Identification of Utility Conflicts and Solutions

DETAILS

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SHRP 2 REPORT S2-R15B-RW-1

Identification of Utility Conflicts and Solutions

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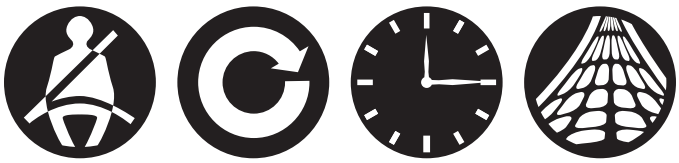

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FOREWORD

Charles Taylor, *SHRP 2 Special Consultant, Renewal*

This report provides comprehensive, optimized concepts and procedures for identifying and resolving utility conflicts that public agency and utility professionals can use to improve the highway project development process. The tools developed include utility conflict matrices (UCMs) that enable users to organize, track, and manage the conflicts that frequently arise when utility lines are under highways.

Two critical factors that contribute to inefficiencies in the highway project development process are the lack of accurate, complete information about utility facilities that might be in conflict with the project and the resolution and overall management of those conflicts. When utility relocation is involved, construction generally takes longer and costs more. Identifying and resolving potential utility conflicts early in the design process can minimize these delays and costs.

Procedures involving the use of UCMs vary widely across the country. This project began with the documentation of these procedures and then developed optimized UCM concepts and techniques. The major research activities were the review of current practice; the development and testing of an optimized UCM concept; the development of a 1-day training course to instruct end users on how to use the optimized concept and tools; and conducting the training for two state DOTs to fine-tune the course. In addition, strategies and guidelines were developed that include specific steps to start and continue implementation. The optimized UCM techniques include a prototype stand-alone UCM in Microsoft Excel that has a main utility conflict table and a supporting worksheet to analyze utility conflict resolution strategies. Project products also include a prototype utility conflict data model and database. This stand-alone product is a scalable UCM that enables the management of conflicts in a database environment.

The users of the research products are the stakeholders who are involved in utility coordination throughout the process of highway transportation projects. The three main groups of stakeholders are public-sector agencies, private-sector consultants, and utility owners. Public-sector agencies include state DOTs, local public agencies (cities and counties), the Federal Highway Administration, and the American Association of State Highway and Transportation Officials (AASHTO). Within these agencies, stakeholders include those responsible for transportation planning, environmental clearance, preliminary design, right-of-way acquisition, utility activities, design, and construction. Private-sector consultants include design consultants, utility consultants, and subsurface utility engineering consultants. Utility owners include owners and operators of privately, publicly, or cooperatively owned utility facilities or systems.

CONTENTS

Executive Summary

Two critical factors that contribute to inefficiencies in the transportation project development process are the lack of accurate, complete information about utility facilities that might be in conflict with the project and the resolution and overall management of those conflicts. Inaccurate or incomplete information about utility facilities in conflict with the project can result in a variety of problems:

- Disruptions when utility installations are encountered unexpectedly during construction, either because there was no previous information about those installations or because their stated location on the construction plans was incorrect;
- Damage to utility installations, which can disrupt utility service, damage the environment, and endanger the health and safety of construction workers and the public; and
- Delays that can extend the period of project development or delivery and increase total project costs.

The traditional approach for resolving utility conflicts at many state departments of transportation (DOTs) is to relocate the affected utility facilities—often at great expense to the utility owner or the DOT or both. Relocating a utility facility is not necessarily the only or best strategy to resolve a utility conflict. Other strategies include designing and constructing the transportation facility in such a way as to leave the affected utility facilities in place.

Utility conflict matrices (UCMs) enable users to organize, track, and manage utility conflicts. Practices involving the use of UCMs vary widely across the country. There is a need to document these practices and develop optimized UCM concepts and techniques that can contribute to standardization and optimization of the utility coordination process. SHRP 2 Renewal Project R15B addressed this need in the following ways:

- Reviewing trends around the country and identifying the best practices on the use of UCMs;
- Developing and testing a standardized UCM concept;
- Developing training materials; and
- Developing implementation guidelines.

The products resulting from this research include the following:

- *Prototype stand-alone UCM (Prototype 1).* This is a stand-alone product in Microsoft Excel format that includes a main utility conflict table and a supporting worksheet to analyze utility conflict resolution strategies.
- *Prototype utility conflict data model and database (Prototype 2).* This stand-alone product is a scalable UCM representation that enables the management of utility conflicts in a database

environment. To facilitate implementation, the research team used industry-standard protocols for the development of the data model (including a logical model, a physical model, and a data dictionary). The data model is in AllFusion ERwin Data Modeler format, which can be easily exported to databases such as Oracle and SQL Server. The prototype data model and the corresponding database in Microsoft Access format were tested using data from sample utility conflict tables from across the country.

- *Hands-on UCM training course.* This stand-alone product includes a lesson plan and presentation materials to assist with the dissemination of research findings. The 1-day UCM training course is divided into six lessons, designed for a total of 7 hours and 15 minutes of instruction. The seminar provides numerous opportunities for participant interaction and enables the instructor to adjust session and lesson start times and durations depending on the audience and the level of participant engagement in the discussions. The training materials use National Highway Institute (NHI) standards and templates.
- *Implementation guidelines.* This product contains strategies and an implementation plan to promote application of the research products (see Chapter 7). The implementation guidelines address topics such as audience or market for the products, assessment of impediments to successful implementation, research product leaders (or champions), activities necessary for successful implementation, and criteria for judging the progress and consequences of implementation. The implementation plan includes a series of specific steps to start and continue the implementation of the research products, including identifying an implementation team, providing UCM training courses, and specific activities in connection with the implementation of both prototypes.

The audience for the research products is the stakeholders who are involved in utility coordination throughout the development process of transportation projects. Because utility conflicts can affect transportation projects from project concept to project completion, the expected audience for the research products is potentially large. This audience includes three main groups of stakeholders:

- *Public sector (project owners).* Agencies that may be interested in the research products include the Federal Highway Administration (FHWA), the American Association of State Highway and Transportation Officials (AASHTO), state DOTs, and local public agencies (cities and counties). Within these agencies, interested groups include those responsible for transportation planning, environmental clearance, preliminary design, right-of-way acquisition, utility activities, design (including plans, specifications, and estimates), and construction. Project owners are expected to play various roles with respect to the research products, including user, developer, manager, and steward.
- *Private sector (consultants and contractors).* Groups that may be interested in the research products include design consultants, utility consultants, subsurface utility engineering consultants, highway contractors, and utility contractors involved in utility coordination activities between conflict elimination stakeholders. Consultants and contractors are expected to play a user role, although, depending on their relationship with project owners, they could also be developers or managers.
- *Utility owners.* Groups that may be interested in the research products include owners and operators of privately, publicly, or cooperatively owned utility facilities or systems. Utility owners are expected to play a user role.

CHAPTER 1

Introduction

Utility accommodation policies, rules, and guidelines around the country provide minimum requirements relative to the accommodation, location, installation, relocation, and maintenance of utility facilities within the state right-of-way. In some cases, these documents describe not just applicable laws and regulations but also include references to industry standards and specifications that require utility owners to provide a higher degree of protection (*1*). Many state rules and guidelines are based on utility accommodation policies and guides developed by AASHTO (*2, 3*). Other guidelines available include publications by AASHTO (*4*) and FHWA (*5, 6*).

A 2002 survey of state DOTs, highway contractors, design consultants, and others identified utility relocations as the most frequent reason for delays in highway construction (*7*). Management of utility conflicts through effective communication, cooperation, and coordination among stakeholders is a critical mechanism to keep transportation projects on schedule (*8*). Delays and inefficiencies in utility-related activities have a tendency to proliferate during project letting and even construction, frequently resulting in higher bids, change orders and damage or delay claims, litigation by utility owners or agencies, safety concerns at the job site, frustration of the traveling public, and negative public perception about the project.

Two critical factors that contribute to inefficiencies in the transportation project development process are the lack of accurate, complete information about utility facilities that might be in conflict with the project and the resolution and overall management of those conflicts. Inaccurate or incomplete information about utility facilities in conflict with the project can result in problems such as the following:

- Disruptions when utility installations are encountered unexpectedly during construction, either because there was no previous information about those installations or because their stated location on the construction plans was incorrect;
- Damage to utility installations, which can disrupt utility service, damage the environment, and endanger the health and safety of construction workers and the public; and
- Delays that can extend the period of project development or delivery and increase total project costs.

Potential utility conflicts exist at most transportation projects and may include the following:

- Interference between utility facilities and transportation design features (existing or proposed);
- Interference between utility facilities and transportation construction activities or phasing;
- Interference between planned and existing utility facilities;
- Noncompliance of utility facilities with utility accommodation policies; and
- Noncompliance of utility facilities with safety regulations.

Although transportation projects are not prerequisites for utility conflicts—since utility conflicts can also occur when utility owners propose new installations or improvements on existing corridors where there are no active transportation projects (*9*)—most utility conflicts that concern this research are associated with transportation projects.

Detection of utility conflicts as early as possible during the project development process can help identify the optimum application of strategies to resolve those conflicts. Strategies normally available include one or more of the following options (*8, 10, 11*):

- Remove, abandon, or relocate the utility facilities in conflict;
- Change the horizontal or vertical alignment of the proposed transportation facility;
- Implement an engineering (protect-in-place) countermeasure that does not involve utility relocation or changes to the transportation project alignment; and
- Accept an exception to policy.

In practice, the traditional approach for resolving utility conflicts at many state DOTs is to relocate the affected utility facilities—often at great expense to the utility owner or the DOT or both—or to allow an exception to policy. An alternative is to design and construct the transportation facility in such a way as to leave the affected utility facilities in place. However, if improperly managed, this approach can result in design changes that negatively affect the total project schedule or cost or degrade the value of the existing utility installation in a manner unacceptable to the facility owner.

Unfortunately, effective communication, cooperation, and coordination are frequently lacking in the project development process to allow for the adoption of cost-effective solution strategies. Factors that contribute to this situation include the following:

- *Limited project resources.* Transportation project managers typically operate with limited resources. In an effort to optimize the use of those resources, project managers might decide to limit utility data acquisition and coordination activities as much as possible or delay those activities until late in the design phase. In many cases, project managers are not sufficiently familiar with the utility coordination process and simply postpone dealing with utility issues until there is a crisis.
- *Transportation project uncertainties.* Utility owners often show little interest in utility coordination until the transportation project is well defined, which frequently means waiting until the project has reached at least the 60% design level. From a utility owner's perspective, it is not cost-effective to spend time and resources on a project that still has too many uncertainties, particularly if the associated expenses are not reimbursable.
- *Availability and quality of existing utility facility data.* Adequate information and documentation about the location and characteristics of existing utility infrastructure that might be affected by a transportation project are frequently deficient or nonexistent. Existing utility owner records are often not up to date, sufficiently accurate, or properly georeferenced for design purposes. Uncertainty about the ownership and operational status of an underground facility can complicate matters even further. Abandoned facilities are particularly troublesome in situations that involve nonreimbursable utility relocations.

Utility coordination involves the production and exchange of enormous amounts of data and supporting documents, including schematics, design files, agreements, and certifications. A critical component of this process is the documentation and management of utility conflict data. Different approaches for tracking utility conflicts exist, including the following:

- Tracking utility agreements (which is an indirect way of tracking utility conflicts since typically a decision to relocate utility facilities precedes the preparation of utility agreements, and each utility agreement may include multiple conflicts);
- Tracking utility conflict status or resolution process separately; and
- Tracking utility conflict resolution milestones, utility agreements, and other documents as part of a comprehensive information system.

Utility conflict tables, also known as utility conflict matrices (UCMs) or utility conflict lists, enable users to organize and track utility conflict data. In practice, these tables or matrices support a wide range of related processes, including conflict analyses, utility agreement development, and construction letting, as well as utility relocation scheduling, billings, and payments. Practices involving the use of UCMs vary widely not just among states but also within states. There is a need to document these practices and develop optimized UCM concepts and techniques that can contribute to standardization and optimization of the utility coordination process. SHRP 2 Renewal Project R15B addressed this need by developing and testing a prototype UCM concept and training materials. Specific objectives identified for this project include the following:

- Review trends around the country and identify best practices on the use of UCMs;
- Develop a recommended UCM and document related processes; and
- Develop training materials for implementing the UCM and related process.

CHAPTER 2

State Practices

Introduction

This chapter summarizes the work completed to assess the state of the practice around the country on the use of UCMs. The characterization of the state of the practice involved the use of an online survey, follow-up interviews with stakeholders, and online searches.

Survey and Follow-Up Interviews

The research team conducted an online survey of state agencies around the country to assess general practices related to utility conflict management and determine potential candidates for follow-up interviews. Appendix A lists the survey questions. The research team sent e-mail invitations to participate in the survey to representatives of all 50 states, the District of Columbia, and Puerto Rico. The research team assembled the list of e-mail recipients by using information available through the AASHTO subcommittees on design and right-of-way and utilities. The e-mail included a request for recipients to forward the invitation to district-level utility engineers and coordinators, as well as relevant design personnel who could be involved in utility conflict management activities. To maximize exposure to the research and the survey, the research team also gave presentations at the AASHTO Right-of-Way and Utilities Subcommittee meeting, Oklahoma City, Oklahoma (April 2009); the AASHTO Subcommittee on Design meeting, Indianapolis, Indiana (July 2009); and the Florida Utilities Coordinating Committee (FUCC) meeting, Marco Island, Florida (August 2009).

The research team sent 196 invitation e-mails. This total includes the original list compiled from the AASHTO website and additional contacts that survey respondents suggested. The research team received 103 responses from 34 state DOTs.

Based on the results of the online survey, the research team identified a sample of state DOTs for follow-up interviews. Although the main goal was to search for established and documented innovative procedures for utility conflict management and UCMs, the follow-up interviews were also intended to gather positive and negative lessons learned, as well as recommendations from state DOTs. As part of the interview process, the research team requested available documentation, such as sample tables, data, manuals, and system screenshots. The research team contacted 64 individuals at both headquarter and district levels in 30 states. This outreach resulted in 38 interviews representing 23 states.

This chapter provides an overall summary of findings and recommendations. Appendix B includes a detailed description of the practices in and lessons learned from each of these states.

Survey Results

General Observations

As mentioned, 103 officials from 34 state DOTs completed the survey. The number of responses per state varied from one response (from 15 state DOTs) to four or more responses (from nine state DOTs), and included a mix of division- and district-level responses. At several state DOTs, particularly those that provided only one response, follow-up interviews confirmed that a strategy for completing the survey was to disseminate the form among districts and consolidate the responses before completing the survey form online. Of the 103 responses, 21 were from design staff, and the remaining 82 responses were from utility staff.

Utility conflict management is typically a district activity, as indicated by the frequency of respondents who marked the "always" option for local or district involvement (Figure 2.1). Division personnel are somewhat less active in utility conflict management. State DOTs also use consultants to assist with the conflict management process, but as Figure 2.1 shows, consultants are not always involved.

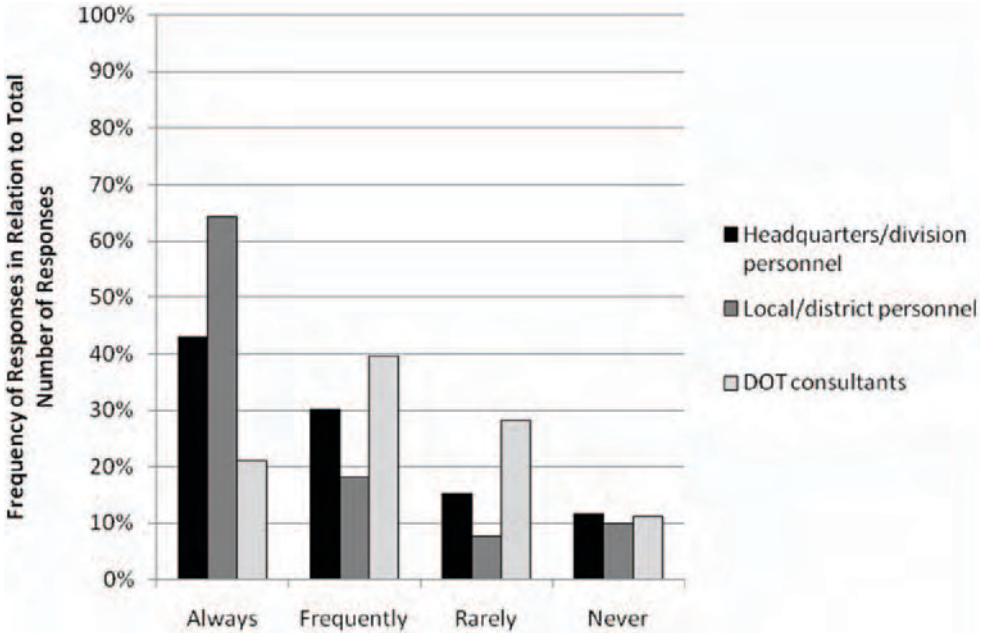


Figure 2.1. Involvement in utility conflict management.

Utility Facility Data Tracking

State DOTs track a wide range of utility facility data items. However, as Figure 2.2 shows, state DOTs have a clear preference for tracking data items such as class of utility facility and utility owner name and contact information. There is a noticeable drop after the top five data items. About two-thirds of respondents track basic utility facility data, such as diameter, material, and depth of cover, and only slightly more than half of the respondents track facility details, such as dimensions or encasement material. Less than half of the respondents track data items such as utility facility foundation characteristics and facility capacity. Only about one-fifth of the respondents track information about affected customers. Respondents also mentioned other data items, such as seasonal preferences, vegetation permits, and joint trenching.

Utility Conflict Data Tracking

State DOTs consistently track a large number of utility conflict data items. Most state DOTs track utility conflict identifiers (IDs), cost estimates, and transportation project IDs (Figure 2.3). Slightly less frequent but still common data items are additional payment information and utility conflict description and location. The least frequently tracked data item mentioned was utility relocation construction status, but even this data item was tracked by more than 50% of respondents. Data items mentioned in the "other" category included the following:

- Certified plans or as-builts;
- Company or contract forces;
- Cost overrun or underrun;
- Cost responsibility;
- Estimated versus actual costs;
- Federal participation;
- Installation inspection diary;
- Method of installation;
- Need for supplemental agreement;
- New scope of work;
- Preliminary engineering costs;
- Reimbursable percentage;
- Reimbursement eligibility; and
- Relocation process milestones.

Utility Conflict Location Referencing

Respondents were asked to provide information about the longitudinal alignment and offsets they use to reference utility conflict locations. As Table 2.1 shows, project centerline and station is the most popular longitudinal alignment for referencing utility conflicts, regardless of offset used (94% of respondents). However, respondents also indicated they use a variety of other longitudinal alignments, including route and mile point (40%), control section and distance (33%), intersection and displacement (32%), route markers and displacement (23%), and street blocks (21%). Similarly, the most common method for referencing utility conflict offsets is with respect to the project centerline (83%). Other offset methods mentioned were right-of-way line (50%), existing centerline (45%), edge of pavement (27%), and back of curb (22%). Only 6% of respondents reported not using offsets.

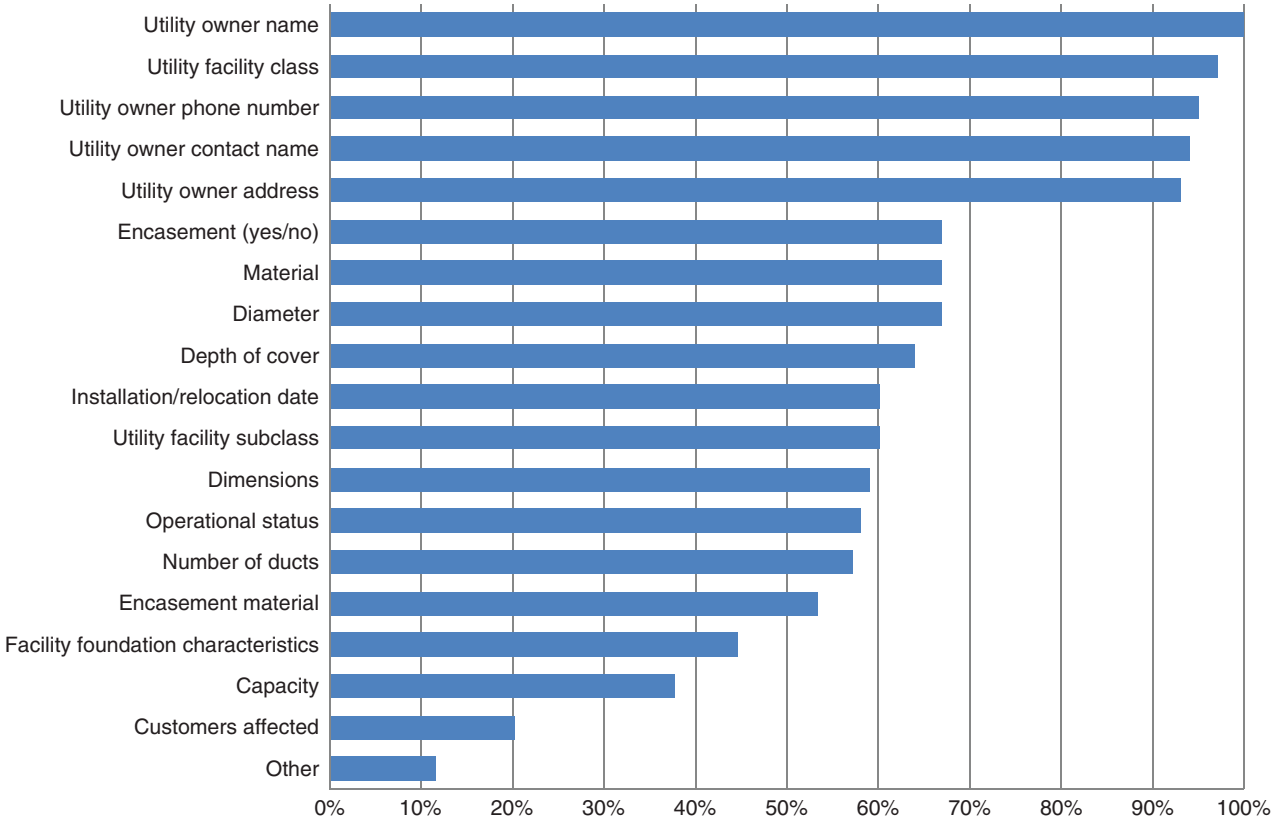


Figure 2.2. Percentage of respondents tracking utility facility data items.

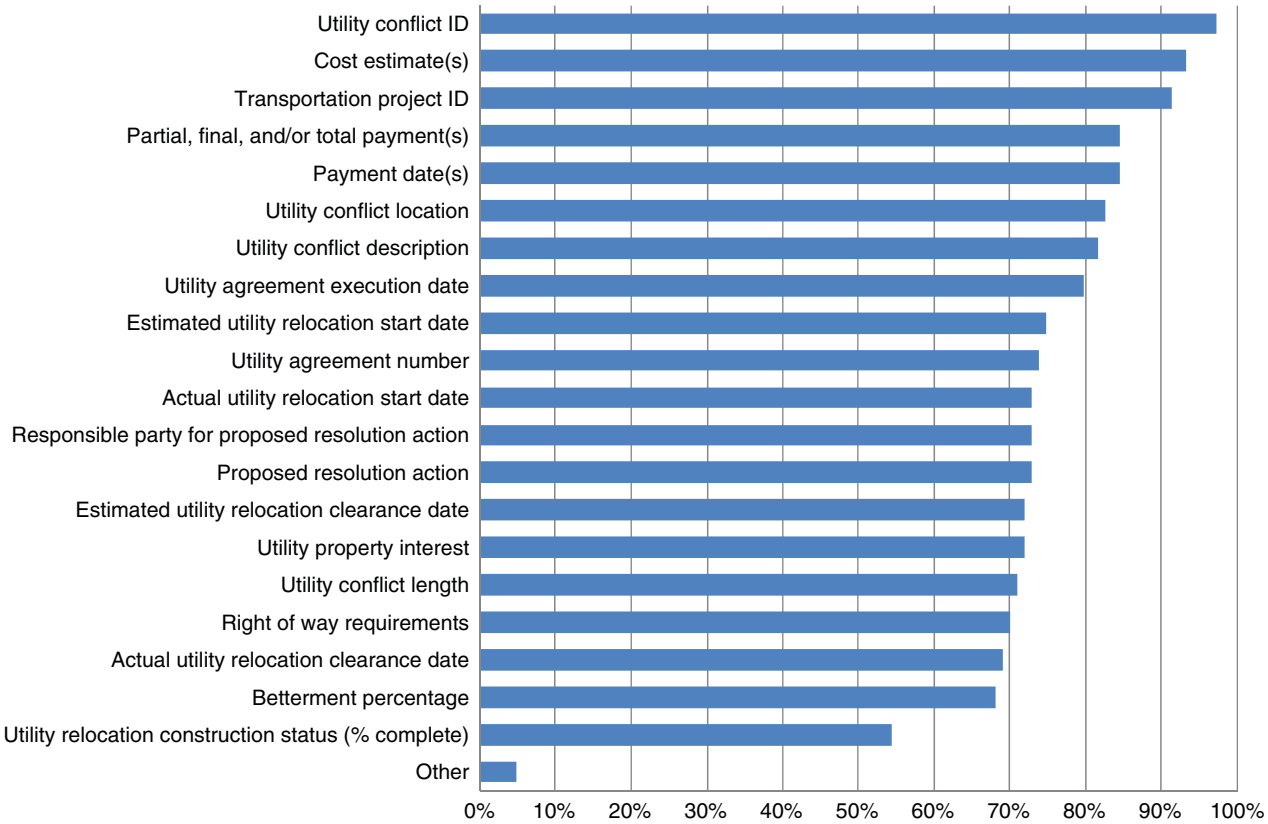


Figure 2.3. Percentage of respondents tracking utility conflict data items.

Table 2.1. Percentage of Respondents Using Utility Conflict Referencing Methods

Longitudinal Alignment	Offset						Overall
	Project Centerline	Right-of-Way Line	Existing Centerline	Edge of Pavement	Back of Curb	Offsets Not Used	
Project centerline and station	81%	47%	37%	25%	19%	1%	94%
Route and mile point	24%	12%	17%	8%	3%	4%	40%
Control section and distance	20%	13%	15%	6%	4%	4%	33%
Intersection and displacement	20%	12%	13%	9%	9%	4%	32%
Other centerline and station	22%	12%	14%	11%	9%	2%	29%
Route markers and displacement	15%	4%	7%	2%	1%	5%	23%
Street block	12%	5%	8%	5%	3%	6%	21%
Other	1%	1%	1%	0%	0%	2%	5%
Overall	83%	50%	45%	27%	22%	6%	—

Table 2.1 also shows different longitudinal alignment and offset combinations. For the survey, the research team provided eight longitudinal alignment options and six offset options in a matrix arrangement. Respondents selected 46 of the 48 possible combinations. As Table 2.1 shows, the most common methods for referencing utility conflict locations were project centerline and station (longitudinal alignment) and project centerline (offset). The next three most commonly used methods were project centerline and station (longitudinal alignment) combined with different offset methods: right-of-way line, existing centerline, and edge of pavement. Interestingly, project centerline and station (longitudinal alignment) and back of curb (offset) were mentioned in ninth place behind other longitudinal reference methods, such as route and mile point, control section and distance, intersection and displacement, and other centerline and station (in combination with project centerline for offset).

Follow-up interviews confirmed that the choice of referencing method depends mostly on project type, project status, and type of available data. For example, if a utility conflict is identified during preliminary design and the schematic is based on an existing centerline, the utility coordinator would use the existing centerline as a reference. If a new project centerline becomes available during the detailed design phase, the utility coordinator would update the utility conflict reference to reflect the change displayed on the plans.

Data Management Platforms

States use a variety of data management platforms to manage utility conflict data. As Figure 2.4 shows, spreadsheets, word processors, and computer-aided design (CAD) are the most common methods for managing utility conflict data, followed by desktop databases, server-based databases, and web-based viewers. Less than half of the states use geographic information system (GIS) applications to manage utility conflict data, and about one-third of states use a customized data management platform.

In practice, states use more than one type of data platform to manage utility conflict data. As Figure 2.5 shows, 80% of states use at least three of the data management tools and 65% states use at least five of the data management tools shown in Figure 2.4.

Utility Conflict Location Tracking and Updating

State DOTs use a variety of methods to track and update utility conflict locations on project drawings. However, as Figure 2.6 shows, there is a clear preference for traditional paper-based approaches to mark up printed drawings or maps. Marking up CAD files is also common, but not as frequent as marking up paper drawings. Interestingly, more than 40% of respondents indicated they mark up 2-D portable document format (PDF) files, clearly indicating the increasing acceptance of PDF files for document editing and updating purposes. In general, state DOTs only rarely use other markup methods, such as GeoPDF, 3-D GeoPDF, or web-based viewers.

Utility Relocation and Conflict Management Process

Respondents were asked about the timing of certain utility-related milestones, more specifically when utility conflict management starts, when utility relocation is completed in the field, and when state DOTs receive as-builts from utility owners

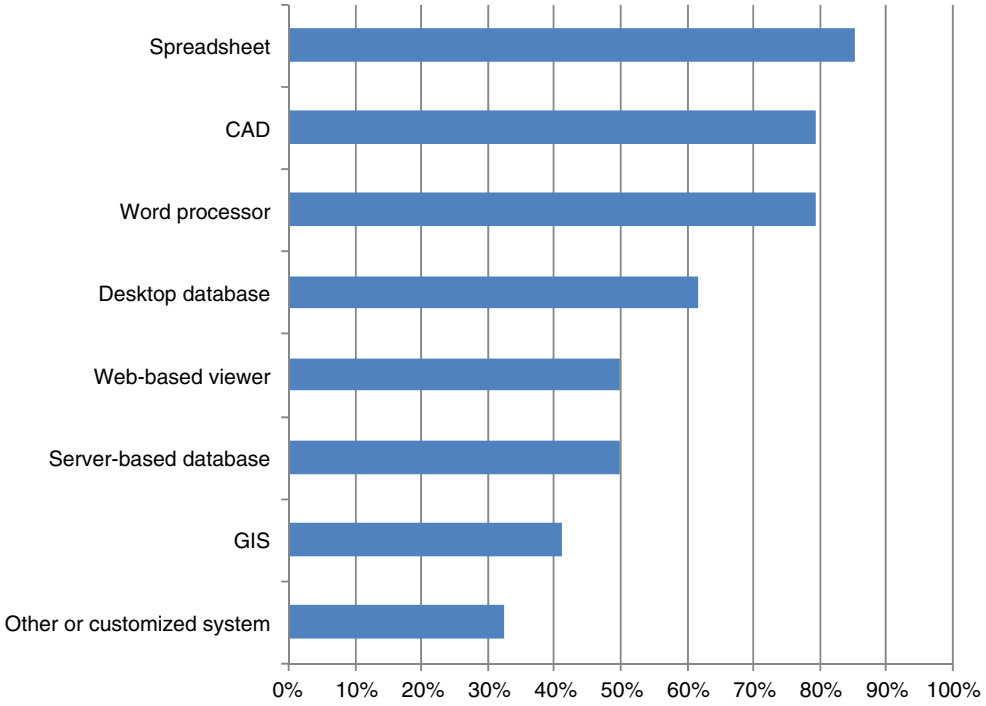


Figure 2.4. Percentage of states using data management platforms.

after the completion of the utility relocation in the field. Possible answers for each project development milestone were always, frequently, rarely, and never. For example, a respondent might answer the question "By what phase has utility coordination started on a project?" with rarely for advance planning, frequently for preliminary design, and always for the detailed design phase.

As Figure 2.7a shows, utility conflict management frequently starts early in the project development process. For example, almost 70% of respondents indicated they frequently or always start utility conflict management during preliminary design or earlier. By 60% design, roughly 85% of respondents indicated they frequently or always start utility conflict management.

The lag between starting utility conflict management and completing utility relocations in the field is significant. For example, by the time a project reaches 100% design, only 40% of respondents indicated that utility relocations frequently or

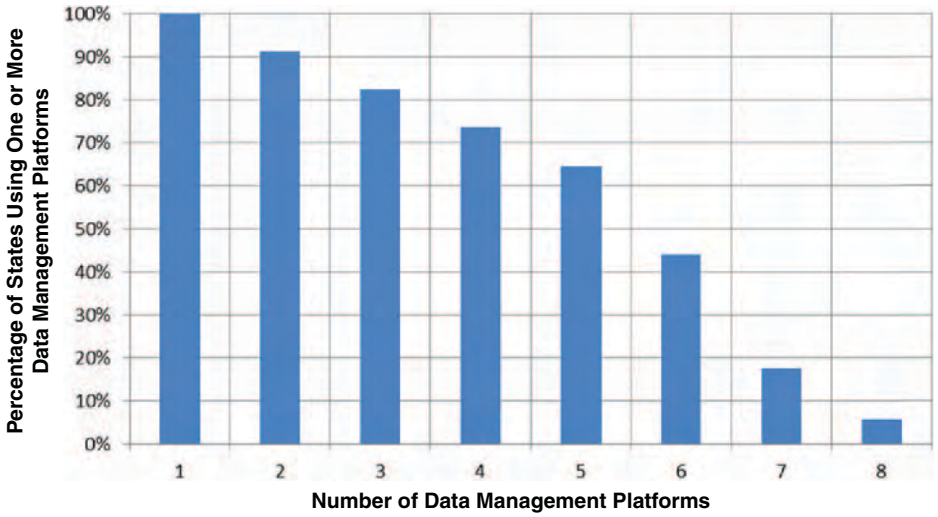


Figure 2.5. Use of data management platforms by states.

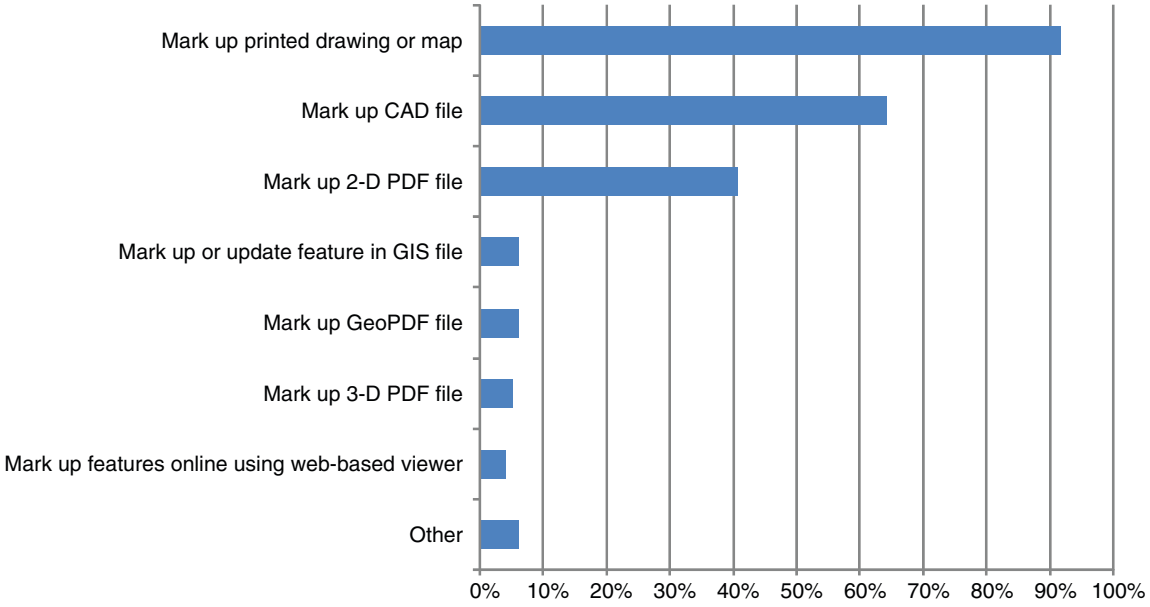


Figure 2.6. Use of different methods for utility conflict tracking and updating.

always finish in the field. Interestingly, by the time a project goes to letting, some 70% of utility relocations frequently or always finish in the field, indicating a great deal of utility relocation activity between the end of design and letting.

The difference between "frequently or always" and "always" is significant. For example, by 60% design, some 85% of respondents indicated they frequently or always start utility coordination. However, only about 60% of respondents indicated they always start utility coordination. The difference is also dramatic in the case of utility relocation completion. For example, by the time a project goes to construction, only about 20% of respondents indicated that utility relocation has always finished in the field. One of the goals of optimizing the utility conflict management process should be to shift the always curves to the left—that is, earlier in the project development process.

In general, state DOTs have a great deal of difficulty obtaining as-builts from utility owners at the conclusion of the utility relocation in the field. The reported frequency of receiving as-builts by the time a project goes to construction was less than 10% for always and only 40% for frequently or always.

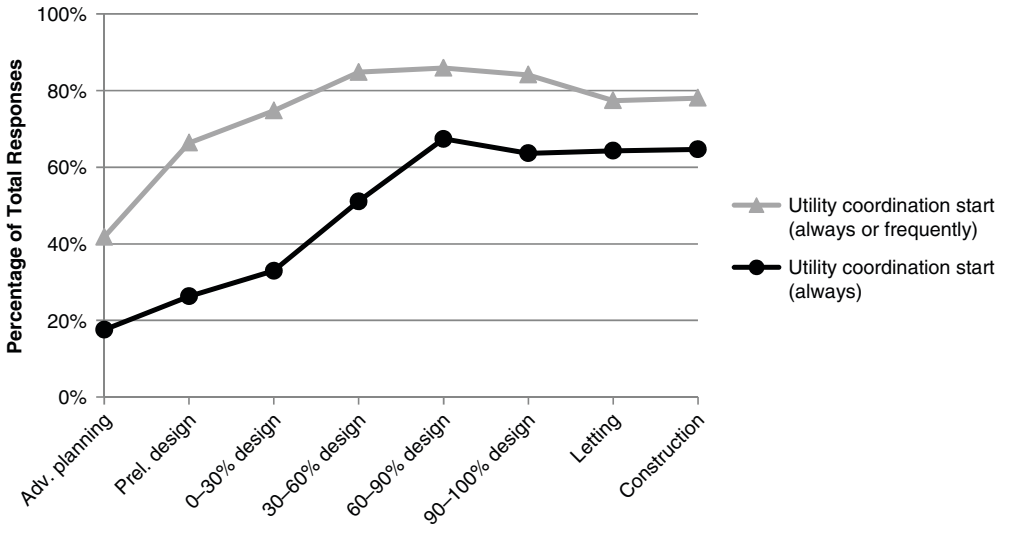
Some of the curves in Figure 2.7 decrease slightly after the 30% to 60% design phase, suggesting that some respondents may have interpreted the questions differently from what was originally intended: instead of answering the question "by when *has* the process typically started?" some respondents may have answered the question "when *do* you start the process?" Follow-up interviews with some of the respondents clarified their intent, which enabled the research team to partially adjust the graphs.

Interview Results

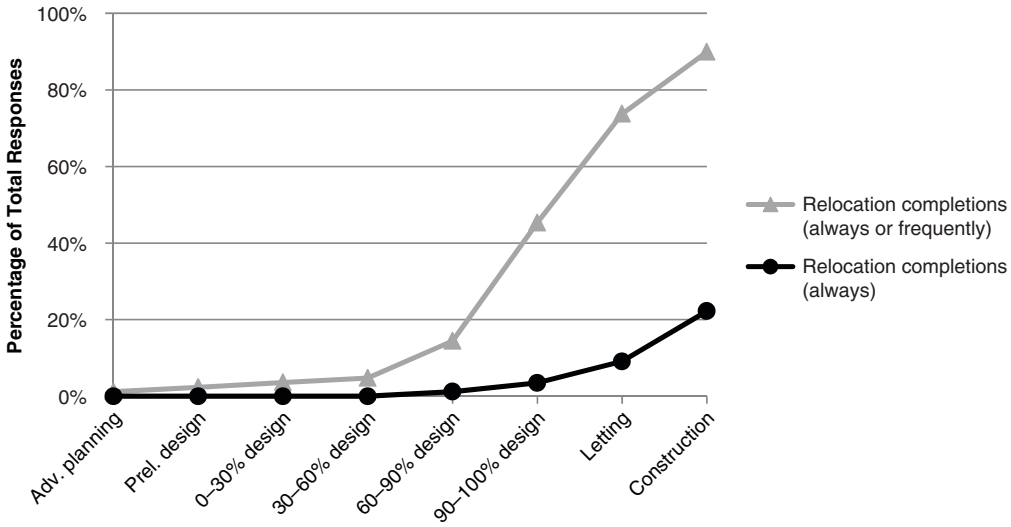
General Observations

During the interviews with state DOT officials, similarities of practices for managing utility conflicts in transportation projects became evident. Many states follow a traditional approach for utility conflict management in which the state DOT sends a set of project plans to utility owners, the utility owners provide markups of their utility facilities (typically on hard copies), and state DOT (or consultant) staff transcribe the markups onto design CAD drawings. Upon review of the design drawings, the roadway designer determines which utility installations are in conflict and need to relocate and communicates this determination to utility owners. The utility owners then develop and submit relocation plans (typically around 60% to 90% design). Utility facilities that are eligible for reimbursement require the submission of utility agreement assemblies that include additional information, such as quantities, cost estimates, betterment data, and local agency participation.

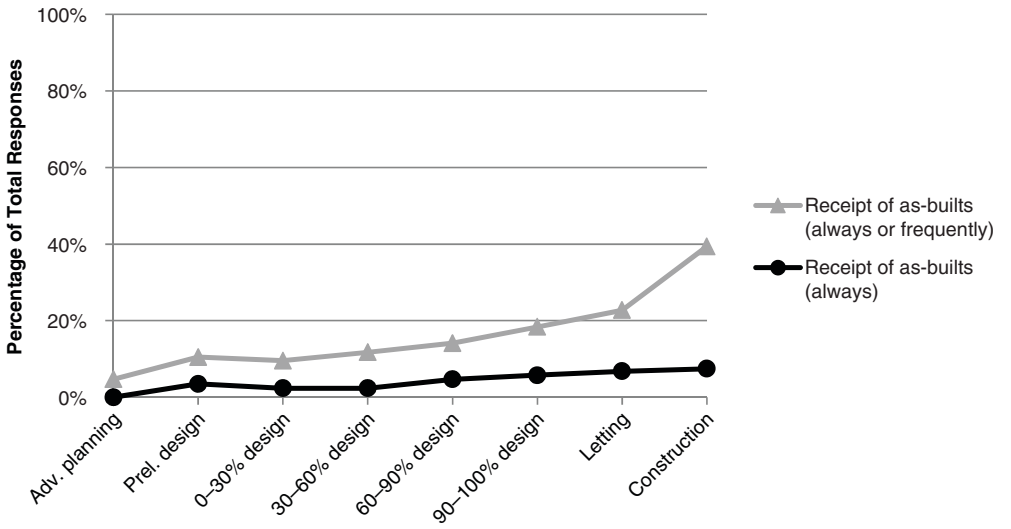
Although several state DOTs use this general procedure to manage utility conflicts, there are significant differences with respect to timing and plan updates. For example, some states start utility conflict management during preliminary design and send a preliminary design drawing to utility owners. Other states wait until 60% design, once drainage design elements are in place (since drainage design frequently drives the need for utility relocations). There are also wide differences in the way states undertake utility investigations. States frequently collect quality level B (QLB) and quality level A (QLA) data at some point during design, although the extent of the investigation varies widely depending on factors such as type of project,



(a) Start of utility coordination.



(b) Completion of utility relocation.



(c) Receipt of as-builts after utility relocation.

Figure 2.7. Timing of utility-related activities in the project development process.

expected utility investigation cost, and awareness or knowledge of subsurface utility engineering (SUE) concepts. In some cases, the collection of QLB and QLA data is limited to critical points during the project development process. Some states are beginning to collect QLB data during preliminary design.

Some states prefer to begin utility relocations once the roadway design is complete and there is certainty the project will go forward as designed. Other states attempt to relocate all utility facilities in conflict by the time a project goes to letting. However, even when a state makes significant efforts to complete all utility relocations by letting, utility facilities often need to relocate during construction. To alert contract bidders of potential delays, most state DOTs include information about known utility conflicts in the letting documentation, typically in the form of utility certifications or special provisions. However, the level and detail of information provided to bidders varies widely among state DOTs. Some state DOTs provide comprehensive lists of outstanding utility conflicts, including utility owner, utility conflict location, and conflict status. Other state DOTs only provide a brief statement to the effect that the contractor is responsible for contacting all utility owners to avoid conflicts or delays in the field.

Many state DOTs use tables or spreadsheets that contain utility owner and utility facility information to track utility conflicts during the project development process. State DOTs use a variety of names for these tables, including utility conflict matrix, utility conflict list, utility conflict table, utility coordination table, and utility list. Practices related to the use of these tables or matrices vary widely among (and within) states, depending on factors such as the following:

- Administrative directive to use utility conflict tables or UCMs;
- Structure and style;
- File format;
- Content;
- Linkages to other tables and existing systems;
- Flexibility and adaptability;
- Updates during the project development process;
- Support for processes such as meetings with stakeholders, utility certifications, and reports;
- Standardization; and
- Training.

Findings and Recommendations from States

A review of 26 sample tables from around the country yielded the following observations:

- *Wide range of styles and content.* The research team counted 144 data items related to utility conflicts in the 26 utility conflict tables. However, the number of data items included in individual tables was not nearly as high. The number of data items per table ranged from four to 39; the average was 14.
- *One size does not fit all.* Some data items were repeated across many utility conflict tables. Some of the most commonly used data items identified in the survey (Figure 2.3) included utility conflict IDs, cost estimates, transportation project IDs, payment information, and utility conflict description and location. However, not a single data item was included in all 26 tables. Roughly, 55% of data items appeared in only one table. The degree of customization was high, even among sample tables collected from the same state, clearly indicating that state DOTs have very different ideas with respect to what type of data to include in the utility conflict tables.
- *Different ideas about consensus tables.* The research team examined two sample tables that were the result of collective brainstorming: one from the California Department of Transportation (Caltrans), and one provided by an FUCC UCM subcommittee. The sample table from Caltrans, which had 24 data items, is being considered by the Caltrans utility engineering group for standardization and implementation after their review of sample tables from around the state. This table was originally developed in Caltrans' District 12. The FUCC table had 13 data items and was the result of considerable discussion within the FUCC UCM subcommittee. After reviewing several sample tables from around the state, the FUCC subcommittee decided that the number of data items in the consensus table had to be relatively low to maximize the chances for acceptance and implementation of the matrix by different stakeholders.
- *Different groups of data tracked.* The research team grouped the 144 data items into the following categories:
  - Data about projects;
  - Data about project contacts;
  - Data about utility facilities;
  - Data about utility conflicts;
  - Data about the right-of-way;
  - Data about utility investigations;
  - Data about utility relocation;
  - Data about utility coordination dates;
  - Data about agreements;
  - Data about costs;
  - Data about billings; and
  - Document-tracking data.

  These data categories provided the foundation for the data model prototype described in Chapter 4.
- *Alternative potential paths for UCM implementation.* The analysis above, which is supported by several pieces of information provided by respondents during the interviews, points to two alternative paths for UCM prototype implementation (readers should note that these two prototype

concepts do not necessarily exclude each other, and, in fact, could complement each other):

- *Compact, stand-alone UCM.* This implementation would involve the selection of a relatively low number of data items to develop a compact, stand-alone UCM that would be deployed using a suitable data platform, such as Microsoft Excel or Word. This prototype is intended to address the needs of many state DOTs and stakeholders who would prefer a stand-alone tool they can easily use, modify, and extend as needed without involving information technology (IT) investments. Chapter 3 explores this option in more detail.
- *Prototype utility conflict relational database.* This implementation would involve the development of a data model that includes at least 12 tables (to account for the 12 data categories mentioned above), which, together, would provide the foundation for a utility conflict relational database. In this case, the UCM would be an information product resulting from a database query, form, or report that provides utility conflict information as needed. This prototype is intended to address the needs of state DOTs that already have, or are planning, IT implementations to manage utility conflict data in a systematic, coherent manner. Chapter 4 explores this option in more detail.

During the interviews, state DOT officials from around the country offered several recommendations for the management of utility conflicts, including the following:

- *Identify utility conflicts at the individual utility facility involved.* Several approaches exist for identifying individual utility conflicts. Examples include location (i.e., a location identifies a utility conflict, which means all the utility facilities involved in the conflict share the same utility conflict ID); utility owner (i.e., a single file or record identifies all the utility conflicts associated with the same owner); and utility facility (i.e., each facility involved in the conflict has its own conflict ID). In general, the method that provides the highest level of flexibility is to identify utility conflict at the individual utility facility involved. Several state DOTs confirmed using that level of disaggregation. As part of a previous research initiative in Texas, members of the research team also found this method useful (*12*).
- *Include control dates in UCMs to document progress within the project development process.* UCMs are dynamic documents, and their content changes continuously during the project development process. Several states date their UCMs and maintain a record of all the updates to document what happens throughout the process. In most cases, states keep a paper record of the updates. Developing database implementations with control dates and event-based procedures to store these data elements electronically would add value to the database implementation.
- *Keep in mind potential environmental implications related to utility relocations.* In general, the environmental review process needs to be completed before a project enters the detailed design phase. Although utility conflicts can be identified during preliminary design, it is more common to identify utility conflicts and conduct the utility conflict analysis during the design phase. If a utility facility needs to be relocated outside the project limits, the environmental review might need to be reopened, which can result in additional delays. A better understanding of the environmental process by all stakeholders can result in a more effective utility coordination process. It is worth noting that, as part of a recent research initiative in Texas, members of the research team developed and documented strategies to integrate the utility and environmental processes and optimize design and preliminary design activities to support the utility process more effectively (*13*).
- *Use utility engineering groups at state DOTs and utility coordinating councils.* A prerequisite for the implementation of standardized utility conflict tables is acceptance by stakeholders. In California, a utility engineering group was assigned the task of identifying an updated UCM model for statewide use. One of the objectives of this group was to help improve and standardize utility procedures. As a member of FUCC, the Florida DOT is participating in an initiative to develop a consensus-based UCM template. The goal is to develop and implement a template that all utility stakeholders in the state can use. Feedback provided to the research team indicates the subcommittee's interest in a simple template design with relatively few data fields to maximize the chances that users will actually use the template.
- *Develop utility conflict sheets for individual utility owners.* While master UCMs are useful, customized (or filtered) versions are critical to help document and track all the utility conflicts that involve just one utility owner. These filtered tables are also useful during discussions and negotiations with utility owners. A database implementation could help automate this process.
- *Maintain and update the UCM regularly.* Updating UCMs can be time consuming, but the time spent on this activity is worth the effort. It is important (and critical for consultants) to require the submission of updates of utility conflict tables as often as possible or at regular intervals (e.g., monthly). If that is not feasible, a state DOT should at least specify utility conflict table updates in preparation for critical milestones, such as 30%, 60%, and 90% design meetings.
- *Keep UCMs simple.* Some states implemented UCMs years ago, but discontinued the practice because the benefit appeared to be too small to justify the cost given the number of person-hours needed to produce and maintain the tables.

In addition, at many state DOTs utility conflict tracking is mostly a function of the right-of-way section, with little or no involvement by the design section. The perceived benefit of using UCMs can be even lower if the information is not used at the end of the design phase—for example, to prepare a utility certification for inclusion in the plans, specifications, and estimate (PS&E) package. It is therefore critical to identify what information needs to be included in the UCM.

- *Use 11 × 17-in. sheets for utility conflict tables.* Many state DOTs have found that utility conflict tables should be on a manageable paper size, such as landscape 11 × 17-in. sheets. Larger sizes can create problems for stakeholders who do not have access to large format printers (e.g., small utility owners). Smaller sizes (8.5 × 11-in. sheets), are frequently inconvenient because they are too small to show all the information needed.
- *Start assembling utility conflict tables during preliminary design.* An effective strategy to avoid utility relocations is to obtain good information about existing utility facilities as early as possible, such as during the preliminary design phase. Avoiding utility relocations is in the best interest of utility owners, which means that providing quality utility information to state DOTs as early as possible is important. Developing utility conflict tables and looking for ways to avoid conflicts early is also a good practice.
- *Include data from the UCM in the PS&E assembly.* Several state DOTs have found it useful to provide comprehensive lists of outstanding utility conflicts in the PS&E assembly, including utility owner, utility conflict location, and conflict status. Mechanisms to provide that information include certifications, special provisions, attachments to documents, and tables and notes on construction drawings.
- *Use document management systems to support the utility conflict management process.* A number of states have implemented or are planning to implement (mostly enterprise-level) document management systems to manage the production and storage of electronic documents used in connection with the utility coordination process. Given the expense and level of effort normally needed to implement document management systems, using them to support the utility coordination process tends to be feasible only if the agency is already implementing the system as part of an agencywide deployment plan.
- *Provide 3-D design details to utility owners.* Providing 3-D information to utility owners (as opposed to, or in addition to, plan and profile sheets) can help identify and manage potential utility conflict locations more effectively. The Nevada DOT (NDOT) has started to provide 3-D design files to utility owners that show special details of the roadway design to highlight utility conflicts in more detail. An example of a typical application is a detail that shows an embankment with a depiction of the utility conflict that results from the raised roadbed. NDOT has also started to use 3-D design files for demonstrations at public meetings, and it distributes 3-D design files to utility owners in 3-D PDF.
- *Involve stakeholders in the review of utility conflicts and solutions.* It is critical to involve both roadway designers and utility owners in the review of utility conflicts and identification of possible solutions. Utility conflict management requires tracking all critical milestone dates (e.g., design conferences, as well as 30%, 60%, and 90% meetings), communicating with all the parties both before and after the meetings, and documenting the process and resolutions. Involving stakeholders and documenting the process is also critical during the construction phase.
- *Conduct a plan-in-hand field trip with utility owners.* A strategy for identifying and confirming utility conflicts is to schedule a plan-in-hand field trip with utility owners. The Virginia DOT (VDOT) provides design plans and a list of utility conflicts to utility owners in advance. The field trip provides an opportunity to verify and complement information gathered previously, as well as to increase the chances of identifying all possible conflicts. The field trip also enables the identification of utility facilities that might be difficult to move or might take a long time to relocate, such as electric transmission lines and gas pipelines.
- *Use and document radio frequency ID (RFID) tags for damage prevention during construction.* VDOT has started to use RFID marker balls for the relocation of utility facilities on several congested projects in the Northern Virginia District. After installing the RFID marker balls, the RFID tags provide a mechanism to warn highway contractors when they are in the immediate vicinity of relocated utility installations. VDOT documents RFID tag locations by annotating construction drawings (in PDF).
- *Work with one-call providers to identify utility owners and facilities.* Several states indicated they have access to one-call data or have reached agreements (e.g., enabled through legislation) that enable one-call providers to generate design tickets. For example, in California, a web-based interface allows Caltrans to download a list of potential utility facilities within project limits. According to a recent study, at least 12 states allow the use of one-call design tickets (*11*). Other industrialized countries encourage the use of locate tickets during the project development process, as the 2008 international scan of right-of-way and utilities found in the case of Australia (*14*).
- *Develop effective communications with utility owners regardless of reimbursement eligibility.* Several states have found that reimbursement has not necessarily improved adherence to project schedules. The willingness of utility owners to cooperate concerning facility location information, relocation design, and scheduling is critical to project success. Despite the increased use of e-mails and electronic

documents, face-to-face meetings with utility owners are necessary to communicate and discuss utility issues. A strategy many state DOTs have found useful is to participate in, or encourage the implementation of, utility coordination council meetings that meet regularly (e.g., monthly or quarterly) to address issues of common interest. These meetings provide a forum for the discussion of topics such as upcoming projects and the need for coordination. This practice also provides an opportunity for stakeholders to learn about each other's business practices.

- *Provide training to utility coordination stakeholders.* A common complaint from transportation officials is that utility owners do not know enough about the transportation project development process and have difficulty reading and understanding DOT roadway design plans. Utility owners have a similar complaint about transportation officials with respect to the utility planning process and utility design plans and other documentation. Developing training materials would improve stakeholder understanding of the utility coordination process, improve familiarity with current laws and regulations, and foster a cooperative utility management approach. Specific training needs in relation to utility conflict management include the following:
  - For utility owners, transportation project development process, milestones, and constraints;
  - For transportation officials, utility project development process, milestones, and constraints;
  - Utility coordination process, practices, and strategies;
  - UCM population, maintenance, and use;
  - Utility conflict analysis;
  - Reading and interpretation of roadway design and utility plans; and
  - Cost estimation procedures.

  Examples of training programs include those in Georgia and Michigan (related to UCMs and utility conflict analysis) and Ohio (related to reading and interpreting roadway construction plans).

Additional recommendations provided by state DOT officials include the following:

- *Include utility relocations in the highway contract.* If and when feasible, this strategy can give utility owners more time to plan for the relocation and ensure that utility relocations only take place if a project actually moves to the construction phase. The state DOT can also reduce or avoid contractor delay claims more effectively because the contractor is responsible for the relocations.
- *Obtain buy-in from the administration to develop IT-based systems.* Enterprise systems can provide substantial benefits to an organization. Planning, funding, and implementing an enterprise system require support from the administration.
- *Ensure system modifications can be implemented quickly.* No matter how well designed an IT system is, chances are it will need improvements and upgrades. It is critical to ensure the infrastructure and funding is in place to support the operation, maintenance, and general upkeep of the system. Sometimes state DOTs do not see utility-related systems as central to the mission of the agency. It is therefore up to utility coordinators and managers to convince DOT management that investing in the operation and maintenance of utility-related systems is not merely desirable but necessary.

CHAPTER 3

Development of Prototype Stand-Alone UCM

Introduction

This chapter documents the results of an analysis to produce a prototype stand-alone UCM based on the results of the survey, follow-up interviews, and a review of data items from the sample documents provided by the states. The purpose of this effort was to develop a UCM that is compact (while at the same time useful to state DOTs) and facilitates tracking utility conflict data and associated information. As such, it was critical to identify what elements of information to include in the UCM.

Sample Utility Conflict Data Analysis

The characterization of the sample documentation provided by the states took into consideration the following dimensions or factors:

- *Sample data item frequency.* This dimension refers to the number of times a specific data item (of the 144 reported) appeared in the sample documents provided by the states. In this context, a data item is any separate piece of information found in a document (e.g., conflict ID, project number, or estimated adjustment date). The corresponding statistic of interest was a rank providing an indication of how popular a data item was. Table 3.1 lists the data items found in at least four of the 26 sample UCMs. For example, utility owner or contact information or both appeared in 20 of the 26 (87%) sample documents.
- *Frequency of use of individual data items in combination with other data items.* This dimension refers to the combined use of several data items to form a coherent UCM. Although Table 3.1 indicates the frequency of individual data items across the states, it does not measure what combinations of data items states typically use.

  One way of measuring this use is to evaluate the relationship between the frequency of use of individual data items and the number of documents in which those data items appear. Table 3.2 illustrates this relationship. As the table shows, 78 of 144 (54%) data items appeared in just one sample document. Similarly, 99 of 144 (69%) data items appeared in only one or two documents, suggesting that most data items were of interest to only a few states or districts. In general, Table 3.2 shows a lack of uniformity among UCMs used by the states and highlights the need to develop a compact UCM that contains data elements used by most states.

  A second way of measuring the combined use of data items by state DOTs is to evaluate the number of data items typically included in a UCM. As Figure 3.1 shows, of the 26 UCMs, two tracked 0 to 5 data items, nine tracked 6 to 10 data items, and one tracked 36 to 40 data items. The simplest UCM tracked four data items, and the most detailed UCM tracked 39 data items. The average number of data items tracked was 14. Further, roughly 50% of sample documents tracked 12 or fewer data items, and 85% of sample documents tracked 22 or fewer data items. These trends suggest that 10 to 25 data items should be included in a prototype UCM. The following section explores this idea in more detail.

Merge of Sample Document Data and Survey Results

Not surprisingly, there were similarities and differences between the online survey responses (discussed in Chapter 2) and the results of the sample document analysis in the previous section. Although the survey included an option to provide "other" answers, it provided a predetermined list of data item options that did not necessarily match the data items included in the sample documents that state DOTs subsequently provided to the research team. Another reason for discrepancies between survey results and the sample data is that, in reality, state DOTs

Table 3.1. Most Common Data Items Found in 26 Sample Documents

Data Item	Use		Rank
	Total	%	
Utility owner and/or contact information	20	87%	1
Project number	15	65%	2
Highway or route	10	43%	3
Comments, remarks, action items, or notes	10	43%	3
Utility type	9	39%	5
Utility conflict/work description	9	39%	5
Utility conflict start station	8	35%	7
Scheduled or estimated adjustment completion or resolution date	8	35%	7
Project description	8	35%	7
Conflict ID	8	35%	7
Utility conflict start offset	7	30%	11
Utility description	6	26%	12
State DOT notifies utility date	6	26%	12
Agreement submittal date	6	26%	12
Right-of-way project number	5	22%	13
Recommended action or resolution type	5	22%	13
Project limits	5	22%	13
Project design manager name/contact information	5	22%	13
Other utility location reference	5	22%	13
Job number or other DOT number	5	22%	13
Estimated total cost to state	5	22%	13
Drawing or sheet number	5	22%	13
District number or name	5	22%	13
County name	5	22%	13
Agreement status	5	22%	13
Utility size and/or material	4	17%	14
UCM date	4	17%	14
Reimbursable (Y/N)	4	17%	14
Letting date	4	17%	14
End station	4	17%	14
Actual begin adjustment or construction date	4	17%	14

track a large number of utility facility and utility conflict data items, but only a few of those data items are typically included in UCMs.

For completeness, the research team developed a composite list of data items by ranking data items according to their use in the sample documents (Table 3.1), ranking data items according to the frequency reported in the survey (Figures 2.2 and 2.3), and by combining the rankings from these data sources. Table 3.3 shows the result of the composite ranking.

Prototype Stand-Alone UCM

After reviewing the results of the sample documentation analysis, the results of the survey analysis, and the combined data item ranking, the research team developed a

prototype UCM that, in principle, should satisfy the requirements of most state DOTs. Key requirements in the determination of which data items to include in the prototype UCM were compactness, efficiency, and completeness (which meant selecting some data items even if they were not at the top of the ranking in Table 3.3). As shown in Figure 3.2, the prototype UCM includes data items in two main sections:

- UCM header (eight data items): This section includes information about the project and control data items.
- UCM body (15 data items): This section includes information about individual utility conflicts (one record per conflict), such as conflict characteristics, data collection needs, and resolution status.

An earlier version of the UCM included a data item for cost estimates. However, discussions with stakeholders at several DOTs indicated that this data item was not clearly defined and could result in confusion during implementation, largely because state DOTs manage a variety of cost estimates in connection with utility relocations. Examples include engineering and cost estimates provided by utility owners, internal DOT cost estimates, betterment calculations, and reimbursement eligibility calculations. In addition, DOTs commonly compare costs associated with several utility resolution strategies.

This realization made it necessary to remove the cost estimate data item from the UCM and, instead, develop a separate sheet to track and analyze cost estimates for all resolution alternatives that may be associated with individual utility conflicts. Different options are possible for developing the cost estimate sheet that essentially follow a one-to-many relationship between it and the main UCM. For example, the cost estimate sheet could be a single tabulation that contains all cost estimates for all utility conflicts in a project. Another option would be to create separate sheets, each one containing relevant alternative information for individual utility conflicts. The first model is appropriate for developing consolidated conflict resolution reports; the second model is more appropriate for detailed utility conflict analysis (which

Table 3.2. Count of Data Items (n = 144) by Frequency of Use in Sample Documentation

Count of Data Items	Number of Sample Documents in Which Data Items Appear
78	1
21	2
14	3
6	4
11	5
3	6
1	7
4	8
2	9
2	10
1	15
1	20

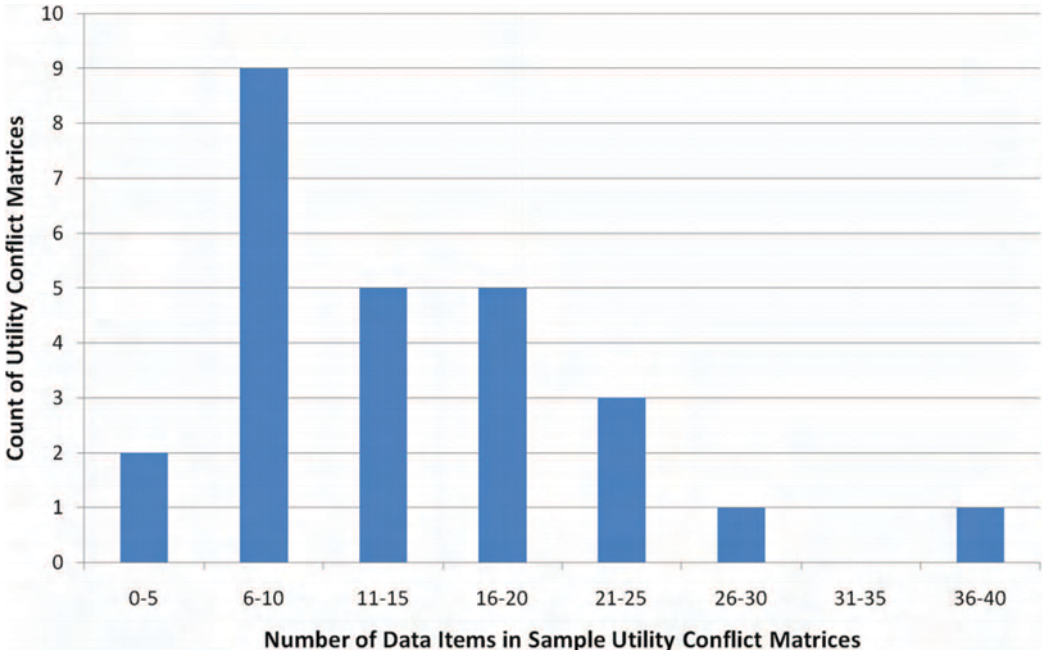


Figure 3.1. Number of data items used in 26 UCMs.

might involve different teams or stakeholders). For simplicity, the research team decided to develop a cost estimate tabulation following the second model. As shown in Figure 3.3, the prototype UCM subsheet includes data items in two main sections:

- UCM subsheet header (23 data items): This section includes information about the specific utility conflict, including information from the main table and control data items.
- UCM subsheet body (12 data items): This section includes information about each resolution alternative, including description, advantages, disadvantages, cost estimates, feasibility, and decision.

The research team developed the prototype UCM and the UCM alternative resolution subsheet for cost estimate analysis in Microsoft Excel 2007. As described in Chapter 4, the research team also developed the prototype UCM and the alternative resolution subsheet as Microsoft Access 2007 reports (i.e., as a reporting tool within a database representation of the utility conflict process). For convenience, the Excel UCM version includes four worksheets: the main UCM, the UCM alternative resolution subsheet, column or field definitions, and drop-down lists to standardize the population of certain columns in the main UCM. Table 3.4 shows the definitions of all the data items used in the main UCM. Table 3.5 shows the definitions of all the data items used in the UCM alternative resolution subsheet. Table 3.6 shows the items included in the following drop-down lists: utility type, utility investigation quality level, responsible party, resolution status, feasibility, and decision.

Using the Prototype Stand-Alone UCM

Used most simply, the prototype stand-alone UCM could provide a basic, convenient mechanism to list all utility conflicts associated with a project. However, for maximum benefit, the UCM could be used in conjunction with the alternative conflict resolution subsheet to identify, document, and track optimum utility conflict resolution strategies.

The training materials in Chapter 6 include a lesson with a hands-on exercise (Lesson 4) that describes an example process for documenting utility conflicts and identifying and comparing conflict resolution strategies using the UCM (Figure 3.2) and the utility conflict resolution subsheet (Figure 3.3). The basic process is summarized as follows:

- Identify and list all potential conflicts in a project. This activity is continuous throughout the utility conflict management process. Use a separate line for each utility facility that may be in conflict at the same location. For example, for a conflict location that involves a water line and a gas line, create one record for the water line and a second record for the gas line. Assign a unique utility conflict ID to each record.

(text continues on page 23)

Table 3.3. Composite Ranking of Data Items from Sample Documents and Survey Responses

Data Item	Combined %	Rank
Utility owner and/or contact information	88%	1
Project number	74%	2
Utility type	66%	3
Conflict ID	64%	4
Utility conflict or work description	58%	5
Start station	57%	6
Estimated total cost to state	56%	7
Job number or other DOT number	55%	8
Start offset	55%	8
Scheduled or estimated adjustment completion or resolution date	53%	10
Utility description	52%	11
Utility conflict end station	49%	12
Payment date(s)	46%	13
Partial, final, and/or total payment(s)	46%	13
Recommended action or resolution type	46%	13
Utility agreement execution date	46%	13
Actual utility relocation start date	44%	17
Responsible party for proposed resolution action	42%	18
Size and/or material	41%	19
Utility agreement number	41%	19
Utility property interest	40%	21
Depth of cover	34%	22
Encasement (Y/N)	33%	23
Utility conflict or resolution status	33%	23
Utility facility subclass	30%	25
Operational status	29%	26
Number of ducts	29%	26
Encasement material	27%	28
Highway or route	19%	29
Comments, remarks, action items, or notes	19%	29

Project Owner: _____
Project No. : _____
Project Description: _____
Highway or Route: _____

Note: Refer to subsheet for utility conflict cost analysis.

Utility Conflict Matrix Developed/Revised By: _____
Date: _____
Reviewed By: _____
Date: _____

Utility Owner and/or Contact Name	Conflict ID	Drawing or Sheet No.	Utility Type	Size and/or Material	Utility Conflict Description	Start Station	Start Offset	End Station	End Offset	Utility Investigation Level Needed	Test Hole	Recommended Action or Resolution	Estimated Resolution Date	Resolution Status

Figure 3.2. Prototype UCM.

Project Owner: _____ **Cost Estimate Analysis Developed/Revised By:** _____
Project No.: _____ **Date:** _____
Project Description: _____ **Reviewed By:** _____
Highway or Route: _____ **Date:** _____

Utility Conflict: _____
Utility Owner: _____
Utility Type: _____
Size and/or Material: _____
Project Phase: _____

Alternative Number	Alternative Description	Alternative Advantage	Alternative Disadvantage	Responsible Party	Engineering Cost (Utility)	Direct Cost (Utility)	Engineering Cost (DOT)	Direct Cost (DOT)	Total Cost	Feasibility	Decision

Figure 3.3. Prototype UCM cost estimate analysis for utility conflict resolution alternatives.

Table 3.4. UCM Column or Field Definitions

Column or Field	Description
Project owner	The owner of the transportation project, typically the DOT.
Project number	A number given by the project owner to identify the project.
Project description	A description of the project.
Highway or route	The highway or route where the project is located.
UCM developed/revised by name	The name of the person who developed or revised the UCM.
UCM developed/revised by date	The date when the UCM was developed or revised.
Reviewed by name	The name of the person who reviewed the UCM.
Reviewed by date	The date when the UCM was reviewed.
Utility owner and/or contact name	The name of the utility owner or a contact at the utility owner who has responsibility for the utility facility in conflict.
Conflict ID	A unique identifier for the utility conflict within the project.
Drawing or sheet number	A reference to the engineering drawing or sheet number.
Utility type	The type of utility facility (e.g., water, sanitary sewer, electricity, or communications).
Size and/or material	The size and/or material used in the utility facility (e.g., 8-in. PVC).

(continued on next page)

Table 3.4. UCM Column or Field Definitions (continued)

Column or Field	Description
Utility conflict description	A short description of the utility conflict and/or a description of the work needed to resolve the conflict.
Start station	The station of the beginning of the utility conflict (e.g., 241+22.35).
Start offset	The offset and side of the beginning of the utility conflict (e.g., 57.24 [L]).
End station	The station of the end of the utility conflict (e.g., 241+25.35).
End offset	The offset and side of the end of the utility conflict (e.g., 68.78 [L]).
Utility investigation level needed	The level of utility investigation needed to determine a resolution strategy for the utility conflict. Valid values are QLD, QLC, QLB, QLA, and undetermined.
Test hole	Test-hole number (normally associated with QLA).
Recommended action or resolution	A text description of the recommended action to resolve the utility conflict.
Estimated resolution date	The estimate date to complete the adjustment or resolve the utility conflict.
Resolution status	The status of the resolution of the utility conflict as of the date the UCM was produced.

Table 3.5. UCM Cost Estimate Analysis Column or Field Definitions

Column or Field	Description
Project owner	The owner of the transportation project, typically the DOT.
Project number	A number given by the project owner to identify the project.
Project description	A description of the project.
Highway or route	The highway or route where the project is located.
Cost estimate analysis developed/revised by name	The name of the person who developed or revised the cost estimate analysis.
Cost estimate analysis developed/revised by date	The date when the cost estimate analysis was developed or revised.
Reviewed by name	The name of the person who reviewed the cost estimate analysis.
Reviewed by date	The date when the cost estimate analysis was reviewed.
Conflict ID	A unique identifier for the utility conflict within the project.
Utility owner	The name of the utility owner or a contact at the utility owner who has responsibility for the utility facility in conflict.
Drawing or sheet number	A reference to the engineering drawing or sheet number.
Utility type	The type of utility facility (e.g., water, sanitary sewer, electricity, or communications).
Size and/or material	The size and/or material used in the utility facility (e.g., 8-in. PVC).
Project phase	The phase of the project development process at which this analysis is performed.
Alternative number	A number for a utility conflict resolution strategy that is unique for the utility conflict.
Alternative description	A description of the utility conflict resolution alternative.
Alternative advantage	A description of the advantages of pursuing this utility conflict resolution alternative.
Alternative disadvantage	A description of the disadvantages of pursuing this utility conflict resolution alternative.
Responsible party	The party responsible for resolving the utility conflict (e.g., the utility owner, DOT, both utility owner and DOT, and not available).
Engineering cost (utility)	The estimated engineering cost to the utility if this utility conflict resolution alternative is selected.
Direct cost (utility)	The estimated direct cost to the utility if this utility conflict resolution alternative is selected.
Engineering cost (DOT)	The estimated engineering cost to the DOT if this utility conflict resolution alternative is selected.
Direct cost (DOT)	The estimated direct cost to the DOT if this utility conflict resolution alternative is selected.
Total cost	The sum of all estimated costs if this utility conflict resolution alternative is selected.
Feasibility	An indicator of whether the alternative is feasible.
Decision	An indicator of whether the alternative is under review, has been selected, or has been rejected.

Table 3.6. UCM Drop-Down Lists

Drop-Down List	List Options
Utility type	Communications
	Electric
	Gas
	Oil
	Reclaimed water
	Sanitary sewer
	Steam
	Storm sewer
	Water
	Unknown
Utility investigation quality level	QLA
	QLB
	QLC
	QLD
	Undetermined
Responsible party	Utility
	DOT
	Utility and DOT
	NA
Resolution status	Utility conflict created
	Utility owner informed of utility conflict
	Utility conflict resolution strategy selected
	Utility conflict resolved
Feasibility	Yes
	No
Decision	Under review
	Selected
	Rejected

Note: NA = not applicable.

(continued from page 19)

- Complete the UCM up to the column that identifies the type of utility investigation needed.
- For each conflict, determine the type of utility investigation needed.
- Collect utility data at the appropriate quality level (QLD, QLC, QLB, or QLA).
- For QLA data, add the test-hole number associated with the utility conflict(s) in question.
- Analyze potential conflict resolution strategies for each utility conflict record. If the available information is not sufficient to make a determination, it may be necessary to collect additional data. In this case, use the recommended action or resolution column to document the need for additional data collection.
- Use the conflict resolution subsheet to analyze and document the advantages, disadvantages, costs, feasibility, and decision of each alternative resolution considered.
- For the selected conflict resolution strategy, complete the recommended action or resolution, estimated resolution date, and resolution status cells in the UCM. This activity is iterative.
- Populate the control fields (name and date) at the top of the UCM.
- Create a historical record of UCM changes by saving the UCM under a different file name each time the information in the table changes.

CHAPTER 4

Prototype UCM Database Design and Testing

Introduction

This chapter describes the development of a data architecture to support the use of a variety of UCMs in a database environment. The following sections describe data architecture components developed as part of this research, a utility conflict database prototype, and the results of testing the prototype with two sample UCMs and the prototype UCM described in Chapter 3.

Data Architecture Definitions

A data architecture can be defined as the manner in which data components are organized and integrated. It usually includes one or more of the following data model components:

- *Business process model.* A business process model is a representation of processes. A variety of tools and techniques may be used depending on the specific need, including flow charts, Gantt charts, project evaluation and review technique (PERT) charts, integration definition (IDEF) methods, and business process modeling notation (BPMN).
- *Conceptual model.* A conceptual data model is a high-level representation of basic objects or concepts and their relationships. Conceptual data models usually provide a mapping of relationships and rules (e.g., a utility owner can own many utility facilities) that facilitate the understanding and implementation of logical and physical data models.
- *Logical data model.* A logical data model is a representation of data characteristics and relationships at a level that is independent of any physical implementation.
- *Physical data model.* A physical data model is a representation of data characteristics and relationships that depends on the specific physical platform chosen for its implementation (e.g., Microsoft Access, Oracle, Microsoft SQL Server, or Sybase).
- *Data dictionary.* A data dictionary is a list that contains definitions, characteristics, and other properties of entities, attributes, and other data elements. A metadata document is an alternative (or complement) to a data dictionary.

The four models are discussed in the following sections.

Business Process Model

Transportation project development processes around the country share many similarities. As a reference, Figure 4.1 shows a typical project development process diagram with six high-level sets of activities from planning and programming to letting and construction, with an emphasis on right-of-way and utilities.

Readers should note that the actual transportation project development process can deviate from the general framework shown in Figure 4.1 depending on specific project characteristics and requirements. For example, different types of projects, such as resurfacing or restoration (2R), nonfreeway rehabilitation (3R), new location and reconstruction (4R), and special facilities, have different design criteria that involve different groups of project development tasks and, therefore, different project scopes, durations, and sequencing. Similarly, project delivery methods such as design–build methods can accelerate task durations and alter the sequencing of certain project development tasks. In the case of utility relocations, there might be a substantial amount of relocation work during construction, as well as reimbursement activities that extend into the postconstruction phase.

Figure 4.2 shows a more detailed view of utility activities in the project development process. To function properly, the utility coordination process needs utility data input, which can occur at different times of the process. Typically, as time progresses, utility data become more detailed and precise. Although any type of utility data can be collected at any time during the project development process, it is common to

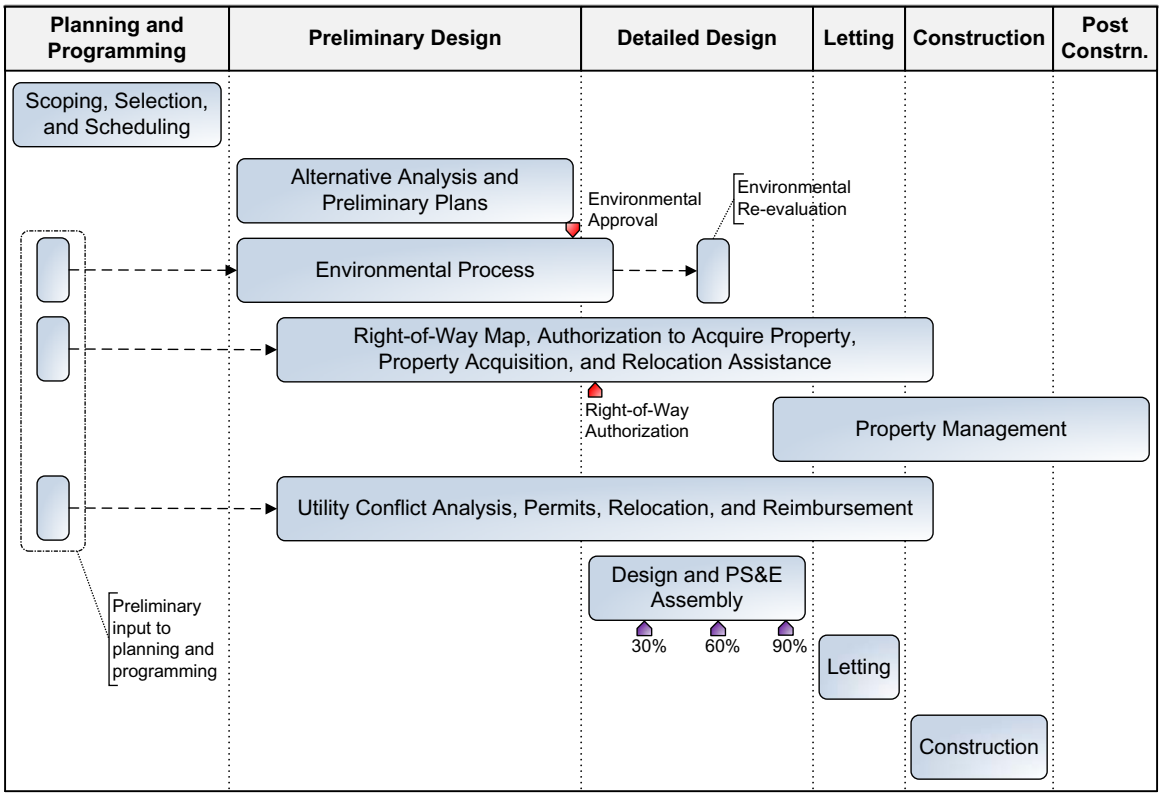


Figure 4.1. Major transportation project development process activities.

collect QLD and QLC data during preliminary design, and QLB and QLA data during the detailed design phase. Similarly, although utility conflict resolution can take place at any time, most utility conflict resolution activities usually occur around or after 60% design.

Although many states follow a utility coordination process similar to that shown in Figure 4.2, there are differences from state to state. For example, the Georgia DOT (GDOT) has a process that includes formalized stages for utility impact analyses and field plan reviews, with the goal of having utility conflicts resolved by the end of the design phase. Appendix B describes the utility coordination process for several of the states contacted.

Conceptual Model

Managing utility conflicts involves managing data about a variety of topics. For example, the review of sample documentation provided by the states revealed that, in the process of managing utility conflicts, states manage data about topics

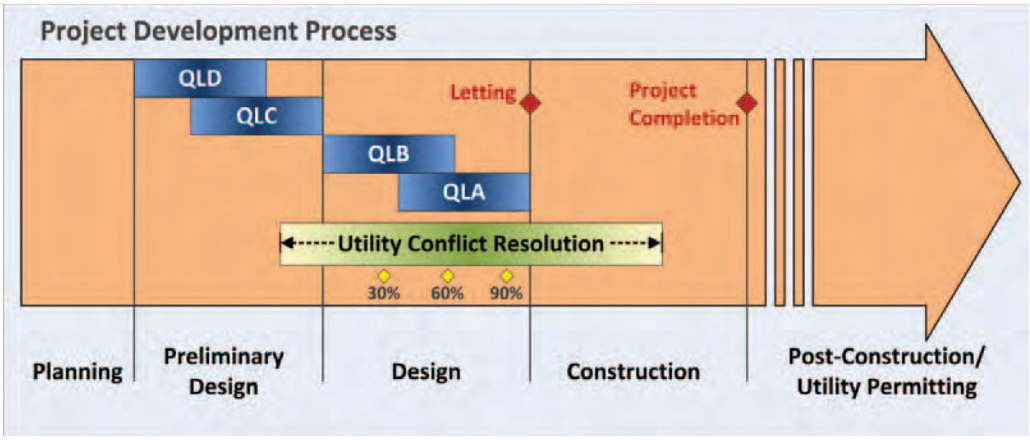


Figure 4.2. Utility coordination in the project development process.

such as projects, project contacts, utility facilities, utility conflicts, right-of-way, utility investigations, utility relocation, utility coordination dates, agreements, costs, and billings.

Some of these topics can be grouped into higher-order categories. Conceptually, it is possible to identify six first-level (or core) topics or data objects: utility conflict, utility facility, utility agreement, document, project, and user (Figure 4.3). Each of these data objects represents a real-world object or concept that can be characterized using a set of relevant tables and attributes. It is also possible to define relationships between those objects.

As Figure 4.3 shows, several types of relationships exist between core data objects. Some of those relationships are many-to-many (depicted by double arrows in the figure). For example, a document can be associated with many projects, utility conflicts, and users. Similarly, a project can be associated with many users, documents, and utility conflicts. Other relationships are one-to-many (depicted by single arrows). For example, a utility agreement can be associated with many utility conflicts, but a utility conflict can only be associated with one utility agreement. Similarly, a utility facility can be associated with many utility conflicts, but a utility conflict can only be associated with one utility facility. Similarly, a project can have many utility conflicts, but a utility conflict can only be associated with one project. This characteristic of the model resulted from observations of state DOT business practices, which typically recommend utility conflicts to be defined and managed within the context of a project. If utility conflicts span more than one project, the solution is to break up the utility conflict at the project boundary to enable tracking and association of utility costs with a project.

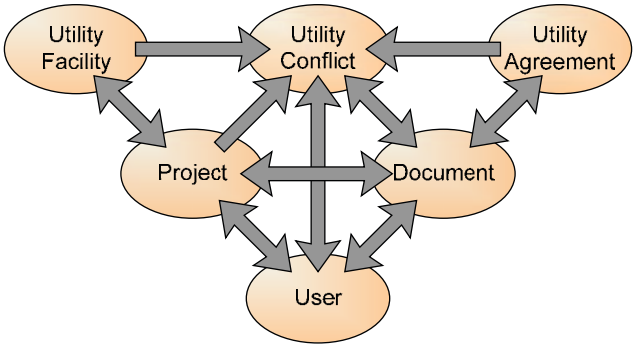


Figure 4.3. Conceptual model for the management of utility conflicts.

Logical Data Model

The research team developed a logical data model using AllFusion ERwin Data Modeler software. For simplicity, the prototype application was called the utility conflict database. The logical data model included the following elements:

- Entities, attributes, and relationships;
- Primary, foreign, and alternate keys; and
- Entity and attribute definitions.

To facilitate implementation, the logical data model complied with the following requirements and standards:

- Information engineering notation is used to model entity relationships.
- Third normal form normalization level is used.
- All entity names use alphanumeric (no special) characters, have fewer than six words, and are derived from the data description.
- Attribute names use alphanumeric (no special) characters; have fewer than six words; and consist of one or more prime words, zero or more qualifier words, and end with one class word. Prime words represent the subject or entity name (e.g., UTILITY CONFLICT). A qualifier word is a descriptive word that further qualifies the prime word (e.g., TYPE). A class word indicates the type of attribute and is chosen from a standardized list of 21 words (e.g., ID, NAME, TEXT) (*15*).
- Attributes use standardized data types. In practice, developing a list of standardized data types was an iterative process because requirements for data items changed as more information about the entity or attribute became known. For example, the company identifier initially had a number data type, but later it became necessary to change the data type to support combinations of numbers and letters. Using standardized data types in the logical data model simplifies compliance with requirements of data types for the physical data model. These requirements can be satisfied by mapping between the logical and physical data types.

The logical data model was built around the core data objects identified in the conceptual model. Each core data object defined a key entity, which was the most important entity within its corresponding subject area. The logical data model used the following key entities:

- *UTILITY CONFLICT.* A UTILITY CONFLICT occurs when a utility facility is noncompliant with the DOT's utility accommodation policies, is noncompliant with safety regulations, is in conflict with a proposed transportation project feature, or is in conflict with another utility facility.
- *UTILITY FACILITY.* A UTILITY FACILITY is a fixed structure or installation used by a utility owner for the purpose of transporting or delivering a utility.
- *UTILITY AGREEMENT.* A UTILITY AGREEMENT is a contract between a DOT and other agencies in connection

with a utility adjustment. A UTILITY AGREEMENT usually consists of a UTILITY AGREEMENT contract form and several attachments, such as the engineering estimate, design drawings, and special provisions.
- *DOT PROJECT.* A DOT PROJECT is a transportation project managed by a state DOT.
- *DOCUMENT.* A DOCUMENT is a tangible product in printed or electronic form produced from, resulting from, or documenting a DOT project development process activity. Examples include stand-alone forms, agreement assemblies, chapters, technical memoranda, invoices, and reports. In general, documents represented by multiple files are handled as document sets.
- *SYSTEM USER.* A SYSTEM USER is someone who has an account and the authority to use the system. The prototype allows two types of users: DOT USERs and COMPANY USERs. (The scope of the research did not include developing a system with user interfaces to create, manage, validate, or authenticate user accounts. However, a SYSTEM USER entity was necessary in the data model to support tracking of utility conflict events, e.g., to associate a UCM version with the name[s] of the individual[s] who prepared, revised, or reviewed the UCM.)

