Report No. CDOT-2007-6
Final Report

DTD Applied Research and Innovation Branch

Where Ideas Become Reality

EVALUATION AND MITIGATION OF ENVIRONMENTAL IMPACTS PRIOR TO PROJECT SELECTION

April 2007

COLORADO DEPARTMENT OF TRANSPORTATION
RESEARCH BRANCH

Technical Report Documentation Page

1. Report No. CDOT-2007-6	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle EVALUATION AND MITIGATION OF ENVIRONMENTAL IMPACTS PRIOR TO PROJECT SELECTION		5. Report Date April 2007
		6. Performing Organization Code
7. Author(s)		8. Performing Organization Report No. CDOT-2007-6
9. Performing Organization Name and Address Environmental Programs Branch Colorado Department of Transportation 4201 E. Arkansas Ave. Denver, CO 80222		10. Work Unit No. (TRAIS)
		11. Contract or Grant No. 32-10
12. Sponsoring Agency Name and Address Colorado Department of Transportation - Research 4201 E. Arkansas Ave. Denver, CO 80222		13. Type of Report and Period Covered Assessment of the Corridor Approach for Early Evaluation of Environmental Resources
		14. Sponsoring Agency Code

15. Supplementary Notes
Prepared in cooperation with the US Department of Transportation, Federal Highway Administration

16. Abstract
This study demonstrates that environmental data collected on a corridor-wide scale is an excellent resource for project-specific planning as well as mitigation planning. The detailed environmental data banks and resource maps that can be created through a corridor approach (CA) provide valuable tools for long-range transportation planning, and expand CDOT’s opportunity to exercise its environmental stewardship roles. The study also indicates that aerial photos provide many advantages when used as a base map and that digital formats are an efficient way to store access data. Finally, the CA provides a convenient framework for setting data collection standards that will improve CDOT’s environmental compliance process.

Implementation:
It appears that the tools utilized in this study were outdated by the time the document was finalized. The data can be implemented in a more updated fashion with the newer methods and technologies available today.

17. Keywords environmental mitigation, environmental impacts, corridor approach (CA), GIS data		18. Distribution Statement No restrictions. This document is available to the public through the National Technical Information Service Springfield, VA 22161	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 36	22. Price

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

EVALUATION AND MITIGATION OF ENVIRONMENTAL IMPACTS PRIOR TO PROJECT SELECTION

US 24, MP 311.7 T0 MP 339.0

Results of an Assessment of the Corridor Approach for Early Evaluation of Environmental Resources

Conducted by

The Environmental Programs Branch
Division of Transportation Development
Colorado Department of Transportation

April 2007

EXECUTIVE SUMMARY

In 1999 and 2000, the Environmental Programs Branch (EPB) of the Colorado Department of Transportation's (CDOT) Division of Transportation Development (DTD) began evaluating methods for collecting corridor-wide data, prior to project-specific planning. DTD chose a corridor along US Highway 24 (US 24), east of Colorado Springs, to identify the methodologies and protocols that should be adopted to efficiently gather environmental data at this scale. DTD was also interested in assessing the benefits of collecting data prior to start of project for mitigation planning. Color infrared and true color aerial photography were used to create a corridor-wide base map to unify the data collection effort. The efficacy of using photo interpretation to aid collection of natural resource and cultural resource data was examined. Location and descriptive information about resources were then entered into CDOT's Geographic Information System (GIS), providing easy access to these data for all future projects within the corridor. Based on the experience of this evaluation, corridor-wide data collected prior to project planning and stored in a standardized digital format in CDOT's GIS will streamline and improve environmental compliance and improve mitigation planning. However, data standards must be defined prior to data collection and the data must be collected in a consistent manner by skilled technicians to maximize its utility.

The field of remote sensing data acquisition is constantly changing. Digital acquisition technologies and laser-based data collection is making this effort more efficient and a time and money saving approach.

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ACRONYMS

CA	Corridor Approach
CDOT	Colorado Department of Transportation
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CIR	Color Infrared
CNHP	Colorado Natural Heritage Foundation
COR	U.S. Army Corps of Engineers
DTD	Division of Transportation Development
EPB	Environmental Programs Branch
EA	Environmental Assessment
EIS	Environmental Impact Statement
ERO	ERO Resources
FWS	Fish and Wildlife Service
GPS	Global Positioning System
GIS	Geographic Information System
LUST	Leaking Underground Storage Tank
MP	Milepost
NMAS	National Map Accuracy Standards
OAHP	Colorado State Office of Archeology and Historic Preservation
PEP	Permission to Enter Private Property
PMJM	Preble's Meadow Jumping Mouse
PWT	Pacific Western Technologies
RCRA	Resource Conservation and Recovery Act
ROW	Right-of-Way
T & E	Threatened and Endangered
USGS	U.S. Geological Survey
UST	Underground Storage Tanks
UTM	Universal Transverse Mercator

INTRODUCTION

Purpose and Need for the Study

CDOT is under increasing pressure to develop projects quickly while complying with environmental requirements. However, lack of information to predict and plan for environmental issues can add significant time and complexity to the project development process, as described below. To address this problem, DTD undertook a project to evaluate methods for identifying key environmental issues and their geographical components, prior to the selection and design of specific projects. Specifically, DTD was interested in approaches that allowed data to be collected with a high degree of accuracy at the corridor level.

Currently, CDOT projects that do not require extensive environmental documentation are frequently not evaluated for environmental issues until the project is already planned. This evaluation often occurs after the locations of alignments and structural features have been chosen. These key decisions are made with little information about the environmental resources that a project may affect. As a result, project delays due to unexpected environmental compliance issues may occur. For example, a project evaluation may reveal the presence of an endangered species, triggering lengthy consultation with the U.S. Fish and Wildlife Service. Further delays may be encountered if project redesign is then required to avoid impacts to the species.

For projects that require documentation such as an Environmental Assessment (EA) or an Environmental Impact Statement (EIS), environmental data are usually collected well in advance of project design. However, these efforts are often hampered by limited availability of needed data. For example, the accuracy of wetland delineations is limited by the resolution and accuracy of available products that can act as base maps. Although delineations are refined later in the project development phase, decisions about where to locate alignments are often made prior to refinement. The same type of unanticipated impacts and redesign issues noted above may then cause delay. In both cases, a pre-project corridor-wide environmental database, developed according to unified standards and data collection protocols would provide the information needed to avoid delays related to environmental compliance.

The Corridor Approach

As discussed above, environmental data collected throughout a corridor prior to planning for a specific project can provide an important database for all future projects within that corridor. With this in mind, DTD set out to examine data collection methods that could facilitate pre-project, corridor-wide resource evaluations before the start of the project. This type of an assessment has been referred to as the corridor approach (CA). DTD also examined the efficacy of storing and using the collected data in digital format. Digital formats were chosen because they offer compressed storage, agency-wide accessibility if stored on CDOT's existing GIS system, and flexibility in subsequent use. If all resource records stored within a CA database are referenced by a common geographic standard, composite maps that accurately depict the relative locations of all environmental constraints to a proposed alignment within that area can easily be created using the GIS.

