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

American Society of Civil Engineers

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Contents

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1.0 INTRODUCTION

The nation's infrastructure continues to grow as a result of population growth and other factors. New technologies are proliferating, such as fiberoptics, which are replacing copper communication cables. In addition, the deterioration and replacement of existing structures have expanded activities dealing with the utility infrastructure. The effort to clean up the environment has necessitated considerable excavation in areas of high-density infrastructure development. Available right-of-way is becoming limited, especially in urban and suburban areas. The "footprint" of new construction, repair, or remediation often conflicts with existing infrastructure. When this existing infrastructure is hidden from view (e.g., buried), it is often discovered in the construction phase of a project. During this phase, the costs of conflict resolution and the potential for catastrophic damages are highest.

Existing subsurface utilities and their related structures constitute a significant portion of this infrastructure. They create risks on projects. Inaccurate, incomplete, and/or out-of-date information on the existence and location of existing subsurface utilities reduces the engineers', owners', and contractors' abilities to make informed decisions and to support risk management decisions regarding the project's impact on existing utilities.

A convergence of new equipment and data-processing technologies now allows for the cost-effective collection, depiction, and management of existing utility information. These technologies encompass surface geophysics, surveying techniques, computer-aided design and drafting and geographic information systems, and minimally intrusive excavation techniques. This convergence of technologies and systematic use of the data derived from these technologies is known as subsurface utility engineering (SUE). Organizations such as the U.S. Department of Transportation, the National Transportation Safety Board, the U.S. Department of Energy, Associated General Contractors of America, Inc., universities, and utility companies are endorsing the use of SUE.

The engineer's job in collecting and depicting utility information is complicated by the relatively limited control over utility owners' record data. The utility owner is typically under no obligation to the engineer to provide information. The engineer is therefore often unable to obtain available and pertinent utility information.

Utility owners are obligated under statute in most states to mark the location of their known active facilities on the ground surface just before construction. This is often too late for design purposes or for contractor bidding purposes. A very few states have laws that encourage utility owners to mark facilities at the time of design; however, utility owners are under no legal requirement to do so. Some utility owners may desire to mark their facilities for the engineer.

For reliable information during design and construction, the engineer, owner, and constructor should be certain that utilities, active, abandoned, or unknown, are identified; that the utilities are marked correctly; that the numbers of actual utility pipes or cables under the ground are known or represented by multiple marks; that the width of facilities is correct; and that the depths of utilities are known. Reliable information has historically not always been provided by utility owners.

Engineers may have received, made, or obtained a mixture of evidence of the existence, character, and location of utilities. Evidence may vary widely as to its credibility. Application of this guideline and the establishment of a credible nomenclature system will permit affixing attributes to utility information that denote the quality of that utility information. Problems with existing utilities are routinely handled through change orders, extra work orders, insurance payouts, and contingency pricing. When problems create significant costs, the finger of blame is pointed everywhere, including at the engineer who has affixed his or her stamp to the plans, regardless of disclaimers. All involved in the design and construction process will benefit from better information for the management of risk.

2.0 SCOPE

The scope of this document is a consensus standard for defining the quality of utility location and the attribute information that is placed on plans. The standard guideline addresses issues such as (a) how utility information can be obtained, (b) what technologies are available to obtain that information, and (c) how that information can be conveyed to the information users.

The intent of this standard guideline is to present a system of classifying the quality of data associated with existing subsurface utilities. Such a classification will allow the project owner, engineer, constructor, and utility owner to develop strategies to reduce risk by improving the reliability of information on existing subsurface utilities in a defined manner. This document, as a reference or as part of a specification, will assist engineers, project and utility owners, and constructors in understanding the classification of the quality of utility data .

3.0 DEFINITIONS

Designating	The process of using a surface geophysical method or methods to interpret the presence of a subsurface utility and to mark its approximate horizontal position (its *designation*) on the ground surface. (Note: Utility owners and contractors sometimes call this process “locating.”)
Engineer	The individual or firm providing engineering and design-related services as a party to the contract. The engineer produces the instruments of service or manages the instruments of service of the subconsultants.
Locating	The process of exposing and recording the precise vertical and horizontal location of a utility.
Minimally intrusive excavation method	A method of excavation that minimizes the potential for damage to the structure being uncovered. Factors such as utility material and condition may influence specific techniques. Typical techniques for utility exposures include air-entrainment/vacuum-extraction systems, water-jet/vacuum-extraction systems, and careful hand tool usage.
One-call notification center	An entity that administers a system through which a person can notify utility owners and operators of proposed excavations. Typically, the one-call center notifies member utility owners that they may send records to the designer or designate and mark on the ground surface the existing indications of some or all of the utilities that may be present.
One-call statute	A local or state requirement that an excavator or designer of excavation call a central number to notify some or all existing utility owners of that planned excavation.