State DOTs have long used database systems to manage project-related data. The use of enterprise-level electronic document management systems is also increasing. Because the level of investment in these applications is substantial, it is safe to assume that most state DOTs would be interested in a data model for managing utility conflict data that supports, or can be integrated with, their already-existing systems. The challenge during the research was to design a logical data model that could minimize data redundancy while simultaneously maximizing compatibility with existing systems in order to increase the chances of implementation of the research prototype.

The research team accomplished this objective by using subject areas that provide a coherent view of all the entities associated with their corresponding core entity. During implementation, it may be possible to develop a linking entity between any of the core entities in the data model and a corresponding entity in an existing information system. For example, a linking entity could be developed to link the PROJECT entity in the data model with a corresponding entity in an enterprise system that manages project-related data. If the state DOT so chooses, it might even be possible to replace an entire subject area in the data model with an existing information system at the state DOT. In this scenario, each of the subject areas in the logical data model actually becomes a placeholder for an information system.

The logical data model consists of approximately 115 entities and numerous relationships. The data model includes six subject areas, one for each core data object in the conceptual model, as follows:

- Utility conflict subject area (Figure 4.4);
- Utility facility subject area (Figure 4.5);
- Utility agreement subject area (Figure 4.6);
- Project subject area (Figure 4.7);
- Document subject area (Figure 4.8); and
- User subject area (Figure 4.9).

Appendix C includes a detailed description of each subject area.

Physical Data Model

The research team used AllFusion ERwin Data Modeler to produce a physical data model (exported to Microsoft Access 2007) based on the logical data model described in the previous section. The data modeling process involved several iterations between the logical and physical data models. As detailed in the following section, the research team used data from the sample documents provided by the states to populate the prototype Access database. During the process of entering data, it became necessary to make modifications to the model (either logical or physical) to address specific situations, such as a data type that was not previously considered, a look-up table that had not been defined, or a many-to-many relationship that had to be optimized.

The physical data model included the following elements:

- Tables, columns, and relationships;
- Primary, foreign, and alternate keys; and
- Table and column definitions.

To ensure a consistent conversion of logical data types (i.e., data types in the logical data model) to Microsoft Access physical data types, the research team used a data type conversion standard. The team also used an extensive glossary of engineering terms to standardize table and column names, as well as a name-mapping standard, to ensure a consistent conversion from logical entity and attribute names to physical tables and columns. The naming conversion process included replacing spaces between logical name words with underscores in the physical model to avoid future implementation issues.

The research team also added foreign key constraints in the physical model according to the following syntax:

FK_<*Child Table Physical Name*>
REF<*Parent Table Physical Name*>

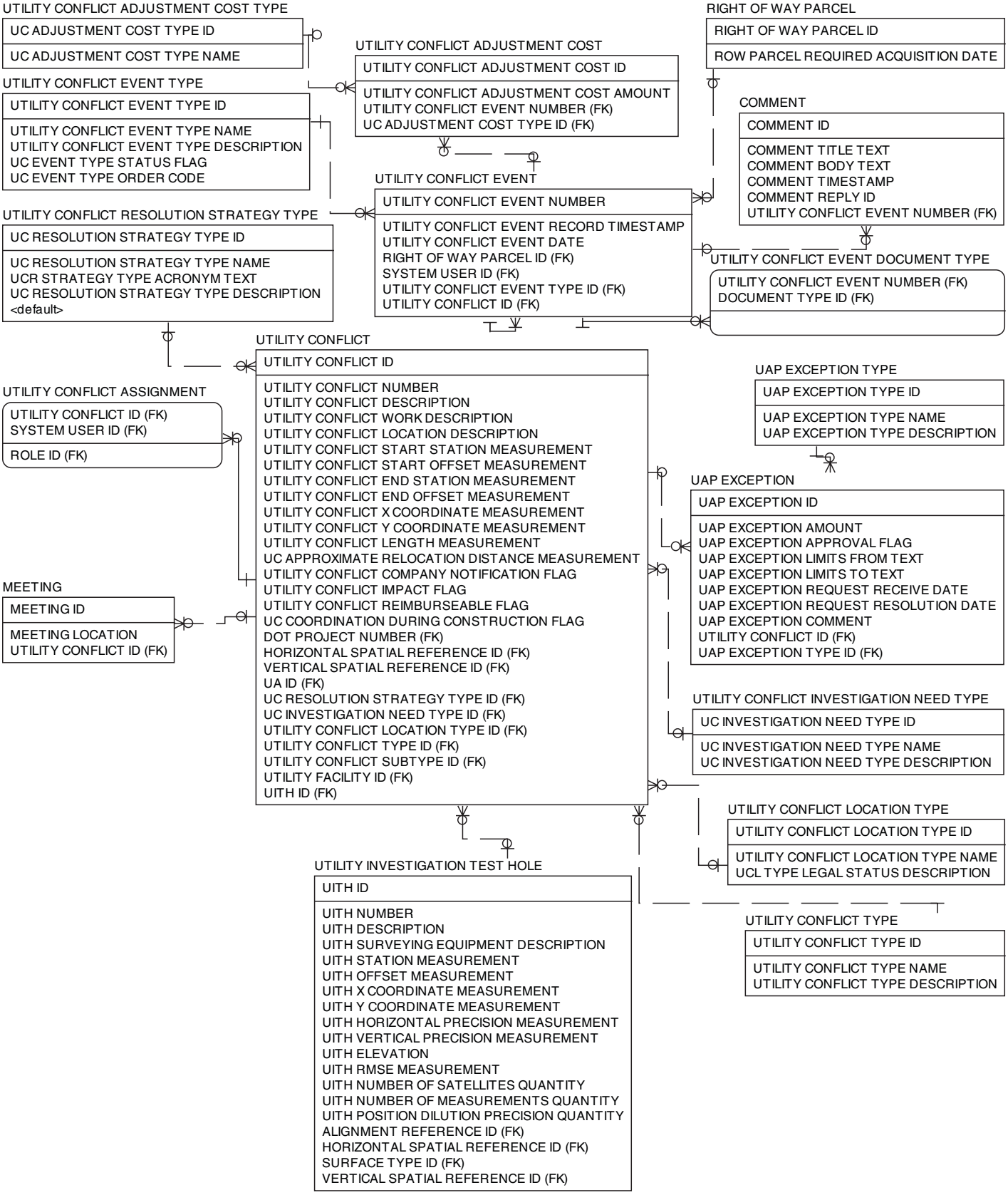


Figure 4.4. Logical data model: Utility conflict subject area.

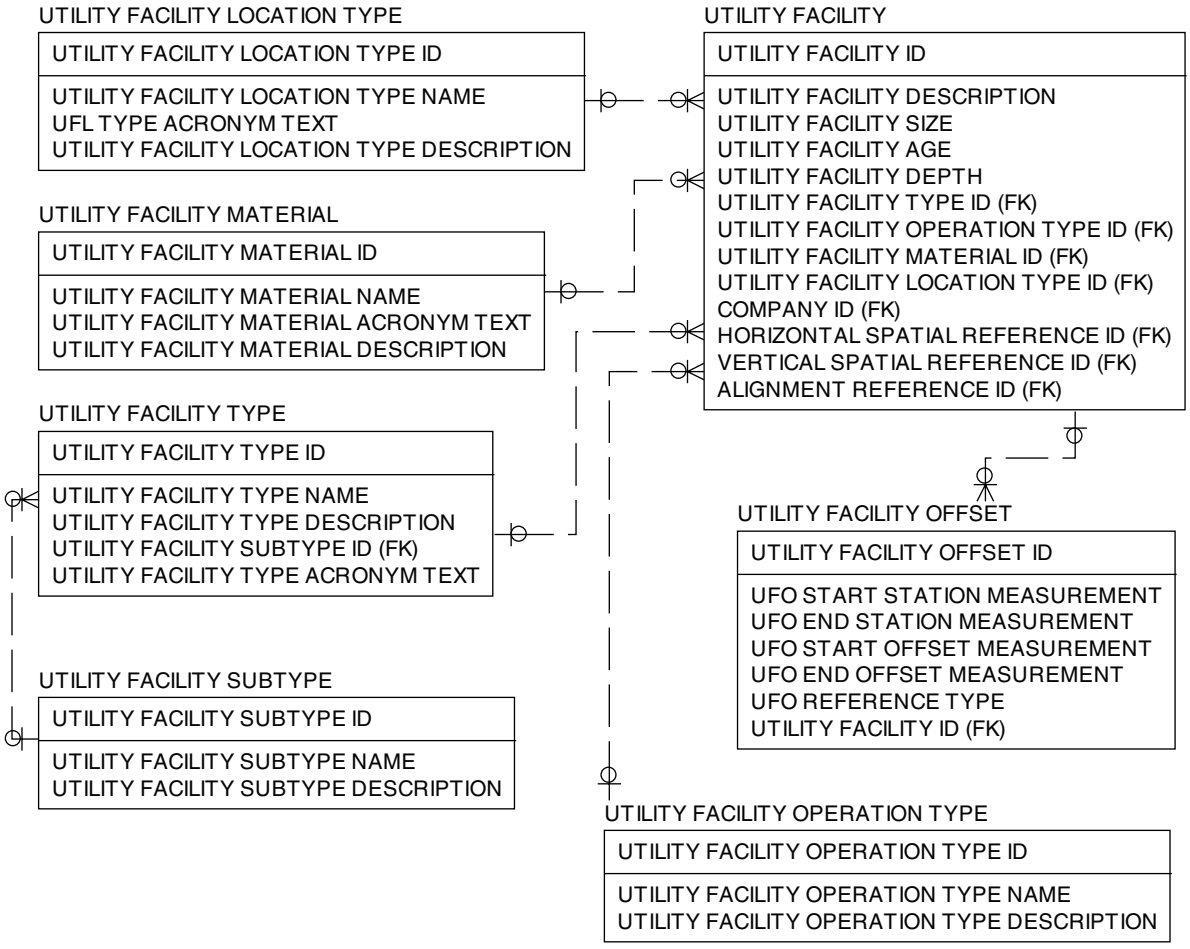


Figure 4.5. Logical data model: Utility facility subject area.

If the foreign key constraint would have been longer than 30 characters using full table names, the research team abbreviated table names as needed.

Prototype Database Testing

The research team populated the Access database with data from sample documents provided by the states. This section summarizes the process to replicate the following UCMs:

- Prototype UCM developed in Chapter 3;
- Sample UCM provided by the Alaska Department of Transportation and Public Facilities (Alaska DOT&PF); and
- Sample UCM provided by the California Department of Transportation (Caltrans).

Appendix D provides detailed descriptions of the replication process for these three UCMs and for sample UCMs provided by GDOT and the Texas DOT (TxDOT). For brevity, this chapter does not provide a summary for the Georgia and Texas UCMs.

In general, the process to replicate UCMs involved the following steps:

- Review requirements and content of the original UCM.
- Develop and test queries.
- Develop and test report(s).
- Enter and manage sample data.

For evaluation and comparison purposes, the analysis included developing queries, forms, and reports in Access in order to reproduce the sample documents as faithfully as possible. The development and testing of forms for data entry was not included in the scope of work for this research. However, the research team did develop a few data entry forms to illustrate the capabilities of the database.

Prototype UCM Example

The prototype UCM and subreport were developed in Chapter 3 (Figures 3.2 and 3.3, respectively). The prototype UCM includes 23 data items (eight data items in the header and

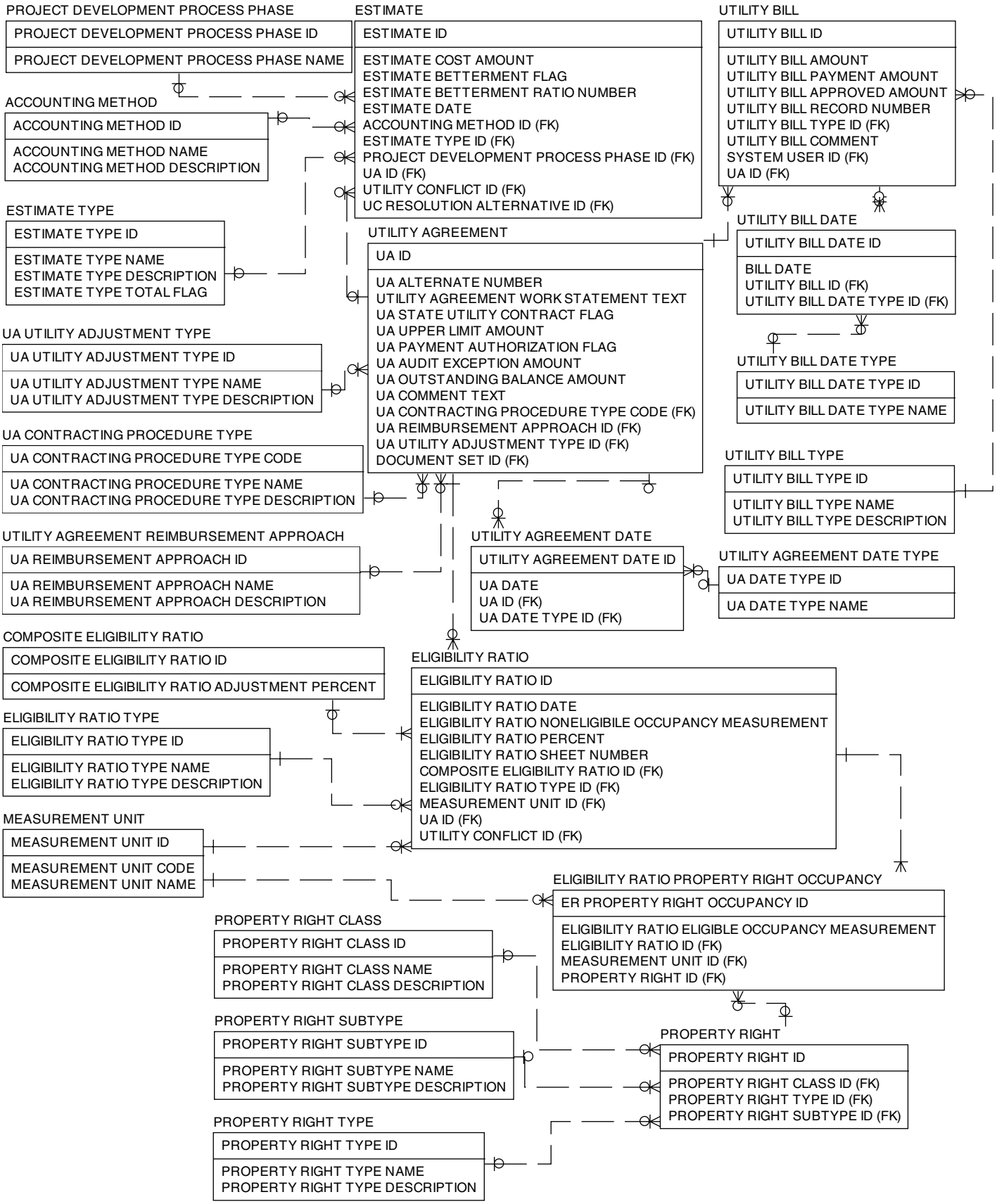


Figure 4.6. Logical data model: Utility agreement subject area.

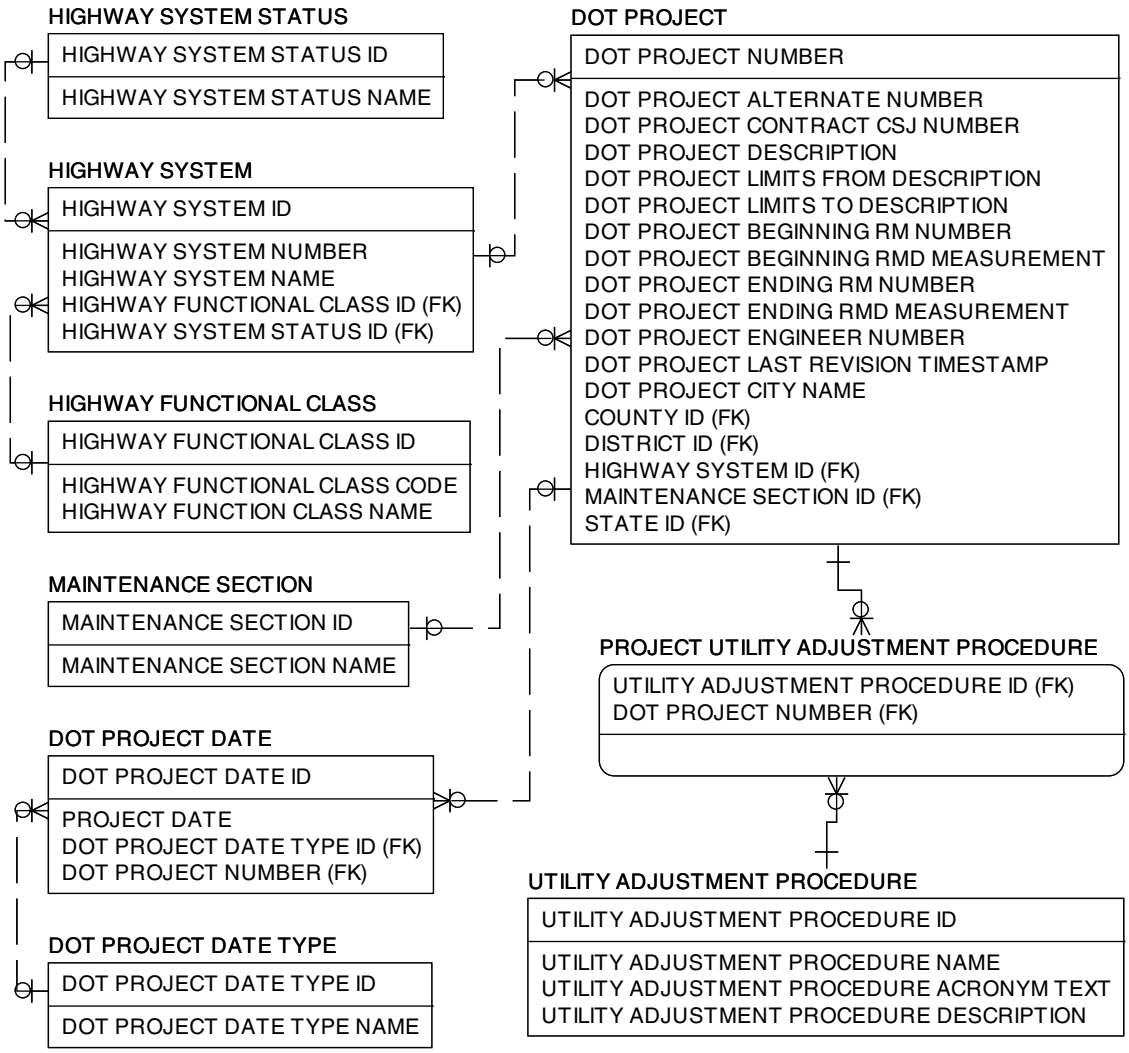


Figure 4.7. Logical data model: Project subject area.

15 data items in the main body). The subreport includes 25 data items (13 data items in the header and 12 data items in the main body). Replicating the UCM and subreport involved developing 10 queries and four reports. Figure 4.10 shows the UCM report that resulted from this replication process. In general, the process to replicate the prototype UCM in the database involved the following data operations:

- Retrieve estimated completion date.
- Retrieve utility conflict status.
- Retrieve plan document sheet number.
- Retrieve conflict resolution alternatives.
- Calculate estimate cost.
- Generate UCM and subreport.

To describe this process, a summary of the Access queries and reports needed to develop the report follows. Appendix D provides a detailed description of each Access query and Access report, including structured query language (SQL) statements.

- Step 1. Create "UCM 1 estimated completion date" query. For a specific project, this query retrieves utility conflicts that have been identified or that have an estimated adjustment completion.
- Step 2. Create "UCM 2 Estimated Completion Date" query. This query uses the query created in Step 1 to display every utility conflict for a project with the estimated completion date if that date was entered for the utility conflict. If the estimated completion date was not entered for a utility conflict, the query displays the utility conflict record without an entry in the utility conflict event date column.
- Step 3. Create "UCM 1 multiple utility conflict status" query. This query selects all utility conflicts associated with a project with any of four utility conflict event types: utility conflict created, utility owner informed of utility conflict, utility conflict resolved, or utility conflict resolution strategy selected. These four utility conflict event types serve as an example of how a state DOT might decide to track the status of a utility conflict (other choices involving more or fewer events are certainly possible).

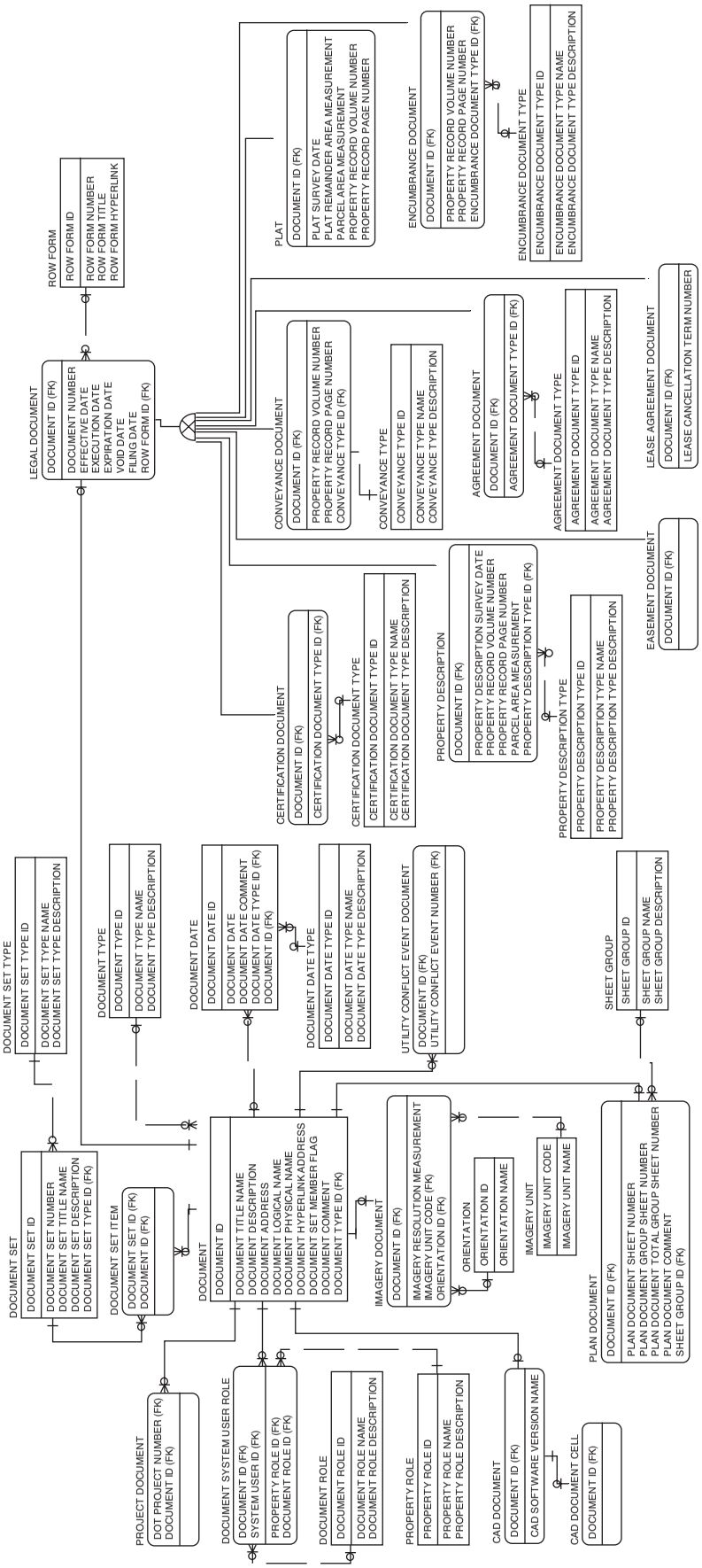


Figure 4.8. Logical data model: Document subject area.

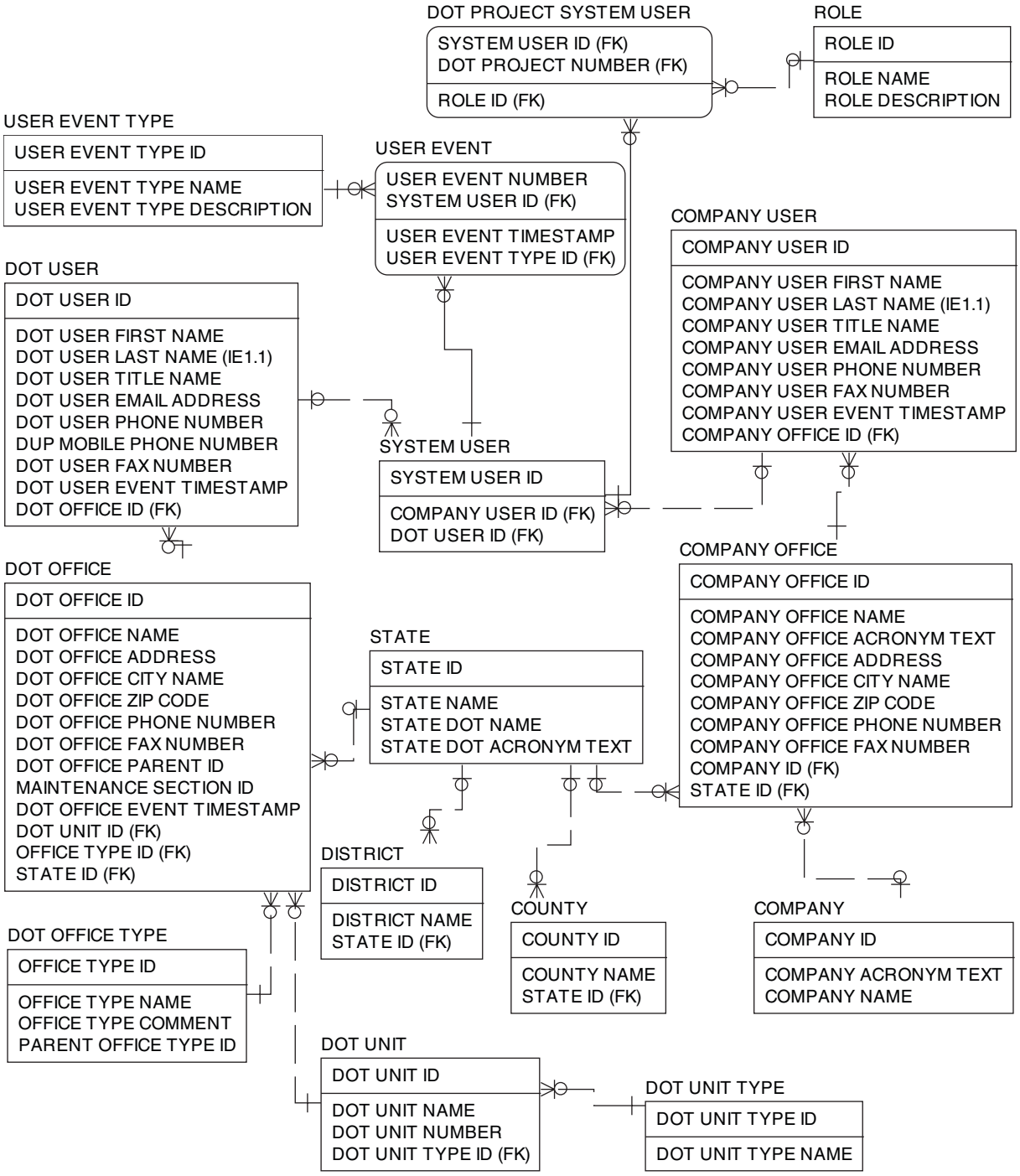


Figure 4.9. Logical data model: User subject area.

- Step 4. Create "UCM 1 plan document sheet number" query. This query retrieves the sheet number and sheet group ID for plan documents that are associated with utility conflicts in a project.
- Step 5. Create "UCM 2 utility conflict status" query. This query uses the query from Step 3 to retrieve the highest order code for all utility conflict event types associated with a project. The order code specifies the order of events for a utility conflict status and the corresponding utility conflict event date for each utility conflict.
- Step 6. Create "UCM 3" query. This query uses the queries from Steps 2, 4, and 5 to retrieve a list of utility conflicts for a specific project.
- Step 7. Create "UCM 1 estimates crosstab" query. For a specific project, this query produces a crosstab between information about alternatives to resolve a utility conflict and

Utility Conflict Resolution Alternatives

Cost Estimate Analysis

Date: 4/6/2011

Project Owner: Texas Department of Transportation
Project No.: 1234-56-789
Project Description: Road construction project in Houston
Highway or Route: I-10 Katy Freeway

Conflict ID:	1
Utility Owner:	AT&T
Utility Type:	Telephone
Size and/or Material:	Fiber Optic
Project Phase:	60% Design

Alternative Number	Alternative Description	Alternative Advantage	Alternative Disadvantage	Responsible Party	Engineering Cost (Utility)	Direct Cost (Utility)	Engineering Cost (DOT)	Direct Cost (DOT)	Total Cost	Feasibility	Decision
0	Relocation before construction.	No design change required and no additional cost to DOT.	Cost to utility for relocation.	Utility Company	$10,375.00	$63,875.00	$0.00	$0.00	$74,250.00	Yes	Selected
1	Protect in-place.			Utility Company	$7,875.00	$32,375.00	$0.00	$0.00	$40,250.00	No	Rejected

Figure 4.10. Utility conflict resolution alternatives: Cost estimate analysis.

related estimate types, as well as a summation of estimate cost amounts.
- Step 8. Create "UCM 2 alternative analysis UC34" query. This query uses the crosstab produced in Step 7 to produce a table of information about alternatives to resolve conflict number 34. A similar query would be required for every conflict that requires a separate cost estimate analysis of available resolution alternatives.
- Step 9. Create "UCM" subsheet report. This report replicates the subsheet for the prototype UCM based on the results of the query from Step 8 (Figure 4.10). All data items provided in the report are selected from database entries, with the exception of the total cost field, which calculates a summation on the fly, and the names (and corresponding dates) of the individuals who developed, revised, or reviewed the UCM report.
- Step 10. Create "UCM" report. This report replicates the prototype UCM based on the results of the query from Step 8 (Figure 4.11). All data items provided in the report are selected from database entries. The only exception is the names (and corresponding dates) of the individuals who developed, revised, or reviewed the UCM report.

Alaska DOT&PF UCM Example

The sample UCM from the Alaska DOT&PF (see Figure 4.12) has an average number of data items: five data items in the header and 14 in the main body. This UCM was also interesting because it included totals, subtotals, and grand totals of cost data elements, grouped according to whether the utility installations involved were distribution or transmission facilities. In general, the process to replicate the Alaska DOT&PF UCM in the database involved the following data operations:

- Identify electric distribution facilities.
- Identify electric transmission facilities.
- Retrieve adjustment and engineering costs for distribution facilities.
- Retrieve adjustment and engineering costs for transmission facilities.
- Calculate totals.
- Generate UCM.

Replicating the sample UCM involved developing 13 queries and three reports. Figure 4.13 shows the result of the replication process. A summary of the queries and reports needed to develop the report in Figure 4.13 follows. Appendix D provides a detailed description of each query and report, including SQL statements.

- Step 1. Create "Alaska 1 distribution crosstab" query. This query selects two types of electric distribution utility facilities for a specific project and lists the adjustment cost estimate and the engineering cost estimate by utility conflict ID.
- Step 2. Create "Alaska 1 transmission crosstab" query. This query is similar to the previous query except that it selects electricity transmission utility facilities.
- Step 3. Create "Alaska 2 total distribution" query. This query uses the crosstab query from Step 1 and produces a total of the adjustment cost and engineering cost estimates for each distribution utility conflict.
- Step 4. Create "Alaska 2 total transmission" query. This query uses the crosstab query from Step 2 and produces a total of the adjustment cost and engineering cost estimates for each transmission utility conflict.
- Step 5. Create "Alaska 3 distribution cost" query. This query uses the queries from Steps 1 and 3 to retrieve engineering cost and adjustment cost estimates as well as total electric distribution utility conflict costs.
- Step 6. Create "Alaska 3 transmission cost" query. This query is similar to the previous query except that it uses the queries produced in Steps 2 and 4 in connection with electric transmission utility conflicts.
- Step 7. Create "Alaska 4 distribution subtotal" query. This query uses the query from Step 5 to calculate subtotals of adjustment and engineering cost estimates, as well as the total cost of electric distribution utility conflicts.
- Step 8. Create "Alaska 4 transmission subtotal" query. This query is similar to the previous query, except that it uses the query from Step 6 in connection with transmission utility conflicts.
- Step 9. Create "Alaska 5 AC total" query. This query uses the queries from Steps 7 and 8 to retrieve totals of adjustment costs for both distribution and transmission utility conflicts. The total adjustment cost is calculated by adding the distribution adjustment cost total to the transmission adjustment cost total.
- Step 10. Create "Alaska 5 EC total" query. This query uses the queries from Steps 7 and 8 and produces totals of engineering costs for both distribution and transmission utility conflicts. The total engineering cost is calculated by adding the distribution engineering cost total to the transmission engineering cost total.
- Step 11. Create "Alaska 6 grand total" query. This query uses the queries from Steps 9 and 10 to produce the grand total utility cost, which is the total adjustment cost plus the total engineering cost.
- Step 12. Create "Alaska 7 UCM distribution" query. This query uses the query from Step 5 and numerous other tables of the data model to produce a tabulation of electric distribution utility conflict data.
- Step 13. Create "Alaska 7 UCM transmission" query. This query uses the query from Step 6 and numerous other tables of the data model to produce a tabulation of electric transmission utility conflict data.
- Step 14. Create "Alaska subreport transmission" report. This report provides a list of utility conflicts, along with

Utility Conflict Matrix

Project Owner: Texas Department of Transportation
Project No.: 1234-56-789
Project Description: Road construction project in Houston
Highway or Route: I-10 Katy Freeway

Utility Conflict Matrix Developed/Revised By: _____ **Date:** _____
Reviewed By: _____ **Date:** _____

Utility Owner and/ or Contact Name	Conflict ID	Drawing or Sheet No.	Utility Type	Size and/or Material	Utility Conflict Description	Start Station	End Station	Start Offset	End Offset	Utility Investigation Level Needed	Test Hole No.	Recommended Action or Resolution	Estimated Resolution Date	Resolution Status	Cost Analysis
AT&T	1	U-1	Telephone	Fiber Optic	Conflict with construction of frontage road widening.	21+00	22+00	45' Lt	45' Lt	QLC		Relocation before construction.	3/8/2010	Utility conflict identified	Detail
AT&T	2	U-1	Telephone	Fiber Optic	Conflict with construction of frontage road widening.	21+80	23+00	37' Rt	37' Rt	QLC		Relocation before construction.	3/8/2010	Utility conflict identified	Detail
AT&T	3	U-1	Telephone	Fiber Optic	Conflict with construction of frontage road widening.	27+50	30+00	48' Rt	48' Rt	QLC		Relocation before construction.	3/8/2010	Utility conflict identified	Detail
AT&T	4	U-1	Telephone	Fiber Optic	Conflict with construction of frontage road widening.	44+40	45+15	48' Rt	48' Rt	QLC		Relocation before construction.	3/8/2010	Utility conflict identified	Detail
AT&T	5	U-1	Telephone	Unknown	Conflict with construction of frontage road widening.	45+10	45+20	49' Lt	49' Lt	QLB		Design change.	3/8/2010	Utility owner informed of utility conflict	Detail
AT&T	6	U-1	Telephone	Copper	Conflict with retaining wall No. 18.	45+80	45+90	57' Lt	49' Lt	QLB		Design change.	3/8/2010	Utility conflict identified	Detail
AT&T	7	U-1	Telephone	Copper	Conflict with retaining wall No. 18.	25+80	25+90	65' Lt	49' Lt	QLC		Protect in-place.	3/8/2010	Utility conflict identified	Detail
AT&T	8	U-1	Telephone	Copper	Conflict with retaining wall No. 18.	25+80	25+90	62' Rt	49' Lt	QLC		Protect in-place.	3/8/2010	Utility conflict identified	Detail
AT&T	9	U-1	Telephone	Copper	Conflict with retaining wall No. 18.	27+40	28+00	55' Lt	55' Lt	QLC		Protect in-place.	3/8/2010	Utility conflict identified	Detail
AT&T	10	U-1	Telephone	Copper	Conflict with retaining wall No. 18.	27+40	28+00	55' Rt	55' Lt	QLC		Protect in-place.	3/8/2010	Utility conflict identified	Detail
AT&T	11	U-1	Telephone	Copper	Conflict with retaining wall No. 18.	28+05	29+00	62' Rt	55' Lt	QLC		Exception to policy.	3/8/2010	Utility conflict identified	Detail
AT&T	12	U-2	Telephone	Multiple Concrete Duct	Conflict with retaining wall No. 18.	15+50	16+00	49' Lt	80' Rt	QLC		Design change.	3/8/2010	Utility owner informed of utility conflict	Detail
AT&T	13	U-2	Telephone	Multiple Concrete Duct	Conflict with retaining wall No. 27.	15+90	16+00	40' Lt	80' Rt	QLC		Design change.	3/8/2010	Utility owner informed of utility conflict	Detail
AT&T	14	U-2	Telephone	Multiple Concrete Duct	Conflict with retaining wall No. 27.	20+40	22+00	115' Rt	80' Rt	QLC		Design change.	3/8/2010	Utility owner informed of utility conflict	Detail
AT&T	15	U-2	Telephone	Multiple Concrete Duct	Conflict with retaining wall No. 27.	22+30	23+00	80' Rt	80' Rt	QLC		Design change.	3/8/2010	Utility owner informed of utility conflict	Detail
AT&T	16	U-2	Telephone	Multiple Concrete Duct	Conflict with retaining wall No. 27.	25+85	28+00	55' Rt	80' Rt	QLB		Design change.	3/8/2010	Utility owner informed of utility conflict	Detail
AT&T	17	U-2	Telephone	Multiple Concrete Duct	Conflict with retaining wall No. 27.	28+05	30+00	62' Rt	80' Rt	QLB		Design change.	3/8/2010	Utility owner informed of utility conflict	Detail
AT&T	18	U-2	Telephone	Multiple Concrete Duct	Conflict with retaining wall No. 27.	33+15	35+00	65' Rt	80' Rt	QLB		Design change.	3/8/2010	Utility owner informed of utility conflict	Detail
AT&T	19	U-2	Manhole	Steel	Conflict with retaining wall No. 27.	445+55	446+00	48' Rt	48' Rt	QLA	1	Relocation before construction.	7/2/2010	Utility conflict identified	Detail
Centerpoint Energy	20	U-3	Electricity	Steel	Conflict with retaining wall No. 27.	445+55	446+00	48' Rt	48' Rt	QLA	2	Relocation before construction.	7/2/2010	Utility conflict identified	Detail

Figure 4.11. Prototype UCM.

DRAFT Utility Conflict Report
West Dowling Road Phase I

Anchorage, Alaska
DOT&PF No. 50898

Table 2: Chugach Electric Association, Incorporated, Conflicts Summary

Station	Offset	Station	Offset	Size/Type	Length	Conflict	ADJ/REL	Cost	PE/CE Cost	Total Cost
CEA Distribution Relocation Costs										
9+00	150' RT		200' LT	3φ UG	350	FG	REL	52,500	15,750	68,250
16+00	100' LT	42+30	80' LT	3φ UG	2630	FG	REL	394,500	118,350	512,850
16+00	100' LT	15+50	100' RT	3φ UG	250	FG	REL	37,500	11,250	48,750
16+00	100' LT	29+00	75' LT	1φ UG	1650	FG	REL	165,000	49,500	214,500
36+40	80' LT	35+80	350' RT	3φ UG	430	FG	REL	64,500	19,350	83,850
36+60	80' LT	36+70	380' LT	3φ UG	300	FG	REL	45,000	13,500	58,500
	UG Loop to the North			3φ UG	1000	FG	REL	150,000	45,000	195,000
							Subtotal	909,000	272,700	1,181,700
CEA Transmission Relocation Costs										
14+75	55' RT			138 kV OH	1	PWY	REL	30,000	9,000	39,000
32+75	55' RT			138 kV OH	1	EX	REL	50,000	15,000	65,000
36+38	45' RT			138 kV OH	1	EX	REL	50,000	15,000	65,000
							Subtotal	130,000	39,000	169,000
							Total CEA Relocation Costs	**1,039,000**	**311,700**	**1,350,700**

1φ Underground (UG) loop to extend across Dowling Road and along the south side to reconnect existing services.
UG loop provided to the north of the project to accommodate undergrounding.
Removal of existing swamp braces removed and steel piling added, down guys replaced with overhead span guy and down guys.

Figure 4.12. Alaska DOT&PF sample utility conflict report excerpt.

Alaska UCM

DRAFT Utility Conflict Report
West Dowling Road Phase 1

Anchorage, Alaska
DOT&PF No. 50898

Start Station	Start Offset	End Station	End Offset	Size	Type	Length	Conflict	ADJ/REL	Cost	PE/CE Cost	Total Cost
CEA Distribution Relocation Costs											
9+00	150' RT		200' LT	3 phi	UG	350	FG	Relocation before construction	$52,500	$15,750	$68,250
16+00	100' LT	42+30	80' LT	3 phi	UG	2,630	FG	Relocation before construction	$394,500	$118,350	$512,850
16+00	100' LT	15+50	100' RT	3 phi	UG	250	FG	Relocation before construction	$37,500	$11,250	$48,750
16+00	100' LT	29+00	75' LT	1 phi	UG	1,650	FG	Relocation before construction	$165,000	$49,500	$214,500
36+40	80' LT	35+80	350' RT	3 phi	UG	430	FG	Relocation before construction	$64,500	$19,350	$83,850
36+60	80' LT	36+70	380' LT	3 phi	UG	300	FG	Relocation before construction	$45,000	$13,500	$58,500
	UG Loop to the North			3 phi	UG	1,000	FG	Relocation before construction	$150,000	$45,000	$195,000
								Subtotal:	$909,000	$272,700	$1,181,700
CEA Transmission Relocation Costs											
14+75	55' RT			138 kV	OH	1	PWY	Relocation before construction	$30,000	$9,000	$39,000
32+75	55' RT			138 kV	OH	1	EX	Relocation before construction	$50,000	$15,000	$65,000
36+38	45' RT			138 kV	OH	1	EX	Relocation before construction	$50,000	$15,000	$65,000
								Subtotal:	$130,000	$39,000	$169,000
								Total Relocation Costs:	**$1,039,000**	**$311,700**	**$1,350,700**

Figure 4.13. Alaska UCM report.

costs for adjustment, engineering, and total costs per transmission utility conflict and totals for all utility conflicts. This report is based on the query developed in Step 13.
- Step 15. Create "Alaska subreport grand total" report. This report provides a total adjustment cost, total engineering cost, and the grand total of both distribution and transmission costs based on the query from Step 11.
- Step 16. Create "Alaska UCM" report. This report uses the data from the query in Step 12 and incorporates the subreports from Steps 14 and 15 into one report. The report includes other data items from the database, such as project number and description.

Caltrans UCM Example

The sample UCM from Caltrans, shown in Figure 4.14, is an example of a detailed UCM with a large number of data items: four data items in the header and 20 in the main body. The UCM was also interesting because it included data items that were included in the prototype UCM, including utility sheet number, utility conflict investigation type, utility relocation strategy type, and utility relocation responsible party. In general, the process to replicate the Caltrans UCM in the database involved the following data operations:

- Retrieve date last revised.
- Retrieve plan document sheet number.
- Retrieve required completion date.
- Retrieve utility conflicts with comments.
- Create list of utility conflicts with required completion date and comments.
- Generate UCM.

Replicating the sample UCM involved developing seven queries and one report. Figure 4.15 shows the result of the replication process. A summary of the queries and reports needed to develop the report in Figure 4.15 follows. Appendix D provides a detailed description of each query and report, including SQL statements.

- Step 1. Create "CA 1 date last revised" query. This query selects the latest time stamp of a utility conflict event that is associated with a specific project.
- Step 2. Create "CA 1 plan document sheet number" query. This query retrieves the sheet number of any plan document that mentions a utility conflict. The query selects a project number and then lists the sheet numbers by utility conflict.
- Step 3. Create "CA 1 required completion date" query. This query produces the date by which a utility conflict is required to be completed in order for a project to proceed to the construction phase without delays.
- Step 4. Create "CA 1 UC comment" query. For a specific project, this query provides a list of utility conflicts that have an associated comment.
- Step 5. Create "CA 2 required completion date outer join" query. This query produces a list of utility conflicts with required completion dates for a specific project, including those utility conflicts that do not have a required completion date. The query creates an outer join of the utility conflict ID between the utility conflict table and the query from Step 3, with two conditions: include all records from the utility conflict table, and include only those records from the Step 3 query in which the joined fields are equal.
- Step 6. Create "CA 2 utility conflict comment outer join" query. This query produces a list of utility conflicts with comments for a specific project, including those utility conflicts that do not have a comment. The query creates an outer join of the utility conflict ID between the utility conflict table and the query from Step 4, with two conditions: include all records from the utility conflict table, and include only those records from the Step 4 query in which the joined fields are equal.
- Step 7. Create "CA 3 UCM" query. This query uses the queries from Steps 1, 5, and 6 to retrieve utility conflict data that provide the basis for the Caltrans UCM report. The query parameter is the project number.
- Step 8. Create "California UCM" report. This report uses data from the query in Step 7. All data items provided in the report are selected from database entries. The only exception is the name of the document preparer, which could be inserted dynamically through a dialog box when the document is prepared.

Advantages of a Database Approach

Implementing a database for managing utility conflict data requires careful planning, experienced staff, and buy-in by multiple affected parties. The effort required to implement a database system is considerably higher than implementing a stand-alone spreadsheet. However, a database approach offers a multitude of advantages and benefits that a spreadsheet cannot offer.

The prototype database structure was based on a large number of state DOT UCMs and many diverse data items, and as a result, the prototype data model and resulting database are flexible and capable of accommodating most data items related to utility conflicts. This flexibility was proven through the process of replicating the sample UCMs described in this report. Further, the prototype data model and database used standard database design principles, which should facilitate the implementation of the database to address the

I-10-EA 122401-Utilities Conflict Status

date of last revision May 30, 2000
this document was prepared by

Conflict No.	Utility Sheet No.	Pothole No. *(On U-sheets)*	Owner	Utility Description	Pothole/Manhole Location	Conflict Location	Utility Conflict/ Work Description	Investigation			Depth	Impact?		Action			***Util. Reloc.*** ***A***- Abandon ***RB***-Reloc.Before ***RD***-Reloc.During ***P***-Protect in place ***NC***-No conflict	***Resp. Party*** ***U***-Utility Co ***C***- Contractor	***Required Completion Date***	Comments
								Pothole	Manhole	Overhead	(ft)	Y	N	Remove	Relocate	Other				
1	U-2	1	PACBELL	40 DU Telephone	62 m Rt of I-405 Sta 165+55	40 m Rt and 57 m Rt of I-405 Sta 165+55	conflict with Retaining Walls No. 166 & No. 168	X			4.55 14.40		N				***P***			
2	U-2	2	PACBELL	40 DU Telephone	48 m Lt of I-405 Sta 165+55	40 m Rt and 57 m Rt of I-405 Sta 165+55	conflict with Retaining Walls No. 166 & No. 168				-		N				***P***			
3	U-3	3	SCE	25 mm DU	35 m Rt of I-405 Sta 165+01	43 m Rt of I-405 Sta 165+01	conflict with Retaining Wall No. 166				-		N				***P***			Located in Bristol OC
4	U-3	4	SCE	25 mm DU	46 m Lt of I-405 Sta 165+01	43 m Rt of I-405 Sta 165+01	conflict with Retaining Wall No. 166				-		N				***P***			Located in Bristol OC
5	U-3	5	MWD	900 mm WSP Water in 380 mL ENC	50 m Rt of I-405 Sta 164+96	44 m Rt of I-405 Sta 164+95	conflict with Retaining Wall No. 166	X			6.70		N				***P***			
6	U-3	6	MWD	900 mm WSP Water in 380 mL ENC	50 m Lt of I-405 Sta 164+96	44 m Rt of I-405 Sta 164+95	conflict with Retaining Wall No. 166	X			6.50		N				***P***			
7	U-3	7	Caltrans	600 mm RCP	53 m Rt of I-405 Sta 163+42	53 m Rt of I-405 from Sta 163+29 to Sta 163+42	conflict with Delhi Channel Bridge	X			6.00		N				***P***			
8	U-3	8	Caltrans	600 mm RCP	53 m Rt of I-405 Sta 163+29	53 m Rt of I-405 from Sta 163+29 to Sta 163+42	conflict with Delhi Channel Bridge	X			9.00		N				***P***			
9	U-3	9	MCWD	300 mm ACP Water in 119mL, 500mm STL Casing	32 m Rt of I-405 Sta 163+25	35 m Rt of I-405 Sta 163+25	conflict with I-405 Widening & BR1 Line	X			10.30		N				***P***			
10	U-3	10	MCWD	300 mm ACP Water 119mL, 500mm STL Casing	32 m Lt of I-405 Sta 163+25	33 m Lt of I-405 Sta 163+25	conflict with I-405 Widening & BR1 Line	X			8.75		N				***P***			
11	U-3	MH 11	CSDOC	Manhole	81 m Rt of I-405 Sta 162+92	35 m Rt of I-405 Sta 162+92	conflict with I-405 Widening & BR1 Line		X		18.40		N				***P***			
12	U-3	12	CSDOC	380 mm VCP Sewer	36 m Lt of I-405 Sta 162+91	32 m Lt of I-405 Sta 162+90	conflict with I-405 Widening & BR1 Line				-		N				***P***			
13	U-4	13	MCWD	600mm CCP Water in 94m L 900mm Dia Stl Casing	67 m Rt of I-405 Sta 161+44	58 m Rt of I-405 Sta 161+44	Conflict with Airport Channel	X			4.55	Y			X	X	***RB***			600 mm Waterline to be Lowered Extend Encasement
14	U-4	14	MCWD	600mm CCP Water in 94m L 900mm Dia Stl Casing	38 m Lt of I-405 Sta 161+40	32 m Lt of I-405 Sta 161+42	conflict with I-405 Widening				-		N				***P***			
15	U-4	15	MCWD	300 mm ACP Water	70 m Rt of I-405 Sta 160+29	72 m Rt of I-405 from Sta 157+20 to Sta 160+29	Conflict with AOA Line and Retaining Wall No. 268	X			-	Y			X		***RD***			Enchroachment CT R/W and Private Owner Encased under Roadway
16	U-4	16	MCWD	300 mm ACP Water	70 m Rt of I-405 Sta 159+07	72 m Rt of I-405 from Sta 157+20 to Sta 160+29	Conflict with AOA Line and Retaining Wall No. 268	X			-	Y			X		***RD***			Enchroachment CT R/W and Private Owner Encased under Roadway
17	U-5	17	MCWD	300 mm ACP Water	70 m Rt of I-405 Sta 156+87	72 m Rt of I-405 from Sta 157+20 to Sta 160+29	conflict with AOA Line and Retaining Wall No. 268	X			4.35		N				***P***			
18	U-5	MH 18	CSDOC	Manhole	60 m Rt of I-405 Sta 156+65	28 m Rt of I-405 Sta 156+65	conflict with I-405 Widening		X		16.20		N				***P***			
19	U-5	19	CSDOC	380 mm VCP Sewer	46 m Lt of I-405 Sta 156+65	25 m Rt of I-405 Sta 156+65	conflict with I-405 Widening	X			18.40		N				***P***			
20	U-5	20	CSDOC	830 mm VCP Sewer	14 m Rt of B2 Sta 24+96		conflict with construction of B2 Line						N				***P***			
21	U-5	21	CSDOC	830 mm VCP Sewer	6 m Lt of B2 Sta 25+54		conflict with construction of B2 Line						N				***P***			
22	U-8	MH 22	CSDOC	Manhole	8m Rt of Main St Sta 102+78				X			Y				X	***RB***			MH to be Lowered New Top MH Elev= 9.588
23	U-8	MH 23 SCE MH 4503	SCE	Manhole No. 4503	8m Rt of Main St Sta 102+87				X			Y				X	***RB***			MH to be Lowered New Top MH Elev= 9.583 m
24	U-8	MH 24 SCE MH 4502	SCE	Manhole No. 4502	8m Rt of Main St Sta 104+17				X			Y				X	***RB***			MH to be Lowered New Top MH Elev= 9.728 m

Figure 4.14. Caltrans sample utility conflict status list.

I-10-EA 122401 - Utilities Conflict Status

California UCM

Date of last revision: 12/4/2009

This document was prepared by: _____

Conflict No.	Utility Sheet No.	Test Hole No.	Owner	Utility Description				Test Hole/ Manhole Location	Start Station	End Station	Offset	Utility Conflict/ Work Description	Utility Conflict Investigation	Depth (ft)	Impact?	Utility Relocation	Resp. Party	Required Completion Date	Comments
1	U-2	1	PACBELL	40 mm	DU	Telephone		62 m Rt of I-405 Sta 165+55	165+55		40 m Rt and 57 m Rt of I-405	Conflict with retaining walls No. 166 and No. 168	QLA	4.55	N	P	U	1/10/2010	
2	U-2	2	PACBELL	40 mm	DU	Telephone		48 m Lt of I-405 Sta 165+55	165+55		40 m Rt and 57 m Rt of I-405	Conflict with retaining walls No. 166 and No. 168		14.40	N	P	U	1/10/2010	
3	U-3	3	SCE	25 mm	DU	Telephone		35 m Rt of I-405 Sta 165+01	165+01		43 m Rt of I-405	Conflict with retaining wall No. 166			N	P	U	1/10/2010	Located in Bristol OC
4	U-3	4	SCE	25 mm	DU	Telephone		46 m Lt of I-405 Sta 165+55	165+01		43 m Rt of I-405	Conflict with retaining wall No. 166			N	P	U		Located in Bristol OC
5	U-3	5	MWD	900 mm		Water	in 380 mL ENC	50 m Rt of I-405 Sta 165+96	164+95		44 m Rt of I-405	Conflict with retaining wall No. 166	QLA	6.70	N	P	U		
6	U-3	6	MWD	900 mm		Water	in 380 mL ENC	50 m Lt of I-405 Sta 165+96	164+95		44 m Rt of I-405	Conflict with retaining wall No. 166	QLA	6.50	N	P	U		
7	U-3	7	Caltrans	600 mm				53 m Rt of I-405 Sta 163+42	163+29	163+24	53 m Rt of I-405	Conflict with Delhi Channel Bridge	QLA	6.00	N	P	U		
8	U-3	8	Caltrans	600 mm				53 m Rt of I-405 Sta 163+29	163+29	163+42	53 m Rt of I-405	Conflict with Delhi Channel Bridge	QLA	9.00	N	P	U		
9	U-3	9	MCWD	300 mm		Water	in 119 mL, 500 mm STL Casing	32 m Rt of I-405 Sta 163+25	163+25		35 m Rt of I-405	Conflict with I-405 widening and BR1 Line	QLA	10.30	N	P	U		
10	U-3	10	MCWD	300 mm		Water	in 119 mL, 500 mm STL Casing	32 m Lt of I-405 Sta 163+25	163+25		33 m Lt of I-405	Conflict with I-405 widening and BR1 Line	QLA	8.75	N	P	U		
11	U-3	MH 11	CSDOC			Manhole		81 m Rt of I-405 Sta 162+92	162+92		35 m Rt of I-405	Conflict with I-405 widening and BR1 Line	QLB	18.40	N	P	U		
12	U-3	12	CSDOC	380 mm		Sewer		36 m Lt of I-405 Sta 162+91	162+92		32 m Lt of I-405	Conflict with I-405 widening and BR1 Line			N	P	U		
13	U-4	13	MCWD	600 mm		Water	in 94 mL, 900 mm STL Casing	67 m Rt of I-405 Sta 161+44	161+44		58 m Rt of I-405	Conflict with airport channel	QLA	4.55	Y	RB	U		600 mm waterline to be lowered, extend encasement
14	U-4	14	MCWD	600 mm		Water	in 94 mL, 900 mm STL Casing	38 m Lt of I-405 Sta 161+40	161+42		32 m Lt of I-405	Conflict with I-405 widening			N	P	U		
15	U-4	15	MCWD	300 mm		Water		70 m Rt of I-405 Sta 160+29	157+20	160+29	72 m Rt of I-405	Conflict with AOA line and retaining wall No. 268	QLA		Y	RD	U		Encroachment CR R/W and private owner, encased under roadway
16	U-4	16	MCWD	300 mm		Water		70 m Rt of I-405 Sta 159+07	157+20	160+29	72 m Rt of I-405	Conflict with AOA line and retaining wall No. 268	QLA		Y	RD	U		Encroachment CR R/W and private owner, encased under roadway
17	U-5	17	MCWD	300 mm		Water		70 m Rt of I-405 Sta 156+87	157+20	160+29	72 m Rt of I-405	Conflict with AOA line and retaining wall No. 268	QLA	4.35	N	P	U		
18	U-5	MH 18	CSDOC			Manhole		60 m Rt of I-405 Sta 156+65	156+65		28 m Rt of I-405	Conflict with I-405 widening	QLB	16.20	N	P	U		
19	U-5	19	CSDOC	380 mm		Sewer		46 m Lt of I-405 Sta 156+65	156+65		25 m Rt of I-405	Conflict with I-405 widening	QLA	18.40	N	P	U		

Figure 4.15. Caltrans UCM report.

needs of a wide range of state DOTs, including linking to existing database systems to avoid data duplication. Additional advantages of a database approach to manage utility conflicts include the following:

- The database can be adapted to address changes in DOT needs and business processes.
- The DOT can choose to implement all or selected portions of the complete system.
- The database is scalable to allow access by many users and store large datasets.
- Look-up tables can be easily expanded as needed to accommodate data items and descriptors unique to the DOT.
- The database can link to existing DOT data systems.

Once a database system is implemented, its real power lies in its ability to enable a wide range of queries and reports. In addition to the various UCMs replicated during the research, a short sample of reports the prototype database could enable includes the following:

- A report listing all utility conflicts associated with company X (for a specific project, corridor, or time frame);
- A report of all water facilities in conflict (for a specific project or corridor);
- A report summarizing average conflict resolution times for electric facilities statewide;
- A report providing average conflict resolution times for water facilities on project Z;
- A report listing all utility conflicts with resolution times of more than 100 days;
- A customized UCM report listing only the utility conflicts of a specific utility owner; and
- A listing of unresolved utility conflicts at time of letting for inclusion in the PS&E package (sometimes called utility certification).

CHAPTER 5

Work Sessions in California, Georgia, and Texas

Introduction

After completing the development of the prototype stand-alone UCM (Chapter 3) and the UCM data model and database (Chapter 4), the research team scheduled work sessions with state DOTs in California, Georgia, and Texas to discuss partial research results and gather recommendations for training materials and implementation of the research results. The selection of these state DOTs was based on feedback from the online surveys and interviews, which indicated a widespread use of UCMs in these states, as well as a willingness to provide materials for use in the development of training materials. In the case of GDOT, it was also of interest to learn more about their experience with the development and implementation of their UCM training program.

During this phase, the research team also gave presentations at the AASHTO Right-of-Way and Utilities Subcommittee meeting in San Diego, California (April 2010), and the Southeastern Association of State Highway and Transportation Officials annual meeting in Little Rock, Arkansas (August 2010). These presentations provided additional opportunities for stakeholders to provide feedback with respect to partial research findings and recommendations for training material testing sites.

The California meeting took place at Caltrans' headquarters in Sacramento and included representatives from headquarters and several districts. Additional district representatives joined the meeting remotely via videoconference. Attendance also included consultants and utility owner representatives, some of whom joined the meeting remotely from Caltrans district offices.

The Georgia meeting took place at GDOT headquarters in Atlanta and included representatives from the GDOT utilities office, along with representatives from the design group, representatives of major utility owners, and consultants.

The Texas meeting took place at the TxDOT Austin district office and included representatives from headquarters and several districts, some of whom attended via conference call. No utility representatives were present.

Feedback and UCM Changes

Overall, feedback from the work sessions in California, Georgia, and Texas did not result in major changes to the stand-alone UCM or the data model and associated Access database. For the most part, participants at the three work sessions noted that the two prototypes developed during the research captured their business processes properly. While no major changes to the UCM concept emerged from the work sessions, feedback from work session participants was critical for the development of the training materials (Chapter 6).

Minor modifications to the UCM that resulted from the work sessions included the following:

- Converting the "recommended action or resolution" column to a text field. This change provides flexibility in the way users describe recommended resolution strategies (as opposed to using standardized entries from a look-up table of generic utility conflict resolution strategies). A review of sample UCMs (Appendix B) revealed that some state DOTs prefer a list of utility conflict resolution types, while other DOTs prefer a comment field to describe the resolution strategy. Selecting strategies from a look-up table has the advantage that users can update UCMs faster and that selections are standardized. The disadvantage is that this method does not easily support combinations of resolution strategies or allow a more detailed description of the resolution strategy chosen. In cases that require multiple resolution strategies, state DOTs tend to record only the most prevalent resolution strategy type. Using a comment field enables DOTs to enter descriptive information about the resolution strategy chosen.
- Relabeling the "utility conflict/work description" column as "utility conflict description." This change clarifies the purpose of the column, which is to provide information

about the utility conflict, not the work needed to resolve the conflict (which is described elsewhere in the UCM).

- Providing more flexibility for handling cost estimates. During the work sessions, the research team noted that the cost estimate column was unclear to some DOT officials. It also became evident that DOT officials were interested not just in the cost to utility owners but also the cost to the DOT. Comparing both cost estimates would enable the state DOT to make the best decision possible. As described in Chapter 4, this realization made it necessary to remove the cost estimate data item from the UCM and, instead, develop a separate sheet to track and analyze cost estimates for all resolution alternatives that may be associated with individual utility conflicts.
- Adding fields in the database to track the location of utility conflicts using absolute coordinates (e.g., latitude and longitude or state plane coordinates). The stand-alone UCM shows start and end stations and offsets because this method is the most prevalent among state DOTs. The data model and database include both stations and offsets as well as absolute coordinates.

State DOT officials emphasized the need to account for a variety of reporting options in the research recommendations. As mentioned, UCM style and content vary widely across the country. Any computerized application that automates the management of utility conflicts needs to consider that different state DOTs have different needs. From a database perspective, the UCM would be one of several reports the system would need to support. At the same time, state DOT officials warned that a potential pitfall for implementing such a system would be the availability of adequate resources at the DOT to implement and maintain the system. Participants highlighted the need to provide a turnkey solution that emphasizes user-friendly interfaces and forms (since most users would likely have limited database knowledge or expertise).

Feedback from utility owner representatives indicated that utility owners tend to see the UCM and many of the activities around it as an internal process within the state DOT. While utility owners value effective communication and coordination, the process to develop or maintain a UCM is not critical to them. This finding means, for instance, that utility owners would need to know how to populate specific UCM cells in response to a request from the state DOT, but not how to create or maintain utility conflict records (since this is the state DOT's responsibility). Training opportunities on the use of UCMs and related processes would also differ between the two groups. Training for utility owners would focus on specific aspects of the UCM and items such as documentation and deadlines, whereas training for state DOT officials would need to be much more comprehensive.

Utility owners also indicated a preference for the use of project stations and offsets to locate utility conflicts, unless conflicts involve localized installations such as transmission towers, in which case a mechanism to report absolute coordinates (e.g., latitude and longitude obtained using global positioning system [GPS] receivers) would be more appropriate. Utility owners also indicated the need for a UCM field to explain why a utility relocation is necessary.

CHAPTER 6

Training Materials

Introduction

This chapter provides an overview of the training materials developed as part of this research project and describes the workshop structure, lesson plan, and individual lesson topics. (All the training materials will be available online at www.trb.org/Main/Blurbs/166731.aspx.) It also summarizes feedback on the effectiveness of the training materials the research team received from participants at two pilot training sessions held at the Arkansas State Highway and Transportation Department (Arkansas SH&TD) and the South Dakota DOT (SDDOT).

Lesson Plan

The research team structured a lesson plan and developed training materials to assist in disseminating the research findings. The 1-day utility conflicts and solutions seminar is divided into six lessons:

- Lesson 1. Introductions and seminar overview (30 minutes).
- Lesson 2. Utility conflict concepts and SHRP 2 Renewal Project R15B research findings (75 minutes).
- Lesson 3. Utility conflict identification and management (75 minutes).
- Lesson 4. Hands-on utility conflict management exercise (90 minutes).
- Lesson 5. Use of database approach to manage utility conflicts (45 minutes).
- Lesson 6. Wrap-up (15 minutes).

The seminar provides 5.5 hours of direct instructor contact and 1.75 hours of breaks (including lunch, which usually would occur between Lessons 3 and 4) for a total time of 7.25 hours. There are many opportunities for participant interaction, and the instructor can adjust session and lesson start times and durations depending on the audience and the level of participant engagement in the discussions. Tables 6.1 through 6.6 provide a more detailed description of the lesson plan.

The training materials use National Highway Institute (NHI) standards and templates, which take into consideration adult learning principles. Using these templates should facilitate the implementation of the training materials at the conclusion of the research. An integral component of the training materials is the use of actual project data that the research team requested from the states visited to illustrate UCM concepts and procedures.

Companion Training Materials

All the training materials described in this report will be available online (www.trb.org/Main/Blurbs/166731.aspx). The training materials are organized as shown in Table 6.7.

Pilot Training Sessions

The structure and content of the training materials reflect recommendations received by the research team at the conclusion of pilot training sessions held in January 2011 at the Arkansas SH&TD and SDDOT.

Each workshop participant received a binder that included the following materials:

- Instructional materials, including workshop instructions and lesson plan;
- Participant handout of the slides presented during the workshop;
- Lesson materials, including UCM samples, UCM sample database reports, sample project files, sample test-hole reports, and selected database look-up tables;
- Feedback forms; and
- Companion CD, including all the above files and a copy of the prototype utility conflict database in Microsoft Access 2007.

Table 6.1. Lesson 1: Introductions and Seminar Overview

Lesson Number	**1**	
Lesson title	Introductions and Seminar Overview	
Topics	• Introductions (both instructor and participants). • Overview of seminar objectives, outcomes, agenda, and reference materials. • Discussion of ground rules, sign-in sheet, feedback forms, and other housekeeping items.	
Instructional method	Activity 1. Instructor welcomes participants, introduces him/herself, and leads participants through introductions. Participants introduce themselves and provide a brief description of their role and experience in utility coordination, design, or other project development process matters. Activity 2. Instructor provides an overview of the seminar objectives, outcomes, agenda, and reference materials. Activity 3. Instructor discusses ground rules, sign-in sheet, feedback forms, and other housekeeping items as needed.	
Instruction time	8:30–9:00 a.m.	
Time allocation	• Activity 1: Introductions • Activity 2: Seminar overview • Activity 3: Housekeeping • Total Lesson 1	15 minutes 10 minutes 5 minutes 30 minutes
	Note: Depending on the seminar setting and the length of time actually spent on Lesson 1 activities, it might be possible to increase the time allocated to Lessons 2 or 3. In any case, for maximum effectiveness, it is not recommended to extend Lesson 3 beyond noon.	
Evaluation plan	Instructor uses the instructor review form to take notes on the background, experience, and role of participants in utility coordination, design, or other project development process matters.	
References	• Seminar binder. • Lesson 1 PowerPoint file and handouts. • SHRP 2 R15B research report (www.trb.org/Main/Blurbs/166731.aspx).	

Table 6.2. Lesson 2: Utility Conflict Concepts and SHRP 2 R15B Research Findings

Lesson Number	**2**	
Lesson title	Utility Conflict Concepts and SHRP 2 R15B Research Findings	
Learning outcomes	• Understanding of relevant concepts related to the management of utility conflicts within the project development process. • Understanding of the findings of the SHRP 2 R15B project.	
Instructional method	Activity 1. Instructor uses PowerPoint slides to describe typical utility conflict management concepts and issues. Activity 2. Instructor uses PowerPoint slides and printed UCM materials to • Describe the purpose and main findings of the SHRP 2 R15B project, with a focus on the stand-alone UCM and prototype Access database application. • Summarize trends and other information gathered through the online surveys and follow-up interviews. • Summarize process used to develop stand-alone UCM. • Describe prototype UCM data model and Access database application. Activity 3. Questions and answers • Instructor answers questions from participants. As needed, other participants participate in the discussion. • Depending on the seminar setting, instructor might choose to encourage questions from participants throughout the presentation instead of allocating 10 minutes at the end of the lesson for questions and answers.	
Instruction time	9:00–10:15 a.m.	
Time allocation	• Activity 1: Utility conflict concepts • Activity 2: SHRP 2 R15B research findings • Activity 3: Questions and answers • Total Lesson 2	25 minutes 40 minutes 10 minutes 75 minutes
Evaluation plan	• Instructor uses the instructor review form to summarize the types of questions and comments from participants. Depending on the setting, this activity might need to be completed after the seminar. • Participants use the participant feedback form to rate the effectiveness of the presentation.	
References	• Lesson 2 PowerPoint file and handouts. • Stand-alone and sample UCM printouts.	

Table 6.3. Lesson 3: Utility Conflict Identification and Management

Lesson Number	**3**	
Lesson title	Utility Conflict Identification and Management	
Learning outcomes	• Understanding of process used to develop and maintain a UCM using data from a sample project. • Understanding of the types of reporting options available when using a database representation of the UCM.	
Instructional method	Activity 1. Instructor uses PowerPoint slides and sample materials to • Demonstrate process used to identify utility conflicts using sample project drawings and associated information. • Describe structure and format of the prototype UCM and the process used to populate and maintain the UCM using sample project data. Activity 2. Discussion, questions, and answers • Instructor answers questions from participants. As needed, other participants participate in the discussion. • Instructor encourages participants to share and discuss real-world examples and/or the applicability of UCMs to real-world situations. • Depending on the seminar setting, instructor might choose to encourage questions and discussion from participants throughout Activity 1 instead of allocating 30 minutes at the end of the lesson for questions and answers.	
Instruction time	10:30–11:45 a.m.	
Time allocation	• Activity 1: Utility conflict management and use of UCM • Activity 2: Discussion, questions, and answers • Total Lesson 3	45 minutes 30 minutes 75 minutes
Evaluation plan	• Instructor uses the instructor review form to summarize the types of questions and comments from participants. Depending on the setting, this activity might need to be completed after the seminar. • Participants use the participant feedback form to rate the effectiveness of the presentation.	
References	• Lesson 3 PowerPoint file and handouts. • Sample UCM printouts, plan sheets, and test-hole reports.	

Table 6.4. Lesson 4: Hands-On Utility Conflict Management Exercise

Lesson Number	**4**	
Lesson title	Hands-On Utility Conflict Management Exercise	
Learning outcomes	• Identification of utility conflicts on sample project design drawings. • Use of UCMs to manage utility conflicts.	
Instructional method	Activity 1. Participants (individually or in groups depending on the setting) use sample project materials and blank UCM template to • Identify as many utility conflicts as possible on sample project materials. • Transcribe utility conflict information into the UCM. Instructor uses PowerPoint presentation and other sample materials to • Direct seminar participants during exercise. • Answer questions as needed. Activity 2. Instructor uses sample materials and feedback from individuals or groups to • Display design drawings with all utility conflicts identified and the UCM completely filled out. • Lead a discussion with participants about the detection and management of utility conflicts using a UCM approach.	
Instruction time	1:00–2:30 p.m.	
Time allocation	• Activity 1: Individual/small group hands-on exercise • Activity 2: Discussion • Total Lesson 4	70 minutes 20 minutes 90 minutes
Evaluation plan	• Instructor uses the instructor review form to summarize the types of questions and comments from participants. Depending on the setting, this activity might need to be completed after the seminar. • Participants use the participant feedback form to rate the effectiveness of the presentation.	
References	• Lesson 4 PowerPoint file and handouts. • Sample UCM printouts, plan sheets, and test-hole reports.	

Table 6.5. Lesson 5: Use of Database Approach to Manage Utility Conflicts

Lesson Number	**5**	
Lesson title	Use of Database Approach to Manage Utility Conflicts	
Learning outcomes	• Understanding of utility conflict data model capabilities. • Understanding of the process used to develop customized queries and reports.	
Instructional method	Activity 1. Instructor uses PowerPoint slides, prototype Access database, and sample materials to • Describe data model structure and capabilities. • Describe data model connections with other DOT information systems. Activity 2. Instructor uses PowerPoint slides, prototype Access database, and sample materials to • Describe how utility conflict data are stored into the database. • Illustrate the process used to develop and run Access queries and reports. Activity 3. Instructor uses prototype Access database to demonstrate the use and capabilities of the UCM data model and database structure. Activity 4. Questions and answers • Instructor answers questions from participants. As needed, other participants participate in the discussion. • Depending on the seminar setting, instructor might choose to encourage questions from participants throughout the presentation instead of allocating 10 minutes at the end of the lesson for questions and answers.	
Instruction time	2:45–3:30 p.m.	
Time allocation	• Activity 1: Data model structure • Activity 2: Use of Access database to manage utility conflicts • Activity 3: Access database demonstration • Activity 4: Questions and answers • Total Lesson 5	5 minutes 20 minutes 10 minutes 10 minutes 45 minutes
Evaluation plan	Participants' learning will be evaluated by their participation and questions.	
References	• Lesson 5 PowerPoint file and handouts. • Printed copies of the logical data model of the database. • Printed copies of sample database queries and reports.	

Table 6.6. Lesson 6: Wrap-Up

Lesson Number	**6**	
Lesson title	Wrap-Up	
Topics	• Instructor provides summary of seminar. • Instructor collects feedback forms.	
Instructional method	Activity 1. Instructor summarizes the activities of the seminar, addresses any final questions of seminar participants, provides closing remarks and collects the feedback forms provided by the seminar participants.	
Instruction time	3:30–3:45 p.m.	
Time allocation	• Activity 1: Final questions and closing remarks • Total Lesson 6	15 minutes 15 minutes
References	• Participant feedback form.	

Table 6.7. Training Materials

Folder Name	File Name	No. of Slides or Pages	Format[a]
Binder	Training material binder participants	204	pdf
	Training material binder presenter	416	pdf
Forms	Instructor review form	6	pdf
	Participant feedback form	6	pdf
	Sign-in sheet	4	pdf
Instructional materials	Lessons 1–6 participant handout	76	pdf
	Lessons 2–5 sample UCMs, plan sheets, look-up tables	90	pdf
	Lesson 3 test hole form	1	pdf
	Lesson 3 utility conflict matrix	3	pdf
	Lesson 4 Group 1 exercise materials	13	pdf
	Lesson 4 Group 2 exercise materials	16	pdf
	Lesson 4 Group 3 exercise materials	13	pdf
	Lesson 4 Group 4 exercise materials	13	pdf
	Lesson 4 group assignment	1	pdf
	Lesson 4 group exercise instructions	2	pdf
	Lesson 4 test hole forms	5	pdf
	Lesson 4 utility conflict solution sheet	1	pdf
	Presenter notes	214	pdf
Lessons	Lesson 1	4	pptx
	Lesson 2	74	pptx
	Lesson 3	54	pptx
	Lesson 4	43	pptx
	Lesson 5	33	pptx
	Lesson 6	3	pptx
	UCM training outline	NA	xls
Prototype 1–Stand-alone UCM	Utility conflict matrix	NA	xls
Prototype 2–Data model and database	UCD data dictionary	11	pdf
	UCD data model	NA	erwin
	UCD export schema Oracle 10	NA	sql
	Utility conflict database	NA	mdb

Note: UCD = utility conflict database.

[a]erwin: Computer Associates ERwin Data Modeler; pptx: Microsoft PowerPoint 2007; mdb: Microsoft Access 2003; sql: structured query language; pdf: Adobe portable document format; and xls: Microsoft Excel 2003.

The Arkansas pilot training session took place at the Arkansas SH&TD headquarters in Little Rock. Twenty participants representing the Arkansas SH&TD, FHWA, and county agencies attended the session. Arkansas SH&TD attendees included officials involved in design, as well as right-of-way and utility coordination. Most attendees were involved in utility coordination. Overall, the workshop was well received, and the feedback from participants was positive. More than 90% of participants thought Lessons 1, 2, 3, and 6 were good or excellent. The corresponding percentages for Lessons 4 and 5 were lower: 63% and 78%, respectively.

The second pilot training session took place at SDDOT headquarters in Pierre. Twenty-seven SDDOT participants attended the session, including officials who work on project development, design, right-of-way, and utility coordination. The proportion of officials who were involved in project development or design was higher in South Dakota than in Arkansas. The South Dakota workshop was also well received. About 73% of participants rated all lessons good or excellent, with the exception of Lesson 3, which was rated good or excellent by 96% of participants.

Based on specific recommendations from training session participants, the research team made several changes to the training materials, particularly in Lessons 4 and 5, including the following:

- Revised several presentation files to add clarity, explain acronyms, and improve the flow of the presentation.
- Added examples provided by SDDOT after the Pierre training session that describe real-life situations of utility conflicts and solutions. The research team included these examples in Lesson 2 to enhance the discussion about potential ways to address utility conflicts.
- Edited the plan sheets to indicate an area of the plan sheet for each group in Lesson 4 to work on, instead of asking each group to work on the whole plan sheet.
- Produced one set of plan sheets for each group in Lesson 4 in Arch D format (22 × 34 in.) to complement the 11 × 17-in. plan sheets for individual participants.
- Increased the time to find utility conflicts and discuss solutions in Lesson 4.
- Produced a solution sheet of utility conflicts in Arch D format for each group in Lesson 4 (after each group had an opportunity to find utility conflicts independently).
- Reduced the overall duration of Lesson 5 and changed its focus from a detailed demonstration on how to do database data entry to a short demonstration of database queries and reports. This change was necessary to take into consideration that most participants at this type of event are design engineers and utility coordinators, not information technology professionals.

CHAPTER 7

Implementation Guidelines

Introduction

This chapter contains implementation guidelines that describe strategies and an implementation plan to promote application of the research products. The implementation guidelines address the following topics:

- Research products;
- Audience or market for the products;
- Assessment of impediments to successful implementation;
- Research product leaders (or champions);
- Activities necessary for successful implementation; and
- Criteria for judging the progress and consequences of implementation.

Research Products

The products resulting from this research include the following:

- *Prototype stand-alone UCM (i.e., Prototype 1).* This stand-alone product in Microsoft Excel includes a main utility conflict table and a supporting worksheet to analyze utility conflict resolution strategies.
- *Prototype utility conflict data model and database (i.e., Prototype 2).* This stand-alone product is a scalable UCM representation that facilitates managing utility conflicts in a database environment. To facilitate implementation, the research team used industry-standard protocols for the development of the data model (including a logical model, a physical model, and a data dictionary). The data model is in AllFusion ERwin Data Modeler format, which can be easily exported to formats such as Oracle and SQL Server. The data model was tested using sample utility conflict tables from across the country.
- *Training materials.* This stand-alone product includes a lesson plan and presentation materials to assist with the dissemination of research findings. The 1-day UCM training course is divided into six lessons, designed for a total of 7 hours and 15 minutes of instruction. The seminar provides numerous opportunities for participant interaction and allows the instructor to adjust session and lesson start times and durations depending on the audience and the level of participant engagement in the discussions. The training materials use NHI standards and templates.
- *Implementation guidelines.* This product contains strategies and an implementation plan to promote application of the research products. The implementation guidelines address topics such as audience or market for the products, assessment of impediments to successful implementation, research product leaders (or champions), activities necessary for successful implementation, and criteria for judging the progress and consequences of implementation.

Audience or Market for the Products

The audience for the research products is the stakeholders who are involved in utility coordination throughout the development process of transportation projects. Because utility conflicts can affect transportation projects from project concept to project completion, the expected audience for the research products is potentially large. This audience includes three main groups of stakeholders, as follows:

- *Public sector (project owners).* Agencies that may be interested in the research products include FHWA, AASHTO, state DOTs, and local public agencies (cities and counties). Within these agencies, groups of interest would include groups responsible for transportation planning, environmental clearance, preliminary design, right-of-way acquisition, utility activities, design (including PS&E), and construction. Project owners are expected to play a number

of roles with respect to the research products, including user, developer, manager, and steward.

- *Private sector (consultants and contractors).* Groups that may be interested in the research products include design consultants, utility consultants, subsurface utility engineering (SUE) consultants, highway contractors, and utility contractors involved in utility coordination activities between conflict elimination stakeholders. Consultants and contractors are expected to play a user role, although, depending on their relationship with project owners, they could also be developers or managers.
- *Utility owners.* Groups that may be interested in the research products include owners and operators of privately, publicly, or cooperatively owned utility facilities or systems. Examples of facilities or systems include those used for producing, transmitting, or distributing communications, cable television, power, electricity, light, heat, gas, oil, crude products, drinkable water, steam, and wastewater. Strictly speaking, owners or operators of facilities or systems such as storm water drainage not connected with highway drainage, fire control, police signal systems, or street lighting systems could also be interested in the products of the research. Utility owners are expected to play a user role.

Impediments to Successful Implementation

The research team conducted an analysis of impediments that might hinder the successful implementation of the research findings. For convenience, the potential impediments are grouped into four categories: technical challenges, economic and financial challenges, stakeholder buy-in and consensus challenges, and policy challenges. Subsequent sections outline potential champions and strategies to address the impediments described in this section.

Technical Challenges

The research team examined technological limitations, hardware and software incompatibilities, and other technical challenges that might impede implementation of the research findings. Examples of potential technical challenges include the following:

- Different districts within a state DOT might already use UCMs that contain different data elements from those included in the prototype UCM. This issue is not critical because, although the prototype table contains 25 data elements, the data model and prototype database include more than 140 data elements from which a suitable set could be selected and integrated into a UCM that addresses the need of that state DOT. It is worth noting that implementing a UCM protocol consistently and thoroughly is more important than which individual data elements to include in a UCM.
- A state DOT might use computer systems that contain different data elements from those included in the prototype UCM. An example of this situation is a state DOT that has a project management system in place that uses different table names from those used in the prototype. This issue is not critical because many of the tables in the prototype utility conflict database, particularly those tables that provide connections to other business processes, are actually placeholders that could be easily replaced with actual table names that the state DOT already uses.
- A state DOT does not use SUE to collect utility data. This issue is not critical for implementing a UCM approach. Although collecting quality utility data using SUE protocols is highly advisable when warranted, none of the data elements in the UCM are mandatory. As a result, a state DOT could decide to leave those fields blank. Readers should note that not collecting quality utility data increases the level of risk for a project owner, but this increased level of risk does not invalidate the use of a UCM approach for managing conflicts. In fact, the agency could use a UCM approach over time to help document the impact of not collecting quality utility data.
- A state DOT does not have the ability in place to evaluate the feasibility of individual utility conflict resolution strategies, including costs. This is an important issue, but, as with the lack of quality utility data, a state DOT could actually use a UCM approach over time to help document the impact resulting from not having the ability to examine alternative conflict resolution strategies reliably.

Overall, the research team's assessment is that the required technology-based tools and knowledge needed to implement the research findings successfully are already in place at most, if not all, state DOTs. First, UCMs are widely used, although perhaps not in a standardized way or throughout the project development process. Second, even in the case of an enterprise-level implementation of the prototype utility conflict database, the reality is that server-based applications are now commonplace. Judging from the successful results of implementing UCMs in some states (e.g., Georgia) and the positive feedback from representatives at other state DOTs (e.g., Arkansas and South Dakota), the research team's conclusion is that implementing UCMs around the country is technically feasible.

Economic and Financial Challenges

The implementation of the research findings might fail if the perceived costs associated with the implementation exceed the benefits that stakeholders would receive or if the

stakeholders do not perceive economic benefits from the implementation. Examples of economic and financial challenges include the following:

- A state DOT does not have the financial resources to implement the research findings. This is an important issue, particularly at a time when most state DOTs are facing severe budgetary constraints. Various strategies are possible to address this issue, some of which are outlined in subsequent sections.

  Readers should note that the three main products of the research (Prototype 1, Prototype 2, and training materials) require different financial commitment levels for their implementation. Prototype 1 is perhaps the most affordable product (in its most basic form, it would simply imply requiring the use of a standardized UCM), followed by dissemination of the training materials. The cost to implement Prototype 2 would be relatively low if a state DOT decides to implement the stand-alone database produced during the research. The cost would be higher for an enterprise-level implementation (although the benefits would also be considerably higher).
- Project managers or districts within a state DOT might not perceive tangible economic benefits from implementing a UCM approach. This is an important issue, for which an obvious counterstrategy is to document and disseminate lessons learned from study cases in which UCM approaches are used.

  Realistically, however, documenting and disseminating lessons learned is not sufficient. Not managing utility conflicts effectively increases the level of risk for a project owner, which in turn can have significant negative economic repercussions. However, the compartmentalized structure at most state DOTs (with handoffs at critical milestones, such as beginning of design, letting, and construction) hinders accountability and internalization of risks. Strategies to address this issue in the context of this research include using UCMs with control dates (to ensure the UCM is a living document) and beginning their use early in the project development process.
- Project managers might decide not to use (or to stop using) a UCM approach because of the perception that total project costs for the agency will increase if the frequency of design-around-the-conflict situations increases, effectively reducing the need for required utility relocations for which utility owners must pay. This important issue is clearly related to which agency internalizes which costs. Ultimately, society pays for all public works within the right-of-way, either in the form of taxes or utility rates. Notwithstanding the need to evaluate each utility conflict on its own, evaluating total project costs and their implications should be addressed at the appropriate agency level (including executive level). Communications and negotiations with utility owners might be warranted to identify strategies and solutions that work for both parties.

Overall, the research team's assessment is that implementation of the research findings can pay for itself within a short period of time. Increasing evidence from around the country, some of which has been described elsewhere in this report or the training materials, indicates that ignoring utility conflicts during the project development process can be costly, and designing a project to minimize utility conflicts can save thousands of dollars. As an illustration, consider the following real-world examples:

- Bridge designers realized during construction that slightly modifying the horizontal alignment of the bridge would have avoided utility impacts without affecting the right-of-way or the construction phase. The numerous affected utility facilities were relocated at a cost of $5 million, which could have been avoided.
- In a rural area, a conflict with an existing 69-kV corner pole was detected at 30% design. Relocating the pole would have cost around $60,000. Timely coordination and redesign of the transportation facility around the pole made it unnecessary to relocate the pole. The total cost, which included building an approach to the pole for maintenance purposes, was $3,000 (for which the utility owner paid).
- For an interstate highway project, widening the highway required raising the embankment by 50 to 60 feet. The state DOT expected significant soil settlement, which would have affected existing major gas and water facilities in the area. The state DOT was able to avoid costly utility relocations by using a foam layer and a concrete cap to protect the existing utility installations in-place.

Stakeholder Buy-In and Consensus Challenges

The opportunity to implement the research findings will increase with the degree of consensus among stakeholders. Conversely, the implementation of the research findings might fail if there is no stakeholder buy-in or consensus about the potential benefits that could result from the implementation. Examples of potential challenges include the following:

- Some stakeholders, such as utility coordinators, might see benefit in implementing the research products, but other stakeholders, such as designers, might be skeptical.
- Critical champions at FHWA, AASHTO, or SHRP 2 might decide that implementing the research products is not critical or strategically important.

The research team's assessment is that, when presented with information such as training materials or PowerPoint presentations describing the research and its findings, state DOT officials will overwhelmingly support implementing the research products. Throughout the research, members of the research team met repeatedly with stakeholders, such as utility coordinators, project managers, designers, area and district engineers, and directors. Almost without exception, the feedback received was that the state DOT would benefit greatly from implementing the research findings.

