Tech Brief

Identifying existing utilities early in a highway or bridge construction project can help State Departments of Transportation (DOTs) avoid or manage potential utility conflicts. One challenge can be obtaining complete information on utilities that are underground or otherwise out of sight.

Many DOTs use subsurface utility engineering (SUE), a system for mapping the locations of underground or underwater utilities on projects, with positive results.

Office of Infrastructure:
FHWA-HIF-22-002
August 2021

U.S. Department of Transportation
Federal Highway Administration

Subsurface Utility Engineering Saves Time and Costs in Delaware

This tech brief gives an overview of potential benefits and challenges of applying subsurface utility engineering (SUE) to highway construction projects, with a focus on SUE in Delaware.

Introduction

Subsurface utility engineering (SUE) is a method for obtaining and conveying reliable information about underground utilities during project planning and design.

Use of SUE can save transportation agencies hundreds of thousands of dollars by avoiding unexpected utility encounters during construction of a highway or bridge.

The Delaware Department of Transportation (DelDOT) had found it challenging to work with inconsistent and incomplete underground utility records on its construction projects.

As a solution, DelDOT began applying SUE to most of its projects. The agency found that more accurate information about utilities upfront saves money and time later. It also gives the highway agency more control of the schedule.

Designating underground utilities. Photo: DelDOT

"If we can control more on our side, then ultimately it means that we're getting the information faster and typically better," said Eric Cimo, DelDOT Utilities Engineer.

About Subsurface Utility Engineering

The SUE process may help reduce the risks associated with mapping utilities, coordinating utilities, relocating and adjustment, relocation design and cost estimates, and communicating utility data to concerned parties.

Typically, the project owner hires a SUE specialist to gather information on any existing utilities within the parameters of a project site before the design is finalized. That way, project designers and coordinators can adjust the design to avoid or mitigate conflicts with the utility during construction.

Depending on the level of SUE desired, the specialist gathers available maps or utility records, surveys the designated area, collects horizontal and vertical locations of various utilities within the project limit, opens manholes as relevant, and digs test holes.

The American Society of Civil Engineers (ASCE) developed Standard Guidelines for the Collection and Depiction of Existing Subsurface Utility Data, CI/ASCE-38-02, which give a system for SUE. The specifications outline four quality levels of information to be gathered, as shown in Table 1. The assigned quality level represents the reliability of the information. The lowest quality level is Quality Level D; the highest is Quality Level A. The higher the level, the more accurate and reliable the utility information is. Use of the ASCE specifications is not required by Federal law.

A 1999 Purdue University study commissioned by the Federal Highway Administration (FHWA) looked at 71 projects among agencies with active SUE programs. The study estimated that SUE saved construction costs by 1.9 percent, or $4.62 for every $1 spent on SUE.

Table 1. ASCE Specification Quality Levels for Subsurface Utility Engineering

Quality Level	Description of Information Obtained
D	• Information from existing utility records, permits, old plans, maps, or oral recollections. • The most basic level.
C	• Information from surveying visible utility facilities (e.g., manholes, power poles, hydrants, and valve boxes). Then, correlating this information with existing utility records (QL-D information).
B	• Information from using geophysical prospecting equipment and techniques to determine the existence and approximate horizontal positions of nearly all underground utilities within the project limits. • This activity is called “designating.” Designating can be done with paint markings or flags.
A	• Information from exposing and measuring subsurface utilities, usually at a specific point, to determine precise horizontal and vertical location on existing utilities. Provides the type, size, condition, material, and other characteristics of underground features. • Test holes and related utility data help achieve this level. • Activities at this level are known as "locating." • The highest level of accuracy available. Involves the full use of subsurface utility engineering services.

Information source: ASCE Standard Guidelines for the Collection and Depiction of Existing Subsurface Utility Data, CI/ASCE-38-02

Applying SUE in Delaware

According to DelDOT, Delaware has been implementing a SUE process for its construction projects since the late 1980s, when the agency would obtain test holes at critical areas of potential conflict to verify utility locations and other utility information. The process evolved to include designating portions of the project limits early in the design phase to seek more accurate information on utilities before deciding whether to obtain test holes. Since 2015, however, DelDOT has consistently utilized a more formal SUE approach after encountering problems during construction when relying heavily on the information provided by utility companies. DelDOT now obtains designation of the full construction project limits along with test holes to receive the most accurate utility information available at the early stages of project design. DelDOT now applies SUE to a majority of its highway and bridge projects.

"Utility companies traditionally supply us with markups of where they think their utilities are, but some companies don't have the best records," Cimo said. "There was a lot of head-scratching."

In some cases, existing utility maps put pipes or lines a few feet off the mark. Many of the region's water and power companies had changed owners or merged with smaller companies over the years, inheriting incomplete records. Abandoned pipes or cables were not accounted for. High groundwater is also an issue in Delaware, which borders the Atlantic Ocean and incorporates the Delaware Bay. Groundwater in the test holes made utilities difficult for the agency to detect.

