Geospatial Environmental and Community Analysis in Pueblo and El Paso Counties, Colorado

Colorado Natural Heritage Program
Colorado State University

NatureServe

Placeways, LLC

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Cover photo: Preble's meadow jumping mouse (*Zapus hudsonius preblei*) habitat along the tributaries of Monument Creek in Colorado Springs, CO. From USDA-FSA Aerial Photography Field Office National Agriculture Imagery Program 2005 aerial photo.

Executive Summary

The Federal Highway Administration chose Pueblo and El Paso Counties in Colorado as a test case for its Planning and Environment Linkages (PEL) initiative. The PEL initiative promotes conservation planning early in the planning stages of transportation decision-making as well as throughout the life of the project. The Pikes Peak Area Council of Governments (PPACG) and the Pueblo Area Council of Governments (PACOG) were interested in demonstrating the utility of interoperating two different software planning tools to support long range planning for Pueblo and El Paso Counties. The Colorado Natural Heritage Program (CNHP), together with NatureServe and Placeways, LLC, were contracted to perform prototype proof of concept analyses focused on the process and integration of these tools. CNHP provided project management, ecological data, and scientific expertise. NatureServe used the decision-support software, NatureServe Vista, to conduct initial conservation planning iteratively with growth and development scenarios created via Placeways' community planning software, CommunityViz.

A total of 59 conservation targets were chosen for the project: 23 plants, 2 amphibians, 3 reptiles, 12 mammals, 9 birds, 3 fish, 5 insects, 1 mollusk, plus CNHP Potential Conservation Areas. Most of the data used to represent target occurrences and viability were derived from CNHP's Biodiversity Tracking and Conservation System (BIOTICS).

There are two main outputs from NatureServe Vista: Conservation Value Summaries and Scenario Evaluations. A Conservation Value Summary combines information about the distribution, quality, imperilment, and data confidence of the conservation targets of concern to identify the relative conservation value (low to high) of different locations in the planning area. Scenario Evaluations quantify and map areas that either contribute to or hinder the achievement of conservation goals. Two weighted Conservation Value Summaries were run, one based on CNHP conservation priorities and the other on legal protection and management of target species. The raw output of each summary was reviewed and refined by CNHP ecologists in order to create discrete polygons representing ecologically relevant areas of conservation importance. This information was then given to Placeways, who used it in CommunityViz growth models.

A Baseline Scenario was created to represent current land use. Spatial data depicting land use and ownership were received from PPACG and PACOG for El Paso and Pueblo counties. CNHP worked with Placeways to create a single land use classification scheme that would meet all analysis needs. A matrix was created to describe the compatibility of each conservation target with each land use class. Conservation goals were based on the Natural Heritage Network Ranking System to create three separate goal sets --Low, Moderate, and High-- that convey a level of risk as to conservation effectiveness. NatureServe evaluated the Baseline Scenario in Vista, which was then provided to Placeways for use in growth modeling in CommunityViz. In addition to the Baseline Scenario, Placeways generated two future scenarios based on growth models generated in CommunityViz, a "Business As Usual" scenario and an "Enhanced Transportation" scenario. An example conservation mitigation scenario was also created to demonstrate this capability in Vista.

The analyses in CommunityViz showed two key factors in the growth and development pattern of the study area; 1) a bus rapid transit system does have the potential to concentrate growth around city centers, and 2) a conservation plan could be effectively applied in conjunction with a transportation plan. A combined transportation and conservation plan would have the potential to focus development around city centers while relieving development pressure on land that is necessary to meet conservation goals.

The Vista analyses highlight species that are threatened, either by existing or potentially planned development, that are not yet listed. This sort of information can help planners be pro-active in their development plans and reassure regulatory entities that conservation values are being taken seriously and incorporated upfront. A third of the targets did not meet goals in the Baseline Scenario, which represents existing conditions. This indicates that there may already be serious concerns about the long-term viability of a number of rare and imperiled species in Pueblo and El Paso counties, and that continued urban development can be expected to worsen the situation, unless pro-active and carefully considered steps are taken now.

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Introduction

The Federal Highway Administration's (FHWA) Planning and Environment Linkages (PEL) initiative presents and promotes an approach to transportation decision-making that considers environmental goals early in the planning stage and carries them through project development, design, and construction. Implementation activities needed to realize PEL concepts include conducting regional or system-wide analysis of environmental issues and documenting related decisions during the transportation planning process. This analysis is to be conducted and documented in such a way that facilitates the National Environmental Policy Act (NEPA) analyses and permitting that are required for individual transportation projects. Also relevant are the planning regulations stemming from Section 6001 of the Safe, Accountable, Flexible, and Efficient Transportation Equity Act: a Legacy for Users (SAFETEA-LU) that call for consultations with resource agencies, comparisons of transportation plans with conservation plans, maps, and inventories, and discussions of environmental mitigation activities and areas.

The FHWA sought to provide innovative analysis of regional environmental and community issues in a specific geographic area to demonstrate the potential benefits of such analysis and document a success story that others can use as models to follow. The project would require analysis both of environmental resources and community land use and growth on a regional scale. The goal of bringing these efforts together was to aid decision-making and speed implementation of infrastructure and conservation projects by providing information on the potential impacts of various agencies' proposed actions and developing avoidance, mitigation, and conservation priorities so that useful information can be carried into analysis and permitting processes for individual projects.

The FHWA selected Pueblo and El Paso Counties in Colorado as the pilot for this analysis. In this area, the Pikes Peak Area Council of Governments (PPACG), the Pueblo Area Council of Governments (PACOG), and the Colorado Department of Transportation (CDOT) conduct long-range planning processes that are relevant to this analysis.

To be successful, this analysis needed to employ the best available data for the specific area of interest. The analysis would also need data analysis tools that enable multiple data sources and layers to be consolidated and assessed geographically to identify sensitive environmental resources in relation to proposed transportation plans and land use visions.

The Colorado Natural Heritage Program (CNHP) was awarded the project in April 2007. The CNHP is the keeper of the most comprehensive biological data for the pilot area. The CNHP specializes in employing experts and GIS technology to inventory natural resources in Colorado and providing this information to data users.

The CNHP proposal included the use of two widely respected software analysis tools to demonstrate the power of their iterative use: NatureServe Vista, developed and maintained by NatureServe, and CommunityViz, developed and maintained by Placeways, LLC. NatureServe is a non-profit organization that oversees a network of Natural Heritage programs in North America, including the CNHP, and supplies information technologies and tools to help these programs manage data. Vista integrates conservation information with land use patterns and policies, enabling users to create plans and policies and assess their impacts on natural resource goals. Placeways, LLC provides GIS-based analysis and visualization services for planning, resource management, and transportation projects. With the use of its GIS extension software, CommunityViz, