DEVELOPMENT OF A RIGHT-OF-WAY COST ESTIMATION AND COST ESTIMATE MANAGEMENT PROCESS FRAMEWORK FOR HIGHWAY PROJECTS

A Thesis

by

MATTHEW A. LUCAS

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

December 2007

Major Subject: Civil Engineering

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Approved by:

Chair of Committee,	Stuart Anderson
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ABSTRACT

Development of a Right-of-Way Cost Estimation and Cost Estimate Management Process Framework for Highway Projects. (December 2007)

Matthew A. Lucas, B.S., Texas A&M University

Chair of Advisory Committee: Dr. Stuart D. Anderson

Escalation of right-of-way (ROW) costs have been shown to be a prime contributor to project cost escalation in the highway industry. Two problems contribute to ROW cost escalation: 1) the ROW cost estimation and cost estimate management process generally lacks structure and definition as compared to other areas of cost estimation; and 2) there is a lack of integration and communication between those responsible for ROW cost estimating and those responsible for general project cost estimating. The research for this thesis was preceded by a literature review to establish the basis for the study. Data collection was completed through interviews of seven state highway agencies (SHAs) and two local public agencies (LPAs). The findings of the research are presented in a set of ROW flowcharts which document the steps, inputs, and outputs of the ROW cost estimation and cost estimate management process.

Three ROW cost estimates and a cost management process take place throughout project development. An effort was made from the onset of the research to relate the ROW cost estimating and cost estimate management process to the first four project development phases (planning, programming. preliminary design, and final design). There are five flowcharts produced as a result of this research: 1) an agency-level flowchart showing all cost estimates and the interaction of ROW with the project development process; 2) a conceptual ROW cost estimating flowchart which depicts the required steps during planning; 3) a baseline ROW cost estimating flowchart which depicts the required steps during programming; 4) an update ROW cost estimating flowchart which depicts the required steps during preliminary design to include a cost

estimate management loop; and 5) a ROW cost management flowchart which depicts the required steps during final design.

Although selected SHA contacts provided input following the development of the flowcharts, the flowcharts were only validated to a limited extent due to time and budget constraints. These flowcharts attempt to address the two contributing problems to ROW cost escalation by providing structure to the ROW cost estimation process and by developing the ROW process flowcharts linked to the project development process. Based on the input provided by SHA contacts, the flowcharts appear to have the potential to provide guidance to SHAs in improving the accuracy of ROW cost estimates through addressing these two problems.

To my family and friends
for all their love and support.

To the love of my life, Tori,
for many years and memories to come.

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Although this research was conducted under the sponsorship of the National Cooperative Highway Research Program, this thesis does not necessarily indicate acceptance of its contents, either inferred or expressed herein, by the NCHRP.

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CHAPTER I
INTRODUCTION

Historically, a large portion of transportation projects have been underestimated (U.S. General Accounting Office, 1997; Flyvbjerg et al., 2002). Approximately 50 percent of the active large transportation projects in the United States have overrun their initial budgets. This problem is complex and difficult to address because the duration of the time span between the initiation of a project and the completion of construction often spans many years. Cost estimation of right of way (ROW) has been shown to be a specific area in which cost escalation is occurring. ROW cost estimates are impacted by many factors throughout the project development process during which multiple estimates are completed. One of the major problems is the lack of structure within the ROW cost estimation and cost management process. This thesis documents the research effort to examine the ROW cost estimation and cost estimate management process and the complexities within. Findings of the research are documented in this thesis through an in-depth analysis of the problems impacting ROW costs and practices of ROW cost estimating. A set of five ROW flowcharts depicting the ROW cost estimation and management process is the primary contribution of this research effort. These flowcharts have the potential to aid state highway agencies in reducing project cost escalation due to increasing cost of land acquisitions.

BACKGROUND

State Highway Agencies (SHAs) have recognized that project cost escalation is a pervasive problem and have sought solutions through research efforts supported by American Association of State Highway and Transportation Officials (AASHTO) and the National Cooperative Highway Research Program (NCHRP). Subsequently, this

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research was conducted under Phase II of NCHRP Project 8-49, *ROW Methods and Tools to Control Project Cost Escalation,* which focuses specifically on cost escalation issues related to ROW. Its precursor, NCHRP Project 8-49 Phase I,, *Cost Estimation and Management for Highway Projects During Planning, Programming, and Preconstruction* focused on the larger issue of general project cost escalation and produced a Guidebook, Report 574 that describes a strategic approach to highway cost estimating and cost estimate management (Anderson et al., 2007a). The aim of Report 574 is to provide SHA's guidance for structuring their estimating and cost management processes to achieve estimate consistency and accuracy. It addresses estimating issues during all phases of project development: planning, programming, preliminary design, and final design. In addition, Report 574 provides appropriate strategies, methods, and tools to develop, track, and document realistic cost estimates during each phase of project development.

Phase I of Project 8-49 and other estimating studies identified right-of-way (ROW) cost estimating and management of right-of-way estimates as areas critical to achieving consistency and accuracy in project cost projections. Phase I findings, which are based on a critical review of estimating literature, recent estimating research, and current estimating practice, suggested that a major component of overall project cost escalation is related to ROW. The Phase II NCHRP Project 8-49 problem statement has identified the following, specifically related to right of way:

- Due to influencing factors, actual expenditures for project right of way are frequently greater than the cost estimate produced during the initial stage of project development;
- Management of these influencing factors and the right-of-way estimating process has the potential to significantly contribute to cost estimate consistency and accuracy throughout the project development process;
- There is an opportunity to develop right-of-way specific cost estimating process steps that are based on successful SHA practices from around the country; and

- There is a need to provide specific guidance on how to minimize controllable influencing factors and implement strategies, methods, and tools such that improved right-of-way estimates can be achieved.

PROBLEM STATEMENT

Cost escalation has been shown by the previous Phase I work of 8-49 that cost escalation is a common occurrence in the highway industry. Furthermore, it indicated that one of the problematic areas of cost estimation is the cost estimation and management of ROW. In addition to this major issue, the research team working on Phase II of the research identified the other problems very early in the research:

1. The ROW cost estimation and cost estimate management process generally lacks structure and definition as compared to other areas of cost estimation;
2. There is a lack of integration and communication between those responsible for ROW cost estimating and those responsible for general project cost estimating.

The cost estimation of ROW is a complex process that is impacted by many factors and other issues which make it difficult to determine an accurate cost value. The above problems are further compounded by issues specific to ROW estimating, such as:

- Future highest and best use of the property;
- Damages due to partial takings of properties;
- Potential development of the property during the time interval between the cost estimate and actual acquisition;
- The number of parcels that proceed to eminent domain and the associated costs of such a process; and
- Inadequate project scope definition and information on parcels during the planning and programming phases of project development.

These issues will be further discussed later in this thesis. Another issue that impacts a ROW cost estimate and complicating the uncertainties listed above is the human factor

related to acquiring property for highway projects. The "human factor" can be defined as the uncertainty and unpredictability related to dealing with property owners when a public agency is attempting to acquire a property. The reaction of individuals affected by the proposed project is difficult to predict. The impacts of all these factors are intensified because of drastically appreciating land values throughout the nation. Therefore, this research proposes a structured process approach for ROW estimating that seeks to mitigate and also account for some of these issues and respond to the problems discussed above.

RESEARCH QUESTIONS

The research problem raises several questions related to the ROW cost estimation and cost estimate management process. These questions are:

- What are the critical issues impacting the right-of-way cost estimation and cost estimate management process?
- Do current SHA practices address the problem of cost escalation related to land acquisition? If so, how?
- What tools and methods are in use by SHAs that address the cost escalation issue related to land acquisition?
- How can the general project cost estimation and estimate management steps of Phase I of the NCHRP Project 8-49 be applied to ROW cost estimation?
- What steps, inputs, and outputs make up an effective ROW cost estimation and cost estimate management process?

RESEARCH OBJECTIVES

In order to address the transportation industry's problems associated with cost estimation and management of ROW estimates several objectives were established to guide the research. The first objective is to document current ROW cost estimation and cost estimate management practices. The second objective of the research is to identify

critical issues and notable practices throughout the ROW process. The third and final objective is to develop a process which integrates the general project cost estimation and management steps of Phase I of the NCHRP Project 8-49 by utilizing flowchart techniques. The flowcharts will include steps, inputs, and outputs of the ROW cost estimation and cost estimate management process.

DELIMITATIONS

There are several limitations associated with this project. The limitation with the most impact was the issue of small sample size. The size of the budget and length of the research project restricted the number of SHAs that were contacted specifically about ROW estimating. This was addressed by acquiring contacts discovered through Phase I of the NCHRP 8-49 Project and with the help of FHWA Office of Real Estate Services. Experience from the previous research and recommendations from others provided the research team with valuable contacts with a large amount of experience and practices that the research team may draw upon. Additionally, 18 formal SHA interviews (Anderson et al., 2007b) had been conducted during the earlier phase of the NCHRP 8-49 project.

Other limitations are associated with the differences that exist from one SHA to the next, including differences in: organizational structure (centralized versus decentralized); terminology; acronyms; and project development phases. These issues were the most significant obstacle during actual interviews. Most notably was the difference in project development phases and the activities completed within the phases. It should be noted that the phases identified in the Phase I work may not be as definite as sometimes shown and they may overlap one another. In general, the ROW cost estimation process is complex and differs from SHA to SHA, and sometimes may even vary from district/region to district/region within a state agency. These differences and inconsistencies from SHA to SHA impacted the data collection and were addressed during interviews by taking detailed and thorough notes that document the specific attributes of a SHA relative to ROW cost estimation. The structure of the interview

protocol also played a role in dealing with these limitations. The unique environments in which each of the SHAs operate affected the research. The operating environment of each SHA is affected by state laws, politics, and social factors. Subsequently, these issues were addressed by specific questions in the interview protocol.

ORGANIZATION OF THE STUDY

This report consists of seven chapters. The first chapter discusses the problem and the basis for the study. The literature review makes up Chapter II while Chapter III concentrates on the how the research was completed. More specifically, Chapter III discusses the research methodology which consists of the research framework, how the data was collected through interviews, and the how the data analysis was completed. Chapter IV further discusses data collection, but concentrates on the different sources of data throughout the research. Chapter V discusses the results of the study through reporting the state of practice discovered through the interviews and then critically reviews the results. Chapter VI presents the ROW flowcharts developed as a result of this research and provides discussion on the basis and rationale of the flowcharts. Finally, the summary and conclusions of the study are found in Chapter VII.

CHAPTER II
LITERATURE REVIEW

The literature review establishes the basis for this research and was aimed at specifically targeting issues relevant to ROW cost estimation and management. The objective was to identify documented practices in the area of cost estimation and cost estimate management specifically relevant to the right-of-way component of project development. This review focused primarily on current literature and established the basis for later stages of the research.

The literature review included locating and reviewing information found in technical papers, reports, and other forms of documentation. The document sources included:

- General internet search engines;
- Transportation Research Board's TRIS Online (Transportation Research Information Systems);
- Academic databases, such as LexisNexis and Engineering Village 2;
- ASCE Civil Engineering database;
- Selected SHA websites; and
- Presentations and papers posted on AASHTO's Subcommittee on Right-of-Way and Utilities website.

The literature review concentrated on documenting and comparing factors and variables that impact right-of-way cost estimating such as project type, property value prior to the project, anticipation of future land use change, timeline, information available at the time of the estimate, and type of acquisition. Information related to the ROW cost estimation and cost management processes and tools in the literature were also surveyed. The accumulated information was reviewed, analyzed, and summarized. Although there is an abundance of literature that concentrates on the appraisal and acquisition of ROW,

the research team discovered only a limited amount of information in the literature that specifically related to ROW cost estimation and cost estimate management.

ROW COST ESTIMATION AND MANAGEMENT

The initial NCHRP 8-49 research identified ROW costs to be a critical driver in highway project cost escalation. This was further confirmed by the literature review herein. ROW cost estimation is a complex undertaking which is dependent on a magnitude of parameters that are difficult to quantify, even for an identifiable date only a few years in the future. Right-of-way cost estimates must attempt to capture all costs that affect the cost of acquiring the needed property. This is exceedingly difficult due to the uncertainties involved in many aspects of ROW acquisition. It is typically necessary to capture deterministic values for each parcel in the following categories:

- Land;
- Property improvements;
- Damages to property in partial takings;
- Utility relocation; and
- Relocation assistance.

The literature particularly stresses the difficulty in estimating ROW cost due to uncertainty in land appreciation and the issue of damages resulting from partial takings. Land values constantly fluctuate and future values are difficult to capture, especially in the case of estimates completed during the earliest stages of project development. Damages are affected by the size and shape of the remainder area, location of the remaining access points, reductions in highest and best use, and length of remaining frontage (Buffington et al., 1995).

In addition, takings by eminent domain or condemnation must be considered when developing an estimate as that process can cause an escalation in acquisition costs because of legal fees and the court's sympathy toward a land owner. Almost 80 percent of all acquisitions are completed without condemnation (CTC Associates and WisDOT,

2006) leaving about 20 percent of parcels, on average, that proceed to eminent domain. However, the percentage of properties proceeding to eminent domain increases when owner's legal fees are paid by the SHA (FHWA, 2006).

The US Supreme Court case of Kelo v. City of New London, which was decided in 2005 (Kelo, 2005), has had an impact on eminent domain expense throughout the nation (Cambridge Systematics, 2006). This case has changed costs, and related cost estimating methods, for right-of-way estimation. In short, the Kelo case involved the use of eminent domain by the city of New London, Connecticut for community redevelopment which benefited a private entity. The Court ruled 5-4 that the city's action was permissible under the Takings Clause of the Fifth Amendment. Following wide criticism of the ruling, 29 states enacted changes to their eminent domain laws in one or more of three ways: 1) restricting the use of eminent domain to certain situations; 2) requiring additional procedures when using eminent domain; and/or 3) defining or redefining certain terms associated with eminent domain (U.S. Government Accountability Office, 2006). Federal legislation was also passed in 2006 to address the issue of using Federal funds in eminent domain. Section 726 of *The Transportation, Treasury, Housing and Urban Development, The Judiciary, and Independent Agencies Appropriations Act of 2006* established that federal funds can only be utilized for public use where "public use" excludes economic redevelopment (Towcimak, 2006). Public use is further clarified "not be construed to include economic development that primarily benefits private entities" (Transportation, 2006).

New compensation requirements which benefit property owners have also been passed by some states since the Kelo decision (Feldman, 2007). These state acts address:

- Acquisition costs including appraisal fees, attorney fees, and expert witness fees;
- Relocation costs including actual costs of rebuilding structures and compensating business for loss of business; and
- "Supercompensation" payments, meaning paying a certain percentage over fair market value.

The accuracy of an estimate is also affected by time constraints placed on completing the estimate, the quality of information available, and project and parcel complexity. Accuracy suffers under estimate preparation time constraints because the estimator has a shorter amount of time to research reliable data. Similarly, the quality of available information can have a negative effect on the estimate since the estimate can only be as accurate as the information upon which it is based. In an attempt to improve ROW cost estimates, several tools and models for ROW cost estimation have been developed. Recently a cost estimation model was developed by Kockelman et al. (2004) in cooperation with TxDOT. Based on data from TxDOT and a commercial property database (CoStar) three models were developed. The accuracy of these Models in predicting parcel acquisition cost was acceptable in the case of agricultural and vacant parcels but the model lacked accuracy in the area of commercial and residential takings. Although the models were not accurate predictors in these areas, the authors argue that the tool may be used in budgeting for gross total ROW cost in a TxDOT District (Kockelman 2004).

Early ROW estimates are often approximations arrived at by using a percentage of the estimated construction cost (CTC Associates and WisDOT, 2006) or some other order of magnitude estimating technique. Project definition is frequently nebulous during the planning phase of project development; therefore ROW boundaries at this point are not well defined. Furthermore, there are typically multiple project alternatives being considered during the planning stage of project development. Alignment changes are likely and these may significantly affect the ROW cost estimate.

It was reported that early public involvement in the form of public meetings is beneficial because it allows the State Highway Agency to gauge the level of support for a project. This can serve as an indicator of the rate of condemnations and even the amount of contingency to include in the estimate (CTC Associates and WisDOT, 2006). A larger cost contingency might be necessary if public support is absent as this may be an indicator as to level of condemnation parcels that can be expected.

Selected SHA websites including those of the California, Florida, Georgia, Minnesota, Wisconsin, and Virginia Departments were searched for procedures and manuals on cost estimation of ROW and other aspects of ROW procurement. Much of the material reviewed on the SHA websites was related to appraisal and acquisition of property including procedures and forms used throughout the process. CalTrans devotes a chapter of its Right of Way Manual (Right, 2007) to ROW cost estimating. This information can be found online at www.dot.ca.gov/hq/row/rowman/manual/ch4.pdf (Estimating, 2007). The manual specifically discusses aspects of the estimate and general estimate information.

ROW APPRAISAL AND ACQUISITION

It should be emphasized again that much of the literature focuses on the appraisal and acquisition of the parcels as opposed to directly discussing cost estimation and cost estimate management. Kockelman discusses how the dollar amount for appraised property values is established through three methods: 1) the Sales Comparison Approach; 2) the Income Approach; and 3) the Cost Approach (Kockelman et al. 2004). These approaches vary in methodology and application. The Sales Comparison Approach in which comparable sales in the area establish the base dollar value of the property is by far the most common approach. The Income Approach is typically used in commercial or investment properties. It attempts to estimate the income that will be realized from the property. The Cost Approach is used when comparable sales cannot be found in the area and calculates the cost of replacement minus any depreciation of the existing structure.

The Uniform Act of 1970 (Uniform, 1997) governs the treatment of property owners for all Federally-funded projects by providing a set of procedures and standards for ROW acquisition. The major implementation of this act is that all property owners be justly compensated for there property and that they receive relocation assistance.

Condemnations are a concern when acquiring property since they have the potential to increase costs and delay the project. Condemnation rates (or the percentage

of properties which move to condemnation proceedings) vary from state to state. The FHWA notes that the percentage of parcels proceeding to condemnation can be potentially reduced by: 1) the use of mediation methods between the property owners and public agency; 2) the use of well trained ROW agents handling acquisitions who have the authority to negotiate settlements; and 3) the use of quick settlements in lieu of allowing the property owner a long period of time to consider the offer (FHWA Office of Real Estate Services, 2006)

Hakimi and Kockelman (2006) discuss best acquisition processes while considering the uniqueness of each state depending on political, social, environmental, and other factors. They recommend that the public should be contacted early in the process and that states should update laws and statutes to outline compensable items with the goal to streamline the acquisition process. Additionally, special acquisition techniques such as land exchange, land consolidation, and advanced acquisition should be utilized.

In summary, the method of right-of-way appraisal and acquisition can affect the accuracy and consistency of cost estimation and cost estimate management. The method of appraisal and acquisition should be understood by the cost estimator. The appraisal and acquisition methods should also be integrated into the overall project development process. As noted in the literature review of cost escalation factors completed in the NCHRP 8-49 research, inaccuracies and/or delays in right-of-way acquisitions can have a profound impact on project cost escalation.

CHAPTER SUMMARY

The literature review provided a basis to begin the research even though there is only a limited amount of literature available on ROW cost estimation. ROW appraisals and acquisitions make up a large portion of the literature found through the search. The ROW cost estimation literature that was discovered was limited to several statistical estimating models, discussion of the impact of the Kelo case, and provided several piecewise descriptions of the line items of an estimate. It did provide some good

information on the impacts of condemnations, land appreciation, and damages have on the cost of acquiring a property. The research methodology used to examine the ROW cost estimation and estimate management process following the literature is discussed in the next chapter, Chapter III.

CHAPTER III
RESEARCH METHODOLOGY

The research methodology serves as a road map by which the research objective was accomplished. The methodology includes establishing the research framework, collecting data, and finally, data analysis. This chapter first discusses the research framework which is a product of previous research, the literature review, and the problem statement of this study. It essentially sets the context in which the study was performed. An interview protocol was developed to perform data collection through the interviews of state highway agencies and other acquiring agencies. Data analysis was completed throughout the interviews and includes critically reviewing all collected data.

RESEARCH FRAMEWORK

In order to achieve the research objectives in a systematic and effective manner, a research framework was required for this study. The research framework in this right-of-way study is similar to that utilized in the earlier phase of the Project 8-49 research which is documented in NCHRP Report 98 (Anderson et al., 2007b). This research focuses more on the process instead of taking on a strategic approach. Report 98 is the research report documenting the research behind the development of NCHRP Report 574 (General project cost estimating Guidebook). Although Phase I of 8-49 did address ROW cost estimating to some extent, the project's scope did not allow for an in-depth treatment of this specialized area. Therefore, the goal of Phase II of NCHRP Project 8-49 is to provide a more in-depth analysis of the current practices of ROW cost estimating with a focus on the existing problems causing cost escalation of highway projects. The main deliverable of the NCHRP research Phase II project is a set of procedures for ROW cost estimation and cost estimate management in the form of a ROW Procedures Guide. The Procedures Guide will be produced as a "how to" to ROW cost estimation and management which includes tools discovered through interviews of state highway

agencies (SHAs). It is intended to be supplemental to the general project cost estimating Guidebook developed in Phase I of the project.

The research for this thesis was conducted in parallel with Phase II of Project 8-49. Therefore, the research was governed by several aspects of the project and guided by similar objectives. Since the major deliverable of 8-49 Phase II is the ROW Procedures Guide, the first aspect that governed this thesis was the approach used while examining ROW cost estimation and management. The research was completed in a manner that establishes a process which can be modeled in a user-friendly and easy to read manner using flowchart techniques. Secondly, the research was conducted in relation to the project development phases documented in NCHRP Report 574. Both of these aspects also involve integrating the general project cost estimation steps of 574. Given that the phase II ROW research is a product of the phase I findings and is intended to be compatible, the motivation behind the last two aspects is to establish a link to the previous Phase I findings. Both of these aspects will be further expanded upon in the following subsections.

In order to establish the framework, the end product of this thesis effort must also be considered throughout the research. A set of flowcharts that document the ROW cost estimation and cost estimate management process is the primary contribution of this thesis. These flowcharts establish the basis of the ROW Procedures Guide of the NCHRP Project 8-49 research, but differ to some extent. Where the ROW Procedures Guide provides a high level of detail into how each of the process steps should be performed as “how to” steps, the flowcharts are limited to only documenting the findings of the interviews and to provide general guidance on ROW cost estimation. The flowcharts produced as part of this thesis map the steps and inputs and outputs of the ROW cost estimation process integrated with the general cost estimation and management steps and developed in relation to the project development phases documented in NCHRP Report 574. The purpose of this thesis research is similarly to examine the ROW cost estimation process relative to the project development phases.

Project Development Phases

In general, this research followed an approach that focused on a process instead of focusing on strategies as the Phase I research did. As previously mentioned, the process-focused approach involves structuring the research framework around the first four project development phases (planning, programming, preliminary design, and final design). These phases were used to structure the data collection strategies, including the design of the interview protocol and the approach utilized during interviews. The results of this study were also analyzed based upon these phases. Furthermore, the ROW flowcharts were developed to communicate the relationship between the ROW cost estimation and management process and the project development process.

As documented and discussed in the NCHRP Reports 574 (Anderson et al., 2007a), estimates are made at various times during the project development process. NCHRP Project 8-49 defined the project development phases as: planning, programming, preliminary design, final design, advertise & bid, and construction. Figure 1 and Table 1 illustrate this process and define the typical activities for each of these phases.

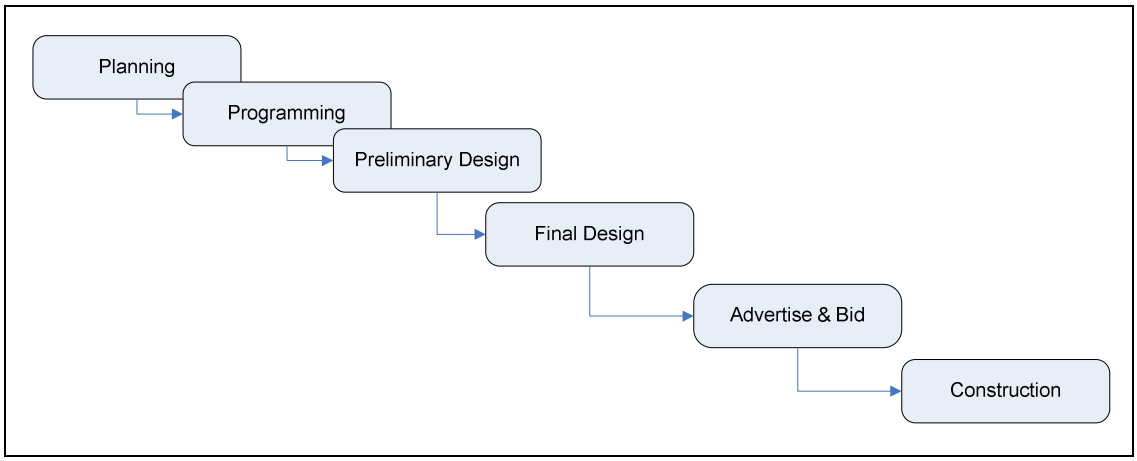

Figure 1. Typical project development phases for highway projects (Anderson et al., 2007a)

Table 1. Development phases and typical activities of a highway construction project (Anderson and Blaschke 2004; Anderson et al., 2007a)

Development Phases	Typical Activities
Planning	Purpose and need; improvement or requirement studies; environmental considerations; right of way considerations; public involvement/participation; interagency conditions.
Programming	Environmental analysis; schematic development; public hearings; right of way impact; project economic feasibility and funding authorization.
Preliminary Design	Right of way development; environmental clearance; design criteria and parameters; surveys/utility locations/drainage; preliminary plans such as alternative selections; geometric alignments; bridge layouts.
Final Design	Right of way acquisitions; PS&E development – final pavement and bridge design, traffic control plans, utility drawings, hydraulics studies/drainage design, final cost estimates.
Advertise and Bid	Prepare contract documents, advertise for bid, pre-bid conference; receive and analyze bids.
Construction	Determine lowest responsive bidder, initiate contract, mobilization; inspection and materials testing; contract administration; traffic control, bridge, pavement, drainage construction.

Although Phase I of NCHRP Project 8-49 identified six of the described project development phases in Table 1, ROW cost estimation and cost estimate management typically span the first four project development phases (planning, programming, preliminary design, and final design). Consequently, this research concentrated on ROW cost estimates and cost management completed during each of these four phases. These four project development phases were utilized during data collection and analysis and development of the ROW flowcharts as a timeline by which to relate the ROW process steps, inputs, and outputs. In other words, the phases serve as benchmarks during project development. Report 574 noted that actual phase length, activities of each phase, and terminology vary between state highway agencies (SHAs) and possibly, projects. Consequently, it was important to take this into account throughout the research.

Throughout the research it was necessary to understand that SHAs are not alike. There are many differences related to the project development phases, terminology used to define the phases and activities within each phase, and their ROW cost estimation processes. This is further complicated by differences in state laws and other factors that are unique to each state. These issues are important to consider throughout the research and are discussed in this thesis, when applicable.

General Project Cost Estimation and Management Steps

In order to produce a consistent and accurate cost estimate, a set of steps are typically performed in some systematic manner. NCHRP Report 574 documents a set of nine cost estimation and management steps developed as a result of the Project 8-49 Phase I research. These steps include (Anderson et al., 2007a):

1. Determine Estimate Basis;
2. Prepare Estimate;
3. Determine Risk/Contingency;
4. Review Estimate;
5. Obtain Appropriate Approval;
6. Determine Estimate Communication Approach;
7. Monitor Project Scope/Project Conditions;
8. Communicate Estimate and Approval; and
9. Adjust Cost Estimate.

The first four of the above steps are defined in Report 574 as cost estimating steps, while steps 5 through step 9 are cost estimating management steps. This distinction is important to make although the manner in which these steps are performed varies depending on the project development phase. The cost estimation steps can be categorized as such since the activities are those that must typically be completed to

produce the actual cost estimate value. Contrastingly, the management steps occur to manage the estimate process and the cost estimates generated throughout project development (Anderson et al., 2007a). These steps support the preparation of consistent and accurate estimates throughout the whole project development process. Accordingly, they were applied to ROW cost estimation as applicable throughout data collection and analysis and development of the flowcharts. For further details of the general project cost estimation and estimate management steps, the four phases of project development documented in NCHRP Report 574 (Anderson et al., 2007a) can be found in Appendix A.

DATA COLLECTION

Following completion of the literature review and establishment of the research framework, data collection was addressed. The literature review produced only a limited amount of information related to ROW cost estimation. Therefore, data was collected through interviews of State Highway Agencies (SHAs) and other potential sources including the Federal Highway Administration (FHWA), Metropolitan Planning Organizations (MPOs), and Local Public Agencies (LPAs). The objective during data collection was to identify and document current practices in the right-of-way cost estimation and cost estimate management areas. Several follow-up interviews were also conducted over the phone to discuss any issues unclear following on-site interviews.

Interview Protocol

An interview protocol was developed to guide data collection during interviews. The objective of the interview protocol was to capture successful practices including ROW cost estimation process steps and tools. It was modeled after the interview protocol used during NCHRP Project 8-49. Questions were developed based upon findings of the literature review completed as part of this study. In particular, the literature review findings identified problem areas that needed to be addressed through the interviews.

The protocol covered six areas and consisted of 15 questions. Additionally, the areas of interest to this research were similar to those in the original NCHRP Project 8-49, but were more specific to right-of-way issues. The interview questions examined six areas within ROW cost estimation and cost estimating management:

1. Determining Right-of-Way Requirements;
2. ROW Cost Estimate Preparation;
3. ROW Cost Estimate Reviews;
4. ROW Cost Estimate Communication;
5. ROW Cost Estimate Management; and
6. State Laws & Other Factors that affect the Right-of-Way process.

The six areas of interest in the above list governed the organization of the protocol. Section 1 of the interview protocol explored the process steps and tools employed by the SHAs to determine ROW requirements. Based on these steps and tools, Section 2 examined how ROW estimators produced estimates for the defined ROW requirements. More specifically, it addressed policies and procedures guiding estimate preparation, the elements of each estimate, how environmental issues were handled in the estimate, whether risk and uncertainty was considered, and if contingency was applied to the estimates. Estimate review processes and practices were the focus of Section 3 of the interview protocol. Section 4 addressed the issue of estimate communication and included training of estimators and communication of estimating procedures. Additionally, Section 4 covered the issue of making contact with property owners. Section 5 of the interview protocol focused on how differences were reconciled between estimates, the procedures for handling changes in ROW requirements, and triggers for an update to cost estimates. The effect of state laws and other factors like environmental, political, and social issues on the ROW process and estimates were addressed in Section 6. Additionally, the effects of acquisition techniques such as advanced acquisition, incentive offers, and other non-standard techniques on estimating ROW costs were also explored in Section 6.

The protocol was prefaced by several introductory pages which confirmed the interview time and date, outlined the background of the research, and provided instructions and interview expectations. The background material covered previous NCHRP 8-49 findings relative to the ROW including a discussion of the typical project development phases relevant to ROW and the basis for the ROW research. The instruction and interview expectation sections outlined such aspects of the interview as the phased approach to be employed relative to each of the questions during the interview and other details. Included in the interview package were the project development phase flowcharts for planning, programming, preliminary design, and final design that had been developed during the earlier NCHRP 8-49 work. These were included to bridge the terminology differences that exist between agencies and address some of the factors limiting this research, which were discussed in Chapter I. A copy of the interview protocol including all introductory material is provided in Appendix B.

Interview Process

Due to the complexity of the ROW cost estimation process and the information being collected from SHAs, onsite interviews were the main activity utilized for data collection. The option of a survey was ruled out because surveys would not provide adequate information describing the complex ROW cost estimation process. The majority of issues could not be answered with yes/no or multiple choice answers. It was necessary to acquire in-depth information about the cost estimation process that included some elaboration and explanation on the part of the interview participants. Onsite interviews provided the opportunity to clearly communicate specifics about the process and provide the detail necessary for developing the ROW cost estimation and cost estimate management flowcharts.

Interviews were conducted with SHAs and other organizations that acquire ROW. The interview process focused on the four phases of project development to provide a frame of reference for linking the application of successful ROW practices to the project development timeline. This enabled effective data collection and helped to

identify differences as project development progresses. Contacts were acquired through Phase I of the NCHRP 8-49 Project and with the help of FHWA Office of Real Estate Services. 18 formal SHA interviews (Anderson et al., 2007b) had been conducted during the earlier phase of the NCHRP 8-49 project. Experience from the previous research and recommendations from others provided the research team with valuable contacts with a large amount of experience and successful practices from which the research could benefit. Some SHAs, especially large states, are highly decentralized and rely on the districts/regions within the state to manage projects and perform estimates. Therefore, when interviewing SHAs the research team attempted to capture perspectives from both central office right-of-way administrators and other administrators in districts/regions around the state. This provided the research team diverse perspectives on right-of-way cost estimation and related issues.

The first step in the interview process was to contact the agencies. Upon initial contact with the potential interview participants, the interview protocol was transmitted by email to the participants several days prior to the scheduled interview. This provided the participants a chance to review protocol and prepare for the interview. Interviews were set up in 2 to 3 hour blocks to allow for ample time to cover the entire process from the first estimate at planning to the activities of final design.

In most cases, the interview was conducted by two individuals from the research team. One member would typically act as facilitator while the other would take detailed notes but would also take an active part in the interview. The first 15 minutes of the interview typically consisted of introductions, a summary of the research background and framework, the objective of the research, and statement of the research team's expectations of the interview. Additionally, the status of the project and findings of previous interviews were summarized to provide the participants with the current status and direction of the research project. Following the introductory portion of the interview, the logical place to begin was to probe the participants for information regarding the SHA's unique project development process and special terminology used. This served to provide the research team a base point to ask questions and to relate participant answers

to the projects general project development phases (planning, programming, preliminary design, and final design). Then the facilitator would guide the interview towards the first estimate completed for ROW. From this point on, a discussion proceeded in which interview participants would tell the "story" behind the SHA's ROW cost estimation process. As the interview was coming to a close, issues not yet covered were addressed using the interview protocol as a checklist. The members of the research team would typically use the time following the interview to make additional notes on general impressions of the interview. All details were recorded in the interview protocol under the related questions.

DATA ANALYSIS

Data analysis was completed as a critical review. The critical review consisted of evaluating the information presented in the literature and the data collected during the SHA interviews. SHA interviews were the primary focus of data analyses since the literature revealed only limited information on cost estimation and cost estimate management. When critically reviewing all collected data, the research questions were closely considered. The review led to the identification of successful SHA practices in ROW cost estimation and cost estimate management based upon the criteria set fourth by the research questions and objectives. The data analysis concentrated on identifying:

- Critical issues impacting the ROW cost estimating process;
- Practices, tools, and methods that address the cost escalation issue; and
- Steps, inputs, and outputs of effective ROW cost estimation and cost estimate management.

This was accomplished by reviewing each of the interview records in detail, completed at two different times. A preliminary review was completed following each of the interviews to identify practices to discuss and potentially confirm with other SHAs in subsequent interviews. This preliminary review also identified successful practices that could be integrated into the draft ROW flowcharts. A final detailed review occurred

following the completion of all interviews. This review consisted of organizing all of the interview data based upon interview question and project development phase so that an in-depth comparison of all SHA practices could be completed.

Flowchart techniques were additionally utilized to categorize and review the materials since the primary deliverable of this study is a set of ROW flowcharts that document the cost estimation and cost estimate management process. The data collected was systematically documented and synthesized into four areas: 1) inputs into the process; 2) outputs of the process; 3) steps that make up the process; and 4) decision milestones that mark a point in which a decision must be made. Additionally, loops associated with the decision milestone that represent cycles within the process were documented, when applicable. The general approach behind the flowchart technique used in this research is represented below in Figure 2.

Generally, a primary input in the form of information or data initiates the process. The primary input in the form of some type of information or data follows a set path of the process, which is represented by an arrow. The process consists of a set of steps or activities which convert inputs into outputs. Throughout the execution of these process steps, secondary inputs enter the system from outside of the system. At some point, the process reaches a decision milestone where the flow of information either continues to the next process step or is returned back to a previous step for further development. At the end of the process, the information is transmitted from the system as an output.

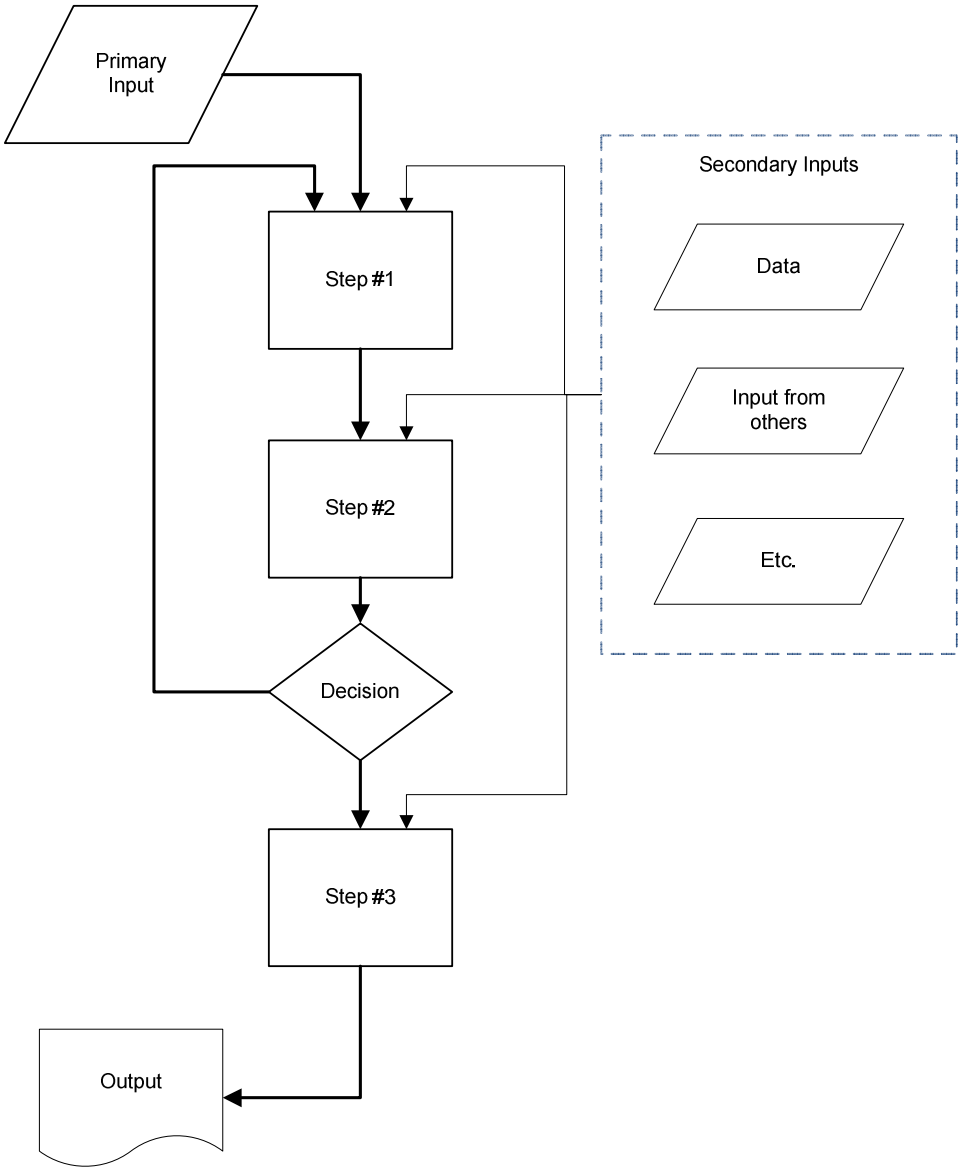

Figure 2. Typical flowchart approach

CHAPTER SUMMARY

This chapter presented the research methodology for the research documented in this thesis. The framework is limited to examining the ROW cost estimation process while considering the general cost estimation steps and project development phases

documented in NCHRP Report 574. Interviews of state highway agencies and other acquiring agencies were conducted based upon an interview protocol which served as the primary method of data collection. The data was consequently analyzed through a critical review considering the framework and the end result of this research: to produce ROW process flowcharts that document current practice to aid SHAs in ROW cost estimation and cost estimating management. Chapter IV will further discuss the data collection process which occurred during interviews.

CHAPTER IV
DATA COLLECTION

Following the literature review, data collection commenced. The main data collection thrust consisted of on-site interviews of seven SHAs and two local public agencies. In some cases, conference calls were conducted to follow up on any unclear issues. The goal of the interviews was to collect data on current ROW cost estimation and cost estimate management practices. The previous chapter discussed the research methodology. This chapter discusses the interviews in more detail beginning with the interview participants. The actual process of the on-site interviews is discussed followed by a short discussion of the documents collected at interviews. Additionally, early feedback on the ROW flowcharts was pursued during later interviews, and this is discussed as well.

INTERVIEW PARTICIPANTS

The seven SHA interviewed include: California, Florida, Georgia, Minnesota, Washington State, Wisconsin, and Virginia. SHAs were selected based upon input provided in Phase I of NCHRP Project 8-49. These SHAs appeared to have systematic and relatively successful ROW cost estimation practices from which the research could benefit. As noted in the methodology, interviews were completed with participants from both the central office and other ROW administrators in districts/regions around the state. In addition to interviewing SHAs, the City of Phoenix Street Transportation Department and the O'Hare Modernization Program Office of the City of Chicago were interviewed to provide other perspectives on ROW cost estimation and cost estimate management. A list of interview participants by position from each agency is provided in Table 2.

Table 2. Agency interview participants

Highway Agency	Interview Participants
California	Senior ROW Agent – Headquarters Office Senior ROW Agent – Headquarters Office Senior ROW Agent – North Region Senior ROW Agent – North Region Senior ROW Agent – District 3 ROW Manager – South Region Senior ROW Agent – South Region Associate ROW Agent – South Region ROW Agent – South Region ROW Estimator – South Region ROW Estimator – South Region
Georgia	Appraisal & Review Manager Manager, ROW Cost Estimates
Florida	Manager, Appraisal & Appraisal Review Director, Office of Right of way Deputy State Manager, Appraisal & Cost Estimating State Cost Estimating Administrator District One Cost Estimates Administrator (Bartow/Lakeland) District Seven Cost Estimates Administrator (Tampa)
Minnesota	Right-of-Way Program Manager – Central Office Assistant Director, R/E & Policy Development – Central Office ROW Engineer – District 1 ROW Engineer – District 2 ROW Engineer – District 3 ROW Engineer – District 4 ROW Engineer – District 5 ROW Engineer – District 6 ROW Engineer – District 7 ROW Engineer – District 8 ROW Engineer – Metro
Washington State	Assistant Director for Appraisal and Appraisal Review Program Appraisal Specialist, Olympia Region Appraiser, Olympia Region
Wisconsin	Real Estate Supervisor – SE Region Real Estate Supervisor – SE Region Real Estate Supervisor – NW Region Real Estate Supervisor – District 3 Real Estate Supervisor – District 5 Division Realty Office – FHWA
Virginia	Assistant Director ROW Manager
City of Chicago	Projects Administrator Relocation Manager Director of Public Affairs
City of Phoenix	Traffic engineering Supervisor Acting Assistant Real Estate Administrator

INTERVIEW PROCESS

In lieu of proceeding straight through the interview questions one by one, the majority of the interviews began with general discussions, which led into specific topics within the context of ROW cost estimation and cost estimate management. This practice was adopted during the first interview with the Minnesota Department of Transportation. That interview served as a "test" dialogue for the newly developed protocol. Consequently the protocol questions served more as a checklist to ensure that all issues were covered. Detailed notes were taken during interviews. Shortly following the interview, an interview report was prepared which consisted of filling out the protocol based on notes taken. An example of a completed interview report for a State DOT can be found in Appendix C. This allowed the team to capture and better understand the process for ROW cost estimation and cost estimate management utilized by the SHAs throughout all phases of project development. In addition to the on-site interviews, conference calls via telephone were utilized to follow up on any issues unclear after the initial interview.

DOCUMENTS COLLECTED

State highway agency ROW estimating tools were documented during interviews and any documents describing the tools or examples of the tools that the agency used were requested at the time of the interviews or in follow-up emails and telephone calls. The documents gathered ranged from cost estimate maps used to determine ROW requirements to cost estimate spreadsheets used in completing estimates. Screenshots of ROW tracking and estimate systems were also requested and provided by the SHAs. The SHAs were always asked for copies or web addresses of manuals, policies, and procedures that supported their ROW cost estimation and cost estimate management processes.

EARLY FLOWCHART FEEDBACK

Due to the expected iterative nature of developing the ROW flowcharts, an effort was made to begin developing draft flowcharts early in the interview process. These draft flowcharts were developed based upon the literature review and data from early interviews. Additionally, the general cost estimation and cost estimation management steps from NCHRP Project 8-49 Phase I were utilized to establish a general structure for the process steps.

Feedback on the draft ROW flowcharts was initiated approximately halfway through the interviews. The general project development phase diagrams from Phase I of the 8-49 research that were attached to the back of the interview protocol were replaced by the draft ROW flowcharts. The purpose of this was to begin receiving feedback on the flowcharts and identify differences in the cost estimation processes of SHAs. Towards the end of an on-site interview, the ROW flowcharts were discussed in detail with interview participants. Generally speaking, the flowcharts were reviewed one by one with the participants comparing the process shown on the flowcharts to the SHA's ROW cost estimation process. Comments were recorded as the interview participants were given the opportunity to suggest changes.

CHAPTER SUMMARY

This chapter provided an overview of the data collection process. Interview participants included seven SHAs and two local public agencies. Interviews were conducted in a way that was more conducive to general conversation which told the story of the process instead of directly following the interview protocol. Therefore, the process of each estimate was effectively understood and differences could be identified. Additionally, draft ROW flowcharts were integrated early in the interview process to receive feedback of participants during interviews. Chapter V presents, and critically reviews, the state of practice.

CHAPTER V
RESULTS AND ANALYSIS

This chapter is made up of two main sections: 1) results of the SHA interviews which covers the state of practice of SHA ROW cost estimation and cost estimate management; and 2) analysis of the results which critically reviews the SHA practices. The data collected through the literature review and the interviews establish the state of practice for ROW cost estimation and cost management. Critical issues of ROW cost estimation were identified through the interviews to be difficult to estimate and/or crucial in preparing an accurate estimate. The results section will discuss these followed by the general state of practice. The state of practice is summarized based upon the project development phases previously mentioned.

Interviews suggest that there are three ROW estimates and a cost management process performed during throughout project development. In order to analyze the data and information collected, the project development phases were also utilized while critically reviewing the SHA practices. All data was critically reviewed in a way that links the SHA practices to a project development phase and to the corresponding ROW estimate or the cost management process. The analysis section presents the critical review in this manner, by project development phase. The chapter is concluded by presenting notable SHA practices discovered through the analysis portion of the research.

RESULTS: ROW ESTIMATION STATE OF PRACTICE

The main objective behind the interviews was to gain an overview of the state of practice in the highway industry. Successful SHA and local public agency practices in estimating and managing right-of-way costs were examined in detail. Data was assembled on process steps and tools in relation to the project development phases. This section first discusses critical issues found through interviews followed by an overview of current practice.

Critical Issues

Critical issues relating to ROW estimating were identified during the interviews as those most difficult to estimate or issues that may have a significant impact (good or bad) on creating an accurate estimate. Based on the responses of the interview participants, the most notable critical issues include (not presented in an order of importance or priority rank):

- Estimation of:
    - Condemnations; and
    - Damages;
- Inflation and other market conditions;
- Risk analysis and assigned contingency;
- Scope definition;
- Estimating tools; and
- Estimator experience and knowledge.

Condemnations

Estimating the costs of condemnations is very difficult because of two major factors. First, there is the issue of determining the number of condemnations, or what percentage of parcels will move to condemnation proceedings. FHWA Office of Real Estate Services' report on state condemnation practices (2006) reported that approximately 80 percent of acquisitions are completed without condemnation while FHWA online data reported 12.5% for 2004 and 12 percent for 2005 (FHWA, 2007). These variables are study specific and may vary drastically between projects, between regions/districts, or even within regions/districts. As discussed previously in the literature review, the condemnation rate is heavily dependent on state laws governing the process and whether the public agency is responsible for paying acquisition costs of the

property owner such as appraisals, expert witnesses, and other legal fees (FHWA Office of Real Estate Services, 2006). The second issue is the actual cost of the condemnation proceedings. These costs include attorney fees, court costs, and the final condemnation award. Additionally, states have specific laws concerning condemnations. In one state it is the financial responsibility of the acquiring agency to reimburse the property owner for an independent appraisal if such is requested by an owner. This stipulation is a result of the Supreme Court Kelo decision. In fact, condemnations may actually cost the project more than just money; they may cost the project valuable time as proceedings can delay the project schedule. Time delays then impact estimated construction cost. The cost and rate of condemnations is heavily dependent on state laws and social factors that exist in a particular local.

Damages

Damages due to partial takings of a property were indicated by agencies to be one of the most difficult aspects of ROW estimating. Damages are defined in the FHWA "Guide for Local Public Agencies" (2001) as a "loss in value of the remaining property" following a partial take of property (Kockelman et al. 2004). Damages are primarily an issue in acquiring a portion of a business. The agency must not only compensate the business for the cost of the land and the improvements to the property, but must also determine a just compensation for the negative effects upon the business. Assigning a cost to damages can be very subjective and many times, the accuracy of the estimated cost is dependent on the experience of the estimator.

Real Estate Inflation and Other Market Conditions

Assessing the potential impact of inflation and other related market conditions is a challenge. This is an issue in preparing cost estimates during every project development phase. Property values increase at rates different than the inflation rates for construction materials and labor. Properties in highly urban areas or areas where there is substantial growth potential may be subject to substantial increases in the market value

of land. The results of the interviews in this project were consistent with the interviews and data collection in Phase I of NCHRP Project 8-49 concerning inflation and other market conditions.

Risk Analysis and Assigned Contingency

The majority of agencies interviewed made no attempt to conduct a formal detailed risk analysis of items that could impact ROW cost although most agencies did assign contingency amounts in some manner. A detailed risk analysis can be defined as a systematic method of identifying and evaluating risks using a formalized agency procedure. The majority of agencies reported that they did not specifically address risk analysis in a formalized and documented procedure. Only two SHAs reported performing detailed risk analyses where specific project risks are identified and then addressed by some application of contingency. These two instances are presented later in the report. Risks for ROW may be associated with schedule, property inflation, condemnations, damages, and many other issues that exhibit uncertainty or may be unknown. Moreover, the use of contingencies is also an issue throughout the SHAs interviewed. Four SHAs reported the regular practice of applying a contingency to their ROW estimates: the two aforementioned states using detailed risk analysis and two others who explicitly assign a contingency. Other SHAs may apply contingency values subjectively based on the estimator's opinion or judgment about the cost estimate.

Scope Definition and Estimating Tools

Determining a project's ROW requirements early in the development process is problematic, particularly during the Planning phase (e.g. 10 to 20 years preceding construction). Phase I of NCHRP Project 8-49 found that actual cost of project right of way is frequently greater than the estimated cost that was projected during the early stages of project development. Two primary factors can explain this: 1) inadequate scope definition; and 2) the absence of effective tools and methods to complete ROW cost estimates. ROW estimates made during the planning phase of project development

are often solely based on a percentage of estimated construction costs. Agencies using this method maintain that the cost benefit is not substantial enough to invest manpower in more detailed ROW estimates at this early stage because limited project scope information is available, there are multiple alignments to consider, and there will be inevitable changes to the project as scope is refined as the project moves through the development process. This is not the case however with the Cities of Chicago and Phoenix which finance their projects with bond money and therefore must have accurate cost estimates before going to the bond market. Both cities work hard to define project scope in detail early in project development and to develop accurate early ROW cost estimates.

Estimator Experience and Knowledge

Estimator experience was consistently noted as having a large impact on the quality and accuracy of right-of-way cost estimates. The estimator's knowledge of the project area and surrounding market plays a role in many subtle ways in achieving estimate accuracy. SHAs are facing issues related to personnel turnover, especially related to employees with 15 to 20 or even 30 years of experience in ROW cost estimating. These people are quickly reaching retirement and when they depart, invaluable experience and knowledge will be lost.

Overview of Current Practice

A ROW cost estimate is produced during each of the first three phases of project development: planning, programming, and preliminary design. Before preparation of the estimates, ROW requirements must be provided by planners or the project design team to establish the basis of the estimate. Following preliminary design, appraisals and acquisition typically commence. No further cost estimates are generated at final design, but ROW cost management should continue as purchases are executed. ROW cost management occurs during final design and is completed by comparing actual costs reflected in the appraisals and acquisitions to the estimated costs. If actual costs exceed

the estimated amount, the project manager is notified and action is taken to either request additional funds or to make design changes that reduce ROW cost.

The following subsections discuss the current and general state of practice relative to each of the project development phases. Current practices are discussed in a general manner that outlines the overall state of practice in the SHAs interviewed. Later in this chapter, specific successful practices will be covered and critical review of these practices is presented.

Determining ROW Requirements

The basis of a ROW cost estimate is the ROW requirements and this is dependent on the level of project scope definition. Even in the case of a planning-level right-of-way cost estimate where the estimate is based solely on a percentage of estimating construction cost, the right-of-way estimate is dependent on the planner's ability to develop an accurate scope definition. Typically, scope definition is clarified as the project development process proceeds from the initial planning phase to final design and construction.

The need for a project is typically defined in the initial project development phase of planning where scope definition is often nothing more than a statement of purpose and need. The scope at this point in time is expressed in very general or broad terms and usually consists of only an approximate number of lanes or a width, several potential alignments, with little definitive supporting information available. A ROW estimator is typically not involved at this stage, and it was found that ROW estimates are often completed within the agency's Planning Division and not the responsibility of the ROW Division. As previously stated, a percent of the estimated construction cost is often used at this point in the process.

At the programming phase of project development the scope of the project has been further defined and usually an alignment relating to right-of-way needs has been selected. In the case of most SHAs, the ROW division or group will receive a request from the project manager for a ROW cost estimate. This request is often accompanied

by an aerial map or other visual representation of the project site with approximate ROW boundaries indicated. This aerial map defines the ROW requirements for the project. The total area to be acquired may also be indicated. In some cases SHAs reported that rough parcels would be indicated along with parcel areas, but this is not common practice at programming.

ROW requirements during preliminary design are reflected in an updated aerial map or a preliminary drawing provided by the design engineers. The map typically shows the refined ROW boundaries, defines each parcel and shows parcel boundaries, and provides the areas required for each parcel.

Final ROW plans exist at the final design phase in which all ROW requirements are explicitly defined as parcels. No further estimates are completed at this point as ROW appraisals begin followed by acquisition of parcels. It is likely that some changes may occur during final design which will impact the ROW requirements, but these changes are typically minor. In that case, new ROW plans may be released and reconciliation of the cost changes occurs, if necessary.

General ROW Cost Estimating Practices

Planning

During planning, ROW estimates in most SHAs are usually limited to percentages of construction costs. Historical ROW costs from general databases or ROW cost from comparable projects may also be used to produce this estimate. Construction costs at planning estimated, as outlined in the NCHRP Report 574, are usually based upon lane-mile cost factors, and do not involve the ROW division. In general, project planning estimates are used for long-term budgeting. ROW value defined in the planning estimate appears to have minimal bearing on later estimates.

Programming

When preparing the programming estimate, a field visit to the project location is usually completed by the estimator. The ROW estimator assigned to complete this early estimate generally will walk or drive the project and make notes of pertinent details like improvements to be removed, potential damages due to partial takings, and the general topography of the project area. Improvements to be removed include any structure, pavement, outdoor sign, or any other enhancement to the property that is necessary to remove before construction begins. A determination must be made by the estimator related to the current use of the property since the land values may be drastically different for each of use. The estimator must determine whether the use of the property is commercial, industrial, residential, or agricultural land. The ROW estimator will prepare the estimate based on the ROW requirements per the aerial map and any data obtained during the project site visit.

SHAs typically follow some sort of cost estimate sheet, or checklist, to ensure that all elements affecting ROW costs are considered. This is the case for the estimate completed at programming, which usually sets the baseline budget (the estimate by which all other estimates are compared for cost management purposes). A cost estimate sheet will have line items for all elements to be included in the estimate. Typically the estimate elements are: 1) land; 2) improvements; 3) relocation costs; 4) damages; and 5) condemnations. These elements also make up the parts of the preliminary design.