Degree of acceptance (i.e., stakeholder buy-in) varied with the research product. Most stakeholders saw considerable potential in implementing the prototype stand-alone UCM (Prototype 1), particularly its potential uses with other elements, such as timely communication between designers and utility coordinators, timely coordination with utility owners, and adequate collection of utility data. The prototype UCM and the training materials addressed this need by placing the UCM approach within an integrated framework that encourages communication and coordination and uses enough data elements to facilitate follow-up and monitoring during the project development process.

In contrast, stakeholders who did not understand databases or computer systems were somewhat skeptical of the prototype utility conflict data model and database (Prototype 2). Those who were more knowledgeable about systems appreciated the benefit that an automated approach for managing utility conflicts could provide their agency. These stakeholders also understood the potential for generating a wide range of queries and reports, as well as the ability to document and manage utility conflicts effectively in conjunction with other computerized systems their agency already had in place.

Acceptance of the training materials was overwhelmingly positive. In general, utility coordinators and other officials who deal with utility issues on a daily basis noted that the training materials validated concerns they had for years about the need for more effective coordination and management of utility conflicts. They also saw in the UCM approach a formalized process to help them manage utility conflicts more effectively and to provide better feedback to the design process. Some project managers and designers were skeptical at first (probably influenced by the traditional assumption in highway design that utility facilities in conflict should move), but after attending the pilot training session, they understood the benefit of adopting a UCM approach to help them address utility conflicts more effectively.

The research team's assessment is that private-sector stakeholders (i.e., consultants and contractors) will strongly support implementing the research findings because the UCM approach will help them provide a better service to their clients (i.e., state DOTs). These stakeholders also see the UCM approach as an opportunity to help bring innovation to an area of the project development process that has long been characterized as needing attention.

In the case of utility owners, the research team's assessment is that these stakeholders are neutral with respect to the potential benefits that a UCM approach can provide. They do not necessarily see the short-term benefit of using a table (or a formalized process around that table) to manage utility conflicts, but they would not object to its use. Feedback from utility owner representatives indicates that utility owners tend to see UCMs as an internal process to state DOTs with which they need to interact only on request.

As a minimum, utility owners would expect UCMs not to add burden or red tape to their interaction with state DOTs. If the new process provides benefits, its chances of acceptance will increase. Based on previous work, the research team is aware that utility owners, like most other organizations, tend to embrace technologies and processes that have a positive impact on their bottom line—that is, translate into savings in money or time. The information presented in this report strongly suggests that utility owners would not lose and, on the contrary, could realize significant economic benefits from an implementation of the research findings.

Policy Challenges

The implementation of the research findings might fail if required policies fail or do not fully support the use of a UCM approach. Examples of policy challenges include the following:

- Although a state DOT might see the value of implementing a UCM approach, it does not formalize or document its use in manuals such as utility, project development process, and design manuals. Describing the use of the UCM approach in agency procedural documents is an effective way to ensure its implementation.
- Despite written documents that describe or require a UCM approach, state DOT officials do not actively monitor its use or continue its development. The value of a UCM approach is directly proportional to the agency's willingness to use it in daily practice, as well as maintain it and continue its development over time.
- A state DOT might not use the UCM approach consistently throughout the project development process. For example, a project manager might use a UCM to identify and manage utility conflicts during the design phase, but the PS&E assembly does not include a utility certification listing all pending utility relocations. In a similar situation, the utility certification might provide a simple list of pending utility relocations, but not include additional critical information (which the agency has already compiled in a UCM) that prospective bidders would need to prepare proposals that properly reflect the level of risk with which they are willing to work.

Overall, the research team's assessment is that with the correct policies in place, it should be possible to implement standardized processes for UCMs nationwide. The following sections outline champions and activities, many of them policy related, to promote application of the research products.

Research Product Leaders (Champions)

Stakeholders who will take a leadership role in the implementation of the research results will be those who expect the greatest benefits. The research team believes champions at the federal and state levels and in the private sector will be needed for successful implementation of the research products.

FHWA, for example, has broad responsibility to ensure that the country's roads and highways are safe and technologically up to date. The UCM approach developed as part of the present research could be an effective tool to assist with FHWA strategies in the area of utilities, such as those promoted by the Every Day Counts initiative. One of the initiative's purposes is to highlight existing flexibilities in federal laws, regulations, and policies to expedite and improve the accommodation or relocation of utility facilities through effective and innovative use of agreements, reimbursements and incentives, and construction provisions.

State DOTs that are already using UCMs to great advantage, or soon will be, could take a leadership role by sharing success stories and technical information with peers at national conferences and meetings or by networking with their counterparts in other states. AASHTO technical committees could also play a role in encouraging state DOTs to implement the research products.

Private-sector stakeholders are expected to acquire the research products for the benefit of their clients, particularly in the case of roadway and utility design consultants, contractors, utility coordinators, and SUE providers. Organizations such as the American Society of Civil Engineers, the American Public Works Association, consultant and contractor associations, and utility coordinating councils could also encourage their members and constituents to implement the research products.

Activities Necessary for Successful Implementation

At a high level, the following steps should ensure the successful implementation of the research products:

- Engage the research product champions early, identify major progress milestones, and maintain good communication channels with the various stakeholders during all phases of the implementation process.
- Identify measurable implementation targets and funding mechanisms for the implementation of the UCM and related processes at one or more state DOTs.
- Monitor the progress of the UCM implementation. Possible activities to monitor progress would be frequent meetings and updates at critical milestones.

More specifically, the following steps should take place to start and continue the implementation of the research products:

- Establish an implementation team as soon as possible. Research product champions should be engaged as members of the team and should include one or more representatives of agencies such as FHWA, AASHTO, state DOTs, the private sector, and utility-related committees. Communication channels with other stakeholders should be established and maintained during all phases of the implementation process.

  The implementation team should first familiarize itself with the UCM approach developed during the research. At a minimum, this activity should include discussions with the research team and participation in a training session similar to the Arkansas and South Dakota pilot presentations. This training session should take place within 2 months of starting the implementation.

  Once familiar with the research products, and within 3 months of starting the implementation, the implementation team should identify the following:
  - Major progress milestones.
  - Measurable implementation targets.
  - One or more states willing to undertake immediately a pilot project to implement the UCM and its processes. Steps to begin this implementation should be taken. These early implementation projects will be effective vehicles to use during the training courses (see below) when encouraging other states to implement the research products.
  - Funding mechanisms for the implementation of the UCM and related processes at state DOTs.

  The present research came about in response to a pressing need throughout the country for the optimization of the management of utility conflicts. State DOTs recognize this need (as indicated by the positive feedback received during the pilot training sessions in Arkansas and South Dakota), but some states might be slow to embrace this new process on their own. Likely reasons for this reluctance include the state of the economy and an unwillingness by some stakeholders to change traditional practices. Therefore, it will be essential for the implementation team to actively promote the use of the research findings. Promotion will require funding.

  Finally, members of the implementation team should discuss actions they can take within their own agencies to obtain help in promoting the UCM and its processes. This may include promotion with upper management, help with

funding, outreach to clients, and presentations at conferences and meetings. This activity is continuous, but should take place primarily within the first 12 months after starting the implementation.

- Conduct a series of UCM training courses at several interested state DOTs. This activity should be completed within 6 months after starting the implementation.

  The UCM training materials were developed using NHI standards and templates. These templates incorporate adult learning principles and have been tested and used at NHI for many years, which will facilitate implementing the training materials at the conclusion of the research (e.g., if FHWA or AASHTO wanted to convert the materials into an NHI course). The transition of the UCM training course to a long-term training mechanism could occur at any time, but for implementation monitoring purposes, it is assumed to take place between 6 and 18 months after starting the implementation.
- In conjunction with work being done by the implementation team, the UCM training course should be presented at as many state DOTs as possible. One of the critical observations made as part of the current research is that there is a huge need across the United States for improvement and optimization of utility conflict processes. Providing the initial presentations at state DOTs (see previous bullet entry) will only be a preliminary step in addressing this huge need. Maintaining momentum will be critical, and perhaps the most effective way to accomplish this objective will be to promote the UCM approach by conducting UCM training courses throughout the country. This activity should be completed within 18 months after starting the implementation.
- In addition to the training component described above, the research team expects two implementation paths (and corresponding plans) for the UCM and related processes, depending on the level of implementation individual state DOTs decide to pursue.
  - For Prototype 1, implementation can take place directly at the administrative unit level (e.g., district level) that deals with utility conflicts on a daily basis. The research team expects little or no involvement by information technology (IT) personnel because Prototype 1 is a stand-alone spreadsheet in Microsoft Excel format.

    To ensure success with this implementation, the state DOT should assemble an agencywide task force composed of personnel such as utility coordinators and designers to plan and monitor the implementation process as well as identify needs (e.g., in connection with training and outreach activities). The state DOT should also introduce modifications to its utility, project development process, and design manuals to incorporate the UCM process.

    This activity is continuous, but for implementation monitoring purposes, it is assumed to occur within 24 months after starting the implementation.
  - For Prototype 2, implementation could take place at the administrative unit level that deals with utility conflicts on a daily basis (e.g., district level) or at a headquarters level, depending on whether the agency chooses a stand-alone database approach or an enterprise-level database approach. A stand-alone database approach would be appropriate if a state DOT does not have the resources to invest in an enterprise-level system or if it decides to first test the prototype locally to see if a statewide implementation would be feasible. Either way, it would be necessary to develop some basic user interfaces, queries, and reports because the prototype developed during the research focused primarily on the data model and sample queries to replicate tables provided by a sample of states from across the country.

    To ensure success with this implementation, the state DOT should assemble an agencywide task force composed of members such as utility coordinators, designers, and IT personnel to plan and monitor the implementation process as well as identify needs (e.g., in connection with specific system requirements, as well as training and outreach activities). The state DOT should also introduce modifications to its utility, project development process, and design manuals to incorporate the UCM process.

    This activity is continuous, but for implementation monitoring purposes, it is assumed to occur within 36 months after starting the implementation.
  - An alternative (or complementary) implementation path for Prototype 2 would be for several states to pool funds to develop a system to automate the management of utility conflicts using as a foundation the data model developed during the research.

    The research team believes this implementation path is technically feasible because the series of queries and reports developed for Prototype 2 to replicate the tables provided by a sample of states used the same data model and the same database. A single data model would not merely facilitate the development of a single system; it would also facilitate the development of queries and reports that satisfy the varying needs of a wide range of states. To facilitate this implementation path, the research team used industry-standard protocols for the development of the data model (including a logical model, a physical model, and a data dictionary). The data model is in AllFusion ERwin Data Modeler format, which can be easily exported to other formats, including a variety of physical model implementations such as Oracle or SQL Server.

    This activity is continuous, but for implementation monitoring purposes, it is assumed to occur within 36 months after starting the implementation.

WBS	Task Name
1	**Implementation Team**
1.a	Assemble implementation team
1.b	Conduct training session with implementation team
1.c	Establish progress milestones, targets, and funding
1.d	Promote research products
2	**UCM Training Courses**
2.a	Conduct UCM training courses at designated state DOTs
2.b	Transition UCM training course to long-term training mechanism
2.c	Conduct UCM training course at additional state DOTs
3	**Prototype 1 Implementation (typical state DOT)**
3.a	Assemble agency-wide task force
3.b	Monitor implementation at district level
4	**Prototype 2 Implementation (typical state DOT)**
4.a	Assemble agency-wide task force
4.b	Identify user and system needs
4.c	Develop and test user interfaces
4.d	Monitor implementation
5	**Alternative Prototype 2 Implementation (pooled fund)**
5.a	Identify participating state DOTs
5.b	Assemble multiagency task force
5.c	Identify user and system needs
5.d	Develop and test user interfaces
5.e	Monitor implementation

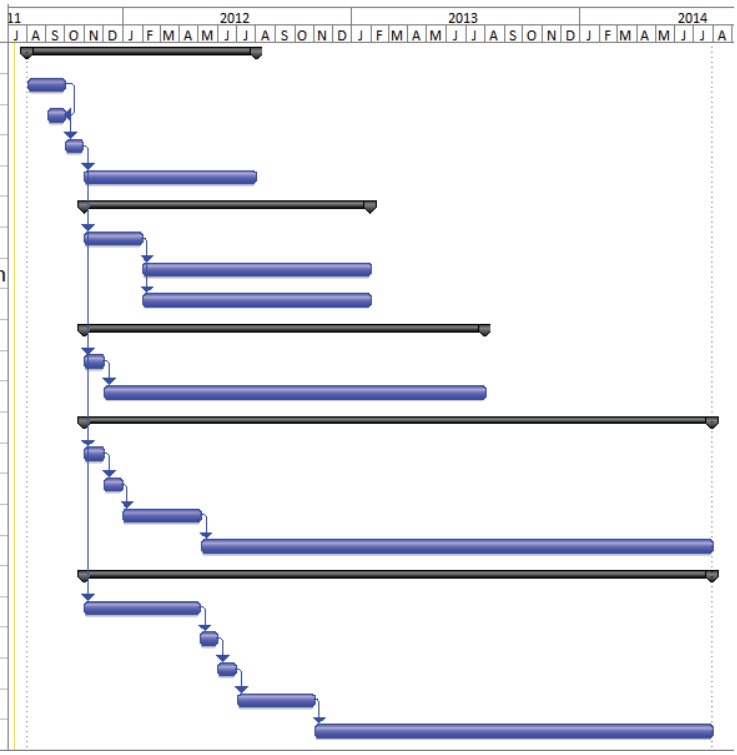


Figure 7.1. Expected implementation schedule.

- Progress of the UCM implementation should be monitored by activities such as frequent meetings of the implementation team and updates at critical milestones. This activity is continuous.

Figure 7.1 shows a preliminary schedule of the activities described above.

Criteria for Judging Implementation Progress and Consequences of Implementation

The research team identified the following criteria or performance measure elements for evaluating the effectiveness of the implementation of the research products:

- Degree of acceptance by state DOTs of the UCM process;
- Number of states that have developed utility management systems that include UCM concepts;
- Demand for and degree of acceptance of the training materials;
- Number of states that have conducted UCM training courses;
- Number of state DOT officials, by function category (e.g., utility coordination, preliminary design, design), who have attended a UCM training course;
- Reduction in the number of, and dollar amount associated with, unnecessary utility relocations;
- Reduction in the number of, and dollar amount associated with, utility-related change orders or claims; and
- Number of states that use UCMs to produce utility certifications within their PS&E assemblies.

CHAPTER 8

Conclusions and Recommendations

Conclusions

Research Framework

Two critical factors that contribute to inefficiencies in the transportation project development process are the lack of accurate, complete information about utility facilities that might conflict with the project and the resolution and overall management of those conflicts. Potential utility conflicts at transportation projects include the following:

- Interference between utility facilities and transportation design features (existing or proposed);
- Interference between utility facilities and transportation construction activities or phasing;
- Interference between planned and existing utility facilities;
- Noncompliance of utility facilities with utility accommodation policies; and
- Noncompliance of utility facilities with safety regulations.

The traditional approach for resolving utility conflicts at many state DOTs is to relocate the affected utility facilities—often at great expense to the DOT or the utility owner or both. Relocating a utility facility is not necessarily the only or best strategy to resolve a utility conflict. Other strategies include designing and constructing the transportation facility in such a way as to leave the affected utility facilities in place.

Utility coordination involves the production and exchange of enormous amounts of data and supporting documents, including schematics, design files, agreements, and certifications. A critical component of this process is how to document and manage utility conflict data. Various approaches for tracking utility conflicts exist, including tracking utility agreements (which is an indirect way of tracking utility conflicts); tracking utility conflict status or resolution separately; and tracking utility conflict resolution milestones, utility agreements, and other documents as part of a comprehensive information system.

UCMs enable users to organize, track, and manage utility conflicts. Practices involving the use of UCMs vary widely across the country. There is a need to document these practices and develop optimized UCM concepts and techniques that can contribute to standardization and optimization of the utility coordination process. SHRP 2 Renewal Project R15B addressed this need in the following ways:

- Reviewing trends around the country and identifying best practices on the use of UCMs;
- Developing and testing a standardized UCM concept;
- Developing training materials; and
- Developing implementation guidelines.

State Practices

The research team conducted an online survey of state agencies around the country to assess general practices related to utility conflict management and determine potential candidates for follow-up interviews. Based on the results of the online survey, the research team identified a sample of state DOTs for follow-up interviews. Although the main goal was to search for established and documented innovative procedures for utility conflict management and UCMs, the follow-up interviews were also intended to gather positive and negative lessons learned, as well as recommendations from state DOTs. As part of the interview process, the research team requested available documentation, such as sample tables, data, and manuals.

State DOTs track a wide range of utility facility data items, although there is a clear preference for data items such as class of utility facility and utility owner name and contact information. About two-thirds of the respondents track basic utility facility data, such as diameter, material, and depth of cover, and only slightly more than half track facility details, such as dimensions or encasement material. State DOTs consistently track a large number of utility conflict data items.

Most state DOTs track utility conflict IDs, cost estimates, and transportation project IDs. Slightly less frequent but still common data items are additional payment information and utility conflict description and location.

Project centerline and station is the most popular method for referencing utility conflicts along transportation project alignments. Respondents also indicated they use a variety of other longitudinal referencing methods, such as route and mile point, control section and distance, and route markers and displacement. The most common method for referencing utility conflict offsets is with respect to the project centerline. Other offset methods mentioned were right-of-way line, existing centerline, edge of pavement, and back of curb.

States use a variety of data management platforms to manage utility conflict data. Spreadsheets, word processors, and CAD are the most common methods for managing utility conflict data, followed by desktop databases, server-based databases, and web-based viewers. Less than half of the states use GIS applications to manage utility conflict data.

State DOTs use a variety of methods to track and update utility conflict locations on project drawings. There is a clear preference for traditional paper-based approaches to mark up printed drawings or maps. Marking up CAD files is also common, but not as frequent as marking up paper drawings. More than 40% of respondents indicated they mark up 2-D PDF files, clearly indicating the increasing acceptance of the PDF file format for document editing and updating purposes.

There are also wide differences in the way states undertake utility investigations. States frequently collect QLB and QLA data at some point during design, although the extent of the investigation varies widely depending on factors such as type of project, expected utility investigation cost, and awareness or knowledge of SUE concepts. In some cases, the collection of QLB and QLA data is limited to critical points during the project development process. Some states are beginning to collect QLB data during preliminary design.

Many states follow a traditional approach for utility conflict management in which the state DOT sends a set of project plans to utility owners, the utility owners provide markups of their utility facilities (typically on hard copies), and state DOT (or consultant) staff transcribe the markups onto design CAD drawings. Some states start utility conflict management during preliminary design and send a preliminary design drawing to utility owners. Other states wait until 60% design, once drainage design elements are in place (since drainage design frequently drives the need for utility relocations). Upon review of the design drawings, the roadway designer determines which utility installations are in conflict and need to relocate and communicates this determination to utility owners. The utility owners then develop and submit relocation plans (typically around 60% to 90% design). Utility facilities that are eligible for reimbursement require the submission of utility agreement assemblies that include additional information, such as quantities, cost estimates, betterment data, and local agency participation.

Some states prefer to begin utility relocations once the roadway design is complete and there is certainty the project will go forward as designed. Other states attempt to relocate all utility facilities in conflict by the time a project goes to letting. However, even when a state makes significant efforts to complete all utility relocations by letting, there are often utility facilities that need to relocate during construction. To alert contract bidders of potential delays, most state DOTs include information about known utility conflicts in the letting documentation, typically in the form of utility certifications or special provisions. Some state DOTs provide comprehensive lists of outstanding utility conflicts, including utility owner, utility conflict location, and conflict status. Other state DOTs only provide a brief statement to the effect that the contractor is responsible for contacting all utility owners.

A review of 26 sample tables from around the country used by state DOTs to manage utility conflicts indicated that state DOTs use a wide range of styles and content to develop and maintain UCMs. Clearly one size does not fit all. The research team counted 144 data items in the 26 utility conflict tables. The number of data items per table ranged from four to 39, with an average of 14. The research team grouped the 144 data items into the following data categories: projects, project contacts, utility facilities, utility conflicts, right-of-way, utility investigations, utility relocation, utility coordination dates, agreements, costs, billings, and document tracking data. These categories provided the foundation for the development of the prototype stand-alone UCM, as well as the development of the prototype UCM data model and database.

Examples of recommendations from around the country include the following:

- Utility conflict matrix
  - Identify utility conflicts at the individual utility facility involved;
  - Include control dates in UCMs to document progress within the project development process;
  - Develop utility conflict sheets for individual utility owners;
  - Keep UCMs simple;
  - Maintain and update the UCM regularly;
  - Use an 11 × 17-in. page size for utility conflict tables;
  - Start assembling utility conflict tables during preliminary design; and
  - Include data from UCMs in PS&E assemblies.

- Utility conflict management
  - Use document management systems to support the utility conflict management process;
  - Conduct plan-in-hand field trips with utility owners;
  - Use one-call services to identify utility owners and facilities early in the process;
  - Use and document RFID tags for damage prevention during construction; and
  - Provide 3-D design details to utility owners early in the design phase.
- Other
  - Involve stakeholders in the review of utility conflicts and solutions;
  - Develop effective communications with utility owners regardless of reimbursement eligibility; and
  - Provide training to utility coordination stakeholders.

Prototype Stand-Alone UCM (Prototype 1)

The research team analyzed the sample documentation received from around the country, ranked and grouped data items, and developed a prototype UCM. In principle, this prototype UCM should satisfy the requirements of the majority of the states. Key requirements in the determination of which data items to include in the prototype UCM were UCM compactness, efficiency, and completeness. Figure 3.2 shows the prototype stand-alone UCM. This UCM includes data items in two main sections: UCM header (eight data items that include information about the project and control data items) and UCM body (15 data items that include information about individual utility conflicts, such as conflict characteristics, data collection needs, and resolution status).

An earlier version of the UCM included a data item for cost estimates. However, discussions with stakeholders at several DOTs indicated this data item was not clearly defined and could result in confusion during implementation, largely because state DOTs manage a variety of cost estimates in connection with utility relocations. This realization made it necessary to remove the cost estimate item from the UCM and, instead, develop a separate sheet to track and analyze cost estimates for all resolution alternatives that may be associated with individual utility conflicts. Several options are possible for developing cost estimate sheets. For simplicity, the research team used a model that contains relevant alternative information for individual utility conflicts.

The research team developed the prototype UCM and the UCM alternative resolution subsheet in Microsoft Excel 2007. For convenience, the Excel UCM version includes four worksheets: the main UCM, the UCM alternative resolution subsheet, column or field definitions, and drop-down lists to standardize the population of certain columns in the main UCM.

Prototype Utility Conflict Data Model and Database (Prototype 2)

As mentioned, in the process of managing utility conflicts, states manage large amounts of data about a wide range of topics, including projects, project contacts, utility facilities, utility conflicts, right-of-way, utility investigations, utility relocation, utility coordination dates, agreements, costs, and billings. Some of these topics can be grouped into higher-order categories that represent real-world objects or concepts that can be characterized using a set of relevant tables, attributes, and relationships. Figure 8.1 shows the conceptual framework for managing utility conflicts used during the research.

To address the need of how to manage large amounts of utility conflict–related data items, the research team developed a prototype data model and database. To facilitate implementation, the research team used industry-standard

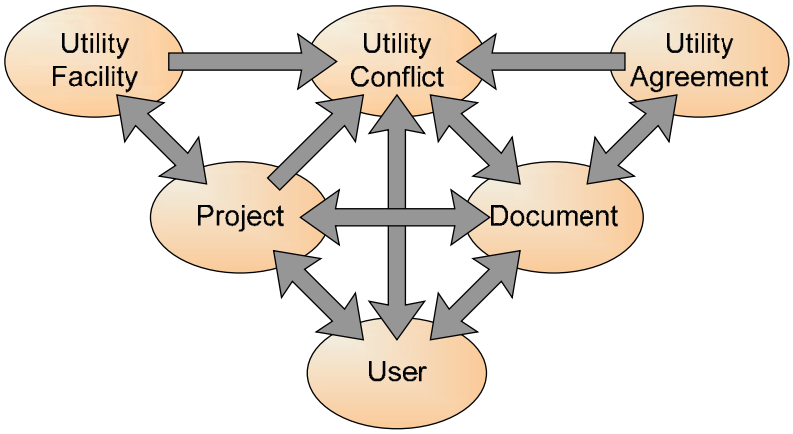


Figure 8.1. Conceptual model for the management of utility conflicts.

protocols for the development of the data model (including a logical model, a physical model, and a data dictionary). The data model is in AllFusion ERwin Data Modeler format, which can be easily exported to formats such as Oracle and SQL Server.

The research team tested the prototype data model using a Microsoft Access database implementation and data from sample utility conflict tables from across the country. This process included the development of queries and reports to replicate several sample UCMs, including the following:

- Prototype UCM example;
- Alaska DOT&PF UCM example;
- Caltrans UCM example;
- GDOT UCM example; and
- TxDOT UCM example.

Using data from a wide range of states across the country makes the prototype data model and resulting database flexible and capable of accommodating most data items related to utility conflicts. Additional advantages of a database approach to manage utility conflicts include the possibility of adapting the database to address changes in DOT needs and business processes, flexibility on what database components to implement, scalability, and linkages to existing state DOT data systems.

Once a database system is implemented, its real power lies in its ability to enable a wide range of queries and reports. Other than the various UCMs that were replicated during the research, a short sample of reports the prototype database could enable includes the following:

- A report listing all utility conflicts associated with company X (for a specific project, corridor, or time frame);
- A report of all water facilities in conflict (for a specific project or corridor);
- A report summarizing average conflict resolution times for electric facilities statewide;
- A report providing average conflict resolution times for water facilities on project Z;
- A report listing all utility conflicts with resolution times of more than 100 days;
- A customized UCM report listing only the utility conflicts of a specific utility owner; and
- A list of unresolved utility conflicts at time of letting for inclusion in the PS&E package (sometimes called utility certification).

Training Materials

The research team structured a lesson plan and developed training materials to assist with the process of disseminating the research findings. The 1-day utility conflicts and solutions seminar was designed for a total of 7 hours and 15 minutes of instruction. It includes 5.5 hours of direct instructor contact and 1.75 hours of breaks (including lunch). The seminar provides numerous opportunities for participant interaction and enables the instructor to adjust session and lesson start times and durations depending on the audience and the level of participant engagement in the discussions.

The UCM training materials were developed using NHI standards and templates. These templates incorporate adult learning principles and have been tested and used at NHI for many years, which will facilitate implementing the training materials at the conclusion of the research (e.g., if FHWA or AASHTO wanted to convert the materials into an NHI course). An integral component of the training materials is the use of actual project data received from state DOTs to illustrate UCM concepts and procedures.

The structure and content of the training materials described above reflect recommendations received by the research team at the conclusion of two pilot training sessions held in January 2011. The first, at the Arkansas SH&TD, included 20 participants from FHWA, the Arkansas SH&TD, and county agencies involved in design, right-of-way, and utility coordination. The second training session included 27 participants from SDDOT who work on project development, design, right-of-way, and utility coordination.

Overall, the workshops were well received, and the feedback from participants was positive. Based on specific recommendations from training session participants, the research team made several changes to the materials, including changes to presentation files to add clarity, explain acronyms, and improve the flow of the presentation, as well as changes to maximize the effectiveness of the hands-on exercises.

Recommendations

Given the positive feedback obtained in response to the development and testing of the stand-alone UCM (Prototype 1), the prototype data model and corresponding database (Prototype 2), and the training materials, the research team recommends that the implementation of the research products proceed.

To assist in this process, the research team developed a set of implementation guidelines that address topics such as audience or market for the products, assessment of impediments to successful implementation, research product leaders (or champions), activities necessary for successful implementation, and criteria for judging the progress and consequences of implementation.

Chapter 7 provides a detailed description of each of these topics. In summary, the audience for the research products is

the stakeholders who are involved in utility coordination throughout the development process of transportation projects. Because utility conflicts can affect transportation projects from project concept to project completion, the expected audience for the research products is potentially large. This audience includes three main groups of stakeholders: public sector (project owners), private sector (consultants and contractors), and utility owners. Stakeholders are expected to play different roles. Project owners are expected to take roles as user, developer, manager, and steward. By comparison, consultants, contractors, and utility owners are expected to play a user role. However, depending on their relationship with project owners, consultants and contractors could also be developers or managers.

The research team conducted an analysis of impediments that might hinder the successful implementation of the research findings. For convenience, the potential impediments are grouped into four categories, as follows:

- *Technical challenges.* This category includes technological limitations, hardware and software incompatibilities, and other technical challenges that might impede implementation of the research findings. The research team's assessment is that the required technology-based tools and knowledge needed to implement the research findings successfully are already in place at most, if not all, state DOTs. First, UCMs are widely used, although perhaps not in a standardized way or throughout the project development process. Second, even in the case of an enterprise-level implementation of the prototype utility conflict database, the reality is that server-based applications are now commonplace. Judging from the successful results of implementing UCMs in some states (e.g., Georgia) and the positive feedback from representatives at other state DOTs (e.g., Arkansas and South Dakota), the research team's conclusion is that implementing UCMs around the country is technically feasible.
- *Economic and financial challenges.* The implementation of the research findings might fail if the perceived costs associated with the implementation exceed the benefits that stakeholders would receive or if the stakeholders do not perceive economic benefits from the implementation. The research team's assessment is that implementation of the research findings can pay for itself within a short period of time. Increasing evidence from around the country, some of which has been described elsewhere in this report or the training materials, indicates that (a) ignoring utility conflicts during the project development process can be costly, and (b) designing a project to minimize utility conflicts can save thousands of dollars.
- *Stakeholder buy-in and consensus challenges.* The opportunity to implement the research findings will increase with the degree of consensus among stakeholders. Conversely, the implementation of the research findings might fail if there is no stakeholder buy-in or consensus about the potential benefits that could result from the implementation. The research team's assessment is that, when presented with information such as training materials or PowerPoint presentations describing the research and its findings, state DOT officials will overwhelmingly support implementing the research products. Throughout the research, members of the team met repeatedly with stakeholders, such as utility coordinators, project managers, designers, area and district engineers, and directors. Almost without exception, the feedback received was that the state DOT would benefit greatly from implementing the research findings.
- *Policy challenges.* The implementation of the research findings might fail if required policies do not fully support the use of a UCM approach. The research team's assessment is that with the correct policies in place, it should be possible to implement standardized processes for UCMs nationwide.

The research team developed a 36-month plan to start and continue the implementation of the research products. This plan includes the following steps:

- Establish an implementation team as soon as possible. The implementation team should first familiarize itself with the UCM approach developed during the research. Once familiar with the research products, the implementation team should identify major progress milestones, measurable implementation targets, and funding mechanisms. One or more states should be identified that may be willing to immediately undertake a pilot project to implement the UCM and its processes, and this implementation should be initiated.
- Conduct a series of UCM training courses at several designated state DOTs that have expressed interest in implementing the UCM. At an appropriate point, transition the training course to an organization (such as NHI) that can provide the training over the long term.
- Present the UCM training course at as many state DOTs as possible. The initial presentations at designated state DOTs (see previous bullet entry) will not completely address the huge need around the country for improvement and optimization of utility processes. Therefore, it will be critical to maintain momentum, and perhaps the most effective way to accomplish this objective will be to promote the UCM approach by conducting UCM training courses throughout the country.
- Follow two implementation paths (and corresponding plans) for the UCM and related processes, depending on

which level of implementation individual state DOTs decide to pursue:

- For Prototype 1, implementation can take place directly at the administrative unit level (e.g., district level) that deals with utility conflicts on a daily basis. The research team expects little or no involvement by IT personnel because Prototype 1 is a stand-alone spreadsheet in Microsoft Excel.
- For Prototype 2, implementation could take place at the administrative unit level that deals with utility conflicts on a daily basis (e.g., district level) or at a headquarters level, depending on whether the agency chooses a stand-alone database approach or an enterprise-level database approach. A stand-alone database approach would be appropriate if a state DOT does not have the resources to invest in an enterprise-level system or if it decides to try the prototype out locally to see whether a statewide implementation would be feasible.
- An alternative (or complementary) implementation path for Prototype 2 would be for several states to pool funds to develop a system to automate the management of utility conflicts using as a foundation the data model developed during the research.

Research Needs

During the research (including the online survey, follow-up interviews, work sessions, pilot training sessions, and conference presentations), the research team had numerous opportunities to interact with state DOT officials and other stakeholders to discuss business practices and ways in which the research products could assist with the improvement and optimization of utility conflict management processes.

These interactions were also useful in identifying areas that were beyond the scope of this research but which stakeholders identified as sources of inefficiency that were in critical need for innovation. These are areas in which stakeholders do not normally conduct research—for example, through state DOT research programs, SHRP 2, or the National Cooperative Highway Research Program (NCHRP).

Areas that stakeholders identified as needing attention, and for which research is warranted, include the following:

- Impact of the acceleration of the project development process, particularly the design phase, on the ability of state DOTs (and utility owners) to complete utility relocations before letting. Most utility owners are reluctant to get involved in utility coordination activities until critical design elements, particularly drainage, are in place (which frequently happens around or after 60% design). With the compression of the design phase, the period between 60% and 90% (or 100%) design is getting shorter, reducing the available time for utility owners to complete their design and schedule relocations in the field before construction starts. Utility owners increasingly complain that relocation schedules imposed by state DOTs are unreasonably short. There is a need to evaluate and quantify this impact and identify strategies to help stakeholders manage the increased level of risk, both during design and construction.
- Impact of getting transportation projects shovel ready (in case construction funding becomes available) on the ability of state DOTs and utility owners to conduct utility coordination activities before construction. With the economic crisis in recent years, many state DOTs have seen their construction budgets slashed. With fewer dollars available, some state DOTs are pursuing a strategy of completing the design of several projects hoping that, if funding becomes available, at least some of those projects could go to construction quickly. A common problem with this strategy is that utility design and relocation (and even right-of-way acquisition) cannot proceed because funding for these activities is frequently tied to construction funding decisions. Some state DOTs have informal coordination meetings with utility owners but warn them that they are not eligible for reimbursement (including engineering and other preliminary activities) until funds are available. There is a need to quantify the magnitude of the problem, evaluate the implications of not engaging in meaningful utility coordination activities during design, and identify strategies to help stakeholders manage the increased level of risk, both during design and construction.
- Streamlining and standardization of cost estimates and protocols for the submission of estimates and billings. A frequent source of contention between state DOTs and utility owners is the preparation and review of utility agreements, cost estimates, and billings. Although current regulations provide flexibility to states with respect to what cost estimation methodologies to require and use, current practices lack standardization. As a result, it is common for states to receive estimates for similar types of installations but, because different utility owners are involved, the estimates cannot be compared for consistency. By extension, it is difficult to compare utility relocations done through agreement with those that are included in the highway contract. Another consequence of the lack of standardization is that state DOT officials must spend more resources than necessary reviewing and checking individual agreements and supporting documentation, not to mention the impact on utility owners because of the need to spend considerable resources (unnecessarily) redoing utility agreements and cost calculations. There is a need to evaluate and quantify the problem, evaluate the feasibility of streamlining federal and state regulations, and develop standardized protocols for state DOTs.

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APPENDIX A

Survey Questions

Name: _____
Title: _____
Agency: _____
Mailing address: _____
Division, office, or bureau: _____
Phone number: _____
Email address: _____

1. How often are the following involved in the management of utility conflicts?

a) Transportation projects $100 million or more *(Note: According to SAFETEA-LU, federal-aid projects $100 million or more need to prepare an annual financial plan.)*

	Always	Frequently	Rarely	Never
Headquarters/division personnel	○	○	○	○
Local/district personnel	○	○	○	○
DOT consultants	○	○	○	○
Other	○	○	○	○
If other, please specify:				

b) Transportation projects $25–$100 million *(Note: According to SAFETEA-LU, projects $25 million or more require a value engineering analysis.)*

	Always	Frequently	Rarely	Never
Headquarters/division personnel	○	○	○	○
Local/district personnel	○	○	○	○
DOT consultants	○	○	○	○
Other	○	○	○	○
If other, please specify:				

c) Transportation projects <$25 million

	Always	Frequently	Rarely	Never
Headquarters/division personnel	○	○	○	○
Local/district personnel	○	○	○	○
DOT consultants	○	○	○	○
Other	○	○	○	○
If other, please specify:				

2. For the following project sizes, what type of data management platform(s) do you use to manage utility conflicts? *Check all that apply.*

	≥$100 million	$25–$100 million	<$25 million
Spreadsheet (Excel, OpenOffice, other)	☐	☐	☐
Word processor (Word, Word Perfect, other)	☐	☐	☐
Desktop database (Access, other)	☐	☐	☐
Server-based database (SQL Server, Oracle, MySQL, other)	☐	☐	☐
CAD (AutoCAD, Microstation, other)	☐	☐	☐
GIS (ArcGIS, TransCAD, Geomedia, other)	☐	☐	☐
Web-based viewer (Google Earth, Virtual Earth, other)	☐	☐	☐
Other or customized system	☐	☐	☐
If other, please provide name(s):			

Note: Questions 3 through 5 gather information about data items. Question 3 focuses on utility ***facility*** *data. Questions 4 and 5 focus on utility* ***conflict*** *data.*

3. What data about utility *facilities* do you track? *Check all that apply*.

☐ Utility owner name
☐ Utility owner contact name
☐ Utility owner address
☐ Utility owner phone number
☐ Utility facility class (e.g., water, electric, gas)
☐ Utility facility subclass (e.g., water line, water manhole, water valve)
☐ Capacity
☐ Diameter
☐ Material
☐ Depth of cover
☐ Encasement (yes/no)
☐ Encasement material
☐ Number of ducts
☐ Installation/relocation date
☐ Operational status (in use/inactive/out of service/abandoned)
☐ Dimensions (e.g., width, height, length)
☐ Facility foundation characteristics (e.g., diameter, depth, material) label
☐ Customers affected
☐ Other
If other, please specify: _____

4. What data about utility *conflicts* do you currently track? *Check all that apply.*

☐ Utility conflict ID
☐ Transportation project ID
☐ Utility conflict description
☐ Utility conflict location
☐ Utility conflict length
☐ Utility property interest
☐ Proposed utility conflict resolution action
☐ Responsible party for proposed utility conflict resolution action
☐ Right-of-way requirements
☐ Betterment percentage
☐ Cost estimate(s)
☐ Utility agreement number
☐ Utility agreement execution date
☐ Estimated start date of utility relocation
☐ Actual start date of utility relocation
☐ Estimated clearance date of utility relocation
☐ Utility relocation construction status (percent complete)
☐ Payment date(s)
☐ Partial, final, and/or total payment(s)
☐ Actual clearance date of utility relocation
☐ Other
If other, please specify: _____

5. What method(s) do you use to reference utility *conflict* locations? *Check all that apply.*

a) Alignment and offset-based methods *(Example: If you use project stations and perpendicular offsets with respect to the centerline, check the box in row "Project centerline and station" under column "Project centerline.")*

Longitudinal Alignment	**Offsets with respect to…**					
	Existing centerline	Project centerline	Right-of-way line	Edge of pavement	Back of curb	Offsets not used
Project centerline and station	☐	☐	☐	☐	☐	☐
Other centerline and station	☐	☐	☐	☐	☐	☐
Control section and distance	☐	☐	☐	☐	☐	☐
Route and mile point	☐	☐	☐	☐	☐	☐
Route markers and displacement	☐	☐	☐	☐	☐	☐
Street intersection and displacement	☐	☐	☐	☐	☐	☐
Street block	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐
If other, please specify:						

b) Coordinate-based methods

☐ State plane coordinates
☐ Latitude and longitude coordinates
☐ Other
If other, please specify: _____

6. What utility facility and/or conflict data do you need that you currently do not track?

_____
_____
_____

7. What method(s) do you use to track and update utility conflict locations? *Check all that apply*.

☐ Mark up printed drawing or map
☐ Mark up CAD file
☐ Mark up 2-D PDF file
☐ Mark up 3-D PDF file
☐ Mark up GeoPDF file
☐ Mark up or update feature in GIS file
☐ Mark up features online using web-based viewer
☐ Other
If other, please specify: _____

8. By when has the utility conflict management and coordination process typically started?

	Always	Frequently	Rarely	Never
Advance planning	○	○	○	○
Preliminary design	○	○	○	○
0%–30% design	○	○	○	○
30%–60% design	○	○	○	○
60%–90% design	○	○	○	○
90%–100% design	○	○	○	○
Letting	○	○	○	○
Construction	○	○	○	○

9. By when are all utility relocations typically completed in the field?

	Always	Frequently	Rarely	Never
Advance planning	○	○	○	○
Preliminary design	○	○	○	○
0%–30% design	○	○	○	○
30%–60% design	○	○	○	○
60%–90% design	○	○	○	○
90%–100% design	○	○	○	○
Letting	○	○	○	○
Construction	○	○	○	○
Postconstruction	○	○	○	○

10. By when are utility relocation as-builts typically received?

	Always	Frequently	Rarely	Never
Advance planning	○	○	○	○
Preliminary design	○	○	○	○
0%–30% design	○	○	○	○
30%–60% design	○	○	○	○
60%–90% design	○	○	○	○
90%–100% design	○	○	○	○
Letting	○	○	○	○
Construction	○	○	○	○
Postconstruction	○	○	○	○

11. What is the typical level of responsibility for the following in relation to utility conflict data? *Check all that apply .*

Stakeholder	**Level of Responsibility**					
	Create	Read	Append	Update	Mark up	None
DOT project manager	☐	☐	☐	☐	☐	☐
DOT project engineer/designer	☐	☐	☐	☐	☐	☐
Area/local DOT engineer	☐	☐	☐	☐	☐	☐
DOT inspector	☐	☐	☐	☐	☐	☐
DOT utility coordinator	☐	☐	☐	☐	☐	☐
DOT consultant (other than SUE)	☐	☐	☐	☐	☐	☐
SUE consultant	☐	☐	☐	☐	☐	☐
DOT contractor	☐	☐	☐	☐	☐	☐
Utility owner	☐	☐	☐	☐	☐	☐
Utility consultant	☐	☐	☐	☐	☐	☐
Utility contractor	☐	☐	☐	☐	☐	☐
Local public agency representative	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐
If other, please specify stakeholder and level(s) of responsibility:						

12. Where is utility coordination located within the agency's organization charts?

	At headquarters/ division level	At district/local level
Right-of-way	☐	☐
Planning and programming	☐	☐
Design	☐	☐
Environmental	☐	☐
Operations	☐	☐
Separate utility office	☐	☐
Other	☐	☐
If other, please specify:		

13. Can you provide sample utility conflict data to the research team?

○ Yes
○ No

14. May we contact you to further discuss your agency's utility conflict management practices and needs?

○ Yes
○ No

15. Is there anyone else at your agency we can contact for additional information?

Name: _____
Title: _____
Division, office, or bureau: _____
Phone number: _____
Email address: _____

16. Use the space below for additional comments, including examples of best practices, innovative approaches, or other ideas that you would like to share with the research team.

_____
_____
_____

APPENDIX B

Review of State Practices

Introduction

This appendix includes a summary of practices and sample documentation from states the research team contacted to gather information about utility conflict management, with a focus on utility conflict matrices (UCMs) and related processes. The review included the following state department of transportation (DOT) agencies:

- Alaska Department of Transportation and Public Facilities (Alaska DOT&PF);
- California Department of Transportation (Caltrans);
- Delaware Department of Transportation (DelDOT);
- Florida Department of Transportation (FDOT);
- Georgia Department of Transportation (GDOT);
- Kansas Department of Transportation (KDOT);
- Louisiana Department of Transportation and Development (Louisiana DOTD);
- Michigan Department of Transportation (MDOT);
- Minnesota Department of Transportation (MnDOT);
- Missouri Department of Transportation (MoDOT);
- Nevada Department of Transportation (NDOT);
- North Carolina Department of Transportation (NCDOT);
- Ohio Department of Transportation (ODOT);
- South Dakota Department of Transportation (SDDOT);
- Tennessee Department of Transportation (TDOT);
- Texas Department of Transportation (TxDOT);
- Vermont Agency of Transportation (VTrans);
- Virginia Department of Transportation (VDOT);
- Washington State Department of Transportation (WSDOT); and
- Wyoming Department of Transportation (WYDOT).

Alaska Department of Transportation and Public Facilities

By statute, the cost of most utility relocations in Alaska is considered a cost of the highway project. However, according to Alaska DOT&PF officials, full payment for utility relocations has not necessarily improved adherence to project schedules. Alaska DOT&PF still largely relies on the willingness of utility owners to cooperate concerning facility location information, the relocation design effort, and the scheduling of utility relocation activities.

Alaska DOT&PF uses data collected on spreadsheets and plan sets to track utility conflicts. By informal agreement, at no cost to the DOT, utility owners provide approximate horizontal locations of facilities as needed to support state projects. At about 30% design, the DOT identifies conflicts, and utility owners verify the utility information. After receiving this information, designers may look for opportunities to avoid or mitigate locations in conflict. If more accurate utility facility location data are needed, utility owners conduct test holes, the cost of which is paid by the state. At about 75% design, utility relocation needs are determined, and utility owners are requested to relocate. At this time, Alaska DOT&PF may also purchase additional right-of-way if needed for utility relocations. Utility relocation agreements are developed and finalized at about the same time as the highway design effort is completed.

In practice, most utility relocation work is completed concurrently with the highway contract, largely because utility relocation funding is available only after highway contract funding is available, and the Alaska construction season is short. However, this practice reduces opportunities for advance utility relocation and adds complexities to project delivery. To address this issue, both highway contracts and utility agreements include provisions to require the parties to coordinate construction schedules. Alaska DOT&PF typically does not require as-builts from utility owners for facilities installed or relocated in state right-of-way beyond what is required for utility permits.

Alaska DOT&PF does not have a statewide utility engineer to oversee utility management tools and practices. State officials also indicated their utility manual needs to be updated. In the central Alaska region, where the majority of the utility work in Alaska is done, the utility conflict management process is somewhat standardized. Alaska has two other regions

DRAFT Utility Conflict Report
West Dowling Road Phase I

Anchorage, Alaska
DOT&PF No. 50898

Table 2: Chugach Electric Association, Incorporated, Conflicts Summary

Station	Offset	Station	Offset	Size/Type	Length	Conflict	ADJ/REL	Cost	PE/CE Cost	Total Cost
CEA Distribution Relocation Costs										
9+00	150' RT		200' LT	3φ UG	350	FG	REL	52,500	15,750	68,250
16+00	100' LT	42+30	80' LT	3φ UG	2630	FG	REL	394,500	118,350	512,850
16+00	100' LT	15+50	100' RT	3φ UG	250	FG	REL	37,500	11,250	48,750
16+00	100' LT	29+00	75' LT	1φ UG	1650	FG	REL	165,000	49,500	214,500
36+40	80' LT	35+80	350' RT	3φ UG	430	FG	REL	64,500	19,350	83,850
36+60	80' LT	36+70	380' LT	3φ UG	300	FG	REL	45,000	13,500	58,500
	UG Loop to the North			3φ UG	1000	FG	REL	150,000	45,000	195,000
							Subtotal	909,000	272,700	1,181,700
CEA Transmission Relocation Costs										
14+75	55' RT			138 kV OH	1	PWY	REL	30,000	9,000	39,000
32+75	55' RT			138 kV OH	1	EX	REL	50,000	15,000	65,000
36+38	45' RT			138 kV OH	1	EX	REL	50,000	15,000	65,000
							Subtotal	130,000	39,000	169,000
							Total CEA Relocation Costs	**1,039,000**	**311,700**	**1,350,700**

1φ Underground (UG) loop to extend across Dowling Road and along the south side to reconnect existing services.
UG loop provided to the north of the project to accommodate undergrounding.
Removal of existing swamp braces removed and steel piling added, down guys replaced with overhead span guy and down guys.

Figure B.1. Alaska DOT&PF sample utility conflict report excerpt.

with significantly smaller programs that have procedures more tailored to local needs.

Figure B.1 shows a sample utility conflict report from Alaska DOT&PF. Such reports, which are an important tool for utility conflict management, provide detailed information about the location of utility conflicts and the corresponding proposed resolution strategies. For each type of utility facility on a project, the utility conflict report describes existing facilities and conflicts with proposed roadway improvements and provides a utility conflict listing. The report also includes plan and profile sheets for all utility facilities within a project.

Alaska DOT&PF officials mentioned that it would be beneficial to provide training for their personnel related to utility facilities, particularly training about the design and construction of utility structures, especially power and communication systems.

California Department of Transportation

Caltrans uses a mainframe system to track utility conflicts and payments called right-of-way and utilities management system (RUMS). RUMS has a download (i.e., read-only) link from the project development database that provides data such as expenditure authorization (EA) numbers and project information (route, county, post miles, and a short project description). A six-digit EA number is unique for each transportation project and is not tied to control sections. The last digit of an EA number represents the phase and expenditure allocation of the activity. For example, during the project initiation document (PID) phase, the EA ends with a K. Similarly, an EA ending with a 9 represents the right-of-way capital fund.

Although RUMS includes a large number of data elements related to utility conflicts, it does not include a data element for proposed utility conflict resolution actions. A comment field enables utility coordinators to enter the conflict resolution method. Practices for adding utility conflict resolution notes vary by district.

District utility coordinators are responsible for creating and maintaining RUMS records that pertain to individual projects. The utility coordinator is the project point of contact for utility owners and Caltrans engineers. For each potential conflict or request for positive location (i.e., a request to conduct test holes to confirm the location of an underground utility facility), the utility coordinator creates a utility file and assigns a utility file number in RUMS. For example, if a conflict involves a gas line, a water line, and an underground electric facility, the utility coordinator creates three utility files, each with its own utility file number. A basic utility file number (e.g., 2222) is unique to a project EA. Attached to this number are digits that represent specific utility facilities—for example, 2222.1 for the gas line, 2222.2 for the water line, and 2222.3 for

the electric line. If the project engineer determines that the electric facility is in conflict, the relocation of the electric facility would be handled under 2222.3.1. In practice, file numbering practices vary across the state.

RUMS lacks reporting capabilities. In most cases, a utility relocation official at Caltrans headquarters has to download the data set and use office applications to generate reports. For the right-of-way certification, the utility clearing memoranda state which utility facilities need to relocate, who will perform the relocation, and who is financially responsible. The right-of-way certification is part of the plans, specifications, and estimate (PS&E) package.

Caltrans expects to replace RUMS soon, although funding issues have affected this initiative. In the meantime, Caltrans has developed a prototype Microsoft Access database as a model to guide the effort to replace RUMS (Figures B.2 and B.3).

Caltrans has long used utility conflict tables, although table formats and names are not standardized across districts. In most districts, utility conflict tables may vary from project to project. A notable exception is District 12 (Orange County), where an engineer developed and essentially standardized the table for the district (Figure B.4). Typical file formats for utility conflict tables include Microsoft Excel and Word and Bentley MicroStation.

Utility conflict tables are stand-alone products. Caltrans uses data from the utility conflict tables to help populate RUMS. Recently, some Caltrans districts started including data from the UCM in the design plans. On conventional highway projects, Caltrans may just list valves and manholes to avoid making the design process too difficult for designers. Similarly, Caltrans shows utility installations on cross sections for special situations—for example, if there is a need for a protect-in-place measure or high-risk utility installations. Typically, districts use UCMs for large, complicated projects, such as freeway interchanges; use of UCMs is less frequent for smaller projects. District 12 uses UCMs for all projects.

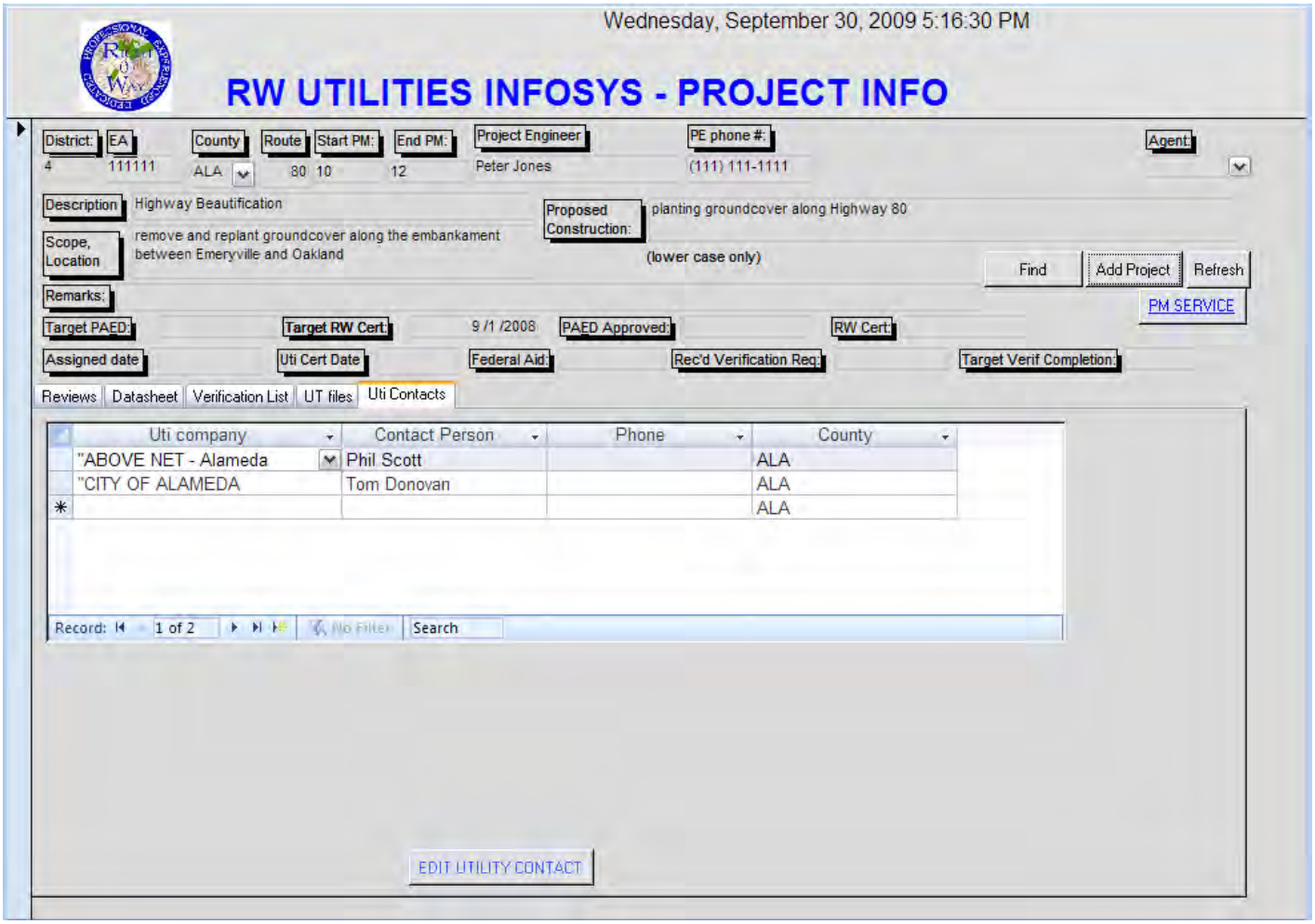


Figure B.2. Beta RUMS project screen.

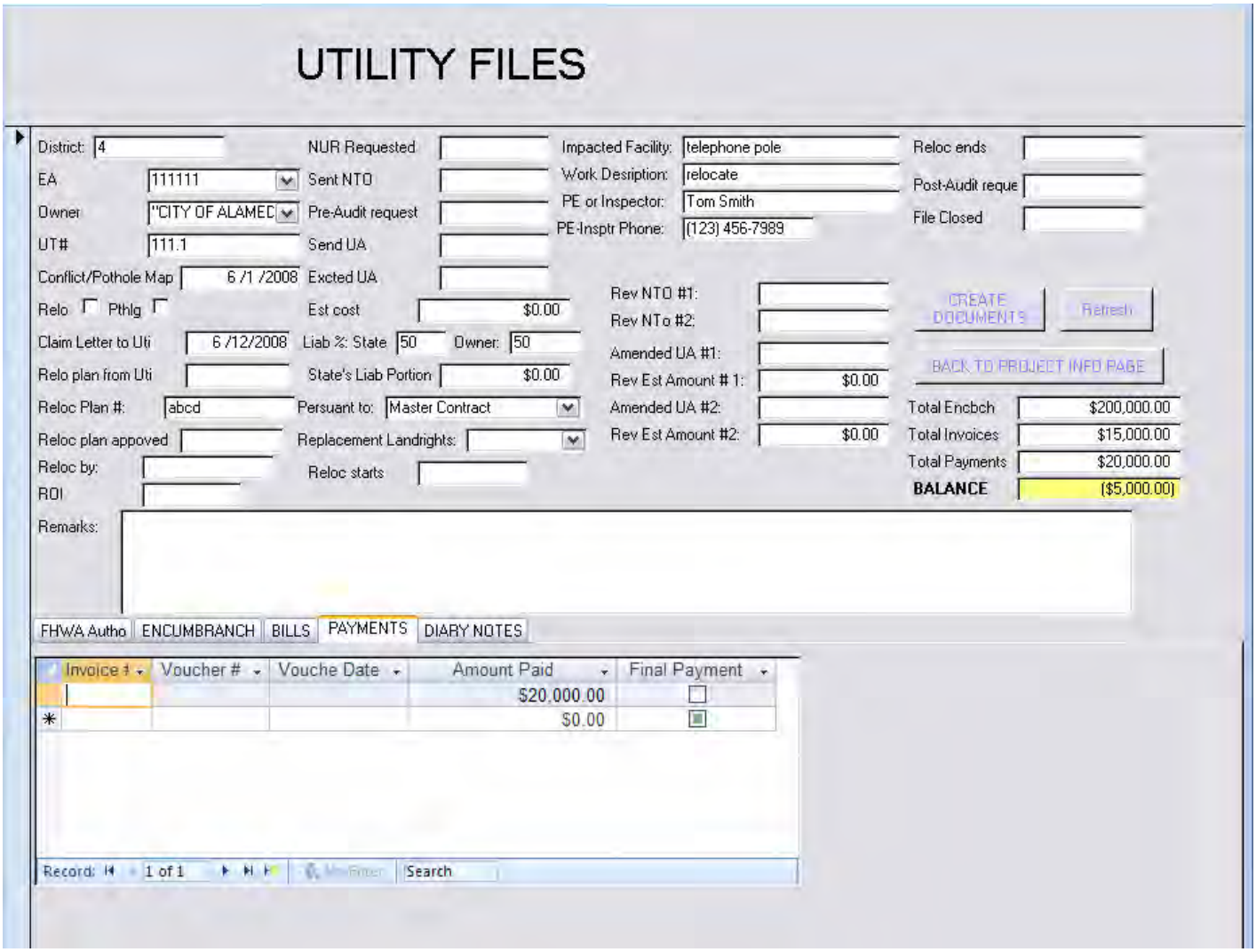


Figure B.3. Beta RUMS utility files screen.

The structure and content of UCMs vary depending on the project and the intended UCM recipient. For example, some UCMs include property parcel information, which could include information about joint-use agreements (e.g., Caltrans might convey an easement within the right-of-way if an existing utility facility is relocated outside an area where they had a prior property right), director's deeds, or utility owner land rights.

Some districts do not share cost information with utility owners. The cost estimate in the UCM is primarily for the project manager, which is important if the utility relocation is reimbursable. Utility sections usually track cost estimates and updates separately. Districts 1 and 2 (North Region) have a field in their UCM to track the cost to the utility owner, which is important if the relocation cost is substantial.

In the mid-2000s, Caltrans started a utility engineering group in an effort to improve and standardize utility procedures. The group is composed of engineers who are responsible for identifying utility conflicts and reviewing relocation plans. One of the initiatives of the group has been to develop a standardized utility conflict table. So far, they have reviewed several models from around the state, but seem to prefer the table from District 12 (Figure B.4). Caltrans expects to select a table (or to develop one, probably based on the District 12 model), although reaching consensus among all districts has been challenging.

District utility sections usually learn about projects around PID time, when a cost estimate, including a utility cost estimate (which the utility coordinator completes), must be produced. The utility relocation estimate is normally based on a worst-case scenario. For example, if a sewer line is located within project limits, the assumption is that the sewer line will be relocated. The decision to relocate and the corresponding cost estimate are refined as the project advances through design.

I-10-EA 122401-Utilities Conflict Status

date of last revision May 30, 2000
this document was prepared by

Conflict No.	Utility Sheet No.	Pothole No. *(On U-sheets)*	Owner	Utility Description	Pothole/Manhole Location	Conflict Location	Utility Conflict/ Work Description	Investigation			Depth (ft)	Impact?		Action			*Util. Reloc.* *A*- Abandon *RB*-Reloc.Before *RD*-Reloc.During *P*-Protect in place *NC*-No conflict	*Resp. Party* *U*-Utility Co *C*- Contractor	*Required Completion Date*	Comments
								Pothole	Manhole	Overhead		Y	N	Remove	Relocate	Other				
1	U-2	1	PACBELL	40 DU Telephone	62 m Rt of I-405 Sta 165+55	40 m Rt and 57 m Rt of I-405 Sta 165+55	conflict with Retaining Walls No. 166 & No. 168	X			4.55 14.40		N				*P*			
2	U-2	2	PACBELL	40 DU Telephone	48 m Lt of I-405 Sta 165+55	40 m Rt and 57 m Rt of I-405 Sta 165+55	conflict with Retaining Walls No. 166 & No. 168				-		N				*P*			
3	U-3	3	SCE	25 mm DU	35 m Rt of I-405 Sta 165+01	43 m Rt of I-405 Sta 165+01	conflict with Retaining Wall No. 166				-		N				*P*			Located in Bristol OC
4	U-3	4	SCE	25 mm DU	46 m Lt of I-405 Sta 165+01	43 m Rt of I-405 Sta 165+01	conflict with Retaining Wall No. 166				-		N				*P*			Located in Bristol OC
5	U-3	5	MWD	900 mm WSP Water in 380 mL ENC	50 m Rt of I-405 Sta 164+96	44 m Rt of I-405 Sta 164+95	conflict with Retaining Wall No. 166	X			6.70		N				*P*			
6	U-3	6	MWD	900 mm WSP Water in 380 mL ENC	50 m Lt of I-405 Sta 164+96	44 m Rt of I-405 Sta 164+95	conflict with Retaining Wall No. 166	X			6.50		N				*P*			
7	U-3	7	Caltrans	600 mm RCP	53 m Rt of I-405 Sta 163+42	53 m Rt of I-405 from Sta 163+29 to Sta 163+42	conflict with Delhi Channel Bridge	X			6.00		N				*P*			
8	U-3	8	Caltrans	600 mm RCP	53 m Rt of I-405 Sta 163+29	53 m Rt of I-405 from Sta 163+29 to Sta 163+42	conflict with Delhi Channel Bridge	X			9.00		N				*P*			
9	U-3	9	MCWD	300 mm ACP Water in 119mL, 500mm STL Casing	32 m Rt of I-405 Sta 163+25	35 m Rt of I-405 Sta 163+25	conflict with I-405 Widening & BR1 Line	X			10.30		N				*P*			
10	U-3	10	MCWD	300 mm ACP Water 119mL, 500mm STL Casing	32 m Lt of I-405 Sta 163+25	33 m Lt of I-405 Sta 163+25	conflict with I-405 Widening & BR1 Line	X			8.75		N				*P*			
11	U-3	MH 11	CSDOC	Manhole	81 m Rt of I-405 Sta 162+92	35 m Rt of I-405 Sta 162+92	conflict with I-405 Widening & BR1 Line		X		18.40		N				*P*			
12	U-3	12	CSDOC	380 mm VCP Sewer	36 m Lt of I-405 Sta 162+91	32 m Lt of I-405 Sta 162+90	conflict with I-405 Widening & BR1 Line				-		N				*P*			
13	U-4	13	MCWD	600mm CCP Water in 94m L 900mm Dia Stl Casing	67 m Rt of I-405 Sta 161+44	58 m Rt of I-405 Sta 161+44	Conflict with Airport Channel	X			4.55	Y			X	X	*RB*			600 mm Waterline to be Lowered Extend Encasement
14	U-4	14	MCWD	600mm CCP Water in 94m L 900mm Dia Stl Casing	38 m Lt of I-405 Sta 161+40	32 m Lt of I-405 Sta 161+42	conflict with I-405 Widening				-		N				*P*			
15	U-4	15	MCWD	300 mm ACP Water	70 m Rt of I-405 Sta 160+29	72 m Rt of I-405 from Sta 157+20 to Sta 160+29	Conflict with AOA Line and Retaining Wall No. 268	X			-	Y			X		*RD*			Enchroachment CT R/W and Private Owner Encased under Roadway
16	U-4	16	MCWD	300 mm ACP Water	70 m Rt of I-405 Sta 159+07	72 m Rt of I-405 from Sta 157+20 to Sta 160+29	Conflict with AOA Line and Retaining Wall No. 268	X			-	Y			X		*RD*			Enchroachment CT R/W and Private Owner Encased under Roadway
17	U-5	17	MCWD	300 mm ACP Water	70 m Rt of I-405 Sta 156+87	72 m Rt of I-405 from Sta 157+20 to Sta 160+29	conflict with AOA Line and Retaining Wall No. 268	X			4.35		N				*P*			
18	U-5	MH 18	CSDOC	Manhole	60 m Rt of I-405 Sta 156+65	28 m Rt of I-405 Sta 156+65	conflict with I-405 Widening		X		16.20		N				*P*			
19	U-5	19	CSDOC	380 mm VCP Sewer	46 m Lt of I-405 Sta 156+65	25 m Rt of I-405 Sta 156+65	conflict with I-405 Widening	X			18.40		N				*P*			
20	U-5	20	CSDOC	830 mm VCP Sewer	14 m Rt of B2 Sta 24+96		conflict with construction of B2 Line						N				*P*			
21	U-5	21	CSDOC	830 mm VCP Sewer	6 m Lt of B2 Sta 25+54		conflict with construction of B2 Line						N				*P*			
22	U-8	MH 22	CSDOC	Manhole	8m Rt of Main St Sta 102+78				X			Y				X	*RB*			MH to be Lowered New Top MH Elev= 9.588
23	U-8	MH 23 SCE MH 4503	SCE	Manhole No. 4503	8m Rt of Main St Sta 102+87				X			Y				X	*RB*			MH to be Lowered New Top MH Elev= 9.583 m
24	U-8	MH 24 SCE MH 4502	SCE	Manhole No. 4502	8m Rt of Main St Sta 104+17				X			Y				X	*RB*			MH to be Lowered New Top MH Elev= 9.728 m

Figure B.4. Caltrans District 12 sample utility conflict status list.

During the PID phase, the utility coordinator conducts a preliminary utility facility search. After this phase, districts complete a utility facility verification within project limits. For this activity, the utility coordinator uses an online application developed by the California one-call service Underground Service Alert (USA). The web-based interface enables Caltrans officials to enter the project limits, and the system generates a list of utility owners that might be operating within that area. There are two USA implementations: North USA (which enables officials to draw a box on the map) and South USA (which lets users identify areas of interest by clicking on individual cells in the displayed grid). USA does not display utility facility locations on the graphical interface.

After retrieving the list from USA, Caltrans sends a letter to each utility owner and requests a utility facility map within the project limits. After receiving the map, Caltrans adds the information to the project plans, which enables the project or utility engineer to identify potential conflicts. In some situations, Caltrans might decide to use a test hole contractor to identify a positive location. After identifying conflicts, the project engineer (or utility engineer) sends the conflict information to the district utility section to add records to RUMS and contact utility owners.

Both utility conflict tables and RUMS records are updated continuously, particularly in the case of cost estimates. Based on actual utility relocation cost estimates from utility owners, the utility coordinator enters the updates before issuing the right-of-way certification. After this milestone, the utility coordinator is still responsible for entering additional updates in RUMS based on actual utility relocation costs. RUMS does not keep track of previously entered values as new values override old values, making paper copies critical for record keeping.

As part of the agreement for the positive location of underground utilities (Pos-Loc) program, the state conducts test holes and pays 100% of the expenses. Before the Pos-Loc program, utility owners conducted test holes, which resulted in disruption and disagreement over the number of holes actually needed. With the new Pos-Loc process, each Caltrans district retains a dedicated contractor on an annual basis. The district contractor performs positive location within 5 days of issuance of a task order. There are no cost disputes with the utility owner since Caltrans pays for these activities. Caltrans can also modify task orders easily. The Pos-Loc program has reduced the average cost of a test hole from about $1,000 to $2,000 to about $300 to $500, which has translated into the ability to conduct more test holes.

Additional Observations and Recommendations from Caltrans

- *Foster communication with utility owners.* Caltrans officials highlighted the need for both state DOT and utility officials to understand each other's processes. This lack of awareness is frequently a source of inefficiency. If transportation officials understand the effort it takes to relocate a utility facility and if a utility official understands how long it takes to change a PS&E package, the overall process will likely improve.
- *Keep in mind any environmental implications related to utility relocations outside the project footprint.* Typically, the environmental process needs to be completed before a project enters the detailed design phase (which is when most utility conflicts are identified). If a utility facility needs to be relocated and the proposed location is outside the project limits, the environmental review needs to be reopened, which can result in additional delays. A better understanding of the environmental process by all stakeholders involved should result in a more effective utility coordination process.

Delaware Department of Transportation

DelDOT outsources more than 50% of its utility coordination work to consultants, primarily on major projects. Subsurface utility engineering (SUE) or design consultants identify utility conflicts on major projects and document them in conflict matrices. Using UCMs is not mandatory, although consultants typically use them.

Quality level B (QLB) utility investigations are typically completed during the survey phase. QLA work is carried out at critical locations—for example, at every point where a utility facility crosses a drainage structure. In-house work on small projects that do not involve QLB or QLA data collection typically consists of notes about conflicts on the plans.

After identifying conflicts, project managers discuss the conflicts with utility owners. It is the responsibility of the utility owners to resolve conflicts in a manner acceptable to the department. Owners are also encouraged to make suggestions to avoid the conflicts. After semifinal plans are developed, utility owners are required to provide commitment letters to DelDOT indicating what relocation work they plan to do and when they plan to do it. DelDOT combines these statements into one project statement that includes contact names and phone numbers; this single project statement is added as a provision to the highway contract.

In practice, DelDOT attempts to relocate utility facilities before construction begins. In the past, utility owners were reluctant to move before the construction phase because of the risk of not being reimbursed if the highway project was canceled. However, enabling legislation now allows DelDOT to reimburse utility owners for advance relocations, including items such as traffic control, surveys, and select material for backfill. DelDOT encourages highway contractors to relocate utility facilities whenever possible in order to avoid

utility-related claims. As part of this process, DelDOT provides potential contractors with a list of subcontractors that normally do utility relocation work.

Additional Observations and Recommendations from DelDOT

- *Emphasize early, effective communication in the utility coordination process.* DelDOT highlighted the importance of involving utility owners at an early stage—that is, at least before the detailed design phase—and communicating and coordinating with them frequently.
- *Include utility relocations in the highway contract if feasible.* This strategy gives utility owners more time to plan for the relocation and ensures that the design is complete, utility facilities do not need to be relocated unnecessarily, and funding for the relocation is available. Further, the state DOT can avoid contractor delay claims since the contractor is responsible for utility relocations.

Florida Department of Transportation

FDOT uses conflict matrix spreadsheets and documentation in all of its districts, although several local versions of the spreadsheets are in use. As a member of the Florida Utilities Coordinating Committee (FUCC), FDOT participates in an initiative to develop a consensus-based UCM template. The goal is to develop and implement a template that all utility stakeholders in the state use. Figure B.5 shows a version of the UCM that the FUCC UCM subcommittee shared with the research team. Feedback from the subcommittee indicated a strong preference for a simple template design with relatively few data fields to reduce the time needed to manage the table and improve the chances that users use it.

FDOT sends roadway design plans to utility owners about 3 weeks before the 30%, 60%, and 90% design meetings. The utility coordinator (frequently a consultant) coordinates between the engineer and utility owners at different stages throughout the project. Drainage structures and cross-section information are usually included in the 60% plans; lighting and signalization are typically included in the 90% plans.

Utility conflicts are usually addressed around or after 60% design, once design plans include drainage structures and cross sections. On all major projects, FDOT uses forms that list utility conflicts, including name, location, and offset. Depending on the size of the project, one or more UCMs might be used. Copies of the UCM(s) are provided to all utility owners involved in the project. FDOT's goal is to have all conflicts resolved at or before the design plans are 100% complete and certified. FDOT also uses a table to track major process events (Figure B.6).

Utility relocation work includes developing a utility work schedule that describes the work to be completed and the corresponding time frames. Utility work schedules are part of the signed agreement between FDOT and the utility owner.

Additional Observations and Recommendations from FDOT

- *Use UCMs to help avoid utility relocations and to keep projects on schedule.* Identifying utility conflicts early in the project development process (sometimes as early as 30% design) results in early conflict resolutions and can help the project meet design and construction time frames and deadlines.
- *Maintain and update UCMs regularly.* Updating UCMs requires effort but it is time well spent. FDOT officials highlighted that time spent at the design table addressing utility conflicts can actually save days of construction or downtime in the field.
- *Investigate acceleration of utility coordination on nontraditional and smaller roadway projects.* FDOT heads a committee that is investigating how utility coordination in design–build and smaller projects with few or no utility conflicts could be accelerated compared with utility coordination in traditional roadway construction.

Georgia Department of Transportation

Utility Conflict Data Management

GDOT uses various systems to manage utility conflicts and utility coordination, including the following:

- Transportation Project (TPro). TPro is an integrated project planning system that includes several modules, including a utility module that contains information about reimbursable and nonreimbursable utility relocations. Data items stored in this module include utility owner, district contact name, type of utility facility, and reimbursement status (e.g., reimbursable, reimbursable and authorized, or nonreimbursable) (Figure B.7).
- Transportation reporting, analysis, and querying system (TRAQS). GDOT uses TRAQS to query data stored in TPro and other databases (Figure B.8).
- Construction management information system. GDOT uses this system to track information on utility owner billing and payments.
- Microsoft Access database. This database is used to import TPro data for reports that TPro and TRAQS cannot provide. In the past, GDOT also used a separate Access database to track information related to reimbursable utility relocation invoices. This database has been replaced by an automated system for electronic payments.

FPID: 1 | Description: 2

Phase #: 4 | Plans Date: 5

Reviewer: 6

Date: 7

This matrix was created by _____3_____ to assist the UAO's in identifying conflicts between the UAO's facilities and proposed roadway construction. _____ accepts no liability for conflicts overlooked for this report. Each UAO or designee is responsible to perform a detailed and comprehensive plans review for conflict analysis.

Conflict #	Utility Agency/ Owner (UAO)	Station/Offset (From C/L)	Facility Description (Material, Type, Number, Size)	Conflict Description (Possible or Actual)	VVH (Y/N)	VVH #	Recommended Conflict Resolution	Resolved Status
8	9	10	11	12	13	14	15	16

Consider using the form from the beginning of a project as a tool for monitoring areas of concern with UAO facilities. That is the reason for the Phase Number space. The form is set up to: 1. Print legal size and have the header information on each page. 2. The cells where the conflicts are listed are set to word wrap automatically. 3. The footer is set to number the pages 1 of ??.

1	Project number.
2	Project description.
3	Disclaimer that the reviewer and their firm is not responsible for any missed conflicts. The blanks are for the name of the design firm.
4	Phase that the plans represent.
5	The date should be on the plans Key Sheet. The phase and plans date should keep everyone working on the same plans.
6	That would be you, the person that wrote the conflict matrix.
7	The date the matrix was completed.
8	For ease of discussion the conflicts are numbered, plan sheet numbers are not used because they change from Phase to Phase which has caused confusion in the past.
9	Owner of the underground line.
10	The standard reference used on FDOT plans is the Centerline of Construction, it is used for all components of the proposed roadway construction.
11	Describe the facility. What is it? Water main? Force main? Cable? Conduit? Overhead electric? Overhead cable? Manhole? Handhold? What's the size? How many? What's it made of?
12	What is it the facility perceived to be in conflict with? It a possible conflict or actually in conflict with proposed work. Consider the trench and hole size required to place pipe and drainage structures. Don't forget aerial facilities when there are signals and large signs in the project.
13	SUE work can be used to if a conflict is considered a possibility. This entry area is a tool to determine areas where test holes should be taken for confirmation or exclusion of a conflict.
14	Entry area for the test hole number. Test holes should be numbered consecutively to avoid confusion.
15	What can be done to remove the conflict? Don't forget to consult with the Designer for alternatives to the proposed construction.
16	Examples of entries could be "Cleared", "Pending", "No Conflict". It's suggested to keep the entries determined as "No Conflict" in the matrix so other reviewers will know a perceived conflict has been noted and determined to not be an issue.

Figure B.5. FUCC UCM.

Project Information And Update

FPID: 416842-1-32-01 **Report Date:** 07/23/09
Description: SR 43 (US 301) from SR 676 (Causeway Blvd.) to SR 574 (MLK Jr. Blvd.) - Hillsborough County **Type Work:** Resurfacing, sidewalk

DOT Project Manager	PM Initials	Engineer of Record	Utility Coordinator	District Oversight
Gordana Jovanovic	GMJ	Grimail Crawford-John Novak	Jennifer Stafford	David Summers

Actual dates for each Phase as applicable, not scheduled dates.

Project Plans to UAO's	
Phase I	N/A
Phase II	10/23/08
Pre Phase III	
Phase III	12/30/08
Phase IV	5/26/2009 & 6/26/09
Final	

Utility Meeting Date	
Phase I	N/A
Phase II	11/19/08
Pre Phase III	
Phase III	

UWHCA With UAO and 56-**	Amount

Issues This Month

06/23/09 Phase IV Revision sent out 06/26/09

UAO Name (Utility Agency Owner)	Ph I Rec'd	Ph II Rec'd	Ph III Rec'd	Ph IV Rec'd	UWS Rec'd	UWS Approval	Master Agmnt	Utility Comments
AT&T	N/A	11/06/08		07/16/09				Rec'd Facilities letter and mark-ups
Bright House	N/A			06/22/09				Rec'd "No Facilities" letter
City of Tampa Water	N/A	12/02/08		06/24/09	06/24/09			Rec'd letter, mark-ups and UWS drafts
City of Tampa Wastewater	N/A	11/24/08		06/24/09	06/24/09			Rec'd letter, mark-ups and UWS drafts
Florida Gas Transmission	N/A	11/19/08						
FPL FiberNet	N/A	11/18/08	01/16/09		06/22/09			Rec'd UWS drafts
Hillsborough County Water Resources	N/A	11/24/08						
Kinder Morgan/Central FL Pipeline	N/A	11/04/08	01/29/09		07/06/09			Rec'd UWS drafts
Level 3	N/A	12/17/08						
MCI	N/A			07/06/09	07/06/09			Rec'd letter, mark-ups and UWS draft
Progress Telecom	N/A	12/17/08						
Qwest Telecommunications	N/A	11/17/08		07/28/09				Rec'd email stating, "engineer reviewed plans dtd 6/23/09 no conflict with facilities
Sprint/Nextel (Embarq)	N/A	11/03/08		06/19/09				07/16/09 rec'd email stating didn't need to supply UWS. JS to speak with him. Rec'd "No Conflict" letter, requested a "zero day UWS".
Tampa Bay Water	N/A	11/19/08			07/17/09			Rec'd UWS draft
TECO	N/A							

Figure B.6. FDOT project information and update sheet.

- Transportation Explorer (TREX). TREX is an online map viewer that GDOT developed in 2001 and updated in 2005 (Figure B.9; http://app5-trex-web.dot.ga.gov/trex_external/index.htm). TREX serves as an information clearinghouse that provides access to maps, reports, plans, video logs, photos, and other data on several GDOT systems, such as TPro, the bridge inventory maintenance and management systems, the FleetAnywhere Traffic Interruptions Report, roadway characteristics, and geographic information system (GIS) data.
- Google Earth Street View and Microsoft Bing Bird's Eye maps. These applications are used to conduct a preliminary review of a project's utility installations.
- Georgia utilities permitting system. This web-based system enables utility owners to apply for permits online.

All these systems include data elements needed for the efficient management of utility conflicts, and GDOT uses them during the utility conflict management process. However, retrieving data from several disconnected databases can be cumbersome and results in data consistency issues. To address this situation, GDOT has begun to integrate several systems into a single database application and is implementing Microsoft SharePoint to facilitate document exchange among stakeholders. The department is considering using this implementation so that consultants can enter utility-related data using online forms into a GDOT database.

In the mid-2000s, GDOT implemented an expanded utility coordination procedure that relied heavily on the collection of QLB and QLA data at critical points during the project development process, as well as a UCM and corresponding

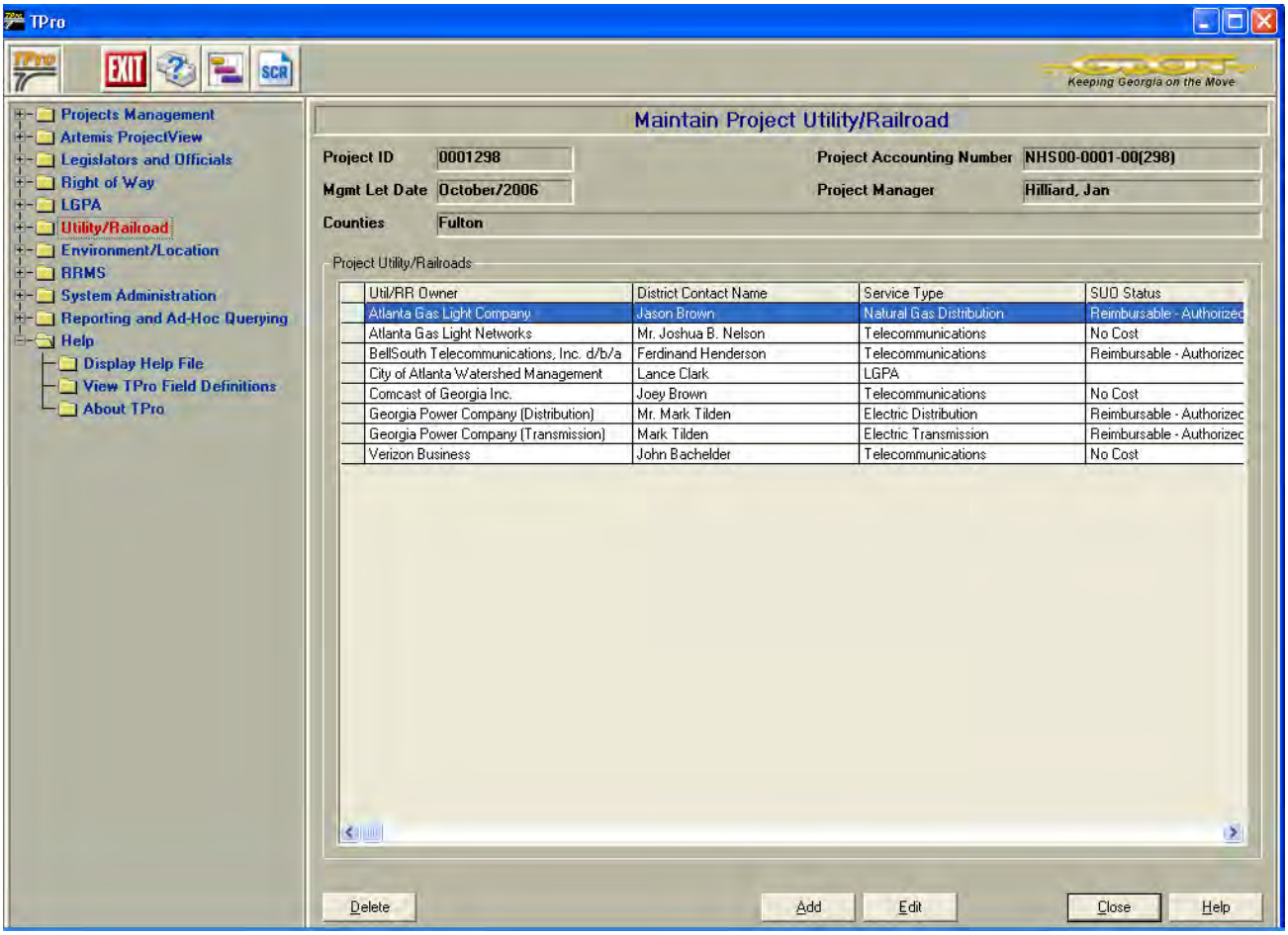


Figure B.7. GDOT TPro maintain project utility/railroad screen.

Figure B.8. Listing of SUE items in TRAQS.

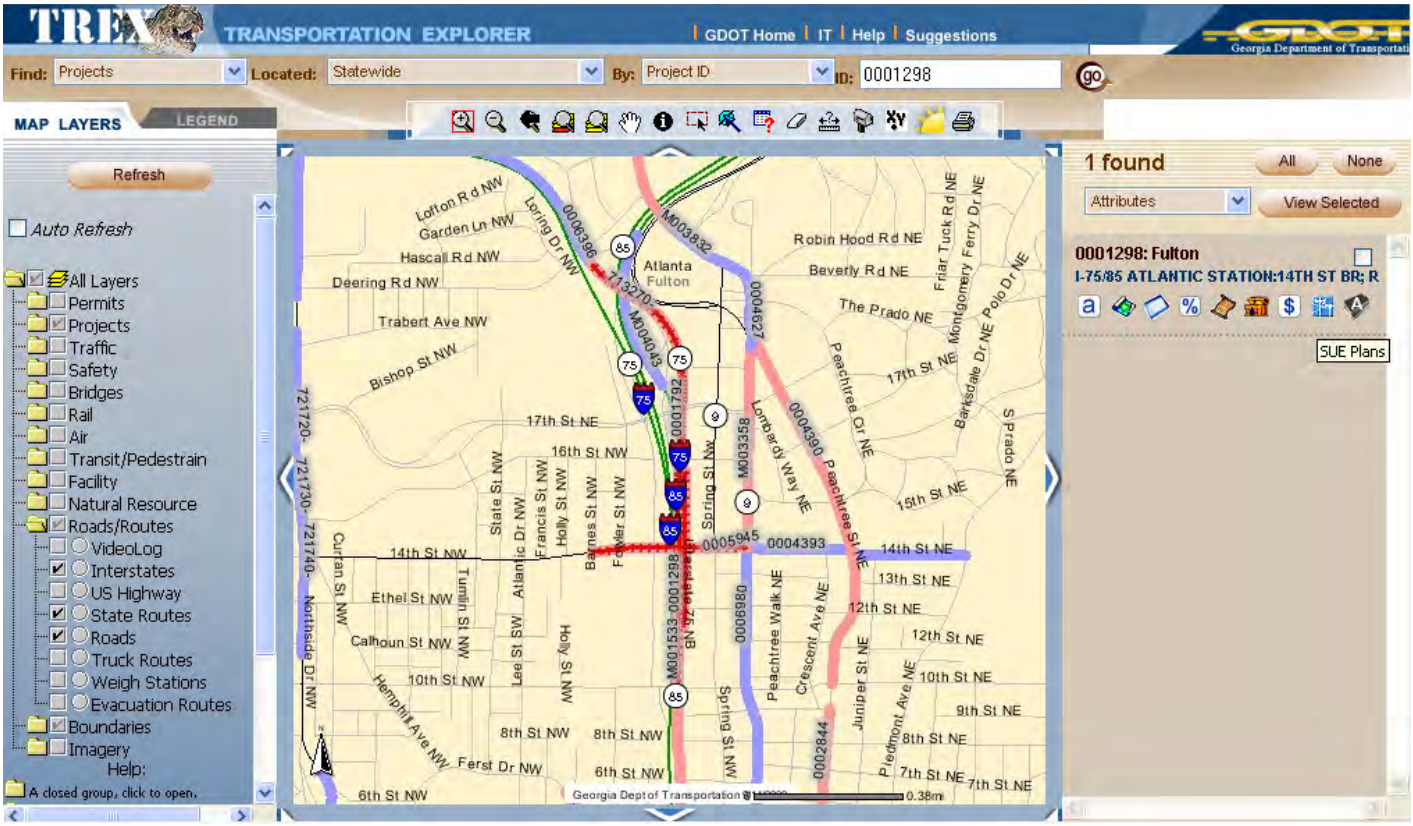
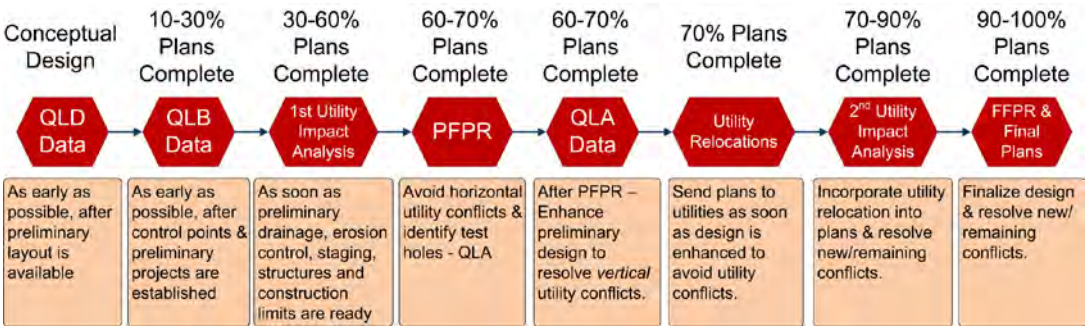


Figure B.9. GDOT TREX map.

utility impact analysis, to identify and resolve utility conflicts. Figure B.10 provides a view of the updated utility coordination process. Figure B.11 shows the UCM template used by GDOT. This template is color-coded based on the utility marking color standard of the American Public Works Association.

