enables SUE providers to assume professional liability
QUESTIONS?

What’s next

• Locating Theory and Practice
• QLB and QLA
LOCATING THEORY & PRACTICE

Basic introduction to common detection theory and methods

- Electromagnetic Pipe and Cable Detection
- Ground Penetrating Radar

Utility Designating – Quality Level B

- making a more accurate, more complete horizontal map

Utility Locating (Test Holes) – Quality Level A

- when accuracy and precision are critical and to validate mapping; including vertical depth
ELECTROMAGNETIC PIPE AND CABLE LOCATING

SOME DEFINITIONS:

**Signal:** a flow of **electrical current** at a specific frequency on conductors such as metallic pipes, wires or cables

**Conductor:** a linear object that electrical current can travel through (in our case... a utility pipe, wire or cable)

**Magnetic Field:** a cylindrical field that forms around a conductor when current is flowing through it
CURRENT CAUSES THE MAGNETIC FIELD TO FORM

Locating instruments indicate point over utility where field is strongest.

Ground surface

4" pipe

Magnetic field lines (number indicate relative strength)
DIRECT CONNECT
WHEN YOU HAVE ACCESS TO THE CONDUCTOR

DIRECT CONNECT LOCATING CIRCUIT

CURRENT = 
MAGNETIC FIELD (SIGNAL) STRENGTH =
INDUCTION WITH CLAMP

WHEN CABLES OR SMALL PIPES ARE ACCESSIBLE

INDUCTIVE CLAMPING

SIGNAL STRENGTH = 

[Diagram showing inductive clamping with cable and clamp]
SURFACE INDUCTION AND SWEEP
NO ACCESS TO THE CONDUCTOR
PASSIVE SIGNAL DETECTION

POWER AND RADIO SIGNALS ARE
NATURALLY OCCurring MAGNETIC FIELDS
INFLUENCING FACTORS: ELECTROMAGNETIC PIPE AND CABLE LOCATING

Depth of bury
- Shallow - stronger field easily detected
- Deep – weaker field, more difficult to detect

No physical access to utility
- surface induction may be the only option for applying signal

Utility type/ material
- conductive cables and pipes with minimal disruptions to signal flow are best

Conductor congestion both above and below ground
- causes signal bleed to adjacent conductors making it difficult to interpret the multitude of magnetic fields

Pavement/ soil characteristics
- rebar and slag
Electromagnetic “pulses” of energy are emitted from transmitting antenna downward through the ground.

The pulses reflect back from objects that contrast with the surrounding soils.

The reflections are detected by the receiving antenna and processed through circuitry and software to produce an “image” of the reflections.
MODERN GPR UNITS
CLASSIC GPR DATA
A SINGLE SCAN (CROSS SECTION)
GPR PENETRATION: 
EFFECT OF SOIL TYPES

Favorable

- Sandy soils, especially dry or well drained
- Gravelly soils, again preferably dry/ well drained
- Homogeneous soils (uniform)

Unfavorable

- Clay soils… worse when wet
- Soils with dissolved salts and minerals… increases conductivity
- Any soils with a high salinity content as may be found near ocean and brackish water tidal areas
- Non-homogeneous soils (varied)

MD & DE soils are rated “moderate” by Natural Resources Conservation Service for GPR suitability – in our experience about a 25% success rate
## CONTRAST AND COMPARE