Land values are established by comparable sales in the general project area using resources such as the tax assessor's records, area realtors, or commercial realtor databases. At this point in project development, the estimate is typically completed on a gross area basis. Therefore, the estimator is looking to establish a value to apply to the total ROW area on a price per acre or price per square-foot basis depending on the property use.

Improvements to the raw land and the condition of the existing site improvements must be included in the cost estimate. In addition to justly compensating a

land owner for their property, improvements such as buildings, outdoor signs, parking lots, etc. must also be included in the compensation.

Relocation costs for all displaced individuals and their belongings are included in the estimate. Most SHAs appear to have reasonable data for estimating relocation costs and apply a set dollar amount based on recent historical costs and depending on the type of displacement (business, residential owners, or residential tenants).

Damages are hard to estimate in almost every case. Estimating such cost requires judgment on the part of the estimator. A value must be assigned based upon the size, shape, and use of the parcel remainder. The estimator's experience and knowledge of the area are very important in establishing this dollar figure.

Condemnations are based on historical data and/or previous experience of the estimator in the project area. The condemnation rate (or the percentage of parcels that will proceed to condemnation) must be estimated in addition to the actual costs of those parcels that may proceed to condemnation. The condemnation rate differs drastically from state to state due to state laws adjudicating property rights and state laws governing condemnation proceedings. Condemnation rates are estimated based upon recent project experience in the area, but estimating the condemnation rates are still quite subjective since there is always a human factor involved. The "human factor" can be defined as the uncertainty and unpredictability related to dealing with property owners when an agency is attempting to acquire their property. The reaction of individuals to an agency acquiring property is difficult to predict. If the condemnation rate is estimated accurately, the cost of condemnations will usually be accurate since they are primarily based upon state laws.

Preliminary Design

At the preliminary design phase of project development the ROW cost estimate is further refined. In most cases, this is a completely new estimate developed by the right-of-way division personnel, but it may be an update of a previously developed estimate. This varies by SHAs practice. The estimator usually makes a project site visit to explore any issues not apparent from aerial photo or preliminary drawing defining the

ROW requirements. The project manager or project engineer will often accompany the ROW cost estimator to provide input on probable design scenarios that will impact the ROW and potential trade-offs between ROW and design may also be discussed.

Again, a cost estimate sheet is used in producing the estimate to insure that all aspects of ROW cost are included in the estimate. The same line items included in the programming estimate sheet are examined for this estimate but now in more detail (e.g. parcel information should be available by this point in project development). The preliminary design estimate is completed using parcel by parcel data where a cost is estimated for each individual parcel. This is the last cost estimate completed before the project's inclusion in the STIP. Consequently once the project is included in the STIP it is fiscally constrained.

Other than the estimates described here, update estimates m ay occur when major changes occur in project design. These changes, though, must be communicated to the ROW Division by the project manager or project engineers. Communication becomes important in this case. Many SHAs attempt to update estimates annually, but some SHAs noted that the small size of their right-of-way offices or groups of individuals is too small for a comprehensive annual update.

Final Design

Final ROW plans are released during the final design phase and appraisals begin followed by acquisition. No further cost estimates are prepared. In general, the ROW agents in charge of appraisals and acquisition will be aware of cost overruns, but requesting more funds seems to be the current practice instead of attempting to manage costs to the previously set budget. This is a major issue, which is addressed later in the analysis section of this chapter.

Review of a completed estimate during any of the project development phases is typically limited to a visual scan by the estimator's supervisor. In specific cases where the cost of ROW is extremely high in value, a division head may be required to sign off on the estimate. No SHA contacted had a formal and documented review process for ROW estimates. The ROW supervisor typically has many years of experience with

ROW estimates and performs a high-level review of the cost estimate by using "rules of thumb" and heuristics that they have developed through their years of estimating experience. This is completed by examining the major elements of the estimate which have a large impact on ROW cost. The supervisor then determines whether these elements of the estimate appear consistent with past cost experience and subsequently approves or disapproves.

State Laws and Other Factors

State laws and environmental, political, and social factors affect the ROW cost estimation process and impact ROW cost. The effects of these factors vary by state. The Kelo vs. City of New London case which went to the U.S. Supreme Court seems only to have affected SHAs to a limited extent as most highway agency practices were in conformance with the requirements prior to the case result. However, changes have been made to the eminent domain laws in several states. Interviews confirmed that some state legislatures have passed laws requiring the SHAs to reimburse property owners for private appraisals, attorney fees, and/or other acquisition costs up to a certain value. Furthermore, some states tightened ROW condemnation requirements in the areas of notification and time to response to SHA actions. All states have a defined process for condemnation proceedings and, depending on the state, condemnation actions have the potential to delay project construction starts.

ANALYSIS: CRITICAL REVIEW OF PRACTICES

This section provides a critical review of SHA practice in dealing with ROW estimation and management of ROW estimates. All practices discussed in the following sections were obtained through the literature review and interviews with the seven SHAs and the cities of Chicago and Phoenix. Specifically, current successful practices discovered during the state of practice review are discussed in detail. As noted previously, since the major contribution of this research is the ROW flowcharts, the critical review was performed considering two elements: 1) the process-based approach

which integrates the project development phases; and 2) the general cost estimation and cost management steps documented in NCHRP Report 574 and previously discussed in Chapter I of this thesis. Once again, the general cost estimation and management steps are:

1. Determine Estimate Basis;
2. Prepare Estimate;
3. Determine Risk/Contingency;
4. Review Estimate;
5. Obtain Appropriate Approval;
6. Determine Estimate Communication Approach;
7. Monitor Project Scope/Project Conditions;
8. Communicate Estimate and Approval; and
9. Adjust Cost Estimate.

Recall that the first 4 steps in the above list are cost estimation steps and the last nine are cost management. Consequently, this section will review the ROW cost estimation practices based upon the project development phase which they are typically associated with. Following the cost estimation practices, the issue of ROW management will be critically discussed.

General ROW Cost Estimating Procedure

Before critically reviewing SHA practices, it is necessary to quickly outline the general process behind completing a ROW cost estimate. The process steps are a consequence of the general project cost estimating steps detailed in the NCHRP Report 574 that were outlined in the previous section and current SHA practice as revealed through the interviews and described in Chapter II. The ROW specific steps

summarized here are utilized in a generic form to some degree at each of the ROW cost estimates throughout project development.

ROW requirements, which are defined by the project scope, establish the ROW cost estimate basis. These requirements are an input to the ROW cost estimation process as a result of project scope and therefore establish the basis for the cost estimate. They typically include basic information such as the width of the project or number of lanes (dictates minimum ROW width) and other physical parameters which define what land will be required. Receipt of this information marks the beginning of the cost estimating activities. Cost estimate activities include:

- Gathering data through field visits and from other sources of information to include assessment of improvements, land values, real estate inflation rates, condemnation rates, and possible damages;
- Quantifying estimate parameters such as total land or parcel areas;
- Computing cost by applying values to estimate parameters and other line items including damages, property improvements, etc; and
- Adjusting the estimate for inflation, uncertainties, and risk.

After the completion of the cost estimate, it is reviewed (usually by a ROW supervisor or manager) and then after approval it is communicated to the appropriate project and program management personnel.

ROW Cost Estimation

ROW cost estimating is completed during the first three project development phases: planning, programming, and preliminary design. There may be some variance between SHA, but this is generally the case found through this research effort. The following section will cover the practices utilized in each of these estimates which includes both tools and general estimating approaches used by SHAs. Planning will be discussed first followed by programming and then preliminary design.

Planning Estimate

The ROW planning estimate is generally the first estimate produced to quantify ROW cost. The typical timeline for the planning estimate is 10 to 20 years before the start of construction. It is usually based on uncertain ROW requirements since the project is typically 10 to 20 years from the expected construction start. In many agencies this estimate is not prepared by the ROW division. Instead, it is often prepared by the planning division and the ROW division is consulted on an as-needed basis, if they are consulted at all.

Right-of-way requirements at the planning phase are usually based upon a preliminary or conceptual project scope definition; therefore, ROW requirements are often unclear and likely to change. In addition, there are often several project alignments being considered, which adds uncertainty to the estimate. Four of the nine interviewed agencies do not involve their ROW personnel at this point and resort to gross historical costs, comparable projects, or to a percentage of the estimated construction cost to create the ROW estimate. However, the other five interview participants (three of the SHAs and the cities of Chicago and Phoenix) do develop a bottom-up ROW cost estimate completed by ROW personnel as part of their planning estimate in order to more accurately predict project cost.

This sub-section discusses and critically reviews four practices used by SHAs for the planning-level ROW cost estimate: 1) Early Scope Definition; 2) the Conceptual Cost Estimate Map; 3) Percent-based ROW Cost Estimate; and 4) Unit Cost Estimate Approach. The section first discusses early scope definition. In general, project scope definition is an integral part of establishing the estimate basis; this also holds true for the ROW cost estimate. Many of the SHAs interviewed do not do a good job of defining the project scope at early stages in project development and consequently, this increases the uncertainty in the ROW requirements. Another problem found through the research is the communication of the ROW requirements to the ROW personnel. A tool that may be useful in communicating ROW requirements effectively is a conceptual cost estimate

map, which is discussed following early scope definition. Planning-level ROW cost estimates are typically completed by a unit-cost approach or a percent-based approach. These approaches will be discussed last in this section to highlight the pros and cons of each. It is the findings of this research that these Approaches lack accuracy and consistency since there are many complexities inherent in estimating the cost of ROW.

Early Scope Definition

Accurate scope definition is important to any type of cost estimate. In the case of a ROW estimate, the scope is directly related to the accuracy of the accuracy of the stated ROW requirements is a function of project scope. Consequently, if project scope is not explicitly defined through these right-of-way requirements, the accuracy of the ROW cost estimate will suffer.

One SHA attempts to increase the accuracy of early project scope definition though a field visit of the project site (or multiple sites if there is more than one potential alignment). This visit is completed by an individual from the planning division along with the project manager. During the visit, likely project designs and pertinent project scope information such as the facility type, the number lanes, and access points are discussed. Following a thorough study of the information gathered as a result of the site visit, the planner communicates the ROW requirements to the ROW estimator. In this agency the estimate is completed based on research of land values, condemnation rates, and other location specific attributes. The level of effort and detail used by this agency is in contrast with percent-based or unit-cost estimate approaches used by other agencies, which do not consider location-specific attributes.

Some SHAs argue that developing this level of detail during the planning process is a waste of manpower since there is likely to be multiple future changes to the project scope. In the case of the two cities and at least two of the SHAs this is not true because they work hard early in planning to develop a definitive project scope. It has been shown through the literature and is evident through the interviews that location specific attributes have a large impact on estimate accuracy. Therefore, it is logical that early scope definition which captures location specific data will produce a better estimate. In

most cases, SHAs need to make a more significant effort to better define scope. It will however dictate a greater investment of time and resources.

Conceptual Cost Estimate Map

The conceptual cost estimate map is a tool used by designers to communicate ROW requirements to ROW personnel. This estimate map is used in conjunction with early scope definition. The term "conceptual" is used since it captures the early "conceptual" scope. Typically, the project designer provides the ROW estimator with an aerial photograph or drawing of each possible alignment. The approximate ROW boundaries are drawn on these graph documents to communicate the ROW limits to the estimator. This tool is clear and easy to read and therefore portrays the ROW requirements effectively. Caution should be taken when using this method, though, since the clear representation may appear to be more accurate than it is at such an early stage of planning.

One SHA does not complete early scope definition but still uses a conceptual cost estimate map to show the location of the project. This SHA similarly uses an aerial photograph provided to the ROW division but the photograph does not include any lines showing the ROW boundaries. Approximate cross sections are then applied by the ROW division to determine the ROW requirements.

Percent-based ROW Cost Estimate

A percent-based ROW cost estimate for planning appears to be the method of choice for three of the SHAs interviewed. The percent-based cost estimate involves applying a percentage value to the estimated construction cost to determine the ROW cost portion for the planning estimate. During the interviews it was not clear how these percentages were determined. It seems that the percentage value was established so far in the past that personnel cannot explain how it was derived. The percent-of-construction estimate approach is advocated by SHAs for planning estimates based on the supposition that a more detailed ROW cost estimate would be a waste of man hours

due to the lack of project scope definition. Using a percentage provides a quick and easy method of assigning a value to ROW cost when scope definition is lacking.

Although the percentage-based approach offers advantages by being quick and easy, two SHAs are of the opinion that these estimates are usually incorrect and may contribute to the cost escalation experienced on their projects. The research findings seem to support this. As discussed previously in the early scope definition, this percentage based estimate does not take into account location specific attributes.

One SHA in particular used this percent based method as recent as 2004 but has transitioned away from such a procedure. The percentages were published in a state-wide estimating guide, which defined the percentage to be used based by project type. Another SHA completed a study on past planning estimates with the objective of exploring the basis and accuracy of planning level ROW cost estimates. This SHA is one of those where the ROW division does not provide the planning-level ROW estimate. The study was initiated by the ROW division as a result of some inconsistency cost escalation issues from the planning estimates to later estimates. This was really an attempt to understand the approach used by the planning division. The agency found that these percent-of-construction estimates are only a close approximately about half of the time.

Unit-Cost Approach

Another method utilized during planning, again typically where the ROW division is not charged with creating the estimate, is the use of unit cost values (per acre or sq. ft). These unit costs are typically derived from historical data or by simply contacting the district/region where the project is and asking them to provide a cost value, which can often be little more than a guess. Like percentage-based ROW estimates, these can prove to be poor approximations of ROW cost as the issues that impact costs such as improvements, damages, and access issues (all location-specific attributes) are not usually addressed using the unit-cost approach.

Programming and Preliminary Design Estimates

NCHRP Report 574 (Anderson et al., 2007a) found that project cost estimates completed at the programming and preliminary design stages of project development are similar. The communication of ROW requirements, the cost estimation process steps, and the cost estimation tools that are used to create these estimates are similar. Therefore the critical review in this section discusses programming and preliminary design ROW cost estimates together.

In general, the programming estimate is usually completed as a step in the project development process prior to project approval by the state's legislature. Once approved, the programming estimate becomes a priority program within the SHAs authorized construction program. The authorized construction program may span a period of five to eight years prior to the construction start. It should be noted that this varies from state to state depending on both the structure of the agency and the state laws that guide the SHA. The preliminary design estimate is typically completed for inclusion in the State Transportation Improvement Plan (STIP). After its inclusion in the STIP, the project is fiscally constrained.

Although there are many similarities between the ROW cost estimate completed at preliminary design and the cost estimate completed at programming, there are several differences that are noted in this section. These differences typically stem from: 1)the level of scope definition (and ROW requirements) on which the estimates are based; and 2) the level of detail to which the estimates are prepared.

Scope definition is refined as the project development process proceeds, therefore the ROW requirements become better defined as the project moves from programming through preliminary design. The preferred highway alignment is typically chosen during the programming phase and ROW boundaries and rough parcels are known with more certainty than at the planning phase. These ROW requirements are identified on an aerial photograph or drawing which is provided to the ROW estimators by the designers or the project manager. By the time the preliminary design estimate is developed, ROW boundaries are fairly definite and exact parcels are identified.

In general, this section covers the critical review of the different practices, tools, and approaches used to complete the preliminary design and programming estimates found through the research. Specific tools covered in this section are: the cost estimate map employed to communicate ROW requirements; estimate documents utilized in preparing estimates; estimate accuracy definition to communicate the certainty/uncertainty in estimates; and estimating software. The remainder of this section covers the practices and approaches which include: the use of historical data in estimates; the use of appraisers as estimators; a parcel-by-parcel cost estimate approach; estimate reviews; and specific risk analysis and application of contingency practices.

Cost Estimate Map

The cost estimate map provided to ROW estimators at programming and preliminary design is similar to the conceptual cost estimate map discussed in the previous section on planning, but it provides more project detail. Right-of-way boundaries are now specified but with greater certainty. Additionally at programming, the map should include rough parcel boundaries and approximate ROW areas. The map provided at preliminary design will include even more detail with greater certainty as a function of the project development evolution. Parcel boundaries and ROW areas of each parcel are identified. The map also shows other details relevant to the ROW such as, access points to the highway, the type of takings, and access rights that are needed for construction. Cost estimate maps are a good tool to aid ROW estimators in understanding the ROW requirements and determining the ROW cost estimate basis.

Parcel-by-Parcel Cost Estimate Approach

A parcel-by-parcel cost estimate approach can be defined as estimating the cost of each parcel on an individual basis by treating each parcel as a unique piece of property in an effort to capture cost impacts on each. The alternative approach is to complete the estimate on an overall basis at a macro-level without considering specific parcels. When completing a parcel-by-parcel estimate, the cost estimator determines a cost for each individual parcel, capturing ROW quantities and parcel attributes in detail.

This estimate approach is similar to completing an appraisal since parcels are appraised one by one. The interviews found that the parcel-by-parcel cost estimate approach is limited to only one SHA for the project programming estimate, while the majority of SHAs interviewed utilized it for the preliminary design ROW cost estimate.

It appears that this approach to ROW cost estimating may produce a more accurate cost estimate because it incrementally captures the individual values in the same manner as the property appraisals, and therefore more realistic values are estimated for the acquisition of each parcel. This also encourages the estimator to consider the ROW in more detail. For example, this is especially effective for estimating costs of damages because the cost impact must be considered on the individual parcel. It is difficult to accurately place a value on the damages from a partial taking unless one considers the impact on the particular business or residence.

Documented Cost Estimate Procedures

All SHAs interviewed have a published set of ROW procedures and these procedures are typically posted on the internet. The majority of these procedures focus on the agency's appraisal and acquisition processes while very few cover ROW cost estimation and cost estimate management processes. In particular, CalTrans is one of the few that have a very effective ROW manual which includes ROW cost estimation in Chapter 4 of the ROW manual (found on the internet at http://www.dot.ca.gov/hq/row/rowman/manual/ch4.pdf). Chapter 4 of the CalTrans ROW Manual consists of four sections, the first of which outlines the general purpose and procedures behind the ROW cost estimation and management process. Section 2 discusses preparation of the actual estimate including all cost parameters. It discusses in detail each aspect of ROW that may impact cost and provides specific guidance on each while the third section focuses on real estate inflation. The last section talks about the updating of estimates which focuses on management of the cost estimates.

Due to the lack of published guidance, ROW estimators, managers, and supervisors must rely heavily on their experience to guide them in developing estimates. Experienced estimators are critically important to creating good cost estimates, but the

ROW process is a complex undertaking and an effective set of procedures is essential in providing a reference for ROW estimators. Moreover, as discussed in the critical issues earlier in this chapter, many experienced estimators are close to reaching retirement age. Therefore the need for well defined processes is becoming more and more important.

ROW/Design Tradeoffs

ROW personnel can provide valuable insight to project design that can combat the cost escalation problem and that may reduce the overall cost of the project. However, very few of the SHAs interviewed maintain effective coordination mechanisms between design and ROW to discuss impacts of design decisions on ROW costs. One of the major factors in cost escalation is related to condemnation costs and awards greater than the appraised value following a court decision. ROW/Design tradeoffs offer the advantage of potentially impacting fewer properties and fewer condemnations. Another advantage is the ability to reduce the overall cost of projects and potentially open up space within the SHA budget for other previously delayed projects. Additionally, project delays caused by a right-of-way acquisitions can be a larger contributor to the project cost escalation than the cost right-of-way cost escalation itself. Involving right-of-way personnel in design analyses and trade-offs can help to avoid costly project delays caused by delays in right-of-way acquisition.

Historical Data

Most SHAs do not use robust historical data when preparing a ROW cost estimates during programming and preliminary design of a project. With the exception of one SHA, all interviewed agencies did not use historical data. A major reason that historical data plays only a minor role in cost estimates is the recognition that the land values are constantly changing and volatile. When determining land values for ROW, it is necessary to use the most recent comparable sales in the area. Inflation from year to year is changing and can even differ by area therefore dated historical data is of little value when attempting to estimate real estate values. Historical data is only useful in areas where prices are relatively stable. Although, in the absence of adequate scope

definition (i.e. during planning), recent historical data may offer the best estimating alternative, but should not be the sole basis for the estimate. Whenever historical data is used, contingency should be applied for the uncertainty involved in predicting future values based upon past behavior.

Historical data may be more useful in estimating demolition costs, relocation costs, and support costs (or indirect costs). These items are less uncertain and lack the complexity seen in estimating land values, condemnations, and real estate inflation. Support costs include the man-hours and costs related to completing the cost estimates, appraisals, and acquisitions which must be charged to the project. These costs can be estimated relatively easily and accurately based upon the size of the project, number of parcels, and other project attributes.

It is difficult to predict cost estimate parameters such as condemnation or real estimate inflation using historical data, but some insight may be gained by understanding the general trends and tendencies shown by historical data. Condemnation rates can be predicted with some effectiveness since they are governed by state laws and SHA policies, but there is still uncertainty, especially related to the human factor. Historical data showing past real estate inflation rates may offer some insight into predicting the future inflation rate, but the historical relationship is tedious as land values are volatile and dependent on many factors.

STATE OF CALIFORNIA • DEPARTMENT OF TRANSPORTATION

RIGHT OF WAY DATA SHEET

(Form #)

EXHIBIT
4-EX-1 (REV 3/2004)
Page 1 of 6

To:

Attention:

Date _____
Dist _____ Co _____ Rte _____ P/M (K/P) _____
EA _____
Project Description _____

Subject: Right of Way Data

Alternate No. _____

This Alternate meets the criteria for a Design/Build project: Yes ☐ No ☐

1. **Right of Way Cost Estimate:** To be entered into PMCS COST RW1-5 Screens.

		Current Value Future Use	Escalation Rate		Escalated Value
A.	**Total Acquisition Cost**				$ 1A1
	Acquisition, including Excess Lands, Damages, and Goodwill.	$ 1A2	1A3	%	$ 1A4
	Project Permit Fees.				$ 1A5
B.	**Utility Relocation** (State Share)	$ 1B1	1B2	%	$ 1B3
C.	**Relocation Assistance**	$ 1C1	1C2	%	$ 1C3
D.	**Clearance/Demolition**	$ 1D1	1D2	%	$ 1D3
E.	**Title and Escrow**	$ 1E1	1E2	%	$ 1E3
F.	**Total Estimated Cost**	$ 1F1			$ 1F2
G.	**Construction Contract Work**	$ 1G	*(These are construction costs that are to be included in the projects PS&E.)*		

2. **Current Date of Right of Way Certification** _____ 2 _____

3. **Parcel Data:** To be entered into PMCS EVNT RW Screen.

Type	3A	Dual/Appr	3C	Utilities	3D	RR Involvements	3E
X				U4-1		None	
A				-2		C&M Agrmt	
B				-3		Svc Contract	
C				-4		Design	
D				U5-7		Const.	
E	XXXX			-8		Lic/RE/Clauses	
F	XXXX			-9			

Total 3B

Misc. R/W Work

RAP Displ	3F
Clear/Demo	3G
Const Permits	3H
Condemnation	3I
Excess	

Areas: R/W _____ No. Excess Parcels _____
Entered PMCS Screens ___/___/___ by _____
Entered AGRE Screen (Railroad data only) ___/___/___ by _____

Figure 3: Example of a cost estimate sheet used by CalTrans

Estimate Documents

To ensure that all major cost items for ROW are included in the estimate several SHAs utilize standardized cost estimate sheets or data sheets. All aspects of the ROW estimate are listed as line items on these sheets. Such standardized sheets help the estimators track costs for all items and serve to present the cost estimate data in an easy to understand and uniform format. Standard formatting is important for reviewing and updating. Although most SHAs use some sort of estimating sheet, it is important to standardize these so that when reviews and communication of the estimates occur, the estimates are easy to read and understand. As discussed in previously, cost estimate sheets vary from one SHA to another, but the elements of the estimate are typically: 1) land; 2) improvements; 3) relocation costs; 4) damages; and 5) condemnations. Other costs that may be included are support costs, demolition costs, and utility relocation, which are all dependent on the SHA. Figure 3 shows an example of a cost estimate sheet used by CalTrans.

Appraisers Employed as Cost Estimators

One SHA employs licensed and experienced appraisers as ROW cost estimators. This does not seem to be a common agency practice. Employing appraisers as ROW estimators appears be effective for this SHA as the appraiser turned estimator brings valuable knowledge and experience to the cost estimating process. These estimators can potentially produce better estimates because they understand the actual appraisal process and how the appraisers in the field come to a value for each parcel.

Risk Analysis

Risks for ROW cost may be associated with schedule, property inflation, condemnations, damages, and potential future development. This issue is critical when preparing estimates in general and can be particularly important to determining contingency amounts for ROW cost estimate. Performing a risk analysis alerts the project participants of cost risks during the estimating process. Only two SHAs out of

the nine interviewed complete a detailed or formal risk analysis for the ROW cost estimate. A formal risk analysis is one in which a systematic approach is used to identify major risks. The risk analysis completed for ROW cost consists of considering schedule risks, risks associated with property value inflation, and condemnation risks, plus others that are deemed critical to a particular project. Based on the risk analysis the estimator would add an appropriate contingency amount to the cost estimate.

The Washington State DOT (WSDOT) requires that projects follow its formal Cost Risk Assessment (CRA) or Cost Estimate Validation Process (CVEP) on projects of significant size (greater than $20 million at the time of this report). Both of these processes focus on the total project cost estimate. As part of either the CRA or CVEP risk assessment process, ROW personnel participate in project risk workshops when there is an element of ROW involved the project. This workshop first validates the cost of the project and its component parts (including right of way) and then assesses estimate uncertainty in terms of cost variation and potential risk events. Through this process, the ROW cost estimate is reviewed and then specific risks are identified. These risks are assessed in terms of probability of occurrence and the magnitude of impact. The cost impact of the ROW risks are then included with the overall project cost estimate as a form of contingency. The ROW risks are highlighted in the workshop report and managed by the project team, which includes ROW personnel.

Another SHA completes an in-depth look at all project risks, which begins with the field visit completed by the estimator. This field visit is used by the estimator to “size up” the project which first entails making a judgment on the complexity and severity of impacts as a result of the takings. The estimator must make a judgment call of “high”, “medium”, or “low” in terms of invasiveness relative to the takings. This will later impact how parcel specific costs and risks are quantified such as damages, improvements, etc. Also during the field visit, the estimator takes note on the geography of the land and current land use as well as trying to make assumptions for possible future development. It should be noted that analyzing the possible future development in an area can be difficult to predict, especially on vacant parcels, but the estimator makes a

judgment to account for the risk. Following the field visit, the estimator will complete the risk analysis by identifying and evaluating all factors that may impact the project. Contingencies are applied accordingly based upon the risk analysis. Specifically related to condemnations, the estimator will estimate a percentage for parcels that go to condemnation versus a percentage that will settle. These percentages are a direct reflection the estimator's rating of "high", "medium", or "low" in terms of invasiveness as made during the field visit. A contingency is then applied for the costs of litigation. Risks are also considered for environmental issues, title issues, or other miscellaneous issues where a dollar amount will be applied to the estimate based upon the probability of occurrence and severity. The potential risks of real estate inflation are also considered in addition to considering any unknowns that have not been addressed throughout the risk analysis.

Application of Contingency

Contingency should be applied to cost estimates to account for the unknown or uncertain events (Anderson et al., 2007b). Only four of the SHAs interviewed confirmed the use of contingency amounts in their estimates. Each uses percentages for contingency values, except in the case of WSDOT who uses a range estimate when conducting a CRA estimate as previously discussed.

One of the SHAs is restricted by agency policy from applying contingency to anything but condemnation. A second SHA applies contingency as a rate that ranges from 20 to 25 percent depending on estimator judgment. The third agency applies a set factor for three separate cost areas in the programming phase ROW estimate. These are: 1) schedule; 2) administrative and court costs; and 3) market appreciation. These contingency rates are built into the agencies estimating sheets and therefore are applied to every ROW estimate. Although these contingency factors are not a product of risk analysis, the agency reports that they appear to be basically accurate for most of the agency's projects.

Risk analysis and the setting of contingency was an issue raised during the original Project 8-49 study and continues to be a concern when considering ROW cost

estimating. Contingency funds are typically applied in response to some uncertainty in the project or to account for inadequate scope definition (Anderson et al., 2007b). This should especially be the case for early estimates, particularly during Planning where there are many uncertainties involved and project scope is extremely broad. Condemnations should be one of the major areas looked at for risk and application of contingency, but there are others including: real estate inflation, potential future development, and project schedule.