Study Goals

The primary goals of the CA assessment project were to:

- Develop a standardized, reproducible system for collecting resource data at a corridor-wide scale;
- Develop protocols for storing and retrieving this type of data to make it widely available for use during all phases of project planning; and
- Evaluate the utility of the CA for planning advance mitigation of environmental impacts and developing supporting agreements.

Study Area

The study corridor was located along US 24 in El Paso County, east of Colorado Springs, beginning at milepost (MP) 311.7 and extending east to MP 339.0. The study area was chosen because this section of highway is slated for upgrade in the near future. Therefore, the data collected for this assessment would be useful for future projects. Additionally, because some environmental conflicts were anticipated within this corridor, CDOT Region 2 had already begun some environmental assessment in the area. DTD saw an opportunity to combine efforts. However, merging data collected at different standards and by different methods proved unwieldy and illustrated the need for consistent methods across a corridor. This was an important lesson learned and will be addressed in the *Discussion* section.

US 24 is a two-lane road throughout most of the corridor with only a short segment of four-lane divided highway near the west end. The study corridor is centered on the highway and extends 150 feet in width on either side of the center line (Figure 1). Elevations range from 6500 feet (1970m) to 6900 feet (2090m). To the north, an area of coniferous vegetation known as the Black Forest borders the study site. This area is at a higher elevation and outside of the study area, and several intermittent drainages running off the Black Forest give the project area mild topographical relief. Near the highway the terrain flattens and the drainages become drier until they disappear almost entirely in the sandy soils south of the study site. The rural character of the study area is currently giving way to suburban expansion from the west. Native cover types within the study area consist of short- and mid-grass prairie, but these ecosystems have been greatly modified by local agricultural practices. Many slopes have been stabilized with erosion control techniques, and ditches and stock ponds control water flows.

METHODS

DTD carried out three primary tasks to evaluate the most efficient methods for assessing resources at a corridor-wide scale. These consisted of: 1) acquiring data and evaluating the level of detail and accuracy that resulted from each method of collecting resource data; 2) evaluating the ease of converting the data to digital format; and 3) reviewing the results to determine if the CA is a valuable tool in general, and which specific methods make it most efficient to implement. These tasks are discussed in detail below. The insights gained into the best methods for the CA and the evaluations of its strengths are presented in the *Discussion*.

Data Acquisition

Aerial Photograph/Base Mapping

Aerial photography was used to create a common base map for the different resource data collection efforts. Additionally, these maps were evaluated to determine the amount and type of resource information that could be assessed directly through photo interpretation. Using aerial photography for the remote sensing of resource data is a recognized field with well-developed methodologies. Depending on the level of information available from analysis of a given set of photos, remote sensing may be used instead of performing any amount of fieldwork. In either case, remote sensing can increase the efficiency of the resource evaluation process.

The photography to create these maps was commissioned specifically for the US 24 study as existing photography proved unsuitable. Both true color and color infrared (CIR) photography were commissioned for the study because they provide different, complimentary image information required for accurate photo interpretation (see Appendix A). The aerial photography for the assessment was flown between June 1 and 30, 2000. DTD commissioned 1:1200 true color scale photography from approximately MP 311.7 to MP 326.0 because it complemented CIR photography which Region 2 had purchased in 1999 for this area. For the area from MP 236.0 to MP 339.0, DTD commissioned photos at a 1:2400 scale (Figure 1), to compare the relative accuracy of and amount of detail visible at the two scales. Because more flight lines, film, and processing are required to produce 1:1200 scale photos, they cost more. DTD wanted to know if the 1:1200 was a significantly better tool for planning level resources inventories, and therefore worth paying more for.

Additionally, 1:12000 scale CIR stereo photos were commissioned specifically for an evaluation of Preble's Meadow Jumping Mouse (PMJM) habitat connectivity in an area adjacent to the study corridor. This evaluation was a subset of the CA assessment, and the PMJM study area covered about 26,884 acres (Figure 2). In summary, the complete set of aerial photography commissioned for the study consisted of:

- One set of CIR, 9x9 stereo contact prints at the original negative scale of 1:4000 (MP 311.7 to MP 326.0) and 1:6000 scale (MP 326.0 to MP 339.0);

- One set of true color, 9x9 stereo contact prints at the original negative scale of 1:6000 scale (MP 311.7 to MP 326.0) and 1:1200 scale (MP 326.0 to MP 339);

- One set of orthorectified true color photographs in paper format, derived from the true color negatives described above. The 1:6000 imagery was enlarged to 1:1200 scale and the 1:12000 scale was enlarged to 1:2400 scale;

- One set of CIR photographs in paper format, CIR negatives described above. This coverage was not orthorectified. The 1:4000 scale imagery was enlarged to 1:1200 scale and the 1:6000 scale was enlarged to 1:2400 scale;

- A true color, orthorectified digital coverage, compatible with CDOT's GIS format (UTM Zone 13, NAD 83); and

- One set of CIR stereo contact prints at the scale of 1:12000 for the PMJM linkage study. This set covered the area north of US 24.

<u>Natural Resources</u>

Wetlands: DTD considered wetlands for this assessment of the CA because federal law requires that impacts to them must be mitigated, and wetland concerns are one of the most common environmental issues that CDOT projects face. The wetlands along the corridor were delineated in two separate phases. In 1999, before the beginning of DTD's assessment, Region 2 commissioned delineations from approximately MP 318.0 to approximately MP 330.0. In 2000, DTD commissioned delineation of the remainder of the corridor. The same contractor was hired to do all the work (see Appendix C for additional details).

The U.S. Army Corps of Engineers (COE) accepts the use of a variety of products as base maps to locate wetlands positionally. CDOT traditionally tends to use plan sheets as base maps for delineations required for highway projects. However, pre-project planning by definition means that plan sheets are unavailable for CA data collection efforts. Therefore, aerial photos were used as base maps in both 1999 and 2000. In 1999, the contractor drew wetland boundaries directly onto the 1:1200 scale set of CIR photos with a blunt felt tip pen. In 2000, wetlands were mapped with a fine hard pencil onto Mylar overlays registered to the CIR photos using registration marks etched into the original photograph during processing. Wetlands delineated in 1999 were checked but not remapped. The contractor did not take advantage of any information on the map available through photo interpretation in either year. Instead, the photos were simply used in the field as a base map to record the positional location of wetlands within the corridor.

Other Vegetation Types: Although CDOT's environmental assessments typically do not consider vegetation types beyond wetlands, DTD considered other vegetation types for this assessment of the CA. Identifying and mapping all types of vegetation throughout a corridor provides an important opportunity to identify habitats that potentially support rare, threatened, or endangered plants and animals. Early identification of potential conflicts with these types of sensitive environmental resources should increase the efficiency of CDOT's environmental compliance process when individual projects come online. Therefore, a major benefit of the CA would be making this type of data easily accessible to project planners.