Scope of work	All services and actions required of the consultant by the obligations of the contract.
Subsurface utility engineer	A person who by education and experience is qualified to practice subsurface utility engineering.
Subsurface utility engineering (SUE)	A branch of engineering practice that involves managing certain risks associated with utility mapping at appropriate quality levels, utility coordination, utility relocation design and coordination, utility condition assessment, communication of utility data to concerned parties, utility relocation cost estimates, implementation of utility accommodation policies, and utility design.
Surface geophysical method	Any of a number of methods designed to utilize and interpret ambient or applied energy fields for the purpose of identifying properties of, and structure within, the earth. Such methods typically include variants of electromagnetic, magnetic, elastic wave, gravitational, and chemical energies.
Survey datum	The points of reference used by the project owner and engineer to define a specific geographic location in three-dimensional space.
Test hole	The excavation made to determine, measure, and record the presence of a utility structure.
Utility	A privately, publicly, or cooperatively owned line, facility, or system for producing, transmitting, or distributing communications, cable television, power, electricity, light, heat, gas, oil, crude products, water, steam, waste, or any other similar commodity, including any fire or police signal system or street lighting system.
Utility accommodation policy	A policy for accommodating utility facilities on the project. This policy includes, but is not limited to, establishing the horizontal and vertical location requirements and clearances for the various types of utilities; referencing applicable provisions of government or industry codes required by law or regulation; providing standards, specifications, detailed procedures, criteria, and methods of installation; providing requirements for the preservation and restoration of project facilities; setting forth limitations on the utility's activities within the project area; and establishing measures necessary to protect traffic, workers, and the general public during and after the installation of utility facilities.
Utility attribute	A distinctive documented characteristic of a utility that may include but is not limited to elevation, horizontal position, configurations of multiple non-encased pipes or cables, shape, size, material type, condition, age, quality level, and date of measurement.
Utility depiction	A visual image of existing utility information using a computer-aided design and drafting system or on project plan sheets.

Utility quality level	A professional opinion of the quality and reliability of utility information. Such reliability is determined by the means and methods of the professional. Each of the four existing utility data quality levels is established by different methods of data collection and interpretation.
Utility quality level A	Precise horizontal and vertical location of utilities obtained by the actual exposure (or verification of previously exposed and surveyed utilities) and subsequent measurement of subsurface utilities, usually at a specific point. Minimally intrusive excavation equipment is typically used to minimize the potential for utility damage. A precise horizontal and vertical location, as well as other utility attributes, is shown on plan documents. Accuracy is typically set to 15-mm vertical and to applicable horizontal survey and mapping accuracy as defined or expected by the project owner.
Utility quality level B	Information obtained through the application of appropriate surface geophysical methods to determine the existence and approximate horizontal position of subsurface utilities. Quality level B data should be reproducible by surface geophysics at any point of their depiction. This information is surveyed to applicable tolerances defined by the project and reduced onto plan documents.
Utility quality level C	Information obtained by surveying and plotting visible above-ground utility features and by using professional judgment in correlating this information to quality level D information.
Utility quality level D	Information derived from existing records or oral recollections.
Utility relocation policy	A policy (typically of the project owner or utility owner) for the relocation of utility facilities required by the project. This policy includes, but is not limited to, establishing provisions for compensating utility owners; for removing and reinstalling utility facilities; for acquiring or permitting necessary rights-of-way at the new location; for moving, rearranging, or changing the type of existing facilities; and for taking necessary protective measures.
Utility search	The search for a specific or unknown utility or utilities using a level of effort in accordance with the specified quality level, within a defined area.
Utility trace	The process of using surface geophysical methods to image and track a particular utility.

4.0 ENGINEER AND OWNER COLLECTION AND DEPICTION TASKS

The list of tasks or work elements below is a guideline to the development of the scope of work and contract between the owner and engineer.

4.1 Engineer

The engineer should:

4.1.1 Advise the project owner regarding potential effects that the project may have on existing subsurface utilities.

4.1.2 Inform the project owner regarding utility quality levels and reliability of data for each quality level. Such information may include a discussion of costs and benefits associated with obtaining quality levels.

4.1.3 Recommend a scope for utility investigations dependent on project needs. This may include a list of the types of utilities for detection and depiction and the desired utility data quality level. It may include certain systems to be investigated and depicted at a lower quality level. It may include geographic sections of the project to have utilities investigated and depicted at various quality levels.

4.1.4 Discuss and recommend formatting of deliverables to clearly distinguish quality levels.

4.1.5 Discuss the sequence of acquiring appropriate quality level data throughout the planning and design process. This is dependent on project design elements, design timetables, the type of project, the criticality of utility service, and so forth.

4.1.6 Prepare a utility composite drawing or file with appropriate supporting documents, in accordance with owner specification, that clearly identifies utilities at their desired quality levels at the appropriate time within project development. The deliverable may contain utilities depicted at quality levels A, B, C, and/or D.

4.1.7 Review data with utility owners.

4.1.8 Review plans as design develops to analyze the effects of design changes to current utility information.

4.1.9 Recommend areas or particular utility systems for a "quality level" upgrade after review. Such an upgrade may be to quality level C, B, or A.

4.1.10 Follow applicable one-call statutes or other applicable laws. Most of these regulations limit engineers to a notification requirement. Other action is typically the responsibility of the utility owner.

4.1.11 Place a note on the plans explaining the different utility "quality levels."

4.1.12 Affix an engineer's stamp on the plans that depict existing subsurface utility data at the indicated quality levels.

4.1.13 Discuss utility accommodation and utility relocation policies for the project owner's implementation.

4.2 Project Owner

The project owner should:

4.2.1 Specify the scope of work and the formatting of deliverables for the engineer. The engineer should review and discuss the scope of work and the specified deliverable formats with the owner.

4.2.2 Render assistance when necessary in persuading utility owners to allow engineers access to pertinent records and facilities. Such persuasion may include landowner involvement and a willingness to accommodate existing utilities with minimal relocations. Discussions and decisions on these topics should be communicated to the engineer. The engineer may render assistance to the owner in these tasks.

4.2.3 Review the definitions of quality levels with the designer, constructor, and other users. The project owner may wish to have the engineer prepare a written summary to accompany the plans or may attend pre-bid or post-bid meetings. The engineer should attend pre-bid and pre-construction meetings, should also be involved in the pre-selection of contractors, and should be retained to perform plan review

4.2.4 Notify the engineer within a reasonable time frame of any suspected deficiencies in the utility depictions at the specified quality level discovered during construction.

4.2.5 Furnish utility information to the utility owners for their consideration during utility marking for construction (one-call statutes).

4.2.6 Furnish appropriate utility accommodation and relocation policy information to involved parties.

5.0 UTILITY QUALITY LEVEL ATTRIBUTES

5.1 Quality Level D

Typical tasks by the engineer leading to utility quality level D are:

5.1.1 Conduct utility records research to assist in identifying utility owners that may have facilities on or be affected by the project. Sources of information may include, but are not limited to (project- and scope-dependent):

- Utility section of the state Department of Transportation or other public agency
- One-call notification center
- Public Service Commission or similar organization
- County Clerk's office
- Landowner
- Internet or computer database search
- Visual site inspection
- Utility owners

5.1.2 Collect applicable utility owner records. Applicable records may include:

Previous construction plans in area
Conduit maps
Direct-buried cable records
Distribution maps
Transmission maps
Service record cards
"As-builts" and record drawings
Field notes
County, city, utility owner or other geographic information system databases
Circuit diagrams
Oral histories

5.1.3 Review records for:
Indications of additional available records
Duplicate information and credibility of such duplicate information
Need for clarifications by utility owners

5.1.4 Develop utility composite drawing or equivalent. The engineer should also make professional judgments regarding the validity and location of topographic features on records versus current topographic features (when available) and conflicting references of utilities. And the engineer should indicate quality levels; utility type and/or ownership; date of depiction; accuracy of depicted appurtenances (quality level C vs. quality level D); end points of any utility data; active, abandoned, or out-of-service status; size; condition; number of jointly buried cables; and encasement.

5.2 Quality Level C

Typical tasks by the engineer leading to utility quality level C are:

5.2.1 Perform tasks as described for quality level D. Quality level C and D tasks do not necessarily need to be performed in any prescriptive order.

5.2.2 Identify surface features on the topographic plan and ground surface that are surface appurtenances of existing subsurface utilities.

5.2.3 Survey such features if the features have not already surveyed by a registered professional. If previously surveyed, check survey accuracy and completeness for applicability with the existing project.

5.2.4 Correlate applicable utility records to these surveyed features, taking into account the geometries and indications on the records of these surface features.

5.2.5 Determine when records and features do not agree and resolve discrepancies. This may be accomplished by depiction of a utility line at quality level D, effectively bypassing or disregarding (but still depicting) a surveyed structure of unknown origin. Additional resolution may result from consultation with utility owners.

5.3 Quality Level B

Typical tasks by the engineer leading to utility quality level B are:

5.3.1 Perform tasks as described for quality level C. Quality level C and B tasks do not necessarily need to be performed in any prescriptive order. It may be more cost effective to perform some quality level B tasks before and/or in conjunction with quality level C or D tasks.

5.3.2 Select an appropriate suite of surface geophysical methods (see the Appendix for discussions of methods, relative merits, and relative costs) to search for utilities within the project limits or to perform a utility trace for a particular utility system.

5.3.3 Apply appropriate surface geophysics to search for utilities within the project limits, or trace a particular utility system if the scope of investigation is limited.

5.3.4 Interpret the surface geophysics. Depending on the methods, this may be performed in the field or in the office.

5.3.5 Mark the indications of utilities on the ground surface for subsequent survey. Local utility owners, agencies, and/or one-call statutes may dictate, or suggest, the markings' colors, sizes, and/or other labeling. Care should be taken to differentiate markings placed on the ground for design purposes from those placed on the ground for damage prevention purposes. (Note: If a particular surface geophysical method allows for field data collection or storage for future computer downloading and evaluation, if a utility search technique that allows for comprehensive area coverage is used, and if a survey grid or line is laid out that allows for future correlations of surface geophysical data to points depicted on a map, then ground markings may be unnecessary.)

5.3.6 Survey all markings that indicate the presence of a subsurface utility. This survey should be to the accuracies and precision dictated by the project's survey control.

5.3.7 Depict all designated utilities. These utility depictions may follow the general guideline as presented in Section 6.0. Depiction is usually accomplished via computer-aided design and drafting or manual plotting methods onto plan sheets, into geographic information systems databases, or onto other appropriate documents. Quality level B data should be reproducible by surface geophysics at any point of their depiction.

5.3.8 Correlate the designated utilities' depictions with utility records and/or surveyed appurtenances to identify utilities that may exist but were not able to be designated.

5.3.9 Resolve differences between designated utilities and utility records and surveyed appurtenances. This may take the form of additional surface geophysical searches or depiction of designated or nondesignated utilities at a lower quality level. It may take the form of an upgrade at appropriate points to quality level A information. Situations require judgment that a designated utility and a utility of record are actually identical, even if not interpreted as geographically coincident.

5.3.10 Recommend to the project owner additional measures to resolve differences if they still exist. Such recommendations may include additional or different surface geophysical methods, exploratory excavation, or an upgrade to quality level A data.

5.4 Quality Level A

Typical tasks by the engineer leading to utility quality level A are:

5.4.1 Perform tasks as described for quality level B at the appropriate project location. Quality level B, C, and D tasks do not necessarily need to be performed in any prescriptive order.

5.4.2 Select an appropriate method of gathering data that will achieve the accuracies and precision required by the project. These accuracies are currently typically set to 15-mm vertical and to applicable horizontal survey and mapping accuracy as defined by the project owner. Exposure and survey of the utility at each specific location where quality level A data are obtained are currently necessary.

5.4.3 Excavate test holes exposing the utility to be measured in such a manner that protects the integrity of the utility to be measured. Exposure is typically performed via minimally intrusive excavation. In some cases, data gathering during utility construction may eliminate the need for excavation of the utility, as it is already exposed.

5.4.4 Comply with applicable utility damage prevention laws, permits, and specifications, and coordinate with utility and other inspectors, as required.

5.4.5 Determine (a) the horizontal and vertical location of the top and/or bottom of the utility referenced to the project survey datum; (b) the elevation of the existing grade over the utility at a test hole referenced to the project survey datum; (c) the outside diameter of the utility and configuration of non-encased, multiconduit systems; (d) the utility structure material composition, when reasonably ascertainable; (e) the benchmarks and/or project survey datum used to determine elevations; (f) the paving thickness and type, where applicable; (g) the general soil type and site conditions; and (h) such other pertinent information as is reasonably ascertainable from each test hole site.

5.4.6 Resolve differences between depicted quality level A data and other quality levels. This may take the form of additional surface geophysical searches or a depiction of adjacent or nearby data points at a lower quality level. It may require that utilities already depicted at quality level B, C, or D should be re-depicted to coincide with the more accurate quality level A data. It may take the form of additional upgrades at appropriate points to quality level A information.

6.0 DELIVERABLES FORMATTING

6.1 General

It is not the intent of this section to prescribe the format of deliverables. Many owners have individual computer-aided design and drafting (CADD) requirements and other specifications that must be adhered to by the engineer. Rather, it is the intent of this section to communicate some broad guidelines and illustrate specific examples that have been effective on past projects.

Attributes such as size; material type; age; condition; ownership; in-service, out-of-service, active, or abandoned status; and number of conduits and direct buried cables are examples of attributes that may have been depicted traditionally. The basic difference between traditional depictions of utilities and utilities depicted as a result of this standard guideline is that a utility quality attribute (i.e., quality level A, B, C, or D) and the date of that attribute should be ascribed to each line segment or discrete point of a utility.

6.2 Basic Deliverable

The basic deliverable for utility information is a CADD file or plan sheet that has utility information in plan view for quality levels A, B, C, and D and utility information in plan and profile view for quality level A. Quality level A data typically consist of a supplemental data form with additional information. Advancing CADD programs (e.g., Geopak and CAiCE in the late 1990s) may allow the engineer to depict three-dimensional views of utility information from various vantage points. This standard guideline does not address the quality of vertical information other than for quality level A data. Written reports, test hole summary sheets, and other data may accompany and supplement plan sheets and quality level A supplemental data sheets.

6.3 Quality Level Attributes

6.3.1 General

Attributes should be ascribed in such a fashion that duplication of plans (e.g.,. blue-printing, monochromatic copier) or portions of plans should not eliminate or obliterate the attribute. Attribute depiction can be achieved by the following methods. There may be other methods that will also suffice. Usually more than one method will be necessary for clarity.

6.3.2 Line Code and Style

This has been one of the main methods to date of differentiating quality level B from quality levels D and C. Not only can line code differentiate quality levels but it can also differentiate utility type and/or ownership. This method has the advantage of differentiating regardless of color, turning off CADD labeling or other quality level layers, omitting accompanying text, or seeing a portion of a line segment that does not include a nearby embedded symbol. Many consultants make the line code for quality levels C and D identical, providing differentiation in the form of labeling structures, if any, "not-to-scale" (for quality level D).

