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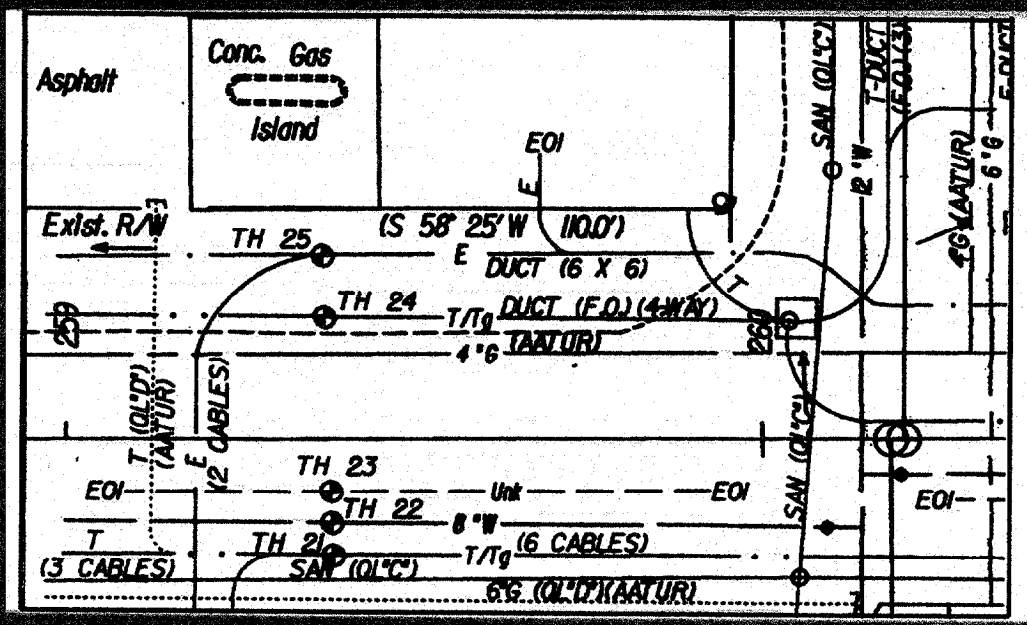
COST SAVINGS ON HIGHWAY PROJECTS UTILIZING SUBSURFACE UTILITY ENGINEERING



PURDUE UNIVERSITY

BUILDING CONSTRUCTION MANAGEMENT

January 2000

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16. Abstract

The Federal Highway Administration (FHWA) has been promoting the use of subsurface utility engineering (SUE) since 1987 as a means to save costs on highway construction projects. In 1996, the FHWA commissioned Purdue University to study the cost savings from four StatesÇ departments of transportation (DOTs) that routinely utilize utility quality levels while producing contract drawings.

A total of seventy-one projects (71) from Virginia, North Carolina, Texas, and Ohio were studied. The total construction costs of these projects were in excess of one billion dollars. These projects involved a mix of Interstate, arterial, and collector roads in urban, suburban, and rural settings. DOT project managers, utility owners, constructors, and designers were interviewed. Two broad category of savings emerged: quantifiable savings and qualitative savings.

A total of $4.62 in savings for every $1.00 spent on SUE was quantified. Qualitative savings were non-measurable, but it is clear that those savings are also significant and may be many times more valuable than the quantifiable savings. Only three projects returned less in savings than expenditures. This leads to the conclusion that SUE is a viable technologic practice that reduces project costs related to the risks associated with existing subsurface utilities and should be used in a systemic manner.

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UTILIZING
SUBSURFACE UTILITY ENGINEERING

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COST SAVINGS ON HIGHWAY PROJECTS
UTILIZING
SUBSURFACE UTILITY ENGINEERING

EXECUTIVE SUMMARY

The Federal Highway Administration (FHWA) commissioned Purdue University to study the effectiveness of Subsurface Utility Engineering (SUE) as a means of reducing costs and delays on highway projects. The effectiveness study was conducted and the results and accompanying recommendations are presented here. The concepts and practice of SUE have been developed and refined over many years, but basically were systematically put into professional practice in the 1980s. Several states have programs whereby the State Department of Transportation (DOT) contracts with SUE providers to map utilities on their projects.

Subsurface utility engineering is the convergence of new site characterization and data processing technologies that allows for the cost-effective collection, depiction, and management of existing utility information. These technologies encompass surface geophysics, surveying techniques, mapping techniques, CADD/GIS systems, etc. Rather than disclaiming responsibility for existing utility information, subsurface utility engineers certify utility information in accordance with a standard classification scheme (utility quality levels) that allows for a clearer allocation of risk between the project owner, project engineer, utility owner, and constructor.

Previous studies and statements of cost savings were performed by various State DOTs, providers of SUE services, and the FHWA. Commissioning Purdue University to conduct this study allowed for an independent and impartial review and study of costs savings.

Virginia, North Carolina, and Ohio were initially selected to be part of this study. Texas was added due to their rapidly growing SUE program. These four states had a total of 71 projects studied in detail. These projects were selected randomly from a list of projects that utilized SUE. They involved a mixture of Interstate, arterial, and collector roads in urban, suburban, and rural settings. DOT project managers and engineers, utility owners, constructors, designers, and subsurface utility engineers were interviewed.

Wyoming, Puerto Rico, and Oregon were given *seed* money from the FHWA to try SUE on a select project. These projects are also included in the study (see Appendices), although data from these projects are extremely limited. Finally, several other states have studied their own projects or programs and have supplied information for this study. Overall, approximately one hundred projects were evaluated in some level of detail in order to accomplish the FHWA study mission.

A savings of $4.62 for every $1.00 spent on SUE was quantified from a total of 71 projects. These projects had a combined construction value in excess of $1 billion. The costs of obtaining Quality Level "B" (QL B) and Quality Level "A" (QL A) data on these 71 projects were less than 0.5 percent of the total construction costs, and it resulted in a construction savings of 1.9 percent over traditional Quality Level C (QL C) and/or Quality Level D (QL D) data. Qualitative savings were non-measurable, but it is clear that those savings are also significant and may be many times more valuable than the quantifiable savings.

The figure $4.62 is somewhat less than the $7.00 to $1.00 (previous Virginia DOT study), $18.00 to $1.00 (previous Maryland DOT study), and $10.00 to $1.00 (Society of American Value Engineers) returns on investment that were previously reported in the literature. However, the quantity of studied projects is much higher; the projects are more random in nature; and no qualitative costs were included in the total. Indeed, one individual project had a $206.00 to $1.00 return on investment (North Carolina DOT). Only 3 of 71 projects had a negative return on investment.

The simple conclusion of this study is that SUE is a viable technologic practice that reduces project costs related to the risks associated with existing subsurface utilities and, when used in a systemic manner, will result in significant quantifiable and qualitative benefits. Using the SUE savings factor data from this study and a national expenditure in 1998 of $51 billion for highway construction that was provided by the FHWA, the use of SUE in a systemic manner should result in a minimum national savings of approximately $1 billion per year.

COST SAVINGS ON HIGHWAY PROJECTS UTILIZING SUBSURFACE UTILITY ENGINEERING

REPORT

Scope of Study

The Federal Highway Administration (FHWA) commissioned Purdue University to study the effectiveness of Subsurface Utility Engineering (SUE) as a means of reducing costs and delays on highway projects. The effectiveness study was conducted and the results and accompanying recommendations are presented here. The concepts and practice of SUE have been developed and refined over many years, but basically were systematically put into professional practice in the 1980s. Several states have programs whereby the state Department of Transportation (DOT) contracts with SUE providers to map utilities on their projects.

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Overview

Many design and construction projects are taking place in areas where an abundance of underground utilities already exists such as in cities, process plants, airports, highways, and so forth. These existing utilities create risks for the project owner, designer, and constructor. Although there are many reasons for these risks, one of the fundamental reasons is that accurate data on the location, and even sometimes on the existence of these *out-of-sight* utilities, are rare. Existing records of underground site conditions are usually incorrect, incomplete, or otherwise inadequate because:

- They were not accurate in the first place: design drawings are not *as-built*, or installations were *field run* and no record was ever made of actual locations;

- On old sites, there have usually been several utility owners, architects/engineers, and contractors installing facilities and burying objects for decades in the area. Seldom are the records placed in a single file, and often they are lost. There is almost never a composite;
- References are frequently lost: records show that an object is a certain distance from a building that is no longer there, or an object is a certain distance from the edge of a two-lane road that is now four lanes or is part of a parking lot;
- Lines, pipes, and tanks are removed from the ground, but aren't removed from the drawings.

Engineers recognize this problem of records with incorrect or incomplete information, and attempt to protect themselves through prominently displayed notes on the drawings. Although these notes may vary in wording, a typical example is as follows:

> *Utilities depicted on these plans are from utility owner's records. The actual locations of utilities may be different. Utilities may exist that are not shown on these plans. It is the responsibility of the contractor at time of construction to identify, verify, and safely expose the utilities on this project.*

Contractors may employ multiple mechanisms to protect themselves. Certainly, the types of excavation equipment used can be important. All states now have a *one-call* statute in place whereby the contractor must call all known utility owners before construction begins. Utility owners then have the burden of marking their utilities on the ground surface for damage prevention purposes. Many times, the *paint* marks indicating the location of the utilities do not agree with the utilities depicted on the design plans. Contractors know this will happen and typically increase their bid price to account for this contingency. They will also ask for change orders and claims when necessary. Usually the project owner is obligated to pay these change orders and claims due to utilities being treated as a *differing or unknown site condition* in the standard contract documents. Some states allow the contractor to seek relief from the designer even though there is no contract between the contractor and the engineer.

Project owners rarely end up with any protection for unknown, unrecorded, or mis-recorded utility data. Savvy project owners are beginning to realize this fact. They are either requiring their engineers to take some responsibility for more accurate utility information or they are hiring specialty engineering firms to obtain more accurate information.

A convergence of new site characterization and data processing technologies now allows for the cost-effective collection and depiction of existing utility information. These technologies encompass surface geophysics, surveying techniques, CADD/GIS systems, *etc.* This convergence is now known as subsurface utility engineering. Rather than disclaiming responsibility, subsurface utility engineers collect utility data and certify its quality. The accepted definition of subsurface utility engineering is:

> *A practice of engineering that manages the risks associated with subsurface utilities via: 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.*

In order to understand SUE, it is important to first define the quality levels of utility information that are available to the design engineer, constructor, and project owner. The concept of quality levels was developed from the realization that sometimes more reliable information on the location of underground utilities is known to the engineer, but is not typically presented within any documents for the benefit of others. Examples of the wide range of notations made include a gas line for which there exists a certified reference to recoverable survey control portrayed in the same manner as a water line for which there is only a verbal recollection by a water company representative.

Four separate quality levels of utility information are now generally recognized by various organizations. The Federal Highway Administration has taken the lead in promoting and using this concept. Other organizations such as the American Society of Civil Engineers (ASCE), Federal Aviation Agency (FAA), Network Reliability Council, various state DOTs, county governments, and so forth have also used this concept. The generally accepted definitions are as follows.

> *Quality Level D (QL D): Information derived solely from existing records or verbal recollections.*
>
> *Quality Level C (QL 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 information.*
>
> *Quality Level B (QL B): Information obtained through the application of appropriate surface geophysical methods to identify the existence and approximate horizontal position of subsurface utilities. "Quality level B" data are reproducible by surface geophysics at any point of their depiction. This information is surveyed to applicable tolerances and reduced onto plan documents.*
>
> *Quality Level A (QL A): Information obtained by the actual exposure (or verification of previously exposed and surveyed utilities) of subsurface utilities, using (typically) minimally intrusive excavation equipment to determine their precise horizontal and vertical positions, as well as their other utility attributes. This information is surveyed and reduced onto plan documents. Accuracy is typically set at 15mm vertical, and to applicable horizontal survey and mapping standards.*

Determining which quality level must be met is an important responsibility of the project owner. In other words, if the owner specifies lower-quality information to the design engineer, the owner must be willing to pay for the associated costs in project delays, bid contingencies, change orders, unnecessary utility relocations, redesign, and perhaps utility damage and other problems. Most projects currently proceed by owner specification at *quality level C* whether or not the owner realizes it. However, engineers should encourage owners to specify higher levels, and inform owners that they may incur liability for lower-quality level depictions.

On projects where owners specify a desire for the highest-quality level of utility information, decisions and judgments must be made by the parties as to costs versus anticipated results. These decisions and judgments will require a thorough knowledge of existing surface geophysical

techniques, their costs, and their limitations. Engineers will recommend and apply appropriate techniques based upon owner budgets and expectations. Decisions and judgments must also be made as to where *quality level A* data should be provided. Finished plans may contain utility data with different quality attributes--all four quality levels may be represented.

Benefits

There are numerous benefits obtained when using SUE on highway projects. By using SUE, significant benefits are derived for the DOT, utility companies, SUE consultants, contractors, and the general public.

Some of the benefits that have been obtained are as follows:

1. Reduction in unforeseen utility conflicts and relocations;
2. Reduction in project delays due to utility relocates;
3. Reduction in claims and change orders;
4. Reduction in delays due to utility cuts;
5. Reduction in project contingency fees;
6. Lower project bids;
7. Reduction in costs caused by conflict redesign;
8. Reduction in the cost of project design;
9. Reduction in travel delays during construction to the motoring public;
10. Improvement in contractor productivity and quality;
11. Reduction in utility companies' cost to repair damaged facilities;
12. Minimization of utility customers' loss of service;
13. Minimization of damage to existing pavements;
14. Minimization of traffic disruption, increasing DOT public credibility;
15. Improvement in working relationships between DOT and utilities;
16. Increased efficiency of surveying activities by elimination of duplicate surveys;
17. Facilitation of electronic mapping accuracy;
18. Minimization of the chance of environmental damage;
19. Inducement of savings in risk management and insurance;
20. Introduction of the concept of a comprehensive SUE process;
21. Reduction in Right-of-Way acquisition costs.

Types of Costs

The reductions in risk for projects utilizing SUE have been difficult to quantify. There are many variables and scenarios that may occur. Historical data is difficult to come by. Some savings are easily quantified; others may be qualitative or speculative in nature. This study categorizes savings accordingly. These types of costs are:

1. Exact costs that can be quantified in a precise manner. Examples are costs much like the costs for test holes, the cost to eliminate construction and utility conflicts, or any other cost for which exact figures can be obtained.

2. Estimated costs that are difficult to quantify, but can be calculated with a high degree of certainty. These costs were estimated by studying projects in detail, interviewing the personnel involved in the project, and applying historical cost data.

3. Costs that cannot be estimated with any degree of certainty due to a lack of data. These are true qualitative costs and may in fact be significant to the real cost savings. These qualitative costs are not quantified in the evaluation study.

Evaluation Plan

Three primary methods were used to examine, study, and collect data on the application of SUE.

1. Conduct an analysis of the overall program of SUE within each study state. This approach involved a cursory examination of all projects utilizing SUE within a particular state.

2. Select and study individual projects. These projects were selected with input from appropriate Departments of Transportation to obtain, as best possible, a mix of projects ranging from simple to complex. One of the selection criteria was to select projects that the designers, constructors, and users were still available to contact and interview.

3. Use a modified combination of the above approaches to analyze SUE. Application of this approach depends on the states being studied. The methods used were specific project analysis where available, and program analysis for overall conclusions.

Some of the items investigated during the interviews and analysis were old utility records and locations (Quality Level D and C information). They were compared to the new upgraded locations (Quality Level B and A information), and the differences were compared to determine the benefits of SUE. The guiding concept utilized with this approach was to obtain data and information on SUE activities from the people who actually were involved in the project.

In addition to conducting interviews and reviewing the available and utilized quality levels and their project impacts, the available paper trail was also investigated. For example, similar projects that used and did not use SUE were examined for existence and quantities of change orders, extra work orders, delay and other claims, time extensions, etc. State and Federal tracking forms for allocation of costs for utility relocations, prior rights, and correspondence were valuable to the study.

Results

Virginia

The Virginia Department of Transportation estimates an annual expenditure of approximately $10 million on SUE in a variety of contracting methods. Virginia has three SUE firms under contract to provide utility mapping (all quality levels) in nine separate districts. Additionally, the DOT's statewide and regional survey contracts require QL B mapping for select projects. There are two

regional consultants providing utility coordination services. There are four regional consultants providing utility relocation design. Certain large projects have subsurface utility engineering (utility mapping, utility coordination, and relocation design) built in to the project requirements. All highway projects in Virginia are required to use SUE, and most projects utilize *Quality Levels A* and *B* information. SUE information has also proven useful to utility companies in their relocation design.

Virginia started their program in 1984. Virginia has the most comprehensive program in the nation. They utilize every aspect of SUE with a combination of in-house and consultant forces. They estimate a project delivery time savings of 12 percent-15 percent has resulted from their systemic approach to utility risk management. Utility owners have been more cooperative after the DOT SUE program commenced. Quality level B mapping identifies an average of 10 percent - 50 percent more utilities than traditional mapping (QL D and QL C).

North Carolina

The North Carolina Department of Transportation (NCDOT) began a subsurface utility engineering program in 1991, after studying the successes of Virginia, Delaware, and Pennsylvania's programs. SUE began as a trial program by NCDOT and has gradually evolved into a continuous process. The primary reason for utilizing SUE in North Carolina is to reduce the cost of highway construction. Cost reduction can be obtained through the elimination or reduction of claims, change orders, and construction delays, and through the minimization of disruption to utility services.

SUE began as an aid to in-house-designed projects with an initial contract with one provider valued at approximately $300,000. The program was successful and, as a result, additional SUE consultants were brought under contract. Currently there are four providers; however, the contract values are not equal. For designs performed by outside consultants, i.e., non-state employees, the DOT requires that the outside designers hire one of the four state-DOT-approved SUE consultants for their team. Consequently, the two contracting methods, i.e., state contract for in-house design and project contract for outside-consultant design, result in a total, state, DOT SUE program valued at approximately $3,000,000 per year. This represents a SUE budget of approximately 2 percent of the total state engineering/ construction budget.

When SUE was initially utilized in North Carolina, a formal review procedure was adopted that was used for one or two periods. The use of the procedure was informally abandoned for no given specific reason. SUE is now employed in North Carolina by an informal procedure based on cooperation between design engineers and area engineers. This informal procedure is accomplished by mutual agreement and judgment between design and area engineers on an as needed project basis due to amount of utilities, potential impact, and engineering judgment. Now that many of the design and area engineers have become familiar with the concepts of SUE, the informal process is working well.

NCDOT only utilizes the utility mapping components of SUE. So far, the NCDOT handles utility coordination and utility relocation design with in-house forces. There has been some discussion to attempt a trial project where all aspects of SUE are performed by a SUE consultant. This would include utility mapping, utility coordination (with utility owners), and perhaps some utility relocation design for publicly owned utilities.

The evaluation study has computed a cost savings of $6.63 for every dollar spent for SUE in North Carolina. The total amount of expenditures to date for SUE in North Carolina is $8,725,371.97. This represents a projected savings of $57,849,211.39 since the SUE process was started in North Carolina. The SUE savings computed in this study are related to the in-house projects designed and constructed by the NCDOT.

NCDOT appears to have figured out how to use SUE effectively in their state and are doing so for the benefit of the taxpayer and ratepayer. NCDOT has utilized SUE for eight years, with a progressive amount of contract value. They are currently funding SUE at levels in excess of $3 million per year. It is difficult to estimate non-quantifiable savings resulting from decreased utility damages, bid prices, construction delays, and so forth; however, quantifiable savings (after studying about 7 percent of NCDOT's in-house projects on both a cost and project basis, indicating a return in excess of $6.60 for every dollar spent) were obtained. Therefore, a quantifiable savings per year for NCDOT projects is approximately $19.8 million. The majority of projects utilizing SUE showed no delays due to utility conflicts, an improvement over past engineering practices.

Ohio

The development of Subsurface Utility Engineering (SUE) in Ohio was started in 1992 with a trial project in the city of Columbus. In May 1995, after evaluation of that project's success, the FHWA funded SUE through a demonstration-projects mechanism for the Ohio Department of Transportation (ODOT).

The primary reason for utilizing SUE in Ohio is to reduce the cost of highway construction. Cost reduction is obtained through the elimination or reduction of claims, change orders, and construction delays, and through the minimization of disruption of utility services. SUE was initially used to solve field utility conflict questions; subsequently it has evolved into some design processes.

Ten of the twelve Districts in Ohio have used SUE on at least one project. Due to successes in the urban districts of Cleveland and Akron/Canton, these two Ohio districts have their own SUE contracts, while the other ten districts share a statewide contract. In Cleveland and Akron/Canton Districts, the Production Department (essentially design and construction) selects projects for SUE. This has evolved today to include virtually every project. In the other districts employing SUE, the District Utility Coordinator selects projects for the use of SUE with input from construction departments. The District Utility Coordinator informs the Central Office who administers the SUE contract and assigns a SUE provider to the District's project on an alternating basis. The provider then sends the district an estimate for SUE services, based on the scope specified by the District Utility Coordinator. The Central Office then formally assigns the project to the SUE provider.

One advantage of this system is that the districts do not have to allocate funds for SUE before the use of SUE. The Central Office supplies the funds, and then back-charges the districts only for those actual SUE expenditures. When using Central Office Funds, the districts do not need to be concerned about losing funds if they are not used. The disadvantages of this system include less local control of SUE services, no choice in SUE providers, and (typically) a less timely procurement of SUE services in the design phase of projects.

Overall, the savings analysis for Ohio was determined to be $5.21 for every dollar expended for SUE. The fourteen projects included in this Ohio SUE evaluation total $284,349,202.07 in construction costs. The net SUE savings (SUE savings less the cost of SUE) is $3,418,069.47.

Applying the ratio of net SUE savings to the construction cost of the SUE evaluation projects yields an annual projects savings of $12,080,000 based on the total highway construction amount.

Texas

In 1994, the FHWA sponsored a series of informational briefings on Subsurface Utility Engineering (SUE). These one-day briefings were held in the five largest TXDOT Districts. The briefing team was comprised of Paul Scott (FHWA Headquarters), Lee Gibbons (FHWA Region), Joe Bissett (Maryland DOT), and Jim Anspach (So-DEEP).

As a result of these briefings, TXDOT began the process of developing a SUE program. The Right-of-Way Division was the spearhead for this program after hearing about SUE from the briefings and the conferences. The Right-of-Way Division was able to initiate SUE knowing that the design benefits would result in SUE becoming a part of the total project process.

In 1995, a Request-for-Proposal (RFP) was published. In 1997, four SUE providers were selected to provide Quality Level B (QL B) and Quality Level A (QL A) mapping services on a state-wide basis. Initial, combined contract values of $4,000,000 over two years were increased to $9,000,000 over 28 months due to good results and the subsequent internal demand.

In 1999, six new contracts totaling $9,000,000 were let for a 3-year term. The SUE program in Texas depends on the district involved and is limited to Interstate (On-System) projects with no municipal or local projects involved. SUE in Texas may be used on any construction project on the state highway system. It is TXDOT's intent to encourage their engineering design consultant community to begin using Subsurface Utility Engineering on these Off-System projects that are more urban in nature, and therefore potentially more utility-complex. TXDOT is now firmly committed to SUE and plans to encourage its use in all districts.

When SUE was initially utilized in Texas in 1997, the Right-of-Way Division began to develop an informal review procedure. This informal procedure is accomplished by mutual agreement and judgment among the Right-of-Way Division, design, and area engineers on an *as needed project basis* regarding the extent of underground utilities, potential impact, and engineering judgment. After the need for SUE is *scoped* by the Right-of-Way Division, the particular district working with the Right-of-Way Division in a team effort decides on the need for SUE. The SUE contract is then administrated from the Right-of-Way Division who manages the contracts with the 6 SUE providers (6 as of August 1999).

As of October 14, 1999, 146 SUE projects have been accomplished in Texas. Now that many of the design and area engineers have become familiar with the concepts of SUE, the informal process is working well.

Twenty-seven (27) projects were studied in detail to collect data and information on time, cost, user, and risk management savings. The evaluation study was then able to compute a cost savings of $4.27 for every dollar expended for SUE. In this study, SUE is considered to be the use of

Quality Level A and Quality Level B Utility Data, as opposed to the traditional Quality Level C and Quality Level D Utility Data. Based on the SUE savings analysis, a projected savings of $108,308,000 is the potential savings to the Texas DOT statewide, if all projects utilize Quality Level B and Quality Level A data, based on the amount of highway construction typically under contract. Based on Fiscal Year 99 construction contract amounts and current performance levels from SUE providers, the potential current annual savings is projected to be $66,092,000.

Conclusion

The Federal Highway Administration (FHWA) commissioned Purdue University to study the effectiveness of subsurface utility engineering (SUE) as a means of reducing costs and delays on highway projects. From a study of 71 projects with a combined construction value in excess of $1 billion, the results indicated the effectiveness of the study was a total of $4.62 in savings for every $1.00 spent on SUE. The costs of obtaining QL B and QL A data on these 71 projects were 0.5 percent of the total construction costs, resulting in a construction savings of 1.9 percent by using SUE. Qualitative savings were non-measurable, but it is clear that those savings are also significant and may be many times more valuable than the quantifiable savings.

This is somewhat less than the $7.00 to $1.00 (previous VDOT study), $18.00 to $1.00 (previous MDSHA study), and $10.00 to $1.00 (Society of American Value Engineers) returns on investment that were previously reported in literature. However, the quantity of studied projects is much higher; the projects are more random in nature; and no qualitative costs were included in the total. Indeed, one individual project had a $206.00 to $1.00 return on investment (NCDOT). Only three of 71 projects had a negative return on investment. This leads to the conclusion that SUE is a viable technologic practice that reduces project costs related to the risks associated with existing subsurface utilities and should be used in a systemic manner. Using the SUE savings factor data from this study and a national expenditure in 1998 of $51 billion for highway construction that was provided by the FHWA, the use of SUE in a systemic manner should result in a minimum national savings of approximately $1 billion per year.

Recommendations

There are several recommendations on state DOT subsurface utility engineering programs that can be justified based upon the following factors.

1. A review of many state DOT subsurface utility engineering programs.

2. Conversations with state and private practice engineers.

3. A review of available literature.

4. Personal attendance at many national, regional, and local functions pertaining at least in part to subsurface utility engineering over the past three years.

Some State DOT programs already incorporate these recommendations as common practices. Other states should consider implementing them in whole or part in order to keep up with the evolving field of subsurface utility engineering, the proven cost savings that result from such practices, and the changing liabilities created from existing subsurface utilities.

These recommendations are in no particular order.

1. Establish subsurface utility engineering as a pre-qualification category for engineering services. Use appropriate criteria as a basis for pre-qualification. Remember that the FHWA, AASHTO, and the ASCE among others all consider this a professional engineering service with multi-disciplinary aspects.

2. Develop statewide, regional, and/or District subsurface utility engineering contracts for DOT in-house and/or consultant-designed projects.

3. Consider including subsurface utility engineering as a prequalification category in consultant RFPs.

4. Administer or make components of subsurface utility engineering available within the appropriate DOT organizational sections. For example, utility mapping and utility avoidance consulting is best performed within the Design section; utility coordination and utility relocation design may be more appropriate within the Right-of-Way / Utility sections. Preliminary utility cost estimates may be appropriate in the Project Planning section. Utility as-builting, utility damage prevention assistance, pre-bid utility data communication, and claims assistance may be appropriate in the Construction section.

5. Consider upgrading all projects to QL B and QL A data as a project self-insurance mechanism. This study shows that the benefits far exceed the costs on average. Trying to select only those projects that may end up with significant utility problems is risky at best.

6. Consider unit pricing for utility mapping functions as a contract mechanism. It is easy to administer, easy to audit for billing accuracy, and easy to budget estimated project costs.

7. Develop a program of continuing education for DOT design personnel and constructors on subsurface utility engineering and its benefits.

8. Consider utilizing all aspects of subsurface utility engineering rather than only the utility mapping component (see Virginia DOT's program).

9. Remain abreast of new developments in the field, e.g., American Society of Civil Engineers' pending national standards, AASHTO's Best Utility Practices Guide, etc.

10. Encourage Local/Municipal Planning Organizations to use subsurface utility engineering. Their projects are usually more urban in nature and can accrue generally higher benefits than rural projects.

11. On plans, place a general note that spells out that subsurface utility engineering utility mapping Quality Levels B and A were utilized on this project. The type and existence of utility quality levels should also be indicated in the legend.

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COST SAVINGS SUMMARY SPREADSHEET

STATE	Project#	SUE Savings	SUE Cost	Savings Analysis	Construction $	Total SUE Savings	Total SUE Costs	Savings Analysis	Total Construction $
Virginia	I.	$98,000.00	$37,252.91	$2.63	$1,979,788.00				
	II.	$679,720.00	$53,168.60	$12.78	$1,153,808.00				
	III.	$342,000.00	$206,249.85	$1.66	$28,198,068.00				
	IV.	$100,000.00	$110,323.27	$0.91	$2,447,843.00				
	V.	$738,425.00	$93,553.00	$7.89	$3,724,592.00				
	VI.	$91,100.00	$26,022.12	$3.50	$1,405,584.00				
	VII.	$100,969.61	$14,492.41	$6.97	$758,848.00				
	VIII.	$131,638.00	$12,697.45	$10.37	$1,115,733.00				
	IX.	$12,000.00	$3,500.00	$3.43	$1,987,593.00				
						$2,293,852.61	$557,259.61	$4.12	$42,771,857.00
N. Carolina	1	$750,000.00	$80,000.00	$9.38	$13,200,000.00				
	2	$26,000.00	$20,296.00	$1.28	$10,226,411.00				
	3	$773,400.00	$5,995.00	$129.01	$34,282,892.00				
	4	$802,500.00	$3,883.00	$206.67	$3,184,231.00				
	5	$135,000.00	$8,789.50	$15.36	$797,604.00				
	6	$51,150.00	$74,696.21	$0.68	$852,505.00				
	7	$24,000.00	$8,438.00	$2.84	$28,093,744.00				
	8	$100,000.00	$6,917.58	$14.46	$1,668,721.00				
	9	$56,220.00	$25,578.00	$2.20	$18,740,421.00				
	10	$193,986.00	$90,307.00	$2.15	$19,831,401.00				
	11	$243,000.00	$7,978.90	$30.46	$13,843,580.00				
	12	$199,548.00	$98,717.46	$2.02	$10,109,782.00				
	13	$27,000.00	$22,760.11	$1.19	$2,949,341.00				
	14	$45,000.00	$9,910.80	$4.54	$2,509,470.00				
	15	$18,000.00	$3,401.52	$5.29	$11,234,361.00				
	16	$6,000.00	$5,778.52	$1.04	$5,002,221.00				
	17	$11,575.00	$3,918.73	$2.95	$7,575,932.00				
	18	$384,000.00	$61,099.76	$6.28	$8,048,488.00				
	19	$61,300.00	$56,279.00	$1.09	$1,479,357.00				
	20	$55,753.00	$27,369.95	$2.04	$2,242,685.00				
	21	$220,000.00	$9,253.38	$23.78	$9,046,526.00				
						$4,183,432.00	$631,368.42	$6.63	204,919,673.00
TEXAS									
San Antonio	S-0001	$370,800.00	$51,527.00	$7.20	$4,332,787.00				
San Antonio	S-0002	$457,700.00	$173,058.32	$2.64	$20,600,355.00				
Dallas	S-0003	$1,049,200.00	$265,304.00	$3.95	$36,100,000.00				
Dallas	S-0081								
Abilene	S-0006	$308,400.00	$86,167.83	$3.58	$5,030,000.00				
Lufkin	S-0007	$152,000.00	$92,333.28	$1.65	$2,669,000.00				
Dallas	S-0011	$3,136,000.00	$229,559.68	$13.66	$69,945,171.00				
Houston	S-0019	$431,000.00	$83,101.96	$5.19	$16,194,444.00				
Dallas	S-0020	$115,600.00	$22,100.64	$5.23	$8,552,250.00				
San Antonio	S-0029	$425,500.00	$226,820.07	$1.88	$31,057,031.00				
San Antonio	S-0036	$467,500.00	$204,026.71	$2.29	$10,000,600.00				
Amarillo	S-0046	$78,700.00	$65,671.14	$1.20	$1,782,000.00				
Houston	S-0049	$789,300.00	$152,212.65	$5.19	$13,508,325.00				
El Paso	S-0054	$260,300.00	$41,260.00	$6.31	$9,948,206.00				
Austin	S-0057	$220,600.00	$39,539.24	$5.58	$3,500,000.00				
Houston	S-0058	$391,000.00	$44,691.51	$8.75	$49,342,060.00				

STATE	Project#	SUE Savings	SUE Cost	Savings Analysis	Construction $	Total SUE Savings	Total SUE Costs	Savings Analysis	Total Construction $
Houston	S-0063	$1,586,000.00	$544,907.06	$2.91	$45,000,000.00				
Houston	S-0065	$2,056,500.00	$478,130.09	$4.30	$66,000,000.00				
Houston	S-0066	$1,739,500.00	$427,105.09	$4.07	$73,000,000.00				
El Paso	S-0068	$136,500.00	$38,758.95	$3.52	$5,600,000.00				
Dallas	S-0069	$566,400.00	$132,276.78	$4.28	$41,350,000.00				
Dallas	S-0070	$348,600.00	$31,842.38	$10.95	$48,353,418.00				
Dallas	S-0071	$208,800.00	$105,092.85	$1.99	$3,600,000.00				
Houston	S-0080	$865,800.00	$209,285.05	$4.14	$15,000,000.00				
Waco	S-0090	$340,400.00	$19,831.64	$17.16	$8,333,247.00				
Dallas	S-0100	$351,700.00	$161,681.75	$2.18	$5,744,357.00				
Dallas	S-0101	$441,000.00	$159,178.24	$2.77	$6,050,000.00				
Dallas	S-0102	$279,200.00	$29,777.85	$9.38	$5,400,000.00				
						$17,574,000.00	$4,115,241.76	$4.27	$605,993,251.00
OHIO									
District 3	1	$201,800.00	$54,365.98	$3.71	$2,470,000.00				
District 4	2	$64,000.00	$10,738.38	$5.96	$360,000.00				
District 4	3	$125,000.00	$4,463.80	$28.00	$275,532.85				
District 4	4	$61,000.00	$5,145.17	$11.86	$349,300.00				
District 4	5	$115,000.00	$29,457.59	$3.90	$7,913,200.04				
District 8	6	$1,806,800.00	$269,615.48	$6.70	$238,000,000.00				
District 11	7	$97,400.00	$4,223.64	$23.06	$859,359.02				
District 11	8	$865,600.00	$12,848.44	$67.37	$19,938,810.16				
District 11	9	$44,140.00	$19,839.92	$2.22	$1,700,000.00				
District 11	10	$81,500.00	$26,683.13	$3.05	$4,500,000.00				
District 12	11	$528,400.00	$193,283.00	$2.73	$4,643,000.00				
District 12	12	$114,700.00	$176,442.00	$0.65	$1,640,000.00				
District 12	13	$62,300.00	$2,279.00	$27.34	$800,000.00				
District 12	14	$62,600.00	$2,785.00	$22.48	$900,000.00				
						$4,230,240.00	$812,170.53	$5.21	$284,349,202.07
		$28,281,524.61	$6,116,040.32	$4.62					$3,418,069.47
									0.012020675
TOTALS		$28,281,524.61	$6,116,040.32	$4.62	$1,138,033,983.07	$28,281,524.61	$6,116,040.32	$4.62	$1,138,033,983.07
Savings		$28,281,524.61							
SUE Cost		$6,116,040.32							
SUE Svgs		$22,165,484.29							
SUE Svgs		$28,281,524.61	$6,116,040.32						
Net SUE Svgs		$22,165,484.29							
SUE Svgs Factor		0.019476997							
SUE % Const.		0.004884547							

Appendix I: GENERAL RESULTS OF SUE IN VIRGINIA

Table 1 contains the results of the questionnaire concerning general questions regarding SUE in Virginia. Virginia annually spends 4 to 5 million dollars on the utility mapping component of subsurface utility engineering with regional mapping contracts and another 5 million in utility coordination, utility relocation design, and project-specific SUE . All highway projects in Virginia are required to use SUE and most projects utilize all utility quality levels. SUE information has proven useful to utility companies, and is used to reduce utility conflict and redesign.

The main proven benefits of SUE are utility conflict evaluation, higher quality plan design, reduced design costs, fewer claims and changes orders, and reduction in project time schedules.

VDOT saves money for every dollar spent of SUE, and reduces the risk involved in highway projects. "If SUE was not worth the time and effort, VDOT would not have used it for 13 years." (Richard Bennett – State Utility Engineer)

Results of the Virginia Questionnaire

Table 1. General Questions for SHAs and utilities.

List the total engineering/ construction budget statewide by year. _____ ___**$500 Million / year**_____ Supply a list of all projects indicating cost ($), length, type, (interstate, reconstruction, urban, arterial), etc. _**All types of projects, $300,000 to $50 million, Sizes vary**_
List the projects using SUE. Indicate designating/ locating and the costs for each. Indicate the footage of designating and number of test holes. **Interstates, Primaries, Secondaries** __**By VDOT Policy - All Projects Use S.U.E. Either Location or designating**_____ __ **Most Projects Use Both - Location and Designation**
Estimate the average time (project duration) for projects using SUE vs. average time for SUE projects. __**Average 12 - 15% in some situations: 25-30%**___
Describe how the SUE program started in your state. _____ ___**It started in 1984 as a trail program for locating underground utilities**___ How is a project selected for the use of SUE? _**All projects use S.U.E.; Typically urban projects require more S.U.E. efforts**_
Amount of $ spent each year on the SUE program in your state. _**$4.5 to 5.0 million per year of direct costs**
Explain the relationship between utilities and DOT before and after SUE. _**Information has proven to be very useful to utility companies for record drawings and future work**
Explain the typical uses of SUE, i.e. designating, locating, planning, utility relocation design, coordination, etc. _**Conflict design for utilities, Storm Sewer, Identifying underground facilities**
Describe the qualitative benefits of SUE by utility owners, constructors, engineers, and highway departments. _**Used for utility conflict evaluation early in design phase, Higher quality plan design, Less dollar spent in design, Fewer contractors claims and change orders, Project time schedule is decreased**
What were utility damages on projects before SUE, or on projects not using SUE? ___**Information is not known** What were the utility damages on projects after SUE was used? _**The damages have been reduced**
What is the cost of a test hole made by traditional means? __**Old method - $1,000 to $1,500 per hole, New vacuum method - $610 each**_____

On SUE projects - what were the type, amount, or cost of utilities not relocated due to **designating** for utilities that had SUE information available to them for their own redesign? ___**Varies, TV cable to 54 inch water mains, S.U.E. information saved** On SUE projects - what were the type, amount, or cost of utilities not relocated due to **locating** for utilities that had SUE information available to them for their own redesign? _____
On SUE projects - what amount of unknown utilities were found through designating activities? _____**Approximately 10 percent or more (up to 50 percent) of all the project sites, Complete records not yet available**
What user savings were estimated on SUE projects with time savings? _____ ___**The inconvenience to customers or the traveling public decreases**
Additional Remarks _ **Plan design quality is now much higher** **VDOT's recent report on SUE indicates $4 direct savings for each $1 cost of S.U.E.** **S.U.E. reduces risk**
Additional Remarks _**If S.U.E. was not worth the time and effort, VDOT would not have used it for 13 years**

SUE DATA AND INFORMATION

Table two, Specific Projects Studied, is presented as follows as a summary of the data and information obtained from the specific projects used in the evaluation study. The projects are labeled ***I*** to ***IX*** with the label appearing in the upper left corner of the table and again at the bottom of the table with the savings analysis amount shown.