The Colorado Natural Heritage Program (CNHP) was commissioned to map plant communities and associations, as well as rare plant and animal occurrences. Additionally, CNHP mapped potential wildlife corridors and crossings, occurrences of state-designated top-ten noxious weeds, and patches of any weeds that were at least ten-feet square. Surveys were conducted during August and September of 2000. CNHP used the full-size enlarged CIR photographs and the 9x9 color stereo contact prints as base maps to positionally locate these features onto Mylar overlays using a .05 hard lead pencil. The photography was used to support the fieldwork as a mapping tool only; CNHP did not use laboratory photo interpretation to identify any of the mapped ecosystem components along this corridor (see Appendix B for additional details).

In addition to on-the-ground mapping of vegetation, DTD tested remote vegetation mapping methods. As described above, remote sensing techniques can be used in the laboratory to identify resource distribution directly from aerial photos. These approaches range from simply "eye-balling" the photos to identifying objects to resource- specific stereo-interpretation techniques. Although these methods do require ground truthing, they minimize the amount of fieldwork required, and skilled applications of these techniques produce highly accurate results. In 2001, DTD collaborated with a resource specialist who had considerable experience and expertise mapping vegetation from aerial photographs using stereoscopes and a three-step process of vegetation mapping, which consisted of:

a) Preliminary field inspection of the area and taking detailed notes on vegetation types corresponding to features easily identifiable on the photographs;
b) Using high quality stereoscopes in the lab to distinguish textures of vegetation, associating these textures with signatures observed in the field and drawing precise boundaries around communities: and,
c) Field verification of the vegetation maps produced.

DTD tested this approach by using it to identify all vegetation types including wetlands along a limited section of the corridor and then compared the results to the field mapping efforts described above.

Threatened and Endangered Species: Federal law requires that impacts to threatened and endangered (T&E) species be mitigated. T&E concerns are a common environmental issue faced by CDOT. DTD considered the PMJM for this assessment of the CA because an individual of the species was captured in an unnamed drainage at MP 329.0 of the study corridor during a broader PMJM survey conducted in 1998. Therefore, as part of the CA assessment, DTD hired a biologist with expertise in PMJM ecology to evaluate PMJM habitat connectivity in an area north of US 24. Habitat connectivity was evaluated by identifying the extent of suitable habitat from previously developed PMJM habitat maps and the 1:12000 scale CIR stereo photos commissioned for the CA assessment. A simple visual inspection of the photos, rather than stereo interpretation, was used to identify vegetation that indicated potential habitat. Additionally, the photos and the habitat maps were used to identify and prioritize several sites that merited a presence/absence trapping survey (Appendix C). The surveys were negative for the presence of PMJM.

<u>Hazardous Materials</u>

DTD considered hazardous material for this assessment of the CA because federal law requires all hazardous sites that may be impacted by a transportation project to be identified and remediated. To locate hazardous materials sites within the corridor, DTD purchased a one-year (1999) subscription to the VISTA database, a hazardous materials GIS database developed from original sources by Fidelity, Inc. VISTA is a statewide coverage depicting the locations of, among other things, Resource Conservation and Recovery Act (RCRA) sites, Comprehensive Environmental Response Compensation and Liability Act (CERCLA; Superfund) sites, underground storage tanks (UST's), and leaking underground storage tanks (LUSTs). VISTA data are geographically referenced and fully compatible with CDOT's existing GIS, as well as the digital base maps created for this assessment of the CA.

Cultural Resources

DTD considered historical, paleontological, and archeological resources for this evaluation of the CA because federal law requires impacts to them to be mitigated, and assessments of cultural resources are routinely carried out for many of CDOT's projects.

Historic Resources: DTD hired a contractor to conduct the historic evaluation along US 24 during summer, 2000. Following the standard methodology for cultural resource assessments, the contractor searched records at the Colorado State Office of Archeology and Historic Preservation (OAHP) prior to conducting fieldwork, and catalogued all known historical sites within the assessment area. The field portion of the study consisted of a reconnaissance survey of the corridor to visually identify potential sites for further research. Locations of interest were marked on USGS quad maps because the base maps created from the aerial photography were not yet available. When these maps became available later in 2000, the contractor used them to verify historic structure locations along the corridor. It was possible to measure both building dimensions and distances from the highway on the photos with acceptable accuracy. This was particularly useful for sites located on properties that CDOT had not been able to obtain permission to enter (Appendix D). Sixteen previously unrecorded sites were identified and evaluated.

Paleontological Resources: Although the CDOT staff paleontologist normally conducts all paleontological surveys, a consultant was hired to conduct part of the US 24 survey, due to the statewide project workload. The consultant conducted an initial field survey from MP 318.0 to MP 339.0 in June 2000 within the CDOT ROW only, as permissions to enter property had not yet been granted. CDOT staff paleontologist Steve Wallace completed the survey in October 2000 after the permissions to enter property were granted. As with the historical resources survey, a background search, including museum records and OAHP files, was conducted prior to fieldwork. The field survey began with a "drive through" of the corridor to identify additional likely resource locations. These locations were then inspected on foot, documented for geological and paleontological resources, and photographed. Resource locations were recorded in UTMs (universal transverse mercators) using USGS topographic maps to interpolate positions.

The closest milepost (MP) was also noted as a reference point. The base maps created from the aerial photos were not used because they were not yet available and because they do not offer a way to determine the UTM coordinates of a location. It should be noted however, that using a GPS device in conjunction with aerial photos would overcome this problem.

Archeological Resources: CDOT assistant staff archeologist O. D. Hand conducted the archaeological survey. This study also began with a search through the files of the OAHP, followed by a pedestrian survey of the entire corridor. Typically, a field search is done in a relatively short period, usually within a few weeks. However, because of the time it took to obtain permission to enter property, the field research stretched out over about 8 months (January through October, 2000). Resource locations were recorded in UTMs using USGS topographic maps to interpolate positions. The closest MP was also noted as a reference point. The base maps created from the aerial photos were not used because they were not yet available and because they do not offer a way to determine the UTM coordinates of a location.

Creating the Digital Data Base

A primary goal of the CA assessment was to determine the ease with which data from different resources could be accessed collectively and used to make multi-resource assessments for planning purposes. Digital formats are easy to store and access and CDOT's GIS capabilities are already well-developed. Additionally, data housed on CDOT's GIS are available to users agency-wide. Therefore, DTD examined how to convert resource data into digital formats that could be stored on, and subsequently accessed from, CDOT's GIS. In general, this proved to be a straightforward process. The steps to integrate each resource's data into this system are described below.