<table>
<thead>
<tr>
<th>EM Pipe and Cable</th>
<th>vs</th>
<th>GPR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Works in a wide variety of soils</td>
<td>Soil can limit or completely prevent effective use</td>
<td></td>
</tr>
<tr>
<td>Utilities need to be conductive *</td>
<td>Can detect non-conductive utilities</td>
<td></td>
</tr>
<tr>
<td>Small utilities can be detected</td>
<td>Small utilities cannot be imaged</td>
<td></td>
</tr>
<tr>
<td>Instrument detects a magnetic field</td>
<td>Instrument detects interface between objects</td>
<td></td>
</tr>
<tr>
<td>Technician interprets real time data and marks position in field</td>
<td>Operator can interpret for field marking and collect data for post processing/ office evaluation</td>
<td></td>
</tr>
<tr>
<td>Magnetic field can be detected but no image or data is created or stored</td>
<td>Data and radar images can be recorded and saved</td>
<td></td>
</tr>
<tr>
<td>Lower cost to detect most utilities</td>
<td>Higher cost to detect fewer utilities</td>
<td></td>
</tr>
<tr>
<td>Should be employed on nearly all SUE projects</td>
<td>Should be employed when circumstances warrant use on SUE projects</td>
<td></td>
</tr>
<tr>
<td>Useful for linear utilities/ conductors</td>
<td>Useful for non-linear objects such as buried tanks, drums, vaults, voids, etc.</td>
<td></td>
</tr>
</tbody>
</table>

*or can be accessed with sonde or rodder
THE SUE PROCESS
HOW IT GETS DONE

• Normally a progression through the Quality Levels D through A
  • QL B and QL A are unique to SUE

• Procedures

• Methods
DESIGNATING – QL “B”
TYPICAL APPROACH

Records Research (Utility Inventory)

Field Investigation

• Geophysical Properties
  • Pipe & Cable Locators
  • Visible Light
  • Ground Penetrating Radar

APWA-ULCC Field Marking (Red—electric, blue—water, etc.)

Field Sketch And/ Or Survey & Map

• Documented Results Represent “Professional Opinion”
  • Most Reliable Non-excavated Utility Location
  • Includes Private, Public, Abandoned Utilities
UTILITY RECORDS
THE FIRST CONSIDERATION
RECORD TYPES
FROM ONE EXTREME TO THE OTHER

A TELECOM PROVIDER  WSSC
FIELD EQUIPMENT
A VARIETY OF EQUIPMENT TO COVER A WIDE RANGE OF UTILITY LOCATING SCENARIOS
UTILITY DESIGNATION:
MARKINGS CAREFULLY PLACED
FIELD SKETCHING, SURVEY & CAD PROCESSING
Debrief field crew for unique site issues and problems
  - QL D search efforts
  - Troubleshoot difficult detection scenarios

Compare field sketch to CAD results

Compare CAD to records

Correlate field data with records

Assign QL to utility depictions (QL-B is the goal with QL-C or D as needed)

Provide mapping in AutoCAD or MicroStation
UTILITY LEGEND

<table>
<thead>
<tr>
<th>Code</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TV</td>
<td>Cable TV Line (QL-0)</td>
</tr>
<tr>
<td>2</td>
<td>TV</td>
<td>Cable TV Line (QL-C or QL-D)</td>
</tr>
<tr>
<td>3</td>
<td>E</td>
<td>Electric Line (QL-8)</td>
</tr>
<tr>
<td>4</td>
<td>E</td>
<td>Electric Line (QL-C or QL-D)</td>
</tr>
<tr>
<td>5</td>
<td>F</td>
<td>Fiber Optic Line (QL-8)</td>
</tr>
<tr>
<td>6</td>
<td>F</td>
<td>Fiber Optic Line (QL-C or QL-D)</td>
</tr>
<tr>
<td>7</td>
<td>G</td>
<td>Gas Line (QL-8)</td>
</tr>
<tr>
<td>8</td>
<td>G</td>
<td>Gas Line (QL-C or QL-D)</td>
</tr>
<tr>
<td>9</td>
<td>T</td>
<td>Telecommunications Line (QL-8)</td>
</tr>
<tr>
<td>10</td>
<td>T</td>
<td>Telecommunications Line (QL-C or QL-D)</td>
</tr>
<tr>
<td>11</td>
<td>UK</td>
<td>Unknown Detected Utility/Conductor (QL-8)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WATER LINE (QL-8)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WATER LINE (QL-C or QL-D)</td>
</tr>
</tbody>
</table>