6.3.3 Labeling

This is also one of the main methods to date of differentiating quality levels D, C, B, and A. Labeling can differentiate quality levels; utility type and/or ownership; date of depiction; accuracy of surveyed appurtenances (quality level C vs. quality level D); end points of any utility data; active, abandoned, or out-of-service status; size; condition; number of jointly buried cables; and encasement.

6.3.4 Symbol Embedding

Symbol embedding conveys quality level A data at a discrete point. It is not a separate layer or level that can be turned off (see Figure 7.2, TH25 annotation in lower left for example).

6.3.5 Color

Color is frequently used to indicate utility type. It must usually be used in conjunction with other methods because of a loss of distinguishing characteristic data with blue-lining or noncolor copying.

6.3.6 Line Weight

Sometimes line weight is used at actual scale to depict the size of the utility. This has the effect of obscuring other data if the line size is large, so it is used infrequently.

6.3.7 Layer or Level
Sometimes layers or levels are used to portray various attributes. For example, quality level A data could be on one layer, quality level B data on another, and so on. All layers must be on to present the complete utility picture on any plot. This approach may be useful for geographic information system uses.

6.3.8 Accompanying Text
This may be difficult to use if the work product has a complex mix of utility quality levels and line segments.

6.4 Utility Depiction Legend

In most cases, a separate utility legend and/or section within the project notes is desirable to clearly indicate the methods of quality level differentiation and other utility attributes. See Figure 6-1.

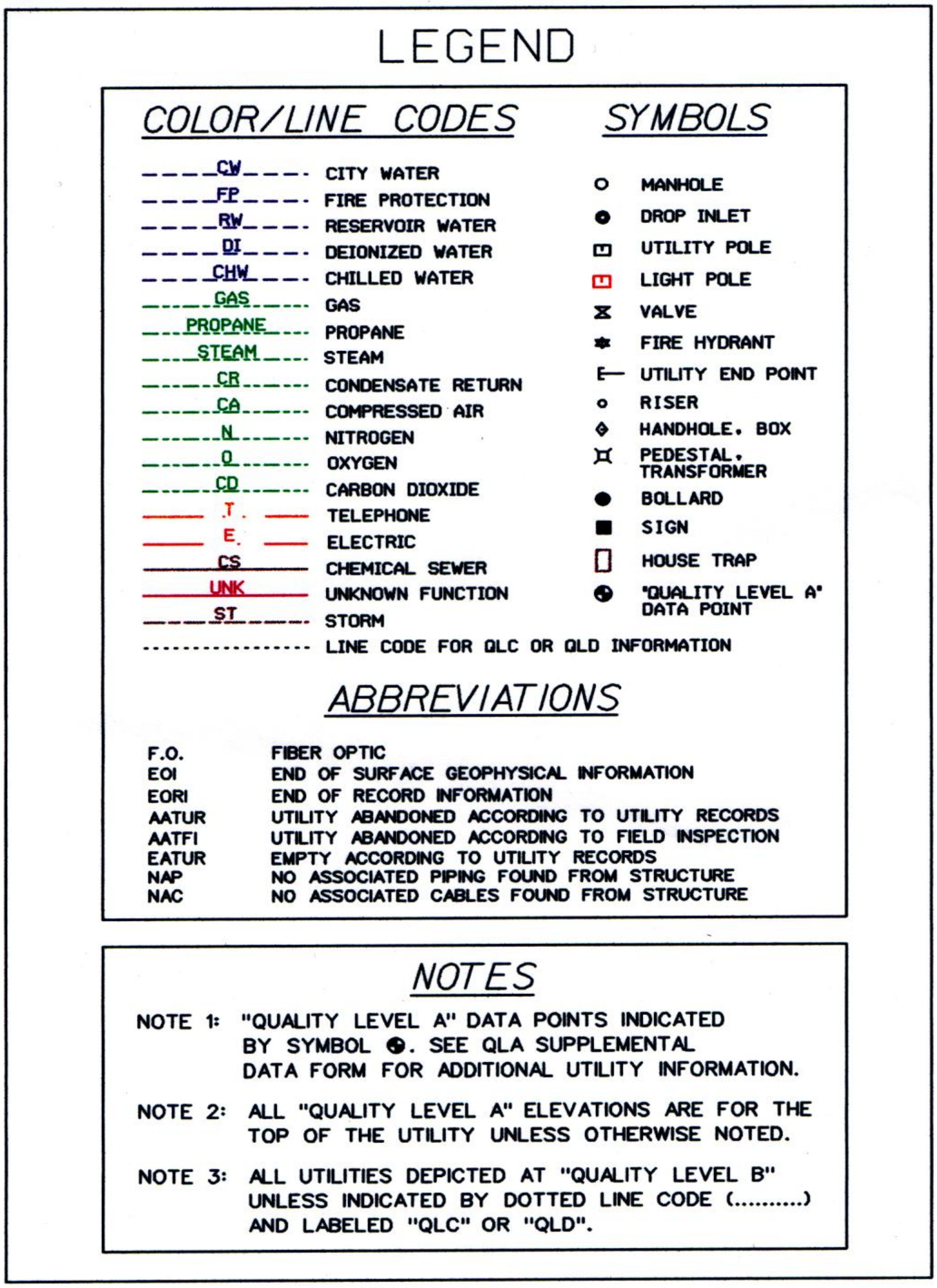
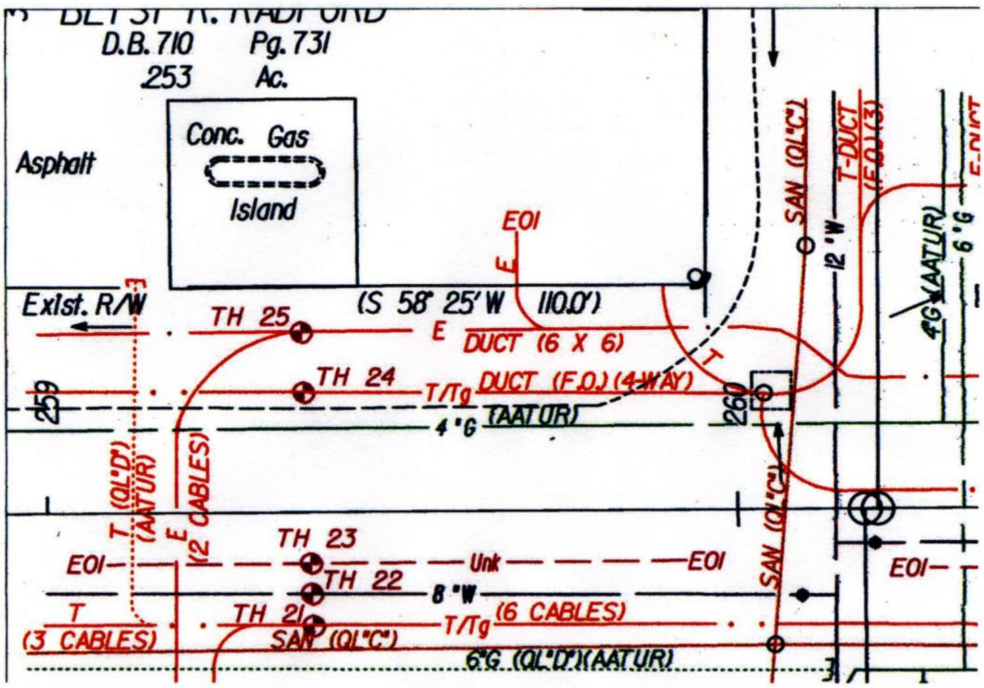