Aerial Photographs/Base Maps

There are a number of industry-standard methods to create spatially-referenced aerial photography that can be stored and manipulated in digital format. For CDOT, creating this type of product is as simple as hiring a contractor qualified to produce this product to CDOT's requirements. The contractor hired to generate the aerial photography used in DTD's assessment of the CA used the process described below, and the digital files of the finished product were then transferred onto CDOT's GIS. The following steps were taken:

- Existing monuments were paneled in study area (coordinates already known to CDOT and provided to the aerial contractor);
- Aerial photography was flown at an elevation that accommodates the desired scale of the orthophoto base map;
- Aerial film was processed and scanned into a digital format; and,
- Digital elevation data along with panel (ground control) data were used in a Soft-copy Photogrammetic System to orthorectify scanned aerial into a digital orthophoto base map product.

Natural Resources

Heads-up digitizing was used to convert the hard copy wetlands and land cover maps created in the field into digital format. This approach is the standard method for converting hard copy positional data (maps) into digital formats, and technicians skilled in this process are widely available. The following steps were taken:

- The hard copy aerial photos with the wetland/land cover polygons delineated in the field were interpolated by GIS technicians using the digital version of the orthophoto displayed in ArcView;
- Polygons identified on hardcopy photos were digitized onto digital orthophotos using common boundaries found between them; and,
- An attribute table including a wetland/vegetation ID number was created for each land cover point or polygon mapped.

These files were then transferred to CDOT's GIS system. The files included a metadata file for each resource, which provides definitions of the attributes classes. These definitions are used to identify each point or polygon. Data about the PMJM were not entered into the GIS.

Hazardous Materials

The VISTA database is a digital product that includes positional tags for each hazardous material site recorded in the file. Both the descriptive data in the file and the positional information were fully compatible with CDOT's GIS. System users can access these data in either a map or a database format.

Cultural Resources

In addition to a narrative report, the cultural resource inventories included a digital file (either Excel or Access) containing fields listing location and descriptions of the identified occurrences. Locations include both a UTM coordinate pair and a MP reference. These files were transferred to CDOT's GIS. Both the descriptive data in these files and the positional information were fully compatible with the system, and the positional information can be output either as a database or in graphical (map) format. However, it should be noted that because cultural resources are vulnerable to collectors, only the general MP locations are available agency-wide through CDOT's GIS. A second database, consisting of an Access file containing detailed resources descriptions and the precise UTM locations, is housed in CDOT's Cultural Resource Section. Requests for precise locations cross-referenced to the MPs can be directed to CDOT's cultural resource specialists as needed to facilitate future project-specific planning.

Assessing Accuracy and Usefulness of Data Collection Methods

Aerial Photography/Base Maps

Following industry standards, the orthorectified digital base maps were developed to meet National Map Accuracy Standards (NMAS). Accordingly, the positional accuracy of at least 90 % of the features on the 1:1200 scale base maps is within 1 meter (3.33 feet) of its global coordinate. The positional accuracy of features on the 1:2400 scale map falls within 2.0 meters of their true location, and features on the 1:12000 scale base maps are within 10 meters (33.33 feet) of their true location. The processes necessary for developing rectified photography that meet NMAS are well-established. Therefore, DTD did not verify their accuracy through independent surveys.

DTD did, however, evaluate the accuracy of these photos relative to the "real world." The distance between pairs of discrete objects was measured on the photos and in the field, and the results were consistent. A t-test was used to determine the number of samples needed in order to detect a real difference between the two types of measurements. Twenty-four paired features were selected from the 1:2400 scale and 25 paired features from the 1:1200 scale photographs were selected. The inter-feature distances also were measured on the photo and in the field. The differences between the two types of measurements were summarized with descriptive statistics. A chi-square test was then used to determine whether each paired set of measurements differed significantly from the others.

Natural Resources

In the summer of 2001, CDOT wetland biologists verified the delineated wetland polygons to determine if the identified wetlands met all of the hydrologic, vegetative, and soil conditions required for a jurisdictional wetland determination, if any wetlands were missed, and if upland areas were delineated as wetlands. In addition, DTD investigated the relative accuracy of wetland boundaries assessed from aerial photography as compared to boundaries measured in the field. CDOT wetland biologists also verified some of the delineated upland plant community polygons to assess their accuracy. However, no accuracy check of the PMJM data was conducted.

Hazardous Materials

In the summer of 2001, CDOT personnel evaluated several addresses given by VISTA to determine the positional accuracy of the addresses and if the hazardous sites listed for those addresses were present.

Cultural Resources

No accuracy check of the cultural data was conducted.

RESULTS

Overview

Well-established methods for collecting data in the field exist for all resources. Standard methods for converting non-digital data into digital formats are well-developed and straightforward. CDOT already supports a GIS where these data can be stored and are then available agency-wide for project-specific planning. By providing a framework for collecting and storing data in a standardized digital format, the CA can streamline and improve environmental compliance.

Results of Accuracy Assessments

Base Maps/Aerial Photography

Comparison of measurements made in the field to measurements made on the photos revealed only minimal differences between the two types of measurements (Table 1). Chi-square tests indicate that the differences between the two types of measurements are not statistically significant at either the 1:1200 or the 1:2400 scale. The level of accuracy provided by either scale of photography should be adequate for determining impacts and potential mitigation approaches for most types of natural resources and generally acceptable to the agencies that regulate them. For example, the difference between measurements made on the photos and measurements made in the field is certainly within the error range of an experienced wetland delineator, and the results should be acceptable to the COE (Corps of Engineers) as well as CDOT for project-level planning purposes.

Table.1. Average difference between interfeature distances measured in the field and from a photo.

	Number of Samples	Average Inter-Feature Distance on Photo	Average Inter-Feature Distance in Field	Average Difference (In feet)	χ^2 and p-value*
1:1200	25	59.2	60.3	0.63	$\chi^2 = 1.702$ $p > 0.25$
1:2400	24	61.5	61.2	0.73	$\chi^2 = 2.209$ $p > 0.25$

* The p-value indicates the probability that two values are significantly different from each other. In general, a p-value < 0.05 is accepted as an indication that two values are significantly different (i.e., you can be 95% certain that the difference observed is real, rather then due to chance).

Natural Resources

Wetlands: DTD's accuracy check of the wetland delineations found that most wetlands had been identified correctly in the field. However, boundaries were sometimes inconsistent with the interpretation of the CDOT biologists. This observation was not particularly troublesome due to the well-known subjective nature of wetland delineation. Although all wetland biologists work within a common framework, it is unlikely that any two wetland biologists would place boundaries in precisely the same place. The limited area delineated using stereo photo interpretation in the lab compared well with the field delineations. DTD believes that that approach would give adequate results for pre-project and mitigation planning.

Other Types of Vegetation: DTD's accuracy check of the other vegetation cover classes determined that they were reasonably accurate in terms of content. However, comparison of the photographs to stands of vegetation in the field showed that the photography contained considerably more land cover variation than was identified. Many relatively homogeneous stands of vegetation were lumped together with other vegetation types. This result was due to the very general approach taken by CNHP in defining and drawing individual polygons. While it is not practical to map every plant, as could have been done using all the information contained in the photographs, greater discrimination between identifiable features would be beneficial to CDOT's environmental compliance process. This result highlights the need for CDOT to decide the level of detail desired for all land cover mapping (including wetlands) prior to data collection, and then to communicate these standards clearly to the consultant hired to do the work. Standards must include the level of detail desired in classifying land cover types as well as the precision desired when choosing boundaries and the method for drawing them on the base map.