Estimate Accuracy Definition

In addition to a detailed risk analysis and the application of contingency, one SHA attempts to quantify estimate confidence for the benefit of other users. This is not a formal risk analysis but only the estimator's personal assessment. After completion of the estimate, the ROW estimator assigns a rating of A, B, C, or D. A letter grade of 'A' indicates the highest level of confidence while 'D' is the lowest. This becomes important when an estimate must be updated as a result of SHA policy or a design change because it communicates to others the estimator opinion of the cost estimate's accuracy. Therefore, in the event of an update or change, the estimator (either a new estimator or the original one) will have a general idea of where the estimate stands while giving them a point of reference to begin the update. For the same reason it is also important to note that limitations and assumptions should be recorded for each estimate.

Estimating Software

Standard ROW specific estimating software was not discovered to be in use by the seven SHAs and two cities interviewed. However, several SHAs have developed ROW cost estimating programs (or workbooks). The Virginia DOT (VDOT) does use the features of its internal estimating system – Project Cost Estimating System (PCES). The system was initially developed by engineering as an early estimate tool and is somewhat cumbersome for ROW, but it addresses all areas of ROW. The system requires input for all of the cost areas of ROW to produce an estimate therefore it serves as a tool to insure that all cost aspects are considered. Estimators prepare an estimate in

present dollars and the system automatically applies inflation. Screen captures of the estimating system are shown in Figure 4, Figure 5, and Figure 6.

In addition to the cost estimate system described above, individuals in several SHAs have developed detailed spreadsheet systems to complete their ROW cost estimates. In general, the workbooks cover all aspects of the ROW that are covered in the above screen captures and appear to be used for the same function. Estimating software and the use of estimating workbooks tend to structure the estimating process and provided consistency from estimate to estimate. This is especially favorable in large SHA organizations.

Estimate Reviews

Review of ROW estimates is typically limited to an examination by the immediate supervisor of the estimator. The majority of SHAs require that a supervisor or ROW manager sign off on the estimate. In most cases the supervisor or manager will perform a quick review of the estimate to check whether major component costs seem reasonable. For the preliminary design estimate, one SHA reported performing a number of "mini estimate" checks on project parcels. A "mini estimate" is an estimate completed on several parcels within the project that may have a high impact on the ROW cost. High impact parcels are those where a large damage amount is expected or ones having many improvements. These mini estimates are checked against the corresponding parcels within the actual estimate. Based on the results of this comparison, the cost estimate is either approved and communicated to design or it is not approved and sent back to the ROW estimator for further work. Another SHA uses a weekly one-hour meeting involving program managers along with the director, assistant director, budget supervisor, and engineering supervisors to review "critical projects". Critical projects are those in which budget, utility, or ROW problems exist. This allows all of the upper management to consider the projects and their estimates and to provide input.

VDOT **Project Cost Estimating System**
RIGHT-OF-WAY ESTIMATE VDOT

Project & PPMS Numbers :

VDOT Construction District : #

Select Project Area Real Estate Costs : Average

Define Project Land Use Characteristics :

Agricultural :
Residential :
Industrial :
Commercial :
0%

Instructions: Please fill-in all applicable White Boxes or make a choice from the Drop-down Lists

Enter the Approximate Number of Parcels on the Project : <<

Select Computed or User Defined Costs : Computed Costs

1. LAND VALUE

Prop. Right-of-Way

Total Right-of-Way Project Length (ML + Connections)		ft	Computed RW Cost per sq ft =	$0.00
Average width of Existing RW		ft	Enter Right-of-Way Estimator's Right-of-Way Cost per sq ft :	
Average width of Proposed RW		ft		
Total area of all additional Prop. Right-of-Way		sf	0 sq ft = 0.000 Ac.	
Approx. % of Prop. CL within		ft of Exist. CL	(Total	
Approx. % of Prop. CL between		ft & ft of Exist. CL	Must =	
Approx. % of Prop. CL greater than		ft from Exist. CL	100%)	

Temp. Ease.

Average Width of parallel Temporary Easements Left		ft	Comp. Temp. Ease. Cost / sq ft =	$0.00
Total Length of parallel Temporary Easements Left		ft	Enter Right-of-Way Estimator's Temp. Ease. Cost per sq ft :	
Average Width of parallel Temporary Easements Right		ft		
Total Length of parallel Temporary Easements Right		ft	0 sq ft = 0.000 Ac.	

Perm. & Util. Ease.

Total Area of All Replacement Utility Easements		sf	Comp. Utility Ease. Cost / sq ft =	$0.00
AND Select % of RW Cost for Util. Ease.			RW Est's. Utility Ease. Cost per sq ft :	
OR			0 sq ft = 0.000 Ac.	
Total Number of Replacement Easements Required		ea	Comp. Perm. Ease. Cost / sq ft =	$0.00
			RW Est's. Perm. Ease. Cost per sq ft :	
Total area of All Permanent Easements		sf	0 sq ft = 0.000 Ac.	

COST OF LAND (Item # 1) $0 (Computed Costs)

2. BUILDING VALUE

Based upon comparison to similar, occupied **Residential Dwellings in the Project Area** enter the Number of:

		Computed
A. Low Cost Residential Dwellings :		$0
B. Moderately Low Cost Dwellings :		$0
C. Average Cost Residential Dwellings :		$0
D. Moderately High Cost Dwellings :		$0
E. High Cost Residential Dwellings :		$0
Computed Total Residential Dwelling Costs :		$0
Estimator's Total Residential Dwelling Costs :		

Enter the total estimated cost of ALL COMMERCIAL & INDUSTRIAL BUILDINGS to be taken:
Note: No Computed Costs Available. Use User Defined Costs Below:
Estimator's Total Commercial / Industrial Buildings Costs : <<

3. OTHER IMPROVEMENTS

Enter the estimated cost of ALL OTHER IMPROVEMENTS on the Project:
Computed Total Other Improvements Costs : $0
Estimator's Total Other Improvements Costs :

4. DAMAGES

Anticipated % of Parcels Affected by Damages to Remainder	
Anticipated Relative Cost Impact of Damages to Remainder	Moderately High
Approximate Number of Parcels Affected :	0
Computed Cost of Damages to Remainder :	$0
Estimator's Total Cost of Damages to Remainder :	

TOTAL ACQUISITIONS (Items # 1 - 4) $0 (Computed Costs)

Figure 4. Screen capture of Virginia's cost estimating system (PCES)

5. ADMINISTRATIVE SETTLEMENTS

Anticipated % of Parcels Affected by Administrative Settlements :	
Anticipated Relative Cost Impact of Administrative Settlements :	
Approximate Number of Parcels Affected :	0
Computed Cost of Administrative Settlements :	$0
Estimator's Total Cost of Administrative Settlements :	

6. CONDEMNATION INCREASES

Anticipated % of Parcels Affected by Condemnation Increases	
Anticipated Relative Cost Impact of Condemnation Increases	
Approximate Number of Parcels Affected :	0
Computed Cost of Condemnation Increases :	$0
Estimator's Total Cost of Condemnation Increases :	

7. ADMINISTRATIVE COSTS & INCIDENTAL EXPENSES

Anticipated Relative Cost Impact of Admin. Costs & Incidental Expenses	
Computed Administrative Costs & Incidental Expenses :	$0
Estimator's Total Administrative Costs & Incidental Expenses :	

8. DEMOLITION CONTRACTS

Anticipated Relative Cost Impact of Demolition Contracts :	
Computed Costs of Demolition Contracts :	$0
Estimator's Total Cost of Demolition Contracts :	

9. HAZARDOUS MATERIALS REMOVAL

Anticipated Number of Demolished Buildings Requiring Asbestos Removal	
Anticipated Relative Cost of Asbestos Removal from Demolished Buildings	
Anticipated Number of Other Hazardous Materials Removal Sites	
Anticipated Relative Cost Impact of Other Hazardous Materials Removal :	
Computed Cost of Hazardous Materials Removal :	$0
Estimator's Total Costs of Hazardous Materials Removal :	

10. PROPERTY MANAGEMENT

Anticipated Relative Cost Impact of Property Management	
Computed Costs of Property Management :	$0
Estimator's Total Cost of Property Management :	

TOTAL OTHER ITEMS (Items # 5 - 10) $0 (Computed Costs)

11. RELOCATION ASSISTANCE

Residential Relocation Costs:

Anticipated Relative Cost Impact of Residential Relocation Expenses	
Computed Residential Relocation Costs :	$0
Estimator's Total Residential Relocation Costs :	

Commercial Relocation Costs:

Note: No Computed Costs Available. Use User Defined Costs Below:

Estimator's Total Comm/Indust Relocation Costs :	

Total Displacements:		Farms:	
Families:		Non-Profit:	
Businesses:		Personal Property Only:	

TOTAL RELOCATION ASSISTANCE (Item # 11) $0 (Computed Costs)

Figure 5. Screen capture of Virginia's cost estimating system (PCES)

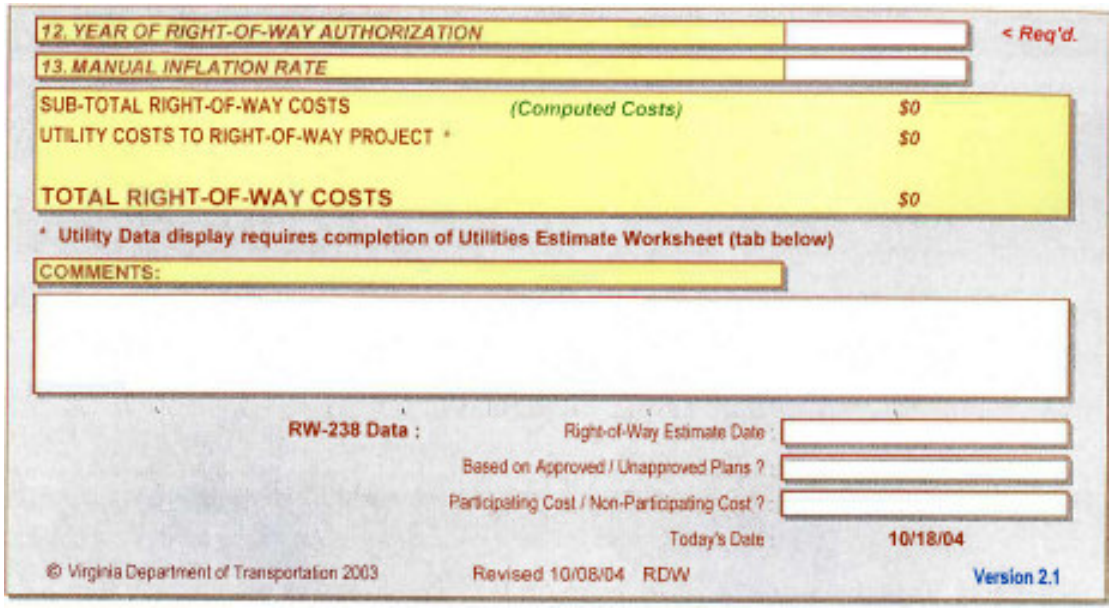
12. YEAR OF RIGHT-OF-WAY AUTHORIZATION < Req'd.
13. MANUAL INFLATION RATE
SUB-TOTAL RIGHT-OF-WAY COSTS (Computed Costs) $0
UTILITY COSTS TO RIGHT-OF-WAY PROJECT * $0
TOTAL RIGHT-OF-WAY COSTS $0
* Utility Data display requires completion of Utilities Estimate Worksheet (tab below)
COMMENTS:
RW-238 Data :
Right-of-Way Estimate Date :
Based on Approved / Unapproved Plans ?
Participating Cost / Non-Participating Cost ?
Today's Date 10/18/04
© Virginia Department of Transportation 2003
Revised 10/08/04 RDW
Version 2.1

Figure 6. Screen capture of Virginia's cost estimating system (PCES)

Every estimate completed for ROW should be reviewed by management. This research and previous 8-49 research documented in Report 574 confirms this, although the level of review appears to be lacking some of the time. Especially in cases of large projects, a higher level review which includes more of an effort by management to scrutinize and evaluate estimates should be undertaken.

Final Design

When a project transitions from preliminary design into final design, ROW requirements are not usually restated. In essence, the right-of-way process must be completed ahead of other design elements in the project development process to ensure that right-of-way is all acquired prior to construction. Another estimate or estimate update is not typically required since appraisal and acquisition has begun. In the case of an ideal project, all parcels will be acquired before construction begins, but this is not always the case. When construction is scheduled to begin most states require one of three things: 1) the property be acquired, 2) a right of entry be granted to the SHA by the

property owner; or 3) the parcel be in the condemnation process. Otherwise, construction may have to be delayed potentially impacting overall project costs and other aspects of the project. Cost estimating practices relative to final design were limited to the use of ROW tracking systems which are now discussed. No other cost estimating practices were discovered through interviews to occur during final design as SHAs should begin to appraise and acquire properties.

ROW Tracking Systems

ROW tracking systems are currently in use by several of the SHAs interviewed. In general, a ROW tracking system tracks parcels from the final estimate (typically at the preliminary design phase) through acquisition. Out of the nine interview participants, three SHAs have ROW tracking systems. These are: 1) Virginia's RUMS; 2) Washington State's REIS; and 3) Minnesota's REALMS, which is the most advanced of the three discovered. Following the approval of the ROW estimate at the preliminary design phase, the dollar value for ROW is input into the system. Further data is input after appraisal and acquisition. The most advanced of the tracking systems has the ability of data storage and the output of a number of report formats. It serves as a database of past and up-to-date parcel data across the state and has the potential to be used for recent comparable sales, predicting possible inflation rates, predicting condemnation rates, or other ROW specific parameters or statistics. Instant access and availability of these forms, reports, and data is a major advantage of the system, particularly when managing costs during appraisals and acquisitions, which is discussed in the next section under ROW management. The system is mapped to the business structure of the SHA with approximately 150 forms and 90 reports that are used throughout the ROW division. This allows all employees of the SHA to access the forms and reports used in daily operation. Consultants are also being trained on the system to allow the SHA the versatility to contract out ROW appraisals and acquisition and still track the parcels.

ROW Management

This research also considered ROW management practices in addition to those of cost estimation. This is reflected in the list of nine steps previously listed in this chapter. ROW Management uncovered through this research may be divided into two related but separate categories: 1) *cost estimation management*; and 2) *ROW cost management*. *Cost estimation management* is defined by NCHRP Report 574 as "a process for evaluating changes in scope and other issues that affect project cost" at each of the cost estimates prepared throughout the project development process (Anderson et al., 2007a). In other words, it serves as a check and balance system as estimates are prepared throughout project development by checking each estimate for changes that impact cost and then evaluating those changes to determine whether the changes are necessary and/or acceptable. Although similar in many ways, *ROW cost management* can be described as the process in which the actual ROW costs reflected in appraisal and acquisition are managed to the dollar amount input into the STIP (the estimate completed at preliminary design). Both of these ROW management processes are discussed in context in this section.

ROW Cost Estimation Management during Preliminary Design

ROW cost estimates prepared during programming are typically input into the project estimate to be approved for the construction program, consequently setting the baseline cost estimate. Following the establishment of the baseline cost estimate and thus the beginning of preliminary design, the basis for cost estimation management is set. Any cost estimate completed therein should be checked and managed against the baseline. In particular, Report 574 defines five steps as falling within the realm of cost estimation management, which usually occur after an estimate is completed. These are:

- Obtain appropriate approvals;
- Determine estimate communication approach;
- Monitor project scope and project conditions;

- Evaluate potential impact of change; and
- Adjust cost estimate.

These steps begin following the review of the estimate in which all appropriate approvals should be sought. By signing off on the estimate, management is agreeing that the cost estimate is completed to the best possible level of accuracy based upon project complexity, availability of cost data, and other constraints. If the estimate is not approved and needs to be changed, it will return to the estimator. In addition, project scope and project conditions should be constantly reviewed for any changes that impact the cost estimate. As these changes are identified they should be evaluated for cost impacts and the cost estimate should be adjusted accordingly. After approval, the estimate communication approach used to communicate the estimate amount to design personnel should be chosen and should consider the amount of uncertainty included in the estimate and the intended use of the estimate.

Only a limited amount of evidence of cost estimation management surfaced during interviews, but every estimate completed at the preliminary design phase should go through some type of cost estimation management process. Cost estimation management should be practiced to control project cost, schedule, and scope (Anderson et al., 2007a). For an example, in the event that a cost increase is identified in subsequent estimates following the baseline estimate, the reason for this should be examined and evaluated. The SHA should look at the change and see if it is really necessary. If it is necessary and acceptable, other areas within the estimate should be examined to find other areas where ROW dollars can be saved to bring the estimate back within the budget set by the baseline estimate.

ROW Cost Management during Final Design

The final design phase for ROW typically marks the point in the project that cost estimation is phased out and appraisals and acquisitions begin. Final ROW plans are usually released as plans and specifications are nearing completion. Up to this point in

project development, the cost management function of ROW should have consisted of managing cost estimate values against the baseline estimate. Beginning at final design, the cost management function should transition from managing subsequent estimates to managing the actual costs (or cost control). These costs are reflected in acquisitions and should be compared to the preliminary design cost estimate. In other words, parcel-specific cost estimate data should be compared to the parcel-specific acquisition costs to determine whether actual costs match up to the estimate. If the costs do not match the estimates, the inconsistencies should be evaluated and adjustments should be made accordingly. It is the goal of ROW Cost Management to complete acquisitions on budget with the estimates, but even if the management process cannot fix the immediate cost escalation problem for that project, lessons can be learned by this process for future projects. The research team has defined this process of managing the actual costs to estimate costs as ROW Cost Management which will be extensively covered in the next chapter when describing the process flowchart.

SUMMARY OF NOTABLE PRACTICES

Although many of the SHAs interviewed for this research are struggling with project cost escalation, particularly with the impacts of ROW cost escalation, there were some successful practices identified during the interviews. Table 3 summarizes the noteworthy SHA practices identified through interviews. The table does not include all practices critically reviewed but only summarizes the most successful practices identified by this research.

CHAPTER SUMMARY

This chapter first described the state of practice relative to highway ROW cost estimation and cost estimate management. A literature review was completed and interviews conducted with SHAs. The interviews with seven SHAs and the cities of Chicago and Phoenix resulted in the identification of critical issues related to cost escalation and the overall state of ROW estimating practice. Cost estimation and cost

estimate management practices currently used by SHAs were reviewed and analyzed in relation to the project development phases. This chapter discussed these SHA practices in reference to ROW estimates completed at the various stages of the project development process. The chapter also discussed ROW management in relation to both the management of the estimates completed during preliminary design and the management of actual costs during final design. Additionally, the chapter summarizes the successful practices discovered through agency interviews. Next, Chapter VI presents the process flowcharts which include process steps, inputs, and outputs for ROW cost estimation and cost estimate management.

Table 3. Summary of notable practices identified through SHA interviews

Project Development Phase	Best Practice	Description
Planning	Conceptual Cost Estimate Map	Aerial photo or map of each potential alignment showing approximate ROW boundaries.
	Early Scope Definition	A Planner and Project Manager (or Design Engineer) performs a field visit to discuss probable design parameters relative to ROW. Basic parameters such as the number of lanes, the number of retention basins, potential access issues, and expected ROW/Design tradeoff issues should be provided to the ROW estimator.
Programming and Preliminary Design	Cost Estimate Map	Aerial photo or detailed map consisting of overall ROW boundaries, parcel boundaries, and ROW areas. The map is provided by the Project Manager or Project Engineers to the ROW division when requesting a ROW cost estimate. Maps will most likely vary in detail between the Programming and Preliminary Design estimates.
	ROW/Design Tradeoff	ROW personnel provide input into design to discuss impacts of design decisions on ROW costs.
	Appraisers as Estimators	Employ experienced and knowledgeable ROW appraisers as ROW cost estimators for improved ROW cost estimates.
	Cost Estimate Sheet	A cost estimate document usually in spreadsheet form which includes line items for all cost items of the ROW estimate.
	Risk Analysis	A thorough risk analysis is completed for each cost estimate completed by the ROW division to include such risks such as time, property value inflation, and condemnations among others. In addition, ROW risks are captured through the WSDOT CRA and CEVP workshop process.
	Estimate Accuracy Definition	An approach to quantify confidence in each estimate that is completed throughout Project Development. After completion of the estimate, the ROW estimator assigns a rating of A, B, C, or D. A letter grade of 'A' indicates the highest level of confidence while 'D' is the lowest.
	Cost Estimating System	A cost estimating tool used throughout the agency's estimation process for all areas of the project. Particularly for right-of-way, it addresses all areas of right-of-way (e.g. land value, building value, other improvements, damages, etc.) and requires that a value for each of these areas must be input. This serves to account for all cost items affecting right-of-way cost.
Final Design	ROW Tracking Systems	The system has the ability of cost reporting and tracking of each parcel from appraisal through acquisition and into management (if necessary). It is not used as cost estimation tool but may offer potential as a source of recent historical data and market trends for land values.
	ROW Cost Management	A technique of managing actual costs reflected by tracking appraisals and acquisition costs against the preliminary design cost estimate.

CHAPTER VI
ROW PROCESS FLOWCHARTS

The main objective of this research was to develop a set of ROW process flowcharts based upon the literature and current SHA practices. The process flowcharts that describe the right-of-way cost estimation and cost estimate management processes displayed as process steps, inputs, and outputs in a user-friendly and easy to read format. There are five flowcharts: 1) an agency-level flowchart showing all cost estimates and the interaction of ROW with the project development process; 2) a conceptual ROW cost estimating flowchart which depicts the required steps during planning; 3) a baseline ROW cost estimating flowchart which depicts the required steps during programming; 4) an update ROW cost estimating flowchart which depicts the required steps during preliminary design to include a cost estimate management loop; and 5) a ROW cost management flowchart which depicts the required steps during final design. The methodology used to develop these flowcharts is discussed first. Following the methodology, the agency-level flowchart is presented and broadly discussed in the context of the project development phases. Then, the organizational-level flowcharts are presented under two key categories: 1) ROW Cost Estimating; and 2) ROW Cost Management. The ROW Cost Estimating section includes the estimates completed at planning, programming, and preliminary design while the ROW Cost Management section discusses the cost control process at final design. In each of these sections, the rationale behind the process flowcharts, and process steps and inputs therein, is covered.

DEVELOPMENT OF THE FLOWCHARTS

Development of the process flowcharts began during the SHA interviews. Preliminary draft flowcharts were developed early in the interview process with the intent of building and capturing detailed ROW process input information that could be verified during future interviews. The draft flowcharts were initially based on the literature review findings, information from SHA manuals (acquired from SHA

websites), and the NCHRP Project 8-49 Phase 1 interviews. Similar charts developed during the 8-49 Phase 1 provided the basic process information for developing these flowcharts. In general, the flowcharts presented in the NCHRP Report 574 (Anderson, et al., 2007) outline the important steps necessary to create an accurate estimate. These were discussed in previous chapters and are once again shown here because they are highly applicable to the development of the ROW flowcharts. Recall that these include:

1. Determine Estimate Basis;
2. Prepare Estimate;
3. Determine Risk/Contingency;
4. Review Estimate;
5. Obtain Appropriate Approval;
6. Determine Estimate Communication Approach;
7. Monitor Project Scope/Project Conditions;
8. Communicate Estimate and Approval; and
9. Adjust Cost Estimate.

These general estimating and cost management steps are the foundation for the ROW flowcharts. It should be noted that although the ROW flowcharts are a result of this research, literature reviewed, and SHA input, all process steps and tools may not necessarily reflect what is currently occurring in all SHAs. Rather, the flowcharts show current practices integrated with what *should* be occurring, as reflected by this research. A good example of this is ROW Cost Management during final design, which is not regularly performed in most of the SHAs interviewed even though it is critical to completing ROW acquisition within the baseline cost estimate, thereby, achieving accurate ROW estimates from planning to acquisition of ROW.

Refinement of the ROW process flowcharts continued during the later interviews. At the beginning of the interviews, the interview protocol contained the project development flowcharts published in NCHRP Report 574, which depicted each

project development phase. These flowcharts were primarily strategic in nature and focused on the higher level cost estimation and cost estimate management process for projects. As SHA input was accumulated from the interviews on cost estimating and cost management processes for ROW, the Report 574 project development flowcharts were replaced by draft ROW process flowcharts. Similar in some ways, yet contrastingly to the Report 574 flowcharts, the ROW flowcharts take a more specific and detailed approach for ROW. Instead of focusing on a strategic approach to ROW cost estimation and cost estimate management, a "how to" approach for the ROW flowcharts was adopted. More detail is provided using bulleted lists under each of the process steps within the flowcharts. In addition to the inclusion of these new flowcharts in the ROW protocol, the ROW process flowcharts were also provided to a panel of experts in the field. The ROW flowcharts were continually revised based upon comments from interviews and the project panel.

Following completion of the interviews, the research team developed a handout for further validation of the flowcharts. The handout consists of the five process flowcharts and a one and a half page summary of the research progress, a summary of the methodology behind development of the process flowcharts, and instructions for providing input (see Appendix D). This handout was distributed to selected SHAs and conference calls were initiated to acquire additional feedback on the processes depicted in the flowcharts. The process flowcharts were revised to reflect comments received from these selected SHAs. Flowcharts were revised from these comments in late August 2007. A panel of experts once again reviewed the flowcharts in late September 2007 although no major changes or revisions to the flowcharts were suggested. The panel was specifically interested in how the inputs might change from one cost estimate to another. Therefore, this will be addressed in this chapter as the flowcharts are presented and discussed.

ROW PROCESS AT THE AGENCY LEVEL

An agency level focus was adopted for this research following the approach used during the initial NCHRP 8-49 work. Consequently, the first flowchart presents the overall ROW cost estimation and cost estimate management process from the identification of transportation need at the planning phase through the acquisition of ROW at the final design phase. Each of the major ROW cost estimates are shown corresponding to its project development phase. Figure 7 shows the agency-level ROW estimating process flowchart.

A major challenge to developing the flowcharts results from the fact that there is not a clear distinction from one SHA to another relative to when the project development phase starts and when it ends and how ROW cost estimates are integrated with these phases. Further, the number of years that comprise a priority program varies across SHAs as some SHAs have programs that have projects that are 10 years from the projected letting date. Alternatively, other SHA have projects that are six years from the projected letting date. The number of years that a project is out from the projected letting impacts the timing of preparing the baseline estimate as well as the number of estimate updates prior to including a project in the STIP (State Transportation Improvement Program). In addition, some SHAs include ROW in their programs for each project that has right of way. Other SHAs use a ROW "set aside" fund "or pot of money" to cover all ROW funds that are programmed for projects with ROW. These variations are represented on the flowcharts with a "spring" to denote that the timing of when projects are included in plans and programs is dynamic and varies across SHAs. As can be seen in the figure, the point at which an SHA's priority program begins and the point at which the estimate is input into the STIP may vary. These milestones and differences in project phase definition and timing can also vary from project to project, depending on the project characteristics such as size and amount of ROW needed.