Figure 6-1. **Legend Example**

6.5 Examples of Mapping Deliverables

Most mapping deliverables consist of a combination of line code and style (Section 6.3.2), labeling (Section 6.3.7), symbol embedding (Section 6.3.4), and color (Section 6.3.5). Figures 6-2 through 6-4 show actual work products already in use. These examples are in no way intended to be exclusive.



All Utilities depicted at QL B unless otherwise noted.

QL A Data Summary (see QL A Supplemental Data Sheets for additional information):

TH 21: 6 non-encased telephone cables

elevation top of cable configuration: 186.15'
elevation bottom of configuration: 183.43'
Coords: N 441987.8011
E 3640280.1310

TH 22: 8 3/4" C.I. water

elevation top of water line: 184.67'
Coords: N 441992.7925
E 3640280.0092

TH 23: 6 3/4" unknown function steel pipe
elevation top of pipe: 181.12'
Coords: N 441997.3469
E 3640280.8993

TH 24: Fiber Optic concrete telephone duct
elevation top of duct: 184.41'
elevation bottom of duct: 182.22
width of duct: 2.62'
Coords: N 442022.7934
E 3640281.0571

TH 25: concrete encased electric duct
elevation top of duct: 186.87'
elevation bottom duct: 183.55
width of duct: 4.66'
Coords: N 442032.1007
E 3640281.2239

Figure 6-2. An example of line code, labeling, symbol embedding, and notes.

NOTES:

All Utilities depicted at Quality Level B (QL B) except:

1. All Sanitary Sewers are Quality Level C (QL C)
2. 6" Gas - 25 feet RT of Centerline Station 260 + 23 to 27 feet RT of Centerline Station 268 + 11 - is Quality Level D (QL D).
3. There are no Quality Level A (QL A) data.