As Figure B.10 shows, the updated procedure includes major steps from conceptual design to 100% plans complete. At the completion of each major step, the resulting outcome is typically submitted to a designated office, such as the district utilities office or the state utilities office, for review, approval, and routing to the next phase. GDOT uses a risk management matrix with this new procedure to determine the need for, and the required level of, utility investigations. In most cases that require QLB data, the department collects the QLB data projectwide. QLB data are supplemented by QLA data at locations where the designer needs more accurate data and/or utility facility depths.

As shown in Figure B.10, the process begins with the identification of existing utility facilities during the conceptual design phase. In this phase, QLD data are obtained, typically by reviewing existing records, requesting utility owners to mark up existing utility facilities on project drawings (typically on hard copy), and transcribing markups into computer-aided



Note: PFPR = Preliminary field plan review.

Figure B.10. GDOT utility coordination process.

Conflict #	Station and Offset	Dwg. No.	*Utility	Identified Conflict	TH	Utility Impact with Cost ("As-designed")	Recommended Resolution	**Benefit of Resolution

*** Please fill the cell with the color code for the utility as shown below. The color code can be found on the Georgia Utilities Protection Center website at www.gaupc.com in the tab "LAWS/POLICIES" in**
****Please include all benefits incurred including time, costs, and safety improvements.**

UTILITY KEY

Underground	Overhead
E - Electric	OE - Overhead Electric
G - Gas	OGW - Overhead Guy Wire
NW - Non-Potable Water	OT - Overhead
P - Petroleum	OTC - Overhead Traffic Control
SFM - Sanitary Sewer	OTV - Overhead Cable TV
SS - Sanitary Sewer	
STM -Steam	
T - Telecommunications	
TC - Traffic Control	
TV - Cable TV	
UNK - Unknown Type	
W - Water	

ABBREVIATIONS

Material

AC - Asbestos Concrete
FO - Fiber Optic
MES - Mitered End Section
RCP - Reinforce Concrete Pipe

Other

BL - Baseline
L - Left
R - Right
TH - Test Hole

UTILITY OWNERS

AGL - Atlanta Gas Light
GP - Georgia Power
ATT - AT&T (formerly BellSouth)
L3 - Level 3 Communications
MFN - Metromedia Fiber Network
FCPW - Fulton County Public
CoA - City of Atlanta
UNK - Unknown Owner

INSTRUCTIONS:

1. **Please fill in the header information for the GREEN items, then change the color back to BLACK.**
2. **For conflicts involving combination overhead lines, please provide a separate entry for each utility.**
3. **For places where there are multiple utilities at one point of conflict, please provide a separate entry for each utility .**
4. **The Abbreviations listed are examples only. Please provide abbreviations as appropriate for this project.**
5. **The Utility Owners listed are examples only. Please provide abbreviations for each Utility Owner as appropriate for this project.**
6. **Please add tabs as needed. See tab 2, "Sample Sheet 2".**

Figure B.11. Georgia DOT UCM template.

design (CAD) files. This information, which GDOT combines with a visual site inspection, is sufficient to use during this phase of a project.

After the conceptual design phase, designers begin developing 10% to 30% design plans. QLB data are typically collected in this phase after survey control points and preliminary project limits are established. As soon as preliminary drainage, erosion control, staging, structures, and construction limits are ready, typically when the plans are 30% to 60% design complete, an initial utility impact analysis is performed to identify the effects of the proposed design on existing utility facilities.

During the 60% to 70% design phase, GDOT conducts a preliminary field plan review. At this time, the designer uses the utility impact analysis to try to avoid horizontal utility conflicts and identify areas where there is a need for QLA test holes. This effort typically requires coordination between the designer, the state utilities office, the district utilities office, the SUE provider, and utility owners. After collecting QLA data, the designer attempts to resolve or avoid vertical utility conflicts and produces a set of enhanced drawings (at about 70% design) that the district utilities office sends to utility owners so that they can start planning the relocation of affected facilities.

Defining the need for test holes could also take place during constructability reviews. However, usually the right-of-way is already set at that point, and following the process to acquire additional right-of-way becomes more difficult. Conducting constructability reviews before defining the right-of-way would be beneficial, since additional right-of-way might be required—for example, for a utility conflict countermeasure such as a retention wall.

At about 70% to 90% design, a second utility impact analysis is conducted to resolve new or remaining utility conflicts. At 90% to 100% design, a final field plan review is conducted, and the designer finalizes the design. GDOT also works to resolve any new or remaining conflicts.

GDOT developed a training course on avoiding utility project impacts to help GDOT staff use UCMs effectively and to provide guidance on how to perform utility impact analyses. The training course, which is now mandatory for all GDOT designers, teaches how to weigh the cost of relocating a major utility facility against a change in the roadway design. A major motivation for developing the training course was that GDOT designers largely did not use the SUE process to introduce changes to the roadway design. GDOT has also developed a new program that encourages junior design engineers to meet with railroad and utility representatives. The program raises awareness about utility and railroad issues on transportation projects. The program has been well received by GDOT staff and railroad and utility owner representatives.

The utility conflict training course is divided into two sessions. The morning session focuses on general utility coordination concepts and describes how to use UCMs for utility conflict analysis. The afternoon session includes hands-on exercises on how to identify conflicts and conduct a basic utility conflict analysis using a sample project. The course also includes an American Society of Civil Engineers video that describes the SUE process. The audience for the training course is mostly GDOT personnel, although there are a few slots for external design consultants and utility representatives. GDOT also advertises the training through the American Council of Civil Engineering Companies.

GDOT originally envisioned the UCM process as an iterative process between right-of-way and design, because frequently there is only one submission from right-of-way to design, and updates from design to right-of-way as a result of design changes or other conflict resolutions do not occur. In the next version of the UCM implementation, GDOT plans to introduce a tool to track changes that designers make in response to a UCM recommendation, with the goal of estimating the cost savings that result from the use of the UCM approach.

GDOT also plans to implement a system to enable project contractors to report when utility conflicts are discovered during construction. GDOT hopes to use this tool to compare projects that include SUE data collection with projects that do not. The goal of this effort is to determine the cost-effectiveness of the SUE process and to develop a performance evaluation criterion for SUE providers.

Although GDOT has found that resolving utility conflicts during design is more cost-effective than during construction, in practice most utility relocations occur during construction. This practice ensures that funding for reimbursable utility facilities is available, but it can create significant project delays. Exceptions to this practice are complex, expensive utility relocations, which GDOT typically completes before the letting date.

To alleviate project delays, the Georgia legislature recently passed a law that authorizes GDOT to reimburse otherwise nonreimbursable utility facilities if the relocation is included in the highway contract. The law applies to cases in which the inclusion of the utility relocation in the highway contract is in the public interest, and the reimbursement is an incentive to the utility owners to cooperate with GDOT. Currently, the law applies to most GDOT projects, and the program has been popular with both GDOT and the utility owners.

Additional Observations and Recommendations from GDOT

- *Consider utility impacts in the environmental process.* Utility facilities can have a significant impact on the environmental

process. For example, GDOT officials mentioned a project in which a utility owner would have had no access to its installations from within the right-of-way; correcting this problem would have required the construction of a new access road through wetlands.

- *Consider an early authorization for utility work in the project development process.* GDOT is experimenting with early authorizations for utility work. In practice, a challenge for implementing this strategy is that environmental and right-of-way clearances must be secured before utility relocations can proceed.
- *Consider showing utility facilities on design cross sections and profiles.* GDOT cross sections and profiles typically do not show utility installations. Showing utility facilities on cross sections and profiles may be advisable if there is a potential utility conflict, with the caveat that this information is only useful if it is reliable (since, in practice, the challenge is how to provide a measure of accuracy for utility facility depictions that are interpolated).
- *Require the use of a UCM approach for design–build projects.* Public–private partnerships, including design–build projects, are becoming more common. For these projects, it is critical to include UCM data tracking in contract specifications or in state DOT policy.

Kansas Department of Transportation

KDOT uses a utility coordination process that includes utility meetings at 30%, 60%, and 90% design, as well as other specific milestones during the design phase. Utility facilities and conflicts are described using location and offset and are shown on required utility permits and agreements. The utility agreements describe which utility facilities are in conflict and need to relocate. If a utility conflict involves a complex, expensive utility relocation plan, it may be necessary to change the highway design to accommodate the existing utility installation. KDOT uses value engineering during the preliminary design phase. During construction, value engineering is not an option unless there is an omission in the design plan. KDOT's goal is to resolve all utility conflicts during the design stage to avoid delays during construction.

Using the KDOT utility agreement tracking database, utility coordinators and engineers can assemble a utility status report, which is also included in the PS&E package. Adding the utility status report to the letting documentation helps contractors bidding on the project to understand the complexity of the utility relocations and develop realistic bids. KDOT uses the utility status report for all projects in the letting phase. Conflicts in the utility status report are identified by location (i.e., a conflict ID is not shown).

Louisiana Department of Transportation and Development

The utility coordination process at the Louisiana DOTD includes utility investigation activities that involve field trips and exchange of information with utility owners during the preliminary design phase. Once a project advances to the detailed design phase, DOTD conducts utility coordination meetings and performs detailed utility investigations.

Louisiana DOTD uses an SQL Server–based system called the utility relocation tracking system (URTS) to track the progress of utility agreements and payment information of reimbursable utility agreements. The system can also generate standard correspondence forms and some data reports, such as a report of a utility owner's utility agreements for a particular project. The system is web-based and available on the DOTD intranet. It has four main modules: a headquarters utilities module, a district utilities module, a report manager, and a system manager. Figures B.12 and B.13 show two views of the headquarters utilities module. Some functions, such as all payment processing options, are only available at the district level.

Louisiana DOTD stores approved drawings in the system (scanned utility relocation design drawings approved by the DOTD design engineer) for both reimbursable and nonreimbursable utility relocations. The system also includes scanned copies of utility agreements.

Utility coordinators enter project ID and contact information into URTS for all utility owners that operate facilities within the project limits. Louisiana DOTD tracks all utility owners associated with a project, not just those for which there are utility conflicts, because the status of a facility (in conflict or not in conflict) can change as a project progresses. Once a utility owner has been added to the system, URTS can automatically create standard letters, such as a request for authorization and funding, a request to close out funding, and a utility release. The system tracks cost estimates for each project and utility owner; tracks payments; and creates reports and forms, including the authorization to begin work for reimbursable utility facilities.

URTS can generate lists of utility owners involved in a project along with data items related to costs and payments (Figure B.12). URTS cannot generate UCMs because it tracks data about utility owners and agreements, not utility conflicts. Louisiana DOTD used UCMs in the past but discontinued the practice. The reasons for this change are unclear, but it appears that maintaining UCMs was perceived as taking too many person-hours with relatively little benefit in return. It is also not clear how much information is exchanged between utility district personnel and designers. Further, DOTD does not have a utility certification or similar document for inclusion

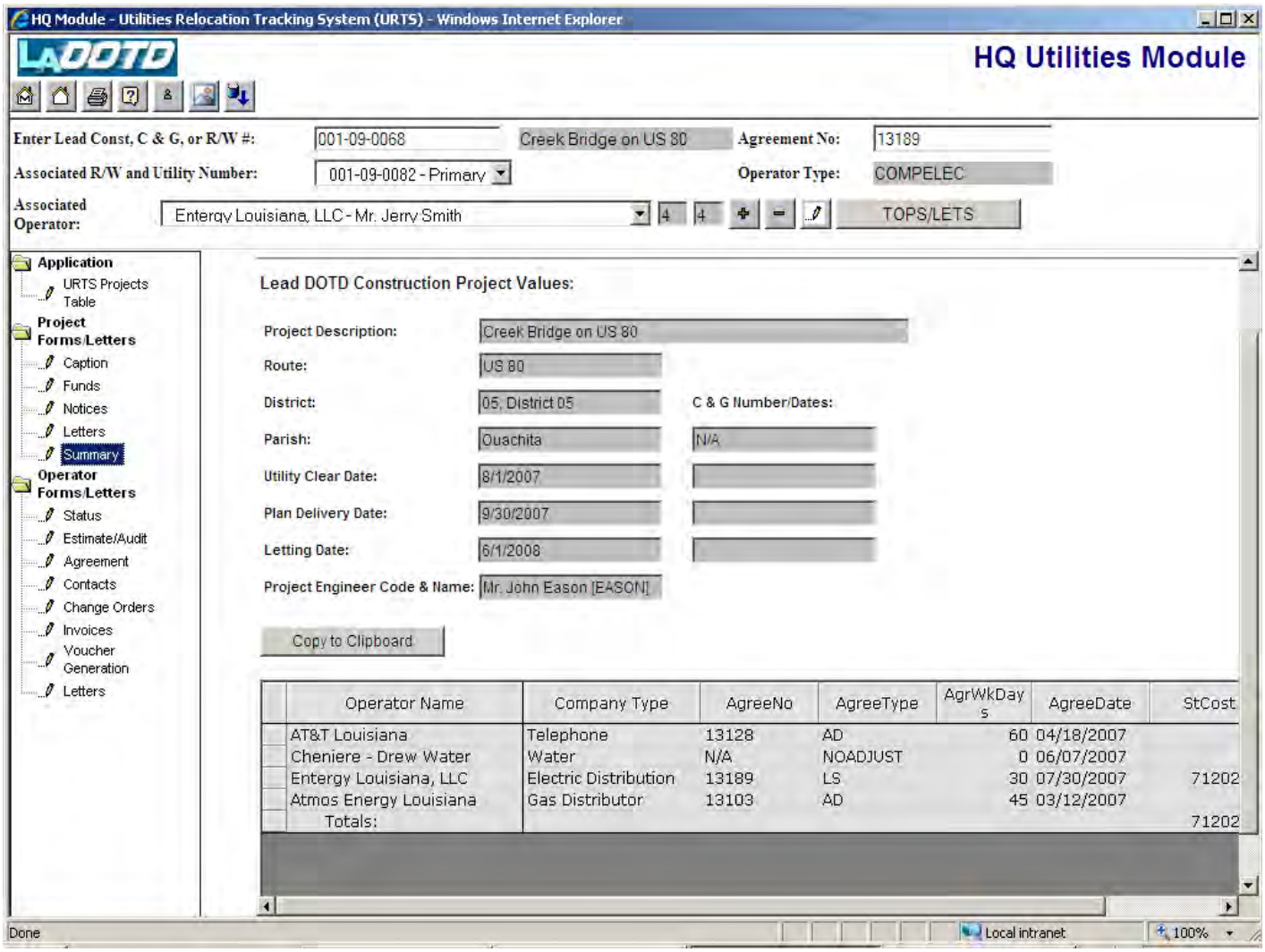


Figure B.12. Louisiana DOTD URTS headquarters utility module: Summary.

in the PS&E documentation, which is a strong motivator at other state DOTs to use UCMs during the project development process.

Louisiana DOTD tracks utility conflict locations by route and log miles, which are equivalent to the route and mile point system used in other states. When offsets are used, they are typically measured from the project centerline.

As mentioned, bidding documentation for contractors does not typically include a listing of known utility conflicts. Instead, Louisiana DOTD typically includes language in the contract documents to alert bidders about utility installations that have been previously identified and included in the plan sheets. It is the responsibility of the contractor to confirm that the proposed design does not conflict with any utility facilities. Contracts also include language that no additional compensation is allowed for delays or damage sustained as a result of utility facility interference or relocations, and that extensions of contract time may be considered only if the contractor experiences significant delays due to utility relocations.

URTS is useful but misses some important features, such as how to deal with overpayments to utility owners. Occasionally, the Louisiana DOTD audit section determines that utility owners owe the state money after the final payment. Once the utility owner pays the amount owed, there is no mechanism to enter the amount into URTS.

According to Louisiana DOTD, the utility coordinator's experience is essential to managing utility conflicts effectively, especially utility conflicts that require utility agreements. A history of relationships with utility owners enables a utility coordinator to develop strategies that foster good communication and an environment of mutual trust, which is critical during the preparation of utility agreements. A utility coordinator's experience is also critical for the identification of existing utility facilities that may require additional attention and follow-up during the project development process.

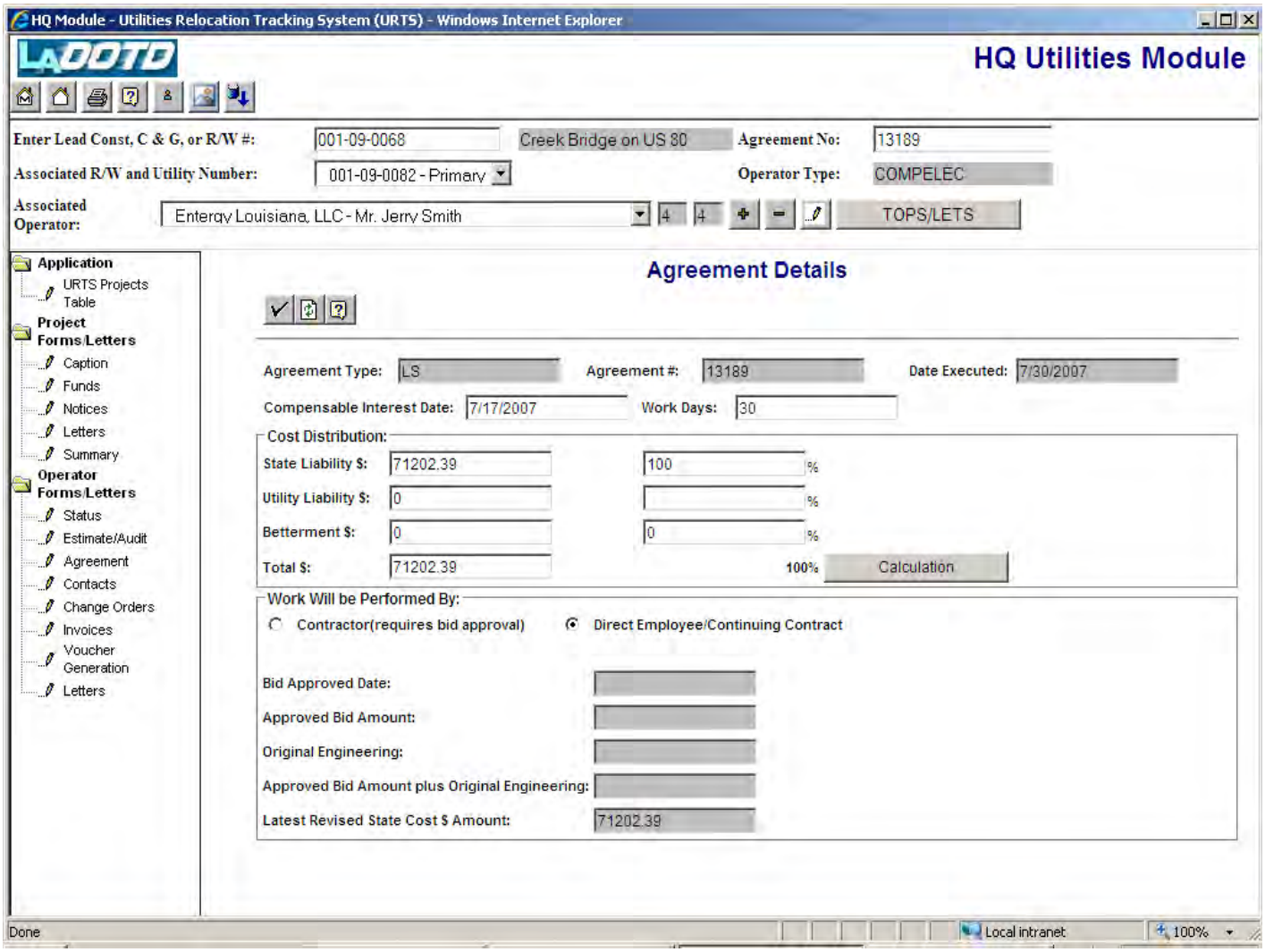


Figure B.13. Louisiana DOTD URTS headquarters utility module: Agreement details.

Louisiana DOTD districts are members of local utility coordination councils, which meet monthly or quarterly. At these meetings, DOTD provides a list of upcoming projects, including important dates such as time periods for right-of-way acquisition, plan completion dates from utility owners, and letting dates. This practice helps utility owners to plan for upcoming relocations and provides an opportunity for utility representatives to become familiar with the DOTD utility liaison and the DOTD utility coordination process. Utility coordination council meetings are also a valuable tool for developing effective working relationships between Louisiana DOTD and utility owners, which, according to DOTD officials, is the most important element for effective utility coordination practices.

Additional Observations and Recommendations from Louisiana DOTD

- *Obtain buy-in from administration to develop information technology (IT)–based systems.* Enterprise systems such as URTS can provide substantial benefits to an organization. Louisiana DOTD has been largely satisfied with URTS, which has provided significant efficiency improvements. However, planning, funding, and implementing an enterprise system can be a challenging process without support from administration. The implementation of URTS was only feasible because of the support by DOTD officials in leadership positions who championed and encouraged the development and implementation of the system.
- *Ensure that IT system modifications can be implemented quickly.* No matter how well designed an IT system is, it is likely that over time the system will need improvements and upgrades. Although URTS is missing some important features, implementing the requests for system modifications has been a slow process.
- *Use information-sharing meetings as an effective tool for utility conflict management.* Despite the increased use of

e-mails and electronic documents, meeting face-to-face with utility owners is still a worthwhile way to communicate and discuss utility issues. Utility coordination council meetings help utility owners to plan for upcoming relocations and provide an opportunity for utility representatives to become familiar with the DOTD liaison and the DOTD utility coordination process.

- *Foster good communication between DOT right-of-way and design sections.* According to Louisiana DOTD officials, transportation project designers are often not aware of cost and time issues related to utility facilities, and educating designers about utility issues can be lengthy and time consuming. Good communications and working relationships across division and section lines can help to make designers more aware of utility issues.
- *Involve utility owners in the preliminary design phase.* Involving utility owners in preliminary design has a great potential for cost savings. It does not take much effort and time on the DOT side to provide preliminary plans to the utility representative, and it does not take much time on the utility side to review these plans.
- *Use training to increase awareness of relevant codes and regulations.* Many utility coordination meetings would be more effective if training were available for both DOT personnel and utility owners that focused on some of the regulations and requirements that both parties need to follow. DOT personnel would benefit from a better understanding of the utility code, and utility owners would benefit from a better awareness of state and federal regulations pertaining to utility facilities.

Michigan Department of Transportation

Like the Louisiana DOTD, MDOT uses URTS, a web-based intranet application. The system focuses on utility owners with facilities on highway projects; it does not track utility facilities or conflicts. The Michigan URTS contains a database of utility owners and facilitates the production of official MDOT letters (including mailing labels) during project design. It also helps track important dates, such as when notifications are sent or agreements are received.

URTS can import basic project data from the Michigan architectural project database, which tracks project limits and description. URTS also interfaces with the MDOT construction permits system database. The main benefits of URTS are acceleration of communication with utility owners using the automated letter-generation feature and the utility representative directory, the ability to link utility owners with control sections of the roadway system, and the ability to track utility owner responses.

MDOT uses Bentley ProjectWise to store data files associated with utility conflicts. In ProjectWise, each utility conflict has a folder that contains relevant files in a variety of formats, including MicroStation, Word, Excel, and PDF. MDOT plans to integrate URTS with ProjectWise.

MDOT has seven administrative regions, each one with three to four transportation service centers. In addition to URTS and ProjectWise, some regions use utility coordination lists, conflict analysis tables, or utility reports to develop notices to bidders, which are included in the PS&E documentation and list both cleared and unresolved utility conflicts at the time of letting. Figure B.14 is a sample of a utility coordination list, and Figures B.15 through B.18 are examples of utility conflict analysis tables. Utility conflict analysis tables are useful throughout the roadway design process, although the format of these tables is not standardized across districts.

Conflict analysis tables are typically included in the scope of work of design consultant contracts. However, because of the lack of a consistent standard, the conflict analysis tables that consultants deliver vary significantly in terms of structure, data items, and update intervals. Multiple formats and layouts also make it more difficult for stakeholders to work with these tables. For projects that do not use design consultants, MDOT designers sometimes prepare conflict analysis tables.

MDOT tries to avoid utility relocations by obtaining reliable information about existing utility facilities as early as possible—for example, during the preliminary design phase. MDOT attempts to locate high-use, large-diameter, and hazardous utility installations as early as possible in the project development process because those facilities can cause considerable problems and delays during construction. Even if a major utility facility is not in conflict, construction near major utility facilities can become a major problem if constructability is not evaluated properly during design.

MDOT officials highlighted the difficulty of engaging utility owners early in the project development process. Utility owners have to deal with reduced work forces and budget constraints that make it challenging to meet DOT project schedules and needs. Not surprisingly, some utility owners wait until the last minute to start coordination and relocation activities, which can affect the project contractor's schedule. This issue can be critical, especially for roadway contracts that include incentive–disincentive clauses. Some utility owners decide to defer dealing with utility conflicts until the roadway construction phase, hoping the project contractor will find a way to work around the conflicts.

Although utility owners can be liable if the information they provide is faulty, it has been MDOT's experience that utility owners do not always provide reliable information. Resulting issues include unreliable depths of cover and inaccuracy of horizontal and vertical utility facility locations plotted from utility owners' as-built records.

Control Section	Job Number	Route	Location	Description	Mailed Base Plans	base plans due back by	Mailed G.I. Plans	Date of Utility meeting	Date of Coordination Clause	Letting Date	Construction Date
30011	79838	M-49	M-49, City of Reading, Hillsdale County	1.04 MILES OF HMA PAVEMENT RECONSTRUCTION, STORM SEWER REPLACEMENT, WATERMAIN REPLACEMENT, CURB & GUTTER, SIDEWALK REPLACEMENT, AND STREETSCAPING.	1/4/2007	2/5/2007	2/10/2007	1-09-08, 6-29-08	7/11/2008		10/1/2008
30012	79893	M-49	M-49, Litchfield and Allen Townships, Hillsdale County	6.49 miles. Roadway resurfacing on M-49 from US-12 to B01 of 30012 and reconstruction of M-49 from B01 of 30012 to M-99. (See plans)	1/4/2007	2/7/2007	12/20/2007	5/11/07, 1/16/2008	1/17/2008		4/1/08
30041	75210	M-99	0.9 miles on M-99 , Steamburg Road to Bacon Road in the City of Hillsdale, Hillsdale Township, Hillsdale County. (Also, 0.13 miles on South Street)	Total HMA Reconstruction, HMA Cold Milling & Resurfacing, Storm Sewer, and Water Main.			6/18/2008	7/9/2008	6/4/2008		6/30/05
30071	100288	US-127	US-127, FROM THE STATE OF OHIO TO JUST NORTH OF M-34, CITY OF HUDSON, WRIGHT, PITTSFORD, MEDINA, AND HUDSON TOWNSHIPS, HILLSDALE AND LENAWEE COUNTIES.	10.24 MILES OF COLD MILLING AND MULTIPLE COURSE HMA RESURFACING, DRAINAGE AND GUARDRAIL IMPROVEMENTS.	1/2/2009	2/2/2009					summer 2009
38101	88258	I-94	Dettman Road over I-94 and Hawkins Road over I-94, Blackman and Leoni Townships, Jackson County. There will also be some work along Blake Road and Young Road	Bridge Replacement and Approach Roadway	1/25/2008	2/25/2008	8/4/2008	8/21/2008	10/8/2008		4/1/09
38101	105448	I-94	Elm Road Bridge over I-94	Emergency Beam Replacement	1/14/2009	1/31/2009		4/18/2009	2/27/2009		8/1/09
38103	105875	I-94	Sargent Rd. to the Washtenaw County Line	reconstruction of the roadway and all ramps, including Race Road interchange, Mt. Hope Road interchange and Clear Lake Road interchange.major bridge work at the Whipple Road bridge over I-94, Race Road bridge over I-94, and the EB & WB Weigh Stations on I-94	3/16/2009	4/16/2009					late 2009
38111	79899	us-127	US-127 from Ayers Road to Floyd Road, Summit and Napoleon Townships, Jackson County.	1.77 miles of reconstruction, cold milling, HMA resurfacing for center left turn lane.	8/3/2005	8/24/2005	9/22/2006	8/6/2006	6/19/2008		4/1/09
38131	103403	us-127	Carpool lot in NE quad of US-127 and Berry Road	HMA resurfacing and approach work	3/16/2009	4/16/2009					Fall 2009 or Spring 2010

Figure B.14. MDOT sample utility coordination list.

Obstruction	Location	Conflict	PROPOSED LOCATION		****** MUST be Coordinated DURING Construction * *****	Notes
			Approx Distance to Relocate	MINIMUM distance of Proposed Front Edge of Pole Behind EXISTING Back of Curb		
CITY OF WYOMING - LIGHTING						
Street Light Pole	Sta 261+40 LT	Too close behind proposed guardrail	Move at least 2' North	**9.5'**		
Street Light Pole	Sta 263+75 LT	Too close behind proposed guardrail and in conflict with operation of guardrail terminal.	Move 35' west & 4' North OR Move 85' East &	**12.0' (west) OR 8.0' (east)**		
Street Light Pole	Sta 267+25 RT	Proposed SW quadrant radius improvement	Move 25' West	**2.7'**		Possibly able to attach to Signal pole
Street Light Pole	Sta 268+70 LT	Too close behind proposed BOC	Move at least 1' North	**4.6'**	**X**	**ALSO RELOCATE NEEDED FOR TEMP WIDENING**
Street Light Pole	Sta 271+23 LT	Too close behind proposed BOC	Move at least 1' North	**4.2'**	**X**	This pole was not picked up in survey **ALSO RELOCATE NEEDED FOR TEMP WIDENING**
Street Light Pole	Sta 273+47 LT	Too close behind proposed BOC	Move at least 1.5' north	**6.8'**	**X**	**ALSO RELOCATE NEEDED FOR TEMP WIDENING**
Street Light Pole	Sta 275+77 LT	**RELOCATE FOR TEMP WIDENING**			**X**	
Street Light Pole	Sta 278+34 LT	**RELOCATE FOR TEMP WIDENING**			**X**	
Street Light Pole - Division Ave Int.	Sta 280+71 RT	In new radius- SW Quadrant of Division	Verify a proposed location with Division Avenue Signal plans			
Street Light Pole - Division Ave Int.	Sta 281+26 LT	In proposed sidewalk- NE Quadrant of Division	Verify a proposed location with Division Avenue Signal plans			

Figure B.15. MDOT conflict analysis table: Example A.

M-6 (South Beltline) from I-196 to West of Eastern Avenue
South of Grand Rapids, Michigan

Utility Log - Electric

CS 70025 - JN 33330

Item #	Utility Owner / Operator	Conflict Location	Segment	Date Relocation Plan must be submitted	Relocation Plan submitted to Design Team	Design Team Review / Comment / Approval	Permit Application Submitted to MDOT	MDOT Permit Number / Approval Date	Relocation Scheduled	Action Items
1	Consumers Energy Transmission	Consumers Power Transmission Overhead – 8th Ave	1			7/6/2000	7/27/00 rev.	41064-0125-00-0174	4/1/2001	Final permit approval from MDOT.
2	Consumers Energy Transmission	West of Kenowa Ave.	1			7/6/2000	7/27/00 rev.	41064-0125-00-0174	4/1/2001	Final permit approval from MDOT.
3	Consumers Energy Distribution	Aerial Lines at Jackson and Angling Road	1							Design in process.
4	Consumers Energy Distribution	Aerial Lines at Kenowa and 64th St.	2							Design in process.
5	Consumers Energy Transmission	64th at Wilson and East and West of Wilson– Overhead	2			7/6/2000	7/27/00 rev.	41064-0125-00-0174	4/1/2001	Final permit approval from MDOT.
6	Consumers Energy Transmission	East and West of Ivanrest	2			7/6/2000	7/27/00 rev.	41064-0125-00-0174	10/15/2000	Final permit approval from MDOT.
7	**Consumers Energy Distribution**	**along Ivanrest**	**2**							**Permit to be submitted the week of August 14, 2000.**
8	Consumers Energy Transmission	East and West of Byron Center - overhead	3			7/6/2000	7/27/00 rev.	41064-0125-00-0174	4/1/2001	Final permit approval from MDOT. Schedule Relocation
9	**Consumers Energy Transmission**	**At Burlingame - overhead**	**3**			**6/5/2000**		**41064-0124-00-173**	**10/15/2000**	**Final permit approval from MDOT.**

Figure B.16. MDOT conflict analysis table: Example B.

M-6 Westerly Half Status of Utility Relocation Permit Applications

Date: May 2, 2002

Permit Application Number	Utility	Location	Description	Reimbursable? Y/N	Reimbursable? Amount	Date Sent	*Circulated for Review* KCRC Returned Date	KCRC Approved Y/N	MDOT Construction Returned Date	MDOT Construction Approved Y/N	MDOT Design Returned Date	MDOT Design Approved Y/N	MDOT Real Estate # of Parcels Involved	MDOT Real Estate Parcels NOT Cleared	MDOT Lansing Utilities Est. Submitted Date/Amount	MDOT Lansing Utilities Auth. Issued Date/Amount	*Follow-Up* Addressed w/ Coord. Cl. (y/n)	Addressed w/ Notice Bidder (y/n)	Permit Issued Date	Staking & On-Site meeting Held Date	Comments
41064-0157-00-0212	Ameritech	Clyde Park	Directional Bore 1239' of one copper cable and interduct.			07-12-00	07-18-00	Y			07-19-00 approved, revision on 07-25-00	Y - with minor comments	15	MDOT only acquired tree rights. should be o.k. within ClydePark ROW				Y	08-21-00	10-18-00 by DLZ	
41064-0154-00-0208	Ameritech	(60th Ave) Burlingame	Place copper cable on Burlingame to existing Term. by directional bore.			07-03-00, Revised and Recirculated 07-17-00	07-07-00	Y	07-21-00	Y	08-10-00	Y- with comments, Ameritech should coordinate details with Design	10	none			Y	Y	08-15-00	N/A	
41064-0125-00-0174	Consumers	Various spots along the work area	Retire and Remove Steel Towers and install new.	Y	$ 2,532,100	06-05-00, Recirculated 07-27-00	06-07-00	Y	08-09-00	Y	07-06-00 \ 08-10-00	Request more detailed plans \ Y- with comments CE should coordinate details with Design	70	none	03-17-00 $2,532,100 05-11-01 Revised to $2,941,100 08-20-01 Submitted to NL increase of $409,000 for total of $2,941,100	04-07-00 $2,532,100 #CE00-15 05-29-01 Received bill for work in amount of $323,174.84 08-17-01 Second Billing $323,174.84 ok'd 08-24-01 $409k increase ok'd	Y	Partial	09-06-00		07-26-00 detailed plans submitted by Consumers Electric. 9/19/00 Status - CE Coord w/Norfolk So. RR re:temp Road Xing. 11-15-00 Payment request on materials recomm ok'd 05-02-01 meeting re: CE tower adj of foundations at US-131, Clyde Park, & Norfolk Southrn RR.
41064-0124-00-0173	Consumers	(64th Ave) Burlingame	Remove & relocate overhd Consumers facilities on Burlingame between 60th & 64th.	Y	$14,441 + $2100	06-05-00	05-30-00	Y			08-10-00	Y- with comments CE should coordinate details with Design	13	none	06-27-00 $14,441 06-12-01 add'l $2,100	07-14-00 $14,441 #CE00-23 08-21-01 Send authorization for increase of $2,100 09-11-01 Increase approved		Y	08-17-00		05-04-01 - Final billing ok'd, work completed 06-07-01 CE has to relocate the existing pole 20' west to avoid ditch per design change. Add'l cost of $2100.
41064-0129-00-0178	Consumers	S. Division	Remove primary underground facilities in way of M-6 in Grand Mobile Estates at 6500 S. Division.	N	$ 7,508	06-05-00, Revised and Recirculated 07-21-00	05-30-00	Y	07-27-00	Y	07-06-00\ 07-25-00	N – Mobile Home Park Issue \ Y- approved	8	none	08-03-00 $7,508	N/A		Y	08-22-00		Reimbursement request cancelled. Utilities to seek reimbursement from Sun Mobile Properties (Grand Mobile Estates & Cuttlerville Mobile Estates).

Figure B.17. MDOT conflict analysis table: Example C.

US-127 Mill and Fill (CS 30071 : JN 100288)
9/1/2009
Ohio State Line to M-34
Potential Utility Conflict

Station	Lt or Rt	Utility	Description/Comment of Potential Conflict	Company / Type
21+00 - 25+50	Rt	Telephone	Ditch Cleanout / Culvert Replacement	Waldron / Copper
24+00 - 37+50	Lt	Telephone	Ditch Cleanout / Culvert Replacement	Waldron / Copper
36+00	**Lt**	**Telephone**	**County Drain Replacement / MH Stucture Replacement**	**Waldron / Copper**
55+00 - 89+50	Lt	Telephone	Ditch Cleanout / Culvert Replacement	Waldron / Copper
64+55	**Lt**	**Telephone**	**County Drain Replacement / MH Stucture Replacement**	**Waldron / Copper**
71+50	**Lt**	**Telephone**	**County Drain Replacement to Toe Slope**	**Waldron / Copper**
91+00	**Lt**	**Telephone**	**County Drain Replacement / MH Stucture Replacement**	**Waldron / Copper**
103+00 222+50	Lt	Telephone	Ditch Cleanout / Culvert Replacement	Waldron / Copper
117+00 - 183+00	Rt	Telephone	Ditch Cleanout / Culvert Replacement	Waldron / Fiber Optic
159+66 - 167+50	**Lt**	**Telephone**	**County Drain Replacement / MH Stucture Replacement**	**Waldron / Copper**
159+66	**Rt**	**Telephone**	**County Drain Replacement / MH Stucture Replacement**	**Waldron / Fiber Optic**
167+50	**Rt**	**Telephone**	**County Drain Replacement**	**Waldron / Fiber Optic**
170+00 Ridgeville Rd.	**Lt / Rt**	**Telephone**	**Culvert Extension. Do not overtop telephone crossing.**	**Waldron / Fiber Optic Waldron / Copper**
180+00 Camden Rd.	**Lt**	**Telephone**	**SW Intersection of Camden Rd. watch for Fiber Optic Cable**	**Waldron / Fiber Optic**
223+00 / Lime Creek	**Lt / Rt**	**Telephone**	**Ditch Cleanout / Culvert Replacement**	**Waldron / Fiber Optic**
233+00 - 300+00	**Shoulder**	**Telephone**	**Verify line exists / If so needs to be relocated.**	**Verizon**
246+30	**Lt**	**Telephone**	**REL - B/O**	**?**
276+50	**Packard Rd**	**Utility Pole**	**SE IntersectionThere is a Utility pole on the plans / Verify**	**NA**
277+00 - 292+00	Rt	Telephone	Ditch Cleanout / Culvert Replacement	Verizon
297+00	Rt	Telephone	Storm Sewer / Catch Basin Replacement	Verizon
307+00	**Rt**	**Telephone**	**REL - B/O**	**Verizon**
319+00 - 438+00	Rt	Telephone	Ditch Cleanout / Culvert Replacement	Verizon
343+00	**Rt**	**Telephone**	**Culvert Replacement and Riprap over EX TPED**	**Verizon**
442+45	**Rt**	**Utility Pole**	**REL - B/O**	**?**
445+10	**Rt**	**Utility Pole**	**REL - B/O**	**?**
445+00 - 485+00	Rt	Telephone	Ditch Cleanout / Culvert Replacement	Verizon
492+00 - 510+00	Rt	Gas	Ditch Cleanout / Culvert Replacement	4" Steel Line
498+50	**Lt**	**Utility Pole**	**REL - B/O**	**?**
498+69	**Lt / Rt**	**Cable TV**	**Ditch Cleanout**	**D&P Communication**
499+00 - 510+00	**Rt**	**Gas**	**Ditch Cleanout / Culvert Replacement**	**Michigan Gas**
498+50 - 507+00	Rt	Telephone	Ditch Cleanout / Culvert Replacement	Verizon
512+00 - 10+00	Rt	Gas	Storm Sewer / Catch Basin Replacement	4" Steel Line
507+00	Lt	Telephone	Culvert Replacement	Verizon
521+00 - 5+50	**Lt**	**Telephone**	**Relocate to Back of ROW**	**Verizon**
13+00	**Rt**	**Utility Pole**	**REL - B/O**	**?**
14+54	**Lt**	**Cable TV**	**Ditch Cleanout / Culvert Replacement**	**D&P Communication**

Figure B.18. Michigan DOT conflict analysis table: Example D.

MDOT has found that collecting QLB data does not guarantee the identification of all underground utility facilities. This recognition, together with the perception of high cost associated with the collection of QLB and QLA data, has caused some design engineers to be reluctant to conduct SUE studies. Utility owners sometimes offer to conduct SUE studies, but MDOT's view is that it is difficult to coordinate SUE activities by multiple utility owners. According to department officials, a limited, targeted, and therefore less costly form of data collection appears to be more beneficial.

Since 2008, MDOT has used MISS DIG (the Michigan one-call system) design tickets to mark utility facility locations during the design phase. Design tickets have been particularly useful for accelerated projects, for which the traditional approach of sending letters to utility owners to request information would result in additional project delays. Design tickets are also useful for traditional projects for which utility owners supply conflicting information or provide little or no information. Unfortunately, not all utility owners contribute data to MISS DIG, which decreases the reliability of the data provided by the system.

MDOT emphasizes the importance of a good working relationship with utility owners. The department has found it to be advantageous to be flexible in the utility accommodation process and to look at issues from the utility owner's point of view. For example, if changes are made to the project design, it is important to notify utility owners about the change. Providing consistency in the way the department moves a project from planning to construction is also beneficial for improving working relationships with utility owners.

MDOT officials highlighted the need to conduct effective utility coordination meetings. When utility owners are not responsive, respond late, or do not attend utility coordination meetings, the result is often hastily or improperly addressed utility issues. However, utility coordination meetings are sometimes ineffective because of the difficulty utility owners encounter in understanding design plans. Training for MDOT and utility personnel would help to improve the efficiency of utility coordination and conflict resolution practices.

A critical utility coordination meeting takes place once the roadway drainage design is substantially complete, typically at about 60% design. This meeting is critical because proceeding with utility relocation design depends on up-to-date plan and profile information. Utility coordinators monitor design progress to schedule the coordination meeting. If the roadway drainage design is not complete by 60% design, utility coordinators remind the design team that further delay will reduce the available time to verify vertical conflict points between proposed storm sewers and major existing utility lines before the end of design.

Although it would help roadway contractors to have all utility conflicts resolved when construction starts, in practice it would be necessary to relocate utility facilities earlier, not just after the 90% design meeting. Projects can still change drastically at 90% design (e.g., major changes can occur if a project is shortened by a mile). In addition, at 90% design there is still uncertainty whether the project will go to letting. For these reasons, MDOT utility coordinators frequently do not feel comfortable requesting utility relocations before the 90% design stage.

MDOT officials also highlighted the need for proper communication and coordination between right-of-way and utility staff and the design section—for example, a utility engineer may like to propose a change to the roadway design or help project managers and designers understand that utility owners need time to complete relocations in the field.

Additional Observations and Recommendations from MDOT

- *Develop a statewide, standardized, consistent format for the conflict analysis table.* Because of the lack of a consistent standard, consultants submit utility conflict tables in multiple formats and layouts. MDOT recommends that other states that do not have a standard for conflict analysis tables determine ahead of time what information is critical to include in the utility conflict table.
- *Specify a standard update interval for utility conflict tables.* It is important to update utility conflict tables at least monthly. Because it takes time and effort to maintain these tables, an alternative would be to provide updates at critical milestones such as 30%, 60%, and 90% design. However, MDOT's experience is that often too much time passes between these meetings, making it necessary to provide updates at shorter intervals.
- *Ensure consistency in all DOT manuals that describe utility coordination activities.* DOT manuals are typically the product of multiple organizational units and individuals contributing content. It is critical to coordinate this effort to avoid conflicting information.
- *Include utility relocations in the highway contract, if feasible.* MDOT's experience including utility relocations in the highway contract has been positive, particularly in the case of municipal utilities, such as water and sewer.
- *Keep all communications with one utility owner in one place.* MDOT uses a communication suite that enables users to store all e-mails and notes about phone calls in one communication folder. This is useful if there are questions about a particular utility conflict.
- *Develop training on utility conflict management.* A training course on utility conflict management should explain the project development process, go through a project from preliminary design to construction, and describe what utility coordination activities need to be completed at what

time in the process. The course should also emphasize the importance of quality utility information in the preliminary design phase, which might help to avoid the need for utility relocations.

Minnesota Department of Transportation

MnDOT updated its utilities manual in 2006. The manual includes a 15-step process for utility conflict analysis and coordination during project delivery that encourages utility owners to participate early and often. Local agencies must also use this 15-step process on projects that take place on a state right-of-way. To get buy-in by all stakeholders and increase the understanding of this new process, MnDOT provided training to its employees, consultants, local agencies, and utility owners. Once the process was implemented, follow-up reviews were conducted to evaluate compliance and process effectiveness.

All MnDOT, local agency, and consultant projects now use the 15-step process. Since MnDOT implemented this new process, there has been a substantial decrease in the number of utility owner delay claims. Two of the eight MnDOT districts (Metro District and District 7) have dedicated utility staff responsible for the coordination process. In the other six districts, the design project manager and the construction project engineer perform these duties.

On design–build projects, MnDOT requires the use of conflict analysis and early utility coordination as part of the SUE process. MnDOT requires early coordination utility workshops at the conclusion of Phase 1 of the SUE process, which involves designating and mapping of utility facilities. During the utility workshops, participants identify possible conflicts and utility constraints. This information is included in the request for proposals for design–build contracts. MnDOT invites utility owners to meet with the short-listed design–build firms to go over the information provided in the request for proposals. During construction, the design–build firm is required to maintain a weekly utility tracking report (Figure B.19), prepare utility design sheets for necessary relocations (Figure B.20), and obtain approval for utility permits before commencing the utility work. MnDOT has observed a reduction in the number of unanticipated utility facilities found within the project and significantly reduced project delays.

MnDOT uses a web-based system called utility and municipal agreements reporting and tracking (UMART) to facilitate utility coordination. This software provides general project information, tracks completion dates of required tasks, provides access to templates for utility documents, and sends alerts to appropriate staff when steps are not completed on time. Reports can be accessed by clicking on a link and selecting appropriate parameters (Figures B.21, B.22, and B.23).

Missouri Department of Transportation

MoDOT uses a Microsoft Access database called utility agreement tracking database (UATD) to track costs for reimbursable utility relocations. UATD tracks several utility agreement data items, including the original relocation estimate and all payments made to utility owners (Figure B.24).

MoDOT has used utility conflict lists for at least 15 years. Before the use of utility conflict lists, MoDOT staff used notes and a journal to manage utility conflicts. Over time, utility conflict lists have proven to be more effective than this alternative.

Having a spreadsheet with utility facility information is highly advisable to remind DOT designers of outstanding utility issues. The list should include all project utility facilities, not just known conflicts, and should be updated as information becomes available. The spreadsheet does not contain information about the resolution method, only whether the conflict has been resolved. Utility conflict lists can also assist in avoiding utility relocations by making it easier to track all utility facilities, especially when working on multiple projects. MoDOT updates utility conflict lists whenever new data become available, which is typically weekly or monthly depending on the project.

MoDOT keeps utility owner contacts on a separate list because contacts might change during the project and there might be multiple contacts for each conflict. Updating the utility owner spreadsheet is the responsibility of the design department utilities liaison engineer.

MoDOT uses several utility conflict list formats. The advantage of this practice is that each list is specific to the needs of individual district users. Rural and urban districts have different demands and requirements, and each district typically knows what works best for them. The disadvantage is that utility owners have to deal with different layouts and lists, and even MoDOT utility coordinators sometimes need time to familiarize themselves with new list layouts. MoDOT is aware of this issue and is now considering the use of a common standard for utility conflict lists (which could still allow more than one format, e.g., one format for rural districts and a second for urban districts).

Some MoDOT districts use a utility project summary to track utility owners for each project (Figure B.25). This document is a simple spreadsheet that lists information related to all utility facilities on a project. The list is similar but not identical to other utility lists used in the state. MoDOT also uses a second, more generic list of utility facilities that the Missouri one-call service generates. MoDOT uses these lists and spreadsheets to generate a special provision that provides information to contract bidders about utility conflicts that have not been resolved before letting. This special provision is included in each PS&E package.

UTILITY TRACKING REPORT

UTILITY COMPANY	MUA NUMBER	CONFLICT #	WORK ORDER & STATUS			UTILITY SIZE & SHAPE	LOCATION	STATION	UTILITY DESIGN SHEET		CONFLICT RESOLUTION		UTILITY PERMIT		DESIGN APPROVAL		Utility Owner Inspection	UTILITY CONSTRUCTION SCHEDULE				EXHIBIT G(1)	EXHIBIT G(2)	As-Builts Compete (Y/ N)	COMMENTS
			WO	Sent to Utility Owner	Executed By Mn/DOT				Started	Finished	Proposed	Mn/ DOT Approval Date	Permit Approval	Permit No.	Exhibit F(1) - Utility Owner	Exhibit F(2) - Contractor	Yes/No	Proposed Sched.	Actual Start	Actual Finish	% Complete	Utility Owner Construction Approval	Contractor Construction Approval		

Figure B.19. MnDOT utility tracking report.

S.P. _____ (T.H. ___)
Agreement Number _____

EXHIBIT D

Mn/DOT Design-Build Project Utility Design Sheet

UTILITY DESIGN SHEET

Utility Owner #	Conflict #

Utility Owner: City of _____ ☐ Public ☐ Private

SECTION TO BE COMPLETED PRIOR TO NEGOTIATION MEETING

Existing Condition

1. General Location: _____

2. Utility Type: ☐ Electric ☐ Gas ☐ Communications ☐ Water ☐ Sanitary ☐ Cable TV ☐ Other: _____

3. Location By: ☐ Utility Plat Maps ☐ Field Located & Surveyed: ☐ Yes ☐ No Pothole: ☐ Yes ☐ No

If Pothole, #_____ From: ☐ Mn/DOT Work or ☐ DBC Work SUE contractor used: _____
Station: _____ to Station: _____ Dist. From CL: _____ Rt. / Lt. _____

4. Utility Size & Materials: _____

5. Encased: ☐ No ☐ Yes, If So, Size & Material: _____

This Section Completed By DBC Rep.: _____ Date: _____

SECTION TO BE COMPLETED AT NEGOTIATION MEETING

Proposed Resolution

1. DBC Recommends Utility be: ☐ Left Alone ☐ Modified ☐ Removed ☐ Relocated ☐ Upgraded ☐ Abandoned

Conflict With: _____

2. This Utility May Be Modified/Relocated To: _____

Station: _____ to Station: _____ Dist. from CL: _____ Rt./Lt. _____

3. Utility In: ☐ Mn/DOT R/W ☐ Other Public R/W ☐ Easement (attach copy) ☐ Not in R/W

4. Who Is To Do the Design? ☐ Utility Owner (UO) ☐ Design-Build Contractor (DBC)

5. Who Is To Do Construction/Relocation? ☐ Utility Owner (UO) ☐ Design-Build Contractor (DBC)

6. UO To Perform Inspection? ☐ No ☐ Yes, If So, Conditions: _____

7. Number of Days Required For Prior Notification by DBC For Construction Relocation by UO: _____ Days

8. Number of Days Required to Complete Design: _____ Days; Construction: _____ Days

9. Any Construction Details Unique to This Location? ☐ No ☐ Yes, Describe: _____

10. Utility Can Only Be Disconnected For: _____ Days/Hours

11. Other Proposed Action: _____

12. Detailed Plan Sheet Attached

This Section Completed By: Mn/DOT _____ UO _____ DBC _____ Date: _____

Figure B.20. MnDOT design–build project utility design sheet.

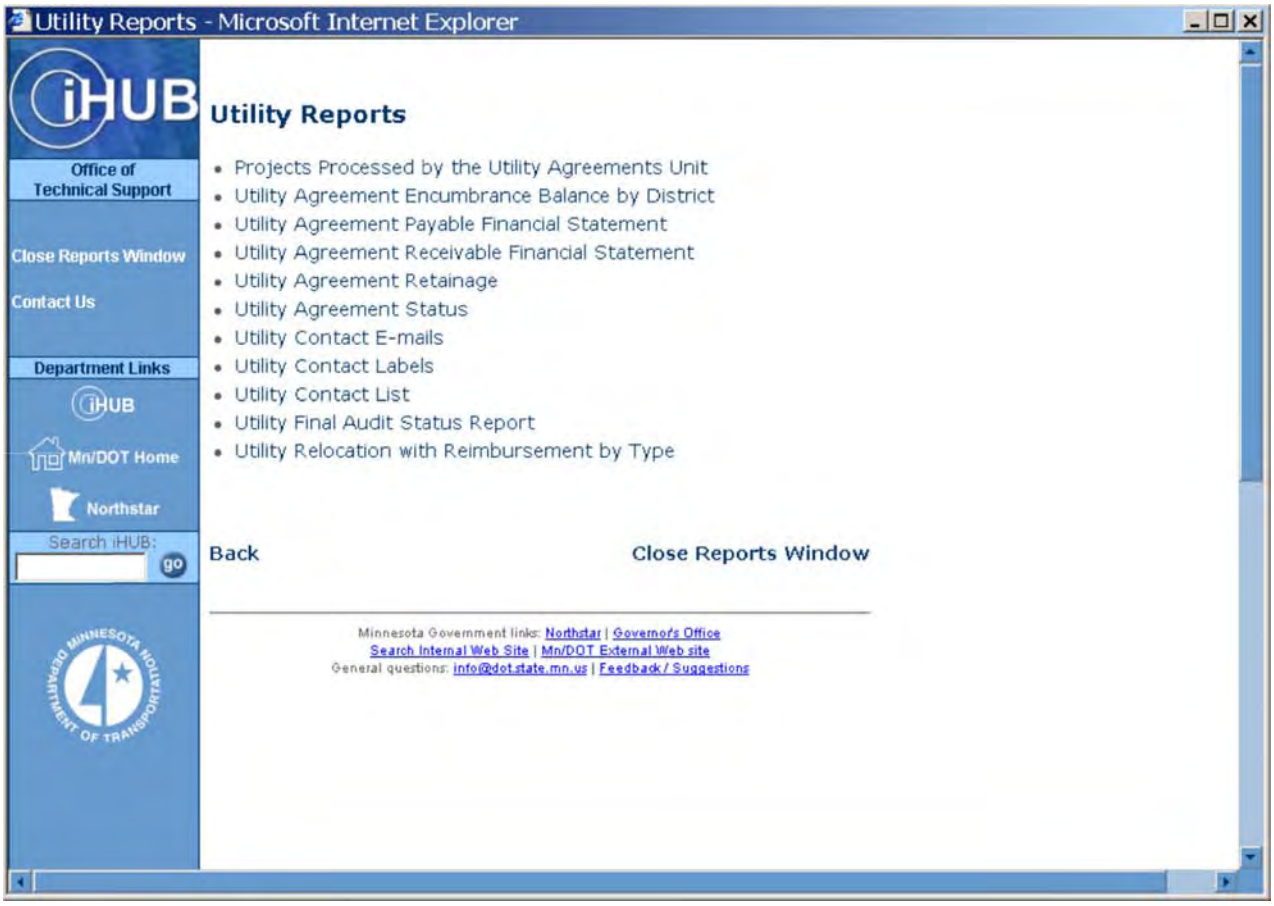


Figure B.21. Types of UMART utility reports.

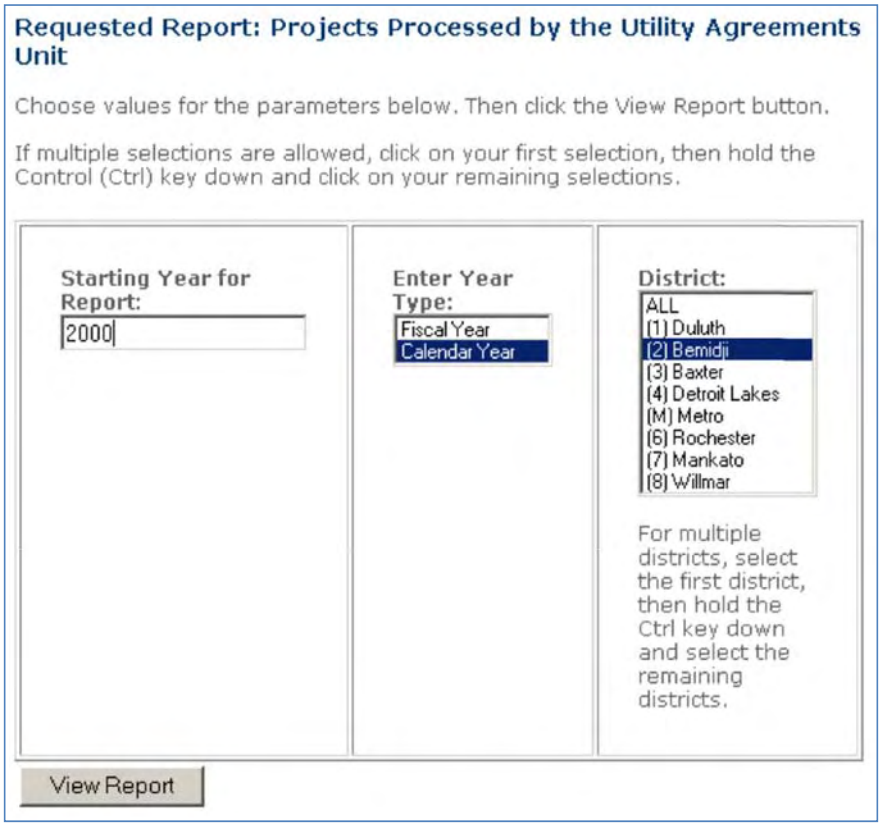


Figure B.22. Parameter selection for UMART report.

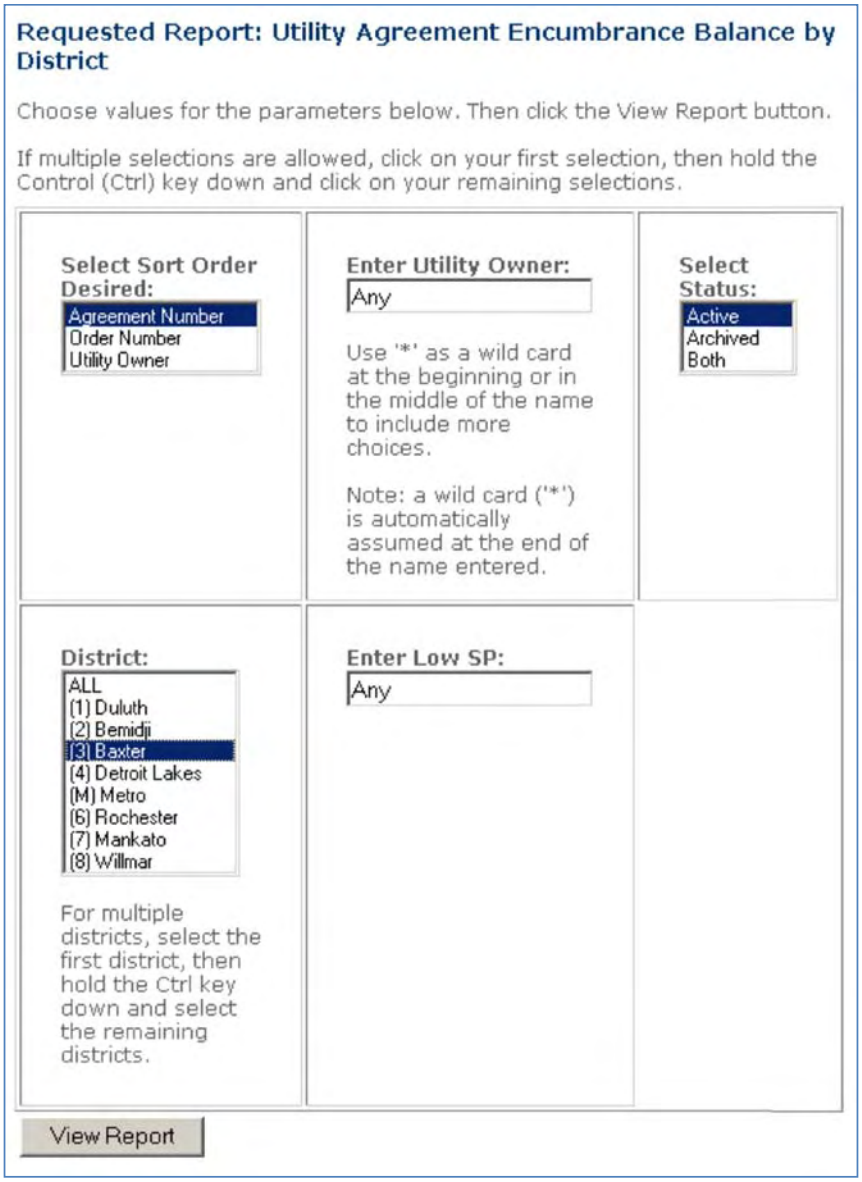


Figure B.23. UMART parameter selection for utility agreement encumbrance balance report.

During the planning phase, MoDOT typically provides a list of upcoming projects to utility owners. After the statewide transportation improvement program is developed, MoDOT conducts an annual meeting with utility owners and provides a list of projects to utility owners to help them budget for potential upcoming relocations. In the early stages of a project, MoDOT staff also uses Google Earth and other online maps to identify aboveground utility installations on a project.

When feasible and as allowed by regulations, MoDOT tries to include utility relocations in the highway contract. This practice is beneficial because it shifts the coordination and timing burden from MoDOT to the highway contractor. MoDOT often includes small water district utility owners and small city utility owners in the highway contract. Utility owners with large facilities typically do not want to be included in the highway contract.

MoDOT has recently developed a utility owner–DOT training course focusing on cooperative utility conflict management as part of the Partnering for Innovative Efficiencies initiative. The course was developed jointly by utility and DOT representatives and has been well received by all utility stakeholders. The course has helped with some recurring issues during utility coordination meetings—for example, it has helped utility owners to read and understand MoDOT design plans.

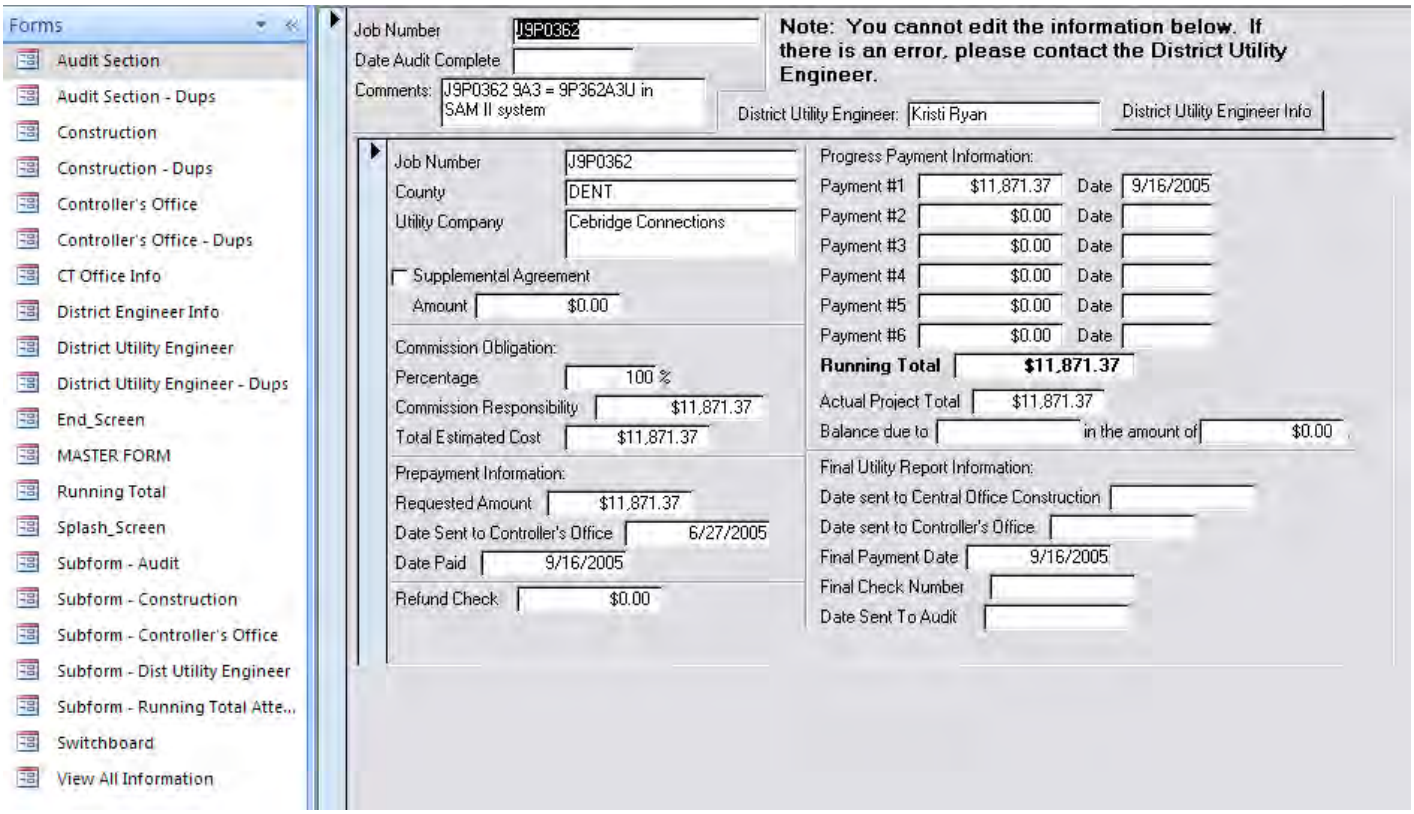


Figure B.24. MoDOT utility agreement tracking database.

Nevada Department of Transportation

NDOT regularly contacts utility owners at the beginning of the detailed design phase, although, realistically, utility coordination for major utility facilities starts at about 30% design and at 60% design for other utility facilities (once drainage design is complete). If funding is available and if the project is complex, NDOT collects QLB data as much as possible, preferably projectwide, to obtain and confirm utility facility information. Once utility facility information has been compared with the roadway design, NDOT designers may request QLA data in limited areas where information on the exact location of the utility facility would be beneficial.

Most utility conflicts at NDOT are related to bridge and drainage structures. In many areas, NDOT builds grade separations that require large fill sections that would cover existing utility facilities. However, these facilities were not designed to withstand the increased load and must be relocated or replaced. NDOT does not use a UCM. Utility owners in Nevada typically have their own tables, but they use them primarily for resource assignments and management.

NDOT has started to provide 3-D PDF design files to utility owners that show special details of the roadway design to present utility conflicts in more detail. Providing 3-D information to utility owners can help to identify and manage potential utility conflict locations more effectively. A typical example is a utility conflict caused by embankments for raised roadbeds. NDOT has also started using 3-D design files for demonstrations at public meetings.

Changing the roadway design in response to utility conflicts is not common at NDOT. Realistically, designers can accommodate shifts in the roadway alignment up to the 30% to 60% design phase. Since NDOT contacts major utility owners at about 30% design, the window of opportunity for a design change is small. Occasionally, design changes occur because the cost to NDOT to relocate a utility facility is much higher than purchasing additional right-of-way for the alignment shift.

NDOT sometimes receives water facility data in GIS format from the Las Vegas Valley Water District. This district collects global positioning system (GPS) data on water facilities during construction, including horizontal location and elevation, and stores the information in a GIS. The system provides a quick, elegant method of mapping utility installations on a project.

When feasible, NDOT includes the relocation of utility facilities such as water and sewer in the roadway contract, which shifts the utility coordination burden to the roadway contractor. This practice has been more popular with smaller

2006-2010 PROJECTS AT A GLANCE

Project Information			Railroads	Agr	Eas	Dr/Levee	Agr	Eas	Utilities	Plan	Agr	Eas
County: **Butler**		Grading, paving, drainage and bridge design box culverts at Beehole Creek	na	na	na	na	na	na	Ozark Border	x	A	na
Route: **60**		and Kearbey Creek from Carter County to Rte. 67. Part 4 lane relocation							SW Bell	x	P	na
Job No: **J0P0573**		with expressway right of way. (9.8 miles)							Alltel	x	A	na
	Dates	Comments	Sqd - Jeff									
R/W	8/7/02	R/W clear with exceptions.	PM - Bill									
Utilities	9/25/02	J0P0573C incorporated into this job.	Util - Marc									
Letting	11/15/02	Bond Project Fiscal Year 2002 or 2003										
Award	12/6/02	McAninch Corporation.										
County: **Butler**		Grading, drainage, paving and bridge at Rte. 60 and Rte. 67 interchange.	na	na	na	na	na	na	na	na	na	na
Route: **60**		Separation of interchange project from the grading, paving, and bridge										
Job No: **J0P0573D**		projects. (0.1 mile)										
	Dates	Comments	Sqd - Jeff									
R/W	na	R/W was acquired as part of J0P0573.	PM - Bill									
Utilities	6/8/04	Utilities relocated in J0P0573.	Util - Marc									
Letting	8/20/04	Power set up for lighting?										
Award	9/10/04	Robertson Contractors, Inc.										
County: **Butler**		Mill and resurface with 1 3/4" asphalt at curb and gutter locations from	na	na	na	na	na	na	na	na	na	na
Route: **67 (Bus)**		Rte.60 interchange south to Rte. M interchange. Amendment 3 smooth										
Job No: **J0D0600I**		roads initiative project. (7.58 miles)										
	Dates	Comments	Sqd - David									
R/W	na		PM - Eric									
Utilities	na	Only need Utility JSP.	Util - Marc									
Letting	7/22/2005											
Award	8/12/2005	Pace Construction Company										
County: **Butler**		1 3/4" asphalt (superpave) all of Rte. 60 in Poplar Bluff, Rte. 67										
Route: **60 (Bus)**		intersection to Rte. 60 interchange. (8.10 miles)										
Job No: **J0P0915**												
	Dates	Comments	Sqd - Spl									
R/W			PM - Andy									
Utilities			Util -									
Letting	11/18/05											
Award												
County: **Butler**		Construct additional lanes (NB) and bridges to provide divided pavement	Un Pacific									
Route: **67**		from Rte. O (near Wayne County line) south for 4 miles to the current										
Job No: **J0P0918**		4-lane divided section of Rte. 67 north of Poplar Bluff. This project made										
	Dates	Comments	Sqd - David									
R/W		possible as a result of a local tax initiative. Major project made possible	PM - Bill									
Utilities	11/18/05	by Amendment 3. (4.00 miles)	Util - Marc									
Letting	1/27/06											
Award												

Figure B.25. Missouri DOT utility project summary sample.

utility owners. NDOT is currently evaluating the program to include other types of utility facilities.

NDOT does not provide a separate bidding document that certifies the status of utility facilities and right-of-way, but rather includes incomplete utility work in the plan sheets. Typically, plans include labels such as "moved by others" or "concurrent work" to alert the roadway contractor.

Highway contractors use a one-call system (USA-DIG) during construction. However, only a portion of utility owners in Nevada are on the one-call system, and contractors sometimes find utility facilities that were missed by both NDOT's utility conflict management and the one-call system. Whenever possible, contractors shift activities to a different section of the project until the utility conflict has been resolved. However, it is not uncommon for NDOT to receive requests for compensation from contractors when projects have been delayed significantly by utility conflicts.

North Carolina Department of Transportation

NCDOT uses a server-based system called scheduling, tracking, and reporting system (STARS) to manage transportation projects from concept to construction. STARS tracks elements or milestones, which are tied to areas of responsibility. Using dates tied to each milestone, it is possible to determine the time it takes to complete portions of a project or the complete project. STARS uses tables to track project information, but it does not include a table for utility conflicts.

NCDOT can purchase permanent utility easements (PUEs) for utility installations with prior property rights. PUEs are typically 15 feet wide and are used to establish utility corridors outside the state right-of-way. The vast majority of PUEs accommodate distribution lines. Once a project designer establishes right-of-way needs for transportation purposes, NCDOT can establish a utility corridor, typically at 80% design. Utility corridors can overlap with NCDOT's right-of-way, so that a portion of the utility corridor is on a PUE, and another portion is within the public right-of-way. NCDOT uses PUEs primarily for longitudinal installations.

For nonreimbursable utility relocations, NCDOT can sometimes purchase a PUE for a utility owner and then receive reimbursement from the utility owner. This method can significantly speed up the relocation process because NCDOT can condemn property much faster than utility owners (e.g., by using a quick-take claim). Under statutory law, these claims allow NCDOT to take immediate possession of property under certain conditions upon filing a complaint, making a declaration of taking, and posting a deposit compensation (*1*).

NCDOT uses a new STARS add-on called monthly primary report to track right-of-way parcels needed to relocate utility facilities and PUEs. An NCDOT utility agent identifies critical parcels and PUEs and highlights them in STARS. The monthly primary report lists the right-of-way parcels needed for utility relocation that have been purchased to date. It also provides an estimate of how long utility owners are taking to relocate their facilities.

NCDOT right-of-way agents also use a Microsoft Access database to manage utility owner information. A challenge in the past has been to keep the database current. NCDOT's utility section also has an internal, limited desktop database to track utility owners, additional dates of the utility management process, compensable interests, and invoices. Other utility information is located on a network drive. The system is unable to archive utility facility plans electronically. NCDOT currently archives all documents as hard copies, which makes it difficult to find and retrieve utility construction documentation.

NCDOT has started to use blanket agreements with utilities for reimbursable utility relocations, primarily pipeline and cable crossings. Blanket agreements reduce administrative burden by combining multiple utility conflicts into one agreement using an electronic permitting system, which reduces the number of agreements that must be developed and monitored. The system enables utility owners to submit plans online, which are then stored and archived electronically.

NCDOT's goal is to complete utility relocations before letting. NCDOT includes utility conflict information on design plans about 4 to 5 months before the letting date. The information is also included in a project special provision to alert project bidders. However, utility owners frequently do not meet the relocation dates they provide and that NCDOT includes in the contract special provision. To get reliable utility relocation estimates, NCDOT finds it critical to get feedback from the utility owner's design and construction engineers.

Additional delays might occur because of missing environmental permits. Many of these delays can be avoided if environmental resource agencies are engaged early in the project development process and kept current on project changes. However, NCDOT sometimes does not receive these permits, such as permits related to the Coastal Area Management Act (CAMA), until 2 months before letting. This delay reduces the time available to complete utility relocations before construction starts. In the case of CAMA, common problems are utility facility upgrades or betterments, especially if the utility facilities in conflict are old installations. From CAMA's point of view, this can be seen as a type of development that is prohibited under CAMA rules.

On average, approximately 10% of projects under construction are currently delayed by utility facilities. In general, NCDOT grants a contract extension to the roadway contractor. Occasionally, if the contractor has idle equipment, NCDOT receives delay claims from the roadway contractor.

Ohio Department of Transportation

Each ODOT district has a utility coordinator who is responsible for all interactions with utility owners during the design phase of a project. A new practice also requires utility coordinators to be involved if there are utility conflicts during construction. It is up to the utility coordinators to monitor and perform coordination functions. No uniform process has been established for handling utility conflicts for the 12 ODOT districts. During ODOT's annual meeting for utility coordinators, meeting participants discuss common topics and determine the need for utility coordinators to perform new functions that appear to be beneficial. However, utility coordinators handle things in different ways.

Early in project development, the utility coordinator participates in a field review of the project and provides thoughts on potential utility impacts and recommendations for the collection of utility data, which become part of the design scope if recommendations are accepted. The field review information is also used to prepare Stage 1 (preliminary design) plans and right-of-way concepts. If major utility facilities can be avoided, ODOT makes all efforts to do so.

ODOT sends Stage 1 plans showing the project right-of-way to all utility owners for their review and input. At this stage in the process, ODOT develops a SUE concept if it believes detailed utility data will be needed in the design phase. This determination is often based on whether the district or central office is paying for utility data collection services. Districts are typically less inclined to spend funds on this activity.

With the information obtained in Stage 1, ODOT develops Stage 2 plans. ODOT sends these plans to affected utility owners, who are then required to provide the utility coordinator with their relocation plans and schedules. If the utility relocation work cannot be completed before construction begins, the information is included in a "4A" note to inform bidding contractors about how utility relocation will be handled on the project and how the relocation schedule will be coordinated with the construction schedule.

If there is a utility conflict during construction, the ODOT project engineer is now required to contact and involve the utility coordinator in the resolution of the problem. ODOT has found this practice useful to reduce utility delays. As part of the process, the utility coordinator must also document issues. For example, in the case of delays and additional costs to the project, ODOT uses the documentation to obtain reimbursement from the responsible utility owner. ODOT considers this coordination between the project construction engineer and the utility coordinator during construction of the project to be one of its best practices.

In recent years, ODOT has focused on improving coordination with utility owners. For many decades, ODOT design and construction engineers viewed utility owner involvement as a secondary process in project delivery. ODOT now recognizes the need to improve the awareness of ODOT personnel that utility relocation is one of the most critical components of efficient project delivery. Utility coordination is now an early involvement criterion in the ODOT project development process.

An example of the focus on improving coordination with utility owners is a 2-day training class that ODOT developed to teach utility owner personnel how to read ODOT construction plans. ODOT designed this course to enhance the cost-effectiveness of the utility relocation process and eliminate delays.

ODOT is also implementing meetings between ODOT's senior leadership and utility owners' senior leadership to discuss the importance of utility coordination in a more global fashion and raise the awareness that early and frequent utility coordination is necessary. As part of the process, ODOT and a major electric utility owner are developing a three-level memorandum of understanding. The first level focuses on general cooperation principles; the second level focuses on issues that are important to both parties, primarily during the design phase, such as budgeting and conflict resolution; and the third level focuses on project-specific issues.

South Dakota Department of Transportation

One of the functions of the SDDOT utility coordinator is to meet with project stakeholders, including SDDOT central office and area personnel, highway grading contractors, and statewide utility owners at an annual workshop. A review of the information collected at these workshops led to the development and implementation of a new advanced utility coordinating process to improve communication and coordination between utility owners and SDDOT personnel in charge of project development and design. Features and goals of the new process include the following:

- Identify potential utility conflicts by meeting with utility owners early during the planning and programming phase—that is, years before projects are anticipated to go to letting;
- Include utility owners in the design process in order to resolve identified utility conflicts and eliminate unnecessary utility relocations;
- Provide at least 1 year before project letting for utility relocations; and
- Hold prebid meetings with contractors and utility owners to provide contractors with as much information as possible about utility involvement.

A significant challenge when SDDOT was implementing the new process was helping utility owners understand the transportation project development process and helping project designers understand utility owners' concerns. An important function of the SDDOT utility coordinator has been to serve as a liaison between both parties.

Early in the design process, utility coordinators perform a preliminary survey by using South Dakota one-call tickets, field inspections, and interviews (in person or by phone or e-mail) with involved utility owners. The goal of this investigation is to learn which utility owners need to be involved, what existing utility facilities are within the project limits, and whether the upcoming project will require SUE services. With the data collected, SDDOT performs a conflict analysis and lists any utility conflicts in the project scope along with design options or directions for the design engineer to eliminate the conflicts.

Later in the design phase, the utility coordinator conducts a group meeting to ensure that all involved utility owners are identified, plans accurately depict all existing utility facilities, and each individual utility conflict is addressed. This conflict review identifies the best cost-effective solution, including options to change the project design or relocate the existing utility facility. The utility coordinator then prepares a meeting summary with the results of the conflict analysis. SDDOT also uses spreadsheets to track utility conflict information (Figure B.26). In preparation for letting, SDDOT includes information about known utility facilities and their conflict status in the PS&E documentation (Figure B.27).

SDDOT's experience is that a forceful, inconsiderate approach on the part of the DOT is detrimental and creates a nonproductive, noncooperative environment. SDDOT has also found it useful to look at utility issues from the utility owner's point of view to understand the challenges a utility owner has to deal with when interacting with the department. By keeping open lines of communication, SDDOT has also noticed that utility owners are more forthcoming in discussing their own projects with the department in order to avoid conflicts with future highway projects.

SDDOT would eventually like to place individual utility coordinators in each of the four SDDOT regions in order to assist designers and utility owners more effectively, give each project more thorough oversight, and help with the resolution of utility conflicts found during construction that were missed earlier in the project development process.

Tennessee Department of Transportation

Each utility agreement for reimbursable utility relocations at TDOT includes a form that documents the utility relocation activity on that particular project; this form becomes part of the PS&E package. All projects participate in a utility certification process that involves the submission of data by the regional or division offices to headquarters staff.

TDOT personnel use a utilities relocation information system that can track project areas and utility owner responses and involvement on roadway projects.

Because utility owners frequently do not have personnel qualified to inspect their contractors in the field, utility relocation work sometimes does not adhere to plans.

Once TDOT has identified the need for a utility facility to be relocated, the affected utility owner is asked to contact a TDOT regional utility engineer to arrange for a preliminary review and, if necessary, a field visit. This review provides a basis for discussing the highway project and the scope of the relocation work.

Utility owners are responsible for the design of the facilities that need to be relocated, and TDOT is responsible for reviewing and approving the utility owner's proposal. In addition to utility relocation matters, the review and approval cover topics such as measures to ensure traffic safety, the structural integrity of the roadway or highway structure, ease of highway maintenance, appearance of the highway, and the integrity of the utility facility.

Texas Department of Transportation

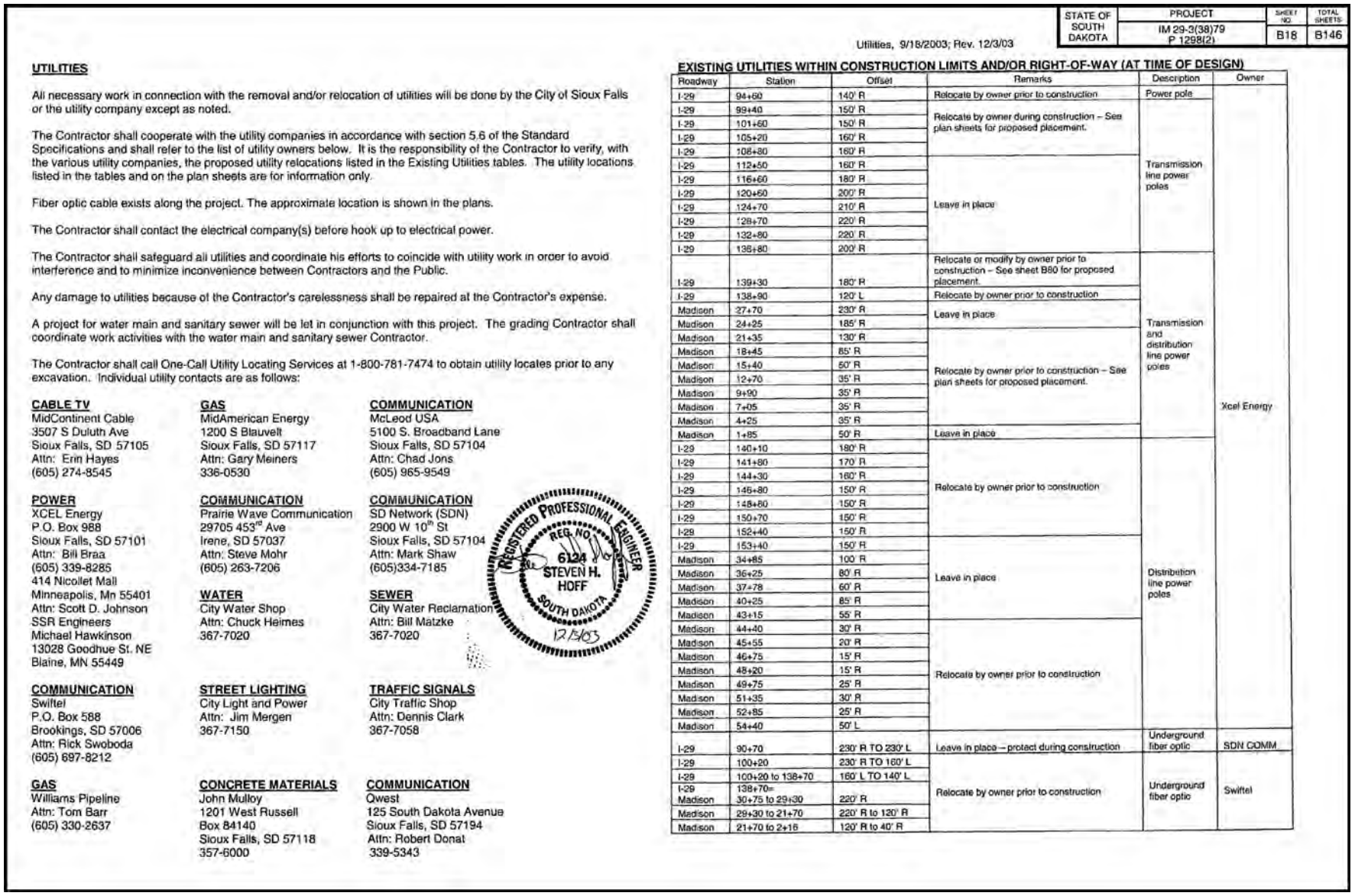
TxDOT has used tables and lists to manage utility conflicts for many years. Examples of lists used by districts include those shown in Figures B.28 through B.35. TxDOT considers the use of utility conflict lists to be worth the effort, considering that delay claims by a contractor resulting from an overlooked utility conflict can be costly to the department. Utility conflict lists at TxDOT have many different names, such as utility conflict lists, utility impact lists, utility coordination lists, utility adjustment reports, right-of-way and utilities status reports, and utility conflict matrices. Officials recognize that using different utility conflict lists in a district, or even in one office, makes the utility coordination process more difficult; TxDOT is increasingly aware of the need to standardize utility conflict lists.

TxDOT uses utility conflict lists to prepare PS&E package certifications. Those documents certify that the project is clear of all utility installations and ready for construction, except for the utility installations listed on the utility certification. In many cases, TxDOT also lists the number of days from the time of letting to actual start of roadway construction, typically 60 to 180 days. This strategy gives contractors time to clear and stake the right-of-way, provides utility owners time to address unresolved utility conflicts, and helps to prevent delay claims.