UTILITY DESIGNATING NOTES

- Utility depictions conform to C/ASCE Standard 38-02.
- Utility quality levels defined as follows:
  - Quality level “A” (QL-A) - Locating
    - Involves the use of nondestructive digging equipment 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.
  - Quality level “B” (QL-B) - Designating
    - Involves the use of destructive testing methods.
  - Quality level “C” (QL-C) - Involving visible underground utility facilities, such as manholes, valve boxes, etc.
  - Quality level “D” (QL-D) - Determining
    - Involves ground-penetrating radar (GPR) and other imaging techniques.
- Survey reference notes:
  - All horizontal survey data contained in utility mapping file "J3009-MooreProperty.dgn" are referenced to traverse points provided by Development Facilitators, Inc., including:

<table>
<thead>
<tr>
<th>Point#</th>
<th>Northing</th>
<th>Easting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>540788.26</td>
<td>1205636.66</td>
<td>Rebar &amp; Cap</td>
</tr>
<tr>
<td>002</td>
<td>540630.19</td>
<td>1386828.46</td>
<td>Rebar &amp; Cap</td>
</tr>
</tbody>
</table>
MAPPING FROM RECORDS

UTILITY INFORMATION ONLY AS GOOD AS ORIGINAL SOURCE MATERIAL AND ONLY IF CORRECTLY FITTED TO CURRENT CONDITIONS.
QL B RESULTS
UTILITIES DESIGNATED, SURVEYED AND MAPPED
OVERLAY
SOME ORIGINAL LOCATIONS GOOD/ SOME NOT
SURFACE FEATURES DON’T TELL THE WHOLE STORY!
- Open /inspect manholes, hand-holes, vaults, pedestals, cabinets
- Connect, clamp or induce on all observable utilities and trace
- Snake with rods and sondes as needed and trace
- 2 person sweep – seek out & trace and ID unknowns
- Use the full “bag of tricks”
SUMMARY – QL “B”

A Standardized Procedure

Records Research
Field Investigation
  • Direct Connect
  • Clamp
  • Induce (Sweep)
Field Marking
Field Sketch
Data Collection (Total Station, RTK GPS)
Map & Correlate With Records
Review & Edit
Deliver In AutoCAD Or MicroStation
LOCATING – QL “A” AIR/ VACUUM TEST HOLES
THE BASIC STEPS

• Perform test hole setup at the site.
  • Test hole plan based on QL B info?
  • QL C or QL D info?
• Notify the one call utility notification center.
• Plan traffic control.
• Apply for an excavation permit.
• Coordinate with utility inspectors.
• Schedule the rig, test hole crew and survey crew.
• Compile results and report to client/ engineer
VACUUM EXCAVATION
VACUUM EXCAVATION
DOWN-HOLE VIEW
TEST HOLE OPERATIONS

SET MARKER/ MEASURE

BACKFILL / COMPACT
CLOSE & RESTORE

• Original Material Reused
• Compacted in lifts
• Seasonal cold-patch
• Turf restored
• Permit closed
WHY AIR/ VACUUM EXCAVATION?
COMPARED TO MECHANICAL/ BACKHOE ETC.

• Less impact to utilities
  • A bit safer than hand digging
  • A lot safer than mechanical digging
• Less impact to property and public
  • Small hole – “test hole” not “test pit”
  • Relatively small work footprint
  • Relatively neat work area (soils contained)
  • Short duration occupancy (9 to 3 restrictions)
• Low cost (particularly in paved roadways)
• Effective for majority of utility measurement needs
TEST HOLE DATA SHEET

A / I / DATA - TEST HOLE DATA SHEET

JOB #: 11004.1  TEST HOLE #: 2

PROJECT NAME: UPPER CHESAPEAKE MEDICAL CENTER
PROJECT LOCATION: HARFORD COUNTY, MARYLAND
CLIENT NAME: FREDERICK WARD ASSOCIATES, INC.
UTILITY REQUESTED: TELEPHONE
UTILITY FOUND: (6) 4" PLASTIC TELEPHONE CONDUITS