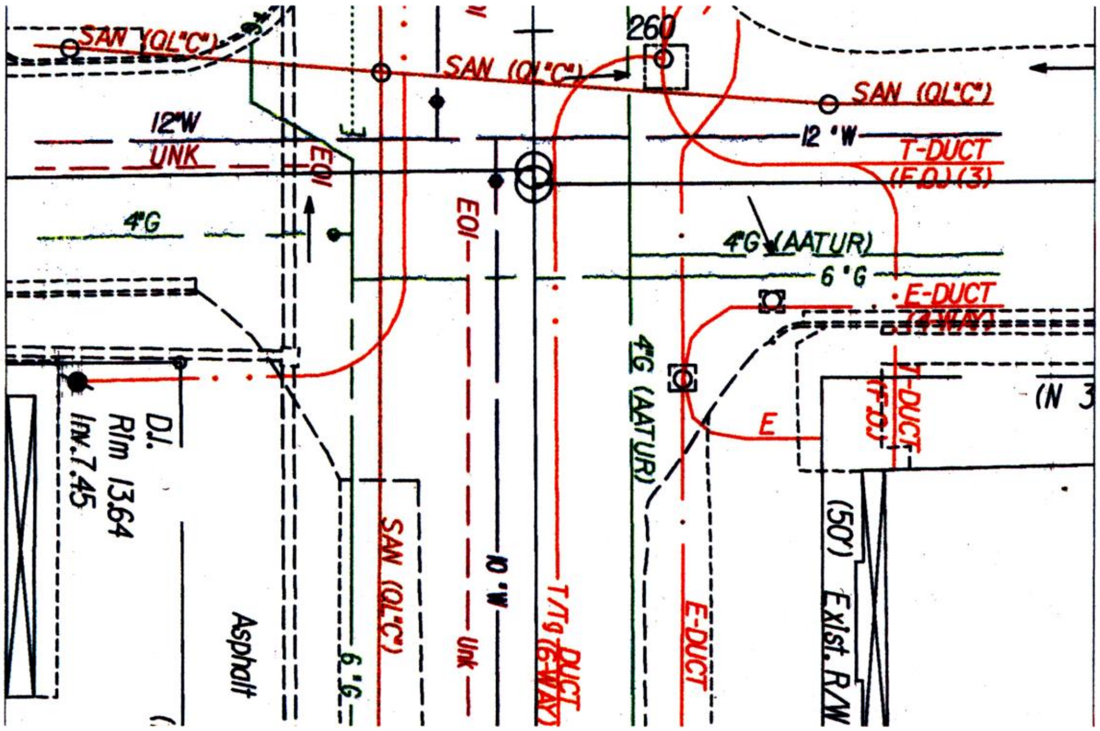
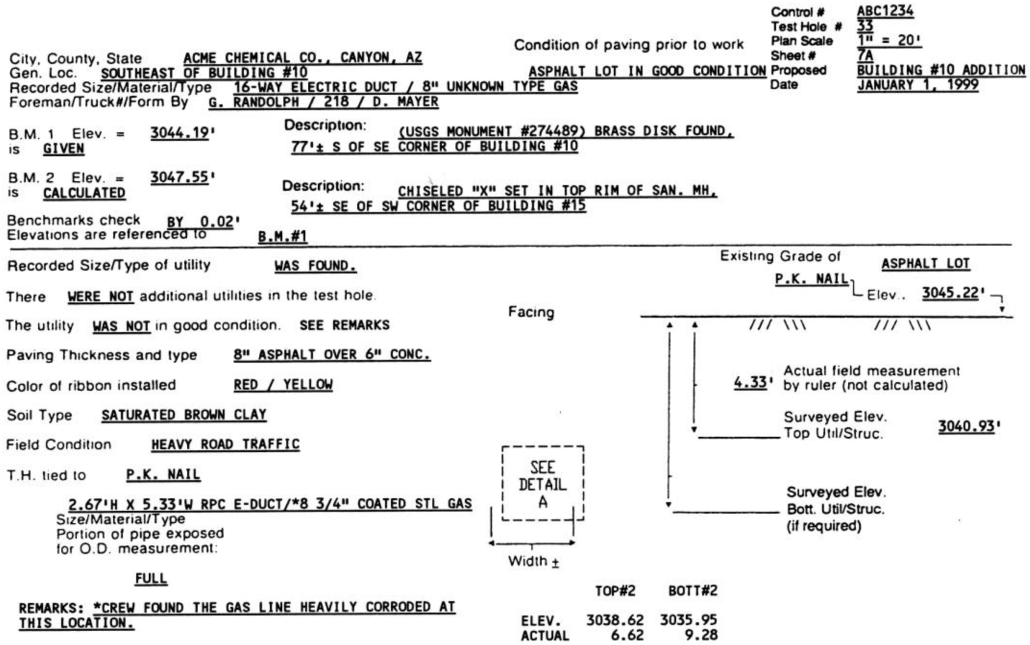


Figure 6-3. An example of quality level delineation by notes



Control # ABC1234
Test Hole # 33
Plan Scale 1" = 20'
Sheet # 7A
Proposed BUILDING #10 ADDITION
Date JANUARY 1, 1999

Condition of paving prior to work ASPHALT LOT IN GOOD CONDITION

City, County, State ACME CHEMICAL CO., CANYON, AZ
Gen. Loc. SOUTHEAST OF BUILDING #10
Recorded Size/Material/Type 16-WAY ELECTRIC DUCT / 8" UNKNOWN TYPE GAS
Foreman/Truck#/Form By G. RANDOLPH / 218 / D. MAYER

B.M. 1 Elev. = 3044.19' is GIVEN
Description: (USGS MONUMENT #274489) BRASS DISK FOUND, 77'± S OF SE CORNER OF BUILDING #10

B.M. 2 Elev. = 3047.55' is CALCULATED
Description: CHISELED "X" SET IN TOP RIM OF SAN. MH, 54'± SE OF SW CORNER OF BUILDING #15