The costs shown in Table Two are based on two types of considerations. The first consideration is estimated costs which are based on estimated construction costs, estimated design costs, or actual construction costs. The estimated costs are based on historical or actual costs. Second consideration costs are based on projections or comparisons. These costs are denoted by the symbol *. Note that Table Two condenses the data and information from the forms contained for reference in Appendix A.

Table 2. Specific Projects Studied

I. Project's Title: 0001-076-V37, & 0001-212-V01 (NOVA, Route 1 Dumfries
Cost of Designating: _$19,947.91_ Locating: __$17,305.00___ Total SUE $37,252.91_
Description of the Project: During the design stages a 16" sanitary force main crossing appeared to be in conflict with both grade changes and drainage elevations. SUE determined that the 16" force main was deeper than indicated plans and is not conflict with construction. Cost savings: $38,000 SUE also was used to correctly locate a 12" water line keeping VDOT from dealing with delay and change claims. The contractor would likely received significantly greater compensation for performing this relocation.
__27,570' of utilities designated/mapped , 25 test holes installed
The cost savings are shown below:

Cost Items and Factors - *for 16" Force Main*	Time Savings	Cost Savings	User Savings	Risk Mgmt.
Reduced the number of utility line relocations	Yes, but no $	$38,000	$7,500	* unknown
Reduced contractor's claims & change orders	10 ds = $10,000*	Yes, no $	Yes, no $	* unknown
Reduced travel delays to the motoring public		$1,000 *		
Reduced the cost of project design		$5,000		
Facilitated electronic map accuracy, as- built	$5,000*	Yes, but no $		
Minimized chance of environmental damage	True, but no $	Yes, but no $		

Cost Items and Factors *12"water main*	Time Savings	Cost Savings	User Savings	Risk Mgmt.
Reduced project delays due to utility relocates		$15,000		
Reduced construction delay due to utility cuts		$6,000		
Reduced contractor's claims & change orders		$10,000		
Reduced travel delays to the motoring public		$1,000 *		
Increased the possibility of reduced bids		Yes, see #4		
Reduced damage to existing site facilities		True, but no$		

I. Savings analysis: $98,000.00/$37,252.91 = $2.63, savings per $ spent.

II. Project's Title: 0629-061-279 City of Suffolk/Route 629
Cost of Designating: _$37,860.00_ Locating: $15,308.00_ Total SUE _$53,168.60__
Description of the Project: The project involved trench widening. There is a 16" water main the entire length of this project that appeared to not be in conflict. The 16"w.m. being in the shoulder of the roadway. Test holes revealed several areas where the 16" was installed with less than 2' of cover. This resulted in 1054' of new 16" water main installed by the contractor @ a unit bid cost of $48 per L.F.
__ 52,360' of utilities designated/mapped, 28 test holes installed

Cost Items and Factors *16" water main*	Time Savings	Cost Savings	User Savings	Risk Mgmt.
Reduced the number of utility line relocations	50 ds = $5,000 *	$450,720		
Reduced the cost of project design		$48,000		
Cost Items and Factors*36" water main (crossing)*	Time Savings	Cost Savings	User Savings	Risk Mgmt.
Reduced project delays due to utility relocates	60 ds = $6,000 *			
Reduced contractor's claims & change orders		$170,000		

II. Savings analysis: $679,720.00/$53,168.60 = $12.78, savings per $ spent.

III. Project's Title: 0064-047-F05 Interstate 64, Grove Interchange
Cost of Designating: _$158097.15_ Locating: _$48,152.7_ Total SUE __$206,249.85_
Description of the Project: James City Co. & York Co./ Interstate 64, Grove Interchange. A 16" gas main for VGN and two offsets were eliminated due to test holes. There were two areas of possible conflict near the crossing of I-64. One was a box culvert extension and the other at the pavement widening for the new exit ramp. Test holes showed the line much deeper than anticipated thus eliminating the need for two vertical offsets.
SUE was utilized on the entire length of the project. 180,990' of utilities were designated/mapped, then 83 test holes were installed.

Cost Items and Factors *30" water main*	Time Savings	Cost Savings	User Savings	Risk Mgmt.
Reduced the number of utility line relocations	20 ds = $40,000 *	$270,000		
Reduced project delays due to utility relocates	Some, no $			
Reduced construction delay due to utility cuts	$2,000 *			
Reduced contractor's claims & change orders	Yes, no $			
Reduced the cost of project design		$30,000		

III. Savings analysis: $342,000.00/$206,249.85 = $1.66, savings per $ spent.

IV. Project's Title: 0199-047-F03 City Co. & York Co. Route 199
Cost of Designating: _$88,452.00_ Locating: _$21,871.27 Total SUE __$110,323.27_
Description (Summary) of the Project: _A 16" sanitary sewer for Eastern State Hospital was never designated on the plans. The result was a contractor's work order for $134,784.21. This consisted of providing 595' of 16" sewer line, and 35 vertical feet of manholes and new frames and covers.

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
Reduced the number of utility line relocations	20 ds = $20,000	Yes		
Reduced project delays due to utility relocates	Yes, no cost			
Reduced construction delay due to utility cuts	Yes, no cost			
Reduced contractor's claims & change orders			$80,000	

IV. Savings analysis: $100,000.00/$110,323.27 = $0.91, savings per $ spent.

V. Project's Title: U000-127-109, C501: Hopkins Road City of Richmond
Description of the Project: _156 potential conflict sites were reduced to only 14 actual conflicts. Approximately half of the sites excavated were in conflict, but by making design changes eighty percent of these conflicts were eliminated. The change in project construction cost was not meaningful since the design changes usually involved minor adjustments that did not effect construction cost. *This project is a "what-if" example*___

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
Reduced the number of utility line relocations		$731,425		
Reduced project delays due to utility relocates	Yes, no $			
Reduced construction delay due to utility cuts	Yes, no $			
Reduced contractor's claims & change orders	Yes, no $			
Reduced delays caused by conflict redesign		$5,000 *		
Reduced travel delays to the motoring public		$2,000 *		
Reduced the damage to existing pavements		Yes, no $		

V. Savings Analysis: $738,425.00/$93,553.00 = $7.89, savings per $ spent.

VI. Project's Title: _0603-099-171, C501: York County – Waller Mill Road
Cost of Designating, _$12,163.12 Locating, _$13,859.00_ Total SUE _$26,022.12 __
Description (Summary) of the Project: 14,428' of utilities designated/ mapped, 22 Test Holes installed. Road way crossing of 48" raw water main owned by Newport News Waterworks. A conflict was assumed was assumed prior to test hole installation. Two test holes were dug on this line. The test holes showed a burial depth sufficient enough that no relocation was necessary.
The cost savings were realized in decreased project cost as well as decreased design cost. A time savings was also realized.

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
Reduced the number of utility line relocations	$21,000 *	$75,000		
Reduced project delays due to utility relocates	Yes, no $	Yes, no $		
Reduced contractor's claims & change orders		Yes, no $		
Reduced the cost of project design		$14,000		

VI. Savings Analysis: $91,100.00/$26,022.12 = $4.22, savings per $ spent

VII. Project's Title: _0615-0470158, C501 / U000-137-105, C501 Iron Bound Road – Williamsburg
Cost of Designating, _$8,332.41 _ Locating, _$6,160.00_ Total SUE _$14,492.41___
Description of the Project: _10,771' of utilities designated/ mapped, 10 Test Holes _ Designating and Locating was done on this project. We test holed an existing 12" water main in several locations. A section of 870 L.F. of pipe was assumed not in conflict based on test holes at either end of the 870'. Once under construction the 12" main was found to be at a higher elevation between those two points, and thus in conflict with the roadway grade. This resulted in a work order for $71,969.61 to eliminate the problem.

The 12" main was uncovered and found to be in conflict without breaking the line. There were no delays, damage expenses, or redesign expenses.

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
Reduced the number of utility line relocations		Yes, no $		
Reduced project delays due to utility relocates	$21,000 *			
Reduced construction delay due to utility cuts		Yes, no $		
Reduced contractor's claims & change orders		$71,969.61		
Reduced delays caused by conflict redesign		$1,000		
Reduced accidents & injuries due to line cuts	Yes, no $	$6,000	Yes, no $	Yes, no $
Reduced travel delays to the motoring public	Yes, no $	$ 500	Yes, no $	
Reduced loss of service to utility customers			$ 200	
Introduced concept of comprehensive SUE				Yes, no $

VII. Savings Analysis: $100,969.61/$14,492.41 = $6.95, savings per $ spent

VIII. Project's Title: _U000-109-103, C501 City of Emporia – Low Ground Road
Cost of Designating, _$4,793.45_ Locating, __$7,904.00__ Total SUE _$12,697.45__
Description (Summary) of the Project: Project had been surveyed some time ago. Plans were ready to be sent to construction division. A field visit by our utility design consultant noticed a new water main and sanitary sewer line had been installed after our survey had been done, They surveyed the lines and developed plans for relocating the line. The total relocation on this project is estimated at $381,460. This was however made a part of the contract and will have to be bid rather than not being shown on the plans and made a work order after construction begins. Real cost savings eliminate work order. Expenses $23,722 for utility consultant to provide additional survey and design for new lines. Unrealized cost savings: Utility down time if break occurs, Contractor down time during redesign, many other unknowns.

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
Reduced the number of utility line relocations		$114,438		
Reduced construction delay due to utility cuts	Yes, no $			
Reduced contractor's claims & change orders	$14,000 * (4.)	Yes, no $		
Reduced delays caused by conflict redesign		Yes, no $		
Reduced accidents & injuries due to line cuts	Yes, no $	$3,000 * (6)		
Reduced loss of service to utility customers		$200 * (8)		
Minimized chance of environmental damage	Yes, no $	Yes, no $		

VIII. Savings Analysis: $131,638.00/$12,697.45 = $10.37, savings per $ spent

IX. Project's Title: : Bristol District Town of Lebanon _____
Cost of Designating, _____ Locating, _____ Total SUE __$3,500 (estimated)
Description (Summary) of the Project: This project was located in the Town of Lebanon, VA, along the main street, in an urban funded project. The project consisted of reconstruction, widening, and drainage . The overall length of project was ¾ miles. The project should have required 1000 feet of designating and locating SUE activities. During construction a force main was found to be 10 feet off from what the as-builts indicated. This resulted in an estimated extra cost of $12,000. *This project is a "what-if" example*___

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
Reduced the number of utility line relocations		$6,000		
Reduced project delays due to utility relocates		Yes, no$		
Reduced contractor's claims & change orders		$3,000		
Reduced delays caused by conflict redesign		$3,000		
Total		$12,000 (1.)		

IX. Savings Analysis: $12,000.00/$3,500.00 = $3.43, savings per $ spent.

Table 3. Costs of Subsurface Designation and Locating (SUE) in Virginia, shown below is presented to show the continuous level of commitment and investment in SUE by Virginia. The Conclusions section shows the amounts of savings gained through the use of SUE in Virginia.

Table 3. Costs of Subsurface Designation and Locating (SUE) in Virginia

Year	# of Designation locations Total Spent	# of Locating locations Total Spent	Total # of locations Total Spent
1985	32 $600,000	46 $462,000	78 $1,062,000
1986	78 $1,606,000	52 $878,000	130 locations $2,484,000
1987	177 $2,391,000	96 $1,371,000	273 $3,762,000
1988	217 $3,342,000	103 $1,108,000	320 $4,450,000
1989	152 $2,155,000	88 $1,067,000	240 $3,222,000
1990	124 $2,264,000	88 $1,220,000	212 $3,484,000
1991	62 $690,000	58 $459,000	120 $1,149,000
1992	59 $1,100,000	44 $800,000	103 $1,900,000
1993	92 $1,100,000	98 $815,000	190 $1,900,000
1994	90 $870,000	77 $581,000	167 $1,915,000
1995	116 $1,800,000	88 $1,100,000	204 $2,900,000
1996			
1997			

CONCLUSIONS OF SUE IN VIRGINIA

Virginia has been a difficult state for which to analyze SUE cost savings. The reasons for this are varied. Some of the reasons are as follows:

1. The program has been in place for a long time. Historical data of "before SUE" projects are hard to find and the data is difficult to analyze due to changing construction practices, utility damage prevention programs, and so forth.

2. No projects could be identified where utilities were plotted from record and then designated. A project with these characteristics would allow easy comparison to accuracy, comprehensiveness, and interpretive ability between existing records and quality level *B* data.

3. Contractors already are well educated about SUE, making bid savings hard to quantify.

4. Project synopses' after construction do not easily separate change orders, redesigns, extras, and claims by categories such as would be helpful to identify specific utility problems.

5. Restructuring of VDOT with lots of early retirements and downsizing of staff makes contacts with previous project managers difficult or impossible.

Any cost savings which are identified here are arguably just the tip of the savings iceberg. Anecdotal evidence from VDOT and utility personnel support this conclusion.

Twenty five or so projects were selected mainly at random for review. From these twenty five projects, seven were selected for an in-depth cost study. These seven projects had project designers and managers available for interviews. Two additional projects were looked at where comprehensive SUE was not used, based upon risk management decisions of the DOT. Unfortunately, these projects went on to have utility problems that could be quantified. These two projects have been included in the study as *what-if* examples. Virginia may well be one of a select few states where this kind of project could be analyzed since they typically require such a thorough use of SUE on a regular basis.

Overall, the savings of SUE in Virginia appear to be quantifiable at $4.12 to every $1.00 spent in upgrading to quality levels *B* and *A* data. See Appendix A for the Summary of Cost Savings that shows how the $4.12 amount was obtained. This does not include qualitative savings, which might make this ratio much higher. Regardless, if we extrapolate the savings across their entire highway program, the savings of SUE may be $20,550,000 per year, minus the $5,000,000 (utility mapping component of SUE only) spent in their program, for an effective savings of $15,550,000 per year or more. The current level of investment in SUE (all aspects) for Virginia is approximately $10,000,000 per year. See Table 3, Costs of Subsurface Designation and Locating (QL B and QL A) in Virginia for the past annual investment amounts in SUE for Virginia.

The following costs for Virginia projects (shown as follows) are based on two types of considerations. The first consideration is estimated costs which are based on estimated construction costs, estimated design costs, or actual construction costs. The estimated costs are based on historical or actual costs. Second consideration costs are based on projections or comparisons. These costs are denoted by the symbol *.

Questionnaire for Subsurface Utility Engineering Evaluation Data From Specific Projects - *I*

Project's Title:0001-076-V37, & 0001-212-V01 (NOVA)_ Year SUE Program Began: __1985
Project's Location: _Route 1 Dumfries _____ State: _____VA__
Name of Person Completing Questionnaire: __J J Lew/ W. Brooks ___Phone:_____
Cost of the Project: _____
Cost of Engineering: _____
Cost of Right-of-Way: _____
Cost of Designating: _$19,947.91_____ Locating: __$17,305.00___ Total SUE $37,252.91_
Description (Summary) of the Project: _Town of Dumfries/Route 1, Prince William Co./ Route 1
During the design stages a 16" sanitary force main crossing appeared to be in conflict with both grade changes and drainage elevations. After utilizing SUE to obtain designation and test holes, it was determined that this 16" force main was at a depth greater than indicated by as-built plans and will be free of conflicts with roadway construction. The estimated cost for relocation would have been approximately $80.00 per L.F. for a length of 175', also line stops would have been utilized due to steady flow volumes. This estimated total would have been $38,000. Surveys indicated that a 12" water main was located in an area where it was free conflict. After utilizing SUE it was determined that this line was actually an abandoned 3" water main. The 12" water main was located in an area of grade change which places it in conflict for approximately 155'. The locating and test holes performed on this water main prevented VDOT from dealing with a delay claim and change claim, since were no bid items for 12" water main work in the original contract. The contractor would likely received significantly greater compensation for performing this relocation.
__27,570' of utilities designated/mapped , 25 test holes installed _____
Project Manager (SHAs): Gary Wilmouth _____Phone: _____
Designer/ Consultant: _____Phone:_____
SUE Consultant: _____Phone: _____
Contractor: _____Phone: _____
Utility Co.: _____Phone: _____

Cost Items and Factors - *for 16" Force Main*	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations	N/A	$38,000	$7,500	* unknown
2. Reduced project delays due to utility relocates				
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders	10 days = $10,000 *	Yes, no $	Yes, no $	* unknown
5. Reduced delays caused by conflict redesign		See #12		

6. Reduced accidents & injuries due to line cuts				
7. Reduced travel delays to the motoring public		$1,000 *		
8. Reduced loss of service to utility customers	N/A			
9. Improved contractor productivity & methods	N/A			
10. Increased the possibility of reduced bids	See #1			
11. Reduced contingency fees from all parties	N/A			
12. Reduced the cost of project design		$5,000		
13. Reduced the damage to existing pavements	N/A			
14. Reduced damage to existing site facilities	N/A			
15. Reduced the cost of needed utility locates	N/A			
16. Minimized disruption to traffic & emergency	N/A			
17. Facilitated electronic map accuracy, as- built	$5,000*	Yes, but no $		
18. Minimized chance of environmental damage	True	Yes, but no $		
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE	Yes, no $			
21.Right-of-Way acquisition/ cost				
22.				

Cost Items and Factors *12"water main*	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations				
2. Reduced project delays due to utility relocates		$15,000		
3. Reduced construction delay due to utility cuts		$6,000		
4. Reduced contractor's claims & change orders		$10,000		
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts		*		
7. Reduced travel delays to the motoring public	(1.)	(1.) $1,000*		
8. Reduced loss of service to utility customers		*		
9. Improved contractor productivity & methods		N/A		
10. Increased the possibility of reduced bids		See #4		
11. Reduced contingency fees from all parties		*		
12. Reduced the cost of project design		*		
13. Reduced the damage to existing pavements		N/A		
14. Reduced damage to existing site facilities		True		
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE				
21. Right-of-Way acquisition costs				
Note to #7 -(1) – need to look at plans to see if it is under pavement				

I. Savings analysis: $98,000.00/$37,252.91 = $2.63, savings per $ spent.
(1.) information obtained fromCH2MHILL

Questionnaire for Subsurface Utility Engineering Evaluation Data From Specific Projects *II*

Project's Title:0629-061-279_____ Year SUE Program Began: ____1985_
Project's Location: _City of Suffolk/Route 629_____State: _____VA_
Name of Person Completing Questionnaire: _J J Lew/ Wayne Brooks__ Phone:_____
Cost of the Project: _____
Cost of Engineering: _____
Cost of Right-of-Way: _____
Cost of Designating: _$37,860.00_____ Locating: $15,308.00____ Total SUE _$53,168.60__
Description (Summary) of the Project: The project involved trench widening. _____
There is a 16" water main the entire length of this project that appeared to not be in conflict. The roadway job was only trench widening with the 16"w.m. being in the shoulder of the roadway. Test holes revealed several areas where the 16" was installed with less than 2' of cover. This resulted in 1054' of new 16" water main installed by the contractor @ a unit bid cost of $48 per L.F.
__ 52,360' of utilities designated/mapped, 28 test holes installed
Project Manager (SHAs): _____Phone: _____
Designer/ Consultant: _____Phone: _____
SUE Consultant: _____Phone: _____
Contractor: _____Phone: _____
Utility Co.: _____Phone: _____

Cost Items and Factors *16" water main*	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations	50 days = $5,000	$450,720		
2. Reduced project delays due to utility relocates				
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders				
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts				
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$48,000		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE				
21. Right-of-Way acquisition costs				
22.				

II Continued

Cost Items and Factors*36" water main (crossing)*	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations				
2. Reduced project delays due to utility relocates	60 days = $6,000			
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders		$170,000		
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts				
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design				
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE				
21. Right-of Way acquisition costs				
22.				

II. Savings analysis: $679,720.00/$53,168.60 = $12.78, savings per $ spent.

Questionnaire for Subsurface Utility Engineering Evaluation Data From Specific Projects *III*

Project's Title:0064-047-F05_____ Year SUE Program Began: ____1985_
Project's Location: _Interstate 64, Grove Interchange_____ State: _____VA_
Name of Person Completing Questionnaire: _____Phone:_____
Cost of the Project: _____
Cost of Engineering: _____
Cost of Right-of-Way: _____
Cost of Designating: _$158097.15_____ Locating: _$48,152.7_ Total SUE __$206,249.85__
Description (Summary) of the Project: _James City Co. & York Co./ Interstate 64, Grove Interchange. A 16" gas main for VGN and two offsets were eliminated due to test holes. There were two areas of possible conflict near the crossing of I-64. One was a box culvert extension and the other at the pavement widening for the new exit ramp. Test holes showed the line much deeper than anticipated thus eliminating the need for two vertical offsets.
SUE was utilized on the entire length of the project. 180,990' of utilities were designated/mapped, then 83 test holes were installed.

Project Manager (SHAs): _____Phone: _____
Designer/ Consultant: _____Phone: _____
SUE Consultant: _____Phone: _____
Contractor: _____Phone: _____
Utility Co.: _____Phone: _____

Cost Items and Factors *30" water main*	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations	20 days @ $2,000 = $40,000 *	$270,000		
2. Reduced project delays due to utility relocates	Some, no $			
3. Reduced construction delay due to utility cuts	2 days @ $1,000 = $2,000 *			
4. Reduced contractor's claims & change orders	Yes, no $			
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts				
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$30,000		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE				
21. Right-of-Way acquisition costs				
22.				

III. Savings analysis: $342,000.00/$206,249.85 = $1.66, savings per $ spent.

Questionnaire for Subsurface Utility Engineering Evaluation Data From Specific Projects *IV*

Project's Title:0199-047-F03_____ Year SUE Program Began: ____1985_
Project's Location: _James City Co. & York Co. Route 199_____State: _____VA_
Name of Person Completing Questionnaire: _____Phone:_____
Cost of the Project: _____
Cost of Engineering: _____
Cost of Right-of-Way: _____
Cost of Designating: _$88,452.00____ Locating: _$21,871.27__ Total SUE __$110,323.27_
Description (Summary) of the Project: _A 16" sanitary sewer for Eastern State Hospital was never designated on the plans. The result was a contractor's work order for $134,784.21. This consisted of providing 595' of 16" sewer line, and 35 vertical feet of manholes and new frames and covers. This is a case where the line was overlooked. The savings analysis is based on what the savings should have been. The costs are based on a reasonable and fair amount that came from the project's contractor. The costs could have been significantly higher.
Project Manager (SHAs): _____Phone: _____
Designer/ Consultant: _____Phone: _____
SUE Consultant: _____Phone: _____
Contractor: _____Phone: _____
Utility Co.: _____Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations	Yes 20 days @ $1,000 = $20,000	Yes		
2. Reduced project delays due to utility relocates	Yes, no $			
3. Reduced construction delay due to utility cuts	Yes, no $			
4. Reduced contractor's claims & change orders			$80,000	
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts				
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design				
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE				
21. Right-of-Way acquisition costs				
22.				

IV. Savings analysis: $100,000.00/$110,323.27 = $0.91, savings per $ spent.

Questionnaire for Subsurface Utility Engineering Evaluation Data From Specific Projects *V*

Project's Title: U000-127-109, C501_____ Year SUE Program Began: ___1984_
Project's Location: Hopkins Road City of Richmond_____ State: ____VA_____
Name of Person Completing Questionnaire: Wayne Brooks, _____ Phone:_____
Cost of the Project: _____
Cost of Engineering: _____
Cost of Designating, _____ Locating, _$93,553____ Total SUE _____
Description (Summary) of the Project: _156 potential conflict sites were reduced to only 14 actual conflicts. Approximately half of the sites excavated were in conflict, but by making design changes eighty percent of these conflicts were eliminated. The change in project construction cost was not meaningful since the design changes usually involved minor adjustments that did not effect construction cost. *This project is a "what-if" example.*

Project Manager (SHAs): _____Phone: _____
Designer/ Consultant: _____Phone: _____
SUE Consultant: _____Phone: _____
Contractor: _____Phone: _____
Utility Co.: _____Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$731,425		
2. Reduced project delays due to utility relocates	Yes, no $			
3. Reduced construction delay due to utility cuts	Yes, no $			
4. Reduced contractor's claims & change orders	Yes, no $			
5. Reduced delays caused by conflict redesign		$5,000 *		
6. Reduced accidents & injuries due to line cuts				
7. Reduced travel delays to the motoring public		Yes 2 days @ $1,000 = $2,000		
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design				
13. Reduced the damage to existing pavements		Yes, no $		
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE				
21. Right-of-Way acquisition costs				
22.				

V. Savings Analysis: $738,425.00/$93,553.00 = $7.89, savings per $ spent.

Questionnaire for Subsurface Utility Engineering Evaluation Data From Specific Projects *VI*

Project's Title: _0603-099-171, C501_____ Year SUE Program Began: ___1985__
Project's Location: York County – Waller Mill Road_____State: _VA_____

Name of Person Completing Questionnaire: _M. Woods_____ Phone:_____

Cost of the Project: _____
Cost of Engineering: _____
Cost of Designating, _$12,163.12_____ Locating, _$13,859.00___ Total SUE _$26,022.12 __
Description (Summary) of the Project: _____
__14,428' of utilities designated/ mapped, 22 Test Holes installed.
Road way crossing of 48" raw water main owned by Newport News Waterworks. A conflict was assumed was assumed prior to test hole installation. Two test holes were dug on this line. The test holes showed a burial depth sufficient enough that no relocation was necessary.
The cost savings were realized in decreased project cost as well as decreased design cost. A time savings was also realized.
Project Manager (SHAs): _____Phone: _____
Designer/ Consultant: _____Phone: _____
SUE Consultant: _____Phone: _____
Contractor: _____Phone: _____
Utility Co.: _____Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations	21 days @$1,000 = $21,000 *	$75,000		
2. Reduced project delays due to utility relocates	Yes, no $	Yes, no $		
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders		Yes, no $		
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts				
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$14,000		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE				
21. Right-of-Way acquisition/ cost				
22.				

VI. Savings Analysis: $91,100.00/$26,022.12 = $3.50, savings per $ spent.

Questionnaire for Subsurface Utility Engineering Evaluation Data From Specific Projects *VII*

Project's Title: _0615-0470158, C501 / U000-137-105, C501 Year SUE Program Began: 1985
Project's Location: _ Iron Bound Road – Williamsburg _____ State: _____VA_____
Name of Person Completing Questionnaire: _ M Woods _____ Phone:_____
Cost of the Project: _____
Cost of Engineering: _____
Cost of Designating, _$8,332.41 _____ Locating, _$6,160.00_ Total SUE _$14,492.41_____
Description (Summary) of the Project: _10,771' of utilities designated/ mapped, 10 Test Holes _ Designating and Locating was done on this project. We test holed an existing 12" water main in several locations. A section of 870 L.F. of pipe was assumed not in conflict based on test holes at either end of the 870'. Once under construction the 12" main was found to be at a higher elevation between those two points, and thus in conflict with the roadway grade. This resulted in a work order for $71,969.61 to eliminate the problem.
The 12" main was uncovered and found to be in conflict without breaking the line. There were no delays, damage expenses, or redesign expenses.
Project Manager (SHAs): _____ Phone: _____
Designer/ Consultant: _____ Phone: _____
SUE Consultant: _____ Phone: _____
Contractor: _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations	(11)			
2. Reduced project delays due to utility relocates	21 days @ $1,000 = $21,000 * (2.)			
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders		$71,969.61		
5. Reduced delays caused by conflict redesign		$1,000 (5.)		
6. Reduced accidents & injuries due to line cuts	Yes, no $	$6,000 (6.)	Yes, no $	Yes, no $
7. Reduced travel delays to the motoring public	Yes, no $	$ 500 (7.)	Yes, no $	
8. Reduced loss of service to utility customers			$ 200 (8.)	
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design				
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE				Yes, no $
21. Right-of-Way acquisition/ cost				
22.				

VII. Savings Analysis: $100,669.61/$14,492.41 = $6.95, savings per $ spent.

1. Utility line relocating savings: xxx' @ $30/foot. xxx' could not be determined.
2. 21 days @ $1,000/day = $21,000
5. 2 days @ $500/day = $1,000
6. $2,000 (est. direct cost) x 3 = $6,000.00 (Accident cost = 3X direct cost)
7. Depends on traffic volume, but estimated to be $500
8. $200 in lost service.

Questionnaire for Subsurface Utility Engineering Evaluation Data From Specific Projects *VIII*

Project's Title: _U000-109-103, C501_____ Year SUE Program Began: ___1985_
Project's Location: _City of Emporia – Low Ground Road_____ State: ____VA _____
Name of Person Completing Questionnaire: M. Woods _____ Phone:_____
Cost of the Project: _____
Cost of Engineering: _____
Cost of Designating, __$4,793.45__ Locating, __$7,904.00__ Total SUE _$12,697.45_____
Description (Summary) of the Project: Project had been surveyed some time ago. Plans were ready to be sent to construction division. A field visit by our utility design consultant noticed a new water main and sanitary sewer line had been installed after our survey had been done, They surveyed the lines and developed plans for relocating the line. The total relocation on this project is estimated at $381,460. This was however made a part of the contract and will have to be bid rather than not being shown on the plans and made a work order after construction begins. Real cost savings eliminate work order. Expenses $23,722 for utility consultant to provide additional survey and design for new lines. Unrealized cost savings: Utility down time if break occurs, Contractor down time during redesign, many other unknowns.
Project Manager (SHAs): _____Phone: _____
Designer/ Consultant (SUE): _____Phone: _____
Contractor: _____Phone: _____
Utility Co.: _____Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$114,438 (1.)		
2. Reduced project delays due to utility relocates				
3. Reduced construction delay due to utility cuts	Yes, no $			
4. Reduced contractor's claims & change orders	$14,000 * (4.)	Yes, no $		
5. Reduced delays caused by conflict redesign		Yes, no $		
6. Reduced accidents & injuries due to line cuts	Yes, no $	$3,000 * (6.)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers		$200 * (8.)		
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design				
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage	Yes (18)	Yes (18.)		
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE				
21. Right-of-Way acquisition/ cost				

VIII. Savings Analysis: $131,638.00/$12,697.45 = $10.37, savings per $ spent.

1. The $381,460 describes a scope of work that is a given project cost, with or without SUE. However, without SUE the cost would be higher by an average of 30% since it would have been a change order rather than bid with the project. Savings + $381,460 x 0.3 = $114,438

3. Cost not able to be projected.
4. 14 days @ $1,000/ day = $14,000
5. No cost information located
6. $1,000 (est. direct cost) x 3 = $3,000.00 (Accident cost = 3X direct cost)
8. $200 projected cost
18. No cost figures available

Questionnaire for Subsurface Utility Engineering Evaluation Data From Specific Projects *IX*

Project's Title: _Town of Lebanon – Bristol District_ Year SUE Program Began: __1984__
Project's Location: Bristol _____ State: _____
Name of Person Completing Questionnaire: _____ Phone:_____
Cost of the Project: _____
Cost of Engineering: _____
Cost of Designating, _____ Locating, _____ Total SUE _$3,500 (estimated)

Description (Summary) of the Project: ___This project was located in the Town of Lebanon, VA, along the main street, in an urban funded project. The project consisted of reconstruction, widening, and drainage . The overall length of project was ¾ miles. The project should have required 1000 feet of designating and locating SUE activities. During construction a force main was found to be 10 feet off from what the as-builts indicated. This resulted in an estimated extra cost of $12,000. *This project is a "what-if" example.*
Project Manager (SHAs): _____ Phone: _____
Designer/ Consultant: _____ Phone: _____
SUE Consultant: _____ Phone: _____
Contractor: _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$6,000		
2. Reduced project delays due to utility relocates				
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders		$3,000		
5. Reduced delays caused by conflict redesign		$3,000		
6. Reduced accidents & injuries due to line cuts				
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design				
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE				
21. Right-of-Way acquisition/ cost				
22.Total $		$12,000 (1.)		

IX. Savings Analysis: $12,000.00/$3,500.00 = $3.43, savings per $ spent.

1. The $12,000 potential savings is based on the actual claim cost of $42,000 less the estimated cost of the work, if it had been bid, at $30,000.

Summary of Savings

	Savings	SUE COST	Savings/$
***I.* Savings analysis:**	**$98,000.00**	**$37,252.90**	**$2.63**
***II.* Savings analysis:**	**$679,720.00**	**$53,168.60**	**$12.78**
***III.* Savings analysis:**	**$342,000.00**	**$206,249.85**	**$1.66**
***IV.* Savings analysis:**	**$100,000.00**	**$110,323.27**	**$0.91**
***V.* Savings Analysis:**	**$738,425.00**	**$93,553.00**	**$7.89**
***VI.* Savings Analysis:**	**$91,100.00**	**$26,022.12**	**$4.22**
***VII.* Savings Analysis:**	**$100,969.61**	**$14,492.41**	**$6.95**
***VIII.* Savings Analysis:**	**$131,638.00**	**$12,697.45**	**$10.37**
***IX.* Savings Analysis:**	**$12,000.00**	**$3,500.00**	**$3.43**
TOTAL	**$2,293852.61**	**$557259.61**	**$4.12**

Table of SUE Evaluation Projects Indicating the Status of Data Collection

#	Project Name	Project Number	Completing Person (s)	Phone Number	Status Comments
I	Route 1 Dumfries	0001-076-V37 & 0001-212-V01	W. Brooks		Completed
II	City of Suffolk/ Route 629	0629-061-279	W. Brooks		Completed
III	Interstate 64, Grove Interchange	0064-047-F05	W. Brooks		Completed
IV	James City Co. & Route 199	0199-047-F03	W. Brooks		Completed
V	Hopkins Road City of Richmond	U000-127-109, C501	Mike Woods/ Wayne Brooks		Completed
VI	York County – Waller Mill Road	0603-0099-171, C501	Mike Woods		Completed
VII	Iron Bound Road	0615-047-158, C501 U000-137-105, C501	Mike Woods/ Wayne Brooks		Completed
VIII	Low Ground Road	U000-109-103, C501	Mike Woods/ Wayne Brooks		Completed
IX	Bristol	7019-252-101	Matt Reynolds/ Wayne Brooks		Completed

Appendix II: GENERAL RESULTS OF SUE IN NORTH CAROLINA

Table __ contains the results of the questionnaire concerning general questions regarding SUE in North Carolina. North Carolina annually spends about 2 million dollars on the utility mapping component of subsurface utility engineering with state-wide mapping contracts and another 1 million in project-specific SUE . Most highway projects in North Carolina use SUE and most projects utilize all utility quality levels. SUE information has proven useful to utility companies, and is used to reduce utility conflict and redesign.

There are numerous benefits obtained when using SUE on highway projects in North Carolina. By using SUE, significant benefits are derived for NCDOT, utility companies, SUE consultants, contractors, and the general public. Some of the benefits that have been obtained in North Carolina are given as follows:

1. Reduced the number of utility relocations, saving time and costs;
2. Reduced project delays due to utility relocates, saving time and costs;
3. Reduced construction delays due to utility cuts, saving time and costs;
4. Reduced contractors' claims and change orders, saving time and costs;
5. Reduced delays caused by redesign due to conflicts, saving time and costs;
6. Reduced accidents and injuries due to utility cuts, saving time and costs;
7. Reduced the loss of service to utility customers, saving costs and user costs;
8. Improved contractor productivity resulting in cost savings;
9. Increased the possibility of reduced bids, resulting in cost savings possibilities;
10. Reduced the cost of project design, saving time and costs
11. Reduced the damage to existing pavements, saving costs;
12. Minimized disruption to traffic and emergency equipment, saving time and costs;
13. Minimized chance of environmental damage, saving time and costs;
14. Induced savings in risk management and insurance, saving costs;
15. Introduced the concept of comprehensive SUE, saving time and costs.

Table 1. General Questions for SHAs and Utilities, was submitted to the NCDOT for information and data collection. The current total construction budget for North Carolina exceeds $1.4 billion. All types of projects are selected for SUE. Project selection is based on a consensus agreement between Area engineers and Design engineers on an as-needed, project-by-project basis. This system is working well based on the actual knowledge of the project's site that the Area engineers bring to the decision-making process coupled with the knowledge of the design process contributed by the Design engineers.

Table 1. General Questions for SHAs and utilities

List the total engineering/ construction budget statewide by year. __1998 $1.295 billion ; 1999 $1.426 billion _____
Supply a list of all projects indicating cost ($), length, type, (interstate, reconstruction, urban, arterial), etc. _____The list of selected projects for the evaluation represent the typical highway, and street projects constructed in North Carolina. All types of roads, streets, and highways are included, both rural and urban. In addition North Carolina does not have county roads, all rural roads are part of the state system.
List the projects using SUE. Indicate designating/ locating and the costs for each. Indicate the footage of designating and number of test holes. __Total list too long, but the list of sample projects being evaluated in this study are representative of SUE in North Carolina. See the Table of SUE expenditures for total SUE expenditures and number of projects where SUE was employed. _____
Estimate the average time (project duration) for projects using SUE vs. average time for SUE projects. _The time savings are difficult to estimate, but time savings of a day or two are the typical minimum.
Describe how the SUE program started in your state. __Out of the desire to save money, reduce conflicts, and reduce redesign._____ How is a project selected for the use of SUE? __By mutual agreement and judgement between design and area engineers on as needed project basis due to amount of utilities, potential impact, and engineering judgement. _____
Amount of $ spent each year on the SUE program in your state. See the table of SUE expenditures for the amount spent per year and the number of projects._____
Explain the relationship between utilities and DOT before and after SUE. __More confident decisions are made relative to design locations of project structures, since better data is used in project design. The Utilities are expecting the NCDOT to provide this data. _____
Explain the typical uses of SUE, i.e. designating, locating, planning, utility relocation design, coordination, etc. ___Used in drainage design; signalization design, substructure design; and Utility relocation design to minimize conflicts. _____
Describe the qualitative benefits of SUE by utility owners, constructors, engineers, and highway departments. ___Better data makes for easier and better designs such as coordinating utility work with highway contractors. _____

What were utility damages on projects before SUE, or on projects not using SUE? _____
unknown, no records _____
What were the utility damages on projects after SUE was used? _____
unknown, no records _____

What is the cost of a test hole made by traditional means? __Cost depends on a lot of factors, such as depth, availability of equipment, traffic, type and quality of utility, etc. A traditional, average test hole, including excavation with a back hoe, utility line location, traffic control, backfilling, and pavement repair will cost $3,000 to $4,000. A test hole for SUE using pneumatic/ vacuum excavation, utility line location, and data entry will cost $800 to $1,200, depending on the number of holes. _____

On SUE projects – what were the type, amount, or cost of utilities not relocated due to **designating** for utilities that had SUE information available to them for their own redesign? _____ No general information was available, but some of the specific projects contained in the evaluation study represent costs for this issue._____

On SUE projects - what were the type, amount, or cost of utilities not relocated due to **locating** for utilities that had SUE information available to them for their own redesign? _____ Again as above, no general information was available, but some of the specific projects contained in the evaluation study represent costs for this issue._____

On SUE projects - what amount of unknown utilities were found through designating activities? __ It is estimated that 2 to 5 percent of the utilities are found in this manner, but no exact records are available._____

What user savings were estimated on SUE projects with time savings? _____
_____Again, covered on some the selected projects._____

Additional Remarks ____The tighter and more congested the road improvement corridor the greater the advantage to using SUE. Prudent use of the service can provide much greater confidence to the designer, utility owner, and the Contractor. _____

Additional Remarks _____

SUE DATA AND INFORMATION

Table 2. SUE Expenditures by Provider and Contract for North Carolina indicates a total expenditure of $8,725,371.64 for SUE on 295 in-house projects in North Carolina since 1991. Annual SUE expenditures are approximately $2,000,000 per year on the in-house projects.

Table 3. Summary of Cost Savings by Selected Project indicates the Savings Analysis obtained for each selected project as shown in Table 3. Total SUE savings obtained in the evaluation were $ 4,183,432. The total SUE cost was $631,368.42, yielding an overall Savings Analysis of $6.63 savings for each dollar spent on SUE for in-house projects.

Table 4. Specific Projects Studied is presented as a summary of the data and information obtained from the specific projects used in the evaluation study. The projects presented in Table 4 are numbered 1 to 21, with the project number appearing in the second line of the Table title. Information for the Cost Items and Factors contained in Table 4 under the columns Time, Cost, User, and Risk Management Savings was collected by interviews with key project personnel listed in the Table by each specific project. Over fifty (50) NCDOT and contractor personnel were interviewed in the process of collecting information and data. The information and data are referenced by line item as noted by a corresponding number in ( ). The Savings Analysis is given for each specific project after the last Cost Item.

The costs presented in Table 4 are based on two types of considerations. The first consideration utilizes *estimated costs* which are based on estimated construction costs, estimated design costs, or actual construction costs. These estimated costs are based on historical or actual costs. The second consideration utilizes *costs that are based on projections or comparisons*. These costs are denoted by the symbol *.

Table 2. SUE Expenditures by Provider and Contract for North Carolina

1	2	3	4	5	6
Provider	Contract Date	Amount Paid	Year of Expenditures	Number of Projects	Total $ Amount Per Year(1)
So-Deep	1991	$290,427.91	1991	6	$290,427.91
So-Deep	1992	$282,883.40			
APA/GEOTRACK	1992	$72,832.38	1992	7	$355,715.78
APA/GEOTRACK	1993	$72,832.38			
GEOTRACK	1993	$205,478.76			
So-Deep	1993	$245,046.30	1993	17	$523,357.44
GEOTRACK	1994	$205,478.76			
So-Deep	1994	$245,046.29			
MA Engineering	1994	$93,161.77			
So-Deep	1994	$296,655.02			
SoftDig	1994	$115,165.63	1994	35	$955,507.47
MA Engineering	1995	$93,161.77			
So-Deep	1995	$296,655.03			

SoftDig	1995	$115,165.64			
MA Engineering	1995	$349,240.77			
SoftDig	1995	$25,532.46			
So-Deep	1995	$1,171,270.91	1995	74	$2,051026.58
MA Engineering	1996	494,277.09			
So-Deep	1996	$1,141,456.18			
TWT	1996	$475,164.94	1996	79	$2,110,898.21
MA Engineering	1997	$494,368.29			
So-Deep	1997	$1,123,677.26			
TWT	1997	$464,838.39	1997	55	$2,082,883.94
Accurate Locating	1998	$42,358.86			
MA Engineering	1998	$163,577.65			
So-Deep	1998	$114,774.91			
TWT	1998	$34,843.22	1998	22	$355,554.64(2)
				Total SUE expenditures:	**$8,725,371.97**

(1) The total $ amount denoted in Column 6 represents the amount invested in SUE for the year indicated in Column 4. The information presented in Column 6 represents summary data and is not connected to the providers listed in Column 1 of the table.

(2) $ expenditures for the first quarter of 1998.

Table 3. Summary of Cost Savings by Selected Project

Project Number	SUE Savings	SUE Cost	Savings Analysis
1	$750,000.00	$80,000.00	$9.38
2	$26,000.00	$20,296.00	$1.28
3	$773,400.00	$5,995.00	$129.00
4	$802,500.00	$3,883.00	$206.67
5	$135,000.00	$8,789.50	$15.36
6	$51,150.00	$74,696.21	$0.68
7	$24,000.00	$8,438.00	$2.84
8	$100,000.00	$6,917.58	$14.37
9	$56,220.00	$25,578.00	$2.20
10	$193,986.00	$90,307.00	$2.15
11	$243,000.00	$7,978.90	$30.45
12	$199,548.00	$98,717.46	$2.02
13	$27,000.00	$22,760.11	$1.19
14	$45,000.00	$9,910.80	$4.54
15	$18,000.00	$3,401.52	$5.29
16	$6,000.00	$5,778.52	$1.04
17	$11,575.00	$3,918.73	$2.95
18	$384,000.00	$61,099.76	$6.29
19	$61,300.00	$56,279.00	$1.09
20	$55,753.00	$27,369.95	$2.04
21	$220,000.00	$9,253.38	$23.78
Total	$4,183,432.00	$631,368.42	Average $6.63

Table 4. Specific Projects Studied

Specific Project - **#1**: R-2105AB

Project's Title:_____ NC 24_____ Year SUE Program Began: ____1991_
Project's Location: _Carteret CO. _____State: _NC_____
Name of Person Completing Questionnaire: ___Greg Stevens _____Phone: (919) 250-4128
Cost of the Project: __Estimated project cost: $13,200,000. Project not yet bid as of 7/98.__
Cost of Engineering: _____
Cost of Right-of-Way: _____
Cost of Designating: _____ Locating: _____ Total SUE __$80,000.00__
Description (Summary) of the Project: _40,000 lf 12" water line was potentially in conflict. Project consisted of symmetrical widening of the existing roadway from two lanes to five lanes. Project located parallel to the beach in a potentially environmentally sensitive area. Expansion includes two travel lanes in each direction and one turning lane in the center for a total of five lanes. Project includes some curb and gutter work and paved shoulders. SUE was used on the 40,000 feet of water line and the crossing lines.
Project Manager (SHAs): _____Phone: _____
Designer/ Consultant: _____Phone: _____
SUE Consultant: _SoDeep # NCL4624 _____Phone: _____
Contractor: _____Phone: _____
Utility Co.: _____Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$750,000 (1)		
2. Reduced project delays due to utility relocates		Yes, no $ (+)		
3. Reduced construction delay due to utility cuts		Yes, no $ (+)		
4. Reduced contractor's claims & change orders		Yes, no $ (+)		
5. Reduced delays caused by conflict redesign		Yes, no $ (+)		
6. Reduced accidents & injuries due to line cuts				
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design				
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage		Yes, no $ (+)		
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				

Savings Analysis: $750,000/$80,000 = $9.38

(1)
The normal policy would have moved all of the 12-inch water line that was located in the project's right-of-way. Using the information supplied by SUE, project designers were able to realize that 25,000 feet of the 12-inch did not have to be moved. Thus a savings of 25,000 feet x $30/lf = $750,000.00 was obtained. (1)

(+) Possible savings most likely will result in these items during construction. The savings that may be achieved need to be analyzed during actual construction of the project.

Table 4. Specific Projects Studied (Continued)

Specific Project - #2: U2307AA: 8.2790902

Project's Title:_Hickory E. Side of Thoroughfare____ Year SUE Program Began: ___1991__
Project's Location: __Catawba CO. from US 70-321 to I-40_____State: _____NC_____
Name of Person Completing Questionnaire: _____Phone:_____
Cost of the Project: __$10,226,411.00 Construction Bid Price _____
Cost of Engineering: _____
Cost of Right-of-Way: _____
Cost of Designating: _____ Locating: _____ Total SUE _$20,296__
Description (Summary) of the Project: ___Grading, Paving, and Drainage Improvements to existing roadway. New Highway construction from US 70-321 to I-40, 0.705 Miles.___
A considerable number of utilities were located by the use of SUE. Utility relocations were reduced, project delays due to relocation were avoided, along with eliminating the possibility of line cut accidents.
Resident Engineer: ___A. M. Grigg _____Phone: _____
Project Manager (SHAs): _____Utilities – Robert Wilcox_____Phone: (919) 250-4128
Designer/ Consultant: _Roadway - Art R. McMillan _____Phone: (919) 250-4016
SUE Consultant: ___SoDeep NCD 2588_____Phone: _____
Contractor: _____Taylor & Murphy Construction Company _____Phone: _____
Utility Co.: _____See Specifications _____Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$10,000 (1)		
2. Reduced project delays due to utility relocates	$4,000 (2)			
3. Reduced construction delay due to utility cuts	$4,000 (3)			
4. Reduced contractor's claims & change orders				
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts		*$5,000 (6)*		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$3,000 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				
22.				

Savings analysis: = $26,000 / $20,296 = $1.28

(1) Savings estimates at 10% of $100,000 = $10,000

(2 & 3) A considerable amount of underground utilities at Hickory were located by the use of SUE. The water line was thought not to be in conflict for construction. But a conflict with the water line was encountered during construction, mostly due to a location error made by the municipal utility. SUE was employed to determine the extent of the conflict, the type of pipe material, and the condition of the pipe material. The water line was found to be too shallow to be left in place, which was contrary to the information supplied by the utility In addition, the pipe material was found to be Asbestos Cement (AC), which by NCDOT policy could not be permitted to remain under the pavement since failure of the pipe is possible. SUE was able to clearly define the extent of the water line replacement. Time savings of 2 days for reducing utility relocates and 2 days for reducing utility cuts are estimated. The delay cost is $2,000 per day. No major problems with utility conflicts were encountered during construction. The contractor expected some minor conflicts which was all they found.

(2) 2 days X $2,000 / day = $4,000

(3) 2 days X $2,000 / day = $4,000

* (6) Reduction in accidents was taken to be 0.05% of the project cost.
$10,226,411 X 0.0005 = $5,000 (6)*

(12) Design savings of 10 days @ design team cost of $300.00 / day:
10 days X $300.00 / day = $3,000 (12)

Table 4. Specific Projects Studied (Continued)

Specific Project - **#3**: R 2228: 6.049004T, 6.049005T, 6.049006T

Project's Title:NC 168 from US 158 A Barco to VA State Line Year SUE Program Began: 1991
Project's Location: __Currituck CO._____ State: _____
Name of Person Completing Questionnaire: _Greg Stevens _____Phone: _(919) 250-4128
Cost of the Project: __$34,282,892.00 Const Bid Price _____
Cost of Engineering: _____
Cost of Right-of-Way: _____
Cost of Designating: _____ Locating: _____ Total SUE ___$5,995__
Description (Summary) of the Project: __Project consisted of 18.5 miles of highway widening. The project was divided into three sections: BB, A, and BA. Project involved widening from 2 lanes to 5 lanes, with the center lane being the turning lane. There were paved shoulders along the length of the project except for curb and gutter sections through Moyock and Sligo _____
Resident Engineer _____T. E. Bright_____ Phone _____
Project Manager (SHAs): __Design Services Ron Wilkins _____Phone: (919) 250-4128
Designer/ Consultant: _____Phone: _____
SUE Consultant: _____SoDeep # NCM 3718_____Phone: _____
Contractor: _Barnhill Contracting Corp. _____Phone: _____
Utility Co.: _____Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$135,000 (1) $638,400 (1)		
2. Reduced project delays due to utility relocates	Yes, no $			
3. Reduced construction delay due to utility cuts	Yes, no $			
4. Reduced contractor's claims & change orders				
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts				
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design				
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				

Savings Analysis: $773,400/$5995 = $129.00

On section BB SUE was used to designate the existing water line on the entire length of the section BB part of the project, 3.0 miles. SUE indicated that the majority of line was not in conflict and could remain as is in the shoulder of the road. The result was that the county utility decided to upgrade anyway. This was the result of a wait and see attitude, since state did not require relocation. So the water line was relocated by the utility. Since the State was in conflict, the line had to be moved and upgraded to SDR 21, quantifiable SUE savings were not realized. Some time savings due to reducing utility relocate delays and utility cuts were probably realized.

(1)
ON A, the length of the section was 8.9 miles. Using SUE, it was determined that 4500 feet of 8" PVC water line could remain in place, otherwise it would have been removed and relocated. The cost would have been:

14,000' of 8" moved, 29.200" of 10" moved, no savings
Savings = 4,500 feet x $30.00/ feet = $135,000.

(1)
On BA, the length of the section was 6.7 miles. 21,280 feet of 8" could remain in place, otherwise it would have been removed.
The cost would have been:

Savings = 21,280 feet x $30/ feet = $638,400.

Subtotal SUE savings $773,400.

Table 4. Specific Projects Studied (Continued)

Specific Project - **#4**: - B -2827B: 8.1622203

Project's Title:_____ Year SUE Program Began: ____1991_
Project's Location: __Forsyth CO. _____State: _____NC
Name of Person Completing Questionnaire: __Roger Worthington ____ Phone (919)250-4128
Cost of the Project: _$3,184,231.00 Const Bid Price _____
Cost of Engineering: _____
Cost of Right-of-Way: _____
Cost of Designating: _____0_____ Locating: __$3,883 _ Total SUE _____$3,883 ___
Description (Summary) of the Project: _____
__Construction of Bridges numbers 227 & 231 over US 421 on SR 1528
SUE was used to determine conflicts with a water line. This allowed considerable reduction in unnecessary water line relocation._____
Resident Engineer: V. G. Davis
Project Manager (SHAs): _____Phone: _____
Designer/ Consultant: _____Phone: _____
SUE Consultant: __NCM3836_____Phone: _____
Contractor: _Lee Construction Corp. _____Phone: _____
Utility Co.: ___City of Winston Salem _____Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations	$236,000(1B)	$582,000(1A)		
2. Reduced project delays due to utility relocates				
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders				
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts				
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		- $15,500(12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $802,500/$3883 = $206.67

Information on existing water pipe allowed NCDOT Design to modify the design of the bridge structure to miss the water line.

Cost to move the water line is estimated at:

2 tunnels –	200' @ $1,2000 =	$240,000
	300' @ $1,000 =	$300,000
Water line	600' @ $70/ foot =	$ 42,000
Total relocation cost (savings):		$582,000 (1A)

Cost to modify the design to miss the water line:

(note: - is a decrease in cost; + is an increase in cost)

Reduction in piles:	- 2 @ $2,000 =	-$2,000
Increase in pile cap	$500 =	$ 500
Auger piles	$500 =	$ 500
Total modification cost (savings):		- $1,000

Design Team

Water line	50 man days @ $300/ day =	$15,000
Structure Redesign:	5 man days @ $300/ day =	$1,500
Subtotal Design Modification Cost (added to project)		$16,500
Total design modification cost increase, or - SUE:		-$15,500 (12)

Construction contract time: (how much time is added into redesign project overall)

Using caution around pipe	+ 2 days @ $2,000 =	-$4,000
for relocating water line	+ 120 days @ $2,000 =	$240,000
Total construction contract time savings:		$236,000 (1B)

Total SUE savings: $802,500

Table 4. Specific Projects Studied (Continued)

Specific Project - **#5**: B-2831: 8.1492201

Project's Title: High Point Bridge Replacement _____ Year SUE Program Began: ____1991_
Project's Location: _Guilford Co. _____State: __NC_____
Name of Person Completing Questionnaire: __Roger Worthington____ Phone:(919) 250-4128
Cost of the Project: __$797,604.00 Const Bid Price _____
Cost of Engineering: _____
Cost of Right-of-Way: _____
Cost of Designating: _____$6,857.65___ Locating: __$1931.91_ Total SUE _$8,789.50____
Description (Summary) of the Project: _____
_The project was a bridge replacement over a RR in the busy downtown area of High Point. Unique scheduling constraints required that the project be completed in a short construction season. Due to short construction season it was decided to use SUE to locate utilities to reduce the potential for construction delays. Also, the project is in the old part of town where many old utilities are located and records are minimal at best. Use of SUE permitted the utilities to be located with minimal disruption to traffic.
Resident Engineer: C. D. Kimes _____Phone (336) 334-3297
Project Manager (SHAs): _____Phone: _____
Designer/ Consultant: _____Phone: _____
SUE Consultant: __SoDeep # NCM4217_____Phone: _____
Contractor: _Lee Construction Corp. _____Phone: _____
Utility Co.: __City of High Point _____Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations	Yes, no $	Yes, no $ (1)		
2. Reduced project delays due to utility relocates	Yes (2, see 3)			
3. Reduced construction delay due to utility cuts	$135,000 *(2&3)			
4. Reduced contractor's claims & change orders	Yes, no $			
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts	Yes, no $			
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design				
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency	Yes, no $			
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage	Yes, no $			
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				

Savings analysis: $135,000 / $8789.50 = $15.36

(*2 and 3) The primary utilities located in the project area were sewer, water, gas, and phone cable. The schedule constraints placed on the project were due to the spring and fall furniture markets that occur in High Point, the "furniture capital of the world." Impeding these markets was something that must not be permitted to happen. Daily delays and detours of traffic are estimated at $45,000 per day. This figure does not include lost business revenues, which are not possible to estimate. Utilization of SUE is estimated to save 3 days of delays.

Savings: 3 days X $45,000 = $135,000 *(2 & 3)

Due to the short construction season, it was decided to use SUE to locate utilities to reduce the potential for construction delays. Also, the project is in the old part of town where many old utilities are located with minimal records. SUE was able to locate with minimal disruption to traffic all the utilities in the area of the project.

(1) The project did relocate some utilities and some money was saved using one contractor for the relocation work. It was not possible to estimate this amount. (1)

The project involved considerable risk due to the furniture market. The detour would cost an estimated $45,000/ day, and could have had caused a minimum 3 days delay without the utilization of SUE.

Table 4. Specific Projects Studied (Continued)

Specific Project - #6: I-306CB: 8.T351206

Project's Title: I-85, Guess Road Interchange Year SUE Program Began: 1991
Project's Location: Durham State: NC
Name of Person Completing Questionnaire: Murray Howell Phone: (919) 733-7932
Cost of the Project: $852,505.00 Const Bid Price
Cost of Engineering:
Cost of Right-of-Way:
Cost of Designating: Locating: Total SUE $74,696.21
Description (Summary) of the Project: Project mainly consisted of the construction of a service road parallel to I-85 near Durham. Service road was connected to I-85.

Project Manager (SHAs): Utility Agent: Murray Howell Phone: (919) 733-7932
Designer/ Consultant: Resident Engineer: T. A. Parrott Phone:
SUE Consultant: SoDeep # Phone:
Contractor: Nello L. Teer Company Phone:
Utility Co.: Phone:

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations	Yes, no $	*$8,525 (1)		
2. Reduced project delays due to utility relocates	Yes, no $	*$8,525 (2)		
3. Reduced construction delay due to utility cuts	Yes, no $	*$8,525 (3)		
4. Reduced contractor's claims & change orders	Yes, no $	*$8,525 (4)		
5. Reduced delays caused by conflict redesign		*$8,525(5)		
6. Reduced accidents & injuries due to line cuts				
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		*$8,525 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE	Yes, no $			
21.Right-of-Way acquisition, costs				
22.				

Savings analysis: $51,150 / $74,696.21 = $0.68

SUE was employed to locate water, sewer, gas, and phone and other cables along the project's length. Utility location was critical to the design and scheduling of the project. There was a time limit on the duration of the project and delays to the project could not be permitted to happen. SUE techniques were able to locate the utilities at all depths and reassure the design of the project. The project is close to completion as of July 1998, and no significant utility conflict delays have been encountered.

* (1) Cost savings projected to be 1 percent of the project's cost = $8,525.00 *
* (2) Cost savings projected to be 1 percent of the project's cost = $8,525.00 *
* (3) Cost savings projected to be 1 percent of the project's cost = $8,525.00 *
* (4) Cost savings projected to be 1 percent of the project's cost = $8,525.00 *
* (5) Cost savings projected to be 1 percent of the project's cost = $8,525.00 *
* (12) Cost savings projected to be 1 percent of the project's cost = $8,525.00 *

Total projected cost savings: = $51,150.00

Table 4 - Specific Projects Studied (Continued)

Specific Project - #7: I-905A: 8.1300503

Project's Title: _I-95 @ Halifax & Northhampton ___ Year SUE Program Began: ____1991_
Project's Location: _Halifax _____ State: _NC_____
Name of Person Completing Questionnaire: __Dave Boyd_____ Phone: (919) 733-4420
Cost of the Project: _$28,093,744.00 Const Bid Price _____
Cost of Engineering: _____
Cost of Right-of-Way: _____
Cost of Designating: ___$4,113.88___ Locating: _$4,325.00_ Total SUE ___$8,438.00 ____
Description (Summary) of the Project: The project involved replacing three bridges on I-95. The bridge at US 158 had some utilities parallel to US 158. These utilities consisted of a 6" plastic coated steel gas line, a phone conduit 6 way multi-tile duct, and a CATV cable. Designers were concerned where the pile bents were to go and needed accurate location to avoid conflict with the buried utilities. If not, it would be required to relocate the gas, phone, and TV cable lines. The designers did not want to hit the gas line. The span under the bridge bent would require about 100' of the utilities to be relocated. NCDOT determined that the utilities could remain in-place, by utilizing the information that the utilities were as submitted by the SUE contractor. The utilities were test holed for design purposes and flagged during construction. Ten (10) test holes were made for the project, 3 for each line and one to check on the location of a power cable. No utility cuts or other problems were encountered during construction.
Resident Engineer: D. W. Jerrigan
Project Manager (SHAs): _____ Phone: _____
Designer/ Consultant: _____Dave Boyd _____Phone: (919) 733-4420
SUE Consultant: _SoDeep # NCM4216_____Phone: _____
Contractor: _Gilbert Southern Corp. _____Phone: _____
Utility Co.: _____Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$14,000 (1)		Yes, no $
2. Reduced project delays due to utility relocates				
3. Reduced construction delay due to utility cuts	$2,000 (3)			
4. Reduced contractor's claims & change orders		* $5,000 (4)		
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts				
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids		Yes, no $		
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$3,000 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $24,000/$8,438 = $2.84

(1) Cost to relocate the gas line and phone duct is estimated at:

$ 40.00/foot x 100 feet =	$4,000
$100.00/foot x 100 feet =	$10,000
Subtotal	$14,000 (1)

(3) Reduced delay costs estimated at:

$ 2 weeks @ $1,000/ week = $2,000 (3)

(4) Reduced claims cost:

* $5,000 is a projected cost (4)*

(12) Reduced project design cost:

10 days @ $300/day design team cost = $3,000 (12)

Table 4. Specific Projects Studied (Continued)

Specific Project - **#8**: K-2800: 8.1943301

Project's Title:__I-40 Welcome Center_____ Year SUE Program Began: ____1991_
Project's Location: _Haywood County _____State: _NC_____
Name of Person Completing Questionnaire: __Roger Worthington ____Phone:(919) 250-4128
Cost of the Project: _$1,668,721.00 Const Bid Price _____
Cost of Engineering: _____
Cost of Right-of-Way: _____
Cost of Designating: _____ Locating: _____ Total SUE __$6917.58_
Description (Summary) of the Project: __The project consisted of the rehabilitation of rest stations, complete with upgrading of utilities, including water and sewer lines. Decelleration and acceleration lanes were rebuilt along with some paving. The rest stations were enlarged as part of the project. _____

Resident Engineer: W. K. Braswell
Project Manager (SHAs): _____Phone: _____
Designer/ Consultant: _____Phone: _____
SUE Consultant: _SoDeep #NCT3600_____Phone: _____
Contractor: _Lyons Construction Corp. _____Phone: _____
Utility Co.: _____Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$100,000 (1)		
2. Reduced project delays due to utility relocates				
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders				
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts				
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design	Yes, no $	Yes, no $		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $100,000/ $6917.58 = $14.37

SUE was utilized to televise the existing sewer line under the interstate. The existing sewer line had sagged on each side, but was serviceable between its ends. Therefore, SUE revealed that most of the existing sewer encasement could be retained. This meant that DOT could replace the sewer line without reboring under I-40. This saved the installation of a tunnel 150 feet in length. Televising showed that the encasement section under I-40 was serviceable and could be allowed to remain in place. The water lines were found to be in the encasement and could also be replaced without additional boring. Records of the water line, sewer line, and encasement were non-existent.

The resulting cost savings is:

150 feet x $600/ foot (plus encasement pipe cost) = $100,000 (1).

Table 4. Specific Projects Studied (Continued)

Specific Project - #9: R-2000CA: 8.U401719

Project's Title: Raleigh Outer Loop Year SUE Program Began: 1991
Project's Location: Wake CO. State: NC
Name of Person Completing Questionnaire: Phone:
Cost of the Project: $18,740,421.00 Const Bid Price
Cost of Engineering:
Cost of Right-of-Way:
Cost of Designating: $25,578.00 Locating: Total SUE $25,578.00
Description (Summary) of the Project: The project included the construction of a 4 lane Freeway on new location from NE US 70 to SW of SR 1826 (Ray Road). Interchanges were included at both ends of the project. The length of the project is three miles, most of the length is through and surrounded by open fields with little potential utility conflicts. There was one major utility crossing and 4 minor crossings along the length of the project. Utility crossings were located at the ends of the project at the interchange locations.

Resident Engineer: Shannon. Sweitzer / Tim Cooney Phone: (919) 840-0914
Project Manager (SHAs): Phone:
Designer/ Consultant: Phone:
SUE Consultant: SoDeep # Phone:
Contractor: Blythe Construction, Inc.: Tim Michael Phone: (919) 563-9366
Utility Co.: Phone:

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations	*$9,370 (1A)	*$9,370 (1B)		
2. Reduced project delays due to utility relocates	Yes, no $	*$9,370 (2)		
3. Reduced construction delay due to utility cuts	Yes, no $	*$9,370 (3)		
4. Reduced contractor's claims & change orders				
5. Reduced delays caused by conflict redesign		*$9,370 (5)		
6. Reduced accidents & injuries due to line cuts				
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		*$9,370 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				
22.				

Savings analysis: $56,220 / $25,578 = $2.20

The utility contractors were very active in project meetings. The prime contractor prepared an estimated schedule. SUE was used by the project management team in cooperation with the projects' contractors to minimize utility conflicts. This process has worked well on the project.

In the new road locations around the town, utility conflicts were found not to be extensive and not much utility conflict was found. Since SUE was used for designating, only horizontal locations were found. Normally, depth locations indicate potential problems where they are located on a project. On this project designating proved to provide sufficient information.

No delay-causing utility conflicts were found yet on the project, which is still under construction as of July 1998. The utilities were cooperative with the contractor in conducting field locating. Some of the locations involved finalizing the design of the project, but this has been accomplished without delays to the contractor.

The relocation of utilities was accomplished without delays to the contractor. The gas main was relocated and the existing main was removed. The copper phone cable was relocated. All of this work was completed without delays. Project personnel expressed the opinion that they can't imagine relocating utilities without locating existing utilities with SUE.

While savings on this project are projected, they are real and realistic.

* (1A & 1B) Cost savings projected to be 0.0005 of the project's cost, or:
$18,740,421.00 x 0.0005 = $9,370.00 *

* (2) Cost savings projected to be 0.0005 of the project's cost, or:
$18,740,421.00 x 0.0005 = $9,370.00 *

* (3) Cost savings projected to be 0.0005 of the project's cost, or:
$18,740,421.00 x 0.0005 = $9,370.00 *

* (5) Cost savings projected to be 0.0005 of the project's cost, or:
$18,740,421.00 x 0.0005 = $9,370.00 *

* (12) Cost savings projected to be 0.0005 of the project's cost, or:
$18,740,421.00 x 0.0005 = $9,370.00 *

Total projected savings: $56,220.00

Table 4. Specific Projects Studied (Continued)

Specific Project - **#10**: R-2000CB:

Project's Title:__Raleigh Outer Loop_____ Year SUE Program Began: ____1991_
Project's Location: _Wake Co. _____ State: ____NC_____
Name of Person Completing Questionnaire: _____Wiley Jones ____Phone: (919) 840-0914
Cost of the Project: _$19,831,401.is bid cost_____
Cost of Engineering: _____
Cost of Right-of-Way: _____
Cost of Designating: ___$90,307.00____ Locating: _____ Total SUE __$90,307.00__
Description (Summary) of the Project: Project involved the construction of a 6 lane freeway on a new location from SW of SR 1826 (Ray Rd.) to East of NC 50. The length of the project was 2.6 miles. Also included in the project was the construction of interchanges at both ends of the project, including a tie-in with project R-2000CA. Most of the project was surrounded by more developed areas with some utility crossings.
Resident Engineer: Wiley Jones _____Phone: (919)840-0914
Project Manager (SHAs): _____Phone: _____
Designer/ Consultant: ____SoDeep #_____Phone: _____
SUE Consultant: _____Phone: _____
Contractor: _____S. T. Wooten __Arthur Collie, Supt. _____Phone: (919)845-4741
Utility Co.: _____Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		*$19,831 (1)		
2. Reduced project delays due to utility relocates		*$19,831 (2)		
3. Reduced construction delay due to utility cuts		*$19,831 (3)		
4. Reduced contractor's claims & change orders		*$19,831 (4)		
5. Reduced delays caused by conflict redesign		*$19,831 (5)		
6. Reduced accidents & injuries due to line cuts		$75,000 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		*$19,831 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				
22.				

Savings analysis: $193,986.00 / $90,307.00 = $2.15

The location at NC 50 has a heavy amount of traffic volume and is congested with a number of utilities. SUE was employed to avoid utility conflicts at this location and to facilitate the relocation of utilities where required. For example, conflicts with Bell South were avoided and the relocation of, and conflicts with, utilities were handled with success on the project. There were three (3) major road crossings on the project. SUE was successfully used to locate utility lines as much as possible before construction, and assist with utility replacement and upgrading, which helped prevent delays to the project As of July 1998, the project is 10 percent complete and no conflicts with utilities have occurred that have resulted in a claim.

SUE was used to cooperate with utility companies to avoid delays. By working with the phone company to bury a replacement cable for a phone cable found by SUE, possible delays were avoided. In summary, if this line had not been located and marked by SUE, it would likely have been cut, which would have resulted in a delay.

Project meetings have been utilized in conjunction with SUE to sort out potential conflicts with utility lines. SUE has helped with project design at utility crossings, increased drawing accuracy, and located unknown utility features. For example, SUE helped find a water meter, and avoided a potential delay.

While most savings on this project are projected, the projected savings are real and realistic. The accident savings is taken to be an estimated savings. Items with projected savings are taken to be 0.001 (0.1 of a percent) of the project's cost.

* (1) Cost savings projected to be 0.001 of the project's cost, or:
  $19,831,401.00 x 0.001 = $19,831.00 *
* (2) Cost savings projected to be 0.001 of the project's cost, or:
  $19,831,401.00 x 0.001 = $19,831.00 *
* (3) Cost savings projected to be 0.001 of the project's cost, or:
  $19,831,401.00 x 0.001 = $19,831.00 *
* (4) Cost savings projected to be 0.001 of the project's cost, or:
  $19,831,401.00 x 0.001 = $19,831.00 *
* (5) Cost savings projected to be 0.001 of the project's cost, or:
  $19,831,401.00 x 0.001 = $19,831.00 *
(6) Cost savings estimated to be:
  $25,000 x 3 = $75,000
* (12) Cost savings projected to be 0.001 of the project's cost, or:
  $19,831,401.00 x 0.001 = $19,831.00 *

Total SUE savings: $193,986.00

Table 4. Specific Projects Studied (Continued)

Specific Project - **#11**: R-218A:

Project's Title:___Bethel Bypass _____ Year SUE Program Began: ____1991_
Project's Location: _Pitt CO., Greenville _____State: __NC_____
Name of Person Completing Questionnaire: __Corey Bousquet ____ Phone☺ (919) 250-4128
Cost of the Project: _____$13,843,580 Bid Cost_____
Cost of Engineering: _____
Cost of Right-of-Way: _____
Cost of Designating: _____ Locating: _____ Total SUE ___$7978.90___
Description (Summary) of the Project: The project was on US 13 and NC 11 from NC 903 at Greenville NW loop to Bethel Bypass at NC 30 South of Bethel. The length of the project 8.057 miles. The projected consisted of widening the existing roadway to 4 lane divided facility, including drainage structures, with a by-pass of Bethel.

Project Manager (SHAs): _Utility Agent: O'hare Parker _____ Phone: (919) 733-7932
Designer/ Consultant: _____Carter Burgess _____ Phone: _____
SUE Consultant: __SoDeep # NCL4967_____Phone: _____
Contractor: __ Barnhill Contracting Co., Taraboro, NC _____Phone: _____
Utility Co.: _____Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations	Yes, no $	$240,000 (1)		
2. Reduced project delays due to utility relocates		Yes, no $		
3. Reduced construction delay due to utility cuts		Yes, no $		
4. Reduced contractor's claims & change orders		Yes, no $		
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts	Yes, no $			
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$3,000 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				
22.				

Savings analysis: $243,000 / 7978.90 = $30.45

SUE was used to check the elevations of the existing force main which was in the project's right-of-way for a length of 9000 meters. The normal procedure employed in the past was to have the entire length of the force main relocated. SUE was able to produce the data needed to find the conflicts with the design of the project and design around them as much as possible. The relocation of the force main was limited to 3000 meters, thus eliminating 6,000 meters of force main from unnecessary relocation. The cost savings are:

(1) 6000 meters X $40 per foot = $240,000 (1)

(12) Design savings: 10 man-days @ $300.00 / day: (12)

10 x $300 / day = $3,000.00

The utilization of SUE was estimated to have prevented damage to utility lines, reduce accidents due to utility line hits, and prevent delays to the project.

Table 4. Specific Projects Studied (Continued)

Specific Project - **#12**: R-2425A: 8.1402105

Project's Title:__Capital Blvd., Raleigh _____ Year SUE Program Began: ____1991_
Project's Location: _Wake CO _____State: _NC_____
Name of Person Completing Questionnaire: Steve McKee, Design, ServicesPhone:(919)2504128
Cost of the Project: _$10,109,782.00 Const Bid Price _____
Cost of Engineering: _____
Cost of Right-of-Way: _____
Cost of Designating: _____ Locating: _____ Total SUE __$98,717.46__
Description (Summary) of the Project: _____Project is located along Capital Blvd., US 401, from US 1 & 401 Interchange in North Raleigh to Raleigh City limits South of SR 2041; a distance of 1.381 miles. The existing roadway was widened to a six lane divided facility, including drainage structures.
Resident Engineer: Ron Hancock _____Phone: (919) 773-2859
Project Manager (SHAs): _____Phone: _____
Designer/ Consultant: __ Lassiter / Robinson: Roadway Design _____ Phone: (919) 250-4016
SUE Consultant: _SoDeep #s NCM3081_____Phone: _____
Contractor: _S. T. Wooten Corp. _____Phone: _____
Utility Co.: _____Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$80,000 (1)		
2. Reduced project delays due to utility relocates	Yes, no $			
3. Reduced construction delay due to utility cuts	Yes, no $	* $50,548 (3)		
4. Reduced contractor's claims & change orders				
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts	Yes, no $			
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods		$54,000 (9)		
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$15,000 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				
22.				

Savings analysis = $199,548 / $98,717.46 = $2.02

SUE was used to locate the depth of the water line. By checking the actual depth, designers were able to modify the design of the project to avoid unnecessary relocation of a 16-inch water line. By using the information obtained from SUE, it was determined that some of the water line would not have to be relocated. 5,000 feet of 16-inch water line would not have to be relocated at a savings of $50/ foot. The cost savings are:

(1) $5,000 feet x $50 / foot = $80,000.00 (1)

Few field conflict problems have been reported as of July 1998, with the project being reported by the resident engineer at 60 percent complete. The possibility exists for additional savings in item number 3.

Cost savings projected to be:*

$10,109,782.00 X 0.005 = $50,548.00* (3)

(9) Cost savings due to improved methods:

The project's plans originally called for the construction of a pedestrian tunnel with an encased water line going under the tunnel. Using SUE negotiations with the city utility and the contractor resulted in a savings by allowing the water line to go on top of the box culvert. This resulted in a project change order for a $54,000 reduction in project cost. The savings were due to deletion of the casing and fittings, and reducing the class of pipe.

$54,000.00 (From project Change Order) (9)

(12)
Using SUE to determine elevations at the drainage crossings allowed the design of the project to work, and the design effort to be efficient. Without SUE, there would have been utility cuts, delays, or slow productivity. Design cost savings are:

50 man-days @ $300 / day

50 X $300 = $15,000 (12)

Table 4. Specific Projects Studied (Continued)

Specific Project - **#13**: R-2826: 9.8050732

Project's Title: Fuquay-Varina Loop Year SUE Program Began: 1991
Project's Location: Wake CO State: NC
Name of Person Completing Questionnaire: Brian Harrington Phone: (919) 733-9499
Cost of the Project: $2,949,341.00 Const Bid Price
Cost of Engineering:
Cost of Right-of-Way:
Cost of Designating: Locating: Total SUE $22,760.11
Description (Summary) of the Project: 1.866 miles from US 401 South to US 401 North of SR 1107, East Academy Street. Project is a 2 lane roadway on a new location forming a loop of 401 bypass around the town, including tie-ins at each end of the project.

Resident Engineer (SHAs): Brian Harrington Phone: 919-733-9499
Designer/ Consultant: Sandra Stepney / Casey Phone: (919) 250-4016
SUE Consultant: SoDeep #s NCM3766 & NCL4534 Phone:
Contractor: S. T. Wooten Corp., Jay Stem, Estimator Phone: (919) 779-9752
Utility Co.: Phone:

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		*$6,000 (1)		
2. Reduced project delays due to utility relocates	$5,000 (2)			
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders	$4,000 (4)			
5. Reduced delays caused by conflict redesign	$4,000 (5)			
6. Reduced accidents & injuries due to line cuts				
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids		Yes, no $		
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design	$5,000 (12)			
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		*$3,000		
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				
22.				

Savings analysis: $27,000 / $22,760.11 = $1.19

No design changes related to utility conflicts were encountered during construction. No problems as far as roadway design (hydraulics does drainage) were encountered during construction. Right-of-Way limitations required that the underground utilities had to be located in less Right-of-Way width, which was effectively accomplished with the use of SUE. Some utility line adjustments had to be accomplished in the field during construction. Some movement of the storm drainage system was made. The adjustments and movements were facilitated with the use of SUE.

* Utility line relocation savings were taken to be: $6,000 (1)*

(2) Project delay cost is $1,000 per day. Time savings for utility relocates was 5 days.
Time savings = 5 days X $1,000 / day = $5,000 (2)

(4) Contractor's claim & change order cost is $2,000 / day. Time savings was 2 days.
Time savings = 2 days X $2,000 / day = $4,000 (4)

(5) Conflict redesign cost is $2,000 / day. Time savings was 2 days.
Time savings = 2 days X $2,000 / day = $4,000 (5)

(12) Project design cost is $1,000 / day. Time design savings was 5 days.
Time savings = 5 days X $1,000 / day = $5,000 (12)

* (19) Cost savings projected on 0.1 percent of the cost of the project:

$2,949,341.00.00 X 0.001 = $3,000.00 (19) *

Total SUE savings = $27,000

Table 4. Specific Projects Studied (Continued)

Specific Project - **#14**: R-2908: 6.951016

Project's Title:____US64 Multi lane Highway _____ Year SUE Program Began: ____1991_
Project's Location: _Henderson _____State: _NC_____
Name of Person Completing Questionnaire: ____Ron Wilkins_____ Phone: (919)250-4128
Cost of the Project: _$2,509,470.00 Const Bid Price _____
Cost of Engineering: _____
Cost of Right-of-Way: _____
Cost of Designating: _____ Locating: _____ Total SUE __$9910.80____
Description (Summary) of the Project: Widening / reconstruction of US 64 from North of I-26 to East of SR 1574 (Fruitland Dr.). Length of the project was 1.005 miles. 2 lanes were widened to 5 lanes, including a center turning lane, with drainage ditches and structures, and culvert extensions

Project Manager (SHAs): _Ron Wilkins, Design Services_____ Phone: (919) 250-4128
Designer/ Consultant: _____Phone: _____
SUE Consultant: _SoDeep # NCL4491_____Phone: _____
Contractor: __Paving Enterprises, Inc. _Arden, NC _____Phone: _____
Utility Co.: _____Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$24,500 (1)		
2. Reduced project delays due to utility relocates		*$8,000 (2)		
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders				
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts		* $12,000 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design				
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				
22.				