In addition to the problem of lost information, DTD also detected numerous conflicts, i.e., overlapping boundaries between the vegetation and the wetland mapping. There were numerous areas where the mapped upland vegetation boundaries extended well into the mapped wetlands. This would not be surprising in areas where the wetland boundary runs through a monotypic stand or a plant association distributed on a gradient from wetland to upland. However, it also occurred where there were sharp distinctions between wetlands and uplands such as a boundary defined by a stand of cattail and steeply sloping uplands.

These conflicts pointed out the need for a single mapping effort under the direction of one editor, i.e., someone who sets the standards that all workers concerned with a common resource will follow, and periodically checks the product to ensure data standards are being met. The solution to this particular problem is to devise a unified land cover/land use classification system. A single land cover classification system that identifies plant communities and other features to be mapped, regardless of their hydrology, should be specified for use with all vegetation inventories. Wetland, wildlife habitat, and other functional boundaries can then be derived in a secondary process of reclassification.

Endangered Species: Interpretation of the aerial imagery prior to fieldwork proved useful in determining possible habitat linkages for PMJM. For example, stands of willows and mesic swales leading up to the willows, the preferred habitat of PMJM, were easily identified and located on the base maps. The photos also aided in identifying possible PMJM movement routes and survey locations. However, the subsequent presence/absence surveys in areas targeted through the use of the photographs did not capture jumping mice. Because this evaluation of PMJM habitat was inconclusive, it is not certain that it will assist CDOT in future consultation with the Fish and Wildlife Service (FWS). The absence of PMJM in the survey area may mean that a consultation will not be necessary when project-specific planning begins. On the other hand, if the jumping mouse is again found in the area, the base maps produced may help in tracking them to their source (Appendix C).

Hazardous Materials

The accuracy of the base maps created from the aerial photography was far greater than the positional accuracy of the data provide by VISTA. DTD evaluated several addresses in the VISTA database. Although most were accurate, in one instance the address of a hazardous waste site was at least a kilometer distant from the actual location of the hazard. DTD has since learned that commercially available databases of this sort are compiled from a multitude of sources before they are provided to distributors such as VISTA, and most distributors do not check the data for accuracy. Therefore, the accuracy contained in the reports depends on the sources' level of quality control, and consequently varies.

Cultural Resources

No accuracy assessment of the identified cultural resource locations was conducted.

DISCUSSION

The study demonstrated that environmental data collected at a corridor-wide scale is an excellent resource for project-specific planning as well as mitigation planning. The detailed environmental data banks and resource maps that can be created through a CA provide a valuable tool for long-range transportation planning, and expand CDOT's opportunity to exercise its environmental stewardship roles. The study also indicates that aerial photos provide many advantages when used as a base map, and that digital formats are an efficient way to store and access data. Finally, the CA provides a convenient framework for setting data collection standards that can improve CDOT's environmental compliance process.

Advantages of the Corridor Approach

During the assessment process, DTD identified a variety of advantages to using the CA. Benefits of the CA include: 1) time and money savings over the long term; 2) a framework for central data storage; 3) the opportunity to set data standards prior to data collection; and 4) improved mitigation planning and project design as well as improved cumulative impact assessment. Although some of these advantages are related to processes and could be applied to other types of data collection efforts, DTD feels that the CA provides a supportive framework that is more likely to instill these processes.

Time and Money Savings

The CA saves time, money, and effort because after the initial investment to create the CA database, it is simply transferred to CDOT's existing GIS. Project planners can then access and use the data at any point in subsequent planning processes, increasing their efficiency. Additionally, collecting data throughout a corridor, rather then project-by-project, creates savings based on efficiencies of scale, and eliminates the potential for redundant data collection efforts due to incompatible data types, inadequate documentation, misplaced results and unrecognized efforts. Using the CA as a framework for data storage (discussed below), i.e., data organized by corridor in a digital format, will also save money.

A Framework for Data Storage

In the past, CDOT lacked a system for collecting and transferring environmental data in a central database. Instead, a great deal of the information gathered for environmental documents remained with the project consultant or the Region after completion of an environmental assessment. Consequently, information that could have been used later for overlapping projects or cumulative effect assessments was lost or unavailable, and had to be re-collected. The CA provides a convenient framework for data storage, as data are easily organized by corridor. Additionally, using digital formats takes advantage of the storage, access, display, and analysis capabilities of CDOT's existing GIS.

An Opportunity to Set Data Standards

Setting data collection standards is not a new issue for CDOT. For individual projects, CDOT has traditionally dealt with these issues in an ad hoc manner. This approach is adequate for small-scale data collection efforts if individual projects are self-contained. However, discrepancies in data standards between locations create data incompatibilities. These problems rapidly become intractable when combining data from two or more project areas to design mitigation or for cumulative impact analyses. To avoid these types of problems, corridor-scale data collection efforts require careful attention to data standards, to ensure that data for a given resource are collected in the same way throughout the corridor, and that data from all resources are compatible for comprehensive evaluations.

This opportunity to set data standards also ensures that consultants deliver consistent products that meet CDOT's needs. Currently, the quality of environmental data varies widely from project to project. Poor quality environmental data and documentation can create difficulties for CDOT's regulatory compliance process. In addition, even if creating digital data is part of a consulting contract, it is currently not collected according to a single standard or protocol. Therefore, data from different sources often cannot be combined. This loss of information then results in a duplication of effort for subsequent analyses of the same area, such as cumulative impact assessments.

Opportunities for Mitigation Prior to Project Selection

The CA offers an important opportunity to improve mitigation planning. The extent of a resource occurrence often exceeds the boundary of a particular project. Resource information from beyond a project's boundaries is frequently needed to devise suitable mitigation. Thus, corridor-wide mitigation plans may offer the best opportunity to successfully comply with regulatory mandates. Corridor-wide databases support cumulative effect assessments by establishing a firm baseline of environmental conditions. Based on this type of information, CDOT can develop conservation strategies and may be able to obtain regulatory concurrence well in advance of projects. For example, with the aid of a CA base map that depicts all of the environmental features in an entire corridor, including land use and hydrological context, it becomes possible to choose wetland mitigation sites based on their position in the watershed and their potential to contribute to the ecological function of the watershed or the region. Consequently, CDOT can mitigate wetland impacts in advance of projects. These types of proactive mitigation strategies provide CDOT with the opportunity to reach agreements with regulatory agencies and assurance of meeting required mitigation needs.

DTD implemented this approach using the information collected during the US 24 CA assessment. By overlaying the wetland maps developed for the assessment with the anticipated construction projects on US 24 within the next 20 years, DTD determined that the projects would collectively impact approximately 30 acres of wetlands. DTD then used this information to approach the COE with a proposal to develop a regional permit for the corridor, which would allow CDOT to impact wetlands along that corridor with the recognition that impacts would be compensated with new wetlands in advance of impacts. Based on the information provided by the CA, the new wetlands could be designed so that regional ecological processes are addressed in both function and landscape position.

Advantages of Aerial Photo Base Maps

Aerial photography provides a powerful tool to aid the collection of corridor-wide natural resources data and can be helpful in collecting culture resources data as well. Although potentially costly, it provides a superior base map for resource assessment. For example, the advantage of the photos over the use of a USGS topographic map or an engineers' plan sheet for wetland delineations is that readily observable features, such as plant communities and ponds, can be mapped and assessed with accuracy. CIR photos are particularly useful for identifying hydrological gradients. Workers in the field can use this information to guide their delineation, potentially increasing precision.

In addition, aerial photos can also be used as sources of information to complement or replace fieldwork. Obviously, this approach only works for resources that are readily visible on the earth's surface. In many cases, cultural resources (fossils, archeological sites) are buried or otherwise not easily observed at the scale of most aerial photography. Still, base maps created from aerial photography can be used to map the locations of cultural sites identified in the field, and indicators, such as fossil-bearing strata, and linear patterns, and they provide an efficient way of determining distance between objects of interest and relative locations.

Using aerial photography to create base maps also provides some important advantages over on-the ground mapping methods, common to all resource types. Conventional methods for delineating and mapping resources on the ground come in three forms: project plans and tape measures, GPS equipment handheld or in backpacks, and land survey equipment. The project map and tape measure method is time-consuming, relatively inaccurate and requires access to all areas impacted by a project. Should projects require detours or modifications beyond the areas contemplated at the time of the survey, then a site needs to be revisited. Use of GPS also has limitations. GPS depends on access to property and depends on the skill and patience of the surveyor.

Land surveys, while potentially highly accurate, are expensive and time-consuming, and depend on an expert identifying resource locations in advance of surveys. Boundaries of resource areas are typically flagged or staked. Since surveyors connect all such dots with straight lines, the accuracy of a survey depends on the distance between flags, and it is difficult to accurately map convoluted boundaries, or resource areas with numerous inclusions. Aerial photography overcomes these limitations and provides a far greater level of detail than required for a corridor-wide pre-project assessment. Irregular boundaries and inclusions can be identified readily on the map and verified in the field. In addition, if a design change falls within the area covered by the photography, any affected resources can be added readily to the map without additional field visits. Unlike conventional methods, aerial photos are not limited to boundaries of a project and do not require direct access to property. Permission to enter issues are avoided.

Finally, creating a useful base map from aerial photos is a straightforward process, and they are easily converted to digital format for use with a GIS, providing an efficient way to store, retrieve, share, and analyze information on an immediate and long-term basis. The photography is simply commissioned at the desired scale and orthorectified so that it accurately reflects the location of designated survey monuments. The contractor hired for the job provides the product to the requested specifications. The photos are then scanned for use in an electronic database, or in some cases, the contractor provides a digital product directly.

Advantages of Electronically Stored Data

Electronically stored data provide a solid baseline from which a variety of analyses can be completed. Applications include analyses of environmental elements that consist of two or more variables, evaluation of transportation alternatives, cumulative impact assessments, and identification of mitigation strategies. Wetlands, habitat for imperiled species, and ecosystems can be identified and mapped by merging several digital databases with the base map. For instance, wetland maps could be created by combining soils maps, hydrological information, and maps of plant communities. Habitat for imperiled species can be mapped by overlaying rare element occurrences from the Colorado Natural Heritage Foundation with features - vegetation, proximity to water, canopy height, etc. – that define habitat for a given species. It is also possible to create these maps using field surveys. However, any time a new species becomes a concern along a transportation corridor, the process starts from the beginning, and new surveys frequently are required to verify presence or absence of potential habitat. Data collected in a spatial, digital format can be used and recombined indefinitely.

Digital databases are also a communications tool par excellence. They allow for two forms of communication: internal - within CDOT - and the public. All of the data layers compiled for US 24, for instance, are now stored in CDOT’s GIS system and accessible to numerous users. The public can also easily be given access to corridor-specific databases through CDOT’s public access website, in cases where public involvement will be part of the project development process. However, it should be noted that access to certain kinds of information, such as locations of cultural resources or rare plant species, must be restricted due to their vulnerability to collectors. The database can also be used to create maps for public meetings, and because of the flexibility of digital map creation, they can be tailored to the needs and interests of the public.

Finally, digitally stored data is quickly and easily updated to reflect the very latest information. For instance, should a user observe that a wetland is no longer in existence or that a hazardous waste site is shown in the wrong location, he can relay that information to the custodian of the database.

RECOMMENDATIONS

The following recommendations will maximize the utility of a CA.

- Use digital, airborne imagery to create a base map to support data collection for all resources.
- 1:2400 scale imagery will generally provide adequate accuracy and detail for pre-project planning.
- Consider using the information about various resources contained on the images as a data source.
- Before fieldwork begins, data collection protocols should be carefully designed to yield the type of data CDOT needs.
- The same assessment protocol must be used throughout the corridor for a given resource.
- Skilled technicians, who have prior experience with that resource, should be employed to do the assessment.
- Careful instruction should be provided as needed to ensure compliance with the protocols.
- When possible, the same person/team should carry out the assessment of a given resource throughout the entire corridor.
- A single person should be appointed data editor, to answer protocol questions as they arise, to design protocols to deal with unforeseen resource classes, and to ensure that standards are met.
- As new technologies are developed for data acquisition and interpretation, they should be considered for use on future projects on a case by case basis.

SUMMARY

The corridor approach (CA) is a corridor-wide resource inventory conducted prior to project-specific planning. DTD believes that using the CA will improve environmental streamlining and compliance. Pre-project resource inventories provide important background for project-specific planning, improve impact assessments, and improve mitigation planning. Corridor-wide inventories provide a structure for central data storage and create efficiencies of scale, both of which can save time and money. The CA approach can be applied to all resources and provides a framework for creating composite databases and maps that indicate the environmental constraints collectively placed on a project by those resources.

DTD recommends two major considerations to maximize the effectiveness of the CA. Firstly, specify standard data collection protocols prior to beginning fieldwork. It is also important to appoint a common editor to ensure all data is collected consistent with specifications and to coordinate addition of detail as needed. Secondly, use a single base map throughout the corridor, for all resources. DTD recommends using a digital map, produced from airborne imagery that has been positionally controlled. The advantages of digital imagery include ease of storage, ease of access, and ease of manipulation. The advantages of positionally controlled airborne imagery are that it can act as a source of both positional and resources data as well as acting as a mapping tool.