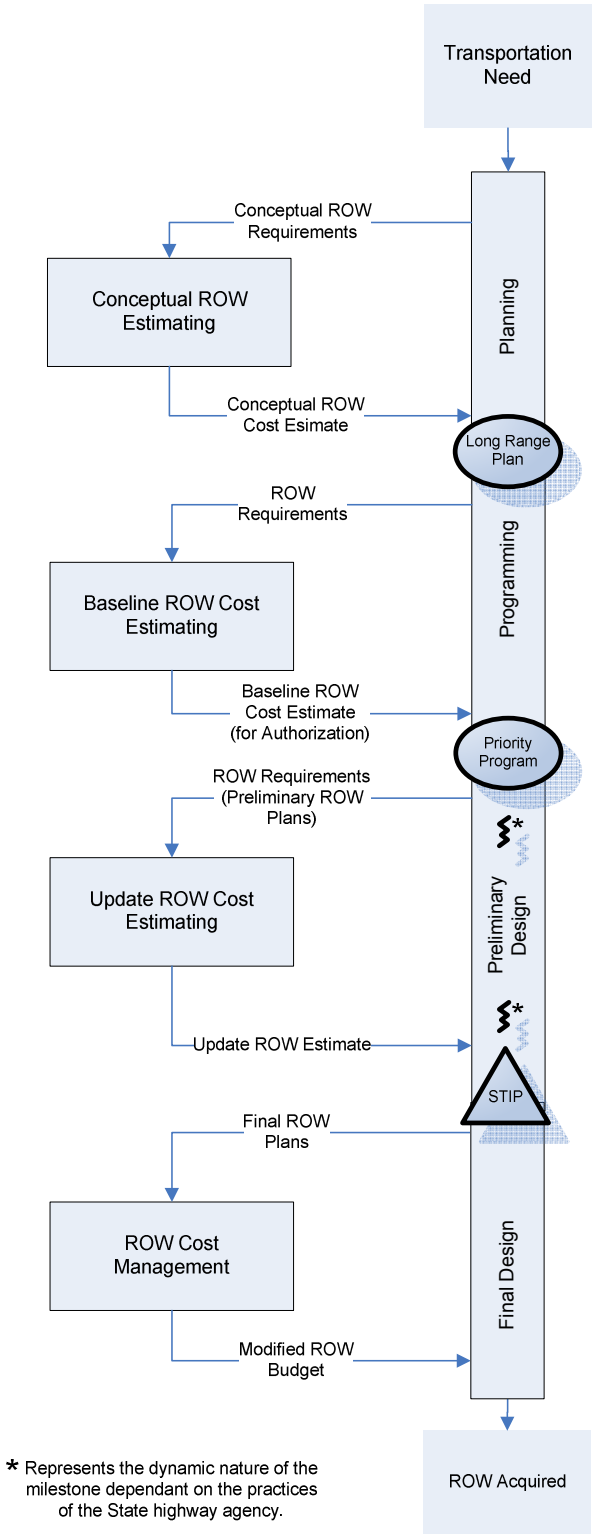

Figure 7. Agency-level ROW cost estimating and cost management flowchart

The intent of displaying the project development phases linked to ROW cost estimating and cost estimate management is to communicate the critical relationship between the two. Moreover, it stresses the relationship which should exist between personnel that estimate and procure ROW and Design personnel. ROW requirements, which are defined through developing the project scope, are the major input into ROW cost estimation and cost estimate management. Design personnel refine the project scope, and hence the ROW requirements, as project development progresses. Following the completion of a ROW cost estimate and its review and approval, a dollar value is communicated back to the Project Manager and Design.

The findings of this research recommend the completion of a ROW cost estimate at each of the first three project development phases. Additionally, the research suggests that a structured ROW Cost Management process that tracks actual costs during appraisals and acquisitions should be occurring during final design. The ROW cost estimates completed during planning, programming, and preliminary design have been defined through this research as the Conceptual ROW Cost Estimate, the Baseline ROW Cost Estimate, and the Update ROW Cost Estimate, respectively. These estimates are shown as the first three estimate processes in the agency level flowchart. The fourth process in the flowchart, ROW Cost Management, typically occurs during the final design phase. Further cost estimates are not usually completed during final design as the emphasis is on ROW appraisals and acquisition with ROW Cost Management tracking expenditures and then forecasting funds needed to complete ROW acquisition based on trends from actual purchases and other impacts (e.g., damages, etc.).

ROW PROCESS AT THE ORGANIZATIONAL LEVEL

The agency-level ROW cost estimating and cost management process flowchart sets the general context of the ROW cost estimates and ROW cost management within the project development process. Following the development of the agency wide flowchart, the specific cost estimate and cost management process flowcharts were developed. These flowcharts provide additional detail about ROW cost estimation and

management processes specific to each phase. They include inputs, outputs, and process steps. Process steps are shown in the flowcharts as rectangles while inputs are denoted by parallelograms. Additionally, the boxes showing the process steps within the flowcharts contain bulleted instructions for completing each step. This section is broken up into two key parts: 1) ROW Cost Estimating and estimation management to include the Conceptual ROW Cost Estimate, the Baseline ROW Cost Estimate, and the Update ROW Cost Estimate which occur during the first three phases of project development; and 2) the ROW Cost Management process which occurs during final design.

ROW Cost Estimating and Estimation Management

The flowcharts documenting Conceptual ROW Cost Estimating, Baseline ROW Cost Estimating, and Update ROW Cost Estimating are shown in Figure 8, Figure 9, and Figure 10, respectively. They are combined in this subsection due to the similarities between each of the estimating processes. Differences typically exist due to the level of scope definition and vary minimally by inputs. The basis by which the three estimates are completed provides an example of differences in the cost estimates due to the level of scope definition. The Conceptual ROW Cost Estimate is typically completed on an overall cost basis where the cumulative ROW characteristics of all of the property to be acquired are taken into account while the Baseline and Update ROW Cost Estimates should be prepared based upon parcel-specific costs. Additionally, one attribute that sets apart the Update ROW Cost Estimate form the other two is an estimation management loop that should be occurring to manage the estimate against the baseline. This will be discussed shortly. The differences between the estimates will be highlighted throughout this section.

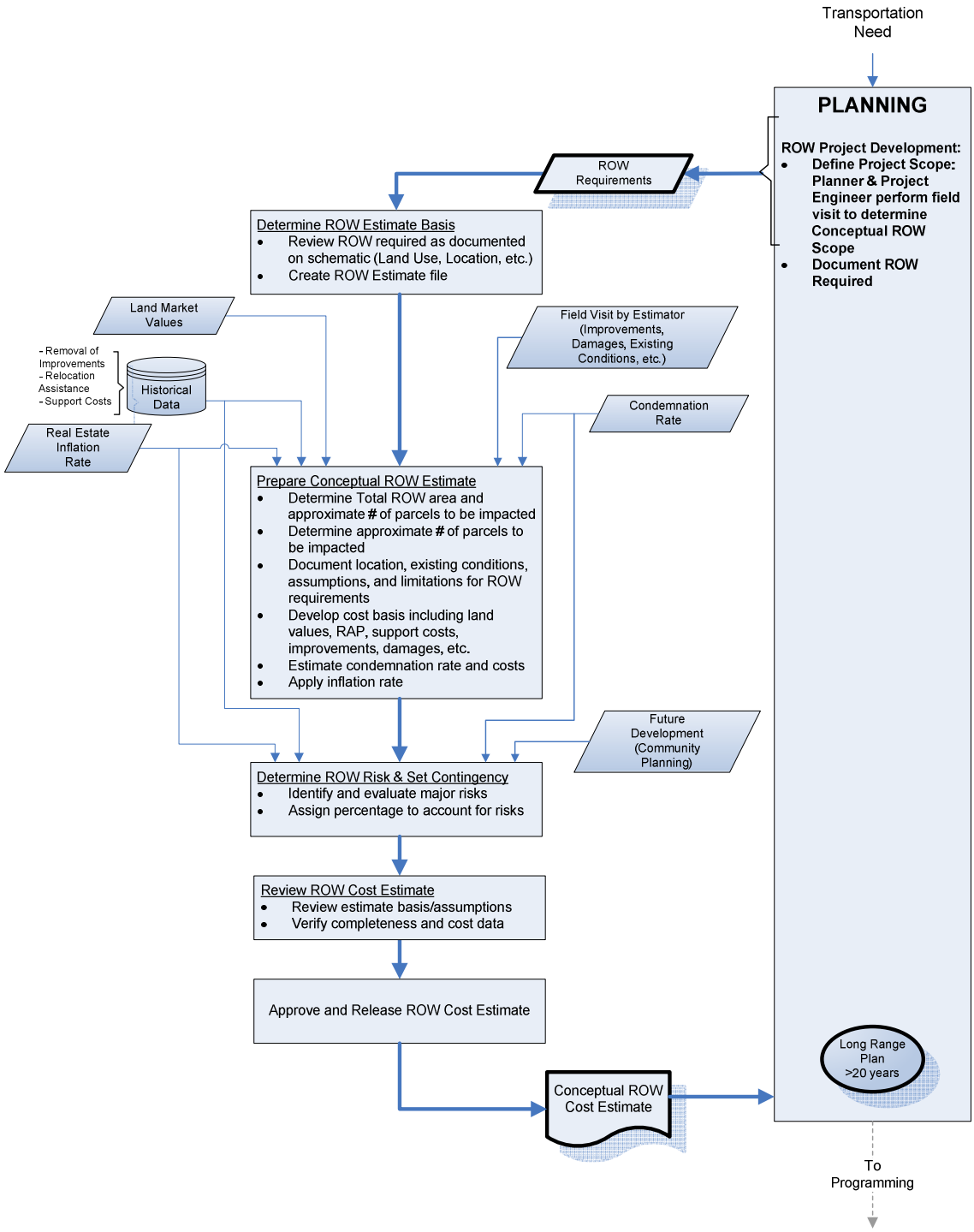

Figure 8. Conceptual ROW cost estimating process flowchart for planning

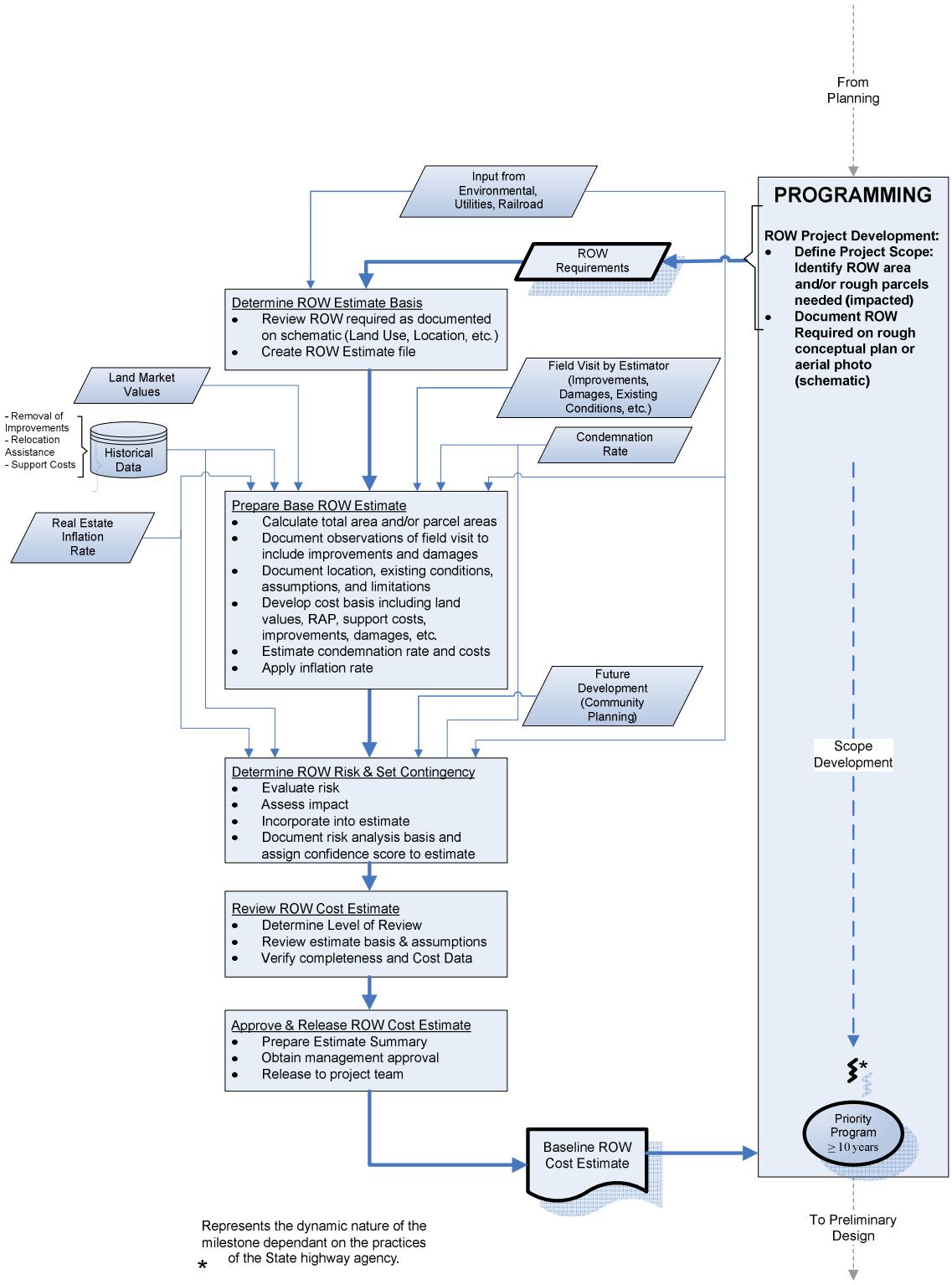

Figure 9. Baseline ROW cost estimating process flowchart for programming

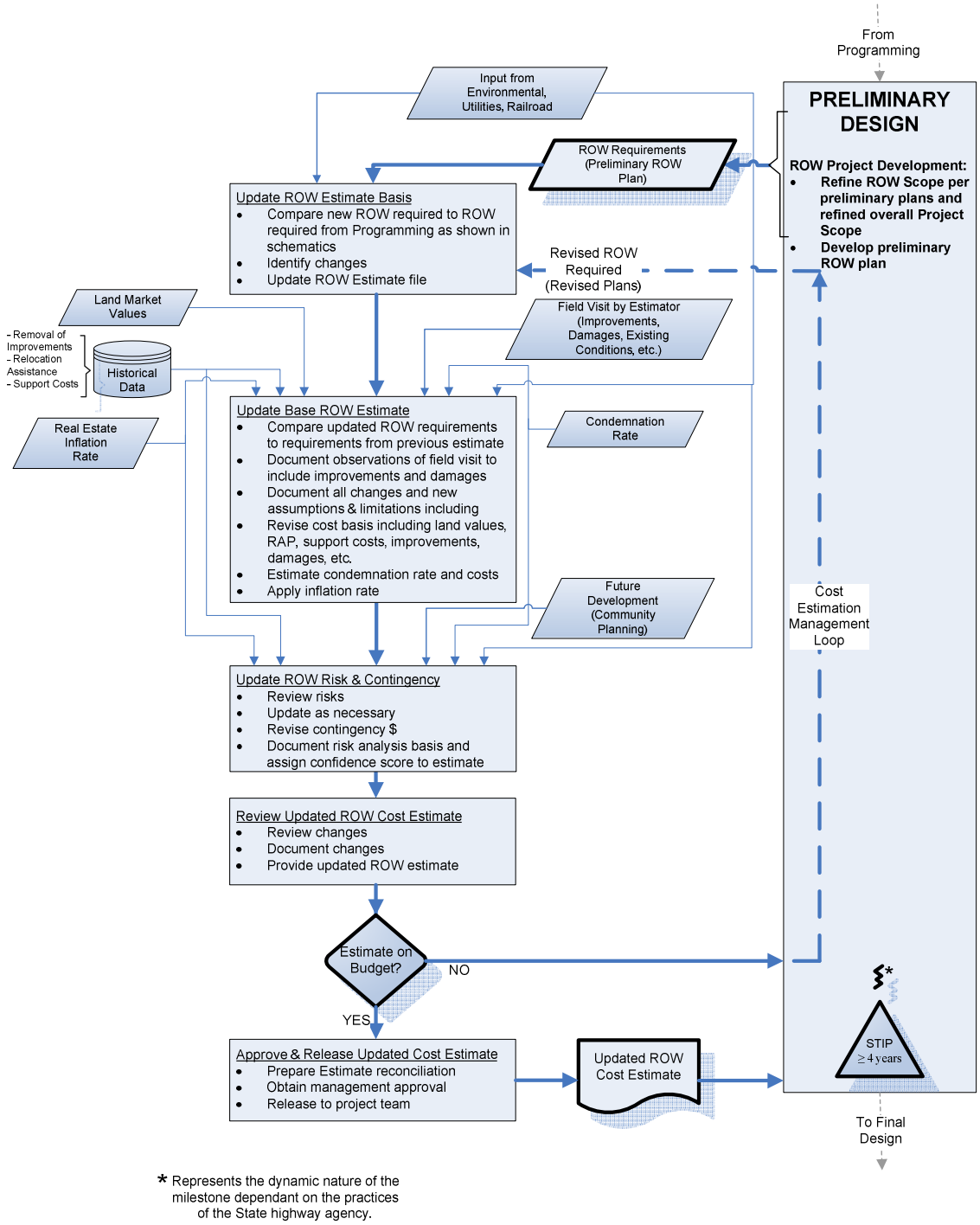

Figure 10. Update ROW cost estimating process flowchart for preliminary design

The *Conceptual ROW Cost Estimate* process flowchart shown in Figure 8 is called such because it is based on conceptual project scope. This estimate is typically prepared 10 or more years out from construction letting. The research recommends that the estimate completed at the end of the programming phase typically sets a baseline cost for the project and is therefore named the *Baseline ROW Cost Estimate* (Figure 9). This cost estimate process should establish the baseline ROW project cost that should be managed as ROW cost estimates are updated during preliminary design and final design prior to actual acquisition during ROW Cost Management. It occurs at a point in the project development process that is less then 10 years from construction letting. Typically, the priority program is 6 to 8 years in length. The *Update ROW Cost Estimate* (Figure 10) is completed during preliminary design and is usually the cost value used as the project's STIP budget. The term "update" is used for this ROW cost estimate because it should be an update (or refinement) of the Baseline estimate. This estimating process shows a cost management loop which indicates that discrepancies identified between the baseline estimate and the update estimate should be examined and adjustments should be made accordingly. The update estimates may additionally occur more than once, depending on the project and circumstances. Another action that may be taken as well is that of performing analyses for ROW/Design tradeoffs throughout the ROW cost estimation process. ROW/Design tradeoffs have the potential to reduce ROW requirements and positively impact the overall project cost.

General ROW Cost Estimating Steps

The process flowcharts follow the cost estimation and management steps described in NCHRP Report 574 combined with information captured during the SHA ROW interviews. In general, the process flowcharts documenting the cost estimates at planning, programming, and preliminary design follow a general set of process steps. Table 4 describes the major process steps that occur during each of the cost estimating processes. It shows the major input as ROW requirements and the major output of the

process flowcharts as being the estimate amount. Following the table, each general step is discussed noting differences between the three ROW cost estimates.

Input: ROW Requirements from Design

The primary input to the cost estimating flowcharts is the set of ROW requirements defined by design and communicated to ROW personnel. The major difference between ROW requirements for each of the ROW estimates is the varying amount of certainty (or uncertainty). The degree to which ROW requirements are certain is directly dependent on the level of scope definition and the time from construction letting. Therefore, there is noticeably more uncertainty in the ROW requirements for the Conceptual ROW Cost Estimate than at the Baseline ROW Cost Estimate and so forth for the Update ROW Cost Estimate. SHAs should make a significant effort to better define scope and hence ROW requirements. Early scope definition prior to the Conceptual ROW Cost Estimate will allow the ROW estimators to provide a more realistic cost estimate for ROW than establishing this value by percent or unit cost based approaches. Additionally, an effort to accurately define scope and communicate ROW requirements to ROW personnel at the baseline and update estimate is a critical issue that SHAs should address since these requirements establish the basis for the estimate and can have a large impact on the accuracy of the cost estimate.

There is also some noticeable difference relative to how the ROW requirements should be communicated to ROW personnel. This research identified the cost estimate map as an effective tool to communicate ROW requirements. Recall that this entails the use of a map or aerial photo with specific ROW information drawn/indicated upon it. The level of information on the map at each estimate varies and the amount of detail on the cost estimate map should increase drastically from the Conceptual ROW Estimate through the Update ROW Cost Estimate. At the Conceptual ROW Cost Estimate the cost estimate map will typically show the location of the project in addition to the approximate ROW boundaries by typical width or number of lanes. The cost estimate map at the Update ROW estimate should identify specific parcels, show expected ROW limits based upon preliminary design, and identify the type of take, if applicable.

Table 4. General process steps and descriptions for ROW cost estimating

Process Step	Activity	Description
Input	ROW Requirements from Design	Design communicates ROW requirements to ROW personnel.
Step #1	Determine ROW Cost Estimate Basis	Review ROW requirements and create an estimate file that documents requirements and assumptions.
Step #2	Prepare ROW Cost Estimate	Complete cost estimate activities, which include: gathering data, quantifying estimate parameters, computing costs by applying values to the estimate parameters, and adjusting the estimate.
Step #3	Determine Risk & Set Contingency	Document and evaluate all major risks that affect cost, assess the impact of the risks, and apply contingency values per risk analysis. Communicate risk mitigation opportunities.
Step #4	Review ROW Cost Estimate	Review major aspects of the ROW cost estimate including: estimate basis, assumptions, and high impact ($) areas of the estimate.
Decision Milestone*	Estimate on Budget?	(YES) If Update $ is less than or equal to Baseline $, proceed to *Approve & Release ROW Cost Estimate* (NO) If Update $ is greater than the Baseline $, complete *Cost Estimate Management*
Step #5	Approve & Release ROW Cost Estimate	Based on the estimate review: approve & release estimate OR disapprove & return to ROW estimator for corrections.
Output	Estimate Amount ($) to Design	Communicate cost estimate amount ($) to Design.

*Denotes a step unique to the Update ROW Cost Estimate (not included in the Conceptual and Baseline Cost Estimates)

Step #1: Determine ROW Cost Estimate Basis

The estimate basis is determined directly from the ROW requirements and involves reviewing the ROW required on the schematic (aerial photograph or map) or other method of communicating the requirements. This includes documenting land use, location, topography, general project data, and any other data that may impact or be pertinent in determining the ROW cost of the project. Determining the estimate basis varies minimally between each of the estimates. The major difference is in the level of detail involved at each estimate which is dependent on the ROW requirements provided by design personnel. Consequently, the estimate basis at the Conceptual ROW cost estimate will be less detailed than in the Baseline ROW Cost Estimate and so on for the Update estimate.

A robust effort must be made by the ROW estimator to define the cost estimate basis in as much detail as possible so that a deterministic value can later be reached. If the estimate basis is loosely defined accuracy may suffer because the estimator has little solid data on which to base the estimate. An estimate file is created to document the estimate basis. The estimate file should typically be created prior to the Conceptual ROW Estimate and be updated with new scope information and ROW requirements at later estimates. The estimate file is important to track project information and to identify changes in scope and project design between each of the estimates, particularly if the changes impact cost.

Step #2: Prepare the ROW Cost Estimate

Preparing the ROW cost estimate generally involves the following activities: gathering project specific data, quantifying estimate parameters, performing research to establish cost values, applying the cost values to the estimate parameters, and adjusting the estimate for real estate inflation. These estimating activities will vary little between each of the estimates, but the time and effort to complete these activities will likely increase as the project develops. All of the activities will be discussed later as inputs.

The estimate approach typically differs between each of the three estimates. Two primary approaches are used to complete an estimate. The estimate is either completed using: 2) the overall approach which estimates a value for the whole project based upon cumulative values for land, improvements, damages, and other cost parameters; and 1) the parcel-by-parcel approach which estimates and assigns a cost value for each parcel. Obviously, it is inadvisable to perform the Conceptual ROW Cost Estimate at the parcel level, and an overall estimate approach in which the all ROW is estimated as a whole instead of on a parcel basis is used. Typically, the overall estimate approach is also used for the Baseline ROW Cost Estimate, but the findings of this research seem to indicate that a parcel-by-parcel approach has the greatest potential to provide an accurate estimate, although this has not specifically been proven. A parcel-by-parcel costing approach takes into account parcel specific data such as the potential impact of damages on the actual parcel that may impact overall cost. The Update ROW Cost Estimate should always be completed on a parcel-by-parcel basis. In addition to having the potential benefit of greater accuracy, a parcel-by-parcel estimate is necessary to complete cost management (or cost control) activities during final design, which will be discussed later in this chapter.

Step #3: Determine Risk and Set Contingency

A systematic risk analysis to identify major risks to cost and schedule should be performed at each of the cost estimates. As a result of the risk analysis, contingency values should be applied to the cost estimate. Additionally, contingency values should also cover project unknowns. Risk analysis and the application of contingency play a major role in adjusting the cost estimate to approach a most probable cost for the ROW. The use of risk analysis and the application of contingency are particularly critical for the Conceptual ROW Cost Estimate due to the large amount of uncertainty associated with the prolonged amount of time before the expected construction letting. This may include uncertainty in ROW requirements as scope is likely to change or other estimate parameters that must be assumed for real estate inflation, land values, and condemnation rates. As a project develops, uncertainty typically lessens, therefore, the amount of

contingency that is applied should also be reduced, but risk analysis and the application of contingency should still be performed as there are always cost and schedule risks. Additionally, risk associated with estimate variation should also be considered.

The amount of detail involved in the Conceptual ROW Cost Estimate is usually minimal when compared to later estimates, but it is critical for the ROW estimator to identify the major risks to project cost and schedule. Based upon these major risks an percentage amount for contingency should be applied to the cost estimate. The risk analysis becomes more detailed at the Baseline ROW Cost Estimate where all risks, large and small, should be identified. These risks are then evaluated for cost and schedule impact and accordingly, contingency amounts are incorporated into the estimate. Each risk analysis completed throughout the project development process should be appropriately documented to include assumptions, limitations, and the overall basis of the risk analysis. This becomes especially important when an estimate is updated. At this level of estimate, it is additionally important to assign a confidence level to the estimate or make detailed estimate notes to communicate the estimator's confidence in the estimate value to other users. This confidence level is similar to the confidence score used by Florida Department of Transportation and presented in the previous chapter documenting results and analysis. At the Update ROW Cost Estimate, the risk analysis involves first reviewing the risks identified at the baseline estimate. If the risks have changed between the two estimates, these changes should be reconciled or updated as necessary and the contingency amounts revised accordingly. A confidence level should also be assigned for this estimate to communicate the estimator's confidence in the estimate to other users.

Step #4: Review the ROW Cost Estimate

Each estimate completed should be reviewed by management and other knowledgeable staff. In general, reviews should consist of reviewing the estimate basis and assumptions and verifying the completeness of the estimate and the cost data. Management should pay close attention to two areas in particular in the Conceptual ROW Cost Estimate: 1) the real estate inflation rate; and 2) the risk analysis and

breakdown of contingencies. The inflation rate can have a large impact on the cost estimate since the project is 10 to 20 years from construction letting. The risk analysis and breakdown of the contingencies should be examined closely as there is much uncertainty and unknowns inherent with the estimate. The Baseline ROW Cost Estimate should be particularly reviewed because it sets the cost value that all later estimates will be compared. Special care should be taken to compare the Update ROW Cost Estimate to the Baseline to determine whether any changes have occurred or discrepancies have arisen. A review process is essential throughout project development in order to control project cost and combat cost escalation. The process should be systematic and clearly documented in the estimating procedures in an easy-to-follow way. Therefore, managers and estimators understand exactly what is required of them before the estimate is allowed to move onto the next step in the process. Documentation of the actual review by the reviewers is critical to keeping estimators and management accountable for the reviews results. Reviewers should take notes on the level of detail of the review, what portion of the estimate was reviewed, and any issues that surfaced during the review.

Decision Milestone: Estimate on Budget?

This decision milestone is unique to the Update ROW Cost Estimate process and can be defined as part of cost estimation management discussed in the latter parts of Chapter V. This should be occurring as updated cost estimates are completed to compare the estimated value against the baseline cost estimate. It is shown in the flowchart (Figure 10) as a decision milestone following "Review ROW Cost Estimate" denoted by a diamond.

If the estimate is on budget with the Baseline ROW Cost Estimate, then the estimate should be approved for release back to Design. If it is not on budget, it should be further examined and the appropriate changes should be made. If discrepancies are identified between the Baseline and the Update ROW Cost Estimates, the estimate is then sent back through the estimation process as shown in the "Cost Management Loop." The changes may include changes in the design, ROW, or both. ROW/Design tradeoff analysis can be utilized to determine what type of changes should be made.

Value engineering or some other method to evaluate the changes should occur to determine whether the changes are necessary or cost effective. An example that should be considered using ROW/Design tradeoff analysis or value engineering is the choice between a retaining wall or a slope. Relative to ROW, this dilemma is less ROW (retaining wall) versus more ROW (a slope). The decision can be considered from both points of view. A retaining wall may be the right choice if the slope creates a high cost of damages to an existing business. A slope typically requires acquiring a larger portion of an impacted piece of property. Contrastingly, this issue can be considered in reverse if the wall is extremely expensive compared to the piece of property that would be necessary for the slope.

Examination and evaluation of differences between the baseline estimate and the update estimate does not regularly occur in most SHAs. Instead, the higher cost estimate amount usually takes precedence and which becomes a source of project cost escalation. This cyclical cost estimation management process should occur for every update estimate that is completed during the preliminary design phase as project design proceeds. Again, this process should be accurately documented by the estimator and management. All discrepancies and resulting changes to the project design or ROW should be documented in the estimate file for other users and in the case that these issues surface once more later in project development. Even if a discrepancy is found and no major change is made, the discrepancy should still be documented as this issue may resurface during subsequent estimate updates or during ROW Cost Management.