Savings analysis: $45,000 / $9910.80 = $4.54

(1) Using SUE allowed 350 feet of the 16-inch water line to remain in-place and not be relocated as normally would be required. The cost savings, based on $70.00 per foot, is:

350 feet X $70.00 = $24,500.00 (1)

(2)* The excavation portion of the project has been completed as of July 1998. The use of SUE enabled the excavation work to be completed without potential utility conflicts, unnecessary utility cuts, and resulting damages or delays. Based on 4 days time savings at $2,000 per day, the project cost savings are:

4 days X $2,000 / day = $8,000.00 (2)*

(6)* A fiber optic cable was located along the length of the project by SUE. The fiber optic cable was not hit during construction excavation work. Based on a savings of 0.5% of the cost of the project, the projected savings are:

$2,509,407 X).005 = $12,500 (6)*

Total SUE savings: $45,000

Table 4. Specific Projects Studied (Continued)

Specific Project - **#15**: R-84BA: 6.319003T

Project's Title: US 70, Smithville by-pass Year SUE Program Began: 1991
Project's Location: Smithville, Johnston, Co. State: NC
Name of Person Completing Questionnaire: Mike McKeel Phone: (919) 934-5863
Cost of the Project: $11,234,361.00 Const Bid Cost
Cost of Engineering:
Cost of Right-of-Way:
Cost of Designating: Locating: Total SUE $3401.52
Description (Summary) of the Project: 2 lane road made into a bypass of 4 lanes on mostly new location, 95% of the project was new location. The total length of the project was 3.806 miles.

Resident Engineer: Mike. McKeel Phone: (919) 934-5863
Project Manager (SHAs): Phone:
Designer/ Consultant: Phone:
SUE Consultant: SoDeep # NCM3923 Phone:
Contractor: Barnhill Contracting Co., Taraboro, NC Phone:
Utility Co.: Phone:

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations				
2. Reduced project delays due to utility relocates		* $12,000(2)		
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders				
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts				
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design				
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		* $6,000 (19)		
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				

Savings analysis: $18,000 / $3,401.52 = $5.29

(2) * Project designers used SUE to locate the existing utilities in the vicinity of the new bridge supports and footings during construction. Originally some of the utilities were not thought to be in conflict with the bridge supports and footings, but were found to be in conflict after the start of construction. Of course, SUE is needed to find out what is in conflict before work is started in a certain area. SUE was used to find out the required distances from the bridge footings to the crossing water line, along with the vertical clearances. There were several locations where water lines crossed the project. SUE supplied the required information to the designers of the project to redesign the footings to miss the water line. Though SUE was employed late in the project, savings were still obtained for the use of SUE. There were no claims or change orders as a result of utility conflicts on the project. The use of SUE resulted in projected savings from project delays due to utility relocates equal to 4 days at $3,000 per day. The projected cost is:

4 days X $3,000.00 = $12,000* (2)

(19) SUE was used primarily on the US 301 crossing with overpass. Complex design of utility relocations was required, and SUE was needed for accuracy in the relocation redesign. SUE activities located an unknown gas line at the bridge location. The risk management savings are projected to be about 0.05 percent, or 0.0005 and are:

11,234,361.00 X 0.0005 = $6,000.00

Total SUE savings: $18,000

Table 4. Specific Projects Studied (Continued)

Specific Project - **#16**: U2202: 8.1750802

Project's Title:_____NC 105 widening _____ Year SUE Program Began: ____1991_
Project's Location: _Watauga County, Boone, _____State: _NC_____
Name of Person Completing Questionnaire: _____Frank Gioscio __ Phone: (828) 265-5373
Cost of the Project: __$5,002,221.00 Const Bid Price _____
Cost of Engineering: _____
Cost of Right-of-Way: _____
Cost of Designating: _____ Locating: _____ Total SUE ___$5778.52__
Description (Summary) of the Project: _____
__ US 221 from US 221& 321 to US 421 & NC 194
__Project was 1.1 miles in length, consisting of widened from 2 lanes and shoulders to 5 lanes (center turning lane), and curb and gutters, with sidewalks on one side of the project. Project included storm drainage structures and piping. SUE was used to locate utilities in the Right-of-Way.

Resident Engineer: Frank. J. Gioscio _____Phone: (828) 265-5373
Project Manager (SHAs): _____Phone: _____
Designer/ Consultant: _____Phone: _____
SUE Consultant: _SoDeep #NCM3277_____Phone: _____
Contractor: _Brown Bro. Construction Co. _Zionville, NC _____Phone: _____
Utility Co.: _____Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations	Yes, see #20			
2. Reduced project delays due to utility relocates	Yes, see # 20	Yes, see # 20		
3. Reduced construction delay due to utility cuts	Yes, see # 20			
4. Reduced contractor's claims & change orders	Yes, see # 20			
5. Reduced delays caused by conflict redesign		Some, no $		
6. Reduced accidents & injuries due to line cuts				
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design	Yes, see #20			
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE	* $6,000.00			
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $6,000/ $5,778.52 = $1.04

Basically, most of the utilities for this project were located overhead. New water and sewer lines were included as part of the project, thus it was assumed that not much accuracy was required for the underground locations. 4600 feet of 16" D.I. water line was installed as part of the project. The D.I. line replaced an existing 12" AC line. SUE verified that the line had to be replaced. Old surveys and drawings were mostly nonexistent and there were no as-builts for the water line.

For the above reason, the horizontal and vertical accuracy of the SUE information was somewhat limited and gave only the general location, or quality level "C" information, on the existing water and sewer lines. While this information was beneficial, it could have been better, in that SUE could have provided more detail if quality level "B" information had been requested..

In addition, due to the lack of exact utility line location, it was not known where signals and signs could be safely located.

Savings on items 1, 2, 3, 4, 5, and 12:

The project's excavation work is 95% complete as of July 1998. As of July 1998, no significant delays due to encounters with unexpected utilities have occurred. A couple of minor conflicts were encountered, but no delays were incurred since the contractor was able to work on other parts of the project while the conflicts were resolved. It was felt that the use of SUE helped avoid a serious delay due to utility conflicts. Also, SUE helped avoid redesign costs.

* (20) The estimated cost savings of the use of SUE on items 1, 2, 3, 4, 5, and 12 is estimated to be $6,000.00

Table 4. Specific Projects Studied (Continued)

Specific Project - **#17**: U-2538: 8.1571003

Project's Title:_____ Year SUE Program Began: ____1991_
Project's Location: _Randolph _____State: _NC_____
Name of Person Completing Questionnaire: ____Robert Wilcox_____ Phone: (919) 250-4128
Cost of the Project: ___$7,575,932.00 Const Bid Price _____
Cost of Engineering: _____
Cost of Right-of-Way: _____
Cost of Designating: _____ Locating: _____ Total SUE __$3918.73____
Description (Summary) of the Project: Description (Summary) of the Project: _High Point, NC, along US 311 from I-85 To just East of SR 1747; a distance of 2.971 miles. Project included widening of existing 2 lane roadway to a 5 lane facility with turning lane. Project contained curb and gutter along the length of the facility. and drainage structures. There were three culverts for drainage crossing the project together with a pedestrian culvert
Resident Engineer: _____Doug Kimes, David Crotts _____Phone: (336) 334-3297
Project Manager (SHAs): _____Phone: _____
Designer/ Consultant: _Design Services: Robert Wilcox _____Phone: (919) 250-4128
SUE Consultant: ___SoDeep # NCM4304_____Phone: _____
Contractor: __Santaro Industries, Inc. _____Phone: _____
Utility Co.: _____Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		Yes, no $		
2. Reduced project delays due to utility relocates	*$4,000 (2)			
3. Reduced construction delay due to utility cuts		Yes, no $		
4. Reduced contractor's claims & change orders		Yes, no $		
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts				
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		Yes, no $		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage		Yes, no $		
19. Induced savings in risk Mgmt., & insurance		*$7575 (19)		
20. Introduced concept of comprehensive SUE	Yes, no $			
21.Right-of-Way acquisition, costs				
22.				

Savings analysis: $11,575 / 3918.73 = $2.95

* (2) 2 days time saved on project delays due to utility relocates at $2,000 per day. There were a lot of conflict locations with the 8-inch gas main along the length of the project. The conflicts were resolved and the gas line was relocated at several locations without project delay. The gas line was hit several times by the contractor with the cause of the hit being contractor's personnel. Savings projected as:

2 days X $2,000 / day = $4,000 (2) *

* (19) Cost savings projected on 0.1 percent of the cost of the project:

$7,575,932.00 X 0.001 = $7575.00 (19) *

Table 4. Specific Projects Studied (Continued)

Specific Project - **#18**: U-2559: 9.8052015

Project's Title: Capital Blvd, US 1 _____ Year SUE Program Began: ____1991_

Project's Location: Wake CO. State: NC

Name of Person Completing Questionnaire: ____Greg Stevens_____ Phone: (919) 250-4128

Cost of the Project: __$8,048,488.00 _____

Cost of Engineering: _____

Cost of Right-of-Way: _____

Cost of Designating: _____ Locating: _____ Total SUE __$61,099.76__

Description (Summary) of the Project: __Project consisted of widening four existing lanes to 6 lanes with turning lanes where needed. Project included drainage structures. SUE was used to determine that the 24" sewer line did not need relocation, and 5,000 of water line did not need relocation.

Resident Engineer: R. A. Hancock _____Phone (919) 773-2859

Project Manager (SHAs): _____Phone: _____

Designer/ Consultant: _____Phone: _____

SUE Consultant: _SoDeep #s NCM3574, NCM3106, NCM 3234 ____Phone: _____

Contractor: _ Nello L. Teer Company _____Phone: _____

Utility Co.: _____Phone: _____

Cost Items and Factors 24-inch sewer line.	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations	Yes, no $	$60,000 (1)		
2. Reduced project delays due to utility relocates	Yes, no $			
3. Reduced construction delay due to utility cuts	Yes, no $			
4. Reduced contractor's claims & change orders	Yes, no $			
5. Reduced delays caused by conflict redesign	$20,000 (5)			
6. Reduced accidents & injuries due to line cuts				
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$9,000 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage		$20,000 (18)		
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE		Yes, no $		
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis = $384,000/$61,099.76 = $6.29

Cost Savings on the 24-inch sewer line. (See next sheet for savings on the 16-inch Ductile Iron waterline.)

(1) A 24-inch sewer line crossing Capital Blvd. was thought to be in conflict and would have to be relocated at an estimated cost of $60,000.00. Using SUE quality level "A" information, the exact location and elevation of the sewer line was obtained. This SUE information was used to determine that the design was adequate and the sewer would not have to be relocated. This saved Relocation cost savings of $60,000 (1)

(5) Estimated times savings:

10 days time to redesign X $2,000 per day = $20,000 (5)

(12) Cost savings:

Based on a three man design team taking 10 days to redesign the project --

30 man days @ $300 / day = $9,000.00 (12)

(18) Estimated environmental savings based on cost of clean-up and by-pass pumping: =

$20,000 (18)

Continued From Specific Project - #18: U-2559: 9.8052015

Cost Items and Factors for 16-inch Ductile Iron

Cost Items and Factors - 16-inch D. I. water line	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$250,000 (1)		
2. Reduced project delays due to utility relocates				
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders		Yes, no $		
5. Reduced delays caused by conflict redesign		Yes, no $		
6. Reduced accidents & injuries due to line cuts				
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers		Yes, no $		
9. Improved contractor productivity & methods		Yes, no $		
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$25,000 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency		Yes, no $		
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				
22.				

(1) Cost analysis for 5,000 feet of 16-inch D.I. water line that did not need relocation:

5,000 feet X $50/ft. = $250,000 (1)

(12) The design cost is taken as10% of $250,000 or $25,000 (12)

Total SUE savings from 24-inch sewer line and 16-inch Ductile Iron water line: $384,000

Table 4. Specific Projects Studied (Continued)

Specific Project: - **#19:** U-2824A: 8.2404001

Project's Title:_____Duraleigh Road_____ Year SUE Program Began: ____1991_
Project's Location: _Wake CO. _____State: _NC_____
Name of Person Completing Questionnaire: ____R. A. Hancock____ Phone: (919) 773-2859
Cost of the Project: ___$1,479,357.00 _____
Cost of Engineering: _____
Cost of Right-of-Way: _____
Cost of Designating: _$53,922.57_ Locating: _$2,356.00_ Total SUE __$56,279.00____
Description (Summary) of the Project: _Two lanes of Urban were widened to four lanes plus a center turning lane. The project length was 1 mile, project went from SR 1664, Duraleigh Road, and SR 1670, Blue Ridge Road, to SR 1649, Ebenezer Road._

Resident Engineer: R. A. Hancock _____Phone: (919) 773-2859
Project Manager (SHAs): _____Phone: _____
Designer/ Consultant: _____Phone: _____
SUE Consultant: _SoDeep #s NCM3566, NCM3979 & NCL4436 ____Phone: _____
Contractor: _Rifenburg Construction ___Glenn Weiss, PM, Durham __ Phone: (919) 598-6921
Utility Co.: _____Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$25,000 (1)		Yes
2. Reduced project delays due to utility relocates				Yes
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders				
5. Reduced delays caused by conflict redesign	$8,000 (5)			
6. Reduced accidents & injuries due to line cuts		$14,800 * (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers			$5,000 (8) *	
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids		call contr		
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$7,500 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency		$1,000 (16)		
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				

Savings Analysis - $61,300/$56,279 = $1.09

(1) SUE was used to analyze, by obtaining designating (Quality Level "B") information, the length of the project where utility lines (mostly water) could be in conflict, or 4,200 feet. It was determined and field-verified that only one place required locating. Vertical locations were obtained as needed at the location of a drainage structure where the water line could not be shut down. Result was that the water line was not in conflict and line could be left in place. This could also be considered risk management. In addition, some relocation would have had to have been done. About 200 feet of the water line at $70 / foot x 200' = $14,00 and 220' of 12" @ $50/' = $11,000. Total $25,00 (1).

(5) Saved 4 days delay time at $2,000 per day.

4 days X $2,000 / day = $8,000 (5)

(6) * Reduced accidents by 1 percent of the project cost. The adjustment of the water line by the city utility was accomplished without an accident or conflict due to the SUE information. No major utility conflicts were encountered in the field during construction.

$1,479,357 X 0.01 = $14,800 (6) *

(8) * The loss of service is projected at $5,000. (8) *

(12) Project redesign is based on 25 man days:

25 man days X $300 / day = $7,500 (12)

(16) Saved some traffic disruption costs by using SUE. Savings are estimated at $1,000 based on traffic volumes. (16)

Table 4. Specific Projects Studied (Continued)

Specific Project - **#20**: U-2910: 9.8101323

Project's Title:_Monroe Road, SR 1009 _____ Year SUE Program Began: ____1991_
Project's Location: _Mecklenburg CO., in Matthews_____ State: __NC _____
Name of Person Completing Questionnaire: _____James R. Cravens Phone: (704) 845-1151
Cost of the Project: _$2,242,685.00 Const Bid Price_____
Cost of Engineering: _____
Cost of Right-of-Way: _____
Cost of Designating: _____ Locating: _____ Total SUE __$27,369.95___
Description (Summary) of the Project: ____The project's length was 1.414 Km. Construction included widening the existing roadway from two lanes to five lanes, with the center lane being the turn lane, in about half of the project, and widening to four lanes in the other half of the project. Curb and gutter, storm drainage structures, and sidewalks on both sides were part of the project. _____
Resident Engineer: James. R. Cravens _____Phone: (704) 845-1151
Project Manager (SHAs): _____Phone: _____
Designer/ Consultant: _____Phone: _____
SUE Consultant: __SoDeep #s NCM3834 & NCM4300 _____Phone: _____
Contractor: APAC, Central Carolina Division, Enrico Cacciatore, Supt. Phone: (704) 527-7179
Utility Co.: _____Phone: _____
_____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$37,966 (1)		
2. Reduced project delays due to utility relocates		$8787 (2)		
3. Reduced construction delay due to utility cuts	$9,000 (3)			
4. Reduced contractor's claims & change orders		Yes, no $		
5. Reduced delays caused by conflict redesign	$9,000 (5)			
6. Reduced accidents & injuries due to line cuts				
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		Yes, no $		
13. Reduced the damage to existing pavements		Yes, no $		
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				
22.				

Savings analysis: $55,753 / $27,369.95 = $2.04

No test holes were included in the initial SUE work during the design stage. SUE data and information were submitted only in xy coordinates, since no time was available for planning. The location of the 16" water line, gas lines, and phone cables were found to be located in the area of the project. Designers needed xyz coordinate information. Potential savings were initially recognized, but were not yet realized. SUE could have saved time, if more lead time would have been available.

On this project, it was possible to employ SUE in the initial construction phases to determine actual utility line conflicts. The use of SUE determined that utility lines did not have to be relocated at three different locations.

205 meters of 500 mm Ductile Iron pipe did not have to be relocated and could be left in place, since conflict with storm drainage structure was avoided. The bid unit price was $185.20 per meter. Total savings:

205 meters X $185.20 / meter = $37,966.00 (1)

29 meters of restrained joint pipe did not have to be relocated and could be left in place, since conflict with storm drainage structure was avoided. The bid unit price was $303.00 per meter. Total savings:

29 meters X $303.00 / meter = $ 8787.00 (2)

Conflict with the water line was avoided when an unexpected water line which was shown in the wrong location was encountered. The line size was indicated on the plans as 6 inches, but was found to be 8 inches and made partly of Ductile Iron and Asbestos Cement. By cooperating and working with the water company, it was determined that the line could be abandoned. Several days of delay to the project were avoided. Total savings:

3 days X $3,000 / day = $9,000.00 (3)

5. Due to poor records, some box structures including a valve box, a fire detector check box, and a service meter were located and then moved with no delays to the project. Total savings:

3 days X $3,000 / day = $9,000.00 (5)

Table 4. Specific Projects Studied (Continued)

Specific Project - **#21**: - R-2406A: 8.T261203

Project's Title:_____ Year SUE Program Began: ____1991_
Project's Location: _ US 17 Onslow County _____State: _NC_____
Name of Person Completing Questionnaire: Ron Wilkins _____ Phone: (919) 250-4128
Cost of the Project: $9,046,526.00 - Const Bid Price _____
Cost of Engineering: _____
Cost of Right-of-Way: _____
Cost of Designating: _____ Locating: _____ Total SUE __$9,253.38 ___
Description (Summary) of the Project: Project was located along US 17 from Holly Ridge and NC 50 to South of SR 1526, near Dixon, NC a distance of 6.67 miles. Project included widening and resurfacing, the existing two lanes were widened to five lanes including a turning lane. Drainage structures with boxes and a box culvert were contained in the project.

Resident Engineer: Pope
Project Manager (SHAs): _____Phone: _____
Designer/ Consultant: Design Services: Roger Worthington, Ron Wilkins Phone:(919) 250-4128
SUE Consultant: ___SoDeep # _____Phone: _____
Contractor: _Barrus Construction Company _____Phone: _____
Utility Co.: _____Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$200,000 (1)		
2. Reduced project delays due to utility relocates				
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders				
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts				
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$20,000 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				

Savings Analysis = $220,000/ $9,253.38 = $23.78

Total length of the project is 6.5 miles with an existing 6" PVC water line located along some of the project. With the aid of SUE information, it was determined that only 1500 linear feet of the water line needed to be relocated. Without this information, approximately 10,000 linear feet of additional water line would have been relocated. The cost of relocation is $20.00 per foot.

(1) The cost savings are: 10,000 feet X $20.00 per foot = $200,000 (1)

Cost of design savings is taken to be 10% of the cost savings (construction cost).

The design savings are: $200,000 X 0.10 = $20,000 (12).

APPENDIX III General Results of Sue in Ohio

Regarding Table 1: The information presented in *Table 1. General Questions for State Highway Agencies and Utilities of Ohio*, was submitted to the ODOT for information and data collection. The results of the questionnaire are shown below.

Table 1. General Questions for State Highway Agencies and Utilities of Ohio

Question	Answer
List the total engineering/ construction budget statewide by year.	FY97, $983+ million FY98, $1005+ million
Supply a list of all projects indicating cost ($), length, type, (interstate, reconstruction, urban, arterial), etc.	Unknown
List the projects using SUE. Indicate designating/locating and the costs for each. Indicate the footage of designating and number of test holes.	Most projects to sale that used SUE were more 11th hour problems. Most projects that used SUE in development are just beginning to go to sale.
Estimate the average time (project duration) for projects using SUE vs. average time for SUE projects.	Unknown
Describe how the SUE program started in your state.	1) Promotional info. from providers and FHWA, 2) Federally funded demo projects, 3) two 2-year (became 3-yr.) Federally funded contracts totaling 2 million, 4) 2 districts separate SUE contract, 5) currently implementing 2 one-half-million statewide contracts.
How is a project selected for the use of SUE?	District Utility Coordinator with Production or Construction input selects.
Amount of $ spent each year on the SUE program in your state.	Unknown
Explain the relationship between utilities and DOT before and after SUE.	
Explain the typical uses of SUE, i.e. designating, locating, planning, utility relocation design, coordination, etc.	Main impetus on early SUE information is to use project design to avoid or mitigate utility involvement, or at a minimum, to make all parties aware of conflicts.
Describe the qualitative benefits of SUE by utility owners, constructors, engineers, and highway departments.	See above
What were utility damages on projects before SUE, or on projects not using SUE?	Unknown
What were the utility damages on projects after SUE was used?	Unknown
What is the cost of a test hole made by traditional means?	Unknown
On SUE projects – what were the type, amount, or cost of utilities not relocated due to *designating* for utilities that had SUE information available to them for their own redesign?	No response
On SUE projects - what were the type, amount, or cost of utilities not relocated due to *locating* for utilities that had SUE information available to them for their own redesign?	No response
On SUE projects - what amount of unknown utilities were found through designating activities?	No response

Question	Answer
What user savings were estimated on SUE projects with time savings?	Hoping to better gauge these at a later date.
Additional Remarks	Some of our districts are totally sold on SUE, but several fall at the other end of the spectra, and we are trying to get the necessary positive results to change them over.

Regarding Table 2. The information presented in *Table 2. Summary of Cost Savings by Selected Project*, summarizes the results of the SUE evaluation of the 14 selected projects in Ohio.

Table 2. Summary of Cost Savings by Selected Project

	Proj.#	SUE Savings	SUE Cost	Savings Analysis
1.	Mansfield	$201,800	$54,365.98	$3.71
2.	Louisville OH	$64,000	$10,738.38	$5.96
3.	Munroe Falls OH	$125,000	$4,463.80	$28.00
4.	Salt Springs Road	$61,000	$5,145.17	$11.86
5.	Struthers OH	$115,000	$29,457.59	$3.90
6.	Fort Washington Way	$1,806,800	$269,615.48	$6.70
7.	Barnesville	$97,400	$4,223.64	$23.06
8.	Bellaire	$865,600	$12,848.44	$67.37
9.	Millersburg	$44,140	$19,839.92	$2.22
10.	Steubenville	$81,500	$26,683.13	$3.05
11.	Cuyahoga Co.	$528,400	$193,283.00	$2.73
12.	Cuyahoga Co.	$147,000	$176,442.00	$0.65
13.	Sprague Road	$62,300	$2279.00	$27.34
14.	Pearl Road	$62,600	$2785.00	$22.48
	Total	$4,219,440.00	$812,170.53	$5.21

Regarding Table 3: On the following pages, *Table 3. Specific Projects Studied*, is presented as a summary of the data and information obtained from the 14 specific projects used in the evaluation study. The projects presented in Table 3 are numbered 1 to 14, with the project number and project name appearing in the second line of the Table title. Information for the Cost Items and Factors contained in Table 3 under the columns Time, Cost, User, and Risk Management Savings was collected by interviews with key project personnel listed in the Table by each specific project. Over fifteen (15) ODOT, SUE provider, and contractor personnel were interviewed in the process of collecting information and data. The information and data are

referenced by line item as noted by a corresponding number in ( ). The Savings Analysis is given for each specific project after the last Cost Item.

Two particular item numbers from Table 3 (#6 and #19) are described here in depth. Asterisks in Table 3 refer specifically to the formulas contained in this description. The description covers accident, insurance, and risk management savings computations for the SUE evaluation.

Item #6. Reduced accidents and injuries due to line cuts.

General liability considerations are presented as savings under Item #6, accident reduction in line cuts. General liability coverage provides protection against accidents such as cutting utility lines, and harm to the general public. Considerable risk exists in excavation work conducted in the vicinity of buried utility lines. Gas lines are cut, or are damaged, resulting in fatal accidents where victims are frequently from the general public.

General liability calculations are made as follows:

The general liability manual rating for Ohio is $35.70 per $1,000 of payroll.

Payroll for urban highway construction varies from 20+% to about 40% of the project cost. For the evaluation, 30% was selected as a representative percentage for urban projects. Rural would be less, so 20% was selected for the percentage on rural projects. These percentages are based on input from highway contractors.

Therefore, if you have a contractor doing excavation in Ohio working on a highway project, the manual annual premium for a job would be:

For an urban project:

Project cost x 0.30 x $35.70 x 1/1,000 =

For a rural project:

Project cost x 0.20 x $69.00 x 1/1,000 =

The amount of the general liability premium is based on the need to pay all the claims resulting from accidents. Not all the accidents are related to excavation work on highway projects, however, a primary concern of the contractor is damage to utility lines, and accidents. The percent related to utilities could approach 50% of premiums, but to be reasonable in the evaluation, 20% is assumed to be the potential cost savings attributed to preventing accidents due to utility conflicts that can be eliminated by SUE.

For **Item #6**, therefore, if you have a contractor doing excavation in Ohio working on a highway project, the cost savings would be:

U For an **urban** project
Project cost x 0.30 x $35.70 x 1/1,000 x 0.20 = project cost x 0.002142

R For a **rural** project:
Project cost x 0.20 x $35.70 x 1/1,000 x 0.20 = project cost x 0.001428

Item 19. Induced savings in risk management and insurance

Possible savings here can be induced by reducing a contractor's Experience Modification Rating (EMR). This reduction results in lower Workers' Compensation (WC) payments being made by the contractors to their insurance carriers. Workers' Compensation premiums are computed on a formula according to manual rate classifications.

For Ohio:

Payroll cost x $7.67/$100 of payroll = WC cost.

For the WC premium, use 5% of payroll for Ohio, as per information from insurance carriers.

The EMR x the manual rate = the actual premium that a contractor pays. Although the savings is not immediate, the effect of no accidents, or a reduction in accidents, will, within 3 years, result in lower WC premiums.

For Ohio, it is assumed that the EMR will be reduced by 0.05 over time with projects utilizing SUE. The amount of reduction depends on many factors, but most likely, for most contractors, it can be greater then 0.05. 0.05 was selected as a reasonable number to be used in the evaluation.

For **Item #19**, Payroll cost x 5.0% x 0.05 = risk management & insurance savings:

***U* For an **urban** project:
0.30 x Project Cost x 0.05 x 0.05 = 0.00075 x Project Cost

***R* For a **rural** project:
0.20 x Project Cost x 0.05 x 0.05 = 0.00005 x Project Cost

Table 3. Specific Projects Studied

Specific Project: **#1 Mansfield**

Project's Title: Richland 13-15.28 295 (96), Mansfield Signalization_ Year SUE Prog. Began:
Project's Location: SR 13, Mansfield, Richland County _____ State: ____OH _____
Name of Person Completing Questionnaire: Cassranda Van Horn__ Phone: (419) 589-2045 _
Cost of the Project: $2,400,000 plus change orders of $140,000 = a total of $2,470,000_____
Cost of Engineering: _____ Cost of Right-of-Way: _____
(1) Cost of Mobilizing: _____ + (2) Cost of Designating: _____
+ (3) Cost of Locating: _____ = (4) TOTAL SUE: $54,365.98 _____
Description (Summary) of the Project: The project was constructed in six square blocks of downtown Mansfield where 4 State Roads intersect. 41 intersections were signalized with the Provider conducting a SUE analysis on 10 of them. Project consisted of new traffic signals, interconnections for programmable controllers, curbs and gutters, with some ADA ramps, some driveways, some of the project included lane widening, and the project involved minor upgrading of roadways.
Project Manager (SHAs): Jim Short _____ Phone: (830) 379-5362 _
Designer/ Consultant: Clyde Williams & Associates _____ Phone: (614) 436-9029 _
SUE Consultant: SoDeep, David Cole_____ Phone: (330) 628-3100 _
Contractor: _Perran Electric, Dale Perran_____ Phone: (330) 239-2661 _
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$22,500 (1)		
2. Reduced project delays due to utility relocates	$30,000 (2)			
3. Reduced construction delay due to utility cuts		$10,000 (3)		
4. Reduced contractor's claims & change orders		$90,000 (4)		
5. Reduced delays caused by conflict redesign		$12,000 (5)		
6. Reduced accidents & injuries due to line cuts		$20,300 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids		$10,000 (10)		
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		Yes, $0 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built		$5,000 (17)		
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$2,000 (19)		
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $201,800 divided by $54,365.98 = $3.71

Table 3. Specific Projects Studied

Specific Project: **#1 Mansfield** *(Continued)*

General Information:
SUE was utilized after the start of construction to correctly locate all utilities and color code them. The project contained 41 signalized intersections with SUE being employed on 10 of them to help determine whether the project could be built as designed. The utilities could not give the proper location of their utilities to allow accurate boring of the streets involved in the project as the design drawings indicated. The utilities involved were electricity, city water and sewer, gas, and phone. The location of the 6 inch gas line was unknown and was a mystery. Their were no existing records of the existing utilities, and no records of the depths of the utilities. If the borings had been allowed to proceed the gas line would have been hit. The borings were to jack under the streets and roads. But the pavement was thicker than anticipated and the borings and jackings had to be located to a lower level. SUE was used to determine whether or not it was possible to bore and jack. The question was whether or not the contractor could miss the existing utilities.

The proper application of SUE on this project saved time and money. The project designer did not know the cost if there is a time delay. The contractor had started the construction of the project and hit several gas lines. The SUE provider was called in and conducted a SUE study of the ten most congested intersections determined from records data. The SUE study revealed 43 conflicts with existing utility lines along the length of the project that were not shown as conflicts on the contracted design plans. These conflicts were mostly with gas lines. After employing SUE the contractor had no more problems with conflicts at the 10 studied intersections.

ODOT could then properly plan and redesign the project. ODOT had made assumptions for utility locations during the initial project design. The redesigned project was conflict free. It was impossible for the contractor to fairly bid the project with the initial, given project information. A sizeable claim could have resulted if SUE had not been utilized to eliminate conflicts contained in the initial design, help avoid claims, and produce a buildable project.

With the SUE information project engineers were able to select the utility to be located and make decisions based on facts as to the position of the relocated utility. The result of the SUE analysis was that 35% of the initial borings could be bored, meaning that the remaining 65% had to be opened trenched. The local locator had marked the lines in error.

It cost $30,000 more to open trench rather than bore. Although SUE found numerous conflicts due to unknown utility conflicts resulting in a considerable amount of money being saved, more than $54,000 was spent on SUE.

Although an exact daily savings cost was not obtained from the project's contract documents, an amount of $1,000 per day was used for the evaluation study. The amount was deemed reasonable since other projects this size used $2,000 to $3,000 per day.

(1)
The 43 conflicts above that were resolved are estimated to have an estimated cost savings of $500 each. Cost Savings: = 43 conflicts x $500 per day = $22,500.

Table 3. Specific Projects Studied

Specific Project: **#1 Mansfield** *(Continued)*

(2)
It is estimated that the 30 days were saved due to reducing project delays due to utility relocates.
Cost Savings: = 30 days x $1,000 per day = $30,000.

(3)
From the above analysis an estimated 10 days reduction in construction delays due to utility cuts was achieved. Cost Savings: 10 days x $1,000 per day = $10,000

(4)
The application of SUE to the redesign after construction started helped bail the project out of an unbuildable situation. The specified bores were impossible to install without conflicts. A lot of this work ended up being open cut trenches, as stated above. An estimated savings in time of 90 days was obtained in eliminating a potential costly claim and change order.
Cost Savings: 90 days x $1,000 per day = $90,000.

(5)
The utilization of SUE enabled the redesign to be accomplished without unnecessary delays. The redesign cost is estimated to be $200 per day.
Cost Savings: 60 days x $200 per day = $12,000

(6)
In the part of the project where SUE was not utilized gas lines were cut three times. It is reasonable to assume that the gas line would have been cut at least three more times without employing SUE on the project. The cost of a gas line cut is $5,000.
The computed Cost Savings is $5,300. ***U***
Cost Savings: $5,000 x 3 cuts plus $5,300 = $20,300.

(10)
As stated above it was impossible for the contractor to bid the project with the initial, given project information. An estimated minimum Cost Savings of $10,000 in bid reduction could have been realized by using correct SUE information in the original bidding process.
Cost Savings: $10,000.

(12)
The cost of the project design could have been reduced by the use of SUE, or at least better controlled. SUE produced an intangible benefit for this item.
Cost Savings: No savings were assigned to this item.

(17)
The SUE data and information provided as part of the project enabled the utilities to have accurate locations in the area of the project.
Cost Savings: $5,000.

(19)
Cost Savings is $2,000. ****U***

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#2 Louisville OH**

Project's Title: STA-SR044-21.050 Year SUE Program Began: ____
Project's Location: Louisville OH State: OH
Name of Person Completing Questionnaire: James McGrath Phone: (330) 297-0801
Cost of the Project: $360,000.00
Cost of Engineering: Cost of Right-of-Way: $20,000.00
(1) Cost of Mobilizing: + (2) Cost of Designating:
+ (3) Cost of Locating: = (4) TOTAL SUE: $10,738.38
Description (Summary) of the Project: The project consists of the replacement of a truss bridge in the City of Louisville and the installation of traffic signals at the intersection of S.R. 153 and Constitution AV. Preliminary plans did not show this intersection, this work was added after the preliminary plan was completed.

Project Manager: Phone:
Designer/ Consultant: Phone:
SUE Consultant: So-Deep, PID 8831, David Cole Phone: (330) 628-3100
Contractor: Phone:
Utility Co.: Phone:

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations				
2. Reduced project delays due to utility relocates				
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders				
5. Reduced delays caused by conflict redesign	$45,000 (5)	$14,000 (5)		
6. Reduced accidents & injuries due to line cuts		Yes, $0 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design				
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built		$5,000 (17)		
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		Yes, $0 (19)		
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $64,000 divided by $10,738.38 = $5.96

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#2 Louisville OH***(Continued)*

General Information

SUE was used on this project because the locations of the utilities (phone, gas and water) shown on the plans did not agree with what was noted in the field. The intersection of S.R. 153 and Constitution AV was a critical part of the project and required a precise and clear location for the traffic signal poles.

(5)

SUE was used to locate the utilities at the above intersection. The arms for the traffic signals require an advance notice of three months to order the arms. If the pole cannot be set at the planned location a potential three month delay would be incurred. In addition the custom designed signal arms cost $7,000 each. There are two pole locations, making the cost $14,000 plus the time delay costs. By using the information provided by SUE the designers were able to avoid this potential conflict problem. The delay cost for this project was given as $5,000 per day.

Time Savings: 90 days @ $5,000 per day = $45,000.00
Cost Savings: $14,000

In addition, a telephone duct on the East side of the bridge is a main feed to the city. The preliminary plans had miss-located this line. This would have resulted in a 2 to 4 month delay to accomplish re-designing No additional cost is added here since it is not likely that both delays would have occurred in sequence. But they could have.

(6)

Assigned cost savings not utilized on this project.

(17)

The SUE provider was able to connect the gas and water lines to vales the survey found and determine that no associated piping existed with these items. This prevents additional change orders during construction.
Cost Savings $5,000

(19)

Assigned cost savings not utilized on this project. A serious accident could have resulted by auguring through a gas line on the project. However, the project was managed in a manner that made this type of an accident unlikely. But an accident could have happened.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#3 Munroe Falls**

Project's Title: SUM-91-7.62 _____ Year SUE Program Began: ____
Project's Location: Munroe Falls _____ State: ____OH _____
Name of Person Completing Questionnaire: James McGrath _____ Phone: (330) 297-0801 _
Cost of the Project: $275,532.85 (Bid Award) _____
Cost of Engineering: _____ Cost of Right-of-Way: _____
(1) Cost of Mobilizing: _____ + (2) Cost of Designating: _____
+ (3) Cost of Locating: _____ = (4) TOTAL SUE: $4,463.80 _____
Description (Summary) of the Project: The project consists of the installation of a left turn lane, improved access to the roadway and the installation of new traffic signals. Project is located on SR 91, 0.18 miles in length around Munroe Falls AV.

Project Manager (SHAs): _____ Phone: _____
Designer/ Consultant: _____ Phone: _____
SUE Consultant: SoDeep, PID 9823, David Cole _____ Phone: (330) 628-3100 _
Contractor: _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$125,000 (1)		
2. Reduced project delays due to utility relocates	$5,000 (2)			
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders				
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts		Yes, $0 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design				
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		Yes, $0 (19)		
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $125,000 divided by $4,463.80 = $28.00

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#3 Munroe Falls** *(Continued)*

SUE was utilized on this project to determine if the electric transmission poles, owned by Ohio Edison, would be required to move for the project. The existing right of way is narrow and filled with underground utilities. SUE was used to assure the contractor and Ohio Edison a clear location for the transmission poles. The complete relocated cost of a new transmission pole is estimated to be $60,000. Using SUE will prevent any delays to the project due to the uncertainty of the clearance between the existing right of way and the existing water line. Ohio Edison was concerned that if the poles were misplaced prior to the start of construction they would have to be relocated twice. A total of 10 poles are possibly effected by the project. SUE was used to locate the water line so that the poles could be accurately relocated.

(1)
The possibility of 2 to 4 poles being misplaced existed without the SUE information. For the evaluation it was assumed that only two would be misplaced.
Cost Savings $120,000

(2)
Time savings of 5 days @ $1,000 per day = $5,000

(6)
Assigned cost savings not utilized on this project.

(19)
Assigned cost savings not utilized on this project.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#4 Salt Springs Road**

Project's Title: TRU-45-3.476 Year SUE Program Began: ____
Project's Location: Salt Springs Road State: ____ OH
Name of Person Completing Questionnaire: James McGrath Phone: (330) 297-0801
Cost of the Project: $349,300
Cost of Engineering: Cost of Right-of-Way: $44,000
(1) Cost of Mobilizing: + (2) Cost of Designating
+ (3) Cost of Locating = (4) TOTAL SUE: $5,145.17
Description (Summary) of the Project: The project consists of the installation of a turn lane along with the installation of new traffic signals.

Project Manager (SHAs): Phone:
Designer/ Consultant: Eric Davis Phone:
SUE Consultant: SoDeep, PID 17443, David Cole Phone: (330) 628-3100
Contractor: The project is expected to bid in early 2000 Phone:
Utility Co.: Phone:

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		Yes, $0 (1)		
2. Reduced project delays due to utility relocates				
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders				
5. Reduced delays caused by conflict redesign	$45,000 (5)	$14,000 (5)		
6. Reduced accidents & injuries due to line cuts		Yes, $0 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design				
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built		$2,000 (17)		
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		Yes, $0 (19)		
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $61,000 divided by $5,145.17 = $11.86

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#4 Salt Springs Road** *(Continued)*

(1) Potential savings from SUE could have resulted for this project. However, for the evaluation study $0 were assigned.