DelDOT typically earmarks $50,000–$200,000 for SUE services, depending on a project's scope. The process takes from just a few weeks to as much as 6 months. Before or soon after a survey plan comes out, DelDOT contacts its SUE consultant to designate any utilities within the project environment.

The agency asks for horizontal locations of utilities, including features that the agency may have missed in its topographic survey: for manholes to be opened; for diagrams of any pipes or lines that are found, and for all collected information to be put into a plan set. After designers incorporate the utilities into the full project plan, DelDOT circles back to the SUE consultant to go out for test holes to verify the depth and other information at locations of potential conflict.

DelDOT seeks to achieve at least the ASCE Quality Level B on its larger projects, Cimo said.

Challenges and Benefits

According to DelDOT, cost was the biggest hurdle to originally achieving buy-in from designers and project managers. "It can be expensive to do the SUE work," Cimo said. "In the whole scheme of the project, it's not that much, but when you're looking at that estimate, and that proposal, and you see it's $100,000 to $200,000—people are taken aback." Project teams also were concerned about adding time for the SUE process, especially on projects with short timelines.

However, Cimo said the agency's project development teams soon saw benefits from investing time and funds for SUE. Cimo agreed with these benefits associated with SUE:

- Provides highway designers better utility information early enough to design a project around many potential conflicts. Construction plans can show the accurate location of virtually all utilities.
- Reduces utility conflicts during construction, and therefore expensive delays and contractor claims when construction cannot follow the original design.

- Reduces construction delays caused by cutting, damaging, or discovering unidentified utility lines.
- Reduces contractor claims for delays resulting from unexpected encounters with utilities.
- Allows design alternatives for avoiding utility conflicts. These can be changing the grade, widening one side of the road, shifting ramps or driveways, shifting retaining walls, altering footing and piling designs, or shifting drainage ditches.
- Enhances safety. Excavation or grading work can be shifted away from existing utilities, avoiding risks that damage to a utility might result in personal injury, property damage, or release of product into the environment.

Probing a test hole. Photo: DelDOT

Project Example

Thorough SUE has proven especially useful on Delaware's bridge construction projects, Cimo said. For example, for a bridge that is currently slated for replacement, DelDOT expects the SUE process to more accurately locate a 16-inch diameter water line beneath the bridge. The water company was unable to provide sufficient specifics on the line's location, Cimo said. "More confident information on where that facility is could totally alter our design."

For instance, with further data from SUE, the agency can design the bridge's pile foundations to be placed out of the way of the main. Construction operations, such as movement of equipment, can be planned to avoid impact.

In the meantime, DelDOT and the water company discussed options to mitigate impacts to the utility, project, and public. Some options being worked through were to run an alternate, temporary main during construction in case of rupture or reduced flow, and to design a shallow bridge foundation to span the water main without impact. The plan was for the original main to be restored when the project is complete and construction crews are no longer in the water.

After DelDOT receives the additional SUE data, agency planners will finalize a path forward.

DelDOT Considerations for Other Agencies

Uncertainty exists even after a thorough SUE process. Groundwater or other conditions may hide utilities, even with test holes, while other pipes or structures may go undetected altogether.

SUE takes time. While the process occasionally moves quickly, it can take several weeks for designation and then another month or more to perform and document the test holes, depending on the project's size, weather conditions, and other factors.

The cost of SUE services may seem high, but the process helps save other costs later, such as avoiding expensive project delays. FHWA guidance on SUE, preliminary engineering, and Federal participation can be found at https://www.fhwa.dot.gov/programadmin/sueindex.cfm.

Taking the lead on SUE puts the transportation agency in control of the project schedule.

"At this point, utilities rely on us to build utility information on the projects," Cimo said. "Showing you're doing everything you can to find the information and work around the utility that exists ... You're not always going to be able to do it, but at least you're showing the good faith of trying."

Contacts and Resources

- Eric Cimo, P.E., Delaware Department of Transportation, eric.cimo@delaware.gov
- American Society of Civil Engineers (ASCE). *Standard Guidelines for the Collection and Depiction of Existing Subsurface Utility Data (38-02),* 2002.
- FHWA website. Subsurface Utility Engineering. https://www.fhwa.dot.gov/programadmin/sueindex.cfm
- Purdue University Study: *Cost Savings on Highway Projects Utilizing Subsurface Utility Engineering*, December 1999, prepared for FHWA. https://www.fhwa.dot.gov/programadmin/pus.cfm

Subsurface Utility Engineering Saves Time and Costs in Delaware

Contact — For more information, contact
Federal Highway Administration (FHWA) Office of Infrastructure
Julie Johnston, Office of Preconstruction, Construction and Pavements, julie.johnston@dot.gov

Distribution — This case study is being distributed according to a standard distribution. Direct distribution is being made to the Division Offices and Resource Center.

Availability — This case study may be found at www.fhwa.dot.gov.

Key Words — Subsurface Utility Engineering, SUE, utility conflict management

FHWA-HIF-22-002 **August 2021**