APPENDIX A

Aerial Photography/Base Map Creation

Base maps for a variety of tasks were created from aerial photographs, and digital representations of these maps were entered into the GIS for ease of access and manipulation. Aerial photography to create these maps was commissioned specifically for the CA assessment, because existing available photography was unsuitable. Rectified color infrared (CIR) and true color photography purchased in 1999 by Region 2, covering the area from about MP 318.7 to MP 330, proved inadequate because although it had been rectified, it had not been orthorectified. Rectifying a photo corrects for geometric distortions caused by a variety of factors and allows the scale to be measured accurately throughout the photograph. Orthorectification corrects the photograph for vertical as well as horizontal distortions and georeferences it, assigning horizontal and vertical coordinates to all points. Both horizontal and vertical correction are required for accurate conversion to a map. Photos not orthorectrified do not provide the level of accuracy required for the study, nor can they easily be merged into CDOT's existing GIS.

Both true color and CIR photography were commissioned for the study because they provide different, complimentary image information required for accurate photogrammetric interpretation. True color photography captures images in the range of light visible to the human eye, as the human eye sees it. Thus, color can be used to identify features in the interpretation process. However, many objects have similar color tones, making it difficult to distinguish them. For example, all types of plants may simply appear green. CIR, or false color photography, captures some wavelengths of light visible to the human eye as well as the infrared spectrum that is not. CIR photographs depict features with similar "real color" tones in striking contrast because of how infrared light is absorbed or reflected. These color differences, combined with other signatures such as texture, can be used to differentiate plant community associations and species. As with true color photography, CIR has its strengths and weaknesses. In areas of great relief, for example, it may be difficult to tell the difference between shadows and water, as both appear black. Thus, comparison of true color and CIR photographs is essential to quality aerial photo interpretation. Additionally, knowledge of the area and features analyzed as well as the strengths and limitations of the photography are required.

Due to safety concerns, it is not possible to fly a manned aircraft at an altitude that will allow for the direct creation of a photograph at scales of 1:1200 or 1:2400 without enlargement. The original scale of 1:4000 was enlarged to 1:1200 and the 1:6000 was enlarged to 1:2400. The true color photography was georeferenced and converted to a digital orthorectified format by Pacific Western Technologies (PWT), the aerial subcontractor hired through USBR. CDOT Region 2 provided the survey control needed for orthorectification. In 1999, Region 2 staff surveyors performed the control survey for the western section of US 24, from Peterson Rd. to Peyton. Mountain Surveying and Mapping was contracted by the Region to complete the control survey for the eastern portion, from Peyton to Calhan in 2000. It fell to PWT to reconcile these two surveys.

In addition to the photography contracted through the USBR, CDOT directly hired PWT to provide CIR stereo photos at a scale of 1:12000 for the PMJM habitat connectivity evaluation, a subset of the US 24 Corridor Study. Using the same contractor for both the corridor study and the PMJM study allowed CDOT to save money by eliminating multiple flights to acquire the photos. The mouse study area was bounded by US 24 north to the top of the Palmer Divide with the town of Falcon to the west and Peyton on the east and covered about 50 square miles. The first aerial flight occurred on June 12, 2000 and the true color photography was obtained from that flight. Because of several large forest fires burning at the time, the Colorado Springs air traffic controller ordered PWT grounded before the CIR photography was completed. PWT returned June 27, 2000 and took all of the CIR photographs at that time. They used the same flight line maps (see attachments) for both of the US 24 flights; the Preble’s study area had a separate flight pattern.

APPENDIX B

Vegetative Land Cover

The wetlands along the corridor were delineated in two separate phases because of the way DTD's project to assess the corridor approach developed. In 1999, before the assessment was initiated, Region 2 hired ERO Resources (ERO) to delineate wetlands for a proposed project within the corridor. ERO used the aerial photography acquired for that project by the Region as a base map, and mapped the wetlands boundaries in ink directly onto a set of these photos. At the inception of this original delineation project, Region 2 and ERO discussed use of Mylar overlays, but the Region chose not to use them due to storage concerns. In 2000, Region 2 again contracted with ERO to complete the wetland delineations for the remainder of the corridor. DTD provided the new full-size CIR photos for the entire corridor to ERO. The mapping was done with a fine, hard pencil onto Mylar overlays registered to the photos using registration marks etched into the original photograph during processing. ERO delineated all wetlands, within sections of the corridor that had not previously been delineated, using the same methodology and standards established in 1999. Wetlands delineated in 1999 were checked but not remapped.

In addition to the efforts by ERO, DTD staff took the photos into the field to gain familiarity with the techniques involved in delineating wetlands and other communities. Mylar overlays were taped to the photo at the top using a wide masking tape secured to the back of the photo so the image would not be damaged when the tape was removed. This was then clipped to a large Plexiglas board in multiple points on all four sides using heavy binder clips. The DTD staff mapped wetlands as well as a variety of vegetation types onto Mylar using .05 colored lead in a mechanical pencil. The Mylar overlays that CDOT purchased for this purpose were single mat 3 mil Mylar.

The Colorado Natural Heritage Program (CNHP) was contracted to non-wetland map plant communities and associations, rare plant and animal occurrences (known as rare elements) as defined by the CNHP watch list, potential wildlife corridors and crossings, occurrences of state-identified top-ten noxious weeds, and any patches of weeds measuring at least ten feet square. The CNHP conducted a reconnaissance to identify areas that appeared to be likely locations for rare element occurrences. CDOT provided the CNHP with the full-size enlarged

CIR photographs and the 9x9 color stereo contact prints taken in June of 2000. David Anderson, a botanist with CNHP, began the fieldwork in August of 2000. CNHP did not use laboratory photo interpretation on this corridor to locate any of the ecosystem components of interest. Instead, the photos were taken into the field and used directly as base maps. Delineations of ecosystem components were drawn onto Mylar overlays using a .05 hard lead pencil. The advantage of this over the use of a USGS Quad map or an engineer's plan sheet is that the plant communities' boundaries are visible on the photo. Therefore, the delineation has the potential for greater accuracy and precision. The scale of these photos made it easy to see the boundary of the plant communities.

After fieldwork was completed, CNHP's GIS unit recorded the field delineations as polygons or points in a digital database using heads-up digitizing. An attribute table including a vegetation ID number was created for the digital files allowing these files to link with the attribute tables created for the fieldwork by the CNHP biologist. These files were transferred to CD and delivered to CDOT. Included on the CD are the metadata, which provide descriptions of the attributes that correspond to the shapefiles. A shapefile is the name ArcView gives to visual data, and it can be a polygon, point or line.

APPENDIX C

Threatened and Endangered Species - Final Report on Preble's Meadow Jumping Mouse Habitat Evaluation on Highway 24 in El Paso County, Colorado

The Colorado Department of Transportation (CDOT) is currently or will be upgrading Highway 24 in El Paso County between the towns of Falcon and Peyton. During a presence/absence survey for the federally threatened Preble's meadow jumping mouse in 1998, a small mouse population was discovered near Peyton, adjacent to Highway 24. This finding represented a new discovery in this area of the county; previous known Preble's habitat was found from the Monument Creek watershed west of this site.