(5)
SUE was used to verify a clear location for the signal poles. The arms for the traffic signals require a three-month advance notice to be ordered. If the pole cannot be set at the planned location a potential three-month delay would be incurred. In addition the custom designed signal arms cost $7,000 each. There are two pole locations, making the cost $14,000 plus the time delay costs. With SUE designers were able to avoid this problem. The delay cost for this project was given as $5,000 per day.
Time Savings: 90 days @ $5,000 per day = $45,000.00.
Cost Savings: $14,000

(6)
Assigned cost savings not utilized on this project.

(17)
The SUE provider was able to provide an accurate depiction of the utilities located within the project. This information was of value to the effected utilities.
Cost Savings: $2,000.00

(19)
Assigned cost savings not utilized on this project.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#5 Struthers**

Project's Title: MAH_616-4.973 _____ Year SUE Program Began: ____
Project's Location: S.R. 616, Struthers _____ State: ___OH _____
Name of Person Completing Questionnaire: James McGrath _____ Phone: (330) 297-0801 _
Cost of the Project: $7,913,200.04 (Bid Award) _____
Cost of Engineering: _____ Cost of Right-of-Way:$1,000,000.00 _____
(1) Cost of Mobilizing: _____ + (2) Cost of Designating: _____
+ (3) Cost of Locating: _____ = (4) TOTAL SUE: $29,457.59_____
Description (Summary) of the Project: The project consists of replacing the State Route 616 bridge in the city of Struthers. The project also includes eliminating the at grade intersection of State Road 616 and the CSX Railroad. In addition the project will realign the State Road 289 and State Road 616 intersection and the installation of a Mechanically Stabilized Earth retaining wall.

Project Manager (SHAs): _____ Phone: _____
Designer/ Consultant: _____ Phone: _____
SUE Consultant: SoDeep, PID 04130, David Cole _____ Phone: (330)-628-3100 _
Contractor: _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$90,000 (1)		
2. Reduced project delays due to utility relocates		$15,000 (2)		
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders				
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts		Yes $0 (6)		
7. Reduced travel delays to the motoring public		$2,000 (7)		
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design				
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built		$2,000 (17)		
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$6,000 (19)		
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				

Savings Analysis: $115,000 divided by $29,457.59 = $3.90

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#5 Struthers** *(Continued)*

General Information:
The project site is in an area that was heavily industrialized with steel mills that have been closed since the early 1980's. It was felt that due to the history of the area it was likely that the contractor would encounter active existing lines and the abandoned lines that served the mills.

(1)
There are over 72 utility pole located along the length of the project and its side streets. 10 poles were allowed to remain, 25 were removed, and the remainder relocated to locations free from utility conflicts or future conflicts with the project. It is not likely that this degree of accuracy would have happened without the use of SUE. It is estimated that at least 5 or 6 would have been misplaced or conflicts would have occurred. The cost of a misplaced utility pole is $60,000.
For purposes of the evaluation it was assumed that only 3 poles would have been misplaced and that the cost would be $30,000 per pole. The $30,000 was selected as a reasonable amount.
Cost Savings: 3 poles x $30,00 per pole = $90,000

(2)
Using SUE on this project limited delays due to conflicts with utility lines by accurately identifying these lines prior to construction so that they can be properly relocated. A delay of two weeks was prevented by determining the location of a 460mm raw water line along S.R. 289. The other water line belonging to Consumers Ohio Water was a 300mm potable water line that was correctly relocated. East Ohio Gas Company has several low and medium pressure lines throughout the length of the project. The medium pressure line is the only feed into the town. The gas lines were relocated properly without conflicts. The delay cost for this project is $1,000 per day.
Cost Savings:
15 days @ $1,000 per day = $15,000

(6)
Assigned cost savings not utilized on this project.

(7)
The maintenance of traffic plans were modified to accommodate the relocation of the 460mm raw water line.
Cost Savings: $2,000

(17)
The SUE provider was able to provide an accurate depiction of the utilities , Ohio Edison, Ameritech, East Ohio Gas, and Consumers Ohio Water all located within the project. This information was of value to the effected utilities.
Cost Savings: $2,000.00

(19)
Cost Savings is $6,000. ***U*

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#6 Fort Washington Way**

Project's Title: Fort Washington Way, Reconfiguration Project I-71 Yr SUE Pgm. Began: 1997
Project's Location: Cincinnati, Ohio _____ State: ____ OH_____
Name of Person Completing Questionnaire: Dan Carrier _____ Phone: (513) 639-2120 _
Cost of the Project: In excess of $238,000,000 _____
Cost of Engineering: Estd. at $20,000,000 __ Cost of Right-of-Way: Est. $15,000,000 _____
(1) Cost of Mobilizing: _____ + (2) Cost of Designating: _____
+ (3) Cost of Locating: __ = (4) TOTAL SUE: $269,615
Description (Summary) of the Project: This project involves the reconstruction of the major Interstate Interchanges in downtown Cincinnati around the sites of two major new sports stadiums. The project is approximately 1.5 miles in length, goes from the Brent Spence Bridge to the Lytle Park Tunnel, and contains over 11 lane miles. The project includes overpasses, bridges, acceleration and deceleration lanes, drainage structures, and storm sewers. Other major features of the project include the construction of retaining walls, replacement of the 3rd Street viaduct, and major flood walls. The project is vitally important to the revival of downtown Cincinnati and is of unique urban design. The project will provide additional road capacity for access to the two stadiums, yet will provide some land for the stadiums. _____

Construction Manager: Don Gindling, City of Cincinnati _____ Phone: (513) 352-1518 _
Designer/ Consultant: Frank Goodwin, Parsons-Brinkerhoff _____ Phone: (513) 639-2120 _
SUE Consultant: SoDeep, David Cole_____ Phone: (330) 628-3100 _
Contractor: _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$247,500 (1)		
2. Reduced project delays due to utility relocates		$110,000 (2)		
3. Reduced construction delay due to utility cuts		$110,000 (3)		
4. Reduced contractor's claims & change orders		$375,000 (4)		
5. Reduced delays caused by conflict redesign		$36,000 (5)		
6. Reduced accidents & injuries due to line cuts		$509,800 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design				
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built		$200,000 (17)		
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$178,500 (19)		
20. Introduced concept of comprehensive SUE		$40,000 (20)		
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $1,806,800 divided by $269,615.48 = $6.70

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#6 Fort Washington Way** *(Continued)*

General SUE Information:
Since the project was located in an established major urban area, numerous existing utilities were buried in the project's right-of-way. The existing utilities included sewer, water, gas, electric cable, phone cable, fiber optic cable, and abandoned utility lines. The area was an extremely complex combination of buried infrastructure with poor and inaccurate existing utility records. SUE was employed on the project to save unnecessary utility relocations, project delays, utility cuts, claims and change orders, project redesign, accidents, and travel delays. Also, SUE assisted with proper and accurate utility relocations, led to better relations with utility companies, and helped to manage risk.

A number of major utilities in the project's area were in conflict and had to be relocated, and now are being relocated with schedules being met. The City of Cincinnati and contractors are cooperating and assisting with utility the relocations, which are on schedule due to the accurate use of SUE information. The City and the utilities are getting the utility relocations done properly. A utility is able to contact the design consultant and obtain accurate crossing locations and elevations. With this SUE based information the relocations are being completed without conflicts. Utilities, the City, and contractors are able to coordinate with the designer to obtain accurate subsurface information, relocate utilities properly, and produce new, correct utility as-builts, and facility cooperation with utilities.

The delay cost for the project is taken from liquidated damages to be $5,500 per day, although the amount could escalate to $11,000, then to $16,000, depending on the number of companies being delayed as specified in the project's contract documents. $5,500 was felt to be a reasonable number to be used in the evaluation.

(1)
Cost Savings based on the savings of 3 weeks or 15 days delay time in reducing unnecessary utility relocations, and the estimation that a minimum of three (3) delay situations (events) would be encountered during the project:
15 days x $5,500 per day = $82,500; $82,500 x 3 events = $247,500 Cost Savings.

(2)
Cost Savings based on the savings of 10 days reduction in delay waiting time due to utility relocates and the estimation that a minimum of two (2) delay situations (events) would be encountered during the project:
10 days x $5,500 = $55,000; $55,000 x 2 events = $110,000 Cost Savings.

(3)
Cost Savings based on the savings of 10 days reduction in delay waiting time due to utility cuts and the estimation that a minimum of three (3) delay situations (events) would be encountered during the project:
10 days x $5,500 = $55,000; $55,000 x 2 events = $110,000 Cost Savings.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#6 Fort Washington Way** *(Continued)*

(4)
Contractor's claims and change orders have been reduced by eliminating an estimated 30 days delay time. The delay cost based on one item of major equipment and a 5 man crew, taken form the project's contract documents, is $2,500 per day. The delay cost for claims and change orders is then $2,500 per day times the estimated average number of delay days per incident when utility conflicts or cuts are encountered on the project. 10 days was determined to be an average delay time. The cost per incident is:

$2,500 x 10 days = $25,000.

This project is scheduled for 30 months duration. Past historical information indicates an expected incident of utility conflict or cut of one per month is likely. For purposes of the evaluation an incident rate of one every two months was assumed as reasonable.

15 incidents x $25,000 = $375,000 Cost Savings.

(5)
SUE saved redesign costs by having accurate SUE information to work with that produces an error free design. The design cost was determined by the design consultant to be $600 per day. The designers estimated SUE saved 60 days design time.

Cost Savings is 60 days x $600 per day = $36,000

(6)
Cost Savings is $509,800. ***U***

(17)
The value is having accurate utility as-built information was felt to be equal to investment in SUE for this project by the design consultant. For the purpose of the SUE evaluation the value was placed at $200,000 for Cost Savings.

(19)
Cost Savings is $178,500. ****U***

(20)
The value using comprehensive SUE is placed at $40,000.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#7 Barnesville**

Project's Title: BEL 147-5.80 Year SUE Program Began: ____
Project's Location: Barnesville State: OH
Name of Person Completing Questionnaire: Bill Wohlwend Phone: (330) 308-3954
Cost of the Project: $859,359.02
Cost of Engineering: Cost of Right-of-Way:
(1) Cost of Mobilizing: + (2) Cost of Designating:
+ (3) Cost of Locating: = (4) TOTAL SUE: $4,223.64
Description (Summary) of the Project: This widening project found a gas tank that was removed with very minimal clean up due to the use of SUE. Project included new storm drains, catch basins, turning lanes and sidewalks.

Project Manager (SHAs): Greg Sanders Phone: (740) 425-9401
Designer/ Consultant: Phone: (740) 695-6481
SUE Consultant: SoDeep SOM4192 Phone:
Contractor: Ohio West Virginia Excavating Phone: (740) 676-7464
Utility Co.: Phone:

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$10,000 (1)		
2. Reduced project delays due to utility relocates	n/a			
3. Reduced construction delay due to utility cuts	n/a			
4. Reduced contractor's claims & change orders	n/a			
5. Reduced delays caused by conflict redesign		Yes, min.$ (5)		
6. Reduced accidents & injuries due to line cuts		$1,800 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design				
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage	$210,000 (18)	+$125,000 (18)		
19. Induced savings in risk Mgmt., & insurance		$600 (19)		
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs	None	$0 (21)		
22.				

Savings Analysis: $97,400 divided by $4,223.64 = $23.06

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#7 Barnesville** *(Continued)*

General Information:
An underground storage tank was located at a Marathon Gas station. Even with the use of SUE the project still had problems. Designers had to make adjustments so as not to move sanitary, gas lines, and fiber optic cables that were exposed. The benefit of SUE was, the city did not know where their lines were but the lines were located by SUE. The city did not have to move the lines. SUE revealed that a gas line had to be moved 10 feet.

(1)
A water line was installed two years ago, directly in the path of the project. With SUE information designers were able to locate a manhole in the street to avoid having to move the water line. In addition, a fiber optic cable was not moved. Designers were able to design around the cable and let it remain in place.
Cost Savings: $10,000.

(5)
The use of SUE helped reduce the cost of redesign. However, the study could not a assign value to this item. Therefore, $0 were assigned to this item.

(6)
Cost Savings is $1,800. ***U***

(18)
During construction a gas tank was located that had environmental clean up. When ODOT bought the land with the tank they bought all the environmental problems. It cost $125,000 for ODOT to clean up and remove the tank, and it could have been more costly. If the owner kept the land and tank and did the clean-up, the cost would have been more. This cost is shown as a +, or an increase in project cost, in item 18.

(18)
The decision was to move on with construction, pay for the clean-up, and not incur a delay cost. The delay would have been at least 60 days. Delay costs are estimated at $3,500 per day x 60 days = $210,000.
Time Savings: $125,000.

(19)
Cost Savings is $600. ****U***

(21)
The use of SUE enabled the DOT to purchase a little less ROW, but the cost savings was not much, so $0 cost savings was assigned.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#8 Bellaire**

Project's Title: Bellaire - 7-16.68 _____ Year SUE Program Began: ____
Project's Location: Bellaire _____ State: _____OH_____
Name of Person Completing Questionnaire: Bill Wohlwend _____ Phone: (330) 308-3954 _
Cost of the Project: $19,938,810.16 - Const Bid Price _____
Cost of Engineering: $131,399.00 _____ Cost of Right-of-Way: _____
(1) Cost of Mobilizing: 0 _____ + (2) Cost of Designating: _____
+ (3) Cost of Locating: _____ = (4) TOTAL SUE: $12,848.44 _____
Description (Summary) of the Project: The project consisted of the construction of a 4-lane divided highway facility (Phase III) located in the city of Bellaire. Project included drainage structures, curb and gutter, and signalization. The length of the project was 1.2 miles.

Project Manager (SHAs): _____ Phone: _____
Designer/ Consultant: Jim Graham; Resident Engineer, Todd Moore Phone: _____
SUE Consultant: So-Deep, # SOM 4192_____ Phone: _____
Contractor: Marschall Rardin _____ Phone: (330) 628-3100 _
Utility Co.: Bellaire Water _____ Phone: (330) 784-1263 _

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations	$87,000 (1)	$648,000 (1)		
2. Reduced project delays due to utility relocates				
3. Reduced construction delay due to utility cuts		$35,000 (3)		
4. Reduced contractor's claims & change orders	n/a			
5. Reduced delays caused by conflict redesign		$25,600 (5)		
6. Reduced accidents & injuries due to line cuts	Yes, no $	Yes w/#3 above (6)		
7. Reduced travel delays to the motoring public	No			
8. Reduced loss of service to utility customers	Yes, no $	Yes w/#3 above (8)		
9. Improved contractor productivity & methods	Yes, no $			
10. Increased the possibility of reduced bids	Yes, no $	$80,000 (10)		
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		+$25,000 (12)		
13. Reduced the damage to existing pavements	Yes, minimal $			
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates	n/a			
16. Minimized disruption to traffic & emergency	Yes, minimal $			
17. Facilitated electronic map accuracy, as- built	Yes, no $			
18. Minimized chance of environmental damage	No			
19. Induced savings in risk Mgmt., & insurance	No	$15,000 (19)		
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs		$0 (21)		
22.				

Savings Analysis: $865,600 divided by $12,848.44 = $67.37

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#8 Bellaire** *(Continued)*

(1)
SUE has saved 25 days delay time on this project. The delay cost is estimated to be $3,500/ day. Time Savings: @ $3500 /day x 25 days = $87,500

(1)
SUE saved the relocation of 1500 feet of utility line at $432 per foot, based on actual construction cost.
Cost Savings:1500 feet x $432/ ft = $648,000 actual construction cost savings.

(3)
SUE is able to save two weeks (10 days) delay time due to utility cuts.
Cost Savings: 10 days @ $3500/ day = $35,000. This savings is for not hitting the water line during construction and causing a delay.

(5)
Using SUE saved on not having to redesign the project after utility conflicts. 80 hours design time is estimated to have been saved at $320/hour.
Cost Savings: $320/hour x 80 hours = $25,600. This savings is for design team survey drafting, and mileage, etc. costs.

(6)
Affected the local hospital and some business and offices if the water line was cut. The chances were that the line would have been cut, but cost savings are included in #3 above. Therefore no computed cost savings were included with this item.

(8)
The water or gas lines would have most likely been cut and would have closed businesses and homes. The cost savings are included in # 3 above.

(10)
The bid cost savings for this project is estimated to be 5% of the bid price of this part of the project, or $4M = $80,000

(12)
The use of SUE added cost to the design of the project by $25,000, including surveying cross-sections and revising 35 plan sheets. This cost is shown as a +, or an increase in project cost.

(17)
Yes, no $

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#8 Bellaire** *(Continued)*

(19)
Cost Savings is $15,000. ***U*

(21)
The project required the removal or relocation of 1000 families and businesses over the last 10 years in three other projects. The property acquisition and relocation costs were included in the costs of these projects. SUE helped specify the scope of this work, but the savings benefits could not be determined in the evaluation study. Therefore $0 were assigned to this item.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#9 Millersburg**

Project's Title: Hol-62-19.05 _____ Year SUE Program Began: ____
Project's Location: Millersburg _____ State: ____ OH _____
Name of Person Completing Questionnaire: Bill Wohlwend _____ Phone: (330) 308-3954 _
Cost of the Project: Projected at $1,700,000 _____
Cost of Engineering: $170,000 _____ Cost of Right-of-Way: _____
(1) Cost of Mobilizing: _____ + (2) Cost of Designating _____
+ (3) Cost of Locating _____ = (4) TOTAL SUE: $19,839.92 _____
Description (Summary) of the Project: The project involved the upgrading of 1.522 Kilometers of US 62 by widening and resurfacing the existing lanes. The project included new curbs and gutters, left turn lane, and storm sewer system complete with drainage structures. The project also included traffic control to be built under construction, new signs, traffic signals, and pavement markings.

Project Manager (SHAs): _____ Phone: _____
Designer/ Consultant: SoDeep # SOD4580 _____ Phone: _____
SUE Consultant: _____ Phone: _____
Contractor: Contract has a projected bid date of March, 2000 _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$30,000 (1)		
2. Reduced project delays due to utility relocates				
3. Reduced construction delay due to utility cuts		$8,000 (3)		
4. Reduced contractor's claims & change orders				
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts	None	$3,600 (6)		
7. Reduced travel delays to the motoring public	No			
8. Reduced loss of service to utility customers	Yes, No $			
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids		n/a		
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design	No			
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates	n/a			
16. Minimized disruption to traffic & emergency	None			
17. Facilitated electronic map accuracy, as- built		$1,240 (17)		
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$1,300 (19)		
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $44,140 divided by $19,839.92 = $2.22

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#9 Millersburg** *(Continued)*

(1)
The use of SUE reduced the cost of utility line relocation by an estimated $30,000.

(3)
The use of SUE resulted in an 8 days estimated savings in delay time. Estimated delay cost is $1,000 per day.
Cost Savings: 8 days x $1,000/day = $8,000.00

(6)
Cost Savings is $3,600. ***U***

(17)
The employment of SUE discovered a station error, saved money due to a survey error, at $60 / hour. The estimated time savings is x 4 hours. Cost Savings: 4 hours x $60.00/ hour = $240.00

In addition a dead water line found and properly identified by SUE.
Cost savings based on one day time delay savings is $1,000.

Total savings item 17: $1,240.00

(19)
Cost Savings is $1,300. ****U***

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#10 Steubenville**

Project's Title: Jef-43-2.189 metric _____ Year SUE Program Began: ____
Project's Location: City of Steubenville _____ State: ____OH _____
Name of Person Completing Questionnaire: Bill Wohlwend _____ Phone: (330) 308-3954 _
Cost of the Project:$4,5000,000.00, Estimated Construction Cost _____
Cost of Engineering: $426,000 _____ Cost of Right-of-Way: $604,000 _____
(1) Cost of Mobilizing: _____ + (2) Cost of Designating: _____
+ (3) Cost of Locating: _____ = (4) TOTAL SUE: $26,683.13 _____
Description (Summary) of the Project: Project consisted of widening of the existing two lanes to five lanes, which includes a continuous left turning lane. New drainage structures are included along the length of the project. New intersections with traffic signals were a part of the project.
Project Manager (SHAs): _____ Phone: _____
Designer/ Consultant: _____ Phone: _____
SUE Consultant: So-Deep (SOD #4613)_____ Phone: _____
Contractor: The project has an April 2000 bid letting date._____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$10,000 (1)		
2. Reduced project delays due to utility relocates		$15,000 (2)		
3. Reduced construction delay due to utility cuts		$38,500 (3)		
4. Reduced contractor's claims & change orders		w/3 above (4)		
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts		$9,600 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design				
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency		$5,000 (16)		
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$3,400 (19)		
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs		Future Savings (21)		
22.				

Savings Analysis: $81,500 divided by $26,683.13 = $3.05

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#10 Steubenville** *(Continued)*

(1)
SUE was used to specify the location of the existing utility lines. Knowing the exact location of the existing utility lines allowed designers to reduce the amount of utility line relocations.
Cost savings: $10,000

(2)
The utilization of SUE on the project specified exact existing and relocated utility locations. This permitted all utilities to be relocated prior to the bid letting date. An estimated 10 days time delay savings was estimated here. The daily delay cost is estimated to be $1,500 per day.
Cost Savings: 10 days x $1,500 = $15,000

(3)
The employment of SUE is estimated to have effected a savings of $38,500 by reducing delays due to utility cuts.

(4)
Using SUE on this project probably will reduce the potential for claims and change orders from the contractor. Presently this savings is assumed to be included in the savings in item 3.

(6)
Cost Savings is $9,600. ***U***

(16)
Since the project is to be built under traffic conditions, there will be savings due to minimizing disruptions to traffic flow and travel delays. The cost savings applied here is estimated to be $5,000

(19)
Cost Savings is $3,400. ****U***

(21)
Future Savings are anticipated with this project.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#11 Cuyahoga Co.**

Project's Title: CUY-237-15.102 (Project 386-99) _____ Year SUE Program Began: ____
Project's Location: Cuyahoga Co. _____ State: ____OH _____
Name of Person Completing Questionnaire: Kathe Sopenski _____ Phone: (216) 581-2333 _
Cost of the Project: $4,643,000.00 _____
Cost of Engineering: $350,468.00 _____ Cost of Right-of-Way: _____
(1) Cost of Mobilizing: _____ + (2) Cost of Designating: $177,162 _____
+ (3) Cost of Locating: $16,121 _____ = (4) TOTAL SUE: $193,283
Description (Summary) of the Project: This project consists of the upgrading and reconstruction of a state highway in an urban municipality which serves as a city street. The project is 4.7 Km long and was let to contract on 5/26/99. Construction started 6/15/99. The bid was $800,000 lower than the engineer's estimate. Some of this bid savings can be attributed to the presence of accurate utility information due to SUE

Project Manager (SHAs): _____ Phone: _____
Designer/ Consultant: Richland Engineering Ltd, PM-Duke Schaus _ Phone: (419) 524-0074 _
SUE Consultant: SoDeep, James Anspach _____ Phone: _____
Contractor: The Perk Company _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations	$20,000 (1)	$50,000 (1)	Yes	
2. Reduced project delays due to utility relocates	Yes	With# 1 above		
3. Reduced construction delay due to utility cuts	Yes	Yes	Yes	
4. Reduced contractor's claims & change orders	Yes	$20,000 (4)		
5. Reduced delays caused by conflict redesign	Yes	Yes		
6. Reduced accidents & injuries due to line cuts	Yes	$9,900 (6)	Yes	Yes
7. Reduced travel delays to the motoring public	Yes	Yes	Yes	
8. Reduced loss of service to utility customers	Yes	Yes	Yes	
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids	Yes	$400,000 (10)		
11. Reduced contingency fees from all parties		Yes		
12. Reduced the cost of project design	Yes	$20,000 (12)		
13. Reduced the damage to existing pavements	Yes	Yes	Yes	
14. Reduced damage to existing site facilities	Yes	Yes	Yes	
15. Reduced the cost of needed utility locates	Yes	Yes		Yes
16. Minimized disruption to traffic & emergency	Yes	Yes	Yes	Yes
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage			Yes	
19. Induced savings in risk Mgmt., & insurance		$3,500 (19)	Yes	
20. Introduced concept of comprehensive SUE	Yes	$5,000 (20)		
21.Right-of-Way acquisition, costs				

Savings Analysis: $528,400 divided by $193,283 = $2.73

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#11 Cuyahoga Co.** *(Continued)*

General Information:
SUE services on this project consisted of designating the entire project, measuring inverts on about 300 storm and sanitary manholes (in a very complex combined sewer system), and installing about 100 test holes. The designating and invert information was comprehensive enough, and early enough, and there was sufficient right-of-way to eliminate all conflicts except for the 100 which required test holes.

The SUE analysis shown below has costs assigned to all items where a cost could reasonably be allocated or for which information could be applied. All other items that contain a Yes for SUE cost benefits have real, actual savings, but no cost savings are assigned to these items. Since the project started construction only three months prior to the completion of the evaluation, future savings for these items will certainly occur, but presently the savings are difficult to document and have not been assigned to the evaluation.

(1)
An estimated time savings of between 20 and 30 days was realized on this project. The delay cost is $1,000 per day on this project.
Time Savings: 20 days x $1,000 per day = $20,000.

(1) and (2)
The use of SUE on this project is estimated to have eliminated or reduced the effects of between 50 to 100 field utility conflicts. Using an average cost of $1,000 per conflict, the Cost Savings is: 50 x $1,000 = $50,000.

(4)
It is estimated that SUE information will help reduce claims and change orders due to field utility conflicts. 20 to 30 days time savings is possible on this project. Using a delay cost of $1,000 per day the cost savings is:
20 days x $1,000 = $20,000.

(6)
Cost Savings is $9,900 ***U***

(10)
It was estimated that SUE was responsible for 50% of the bid savings or:
Cost Savings: $800,000 x 0.50 = $400,000.

(12)
The project designer Estimates that the use of SUE saved about three weeks time and between $20,000 to $25,000 since they did not have to pursue utility company information and wait for the same.
Cost Savings: $20,000

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#11 Cuyahoga Co.** *(Continued)*

(19)
Cost Savings is $3,500 ***U*

(20)
Introducing the concept of SUE has an estimated cost benefit of $5,000.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#12 Cuyahoga Co.**

Project's Title: CUY-237-13.248 _____ Year SUE Program Began: ____
Project's Location: Cuyahoga County_ _____ State: ____ OH_____
Name of Person Completing Questionnaire: Kathe Sopenski _____ Phone: (216) 581-2333 _
Cost of the Project: $1,640,000.00 _____
Cost of Engineering: $231,047.00 _____ Cost of Right-of-Way: _____
(1) Cost of Mobilizing: _____ + (2) Cost of Designating: $76,442.00 _____
+ (3) Cost of Locating: $100,000.00_____ = (4) TOTAL SUE: $176,442.00
Description (Summary) of the Project: This project consists of the upgrading and reconstruction of a state route located in a municipality which functions as a local road. The length of the project is 1.8 Km. There are numerous driveways, side streets, small shopping areas and the road abuts an area being developed by the city of Cleveland for light industrial use. The project has a section that directly abuts a freeway entrance. The entire area is honeycombed with existing underground utilities.

Project Manager (SHAs): _____ Phone: _____
Designer/ Consultant: Richland Engineering Ltd., PM-Duke Schaus Phone: (419) 524-0074 _
SUE Consultant: SoDeep, David Cole _____ Phone: (330) 628-3100 _
Contractor: _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations	$20,000 (1)	$25,000 (1)	Yes	
2. Reduced project delays due to utility relocates	Yes	With#1 above		
3. Reduced construction delay due to utility cuts	$10,000	Yes	Yes	
4. Reduced contractor's claims & change orders	Yes	$20,000		
5. Reduced delays caused by conflict redesign	Yes	Yes		
6. Reduced accidents & injuries due to line cuts	Yes	$3,500.00 (6)	Yes	Yes
7. Reduced travel delays to the motoring public	Yes	Yes	Yes	
8. Reduced loss of service to utility customers	Yes	Yes	Yes	
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids	Yes	Yes	Yes	
11. Reduced contingency fees from all parties		Yes		
12. Reduced the cost of project design	Yes	$20,000 (12)		
13. Reduced the damage to existing pavements	Yes	Yes	Yes	
14. Reduced damage to existing site facilities	Yes	Yes	Yes	
15. Reduced the cost of needed utility locates	Yes	Yes		Yes
16. Minimized disruption to traffic & emergency	Yes	Yes	Yes	Yes
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage			Yes	
19. Induced savings in risk Mgmt., & insurance		$1,200 (19)	Yes	
20. Introduced concept of comprehensive SUE	Yes	$5,000 (20)		
21.Right-of-Way acquisition, costs				

Savings Analysis: $114,700 divided by $176,442 = $0.65

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#12 Cuyahoga Co.** *(Continued)*

General Information:
This project is similar to #11, CUY-237-15.102. The cost items and factors are nearly same as the previous project with the benefits somewhat higher since this section directly abuts a freeway section. , and the underground utility locations are somewhat more complex.
SUE services on this project consisted of designating the entire project and obtaining the locating information required to eliminate utility conflicts.
The SUE analysis shown below has costs assigned to all items where a cost could reasonably be allocated or for which information could be applied. All other items that contain a Yes for SUE cost benefits have real, actual savings, but no cost savings are assigned to these items. The project is not under construction as of the date of the completion of the evaluation study. However, future savings for these items will certainly occur, but presently the savings are difficult to document and have not been assigned specific values to the evaluation. In addition the possibility of reduced bids exists as a definite benefit but until the project is bid no cost savings could be assigned to this item (#10).

(1)
Time Savings is 20 days at $1,000 = $20,000.
(1) and (2)
The use of SUE on this project is estimated to have eliminated or reduced the effects of between 25 to 50 field utility conflicts. Using an average cost of $1,000 per conflict, the cost savings is: 25 x $1,000 = $25,000.
(3)
The use of SUE information is estimated to have the potential to reduce construction delays by a minimum of 10 days. Time Savings: 10 days x $1,000 per day = $10,000.
(4)
It is estimated that SUE information will help reduce claims and change orders due to field utility conflicts. 20 to 30 days time savings is possible on this project. Using a delay cost of $1,000 per day the cost savings is: 20 days x $1,000 = $20,000.
(6)
Cost Savings is $3,500 ***U***
(12)
The project designer Estimates that the use of SUE saved about three weeks time and between $20,000 to $25,000 since they did not have to pursue utility company information and wait for the same. Cost Savings: $20,000
(19)
Cost Savings is ****U***
$1,200
(20)
Introducing the concept of SUE has an estimated cost benefit of $5,000.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#13 Sprague Road**

Project's Title: CUY-71-0521L/R _____ Year SUE Program Began: ____
Project's Location: _I-71 Overpass at Sprague Road _____ State: _____OH _____
Name of Person Completing Questionnaire: Kathe Sopenski _____ Phone: (216) 581-2333 _
Cost of the Project: $800,000 bridge portion of the $16,391,867 project _____
Cost of Engineering: $50,000 _____ Cost of Right-of-Way: _____
(1) Cost of Mobilizing: _____ + (2) Cost of Designating: _____
+ (3) Cost of Locating: _____ = (4) TOTAL SUE: $2279.00_____
Description (Summary) of the Project: The project consists of a portion of a large project in Cuyahoga County and is part of the addition of a third lane to a two-lane (each direction) urban freeway. The project is a freeway crossing (overpass) of a local roadway. The freeway structure had to be widened with plans that were completed five years prior to the start of construction.

Project Manager (SHAs): _____ Phone: _____
Designer/ Consultant: _____ Phone: _____
SUE Consultant: _____ Phone: _____
Utility Co.: Columbia Gas _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations				
2. Reduced project delays due to utility relocates				
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders		$60,000 (4)		
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts		$1,700 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design				
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$600 (19)		
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $62,300 divided by $2279 = $27.34

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#13 Sprague Road** *(Continued)*

General Information:

SUE was used to update the project's plans to include any utility facilities added within the last five years. The Columbia Gas Company gave ODOT information on a gas line which had been added through the area where the bridge structure footings were to be widened. This information was added to the plans and the project was let to construction. The contractor was ready to excavate for the footings and asked if the gas line had been relocated. OUPS and the Gas Company both said that it had not been relocated. The gas company also said that construction would have to stop while the gas line was relocated. It was estimated that 30 days delay time would be required to relocate the line. The contractor estimated downtime at $2,000 per day for labor and equipment plus unspecified damages. Columbia Gas is a private utility that would be responsible to pay for their own relocation, the cost to ODOT would have been contractor delay.

ODOT design did not think that the gas company would install a line in the path of the project since the plans to widen the bridge were well known. The SUE provider was sent to locate the line. Despite the gas company plans which were less than five years old and the city permit, SUE determined that the gas line had actually been installed out of the way of the footing excavation.

(4)
SUE eliminated the possibility of a claim and change order as stated above.
Cost Savings = 30 days x $2,000 = $60,000.

(6)
Cost Savings is $1700. ***U***

(19)
Cost Savings is $600 ****U***

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#14 Pearl Road**

Project's Title: CUY-71-0553L/R _____ Year SUE Program Began: ____
Project's Location: I-71 overpass at Pearl Road _____ State: _____OH _____
Name of Person Completing Questionnaire: Kathe Sopenski _____ Phone: (216) 581-2333 _
Cost of the Project: $900,000 bridge portion of the $16,391,867.00 _____
Cost of Engineering: $90,000.00 _____ Cost of Right-of-Way: _____
(1) Cost of Mobilizing: _____ + (2) Cost of Designating: _____
+ (3) Cost of Locating: _____ = (4) TOTAL SUE: $2,785.00 _____
Description (Summary) of the Project: The project consists of a portion of a large project in Cuyahoga County and is part of the addition of a third lane to a two-lane (each direction) urban freeway. The project is a freeway crossing (overpass) of a local roadway. The freeway structure had to be widened with plans that were completed five years prior to construction.

Project Manager (SHAs): _____ Phone: _____
Designer/ Consultant: _____ Phone: _____
SUE Consultant: SoDeep _____ Phone: _____
Utility Co.: Columbia Gas _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations				
2. Reduced project delays due to utility relocates				
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders		$60,000 (4)		
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts		$1900 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design				
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$700 (19)		
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $62,600 divided by $2785 = $22.48

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#14 Pearl Road** *(Continued)*

General Information:

SUE was used to update the plans to include any utility facilities added within the last five years. The East Ohio Gas Company gave ODOT information on a gas line which had been added through the area where the bridge structure footings were to be widened. This information was added to the plans and the project was let to construction. The contractor was ready to excavate for the footings and asked if the gas line had been relocated. OUPS and the Gas Company both said that it had not been relocated. The gas company also said that construction would have to stop while the gas line was relocated. It was estimated that 30 days delay time would be required to relocate the line. The contractor estimated downtime at $2,000 per day for labor and equipment plus unspecified damages. Columbia Gas is a private utility that would be responsible to pay for their own relocation, the cost to ODOT would have been contractor delay.

ODOT design did not think that the gas company would install a line in the path of the project since the plans to widen the bridge were well known. The SUE provider was sent to locate the line. Despite the gas company plans which were less than five years old and the city permit, SUE determined that the gas line had actually been installed out of the way of the footing excavation.

(4)
SUE eliminated the possibility of a claim and change order as stated above.
Cost Savings = 30 days x $2,000 = $60,000.

(6)
Cost Savings is $1,900. ***U***

(19)
Cost Savings is $700 ****U***

APPENDIX IV: General Results of Sue in Texas

The questions listed in *Table 1. General Questions for State Highway Agencies and Utilities*, was submitted to the TXDOT for information and data collection. The results of these questions are also listed in Table 1.

Table 1. General Questions for State Highway Agencies and Utilities for Texas

Question	Answer
List the total engineering/ construction budget statewide by year.	1998 $1.295 billion; 1999 $1.426 billion
Supply a list of all projects indicating cost ($), length, type, (interstate, reconstruction, urban, arterial), etc.	The list of selected projects for the evaluation represent the typical highway, and street projects constructed in Texas. All types of roads, streets, and highways are included, both rural and urban. In addition Texas does not have county roads, all rural roads are part of the state system.
List the projects using SUE. Indicate designating/ locating and the costs for each. Indicate the footage of designating and number of test holes.	Total list too long, but the list of sample projects being evaluated in this study are representative of SUE in Texas. See the Table of SUE expenditures for total SUE expenditures and number of projects where SUE was employed.
Estimate the average time (project duration) for projects using SUE vs. average time for SUE projects.	The timesavings are difficult to estimate, but timesavings of a day or two are the typical minimum.
Describe how the SUE program started in your state	Out of the desire to save money, reduce conflicts, and reduce redesign.
How is a project selected for the use of SUE?	By mutual agreement and judgment between design and area engineers on as needed project basis due to amount of utilities, potential impact, and engineering judgment.
Amount of $ spent each year on the SUE program in your state.	See the table of SUE expenditures for the amount spent per year and the number of projects
Explain the relationship between utilities and DOT before and after SUE.	More confident decisions are made relative to design locations of project structures, since better data is used in project design. The Utilities are expecting the TXDOT to provide this data.
Explain the typical uses of SUE, i.e. designating, locating, planning, utility relocation design, coordination, etc.	Used in drainage design; signalization design, substructure design; and Utility relocation design to minimize conflicts
Describe the qualitative benefits of SUE by utility owners, constructors, engineers, and highway departments.	Better data makes for easier and better designs such as coordinating utility work with highway contractors.
What were utility damages on projects before SUE, or on projects not using SUE?	Unknown, no records
What were the utility damages on projects after SUE was used?	Unknown, no records

Question	Answer
What is the cost of a test hole made by traditional means?	Cost depends on a lot of factors, such as depth, availability of equipment, traffic, type and quality of utility, etc. A traditional, average test hole, including excavation with a backhoe, utility line location, traffic control, backfilling, and pavement repair will cost $3,000 to $4,000. A test hole for SUE using pneumatic/ vacuum excavation, utility line location, and data entry will cost $800 to $1,200, depending on the number of holes.
On SUE projects – what were the type, amount, or cost of utilities not relocated due to designating for utilities that had SUE information available to them for their own redesign?	No general information was available, but some of the specific projects contained in the evaluation study represent costs for this issue.
On SUE projects - what were the type, amount, or cost of utilities not relocated due to locating for utilities that had SUE information available to them for their own redesign?	Again as above, no general information was available, but some of the specific projects contained in the evaluation study represent costs for this issue
On SUE projects - what amount of unknown utilities were found through designating activities?	It is estimated that 2 to 5 percent of the utilities are found in this manner, but no exact records are available.
What user savings were estimated on SUE projects with timesavings?	Again, covered on some the selected projects
Additional Remarks	The tighter and more congested the road improvement corridor the greater the advantage to using SUE. Prudent use of the service can provide much greater confidence to the designer, utility owner, and the Contractor.

Table 2. Summary of Cost Savings by Selected Project indicates the Savings Analysis obtained for each of the selected 27 projects as shown in Table 2. Total SUE savings obtained in the evaluation of the 27 projects were $17,894,000.

Table 2. Summary of Cost Savings by Selected Project

Proj.#	SUE Savings	SUE Cost	Savings Analysis
#S0001	$370,800.00	$51,527.00	$7.20
#S0002	$457,700.00	$173,058.32	$2.64
#S0003 **#S0081**	$1,049,200.00	$265,304.00	$3.95
#S0006	$308,400.00	$86,167.83	$3.58
#S0007	$152,000.00	$92,333.28	$1.65
#S0011	$3,136,000.00	$229,559.68	$13.66
#S0019	$431,000.00	$83,101.96	$5.19
#S0020	$115,600.00	$22,100.64	$5.23
#S0029	$425,500.00	$226,820.07	$1.88

Proj.#	SUE Savings	SUE Cost	Savings Analysis
#S0036	$467,500.00	$204,026.71	$2.29
#S0046	$78,700.00	$65,671.14	$1.20
#S0049	$789,300.00	$152,212.65	$5.19
#S0054	$260,300.00	$41,260.00	$6.31
#S0057	$220,600.00	$39,539.24	$5.58
#S0058	$391,000.00	$44,691.51	$8.75
#S0063	$1,586,000.00	$544,907.06	$2.91
#S0065	$2,056,500.00	$478,130.99	$4.30
#S0066	$1,739,500.00	$427,105.09	$4.07
#S0068	$136,500.00	$38,758.95	$3.52
#S0069	$566,400.00	$132,276.78	$4.28
#S0070	$348,600.00	$31,842.38	$10.95
#S0071	$208,800.00	$105,092.85	$1.99
#S0080	$865,800.00	$209,285.05	$4.14
#S0090	$340,400.00	$19,831.64	$17.16
#S0100	$351,700.00	$161,681.75	$2.18
#S0101	$441,000.00	$159,178.24	$2.77
#S0102	$279,200.00	$29,777.85	$9.38
Total	$17,574,000.00	$4,115,241.76	$4.27

Presented in *Table 3. Specific Projects Studied*, is a summary of the data and information from the specific projects studied in the evaluation. The 27 projects presented in Table 3 are numbered in accordance with TXDOT SUE contract numbering system procedures starting with S0001. 146 SUE project numbers have been assigned to date in Texas. 27 of these projects are included in the evaluation study. Information for the Cost Items and Factors contained in Table 3 under the columns Time, Cost, User, and Risk Management Savings was collected by interviews with key project personnel. Key project personnel are listed in Table 3 by each specific project. Over thirty-four (34) TXDOT, contractor, and SUE provider personnel were interviewed in the process of collecting information and data for the study. The information and data are referenced by line item as noted by a corresponding number in ( ) on the form and in the written information contained on the pages following the tabular portion of the form. The written information explains how the amount of SUE cost savings was determined. The SUE cost savings are shown by selected project in Table 2, and at the bottom of the tabular portion of the specific projects studied form.

Two particular item numbers from Table 3 (#6 and #19) are described here in depth. Asterisks in Table 3 refer specifically to the formulas contained in this description. The description covers accident, insurance, and risk management savings computations for the SUE evaluation. Refer to the following explanation to verify the amounts shown for savings on items #6 and #19 on the specific projects studied.

Item #6. Reduced accidents and injuries due to line cuts.

General liability considerations could be considered as savings under Item #6, accident reduction in line cuts. General liability coverage provides protection against accidents such as cutting utility lines, and harm to the general public. Considerable risk exists in excavation work conducted in the vicinity of buried utility lines. Gas lines are cut, or are damaged, resulting in fatal accidents where victims are frequently from the general public.

General liability calculations are made as follows:

The general liability manual rating for Texas is $69.00 per $1,000 of payroll.

Payroll for urban highway construction varies from 20+% to about 40% of the project cost. For the evaluation, 30% was selected as a representative percentage for urban projects. Rural would be less, so 20% was selected for the percentage on rural projects. These percentages are based on input from highway contractors.

Therefore, if you have a contractor doing excavation in Texas working on a highway project, the manual annual premium for a job would be:

For an urban project:

Project cost x 0.30 x $69.00 x 1/1,000 =

For a rural project:

Project cost x 0.20 x $69.00 x 1/1,000 =

The amount of the general liability premium is based on the need to pay all the claims resulting from accidents. Presently in Texas, actual claims costs are $1.10 for each $1.00 of premiums. Not all the accidents are related to excavation work on highway projects; however, a primary concern of the contractor is damage to utility lines, and accidents. The percent related to utilities could approach 50% of premiums, but to be reasonable in the evaluation, 20% is assumed to be the potential cost savings attributed to preventing accidents due to utility conflicts that can be eliminated by SUE.

For **Item #6**, therefore, if you have a contractor doing excavation in Texas working on a highway project, the cost savings would be:

U For an **urban** project

Project cost x 0.30 x $69.00 x 1/1,000 x 0.20 = project cost x 0.00414

R For a **rural** project:

Project cost x 0.20 x $69.00 x 1/1,000 x 0.20 = project cost x 0.00276

Item 19. Induced savings in risk management and insurance

Possible savings here can be induced by the reduction in a contractor's Experience Modification Rating (EMR) which results in lower Workers' Compensation (WC) payments being made by the contractors to their insurance carriers. Workers' Compensation premiums are computed on a formula according to manual rate classifications.

For Texas:

Payroll cost x $11.25/$100 of payroll = WC cost.

For the WC premium, use 8.9% of payroll for Texas, as per information from insurance carriers.

The EMR x the manual rate = the actual premium that a contractor pays. Although the savings is not immediate, the effect of no accidents, or a reduction in accidents, will, within 3 years, result in lower WC premiums.

For Texas, it is assumed that the EMR will be reduced by 0.05 over time with projects utilizing SUE. The amount of reduction depends on many factors, but most likely, for most contractors, it can be greater then 0.05. 0.05 was selected as a reasonable number to be used in the evaluation.

For **Item #19**, Payroll cost x 8.9% x 0.05 = risk management & insurance savings:

***U* For an **urban** project:

0.30 x Project Cost x 0.089 x 0.05 = 0.001335 x Project Cost

***R* For a **rural** project:

0.20 x Project Cost x 0.089 x 0.05 = 0.00089 x Project Cost

Table 3. Specific Projects Studied

Specific Project: **#S0001**

Project's Title: FM 78 _____ Year SUE Program Began: 1997
Project's Location: San Antonio, Bexar Co., Guadalupe _____ State: ____TX _____
Name of Person Completing Questionnaire: ___Smokey Villarreal _ Phone: (830) 379-5362 _
Cost of the Project: $4,332,787 _____
Cost of Engineering: _____ Cost of Right-of-Way: $302,687 _____
(1) Cost of Mobilizing: $0.00 _____ + (2) Cost of Designating: $40,962.00 _____
+ (3) Cost of Locating: $10,565.00 _____ = (4) TOTAL SUE: $51,527.00 _____
Description (Summary) of the Project: The project was 3.164 Km (about 1.9 miles) in length. The project involved the widening of the existing 2 lanes to 5 lanes, which includes a continuous left-turn lane. All new drainage structures and curbs were contained in the project. All cross drainage lines and structures were upgraded. At the bridge portion of the project, the storm drainage design was upgraded to a 50-year-storm frequency. Some additional right-of-way had to be acquired. A bridge was constructed over Cibolo Creek._____

Project Manager (SHAs): ___Smokey Villarreal _____ Phone: (830) 379-5362 _
Designer/ Consultant: _____So-Deep, Mike Rice _____ Phone: _____
SUE Consultant: _____ Phone: _____
Contractor: _ Capital Excavating, Box 47015 Austin, TX, Jeff Dubose__ Phone: (210) 599-7840 _
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$35,000 (1)		
2. Reduced project delays due to utility relocates	$60,000 (2)	$60,000 (2)		
3. Reduced construction delay due to utility cuts	$10,000 (3)			
4. Reduced contractor's claims & change orders		$120,000 (4)		
5. Reduced delays caused by conflict redesign		$12,000 (5)		
6. Reduced accidents & injuries due to line cuts		$50,000 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$18,000 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$5,800 (19)		
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $370,800 divided by $51,527.00 = $7.20

Table 3. Specific Projects Studied

Specific Project: **#S0001** *(Continued)*

(1)
The project was limited in the amount of available right-of-way. The vertical location of the utilities was needed to do the design. The SUE information eliminated the guesswork in the design process. Accurate SUE information eliminates the uncertainty as to the water line location. The water line had no as-built records, so SUE saved the possibility of hitting the water line. Moving the water line was estimated to be $35,000.
Construction had not begun as of August 1999. But contract has been awarded to Capital excavation.
(2)
Field conflicts encountered after construction was awarded revealed 4 gas lines and 3 SW Bell conflicts. Time Savings is $60,000 = $2,000 x 30 days.
The bridge design at Cibolo Creek required the sanitary, gas, and water lines to be relocated. The benefits of SUE are the ability to maintain grade and location. Avoided delays of $2,000 per day and specified location of the utilities. A Cost Savings of $2,000 per day for 30 days was realized. $60,000 = $2,000 x 30 days.
(3)
Reduction in construction delays due to utility cuts is 5 days. Time cost savings = $2,000 per day x 5 days = $10,000
(4)
Saved the cost of change orders at the locations of the 4 gas lines and the 3 SW Bell locations. Design will let them know. The daily construction delay cost is $2000 per day. SUE will save 60 days in delays that the contractor would file claims for, or $2,000 x 60 days = $120,000
(5)
The estimated design cost is $200/ day. SUE could save 60 days in redesign costs at conflict locations. Or $200 pre day x 60 days = $12,000.
(6)
The utilization of SUE reduced the possibility of accidents. The estimated cost savings from the analysis of the design of this urban project is $50,000.(The large magnitude of the project was a first.)
Cost Savings is $50,000. ***U***
(12)
A benefit was that SUE information aided the storm sewer design. Estimated 15 days at $400.00 per day, or 15 times $400 = $6,000. In addition, SUE was a big help for the design team since they did not have to locate the utilities, the SUE provider did it which was a big help to the designer. This saved time and money for the designer. Estimated 30 days at $400 per day, or 30 x $400.00 = $12,000. Total savings = $18,000.
(19)
Cost Savings is $5,800. ****U***

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0002**

Project's Title: 2708-01-017, S-0002 _____ Year SUE Program Began: 1997
Project's Location: __FM 2696 Blanco Road _____ State: ____TX _____
Name of Person Completing Questionnaire: ___Tony Martinez ____ Phone:_(210) 615-6233 _
Cost of the Project:____$20,600,355.00_____
Cost of Engineering: _____ Cost of Right-of-Way: _____
(1) Cost of Mobilizing: $0.00 _____ + (2) Cost of Designating: $162,913.32 _____
+ (3) Cost of Locating: $10,145.00 _____ = (4) TOTAL SUE: $173,058.32 _____
Description (Summary) of the Project: __Upgrade the existing 4-lane road to a 6-lane road with continuous left-turn lanes. Project includes drainage structures, curb and gutter, and some signalized intersections. SUE was utilized to avoid interference of the drainage structures with existing utilities. _____

Project Manager:
(SHAs): R/W Juan Zaragosa (210) 615-5910 & Tony Martinez _ Phone: (210) 615-6233 _
Designer/ Consultant: TXDOT Greg Granto, Larry Coyle _____ Phone: (210) 615-6124 _
SUE Consultant: __So-Deep, Mike Rice _____ Phone: (210) 829-7388 _
Contractor: _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$206,700 (1)		
2. Reduced project delays due to utility relocates	$60,000 (2)	$10,000 (2)		
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders				
5. Reduced delays caused by conflict redesign		4,000 (5)		
6. Reduced accidents & injuries due to line cuts		$105,500 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$4,000 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built	$20,000 (17)			
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$27,500 (19)		
20. Introduced concept of comprehensive SUE	$20,000 (20)			
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $457,700 divided by $173,058.32 = $2.64

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0002** *(Continued)*

(1)
The SUE data indicates the location of utilities is known, but the contractor did not avoid them and hit them anyway. The design section reduced some conflicts by moving some of the storm drainage inlets.

Some of the 24-inch gas line did not have to be relocated by designing drainage structures around it. 200 feet was not relocated. Or 24" @ $150 per foot x 200 feet = $30,000.

Some of the 24-inch water line did not have to be not relocated by designing around it. 700 feet was not relocated. Or 24" water main @ $121 per foot x 700 feet = $84,700.

2000 feet of 12-inch water line did not have to be relocated because drainage lines could be designed around it. Or 12" water line @ $46 per foot x 2000 feet = $92,000

Sub totals Cost Savings: (1) $206,7000

(2)
Limited success was realized in utilizing SUE to achieve delay reduction, since all the parties involved in the project were using SUE for the first time. More savings could have been obtained, but were not. SUE procedures are being developed that will work on improving delay costs and their causes.

On July 7, 1999, a water line conflict problem was encountered. The 12-inch water line was found to be in conflict with drainage lines. But the conflict is properly shown on the project drawings indicating the SUE data is correct. There were no errors found in the SUE data. The SUE data was correctly provided to the utilities and they were to adjust their lines to avoid the conflicts at the catch basin locations. But this did not happen. So even though the SUE data is correct there are still conflicts being encountered in the field that are causing delays. The utilities were not relocated to get out of the way of the designed drainage lines. Something was overlooked, due to lack of time, or some other reason. The potential problems were discussed but the SUE benefits were not realized.

Quality level A information could have helped to avoid time delays. But times delays are being encountered, proper use of SUE information should have avoided the encountered delays. The project is one month behind schedule at a delay cost of $30,000 to $60,000, or $1,000 to $2,000 per day.

Time Savings $60,000
Cost Savings $10,000

(5)
Conflict redesign. Some redesign had to be done, due to oversight by utility companies. 2 days @ $200/ day = $4000.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0002** *(Continued)*

(6)
So far there have been 2 gas line cuts on the project and 2 water line cuts. Again the lines were shown right (in 2 dimensions, Quality level B information) but the contractor kept on digging. Vertical locations would have helped avoid the cuts, (Quality level A information.)
$20,000 Cost Savings based on actual project information.
Total cost savings = projected savings ***U*** + $20,000.

Only 10 test holes were produced with the SUE work. The utility companies were to do their own locating and pot-holing. Locating was not done by SUE.

(12)
Some cost savings in the cost of project design for utilities. SUE data allows the burden of accurately depicting the location of utilities on the drawings to be assumed by the SUE provider. This saves the designers a lot of repetitive time on routine data entry. This data entry could take 4 weeks. A savings of 4 weeks or 20 days @ $200 per day = $4,000.

(17)
The SUE information could have helped the utilities. The utilities were sent SUE survey information and data and they all liked it. The data and information really helped them out and gave a lot more confidence to the utilities.
Time Savings $20,000

(19)
Cost Savings is $27,500 ****U***

(20)
SUE needs to become available as a tool to all parties involved in the project.
Time Savings: $20,000

The SUE information on this project was liked by the designers and it was good and accurate information. The results could have and should have been better, but there was just not enough time to complete review and checking procedures to the requirements of meeting deadlines.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0003**

Project's Title: I 635, US 75 _____ Year SUE Program Began: ____
Project's Location: Interchange of I-635 and US 75 _____ State: ____TX _____
Name of Person Completing Questionnaire: Scott Stockburger ____ Phone: (214) 320-6650 _
Cost of the Project: $36,100,000.00_____
Cost of Engineering: _____ Cost of Right-of-Way: _____
(1) Cost of Mobilizing: $0.00 _____ + (2) Cost of Designating: $190,190 _____
+ (3) Cost of Locating: _____ = (4) TOTAL SUE: **$265,304** _____
Description (Summary) of the Project: This project consisted of the reconstruct of the interchange of I-635 and US 75. Project included storm sewers, sanitary sewers, water lines, new bridge structures, and the alignment of existing roadways. The Subsurface Utility Engineering performed for the interchange was divided into two contracts. The first was for designation (S0003) and the second (S0081) was for digging test holes to the existing facilities to determine depth.

Project Manager (SHAs): _____ Phone: _____
Designer/ Consultant: _____ Phone: _____
SUE Consultant: TBE Group, Buddy Dees _____ Phone: (512) 836-1130 _
Contractor: _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$500,000 (1)		
2. Reduced project delays due to utility relocates		$60,000 (2)		
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders		$60,000 (4)		
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts		$299,000 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids		Future Savings (10)		
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$12,000 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built		$20,000 (17)		
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$48,200 (19)		
20. Introduced concept of comprehensive SUE		$50,000 (20)		
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $1,049,200 divided by $265,304 = $3.95.

(Total Sue Cost = $190,190 *[from S0003]* + $75,195 *[from S0081]* = $265,304)

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0003** *(Continued)*

(1)
The data provided as a result of the first SUE contract has allowed TXDOT to recommend changes in the design to avoid disturbing existing utilities. The cost of utility relocations for this project is currently estimated at $4M. One such change to the plans being made involves the location of a proposed bridge bent. The location of the bent is being changed to miss an existing TU Electric Duct bank. The cost of relocating the Duct bank would have exceeded $300,000. Another plan adjustment involved changing the grade of a proposed storm sewer trunk line that would have intersected a fiber optic cable owned by MCI/WorldCom. The estimated cost of relocating this cable was approximately $200,000. The designating was completed one year ago. Kim Limberger, head of the design section, believes the SUE information permitted them to redesign to avoid the above significant conflicts. Therefore, the Cost Savings are $300,000 + $200,000 = $500,000.
(2)
Project delays were reduced by an estimated 30 days at a cost of $2000 per day = $60,000.
(4)
Reduced contractors' claims and change orders by 30 days at $2,000 per day = $60,000.
(6)
SUE located the utilities that were not known to exist. Approximately an additional 10% were found, and all of these were cable. This reduced the possibility of accidents and injuries.
Cost Savings is $299,000 ***U***
(12)
The test hole data will allow TXDOT to determine if further savings can be achieved by adjusting design where possible. SUE was used to locate existing utilities enabling the designers to produce plans where the alignments were already finished. Project design was 65 % complete when SUE was started. Design savings were estimated to be 30 days @ $400 per day = $12,000.
(17)
Using SUE on this project facilitated electronic map accuracy in the as-built drawings for the project. This information is of substantial value to the affected utilities. The value placed on this Cost Savings was determined to be $20,000.

(19)
The construction contractor can also use this information in the field in order to avoid accidents such as cutting active utility lines. This will be important, as some of the relocated facilities will be under the proposed pavement due to right-of-way constraints and the design of several straddle bents. Cost Savings is $48,200 ****U***
(20)
SUE information will help utility relocations, but it is not planned and accomplished yet. Relocation planning may need some additional information for tie-ins and other work. The project was able to go to bid with utilities clear benefiting contractors, the construction process, and safety. A lot of people are learning what SUE is all about and are starting to gain confidence in using SUE. In addition, $20,000 savings was realized for map accuracy and as-builts (See Item #17 above). Cost Savings for Item #20 is $50,000.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0081**

Project's Title: I-635, US 75 _____ Year SUE Program Began: ____
Project's Location: Interchange of I-635 & US 75 _____ State: ____TX _____
Name of Person Completing Questionnaire: Scott Stockburger ___ Phone: (214) 320-6650 _
Cost of the Project: _____
Cost of Engineering: _____ Cost of Right-of-Way: _____
(1) Cost of Mobilizing: _____ + (2) Cost of Designating: _____
+ (3) Cost of Locating: _____ = (4) TOTAL SUE: $86,398_____
Description (Summary) of the Project: _____
SUE work consisted of 90 test holes. This project is combined with S0003 to be evaluated as one project for the SUE study. **SEE S0003 for write up and savings analysis.**

Project Manager (SHAs): _____ Phone: _____
Designer/ Consultant: _____ Phone: _____
SUE Consultant: _____ Phone: _____
Contractor: _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations				
2. Reduced project delays due to utility relocates				
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders				
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts				
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design				
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance				
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				
22.				

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0006**

Project's Title: _____ Year SUE Program Began: ____
Project's Location: Taylor Co Abilene, US 83 _____ State: ____ TX _____
Name of Person Completing Questionnaire: Charles Webb _____ Phone: (214) 752-8300 _
Cost of the Project: $5,030,000.00 _____
Cost of Engineering: _____ Cost of Right-of-Way: _____
(1) Cost of Mobilizing: $3,122.00 _____ + (2) Cost of Designating $64,973.83 _____
+ (3) Cost of Locating $18,072.00 _____ = (4) TOTAL SUE: $86,167.83 _____
Description (Summary) of the Project: This rural project went from Iberis Road North to Antiley Interchange, a distance of about 3.371 km. Frontage roads were added to each side of the road and the median was converted to a barrier type. Lanes were moved in order to add the frontage roads. All drainage structures were extended or replaced. An overpass bridge was constructed over FM 707 along with a full interchange. _____

Project Manager (SHAs): _____ Phone: _____
Designer/ Consultant: Eric Davis _____ Phone: _____
SUE Consultant: Underground Services _____ Phone: (210) 828-9896 _
Contractor: _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations	$10,000 (1)			
2. Reduced project delays due to utility relocates	$10,000 (2)			
3. Reduced construction delay due to utility cuts	$10,000 (3)			
4. Reduced contractor's claims & change orders		$120,000 (4)		
5. Reduced delays caused by conflict redesign		$120,000 (5)		
6. Reduced accidents & injuries due to line cuts		$13,900 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids		Future Savings (10)		
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$10,000 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency		$5,000 (16)		
17. Facilitated electronic map accuracy, as- built		$5,000 (17)		
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$4,500 (19)		
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $308,400 divided by $86,167.83 = $3.58

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0006** *(Continued)*

(1)

The water lines and the phone lines were relocated due to their own convenience. A benefit, but not a tangible. Above ground transmission lines SUE benefits. $10,000 Time Savings

(2) and (3)

Since SUE information was obtained after the design consultant began working on the design of the project, it was not possible to obtain the full benefits of SUE. The SUE provider has the responsibility for the location of the existing utility lines, not TXDOT nor the design consultant. The existing utilities are difficult to find and take time to locate. Accurate SUE information is now being included in the project's plan, along with the sewer line and the design of the drainage system. An estimated Time Savings for reducing project delays is $10,000. An estimated Time Savings for reducing construction delay due to utility cuts in $10,000.

(4)

The application of SUE reduced the possibility of claims and change orders. An estimated 60 days time delay savings at $2,000 per day is realized.
60 days x $2,000 per day = $120,000.

(5)

The potential delay caused by conflict redesign is estimated to be 60 days.
Cost Savings then is 60 days @ $2,000 per day = $120,000

(6)

Cost Savings is $13,900. ***R**

(10)

If the contractor is working off accurate contract information, will a better or lower bid price be the result? Maybe or maybe not—the better bid price depends upon all parties being familiar with the SUE process. A Future Savings should result in this item.

(12)

The advantage of using SUE on this project during the design phase is that after the preliminary design is completed, 30 accurately located test holes were used to produce a design free from all possible conflicts. SUE information was used to obtain a correct design, thus the cost of design was reduced. Cost Savings: 5 days @ $2,000 per day = $10,000.

The project is located in a rural area with underground utilities including sewer, water, electric cable, natural gas, and fiber optic cable.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0006** *(Continued)*

(16)

The use of SUE on this project helps minimize user impacts. The use of SUE was beneficial in that it induced utility owners to look at what they have and it saves time and money on future project delays. Estimated Cost Savings was $5,000.

(17)
After this project is completed, the utility information becomes part of the as-built project drawings. The utilities are aware what lines are to be moved and when to move them which is a great benefit to them. The utility relocation process can now be accomplished without error. Estimated Cost Savings: $5,000.

(19)
Cost Savings is $4,500. ***R***

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0007**

Project's Title: CCSJNOo. 0175-06-037 _____ Year SUE Program Began: ____
Project's Location: Lufkin Dist, Nacogdoches Co. _____ State: ___TX _____
Name of Person Completing Questionnaire: Chuck Still _____ Phone: (409) 564-7782 _
Cost of the Project: $2,669,000.00_____
Cost of Engineering: _____ Cost of Right-of-Way: _____
(1) Cost of Mobilizing: $4,096.48 _____ + (2) Cost of Designating: $36,675.80 _____
+ (3) Cost of Locating: $51,561.00 _____ = (4) TOTAL SUE: $92,333.28 _____
Description (Summary) of the Project: This project was 2 miles in length, and located in the town of Garrison, a RR town. The existing road was widened from 4 lanes to 5 lanes with the addition of paved shoulders with curb and gutter, drainage structures, and storm sewer. The RR flashers were moved as part of the project. Historic building structures were avoided, and the RR mainline was parallel to the road through the town._____

Project Manager (SHAs): _____ Phone: _____
Designer/ Consultant: Chuck Still _____ Phone: _(409) 564-7782
SUE Consultant: Cobb, Fendley, & Associates, Stacy Davis _____ Phone: _(713) 462-3242
Contractor: _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$13,500 (1)		
2. Reduced project delays due to utility relocates	$10,000 (2)			
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders		$100,000 (4)		
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts		$11,000 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$12,000 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built		$3,500 (17)		
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$2,000 (19)		
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				

Savings Analysis: $152,000 divided by $92,333.28 = $1.65.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0007** *(Continued)*

SUE information was first obtained by designating all existing utilities. The design was then roughed out with approximate locations of drainage structures and all project features. The designers were then able to specify the locating for the SUE provider. Thirty-eight mostly shallow test holes were utilized where conflicts were seen from the initial design. The final design was then free from potential conflicts.

(1)
The accurate SUE information allowed designers to know where to relocate the City of Garrison water, sewer, and gas lines along with the Southwestern Bell cable. The amount of utility relocations were reduced. The estimated amount of reduced utility relocation was taken to be 0.005 x $2.7M (project cost) = $13,500.

(2)
SUE information provided a Time Savings by reducing project delays due to utility relocates. An estimated Time Savings of 10 days @ $1,000 per day = $10,000.

(4)
SUE was a benefit in reducing the contractor's claims. The City of Garrison could have been required to move their lines at a high cost. An estimated 2,000 feet of utility lines @ $50 per foot = $100,000 Cost Savings.

(6)
Cost Savings is $11,000. ***U***

(12)
The use of SUE reduced the cost of design and construction.
An estimated 20 days Cost Savings @ $200 per day = $4,000.

(17)
SUE helped with utility locations. Located utilities were spotted on drawings with correct utility information on the cross sections. This information is accurate and will be available to contractors and utilities if asked or needed.
Cost Savings = $5,000.

TXDOT must make sure all utilities are moved completely out of the way. If the utility says it has moved, but the move is not far enough, it is still in the way. The use of SUE eliminates this problem.

(19)
Cost Savings is $3,500. ****U***

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0011**

Project's Title: I-35 E Year SUE Program Began:
Project's Location: Dallas State: TX
Name of Person Completing Questionnaire: Scott Stockburger Phone: (214) 320-6650
Cost of the Project: $69,945,171.00
Cost of Engineering: Cost of Right-of-Way:
(1) Cost of Mobilizing: $1,657.60 + (2) Cost of Designating: $130,054.08
+ (3) Cost of Locating: $97,848.00 = (4) TOTAL SUE: $229,559.68
Description (Summary) of the Project: The project consisted of the reconstruction and widening of the existing freeway. Project included storm sewer drainage, bridge structures, sanitary sewers, water, and frontage roads. Curb and gutters were included the entire length of the project. Length of the project is 6 miles. SUE utilized 164 test holes on the project.

Project Manager (SHAs): Phone:
Designer/ Consultant: Phone:
SUE Consultant: Underground Services, Jim Witten Phone: (210) 828-9896
Contractor: Phone:
Utility Co.: Phone:

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations				
2. Reduced project delays due to utility relocates				
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders		$2,700,000 (4)		
5. Reduced delays caused by conflict redesign		$40,000 (5)		
6. Reduced accidents & injuries due to line cuts		$290,000 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$12,000 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$94,000 (19)		
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $3,136,000 divided by $229,559.68 = $13.66.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0011** *(Continued)*

(4)
Initial project information indicated that two high pressure gas lines were clear, but a review of the design using SUE information showed that the gas lines were in conflict. The Lower the 2 lines at a cost of $3M. 4 storm sewer crossing that could not be avoided, plus retaining walls, the lines were 4 feet. Lines would be exposed. No way avoid conflict. Savings were due to eliminating the delay to contractor to shut down in order to move the utility lines. A delay of 6 months would be reasonable. Cost of the delay would range between $15,000 to $20,000 per day based on traffic studies.
Cost savings is estimated to be $15,000 per day x 6 months = $2,700,000.

(5)
Redesign Costs based on 6 months delay @ 100 working days x $400 per day = $40,000.

(6)
Cost Savings is $290,000. **U*

(12)
TXDOT design department knew that there were extensive existing utilities located within this project. These utilities were needed to be located before the design could be properly completed. Soft Dig provided deliverables that were instrumental in developing the plan for relocation of existing utilities in conflict with the proposed construction. The layouts of existing facilities were distributed to the utility owners impacted by this project and used to develop their proposed adjustment plan and estimate. All utility adjustments necessary due to the proposed construction of this project are reimbursable since it is a federally funded Interstate project. This information was also useful in determining where changes to TXDOT's design would eliminate a conflict with an existing facility, thus saving tax dollars by eliminating unnecessary adjustments. The construction contractor can also use this information in the field in order to avoid accidents such as cutting active utility lines.
Cost Savings: 30 days time savings @ $400 per day = $12,000.

(19)
Cost Savings is $94,000. ***U*

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0019**

Project's Title: FM 529 _____ Year SUE Program Began: ____
Project's Location: In NW Houston, Harris Co., Huffmeister Rd & US 290 State: __TX____
Name of Person Completing Questionnaire: Larry Blackburn _____ Phone: (713) 802-5381 _
Cost of the Project: $16,194,444.00, (based on July 1998 bid cost) _____
Cost of Engineering: _____ Cost of Right-of-Way: _____
(1) Cost of Mobilizing: $7,378.80 _____ + (2) Cost of Designating: $43,743.16 _____
+ (3) Cost of Locating: $31,980.00 _____ = (4) TOTAL SUE: $83,101.96 _____
Description (Summary) of the Project: Project consisted of widening of 2 existing lanes to 6 lanes plus a center turning lane. Project includes curb and gutter, underground storm drainage, manholes, and curb inlets along the entire length of the 3-mile (5.364 Km) project. The project also included 4 signalized intersections. Project is presently under construction in August 1999.

Project Manager (SHAs): Larry Blackburn _____ Phone: (713) 802-5381 _
Designer/ Consultant: _____ Phone: _____
SUE Consultant: So-Deep, Mike Rice _____ Phone: (210) 829-7388 _
Contractor: J. D. Abrams, Inc. _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations	$60,000 (1)			
2. Reduced project delays due to utility relocates	$60,000 (2)			
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders		$120,000 (4)		
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts		$67,000 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids		Future Savings (10)		
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$12,000 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built		$20,000 (17)		
18. Minimized chance of environmental damage		$50,000 (18)		
19. Induced savings in risk Mgmt., & insurance		$22,000 (19)		
20. Introduced concept of comprehensive SUE		$20,000 (20)		
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $431,000 divided by $83,101.96 = $5.19

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0019** *(Continued)*

(1)
Avoided pipelines
SW Bell fiber optic cable was located. Located all the manholes, big duct bank. Duct bank cable was a problem. Was the first SUE contract and did not take advantage of SUE information. Shifted storm sewer trunk line to avoid conflict with the fiber optic duct bank along about 2 miles of the fiber optic. 1168 meters of the storm sewer was adjusted. Saved relocating the FO cable. Cost too much to move. Tried to avoid but it was further into the R/W than thought. Kept the project going saved several weeks delay, time was saved. Could have hit the FO cables, it was in the plans but not where it was supposed to be. Numerous petroleum pipelines, phone, water, cable TV.
Time Savings = $60,000.
(2)
Would have been some construction delays. 25 to 30 % complete on 7/8/99.
30 Days Time Savings @ $2000 per day = $60,000.
(4)
Reduced potential for change orders and claims.
60 days time savings @ $2,000 per day = $120,000.
(6)
Potential for accidents was eliminated by the use of SUE.
Cost Savings is $67,000. **U*
(10)
Did bidders know that SUE had been used? TXDOT personnel not sure due to no pre-bid conference. No Cost Savings determined at this time, but cost savings could have resulted with better utilization of SUE. Future Savings possible.
(12)
Saved us time gathering information, asking utility companies is time consuming and not accurate. Designed around several of them. SW Bell did some adjustments of their regular facilities.
30 Days time savings @ $400 per day = $12,000.

(17)
Took this info put it in the plans had several meeting with utility owners. Good PR. Utilities did not know where the are, shared info with the utilities
Cost Savings: $20,000

(18)
Saved environmental damage, redesigned to miss a couple, more casing on others. Abandoned lines were removed by the owner of it.
Cost Savings: $50,000.

(19)
Cost Savings is $22,000. ***U*

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0019** *(Continued)*

(20)
Helped concept of comprehensive SUE.
Cost Savings: $20,000.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0020**

Project's Title: US 287 Year SUE Program Began: ____
Project's Location: US 287 from W. of the city of Midlothian to existing US 287 State: TX__
Name of Person Completing Questionnaire: Steve Christian _____ Phone: (214) 320-6676 _
Cost of the Project: $8,552,250.00
Cost of Engineering: _____ Cost of Right-of-Way: _____
(1) Cost of Mobilizing: $4,824.60 _____ + (2) Cost of Designating: $13,456.04 _____
+ (3) Cost of Locating: $3,820.00 _____ = (4) TOTAL SUE: $22,100.64 _____
Description (Summary) of the Project: This project involved the construction of a new 4-lane divided rural by-pass around the city of Midlothian. The length of the project was 1.394 miles. The project included new drainage structures the entire length of the project. A significant portion of the route of this project is through unimproved lands and across a limited access right-of-way.
Project Manager (SHAs): _____ Phone: _____
Designer/ Consultant: Scott Stockburger _____ Phone: (214) 320-6271 _
SUE Consultant: SoDeep, Mike Rice _____ Phone: (210) 829-7388 _
Contractor: _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$10,000 (1)		
2. Reduced project delays due to utility relocates		$20,000 (2)		
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders		$40,000 (4)		
5. Reduced delays caused by conflict redesign		$4,000 (5)		
6. Reduced accidents & injuries due to line cuts		$23,600 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$6,000 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built		$5,000 (17)		
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$7,600 (19)		
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $115,600 divided by $22,100.64 = $5.23

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0020** *(Continued)*

General SUE Information.
The SUE provider was provided with a utility contact list and right-of-way CADD file before the design project began. The SUE work on this project began on 11-07-97, and was concluded on 04-30-98. Two supplemental work authorizations extended the contract time by 120 days. SUE work consisted of 2,931 meters of designating, and 4 test holes for locating

(1)
The use of SUE information in the design phase of this project allowed the design to proceed in a fashion that helped scope out the work required to relocate effected utilities.
The Cost Savings for utility line relocation is taken as $10,000.

(2)
The project delay cost is estimated to be $2,000 per day. The use of SUE will reduce project delays due to utility relocates. An estimated 10 days reduction is possible. The Cost Savings for 10 days @ $2,000 per day = $20,000.

(4)
The use of SUE will reduce contractor's claims and change orders by an estimated 20 days. Cost Savings for 20 days @ $2,000 per day = $40,000.

(5)
The use of SUE reduced the cost of redesigning due to utility conflicts. This Cost Savings is based on 10 days design time savings @ $400 per day = $4,000.

(6)
Future Savings for accidents.
Cost Savings is $23,600. ***R***

(12)
The design of the project was facilitated by the use of accurate SUE data. Design time savings of 30 days @ $200 per day was realized for a Cost Savings of $6,000.

(17)
The accuracy of the SUE information was a benefit to the effected utilities.
Cost Savings: $5,000.

(19)
Cost Savings is $7,600. ****R***

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0029**

Project's Title: CSJ 0291-11-016, S-0029 _____ Year SUE Program Began: 1997
Project's Location: Spur 421 in San Antonio I-410 to I-10_____ State: ____ TX_____
Name of Person Completing Questionnaire: Tony Martinez_____ Phone: (210) 615-6233 _
Cost of the Project: $31,057,031.00_____
Cost of Engineering: _____ Cost of Right-of-Way: $3,000,000 _____
(1) Cost of Mobilizing: $0.00 _____ + (2) Cost of Designating $209,065.07 _____
+ (3) Cost of Locating $17,755.00_____ = (4) TOTAL SUE: $226,820.07 _____
Description (Summary) of the Project: Spur 421 currently exists as a 4-lane section with left turn bays at the major intersections. The pavement width varies between 46' and 54'. The pavement section consists of approximately 10" of base material with an ACP surface. No storm drain system currently exists. The length of the project is 4.77 miles (7.677 km). The project includes widening existing lanes and installing new drainage structures the entire length of the project._
Project Manager (SHAs): Bill Chancellor _____ Phone: (210) 615-6207 _
Designer/ Consultant: Ken Davenport Fax: (210) 633-9473_____ Phone: (210) 633-1420 _
SUE Consultant: So-Deep, Mike Rice _____ Phone: (210) 829-7388 _
Contractor: _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$40,000 (1)		
2. Reduced project delays due to utility relocates		$50,000 (2)		
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders		$60,000 (4)		
5. Reduced delays caused by conflict redesign	$40,000 (5)	$4,000 (5)		
6. Reduced accidents & injuries due to line cuts		$129,000 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods		Yes, no $		
10. Increased the possibility of reduced bids		Future Savings (10)		
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design	$40,000 (12)	$8,000 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built		$20,000 (17)		
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$41,500 (19)		
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $425,500 divided by $226,820.07 = $1.88.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0029** *(Continued)*

General SUE Information:

The project is located in an urban area that contains numerous subsurface utilities. The location of many of these utilities is not know. Utilizing SUE on this project is the best way to proceed to produce a design that will be free of utility conflicts in the field, or at least minimize field conflicts.

(1)
The SUE information found and traced a considerable number of ghost lines, that is it found abandoned utility lines and located them allowing them to be eliminated as potential conflicts. Relocation Costs was estimated as $2,000 for each abandoned line. Approximately 20-locations are involved. Cost Savings: $2,000 x 20 = $40,000

(2)
There is no real way to determine the actual number of conflicts that were eliminated by the use of SUE; but by using SUE, a better idea of conflicts was obtained. About 10 to 25 conflicts were eliminated. A savings of $2,000 each could be reasonably assumed to have been obtained.
Cost Savings: 25 x $2,000 = $50,000

(4)
The cost of delay charges could be taken to be $2,000 per day. Claims and change orders were reduced. Cost Savings: 30 days @ $2,000 per day = $60,000

(5)
New storm drainage lines are located with inlets positioned to avoid conflicts with existing utilities as much as possible. On this project conflicts and redesign savings were realized. Redesign costs can be computed at 2 people at $200 per day. 20 day savings were achieved.
Cost Savings: 20 days @ $200/ day = $4,000.
Time Savings: 20 days @ $2,000 per day = $40,000

(6)
Cost Savings is $129,000. ***U***

(9)
The use of SUE is believed to foster conditions for improving contractor productivity on this project, however no exact amounts could be determined during the evaluation study, so no savings were assigned to this item.

(10)
The use of SUE is believed to create the possibility of reduced contractors' bids. However, no exact amount could be determined during the evaluation study, therefore future savings is listed for this item.

Table 3. Specific Projects Studied (Continued)

Specific Project: **#S0029** (Continued)

(12)
Design costs were reduced. The benefits of SUE were that the design team obtained a better idea of what and where were the potential conflicts. The utilities that had to be moved were accurately determined. Savings by reducing design costs. SUE information was help for the design consultants so that they would not have to do utility locations over. Time savings in design and construction were realized.
Time Savings: 20 days @ $2000 per day = $40,000.
Cost Savings: $400 per day x 20 days = $8,000. The Sue information helped the design consultants prepare the drawings because of the confidence in the SUE data and utility locations.

Savings were obtained by reducing contract delays.

(17)
The utilities were glad to receive better and more accurate utility location information.
Cost Savings: $20,000

(19)
Cost Savings is $41,500. ***U*

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0036**

Project's Title: Loop 1604 _____ Year SUE Program Began: ____
Project's Location: Bexar County _____ State: ____TX _____
Name of Person Completing Questionnaire: Tony Martinez/ G Gorman Phone: (210) 633-1420 _
Cost of the Project: $10,000,600.00 _____
Cost of Engineering: _____
Cost of Right-of-Way: R/W will be acquired and will cost $ millions, but the amount is not know as of the date of the evaluation study._____
(1) Cost of Mobilizing: $3,381.50 _____ + (2) Cost of Designating: $164,661.21 _____
+ (3) Cost of Locating: $35,984.00 _____ = (4) TOTAL SUE: $204,026.71 _____
Description (Summary) of the Project: The project will provide a divided facility for Loop 1604. The project goes from FM 471 to the SH 151 Interchange, then to US 90, a distance of approximately 9 miles. The section from FM 471 to the SH 151 Interchange is 4 lanes divided with 2-lane frontage roads on both sides. The section from the SH 151 Interchange to US 90 will have main lanes with 2-lane frontage roads with access to the main lanes. Project will include drainage structures, curb and gutters at the interchanges, and traffic signals at the grade crossings. There are 6 bridges in the project. An overpass is located at Culebra Road at the north end of the project.

Project Manager (SHAs): _____ Phone: _____
Designer/ Consultant: George Gorman, Fax (210) 633-9473 _____ Phone: (210) 633-1420 _
SUE Consultant: _____ Phone: _____
Contractor: _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations	$40,000 (1)	$120,000 (1)		
2. Reduced project delays due to utility relocates	$60,000 (2)	$80,000 (2)		
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders		$80,000 (4)		
5. Reduced delays caused by conflict redesign		$8,000 (5)		
6. Reduced accidents & injuries due to line cuts		$27,600 (6)		
7. Reduced travel delays to the motoring public		$10,000 (7)		
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$18,000 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built		$10,000 (17)		
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$8,900 (19)		
20. Introduced concept of comprehensive SUE		$5,000 (20)		
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $467,500 divided by $204,026.71 = $2.29

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0036** *(Continued)*

(1)
A Time Savings of 20 days was realized in the process of utility relocations.
20 days @ $2,000 per day = $40,000.
(1) (2) (6)
The use of SUE will assist the process of utility line relocations by defining the amount and length of utility relocations. SUE is helpful to eliminating utility conflicts and working around them. The SUE work revealed water, phone cables, gas, and cable TV lines that were in potential conflict with many locations that were not correctly shown on the as-builts. The cable TV Company indicated that their lines were all overhead and nothing was buried in the location of the project. SUE found a buried TV cable, which the cable TV Company finally admitted belonged to them. They could not find a record of this cable. It would have been cut during construction.
Cost Savings due to savings on utility relocations: $120,000. (1)

(2)
A Time Savings of 20 days was realized by the application of the SUE process by reducing potential project delays due to utility line relocations.
30 days @ $2,000 per day = $60,000.

A Cost Savings by reducing project delays due to utility relocates caused by field conflicts of 30 days can be achieved on this project.
40 days @ $2,000 per day = $80,000

(4)
The Cost Savings is based on a 40-day time delay reduction by reducing contractor's claims and change orders.
40 days $2,000 per day = $80,000.

(5)
The use of SUE allows a cost savings by reducing the redesign of the project caused by utility conflicts. A savings of 15 days can be realized through SUE.
Cost Savings: 20 days @ $400/ day = $8,000.

(6)
Cost Savings is $27,600. ***R**

(7)
Traffic and travel delays reduced will be reduced along the length by the utilization of SUE on the project.
Cost Savings: $10,000

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0036** *(Continued)*

(12)
The application of SUE to the design process of the project allows a savings in design time requirements. The use of horizontal and vertical accurate SUE information makes a difference of night and day in the design process. SUE reduced the cost of design based on a design savings of 45 days.
Cost Savings: 45 days @ $400 per day = $18,000.

(17)
The accuracy of the SUE information described in the above general information was of great benefit to the effected utilities. The utilities will be able to use the information from the project for future locating of their lines. SUE enabled relations with the utilities to be improved. The utility companies are happy to get accurate utility line location information.
A Cost Savings of $10,000 is realized here.

(19)
Cost Savings is $8,900. ***R***

(20)
Utilizing SUE on the project introduced the concept of comprehensive SUE to the parties involved in the project.
A cost Savings of $5,000 is realized here.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0046**

Project's Title: Spur 246 _____ Year SUE Program Began: ____
Project's Location: Borger, Amarillo District _____ State: _____TX _____
Name of Person Completing Questionnaire: Tracy Cain, D & C____ Phone: (806) 934-1122 _
Cost of the Project: $1,782,000.00_____
Cost of Engineering: _____ Cost of Right-of-Way: _____
(1) Cost of Mobilizing: $3,345.28 _____ + (2) Cost of Designating: $40,275.86 _____
+ (3) Cost of Locating: $22,050.00 _____ = (4) TOTAL SUE: $65,671.14 _____
Description (Summary) of the Project: The length of the project is 1.70 miles The existing 2 lane road was widened to 4 lanes with a 16-foot flush continuous median left-turn lane. The project included new storm sewer drainage structures with curb inlets, underground concrete pipe, and curb and gutters. Two signalized intersections are included in the project. _____

Project Manager (SHAs): _____ Phone: _____
Designer/ Consultant: _____ Phone: _____
SUE Consultant: Underground Services, Inc. , Jim Witten _____ Phone: (210) 828-9896 _
Contractor: _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$15,000 (1)		
2. Reduced project delays due to utility relocates		$10,000 (2)		
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders		$10,000 (4)		
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts		$7,500 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$4,000 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built		$10,000 (17)		
18. Minimized chance of environmental damage		$30,000 (18)		
19. Induced savings in risk Mgmt., & insurance		$2,400 (19)		
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				

Savings Analysis: $78,700 divided by $65,671.14 = $1.20.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0046** *(Continued)*

A 10-inch water main was located along the west side of the roadway. It is not the intention to relocate this water main. An existing oil well in the vicinity of the project had pipelines relocated so the design of the project would not interfere with them. The project designers realized it would be easier to move or relocate the oil well piping and not relocate the 10-inch water main. SUE could be utilized to locate the oil well lines and determine which ones were in use. The application of SUE will save time by reducing conflicts and delays found in the field during construction.

(1)
The cost to relocate the water main was estimated to be between $150,000 and $200,000. The City of Borger's water main was old and made of transite. The City of Borger wanted this widening project to take place. Estimated Cost Savings: Most of the cost savings here is not SUE related. $15,000

(2)
The location of utilities in the area of the project was accomplished with enough accuracy that future delays due to field conflicts will be avoided. The estimated time reduction is 10 to 20 days. The delay daily cost savings is taken to be $1,000 per day
Cost Savings: 10 days @ $1,000 = $10,000.

(4)
The application of SUE to this project will reduce the potential for claims due to project delays from utility conflicts. The estimated time reduction is 10 to 20 days. The delay daily cost savings is taken to be $1,000 per day.
Cost Savings: 10 days @ $1,000 = $10,000.

(6)
Cost Savings is $7,500. ***U***

(12)
The water main was known to exist, but its location was unknown. The main advantage of SUE was that it saved time for the design team. The design team did not have to be responsible for locating this water line. 20 days design time savings @ $200 per day = $4,000 Cost Savings.

> **RECOMMENDATION**: The use SUE for design information is still skeptical within the design department. Thirty-seven test holes were used to obtain a picture of the location of the main utility lines. Some test holes will still have to be dug during construction, but there will be less because of the use of SUE. What designers learned about SUE on this project is that it's best to get Quality Level A locating information after the initial design is completed based on designating information.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0046** *(Continued)*

(17)
Utilities appreciate the use of SUE since they are not required to do as many or any dig-ups to locate their utilities. In addition, the Utilities have limited CADD capabilities. TXDOT offered the SUE information to the Utilities for goodwill and the Utilities like this information. Both parties are still learning to trust in the accuracy of SUE.
Estimated Cost Savings: $10,000.

(18)
SUE discovered some private utility lines and was able to determine that they were abandoned. Other private lines were discovered, but none were high pressure. These private lines were petroleum pipe lines. The use of SUE helped prevent environmental damage on this project. An estimated Cost Savings of $30,000 is realized.

(19)
Cost Savings is $2,400. ***U*

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0049**

Project's Title: FM 2094 League City _____ Year SUE Program Began: ____
Project's Location: _____Near Clear Lake _____ State: ____ TX_____
Name of Person Completing Questionnaire: Keith Robison _____ Phone: (713) 802-5777 _
Cost of the Project: $13,508,325.00_____
Cost of Engineering: _____ Cost of Right-of-Way: _____
(1) Cost of Mobilizing: $5,650.00 _____ + (2) Cost of Designating: $35,622.65 _____
+ (3) Cost of Locating: $110,940.00 _____ = (4) TOTAL SUE: $152,212.65 _____
Description (Summary) of the Project: Existing 2-lane roadway with gravel shoulder was widened to 4 lanes with a continuous center left-turning lane. The project included new drainage structures and curbs and gutters the entire length of the project. A new bridge was part of the project. Project also included traffic signals. The total distance was 1.8 miles.

Project Manager (SHAs): _____ Phone: _____
Designer/ Consultant: Baker and Lawsen, Sylvester _____ Phone: _____
SUE Consultant: Cobb, Fendley, & Associates, Stacy _____ Phone: (713) 462-3242 _
Contractor: _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$670,000 (1)		
2. Reduced project delays due to utility relocates				
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders				
5. Reduced delays caused by conflict redesign		$60,000 (5)		
6. Reduced accidents & injuries due to line cuts		$37,300 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design				
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built		$10,000 (17)		
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$12,000 (19)		
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $789,300 divided by $152,212.65 = $5.19.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0049** *(Continued)*

(1)
TXDOT let the contract and did the SUE work at the start of construction. Ideally, this would have been done in the design phase, however, SUE was just being implemented at this time. SUE was utilized to see if the GTE lines and Intex (gas) could remain under the pavement. The SUE information was used to show Intex that they had to adjust their line. SUE was used so that their relocation question was answered. The project storm sewer was redesigned as a result of the SUE information.

It was going to cost $1M to relocate the GTE phone lines that were contained in nine 4"-ducts. The estimated distance of the GTE ducts that would have been relocated was 2 miles, including main and laterals. The SUE information allowed the redesign of the project to keep the GTE phone lines from being relocated. The cost of this redesign was $30,000, plus an additional $150,000 of construction work. The total additional cost was $180,000 off of $1M, leaving $820,000 in savings; however, the project had to be stopped to do the redesign, which cost $150,000. Instead of spending $1M to relocate the GTE phone lines, the Total Savings by not relocating was $670,000.

(5)
There would have been project delays if the conflicts determined by the use of SUE had actually been found in the field during construction. The project would have been delayed a minimum of 30 days @ $2,000 per day, or a cost savings of $60,000.

(6)
Cost Savings is $37,300. ***R***

(17)
The accuracy of the redesign project was of great benefit to the affected utilities. An estimated Cost Savings of $10,000 was realized.

(19)
Cost Savings is $12,000. ****R***

General Comments on the use of SUE:

SUE helped by allowing a different storm sewer design that enabled the GTE duct to remain. Had the SUE information been available during the initial project design, all the $1M relocation savings would have been realized.

> TXDOT was asked to designate phone and gas lines. Approximately 100 test holes were used in locating, which proved to be more than necessary. The gas line had to be relocated, because it was essentially under the road. SUE saved relocating the GTE duct.
>
> In Texas, every district utilizes SUE differently. SUE is utilized best in districts that sit down and discuss with designers and SUE providers to understand the scope of work. When designers communicate with SUE providers, the project's design works out better.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0054**

Project's Title: Cotton Street Bridge _____ Year SUE Program Began: ____
Project's Location: _I-10, El Paso _____ State: _____TX _____
Name of Person Completing Questionnaire: Veronica Chanez _____ Phone: (915) 757-5913 _
Cost of the Project: $9,948,206.00_____
Cost of Engineering: _____ Cost of Right-of-Way: _____
(1) Cost of Mobilizing: $10,472.75 _____ + (2) Cost of Designating: $18,871.25 _____
+ (3) Cost of Locating: $11,916.00 _____ = (4) TOTAL SUE: $41,260.00 _____
Description (Summary) of the Project: The project consisted of 2 interchanges and intersections with ramps at I-10 and Cotton St., in El Paso, Texas.

Project Manager (SHAs): _____ Phone: _____
Designer/ Consultant: ___Veronica Chanez _____ Phone: (915) 757-5913 _
SUE Consultant: ____Underground Services, Jim Witten _____ Phone: (210) 828-9896 _
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations				
2. Reduced project delays due to utility relocates	$40,000 (2)			
3. Reduced construction delay due to utility cuts	$40,000 (3)			
4. Reduced contractor's claims & change orders		$60,000 (4)		
5. Reduced delays caused by conflict redesign		In above (5)		
6. Reduced accidents & injuries due to line cuts		$41,000 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids		$50,000 (10)		
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$6,000 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built		$10,000 (17)		
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$13,300 (19)		
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $260,300 divided by $41,260.00 = $6.31

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0054** *(Continued)*

(2) (3) (4) (5) (6) (12)
Nine railroad tracks were located under the new Cotton St. bridge with numerous utility lines located on the railroad right-of-way. The bridge supports and footings had to be designed around these utility lines. SUE determined that there were more utility lines than were originally known by Union Pacific. Union Pacific did not know the exact location of these utility lines. The design was adjusted to accommodate the location of the drilled shaft foundations for the bridge. The additional utilities that were located were gas lines, along with fiber optic cables. The designers were able to relocate the bridge columns to avoid moving several utility lines. Some utility lines still had to be moved, but the amount of lines that were relocated were a lot less due to use of SUE.

(2) and (3)
Time Savings: 20 days @ $2,000 per day = $40,000 each for (2) and (3)

(4) (5)
Claims: Times Savings of 30 days delay @ $2,000 per day = $60,000.

(6)
The potential was there to prevent an accident.
Future Savings: No costs assigned here yet.
Cost Savings is $41,000. ***U***

(10)
The information from # (17) was included on the project's plans so the contractor would have accurate utility location information.
Cost Savings for Bid Reduction is estimated to be $50,000.

(12)
SUE information saved 15 days for design time @ $400 per day = $6,000.

(17)
Southern Union Gas, SW Bell Fiber Optic Cable, city water, and Union Pacific resources—these utilities wanted the SUE information in order to verify the location of their utility lines.
Cost Savings: $10,000.

(19)
Cost Savings is $13,300. ****U***

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0057**

Project's Title: Spur 69 Larson Blvd. to Airport Blvd._____ Year SUE Program Began: 3/97
Project's Location: Austin _____ State: _____TX _____
Name of Person Completing Questionnaire: Mike Springfield _____ Phone: (512) 832-7238 _
Cost of the Project: $3,500,000.00_____
Cost of Engineering: _____ Cost of Right-of-Way: _____
(1) Cost of Mobilizing: $5,638.69 _____ + (2) Cost of Designating: $6,056.80 _____
+ (3) Cost of Locating: $27,843.75 _____ = (4) TOTAL SUE: $39,539.24 _____
Description (Summary) of the Project: Project is 1.31 miles in length. The project involved the widening of existing lanes and the installation of a continuous left-turn lane. New drainage structures were included along the length of the project with some signalized intersections. ___
_____
Project Manager (SHAs): _____ Phone: _____
Designer/ Consultant: Mike Springfield _____ Phone: (512) 832-7238 _
SUE Consultant: TBE Group, Buddy Dees _____ Phone: (972) 682-5432 _
Contractor: _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$42,400 (1)		
2. Reduced project delays due to utility relocates		$90,000 (2)		
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders		$45,000(4)		
5. Reduced delays caused by conflict redesign		$9,000 (5)		
6. Reduced accidents & injuries due to line cuts		$14,500 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		With item 5		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built		$5,000 (17)		
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$4,700 (19)		
20. Introduced concept of comprehensive SUE		$10,000 (20)		
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $220,600 divided by $39,539.24 = $5.58

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0057** *(Continued)*

General Information:
Based on public input the project was designed to be built in the existing Right-of-Way. SUE information was used to avoid utility conflicts along the project and at utility crossings. A major intersection contained 8 different utilities the had to be located in order to design the storm sewer without conflicts. The design of the project was difficult and critical to the success of the project. Existing utility information was not accurate and the exact locations of most of the utilities was not known.

The design of the project had been completed before SUE was employed on the project, since SUE was not yet being by TXDOT. When TXDOT decided to utilized SUE, this project was selected for SUE due to the suspected complex nature of utilities in the area of the project. After the SUE data and information was obtained, the project was redesigned to avoid utility conflicts. Admittedly it would have been better to design the project based on SUE information, but this was not possible. Utilizing SUE on this project enabled TXDOT to learn how to apply SUE to their Design process.

(1)
SUE information enabled the project to be redesigned so that many utilities did not have to be relocated. 90% of the effected utilities at the major intersection with 8 utilities did not have to be relocated. 200 feet of 2 inch gas line could stay in place along with 1000 feet of 8" water line.

8" water line @ $40 per foot x 1000 feet = $40,000

2" gas line @ $12 per foot x 200 feet = $2,400

Sub totals Cost Savings: (1) $42,400

(2)
The use of SUE will reduce the potential for delays due to utility relocates. 60 days delay reduction is estimated for this project. The delay cost is $1,500 per day.
60 days @ $1,500 per day = $90,000

(4)
The use of SUE will reduce the possibility of claims and change orders due to unforeseen underground utility conflicts. There are numerous utility crossings along the length of this project. The estimated reduction in delay days is 30 days.
30 days @ $1,500 per day = $45,000

(5)
The redesign of the project was accomplished before the start of construction. This cost is a benefit of SUE and is included in the study. The design cost is $300 per day. Design time savings is 30 days.
30 days @ $300 per day = $9,000

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0057** *(Continued)*

(6)
Cost Savings is $14,500. ***U***

(12)
As stated above the project was designed before SUE was employed. A lot of changes were made in the redesign. The design cost savings are then included in item 5.

(17)
The use of USE was extremely helpful in the relations with the utilities. They did not know where their lines were located and were concerned that all of their lines would have to be moved. The SUE information defined the exact locations of the utilities updating their records and minimized the amount of relocations.
Cost savings $5,000

(19)
Cost Savings is $4,700. ****U***

(20)
This was the first TXDOT SUE project in the Austin District and it functioned as introduce the concept of SUE to other TDOT personnel. It served as an excellent demonstration project that showed the proper application of SUE principles to the design of a project.
Cost Savings $10,000

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0058**

Project's Title: US 90A Year SUE Program Began
Project's Location: Beltway 8 to Hiram Clarke State: TX
Name of Person Completing Questionnaire: Mike Galloway Phone: (713) 802-5779
Cost of the Project: $49,342,060.00
Cost of Engineering: Cost of Right-of-Way:
(1) Cost of Mobilizing: $6,008.96 + (2) Cost of Designating: $2,522.80
+ (3) Cost of Locating: $36,159.75 = (4) TOTAL SUE: $44,691.51
Description (Summary) of the Project: Project consisted of widening an old highway with numerous existing utilities. Project had limited right-of-way area for redevelopment of utility relocation. All utilities had to be placed in a 10-foot corridor in a stacked manner. It was critical to locate all utilities before construction in order to avoid construction phasing conflict problems. The utilities had to know where they are to go. The size of the utilities had to be known in order to decide what sizes to replace, and exact widths had to be known to plan the relocations. Phasing of the utility relocations was critical in this project.

Project Manager (SHAs): Phone:
Designer/ Consultant: Sylvester Onwas, Brown and Root Phone: (713) 802 5504
SUE Consultant: TBE Group, Buddy Dees Phone: (512) 836-1103
Contractor: Phone:
Utility Co.: Phone:

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$40,000 (1)		
2. Reduced project delays due to utility relocates		$25,000 (2)		
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders		$50,000 (4)		
5. Reduced delays caused by conflict redesign		$2,000 (5)		
6. Reduced accidents & injuries due to line cuts		$204,500 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids		Future Savings (10)		
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$4,000 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built				
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$65,900 (19)		
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				

Savings Analysis: $391,000 divided by $44,691.51 = $8.22

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0058** *(Continued)*

(1)
The bridge overpass portion of the project needed to have its foundation system designed miss the sanitary and water lines in the vicinity of the project. SUE allowed the design of the project to proceed with a minimum of sewer and water relocations. Some problems with the elevations of the utility lines occurred from SUE provider. The problems were determined to be mistakes caused by sending the wrong information. The problem was resolved without major impact. Cost Savings are based on 800 feet of utility lines not having to be relocated.
Cost Savings: 800 ft @ $50.00/ ft = $40,000.

(2)
SUE work saved an estimated 5 days delay time for utility line relocations.
Cost Savings: 5 days @ $5,000/ day = $25,000.

(4)
The delay cost for this project is estimated to be $5,000 per day for item 2 and 4. The application of SUE saved an estimated 10 to 15 days time that could be claimed in a change order.
Cost Savings: 10 days @ $5,000/ day = $50,000

(5)
SUE also saved redesign delays to avoid conflicts, a total of 5 days is estimated to have been saved.
Cost Savings: 5 days @ $400/ day = $2,000

(6)
Cost Savings is $204,500. ***U***

(10)
May help reduce bid prices by confidence of not being delayed due to utility relocates. This is taken to be a future savings.

(12)
Although the project is not yet in construction. SUE saved a lot of time in the design phase of the project. An estimated design time savings of 10 days is included. The daily design cost is $400.
Cost Savings: 10 days @ $400/day = $4,000.

(19)
Cost Savings is $65,900. ****U***

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0063**

Project's Title: S0063, IH 10 _____ Year SUE Program Began: ____
Project's Location: IH-10 from SH 6 to Ft Bend Co. Line _____ State: ____TX _____
Name of Person Completing Questionnaire: Keith Robison_____ Phone: (713) 802-5777 _
Cost of the Project: $45,000,000.00_____
Cost of Engineering: _____
Cost of Right-of-Way: $25 Million Bought RR R/W, plus $3.4M for other R/W = $28.4 M __
(1) Cost of Mobilizing: $50,536.75 _____ + (2) Cost of Designating: $495,370.31 _____
+ (3) Cost of Locating: _____ = (4) TOTAL SUE: $545,907.06
Description (Summary) of the Project: Project consisted of widening existing IH-10 from 6 lanes to 8 main lanes, with the addition of 2 lanes of High Occupancy Vehicle to the project. Total length is 10.18 miles. Project also includes two 3-lane frontage roads, bridges, and drainage structures, all located in an urban area. The route of the project is in an urban area that is an established commercial and residential area with numerous buried utilities.
Project Manager (SHAs): Not yet selected, see below: _____ Phone: _____
Designer/ Consultant: There will be 3 or 4 design consultants employed along with one overall coordinator consultant in charge of the design of the project. _____ Phone: _____
SUE Consultant: TBE Group, Buddy Dees _____ Phone: (512) 836-1103 _
Contractor: _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations	No	$200,000 (1)		
2. Reduced project delays due to utility relocates		$400,000 (2)		
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders		$120,000 (4)		
5. Reduced delays caused by conflict redesign		$90,000 (5)		
6. Reduced accidents & injuries due to line cuts		$186,300 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids		Future Savings (10)		
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		Future Savings (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built		$20,000 (17)		
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$60,000 (19)		
20. Introduced concept of comprehensive SUE		$10,000 (20)		
21.Right-of-Way acquisition, costs		$500,000 (21)		
22.				

Savings Analysis: $1,586,000 divided by $544,907.06 = $2.91

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0063** *(Continued)*

General SUE Information and:
(1) (2) (4) (5) (12) (21)
Project contains numerous utilities, many of which have unknown locations. The project is still in the early design phase. SUE is expected to reduce project delays due to utility conflicts. TXDOT know what utilities are located in the area of the project and the magnitude of the utilities. Utilities located within the project will be moved. The project will build a new facility for the utilities. With SUE designers can better determine where and how to relocate the utilities. The primary benefit is time, and the estimated 1 out of 20 potential construction utility conflicts being eliminated. With SUE TXDOT can establish the required utility corridor. The Right-of-Way can be better specified saving money. The Right-of-Way cost savings can be up to $1,000,000, or more. This cost and savings still remains to be specified. TXDOT is in the process of redefining what information is required from the utilities to give to the SUE providers. The money spent for SUE is developmental, since TXDOT is still in a learning phase. TXDOT is in the process of designing the overhead electrical to go underground and save the cost of additional Right-of-Way for relocating the electrical overhead.

(1)
Estimated savings on reduction in utility relocations is $200,000.

(2)
With SUE the design will be able to save some cost on crossing pipelines. Could anticipate at least one at $400,000 major conflict delay.

All of the effected utilities will be required to move but it is possible that some may not be found until project is under construction. Some utilities are still to be installed that will have to be moved since they have no where to go. But SUE will reduce potential field conflicts for utility relocation.

(4)
The use of SUE will help reduce claims and change orders due to conflicts with unknown utility lines or conflicts with utility lines that were not relocated. An estimated 60 days time savings can be achieved by using SUE. The delay cost is $2,000 per day.
Cost Savings: 60 days @ $2,000 per day = $120,000.

(5)
The use of SUE will reduce delays caused by redesign. Redesign costs can be $500 to $1,000 per day. An estimated time savings of 6 months can be used.
Cost Savings: 180 days x $500 = $90,000.

(6)
Cost Savings is $186,300. ***U***

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0063** *(Continued)*

(10)
The utilization of SUE will result improved (lowered) bid prices. A future savings will result here.

(12)
The savings produced by SUE in design cost is probably a wash. When designing the entire project it is hard to say what design savings result. The project will not be built until 2008. Design Savings will result due to the savings achieved in phasing the project's design. Future savings will result here.

(17)
Sue helps relations with utilities. They are trying to be cooperative. The SUE information is good locating information for the utilities. Many have plastic lines which are difficult to find. SUE is helping locate them.
Cost Savings: $20,000.

(19)
Cost Savings is $60,000. ***U*

(20)
introduced new concept and new procedures for SUE.
Cost Savings: $10,000.

(21)
From the general information above, use $500,000 for cost savings.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0065**

Project's Title: IH-10 _____ Year SUE Program Began: ____
Project's Location: IH-10 from SH 6 to 0.5 miles East of Beltway 8 in Houston _State: ___TX
Name of Person Completing Questionnaire: Keith Robison _____ Phone: (713) 802-5777 _
Cost of the Project: $66,000,000.00 _____
Cost of Engineering: _____ Cost of Right-of-Way: $73.8M _____
(1) Cost of Mobilizing: $2,660.00 _____ + (2) Cost of Designating: $475,470.09 _____
+ (3) Cost of Locating: _____ = (4) TOTAL SUE: $478,130.99 _____
Description (Summary) of the Project: Project consisted of widening existing IH 10 from 6 lanes to 8 main lanes, plus the addition of a 4-lane AVL (special-use lanes) to the project. Length of the project is 5.41 miles. Project also includes two 3-lane frontage roads, bridges, and drainage structures, all located in an urban area. The route of the project is in an urban area that is an established commercial and residential area with numerous buried utilities.
Project Manager (SHAs): Not yet selected, see below: _____ Phone: _____
Designer/ Consultant: There will be 3 or 4 design consultants employed along with one overall coordinator consultant in charge of the design of the project. _____ Phone: _____
SUE Consultant: Cobb, Fendley, and Associates, Stacy Davis ____ Phone: (713) 462-3242 _
Contractor: _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$100,000 (1)		
2. Reduced project delays due to utility relocates		$400,000 (2)		
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders		$120,000 (4)		
5. Reduced delays caused by conflict redesign		$45,000 (5)		
6. Reduced accidents & injuries due to line cuts		$273,500 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids		Future Savings (10)		
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		Future Savings (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built		$20,000 (17)		
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$88,000 (19)		
20. Introduced concept of comprehensive SUE		$10,000 (20)		
21.Right-of-Way acquisition, costs		$1,000,000(21)		
22.				

Savings Analysis: $2,056,500 divided by $478,130.99 = $4.30

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0065** *(Continued)*

General SUE Information and:
(1) (2) (4) (5) (12) (21)
S0065 is similar to S0063, but gets a little more complex as the area is more urbanized than S0063. The project contains numerous utilities, many of which have unknown locations. The project is still in the early design phase. SUE is expected to reduce project delays due to utility conflicts. TXDOT know what utilities are located in the area of the project and the magnitude of the utilities. Utilities located within the project will be moved. The project will build a new facility for the utilities. With SUE designers can better determine where and how to relocate the utilities. The primary benefit is time, and the estimated 1 out of 20 potential construction utility conflicts being eliminated. With SUE TXDOT can establish the required utility corridor. The Right-of-Way can be better specified saving money. The Right-of-Way cost savings can be up to $1,000,000, or more. This cost and savings still remains to be specified. TXDOT is in the process of redefining what information is required from the utilities to give to the SUE providers. The money spent for SUE is developmental, since TXDOT is still in a learning phase.

(1)
On this job about 10% additional utility lines were found that were not on records. $100 to 150,000,000 in value is the estimated worth of this information to save relocation costs. Estimated savings on reduction in utility relocations is $100,000.

(2)
With SUE the design will be able to save some cost on crossing pipelines. Could anticipate at least one at $400,000 major conflict delay.

All of the effected utilities will be required to move but it is possible that some may not be found until project is under construction. Some utilities are still to be installed that will have to be moved since they have no where to go. But SUE will reduce potential field conflicts for utility relocation..

(4)
The use of SUE will help reduce claims and change orders due to conflicts with unknown utility lines or conflicts with utility lines that were not relocated. An estimated 60 days time savings can be achieved by using SUE. The delay cost is $2,000 per day.
Cost Savings: 60 days @ $2,000 per day = $120,000.

(5)
The use of SUE will reduce delays caused by redesign. Redesign costs can be $500 to $1,000 per day. An estimated time savings of 3 months can be used.
Cost Savings: 90 days x $500 = $45,000.

(6)
Cost Savings is $273,500. ***U***

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0065** *(Continued)*

(10)
The utilization of SUE will result improved (lowered) bid prices. A future savings will result here.

(12)
The savings produced by SUE in design cost is probably a wash. When designing the entire project it is hard to say what design savings result. SUE will help push the design process along to get the deign done. SUE will help locate where every thing which will help reduce the design time by 2 or 3 months. Design costs can be $500 to $1000. The project will not be built until 2008. Design Savings will result due to the savings achieved in phasing the project's design. Future savings will result here.

(17)
Sue helps relations with utilities. They are trying to be cooperative. The SUE information is good locating information for the utilities. Many have plastic lines which are difficult to find. SUE is helping locate them.
Cost Savings: $20,000.

(19)
Cost Savings is $88,000. ***U*

(20)
introduced new concept and new procedures for SUE.
Cost Savings: $10,000.

(21)
From the general information given above use $1,000,000 for Right-of-Way acquisition cost savings.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0066**

Project's Title: IH10 Houston _____ Year SUE Program Began: ____
Project's Location: from 0.5 miles East of Beltway 8 in Houston past IH-610 to Bingle Road
_____ State: ____TX _____
Name of Person Completing Questionnaire: Keith Robison _____ Phone: (713) 802-5777 _
Cost of the Project: $73,000,000.00_____
Cost of Engineering: _____ Cost of Right-of-Way: $105.7M _____
(1) Cost of Mobilizing: $1,542.90 _____ + (2) Cost of Designating: $425,562.19 _____
+ (3) Cost of Locating: _____ = (4) TOTAL SUE: $427,105.09 _____
Description (Summary) of the Project: Similar to S0065, but gets a little more complex closer to I-610 which the more built up urban area. Reconstruct and widen to 8 main lanes, four single-use lanes, and two 3-lane frontage roads. Project includes drainage structures and is in a heavily urbanized area. Total length of the project is 6.38 miles. _____
Project Manager (SHAs): Not yet selected, see below: _____ Phone: _____
Designer/ Consultant: There will be 3 or 4 design consultants employed along with one overall coordinator consultant in charge of the design of the project. _____ Phone: _____
SUE Consultant: Underground Serv., Jim Whitten (888) 362-7517 pgr _ Phones: (800) 545 1531 _
_____ Also: (210) 828-9896_
Contractor: _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$200,000 (1)		
2. Reduced project delays due to utility relocates		$400,000 (2)		
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders		$120,000 (4)		
5. Reduced delays caused by conflict redesign		$90,000 (5)		
6. Reduced accidents & injuries due to line cuts		$302,000 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids		Future Savings (10)		
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		Future Savings (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built		$20,000 (17)		
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$97,500 (19)		
20. Introduced concept of comprehensive SUE		$10,000 (20)		
21.Right-of-Way acquisition, costs		$500,000 (21)		
22.				

Savings Analysis: $1,739,500 divided by $427,105.09 = $4.07

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0066** *(Continued)*

General SUE Information and:
(1) (2) (4) (5) (12) (21)
The SUE work is more complex in S0066 than in S0065. The North side of the project has an existing area that is being taken for Right-of-Way, since it is a city street, its utilities must accurately located. Need to identify and locate the utility lines better in this area. But SUE did not do it. TXDOT has standard template to label utilities, and this was not done. At first it was thought that the SUE work would be done as per the standard, but it was not since it was not exactly specified correctly. This was part of the learning curve. This shows the need to manage SUE activities and procedures. A procedure is now in place to avoid future confusion.

This project contains numerous utilities, many of which have unknown locations. The project is still in the early design phase. SUE is expected to reduce project delays due to utility conflicts. TXDOT know what utilities are located in the area of the project and the magnitude of the utilities. Utilities located within the project will be moved. The project will build a new facility for the utilities. With SUE designers can better determine where and how to relocate the utilities. The primary benefit is time, and the estimated 1 out of 20 potential construction utility conflicts being eliminated. With SUE TXDOT can establish the required utility corridor. The Right-of-Way can be better specified saving money. The Right-of-Way cost savings can be up to $1,000,000, or more. This cost and savings still remains to be specified. TXDOT is in the process of redefining what information is required from the utilities to give to the SUE providers. The money spent for SUE is developmental, since TXDOT is still in a learning phase. TXDOT is in the process of designing the overhead electrical to go underground and save the cost of additional Right-of-Way for relocating the electrical overhead.

(1)
Estimated savings on reduction in utility relocations is $200,000.

(2)
With SUE the design will be able to save some cost on crossing pipelines. Could anticipate at least one at $400,000 major conflict delay.

All of the effected utilities will be required to move but it is possible that some may not be found until project is under construction. Some utilities are still to be installed that will have to be moved since they have no where to go. But SUE will reduce potential field conflicts for utility relocation..

(4)
The use of SUE will help reduce claims and change orders due to conflicts with unknown utility lines or conflicts with utility lines that were not relocated. An estimated 60 days time savings can be achieved by using SUE. The delay cost is $2,000 per day.
Cost Savings: 60 days @ $2,000 per day = $120,000.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0066** *(Continued)*

(5)
The use of SUE will reduce delays caused by redesign. Redesign costs can be $500 to $1,000 per day. An estimated time savings of 6 months can be used.
Cost Savings: 180 days x $500 = $90,000.

(6)
Cost Savings is $302,000. ***U***

(10)
The utilization of SUE will result improved (lowered) bid prices. A future savings will result here.

(12)
The savings produced by SUE in design cost is probably a wash. When designing the entire project it is hard to say what design savings result. The project will not be built until 2008. Design Savings will result due to the savings achieved in phasing the project's design. Future savings will result here.

(17)
Sue helps relations with utilities. They are trying to be cooperative. The SUE information is good locating information for the utilities. Many have plastic lines which are difficult to find. SUE is helping locate them.
Cost Savings: $20,000.

(19)
Cost Savings is $97,500. ****U***

(20)
introduced new concept and new procedures for SUE.
Cost Savings: $10,000.

(21)
From the general information above, use $500,000 for cost savings.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0068**

Project's Title: Oak Street Loop FM 3500 _____ Year SUE Program Began: ____
Project's Location: Anthony, N of El Paso Spur 6 _____ State: ___TX _____
Name of Person Completing Questionnaire: Mark Logenbaugh ____ Phone: (915) 774-4240 _
Cost of the Project: $5,600,000.00 _____
Cost of Engineering: _____ Cost of Right-of-Way: _____
(1) Cost of Mobilizing: $3,635.20 _____ + (2) Cost of Designating: $19,085.75 _____
+ (3) Cost of Locating: $16,038.00 _____ = (4) TOTAL SUE $38,758.95 _____
Description (Summary) of the Project: Project consisted of constructing a 4-lane East-West Arterial to FM 1905 which connects to I 10, a distance of 1.5 miles. Project contained flexible pavement design, rural and urban sections, and a rural area with 4-lane divided median. Project contained all new locations. The urban section contained a closed storm sewer, sidewalks, and curb and gutters. Also included were 2 traffic signals, and a bridge crossing at a creek. _____
Project Manager (SHAs): Mark Logenbaugh _____ Phone: (915) 774-4240 _
Designer/ Consultant: Turner, Gillam, and Bieden _____ Phone: _____
SUE Consultant: Underground Services, Jim Witten _____ Phone: (210) 828-9896 _
Contractor: _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$15,000 (1)		
2. Reduced project delays due to utility relocates		$30,000 (2)		
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders		$60,000 (4)		
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts		$15,500 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids		Future Savings (10)		
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$6,000 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built		$3,000 (17)		
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$5,000 (19)		
20. Introduced concept of comprehensive SUE		$2,000 (20)		
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $136,500 divided by $38,758.95 = $3.52

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0068** *(Continued)*

General:
The City of Anthony had installed a new sewer line in the vicinity of the project. The project also was concerned with gas line crossings, as well as gas lines, phone cable, water lines, and sewer lines parallel to the railroad and to the project. The project is going to cross a pond near the river in a flat or level topographic area. The project was required to acquire right-of-way for the pond for drainage of the project. Designers were able to utilize SUE to ensure that utility conflicts were scoped out for the project's drainage structures in order to produce an accurate design. The past method of locating existing utilities was not an accurate assessment of those utilities and would not have produced an accurate design.

(1)
SUE was utilized to determine utility conflicts and relocations before construction. SUE could eliminate unforeseen conflicts. SUE information will result in a time savings since a more aggressive schedule can be produced because the biggest unknown is utility location. SUE eliminates this unknown on this project. This project required the utilities to be relocated to an assigned utility corridor. The Utilities are cooperating in this relocation process since they now know where they are located and have an exact location of where to be relocated. TXDOT now has a sealed document showing exact utility locations.
Costs Savings: $15,000.

(2)
Project designers were concerned about the location of communication cables located in the railroad right-of-way. SUE located these cables and they were found not to be in conflict. Notes to this effect were placed on the plans to eliminate this conflict during construction. The project is located in an area with a lot of utilities. The storm sewer trunk line draining the project will have to cross an existing highway to reach the new drainage pond. So the design of this trunk line was located deep enough to miss the utility lines located by SUE. This resulted in reduced utility relocations and delays due to utility relocation.
Cost Savings: $30,000.

(4)
The use of SUE helped reduce claims and change orders due to conflicts with unknown utility lines or conflicts with utility lines that were not relocated. An estimated 60 days time savings is achieved by using SUE. The delay cost is $1,000 per day.
Cost Savings: 60 days @ $1,000 per day = $60,000.

(6)
Cost Savings is $15,500. ***R***

(10)
The SUE information described in Item 2 will give the contractor more and better bidding information, and no unforeseen utilities, which should lower the project's bids. A Future Savings should result here.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0068** *(Continued)*

(12)
The use of SUE helped save design costs. The descriptions for Items 1, 2, and 4 result in a design Time Savings of 30 days. A Design Cost is $200 per day.
Cost Savings: 30 days x $200 per day = $6,000.

(17)
Established good cooperation with utilities not gone to construction yet. The Utilities are happy with the SUE information and the SUE process, and this has won some real good will with the Utilities.

(19)
Cost Savings is $5,000. ***R***

(20)
SUE is money well spent since there were a lot of problems with utilities in the past history of this project. This project will adjust utility locations and relocate them before construction. SUE will resolve a majority of utility location problems and take care of them before construction.
Cost Savings: $2,000.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0069**

Project's Title: SH 121 Year SUE Program Began: ____
Project's Location: From SH 289 to US 75 in Colin County State: ____TX _____
Name of Person Completing Questionnaire: Darla Payberah Phone: (214) 320-6671 _
Cost of the Project: $41,350,000.00 _____
Cost of Engineering: _____ Cost of Right-of-Way: _____
(1) Cost of Mobilizing: $3,108.78 _____ + (2) Cost of Designating $129,168.00 _____
+ (3) Cost of Locating: _____ = (4) TOTAL SUE $132,276.78_____
Description (Summary) of the Project: Project consisted of the widening of 10.3 miles from existing 2 lanes to 6 lanes. The project included drainage structures and curb and gutters. The project also included a few traffic signals. SUE consisted of 89,700 feet of designating. _____

Project Manager (SHAs): Kelly Selman, McKinney Area _____ Phone: (972) 542-2345 _
Designer/ Consultant: _____ Phone: _____
SUE Consultant: Cobb, Fendley, & Assoc., Stacy Davis _____ Phone: (713) 462-3242 _
Contractor: _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations	$60,000 (1)			
2. Reduced project delays due to utility relocates		$120,000 (2)		
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders		$120,000 (4)		
5. Reduced delays caused by conflict redesign		$8,000 (5)		
6. Reduced accidents & injuries due to line cuts		$171,200 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$12,000 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built		$10,000 (17)		
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$55,200 (19)		
20. Introduced concept of comprehensive SUE		$10,000 (20)		
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $566,400 divided by $132,276.78 = $4.28

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0069** *(Continued)*

(1)
The reduction in utility line relocation was taken to be in the project cost.
Times Savings is 15 days. SUE will assist the process of utility relocations by defining the amount and length of utility relocations.
15 days @ $4,000 per day = $60,000.

(2)
Area office is reviewing the data and information. Just want to know the utilities involved. All utilities have been designated. Will save future delays due to field conflicts.
Cost Savings: 30 days @ $4,000 per day = $120,000.

(4)
SUE reduced change orders and claims by 30 days.
Cost Savings: 30 days @ $4,000 per day = $120,000.

(5)
The use of SUE allows a cost savings by reducing redesigning the project caused by utility conflicts encountered during construction. A savings of 20 days can be realized through SUE.
Cost Savings: 20 days @ $400/ day = $8,000.

(6)
Cost Savings is $171,200. ***U***

(12)
SUE saved design costs by reducing design time 30 days. Design personnel were able to work with exact locations that they did not have to obtain.
Cost Savings: 30 days @ $400 per day = $12,000.

(17)
Utilities will have to move closer to the R/W line in order to comply with TXDOT policy. However, this helps the relations with the utilities since the exact scope of relocations was specified and exact as-builts result from the project.
Cost Savings: $10,000.

(19)
Cost Savings is $55,200. ****U***

(20) Utilizing SUE on the project introduced the concept of comprehensive SUE to all parties connected to the project.
Cost savings: $10,000

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0070**

Project's Title: SH 66 Year SUE Program Began: ___
Project's Location: SH 66 from Dallas Co Line (Dalrock Road) to SH205 (Goliad St.) State: TX_
Name of Person Completing Questionnaire: Steve Christian _____ Phone: (214) 329-6650 _
Cost of the Project: $48,353,418.00
Cost of Engineering: _____ Cost of Right-of-Way: _____
(1) Cost of Mobilizing: $3,094.08 _____ + (2) Cost of Designating: $28,748.30 _____
+ (3) Cost of Locating: _____ = (4) TOTAL SUE: $31,842.38 _____
Description (Summary) of the Project: The project involved the widening of SH-66 from Rowlette to Rockwall a distance of 3.59 miles. The 2-lane road was widened from 2 lanes to 4 lanes urban. The project included curb and gutter, new drainage structures, and some traffic signals. SUE was utilized to define crossing points along the length of the project. _____

Project Manager (SHAs): _____ Phone: _____
Designer/ Consultant: _____ Phone: _____
SUE Consultant: So-Deep, Mike Rice _____ Phone: (210) 829-7388 _
Contractor: _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations	$10,000 (1)	$10,000 (1)		
2. Reduced project delays due to utility relocates	$10,000 (2)	$10,000 (2)		
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders		$30,000 (4)		
5. Reduced delays caused by conflict redesign		$3,000 (5)		
6. Reduced accidents & injuries due to line cuts		$200,200 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$6,000 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built		$5,000 (17)		
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$64,600 (19)		
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $348,600 divided by $31,842.38 = $10.95

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0070** *(Continued)*

General SUE Information:

Prior to the start of the SUE work, a meeting was held with the SUE provider in which the limits for the designation work were clarified. It was decided there would be no designation over the bridge portion of this project. The provider was to designate, survey, and map on plans of TXDOT and provide an inter-graph file depicting existing underground utilities on the project. A listing of known utility owners, a CADD file, and a listing of the project control points were furnished to the provider. The SUE work consisted of 20,534.5 feet of designating. Although 10 "Quality Level A" locations were budgeted, they subsequently were not needed. SUE work started on 11-05-98 and finished on 03-05-99.

(1)
A Time Savings of 10 days was realized in the process of utility relocations.
10 days @ $1,000 per day = $10,000.

The use of SUE will assist the process of utility line relocations by defining the amount and length of utility relocations.
Cost Savings $10,000.

(2)
A Time Savings of 10 days was realized by the application of the SUE process by reducing potential project delays due to utility line relocations.
10 days @ $1,000 per day = $10,000.

A Cost Savings by reducing project delays due to utility relocates of 10 days can be achieved on this project.
10 days @ $1,000 per day = $10,000

(4)
The Cost Savings is based on a 30-day time delay reduction.
30 days $1,000 per day = $30,000.

(5)
The use of SUE allows a cost savings by reducing the redesign of the project caused by utility conflicts. A savings of 15 days can be realized through SUE.
Cost Savings: 15 days @ $200/ day = $3,000.

(6)
Cost Savings is $200,200. ***U***

(12)
The application of SUE to the design process of the project as described in the above general information allows a savings in design time of 30 days.

Cost Savings: 30 days @ $200 per day = $6,000.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0070** *(Continued)*

(17)

The accuracy of the SUE information described in the above general information was of great benefit to the effected utilities. The utilities will be able to use the information from the project for future locating of their lines.

A Cost Savings of $5,000 is realized here.

(19)

Cost Savings is $64,600. ***U*

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0071**

Project's Title: FM 3040 _____ Year SUE Program Began: ___
Project's Location: From FM 2499 to Edmonds Lane, Denton Co __ State: ___TX _____
Name of Person Completing Questionnaire: Steve Christian _____ Phone: (214) 329-6650 _
Cost of the Project: $3,600,000.00_____
Cost of Engineering: _____ Cost of Right-of-Way: _____
(1) Cost of Mobilizing: $0.00 _____ + (2) Cost of Designating: $105,092.85 _____
+ (3) Cost of Locating: _____ = (4) TOTAL SUE: $105,092.85 _____
Description (Summary) of the Project: The project consisted of 3.9 miles of roadway widening from the town of Flower Mound to the city of Lewisville. The roadway was widened from two lanes rural to six divided lanes urban section with a continuous left-turning lane. The project included curb and gutter, new drainage structures, and some traffic signals. The city is in the process of acquiring needed right-of-way for the project. SUE was utilized to define conflicts at the crossing locations that could cause delays to the project._____
Project Manager (SHAs): _____ Phone: _____
Designer/ Consultant: Barry Heard _____ Phone: (940) 387-1414 _
SUE Consultant: TBE Group, Buddy Dees _____ Phone: (512) 836-1130 _
Contractor: _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations	$20,000 (1)	$20,000 (1)		
2. Reduced project delays due to utility relocates	$20,000 (2)	$20,000 (2)		
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders		$80,000 (4)		
5. Reduced delays caused by conflict redesign		$6,0000 (5)		
6. Reduced accidents & injuries due to line cuts		$15,000 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$8,000 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built		$10,000 (17)		
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$4,800 (19)		
20. Introduced concept of comprehensive SUE		$5,000 (20)		
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $208,800 divided by $105,092.85 = $1.99

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0071** *(Continued)*

General SUE Information:

The SUE provider performed "Quality Level B" designating for the project on FM 3040 in Denton Co., from FM 2499 to Edmunds Lane. SUE work began on 10-12-98 and finished on 02-09-99. SUE work consisted of 31,371 meters of designating. The total length of designating exceeds the length of the project since communication cables were located on both sides of the right-of-way. The SUE contract depends on the total number of utilities along the length of the project.

(1) (2) (5) (12)
The Benefits of SUE are to reduce significant utility location problems. The project contains a large high pressure water main that is not cost effective to relocate. So the water main will be allowed to remain in place. SUE helped by determining the water mains exact location. Eight (8) utilities were located by SUE throughout the project. These locations helped design the project to avoid utility relations and conflicts. SUE found that a number of existing utility as-built were incorrect. Also, additional lines were found that were not on plans. About 5% of the lines located by SUE were not on the as-builts. Most of these discovered lines were crossing lines that were never included on as builts.

(1)
A Time Savings of 20 days was realized in the process of utility relocations.
20 days @ $1,000 per day = $20,000.

The use of SUE will assist the process of utility line relocations by defining the amount and length of utility relocations.
Cost Savings $20,000.

(2)
A Time Savings of 20 days was realized by the application of the SUE process by reducing potential project delays due to utility line relocations.
20 days @ $1,000 per day = $20,000.

A Cost Savings by reducing project delays due to utility relocates of 20 days can be achieved on this project.
20 days @ $1,000 per day = $20,000

(4)
The Cost Savings is based on a 40-day time delay reduction.
40 days $2,000 per day = $80,000.

(5)
The use of SUE allows a cost savings by reducing the redesign of the project caused by utility conflicts. A savings of 15 days can be realized through SUE.

Cost Savings: 15 days @ $400/ day = $6,000.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0071** *(Continued)*

(6)
Cost Savings is $15,000. ***U***

(12)
The application of SUE to the design process of the project as described in the above general information allows a savings in design time requirements of 30 days.
Cost Savings: 30 days @ $200 per day = $6,000.

(17)
The accuracy of the SUE information described in the above general information was of great benefit to the effected utilities. The utilities will be able to use the information from the project for future locating of their lines. SUE enabled relations with the utilities to be improved.
A Cost Savings of $10,000 is realized here.

(19)
Cost Savings is $4,800. ****U***

(20)
Utilizing SUE on the project introduced the concept of comprehensive SUE to the parties involved in the project.
Coat Savings: $5,000.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0080**

Project's Title: SH 249 Tom Ball by-pass _____ Year SUE Program Began: ____
Project's Location: Harris Co. _____ State: ____ TX_____
Name of Person Completing Questionnaire: Mike Galloway _____ Phone: (713) 802-5779 _
Cost of the Project: $15,000,000.00_____
Cost of Engineering: _____ Cost of Right-of-Way: _____
(1) Cost of Mobilizing: $99,460.05 _____ + (2) Cost of Designating: _____
+ (3) Cost of Locating: $109,825.00 _____ = (4) TOTAL SUE: $209,285.05 _____
Description (Summary) of the Project: Project entailed construction of an 8-lane freeway with 3-lane frontage roads on both sides of the freeway. Project included a major overpass. Project was about 2.8 miles in length. Project included drainage structures along the entire length of the project, and curb and gutter on the frontage roads._____

Project Manager (SHAs): _____ Phone: _____
Designer/ Consultant: Larry Blackburn_____ Phone: (713) 802-5381 _
SUE Consultant: SoDeep, Mike Rice _____ Phone: (210) 829-7388 _
Contractor: _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$800,000 (1)		
2. Reduced project delays due to utility relocates				
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders				
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts		$41,400 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$6,000 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built		$5,000 (17)		
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$13,400 (19)		
20. Introduced concept of comprehensive SUE				
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $865,800 divided by $209,285.05 = $4.14

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0080** *(Continued)*

(1)
The project is located along an area containing numerous buried petroleum pipelines used in an oil storage and transportation area. At least four (4) Oil companies are involved and are represented by an attorney who wants compensation for relocating the salt-water pipelines involved in the project. The existing piping facilities contain a lot of different pipelines. All of the involved existing pipelines had to be accurately located both horizontally and vertically to determine the situation and to find if the lines are active or non-active for appraisal purposes. The oil companies want $1,000,000 to relocate the effected pipelines. TXDOT thought this scope of work to be excessive and employed SUE to accurately locate the effected pipelines and determine the true relocation cost. The accurately designed relocation cost was determined to be $200,000. The difference in costs of $800,000 was due to using SUE on the project.
Cost Savings: $800,000.

(6)
Cost Savings is $41,400. ***R***

(12)
SUE helped with water and sewer locations so that TXDOT could design around them. Some savings, 3 weeks design savings.
Cost Savings: 15 days @ $400 per day = $6,000.

(17)
Cost Savings: $5,000.

(19)
Cost Savings is $13,400. ****R***

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0090**

Project's Title: SH 6 _____ Year SUE Program Began: ___
Project's Location: Riesel, (Waco District) _____ State: ____ TX _____
Name of Person Completing Questionnaire: Gary Reinhardt _____ Phone: (254) 867-2755 _
Cost of the Project: $8,333,247.00 _____
Cost of Engineering: _____ Cost of Right-of-Way: _____
(1) Cost of Mobilizing: $2,605.24 _____ + (2) Cost of Designating: $3,291.40 _____
+ (3) Cost of Locating: $13,935.00 _____ = (4) TOTAL SUE: $19,831.64 _____
Description (Summary) of the Project: The project consisted of the construction of a by-pass around the city of Riesel, approximately 2.5 miles in length. The project included new drainage structures, including curb and gutter, and new storm sewers. SUE was employed after the project was under construction to help define conflicts with gas lines. _____

Project Manager (SHAs): _____ Phone: _____
Designer/ Consultant: Gary Reinhardt (FAX: 2890) _____ Phone: (254) 867-2755 _
SUE Consultant: So-Deep, Mike Rice _____ Phone: (210) 829-7388 _
Contractor: _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations		$300,000 (1)		
2. Reduced project delays due to utility relocates				
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders				
5. Reduced delays caused by conflict redesign				
6. Reduced accidents & injuries due to line cuts		$23,000 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design				
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built		$5,000 (17)		
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$7,400 (19)		
20. Introduced concept of comprehensive SUE		$5,000 (20)		
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $340,400 divided by $19,831.64 = $17.16

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0090** *(Continued)*

General Information and:

(1)

Lonestar Gas Company told TXDOT that the natural gas pipelines were in conflict and that they would have to be relocated at the expense of TXDOT at a cost of $650,000 to $740,000. The cost of relocation, the extent of the relocation, and the need for relocation was questioned by TXDOT. SUE was employed to determine what the actual conflicts were. SUE information showed that the relocation as envisioned by Lonestar was not totally necessary. SUE was utilized to minimize the pipeline adjustments, and specify exact adjustments that avoided conflicts with the project and its storm sewers. There were 3 gas pipeline crossings approximately within 100 feet of each other that had to have their locations exactly determined. 20 inch and 12 inch pipelines were in direct conflict with the storm sewer, but did not have to be relocated to the extent that the gas company indicated, and a 4 inch gas line had to be relocated. The actual cost of relocation that was implemented with the use of SUE information was $350,000, for a savings of at least $300,000.

Cost Savings = $300,000

(6)

Cost Savings is $23,000. ***R***

(17)

The use of SUE information improved map accuracy and as-builts. A cost savings of $5,000 was taken for this item.

Cost Savings: $5,000.

(19)

Cost Savings is $7,400. ****R***

(20)

The use of SUE helped to introduce the overall concept of SUE to utilities, engineers, and contractors. The savings cost is long-term for this item, but a cost savings of $5,000 was taken for this project.

Cost Savings: $5,000

Additional SUE Information:

The SUE information for this project is listed as $19,831.64 and includes resolution of conflicts at 5 critical crossing locations. Three of those locations were include in this project, the remaining two will be included in a future phase of work on SH 6. But the entire cost was include in this analysis since it was not possible to separate the SUE costs. Actually, the savings analysis could be higher for this project, but was kept as shown to keep the evaluation estimates reasonable.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0100**

Project's Title: FM 1171 _____ Year SUE Program Began: ____
Project's Location: From Shiloh Road to FM 2499, Denton State: ____ TX _____
Name of Person Completing Questionnaire: Darla Payberah _____ Phone: (214) 320-6671 _
Cost of the Project: $5,744,357.00 _____
Cost of Engineering: _____ Cost of Right-of-Way: _____
(1) Cost of Mobilizing: $0.00 _____ + (2) Cost of Designating: $94,654.25 _____
+ (3) Cost of Locating: $67,027.50 _____ = (4) TOTAL SUE: $161,681.75 _____
Description (Summary) of the Project: The project was 3.794 miles in length. The project consisted of widening the existing 2 lanes rural to 6 lanes urban. The project included drainage structures the entire length of the project, curbs and gutters, and some traffic signals. SUE consisted of 33,796 meters of designating, and 60 test holes for locating. _____

Project Manager (SHAs): _____ Phone: _____
Designer/ Consultant: Arredondo Brunz & Assoc., Weldon Jarret __ Phone: (817) 429-7870 _
SUE Consultant: TBE, Buddy Dees _____ Phone: (972) 682-5432 _
Contractor: _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations	$60,000 (1)	$40,000 (1)		
2. Reduced project delays due to utility relocates		$120,000 (2)		
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders		$60,000 (4)		
5. Reduced delays caused by conflict redesign		$8,000 (5)		
6. Reduced accidents & injuries due to line cuts		$24,000 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$12,000 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built		$10,000 (17)		
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$7,700 (19)		
20. Introduced concept of comprehensive SUE		$10,000 (20)		
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $351,700 divided by $161,681.75 = $2.18

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0100** *(Continued)*

General Information:
The benefits of SUE are to reduce significant utility location and relocation problems. SUE helped to determine the scope of the utility relocations. Southwestern Bell (fiber optic and phone cable), Cable TV, city water, some sanitary sewer, and electric cables were located within the limits of the project. The process of using SUE got everyone involved in the project together to discuss utility relocations obtain consensus on the scope, scheduling, and exact location of the utility lines.

The SUE provider identified all utilities within the limits of the project. The effected utility companies know they are part of the project. The utilities have been provide SUE information which is something they can see we and they realize that SUE work on the project is doing accurate utility location for them. Proper relocation planning can now be done as a result of using SUE on the project. Using SUE will save delays in the future construction of the project. Redesign and construction delays will be avoided or kept to a minimum as a result of using SUE. In addition SUE will help avoid delays due to not relocating utilities or doing the relocation incorrectly.

(1) (2) (4) (5) (12)
Crossing utility locations are potential points of conflict, and there are numerous crossing utilities in this project. The depth of utility crossings would be a problem since the depth of pavement will be greater than the depth of some of the utilities. SUE was utilized to establish test holes at the points of potential conflicts.. Designating was used to determine need for and location of test holes. The locating accomplished with test holes resolved potential conflicts by utilizing the SUE information. The project is to be located in a congested urban area. 25% of the utility lines were found by SUE to be located in areas not as shown on the drawings. The existing as-builts were not accurate. There are 8 to 10 utilities located in the Right-of-Way, including a new fiber optic cable. The completed design is much better than a design accomplished without SUE. One of the gas companies is already clear (relocated their line) so no time delays due to not getting the gas relocated is certain.

(1)
SUE helped to achieve a reduction in utility line relocation.
Times Savings is 30 days is estimated to be saved. SUE will assist the process of utility relocations by defining the amount and length of utility relocations.
30 days @ $2,000 per day = $60,000.

A cost Savings will be obtained by defining the amount, length and location of utility line relocations.
Cost Savings: $40,000

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0100** *(Continued)*

(2)
A savings of time of 60 days .can be realized by the application of the SUE process by reducing potential project delays due to utility line relocations.
Cost Savings: 60 days @ $2,000 per day = $120,000.

(4)
SUE reduced change orders and claims by reducing the time involved for the claims and change orders. A savings in time of 30 days can be realized on the project.
Cost Savings: 30 days @ $2,000 per day = $60,000.

(5)
The use of SUE allows a cost savings by reducing redesigning the project caused by utility conflicts encountered during construction. A savings of 20 days can be realized through SUE.
Cost Savings: 20 days @ $400/ day = $8,000.

(6)
Cost Savings is $24,000. ***U***

(12)
SUE saved design costs by reducing design time 30 days. Design personnel were able to work with exact locations that they did not have to obtain.
Cost Savings: 30 days @ $400 per day = $12,000.

(17)
Utilities will have to move closer to the R/W line in order to comply with TXDOT policy. However, this helps the relations with the utilities since the exact scope of relocations were specified and exact as-builts result from the project.
Cost Savings: $10,000.

(19)
Cost Savings is $7,700. ****U***

(20) Utilizing SUE on the project introduced the concept of comprehensive SUE to all parties connected to the project.
Cost savings: $10,000

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0101**

Project's Title: FM 1171 _____ Year SUE Program Began: ____
Project's Location: From US 377 to Shiloh/McMakin Roads _____ State: ____ TX _____
Name of Person Completing Questionnaire: Darla Payberah _____ Phone: (214) 320-6671 _
Cost of the Project: $6,050,000.00_____
Cost of Engineering: _____ Cost of Right-of-Way: _____
(1) Cost of Mobilizing: $0.00 _____ + (2) Cost of Designating: _____
+ (3) Cost of Locating: _____ = (4) TOTAL SUE: $159,178.24 _____
Description (Summary) of the Project: The project was 4.634 miles in length. The project consisted of widening the existing 2 lanes rural to 6 lanes urban. The project included drainage structures the entire length of the project, curbs and gutters, and some traffic signals. SUE work consisted of 111,000 feet of designating, and 40 test holes of locating._____
_____
Project Manager (SHAs): _____ Phone: _____
Designer/ Consultant: Arredondo Brunz & Assoc., Weldon Jarret __ Phone: (817) 429-7870 _
SUE Consultant: Underground Services, Jim Whitten _____ Phone: (210) 416-5832 _
Contractor: _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations	$120,000 (1)	$60,000 (1)		
2. Reduced project delays due to utility relocates		$120,000 (2)		
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders		$60,000 (4)		
5. Reduced delays caused by conflict redesign		$12,000 (5)		
6. Reduced accidents & injuries due to line cuts		$25,000 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$16,000 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built		$10,000 (17)		
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$8,000 (19)		
20. Introduced concept of comprehensive SUE		$10,000 (20)		
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $441,000 divided by $159,178.24 = $2.77

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0101** *(Continued)*

General SUE Information:
The benefits of SUE are to reduce significant utility location and relocation problems. SUE helped to determine the scope of the utility relocations. Southwestern Bell (fiber optic and phone cable), Cable TV, city water, some sanitary sewer, and electric cables were located within the limits of the project. The process of using SUE got everyone involved in the project together to discuss utility relocations obtain consensus on the scope, scheduling, and exact location of the utility lines.

The SUE provider identified all utilities within the limits of the project. The effected utility companies know they are part of the project. The utilities have been provide SUE information which is something they can see we and they realize that SUE work on the project is doing accurate utility location for them. Proper relocation planning can now be done as a result of using SUE on the project. Using SUE will save delays in the future construction of the project. Redesign and construction delays will be avoided or kept to a minimum as a result of using SUE. In addition SUE will help avoid delays due to not relocating utilities or doing the relocation incorrectly.

(1) (2) (4) (5) (12)
Crossing utility locations are potential points of conflict, and there are numerous crossing utilities in this project. The depth of utility crossings would be a problem since the depth of pavement will be greater than the depth of some of the utilities. SUE was utilized to establish test holes at the points of potential conflicts.. Designating was used to determine need for and location of test holes. The locating accomplished with test holes resolved potential conflicts by utilizing the SUE information. The project is to be located in a congested urban area.

(1)
SUE helped to achieve a reduction in utility line relocation.
Times Savings is 60 days is estimated to be saved. SUE will assist the process of utility relocations by defining the amount and length of utility relocations.
60 days @ $2,000 per day = $120,000.

A cost Savings will be obtained by defining the amount, length and location of utility line relocations.
Cost Savings: $60,000

(2)
A savings of time of 60 days .can be realized by the application of the SUE process by reducing potential project delays due to utility line relocations.
Cost Savings: 60 days @ $2,000 per day = $120,000.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0101** *(Continued)*

(4)
SUE reduced change orders and claims by reducing the time involved for the claims and change orders. A savings in time of 30 days can be realized on the project.
Cost Savings: 30 days @ $2,000 per day = $60,000.
(5)
The use of SUE allows a cost savings by reducing redesigning the project caused by utility conflicts encountered during construction. A savings of 30 days can be realized through SUE.
Cost Savings: 30 days @ $400/ day = $12,000.

(6)
Cost Savings is $25,000. ***U***

(12)
SUE saved design costs by reducing design time 40 days. Design personnel were able to work with exact locations that they did not have to obtain.
Cost Savings: 40 days @ $400 per day = $16,000.

(17)
Utilities will have to move closer to the R/W line in order to comply with TXDOT policy. However, this helps the relations with the utilities since the exact scope of relocations were specified and exact as-builts result from the project.
Cost Savings: $10,000.

(19)
Cost Savings is $8,000. ****U***

(20) Utilizing SUE on the project introduced the concept of comprehensive SUE to all parties connected to the project.
Cost savings: $10,000

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0102**

Project's Title: FM 1171 _____ Year SUE Program Began: ____
Project's Location: From IH 35 W to US 377 _____ State: ____ TX _____
Name of Person Completing Questionnaire: Darla Payberah _____ Phone: (214) 320-6671 _
Cost of the Project: $5,400,000.00 _____
Cost of Engineering: _____ Cost of Right-of-Way: _____
(1) Cost of Mobilizing: $2,977.79 _____ + (2) Cost of Designating: $18,700.06 _____
+ (3) Cost of Locating: $8,100.00 _____ = (4) TOTAL SUE: $29,777.85 _____
Description (Summary) of the Project: The project was 2.6 miles in length. The project consisted of widening the existing 2 lanes rural to 6 lanes urban. The project included drainage structures the entire length of the project, curbs and gutters, and some traffic signals. SUE work consisted of 9,053 meters of designating, and 20 test holes of locating. _____

Project Manager: (SHAs): _____ Phone: _____
Designer/ Consultant: Arredondo Brunz & Assoc., Weldon Jarret _ Phone: (817) 429-7870 _
SUE Consultant: TBE Group, Buddy Dees _____ Phone: (904) 755-2626 _
Contractor: _____ Phone: _____
Utility Co.: _____ Phone: _____

Cost Items and Factors	Time Savings	Cost Savings	User Savings	Risk Mgmt.
1. Reduced the number of utility line relocations	$60,000 (1)	$40,000 (1)		
2. Reduced project delays due to utility relocates		$60,000 (2)		
3. Reduced construction delay due to utility cuts				
4. Reduced contractor's claims & change orders		$60,000 (4)		
5. Reduced delays caused by conflict redesign		$8,000 (5)		
6. Reduced accidents & injuries due to line cuts		$22,500 (6)		
7. Reduced travel delays to the motoring public				
8. Reduced loss of service to utility customers				
9. Improved contractor productivity & methods				
10. Increased the possibility of reduced bids				
11. Reduced contingency fees from all parties				
12. Reduced the cost of project design		$12,000 (12)		
13. Reduced the damage to existing pavements				
14. Reduced damage to existing site facilities				
15. Reduced the cost of needed utility locates				
16. Minimized disruption to traffic & emergency				
17. Facilitated electronic map accuracy, as- built		$5,000 (17)		
18. Minimized chance of environmental damage				
19. Induced savings in risk Mgmt., & insurance		$7,200 (19)		
20. Introduced concept of comprehensive SUE		$5,000 (20)		
21.Right-of-Way acquisition, costs				
22.				

Savings Analysis: $279,200 divided by $29,777.85 = $9.38

Table 3. Specific Projects Studied *(Continued)*
Specific Project: **#S0102** *(Continued)*

General SUE Information:
The benefits of SUE are to reduce significant utility location and relocation problems. SUE helped to determine the scope of the utility relocations. Southwestern Bell (fiber optic and phone cable), Cable TV, city water, some sanitary sewer, and electric cables were located within the limits of the project. The process of using SUE got everyone involved in the project together to discuss utility relocations obtain consensus on the scope, scheduling, and exact location of the utility lines.

The SUE provider identified all utilities within the limits of the project. The effected utility companies know they are part of the project. The utilities have been provide SUE information which is something they can see we and they realize that SUE work on the project is doing accurate utility location for them. Proper relocation planning can now be done as a result of using SUE on the project. Using SUE will save delays in the future construction of the project. Redesign and construction delays will be avoided or kept to a minimum as a result of using SUE. In addition SUE will help avoid delays due to not relocating utilities or doing the relocation incorrectly.

(1) (2) (4) (5) (12)
Crossing utility locations are potential points of conflict, and there are numerous crossing utilities in this project. The depth of utility crossings would be a problem since the depth of pavement will be greater than the depth of some of the utilities. SUE was utilized to establish test holes at the points of potential conflicts.. Designating was used to determine need for and location of test holes. The locating accomplished with test holes resolved potential conflicts by utilizing the SUE information. The project is to be located in a congested urban area.

Found 1000' of phone cable not on drawings. TXDOT had a utility layout phone not on it.

Save design time and bid cost. Construction delay time saved redesign.
(1)
SUE helped to achieve a reduction in utility line relocation.
Times Savings is 30 days is estimated to be saved. SUE will assist the process of utility relocations by defining the amount and length of utility relocations.
30 days @ $2,000 per day = $60,000.

A cost Savings will be obtained by defining the amount, length and location of utility line relocations.
Cost Savings: $40,000

(2)
A savings of time of 30 days .can be realized by the application of the SUE process by reducing potential project delays due to utility line relocations.
Cost Savings: 30 days @ $2,000 per day = $60,000.

Table 3. Specific Projects Studied *(Continued)*

Specific Project: **#S0102** *(Continued)*

(4)
SUE reduced change orders and claims by reducing the time involved for the claims and change orders. A savings in time of 30 days can be realized on the project.
Cost Savings: 30 days @ $2,000 per day = $60,000.

(5)
The use of SUE allows a cost savings by reducing redesigning the project caused by utility conflicts encountered during construction. A savings of 20 days can be realized through SUE.
Cost Savings: 20 days @ $400/ day = $8,000.

(6)
Cost Savings is $22,500. ***U***

(12)
SUE saved design costs by reducing design time 30 days. Design personnel were able to work with exact locations that they did not have to obtain.
Cost Savings: 30 days @ $400 per day = $12,000.

(17)
Utilities will have to move closer to the R/W line in order to comply with TXDOT policy. However, this helps the relations with the utilities since the exact scope of relocations were specified and exact as-builts result from the project.
Cost Savings: $5,000.

(19)
Cost Savings is $7,200. ****U***

(20) Utilizing SUE on the project introduced the concept of comprehensive SUE to all parties connected to the project.
Cost savings: $5,000

Table4. Construction Recapitulation in Texas, December 1998 indicates the number of current contracts under construction and the total amount of dollars under contract.

Table 4. Construction Recapitulation in Texas, December 1998

		$ Under Contract
Abilene	22	$ 62,175,915.69
Amarillo	35	117,239,877.99
Atlanta	35	62,702,656.19
Austin	57	149,538,076.56
Beaumont	40	163,150,208.54
Brownwood	21	27,900,899.78
Bryan	56	111,813,030.83
Childress	18	31,983,408.01
Corpus Christi	32	118,173,724.86
Dallas	125	991,384,945.95
El Paso	30	161,711,821.00
Fort Worth	71	307,347,890.06
Houston	151	1,171,394,983.05
Laredo	34	122,829,384.36
Lubbock	25	88,032,036.68
Lufkin	60	93,114,349.77
Odessa	22	47,769,658.23
Paris	64	161,466,543.59
Pharr	43	126,695,025.08
San Angelo	24	40,085,873.35
San Antonio	81	339,246,466.13
Tyler	35	142,925,539.06
Waco	26	81,487,675.54
Wichita Falls	17	69,782,001.99
Yoakum	38	86,706,344.79
Total	1,162	$ 4,876,658,337.08

Source: Construction Division, *Construction Recapitulation*, 12-98.
Available: *http://www.dot.state.tx.us/rtmodes/pfacts/pfacts.htm#ROW*

APPENDIX V: General Results of Sue in Federally Funded Demonstration Projects

The FHWA participated in three SUE demonstration projects in Oregon, Puerto Rico, and Wyoming. A summary of these projects follows:

PUERTO RICO

Project Information

The selected demonstration project for Puerto Rico was a section of highway PR-2 (Kennedy Avenue), between Constitution Bridge and Segarra Street near PR-22 (De Diego Freeway) in San Juan. PR-2 is a major, heavily traveled arterial between San Juan and the Southwest suburbs with a project length of 2.1063 kms. This section of highway was originally constructed in the 1940's as a two-lane road over poor soil conditions and a high ground water table. Over time, the road had been widened to the present six to eight lanes. The construction improvements planned for PR-2 included grade separation at the intersection with the ports access road, conversion to expressway, and drainage improvements where the road was subject to frequent flooding. When the SUE work was started, the design of the construction improvements was essentially complete.

SUE Information

The utilities that existed within the project limits were: Puerto Rico Electric Power Authority (PREPA), electric lines; Puerto Rico Telephone Company (PRTC), telephone lines; Puerto Rico Aqueducts and Sewer Authority (PRASA), water and sewer lines; Puerto Rico Pipelines, gasoline lines. Seventy-three (73) test holes were completed under difficult, high ground water conditions. Locating the test holes was dictated by the need for design information in the area of the proposed bridges at the port access road, at an existing channel, and in the areas of proposed drainage structures. In all of the listed areas, the probability of conflicts during construction was greater than in other areas of the project. The results of the SUE study found that 30 percent to 35 percent of the utilities found on the supplied as-builts were incorrect. The water and sewer utilities were the least accurate. The most accurate was a gasoline pipeline.

Conclusions and Recommendations regarding Puerto Rico

Following are the conclusions and recommendations resulting from the SUE demonstration project in Puerto Rico:

- It is the opinion of Puerto Rico Transportation and Highway Authority (PRTHA) personnel that SUE is a valuable tool when applied systematically and in the preliminary design phases of a project.

- SUE was used to verify the location of utilities along the length of the project. Two water lines were found to be off by about a lane-width from the location shown on the

design plans. Also, a conflict was found between proposed and existing PRTC and PREPA lines; consequently, it was avoided.

- The use and presence of State or City police is recommended to maintain orderly traffic when working in heavy traffic areas.

- SUE should be used by utility companies when they are locating their facilities so that better, more accurate information is provided to frequent users, such as highway designers.

- Larger SUE studies will likely result from this demonstration project.

OREGON

Project Information

The selected project for Oregon was Highway 99W through Newburg, Oregon. This 2-mile-long project started at Brutscher Street and ended at Main Street. The construction cost was estimated at $6 million, right-of-way at $3 million, and preliminary engineering at $850,000. The proposed cost of SUE was $108,000. Phone, gas, and water lines needed to be located to specify the exact scope of relocation work. The project is located in a narrow urban corridor where traffic gridlock gets a lot of media attention.

SUE Information

SUE was employed on this project to evaluate the potential impact of buried telephone structures that could require at least three months of lead time for designing required relocations, six months to build new substructures, and six months to splice and cut-over to the new facility. The gas lines require four months to design new facilities, and at least 3 months good weather for their construction. The city water utility would have to relocate 1.5 kilometers of water main, and this work would be included in the project, thus adding three months to the project's schedule. Without the SUE information the utility relocations could not accurately be made, and at one year, would have to be added to the project due to utility relocations.

Oregon law requires that utility companies mark all underground lines before both highway design and construction activities. The result of the SUE investigation was that marks provided by utility companies could be compared to SUE designating. Approximately 30 percent more utilities were found by the SUE process than were marked by the utility companies. The gas company marked 7,272 m, while SUE designating found 8,373 m. The power company marked 400 m, while SUE designating found 587 m. The telephone company marked 3,085 m, while SUE designating found 3,455 m. The water company marked 4,921 m, while SUE designating found 7,180 m. The sewer department marked 4350 m, while SUE designating found the same amount. SUE also found 268 m of unknown utility lines.

Comprehensive utility mapping has been developed by the SUE process and is providing Oregon DOT designers with reliable information that will allow designers to avoid

conflicts with utilities. This procedure will reduce costly relocation expenses and construction delays. The city of Newburg is using the SUE information to determine the alignment of a new water line.

Conclusions and Recommendations regarding Oregon

Following are the conclusions and recommendations resulting from the SUE demonstration project in Oregon:

- ODOT's project designers believe that SUE is a tool that should be used on projects with potential utility conflicts. Additional SUE presentations will be made to increase the use of SUE throughout Oregon.

- Additional SUE benefits are expected to be realized. These benefits will lower construction costs since contractors will be able to take into consideration that the exact location of all utilities is known, thus reducing the risk of utility conflicts during construction.

- Another anticipated benefit of SUE is avoiding unnecessary utility relocations by designing around the potential conflicts.

- The last anticipated benefit of SUE is being able to coordinate with utilities to complete utility relocation ahead of time, which will decrease interference and delays with the project schedule.

WYOMING

Project Information

The selected project for Wyoming is located in a busy downtown street in Cheyenne, WY. The project is an urban congested street where the potential for several utility conflicts exists. The project is an old, main east-west thoroughfare in Cheyenne which provides for the possibility of long forgotten utility lines being present. The utility relocation work needs to be expedited to coincide with the restricted schedule of the contractor.

SUE Information

Using plans and information gathered from the utility companies and other sources, the SUE provider vacuum excavated 247 holes along the limits of the project, and identified the utilities by locations and type of facility. The resulting SUE location information was incorporated into the project's general construction plans. A matrix showing SUE information was created in an 11x17-border format so that it could be inserted into the plans, listing all 247 test holes with all pertinent information. Then, a number was plotted on the project's plan sheets that was cross-referenced to the SUE matrix. By this method, all the test holes and all possible conflicts were thoroughly identified. The SUE provider felt that about 15 percent previously unidentified utilities were found in the SUE study.

The design of the project was substantially complete before the SUE work was started. WYDOT indicated that it was impossible to redo the design to make adjustments for utility conflicts. Fortunately, the design did not change the general roadway grades along the route; however, the proposed storm sewer did affect several of the utilities located along the project. If the SUE work had been conducted earlier, some adjustments could have been made to the storm sewer design, avoiding some utility adjustment expenses. WYDOT was provided with timely, accurate SUE data from the provider.

Conclusions and Recommendations regarding Wyoming

Following are the conclusions and recommendations resulting from the SUE demonstration project in Wyoming:

- The timely and accurate SUE data provided for this project enabled WYDOT to recommend that SUE be utilized whenever appropriate for WYDOT projects.

- When a project contains the types of utilities that are a cause or concern for safety such as gas, oil, buried power, or high speed data transmission lines, SUE is the only choice for accurately and safely locating these facilities.

- When locating of underground facilities is required, SUE is the least disruptive to roadway surfaces and traffic movement.

- Rural conditions do not warrant using SUE on every project; however, projects involving urban conditions, old oil fields, or gas and oil lines do warrant the use of SUE.

- SUE information needs to be gathered with the first utility survey and incorporated into the design of the project. Early identification of conflicts and their related costs can be planned for by the State and utility companies. Large financial surprises can be avoided.

- Utility companies should be brought into the project as the SUE information is developed, and informed what is expected of them. Utilities should be kept informed of the project's schedule and, in turn, provide a schedule of their own work that should be followed.

*U.S. G.P.O.:2000-463-749:10861

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