Step #5: Approve and Release ROW Cost Estimate

The approval and release step is the first true cost estimation management step included in each of the cost estimate processes. Appropriate approvals should be sought for the cost estimate before it can be released back to Design. This step ensures that management is aware of project cost and by their signature confirms their acceptance and their department's accountability for the cost estimate.

Output: Estimate Amount to Design

Following approval and release of the cost estimate a value is communicated back to Design. Care must be taken to communicate the cost estimate value and management must recognize that the value is just one of the many probable ROW costs (Anderson et al., 2007b). This is also an estimation management step completed by ROW personnel.

Cost Estimating Inputs

In addition to the key input and output integrated with the general process steps shown in the in the table above, there are also other inputs into the process steps. As previously discussed, the major input into the process flowcharts are the ROW requirements which are used to establish the estimate basis for ROW cost estimates and to determine whether changes have occurred in ROW Cost Management. Research has shown that other inputs are necessary throughout the process to create an accurate estimate. These inputs will typically vary between each of the estimates and will be highlighted throughout this section.

Inputs to Determining the Cost Estimate Basis

Discipline input from Environmental, Railroads, and Utilities is important when determining the estimate basis because input from these disciplines can impact the ROW requirements and may not have been considered by the project manager. Environmental needs may include supplementary lands for retention basins (or ponds) to control storm water runoff or for lands to replace impacted environmentally sensitive parcels in order to satisfy environmental mitigation as required by state and federal law(s). Railroads and utilities may require additional land for relocation. Input from the Disciplines are only included in the Baseline Cost Estimate and the Update Cost Estimate. It is not included in the Conceptual ROW Cost Estimate since project scope and ROW requirements are likely to change, but when the estimator makes the field visit

environmental and utility issues must be considered. If requirement issues are unclear, advice from these divisions should be requested.

Inputs to Preparing the ROW Cost Estimate

There are various inputs necessary to prepare the ROW Cost Estimate, which include:

- Data from a field visit performed by the ROW estimator;
- Land Market Values;
- Historical Data;
- Condemnation Rates; and
- Real Estate Inflation Rates.

These inputs will vary depending on the particular ROW Cost Estimate being performed and the data available at the specific point in project development.

A *Field Visit* by the ROW estimator should be performed to gather data relevant to the cost estimate. Many times this is completed as a drive through (a windshield survey) or by walking the project corridor(s). It should be performed for all cost estimates throughout the project development process because it is important for the cost estimator to comprehend the complex attributes specific to the project location. The field visit should include documenting existing conditions and making notes of potential damages and improvements or other issues that may impact the cost of acquiring the ROW. Although the field visit attempts to gather the same information at each of the estimates, the level of detail and certainty varies. The field visit completed at the Conceptual ROW Cost Estimate which is typically completed 10 to 20 years from construction letting will pose the most difficulty to the estimator in establishing information on existing conditions and extrapolating those conditions to acquisition. For example, it is difficult to guess what the highest and best use a piece of vacant agricultural land will be in 10 to 20 years. Potential damages and improvements are also likely to change in the 10 to 20 year span. The field visit completed at later estimates

begin to provide more solid information to the estimator. The estimator must also take into account information gathered at the field visit in the risk analysis and when setting contingency values, which is discussed shortly.

Land Market Values can be established by the method of comparable sales or a similar approach. This is a major portion of, and input into, estimate preparation in which fair market value must be determined for the ROW. The source of land market values will usually vary between the cost estimates. At the conceptual cost estimate, the land market values may be limited to a cost per acre value. Recall that this estimate is usually prepared based upon a total area to be acquired as opposed to considering each parcel. .In contrast, the land market values are likely established through comparable sales as shown in realtor listings and the tax assessor records at the Baseline and Update ROW Cost Estimates.

Historical Data is utilized to determine the cost for removal of improvements, relocation assistance, and support costs. Support costs are defined as all costs to complete the estimate, appraisals, and acquisitions which the SHA is expected to incur. Historical data can also play a limited roll in understanding the trends for real estate inflation and condemnations. Real estate inflation and condemnation rates are easily recorded data which may be able to give the estimator an average rate over past years to be used as an indicator of a probable future behavior. Caution is recommended, though, in assuming these values for future values since the past is not always the best indicator of the future. In the absence of acceptable scope definition, historical data can be used to establish a cost value for the Conceptual ROW Cost Estimate, but it is not recommended. An effort to define scope early in the project development process seems to result in a more accurate estimate. Later estimates begin to use historical data less and less as updated information on costs become available.

Condemnation Rates must be estimated for the project as the number of condemnations will impact the cost of ROW acquisition. This rate is typically expressed as the percentage of properties to proceed to eminent domain proceedings. The rate of condemnation is location specific and significant research should be completed to

establish this rate and the cost impact on the estimate. Barring any change in state laws that govern the eminent domain process, the determination of the condemnation rates will not vary from estimate to estimate.

Real Estate Inflation Rates are used to adjust land market values to the time of acquisition. Like condemnation rates, this rate is also typically expressed as a percentage. This is an important factor in the cost estimate since land market values are extremely volatile and difficult to predict. This is especially the case for the Conceptual ROW Cost Estimate where there is a high amount of uncertainty inherent in predicting the inflation rates so far out from acquisition. The inflation rates appear to become somewhat less uncertain the closer to acquisition but still can be volatile. It should be noted that real estate inflation is not the same as construction cost inflation therefore a different index than used for construction purposes is used.

Inputs to Risk Analysis and Setting Contingency

Risk analysis should be performed to identify and evaluate all major risks to the project and then to apply contingency amounts. Inputs into this process step are:

- Future Development;
- Historical Data;
- Condemnation Rates; and
- Real Estate Inflation Rates.

Generally speaking, much of the risk inherent in these inputs to the risk analysis result from uncertainty which typically decreases as the project scope becomes better defined and the project develops. Therefore, the major difference from the Conceptual ROW Cost Estimate and so on is that the predicted values become more certain and the amount of contingency applied to the estimates may be reduced.

Future Development input is utilized to capture the risk of future improvements to the properties or the change in land use. For example, future improvement that may impact property value and hence, ROW cost is the development of a previously vacant

piece of property at the planning estimate into a shopping center at the programming estimate. Consequently, it is necessary to identify this potential risk and assign a contingency amount. One potential source of information that may indicate future development is the use of Strategic Community Development plans, especially in an urban setting. There is a large difference between the risk and uncertainty associated with predicting future development at the Conceptual ROW Cost Estimate and the Baseline and Update ROW Cost Estimates. This is due to the ability of the estimator to be able to predict the future highest and best use of the ROW. One resource that may be utilized by the ROW estimator at the Conceptual ROW Cost Estimate is a strategic community plan which usually consists of a 15-20 year growth plan for a city or town. Therefore, the estimator can make a prediction for the future development of an area based upon this. Community planning may also be utilized for later estimates in addition to examining growth trends throughout the area. Private developers may also be a resource for predicting the future development of an area.

Historical Data should be included in the risk analysis on the basis that history is not always the best indicator of the future. Again, as the project approaches the point of acquisition uncertainty decreases, and recent historical data may offer better insight into the probable support costs, costs of relocation assistance, and cost of removing improvements than in earlier phases of the project. The use of historical data for condemnations or real estate inflation appears to be ill-advised for any estimate by the findings of this research even though it may be the only alternative in cases where very little scope is defined. Historical data for these values are more likely to be used in the Conceptual ROW Cost Estimate when there is limited information to formulate a cost estimate.

Condemnation Rates should be the largest component considered in the risk analysis due to its potentially significant impact on not only costs but on schedule. Costs associated with condemnations have been shown by the literature and this research to have a large impact on the cost estimate and hence, cost escalations. Many states are required to pay the property owner's court fees, appraisals, and other costs in addition to

their own expenses. Moreover, condemnation risk must also consider risk to the project schedule. In some states, the condemnation process can drag out and delay acquisition of the property, which may delay construction.

Real Estate Inflation Rates have been shown by the literature and this research to be highly volatile and dependent on many market factors. The impact on overall ROW costs must be taken into account as land values make up a large portion of the total costs. Real estate inflation is exceptionally difficult to predict any time during the estimating process but more so at Conceptual ROW Cost Estimate since the project is so far from actual acquisition. Contingency amounts should always be applied for real estate inflation due to the high volatility of the market and the rates' dependence on uncontrollable external factors.

ROW Cost Management

The process of *ROW Cost Management* was generally defined in Chapter V to be the management of actual costs reflected in appraisals and acquisitions against the estimated parcel costs in the Update ROW Cost Estimate. This process does not involve cost estimation; it is strictly used to track and control the costs of ROW acquisitions. These costs are reflected in acquisitions and should be tracked on a parcel-by-parcel basis. The ROW Cost Management process is presented in Figure 11.

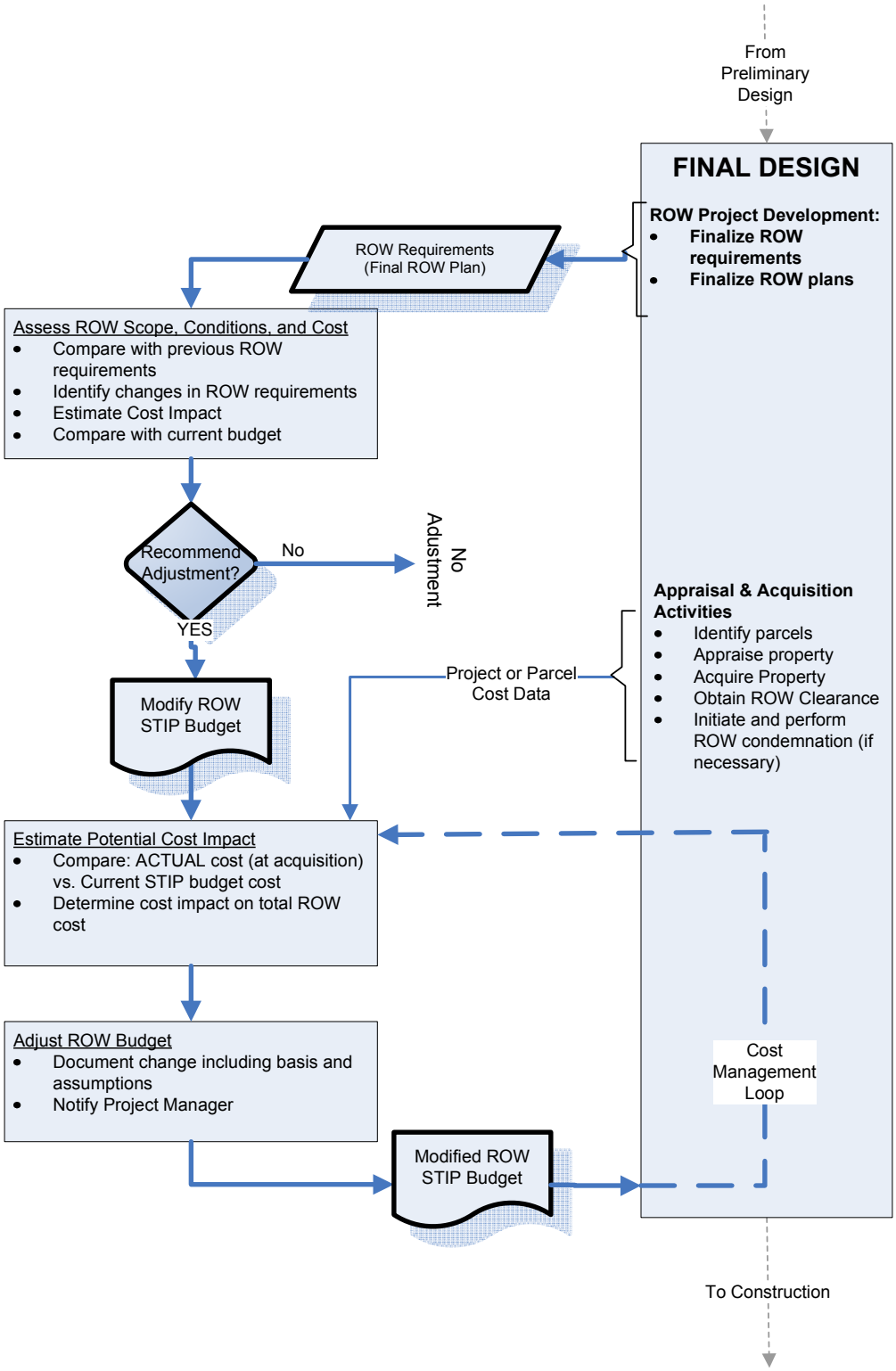

Figure 11. ROW cost management process flowchart for final design

ROW Cost Management Process Steps

The process flowchart documenting ROW activities during final design is the only exception since it is not a cost estimation process. It was developed solely on the basis of ROW Cost Management and therefore the process steps vary. The process steps used in the ROW Cost Management Flowchart are presented and explained in Table 5.

Input: ROW Requirements from Design

The major input into the ROW Cost Management process is final ROW plans. These plans document the ROW required based upon the final design of the highway project. The exact location and area of each parcel to be acquired is documented in these plans.

Step #1: Assess ROW Scope, Conditions, and Cost

Before appraisals begin, each parcel in the final ROW plan should be examined and compared to the most recent ROW requirements used to complete the latest updated ROW Cost Estimate. ROW personnel must make a significant effort to identify whether there are potential changes in scope, conditions, or cost that will impact the final acquisition cost for the entire project. For example, design changes that occurred since the Update ROW Cost Estimate was completed qualify as potential changes that may impact final project ROW cost. This cost management step will also be significant in identifying any errors or omissions in estimation that may have occurred in previous estimates.

Table 5. General process steps and descriptions for ROW cost management

Process Step	Activity	Description
Input	ROW Requirements from Design	Design communicates ROW requirements as Final ROW Plans to ROW personnel.
Step #1	Assess ROW Scope, Conditions, and Cost	Review ROW requirements and document changes, if present. In the event that changes are discovered, evaluate the cost impact on the overall ROW Budget.
Decision Milestone	Recommend Adjustment?	If the changes are expected to increase the final ROW project cost, an adjustment to the budget should be recommended. If no impact on the budget or a decrease in cost is expected then no adjustment is necessary.
ROW STIP Budget	Modify ROW STIP Budget	An adjustment should be made to the ROW STIP Budget if changes are recommended.
Step #2	Estimate Potential Cost Impact	Compare actual costs as reflected in appraisals and acquisitions to estimated costs. Determine whether overall project cost may be impacted and document.
Step #3	Adjust ROW Budget	Adjust the ROW budget if the cost of acquisitions reflect an increase in overall cost and take appropriate steps to request additional funds.
Output	Modified ROW STIP Budget	Communicate modified budget ($) to Design and continue cost management (return to Step #2) until all ROW is acquired.

Decision Milestone: Recommend Adjustment

The decision milestone represents the decision making process that must occur based on the output of Step #1. If potential changes are discovered the impact of the changes should be evaluated based upon the ROW STIP Budget and a decision is made to recommend adjustment of the budget or not. Additionally, a change might be

considered if there is a potential for a reduction in cost. Although in most cases adjustments should be made to reduce cost, necessary adjustments can increase cost, too. Obviously, if no changes are discovered, then no adjustment is necessary.

Step #2: Evaluate Potential Cost Impact

As appraisals and acquisitions are executed, cost data should be recorded for each parcel. This step of ROW Cost Management involves checking the actual costs reflected in appraisals and acquisitions against estimate values of the ROW STIP Budget. Throughout appraisal and acquisition activities, costs should be tracked by some process or system by which up-to-date parcel expenditures can be reported. ROW tracking enables the SHA to periodically check expenditures and forecast the expected project cost to the end of acquisitions. The ROW tracking systems in place at Virginia, Minnesota, and Washington are ideal for this. This step should occur multiple times throughout the appraisal and acquisition process. The "Cost Management Loop" shown in Figure 11 indicates the need for this management process to be cyclical. Reports should be generated at milestones such as 30%, 60%, and 90% of land acquired or when the ROW manager deems pertinent. The cost management loop denotes this cyclical reporting and comparison between the actual expenditures and the estimated.

Step #3: Adjust the ROW Budget

If the forecasted project cost calculated in Step #2 is expected to be greater than the ROW STIP Budget amount, the budget should be adjusted and the appropriate steps towards requesting additional funds taken. The project manager should be notified immediately, and the basis for the budget adjustment and any supporting assumptions and calculations should be documented.

Output: Modified ROW STIP Budget

Following adjustment of the budget and notification of the project manager, the adjusted budget should be effectively communicated to Design. The ROW Cost management process should continue until all ROW is acquired. Following the

completion of all acquisition, the project is ready to be let for construction. This process has the potential to reduce cost escalation problems inherent in ROW during acquisitions in addition to providing opportunities for lessons learned by evaluating the cost impacts which can be applied to later estimates.

CHAPTER SUMMARY

Process flowcharts for the cost estimation and cost estimate management process were developed based upon the earlier phase of NCHRP Project 8-49 research, the findings of the current phase of the research, and further review of ROW literature. These flowcharts were presented in this chapter in addition to the methodology behind their development and rationale for the process steps and inputs within the flowcharts. There are five flowcharts: 1) an agency-level flowchart showing all cost estimates and the interaction of ROW with the project development process; 2) a conceptual ROW cost estimating flowchart which depicts the process during planning; 3) a baseline ROW cost estimating flowchart which depicts the process during programming; 4) an update ROW cost estimating flowchart which depicts the process during preliminary design to include a cost estimate management loop; and 5) a ROW cost management flowchart which depicts the cost management process during final design. Chapter VII of this thesis presents the conclusions and recommendations for future research.

CHAPTER VII
CONCLUSION

The past research of NCHRP Project 8-49 identified ROW estimating as having a large impact in cost escalation of highway projects. Two major contributing factors were established prior to beginning this research: 1) the ROW cost estimation and cost estimate management processes lack structure; and 2) there is a lack of integration and communication between those responsible for ROW cost estimating and those responsible for general project cost estimating. Therefore, this research addressed cost escalation issues relative to the ROW cost estimation and management through a process-focused approach. This Chapter summarizes the report, presents conclusions of the research, and provides input on potential areas for further research.

SUMMARY

This research effort examined the ROW cost estimation and cost estimate process in detail to address the problems of:

- Cost escalation;
- The lack of structure; and
- The lack of communication with design personnel.

It answered all of the research questions and research objectives discussed in the Chapter I of this thesis. Critical issues that impact the ROW cost estimation process were identified in this study. Through the interviews of seven SHAs and two LPAs, it additionally discovered and reviewed current practices, tools, and methods. Inputs, outputs, and process steps were documented using flowchart techniques to form the basis of the development of five ROW flowcharts. Furthermore, the ROW flowcharts integrate the general cost estimation and cost estimate management steps of NCHRP Project 8-49 Phase I.

The primary deliverable of the research is the ROW flowcharts which document the framework of the ROW cost estimation and cost estimate management process. The flowcharts developed as a result of this research encompass the first four phases in project development. Three ROW estimates are typically prepared during the phases of project development, each corresponding with the first three project development phases. These are: 1) the Conceptual ROW Cost Estimate which is produced during the planning phase; 2) the Baseline ROW Cost Estimate which is produced during the programming phase; and 3) the Update ROW Cost Estimate which is produced during preliminary design. A fourth process was also defined as ROW Cost Management which occurs during final design. Moreover, a cost management process is also integrated into the Update ROW Cost Estimating process to manage subsequent estimates following the Baseline ROW Cost Estimate. The estimate preparation steps during the four project development phases are graphically presented in the flowcharts which cover the specific estimating steps within the process, inputs, and outputs. Additionally, an agency-level flowchart shows the global relationship between ROW and project development.

CONCLUSIONS

This research was completed by interviewing a multitude of individuals throughout nine acquiring agencies. Copious amounts of data was collected and analyzed. The general conclusions of this thesis are that:

- There are few systematic and structured processes for ROW estimating and cost management therefore impacting consistency between estimates. The lack of structure is compounded when an SHA is decentralized thereby each region/district will complete estimates by different processes.
- There is a lack of communication and coordination between ROW and design personnel throughout project development.

- There appears to be a small number of tools utilized for cost estimation of ROW. This is particularly the case with ROW databases and estimating systems used to capture ROW information for estimating purposes.
- Planning estimates do not typically involve ROW estimating personnel or input from ROW.
- There appears to be no connection between the ROW planning estimate and later estimates in most SHAs interviewed.
- Cost estimation management appears to be underutilized throughout the cost estimation process, especially during preliminary design.
- SHA ROW manuals tend to concentrate on the appraisal and acquisition process while very few document cost estimation and cost management activities.
- There appears to be a lack of systematic risk analysis and use of contingency in ROW estimates.
- Clear and effective scope definition and communication of ROW requirements is critical to preparing an accurate estimate.
- ROW Estimator experience and knowledge play a significant role in the cost estimation of ROW.
- ROW Cost Management (cost control) is not utilized nearly enough while completing appraisals and acquisitions.

RECOMMENDATIONS FOR FUTURE RESEARCH

This research focused on developing a framework for the ROW cost estimation and cost estimate management process that would support the creation of accurate cost estimates. The flowcharts developed as a result of this thesis research were only validated to a limited extent due to time and budget constraints. Therefore, further validating work would strengthen the content and effectiveness. Other areas of further research may include a more in-depth look at specific tools that support ROW cost

estimation. This research presented tools discovered through interviews, but did not focus on additional development or application of these tools, nor did it evaluate the effectiveness of any of the tools.

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APPENDIX A

PROJECT DEVELOPMENT PHASES

(Anderson et al., 2007a)

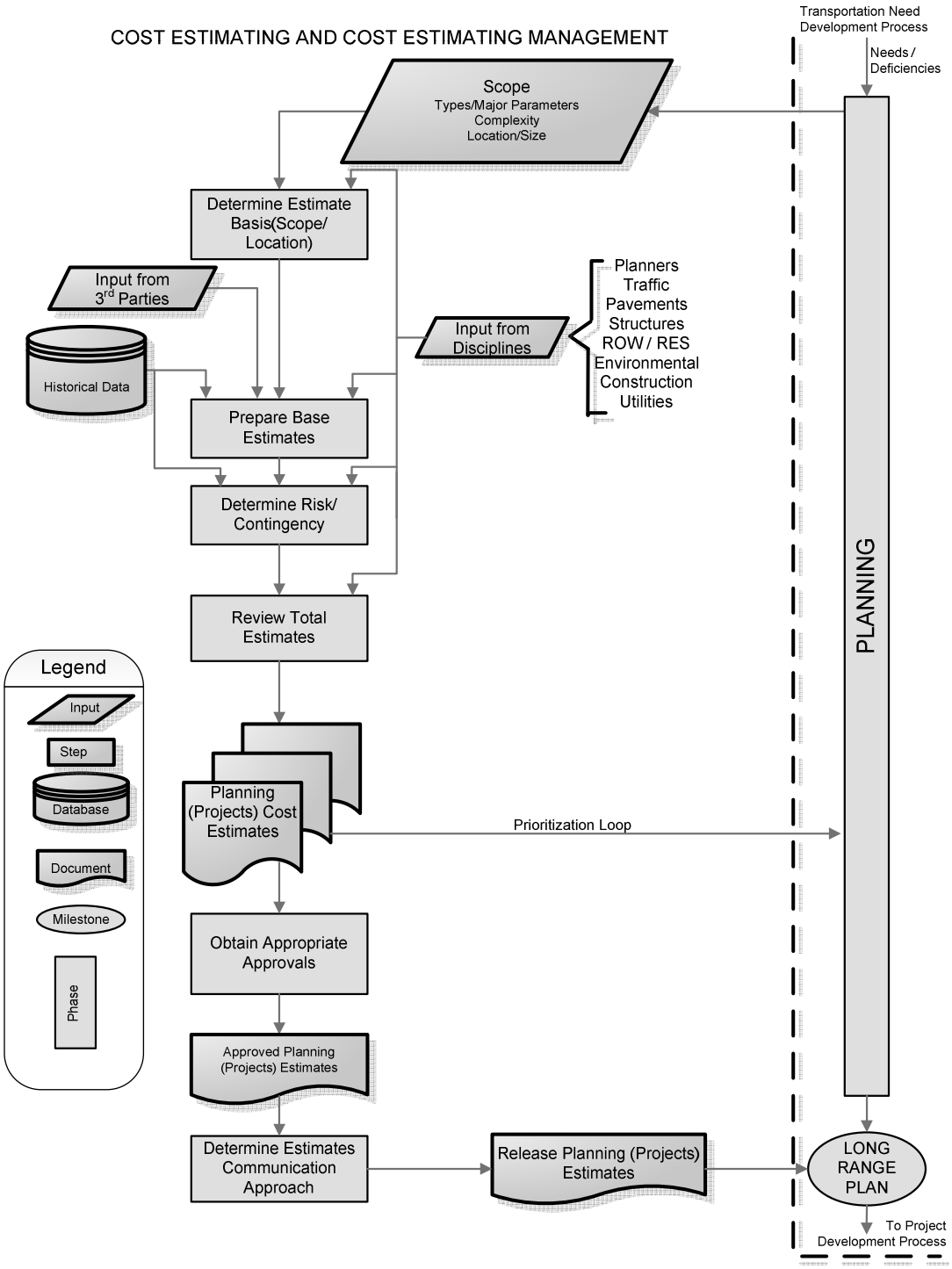


Figure 12: General cost estimating and estimate management during planning (NCHRP 8-49, Phase I).

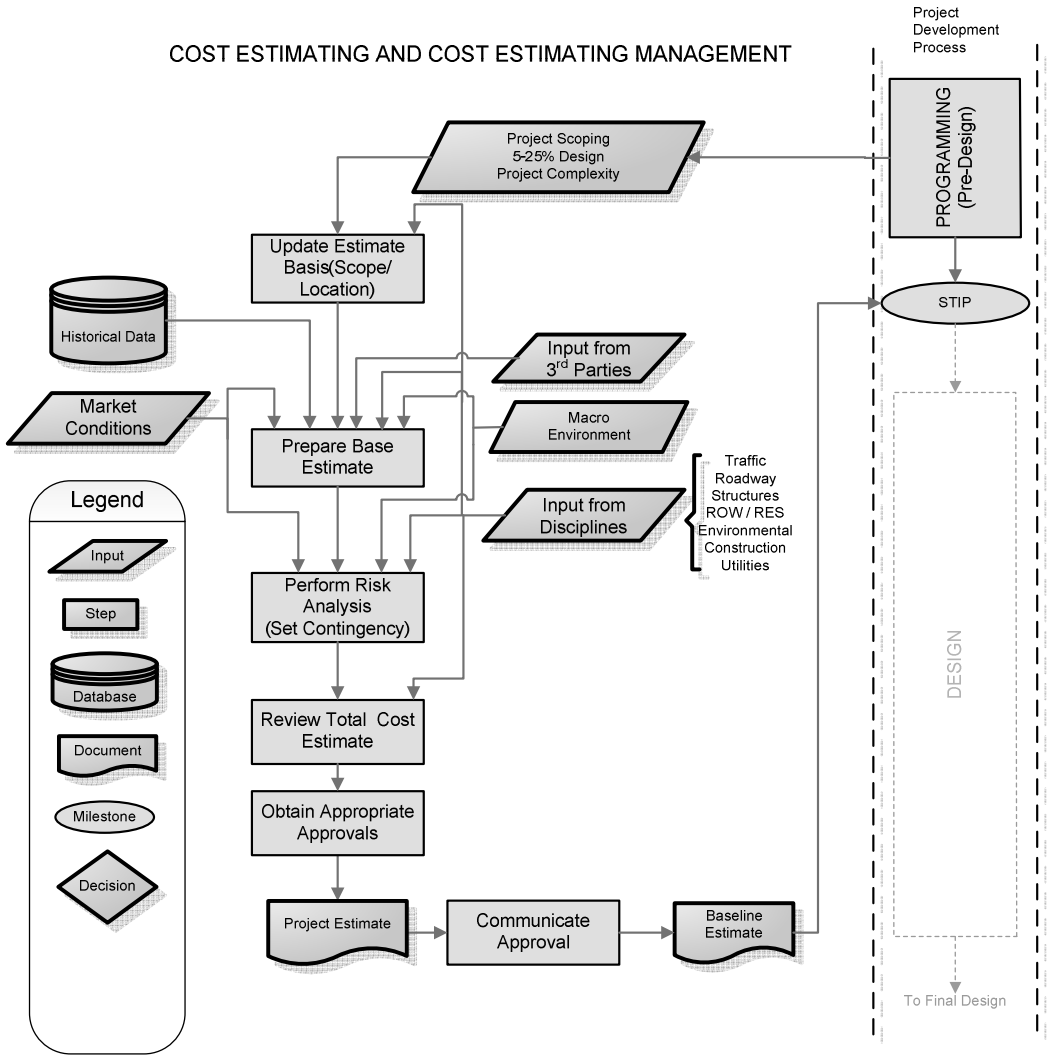


Figure 13: General cost estimating and estimate management during programming (NCHRP 8-49, Phase I).