Utility certifications are typically prepared by the district staff using previously developed utility conflict lists, often

Picture No.	PCN	Picture Looking	City or Town	Hwy. No.	Description
6.JPG	02BF	N	Platte	44	Water valve in the SE quadrant of Hwy 44 & Indiana
7.JPG	02BF	W	Platte	44	Power Pole in the SW quadrant of Hwy 44 & Indiana
8.JPG	02BF	N	Platte	44	Power Pole in the SW quadrant of Hwy 44 & Indiana
9.JPG	02BF	N	Platte	44	Power Pole in the SW quadrant of Hwy 44 & Indiana
10.JPG	02BF	E	Platte	44	Power Pole (Transmission w/ riser) in the SE quadrant of Hwy 44 & Ohio
11.JPG	02BF	E	Platte	44	Power Pole (Transmission w/ riser) in the SE quadrant of Hwy 44 & Ohio
12.JPG	02BF	N	Platte	44	Power Pole, Fire hydrant & water valve in the SE quadrant of Hwy 44 & Ohio
13.JPG	02BG	S	Platte	45	Light Pole in the SW quadrant of Hwy 45 & 4th St
14.JPG	02BG	E	Platte	45	Light Pole in the NE quadrant of Hwy 45 & 4th St
15.JPG	02BG	S	Platte	45	Light Pole in the SW quadrant of Hwy 45 & 6th St
16.JPG	02BG	E	Platte	45	Power Pole in the NE quadrant of Hwy 45 & 6th St
17.JPG	02BG	E	Platte	45	Power Pole in the NE quadrant of Hwy 45 & 6th St
18.JPG	02BG	W	Platte	45	Power Pole & Fire hydrant in the NW quadrant of Hwy 45 & 6th St
19.JPG	02BG	W	Platte	45	Power Pole w/ riser in the NW quadrant of Hwy 45 & 6th St

Figure B.26. SDDOT sample utility conflict list.



STATE OF SOUTH DAKOTA	PROJECT	SHEET NO.	TOTAL SHEETS
	IM 29-3(38)79 P 1298(2)	B18	B146

Utilities, 9/18/2003; Rev. 12/3/03

UTILITIES

All necessary work in connection with the removal and/or relocation of utilities will be done by the City of Sioux Falls or the utility company except as noted.

The Contractor shall cooperate with the utility companies in accordance with section 5.6 of the Standard Specifications and shall refer to the list of utility owners below. It is the responsibility of the Contractor to verify, with the various utility companies, the proposed utility relocations listed in the Existing Utilities tables. The utility locations listed in the tables and on the plan sheets are for information only.

Fiber optic cable exists along the project. The approximate location is shown in the plans.

The Contractor shall contact the electrical company(s) before hook up to electrical power.

The Contractor shall safeguard all utilities and coordinate his efforts to coincide with utility work in order to avoid interference and to minimize inconvenience between Contractors and the Public.

Any damage to utilities because of the Contractor's carelessness shall be repaired at the Contractor's expense.

A project for water main and sanitary sewer will be let in conjunction with this project. The grading Contractor shall coordinate work activities with the water main and sanitary sewer Contractor.

The Contractor shall call One-Call Utility Locating Services at 1-800-781-7474 to obtain utility locates prior to any excavation. Individual utility contacts are as follows:

CABLE TV
MidContinent Cable
3507 S Duluth Ave
Sioux Falls, SD 57105
Attn: Erin Hayes
(605) 274-8545

GAS
MidAmerican Energy
1200 S Blauvelt
Sioux Falls, SD 57117
Attn: Gary Meiners
336-0530

COMMUNICATION
McLeod USA
5100 S. Broadband Lane
Sioux Falls, SD 57104
Attn: Chad Jons
(605) 965-9549

POWER
XCEL Energy
P.O. Box 988
Sioux Falls, SD 57101
Attn: Bill Braa
(605) 339-8285
414 Nicollet Mall
Minneapolis, Mn 55401
Attn: Scott D. Johnson
SSR Engineers
Michael Hawkinson
13028 Goodhue St. NE
Blaine, MN 55449

COMMUNICATION
Prairie Wave Communication
29705 453rd Ave
Irene, SD 57037
Attn: Steve Mohr
(605) 263-7206

WATER
City Water Shop
Attn: Chuck Heimes
367-7020

COMMUNICATION
SD Network (SDN)
2900 W 10th St
Sioux Falls, SD 57104
Attn: Mark Shaw
(605)334-7185

SEWER
City Water Reclamation
Attn: Bill Matzke
367-7020

REGISTERED PROFESSIONAL ENGINEER
REG. NO. 6124
STEVEN H. HOFF
SOUTH DAKOTA
12/3/03

COMMUNICATION
Swiftel
P.O. Box 588
Brookings, SD 57006
Attn: Rick Swoboda
(605) 697-8212

STREET LIGHTING
City Light and Power
Attn: Jim Mergen
367-7150

TRAFFIC SIGNALS
City Traffic Shop
Attn: Dennis Clark
367-7058

GAS
Williams Pipeline
Attn: Tom Barr
(605) 330-2637

CONCRETE MATERIALS
John Mulloy
1201 West Russell
Box 84140
Sioux Falls, SD 57118
357-6000

COMMUNICATION
Qwest
125 South Dakota Avenue
Sioux Falls, SD 57194
Attn: Robert Donat
339-5343

EXISTING UTILITIES WITHIN CONSTRUCTION LIMITS AND/OR RIGHT-OF-WAY (AT TIME OF DESIGN)

Roadway	Station	Offset	Remarks	Description	Owner
I-29	94+60	140' R	Relocate by owner prior to construction	Power pole	Xcel Energy
I-29	99+40	150' R	Relocate by owner during construction – See plan sheets for proposed placement.	Transmission line power poles	
I-29	101+60	150' R			
I-29	105+20	160' R			
I-29	108+80	160' R			
I-29	112+50	160' R	Leave in place		
I-29	116+60	180' R			
I-29	120+50	200' R			
I-29	124+70	210' R			
I-29	128+70	220' R			
I-29	132+80	220' R			
I-29	136+80	200' R			
I-29	139+30	180' R	Relocate or modify by owner prior to construction – See sheet B80 for proposed placement.	Transmission and distribution line power poles	
I-29	138+90	120' L	Relocate by owner prior to construction		
Madison	27+70	230' R	Leave in place		
Madison	24+25	185' R			
Madison	21+35	130' R	Relocate by owner prior to construction – See plan sheets for proposed placement.		
Madison	18+45	85' R			
Madison	15+40	50' R			
Madison	12+70	35' R			
Madison	9+90	35' R			
Madison	7+05	35' R			
Madison	4+25	35' R			
Madison	1+85	50' R	Leave in place		
I-29	140+10	180' R	Relocate by owner prior to construction	Distribution line power poles	
I-29	141+80	170' R			
I-29	144+30	160' R			
I-29	146+80	150' R			
I-29	148+80	150' R			
I-29	150+70	150' R			
I-29	152+40	150' R			
I-29	153+40	150' R	Leave in place		
Madison	34+85	100' R			
Madison	36+25	80' R			
Madison	37+78	60' R			
Madison	40+25	85' R			
Madison	43+15	55' R			
Madison	44+40	30' R	Relocate by owner prior to construction		
Madison	45+55	20' R			
Madison	46+75	15' R			
Madison	48+20	15' R			
Madison	49+75	25' R			
Madison	51+35	30' R			
Madison	52+85	25' R			
Madison	54+40	50' L			
I-29	90+70	230' R TO 230' L	Leave in place – protect during construction	Underground fiber optic	SDN COMM
I-29	100+20	230' R TO 160' L	Relocate by owner prior to construction	Underground fiber optic	Swiftel
I-29	100+20 to 138+70	160' L TO 140' L			
I-29 Madison	138+70= 30+75 to 29+30	220' R			
Madison	29+30 to 21+70	220' R to 120' R			
Madison	21+70 to 2+16	120' R to 40' R			

Figure B.27. SDDOT sample utility conflict certification.

90% Utility Conflict List
FM 2218 and FM 1640 Widening
CSJ: 2093-01-009, etc.

9/1/09

OWNER & CONTACT	UTILITY DESCRIPTION	CONFLICT STA AND OFFSET	CONFLICT DESCRIPTION	ADJUST. DATE	REMARKS
AT&T Texas Contact: Carl Holzwarth 5252 Hollister, RM 600 Houston, TX 77040 713-XXX-XXXX xxxxxx@att.com		The location of all facilities are called out in an approximate way only. The contractor shall determine the exact location before commencing work.			
	SBC Buried Cable	STA 21+09, 45' LT	Prop. Storm Sewer		SBC/AT&T will adjust or place new cable (B1)
	SBC Buried Cable	STA 21+88, 37' RT	Prop. Storm Sewer and Pavement		SBC/AT&T will adjust or place new cable (B2)
	SBC Buried Cable	STA 27+50 TO STA 30+00, 48' RT	Prop. Storm Sewer		SBC/AT&T will adjust or place new cable (B3)
	SBC Buried Cable	STA 44+40 TO STA 45+15	Prop. Storm Sewer and Pavement		SBC/AT&T will adjust or place new cable (B4)
	Telephone Pedestal	STA 45+12, 49' LT	Prop. Pavement		
	SBC Buried Cable	FM 1640 STA 22+33, 80' RT	Prop. Storm Sewer		No Conflict, approximately 12" of clearance (B19)
	SBC Buried Cable	FM 1640 STA 25+81, 55' RT	Prop. Storm Sewer		No Conflict, approximately 12" of clearance (B20)
	SBC Buried Cable	FM 1640 STA 25+81, 65' LT	Prop. Storm Sewer		No Conflict, approximately 12" of clearance (B21)
	SBC Buried Cable	FM 1640 STA 25+89, 62' RT	Prop. Storm Sewer		No Conflict, approximately 12" of clearance (B22)
	9-4" MCD	STA 12+50 TO 15+50, 49' LT	Prop. Storm Sewer		Look at design alternative (C1)
	9-4" MCD	STA 15+92, 40' LT	Prop. Storm Sewer		Field verify (C2)
	9-4" MCD	STA 20+40, 115' RT	Prop. Storm Sewer		Field verify (C3)
	9-4" MCD	STA 22+33, 80' RT	Prop. Storm Sewer		Field verify and look at design alternative (C4)
	9-4" MCD	STA 25+81, 55' RT	Prop. Storm Sewer		Field verify and look at design alternative (C5)
	9-4" MCD	STA 28+05, 62' RT	Prop. Storm Sewer		
	9-4" MCD	STA 33+15, 65' RT	Prop. Storm Sewer		Field verify (C7)
	ALL MANHOLES		Prop. Pavement		
CenterPoint Energy Electric Contact: Cynthia Martinez 1111 Louisiana, 802 C Houston, TX 77002 713-XXX-XXXX xxxxxx@centerpointenergy.com		The location of all facilities are called out in an approximate way only. The contractor shall determine the exact location before commencing work.			
	Power Poles	Parallel to LT/RT ROW along Project	Prop. Sidewalk		
	Power Pole	STA 21+09, 47' LT	Prop. Storm Sewer and Sidewalk		
	Power Poles	Parallel to Airport	Prop. Pavement		
	Power Poles	Ave N and Homestead	Prop. Pavement		
	Power Poles	Reading	Prop. Pavement		
	Power Poles	Town Center Blvd.	Prop. Pavement		
	Power Poles	Intersection at FM 2218/FM 1640	Prop. Storm Sewer and Pavement		

Figure B.28. TxDOT utility conflict list: Example A.

TxDOT- Houston District
IH 10: from Gelhorn to Mercury Dr.
US 90: from IH 10 to 0.29 miles west of Mercury Dr.
CSJ: 0508-01-166
CSJ: 0028-02-081

UTILITY CONFLICT LIST - CENTER POINT ENERGY ELECTRICAL

Item Number	Owner	Utility	Utility Size/ Material	Location	Crossing	Conflict	Sheet Number	Conflict Status	Estimated Conflict Resolution Date	Agreement Assembly	Agreement Status	Agreement Submittal Date	Comments
1	Centerpoint Energy	Electrical Conduit	18" Conduit Duct	Sta 115+36.31 (US 90)	Underground	Proposed Pavement , Ditch	Utility Sketch - Centerpoint Electric Sheet 1 of 1	Ongoing	3/1/2006	JUA A			CPEE completed design
2	Centerpoint Energy	Transmission Tower	N/A	Sta 115+57 (US 90)	Underground	Proposed Pavement	Utility Sketch - Centerpoint Transmission Sheet 1 of 1	Ongoing	TBD	JUA B			CPEE completed design
3	Centerpoint Energy	Transmission Lines	N/A	Sta 114+56 (US 90)	Overhead	Minimum Clearance requirement	Utility Sketch - Centerpoint Transmission Sheet 1 of 1	Ongoing	TBD	JUA A			CPEE completed design
4	Centerpoint Energy	Distribution Line	N/A	IH 10 at Oates Rd	Overhead	Minimum Clearance requirement	N/A	Closed	1/12/2006	JUA B			CPEE completed design
5	Centerpoint Energy	Distribution Line	N/A	US 90 WBFR Sta 102+00	Overhead	Minimum Clearance requirement	N/A	Ongoing	TBD	JUA B			CPEE completed design
6	Centerpoint Energy	Distribution Line	N/A	US 90 Sta 129+00	Overhead	Minimum Clearance requirement, Proposed Bridge at Oates Rd	Utility Sketch - Centerpoint Distribution Sheet 1 of 1	Ongoing	TBD	JUA B			CPEE completed design

Figure B.29. TxDOT utility conflict list: Example B.

RIGHT OF WAY UTILITY RELOCATION SUMMARY
REPORT DATE: April 6, 2009

Project: BU 287P **County:** Tarrant
From: On Rosedale St. Fr IH35
To: Riverside in Ft worth
Description: Widen 4ln to 6ln
CSJ No: 0172-01-042 ROWCSJ 0172-01-046

Area Engineer: Joe Fossett
Proj. Design Manager: **Ram Gupta (817) 370-6637**
Utility Coordinator: Joseph Bennett (817) 370-6883
Utility Consultant:
Letting Date: LET August 2008

Utility Company and Description	(NOPC) Notice of Proposed Construction	Level B SUE Received ** sent to Design	30% plans& SUE made available to Utilities	60% plans to Utilities (Strom Drain & cross section Included)	Level A 60 day 90% plans to utility Co.'s (Adequate Plans)	Permit or Agreement Received Date	R.O.W. Clear for Adjustment	Begin Adjustment Date	End Adjustment Date	Paid In Full
AT&T	N/A	07-23-04	N/A	03-01-07	05-15-07	P9/22/08	03-31-04	09-30-08	04-09	NA
Oncor ELECTRIC DELIVERY(U 12217)	N/A	07-23-04	N/A	03-01-07	05-15-07	P2/25/08	03-31-04	04-11-08	05-09	NA
CHARTER COMMUNICATION	N/A	07-23-04	N/A	03-01-07	05-15-07	P04/09	03-31-04	03-27-09	04-03-09	NA
City of Ft. Worth (Water, Sewer) (U 12373)	N/A	07-23-04	N/A	03-01-07	05-15-07	P11-15-07	03-31-04	02-25-08	05-09	NA
LEVEL3 COMMUNICATION	N/A	07-23-04	N/A	03-01-07	05-15-07	A05-09	03-31-04	05-09	08-09	$500, 000
KOCH	N/A	07-23-04	N/A	03-01-07	05-15-07	A05-09	03-31-04	06-09	08-09	$400, 000
Atmos gas (U 12218)	N/A	07-23-04	N/A	03-01-07	05-15-07	P11-15-07	03-13-04	01-07-08	04-03-08	NA
Oncor Transmission	N/A	07-23-04	N/A	03-01-07	05-15-07	P10-07	03-13-04	11-01-07	12-27-07	NA

(A) Agreement, (JA) Joint use acknowledgement, (EX) Executed date (*) There will be more to come; (**) Utility location sent to design: (NA) The utility is clear and ready for TxDOT construction.

COMMENTS: This project let in June 08 and has been held up waiting on RR agreement. There are two utility companies on the RR that will have to be adjusted after the RR agreement is signed.
11-18-08 spoke to Micheal Hyzak of Division bridge design, Division let the project in august. The construction contract was awarded to Texas Sterling. A pre-con meeting date hasn't been set yet.

There is two utilities on the bridge, level3 and kochpipeline.

Figure B.30. TxDOT sample right-of-way relocation summary.

GRAYSON COUNTY R.O.W & UTILITY UPDATE REPORT

LETTING SCHEDULE								OUTSTANDING R.O.W. PARCELS				UTILITIES LOCATED WITHIN THE PROJECT AND POSSIBLE CONFLICTS											
												UTILITY COMPANIES					DATE OF INITIAL LETTER TO THE UTILITIES FROM PARIS DISTRICT R.O.W. OFFICE	DATE OF LETTER OR PHONE CALL FROM THE SHERMAN AREA OFFICE	ADJUSTMENT NEEDS BY OR NO ACCOMMODATION FOR UTILITY COMPANIES	HANDOUT DATE OF R.O.W. MAP, PLAN & PROFILE SHEETS, AND X-SECTIONS	DATE OF SIGNED UTILITY AGREEMENT RETURNED TO SHERMAN AREA OFFICE OR DISTRICT R.O.W.	DATE ESTIMATED UTILITY ADJUSTMENTS TO BE COMPLETED	UTILITY STATUS AND/OR DATE COMPLETED
FY	CALENDAR MONTH & YEAR	HIGHWAY / I-SECTION	CSJ / PROJECT NO.	DESCRIPTION OF WORK	SURVEYOR & ESTIMATED DATE FOR PROJECT TO BE SURVEYED	DESIGNER / OFFICE OF PROJECT	DUE DATE OF INFORMATION NEEDED FROM DESIGNER: PLAN & PROFILE SHEETS W/ UTILITIES	DUE DATE OF INFORMATION NEEDED FROM DESIGNER: PROPOSED CROSS-SECTIONS	PARCEL NUMBER	OWNER, ADDRESS, & PHONE NUMBER	INITIAL DATE OF CONTACT FROM DISTRICT R.O.W.	ESTIMATED ACQUISITION DATE TO BE COMPLETED	INVOLVED	TYPE	STATION BEGIN	STATION END	LOCATION							
FY 2000	Aug-00	US 82	0045-19-026	NEW LOCATION	ALREADY COMPLETED	CLAY &	1-Jun-00	1-Jun-00	2/2E	Larry Hoodgendorn 204 Laurel Ridge Sherman,TX 75090 Tel. (903)813-1434)	2/2/2000	RTE	VERIZON / GTE	PHONE	ALL COUNTY ROADS	ALL COUNTY ROADS	UG	UNKNOWN	4/1/2000	LINES NEED TO BE RELOCATED & NO ACCOMODATIONS	6/1/2000	NOT NEEDED	12/1/2000	NO WORK YET 2/5/2000
		# 1,2,3			UNDERWOOD	BOB			5/5E	Harold N. Shannon 5927 Over Downs Circle Dallas,TX 75230-4039	5/27/1999	ROE 6/1/00	PINK HILL WATER	WATER/SEWER	ALL COUNTY ROADS	ALL COUNTY ROADS	UG	UNKNOWN	4/1/2000	ALL LOCATIONS NEED TO BE RELOCATED	3/24/2000	6/1/2000	8/1/2000	9/6/2000
									10	Charlotte Durbin & Felicia Eichner 11038 Westmore Circle Dallas,TX 75230-3552	3/1/2000	ROE 6/1/00	TXU PIPELINE(TUFCO)	GAS	STA 1415+00 STA 1537+75	STA 1450+00 STA 1547+00	UG	UNKNOWN	4/1/2000	BOTH LOCATIONS NEED TO BE RELOCATED	4/5/2000	NOT SIGNED	12/1/2000	NO WORK YET 2/5/2000
									12E	Same as Parcel 10	3/1/2000	ROE 6/1/00	KOCH PIPELINE	GAS	APPROX. STA 1596+00	APPROX. STA 1598+00	UG	UNKNOWN	4/1/2000	NO RELOCATION NEEDED BUT DITCH BLOCKS MUST BE PUT IN	4/1/2000	NOT SIGNED	12/1/2000	NO WORK YET 2/5/2000
									13	Nolene Morphew 415 S. Hazelwood St. Sherman,TX 75090-6210	5/13/1999	RTE	GRAYSON/COLLIN	ELECTRIC	ALL COUNTY ROADS	ALL COUNTY ROADS	OH	UNKNOWN	4/1/2000	ALL LOCATIONS NEED TO BE RELOCATED	6/1/2000	NOT SIGNED	12/1/2000	NO WORK YET 2/5/2000
									14	Glen E. Moore 207 N. Tolbert Ave. Sherman, TX 75092	5/13/1999	RTE	AT&T	FIBER OPTIC	APPROX. STA 1340+00	APPROX. STA 1345+00	UG	UNKNOWN	4/1/2000	NO RELOCATION NEEDED	6/15/2000	-	-	-
									15	Shafer Plaza III, LP 4514 Cole Suite 1201 Dallas,TX 75205-000	5/27/1999	ROE 6/1/00	ARCO	GAS	APPROX. STA 1524+55	APPROX. STA 1529+80	UG	UNKNOWN	8/1/2000	NO RELOCATION NEEDED	8/1/2000	-	-	-
									18/18E	Gary Andrews & Patsy Andrews 27726 Snow Rd Bakersfield, CA 93312-9591	2/7/2000	ROE 6/1/00												
									25	L.O Cherry Heirs c/o Mrs. George Perry, Jr. Route 2 Box SB Henrietta,TX 76365	6/25/1999	(Curative)ROE 6/1/00												
									27/27E	Walter W. Jansen 565 Watson Rd. Bells,TX75414-9724	8/20/1999	ROE 6/1/00												
									32/32TE	Mr. James Laster & Mrs. Teresa Hill 1269 Watson Rd. Bells,TX 75414	9/18/1999	RTE												
									33/33E	L.V. Owens & Shirley 11355 Watson Rd. Bells,TX 75414	9/10/1999	RTE												
FY 2001	Sep-00	SH 5 @		FLASHING BEACON	N/A	TRAFFIC	1-Jun-00	1-Jun-00		NO NEW R.O.W. REQUIRED FOR THIS PROJECT														
		FM 902				OPERATIONS																		
	Oct-00																							
	Nov-00	SH 91 @		HES: SIGNALS	N/A	TRAFFIC	1-Jun-00	1-Jun-00		NO NEW R.O.W. REQUIRED FOR THIS PROJECT														
		WOODLAKE				OPERATIONS																		
		FM 691 @		HES: SIGNALS	N/A	TRAFFIC	1-Jun-00	1-Jun-00		NO NEW R.O.W. REQUIRED FOR THIS PROJECT														
		THERESA				OPERATIONS																		
		FM 120 (#2)		WIDEN	ALREADY COMPLETED	MIKE B.	1-Apr-00	1-Apr-00		NO NEW R.O.W. REQUIRED FOR THIS PROJECT														
		ANSLEY LANE		ROADWAY	UNDERWOOD																			
		YOUNG ST.		REHAB	ALREADY COMPLETED	MIKE P.	1-Jun-00	1-Jun-00		NO NEW R.O.W. REQUIRED FOR THIS PROJECT														
		CITY OF HOWE		ROADWAY	UNDERWOOD																			
	Dec-00	VARIOUS		SEAL COAT	N/A	T.P. & D.				NO NEW R.O.W. REQUIRED FOR THIS PROJECT														
	Jan-01	US 69 @		TRAFFIC SIGNALS	N/A	TRAFFIC	1-Jun-00	1-Jun-00		NO NEW R.O.W. REQUIRED FOR THIS PROJECT														
		SPUR 503				OPERATIONS																		
		US 82 FR @		TRAFFIC SIGNALS	N/A	TRAFFIC	1-Jun-00	1-Jun-00																
		FM 1417				OPERATIONS																		
	Feb-01																							

NOTE: RTE (Property in Condemnation), ROE (Right of Entry), 9 other properties expected to be closed by 12/1/00, and 16 other properties have already been closed

Figure B.31. TxDOT sample right-of-way and utilities status report.

PARIS DISTRICT
UTILITY ADJUSTMENT REPORT

As Of: **August 19, 2009**
Changes since last update in RED

County Highway ROW CSJ	Name of Utility	Reimbursable?	Location of Agreement Package	Packet Status?	Current Action	Adjustment Status	Responsible TxDOT Employee	Amount Approved	Amount Billed	90% Payment	Audit Exceptions	10% Retainage	Outstanding Balance
HOPKINS SH 11 ROW CSJ: **0083-03-046** SH 19 **0108-09-039**	Verizon	No	ROW	Approved	U11114: Relocation is complete. NR	Complete	Keith Hollje						
	TXU Electric	Yes	ROW	Approved	U11655: Relocation & Reimbursement is complete	Complete	Keith Hollje	$ 74,397.96	$ 62,850.69	$ 56,565.62	$ -	$ 6,285.07	$ -
	Atmos Energy (Trans)	Yes	ROW	Approved	U12208: Relocation & Reimbursement is complete	Complete	Mike Powers	$ 235,912.59	$ 184,436.76	$ 165,993.08	$ -	$ 18,443.68	$ -
	Atmos Energy (Distribution)	No	ROW	Approved	U12446: Relocation is complete. NR	Complete	Mike Powers						
	SS Water & Sewer	No	ROW	Approved	U12450: Relocation is complete. NR	Complete	Mike Powers						
	TXU Distribution	No	ROW	Approved	U12614: Relocation is complete. NR	Complete	Mike Powers						
	Sudden Link Communications	No	AO	Approved	Relocation is complete by Permit. NR	Complete	Tim Taylor						
	People's Telephone	No	AO	Approved	Relocation is complete by Permit. NR	Complete	Tim Taylor						
	Shady Grove WSC	No	AO	Approved	Relocation is complete by Permit. NR	Complete	Tim Taylor						
								$ 310,310.55	$ 247,287.45	$ 222,558.70	$ -	$ 24,728.75	$ -
HUNT US 380 ROW CSJ: **0135-06-022**	Caddo Basin	Yes	ROW	Approved	U11423: Relocation & Reimbursement is complete.	Complete	Mike Powers	$ 853,746.47	$ 783,618.01	$ 705,256.21	$ -	$ 78,361.80	$ -
	Verizon	No	ROW	Approved	U11450: Relocation is complete. NR	Complete	Mike Powers						
	One OK Pipeline	Yes	ROW	Approved	U11523: Relocation is complete. Reimbursement has not been submitted.	Complete	Keith Hollje	$ 229,170.00	$ -	$ -	$ -	$ -	$ 229,170.00
	Cap Rock Energy	Yes	ROW	Approved	U11524: Relocation & Reimbursement is complete.	Complete	Mike Powers	$ 741,668.69	$ 741,668.69	$ 667,388.42	$(27,771.80)	$ 46,508.47	$ -
	AT&T	No	ROW	Approved	U11526: Relocation is complete. NR	Complete	Mike Powers						
	Explorer	Yes	ROW	Approved	U11534: Relocation & Reimbursement is complete.	Complete	Keith Hollje	$ 191,805.22	$ 201,206.44	$ 181,085.80	$ -	$ 20,120.64	$ -
	Energy Transfer (Gas)	Yes	ROW	Approved	U11695: Relocation is complete. Reimbursement returned to Utility 4/29/09. No Coorespondence!	Complete	Mike Powers	$ 370,006.39	$ 420,136.25	$ -	$ -	$ -	$ 370,006.39
	GEUS	No	ROW	Approved	U11850: Relocation is complete. NR	Complete	Mike Powers						
	AT&T	No	ROW	Approved	U12358: Relocation is complete. NR	Complete	Mike Powers						
	TMPA	No	n/a	n/a	No effect (no adjustment required)	n/a	Mike Powers						
	Comcast	No	n/a	n/a	No effect (no adjustment required)	n/a	Mike Powers						
	Kinder-Morgan	No	n/a	n/a	No effect (no adjustment required)	n/a	Mike Powers						
								$ 2,386,396.77	$ 2,146,629.39	$ 1,553,730.43	$(27,771.80)	$ 144,990.91	$ 599,176.39
HUNT US 380 ROW CSJ: **0135-07-037**	AT&T	No	ROW	Approved	U11525: Relocation is complete. NR	Complete	Mike Powers						
	Atmos Energy (Pipeline)	Yes	ROW	Approved	U12012: Relocation & Reimbursement is complete.	Complete	Mike Powers	$ 193,912.59	$ 73,187.29	$ 65,868.56	$ -	$ 7,318.73	$ -
	Atmos Energy (Distribution)	No	ROW	Approved	U12013: Relocation is complete. NR	Complete	Mike Powers						
	Caddo Basin	Yes	ROW	Approved	U12026: Relocation & Reimbursement is complete.	Complete	Mike Powers	$ 651,005.00	$ 383,518.60	$ 345,166.74	$ -	$ 38,351.86	$ -
	TMPA	Yes	ROW	Approved	U12076: Relocation is complete. Supplemental Agreement approved 8/06/09.	Complete	Mike Powers	$ 514,097.06	$ 516,702.66	$ 462,196.85	$ -	$ 51,355.21	$ 51,355.21
	GEUS	No	ROW	Approved	U12077: Relocation is complete. NR	Complete	Mike Powers						
	TXU Electric(Transmission)	No	ROW	Approved	U12079: Relocation is complete. NR	Complete	Mike Powers						
	GEUS	Yes	ROW	No	U12445: Utility Package approved 5/19/09. Utility working on relocation.	35%	Mike Powers	$ 88,073.29	$ -	$ -			$ 88,073.29
	City of Greenville (Water)	No	AO	n/a	City has already moved utility on private easement. (no agreement required)	n/a	Mike Powers						
	City of Greenville (Sewer)	No	AO	n/a	City has already moved utility on private easement. (no agreement required)	n/a	Mike Powers						
	Cap Rock Energy	No	AO	n/a	No effect (no adjustment required)	n/a	Mike Powers						
								$ 1,447,087.94	$ 973,408.55	$ 873,232.15	$ -	$ 97,025.80	$ 139,428.50
PROJECT TOTALS OF ALL UTILITY COST:								$ 4,143,795.26	$ 3,367,325.39	$ 2,649,521.28	$ (27,771.80)	$ 266,745.46	$ 738,604.89

NOTE: US 82 in Lamar County from Reno to Blossom: The utilities have not been completely determined and is not available for Status update!

Figure B.32. TxDOT sample utility relocation report.

County:
Highway:
ROW CSJ: **Construction Control CSJ:**
Phase I CSJ: **Limits: From:** **To:**
Phase II CSJ: **Limits: From:** **To:**
Phase III CSJ: **Limits: From:** **To:**

Utility Name	ROW Map & Notice of Construction Sent to Utility	Date of 2nd Notice (If Needed)	ROW Map Markups Received from Utility	Agreement Package						Estimated Relocation Cost	Notice to Proceed Sent to Utility	Begin Adjustment	Adjustment Completed	Billing						Utility Adjustment Closed Out	Remarks
				Sent to Utility	Received from Utility	Sent Back to Utility for Corrections	Resubmitted by Utility w/ Corrections	Sent to ROW Division	Approved by ROW Division					Received from Utility	Sent Back to Utility for Corrections	Resubmitted by Utility w/ Corrections	Sent to ROW Division	90% Payment Issued to Utility	10% Retainage Issued to Utility		
Phase I																					
Phase II																					
Phase III																					

Figure B.33. TxDOT sample utility coordination report.

Highway County	Construction Limits	R.O.W. Limits	Utility Company TxDOT U.C.	U-Number Procedure	C.C.S.J. Joint Bid	R.C.S.J. U.C.S.J.	R.O.W Release Requested/Approved	Approved ROW Map Env Clearance	Alternate Procedure (AP) Requested/Received	Alternate Procedure (AP) Submitted/Approved
IH 10 Bexar	0.12 Mi. S 0.32 Mi. S	FILE CLOSED	AT&T Rick Hanks	U8200 FUP	0072-12-159 No	0072-12-151 N/A	UnKnown August 15, 1991	Unknown November 16, 1987	Unknown Unknown	March 7, 2002 March 18, 2002
IH 10 Bexar	0.12 Mi. S. of Callaghan Rd. 0.32 Mi. S. of N. Crossroads Blvd.	0.2 Mi. S. of Callaghan Rd. N. Crossroads Blvd.	CPS Energy UG Rick Hanks	U8207 FUP	0072-12-159 No	0072-12-151 N/A	UnKnown August 15, 1991	Unknown November 16, 1987	Unknown February 27, 2002	March 7, 2002 March 18, 2002
IH 10 Bexar	0.12 Mi. S. of Callaghan Rd. 0.32 Mi. S. of N. Crossroads Blvd.	0.2 Mi. S. of Callaghan Rd. N. Crossroads Blvd.	TWC Rick Hanks	U8212 FUP	0072-12-159 No	0072-12-151 N/A	UnKnown August 15, 1991	Unknown November 16, 1987	March 5, 2002 March 6, 2006	March 7, 2002 March 18, 2002
IH 10 Bexar	0.12 Mi. S 0.32 Mi. S	FILE CLOSED	CPS Energy Gas Rick Hanks	U8217 FUP	0072-12-159 No	0072-12-151 N/A	UnKnown August 15, 1991	Unknown November 16, 1987	February 19, 2002 February 21, 2002	March 7, 2002 March 18, 2002
IH 10 Bexar	0.12 Mi. S. of Callaghan Rd. 0.32 Mi. S. of N. Crossroads Blvd.	0.2 Mi. S. of Callaghan Rd. N. Crossroads Blvd.	SAWS Rick Hanks	U8311 FUP	0072-12-159 Yes	0072-12-151 N/A	UnKnown August 15, 1991	Unknown November 16, 1987	February 19, 2002 February 21, 2002	March 7, 2002 March 18, 2002
IH 10 Bexar	0.12 Mi. S 0.32 Mi. S	FILE CLOSED	City of Balcones Heights Rick Hanks	U10425 FUP	0072-12-159 Yes	0072-12-151 N/A	UnKnown August 15, 1991	Unknown November 16, 1987	Unknown Unknown	December 1, 2004 December 20, 2004
IH 37 Bexar	LP 13 (SW 0.2 Mi. N	FILE CLOSED NO CONFLICTS Ave.	AT&T Texas Rick Hanks	U11445 FUP	0073-08-148 No	0073-08-161 0073-08-161	August 9, 2007 November 2, 2007	March 19, 2007 April 27, 2007	October 5, 2006 N/A	N/A N/A
IH 37 Bexar	LP 13 (SW 0.2 Mi. N	FILE CLOSED NO CONFLICTS Ave.	CPS Energy Gas Rick Hanks	U11446 FUP	0073-08-148 No	0073-08-161 0073-08-161	August 9, 2007 November 2, 2007	March 19, 2007 April 27, 2007	October 5, 2006 N/A	N/A N/A
IH 37 Bexar	LP 13 (SW 0.2 Mi. N	FILE CLOSED NO CONFLICTS Ave.	CPS Energy OH Rick Hanks	U11447 FUP	0073-08-148 No	0073-08-161 0073-08-161	August 9, 2007 November 2, 2007	March 19, 2007 April 27, 2007	October 5, 2006 N/A	N/A N/A
IH 37 Bexar	LP 13 (SW Military Dr) 0.2 Mi. N. of New Braunfels Ave.	LP 13 (SW Military Dr) 0.2 Mi. N. of New Braunfels Ave.	SAWS Rick Hanks	U11448 FUP	0073-08-148 Yes	0073-08-161 0073-08-161	August 9, 2007 November 2, 2007	March 19, 2007 April 27, 2007	October 5, 2006 November 28, 2006	November 13, 2007 November 15, 2007
IH 37 Bexar	LP 13 (SW 0.2 Mi. N	FILE CLOSED NO CONFLICTS Ave.	TWC Rick Hanks	U11491 FUP	0073-08-148 No	0073-08-161 0073-08-161	August 9, 2007 November 2, 2007	March 19, 2007 April 27, 2007	November 8, 2006 N/A	N/A N/A

Alternate Procedure (AP) Estimate	Utility Plans Certified Project Manager	Agreement Assembly (AA) Requested/Received	Agreement Assembly (AA) Submitted/Approved	State Cost Actual Cost	Joint Bid Cost Actual Cost	Total State Cost Total Actual Cost	Joint Use Only Submitted/Approved	Exception Requested/Approved	DOE / EWA Requested/Approved	Adjustment Completion Date Agreement / Actual	Letting Date Status
$254,100.00	N/A Rick Butler	March 20, 2002 Unknown	Unknown April 28, 2003	$217,921.04 $200,298.42		$217,921.04 $200,298.42	N/A N/A	N/A N/A	— August 7, 2002	April 7, 2003 April 17, 2003	July 25, 2007 Closed (Paid Out)
$168,000.00	N/A Rick Butler	September 12, 2002 September 20, 2002	September 25, 2002 October 4, 2002	$214,527.00 $171,621.60		$214,527.00 $171,621.60	N/A N/A	N/A N/A	N/A N/A	January 31, 2004	July 25, 2007 Pending SA Submission
$95,650.00	N/A Rick Butler	Unknown September 25, 2002	October 4, 2002 October 10, 2002	$75,790.90		$75,790.90	N/A N/A	N/A N/A	N/A N/A		July 25, 2007 Pending Billing Submission
$164,450.00	N/A Rick Butler	March 20, 2002 October 11, 2002	October 17, 2002 November 4, 2002	$16,200.00		$16,200.00	N/A N/A	N/A N/A	N/A N/A		July 25, 2007 Closed
$455,200.00	N/A Rick Butler	Unknown Unknown	February 20, 2003 March 28, 2003	$455,195.79	$423,137.00 $566,228.38	$878,332.79 $566,228.38	N/A N/A	N/A N/A	N/A N/A	Joint Bid Joint Bid	July 25, 2007 Pending Billing Submission
$100,000.00	N/A Rick Butler	January 7, 2005 May 25, 2006	District Tier 1 August 29, 2006	$23,325.00 $ 27,505.12	$5,429.00 $ 18,935.53	$28,754.00 $46,440.65	N/A N/A	N/A N/A	December 7, 2004 December 20, 2004	Joint Bid Joint Bid	July 25, 2007 Closed (Paid Out)
$1,237,400.00				$1,002,959.73 $399,425.14	$428,566.00 $585,163.91	$1,431,525.73 $984,589.05					
	N/A Lizette Colbert	October 5, 2006 N/A	N/A N/A				N/A N/A	N/A N/A	N/A N/A		June 26, 2007 Closed (No Conflicts)
	N/A Lizette Colbert	October 5, 2006 N/A	N/A N/A				N/A N/A	N/A N/A	N/A N/A		June 26, 2007 Closed (No Conflicts)
	N/A Lizette Colbert	October 5, 2006 N/A	N/A N/A				N/A N/A	N/A N/A	N/A N/A		June 26, 2007 Closed (No Conflicts)
$1,500,000.00	Joint Bid Lizette Colbert	October 5, 2006 January 17, 2007	December 3, 2007 December 14, 2007	$103,576.00	$1,338,685.00 $1,296,357.00	$1,442,261.00 $1,296,357.00	N/A N/A	N/A N/A	N/A N/A	Joint Bid Joint Bid	June 26, 2007 Pending Billing Submission
	N/A Lizette Colbert	November 8, 2006 N/A	N/A N/A				N/A N/A	N/A N/A	N/A N/A		June 26, 2007 Closed (No Conflicts)
$1,500,000.00				$103,576.00	$1,338,685.00	$1,442,261.00					

Figure B.34. TxDOT sample utility status chart.

CSJ	HWY	DIV OST #	Tot. Adj's.		Adj. Comp.	Adj. Outst.		Let Date	Comments: RCSJ 0675-08-089, 0.717 MI NORTH OF NORTH LOOP 336 TO 0.118 MI NORTH OF SOUTH LOOP 336. WIDEN TO 8 MAIN LANES W/ 2-3 LANE FRONTAGE ROADS, RAMPS, GRADE SEPARATIONS & PROVISION FOR FUTURE HOV AND TMS
0675-08-052	45	$9,770,863	18		1	17		Aug-07	

U#	Utility	Anticip. Agreement Date	Agreement Date	Est. Fld. Comp. Date	Actual Fld. Comp. Date	AP Estimate	Agreement Estimate	Prior to FY 07 Payments	FY 07 Payments	FY 07 Anticip. Payments	FY 08 Payments Made	FY 08 Anticip. Payments	FY 09 Payment Made	FY 09 Anticip. payments	FY 10 Anticip. Payments	FY 10 Payment Made	FY 11 Anticip. Payments	FY 11 Payment Made	FY 12 Anticip. Payments	FY 12 Payment Made	FY 13 Anticip. Payments	FY 13 Payment Made	Total Paid to Date	Est or AP Balance (if any)	Total Remainder to be Paid	Type of Payment
U11494	Chaparall		7/25/2007		9/26/2007	$200,000	$269,137	$0	$0	$0	$206,731	$0	$22,970	$0									$229,701	$39,436	$0	FP-AP
U11495	Copano	Feb-08	6/18/2008	10/1/2008		$200,000	$220,189	$0	$0	$0	$0	$0	$254,443			$28,271							$282,714	$0	$0	FP-AP
U11495 S1							$62,525																			
U11496	Valero	2008	Adjustment not required			$0		$0	$0	$0	$0	$0		$0									$0	$0	$0	VOID
U11499	CPE Gas	2008		FY10		$2,200,000	$312,198	$0	$0	$0	$0				$312,198								$0	$312,198	$312,198	
U11501	AT&T Trans.	6/30/2009 Terry Hopper	8/17/2009	Sep-09		$1,200,000	$26,470	$0	$0	$0	$0	$0			$26,470								$0	$26,470	$26,470	
U11502	AT&T	Apr-08	Aug-09			$900,000	$2,721,907	$0	$0	$0	$0	$0			$2,721,907								$0	$2,721,907	$2,721,907	rev. agmt.
U11503	Wave	6/30/2009		2009		$200,000	$141,378	$0	$0	$0	$0	$0			$201,874								$0	$200,000	$141,378	
U11503s1	Supplemented on 11/23/09		Nov-09				$60,496																			
U11504	Consolid		07/25/07	FY10			$422,521	$0	$0	$0	$9,040	$0			$422,521								$9,040	$413,481	$413,481	PP
U11505	Phono		09/24/07	2/1/2008		$66,227	$66,227	$0	$0	$0	$0	$66,227		$0									$0	$66,227	$66,227	
U11510	Level 3	6/30/2009	Nov-09	Aug-10		$1,000,000	$2,289,645	$0	$0	$0	$0	$0			$2,289,645								$0	$2,289,645	$2,289,645	awaiting adjustment and inv.
U11528	Suddnlnk	2008	03/07/08	2009		$1,000,000	$76,152	$0	$0	$0	$0	$0			$79,152								$0	$76,152	$76,152	
U11819	Entergy	6/30/2009	Sep-09	Mar-10		$1,500,000	$60,538				$0	$0		$0	$60,538								$0		$60,538	No Inv Yet
The total Entergy adjustment cost will be ~$589,249, to be done																										
U11868	Consolid		Jun-07	FY 2010			$2,528,841	$0	$0	$0	$0	$0	$0	$0		$127,632							$0	$136,263	$136,263	PP
U11868 S1	Consolid		Jun-09	Note - Reduction Supplement. Moving			-$2,264,946																			
U11500	Entergy		09/2008	Oct-08		$900,000	$650,372				$0	$0		$19,331	$650,372								$0	$669,703	$669,703	
U11500 S1	Entergy		Jun-09				$19,331																			
U12645	ATT		DO NOT USE																							
U11506	Conroe - Waterline		13-Sep-07	PS&E = $3,100,288 + $109,608							$0	$0		$3,209,896									$0	$3,209,896	$0	
U11507	Conroe Sewerline		12-Sep-07	PS&E = $3,271,715 + $62,327							$0	$0		$3,369,950									$0	$3,369,950	$0	
U11497	H&W		NO CONFLICT								$0	$0		$0									$0	$0	$0	
U11498	Brinker		NO CONFLICT								$0	$0		$0									$0	$0	$0	
Totals						**$9,366,227**	**$7,662,981**	**$0**	**$0**	**$0**	**$215,771**	**$66,227**	**$277,413**	**$6,599,177**	**$6,764,677**								**$521,455**	**$13,531,328**	**$6,913,962**	

Figure B.35. TxDOT sample utility conflict status list.

relying on ad hoc procedures and providing only a rough estimate of the actual status of utility conflicts on a project. Since most of the utility coordination is completed at the district level, division-level staff normally see the utility certification, not the more extensive utility conflict list.

Some districts report that most problems during construction are related to utility conflicts. To address this issue, many districts attempt to produce utility conflict lists as early as possible to give utility coordinators and designers more time and flexibility to deal with utility conflicts. Frequently, if a utility in conflict is not identified during the preliminary design phase, it becomes more difficult to avoid a utility relocation. Preliminary design-level utility conflict lists are often called potential utility conflict lists because often utilities are not confirmed and established as conflicts until a project's detailed design is around 60% complete.

Districts frequently use two tables: a utility conflict list and a utility contact list. Districts use two separate tables because there might be many contacts associated with one conflict, such as a coordination contact, design contact, construction contact, and payment–reimbursement contact. Districts have used electronic utility conflict lists for years. Over time, they have modified the type of information tracked to balance useful information with the time needed to maintain the list. Some districts reported the utility conflicts lists they use have worked well and have not changed for years.

In some districts, the utility coordination function is divided between reimbursable (for which it is necessary to prepare and execute utility agreements) and nonreimbursable (for which a utility permit is frequently sufficient) utility relocations. The first utility conflict list is frequently developed during planning; at this point it is simply a list of utility facilities or a list of potential utility conflicts. The preliminary design group updates this list and includes information from utility owners and data from utility permits. Once the design phase starts, the project designer develops a more detailed utility conflict list that also tracks utility facilities not in conflict or only potentially in conflict. This practice is useful in case a design modification changes potential utility conflicts to actual utility conflicts or if utility conflicts appear during construction, which might require change orders.

Determining if a utility facility is in conflict often demands not just horizontal but also vertical positions. Vertical information is normally difficult to obtain. Although permits might include information such as depth of cover, this information is usually not sufficiently detailed or accurate. In these cases, districts collect QLB or QLA data.

Updating utility conflict lists is typically the designer's responsibility, but the right-of-way section helps when possible. Typically, the right-of-way section has better information about utility owner names and contacts. As a minimum, utility conflict lists are revised at 30%, 60%, and 90% design. Sometimes districts keep two versions of the same list. One version includes all data items used for daily utility conflict management activities. The second version, which is forwarded to the district engineer, only includes the most important data items.

Some TxDOT districts do not use a utility conflict list, but track the status of permits for utility facilities that need to relocate. The document used to track the status of permits, called a right-of-way utility summary, tracks the dates of important milestones for each utility owner involved in the utility coordination process.

Some districts participate in utility coordination councils that meet quarterly to discuss utility and policy issues. While these discussions can be useful for communicating with utility owners, some districts find that keeping utility owners interested in these meetings can be difficult. Experienced utility coordinators have witnessed how utility coordination councils start out with enthusiastic participation by members but lose members over time as a result of decreasing interest or staff turnover.

Although the official process calls for sending design plans to utility owners in preparation for 30%, 60%, and 90% design meetings, TxDOT sometimes does not send the 30% design drawings to utility owners because utility owners tend not to get involved at that point. Most utility conflict management activities take place between 60% and 90% design. At project meetings, TxDOT provides design plans to utility owners and lets them determine how to resolve the utility conflicts. In practice, based on anecdotal information provided in the past, utility owners prefer TxDOT to take the lead in determining "who goes where."

In recent years, there has been considerable pressure from the public, the legislature, and the administration to accelerate the project development process. Unintended consequences for utility coordination include making utility owners design and relocate faster than they would have in the past. On small projects with only a few utility conflicts, changes to the project schedule might be easier to handle, but on major projects, it is imperative to stick to a project schedule.

Project decelerations can be equally disruptive. Although TxDOT has a 3-year letting schedule, districts frequently have projects that do not go to letting as planned and are delayed, creating tensions with utility owners who may have already spent considerable resources planning and preparing for the relocation of their facilities (and might not be reimbursed if construction funds for the project are not allocated).

During utility relocations, some districts make an effort to certify the utility installation drawings that utility owners include in permit requests or utility agreements. These districts use an internal form the utility inspector uses to note if the utility facility was inspected as planned or if any deviations

from the previously submitted plan have occurred. If there are significant changes, the utility inspector may request a new set of plans. Otherwise, the utility coordinator modifies or annotates the original plans, which then become the as-built plans. Some districts request utility facility plans signed and sealed by a professional engineer. However, small projects and small utility owners typically do not have staff professional engineers.

TxDOT's perception is that utility owners are frequently not sufficiently familiar with the utility coordination process (since utility conflict management is not their core business). Strategies mentioned for addressing this issue include getting to know and engaging utility representatives and stressing the importance of critical dates, such as the letting date and the date by which the utility relocation must be complete.

TxDOT has started to use web-based applications such as Google Earth and Microsoft Bing maps to review locations for potential utility conflicts. Some districts have also started to plot GPS coordinate data of utility installations on GIS platforms. Utility coordinators can make preliminary assessments of whether a utility is in conflict and confirm the assessment through a field visit. However, not all TxDOT officials currently have access to the Internet.

For small- to medium-size projects, some districts use the task feature in their e-mail client application to track utility conflicts. District officials log relevant information or data received and any contact made throughout the process. The result is a chronological summary of the utility coordination efforts with each utility owner. For large projects or for projects on a tight schedule, some districts use scheduling software to track utility coordination activities, which simplifies scheduling and tracking of deadlines for the completion of utility agreements.

TxDOT does not have a centralized system for managing utility conflict data. Some districts have developed systems, typically in a Microsoft Access format, to track utility conflicts (Figures B.36 and B.37). Although helpful, those systems tend to be ad hoc, with informal database structures, table structures, and user interfaces. Districts stated a great need to have a centralized utility conflict tracking system supported by a server-based utility database.

TxDOT tracks reimbursable utility agreement payments using the right-of-way information system (ROWIS), which TxDOT implemented in 1997 to manage the right-of-way acquisition process. ROWIS was not designed to handle utility relocations. TxDOT tracks utility agreements by creating

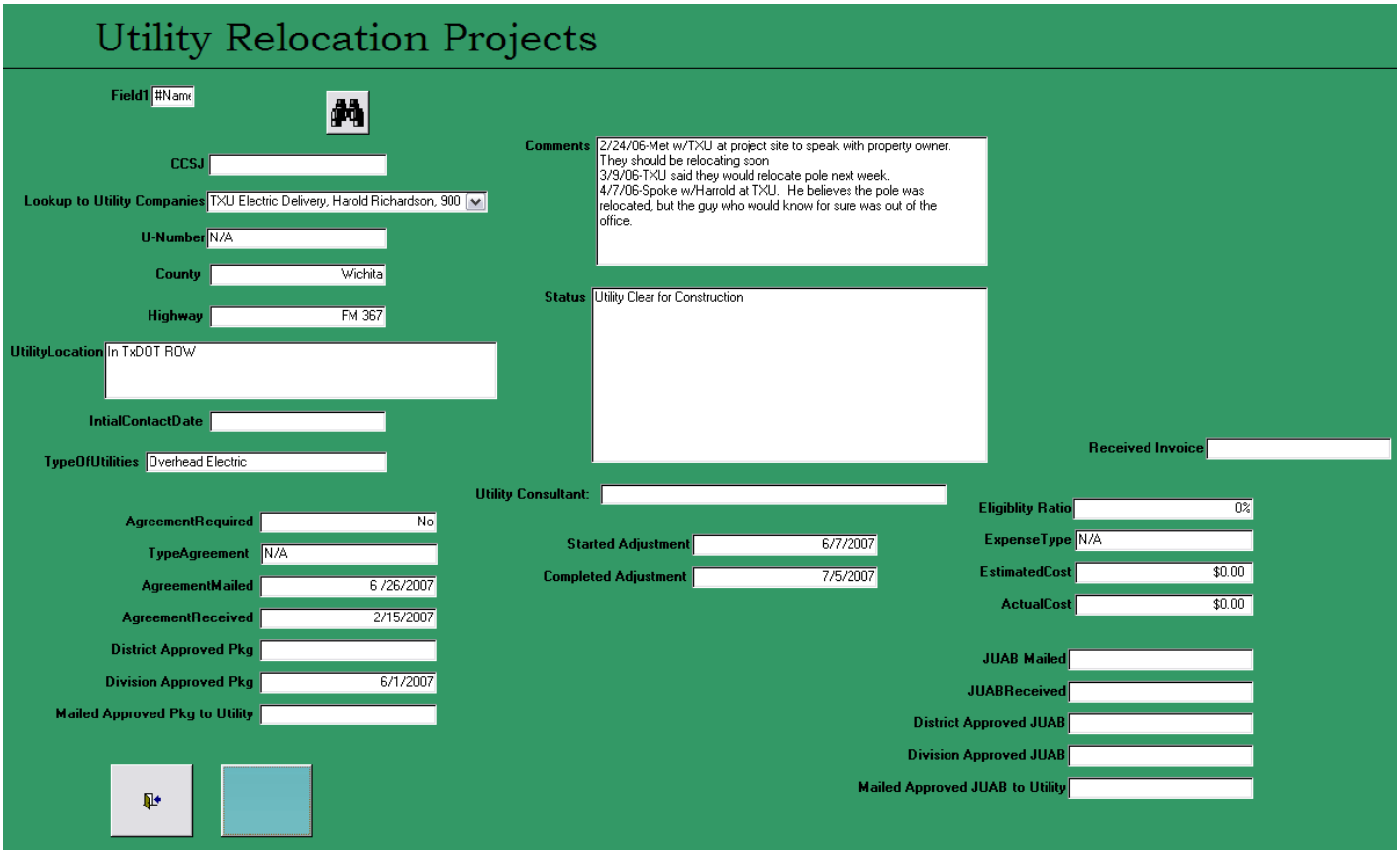


Figure B.36. Utility relocation projects screen from the TxDOT district utility conflict database.

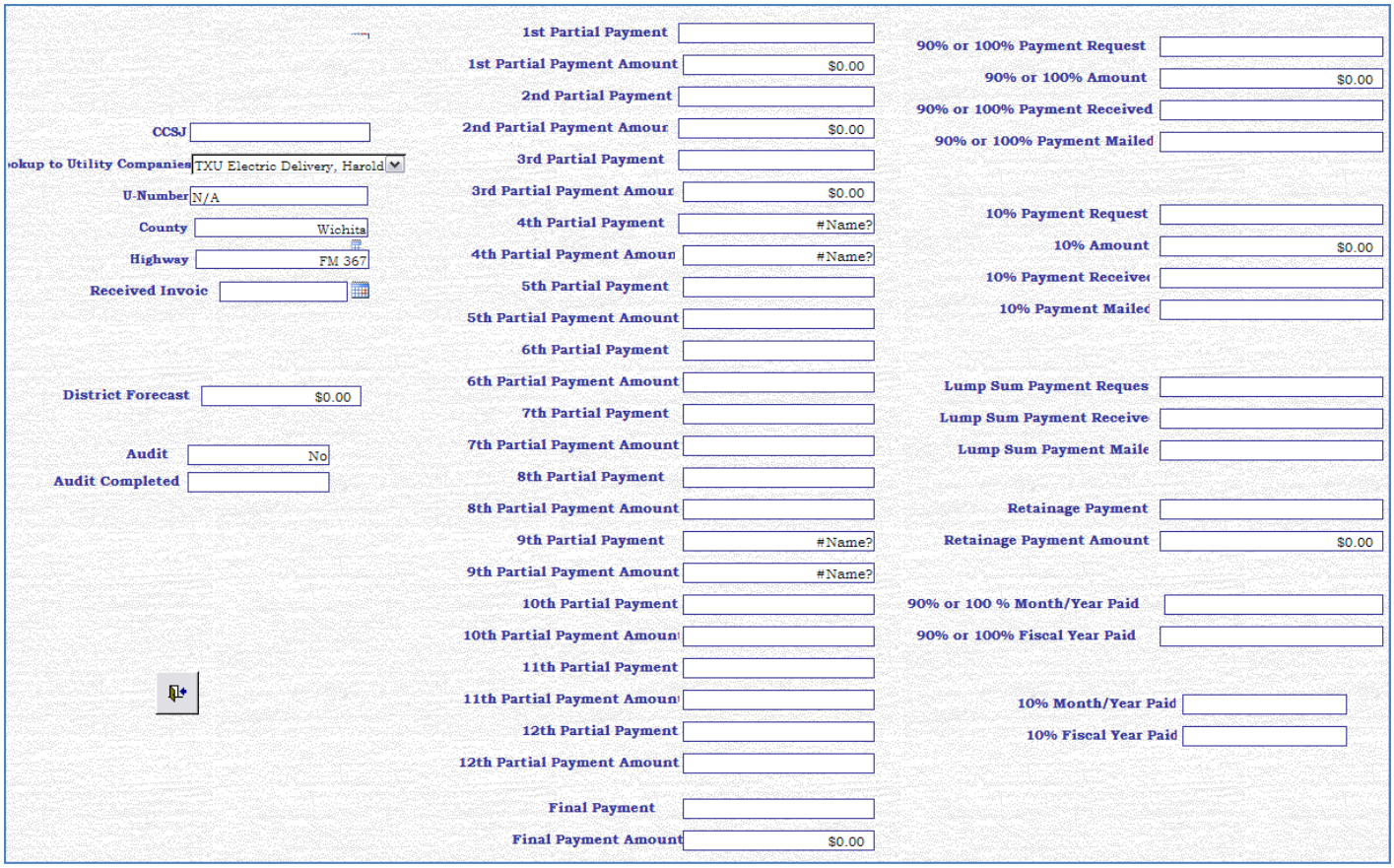


Figure B.37. Utility relocation billing screen from the TxDOT district utility conflict database.

parcel records in ROWIS that represent utility agreements. Figure B.38 shows a ROWIS screen. The system runs on a Microsoft SQL Server database platform. The system interface includes screens to display or query data on topics such as projects, parcels, tasks, owners, control section job numbers, minute orders, and public agencies.

ROWIS uses some data from TxDOT's design and construction information system (DCIS), such as control section job numbers, federal project number, project limits, and authorized funds. However, ROWIS is not integrated with DCIS, which means that DCIS data must be manually entered into ROWIS. Data synchronization issues arise when there are data updates in DCIS that are not reflected in ROWIS.

Because the capability within ROWIS to support the utility process is limited, TxDOT uses a utility agreement database, which is a stand-alone Access database, to track reimbursable agreement billings and payments. TxDOT considers this database to be a temporary solution to track billings and payments. Because the two systems are not linked, all relevant project information in the utility agreement database needs to be entered manually into ROWIS.

For high-profile projects, TxDOT has started to match utility conflicts to critical right-of-way acquisition parcels in an effort to prioritize right-of-way acquisitions based on the urgency of resolving utility conflicts.

Additional Observations and Recommendations from TxDOT

- *Foster communication between DOT project designer and utility engineers.* In general, a holistic engineering approach in which the DOT project designer communicates well with utility engineers is mutually beneficial. For example, the DOT could designate a DOT utility champion as a contact for utility owners. The utility champion should be knowledgeable about utility needs and processes and should be able to communicate these needs to DOT designers.
- *Consider DOT–utility cost sharing for SUE.* Cost sharing or cost participation for SUE activities by utility owners could be beneficial to both parties, but it would require new legislation in Texas and many other states.
- *Provide training for DOT and utility personnel about utility coordination topics.* To address the lack of familiarity of

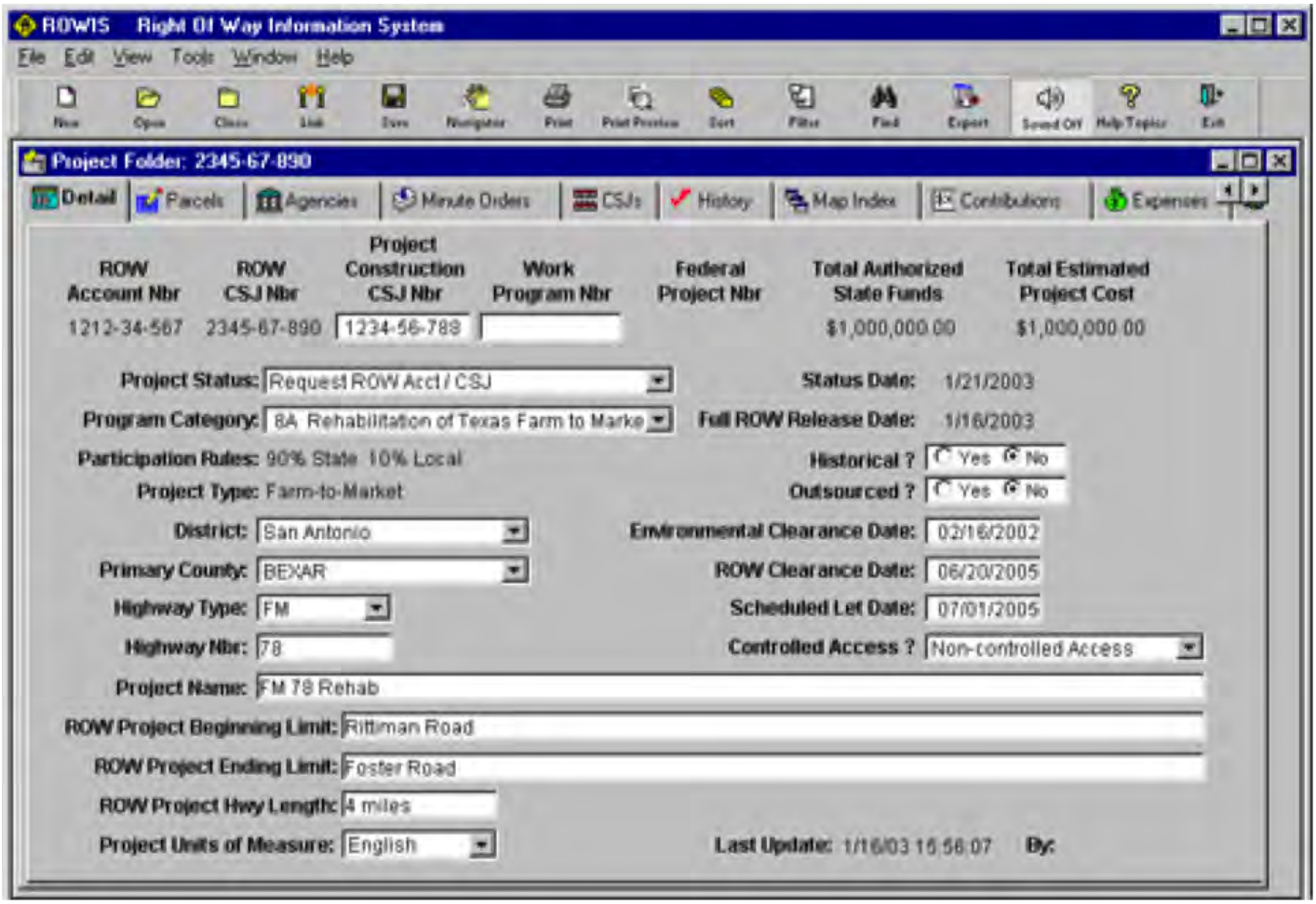


Figure B.38. ROWIS screen.

utility personnel with state DOT processes (and the lack of familiarity of state DOT personnel with utility owner processes), it would be advisable to develop and deliver a variety of training modules to address specific areas. Examples include preparation of documents pertinent to different types of utility relocations, case studies of utility relocations, the process to develop cost estimates, an introduction to highway design plans, and an introduction to utility facility design plans.

Vermont Agency of Transportation

VTrans assigns a project supervisor from the utilities and permits unit to every transportation project to coordinate utility relocations and provide a utility clearance document before letting. The project supervisor works with utility owners, the VTrans right-of-way section, and the VTrans roadway design section to address utility conflicts and maintain individual utility project correspondence files. During the project development process, the project supervisor provides utility owners operating within and near the project area design plans to identify and document any utility conflicts.

During the scoping process or development of conceptual plans, VTrans conducts a field review of the project area to identify all utility facilities operating within or near the project limits and to determine if any additional facilities are not shown on plans. VTrans then starts a project file and sends any changes resulting from the field visit to the project manager. Results from the field study also help VTrans to make a preliminary determination as to which utility owners might be operating utility facilities within the project area, what aerial utility facilities are in joint occupancy, and a preliminary determination of reimbursement eligibility. If VTrans anticipates significant utility conflicts, it might send utility owners a "preliminary notice to utilities," which informs utility owners of the proposed project. VTrans then confirms areas of responsibility to prevent duplication of work and misunderstandings during subsequent steps in the project development process.

During the development of preliminary plans, VTrans sends plans to utility owners and/or municipal departments and requests a relocation routing, including construction time duration once VTrans gives notification to relocate. When VTrans receives proposed relocation routing, the project manager, the design unit, and the right-of-way section determine jointly whether the routing is reasonable and whether there is a need to purchase additional right-of-way to accommodate the relocation. If VTrans purchases additional right-of-way for the project, the project manager and right-of-way agent hold property owner visits with a representative from the utility owner, which might result in revisions to relocation routes. After property owner visits, VTrans updates preliminary plans as necessary to reflect the agreed-on relocation routing, and the project manager submits the updated plans to the right-of-way section to initiate the right-of-way acquisition process. If VTrans proposes to purchase right-of-way to satisfy proposed utility relocation routes, VTrans representatives must attend a Superior Court necessity hearing to defend the purchase.

At the end of the design phase, VTrans prepares what is known as a utility clearance to document the completion of coordination activities with utility owners and municipalities. VTrans also prepares a set of special provisions to include in the highway contract to inform the contractor of various conditions the contractor might have to work with during the construction phase. Vermont has also attempted to avoid liability for utility delays by including a no damage for delay clause in the VTrans standard construction specifications. Although these tools are effective in reducing contractor claims, they have had little effect on reducing utility-related delays. In fact, utility-related problems are becoming a leading cause of delays during construction.

VTrans uses scheduling software for all programmed projects. The project manager maintains the schedule with input from various agency sections and units. Utility-related activities in the schedule include the following:

- *Existing utilities.* This activity involves the documentation and verification of the existing utility facilities within the project area.
- *Utility relocation routing.* This activity requires the utility owner to design a relocation route that does not conflict with the construction limits on the design plans.
- *Utility agreements.* This activity involves the development of the agreement between the agency and utility owner covering the work to accommodate the utility relocation.
- *Utility clearance and special provisions.* The utility clearance confirms the verification of the utility agreement execution and that any highway work permits are in order. The special provisions summarize the contractor's obligations necessary to accommodate utility relocations.

Occasionally, a utility owner or municipality requests VTrans to include utility relocation work in the highway contract. In these cases, VTrans develops a design that includes the utility relocation work. If the utility relocation is nonreimbursable, VTrans prepares an agreement with the utility for reimbursement to the state.

In general, utility owners have a desire to work with the VTrans schedules in a cooperative manner since they need highway work permits for maintenance and expansion of their facilities. The utilities and permits unit maintains a database for highway work permits.

When a utility conflict has a negative impact on the project schedule (e.g., if a utility relocation is taking too long or if a utility owner does not provide utility relocation plans in a timely manner), the project supervisor and project manager determine a course of action that generally involves written communications and meetings with utility owners to resolve problems.

During the recent implementation of the American Recovery and Reinvestment Act (ARRA), utility owners in Vermont lobbied the state legislature to require reimbursement of all utility relocations on all ARRA projects in order to accelerate project delivery. VTrans considered several sources to determine if comprehensive utility owner reimbursements would accelerate project delivery, but concluded that reimbursements most likely would not improve project delivery times. The initiative did not pass. VTrans continues to operate using the same reimbursement procedures for all transportation projects, including ARRA projects.

Virginia Department of Transportation

VDOT uses a system called right-of-way and utility management system (RUMS) to manage right-of-way acquisition and utility relocation data. RUMS tracks utility relocation costs, easements, bills, and payments organized by utility owner (Figure B.39). For each utility owner on a project, RUMS tracks general information (e.g., type, plan and estimate information, authorizations, and payments), field inspection data, right-of-way parcels affected by the relocation, utility construction data, and related contacts (Figure B.40). RUMS is also linked to project scheduling software and an internal schedule of activities. VDOT has used RUMS since approximately 2000 and has updated it several times over the years. At this point, RUMS can print a report of utility owners involved in a project (Figure B.41), but not utility conflicts.

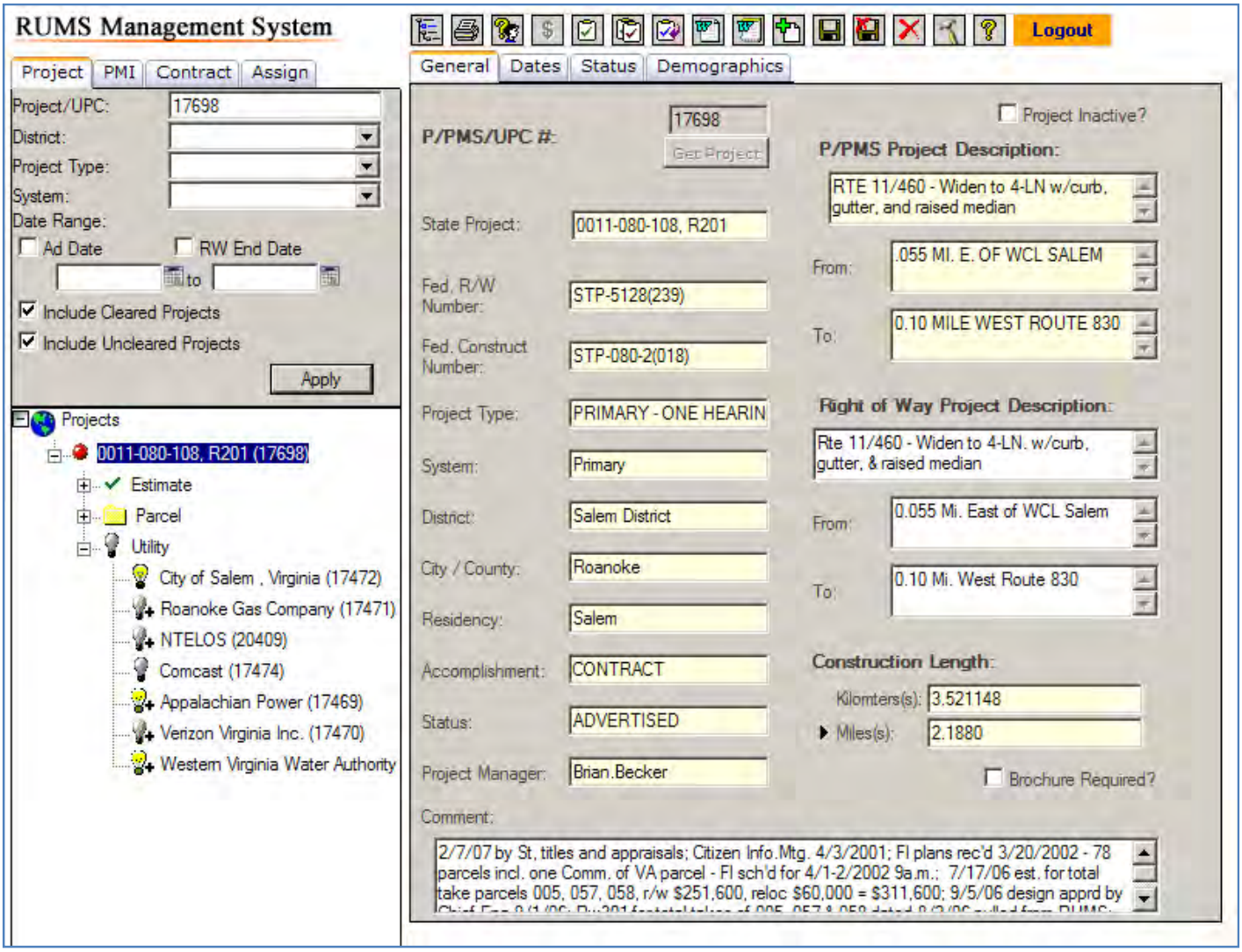


Figure B.39. VDOT sample RUMS project screen.

VDOT uses a standardized form (Form UT-9) for managing utility conflicts on all projects that lists utility facilities and conflicts and includes cost responsibility (Figure B.42). One project might have multiple forms because a separate form is used for each utility owner in the project. VDOT updates the forms as the project development process continues (e.g., to indicate when a utility facility is no longer in conflict). The tracking mechanism for changes is the date on the form. VDOT maintains copies of each version for documentation purposes. The UT-9 form includes a comment field for entering recommendations, such as moving a highway feature instead of relocating a utility facility. However, in most cases, discussions about alternative conflict resolutions take place through normal project discussions.

Other than attaching forms to plans (which VDOT does on a routine basis), VDOT has not seen the need to change Form UT-9 and has not revised the form for several years. UT-9 is a stand-alone form that is not linked to any system. VDOT uses UT-9 data to populate records in RUMS.

VDOT involves utility owners as early as possible in the project development process, and considers early involvement of utility owners the key to successful utility conflict management. Early involvement activities include field reviews and scoping meetings to identify conflicts and discuss potential resolutions before design plans are developed.

Once VDOT receives plan markups from utility owners, the design section includes the information in the CAD drawings. If the utility facility needs to move, VDOT requests relocation plans from the utility owner, which are also included in the CAD drawings. Using the relocation plans, a survey team goes to the field and stakes out the locations where the utility facilities need to move. This practice is

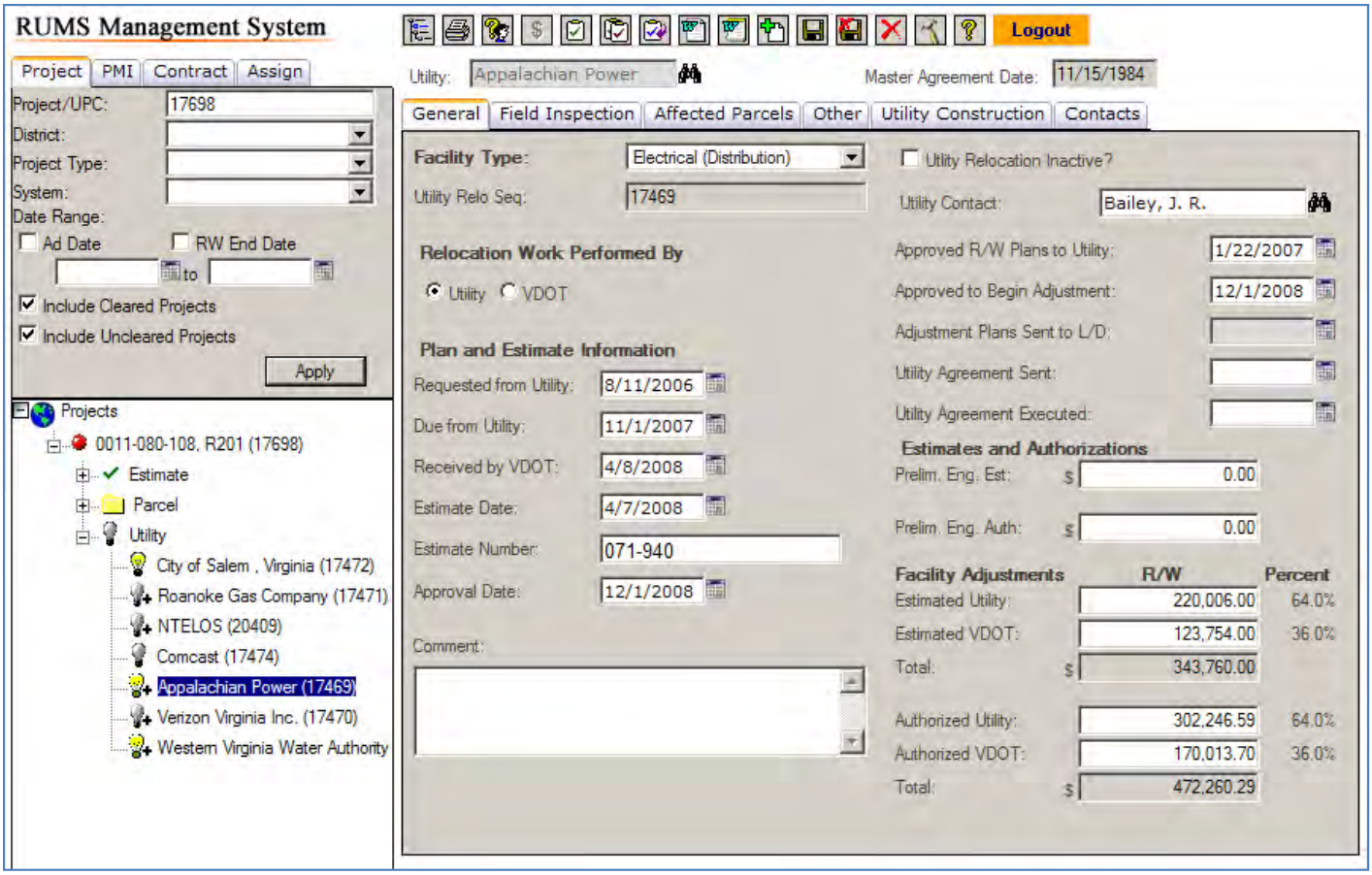


Figure B.40. VDOT sample RUMS utility data screen.

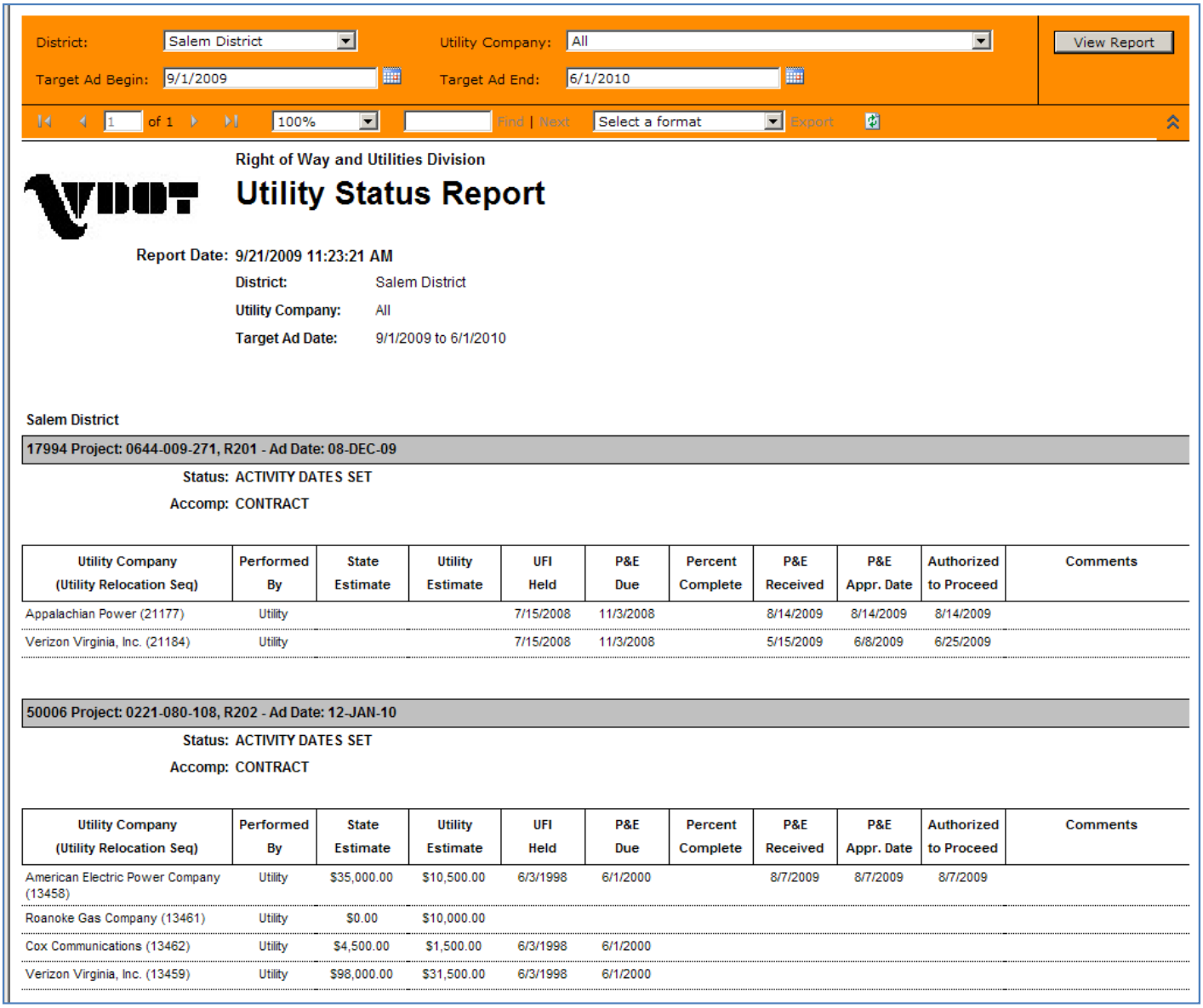
sometimes time consuming, but it has been useful to avoid additional conflicts.

In conjunction with FHWA, VDOT reimburses 100% of engineering expenses in connection with utility relocations, including the preparation of relocation plans and cost estimates (within a certain deadline), regardless of reimbursement eligibility of the actual relocation. About 90% of all VDOT projects are eligible for federal reimbursement. For the remaining 10% (i.e., state projects), VDOT has recognized the benefits of using the program and now reimburses engineering expenses using state funds. The 100% reimbursement program has been in place for several years and has resulted in an accelerated utility relocation process, partly because VDOT imposes a deadline for program eligibility.

VDOT commonly uses the value engineering process during preliminary design. During the design, discussions about value tend to be more informal. Sometimes during construction, a contractor might request a value engineering study. The incentive for the contractor is that any net monetary savings are split between VDOT and the contractor. Utility owners are involved in this process depending on considerations such as proximity to the locations affected by the value engineering study. In general, the contractor must pay for any secondary utility relocation that might result from the study.

When design plans are about 30% to 50% complete, usually about 2 to 12 months before letting, some offices schedule a plan-in-hand field trip and invite utility owners to participate. In preparation for the meeting, VDOT provides plans and a list of utility conflicts to utility owners. During the field trip, VDOT officials verify and edit information as needed, making sure that all information previously provided to the designers has been included on the plans, and take one last look to make sure all known conflicts have been considered. VDOT gives particular emphasis to utility facilities that are difficult to move or might take a long time to relocate, such as electric transmission lines and gas pipelines.

The UT-9 form is usually completed before the plan-in-hand field trip. Frequently, before VDOT officials complete the UT-9 form, they have already had discussions with designers and utility stakeholders and have outlined alternative solutions. The UT-9 form is then a mechanism to formalize those discussions and the corresponding conclusions.



District: Salem District | Utility Company: All | View Report
Target Ad Begin: 9/1/2009 | Target Ad End: 6/1/2010
1 of 1 | 100% | Find | Next | Select a format | Export

Right of Way and Utilities Division

Utility Status Report

Report Date: 9/21/2009 11:23:21 AM
District: Salem District
Utility Company: All
Target Ad Date: 9/1/2009 to 6/1/2010

Salem District

17994 Project: 0644-009-271, R201 - Ad Date: 08-DEC-09
Status: ACTIVITY DATES SET
Accomp: CONTRACT

Utility Company (Utility Relocation Seq)	Performed By	State Estimate	Utility Estimate	UFI Held	P&E Due	Percent Complete	P&E Received	P&E Appr. Date	Authorized to Proceed	Comments
Appalachian Power (21177)	Utility			7/15/2008	11/3/2008		8/14/2009	8/14/2009	8/14/2009	
Verizon Virginia, Inc. (21184)	Utility			7/15/2008	11/3/2008		5/15/2009	6/8/2009	6/25/2009	

50006 Project: 0221-080-108, R202 - Ad Date: 12-JAN-10
Status: ACTIVITY DATES SET
Accomp: CONTRACT

Utility Company (Utility Relocation Seq)	Performed By	State Estimate	Utility Estimate	UFI Held	P&E Due	Percent Complete	P&E Received	P&E Appr. Date	Authorized to Proceed	Comments
American Electric Power Company (13458)	Utility	$35,000.00	$10,500.00	6/3/1998	6/1/2000		8/7/2009	8/7/2009	8/7/2009	
Roanoke Gas Company (13461)	Utility	$0.00	$10,000.00							
Cox Communications (13462)	Utility	$4,500.00	$1,500.00	6/3/1998	6/1/2000					
Verizon Virginia, Inc. (13459)	Utility	$98,000.00	$31,500.00	6/3/1998	6/1/2000					

Figure B.41. VDOT sample RUMS utility status report.

VDOT uses the UT-9 form to prepare a special provision for inclusion in the PS&E assembly that summarizes pending utility relocations and an estimated time for completion of the relocation. It is also VDOT's practice to include names of utility owners on design drawings under the assumption that the contractor is responsible for contacting utility owners (although VDOT is aware of cases in which the highway contractor has not contacted utility owners because the contractor's perception is that utility owners only provide limited information of little use to the contractor). VDOT has also started using radio frequency identification marker balls for damage prevention purposes in connection with relocated utility facilities on several congested projects in the Northern Virginia District, as well as collecting GPS data on projects in the Hampton Roads District.

On many projects, VDOT acquires a 10-foot corridor near (inside) the right-of-way line specifically for utility facilities. The corridor provides ducts for electric, communications, gas, water, sewer, and other utility facilities. If utility owners do not want to relocate in this corridor and use the ducts provided, they must move outside the right-of-way at their own expense.

In an effort to give utility owners more time to relocate before construction, VDOT has changed its policy for the completion of utility relocations. The deadline for utility

U26

Form UT-9
Rev. 04/00

Sheet 1 of 5

Project: 0011-080-108-R201

PPMS No.: 17698

Determination of Cost Responsibility Made By:
Brad Bowles
Date: July 27, 2006

Utility Owner: Appalachian Power
Utility Owner Rep.: Mr. Martin A. McGee
VDOT Rep.: B. Bowles / S. Ray

Date of Utility Field Inspection: 07/26/2006

Project Prorate: **State 36.0%** **Utility 64.0%** (Percentage to be determined to the nearest tenth.)

SHOW ALL FACILITIES WITHIN THE PROJECT LIMITS AND PROPOSED RIGHT OF WAY LINES (INCLUDING CONNECTIONS).

Plan Sheet No.	Route or Street	Type and/or Size Facility **See Legend		Stations From - To	L or R	Distance from Center Line	Relation to Existing Hwy. R/W ***		Cost Resp UT or ST	*Auth. Docum.	Units Used to Determine Cost Resp.	Remarks
		Type	Size/Pole No.				ON	OFF				
3	11	P	250-1601	13+00	R	39		X	ST	7	1	
		P	250-1602	14+53	R	39		X	ST	7	1	
		P		16+70	R	40		X	ST	7	1	
		P	250-202	16+84	L	40	X		UT		1	
4	11	P	250-203	18+42	L	41	X		UT		1	
		P	250-205	19+88	L	27	X		UT		1	
		P	250-206	21+01	L	27	X		UT		1	
		P		22+56	L	27	X		UT		1	
		P		24+19	L	32	X		UT		1	
		P	250-2072	24+65	L	91		X	ST	7	1	
		P	250-2073	25+22	L	72		X	ST	7	1	

***** From the list below, select the appropriate authority or documentation which makes the state responsible for the cost of the utility and indicate same in the "Authority or Documentation" column by referring to the corresponding number:

1. 33.1-44 used on urban projects for utilities owned by a municipality, public utility district or public utility authority
2. 33.1-55 (a) used on Interstate in cities or towns for utilities located in city streets.
3. 33.1-55 (b) used on Arterial projects for utilities owned by a county, city, town or public utility authority located in existing streets.
4. 33.1-56 used on Interstate and Primary projects in counties for all utilities owned by a county or political subdivision of the state or county and for water or sanitary sewer owned by a city or town located extending into any county.
5. 33.1-69.2 used on secondary projects for utilities owned by county, city, town, authority or district.
6. 33.1-269 used on certain bond projects.
7. 33.1-96 used for utilities located on private property.
8. Prior rights.
9. Prior agreements (provide date)
10. (other)

** **P**=Pole, **T**=Buried Tel. Cable, **TC**=Tel. Conduit, **PD**=Pedestal, **G**=Gas, **W**=Water, **S**=Sewer, **SFM**=Sewer Force Main, **MH**=Manhole, **TV**=Buried Cable TV, **UE**=Underground Electric
***Use Linear Meters (linear feet) in the proper column for entry of underground utilities and an X or ✓ for other units not requiring a length of measurement.

Figure B.42. VDOT sample form UT-9 utility inventory.

relocations used to be prior to request for bids, but now the deadline is prior to award of contract.

Washington State Department of Transportation

WSDOT comprises six regions that at present follow different formats for managing utility information. WSDOT recently updated its utility manual to include a chapter on the effects of utility relocations on project delivery, and it is in the process of developing a statewide process to manage utility conflicts consistently within regional utility offices. The intent of this approach is to streamline and clarify procedures, increase transparency, and improve institutional barriers such as communication between WSDOT offices.

Some WSDOT regional offices use spreadsheets called project utilities summary sheets to track utility conflict information. Figure B.43 is an example of a project utilities summary sheet used in the Northwest Region. Project design engineers manage utility conflicts with the help of regional utility office staff. During the project development process, utility staff extract utility owner information from the utility permit database and provide this information to the design team. Staff also work with the state one-call system for design tickets and, as needed, request utility owners to mark the location of existing utility facilities on the ground or conduct test holes.

At the beginning of the design phase, WSDOT typically contacts utility owners known to be in the project area, and then schedules meetings with utility owners on a regular basis starting at about 30% design. Designers try to identify conflicts before 60% design. Utility office staff help designers to mitigate utility conflict impacts, send project schedule and utility relocation notice letters to utility owners, and monitor utility relocation progress.

WSDOT has found it a challenge to modify roadway design using utility conflict information. The time allotted for designing and building projects is short, which leaves little time for a design change caused by a utility conflict. This restrictive time frame limits the effectiveness of the ongoing coordination and communication required for successful utility relocation efforts. For large projects, such as the Alaskan Way Viaduct and the SR 520 Floating Bridge, WSDOT engaged the help of consultants to manage utility conflicts. These consultants have utility coordination groups that are responsible for managing utility issues on these projects.

WSDOT documents pending utility relocations in the PS&E package by establishing risk levels based on the characteristics and timing of individual relocations. WSDOT evaluates and classifies each project based on the estimated level of risk that pending utility relocations pose to the successful delivery of the project. WSDOT advertises projects using one of the following utility relocation risk levels:

- *Risk Level 1.* Utility relocations are complete.
- *Risk Level 2.* Utility relocations are ongoing but will be completed by bid opening.
- *Risk Level 3.* Utility work will be concurrent with construction or depends on a construction element in order to be completed.

Wyoming Department of Transportation

Recently, WYDOT developed a new project process, including a process flow chart scheduler, for use with Oracle's Primavera. The WYDOT utility section at headquarters updates the Primavera schedule portion. Specific coordination prior to construction is performed separately using Excel spreadsheets (Figure B.44).

WYDOT uses separate spreadsheets for right-of-way and utility owner notification and for grading, overlay, preliminary, service acquisition, and maintenance projects. Workbooks are linked so that projects on preliminary and grading lists are grayed out when right-of-way and utility plans are issued, indicating that new plans have been issued that identify the individual responsible for notification and the tracking number for that project. Once utility conflict data are transferred to the district offices, the utility section at headquarters continues tracking conflicts and relocation status. The utility section often works directly with utility owners on behalf of the districts. Headquarters makes the final reimbursement payment after the relocation is complete and a completion report has been received from the district.

The new process does not include much detail on how to interact with utility owners early and often in the project development process. WYDOT notifies utility owners about 3 years before the start of the project. Required notifications are identified in a reconnaissance report, which is a result of an earlier reconnaissance field meeting that WYDOT conducts to determine how to approach the project. At this time, officials include utility facilities in the discussion if the facilities are apparent in the field or if a local member of the project team is aware of a significant utility issue. If there is an apparent utility issue, WYDOT notifies the utility owner that there is a planned project in the area.

Approximately 1 year before construction or at the beginning of the design phase, WYDOT sends right-of-way and utility plans to utility owners, including WYDOT's determination of the location of existing utility facilities. At that point, utility owners have the opportunity to review and mark up the plans if they find discrepancies, and they are

Project Utilities Summary Sheet - xxxxx/xxxxx Design Team
Utilities Project Engineer: John Curry & phone #

	Project	Ad Date	MP Range	Utilities Affected	As Builts		Utility	Reloc Plans		Reloc. Meeting	Requested Utility Reloc. CN Sched.		Ltrs of Understanding	Ltrs of Adv. Auth.	Franchise/ Permits	UT Agrmts Open	Design Engineer
					Requested	Received	Coord. mtg	Requested	Received		Start	Complete					
1	I-5 Dakota Creek I-5 Fisher Creek vic. Stormwater XL 2891	03/23/09	MP 219.15 to MP 274.15 Scenic Class B, BX, C	Skagit County PUD #1	8/23/2007	8/24/2007		N/A									Carl Vogt 360-757-5839
				CNGC	7/25/2007	8/2/2007		N/A									
				Verizon	7/25/2007	12/13/2007		N/A									
				City of Bellingham	7/25/2007	8/6/2007		N/A									
				PSE	7/25/2007	1/9/2008		N/A									
2	SR 11/I-5 Park and Ride XL 2619	05/18/09	MP 0.00 No relocs. will be required. Scenic Class B	Comcast	4/24/2008	11/18/2008		N/A									Carl Vogt 360-757-5839
				City of Burlington	12/8/2006	1/8/2007		N/A									
				CNGC	12/8/2006	12/21/2006		N/A							Rcvd 6/17/08 19011		
				Verizon	12/8/2006	12/6/2006		N/A									
				Samish Water District													
				Skagit Cty PUD#1	12/8/2006	1/29/2007		N/A									
				PSE	12/8/2006	5/16/2007		N/A									
3	SR 542 at Britton Road Intersection		MP 2.79 Scenic Class C	PSE	7/24/2008	Earlier		9/16/2008	Check back after 12/17/08								Matt Gunn Paul J. John C.
				Black Rock Cable Co.	7/24/2008			9/16/2008									
				Broadstripe	7/24/2008	7/24/2008		9/16/2008									
				Comcast	7/24/2008	N/A 7/24/2008		N/A	N/A								
				City of Bellingham	7/24/2008	7/24/2008		N/A	N/A								
				360 Networks	7/24/2008	N/A 7/24/2008		N/A	N/A								
				Qwest	7/24/2008			9/16/2008									
4	SR 542 Warnick Bluff Site	01/12/09	MP 20.5 to MP 45.2 Scenic Class Ax, B, BX, C	PSE - Overhead; No relocation necessary.													Barbara Hathaway
5	SR 542 Gallup Creek Bridge Replacement XL 2829	01/19/10	MP 33.42 to MP 33.48 Scenic Class BX	Glacier Water Dist. (Instl. during const.)	6/13/2007	7/2/2007		4/1/2009		2/26/2009	6/1/2010	12/1/2010				PE - 01401 CN - 01402	Barbara Hathaway 360-757-5838
				PSE	9/17/2007	10/22/2007		4/1/2009 6/19/2009		2/26/2009	8/1/2009	9/15/2009					
				Verizon	9/17/2007	9/20/2007		4/1/2009 6/19/2009		2/26/2009	8/1/2009	9/15/2009					
6	SR 542 CED East Church Mt. Rd	10/19/09	MP 20.5 to MP 45.2 Scenic Class Ax, B, BX, C	No utilities present													Barbara Hathaway

Figure B.43. WSDOT sample project utilities summary sheet.

Sort	Go to last used row	PROJECT INFORMATION	DISTRIBUTION DATE	PERSON	JOB #	FUNCTION	*AGMT'S REQ'D COMPANY	PCS UT 700	CLOSED	Utility Follow up
0251146	DS 037	Cheyenne Marginal Randall Avenue Interchange Laramie County	June 16, 2008	DLS		UTL	Bresnan Communications Level 3 Communications Cheyenne BPU City of Cheyenne *Cheyenne Light Fuel & Power - 60648 (gas) & 60649 (elect) Qwest Corporation	DLS		
1006016	DS 038	Kaycee Streets Nolan Avenue Johnson County	June 27, 2008	DLS		PE2	Town of Kaycee Montana-Dakota Utilities Co Powder River Energy Corp RT Communications	DLS		
N212084	DS-032	Casper Streets West Belt Loop Road - Grading NBL Natrona County	July 11, 2008	DLS	B32U	PE2	*Casper BPU - 60278 *Central WY Regional Water - 60279 City of Casper *Kinder Morgan - 60280 - $632,927.00 Pioneer Water District Source Gas *Town of Mills - 60450 *Sinclair Pipeline Co. - 60448 Terasen Pipeline (Kinder) *Qwest Corporation - 60449 *Rocky Mountain Power - 60447 *Western Area Power Administration - Theirs	DLS		July 1, 2009
N131052	DS-039	Rock Springs - Pinedale US 191 & Yellowstone Rd Sweetwater County	July 11, 2008	DLS		UTL	Questar Qwest Corporation Rocky Mountain Power City of Rock Springs	DLS		
N103104	DS-040	Alpine Junction US 26 & US 89 Intersection Alpine Jct. - Idaho State Line Alpine Port of Entry Lincoln County	July 22, 2008	DLS		PE2	Lower Valley Energy North Star Utility Co Qwest Corporation Silver Star Telephone Co.	DLS		
N212086	JD-016	Muddy Gap -- Casper Casper South Section (Wyoming State Highway 220) Natrona County	July 29, 2008	JAD	B34L	UTL	Kinder Morgan Source Gas Qwest Corporation Rocky Mountain Power Wyoming Department of Transportation Private (PRVT)	JAD		

Figure B.44. WYDOT sample utility project list.

advised to contact the resident engineer for a field review to discuss conflicts and potential solutions. However, it is the responsibility of the utility owners to determine actual conflicts and to develop solutions.

At about 60% design, WYDOT sends utility owners a grading plan that includes plan and profiles. WYDOT headquarters assists with the coordination between project engineer and utility owners, but it no longer identifies utility conflicts due to legal issues. Under certain conditions, small utility owners (i.e., utility owners with fewer than 15,000 customers) may be reimbursed by WYDOT for 50% of their relocation costs.

Problems with utility facilities on roadway projects have prompted WYDOT to involve utility owners earlier in the project development process. Early involvement of utility owners can provide significant cost savings to the DOT and the utility owner. Knowledge about utility facilities located within or close to the project limits can help in evaluating the feasibility of a project. For example, one project involved the relocation of utility facilities that infringed on wetlands at a cost of about $1 million, which brought the project to a stop until WYDOT developed a new design and a different alignment to avoid the wetlands. Eventually, the utility facilities had to be relocated a second time at significant cost. On a different project, WYDOT purchased the land for a rest area project and then notified utility owners. At that point, WYDOT learned about a major gas transmission line within 100 feet of the new rest area. The cost to relocate the gas line or upgrade it to a Class 3 facility would have been about $8 million. WYDOT abandoned the project and returned the land to the previous landowner.

Reference

1. North Carolina Statutes Chapter 136, Section 104. www.ncleg.net/gascripts/statutes/statutelookup.pl?statute=136-104. Accessed April 11, 2011.

APPENDIX C

Logical Data Model Subject Areas

Introduction

The logical data model consists of approximately 115 entities and numerous relationships. The data model includes six subject areas, one for each core data object in the conceptual model, as follows:

- Utility conflict subject area;
- Utility facility subject area;
- Utility agreement subject area;
- Project subject area;
- Document subject area; and
- User subject area.

A description of each subject area follows.

Utility Conflict Subject Area

The purpose of the utility conflict subject area is to track data about utility conflicts. Table C.1 lists the entities included in this subject area. The main entity is UTILITY CONFLICT. This entity includes a description, conflict location in terms of start and end stations and offsets, and an alternative location description if needed. UTILITY CONFLICT also references conflict type and project number. UTILITY CONFLICT TYPE provides four types of utility conflicts that can be associated with a utility conflict (Table C.2).

UTILITY CONFLICT EVENT enables tracking of certain changes or events associated with a utility conflict. Table C.3 lists the valid utility conflict event types in the data model.

RIGHT OF WAY PARCEL provides a listing of right-of-way parcels that must be acquired as part of a DOT transportation project. In the context of this data model, the listing enables the identification of right-of-way parcels that are associated with the management of individual utility conflicts.

Utility facilities are referenced in UTILITY CONFLICT by using UTILITY FACILITY ID as a foreign key. This construct allows a utility conflict to be associated with only one utility facility (although a utility facility could be associated with multiple utility conflicts, which could be useful for long-term data management). Depending on how a DOT defines a utility conflict, it may be possible to associate a utility conflict with multiple utility facilities (if so, it would be necessary to replace the current relationship between UTILITY CONFLICT and UTILITY FACILITY with an associative entity). However, testing of the prototype database indicated that managing utility conflicts in the database, in particular contractual documents such as utility agreements, is much more difficult if a utility conflict is allowed to be related to multiple utility facilities. Interviews with stakeholders also confirmed that state DOTs prefer to associate a utility conflict with only one utility facility.

UTILITY CONFLICT EVENT DOCUMENT TYPE provides a mapping between a UTILITY CONFLICT EVENT and a DOCUMENT TYPE. Its purpose is to identify the type of document associated with certain utility conflict events. For example, it would enable a user to confirm that a utility conflict event of the type "document received" is associated with a work authorization document.

UTILITY CONFLICT RESOLUTION STRATEGY TYPE provides a listing of strategies to resolve a utility conflict (Table C.4).

UTILITY CONFLICT ADJUSTMENT COST stores cost amounts associated with a utility conflict event. UTILITY CONFLICT ADJUSTMENT COST TYPE provides a characterization about the kind of utility conflict relocation cost that is associated with a utility conflict event.

UAP EXCEPTION documents whether a utility conflict is subject to an exception to the state's utility accommodation policy. It also documents any related amounts, dates, comments, and indication of approval. The type of exception is tracked in UAP EXCEPTION TYPE.

UTILITY CONFLICT ASSIGNMENT links UTILITY CONFLICT and SYSTEM USER. Its purpose is to link a system user to a utility conflict along with a role, such as utility coordinator or project manager.

Table C.1. Utility Conflict Subject Area Entity Definitions

Name	Definition
COMMENT	A COMMENT is miscellaneous information that provides extra detail or description for an event.
MEETING	A MEETING is a gathering of people for the purpose of discussing a typically predetermined topic.
RIGHT OF WAY PARCEL[a]	A RIGHT OF WAY PARCEL is a parcel that must be acquired as part of a DOT project.
SURFACE TYPE	A SURFACE TYPE is a category that describes a kind of manmade or natural ground surface. Examples of a SURFACE TYPE are asphalt, concrete, or natural ground.
TEST HOLE UTILITY FACILITY	A TEST HOLE UTILITY FACILITY is a mapping that represents the many-to-many relationship between a TEST HOLE and a UTILITY FACILITY. TEST HOLE UTILITY FACILITY enables the identification of UTILITY FACILITIES associated with a TEST HOLE and the identification of TEST HOLES associated with a UTILITY FACILITY.
UAP EXCEPTION	A UAP EXCEPTION is an exception to the state's utility accommodation policy.
UAP EXCEPTION TYPE	A UAP EXCEPTION TYPE is a category that describes a certain kind of UAP EXCEPTION.
UTILITY CONFLICT	A UTILITY CONFLICT is an instance in which a utility facility is noncompliant with the DOT's utility accommodation policies, is noncompliant with safety regulations, is in conflict with a proposed transportation project feature, or is in conflict with another utility facility. A UTILITY CONFLICT can be resolved by using an appropriate measure such as modifying the proposed transportation design, relocating the utility facility, abandoning the facility in-place, protecting the facility in-place, or granting an exception to the state's utility accommodation policies or safety regulations.
UTILITY CONFLICT ADJUSTMENT COST	A UTILITY CONFLICT ADJUSTMENT COST is the amount that a utility owner estimates will be needed to remove a utility conflict by adjusting the utility facility.
UTILITY CONFLICT ADJUSTMENT COST TYPE	A UTILITY CONFLICT ADJUSTMENT COST TYPE is a characterization of a UTILITY CONFLICT ADJUSTMENT COST.
UTILITY CONFLICT ASSIGNMENT	A UTILITY CONFLICT ASSIGNMENT is the designation of a person to a UTILITY CONFLICT for a specific purpose, such as responsibility for managing and resolving the conflict.
UTILITY CONFLICT EVENT	A UTILITY CONFLICT EVENT is the occurrence of a change to a UTILITY CONFLICT.
UTILITY CONFLICT EVENT DOCUMENT TYPE	A UTILITY CONFLICT EVENT DOCUMENT TYPE is a mapping that represents the many-to-many relationship between a UTILITY CONFLICT EVENT and a DOCUMENT TYPE. UTILITY CONFLICT EVENT DOCUMENT TYPE enables the identification of UTILITY CONFLICT EVENTS associated with a DOCUMENT TYPE and the identification of DOCUMENT TYPES associated with a UTILITY CONFLICT EVENT.
UTILITY CONFLICT EVENT TYPE	A UTILITY CONFLICT EVENT TYPE is a category that describes a certain kind of UTILITY CONFLICT EVENT.
UTILITY CONFLICT INVESTIGATION NEED TYPE	A UTILITY CONFLICT INVESTIGATION NEED TYPE is a characterization of the kind of investigation that is needed for a UTILITY CONFLICT. Examples of a UTILITY CONFLICT INVESTIGATION NEED TYPE include subsurface utility engineering (SUE) Level A (test hole), SUE Level B, SUE Level C, SUE Level D, manhole, and no investigation needed.
UTILITY CONFLICT LOCATION TYPE	A UTILITY CONFLICT LOCATION TYPE is a characterization of the location of a utility conflict relative to the surface of the earth. Valid values for a UTILITY CONFLICT LOCATION TYPE are overhead (aboveground) and underground.
UTILITY CONFLICT RESOLUTION ALTERNATIVE	A UTILITY CONFLICT RESOLUTION ALTERNATIVE is an option to resolve a utility conflict. Typically, there are multiple resolution alternatives for each utility conflict, which may or may not be feasible.
UTILITY CONFLICT RESOLUTION ALTERNATIVE DECISION	A UTILITY CONFLICT RESOLUTION ALTERNATIVE DECISION is an option for a determination on how to proceed with one of multiple alternatives for the resolution of a utility conflict. Examples of a UTILITY CONFLICT RESOLUTION ALTERNATIVE DECISION are rejected, under review, and selected.
UTILITY CONFLICT RESOLUTION ALTERNATIVE RESPONSIBILITY	A UTILITY CONFLICT RESOLUTION ALTERNATIVE RESPONSIBILITY is a description of the party that is responsible for resolving a utility conflict. Examples of a UTILITY CONFLICT RESOLUTION ALTERNATIVE RESPONSIBILITY are DOT, utility owner, utility owner and DOT, and undetermined.
UTILITY CONFLICT RESOLUTION STRATEGY TYPE	A UTILITY CONFLICT RESOLUTION STRATEGY TYPE is an option to resolve a utility conflict. Examples include design change, utility adjustment, and UAP exception.
UTILITY CONFLICT SUBTYPE	A UTILITY CONFLICT SUBTYPE is a characterization that further describes a kind of UTILITY CONFLICT TYPE. Examples of a UTILITY CONFLICT SUBTYPE are finish grade, pathway, and excavation.
UTILITY CONFLICT TYPE	A UTILITY CONFLICT TYPE is a characterization that describes a kind of UTILITY CONFLICT. Examples of a UTILITY CONFLICT TYPE are project feature conflict and utility regulation conflict.
UTILITY INVESTIGATION TEST HOLE	A UTILITY INVESTIGATION TEST HOLE is a small opening in the ground, typically using a vacuum excavation technique, for the purpose of determining the exact vertical and horizontal position of a buried utility facility.

[a] The data model uses the term RIGHT OF WAY without hyphens to facilitate the automated conversion of spaces in the logical data model to underscores in the physical data model.

Table C.2. Utility Conflict Types

ID	Name
0	Conflict with roadway project features
1	Conflict with another utility feature
2	Conflict with utility regulations or standards
3	Conflict with safety regulations
4	Conflict with transportation construction or phasing

Table C.3. Utility Conflict Event Types

ID	Name
0	Utility conflict identified
1	Comment created
2	Utility owner informed of utility conflict
3	Utility conflict resolved
4	Utility owner acknowledges receipt of document
5	Document requested
6	Document sent
7	Document received
8	Document reviewed
9	Document certified
10	Document approved
11	Document uploaded
12	Document review, comment, and approval
13	Utility coordination meeting
14	ROW cleared for adjustment
15	Required adjustment completion
16	Estimated adjustment completion
17	Scheduled adjustment completion
18	Notice to proceed to utility owner
19	Adjustment construction start
20	Adjustment construction end
21	Permit application
22	Permit approved
23	Exception requested
24	Exception approved
25	Plans sufficient sent to utility owner
26	30-day notice submitted
27	90-day notice submitted
28	Utility conflict resolution strategy selected
29	Utility relocation under construction
30	Utility conflict archived

Note: ROW = Right-of-way.

Table C.4. Utility Conflict Resolution Strategy Types

ID	Name	Acronym
0	Unknown	U
1	Relocation before construction	RB
2	Relocation during construction	RD
3	Abandon in-place	A
4	Protect in-place	P
5	Exception to policy	E
6	Design change	DC
7	No conflict	NC

Utility Facility Subject Area

The utility facility subject area contains entities that provide information about utility facilities involved in utility conflicts. Table C.5 lists the entities included in this subject area. The core entity is UTILITY FACILITY. This entity contains information about utility facilities such as description, size, age, depth, facility type, operation type (public or private), material, and location type (underground or aboveground). The data model includes several look-up tables, including UTILITY FACILITY TYPE, UTILITY FACILITY OPERATION TYPE, UTILITY FACILITY MATERIAL, and UTILITY FACILITY LOCATION TYPE.

UTILITY FACILITY OFFSET describes the location of a facility in relation to the transportation project in terms of start and end stations and offsets. It also includes offset reference types such as centerline, edge of pavement, or edge of curb.

It is worth noting that the list of entities in Table C.5 oversimplifies the number and variety of entities that would be necessary to develop and maintain a robust inventory of utility facilities within the right-of-way and provides only the minimum level of functionality needed to track utility conflicts and produce utility conflict matrix (UCM) reports. As such, these entities are placeholders. More sophisticated utility data models are available, such as the utility facility model developed by members of the research team as part of a previous research initiative in Texas, which provides spatial and data resolution at the individual utility facility level (e.g., water valve, sanitary sewer manhole, and communication cabinet). These data models contain a large number of entities, which, for simplicity, were not included in this report. In any case, the relational structure of the utility conflict database prototype is such that, if needed, it should be possible to replace the utility facility subject area with entities from an existing utility inventory system.

Table C.5. Utility Facility Subject Area Entity Definitions

Name	Definition
ALIGNMENT REFERENCE	An ALIGNMENT REFERENCE is a point or line that can be used to define a location in reference to the point or a position on the line. Examples of an ALIGNMENT REFERENCE are edge of pavement, baseline, right-of-way line, centerline, back of curb, survey hub, and reference point in driveway.
HORIZONTAL SPATIAL REFERENCE	A HORIZONTAL SPATIAL REFERENCE is a coordinate system that describes the horizontal location of a feature. Examples include NAD 1983 UTM Zone 12N, NAVD 1988, and GCS WGS 1984.
UTILITY FACILITY	A UTILITY FACILITY is a fixed structure or installation used by a utility owner for the purpose of transporting or delivering a utility.
UTILITY FACILITY LOCATION TYPE	A UTILITY FACILITY LOCATION TYPE is a characterization of the site where a UTILITY FACILITY is located. Examples of UTILITY FACILITY LOCATION TYPE include state right-of-way (permit), private easement, and franchise.
UTILITY FACILITY MATERIAL	A UTILITY FACILITY MATERIAL is the matter or substance that composes a UTILITY FACILITY.
UTILITY FACILITY OFFSET	A UTILITY FACILITY OFFSET is a description of the distance between a UTILITY FACILITY and a reference line such as edge of pavement or centerline.
UTILITY FACILITY OPERATION TYPE	A UTILITY FACILITY OPERATION TYPE is a characterization of whether the utility owner provides services for the public or for a private entity.
UTILITY FACILITY SUBTYPE	A UTILITY FACILITY SUBTYPE is a characterization of a kind of UTILITY FACILITY TYPE. Examples include electric distribution and electric transmission.
UTILITY FACILITY TYPE	A UTILITY FACILITY TYPE is a characterization of a kind of UTILITY FACILITY. Examples include water, gas, and communication.
VERTICAL SPATIAL REFERENCE	A VERTICAL SPATIAL REFERENCE is a coordinate system that describes the vertical location of a feature. Examples include NAD 1983 UTM Zone 12N, NAVD 1988, and GCS WGS 1984.

Utility Agreement Subject Area

The utility agreement subject area includes entities that provide information about utility agreements, associated documentation, and the cost reimbursement process. Table C.6 lists the entities in this subject area. The core entity is UTILITY AGREEMENT. Its purpose is to store information about the utility agreement between a DOT and a utility owner. It includes a flag for payment authorization and documents the contracting procedure type, reimbursement approach, utility relocation type, and the document set. The primary key of UTILITY AGREEMENT is UA ID. For convenience, UTILITY AGREEMENT also includes an alternate key (UA ALTERNATE NUMBER) to enable utility agreement identifications different from the default identifier.

ESTIMATE stores information about estimated utility relocation costs, including estimate amount, estimate date and type, betterment ratio number, and the phase of the project development process when the estimate was prepared. ESTIMATE enables the production of estimates at the utility conflict and utility agreement levels, depending on the business process a state DOT has in place. For example, many states produce an estimate per utility agreement, regardless of the number of utility conflicts included in the agreement. Other states produce separate estimates for each utility conflict.

ELIGIBILITY RATIO tracks the percentage of a utility relocation that is eligible for reimbursement—for example, in cases in which a portion of a utility facility is located on a private easement (and therefore is reimbursable) and the rest is located within the state right-of-way by permit (and therefore is nonreimbursable). ELIGIBILITY RATIO TYPE documents different ways to calculate eligibility based on the type and location of the utility. Related entities such as MEASUREMENT UNIT, ELIGIBILITY RATIO PROPERTY RIGHT OCCUPANCY, and PROPERTY RIGHT are used to determine eligibility ratios.

ACCOUNTING METHOD lists accounting methods for utility relocation reimbursements, including category costs and unit costs. UTILITY BILL documents requests for reimbursements (i.e., utility bills) and DOT payments to a utility. UTILITY BILL TYPE documents the type of bill, such as final bill (lump sum), incremental bill (actual cost), and final bill (actual cost). UTILITY BILL DATE stores important dates associated with a utility bill such as "bill receive date" and "DOT response date." UTILITY BILL DATE TYPE provides information about the kind of date that is stored in UTILITY BILL DATE. Referencing the date type from a separate table instead of including numerous dates as fields in UTILITY AGREEMENT DATE avoids a large UTILITY AGREEMENT DATE table with columns for every type of date that may not be used in a state's particular business process.

Table C.6. Utility Agreement Subject Area Entity Definitions

Name	Definition
ACCOUNTING METHOD	An ACCOUNTING METHOD is a process that accounts for costs incurred during the adjustment of a utility facility, such as the category cost approach or the unit cost approach.
COMPOSITE ELIGIBILITY RATIO	A COMPOSITE ELIGIBILITY RATIO is a percentage that describes the relative amount of multiple estimated utility adjustment cost that is eligible for reimbursement by the state. A COMPOSITE ELIGIBILITY RATIO is calculated by dividing the sum of the eligible costs of the adjustments by the sum of the costs of the adjustments.
ELIGIBILITY RATIO	An ELIGIBILITY RATIO is a percentage that describes the relative amount of an estimated utility adjustment cost that is eligible for reimbursement by the state.
ELIGIBILITY RATIO PROPERTY RIGHT OCCUPANCY	An ELIGIBILITY RATIO PROPERTY RIGHT OCCUPANCY is an association of an ELIGIBILITY RATIO with a PROPERTY RIGHT OCCUPANCY. The purpose of this association entity is to resolve a many-to-many relationship between the two entities.
ELIGIBILITY RATIO TYPE	An ELIGIBILITY RATIO TYPE is a category that describes a certain kind of ELIGIBILITY RATIO.
ESTIMATE	An ESTIMATE is an approximation of costs for a utility adjustment that a utility provides to a DOT that is part of a UTILITY AGREEMENT in the form of an attachment.
ESTIMATE TYPE	An ESTIMATE TYPE is a characterization of an ESTIMATE. Examples of an ESTIMATE TYPE are utility adjustment cost and engineering cost.
MEASUREMENT UNIT	A MEASUREMENT UNIT is an agreed-upon standard for expressing distance.
PROJECT DEVELOPMENT PROCESS PHASE	A PROJECT DEVELOPMENT PROCESS PHASE is a distinct period in time for the development of a typical highway project, including the phases planning and programming, preliminary design, design, construction, and postconstruction.
PROPERTY RIGHT	A PROPERTY RIGHT is an entity that provides information about the legal rights of a utility installation that allow it to occupy the land where it is installed.
PROPERTY RIGHT CLASS	A PROPERTY RIGHT CLASS is a definition of rights associated with a UTILITY FEATURE that provides the utility owner the legal right to occupy land with a utility installation. It is the highest level in the hierarchy of property rights. A PROPERTY RIGHT CLASS provides information about the underlying property rights that enable a utility owner to occupy land, for example, the property rights of a utility owner for a utility facility in a particular location on the state ROW. A PROPERTY RIGHT CLASS may have several types to distinguish the property right further. Examples of PROPERTY RIGHT CLASS include statutory, compensable interest, and encroachment.
PROPERTY RIGHT SUBTYPE	A PROPERTY RIGHT SUBTYPE is a subdivision of a PROPERTY RIGHT TYPE. Examples include private easement and public utility easement for the PROPERTY RIGHT TYPE easement.
PROPERTY RIGHT TYPE	A PROPERTY RIGHT TYPE is a subdivision of a PROPERTY RIGHT CLASS. A PROPERTY RIGHT TYPE may have several subtypes to distinguish the property right further. Examples include lease agreement, license agreement, and easement for the PROPERTY RIGHT CLASS compensable interest.
UA CONTRACTING PROCEDURE TYPE	A UA CONTRACTING PROCEDURE TYPE is a description of the work procedure used by a utility to adjust its facility that is part of a UTILITY AGREEMENT in the form of an attachment.
UA UTILITY ADJUSTMENT TYPE	A UA UTILITY ADJUSTMENT TYPE is a method a utility uses to relocate or remove its facility. An example is a contract, in which a utility uses the services of a contractor to relocate its facilities.
UTILITY AGREEMENT	A UTILITY AGREEMENT is a contract between a DOT and other agencies in connection with a utility adjustment. A UTILITY AGREEMENT usually consists of a UTILITY AGREEMENT contract form and several attachments, such as engineering estimate, design drawings, and special provisions.
UTILITY AGREEMENT DATE	A UTILITY AGREEMENT DATE is the day, month, and year of an event or milestone associated with a UTILITY AGREEMENT.

(continued on next page)

Table C.6. Utility Agreement Subject Area Entity Definitions (continued)

Name	Definition
UTILITY AGREEMENT DATE TYPE	A UTILITY AGREEMENT DATE TYPE is the characterization of a date or milestone that is associated with the process of completing and approving a UTILITY AGREEMENT. Examples of a UTILITY AGREEMENT DATE TYPE are agreement submittal date, agreement returned to utility for corrections date, and agreement approval or execution date.
UTILITY AGREEMENT REIMBURSEMENT APPROACH	A UTILITY AGREEMENT REIMBURSEMENT APPROACH is one of three allowable processes selected by a utility owner for reimbursement for costs incurred during the adjustment of a utility facility. The utility's selection is recorded in an attachment that is part of a UTILITY AGREEMENT.
UTILITY BILL	A UTILITY BILL is a request for payment that a utility submits to a DOT.
UTILITY BILL DATE	A UTILITY BILL DATE is the day, month, and year of an event or milestone associated with a UTILITY BILL.
UTILITY BILL DATE TYPE	A UTILITY BILL DATE TYPE is a characterization of a date or milestone that is associated with the process of receiving the request for a utility payment and completing the payment process. Examples of a UTILITY BILL DATE TYPE are billing received from utility date, billing sent to headquarters date, and utility paid in full date.
UTILITY BILL TYPE	A UTILITY BILL TYPE is a category that describes a certain kind of UTILITY BILL.

UTILITY AGREEMENT REIMBURSEMENT APPROACH describes the method by which a utility seeks to be reimbursed for costs incurred by an eligible utility relocation, including actual cost method of reimbursement, lump sum method of reimbursement, and alternative method of reimbursement. UA UTILITY ADJUSTMENT TYPE provides information on the method a utility owner uses to perform the relocation, including force account method and contract method. UA CONTRACTING PROCEDURE TYPE describes the procedure a utility owner uses to contract the work for the utility relocation. Examples of contracting procedures are open advertising/low bid, prequalified/low bid, existing continuing contract, other approved procedure, and inclusion in the highway contract.

Project Subject Area

The project subject area includes entities that provide information about the DOT transportation project. Table C.7 lists the entities included in this subject area. The core entity is DOT PROJECT, which stores project-related data such as project name, description, location, and project limits. The primary key of DOT PROJECT is DOT PROJECT NUMBER.

As in the case of other subject areas (e.g., the utility facility subject area), the list of entities in Table C.7 is an oversimplification of the entities that would be necessary to capture all data related to a transportation project. The entities in Table C.7 provide only the minimum level of functionality needed to track utility conflicts and produce UCM reports. As such, they are placeholders. However, the relational structure of the utility conflict database prototype is such that, if needed, it should be possible to replace the project subject area with entities from an existing project management information system.

DOT PROJECT facilitates tracking of right-of-way projects associated with a transportation project, which is useful if a state DOT tracks right-of-way costs separately from transportation design and construction costs. DOT PROJECT provides a many-to-many connection between a transportation project and a right-of-way project.

DOT PROJECT DATE enables the management of multiple dates that may be associated with a project, such as letting date, project authorization date, or right-of-way map approval date. DOT PROJECT DATE TYPE includes a list of available dates a DOT can track.

HIGHWAY SYSTEM tracks the name, number, functional class, and status of a highway. HIGHWAY FUNCTIONAL CLASS lists all potential functional classes. HIGHWAY SYSTEM STATUS provides a description of the highway status, such as planned, under construction, and existing.

UTILITY ADJUSTMENT PROCEDURE describes the general process a state DOT uses to complete utility relocations. The different procedures are typically distinguished by the source of the project funding and the agency that is responsible for the management of the utility accommodation and coordination activities. For example, a state DOT may have a different utility relocation procedure when federal funding is involved in the project, or the procedure may be different if a local public agency is responsible for the management of the utility relocation.

Table C.7. Project Subject Area Entity Definitions

Name	Definition
DOT PROJECT	A DOT PROJECT is a transportation improvement project managed by a state DOT.
DOT PROJECT DATE	A DOT PROJECT DATE is the day, month, and year of an event or milestone associated with a DOT PROJECT.
DOT PROJECT DATE TYPE	A DOT PROJECT DATE TYPE is a characterization of a date or milestone of the project development process that is associated with a DOT PROJECT. Examples of a DOT PROJECT DATE TYPE are approved ROW map date, letting date, and DOT estimated construction cost date.
HIGHWAY FUNCTIONAL CLASS	A HIGHWAY FUNCTIONAL CLASS is the functional classification of the roadway section for a project. Examples of a HIGHWAY FUNCTIONAL CLASS are Interstate, other urban freeway or expressway, and rural principal arterial.
HIGHWAY SYSTEM	A HIGHWAY SYSTEM is a roadway that can be classified as a roadway that is maintained by a governmental unit such as a state or county.
HIGHWAY SYSTEM STATUS	A HIGHWAY SYSTEM STATUS is the state of a roadway, which can be either planned, under construction, or existing.
MAINTENANCE SECTION	A MAINTENANCE SECTION is an administrative unit of a DOT for the purpose of maintaining a portion of the highway system.
PROJECT UTILITY ADJUSTMENT PROCEDURE	A PROJECT UTILITY ADJUSTMENT PROCEDURE is an association of a PROJECT with a UTILITY ADJUSTMENT PROCEDURE. The purpose of this association entity is to resolve a many-to-many relationship between the two entities.
UTILITY ADJUSTMENT PROCEDURE	A UTILITY ADJUSTMENT PROCEDURE is a process for accomplishing the adjustment and accommodation of reimbursable and nonreimbursable utility facilities on a DOT project.

Document Subject Area

The document subject area includes entities that provide information about documents used in connection with other subject areas, including utility conflicts, projects, and utility agreements. Table C.8 lists the entities included in this subject area. The core entity is DOCUMENT, which is the representation of a single logical document. The primary key of DOCUMENT is DOCUMENT ID. Examples of a DOCUMENT are meeting attendance lists, construction plans, or utility agreements.

The data model allows the association of documents to entities in other subject areas through associative entities. For example, the data model includes an associative entity called PROJECT DOCUMENT (which links DOCUMENT to PROJECT) to list all the documents developed in connection with a specific project.

In the data model, a DOCUMENT is assumed to consist of a single file. In some cases, a user may wish to link multiple files; for example, if a user submits a report composed of chapters in separate physical files. The user can link these files by creating a DOCUMENT SET and marking all documents that are part of the set. Another example of a DOCUMENT SET is an agreement contract and all the attachments needed for a utility agreement. DOCUMENT DATE provides the mechanism to track specific dates used in connection with a DOCUMENT, which could be useful for legal or audit purposes.

The data model provides two mechanisms for dealing with different types of documents:

- Document type tables, such as LEGAL DOCUMENT, CAD DOCUMENT, IMAGERY DOCUMENT, and PLAN DOCUMENT, can be used to track certain types of documents by using specific sets of attributes that are unique to those documents. While this construct facilitates customization and can produce more compact databases, a downside is additional complexity and difficulty to support what could be, in effect, a large number of document type tables. For illustration purposes, the research team included several document type tables and further expanded LEGAL DOCUMENT to several subtype tables, such as ENCUMBRANCE DOCUMENT, PROPERTY DESCRIPTION, and LEASE AGREEMENT DOCUMENT.
- DOCUMENT TYPE provides a simple mechanism for tracking different types of documents by using an attribute in DOCUMENT that points to a list of document types in DOCUMENT TYPE. This construct is simple to implement and is easily scalable, but it does not handle attributes that only pertain to specific types of documents very effectively (the result can be a large number of attributes in the main document table that are only used sparingly depending on the type of document). Despite its limitations, most electronic document management systems use this type of construct.

Table C.8. Document Subject Area Entity Definitions

Name	Definition
AGREEMENT DOCUMENT	An AGREEMENT DOCUMENT is a document that identifies the relationships, rights, and responsibilities between two or more parties.
AGREEMENT DOCUMENT TYPE	An AGREEMENT DOCUMENT TYPE is a word or phrase that characterizes an AGREEMENT DOCUMENT. Examples of agreement documents in use at TxDOT include federal project authorization and agreement, LPA agreement, and municipal maintenance agreement.
CAD DOCUMENT	A CAD DOCUMENT is a document in electronic format that represents entities graphically by using points, lines, or polygons generated in a CAD environment (e.g., MicroStation).
CAD DOCUMENT CELL	A CAD DOCUMENT CELL is the name of a CAD cell used in a CAD document. A CAD document could have zero, one, or many CAD DOCUMENT CELLs.
CERTIFICATION DOCUMENT	A CERTIFICATION DOCUMENT is a LEGAL DOCUMENT that provides certification that a given task is complete for a TxDOT highway improvement project.
CERTIFICATION DOCUMENT TYPE	A CERTIFICATION DOCUMENT TYPE is a word or phrase that characterizes a CERTIFICATION DOCUMENT. Examples of certification documents include appraisal report, LPA resolution, and negotiator report.
CONVEYANCE DOCUMENT	A CONVEYANCE DOCUMENT is a document that describes the rights and responsibilities of all the parties in a transaction that involves the transfer of property rights.
CONVEYANCE TYPE	A CONVEYANCE TYPE is a word or phrase that characterizes a CONVEYANCE DOCUMENT. Examples of a CONVEYANCE TYPE are standard deed, quitclaim deed, donation deed, agreed judgment, and judgment of court in absence of objection.
DOCUMENT	A DOCUMENT is a tangible product in printed or electronic form produced from, resulting from, or documenting a DOT project development process activity. A DOCUMENT can be indexed or catalogued in terms of business process operations or activities. Examples include forms, chapters, technical memoranda, invoices, and reports (provided the entire report is represented by a single file; otherwise the report would need to be represented using document sets).
DOCUMENT DATE	A DOCUMENT DATE is a specific point in time that relates to a DOCUMENT and is stored in the database for legal or audit purposes.
DOCUMENT DATE TYPE	A DOCUMENT DATE TYPE is a word or phrase that characterizes a DOCUMENT DATE.
DOCUMENT ROLE	A DOCUMENT ROLE is a role or function that an individual has with respect to a document. Examples of a DOCUMENT ROLE are reviewer and preparer.
DOCUMENT SET	A DOCUMENT SET is a collection of documents. Examples include PS&E plan sets, proposals, and reports (provided several documents, e.g., chapters in separate files, make up the report; if a report is in a single file, the report is considered a document, not a document set).
DOCUMENT SET ITEM	A DOCUMENT SET ITEM is a document that is part of a DOCUMENT SET. Examples include each of the chapters that make up a report (if each chapter is a separate document) and each of the plan documents that make up a PS&E plan set.
DOCUMENT SET TYPE	A DOCUMENT SET TYPE is a word or phrase that characterizes document sets with similar attributes and characteristics. Examples include utility agreements, utility agreement assemblies, change orders, PS&E assemblies, and plan sets.
DOCUMENT SYSTEM USER ROLE	A DOCUMENT SYSTEM USER ROLE is a mapping that represents the many-to-many relationships between a DOCUMENT, a SYSTEM USER, and a PROPERTY ROLE. DOCUMENT SYSTEM USER ROLE enables the identification of system users associated with a DOCUMENT and the PROPERTY ROLE of each SYSTEM USER. DOCUMENT SYSTEM USER ROLE can identify the parties of a legal document and their perspective roles.
DOCUMENT TYPE	A DOCUMENT TYPE is a word or phrase that characterizes a document with similar attributes and characteristics. Examples include plan document, imagery document, and easement document.
EASEMENT DOCUMENT	An EASEMENT DOCUMENT is a document that describes the right to use the real property of another for a specific purpose, mostly in connection with right-of-way needs. The two parties in an easement are the grantor and the grantee.
ENCUMBRANCE DOCUMENT	An ENCUMBRANCE DOCUMENT is a document that defines the right or interest in a property that is held by someone who is not the legal owner of the property.

(continued on next page)

Table C.8. Document Subject Area Entity Definitions (continued)

Name	Definition
ENCUMBRANCE DOCUMENT TYPE	An ENCUMBRANCE DOCUMENT TYPE is a word or phrase that characterizes an ENCUMBRANCE DOCUMENT. Examples include control of access agreement document and height restriction document.
IMAGERY DOCUMENT	An IMAGERY DOCUMENT is a document that represents entities graphically using pixel structures.
IMAGERY UNIT	An IMAGERY UNIT is a measurement unit for an IMAGERY DOCUMENT that provides an indication of the image resolution level (or pixel size). Examples include feet, inches, meters, miles, and kilometers.
LEASE AGREEMENT DOCUMENT	A LEASE AGREEMENT DOCUMENT is a document that describes the temporary right to possess and use property (real or personal), usually in exchange for payment. The two parties in a lease are the lessor and the lessee (or tenant).
LEGAL DOCUMENT	A LEGAL DOCUMENT is a document that describes contractual rights and responsibilities.
ORIENTATION	An ORIENTATION is a compass reading, including north, east, south, and west.
PLAN DOCUMENT	A PLAN DOCUMENT is a document that contains one or more plan sheets. A PLAN DOCUMENT normally includes graphical elements that facilitate plan sheet printing for document submission purposes, such as title boxes, notes, and annotations.
PLAT	A PLAT is a map of a PARCEL.
PROJECT DOCUMENT	A PROJECT DOCUMENT is a mapping that represents the many-to-many relationship between a PROJECT and a DOCUMENT. PROJECT DOCUMENT enables the identification of DOCUMENTS associated with a PROJECT and the identification of PROJECTS associated with a DOCUMENT.
PROPERTY DESCRIPTION	A PROPERTY DESCRIPTION is a document that contains the necessary information to locate and survey a piece of property. A PROPERTY DESCRIPTION may include a metes and bounds description and a plat.
PROPERTY DESCRIPTION TYPE	A PROPERTY DESCRIPTION TYPE is a word or phrase that characterizes a PROPERTY DESCRIPTION. An example of a PROPERTY DESCRIPTION TYPE is metes and bounds.
PROPERTY ROLE	A PROPERTY ROLE is a role or function that an individual or an agency has with respect to a document that involves the transfer of property rights. Examples of a PROPERTY ROLE are grantor, grantee, lessor, lessee, appraiser, negotiator, and owner.
ROW FORM	A ROW FORM is a document in a standard format that a DOT uses for right-of-way purposes.
SHEET GROUP	A SHEET GROUP is a document category that facilitates plan document grouping. Examples of a SHEET GROUP are typical sections, estimate and quantity sheets, plan and profile, and traffic control plans.
UTILITY CONFLICT EVENT DOCUMENT	A UTILITY CONFLICT EVENT DOCUMENT is a mapping between a UTILITY CONFLICT EVENT and a DOCUMENT.

Note: LPA = Local public agency.

During Phase II of the research, the research team will discuss the advantages and disadvantages of both approaches with stakeholders.

User Subject Area

The user subject area includes entities that provide information about users who need to interact with the database. Table C.9 lists the entities included in this subject area. The core entity is SYSTEM USER. In the data model, a SYSTEM USER could be a DOT USER or a COMPANY USER. The primary key of SYSTEM USER is SYSTEM USER ID. The data model uses SYSTEM USER to handle references to individual persons throughout the database. For example, in UTILITY CONFLICT EVENT, the SYSTEM USER ID tracks the user who made a change to a utility conflict and thus created a new UTILITY CONFLICT EVENT.

The data model manages DOT users and external users in separate entities to enable the assignment of different privileges for each user group. DOT USER handles information about DOT users. COMPANY USER handles information about users who are not DOT employees. For security, the data model handles user profile data in separate entities (i.e., DOT USER PROFILE and COMPANY USER PROFILE).

DOT OFFICE, DOT UNIT, and DOT UNIT TYPE characterize individual offices within a DOT. DOT OFFICE handles information about individual DOT offices (e.g., utility permit office), with DOT UNIT indicating the corresponding administrative unit within the DOT (e.g., Houston), and DOT UNIT

Table C.9. User Subject Area Entity Definitions

Name	Definition
COMPANY	A COMPANY is any organization typically external to a DOT that performs a role in the project development process.
COMPANY OFFICE	A COMPANY OFFICE is an organizational subdivision of a COMPANY. An example of a COMPANY OFFICE is a local office of a statewide operating COMPANY.
COMPANY USER	A COMPANY USER is an employee of a COMPANY that is registered with the database authentication system.
COUNTY	A COUNTY is a political division within a STATE.
DISTRICT	A DISTRICT is an administrative division within a STATE defined by a DOT.
DOT OFFICE	A DOT OFFICE is an administrative unit within a DOT that has a specific responsibility in the project development process.
DOT OFFICE TYPE	A DOT OFFICE TYPE is a category of DOT OFFICE that defines its role in a state DOT's business processes.
DOT PROJECT SYSTEM USER	A DOT PROJECT SYSTEM USER is a mapping that represents the many-to-many relationship between a DOT PROJECT and a SYSTEM USER. DOT PROJECT SYSTEM USER enables the identification of SYSTEM USERS associated with a PROJECT and the identification of PROJECTS associated with a SYSTEM USER.
DOT UNIT	A DOT UNIT is an organizational subdivision of a DOT. Examples of a DOT UNIT are construction division, planning division, and local districts.
DOT UNIT TYPE	A DOT UNIT TYPE is an organizational category for a DOT UNIT. Examples for DOT UNIT TYPE are DOT district and DOT division.
DOT USER	A DOT USER is a DOT employee who is registered with the database authentication system.
ROLE	A ROLE is a function a SYSTEM USER may perform for a specific project. Examples of a ROLE include project manager, surveyor, SUE provider, and utility coordinator.
STATE	A STATE is a political division within the United States.
SYSTEM USER	A SYSTEM USER is someone who has an account and the authority to use the database. The system allows two types of users: DOT USERS and COMPANY USERS.
USER EVENT	A USER EVENT is a creation or modification of a SYSTEM USER.
USER EVENT TYPE	A USER EVENT TYPE is a category that describes a certain kind of a USER EVENT transaction.

TYPE indicating whether a DOT UNIT is at the district or headquarters/division level (e.g., district).

USER EVENT tracks changes to user data, including the date and time when the change occurred. USER EVENT TYPE lists USER EVENT types, including creation, modification, or deletion.

DOT PROJECT SYSTEM USER enables a many-to-many relationship between SYSTEM USER and PROJECT so that a PROJECT can have multiple SYSTEM USERS and a SYSTEM USER can be assigned to multiple PROJECTS. ROLE describes the specific function(s) a user can have in a particular project.

APPENDIX D

Prototype Database Queries

Introduction

This appendix describes the process followed to replicate the following utility conflict matrix (UCM) examples:

- Prototype UCM;
- Alaska Department of Transportation and Public Facilities (Alaska DOT&PF) UCM;
- California DOT (Caltrans) UCM;
- Georgia DOT (GDOT) UCM; and
- Texas DOT (TxDOT) UCM.

Replicating a UCM involved developing several queries. The purpose of the queries was to demonstrate the feasibility of the data model and to illustrate conceptually the basic steps to replicate the UCMs. As a result, the queries might not be optimized for a production-level database implementation. Readers should also note that the queries described below constitute a very small sample of the nearly endless options that might be available for developing queries and reports to satisfy the typical needs of a state DOT.

Prototype UCM Example

The prototype UCM in Figure D.1 includes 23 data items (eight data items in the header and 15 data items in the main body). The prototype UCM subsheet in Figure D.2 includes 25 data items (13 data items in the header and 12 data items in the subsheet body). Replicating the prototype UCM and subsheets for three sample utility conflicts involved developing 10 queries and four reports.

Step 1: Create "UCM 1 Estimated Completion Date" Query

This query retrieves utility conflicts that have been identified (utility conflict event type = 0) or that have an estimated adjustment completion date (utility conflict event type = 16) for a specific project (Figure D.3).

The SQL statement is as follows:

```
SELECT UTIL_CNFLT.DOT_PROJ_NBR, UTIL_CNFLT_EVNT.UTIL_CNFLT_ID,
    UTIL_CNFLT_EVNT.UTIL_CNFLT_EVNT_TYPE_ID, UTIL_CNFLT_EVNT.UTIL_
    CNFLT_EVNT_DT
FROM UTIL_CNFLT INNER JOIN UTIL_CNFLT_EVNT ON UTIL_CNFLT.UTIL_
    CNFLT_ID = UTIL_CNFLT_EVNT.UTIL_CNFLT_ID
WHERE (((UTIL_CNFLT.DOT_PROJ_NBR)=123456789) AND ((UTIL_CNFLT_
    EVNT.UTIL_CNFLT_EVNT_TYPE_ID)=0 Or (UTIL_CNFLT_EVNT.UTIL_CNFLT_
    EVNT_TYPE_ID)=16));
```

Step 2: Create "UCM 2 Estimated Completion Date" Query

This query uses the query created in Step 1 to display every utility conflict for a project with the estimated completion date if that date was entered for the utility conflict. If the estimated completion date was not entered for a utility conflict, the query displays the utility conflict record without an entry in the utility conflict event date column (Figure D.4).

The SQL statement is as follows:

```
SELECT UC1.DOT_PROJ_NBR, UC1.UTIL_CNFLT_ID, UC1.UTIL_CNFLT_
    EVNT_TYPE_ID, IIf(UC1.UTIL_CNFLT_EVNT_TYPE_ID=16,UC1.UTIL_
    CNFLT_EVNT_DT,'') AS UTIL_CNFLT_EVNT_DT
FROM [UCM 1 Estimated Completion Date] AS UC1 INNER JOIN (SELECT
    [UCM 1 Estimated Completion Date].DOT_PROJ_NBR, [UCM 1 Estimated
    Completion Date].UTIL_CNFLT_ID, Max([UCM 1 Estimated Completion
    Date].UTIL_CNFLT_EVNT_TYPE_ID)
AS MaxOfUTIL_CNFLT_EVNT_TYPE_ID FROM [UCM 1 Estimated Completion
    Date]
GROUP BY [UCM 1 Estimated Completion Date].DOT_PROJ_NBR, [UCM 1
    Estimated Completion Date].UTIL_CNFLT_ID) AS UC2 ON (UC1.UTIL_
    CNFLT_ID = UC2.UTIL_CNFLT_ID) AND (UC1.UTIL_CNFLT_EVNT_TYPE_ID
    = UC2.MaxOfUTIL_CNFLT_EVNT_TYPE_ID);
```

Step 3: Create "UCM 1 Multiple Utility Conflict Status" Query

This query selects all utility conflicts associated with a project that have a utility conflict event type ID equal to 0, 2, 3, or 28 (Figure D.5). The corresponding utility conflict event type names are utility conflict created, utility owner informed of utility conflict, utility conflict resolved, and utility conflict resolution strategy selected. (Table C.3 in Appendix C lists all the valid utility conflict event types in the data model.) This

Project Owner: _____
Project No. : _____
Project Description: _____
Highway or Route: _____

Note: refer to subsheet for utility conflict cost analysis.

Utility Conflict Matrix Developed/Revised By: _____
Date: _____
Reviewed By: _____
Date: _____

Utility Owner and/or Contact Name	Conflict ID	Drawing or Sheet No.	Utility Type	Size and/or Material	Utility Conflict Description	Start Station	Start Offset	End Station	End Offset	Utility Investigation Level Needed	Test Hole	Recommended Action or Resolution	Estimated Resolution Date	Resolution Status

Figure D.1. Prototype UCM.

Project Owner: _____ **Cost Estimate Analysis Developed/Revised By** _____

Project No. : _____ **Date** _____

Project Description: _____ **Reviewed By** _____

Highway or Route: _____ **Date** _____

Utility Conflict: _____

Utility Owner: _____

Utility Type: _____

Size and/or Material: _____

Project Phase: _____

Alternative Number	Alternative Description	Alternative Advantage	Alternative Disadvantage	Responsible Party	Engineering Cost (Utility)	Direct Cost (Utility)	Engineering Cost (DOT)	Direct Cost (DOT)	Total Cost	Feasibility	Decision

Figure D.2. Prototype UCM subsheet: Cost estimate analysis for utility conflict resolution alternatives.

group of utility conflict event types serves as an example of how a state DOT might track the status of a utility conflict (other combinations are certainly possible).

The SQL statement is as follows:

```
SELECT UTIL_CNFLT.DOT_PROJ_NBR, UTIL_CNFLT.UTIL_CNFLT_ID, UTIL_
    CNFLT_EVNT.UTIL_CNFLT_EVNT_TYPE_ID, UTIL_CNFLT_EVNT.UTIL_
    CNFLT_EVNT_TS, UTIL_CNFLT_EVNT_TYPE.UTIL_CNFLT_EVNT_TYPE_NM
FROM UTIL_CNFLT INNER JOIN (UTIL_CNFLT_EVNT_TYPE INNER JOIN UTIL_
    CNFLT_EVNT ON UTIL_CNFLT_EVNT_TYPE.UTIL_CNFLT_EVNT_TYPE_ID
    = UTIL_CNFLT_EVNT.UTIL_CNFLT_EVNT_TYPE_ID) ON UTIL_CNFLT.UTIL_
    CNFLT_ID = UTIL_CNFLT_EVNT.UTIL_CNFLT_ID
GROUP BY UTIL_CNFLT.DOT_PROJ_NBR, UTIL_CNFLT.UTIL_CNFLT_ID, UTIL_
    CNFLT_EVNT.UTIL_CNFLT_EVNT_TYPE_ID, UTIL_CNFLT_EVNT.UTIL_
    CNFLT_EVNT_TS, UTIL_CNFLT_EVNT_TYPE.UTIL_CNFLT_EVNT_TYPE_NM
HAVING (((UTIL_CNFLT.DOT_PROJ_NBR)=123456789) AND ((UTIL_CNFLT_
    EVNT.UTIL_CNFLT_EVNT_TYPE_ID)=0 Or (UTIL_CNFLT_EVNT.UTIL_CNFLT_
    EVNT_TYPE_ID)=2 Or (UTIL_CNFLT_EVNT.UTIL_CNFLT_EVNT_TYPE_ID)=3
    Or (UTIL_CNFLT_EVNT.UTIL_CNFLT_EVNT_TYPE_ID)=28));
```

Step 4: Create "UCM 1 Plan Document Sheet Number" Query

This query retrieves the sheet number and sheet group ID for plan documents that are associated with utility conflicts in a project (Figure D.6).

The SQL statement is as follows:

```
SELECT UTIL_CNFLT.UTIL_CNFLT_ID, UTIL_CNFLT.DOT_PROJ_NBR, PLAN_
    DCMNT.PLAN_DCMNT_SHT_NBR, PLAN_DCMNT.SHT_GRP_ID
FROM UTIL_CNFLT INNER JOIN (UTIL_CNFLT_EVNT INNER JOIN ((DCMNT
    INNER JOIN PLAN_DCMNT ON DCMNT.DCMNT_ID = PLAN_DCMNT.
    DCMNT_ID) INNER JOIN UTIL_CNFLT_EVNT_DCMNT ON DCMNT.DCMNT_
    ID = UTIL_CNFLT_EVNT_DCMNT.DCMNT_ID) ON UTIL_CNFLT_EVNT.UTIL_
    CNFLT_EVNT_NBR = UTIL_CNFLT_EVNT_DCMNT.UTIL_CNFLT_EVNT_NBR)
    ON UTIL_CNFLT.UTIL_CNFLT_ID = UTIL_CNFLT_EVNT.UTIL_CNFLT_ID
WHERE (((UTIL_CNFLT.DOT_PROJ_NBR)=123456789));
```

Step 5: Create "UCM 2 Utility Conflict Status" Query

This query uses the query from Step 3 to retrieve the highest utility conflict event type order code, which specifies the order of events for a utility conflict status, and the corresponding utility conflict event date for each utility conflict (Figure D.7).

The SQL statement is as follows:

```
SELECT [UCM 1 Multiple Utility Conflict Status].UTIL_CNFLT_ID, [UCM 1 Multiple
    Utility Conflict Status].UTIL_CNFLT_EVNT_TYPE_ID, [UCM 1 Multiple Utility
    Conflict Status].UC_EVNT_TYPE_ORDR_CD, [UCM 1 Multiple Utility Conflict
    Status].UTIL_CNFLT_EVNT_DT, [UCM 1 Multiple Utility Conflict Status].
    UTIL_CNFLT_EVNT_TYPE_NM
```

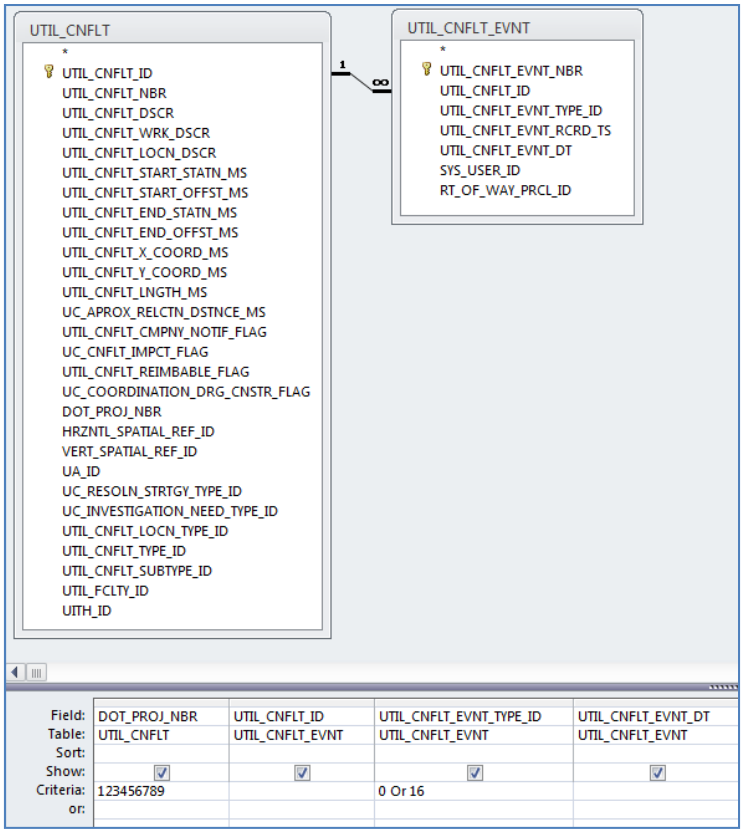


Figure D.3. Design view of "UCM 1 estimated completion date" query.

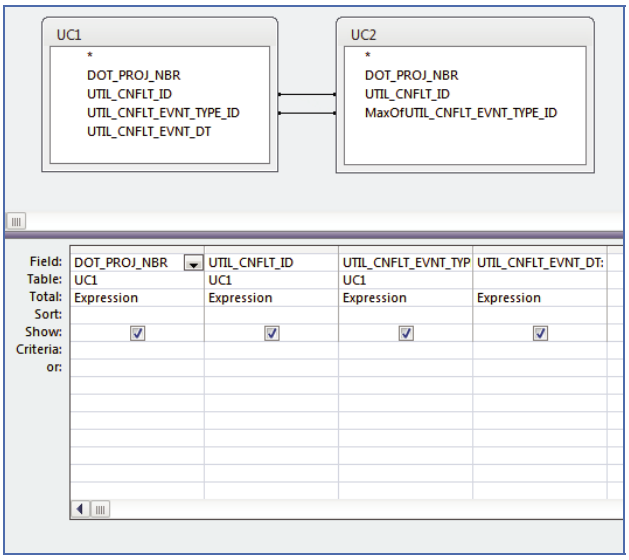


Figure D.4. Design view of "UCM 2 estimated completion date" query.

```
FROM [UCM 1 Multiple Utility Conflict Status]
WHERE ((([UCM 1 Multiple Utility Conflict Status].UC_EVNT_TYPE_ORDR_
    CD)=(SELECT MAX (UC2.UC_EVNT_TYPE_ORDR_CD)
    FROM [UCM 1 Multiple Utility Conflict Status] AS UC2
    WHERE [UCM 1 Multiple Utility Conflict Status].UTIL_CNFLT_ID = UC2.
    UTIL_CNFLT_ID)));
```

Step 6: Create "UCM 3" Query

This query uses the queries from Steps 2, 4, and 5 to retrieve a list of utility conflicts for a specific project (Figure D.8).

The SQL statement is as follows:

```
SELECT CMPNY.CMPNY_NM, DOT_PROJ.DOT_PROJ_NBR, UTIL_CNFLT.
    UTIL_CNFLT_ID, UTIL_CNFLT.UTIL_CNFLT_NBR, UTIL_FCLTY_TYPE.
    UTIL_FCLTY_TYPE_NM, UTIL_CNFLT.UTIL_CNFLT_START_STATN_MS,
    UTIL_CNFLT.UTIL_CNFLT_END_STATN_MS, UTIL_CNFLT.UTIL_CNFLT_
    START_OFFST_MS, UTIL_CNFLT.UTIL_CNFLT_END_OFFST_MS, UTIL_
    CNFLT_RESOLN_ALTERNAT.UC_RESOLN_ALTERNAT_DSCR, UTIL_
    CNFLT_RESOLN_ALTERNAT.UCR_ALTERNAT_DCSN_ID, STATE.STATE_
    DOT_NM, DOT_PROJ.DOT_PROJ_NBR, DOT_PROJ.DOT_PROJ_
    DSCR, HWY_SYS.HWY_SYS_NM, HWY_FUNCL_CLASS.HWY_FUNCL_
    CLASS_CD, HWY_SYS.HWY_SYS_NBR, UTIL_FCLTY_MTRL.UTIL_
    FCLTY_MTRL_NM, UTIL_CNFLT_INVESTIGATION_NEED_TYPE.UC_
    INVESTIGATION_NEED_TYPE_NM, UTIL_CNFLT.UITH_ID, UTIL_
    CNFLT_RESOLN_ALTERNAT_RSPNBL.UCR_ALTERNAT_RSPNBL_CD,
    [UCM 2 Estimated Completion Date].UTIL_CNFLT_EVNT_DT, [UCM 2
    Utility Conflict Status].UTIL_CNFLT_EVNT_TYPE_NM, [UCM 1 Plan
    Document Sheet Number].PLAN_DCMNT_SHT_NBR, UTIL_CNFLT.UTIL_
    CNFLT_WRK_DSCR
FROM (STATE INNER JOIN (UTIL_FCLTY_TYPE INNER JOIN (UTIL_FCLTY_
    MTRL INNER JOIN ((CMPNY INNER JOIN UTIL_FCLTY ON CMPNY.
```

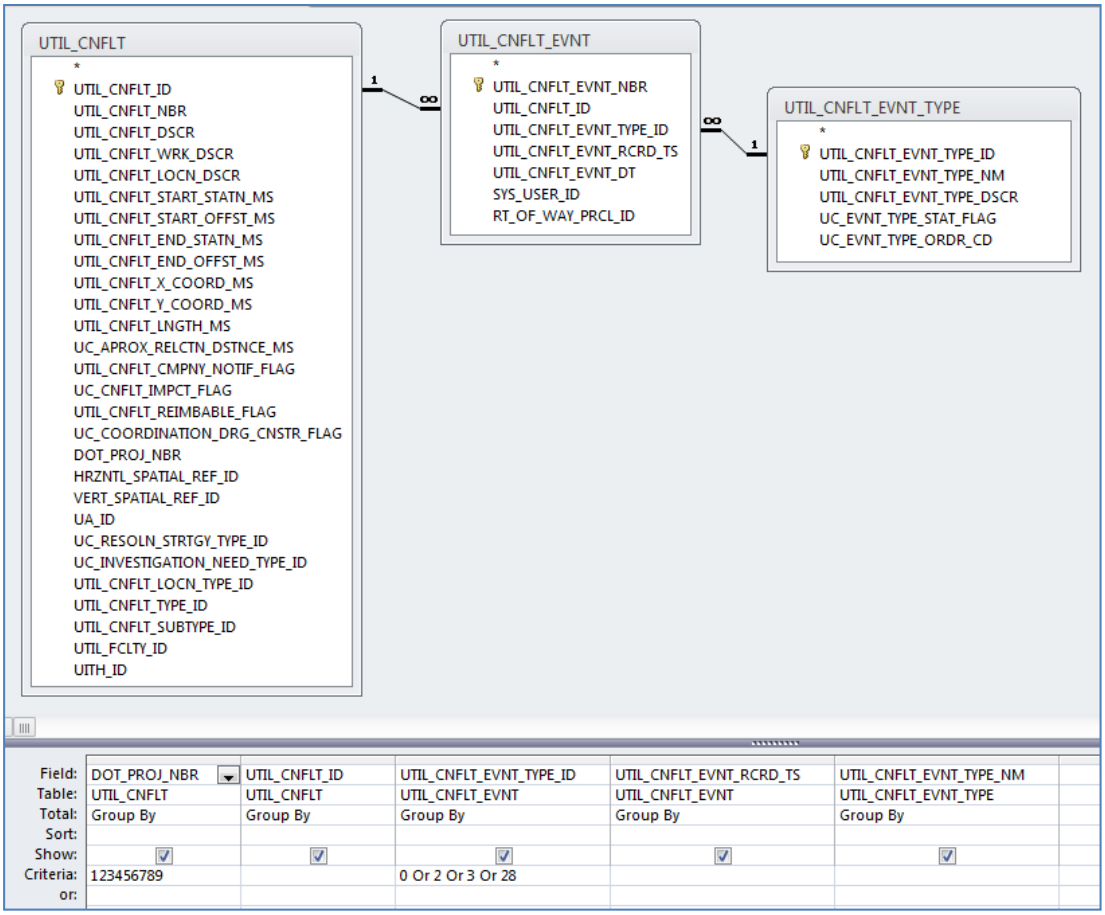


Figure D.5. Design view of "UCM 1 multiple utility conflict status" query.

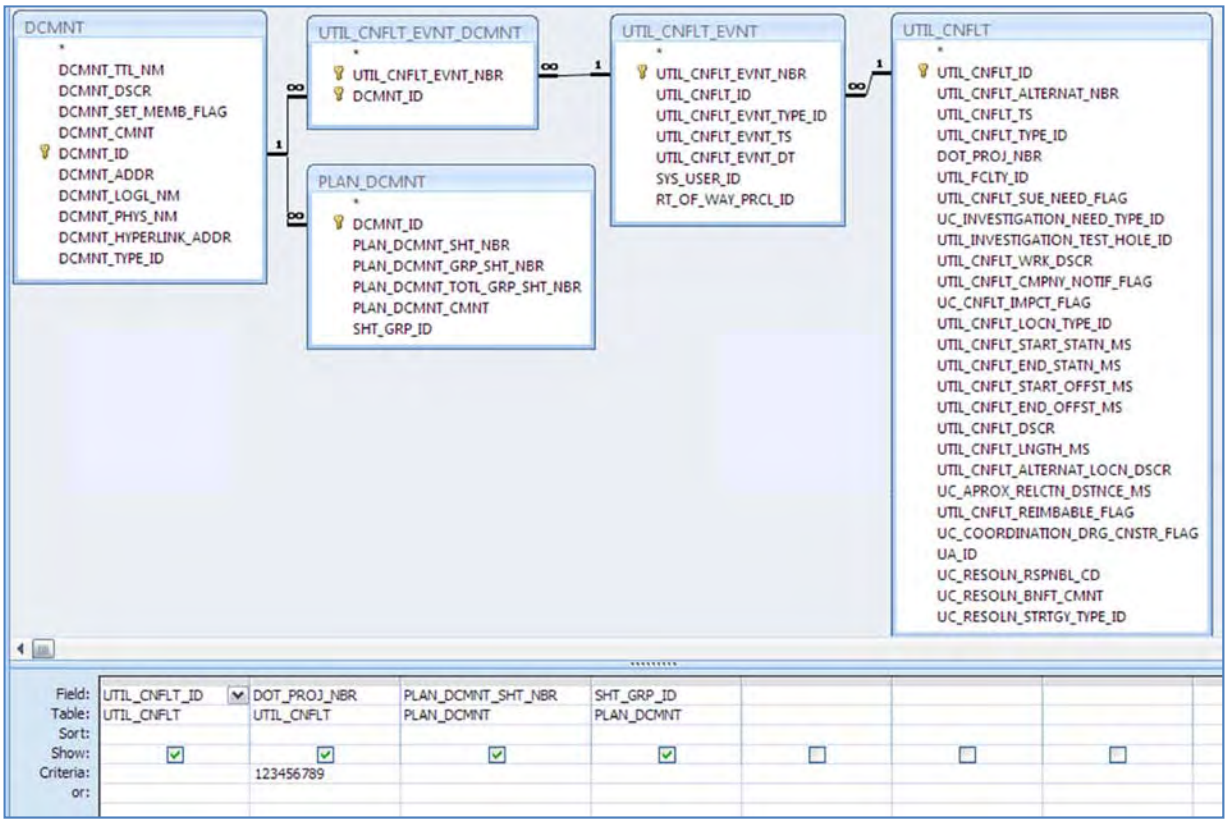


Figure D.6. Design view of "UCM 1 plan document sheet number" query.

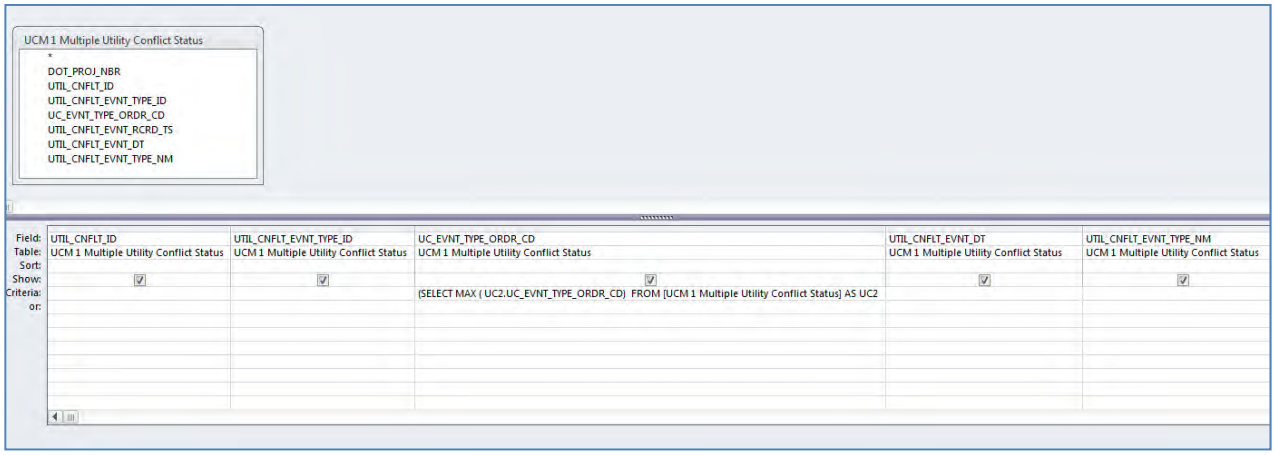


Figure D.7. Design view of "UCM 2 utility conflict status" query.

CMPNY_ID = UTIL_FCLTY.CMPNY_ID) INNER JOIN (UTIL_CNFLT_INVESTIGATION_NEED_TYPE INNER JOIN (HWY_FUNCL_CLASS INNER JOIN (HWY_SYS INNER JOIN (((UTIL_CNFLT INNER JOIN [UCM 2 Utility Conflict Status] ON UTIL_CNFLT.UTIL_CNFLT_ID = [UCM 2 Utility Conflict Status].UTIL_CNFLT_ID) INNER JOIN [UCM 1 Plan Document Sheet Number] ON UTIL_CNFLT.UTIL_CNFLT_ID = [UCM 1 Plan Document Sheet Number].UTIL_CNFLT_ID) INNER JOIN (DOT_PROJ INNER JOIN [UCM 2 Estimated Completion Date] ON DOT_PROJ.DOT_PROJ_NBR = [UCM 2 Estimated Completion Date].DOT_PROJ_NBR) ON (DOT_PROJ.DOT_PROJ_NBR = UTIL_CNFLT.DOT_PROJ_NBR) AND (UTIL_CNFLT.UTIL_CNFLT_ID = [UCM 2 Estimated Completion Date].UTIL_CNFLT_ID)) ON HWY_SYS.HWY_SYS_ID = DOT_PROJ.HWY_SYS_ID) ON HWY_FUNCL_CLASS.HWY_FUNCL_CLASS_ID = HWY_SYS.HWY_FUNCL_CLASS_ID) ON UTIL_CNFLT_INVESTIGATION_NEED_TYPE.UC_INVESTIGATION_NEED_TYPE_ID = UTIL_CNFLT.UC_INVESTIGATION_NEED_TYPE_ID) ON UTIL_FCLTY.UTIL_FCLTY_ID = UTIL_CNFLT.UTIL_FCLTY_ID) ON UTIL_FCLTY_MTRL.UTIL_FCLTY_MTRL_ID = UTIL_FCLTY.UTIL_FCLTY_MTRL_ID) ON UTIL_FCLTY_TYPE.UTIL_FCLTY_TYPE_ID = UTIL_FCLTY.UTIL_FCLTY_TYPE_ID) ON STATE.STATE_ID = DOT_PROJ.STATE_ID) INNER JOIN (UTIL_CNFLT_RESOLN_ALTERNAT_RSPNBL INNER JOIN UTIL_CNFLT_RESOLN_ALTERNAT ON UTIL_CNFLT_RESOLN_ALTERNAT_RSPNBL.UCR_ALTERNAT_RSPNBL_ID = UTIL_CNFLT_RESOLN_ALTERNAT.UCR_ALTERNAT_RSPNBL_ID) ON
UTIL_CNFLT.UTIL_CNFLT_ID = UTIL_CNFLT_RESOLN_ALTERNAT.UTIL_CNFLT_ID
WHERE (((UTIL_CNFLT_RESOLN_ALTERNAT.UCR_ALTERNAT_DCSN_ID)=1) AND ((DOT_PROJ.DOT_PROJ_NBR)=123456789));

Step 7: Create "UCM 1 Estimates Crosstab" Query

This query produces a list of all estimates for a utility conflict resolution alternative in one row, adding more rows to the output for each utility conflict resolution alternative that exists for a utility conflict. Multiplying the total number of alternatives by the number of utility conflicts for a project equals the total number of rows in this query. Figure D.9 provides a design view of the query; the estimate type name is the column heading in this query, and all other data items are selected as row headings.

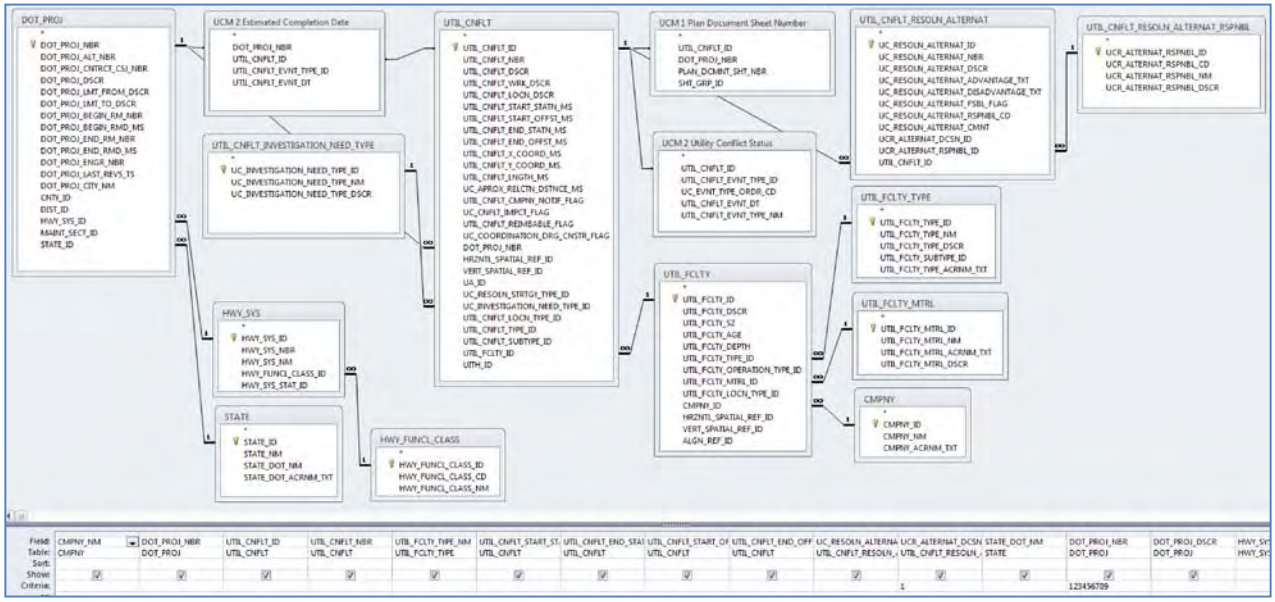


Figure D.8. Design view of "UCM 3" query.

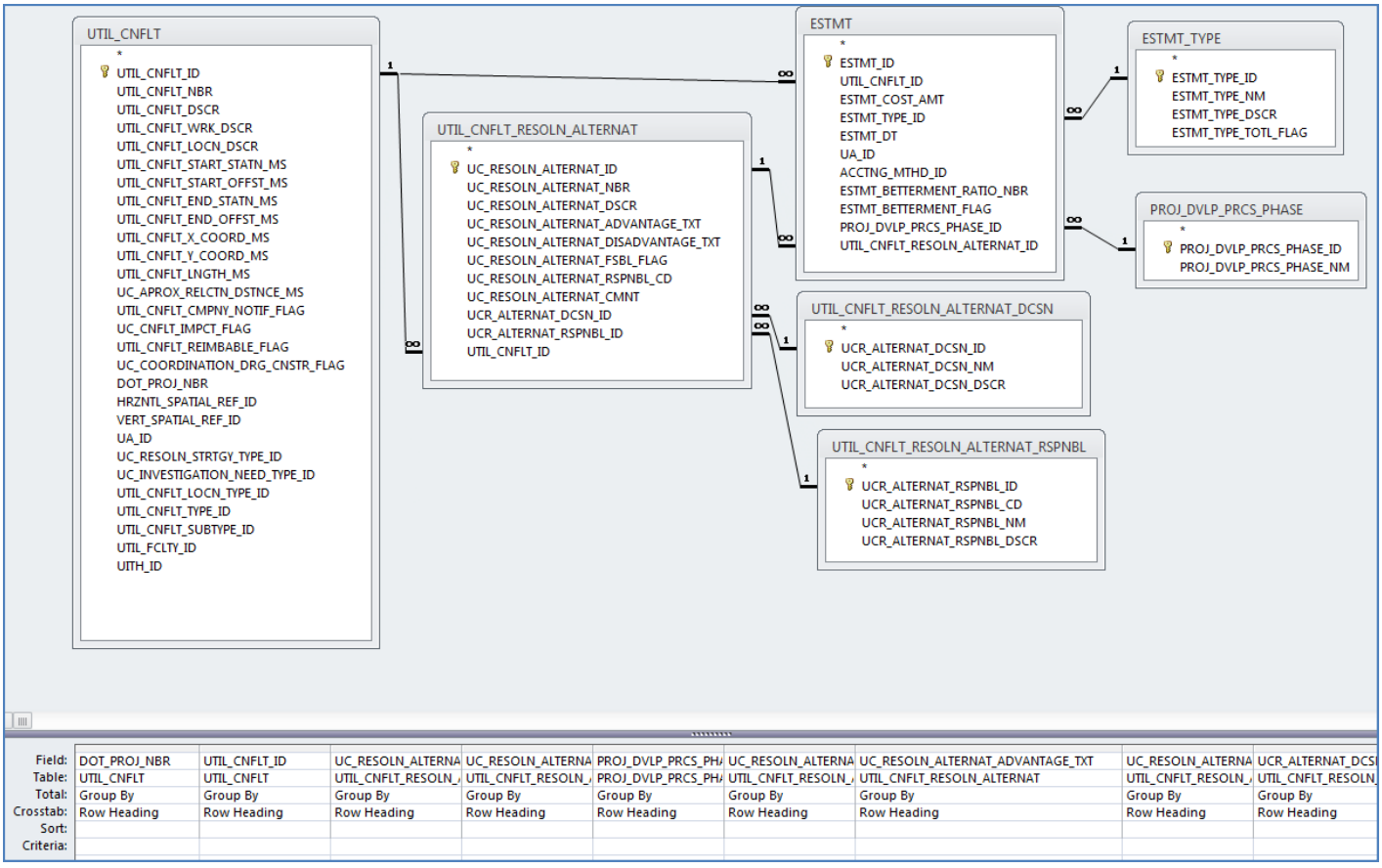


Figure D.9. Design view of "UCM 1 estimates crosstab" query.

The SQL statement is as follows:

```
TRANSFORM Sum(ESTMT.ESTMT_COST_AMT) AS SumOfESTMT_COST_
    AMT
SELECT UTIL_CNFLT.DOT_PROJ_NBR, UTIL_CNFLT.UTIL_CNFLT_ID, UTIL_
    CNFLT_RESOLN_ALTERNAT.UC_RESOLN_ALTERNAT_NBR, UTIL_CNFLT_
    RESOLN_ALTERNAT.UC_RESOLN_ALTERNAT_DSCR, PROJ_DVLP_PRCS_
    PHASE.PROJ_DVLP_PRCS_PHASE_NM, UTIL_CNFLT_RESOLN_ALTERNAT.
    UC_RESOLN_ALTERNAT_FSBL_FLAG, UTIL_CNFLT_RESOLN_ALTERNAT.
    UC_RESOLN_ALTERNAT_ADVANTAGE_TXT, UTIL_CNFLT_RESOLN_
    ALTERNAT.UC_RESOLN_ALTERNAT_DISADVANTAGE_TXT, UTIL_CNFLT_
    RESOLN_ALTERNAT_DCSN.UCR_ALTERNAT_DCSN_NM, UTIL_CNFLT_
    RESOLN_ALTERNAT.UC_RESOLN_ALTERNAT_RSPNBL_CD, UTIL_CNFLT_
    RESOLN_ALTERNAT_RSPNBL.UCR_ALTERNAT_RSPNBL_NM
FROM UTIL_CNFLT INNER JOIN ((UTIL_CNFLT_RESOLN_ALTERNAT_RSPNBL
    INNER JOIN (UTIL_CNFLT_RESOLN_ALTERNAT_DCSN INNER JOIN UTIL_
    CNFLT_RESOLN_ALTERNAT ON UTIL_CNFLT_RESOLN_ALTERNAT_DCSN.
    UCR_ALTERNAT_DCSN_ID = UTIL_CNFLT_RESOLN_ALTERNAT.UCR_
    ALTERNAT_DCSN_ID) ON UTIL_CNFLT_RESOLN_ALTERNAT_RSPNBL.
    UCR_ALTERNAT_RSPNBL_ID = UTIL_CNFLT_RESOLN_ALTERNAT.UCR_
    ALTERNAT_RSPNBL_ID) INNER JOIN (PROJ_DVLP_PRCS_PHASE INNER
    JOIN (ESTMT_TYPE INNER JOIN ESTMT ON ESTMT_TYPE.ESTMT_TYPE_
    ID = ESTMT.ESTMT_TYPE_ID) ON PROJ_DVLP_PRCS_PHASE.PROJ_
    DVLP_PRCS_PHASE_ID = ESTMT.PROJ_DVLP_PRCS_PHASE_ID) ON
    UTIL_CNFLT_RESOLN_ALTERNAT.UC_RESOLN_ALTERNAT_ID = ESTMT.
    UTIL_CNFLT_RESOLN_ALTERNAT_ID) ON (UTIL_CNFLT.UTIL_CNFLT_
    ID = UTIL_CNFLT_RESOLN_ALTERNAT.UTIL_CNFLT_ID) AND (UTIL_
    CNFLT.UTIL_CNFLT_ID = ESTMT.UTIL_CNFLT_ID)
WHERE (((UTIL_CNFLT.DOT_PROJ_NBR)=123456789))
GROUP BY UTIL_CNFLT.DOT_PROJ_NBR, UTIL_CNFLT.UTIL_CNFLT_ID,
    UTIL_CNFLT_RESOLN_ALTERNAT.UC_RESOLN_ALTERNAT_NBR, UTIL_
    CNFLT_RESOLN_ALTERNAT.UC_RESOLN_ALTERNAT_DSCR, PROJ_
    DVLP_PRCS_PHASE.PROJ_DVLP_PRCS_PHASE_NM, UTIL_CNFLT_
    RESOLN_ALTERNAT.UC_RESOLN_ALTERNAT_FSBL_FLAG, UTIL_
    CNFLT_RESOLN_ALTERNAT.UC_RESOLN_ALTERNAT_ADVANTAGE_
    TXT, UTIL_CNFLT_RESOLN_ALTERNAT.UC_RESOLN_ALTERNAT_
    DISADVANTAGE_TXT, UTIL_CNFLT_RESOLN_ALTERNAT_DCSN.UCR_
    ALTERNAT_DCSN_NM, UTIL_CNFLT_RESOLN_ALTERNAT.UC_RESOLN_
    ALTERNAT_RSPNBL_CD, UTIL_CNFLT_RESOLN_ALTERNAT_RSPNBL.
    UCR_ALTERNAT_RSPNBL_NM
PIVOT ESTMT_TYPE.ESTMT_TYPE_NM;
```

Step 8: Create "UCM 2 Alternative Analysis UC34" Query

This query produces a list of utility conflict resolution alternatives and related cost estimates for a specific conflict, in this case utility conflict number 34 (UC34). This query effectively reduces the list of alternatives and cost estimates for all utility conflicts that was created in Step 7 to a list of alternatives and cost estimates for one conflict. This query is the foundation of a subsheet that will be linked to the main UCM. Thus, a separate query like the one created in this step will need to be created for every utility conflict in the UCM. Figure D.10 shows a design view of the query. For illustration purposes, two additional queries are included in the database that follow the same structure, one for utility conflict number 2 ("UCM 2 alternative analysis UC35"), and one for utility

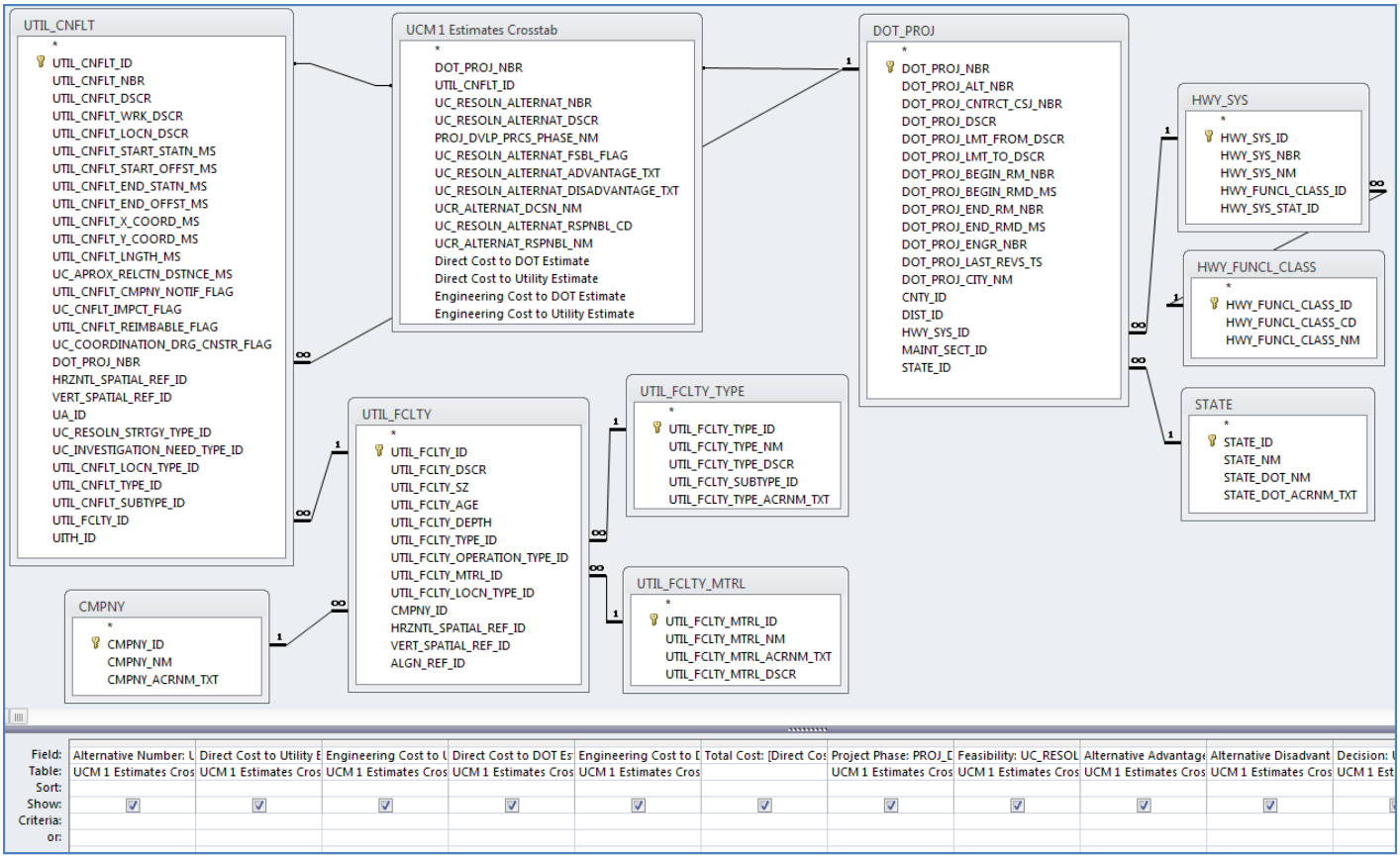


Figure D.10. Design view of "UCM 2 alternative analysis UC34" query.

conflict number 11 ("UCM 2 alternative analysis UC44"). Note that the query includes a total cost field that does not retrieve data from the database, but calculates data on the fly to give a summation of the following estimates: direct cost to utility plus direct cost to DOT plus engineering cost to utility plus engineering cost to DOT.