This discovery prompted a re-evaluation of potential Preble's habitat in eastern El Paso County. CDOT staff were particularly interested in other potential habitat that might be near or adjacent to Highway 24, so that a regional perspective of habitat and potential impacts could guide the construction projects.

CDOT staff obtained 1:12,000 color infrared 9" by 9" aerial photographs in June 2000. Photographs covered much of the area north of Highway 24 between Peyton and Falcon. This is an area on the south side of a long, east-west oriented watershed divide known as the Palmer Divide. There are many small drainages, both ephemeral and permanent, that flow south and intersect Highway 24. These streams were the focus of the habitat evaluation.

Many of the streams begin in ponderosa pine forest (the Black Forest) near the top of the divide, and then travel through mid to tall grass prairie as they flow south. The landscape flattens as you proceed south, and there is a high density of small streams and obscure drainage pathways, all of which were considered potential Preble's habitat.

The project developed into a cooperative venture between Ensight, Colorado Division of Wildlife, and El Paso County. As previously described (see attachment), these parties sat down and evaluated potential habitat on the aerial photographs and previously developed Preble's riparian habitat maps. Several potential habitat sites were selected and prioritized, with the intention of trapping some or all of these sites to check for presence/absence of the mouse. Most of these sites were visited in the field to verify habitat conditions.

The selected sites have been previously described. There has been new trapping survey information since that time, which is summarized here. The trapping surveys listed here were primarily conducted in late August-early September 2000 by El Paso County staff managed by Mike Bonar. The County has not completed formal reports on these surveys at this time, and information was obtained from Mr. Bonar over the phone (October 26, 2000). Exact survey locations were not given, but general locations were sufficient for this analysis. All survey results were negative (Preble's meadow jumping mice were not found at any of these sites).

1) Kiowa Creek west of Eastonville Road and south of Hodgen Road. This had been a prioritized area.
2) Peyton site. This was the site where Preble's mice were found in 1998. The same site was trapped unsuccessfully in 1999, and the negative survey in 2000 was conducted only on the north side of the road.
3) Black Squirrel Creek was trapped near Latigo Boulevard; this site was trapped by a contractor, and Mike Bonar did not have details. This site was up gradient of the Peyton site, with possible habitat connections.
4) Two sites along the Rock Island railroad right-of-way on Highway 24. Mr. Bonar did not have more detailed location data.
5) Ramah Reservoir (east of the Highway 24 corridor) at the Big Sandy Creek inlet (previously trapped with negative results).

There may be additional sites that were trapped in eastern El Paso County in summer 2000, but data are not generally available from the Preble's database until February-March of the following year.

These trapping surveys have been conducted in some of the better habitat in eastern El Paso County; all trapping surveys to date have been negative with the exception of the 1998 Peyton capture site. During that 1998 survey, three adult animals were captured in late August with multiple captures of some individuals. Such survey results often indicate that the captured animals were not the odd dispersing individuals that are occasionally found in surprising habitat conditions. In other words, the mice captured in 1998 could have represented a small population resident at that site, or associated with suitable habitat nearby. However, subsequent surveys in two successive years have not detected jumping mice at that site. This information, coupled with the many other negative surveys from eastern El Paso County, indicate that Preble's mice appear to be extremely rare in this section of their range. Other subspecies of the meadow jumping mouse are known from tall grass prairie in Kansas, but the Preble's subspecies in Colorado and Wyoming is known to occur almost exclusively in riparian habitats with associated upland grasslands. Such habitat conditions become rarer in the dryer, eastern areas of El Paso County.

Although trapping efforts this year have not found any new Preble's locations in eastern El Paso County, there are other potential sites that have not been trapped. County staff has indicated that they will likely continue trapping efforts next year.

The approach of using infrared aerial photographs to evaluate habitat for this project had strengths and weaknesses. Some thoughts:

- Aerial photography was particularly helpful in evaluating prairie areas with mild relief; drainage pathways can be difficult to see in the field and may not appear on topographic maps. There is also a seasonal aspect to evaluating this habitat, with wetland areas harder to discern later in the growing season. The June flyover dates appeared to adequately show growing conditions and drainage pathways.

- Aerial photographs were not particularly helpful in discerning Preble's habitat in the Black Forest area, which is blanketed with a ponderosa pine overstory. Surprisingly, some small streams had suitable patches of shrubs under the forest canopy that were not discernable on the photographs.

- The evaluation of habitat was most effective when the photography was combined with existing habitat mapping and staff experienced with this region of the county. Field verification of areas selected from the maps was relatively easy and efficient. There were some areas of potential habitat that were identified in this exercise that could not be trapped this year – either because of ownership or scheduling issues. These areas should be re-evaluated for year 2001. It is recommended that the same collaborative approach be taken for future work here, with participation from County and Division of Wildlife staff.

APPENDIX D

Permission to Enter Property

Permission to enter property is a significant issue for surveys that require intensive ground inspection, such as archaeology and wetlands delineation. Because the limit of these resources can exceed the Right-of-Way (ROW) boundary, it is often not possible to adequately complete the survey without permission. When access to private property is needed for a specific road project, CDOT ROW personnel have the legal means and the expertise to acquire the permissions in order to complete the studies necessary to allow the project to go forward. However, these legal avenues do not exist for a planning project; the department cannot require owners to allow studies on property where no road project is planned.

The minimum 150 foot wide buffer used for DTD's study of the corridor approach exceeded the boundaries of CDOT ROW and therefore required Permission to Enter Private Property (PEP). It was necessary to have permission even though we had aerial photography because some studies such as cultural resources were conducted using traditional survey methods, and natural resources studies require ground truthing. For this study, Region 2 was responsible for acquiring permissions west of Peyton because of current projects occurring on that section of the corridor. DTD assumed the responsibility of acquiring permission to access properties from Peyton eastwards.

Requests to enter property for the corridor approach study met with limited success. Some landowners denied access to their property, while others did not respond at all. Some effort was made to contact non-responders by telephone, but most people were not at home during business hours and did not return phone calls when messages were left. Other landowners did not have message systems or had unlisted numbers. Additional problems were caused because more then one department was working to secure the PEPs and the scope of responsibilities between them was not clearly defined.

To facilitate the process of acquiring PEPs when planning data are needed in the future, a clear agreement about who will coordinate the effort and the limits of each work area should be put in place. The lead coordinator needs to ensure that regular updates about which property owners have been contacted and the responses CDOT receives are shared between the work groups regularly. However, it may be appropriate to have one person conduct the whole permission to enter process. Permission to access property can be a very hot button with some property owners. Personnel with training and experience in this kind of work are most appropriate to conduct these requests. For some data acquisition efforts, only a subset of properties along the corridor may require access. PEP requests could be limited to those properties if they were identified beforehand. This would save a great deal of time and effort and could allow contacts with the owner to be more focused and personal.