ELEV SURVEY MARKER
315.73

SURVEY MARKER SET:
EXISTING GRADE
0.6 ASPHALT
SURFACE THICKNESS AND MATERIAL

DEPTH (TOP)
5.89
308.84
ELEV. (TOP)

DEPTH (BOTTOM)
0.76
0.76
WIDTH
4.2" x .6A

SECTION VIEW OF TEST HOLE
NOT TO SCALE

SURVEYORE

SURVEY MARKER SET:
EXISTING GRADE
0.6 ASPHALT
SURFACE THICKNESS AND MATERIAL

CONTROL POINTS PROVIDED BY:
FREDERICK WARD ASSOCIATES, INC.
675683.34  E = 1496305.51  ELEV = 300.64
675477.42  E = 1496612.34  ELEV = 300.21

A / I / DATA MARKER:
NORTHING
EASTING
ELEVATION
765683.59
1496305.51
300.64

NOTES:
PK NAIL SET OVER CROWN OF SOUTHERNMOST CONDUIT. COVER TO MIDDLE CONDUIT = 5.46. COVER TO NORTHERNMOST CONDUIT = 5.91.

TEST HOLES DATA PRODUCED BY
ACCURATE INFRASTRUCTURE DATA, INC.
1100 BATAVIA FARM ROAD, SUITE 200, BALTIMORE, MD 21237

A / I / DATA - TEST HOLE DATA SHEET

PROJECT NAME: UPPER CHESAPEAKE MEDICAL CENTER
PROJECT LOCATION: HARFORD COUNTY, MARYLAND
CLIENT NAME: FREDERICK WARD ASSOCIATES, INC.
UTILITY REQUESTED: TELEPHONE
UTILITY FOUND: (6) 4" PLASTIC TELEPHONE CONDUITS

SECTION VIEW OF TEST HOLE

ELEV SURVEY MARKER
315.73

EXISTING GRADE

SURFACE THICKNESS AND MATERIAL

0.6 ASPHALT

DEPTH (TOP)
5.89
309.84

ELEV. (TOP)

DEPTH (BOTTOM)

ELEV. (BOTTOM)

WIDTH
4.5"± EA

SECTION DRAWN FACING WEST

PK NAIL ABOVE: CROWN OF UTILITY MARKING TAPE INSTALLED: ORANGE

CONTROL POINTS PROVIDED BY: FREDERICK WARD ASSOCIATES, INC.
101  N= 675583.54   E= 1496556.51   ELEV= 320.64
102  N= 675477.42   E= 1496612.14   ELEV = 320.21

A / I / DATA MARKER: NORTHING EASTING ELEVATION
675663.59  1496384.71  315.73

NOTES:
PK NAIL SET OVER CROWN OF SOUTHERNMOST CONDUIT. COVER TO MIDDLE CONDUIT = 5.48. COVER TO NOthermMOST CONDUIT = 5.91.

ALL MEASUREMENTS ARE SHOWN IN DECIMAL FEET EXCEPT WHERE NOTED

TEST HOLE DATA PRODUCED BY:
ACCURATE INFRASTRUCTURE DATA, INC.
1100 BATAVIA FARM ROAD, SUITE 200, BALTIMORE, MD 21237
PH: 410-686-5091  FAX: 410-686-5093