The SQL statement is as follows:

```
SELECT [UCM 1 Estimates Crosstab].DOT_PROJ_NBR, STATE.STATE_DOT_NM,
    UTIL_FCLTY_TYPE.UTIL_FCLTY_TYPE_NM, DOT_PROJ.DOT_PROJ_DSCR,
    UTIL_FCLTY_MTRL.UTIL_FCLTY_MTRL_NM, CMPNY.CMPNY_NM, HWY_
    SYS.HWY_SYS_NBR, HWY_SYS.HWY_SYS_NM, HWY_FUNCL_CLASS.
    HWY_FUNCL_CLASS_CD, UTIL_CNFLT.UTIL_CNFLT_ID, UTIL_CNFLT.UTIL_
    CNFLT_NBR, [UCM 1 Estimates Crosstab].UC_RESOLN_ALTERNAT_DSCR
    AS [Alternative Description], [UCM 1 Estimates Crosstab].UC_RESOLN_
    ALTERNAT_NBR AS [Alternative Number], [UCM 1 Estimates Crosstab].[Direct
    Cost to Utility Estimate], [UCM 1 Estimates Crosstab].[Engineering Cost to
    Utility Estimate], [UCM 1 Estimates Crosstab].[Direct Cost to DOT Estimate],
    [UCM 1 Estimates Crosstab].[Engineering Cost to DOT Estimate], [Direct Cost
    to Utility Estimate]+[Engineering Cost to Utility Estimate]+[Direct Cost to DOT
    Estimate]+[Engineering Cost to DOT Estimate] AS [Total Cost], [UCM 1
    Estimates Crosstab].PROJ_DVLP_PRCS_PHASE_NM AS [Project Phase],
    [UCM 1 Estimates Crosstab].UC_RESOLN_ALTERNAT_FSBL_FLAG AS
    Feasibility, [UCM 1 Estimates Crosstab].UC_RESOLN_ALTERNAT_
    ADVANTAGE_TXT AS [Alternative Advantage], [UCM 1 Estimates Crosstab].
    UC_RESOLN_ALTERNAT_DISADVANTAGE_TXT AS [Alternative
    Disadvantage], [UCM 1 Estimates Crosstab].UCR_ALTERNAT_DCSN_NM
    AS Decision, [UCM 1 Estimates Crosstab].UC_RESOLN_ALTERNAT_
    RSPNBL_CD, [UCM 1 Estimates Crosstab].UCR_ALTERNAT_RSPNBL_NM
FROM STATE INNER JOIN (UTIL_FCLTY_TYPE INNER JOIN (UTIL_FCLTY_
    MTRL INNER JOIN ((CMPNY INNER JOIN UTIL_FCLTY ON CMPNY.
    CMPNY_ID = UTIL_FCLTY.CMPNY_ID) INNER JOIN (HWY_FUNCL_CLASS
    INNER JOIN (HWY_SYS INNER JOIN (DOT_PROJ INNER JOIN ([UCM 1
    Estimates Crosstab] INNER JOIN UTIL_CNFLT ON [UCM 1 Estimates
    Crosstab].UTIL_CNFLT_ID = UTIL_CNFLT.UTIL_CNFLT_ID) ON (DOT_PROJ.
    DOT_PROJ_NBR = UTIL_CNFLT.DOT_PROJ_NBR) AND (DOT_PROJ.DOT_
    PROJ_NBR = [UCM 1 Estimates Crosstab].DOT_PROJ_NBR)) ON HWY_
    SYS.HWY_SYS_ID = DOT_PROJ.HWY_SYS_ID) ON HWY_FUNCL_CLASS.
    HWY_FUNCL_CLASS_ID = HWY_SYS.HWY_FUNCL_CLASS_ID) ON UTIL_
    FCLTY.UTIL_FCLTY_ID = UTIL_CNFLT.UTIL_FCLTY_ID) ON UTIL_FCLTY_
    MTRL.UTIL_FCLTY_MTRL_ID = UTIL_FCLTY.UTIL_FCLTY_MTRL_ID) ON
    UTIL_FCLTY_TYPE.UTIL_FCLTY_TYPE_ID = UTIL_FCLTY.UTIL_FCLTY_
    TYPE_ID) ON STATE.STATE_ID = DOT_PROJ.STATE_ID
WHERE (((UTIL_CNFLT.UTIL_CNFLT_NBR)=1));
```

Step 9: Create "UCM" Subsheet Report

This report, which is shown in Figure D.11, replicates the subsheet for the prototype UCM based on the results of the query from Step 8. All data items provided in the report are selected from database entries, with the exception of the total cost field, which calculates a summation on the fly, and the names (and corresponding dates) of the individuals who developed, revised, or reviewed the UCM report. These data items could be inserted dynamically through a dialog box at the time of preparing, revising, or reviewing the document. The report also formats certain data items—for example, the project number stored as 123456789 in the database becomes 1234-56-789 in the report.

Utility Conflict Resolution Alternatives

Cost Estimate Analysis

Date: 4/6/2011

Project Owner: Texas Department of Transportation
Project No.: 1234-56-789
Project Description: Road construction project in Houston
Highway or Route: I-10 Katy Freeway

Conflict ID:	1
Utility Owner:	AT&T
Utility Type:	Telephone
Size and/or Material:	Fiber Optic
Project Phase:	60% Design

Alternative Number	Alternative Description	Alternative Advantage	Alternative Disadvantage	Responsible Party	Engineering Cost (Utility)	Direct Cost (Utility)	Engineering Cost (DOT)	Direct Cost (DOT)	Total Cost	Feasibility	Decision
0	Relocation before construction.	No design change required and no additional cost to DOT.	Cost to utility for relocation.	Utility Company	$10,375.00	$63,875.00	$0.00	$0.00	$74,250.00	Yes	Selected
1	Protect in-place.			Utility Company	$7,875.00	$32,375.00	$0.00	$0.00	$40,250.00	No	Rejected
2	Design change.			DOT	$0.00	$0.00	$95,375.00	$0.00	$95,375.00	No	Rejected
3	Exception to policy.			DOT	$0.00	$0.00	$0.00	$0.00	$0.00	No	Rejected

Figure D.11. Utility conflict resolution alternatives: Cost estimate analysis (using hypothetical data from TxDOT Katy Freeway project).

Step 10: Create "UCM" Report

This report replicates the prototype UCM based on the results of the query from Step 8 and is shown in Figure D.12. All data items provided in the report are selected from database entries. The only exception is the names (and corresponding dates) of the individuals who developed, revised, or reviewed the UCM report. These data items could be inserted dynamically through a dialog box at the time of preparing, revising, or reviewing the document. The report also formats certain data items—for example, a station stored as 2100 in the database becomes 21+00 in the report.

Alaska Department of Transportation and Public Facilities UCM Example

The sample UCM provided by Alaska DOT&PF is included in Appendix B (Figure B.1). This UCM, which includes 19 data items (five data items in the header and 14 data items in the main body), is an example of a UCM with an average number of data items. The Alaska UCM offered a number of unique challenges. First, it included totals, subtotals, and grand totals of cost data elements, and it was of interest to derive these values dynamically through query calculations. Second, this UCM grouped cost data according to whether the utility installations involved were distribution or transmission facilities. Replicating the sample UCM involved developing 13 queries and three reports.

Step 1: Create "Alaska 1 Distribution Crosstab" Query

This query selects two types of electric distribution utility facilities for a specific project and produces a list of the adjustment cost estimate and the engineering cost estimate by utility conflict ID (Figure D.13).

The SQL statement is as follows:

```
TRANSFORM Sum(ESTMT.ESTMT_COST_AMT) AS SumOfESTMT_COST_AMT
SELECT UTIL_CNFLT.UTIL_CNFLT_ID
FROM (UTIL_FCLTY_TYPE INNER JOIN (UTIL_FCLTY INNER JOIN UTIL_CNFLT
    ON UTIL_FCLTY.UTIL_FCLTY_ID=UTIL_CNFLT.UTIL_FCLTY_ID) ON UTIL_
    FCLTY_TYPE.UTIL_FCLTY_TYPE_ID=UTIL_FCLTY.UTIL_FCLTY_TYPE_ID)
    INNER JOIN (ESTMT_TYPE INNER JOIN ESTMT ON ESTMT_TYPE.ESTMT_
    TYPE_ID=ESTMT.ESTMT_TYPE_ID) ON UTIL_CNFLT.UTIL_CNFLT_
    ID=ESTMT.UTIL_CNFLT_ID
WHERE (((UTIL_FCLTY_TYPE.UTIL_FCLTY_TYPE_ID)=0 Or (UTIL_FCLTY_TYPE.
    UTIL_FCLTY_TYPE_ID)=1) AND ((UTIL_CNFLT.DOT_PROJ_NBR)=50898))
GROUP BY UTIL_CNFLT.UTIL_CNFLT_ID
PIVOT ESTMT_TYPE.ESTMT_TYPE_NM;
```

Step 2: Create "Alaska 1 Transmission Crosstab" Query

This query is similar to the previous query except that it selects electricity transmission utility facilities.

The SQL statement is as follows:

```
TRANSFORM Sum(ESTMT.ESTMT_COST_AMT) AS SumOfESTMT_COST_AMT
SELECT UTIL_CNFLT.UTIL_CNFLT_ID
FROM (UTIL_FCLTY_TYPE INNER JOIN (UTIL_FCLTY INNER JOIN UTIL_CNFLT
    ON UTIL_FCLTY.UTIL_FCLTY_ID = UTIL_CNFLT.UTIL_FCLTY_ID) ON UTIL_
    FCLTY_TYPE.UTIL_FCLTY_TYPE_ID = UTIL_FCLTY.UTIL_FCLTY_TYPE_ID)
    INNER JOIN (ESTMT_TYPE INNER JOIN ESTMT ON ESTMT_TYPE.ESTMT_
    TYPE_ID = ESTMT.ESTMT_TYPE_ID) ON UTIL_CNFLT.UTIL_CNFLT_ID =
    ESTMT.UTIL_CNFLT_ID
WHERE (((UTIL_FCLTY_TYPE.UTIL_FCLTY_TYPE_ID)=2) AND ((UTIL_CNFLT.
    DOT_PROJ_NBR)=50898))
GROUP BY UTIL_CNFLT.UTIL_CNFLT_ID
PIVOT ESTMT_TYPE.ESTMT_TYPE_NM;
```

Step 3: Create "Alaska 2 Total Distribution" Query

This query uses the Step 1 crosstab query and produces a total of the adjustment cost and engineering cost estimates for each distribution utility conflict (Figure D.14).

The SQL statement is as follows:

```
SELECT UTIL_CNFLT.UTIL_CNFLT_ID, [Adjustment Cost Estimate]+[Engineering
    Cost Estimate] AS [Total Cost]
FROM UTIL_CNFLT INNER JOIN [Alaska 1 Distribution Crosstab] ON UTIL_
    CNFLT.UTIL_CNFLT_ID = [Alaska 1 Distribution Crosstab].UTIL_CNFLT_ID;
```

Step 4: Create "Alaska 2 Total Transmission" Query

This query uses the Step 2 crosstab query and produces a total of the adjustment cost and engineering cost estimates for each transmission utility conflict. The SQL statement is as follows:

```
SELECT UTIL_CNFLT.UTIL_CNFLT_ID, [Adjustment Cost Estimate]+[Engineering
    Cost Estimate] AS [Total Cost]
FROM UTIL_CNFLT INNER JOIN [Alaska 1 Transmission Crosstab] ON UTIL_
    CNFLT.UTIL_CNFLT_ID = [Alaska 1 Transmission Crosstab].UTIL_CNFLT_ID;
```

Step 5: Ceate "Alaska 3 Distribution Cost" Query

This query uses the queries from Steps 1 and 3 to retrieve engineering cost and adjustment cost estimates, as well as total electric distribution utility conflict costs (Figure D.15). The query selects all utility conflicts with a utility conflict event type = 28, which indicates a utility conflict resolution strategy has been selected for a utility conflict (see Table C.3 in Appendix C). The SQL statement is as follows:

```
SELECT UTIL_CNFLT.UTIL_CNFLT_ID, [Alaska 1 Distribution Crosstab].
    [Adjustment Cost Estimate], [Alaska 1 Distribution Crosstab].[Engineering
    Cost Estimate], [Alaska 2 Total Distribution].[Total Cost]
FROM ((UTIL_CNFLT INNER JOIN [Alaska 2 Total Distribution] ON UTIL_CNFLT.
    UTIL_CNFLT_ID = [Alaska 2 Total Distribution].UTIL_CNFLT_ID) INNER JOIN
    [Alaska 1 Distribution Crosstab] ON UTIL_CNFLT.UTIL_CNFLT_ID = [Alaska 1
    Distribution Crosstab].UTIL_CNFLT_ID) INNER JOIN UTIL_CNFLT_EVNT ON
    UTIL_CNFLT.UTIL_CNFLT_ID = UTIL_CNFLT_EVNT.UTIL_CNFLT_ID
WHERE (((UTIL_CNFLT_EVNT.UTIL_CNFLT_EVNT_TYPE_ID)=28))
GROUP BY UTIL_CNFLT.UTIL_CNFLT_ID, [Alaska 1 Distribution Crosstab].
    [Adjustment Cost Estimate], [Alaska 1 Distribution Crosstab].[Engineering
    Cost Estimate], [Alaska 2 Total Distribution].[Total Cost];
```

Utility Conflict Matrix

Project Owner: Texas Department of Transportation
Project No.: 1234-56-789
Project Description: Road construction project in Houston
Highway or Route: I-10 Katy Freeway

Utility Conflict Matrix Developed/Revised By: _____ **Date:** _____
Reviewed By: _____ **Date:** _____

Utility Owner and/ or Contact Name	Conflict ID	Drawing or Sheet No.	Utility Type	Size and/or Material	Utility Conflict Description	Start Station	End Station	Start Offset	End Offset	Utility Investigation Level Needed	Test Hole No.	Recommended Action or Resolution	Estimated Resolution Date	Resolution Status	Cost Analysis
AT&T	1	U-1	Telephone	Fiber Optic	Conflict with construction of frontage road widening.	21+00	22+00	45' Lt	45' Lt	QLC		Relocation before construction.	3/8/2010	Utility conflict identified	Detail
AT&T	2	U-1	Telephone	Fiber Optic	Conflict with construction of frontage road widening.	21+80	23+00	37' Rt	37' Rt	QLC		Relocation before construction.	3/8/2010	Utility conflict identified	Detail
AT&T	3	U-1	Telephone	Fiber Optic	Conflict with construction of frontage road widening.	27+50	30+00	48' Rt	48' Rt	QLC		Relocation before construction.	3/8/2010	Utility conflict identified	Detail
AT&T	4	U-1	Telephone	Fiber Optic	Conflict with construction of frontage road widening.	44+40	45+15	48' Rt	48' Rt	QLC		Relocation before construction.	3/8/2010	Utility conflict identified	Detail
AT&T	5	U-1	Telephone	Unknown	Conflict with construction of frontage road widening.	45+10	45+20	49' Lt	49' Lt	QLB		Design change.	3/8/2010	Utility owner informed of utility conflict	Detail
AT&T	6	U-1	Telephone	Copper	Conflict with retaining wall No. 18.	45+80	45+90	57' Lt	49' Lt	QLB		Design change.	3/8/2010	Utility conflict identified	Detail
AT&T	7	U-1	Telephone	Copper	Conflict with retaining wall No. 18.	25+80	25+90	65' Lt	49' Lt	QLC		Protect in-place.	3/8/2010	Utility conflict identified	Detail
AT&T	8	U-1	Telephone	Copper	Conflict with retaining wall No. 18.	25+80	25+90	62' Rt	49' Lt	QLC		Protect in-place.	3/8/2010	Utility conflict identified	Detail
AT&T	9	U-1	Telephone	Copper	Conflict with retaining wall No. 18.	27+40	28+00	55' Lt	55' Lt	QLC		Protect in-place.	3/8/2010	Utility conflict identified	Detail
AT&T	10	U-1	Telephone	Copper	Conflict with retaining wall No. 18.	27+40	28+00	55' Rt	55' Lt	QLC		Protect in-place.	3/8/2010	Utility conflict identified	Detail
AT&T	11	U-1	Telephone	Copper	Conflict with retaining wall No. 18.	28+05	29+00	62' Rt	55' Lt	QLC		Exception to policy.	3/8/2010	Utility conflict identified	Detail
AT&T	12	U-2	Telephone	Multiple Concrete Duct	Conflict with retaining wall No. 18.	15+50	16+00	49' Lt	80' Rt	QLC		Design change.	3/8/2010	Utility owner informed of utility conflict	Detail
AT&T	13	U-2	Telephone	Multiple Concrete Duct	Conflict with retaining wall No. 27.	15+90	16+00	40' Lt	80' Rt	QLC		Design change.	3/8/2010	Utility owner informed of utility conflict	Detail
AT&T	14	U-2	Telephone	Multiple Concrete Duct	Conflict with retaining wall No. 27.	20+40	22+00	115' Rt	80' Rt	QLC		Design change.	3/8/2010	Utility owner informed of utility conflict	Detail
AT&T	15	U-2	Telephone	Multiple Concrete Duct	Conflict with retaining wall No. 27.	22+30	23+00	80' Rt	80' Rt	QLC		Design change.	3/8/2010	Utility owner informed of utility conflict	Detail
AT&T	16	U-2	Telephone	Multiple Concrete Duct	Conflict with retaining wall No. 27.	25+85	28+00	55' Rt	80' Rt	QLB		Design change.	3/8/2010	Utility owner informed of utility conflict	Detail
AT&T	17	U-2	Telephone	Multiple Concrete Duct	Conflict with retaining wall No. 27.	28+05	30+00	62' Rt	80' Rt	QLB		Design change.	3/8/2010	Utility owner informed of utility conflict	Detail
AT&T	18	U-2	Telephone	Multiple Concrete Duct	Conflict with retaining wall No. 27.	33+15	35+00	65' Rt	80' Rt	QLB		Design change.	3/8/2010	Utility owner informed of utility conflict	Detail
AT&T	19	U-2	Manhole	Steel	Conflict with retaining wall No. 27.	445+55	446+00	48' Rt	48' Rt	QLA	1	Relocation before construction.	7/2/2010	Utility conflict identified	Detail
Centerpoint Energy	20	U-3	Electricity Distribution	Steel	Conflict with retaining wall No. 27.	445+55	446+00	48' Rt	48' Rt	QLA	2	Relocation before construction.	7/2/2010	Utility conflict identified	Detail
Centerpoint Energy	21	U-3	Electricity Distribution	Steel	Conflict with construction of storm sewer.	445+50	446+00	48' Rt	48' Rt	QLA	3	Relocation before construction.	7/2/2010	Utility conflict identified	Detail
Centerpoint Energy	22	U-3	Electricity Distribution	Steel	Conflict with construction of storm sewer.	445+60	447+00	55' Rt	48' Rt	QLA	4	Relocation before construction.	7/2/2010	Utility conflict identified	Detail
Centerpoint Energy	23	U-3	Electricity Distribution	Steel	Conflict with construction of storm sewer.	445+80	448+00	55' Rt	48' Rt	QLA	5	Relocation before construction.	7/2/2010	Utility conflict identified	Detail
Centerpoint Energy	24	U-3	Electricity Distribution	Steel	Conflict with construction of storm sewer.	445+80	448+00	55' Rt	48' Rt	QLA	6	Relocation before construction.	7/2/2010	Utility conflict identified	Detail
Centerpoint Energy	25	U-3	Electricity Distribution	Steel	Conflict with construction of storm sewer.	445+80	448+00	55' Rt	48' Rt	QLA	7	Relocation before construction.	7/2/2010	Utility conflict identified	Detail
Centerpoint Energy	26	U-3	Electricity Distribution	Steel	Conflict with construction of storm sewer.	445+90	448+00	55' Rt	48' Rt	QLA	8	Design change.	7/2/2010	Utility conflict identified	Detail

Figure D.12. Prototype UCM report.

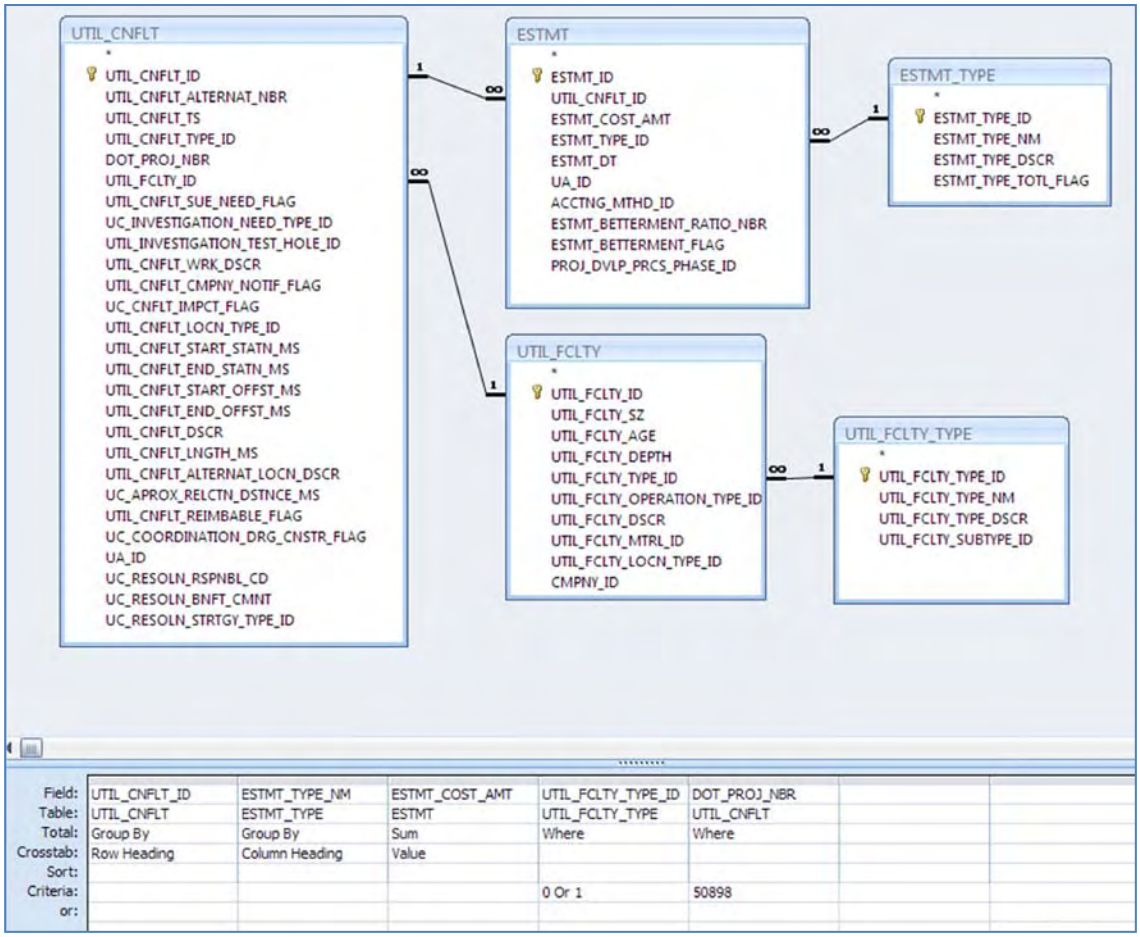


Figure D.13. Design view of "Alaska 1 distribution crosstab" query.

Step 6: Create "Alaska 3 Transmission Cost" Query

This query is similar to the previous query except that it uses the queries from Steps 2 and 4 in connection with electric transmission utility conflicts. The SQL statement is as follows:

```
SELECT UTIL_CNFLT.UTIL_CNFLT_ID, [Alaska 1 Transmission Crosstab].
    [Adjustment Cost Estimate], [Alaska 1 Transmission Crosstab].[Engineering
    Cost Estimate], [Alaska 2 Total Transmission].[Total Cost]
FROM ((UTIL_CNFLT INNER JOIN [Alaska 2 Total Transmission] ON UTIL_
    CNFLT.UTIL_CNFLT_ID = [Alaska 2 Total Transmission].UTIL_CNFLT_ID)
    INNER JOIN [Alaska 1 Transmission Crosstab] ON UTIL_CNFLT.UTIL_
    CNFLT_ID = [Alaska 1 Transmission Crosstab].UTIL_CNFLT_ID) INNER JOIN
    UTIL_CNFLT_EVNT ON UTIL_CNFLT.UTIL_CNFLT_ID = UTIL_CNFLT_EVNT.
    UTIL_CNFLT_ID
WHERE (((UTIL_CNFLT_EVNT.UTIL_CNFLT_EVNT_TYPE_ID)=28))
GROUP BY UTIL_CNFLT.UTIL_CNFLT_ID, [Alaska 1 Transmission Crosstab].
    [Adjustment Cost Estimate], [Alaska 1 Transmission Crosstab].[Engineering
    Cost Estimate], [Alaska 2 Total Transmission].[Total Cost];
```

Step 7: Create "Alaska 4 Distribution Subtotal" Query

This query uses the query from Step 5 to calculate subtotals of adjustment and engineering cost estimates, as well as the total cost of electric distribution utility conflicts (Figure D.16).

The SQL statement is as follows:

```
SELECT Sum([Alaska 3 Distribution Cost].[Adjustment Cost Estimate]) AS
    [SumOfAdjustment Cost Estimate], Sum([Alaska 3 Distribution Cost].
    [Engineering Cost Estimate]) AS [SumOfEngineering Cost Estimate],
    Sum([Alaska 3 Distribution Cost].[Total Cost]) AS [SumOfTotal Cost]
FROM [Alaska 3 Distribution Cost];
```

Step 8: Create "Alaska 4 Transmission Subtotal" Query

This query is similar to the previous query, except that it uses the query from Step 6 in connection with transmission utility conflicts. The SQL statement is as follows:

```
SELECT Sum([Alaska 3 Transmission Cost].[Adjustment Cost Estimate]) AS
    [SumOfAdjustment Cost Estimate], Sum([Alaska 3 Transmission Cost].
    [Engineering Cost Estimate]) AS [SumOfEngineering Cost Estimate],
    Sum([Alaska 3 Transmission Cost].[Total Cost]) AS [SumOfTotal Cost]
FROM [Alaska 3 Transmission Cost];
```

Step 9: Create "Alaska 5 AC Total" Query

This query uses the queries from Steps 7 and 8 to retrieve totals of adjustment costs for both distribution and transmission utility conflicts. The total adjustment cost is calculated by

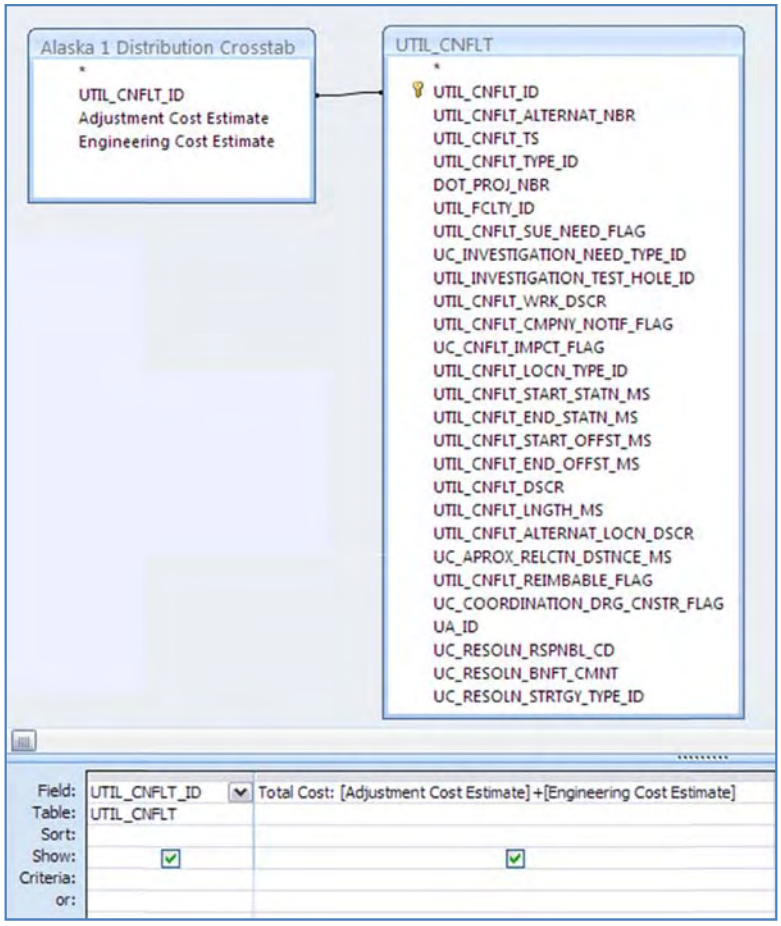


Figure D.14. Design view of "Alaska 2 total distribution" query.

adding total distribution adjustment cost and total transmission adjustment cost (Figure D.17).

The SQL statement is as follows:

```
SELECT [Alaska 4 Distribution Subtotal].[SumOfAdjustment Cost Estimate] AS
    [Distribution Adjustment Cost], [Alaska 4 Transmission Subtotal].[SumOf
    Adjustment Cost Estimate] AS [Transmission Adjustment Cost], [Alaska 4
    Distribution Subtotal.SumOfAdjustment Cost Estimate]+[Alaska 4 Transmission
    Subtotal.SumOfAdjustment Cost Estimate] AS [Total Adjustment Cost]
FROM [Alaska 4 Transmission Subtotal], [Alaska 4 Distribution Subtotal];
```

Step 10: Create "Alaska 5 EC Total" Query

This query uses the queries from Steps 7 and 8 and produces totals of engineering costs for both distribution and transmission utility conflicts. The total engineering cost is calculated by adding the distribution engineering cost total to the transmission engineering cost total (Figure D.18).

The SQL statement is as follows:

```
SELECT [Alaska 4 Distribution Subtotal].[SumOfEngineering Cost Estimate] AS
    [Distribution Engineering], [Alaska 4 Distribution Subtotal.SumOfEngineering
    Cost Estimate]+[Alaska 4 Transmission Subtotal.SumOfEngineering Cost
    Estimate] AS [Total Engineering Cost]
FROM [Alaska 4 Transmission Subtotal], [Alaska 4 Distribution Subtotal];
```

Step 11: Create "Alaska 6 Grand Total" Query

This query uses the queries from Steps 9 and 10 to produce the grand total utility cost, which is the total adjustment cost plus the total engineering cost (Figure D.19).

The SQL statement is as follows:

```
SELECT [Alaska 5 AC Total].[Total Adjustment Cost], [Alaska 5 EC Total].[Total
    Engineering Cost], [Total Adjustment Cost]+[Total Engineering Cost] AS
    [Grand Total]
FROM [Alaska 5 AC Total], [Alaska 5 EC Total];
```

Step 12: Create "Alaska 7 UCM Distribution" Query

This query uses the query from Step 5 and numerous other tables of the data model to produce a tabulation of electric distribution utility conflict data (Figure D.20).

The SQL statement is as follows:

```
SELECT UTIL_CNFLT.UTIL_CNFLT_START_STATN_MS, UTIL_CNFLT.UTIL_
    CNFLT_START_OFFST_MS, UTIL_CNFLT.UTIL_CNFLT_END_STATN_MS,
    UTIL_CNFLT.UTIL_CNFLT_END_OFFST_MS, UTIL_FCLTY_SUBTYPE.UTIL_
    FCLTY_SUBTYPE_NM, UTIL_FCLTY_LOCN_TYPE.UFL_TYPE_ACRNM_TXT,
    UTIL_CNFLT.UTIL_CNFLT_LNGTH_MS, UTIL_CNFLT_TYPE.UTIL_CNFLT_
```

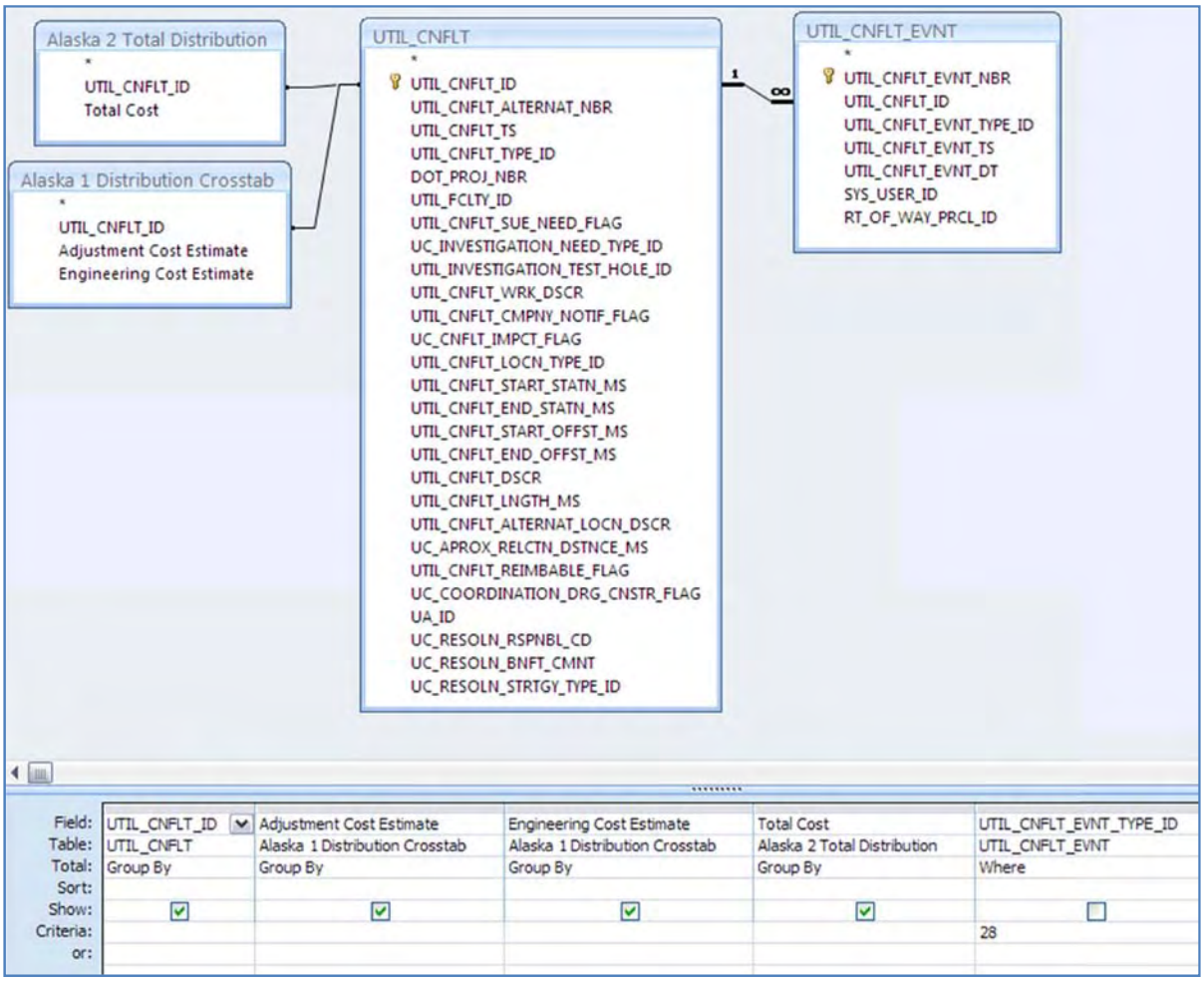


Figure D.15. Design view of "Alaska 3 distribution cost" query.

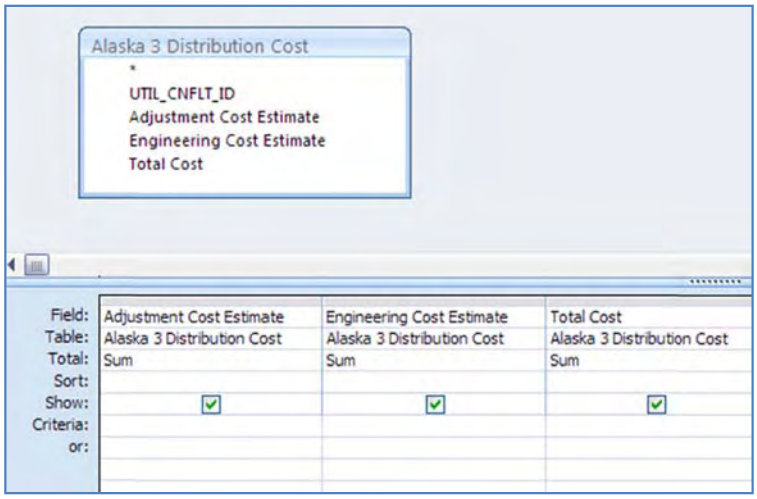


Figure D.16. Design view of "Alaska 4 distribution subtotal" query.

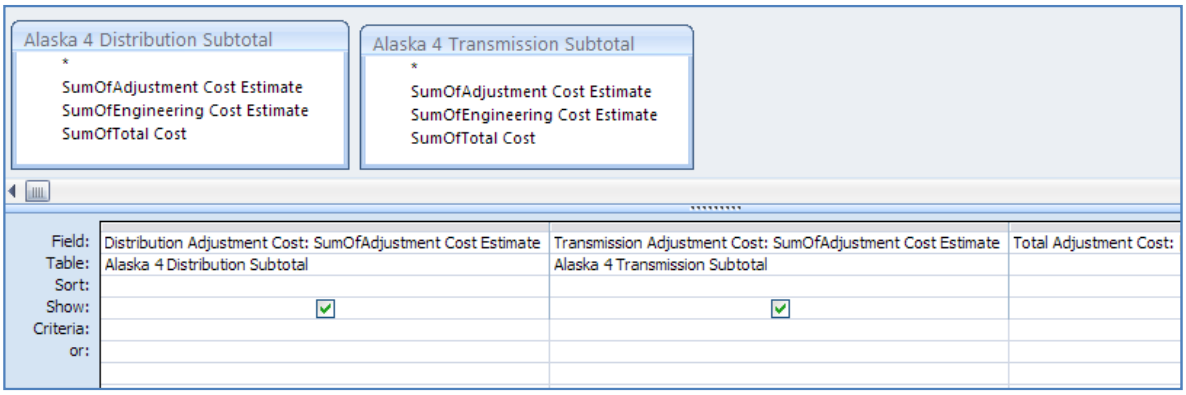


Figure D.17. Design view of "Alaska 5 AC total" query.

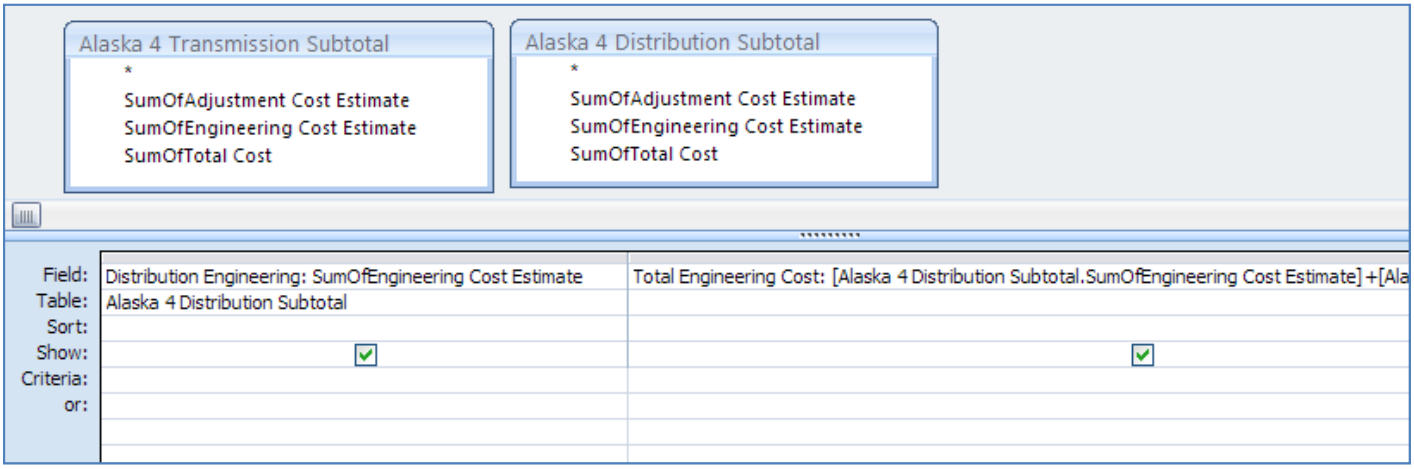


Figure D.18. Design view of "Alaska 5 EC total" query.

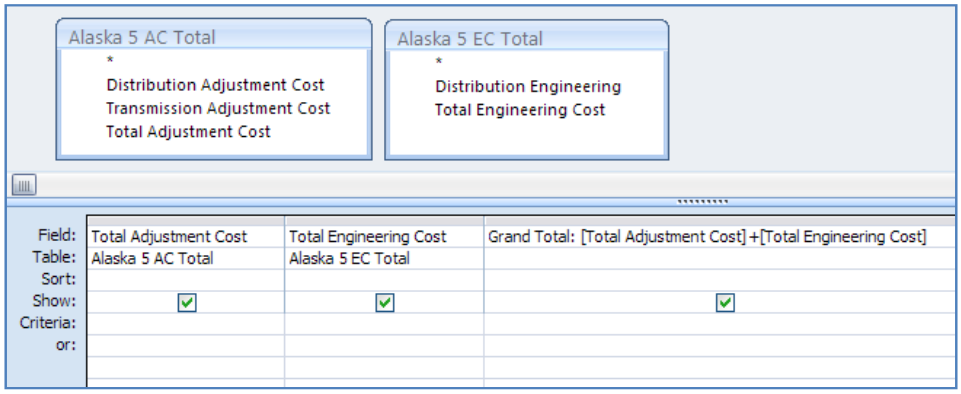


Figure D.19. Design view of "Alaska 6 grand total" query.

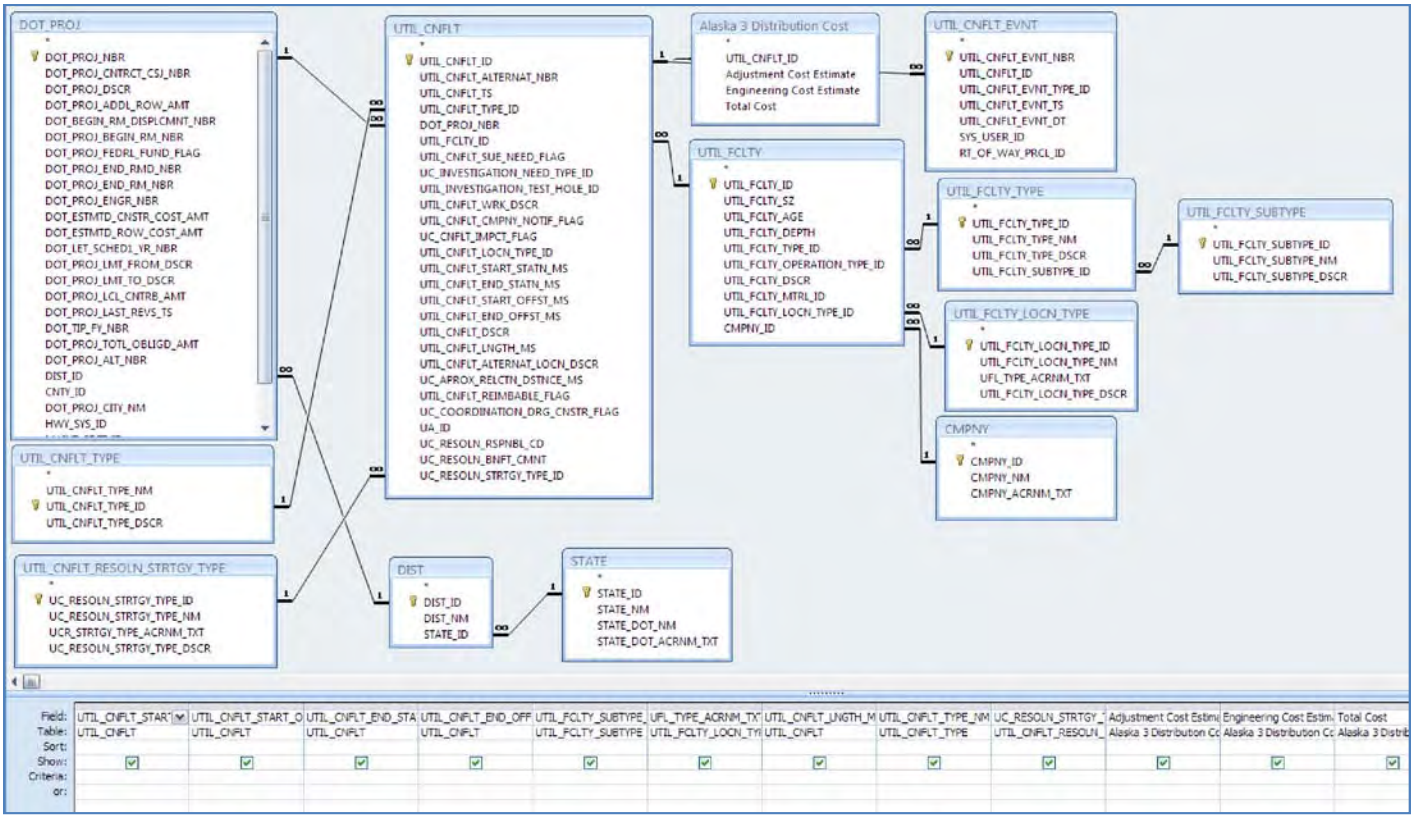


Figure D.20. Design view of "Alaska 7 UCM distribution" query.

```
    TYPE_NM, UTIL_CNFLT_RESOLN_STRTGY_TYPE.UC_RESOLN_STRTGY_
    TYPE_NM, [Alaska 3 Distribution Cost].[Adjustment Cost Estimate], [Alaska
    3 Distribution Cost].[Engineering Cost Estimate], [Alaska 3 Distribution Cost].
    [Total Cost], DOT_PROJ.DOT_PROJ_NBR, DOT_PROJ.DOT_PROJ_CITY_
    NM, STATE.STATE_NM, DOT_PROJ.DOT_PROJ_DSCR, CMPNY.CMPNY_
    ACRNM_TXT
FROM UTIL_FCLTY_SUBTYPE INNER JOIN ((UTIL_CNFLT_RESOLN_STRTGY_
    TYPE INNER JOIN (UTIL_FCLTY_TYPE INNER JOIN (UTIL_FCLTY_LOCN_
    TYPE INNER JOIN ((CMPNY INNER JOIN UTIL_FCLTY ON CMPNY.
    CMPNY_ID = UTIL_FCLTY.CMPNY_ID) INNER JOIN (UTIL_CNFLT_TYPE
    INNER JOIN (((STATE INNER JOIN DIST ON STATE.STATE_ID = DIST.STATE_
    ID) INNER JOIN DOT_PROJ ON DIST.DIST_ID = DOT_PROJ.DIST_ID) INNER
    JOIN (UTIL_CNFLT INNER JOIN [Alaska 3 Distribution Cost] ON UTIL_
    CNFLT.UTIL_CNFLT_ID = [Alaska 3 Distribution Cost].UTIL_CNFLT_ID) ON
    DOT_PROJ.DOT_PROJ_NBR = UTIL_CNFLT.DOT_PROJ_NBR) ON UTIL_
    CNFLT_TYPE.UTIL_CNFLT_TYPE_ID = UTIL_CNFLT.UTIL_CNFLT_TYPE_ID)
    ON UTIL_FCLTY.UTIL_FCLTY_ID = UTIL_CNFLT.UTIL_FCLTY_ID) ON UTIL_
    FCLTY_LOCN_TYPE.UTIL_FCLTY_LOCN_TYPE_ID = UTIL_FCLTY.UTIL_
    FCLTY_LOCN_TYPE_ID) ON UTIL_FCLTY_TYPE.UTIL_FCLTY_TYPE_ID =
    UTIL_FCLTY.UTIL_FCLTY_TYPE_ID) ON UTIL_CNFLT_RESOLN_STRTGY_
    TYPE.UC_RESOLN_STRTGY_TYPE_ID = UTIL_CNFLT.UC_RESOLN_
    STRTGY_TYPE_ID) INNER JOIN UTIL_CNFLT_EVNT ON UTIL_CNFLT.UTIL_
    CNFLT_ID = UTIL_CNFLT_EVNT.UTIL_CNFLT_ID) ON UTIL_FCLTY_SUB-TYP-
    EUTIL_FCLTY_SUBTYPE_ID = UTIL_FCLTY_TYPE.UTIL_FCLTY_SUBTYPE_ID
WHERE (((DOT_PROJ.DOT_PROJ_NBR)=50898) AND ((UTIL_FCLTY.UTIL_
    FCLTY_TYPE_ID)=0 Or (UTIL_FCLTY.UTIL_FCLTY_TYPE_ID)=1) AND ((UTIL_
    CNFLT_EVNT.UTIL_CNFLT_EVNT_TYPE_ID)=28))
ORDER BY UTIL_CNFLT.UTIL_CNFLT_ID;
```

Step 13: Create "Alaska 7 UCM Transmission" Query

This query uses the query from Step 6 and numerous other tables of the data model to produce a tabulation of electric transmission utility conflict data (Figure D.21).

The SQL statement is as follows:

```
SELECT UTIL_CNFLT.UTIL_CNFLT_START_STATN_MS, UTIL_CNFLT.UTIL_
    CNFLT_START_OFFST_MS, UTIL_CNFLT.UTIL_CNFLT_END_STATN_MS,
    UTIL_CNFLT.UTIL_CNFLT_END_OFFST_MS, UTIL_FCLTY_SUBTYPE.UTIL_
    FCLTY_SUBTYPE_NM, UTIL_FCLTY_LOCN_TYPE.UFL_TYPE_ACRNM_TXT,
    UTIL_CNFLT.UTIL_CNFLT_LNGTH_MS, UTIL_CNFLT_TYPE.UTIL_CNFLT_
    TYPE_NM, UTIL_CNFLT_RESOLN_STRTGY_TYPE.UC_RESOLN_STRTGY_
    TYPE_NM, [Alaska 3 Transmission Cost].[Adjustment Cost Estimate], [Alaska
    3 Transmission Cost].[Engineering Cost Estimate], [Alaska 3 Transmission
    Cost].[Total Cost]
FROM UTIL_FCLTY_SUBTYPE INNER JOIN ((UTIL_CNFLT_RESOLN_
    STRTGY_TYPE INNER JOIN (UTIL_FCLTY_TYPE INNER JOIN (UTIL_
    FCLTY_LOCN_TYPE INNER JOIN (UTIL_FCLTY INNER JOIN (UTIL_
    CNFLT_TYPE INNER JOIN (DOT_PROJ INNER JOIN (UTIL_CNFLT INNER
    JOIN [Alaska 3 Transmission Cost] ON UTIL_CNFLT.UTIL_CNFLT_ID =
    [Alaska 3 Transmission Cost].UTIL_CNFLT_ID) ON DOT_PROJ.DOT_
    PROJ_NBR = UTIL_CNFLT.DOT_PROJ_NBR) ON UTIL_CNFLT_TYPE.
    UTIL_CNFLT_TYPE_ID = UTIL_CNFLT.UTIL_CNFLT_TYPE_ID) ON UTIL_
    FCLTY.UTIL_FCLTY_ID = UTIL_CNFLT.UTIL_FCLTY_ID) ON UTIL_FCLTY_
    LOCN_TYPE.UTIL_FCLTY_LOCN_TYPE_ID = UTIL_FCLTY.UTIL_FCLTY_
    LOCN_TYPE_ID) ON UTIL_FCLTY_TYPE.UTIL_FCLTY_TYPE_ID = UTIL_
    FCLTY.UTIL_FCLTY_TYPE_ID) ON UTIL_CNFLT_RESOLN_STRTGY_TYPE.
    UC_RESOLN_STRTGY_TYPE_ID = UTIL_CNFLT.UC_RESOLN_STRTGY_
    TYPE_ID) INNER JOIN UTIL_CNFLT_EVNT ON UTIL_CNFLT.UTIL_CNFLT_ID
    = UTIL_CNFLT_EVNT.UTIL_CNFLT_ID) ON UTIL_FCLTY_SUBTYPE.UTIL_
    FCLTY_SUBTYPE_ID = UTIL_FCLTY_TYPE.UTIL_FCLTY_SUBTYPE_ID
WHERE (((DOT_PROJ.DOT_PROJ_NBR)=50898) AND ((UTIL_FCLTY.UTIL_FCLTY_
    TYPE_ID)=2) AND ((UTIL_CNFLT_EVNT.UTIL_CNFLT_EVNT_TYPE_ID)=28))
ORDER BY UTIL_CNFLT.UTIL_CNFLT_ID;
```

Step 14: Create "Alaska Subreport Transmission" Report

This report provides a list of utility conflicts along with costs for adjustment, engineering, and total costs per transmission

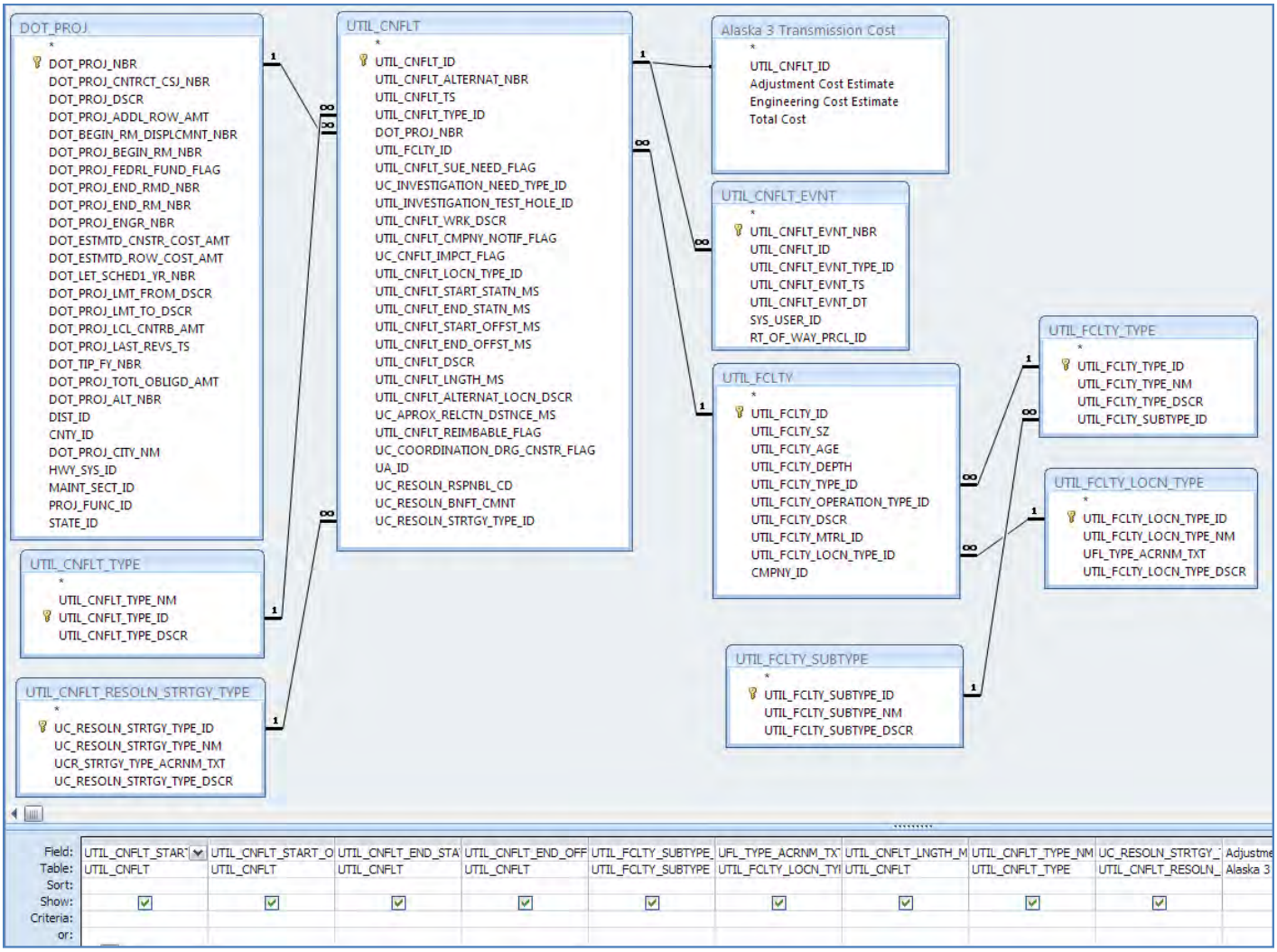


Figure D.21. Design view of "Alaska 7 UCM transmission" query.

utility conflict and totals for all utility conflicts. This report is based on the query developed in Step 13.

Step 15: Create "Alaska Subreport Grand Total" Report

This report provides a total adjustment cost, total engineering cost, and the grand total of both distribution and transmission costs based on the query from Step 11.

Step 16: Create "Alaska UCM" Report

This report uses the data from the query in Step 12 and incorporates the subreports from Steps 14 and 15 into one report (Figure D.22). The report includes other data items from the database, such as project number and description. It also formats certain data items—for example, a station stored as 3640 in the database becomes 36+40 in the report.

California Department of Transportation UCM Example

The sample UCM provided by Caltrans (shown in Appendix B, Figure B.4) includes 24 data items (four data items in the header and 20 data items in the main body) and is an example of a detailed UCM with a large number of data items. This UCM was also interesting because it included data items that were included in the prototype UCM, including utility sheet number, utility conflict investigation type, utility relocation strategy type, and utility relocation responsible party. Replicating the sample UCM involved developing seven queries and one report.

Step 1: Create "CA 1 Date Last Revised" Query

This query selects the latest time stamp of a utility conflict event that is associated with a specific project (Figure D.23).

Alaska UCM

DRAFT Utility Conflict Report — Anchorage, Alaska

West Dowling Road Phase 1 — DOT&PF No. 50898

Start Station	Start Offset	End Station	End Offset	Size	Type	Length	Conflict	ADJ/REL	Cost	PE/CE Cost	Total Cost
CEA Distribution Relocation Costs											
9+00	150' RT		200' LT	3 phi	UG	350	FG	Relocation before construction	$52,500	$15,750	$68,250
16+00	100' LT	42+30	80' LT	3 phi	UG	2,630	FG	Relocation before construction	$394,500	$118,350	$512,850
16+00	100' LT	15+50	100' RT	3 phi	UG	250	FG	Relocation before construction	$37,500	$11,250	$48,750
16+00	100' LT	29+00	75' LT	1 phi	UG	1,650	FG	Relocation before construction	$165,000	$49,500	$214,500
36+40	80' LT	35+80	350' RT	3 phi	UG	430	FG	Relocation before construction	$64,500	$19,350	$83,850
36+60	80' LT	36+70	380' LT	3 phi	UG	300	FG	Relocation before construction	$45,000	$13,500	$58,500
	UG Loop to the North			3 phi	UG	1,000	FG	Relocation before construction	$150,000	$45,000	$195,000
								Subtotal:	$909,000	$272,700	$1,181,700
CEA Transmission Relocation Costs											
14+75	55' RT			138 kV	OH	1	PWY	Relocation before construction	$30,000	$9,000	$39,000
32+75	55' RT			138 kV	OH	1	EX	Relocation before construction	$50,000	$15,000	$65,000
36+38	45' RT			138 kV	OH	1	EX	Relocation before construction	$50,000	$15,000	$65,000
								Subtotal:	$130,000	$39,000	$169,000
								Total Relocation Costs:	**$1,039,000**	**$311,700**	**$1,350,700**

Figure D.22. "Alaska UCM" report.

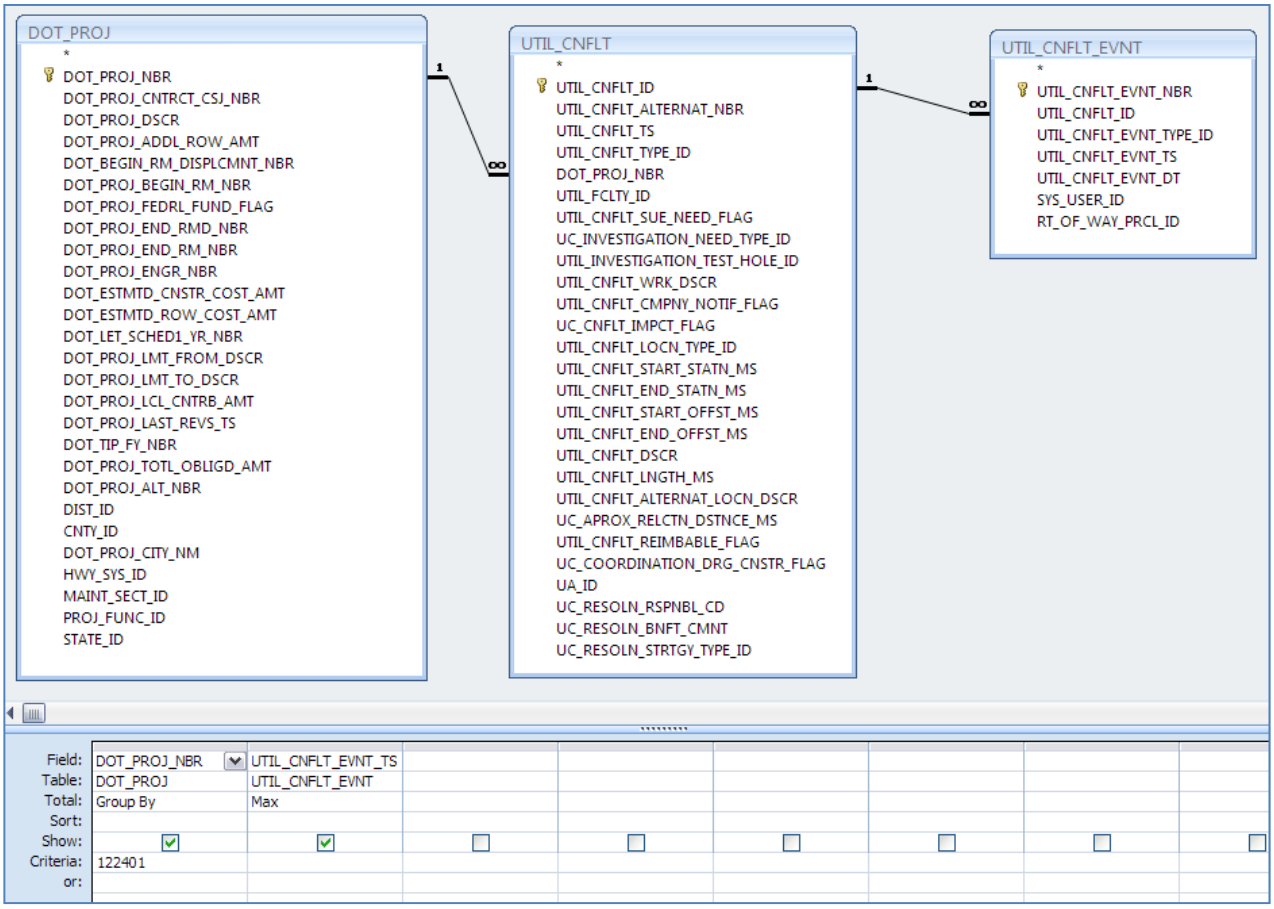


Figure D.23. Design view of "CA 1 date last revised" query.

The SQL statement is as follows:

```
SELECT DOT_PROJ.DOT_PROJ_NBR, Max(UTIL_CNFLT_EVNT.UTIL_CNFLT_
    EVNT_TS) AS MaxOfUTIL_CNFLT_EVNT_TS
FROM (DOT_PROJ INNER JOIN UTIL_CNFLT ON DOT_PROJ.DOT_PROJ_NBR
    = UTIL_CNFLT.DOT_PROJ_NBR) INNER JOIN UTIL_CNFLT_EVNT ON UTIL_
    CNFLT.UTIL_CNFLT_ID = UTIL_CNFLT_EVNT.UTIL_CNFLT_ID
GROUP BY DOT_PROJ.DOT_PROJ_NBR
HAVING (((DOT_PROJ.DOT_PROJ_NBR)=122401));
```

Step 2: Create "CA 1 Plan Document Sheet Number" Query

This query retrieves the sheet number of a plan document in which a utility conflict is mentioned (Figure D.24). The query selects a project number and then lists the sheet numbers by utility conflict.

The SQL statement is as follows:

```
SELECT UTIL_CNFLT.UTIL_CNFLT_ID, UTIL_CNFLT.DOT_PROJ_NBR, PLAN_
    DCMNT.PLAN_DCMNT_SHT_NBR, PLAN_DCMNT.SHT_GRP_ID
FROM UTIL_CNFLT INNER JOIN (UTIL_CNFLT_EVNT INNER JOIN ((DCMNT
    INNER JOIN PLAN_DCMNT ON DCMNT.DCMNT_ID = PLAN_DCMNT.
    DCMNT_ID) INNER JOIN UTIL_CNFLT_EVNT_DCMNT ON DCMNT.DCMNT_
    ID = UTIL_CNFLT_EVNT_DCMNT.DCMNT_ID) ON UTIL_CNFLT_EVNT.UTIL_
    CNFLT_EVNT_NBR = UTIL_CNFLT_EVNT_DCMNT.UTIL_CNFLT_EVNT_NBR)
    ON UTIL_CNFLT.UTIL_CNFLT_ID = UTIL_CNFLT_EVNT.UTIL_CNFLT_ID
WHERE (((UTIL_CNFLT.DOT_PROJ_NBR)=122401));
```

Step 3: Create "CA 1 Required Completion Date" Query

This query produces the date by which a utility conflict is required to be completed in order for a project to proceed to the construction phase without delays (Figure D.25). For a specific project, the query selects utility conflicts with an associated utility conflict event of "required adjustment completion" (utility conflict event type = 15).

The SQL statement is as follows:

```
SELECT UTIL_CNFLT.DOT_PROJ_NBR, UTIL_CNFLT_EVNT.UTIL_CNFLT_ID,
    UTIL_CNFLT_EVNT.UTIL_CNFLT_EVNT_TYPE_ID, UTIL_CNFLT_EVNT.UTIL_
    CNFLT_EVNT_DT
FROM UTIL_CNFLT INNER JOIN UTIL_CNFLT_EVNT ON UTIL_CNFLT.UTIL_
    CNFLT_ID = UTIL_CNFLT_EVNT.UTIL_CNFLT_ID
WHERE (((UTIL_CNFLT.DOT_PROJ_NBR)=122401) AND ((UTIL_CNFLT_EVNT.
    UTIL_CNFLT_EVNT_TYPE_ID)=15));
```

Step 4: Create "CA 1 UC Comment" Query

For a specific project, this query provides a list of utility conflicts that have an associated comment (Figure D.26).

The SQL statement is as follows:

```
SELECT DOT_PROJ.DOT_PROJ_NBR, UTIL_CNFLT.UTIL_CNFLT_ID, CMNT.
    CMNT_BODY_TXT
```

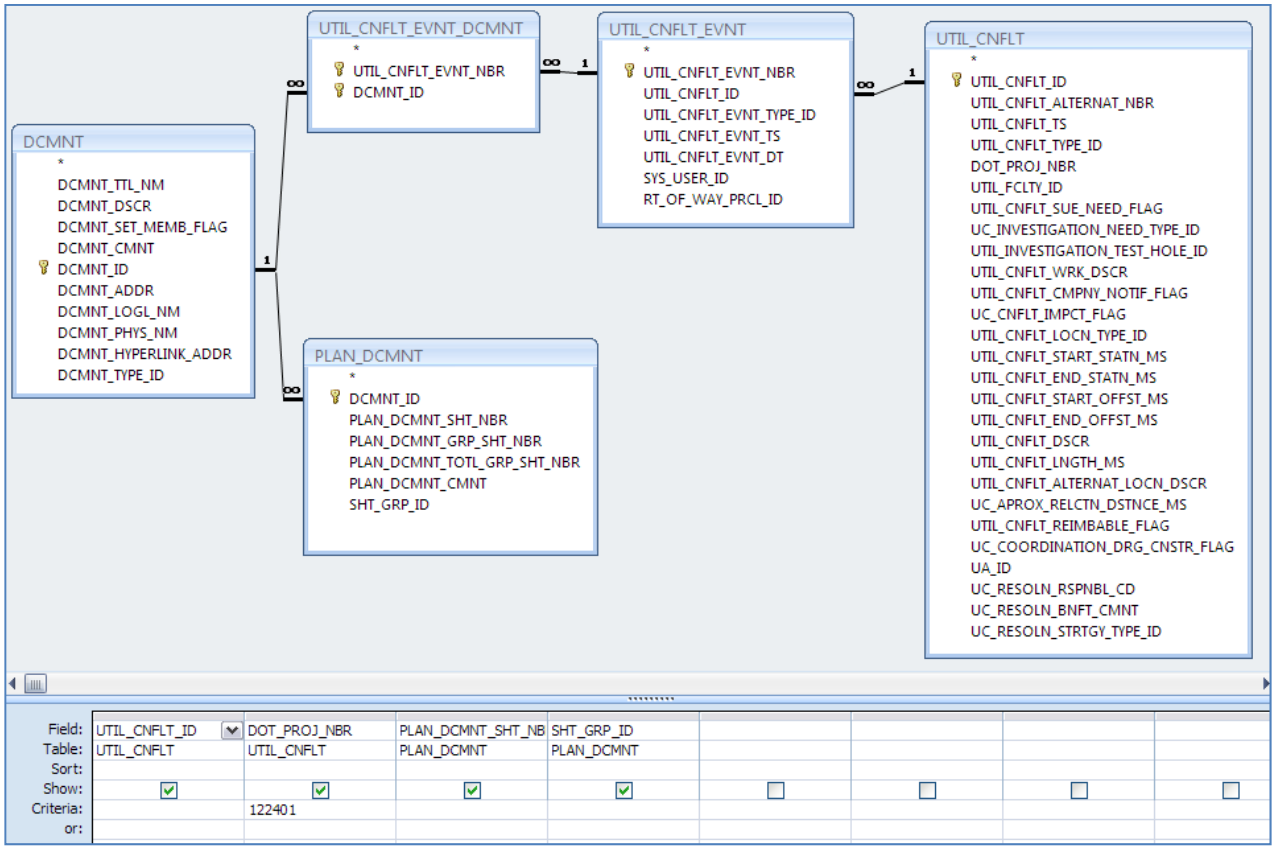


Figure D.24. Design view of "CA 1 plan document sheet number" query.

```
FROM (DOT_PROJ INNER JOIN UTIL_CNFLT ON DOT_PROJ.DOT_PROJ_NBR
    = UTIL_CNFLT.DOT_PROJ_NBR) INNER JOIN (UTIL_CNFLT_EVNT INNER
    JOIN CMNT ON UTIL_CNFLT_EVNT.UTIL_CNFLT_EVNT_NBR = CMNT.
    UTIL_CNFLT_EVNT_NBR) ON UTIL_CNFLT.UTIL_CNFLT_ID = UTIL_CNFLT_
    EVNT.UTIL_CNFLT_ID
WHERE (((DOT_PROJ.DOT_PROJ_NBR)=122401));
```

Step 5: Create "CA 2 Required Completion Date Outer Join" Query

This query produces a list of utility conflicts with required completion dates for a specific project, including those utility conflicts that do not have a required completion date. The query creates an outer join of the utility conflict ID between the utility conflict table and the query from Step 3, with the following conditions: include all records from the utility conflict table and include only those records from the Step 3 query in which the joined fields are equal (Figure D.27).

The SQL statement is as follows:

```
SELECT UTIL_CNFLT.DOT_PROJ_NBR, UTIL_CNFLT.UTIL_CNFLT_ID, [CA 1
    Required Completion Date].UTIL_CNFLT_EVNT_DT
FROM UTIL_CNFLT LEFT JOIN [CA 1 Required Completion Date] ON UTIL_
    CNFLT.UTIL_CNFLT_ID = [CA 1 Required Completion Date].UTIL_
    CNFLT_ID
WHERE (((UTIL_CNFLT.DOT_PROJ_NBR)=122401));
```

Step 6: Create "CA 2 Utility Conflict Comment Outer Join" Query

This query produces a list of utility conflicts with comments for a specific project, including those utility conflicts that do not have a comment. The query creates an outer join of the utility conflict ID between the utility conflict table and the query from Step 4, with the following conditions: include all records from the utility conflict table and include only those records from the Step 4 query in which the joined fields are equal (Figure D.28).

The SQL statement is as follows:

```
SELECT UTIL_CNFLT.DOT_PROJ_NBR, UTIL_CNFLT.UTIL_CNFLT_ID, [CA 1 UC
    comment].CMNT_BODY_TXT
FROM [CA 1 UC comment] RIGHT JOIN UTIL_CNFLT ON [CA 1 UC comment].
    UTIL_CNFLT_ID = UTIL_CNFLT.UTIL_CNFLT_ID
WHERE (((UTIL_CNFLT.DOT_PROJ_NBR)=122401));
```

Step 7: Create "CA 3 UCM" Query

This query uses the queries from Steps 1, 5, and 6 to retrieve utility conflict data that provide the basis for the Caltrans UCM report (Figure D.29). The query parameter is the project number.

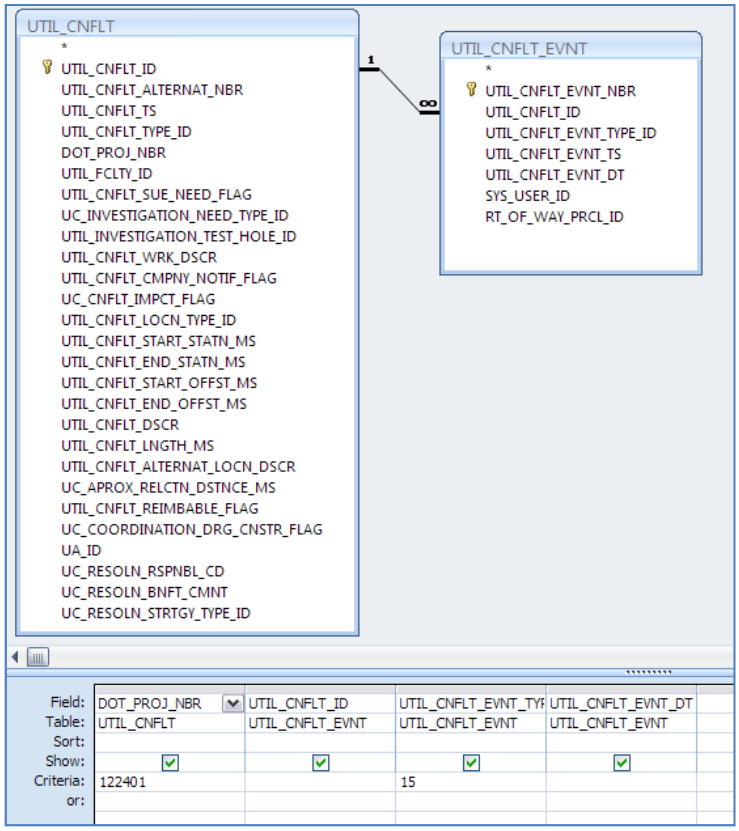


Figure D.25. Design view of "CA 1 required completion date" query.

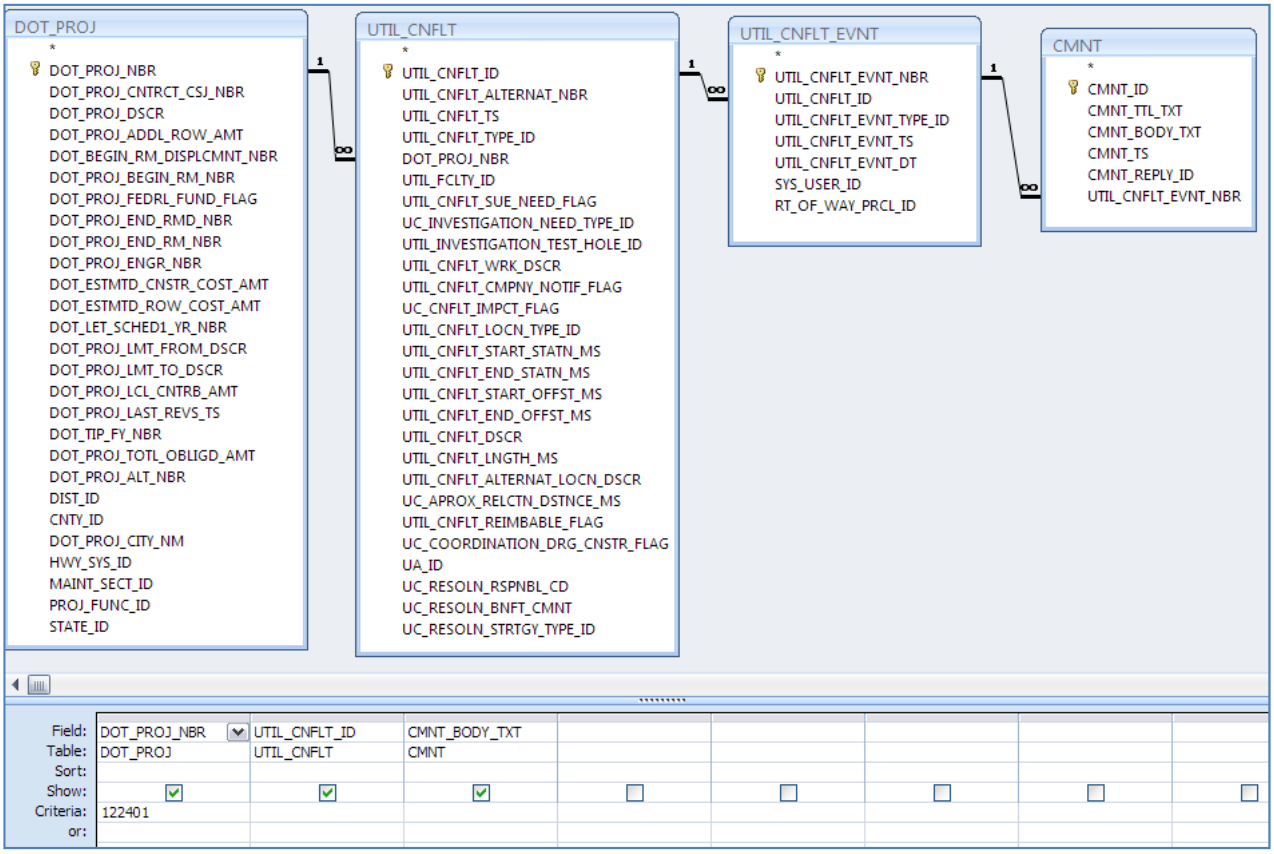


Figure D.26. Design view of "CA 1 UC comment" query.

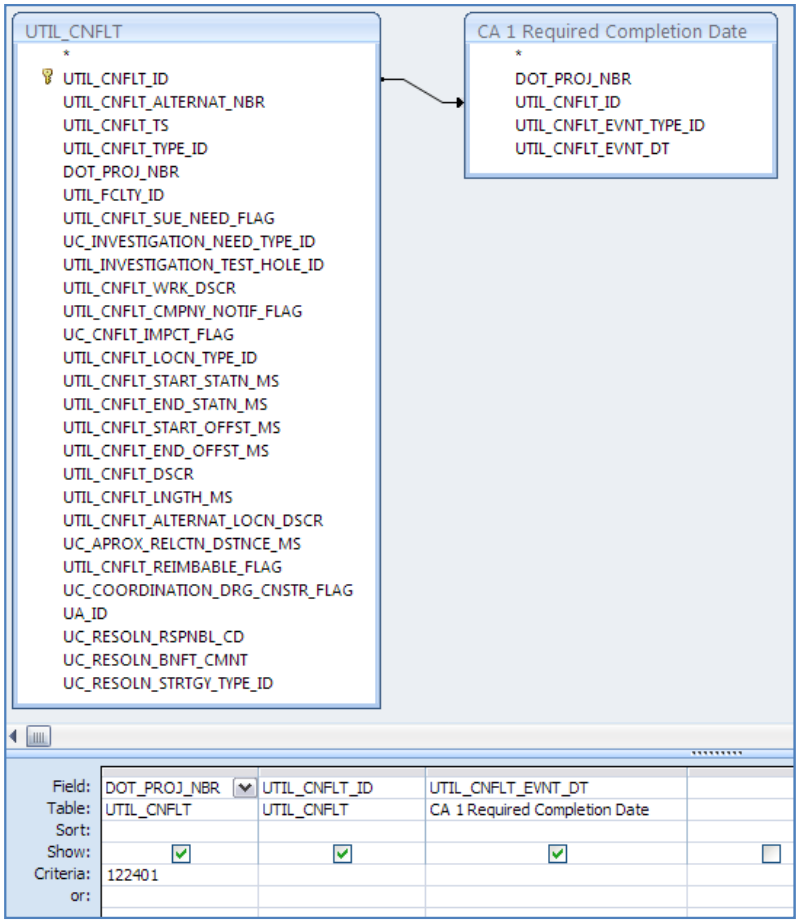


Figure D.27. Design view of "CA 2 required completion date outer join" query.