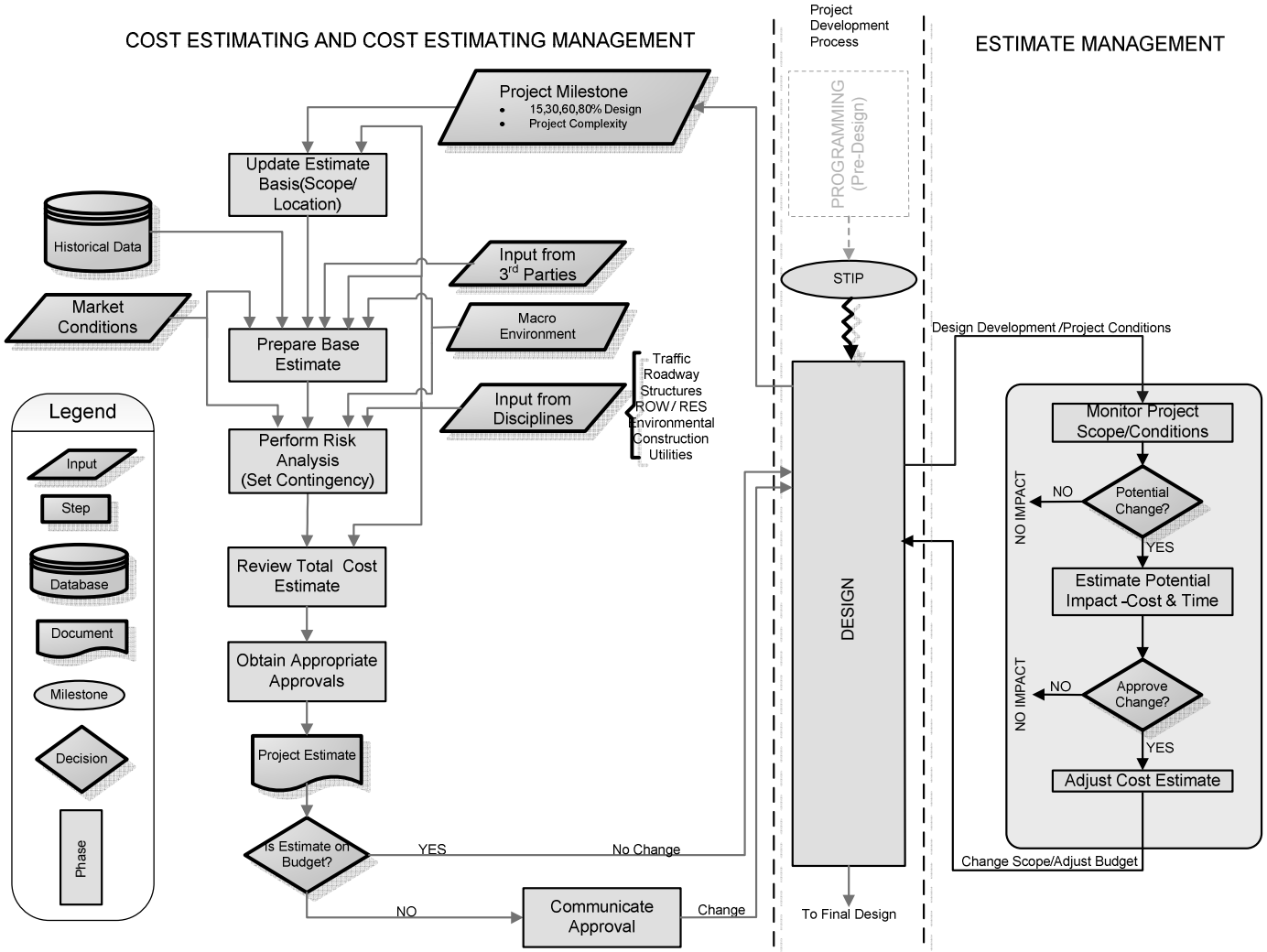


Figure 14: General cost estimating and estimate management during preliminary design (NCHRP 8-49, Phase I).

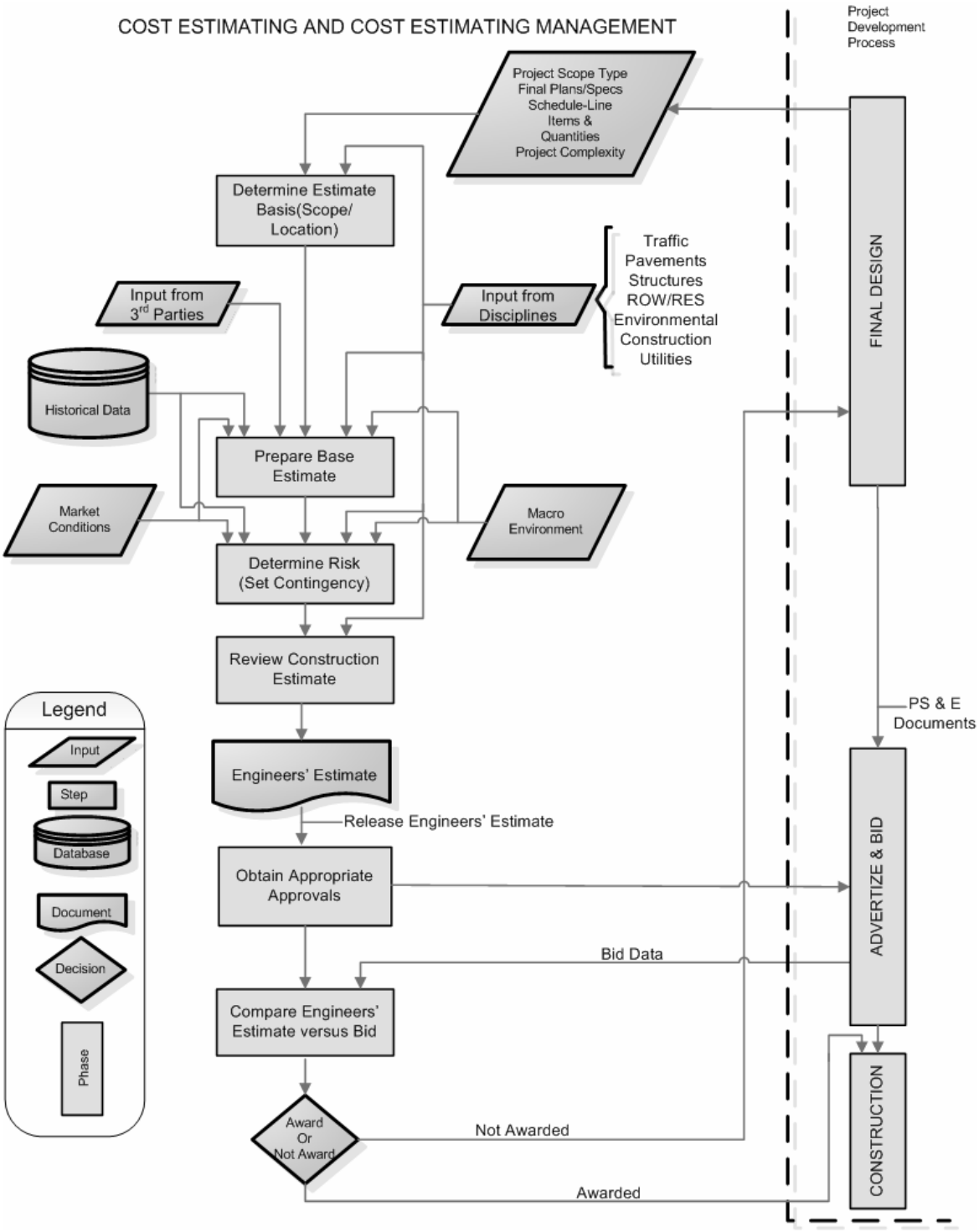


Figure 15: General cost estimating and estimate management during final design (NCHRP 8-49, Phase I).

APPENDIX B

INTERVIEW PROTOCOL

MEMORANDUM
November 26, 2007

TO: Survey Participant

FROM: Stu Anderson
Principal Investigator

SUBJECT: NCHRP 8-49 Phase II Interview Questionnaire

Thank you for participating in the NCHRP 8-49 Research Project concerning methods and tools to control cost escalation related to Right-of-Way. We have enclosed some brief background information about the research project along with the questionnaire we plan to discuss with you during our interview on (*insert day/month*) at (*insert time*). Please review the questionnaire prior to the interview to become acquainted with the nature of the questions that we will be discussing.

If you have any questions, please contact me by telephone at 979-845-2407 or by email at s-anderson5@tamu.edu.

Background

The Texas Transportation Institute (TTI) is conducting an NCHRP project (8-49, Phase II) entitled "Right of Way Methods and Tools to Control Project Cost Escalation." The research team consists of Dr. Stuart Anderson (Principal Investigator), Dr. Keith Molenaar (Co-Principal Investigator), Dr. Cliff Schexnayder (Consultant), as well as an industry review and implementation team. Phase I of NCHRP 8-49 documented the problems manifested in cost management approaches and cost estimate processes that often do not promote consistency and accuracy of costs over the entire project development process. NCHRP 8-49 Phase II will focus on the cost escalation problem that most state highway agencies, transit agencies, and metropolitan planning organizations face dealing specifically with *right-of-way*. Phase I findings, which are based on a critical review of literature, recent research, and current estimating practice, suggests that there are numerous factors influencing project cost escalation. These factors manifest themselves in increased costs in a number of project areas. The 8-49, Phase I research found that:

1. Actual cost of project right of way is frequently greater than the estimates of such cost that were produced during early stages of project development;
2. Management of the right-of-way estimating process has the potential to contribute significantly to addressing cost estimate consistency and accuracy throughout the entire project development process;
3. There is an opportunity to develop more right-of-way estimating methods and tools from successful practices around the country; and
4. There is a need to provide more specific guidance on how to implement strategies, methods, and tools such that improved right-of-way estimates can be achieved.

Because the study scope requires the research team to consider right-of-way estimating procedures and management methods during various phases of project development, particularly early stages, we have developed the following interview instrument that addresses various cost estimation and cost estimation management tools and methods that are in use in practice today. The team will assemble "state of practice" estimating information by project development phase so that the final guidelines will present tools to develop, track (manage), and document realistic right-of-way cost estimates during each phase of a project. The findings of 8-49, Phase I defined the different project phases shown in Figure 1 and further described in Table 1. A more detailed breakdown of the planning, programming, and preliminary design phases can be found as Attachment A following the questionnaire (NCHRP 8-49, Phase I).

Instructions

We have enclosed a questionnaire with sections relevant to the first four project phases shown in Figure 1. The interview will be based on the enclosed interview questionnaire. During the interview, all persons representing your state agency may be present for a group interview, or each person can be interviewed individually. The interview will last approximately two hours depending on the number of individuals involved in the discussion. The questionnaire to be discussed has been attached for review prior to the interview. Please note that not all the

questions will apply to every individual and some of the questions are repetitive from phase to phase. The research team would also appreciate receiving any supplemental information regarding the DOT's R/W estimating methods and tools such as information about computer programs you use or published guidelines.

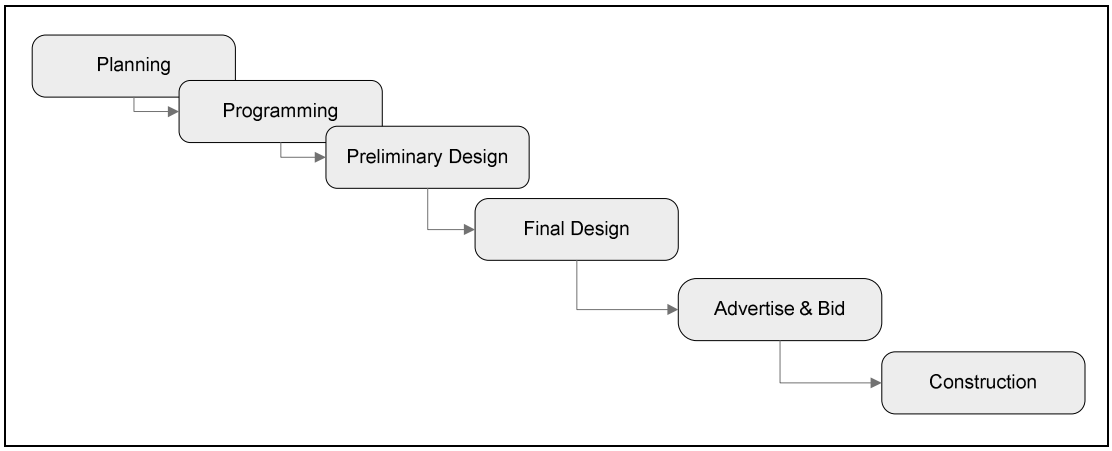


Figure 1 Typical Project Development Phases for Highway Projects (NCHRP 8-49, Phase I)

Table 1: Development Phases and Activities (Anderson and Blaschke 2004[1]; NCHRP 8-49, Phase I)

Development Phases	Typical Activities
Planning	Purpose and need; improvement or requirement studies; environmental considerations; right of way considerations; public involvement/participation; interagency conditions.
Programming	Environmental analysis; schematic development; public hearings; right of way impact; project economic feasibility and funding authorization.
Preliminary Design	Right of way development; environmental clearance; design criteria and parameters; surveys/utility locations/drainage; preliminary plans such as alternative selections; geometric alignments; bridge layouts.
Final Design	Right of way acquisitions; PS&E development – final pavement and bridge design, traffic control plans, utility drawings, hydraulics studies/drainage design, final cost estimates.
Advertise and Bid	Prepare contract documents, advertise for bid, pre-bid conference; receive and analyze bids.
Construction	Determine lowest responsive bidder, initiate contract, mobilization; inspection and materials testing; contract administration; traffic control, bridge, pavement, drainage construction.

1. Anderson, Stuart D. and Blaschke, Byron C. (2004). NCHRP Synthesis 33-09 "Statewide Highway Letting Program Management"

Right-of-Way Interview

The following list of questions has been developed to target specific areas of right-of-way cost estimation, estimate management, and other aspects of the right-of-way process. As mentioned previously, the project team is particularly interested in the right-of-way process as it parallels with the phases of project development. We are primarily concerned with the first four phases which include: ***Planning; Programming; Preliminary Design;*** and ***Final Design***. Therefore, as the interview progresses, each question will be discussed in reference to each of the first four phases of project development. In other words, each question will be asked 4 times. The first time a question will be asked as related to the *planning phase*. The second time it will be asked as related to *programming* and so on for *preliminary design* and *detailed design*. This line or type of questioning will help the team to identify similarities and differences of the right-of-way process as related to the project development process. Additionally, we acknowledge that some questions may not apply to a particular phase; if this is the case, please respond as such. Recall that detailed figures documenting the project development phases referenced above are shown in Attachment A.

Contact(s):

Determining Right-of-Way requirements

1. How are right-of-way requirements quantified for a particular project during each phase of project development? What sources of data are used in determining right-of-way dimensions at each point in project development (e.g. alignments, ROW maps, topographical maps, typical cross sections, land surveys, etc.)?

Estimate Preparation

2. Describe policies, procedures, techniques, and/or standards used in preparing right-of-way cost estimates during each phase of project development? If these policies, procedures, techniques, and/or standards are formally documented (written), can you provide us with a copy or a website location where we can obtain a copy?

3. Is historical data (or other data) used as a basis for preparing right-of-way estimates during each phase of project development? How is this data adjusted for time (schedule), location, and other project specific conditions?

4. What elements (e.g. utility adjustments, land use, damages, improvements, relocation assistance, eminent domain proceedings, etc.) are included in a right-of-way estimate prepared during each phase of project development? At each phase, which one element is

most difficult to quantify accurately? Which one is the least difficult? What methods and tools are used to quantify each?

5. How does the DOT address potential environmental issues (e.g. hazardous materials, wetlands, etc.) in right-of-way cost estimates during each phase of project development?

6. How do you insure that estimates completed during each phase of project development reflect all elements of the required right-of-way (e.g. utility adjustments, land use, damages, improvements, relocation assistance, eminent domain proceedings, etc.)?

7. During each phase of project development, is risk considered in the right-of-way estimate? If so, how is risk quantified and applied to the cost estimate?

Estimate Reviews

8. Is a formal review conducted within the DOT at each phase of project development to verify the right-of-way estimate? If yes, go to 8a, otherwise go to 8b.

   8a. Do the reviews follow a set of formalized and institutionalized procedures? Does the magnitude of right-of-way cost or right-of-way complexity trigger the review or additional reviews? Please identify these trigger values. What personnel outside of those responsible for preparing the estimate are involved in the review and approval of the estimate?

   8b. How does your DOT verify a right-of-way estimate?

Estimate Communication

9. Is there a systematic program that is used to standardize right-of-way estimating procedures and train those responsible for assembling the estimates during each phase of project development? What formal mechanisms are used for capturing and transferring knowledge about right-of-way cost estimating techniques?

10. Is contact made with the property owners during each phase of project development? If so, what information is communicated to the property owners? Is there an effort to discover potential problems or possible excessive damages that are unforeseen or unknown to the acquiring agency through communication with land owners at this time?

Cost Estimating Management

11. Are differences in right-of-way cost estimates between each phase reconciled? If so, how is the reconciliation performed?

12. What triggers an update of a right-of-way estimate during each phase of project development? Are estimates updated on a periodic basis, when major design changes occur, or through some other triggering mechanism?

13. Is the right-of-way cost estimate updated based upon continuing experience throughout the acquisition process or at each phase of the project development process? For example, the cost of parcels which are acquired early in the acquisition process exceed the estimated values may indicate the same for the remainder of the parcels.

14. If project requirements change and there is a requirement for additional right-of-way, how are these changes and requirements communicated to the personnel responsible for right-of-way cost estimating and acquisition during each phase of project development? Please explain how these changes are implemented by the right-of-way officials?

State Laws & Other Factors

15. Are there specific state laws or statutes that affect the ROW process during each phase of project development? If so, please identify such laws and describe each including background and effect on the ROW process.

16. Are there any other factors that affect the ROW process during each phase of project development (e.g. environmental, social, political; such parameters may apply to the whole state or a particular district or metropolitan area)? If so, please name these and describe each including background and effect on the ROW process.

17. Do state laws allow for the use of acquisition techniques such as advanced acquisition, land consolidation, land exchange, incentives, or other non-standard techniques? If so, are these used and how effective are such techniques? Please include the particular phase of project development where these techniques are applicable.

(General cost estimating and estimate management flowcharts from Phase I of NCHRP 8-49 which are displayed in Appendix A were included in the interview protocol here)

APPENDIX C

EXAMPLE OF STATE DOT INTERVIEW REPORT

CalTrans Right-of-Way Interview
@State Office
@District Office

The following list of questions has been developed to target specific areas of right-of-way cost estimation, estimate management, and other aspects of the right-of-way process. As mentioned previously, the project team is particularly interested in the right-of-way process as it parallels with the phases of project development. We are primarily concerned with the first four phases which include: ***Planning; Programming; Preliminary Design;*** and ***Final Design***. Therefore, as the interview progresses, each question will be discussed in reference to each of the first four phases of project development. In other words, each question will be asked 4 times. The first time a question will be asked as related to the *planning phase*. The second time it will be asked as related to *programming* and so on for *preliminary design* and *detailed design*. This line or type of questioning will help the team to identify similarities and differences of the right-of-way process as related to the project development process. Additionally, we acknowledge that some questions may not apply to a particular phase; if this is the case, please respond as such. Recall that detailed figures documenting the project development phases referenced above are shown in Attachment A.

Contact(s):
Senior ROW Agent

Senior ROW Agent (North Region)

Senior ROW Agent (North Region)

Senior ROW Agent (North Region)

Overview: ROW Process
***refer to figure provided showing the ROW process in relation to the overall project development process

- There are only 3 phases in the ROW process: Project Initiation (Planning, Programming), Permits and Studies (Preliminary Design), PS&E (Final Design)
- Planning (with Programming) - Programming is not considered a phase by itself in the process. It takes place at the end of planning and before preliminary design

occurs. Multiple alternatives exist during the planning phase. The ROW cost estimate completed at this point usually sets the ROW baseline for the project.

- Preliminary Design – a preferred alternative is chosen here based upon cost estimates of design, construction, and ROW per each alternative. After a preferred alternative is chosen the cost estimate is usually updated.
- Final Design – appraisals and acquisition occur during this phase. In the perfect world, all acquisition is complete before construction begins.

*** Marysville provided the following:

- 2 copies of completed ROW cost estimates which includes cost data sheets
- A ROW cost data sheet request with a cost estimate map
- the excel template for their cost estimation process

Determining Right-of-Way requirements

1. How are right-of-way requirements quantified for a particular project during each phase of project development? What sources of data are used in determining right-of-way dimensions at each point in project development (e.g. alignments, ROW maps, topographical maps, typical cross sections, land surveys, etc.)?

- A cost estimate map is typically provided by the ROW engineers. The cost estimate map consists of an aerial photo of the project area in which each parcel is labeled and ROW boundaries are drawn in. The level of detail shown on the cost estimate map is crucial to producing an accurate cost estimate.
- On a parcel by parcel basis, structures (improvements) are identified along with any problems and the market value is applied as determined by the ROW agent.
    - Market trends are the prime source of assigning value to a property. The ROW agent will contact the tax assessor, realtors in the area, and any other sources.
    - Field visits and maps such as provided by Google Earth also are used by agents to identify structures, damages, and other potential problems by parcel.
    - Experience and knowledge of the area is a large indicator for an accurate cost estimate. The best estimators are those that are experienced because they have a feel for property values and other aspects of ROW.
    - This portion of the estimate is restricted by the amount of time available.
    - When partial takings, damages must be assessed.
- The level of detail of the Cost Estimate Map was emphasized by Marysville to affect the quality and ease of the cost estimate.

Estimate Preparation

2. Describe policies, procedures, techniques, and/or standards used in preparing right-of-way cost estimates during each phase of project development? If these policies, procedures, techniques, and/or standards are formally documented (written), can you provide us with a copy or a website location where we can obtain a copy?

- Policies and procedures related to cost estimates of ROW can be found in **Chapter 4 of the ROW manual**. These policies and procedures provide information to the districts but these are only guides by which they estimate ROW. The manual does not provide actual tools for the districts to use. The actual tools and methods are not consistent throughout the districts.
- early collaboration of ROW with the PM and Design is encouraged to identify problems at early stages in project development
- All the above confirmed by Marysville. They follow the general outline set in the ROW manual.

3. Is historical data (or other data) used as a basis for preparing right-of-way estimates during each phase of project development? How is this data adjusted for time (schedule), location, and other project specific conditions?

- historical data is used for support costs which are the man-hours used to complete the estimates
- demolition of existing buildings is also estimated by recent historical data
- capital costs are based on recent sales in the area (market value)
- all the above confirmed by Marysville

4. What elements (e.g. utility adjustments, land use, damages, improvements, relocation assistance, eminent domain proceedings, etc.) are included in a right-of-way estimate prepared during each phase of project development? At each phase, which one element is most difficult to quantify accurately? Which one is the least difficult? What methods and tools are used to quantify each?

- All elements above are included in the ROW estimate beginning with Planning. This estimate is updated after programming, during preliminary design and may be updated during Final Design dependent on appraisals. Appraisals are considered more accurate than early estimates and if there is enough increase over the cost estimate the budget may be adjusted through communication with the Project Manager.
- Additional elements in ROW estimate: permit costs, support costs
- The number of parcels that will go to eminent domain proceedings are also estimated.
- Most difficult: highest and best use, damages in partial takings.
- Least difficult: relocation assistance program, demolition costs,
- each district is responsible for tools and methods to estimate costs
- A minimum of two estimates are prepared for a project: Planning and Preliminary Design.
- Most difficult: damages, environmental mitigation
    - there are many unknowns at the estimate level which aren't realized until the appraisal stage of the project
- Least difficult: relocation costs

5. How does the DOT address potential environmental issues (e.g. hazardous materials, wetlands, etc.) in right-of-way cost estimates during each phase of project development?

- Environmental issues are addressed before a project can be programmed. This is especially the case for projects in the STIP.
- There is a division in each district that handles environmental issues for the projects. It seemed that the environmental impacts are not specified until the preliminary design phase; therefore it is not captured in the planning phase estimate. There is a need for environmental impacts to be identified earlier so that mitigation lands can be acquired if necessary and also included in the cost estimate.
- Impacts of possible hazardous materials on parcels are usually estimated by the ROW agent doing the estimate to the best of their ability based on the limited information at hand and other indicators.

6. How do you insure that estimates completed during each phase of project development reflect all elements of the required right-of-way (e.g. utility adjustments, land use, damages, improvements, relocation assistance, eminent domain proceedings, etc.)?

- The use of a cost data sheet which has an itemized list of costs that apply to the project. Also included in the data sheet is a list of questions pertaining to the ROW including assumptions and limitations. There is a section that summarizes types of parcels to be acquired and types of utility relocations.
- Cost areas include:
    - total acquisition cost (includes acquisition, excess lands, damages, and Goodwill (???))
    - utility relocation
    - relocation assistance
    - clearance/demolition
    - title and escrow
- There is an example cost data sheet that is in the exhibits portion of Chapter 4 of the ROW manual.
- The Marysville district uses an excel spreadsheet that has 3 parts to it and then is summarized by the cost data sheet similar to the one provided by the ROW manual, Ch. 4:
    - Capital cost estimate which estimates the cost of acquisition by each parcel
        - includes the complexity of each parcel, damages, utilities, relocation costs, etc.
        - an escalation rate and contingency factor (usually 20 to 25%) is also applied to the estimate
        - each involved party signs off on their area of expertise within the cost estimate
    - Support allocation request which estimates the cost in man-hours to complete the work on the cost estimate(s) and any updates required throughout the project. This is done by a standard WBS that denotes the level of all individuals that may be involved in the cost estimate.
    - Timeline needed for acquisition which is the time necessary for all appraisals and acquisition beginning from the last map provided.

7. During each phase of project development, is risk considered in the right-of-way estimate? If so, how is risk quantified and applied to the cost estimate?

- there is no formal risk analysis done
- Contingency of approximately 20-25% is applied to cover cost escalation.
- Contingency does not vary from estimate to estimate. It is usually applied by percentage to the aggregate project. There is no methodology for assigning this contingency amount, but early communication with land owners may increase the contingency amount being applied.

Estimate Reviews

8. Is a formal review conducted within the DOT at each phase of project development to verify the right-of-way estimate? If yes, go to 8a, otherwise go to 8b.

   8a. Do the reviews follow a set of formalized and institutionalized procedures? Does the magnitude of right-of-way cost or right-of-way complexity trigger the review or additional reviews? Please identify these trigger values. What personnel outside of those responsible for preparing the estimate are involved in the review and approval of the estimate?

   8b. How does your DOT verify a right-of-way estimate?

- The ROW data sheet has a place for a supervisor of ROW, Railroad, and Utilities to sign off on the estimate.
- The Deputy District Chief of ROW eventually signs off on the ROW estimate.
- Reviews are done on ROW appraisals, but there is not much of a review for cost estimates during early stages of project development.
- Following the completion of the ROW data sheet it is circulated to all parties involved in the cost estimate. Each of the parties must sign off that the portion of the estimate completed that affects their department is correct.

Estimate Communication

9. Is there a systematic program that is used to standardize right-of-way estimating procedures and train those responsible for assembling the estimates during each phase of project development? What formal mechanisms are used for capturing and transferring knowledge about right-of-way cost estimating techniques?

- No, there is no program in place to standardize estimating procedures and train estimators.
- There is not systematic program but training is facilitated by those individuals that have the most experience in ROW. The excel spreadsheet serves as a systematic tool that attempts to streamline the ROW estimation process; the general procedure used for cost estimation is outlined within the spreadsheet.