DATA VIEW
PLAN VIEW SKETCH

TEST HOLE RESULTS ARE TIED BY SURVEY METHODS TO PROJECT CONTROL AS NEEDED.
PIPPES VS DUCTS OR OTHER STRUCTURES

**TEST HOLE DATA SHEET**

**PROJECT NAME:** TOWNPLACE SUITES

**PROJECT LOCATION:** PRINCE GEORGE'S COUNTY, MARYLAND

**CLIENT NAME:** BOHLER ENGINEERING, P.C.

**UTILITY REQUESTED:** 12" WATER

**UTILITY FOUND:** 12" CAST IRON WATER & 3" METAL GAS (SEE NOTES)

**SECTION VIEW OF TEST HOLE**

- **ELEV. SURVEY MARKER:** 158.10
- **DEPTH (TOP):** 5.00
- **ELEV. (TOP):** 153.10

**EXISTING GRADE**

- **0.3 ASPHALT**
- **0.6 CONCRETE**
- **12" WATER**
- **3" GAS**

**SURVEY MARKER SET:**

**SECTION DRAWN FACING:** SOUTH

**TEST HOLE DATA SHEET**

**PROJECT NAME:** NAVY FEDERAL CREDIT UNION - BESTGATE ROAD

**PROJECT LOCATION:** ANNE ARUNDEL COUNTY, MARYLAND

**CLIENT NAME:** BOHLER ENGINEERING

**UTILITY REQUESTED:** ELECTRIC

**UTILITY FOUND:** CONCRETE ELECTRIC DUCT

**SECTION VIEW OF TEST HOLE**

- **ELEV. SURVEY MARKER:** 81.26
- **DEPTH (TOP):** 2.62
- **ELEV. (TOP):** 78.64

**EXISTING GRADE**

- **TURF**

**SURFACE THICKNESS AND MATERIAL**

**DEPTH (BOTTOM):**

- **6.16**
- **75.10**

**ELEV. (BOTTOM):**

**SECTION DRAWN FACING:** WEST

**WIDTH:** N/A
DETECTION ACCURACY

0.4’+/- OFFSET FROM DESIGNATED POSITION

ACTUAL POSITION OF WATER LINE

DESIGNATED POSITION OF WATER LINE
SUMMARY – QL “A”

Engineering / Survey Grade Data

Most Reliable Determination Of Utility Data **however**...

- Point Specific Results
- May not accurately predict utility characteristics beyond test hole location. QL B may still be needed.

Minimizes Risk Of Damage To Exposed Utilities

May Be Used For A Variety Of Structure Types

Most often used when precision is needed for conflict identification and resolution
Possible Surveyor’s/Engineer’s Note

- *Subsurface utilities are depicted by their Quality Levels in accordance with ASCE 38-02 based on professional designating services provided by A/I/DATA on January 14, 2014. Contractors shall validate subsurface utility data to their own satisfaction.*
  - “designating and locating…” if test holes performed as part of services provided.

**Show 38-02 Quality Level definitions in drawing legend.**

**Use 38-02 labeling conventions in plan view.**

- These steps help distinguish “paint on the ground” from professional services rendered
- Design excellence is built on quality base data
SUE APPLICATIONS

Location And Depth Of Subsurface Facilities
  • Design Development
  • Conflict Identification And Resolution
  • Risk Reduction Service
    • Avoid Change Orders
    • Avoid Extra Work Orders
    • Avoid Project Delays
  • Meet Standard Of Professional Care

Manhole Blowdown & Documentation Services
Enhanced Topographic Services
As Built Survey Requirements
GIS Data Population For Utility Network Management

Pre-construction “Existing Conditions” Marking
QUESTIONS?

FHWA -
http://www.fhwa.dot.gov/programadmin/sueindex.cfm
ASCE - http://www.asce.org/codes-standards/list/

COMMON GROUND ALLIANCE
http://www.commongroundalliance.com/
UNDERGROUND CONSTRUCTION
http://www.undergroundconstructionmagazine.com/
UNDERGROUND FOCUS
http://www.underspace.com/ufm_magazine.php

A/I/DATA
ACCURATE INFRASTRUCTURE DATA, INC.

1100 Batavia Farm Road, Suite 200
Baltimore, MD 21237
888-686-5091 (TOLL FREE)
410-686-5091 (PHONE)
410-686-5093 (FAX)

mmaguire@aidatainc.com
jberrettini@aidatainc.com

THE END?