The SQL statement is as follows:

```
SELECT DOT_PROJ.DOT_PROJ_DSCR, UTIL_CNFLT.UTIL_CNFLT_ALTERNAT_
    NBR, UTIL_INVESTIGATION_TEST_HOLE.UTIL_INVESTIGATION_TEST_
    HOLE_NBR, UTIL_INVESTIGATION_TEST_HOLE.UTIL_INVESTIGATION_
    TEST_HOLE_LOCN, CMPNY.CMPNY_ACRNM_TXT, UTIL_FCLTY.UTIL_
    FCLTY_SZ, UTIL_FCLTY_SUBTYPE.UTIL_FCLTY_SUBTYPE_NM, UTIL_
    FCLTY_TYPE.UTIL_FCLTY_TYPE_NM, UTIL_FCLTY.UTIL_FCLTY_DSCR,
    UTIL_CNFLT.UTIL_CNFLT_START_STATN_MS, UTIL_CNFLT.UTIL_CNFLT_
    END_STATN_MS, UTIL_CNFLT.UTIL_CNFLT_ALTERNAT_LOCN_DSCR,
    UTIL_CNFLT.UTIL_CNFLT_WRK_DSCR, UTIL_CNFLT_INVESTIGATION_
    NEED_TYPE.UC_INVESTIGATION_NEED_TYPE_NM, UTIL_FCLTY.UTIL_
    FCLTY_DEPTH, UTIL_CNFLT.UC_CNFLT_IMPCT_FLAG, UTIL_CNFLT_
    RESOLN_STRTGY_TYPE.UCR_STRTGY_TYPE_ACRNM_TXT, UTIL_CNFLT.
    UC_RESOLN_RSPNBL_CD, DOT_PROJ.DOT_PROJ_NBR, [CA 1 Date Last
    Revised].MaxOfUTIL_CNFLT_EVNT_TS, [CA 1 Plan Document Sheet Number].
    PLAN_DCMNT_SHT_NBR, [CA 2 Required Completion Date Outer Join].
    UTIL_CNFLT_EVNT_DT, [CA 2 Utility Conflict Comment Outer Join].CMNT_
    BODY_TXT
FROM UTIL_FCLTY_SUBTYPE INNER JOIN (UTIL_CNFLT_RESOLN_STRTGY_
    TYPE INNER JOIN (UTIL_FCLTY_TYPE INNER JOIN (UTIL_FCLTY_MTRL
    INNER JOIN (UTIL_INVESTIGATION_TEST_HOLE INNER JOIN ((CMPNY
    INNER JOIN UTIL_FCLTY ON CMPNY.CMPNY_ID = UTIL_FCLTY.CMPNY_
    ID) INNER JOIN (UTIL_CNFLT_INVESTIGATION_NEED_TYPE INNER
    JOIN ((((DOT_PROJ INNER JOIN [CA 1 Date Last Revised] ON DOT_
    PROJ.DOT_PROJ_NBR = [CA 1 Date Last Revised].DOT_PROJ_NBR)
    INNER JOIN ((UTIL_CNFLT INNER JOIN [CA 1 Plan Document Sheet
    Number] ON UTIL_CNFLT.UTIL_CNFLT_ID = [CA 1 Plan Document
    Sheet Number].UTIL_CNFLT_ID) INNER JOIN [CA 2 Required Completion
    Date Outer Join] ON UTIL_CNFLT.UTIL_CNFLT_ID = [CA 2 Required
    Completion Date Outer Join].UTIL_CNFLT_ID) ON (DOT_PROJ.DOT_
    PROJ_NBR = UTIL_CNFLT.DOT_PROJ_NBR) AND (DOT_PROJ.DOT_
    PROJ_NBR = [CA 2 Required Completion Date Outer Join].DOT_PROJ_
    NBR)) INNER JOIN [CA 2 Utility Conflict Comment Outer Join] ON
    (DOT_PROJ.DOT_PROJ_NBR = [CA 2 Utility Conflict Comment Outer
    Join].DOT_PROJ_NBR) AND (UTIL_CNFLT.UTIL_CNFLT_ID = [CA 2
    Utility Conflict Comment Outer Join].UTIL_CNFLT_ID)) INNER JOIN
    PROJ_DCMNT ON DOT_PROJ.DOT_PROJ_NBR = PROJ_DCMNT.
    DOT_PROJ_NBR) ON UTIL_CNFLT_INVESTIGATION_NEED_TYPE.UC_
    INVESTIGATION_NEED_TYPE_ID = UTIL_CNFLT.UC_INVESTIGATION_
    NEED_TYPE_ID) ON UTIL_FCLTY.UTIL_FCLTY_ID = UTIL_CNFLT.
    UTIL_FCLTY_ID) ON UTIL_INVESTIGATION_TEST_HOLE.UTIL_
    INVESTIGATION_TEST_HOLE_ID = UTIL_CNFLT.UTIL_INVESTIGATION_
    TEST_HOLE_ID) ON UTIL_FCLTY_MTRL.UTIL_FCLTY_MTRL_ID = UTIL_
    FCLTY.UTIL_FCLTY_MTRL_ID) ON UTIL_FCLTY_TYPE.UTIL_FCLTY_
    TYPE_ID = UTIL_FCLTY.UTIL_FCLTY_TYPE_ID) ON UTIL_CNFLT_
    RESOLN_STRTGY_TYPE.UC_RESOLN_STRTGY_TYPE_ID = UTIL_
    CNFLT.UC_RESOLN_STRTGY_TYPE_ID) ON UTIL_FCLTY_SUBTYPE.
    UTIL_FCLTY_SUBTYPE_ID = UTIL_FCLTY_TYPE.UTIL_FCLTY_
    SUBTYPE_ID
WHERE (((DOT_PROJ.DOT_PROJ_NBR)=122401));
```

Step 8: Create "California UCM" Report

This report, which is shown in Figure D.30, uses data from the query in Step 7. All data items provided in the report are selected from database entries. The only exception is the name of the document preparer, which could be inserted dynamically through a dialog box when the document is prepared. The

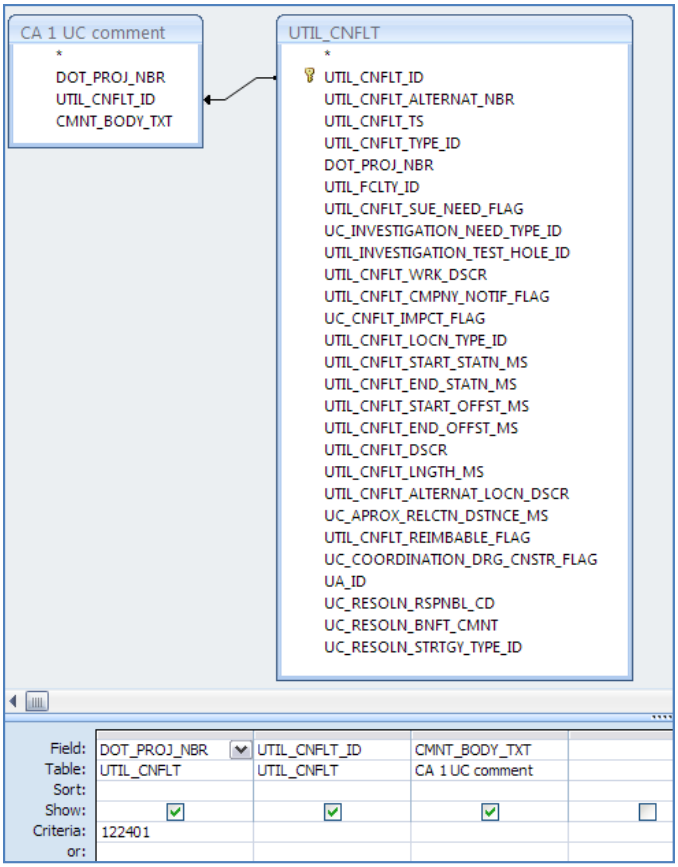


Figure D.28. Design view of "CA 2 utility conflict comment outer join" query.

report also formats certain data items—for example, a station stored as 16555 in the database becomes 165+55 in the report.

Georgia Department of Transportation UCM Example

The sample UCM provided by GDOT is included in Appendix B (Figure B.11). This UCM, which includes 10 data items (two data items in the header and eight data items in the main body), is an example of a UCM with a small number of data items. This UCM was of particular interest because it has been used extensively in the past and is the product of several iterations of improvements resulting from experience with previous versions. A unique challenge in the development of the UCM report from a data management perspective was the combination of the utility owner acronym with the facility type in certain cases. Replicating this sample UCM involved developing five queries and one report.

Step 1: Create "GDOT 1 Station" Query

This query selects all conflicts for a project ID and formats the value stored in the utility conflict start station measurement field using typical stationing format. The query then combines the value stored in the utility conflict start station measurement field with the value stored in the utility conflict start offset measurement field and stores the combined value in a temporary field called Sta (Figure D.31).

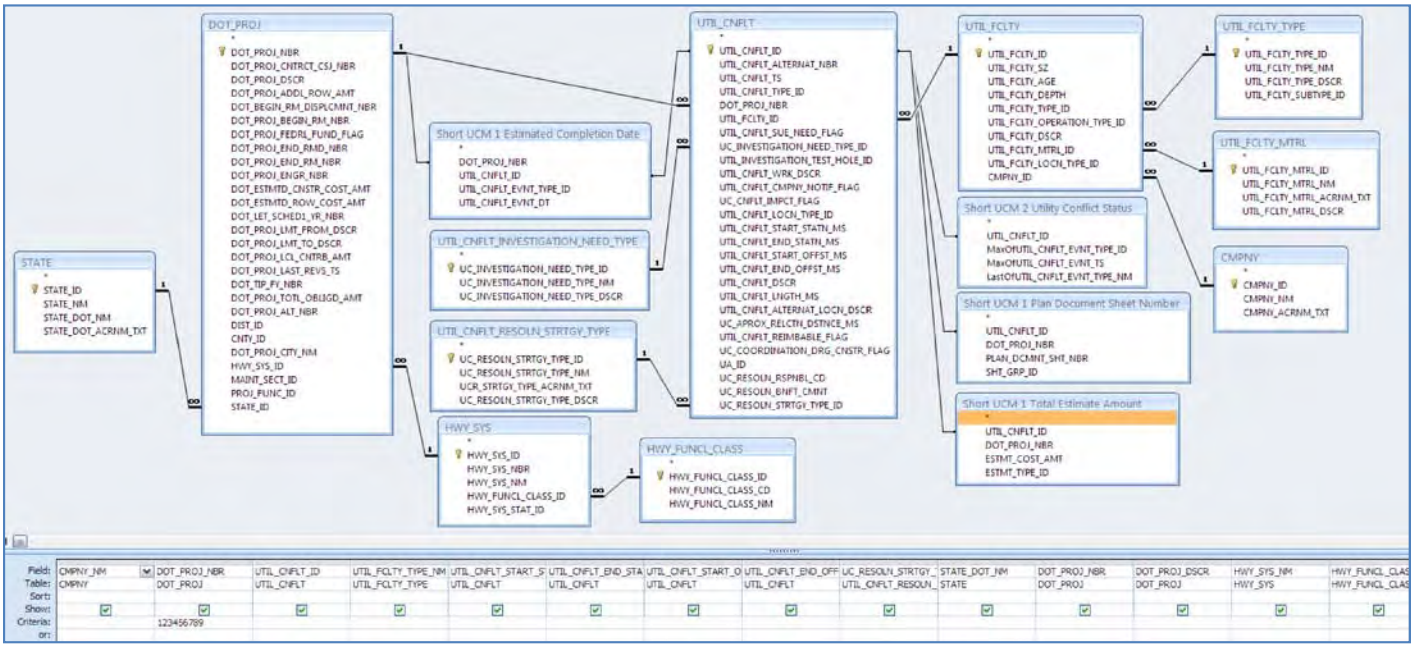


Figure D.29. Design view of "CA 3 UCM" query.

I-10-EA 122401 - Utilities Conflict Status

Date of last revision: 12/4/2009

This document was prepared by: _____

Conflict No.	Utility Sheet No.	Test Hole No.	Owner	Utility Description			Test Hole/ Manhole Location	Start Station	End Station	Offset	Utility Conflict/ Work Description	Utility Conflict Investigation	Depth (ft)	Impact?	Utility Relocation	Resp. Party	Required Completion Date	Comments
1	U-2	1	PACBELL	40 mm	DU	Telephone	62 m Rt of I-405 Sta 165+55	165+55		40 m Rt and 57 m Rt of I-405	Conflict with retaining walls No. 166 and No. 168	QLA	4.55	N	P	U	1/10/2010	
2	U-2	2	PACBELL	40 mm	DU	Telephone	48 m Lt of I-405 Sta 165+55	165+55		40 m Rt and 57 m Rt of I-405	Conflict with retaining walls No. 166 and No. 168		14.40	N	P	U	1/10/2010	
3	U-3	3	SCE	25 mm	DU	Telephone	35 m Rt of I-405 Sta 165+01	165+01		43 m Rt of I-405	Conflict with retaining wall No. 166			N	P	U	1/10/2010	Located in Bristol OC
4	U-3	4	SCE	25 mm	DU	Telephone	46 m Lt of I-405 Sta 165+55	165+01		43 m Rt of I-405	Conflict with retaining wall No. 166			N	P	U		Located in Bristol OC
5	U-3	5	MWD	900 mm		Water	50 m Rt of I-405 Sta 165+96	164+95		44 m Rt of I-405	Conflict with retaining wall No. 166	QLA	6.70	N	P	U		
6	U-3	6	MWD	900 mm		Water	50 m Lt of I-405 Sta 165+96	164+95		44 m Rt of I-405	Conflict with retaining wall No. 166	QLA	6.50	N	P	U		
7	U-3	7	Caltrans	600 mm			53 m Rt of I-405 Sta 163+42	163+29	163+24	53 m Rt of I-405	Conflict with Delhi Channel Bridge	QLA	6.00	N	P	U		
8	U-3	8	Caltrans	600 mm			53 m Rt of I-405 Sta 163+29	163+29	163+42	53 m Rt of I-405	Conflict with Delhi Channel Bridge	QLA	9.00	N	P	U		
9	U-3	9	MCWD	300 mm		Water	in 119 mL, 500 mm STL Casing	32 m Rt of I-405 Sta 163+25	163+25		35 m Rt of I-405	Conflict with I-405 widening and BR1 Line	QLA	10.30	N	P	U	
10	U-3	10	MCWD	300 mm		Water	in 119 mL, 500 mm STL Casing	32 m Lt of I-405 Sta 163+25	163+25		33 m Lt of I-405	Conflict with I-405 widening and BR1 Line	QLA	8.75	N	P	U	
11	U-3	MH 11	CSDOC			Manhole		81 m Rt of I-405 Sta 162+92	162+92		35 m Rt of I-405	Conflict with I-405 widening and BR1 Line	QLB	18.40	N	P	U	
12	U-3	12	CSDOC	380 mm		Sewer		36 m Lt of I-405 Sta 162+91	162+92		32 m Lt of I-405	Conflict with I-405 widening and BR1 Line			N	P	U	
13	U-4	13	MCWD	600 mm		Water	in 94 mL, 900 mm STL Casing	67 m Rt of I-405 Sta 161+44	161+44		58 m Rt of I-405	Conflict with airport channel	QLA	4.55	Y	RB	U	600 mm waterline to be lowered, extend encasement
14	U-4	14	MCWD	600 mm		Water	in 94 mL, 900 mm STL Casing	38 m Lt of I-405 Sta 161+40	161+42		32 m Lt of I-405	Conflict with I-405 widening			N	P	U	
15	U-4	15	MCWD	300 mm		Water		70 m Rt of I-405 Sta 160+29	157+20	160+29	72 m Rt of I-405	Conflict with AOA line and retaining wall No. 268	QLA		Y	RD	U	Encroachment CR R/W and private owner, encased under roadway
16	U-4	16	MCWD	300 mm		Water		70 m Rt of I-405 Sta 159+07	157+20	160+29	72 m Rt of I-405	Conflict with AOA line and retaining wall No. 268	QLA		Y	RD	U	Encroachment CR R/W and private owner, encased under roadway
17	U-5	17	MCWD	300 mm		Water		70 m Rt of I-405 Sta 156+87	157+20	160+29	72 m Rt of I-405	Conflict with AOA line and retaining wall No. 268	QLA	4.35	N	P	U	
18	U-5	MH 18	CSDOC			Manhole		60 m Rt of I-405 Sta 156+65	156+65		28 m Rt of I-405	Conflict with I-405 widening	QLB	16.20	N	P	U	
19	U-5	19	CSDOC	380 mm		Sewer		46 m Lt of I-405 Sta 156+65	156+65		25 m Rt of I-405	Conflict with I-405 widening	QLA	18.40	N	P	U	
20	U-5	20	CSDOC	830 mm		Sewer		14 m Rt of B2 Sta 24+96				Conflict with construction of B2 line			N	P	U	
21	U-5	21	CSDOC	830 mm		Sewer		6 m Lt of B2 Sta 25+54				Conflict with construction of B2 line			N	P	U	
22	U-8	MH 22	CSDOC			Manhole		8 m Rt of Main St Sta 102+78					QLB		Y	RB	C	MH to be lowered, new top MH elev.=9.588 m
23	U-8	MH 23 SCE MH 4503	SCE			Manhole	No. 4503	8 m Rt of Main St Sta 102+87					QLB		Y	RB	C	MH to be lowered, new top MH elev.=9.583 m
24	U-8	MH 24 SCE MH 4502	SCE			Manhole	No. 4502	8 m Rt of Main St Sta 104+17					QLB		Y	RB	C	MH to be lowered, new top MH elev.=9.728 m

Figure D.30. "California UCM" report.

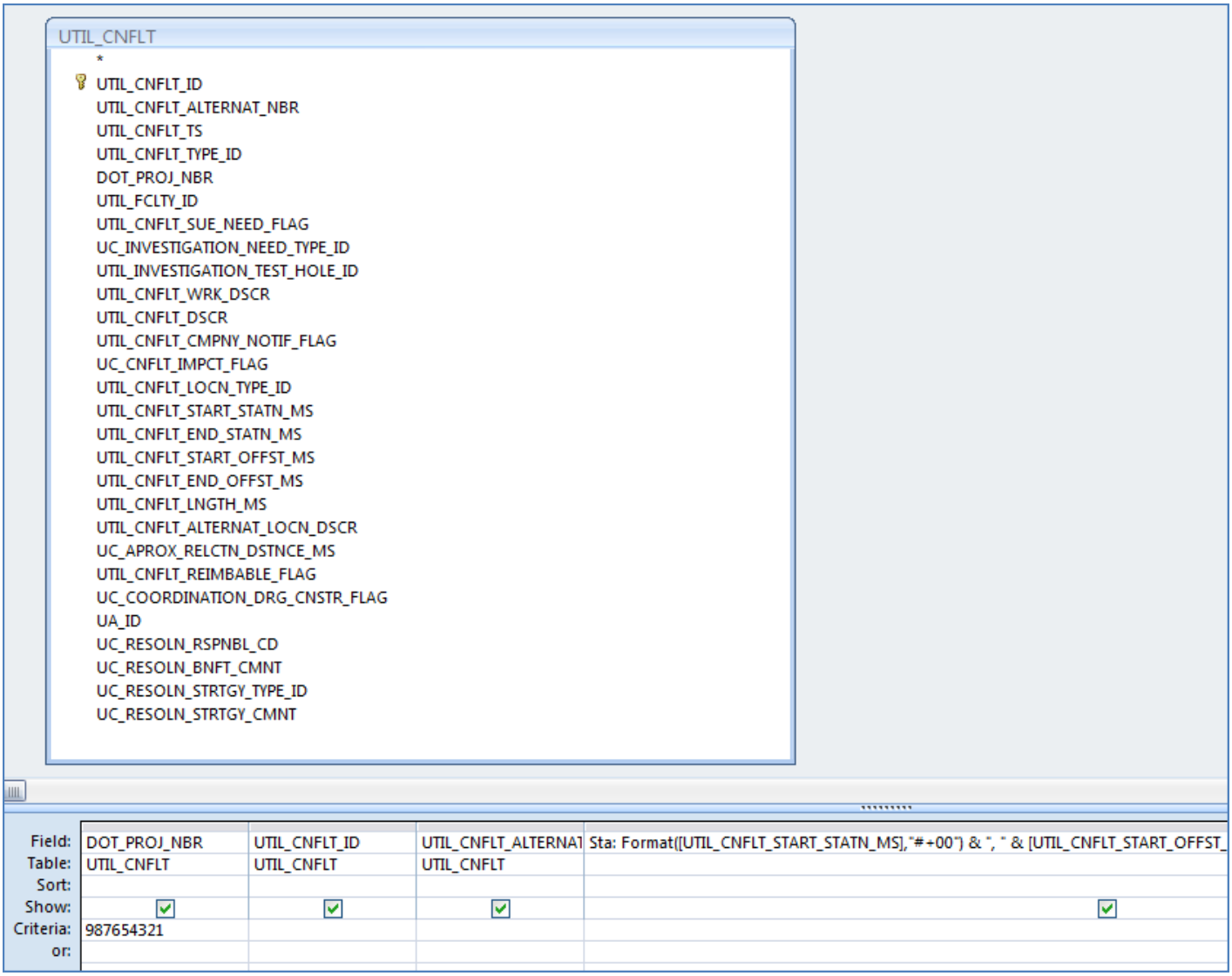


Figure D.31. Design view of "GDOT 1 station" query.

The SQL statement is as follows:

```
SELECT UTIL_CNFLT.DOT_PROJ_NBR, UTIL_CNFLT.UTIL_CNFLT_ID, UTIL_
    CNFLT.UTIL_CNFLT_ALTERNAT_NBR, Format([UTIL_CNFLT_START_
    STATN_MS], "#+00") & "," & [UTIL_CNFLT_START_OFFST_MS] & "," &
    [UTIL_CNFLT_ALTERNAT_LOCN_DSCR] AS Sta
FROM UTIL_CNFLT
WHERE (((UTIL_CNFLT.DOT_PROJ_NBR)=987654321));
```

Step 2: Create "GDOT 1 Utility Column—Company" Query

This query selects all conflicts for a given project number, displays the value in utility conflict alternative number, combines the value in company acronym text with the value in utility facility type acronym text if the value in company ID is not null, and stores this combination in a temporary field called UtilA (Figure D.32). The result of this query is a list of all utility conflicts for which a utility owner acronym was provided that can be combined with a utility facility type acronym. If no utility owner acronym is available, there is no entry for that utility conflict in the UtilA field, and the record is not displayed in this query.

The SQL statement is as follows:

```
SELECT UTIL_CNFLT.DOT_PROJ_NBR, UTIL_CNFLT.UTIL_CNFLT_ID, UTIL_
    CNFLT.UTIL_CNFLT_ALTERNAT_NBR, [CMPNY_ACRNM_TXT] &
    Format([UTIL_FCLTY_TYPE_ACRNM_TXT], "-@@@") AS UtilA
FROM UTIL_FCLTY_TYPE INNER JOIN ((CMPNY INNER JOIN UTIL_FCLTY
    ON CMPNY.CMPNY_ID = UTIL_FCLTY.CMPNY_ID) INNER JOIN UTIL_
    CNFLT ON UTIL_FCLTY.UTIL_FCLTY_ID = UTIL_CNFLT.UTIL_FCLTY_ID)
    ON UTIL_FCLTY_TYPE.UTIL_FCLTY_TYPE_ID = UTIL_FCLTY.UTIL_
    FCLTY_TYPE_ID
WHERE (((UTIL_CNFLT.DOT_PROJ_NBR)=987654321) AND ((CMPNY.CMPNY_
    ID) Is Not Null));
```

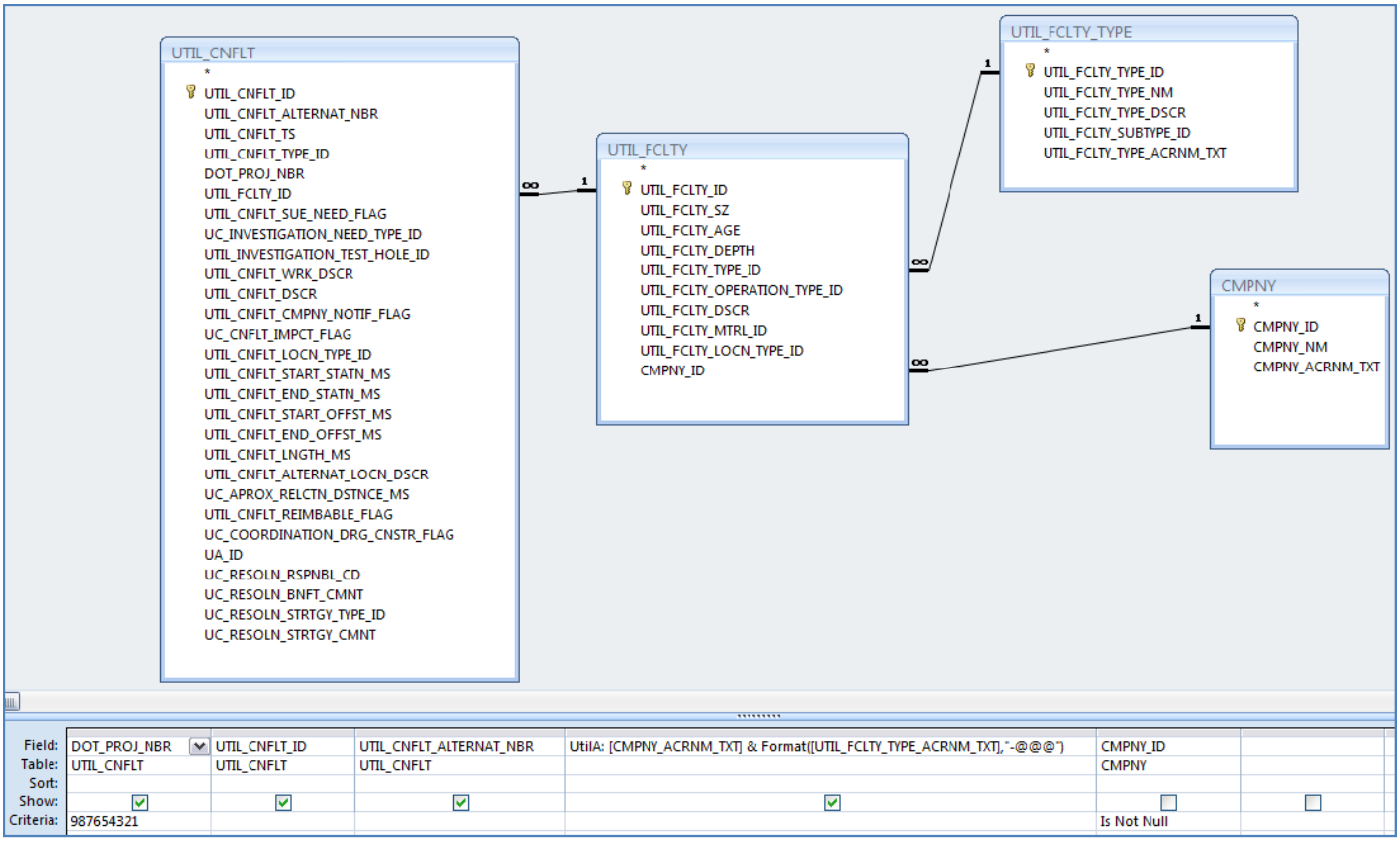


Figure D.32. Design view of "GDOT 1 utility column—company" query.

Step 3: Create "GDOT 1 Utility Column—Facility Size" Query

This query selects all conflicts for a given project number, displays the value in utility conflict alternative number, combines the value in utility facility size with the value in utility facility type acronym text if the value in utility facility size is not null, and stores this combination in a temporary field called UtilB (Figure D.33). The result of this query is a list of all utility conflicts for which a utility facility size was provided that can be combined with a utility facility type acronym. If no utility facility size is available, there is no entry for that utility conflict in the UtilB field, and the record is not displayed in this query.

The SQL statement is as follows:

```
SELECT UTIL_CNFLT.DOT_PROJ_NBR, UTIL_CNFLT.UTIL_CNFLT_ID, UTIL_
    CNFLT.UTIL_CNFLT_ALTERNAT_NBR, [UTIL_FCLTY_SZ] & [UTIL_FCLTY_
    TYPE_ACRNM_TXT] AS UtilB
FROM UTIL_FCLTY_TYPE INNER JOIN (UTIL_FCLTY INNER JOIN UTIL_
    CNFLT ON UTIL_FCLTY.UTIL_FCLTY_ID = UTIL_CNFLT.UTIL_FCLTY_ID)
    ON UTIL_FCLTY_TYPE.UTIL_FCLTY_TYPE_ID = UTIL_FCLTY.UTIL_
    FCLTY_TYPE_ID
WHERE (((UTIL_CNFLT.DOT_PROJ_NBR)=987654321) AND ((UTIL_FCLTY.UTIL_
    FCLTY_SZ) Is Not Null));
```

Step 4: Create "GDOT 2 Utility Column Concatenate" Query

This query selects all conflicts for a given project number, displays the value in utility conflict alternative number, combines the values in the temporary fields UtilA and UtilB, and stores the combined value in a temporary field called UtilC. This combined value is later displayed in the UCM report as the utility field of the Georgia UCM (Figure D.34).

The SQL statement is as follows:

```
SELECT UTIL_CNFLT.UTIL_CNFLT_ID, UTIL_CNFLT.DOT_PROJ_NBR, UTIL_
    CNFLT.UTIL_CNFLT_ALTERNAT_NBR, [UtilA] & [UtilB] AS UtilC
FROM (UTIL_CNFLT LEFT JOIN [GDOT Q2] ON UTIL_CNFLT.UTIL_CNFLT_ID =
    [GDOT Q2].UTIL_CNFLT_ID) LEFT JOIN [GDOT Q1] ON UTIL_CNFLT.UTIL_
    CNFLT_ID = [GDOT Q1].UTIL_CNFLT_ID
WHERE (((UTIL_CNFLT.DOT_PROJ_NBR)=987654321));
```

Step 5: Create "Georgia UCM" Query

This query uses the queries from Steps 1 through 4 and combines the data into one datasheet that is used as the foundation for the report that creates the Georgia UCM in Step 6. In addition to the queries from Steps 1 through 4, this query uses the tables utility conflict, utility facility, utility facility type, utility investigation test hole, and company (Figure D.35).

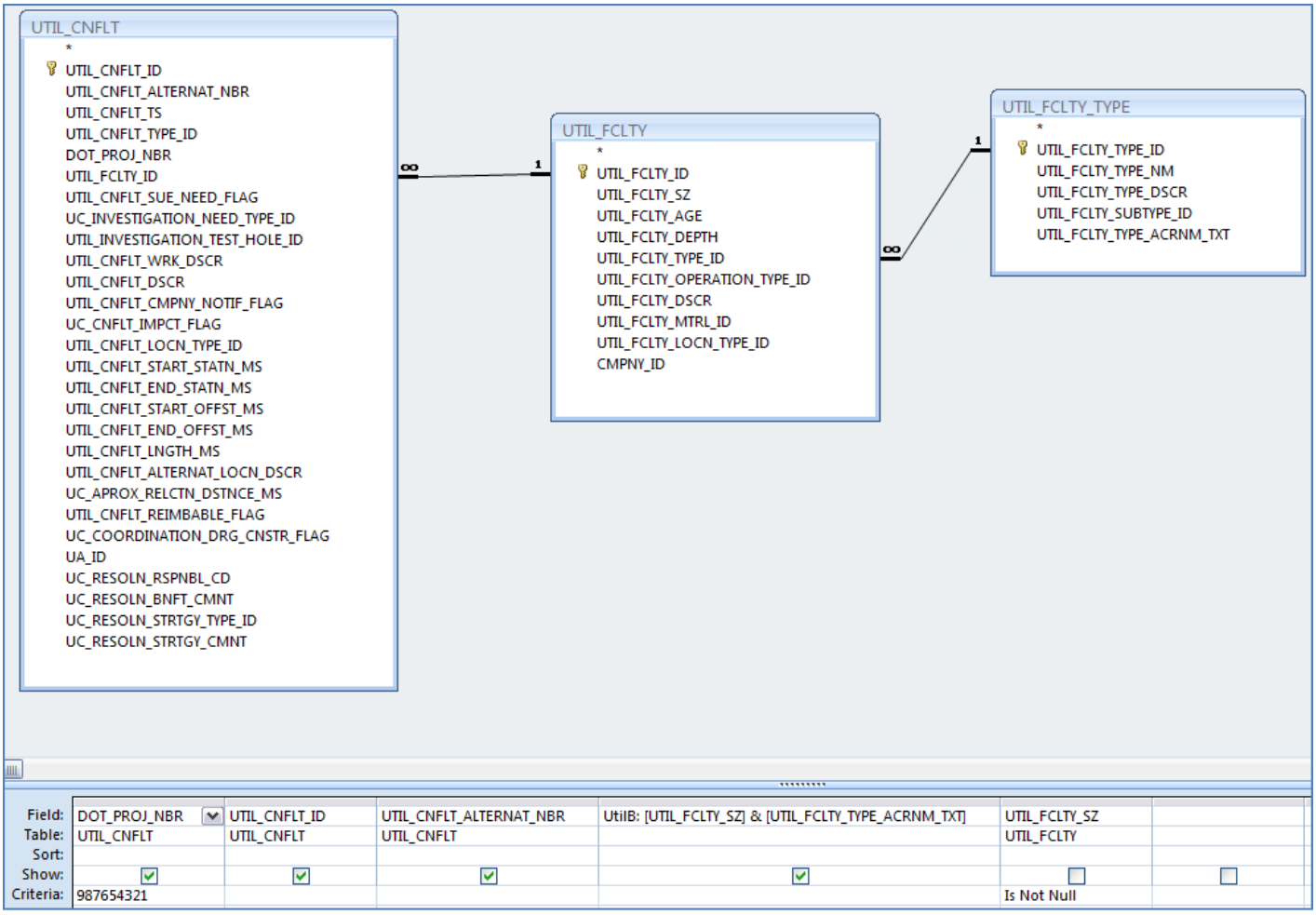


Figure D.33. Design view of "GDOT 1 utility column—facility size" query.

The SQL statement is as follows:

```
SELECT UTIL_CNFLT.UTIL_CNFLT_NBR, [GDOT 1 Station].Sta, [GDOT 2 Utility
    Column Concatenate].UtilC, UTIL_CNFLT.UTIL_CNFLT_DSCR, UTIL_
    INVESTIGATION_TEST_HOLE.UITH_NBR, UTIL_CNFLT.UTIL_CNFLT_WRK_
    DSCR, UTIL_CNFLT.DOT_PROJ_NBR, UTIL_CNFLT_RESOLN_ALTERNAT.
    UC_RESOLN_ALTERNAT_DSCR, UTIL_CNFLT_RESOLN_ALTERNAT.UC_
    RESOLN_ALTERNAT_ADVANTAGE_TXT, UTIL_CNFLT_RESOLN_ALTERNAT.
    UCR_ALTERNAT_DCSN_ID
FROM (UTIL_FCLTY_TYPE INNER JOIN ((CMPNY RIGHT JOIN UTIL_FCLTY
    ON CMPNY.CMPNY_ID = UTIL_FCLTY.CMPNY_ID) INNER JOIN (UTIL_
    INVESTIGATION_TEST_HOLE RIGHT JOIN ((UTIL_CNFLT INNER JOIN
    [GDOT 1 Station] ON UTIL_CNFLT.UTIL_CNFLT_ID = [GDOT 1 Station].UTIL_
    CNFLT_ID) INNER JOIN [GDOT 2 Utility Column Concatenate] ON UTIL_
    CNFLT.UTIL_CNFLT_ID = [GDOT 2 Utility Column Concatenate].UTIL_CNFLT_
    ID) ON UTIL_INVESTIGATION_TEST_HOLE.UITH_ID = UTIL_CNFLT.[UITH_
    ID]) ON UTIL_FCLTY.UTIL_FCLTY_ID = UTIL_CNFLT.UTIL_FCLTY_ID) ON
    UTIL_FCLTY_TYPE.UTIL_FCLTY_TYPE_ID = UTIL_FCLTY.UTIL_FCLTY_
    TYPE_ID) INNER JOIN UTIL_CNFLT_RESOLN_ALTERNAT ON UTIL_CNFLT.
    UTIL_CNFLT_ID = UTIL_CNFLT_RESOLN_ALTERNAT.UTIL_CNFLT_ID
WHERE (((UTIL_CNFLT.DOT_PROJ_NBR)=987654321) AND ((UTIL_CNFLT_
    RESOLN_ALTERNAT.UCR_ALTERNAT_DCSN_ID)=1));
```

Step 6: Create "Georgia UCM" Report

This report, which is shown in Figure D.36, replicates the Georgia UCM based on the results of the query from Step 5. All data items provided in the report are selected from database entries, including additional data items such as project number, date, and time that appear in the header of the UCM. Names of individuals who developed, revised, or reviewed the UCM report could be added to the header as needed using an insertion mechanism such as a dialog box at the time of preparing, revising, or reviewing the document.

Texas Department of Transportation UCM Example

The sample UCM provided by TxDOT is included in Appendix B (Figure B.29). This UCM, which includes 19 data items (five data items in the header and 14 data items in the main body), is an example of a UCM with an average number of data items. The UCM was of particular interest because it offered a number of unique challenges. First, it combined the

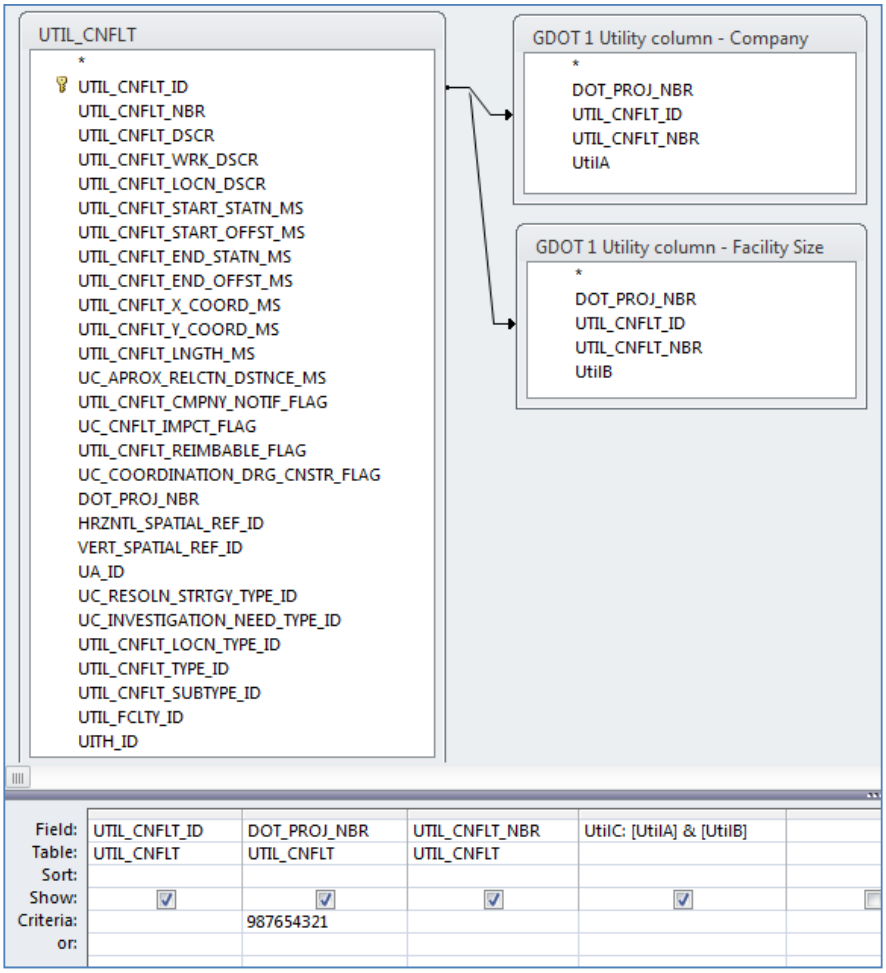


Figure D.34. Design view of "GDOT 2 utility column concatenate" query.

utility conflicts from two projects into one UCM, as can be seen by the two project numbers (CSJ numbers) and project descriptions in the header. Second, the UCM included some unusual fields, such as agreement status and sheet number. Replicating this sample UCM involved developing seven queries and one report.

Step 1: Create "TxDOT 1 Agreement Status" Query

This query selects the utility conflicts for two project IDs and groups the data by the utility agreement ID for each utility conflict. The query then displays the last entry in the utility agreement date field and the associated utility agreement date type of that entry. The result of this query is the latest date and date type for a utility agreement, which is essentially the current utility agreement status (Figure D.37).

The SQL statement is as follows:

```
SELECT UTIL_CNFLT.UTIL_CNFLT_ID, UTIL_CNFLT.DOT_PROJ_NBR, UTIL_
    AGRMT.UA_ID, Last(UTIL_AGRMT_DT_TYPE.UA_DT_TYPE_NM) AS Last
    OfUA_DT_TYPE_NM, Last(UTIL_AGRMT_DT.UA_DT) AS LastOfUA_DT
FROM (UTIL_AGRMT_DT_TYPE INNER JOIN (UTIL_AGRMT INNER JOIN UTIL_
    AGRMT_DT ON UTIL_AGRMT.UA_ID = UTIL_AGRMT_DT.UA_ID) ON UTIL_
    AGRMT_DT_TYPE.UA_DT_TYPE_ID = UTIL_AGRMT_DT.UA_DT_TYPE_ID)
    INNER JOIN UTIL_CNFLT ON UTIL_AGRMT.UA_ID = UTIL_CNFLT.UA_ID
GROUP BY UTIL_CNFLT.UTIL_CNFLT_ID, UTIL_CNFLT.DOT_PROJ_NBR, UTIL_
    AGRMT.UA_ID
HAVING (((UTIL_CNFLT.DOT_PROJ_NBR)=2802081 Or (UTIL_CNFLT.DOT_
    PROJ_NBR)=50801166));
```

Step 2: Create "TxDOT 1 Agreement Submittal Date" Query

This query selects the utility agreement submittal date, which is the utility agreement date type = 1, for a utility agreement that is related to one or more utility conflicts. The query only displays those utility conflicts for a particular project that have a utility agreement submittal date (Figure D.38).

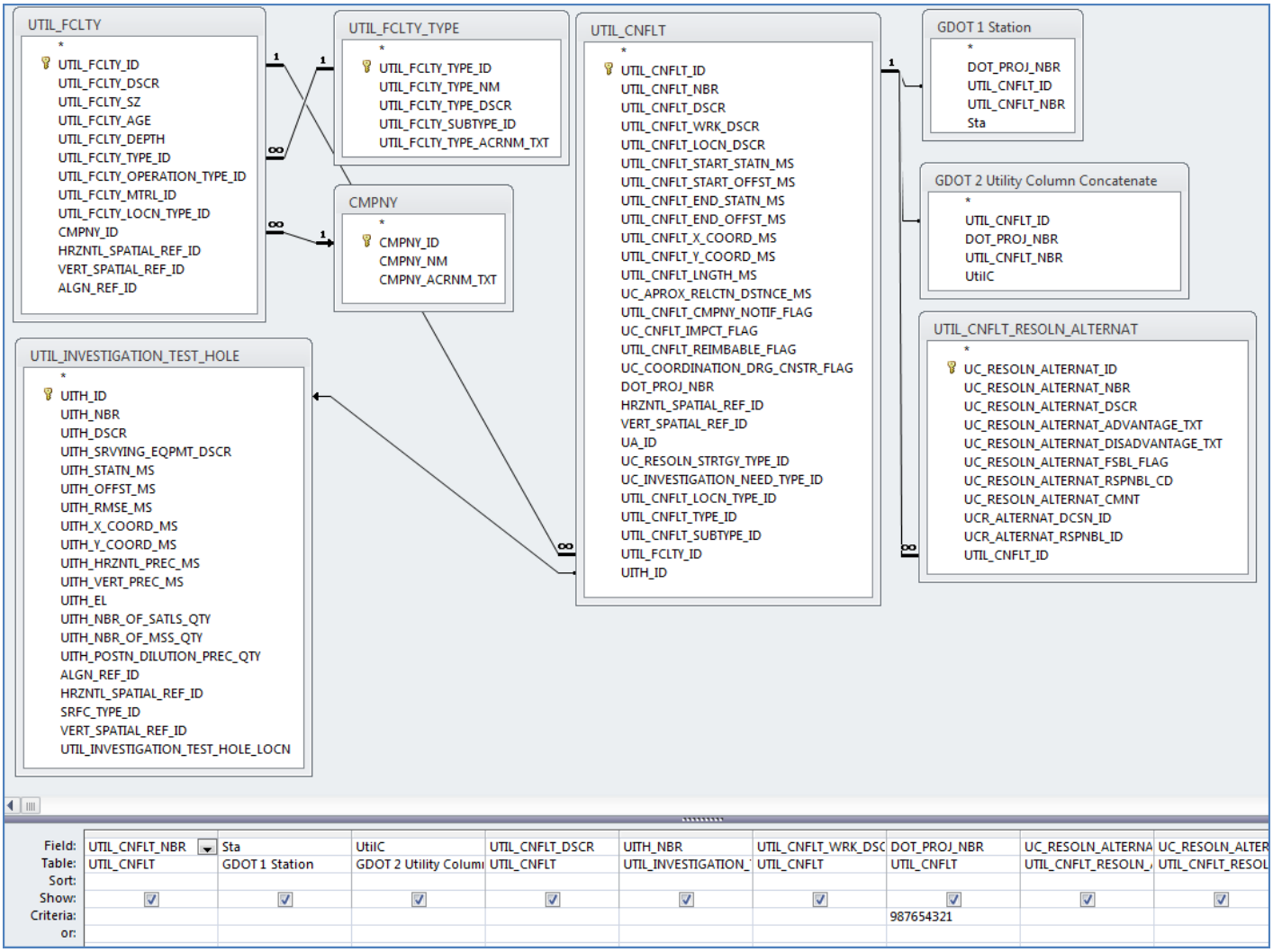


Figure D.35. Design view of "Georgia UCM" query.

The SQL statement is as follows:

```
SELECT UTIL_CNFLT.UTIL_CNFLT_ID, UTIL_CNFLT.DOT_PROJ_NBR, UTIL_
    AGRMT.UA_ID, UTIL_AGRMT_DT.UA_DT_TYPE_ID, UTIL_AGRMT_
    DT.UA_DT
FROM (UTIL_AGRMT_DT_TYPE INNER JOIN (UTIL_AGRMT INNER JOIN
    UTIL_AGRMT_DT ON UTIL_AGRMT.UA_ID = UTIL_AGRMT_DT.UA_ID) ON
    UTIL_AGRMT_DT_TYPE.UA_DT_TYPE_ID = UTIL_AGRMT_DT.UA_DT_
    TYPE_ID) INNER JOIN UTIL_CNFLT ON UTIL_AGRMT.UA_ID = UTIL_
    CNFLT.UA_ID
WHERE (((UTIL_CNFLT.DOT_PROJ_NBR)=2802081 Or (UTIL_CNFLT.DOT_
    PROJ_NBR)=50801166) AND ((UTIL_AGRMT_DT.UA_DT_TYPE_ID)=1));
```

Step 3: Create "TxDOT 1 Conflict Status" Query

This query produces the utility conflict status for all utility conflicts of a particular project. The utility conflict status is essentially the latest utility conflict event that is stored in the utility conflict event table (Figure D.39).

The SQL statement is as follows:

```
SELECT UTIL_CNFLT.DOT_PROJ_NBR, UTIL_CNFLT.UTIL_CNFLT_ID,
    Last(UTIL_CNFLT_EVNT.UTIL_CNFLT_EVNT_NBR) AS LastOfUTIL_CNFLT_
    EVNT_NBR, Last(UTIL_CNFLT_EVNT_TYPE.UTIL_CNFLT_EVNT_TYPE_NM)
    AS LastOfUTIL_CNFLT_EVNT_TYPE_NM
FROM UTIL_CNFLT INNER JOIN (UTIL_CNFLT_EVNT_TYPE INNER JOIN UTIL_
    CNFLT_EVNT ON UTIL_CNFLT_EVNT_TYPE.UTIL_CNFLT_EVNT_TYPE_ID =
    UTIL_CNFLT_EVNT.UTIL_CNFLT_EVNT_TYPE_ID) ON UTIL_CNFLT.UTIL_
    CNFLT_ID = UTIL_CNFLT_EVNT.UTIL_CNFLT_ID
GROUP BY UTIL_CNFLT.DOT_PROJ_NBR, UTIL_CNFLT.UTIL_CNFLT_ID
HAVING (((UTIL_CNFLT.DOT_PROJ_NBR)=2802081 Or (UTIL_CNFLT.DOT_
    PROJ_NBR)=50801166))
ORDER BY UTIL_CNFLT.UTIL_CNFLT_ID;
```

Step 4: Create "TxDOT 1 Estimated Resolution Date" Query

This query selects the utility conflict event type = 16, which is the estimated conflict resolution date, and returns the associated date value, if such an event exists. If no estimated conflict

Georgia DOT Utility Conflict Matrix

Tuesday, September 18, 2012
5:24:53 PM

GDOT Project Number: 987654321

Conflict	Station and Offset	Utility	Identified Conflict	Testhole Needed	Utility Impact with Cost ("As-designed")	Recommended Resolution	Benefit of Resolution*
C1	100+05, 21' L, 14th St Constr. BL	AGL-BFO	Proposed storm structure and existing BFO.		Relocate 1150 LF of BFO-DUCT ($91,000).	Relocate proposed storm drainage into street. Use DI's that drain toward roadway.	Save cost to relocate BFO-DUCT ($91,000).
C2	100+66, 21' L, 14th St Constr. BL	AGL-BFO	Proposed storm structure and existing BFO.		Relocate 1150 LF of BFO-DUCT ($91,000).	Relocate proposed storm drainage into street. Use DI's that drain toward roadway.	Save cost to relocate BFO-DUCT ($91,000).
C3	100+38, 24' R, 14th St Constr. BL	UNK-UNK	Proposed 18" storm and unknown utility tee.	TH 1	Relocate unknown type and function utility.	TH to identify utility and conflict.	Eliminate possible delay during construction.
C4	100+56, 25' R, 14th St Constr. BL	8"W	Proposed 18" storm and existing 8" W.	TH 2	Relocate 8" W ($7,500).	TH on 8" W, adjust depth of proposed storm drainage.	Save cost to relocate 8" W ($6,000).
C5	100+61, 25' R, 14th St Constr. BL	8"W	Proposed 18" storm and existing 8" W.	TH 3	Relocate 8" W ($7,500).	TH on 8" W, adjust depth of proposed storm drainage.	Save cost to relocate 8" W ($6,000).
C6	100+82, 28' R, 14th St Constr. BL	4"G	Proposed storm structure and existing 4" G.	TH 4	Relocate 20 LF of 4" G ($6,000).	TH on 4" G, adjust depth of proposed storm structure.	Save cost to relocate 4" G ($4,500).
C7	101+22, 27' R, 14th St Constr. BL	4"G	Proposed 18' and existing 4" by 2" gas tee.	TH 5	Relocate 2" G and 4" G Tee ($12,500).	TH on G lines, adjust depth of proposed storm structure.	Save cost to relocate G lines ($11,000).
C8	101+01, 28' L, 14th St Constr. BL	16"G	Proposed storm structure and existing 16" G.	TH 6	Relocate 16" G ($10,000).	TH on 16" G, adjust depth of proposed storm structure.	Save cost to relocate 16" G ($8,500).
C9	101+25, 41' L, 14th St Constr. BL	UNK-BT-DUCT	Proposed storm structure and two BT ducts.	TH 7	Relocate BT-DUCT and 2" G ($11,000).	TH on BT-DUCT and 2" G, adjust depth of proposed storm structure.	Save cost to relocate BT duct and 2" G ($10,500).
C10	101+37, 41' L, 14th St Constr. BL	6"W	Proposed 18" storm and existing 6" W.	TH 8	Relocate 6" W ($5,000).	TH on 6" W, adjust depth of proposed storm drainage.	Save cost to relocate 6" W ($3,500).
C11	101+57, 27' L, 14th St Constr. BL	16"G	Proposed 18" storm and existing 16" G.	TH 9	Relocate 16" G ($10,000).	TH on 16" G, adjust depth of proposed storm structure.	Save cost to relocate 16" G ($8,500).
C12	101+58, 22' L, 14th St Constr. BL	AGL-BFO	Proposed storm structure and existing BFO.		Relocate 1150 LF of BFO-DUCT ($91,000).	Relocate proposed storm drainage into street. Use DI's that drain toward roadway.	Save cost to relocate BFO-DUCT ($91,000).
C13	101+90, 22' L, 14th St Constr. BL	AGL-BFO	Proposed storm structure and existing BFO.		Relocate 1150 LF of BFO-DUCT ($91,000).	Relocate proposed storm drainage into street. Use DI's that drain toward roadway.	Save cost to relocate BFO-DUCT ($91,000).
C14	102+20, 27' R, 14th St Constr. BL	4"G	Proposed storm structure and existing 4" G.		Relocate 4" G ($4,500).	Relocate 4" G.	Eliminate conflict with proposed DI.
C15	102+36, 24" L, 14th St Constr. BL	AGL-BFO	Proposed storm structure and existing BFO.		Relocate 1150 LF of BFO-DUCT ($91,000).	Relocate proposed storm drainage into street. Use DI's that drain toward roadway.	Save cost to relocate BFO-DUCT ($91,000).

*** Please include all benefits incurred including time, costs, and safety improvements**

Key:

AC - Asbestos Concrete
BE - Buried Electric
BFO - Buried Fiber Optic
BT - Buried Telephone
G - Gas
L - Left
MES - Mitered End Section
OT - Overhead Telephone
R - Right
RCP - Reinforced Concrete Pipe
W - Water
WM - Water Main
TH - Test Hole
UNK - Unknown

Utility Owner:

AGL Atlanta Gas Light
BE Georgia Power
BT Bell South
L3 Level 3 Communications
MFN Metromedia Fiber Network
SAN Fulton County Public Works
W City of Atlanta

Figure D.36. "Georgia UCM" report.

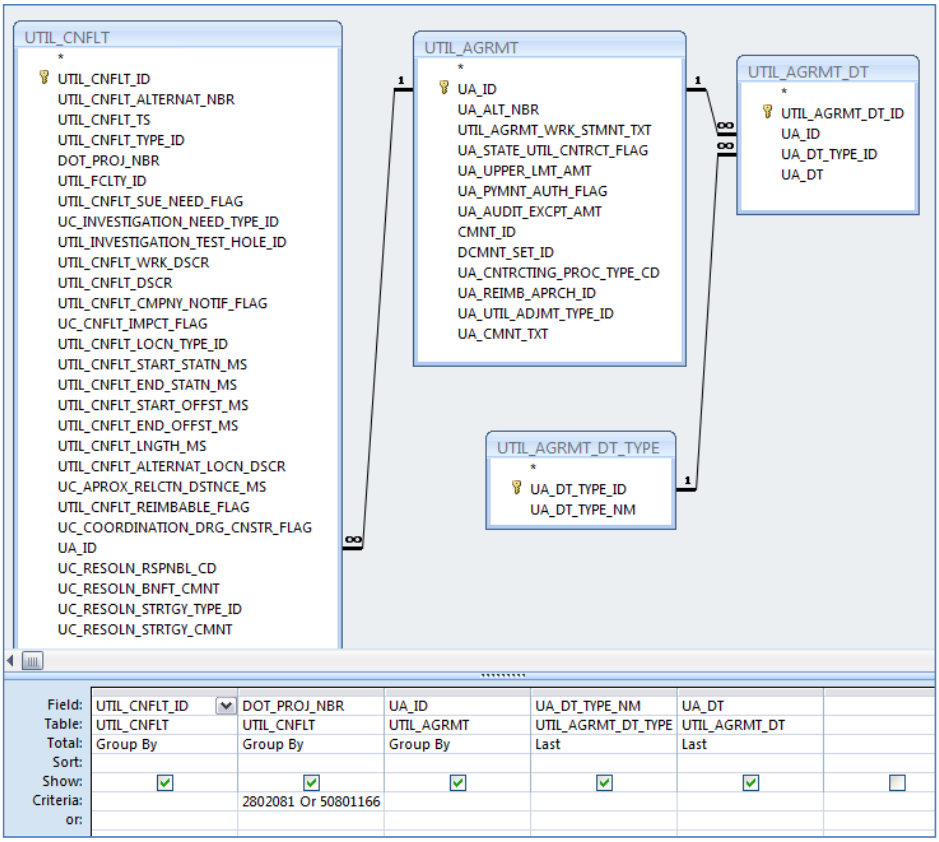


Figure D.37. Design view of "TxDOT 1 agreement status" query.

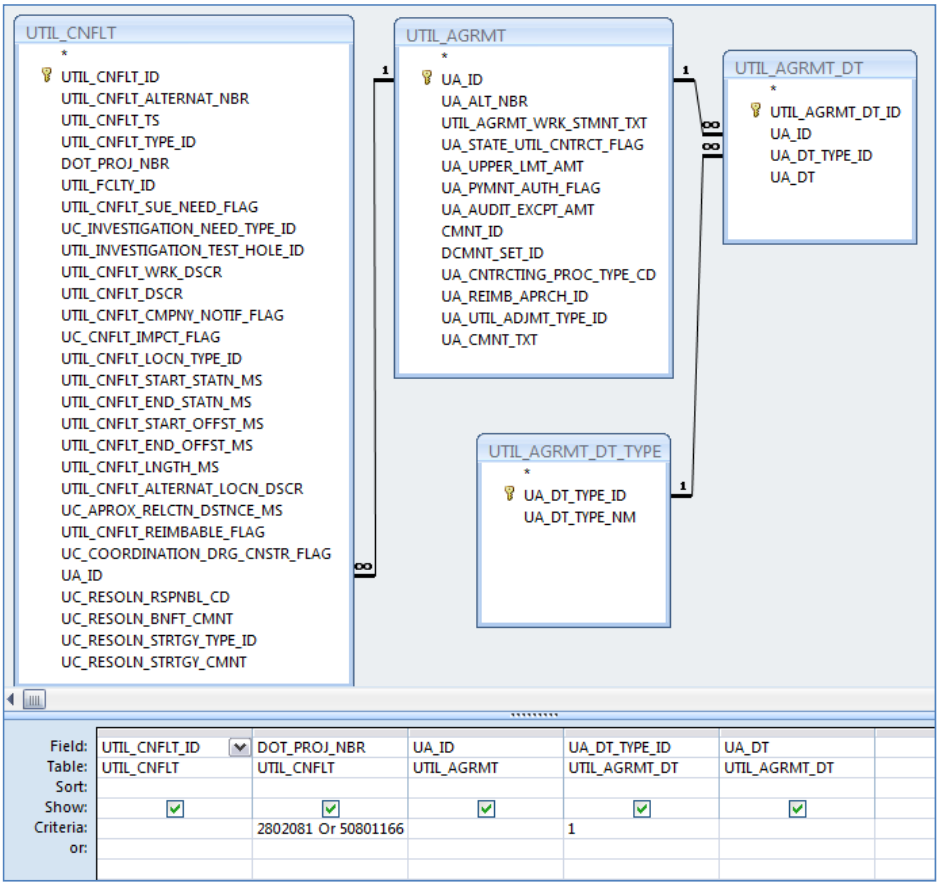


Figure D.38. Design view of "TxDOT 1 agreement submittal date" query.

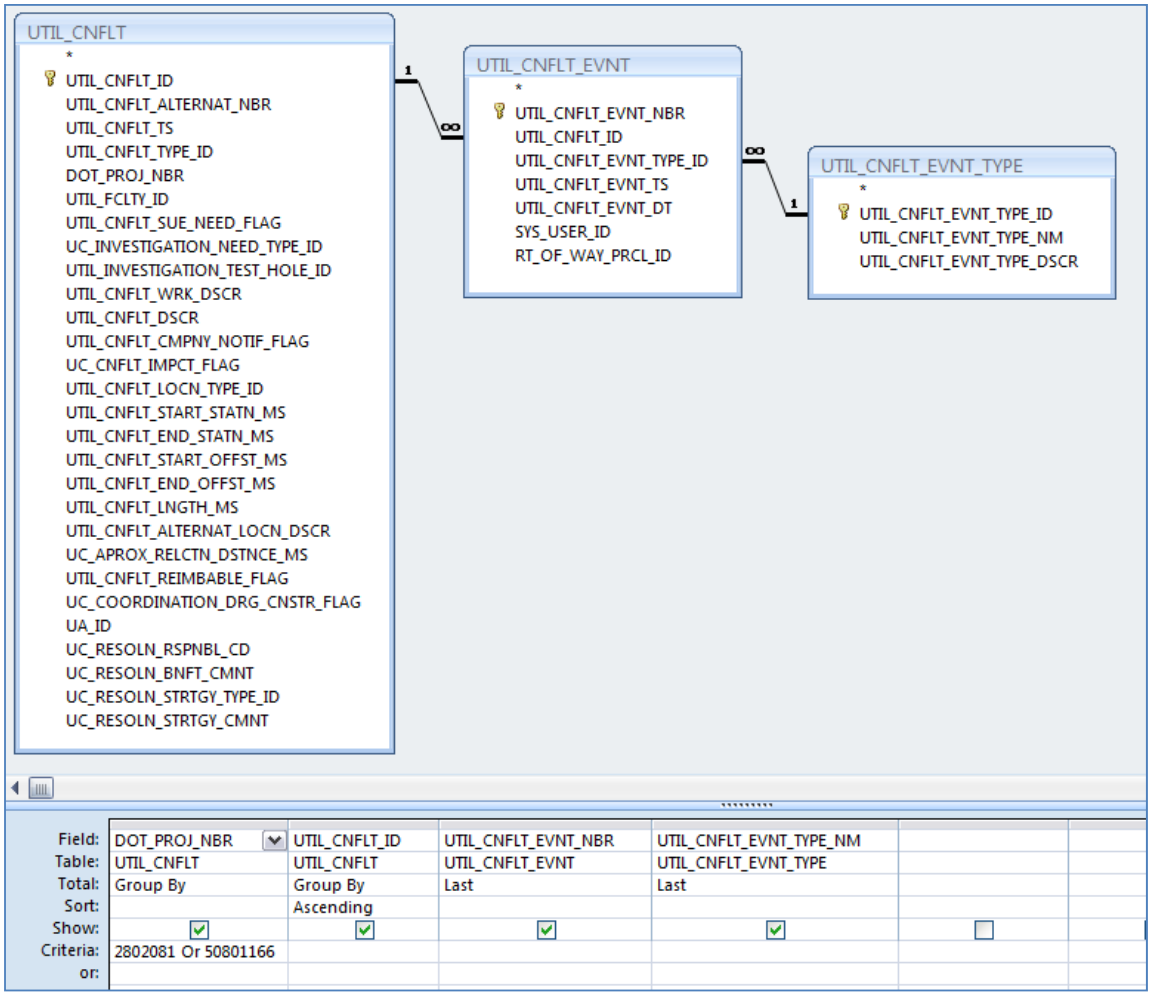


Figure D.39. Design view of "TxDOT 1 conflict status" query.

resolution date is found in the database, the query does not display the utility conflict record (Figure D.40).

The SQL statement is as follows:

```
SELECT UTIL_CNFLT.DOT_PROJ_NBR, UTIL_CNFLT.UTIL_CNFLT_ID, UTIL_
    CNFLT_EVNT.UTIL_CNFLT_EVNT_TYPE_ID, UTIL_CNFLT_EVNT.UTIL_
    CNFLT_EVNT_DT
FROM UTIL_CNFLT INNER JOIN (UTIL_CNFLT_EVNT_TYPE INNER JOIN UTIL_
    CNFLT_EVNT ON UTIL_CNFLT_EVNT_TYPE.UTIL_CNFLT_EVNT_TYPE_ID =
    UTIL_CNFLT_EVNT.UTIL_CNFLT_EVNT_TYPE_ID) ON UTIL_CNFLT.UTIL_
    CNFLT_ID = UTIL_CNFLT_EVNT.UTIL_CNFLT_ID
WHERE (((UTIL_CNFLT.DOT_PROJ_NBR)=2802081 Or (UTIL_CNFLT.DOT_
    PROJ_NBR)=50801166) AND ((UTIL_CNFLT_EVNT.UTIL_CNFLT_EVNT_
    TYPE_ID)=16));
```

Step 5: Create "TxDOT 1 Multiple Projects" Query

This query selects all conflicts for two project IDs, formats the value stored in the utility conflict start station measurement field using typical stationing format, and displays the value in the start station field. The query further creates a location field, which is a concatenation of the start station and utility conflict alternate location description fields. The query concatenates the two if both fields have an entry; otherwise, it displays either field content (Figure D.41).

The SQL statement is as follows:

```
SELECT UTIL_CNFLT.UTIL_CNFLT_ID, UTIL_CNFLT.DOT_PROJ_NBR,
    Format(UTIL_CNFLT_START_STATN_MS,'#+00') AS Start_Stn, [Start_Stn] &
    IIf([Start_Stn]<>" And [UTIL_CNFLT_ALTERNAT_LOCN_DSCR]<>",', ',") &
    [UTIL_CNFLT_ALTERNAT_LOCN_DSCR] AS LOCATION
FROM UTIL_CNFLT
WHERE (((UTIL_CNFLT.DOT_PROJ_NBR)=2802081 Or (UTIL_CNFLT.DOT_
    PROJ_NBR)=50801166));
```

Step 6: Create "TxDOT 1 Sheet Number" Query

This query selects all plan documents associated with documents that are related to utility conflicts. This query allows the system to determine which plan sheet a particular utility conflict is located on (Figure D.42).

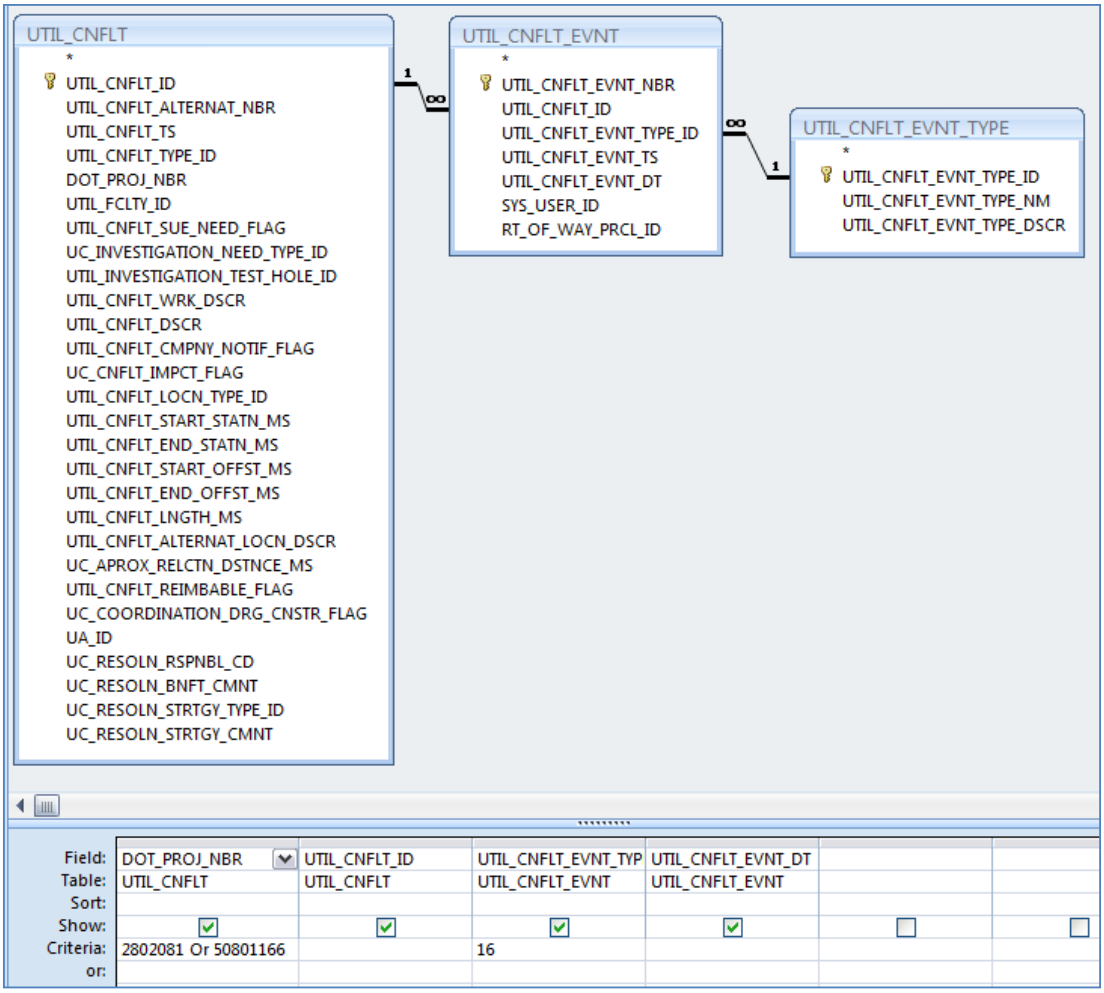


Figure D.40. Design view of "TxDOT 1 estimated resolution date" query.

The SQL statement is as follows:

```
SELECT UTIL_CNFLT.UTIL_CNFLT_ID, DCMNT.DCMNT_ID, PLAN_DCMNT.
    PLAN_DCMNT_CMNT
FROM UTIL_CNFLT INNER JOIN (UTIL_CNFLT_EVNT INNER JOIN ((DCMNT
    INNER JOIN PLAN_DCMNT ON DCMNT.DCMNT_ID = PLAN_DCMNT.
    DCMNT_ID) INNER JOIN UTIL_CNFLT_EVNT_DCMNT ON DCMNT.
    DCMNT_ID = UTIL_CNFLT_EVNT_DCMNT.DCMNT_ID) ON UTIL_CNFLT_
    EVNT.UTIL_CNFLT_EVNT_NBR = UTIL_CNFLT_EVNT_DCMNT.UTIL_
    CNFLT_EVNT_NBR) ON UTIL_CNFLT.UTIL_CNFLT_ID = UTIL_CNFLT_
    EVNT.UTIL_CNFLT_ID;
```

Step 7: Create "TxDOT 2 UCM" Query

This query uses the queries from Steps 1 through 6 and combines the data into one datasheet that is used as the foundation for the report that creates the Texas UCM in Step 8. In addition to the queries from Steps 1 through 6, this query uses the tables utility conflict, DOT project, district, utility facility, utility facility type, utility facility location type, and company (Figure D.43).

The SQL statement is as follows:

```
SELECT UTIL_CNFLT.UTIL_CNFLT_NBR, CMPNY.CMPNY_NM, UTIL_FCLTY_
    TYPE.UTIL_FCLTY_TYPE_NM, [UTIL_FCLTY_SZ] & ≤ ≤ & [UTIL_FCLTY_DSCR]
    AS [Utility Size Material], [TxDOT 1 Multiple Projects].LOCATION, UTIL_FCLTY_
    LOCN_TYPE.UTIL_FCLTY_LOCN_TYPE_NM, UTIL_CNFLT.UTIL_CNFLT_
    DSCR, [TxDOT 1 Sheet Number].PLAN_DCMNT_CMNT, [TxDOT 1 Conflic
    Status].LastOfUTIL_CNFLT_EVNT_TYPE_NM, [TxDOT 1 Estimated Resolution
    Date].UTIL_CNFLT_EVNT_DT, IIf([UTIL_CNFLT_REIMBABLE_FLAG]='Y','JUA
    A','JUA B') AS AGREEMENT, [TxDOT 1 Agreement Status].LastOfUA_DT_
    TYPE_NM, [TxDOT 1 Agreement Submittal Date].UA_DT, UTIL_CNFLT_
    RESOLN_ALTERNAT.UC_RESOLN_ALTERNAT_CMNT, UTIL_CNFLT_
    RESOLN_ALTERNAT.UCR_ALTERNAT_DCSN_ID, UTIL_CNFLT.DOT_PROJ_
    NBR, DOT_PROJ.DIST_ID, DIST.DIST_NM, DOT_PROJ.DOT_PROJ_DSCR
FROM (UTIL_FCLTY_TYPE INNER JOIN (UTIL_FCLTY_LOCN_TYPE INNER
    JOIN ((CMPNY INNER JOIN UTIL_FCLTY ON CMPNY.CMPNY_ID = UTIL_
    FCLTY.CMPNY_ID) INNER JOIN (DIST INNER JOIN (DOT_PROJ INNER
    JOIN ((((((UTIL_CNFLT INNER JOIN [TxDOT 1 Multiple Projects] ON UTIL_
    CNFLT.UTIL_CNFLT_ID = [TxDOT 1 Multiple Projects].UTIL_CNFLT_ID) LEFT
    JOIN [TxDOT 1 Sheet Number] ON UTIL_CNFLT.UTIL_CNFLT_ID = [TxDOT 1
    Sheet Number].UTIL_CNFLT_ID) INNER JOIN [TxDOT 1 Conflict Status] ON
    UTIL_CNFLT.UTIL_CNFLT_ID = [TxDOT 1 Conflict Status].UTIL_CNFLT_ID)
    LEFT JOIN [TxDOT 1 Estimated Resolution Date] ON UTIL_CNFLT.UTIL_
    CNFLT_ID = [TxDOT 1 Estimated Resolution Date].UTIL_CNFLT_ID) LEFT
    JOIN [TxDOT 1 Agreement Status] ON UTIL_CNFLT.UTIL_CNFLT_ID =
    [TxDOT 1 Agreement Status].UTIL_CNFLT_ID) LEFT JOIN [TxDOT 1
```

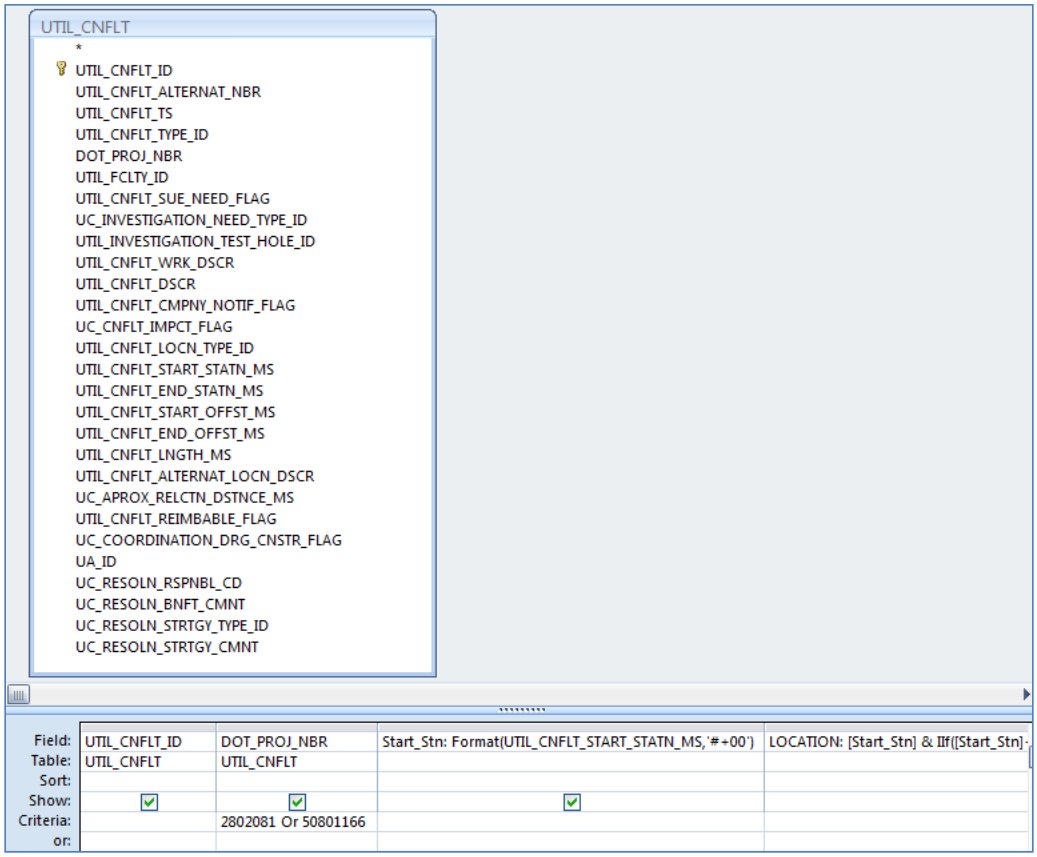


Figure D.41. Design view of "TxDOT 1 multiple projects" query.

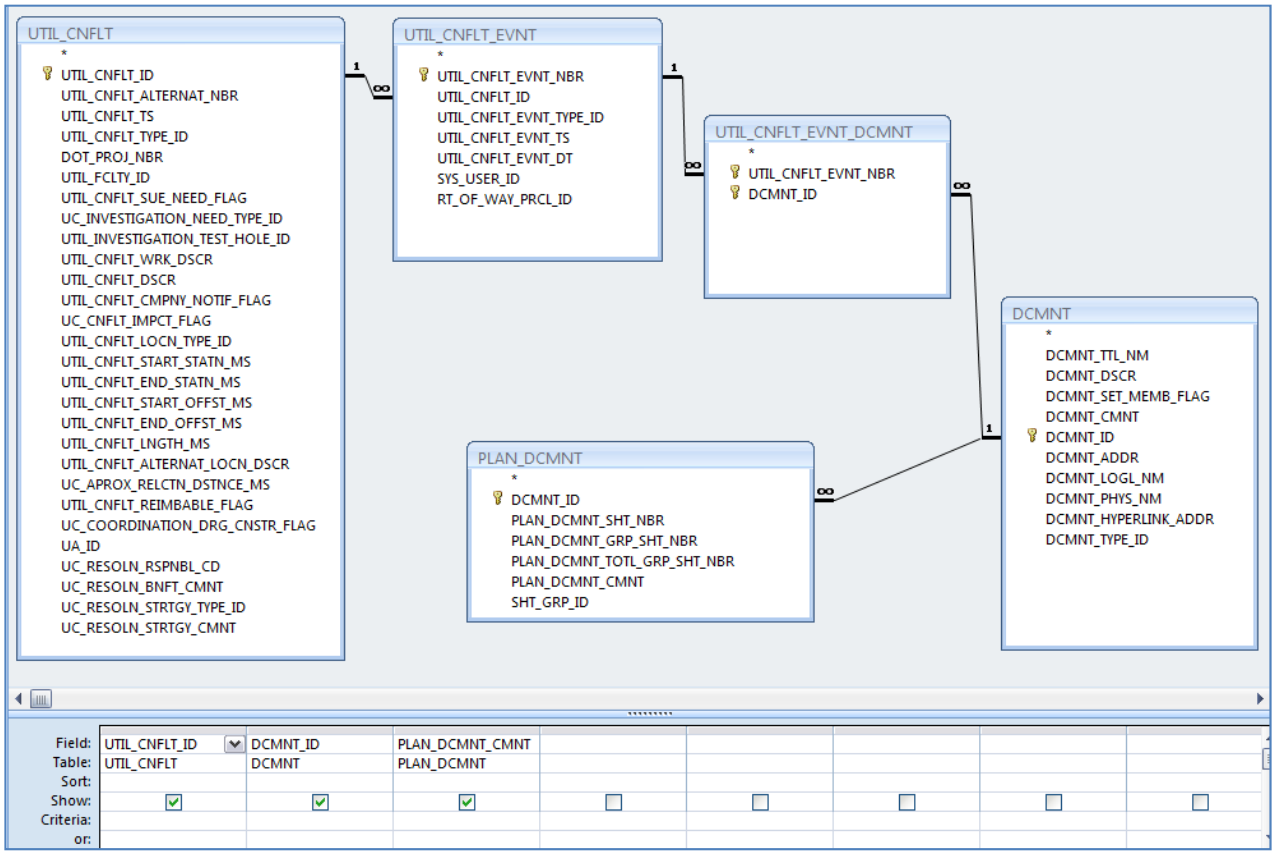


Figure D.42. Design view of "TxDOT 1 sheet number" query.

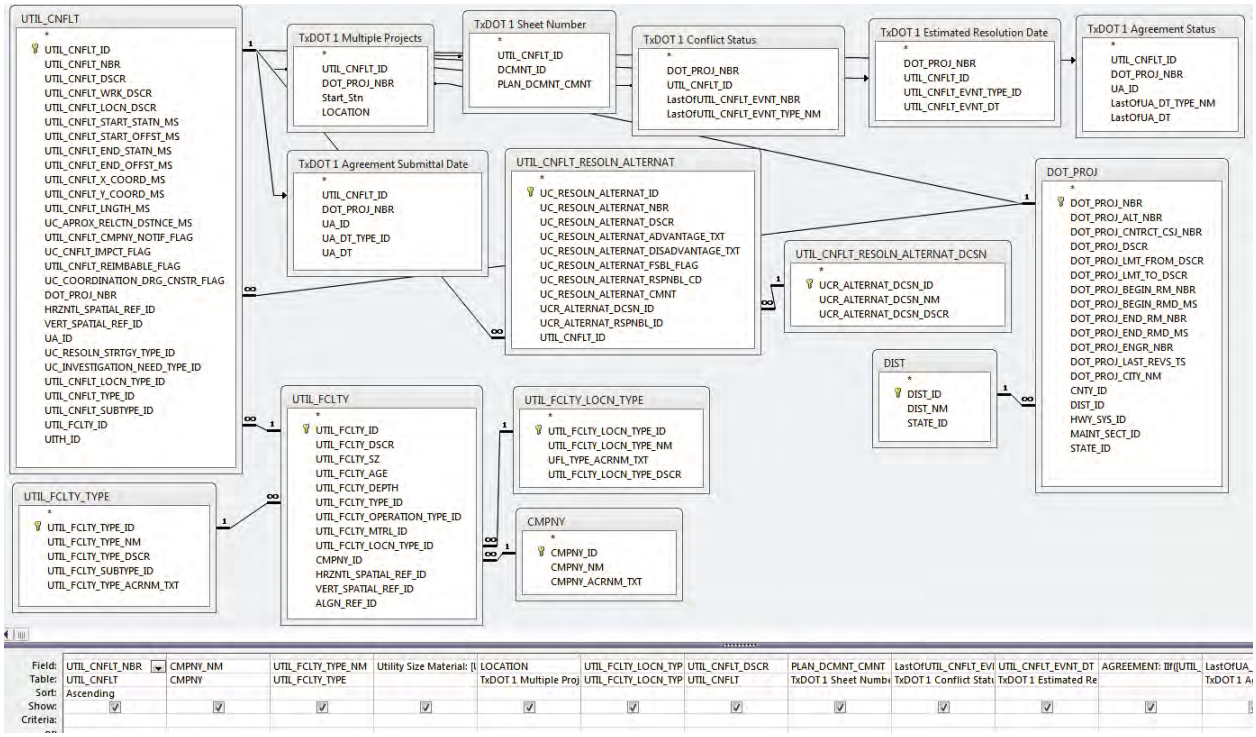


Figure D.43. Design view of "TxDOT 2 UCM" query.

```
    Agreement Submittal Date] ON UTIL_CNFLT.UTIL_CNFLT_ID = [TxDOT 1
    Agreement Submittal Date].UTIL_CNFLT_ID) ON (DOT_PROJ.DOT_PROJ_
    NBR = UTIL_CNFLT.DOT_PROJ_NBR) AND (DOT_PROJ.DOT_PROJ_NBR =
    [TxDOT 1 Multiple Projects].DOT_PROJ_NBR)) ON DIST.DIST_ID = DOT_
    PROJ.DIST_ID) ON UTIL_FCLTY.UTIL_FCLTY_ID = UTIL_CNFLT.UTIL_
    FCLTY_ID) ON UTIL_FCLTY_LOCN_TYPE.UTIL_FCLTY_LOCN_TYPE_ID =
    UTIL_FCLTY.UTIL_FCLTY_LOCN_TYPE_ID) ON UTIL_FCLTY_TYPE.UTIL_
    FCLTY_TYPE_ID = UTIL_FCLTY.UTIL_FCLTY_TYPE_ID) INNER JOIN (UTIL_
    CNFLT_RESOLN_ALTERNAT_DCSN INNER JOIN UTIL_CNFLT_RESOLN_
    ALTERNAT ON UTIL_CNFLT_RESOLN_ALTERNAT_DCSN.UCR_ALTERNAT_
    DCSN_ID = UTIL_CNFLT_RESOLN_ALTERNAT.UCR_ALTERNAT_DCSN_ID)
    ON UTIL_CNFLT.UTIL_CNFLT_ID = UTIL_CNFLT_RESOLN_ALTERNAT.
    UTIL_CNFLT_ID
WHERE (((UTIL_CNFLT_RESOLN_ALTERNAT.UCR_ALTERNAT_DCSN_ID)=1)
    AND ((UTIL_CNFLT.DOT_PROJ_NBR)=2802081 Or (UTIL_CNFLT.DOT_
    PROJ_NBR)=50801166))
ORDER BY UTIL_CNFLT.UTIL_CNFLT_NBR;
```

Step 8: Create "Texas UCM" Report

This report, which is shown in Figure D.44, uses the data from the query in Step 7. The report includes other data items from the database, including project numbers, project descriptions, and TxDOT district. One particular issue was to display both project numbers on the UCM report. The research team solved this issue by writing functions in VBA code, which is included below:

```
Option Compare Database
Private Sub Report_Open(Cancel As Integer)
   Dim sSQL As String
   Dim result As String
   sSQL = "SELECT DOT_PROJ_NBR FROM [TxDOT 2 UCM] WHERE UTIL_
     CNFLT_NBR < 4 "
   ' lbCSJ1.SetFocus
   lbCSJ1.Caption = GetProjCSJ(sSQL, "DOT_PROJ_NBR")
   sSQL = "SELECT DOT_PROJ_NBR FROM [TxDOT 2 UCM] WHERE UTIL_
     CNFLT_NBR >= 4 "
   lbCSJ2.Caption = GetProjCSJ(sSQL, "DOT_PROJ_NBR")
   sSQL = "SELECT DP.DOT_PROJ_DSCR FROM DOT_PROJ DP INNER JOIN
     [TxDOT 2 UCM] TQ ON DP.DOT_PROJ_NBR = TQ.DOT_PROJ_NBR WHERE
     UTIL_CNFLT_NBR < 4 "
   lbDesc1.Caption = GetProjDesc(sSQL, "DOT_PROJ_DSCR")
   sSQL = "SELECT DP.DOT_PROJ_DSCR FROM DOT_PROJ DP INNER JOIN
     [TxDOT 2 UCM] TQ ON DP.DOT_PROJ_NBR = TQ.DOT_PROJ_NBR WHERE
     UTIL_CNFLT_NBR >= 4 "
   lbDesc2.Caption = GetProjDesc(sSQL, "DOT_PROJ_DSCR")
End Sub

Private Function GetProjCSJ(strSQL As String, OutputFld As String)
   Dim db As Database
   Dim rs As DAO.Recordset
   Dim sSQL As String
   Dim sResult As String
   Set db = CurrentDb()
   Set rs = db.OpenRecordset(strSQL)
   sResult = rs(OutputFld)
   rs.Close
   Set rs = Nothing
   GetProjCSJ = FormatCSJ(sResult)
End Function

Public Function FormatCSJ(CSJ As String) As String
   Dim TempCSJ As String
   TempCSJ = Right("0000000000" & CSJ, 9)
   TempCSJ = Left(TempCSJ, 3) & "-" & Mid(TempCSJ, 4, 2) & "-" &
     Right(TempCSJ, 4)
   FormatCSJ = TempCSJ
End Function

Private Function GetProjDesc(strSQL As String, OutputFld As String)
   Dim db As Database
   Dim rs As DAO.Recordset
   Dim sSQL As String
   Dim sResult As String
   Set db = CurrentDb()
   Set rs = db.OpenRecordset(strSQL)
   sResult = rs(OutputFld)
   rs.Close
   Set rs = Nothing
   GetProjDesc = sResult
End Function
```

TxDOT District: Houston

CSJ: 050-80-1166 IH 10: from Gelhorn to Mercury Dr.

CSJ: 002-80-2081 US 90: from IH 10 to 0.29 miles west of Mercury Dr.

Texas UCM

Wednesday, November 24, 2010

1:46:25 PM

Item Number	Owner	Utility	Utility Size Material	Location	Crossing	Conflict	Sheet Number	Conflict Status	Estimated Conflict Resolution Date	Agreement Assembly	Agreement Status	Agreement Submittal Date	Comments
1	Centerpoint Energy	Electrical Conduit	18" Conduit Duct	115+36, US 90	Underground	Proposed pavement, ditch.	Utility Sketch - Centerpoint Electric Sheet 1 of 1	Document received	3/1/2006	JUA A	Agreement Submittal	5/17/2010	CPEE completed design.
2	Centerpoint Energy	Transmission Tower	N/A	115+57, US 90	Underground	Proposed pavement.	Utility Sketch - Centerpoint Transmission Sheet 1 of 1	Document received		JUA B			CPEE completed design.
3	Centerpoint Energy	Transmission Lines	N/A	114+56	Overhead	Minimum clearance requirement.	Utility Sketch - Centerpoint Transmission Sheet 1 of 1	Document received		JUA A	Agreement Approval or Execution	5/17/2010	CPEE completed design.
4	Centerpoint Energy	Distribution Line	N/A	IH 10 at Oates Rd	Overhead	Minimum clearance requirement.		Utility conflict resolved	1/12/2006	JUA B			CPEE completed design.
5	Centerpoint Energy	Distribution Line	N/A	102+00, US 90 WBFR	Overhead	Minimum clearance requirement.		Utility conflict identified		JUA B			CPEE completed design.
6	Centerpoint Energy	Distribution Line	N/A	129+00, US 90	Overhead	Minimum clearance requirement, proposed bridge at Oates Rd.	Utility Sketch - Centerpoint Distribution Sheet 1 of 1	Document received		JUA B			CPEE completed design.

Figure D.44. "Texas UCM" report.

Related SHRP 2 Research

Encouraging Innovation in Locating and Characterizing Underground Utilities (R01)

Technologies to Support Storage, Retrieval, and Utilization of 3-D Utility Location Data (R01A)

The Process of Managing Risk on Rapid Renewal Contracts (R09)

Project Management Strategies for Complex Projects (R10)

Integrating the Priorities of Transportation Agencies and Utility Companies (R15)