10. Is contact made with the property owners during each phase of project development? If so, what information is communicated to the property owners? Is there an effort to discover

potential problems or possible excessive damages that are unforeseen or unknown to the acquiring agency through communication with land owners at this time?

- Formal contact is not made with property owners until the appraisal stage during final design.
- Public hearings during the Permits & Studies phase (Planning) take place according to state law.
- All the above confirmed by Marysville

Cost Estimating Management

11. Are differences in right-of-way cost estimates between each phase reconciled? If so, how is the reconciliation performed?

- At minimum, two estimates are completed (planning and preliminary design).
- The Planning cost estimate is updated during the Preliminary Design phase after a preferred alternative is chosen. The estimate is updated by review of the cost data sheet and supporting estimate information.
- All the above confirmed by Marysville. The planning estimate is reviewed based on market conditions, design details, improvements completed since planning estimate, etc.

12. What triggers an update of a right-of-way estimate during each phase of project development? Are estimates updated on a periodic basis, when major design changes occur, or through some other triggering mechanism?

- major changes in design trigger an update of the ROW estimate
- Review of cost estimates is completed once a year if time and work loads permit.
- At minimum, the planning estimate is updated during preliminary design when a preferred alternative is chosen and when any major design changes take place.

13. Is the right-of-way cost estimate updated based upon continuing experience throughout the acquisition process or at each phase of the project development process? For example, the cost of parcels which are acquired early in the acquisition process exceed the estimated values may indicate the same for the remainder of the parcels.

- an update occurs during preliminary design after a preferred alignment is selected
- yes, an update of the cost estimate (or budget) may occur during final design based on appraisal values if there are significant differences from the cost estimate
- All the above confirmed by Marysville

14. If project requirements change and there is a requirement for additional right-of-way, how are these changes and requirements communicated to the personnel responsible for right-of-way cost estimating and acquisition during each phase of project development? Please explain how these changes are implemented by the right-of-way officials?

- these changes are communicated through the project manager to ROW, but no formal process for communicating these changes were discussed in the interview
- All the above confirmed by Marysville

State Laws & Other Factors

15. Are there specific state laws or statutes that affect the ROW process during each phase of project development? If so, please identify such laws and describe each including background and effect on the ROW process.

    - following the Kelo case decision by the Supreme Court, each land owner is allowed up to $5000 reimbursement towards an independent appraisal. The Kelo case statute may be a source of delay in the acquisition process. Previously, it was easy to predict when a property's acquisition would be complete even if it would go to condemnation because there was a more systematic timeline associated.
    - state dollars can not be spent towards ROW until environmental clearance has been obtained
    - laws seem to favor property owners
    - All the above confirmed by Marysville

16. Are there any other factors that affect the ROW process during each phase of project development (e.g. environmental, social, political; such parameters may apply to the whole state or a particular district or metropolitan area)? If so, please name these and describe each including background and effect on the ROW process.

    - Environmental mitigation directly affects ROW. Lands may need to be purchased to replace wetlands or other environmentally sensitive lands that are destroyed by highway projects.
        - A lot of emphasis was placed on environmental by Marysville. The need to know environmental impacts early in the ROW process so that mitigation lands can be included in the cost estimate is essential. Marysville is constantly trying to get numbers from the environmental group earlier.
        - There are 2 options for environmental mitigation:
            - Purchase lands, develop land, and maintain perpetually
            - buy credits from others (this is preferred so that they do not have to develop and maintain the land)
    - Political influences may affect how funds are prioritized for each project.
    - Non-traditional project delivery methods, particularly Design Sequencing, make it more difficult to estimate ROW costs.

17. Do state laws allow for the use of acquisition techniques such as advanced acquisition, land consolidation, land exchange, incentives, or other non-standard techniques? If so, are these used and how effective are such techniques? Please include the particular phase of project development where these techniques are applicable.

    - Advanced Acquisition is limited to hardships or protection buying.

- Some projects may meet certain conditions for early acquisition, but all public hearings must still take place and environmental documents must be circulated. This may be a stretch due to the state law pertaining to spending state dollars only after environmental clearance has been obtained.
- not discussed with Marysville

Other notes:

- ROW capital costs and support costs are based on projects, but a lump sum is given to the districts by the CTC by fiscal year.
    - This lump sum approach offers the districts some flexibility in spending funds. This is the case when a project is delayed, the districts may choose to spend the money allotted to that project on more pressing projects that were not actually programmed at the time budget was submitted to the CTC.
    - The lump sum is favored over a project by project approach because of changes in design and construction. Lump sum avoids the adjustments required by project to project approach and also avoids further escalation of market values.
- Delays to projects include:
    - environmental
    - political
    - community opposition
- Market values, even within the district, will vary from area to area.
- project managers have come to except the cost escalation involved in ROW, but man-hours estimated to complete the cost estimates have become more crucial
- In order to know the estimating process and the market values across the district the job of cost estimator at the Marysville office is a full-time job who have no other responsibilities.
- Cost estimates are completed by market value. This differs from appraisals which may be done by the cost or income methods of valuation.
- ROW has a huge human factor involved with it. Regardless of the accuracy of your estimate, it is difficult to predict the property owner and what actions they may take and the resources they may have to back up those actions.

APPENDIX D

ROW FLOWCHART HANDOUT

(August 15, 2007 version)

Thank you for participating in the NCHRP 8-49 (Phase II) Research Project concerning procedures, methods, and tools to control cost escalation related to Right-of-Way. The main objective of NCHRP Project 8-49(II) is to:

> *Develop an all-inclusive set of ROW cost estimation and cost estimate management procedures based upon literature and current SHA practice, which integrates cost estimate steps documented in NCHRP Report 574 to support the right-of-way process.*

To date, the research team has completed all nine interviews in all. This includes seven State highway agencies and two local public agencies. Following these interviews process flowcharts were created to synthesize ROW practices of these agencies. The flowcharts document the process steps, inputs, and outputs related to the ROW process throughout the project development process.

As defined by Phase I of NCHRP Project 8-49, the project development process consists of: Planning, Programming, Preliminary Design, Final Design, and Construction. Since Phase I established this general project timeline, the process flowcharts have been developed relative to these phases. These phases are outlined in Table 1, below.

Table 1: Development Phases and Activities (Anderson and Blaschke 2004[1]; NCHRP 8-49, Phase I)

Development Phases	Typical Activities
Planning	Purpose and need; improvement or requirement studies; environmental considerations; right of way considerations; public involvement/participation; interagency conditions.
Programming	Environmental analysis; schematic development; public hearings; right of way impact; project economic feasibility and funding authorization.
Preliminary Design	Right of way development; environmental clearance; design criteria and parameters; surveys/utility locations/drainage; preliminary plans such as alternative selections; geometric alignments; bridge layouts.
Final Design	Right of way acquisitions; PS&E development – final pavement and bridge design, traffic control plans, utility drawings, hydraulics studies/drainage design, final cost estimates.

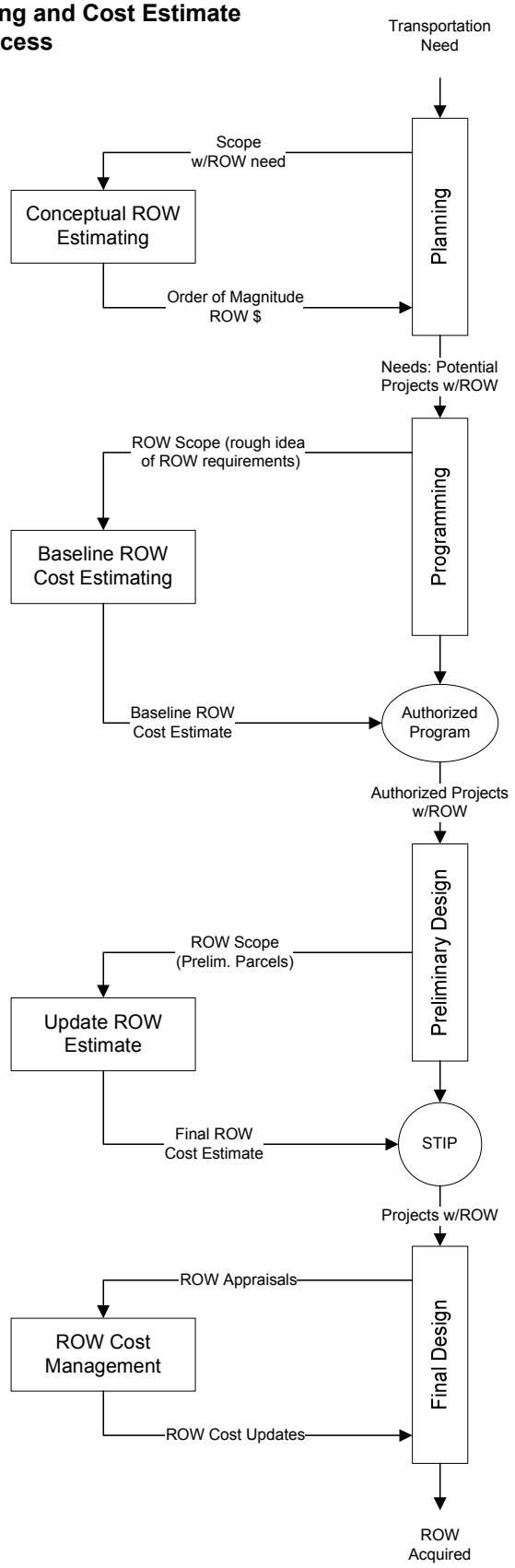
Five flowcharts have been developed which are attached below. The first outlines the process at the agency level. The following four diagrams document the ROW process at the four stages of project development shown above. Table 2 quickly outlines the ROW processes that occur during each of the phases.

Table 2: Development Phases and Purpose of each of the process flowcharts

Flowchart	Development Phases	Purpose
Agency Level ROW Process	All Phases	Display the overall ROW cost estimation and cost management process at the Agency Level
Conceptual ROW Cost Estimating	Planning	Estimate a ROW cost 10-20 years from the start of construction for planning purposes.
Baseline ROW Cost Estimating	Programming	Establish the Baseline ROW Cost Estimate
Update ROW Cost Estimating	Preliminary Design	Update the Baseline ROW Cost Estimate per changes/revisions since last cost estimate
ROW Cost Management	Final Design	Manage appraised values and actual acquisition costs versus the Update ROW Cost Estimate

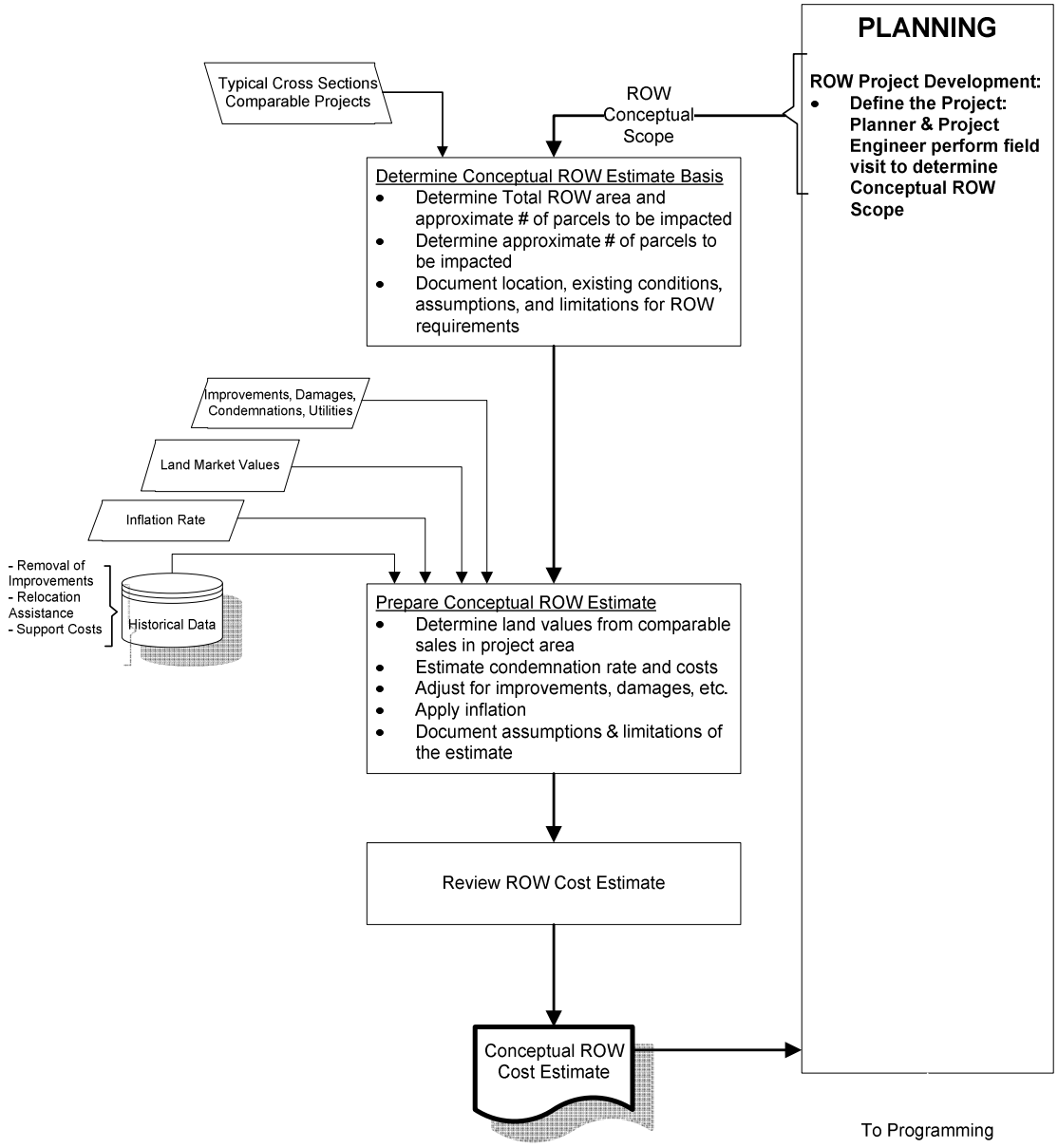
It is the intention of the research team to continue to develop these process flowcharts through validation and revisions by input provided by officials of each of the acquiring agencies interviewed. The research team would like to complete this through the method of a conference call which will last 30 to 45 minutes. Please review the enclosed ROW process flowcharts and be prepared to provide input on these flowcharts. Thank you, once again, for your time and contribution to this research.

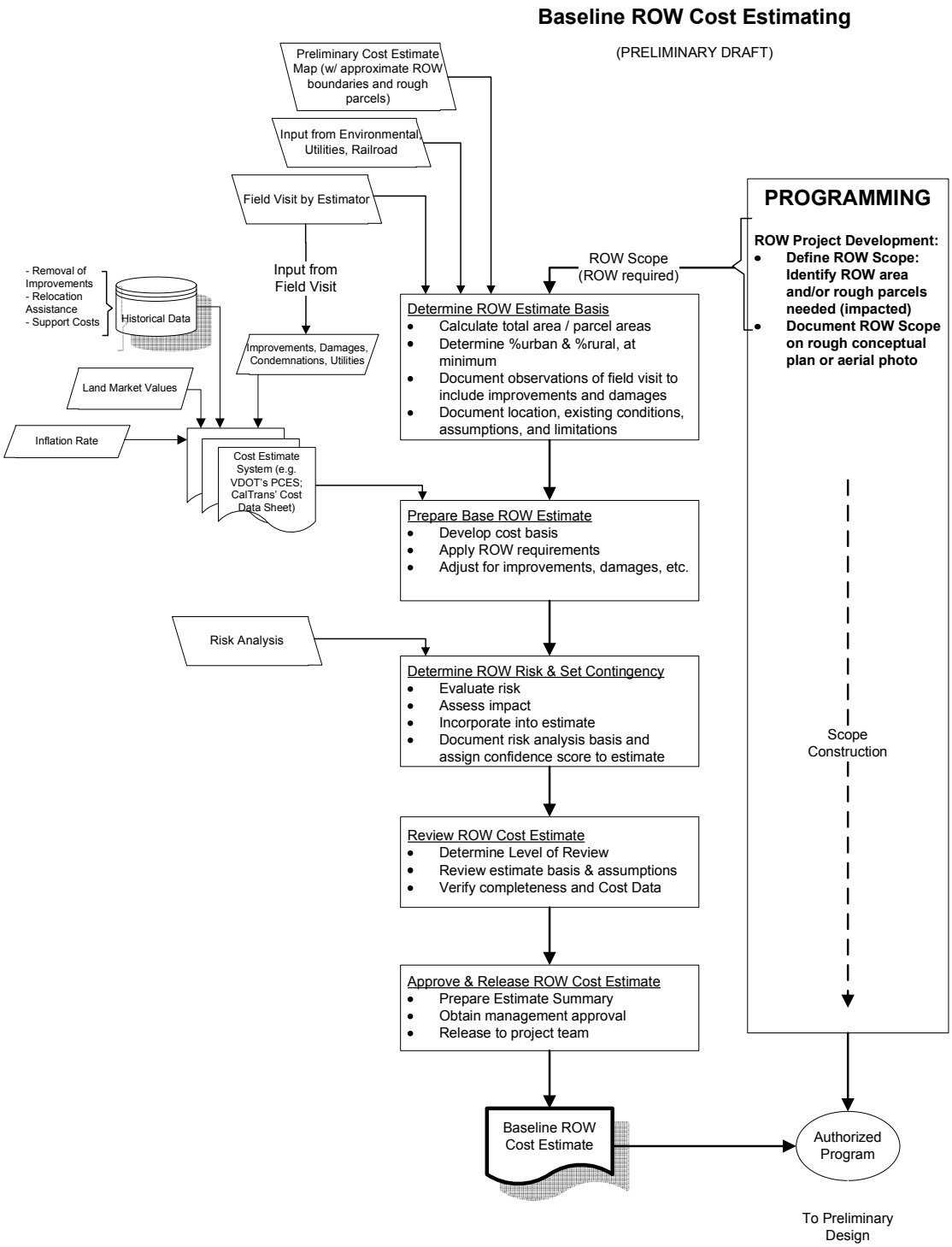
Agency Level ROW Cost Estimating and Cost Estimate Management Process

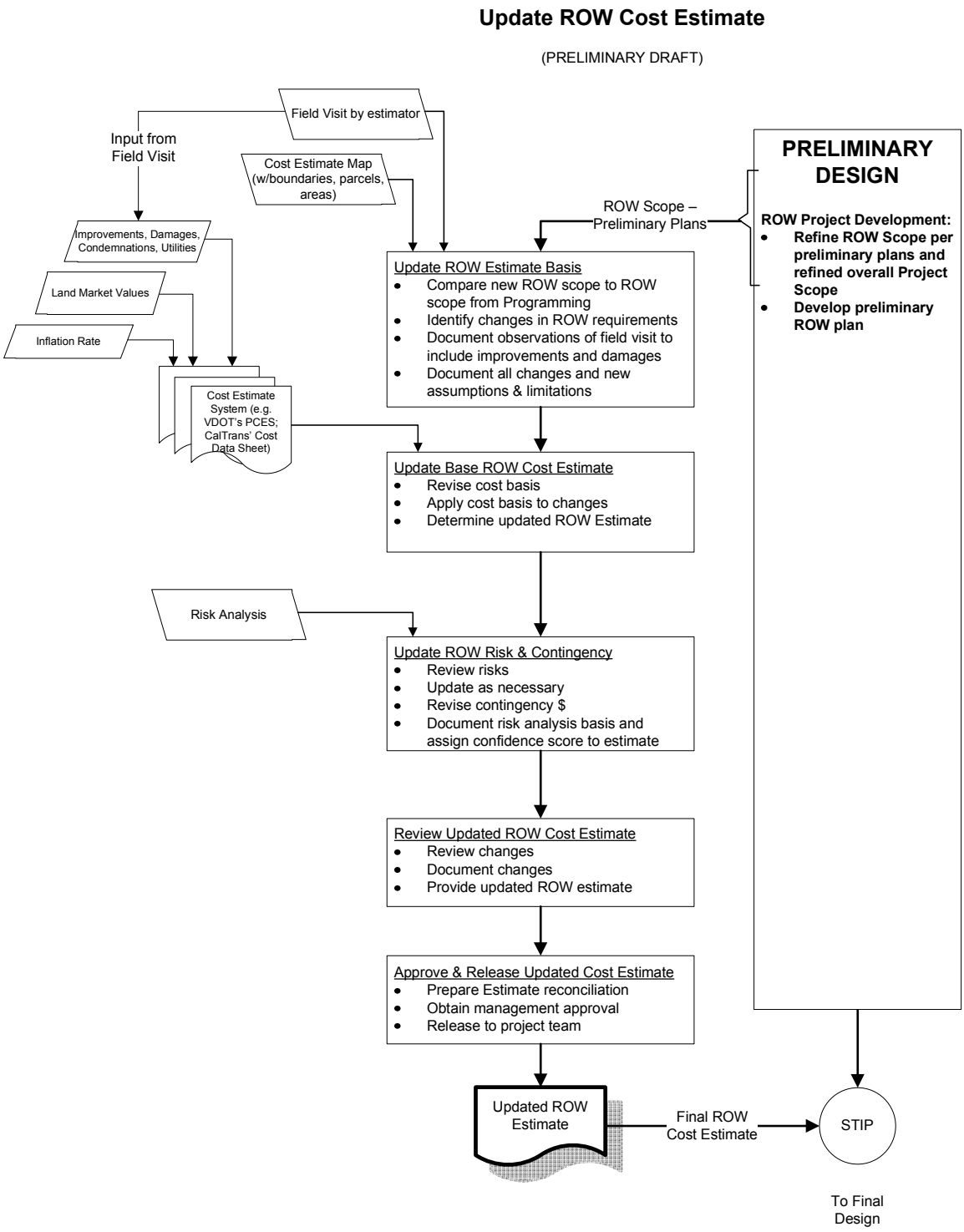


Conceptual ROW Cost Estimating

(PRELIMINARY DRAFT)

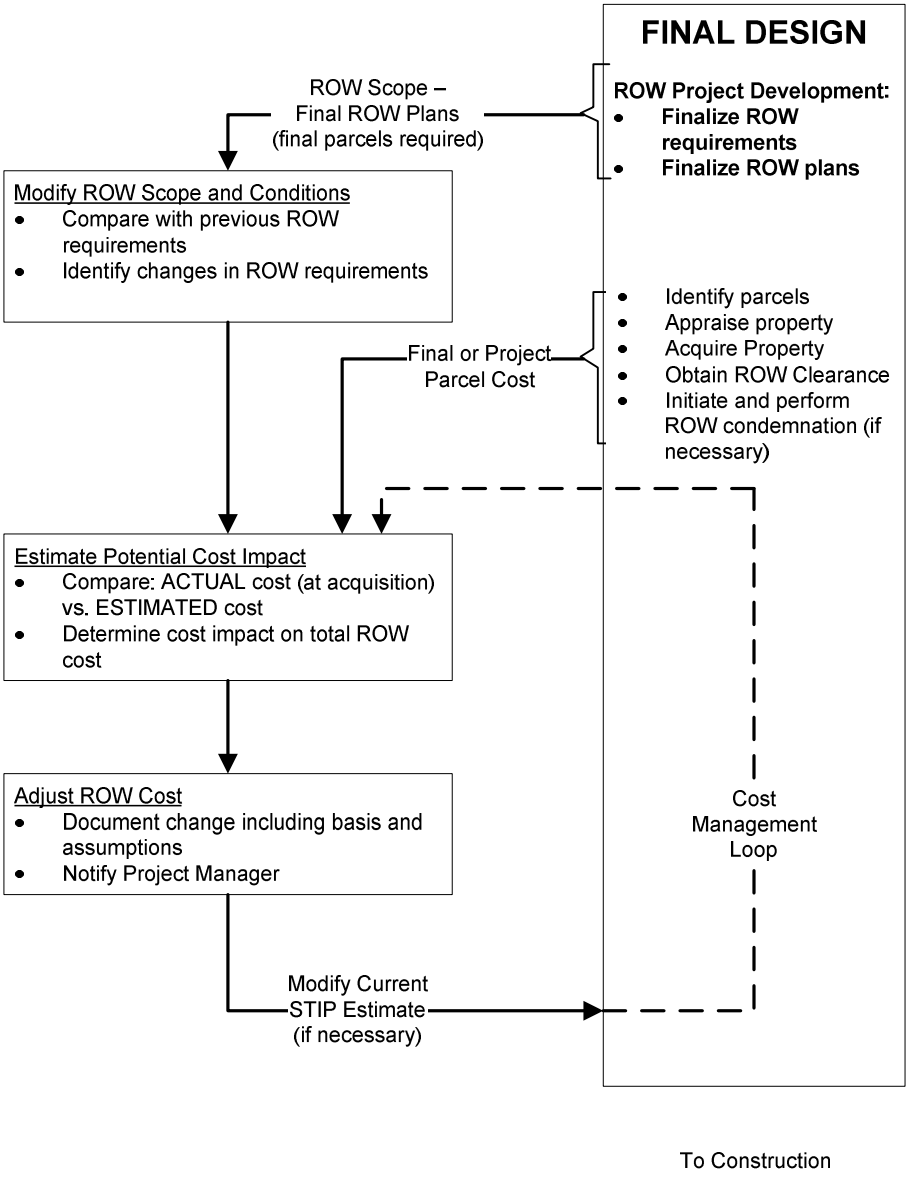



Baseline ROW Cost Estimating
(PRELIMINARY DRAFT)
Preliminary Cost Estimate Map (w/ approximate ROW boundaries and rough parcels)
Input from Environmental, Utilities, Railroad
Field Visit by Estimator
Input from Field Visit
- Removal of Improvements
- Relocation Assistance
- Support Costs
Historical Data
Improvements, Damages, Condemnations, Utilities
Land Market Values
Inflation Rate
Cost Estimate System (e.g. VDOT's PCES; CalTrans' Cost Data Sheet)
ROW Scope (ROW required)
Determine ROW Estimate Basis
• Calculate total area / parcel areas
• Determine %urban & %rural, at minimum
• Document observations of field visit to include improvements and damages
• Document location, existing conditions, assumptions, and limitations
Prepare Base ROW Estimate
• Develop cost basis
• Apply ROW requirements
• Adjust for improvements, damages, etc.
Risk Analysis
Determine ROW Risk & Set Contingency
• Evaluate risk
• Assess impact
• Incorporate into estimate
• Document risk analysis basis and assign confidence score to estimate
Review ROW Cost Estimate
• Determine Level of Review
• Review estimate basis & assumptions
• Verify completeness and Cost Data
Approve & Release ROW Cost Estimate
• Prepare Estimate Summary
• Obtain management approval
• Release to project team
Baseline ROW Cost Estimate
PROGRAMMING
ROW Project Development:
• Define ROW Scope: Identify ROW area and/or rough parcels needed (impacted)
• Document ROW Scope on rough conceptual plan or aerial photo
Scope Construction
Authorized Program
To Preliminary Design


Update ROW Cost Estimate
(PRELIMINARY DRAFT)
Field Visit by estimator
Input from Field Visit
Cost Estimate Map (w/boundaries, parcels, areas)
Improvements, Damages, Condemnations, Utilities
Land Market Values
Inflation Rate
Cost Estimate System (e.g. VDOT's PCES; CalTrans' Cost Data Sheet)
ROW Scope – Preliminary Plans
PRELIMINARY DESIGN
ROW Project Development:
Refine ROW Scope per preliminary plans and refined overall Project Scope
Develop preliminary ROW plan
Update ROW Estimate Basis
Compare new ROW scope to ROW scope from Programming
Identify changes in ROW requirements
Document observations of field visit to include improvements and damages
Document all changes and new assumptions & limitations
Update Base ROW Cost Estimate
Revise cost basis
Apply cost basis to changes
Determine updated ROW Estimate
Risk Analysis
Update ROW Risk & Contingency
Review risks
Update as necessary
Revise contingency $
Document risk analysis basis and assign confidence score to estimate
Review Updated ROW Cost Estimate
Review changes
Document changes
Provide updated ROW estimate
Approve & Release Updated Cost Estimate
Prepare Estimate reconciliation
Obtain management approval
Release to project team
Updated ROW Estimate
Final ROW Cost Estimate
STIP
To Final Design

ROW Cost Management

(PRELIMINARY DRAFT)



VITA

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