Benchmarks check BY 0.02'
Elevations are referenced to B.M.#1

Recorded Size/Type of utility WAS FOUND.
There WERE NOT additional utilities in the test hole.
The utility WAS NOT in good condition. SEE REMARKS
Paving Thickness and type 8" ASPHALT OVER 6" CONC.
Color of ribbon installed RED / YELLOW
Soil Type SATURATED BROWN CLAY
Field Condition HEAVY ROAD TRAFFIC
T.H. tied to P.K. NAIL

2.67'H X 5.33'W RPC E-DUCT/*8 3/4" COATED STL GAS
Size/Material/Type
Portion of pipe exposed for O.D. measurement:
FULL

REMARKS: *CREW FOUND THE GAS LINE HEAVILY CORRODED AT THIS LOCATION.

Existing Grade of ASPHALT LOT
P.K. NAIL Elev. 3045.22'
Facing
Actual field measurement by ruler (not calculated) 4.33'
Surveyed Elev. Top Util/Struc. 3040.93'
SEE DETAIL A
Surveyed Elev. Bott. Util/Struc. (if required)
Width ±

	TOP#2	BOTT#2
ELEV.	3038.62	3035.95
ACTUAL	6.62	9.28

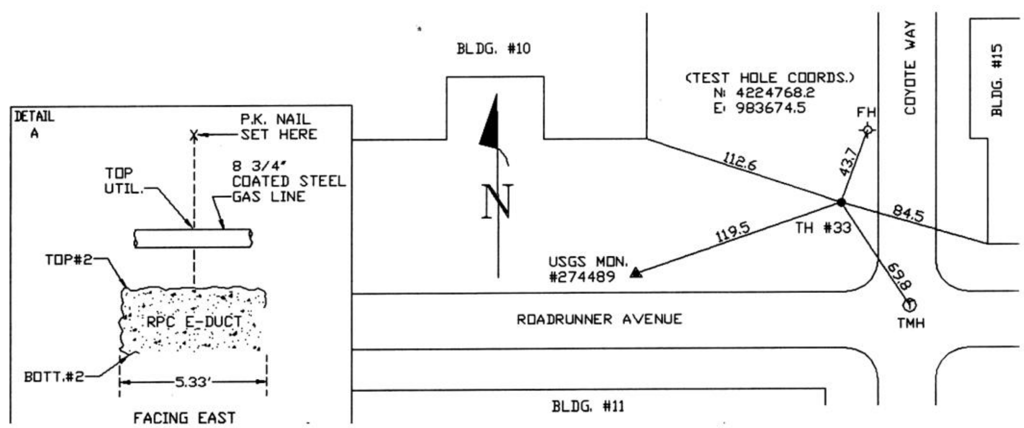


Figure 6-4. An example of quality level A supplemental data

7.0 RELATIVE COSTS AND BENEFITS OF QUALITY LEVELS

7.1 Cost Savings

7.1.1 Stevens, R.E. (1993). Society of American Value Engineers, General Percentages of Cost Savings

A paper by Stevens (1993) states that the total savings on a typical project using quality level B and A data may range from 10% to 15% (compared with costs from a project using quality level C and D data). The approximate cost savings as a percentage of project costs are as follows:

Administrative (1/10 of 20%)	2.00%
Engineering (1/20 of 10%)	0.50%
Utility relocation (1/2 of 10%)	5.00%
Construction (1/20 of 45%)	2.25%
Cost Overruns (1/3 of 15%)	5.00%

7.1.2 Lew, J.J. (1999). Purdue University Study

Purdue University, under contract to the Federal Highway Administration, studied 74 randomly selected highway transportation projects in which quality level B and A data were obtained by the state Department of Transportation in Virginia, Ohio, North Carolina, Texas, Oregon, Wyoming, and Puerto Rico. Included in the study were rural, urban, suburban, arterial, and interstate projects. The total value of construction studied exceeded $1 billion. Overall, a savings of $4.62 per every $1.00 spent on upgrading traditional quality level D and/or C data to quality level B and A data was quantified. This resulted in a savings of 1.9% in the total design and construction budget. Savings that could not be quantified were not included in this amount. In general, urban and suburban projects realized greater savings than did rural projects. Only three of 74 projects had a negative return on investment.

7.2 Costs

Cost data vary greatly as a factor of climate, soil, project specifics, geography, and so forth. Providers and project owners have used the following rules of thumb for transportation projects:

(a) The costs of obtaining quality level B throughout a project and quality level A in sufficient locations to identify important utility conflicts are about 1% of a typical highway design and construction budget.

(b) The costs of obtaining quality level B throughout a project and quality level A in sufficient locations to identify important utility conflicts are about 10% of a typical highway design budget.

(c) The costs of obtaining quality level B throughout a project and quality level A in sufficient locations to identify important utility conflicts are greater on urban projects than on rural projects.

The Purdue Study (1999) shows the following:

(a) The costs of obtaining quality level B throughout a project and quality level A in sufficient locations to identify important utility conflicts are about 0.5% of a typical highway design and construction budget.

(b) Costs were higher for urban versus rural projects.

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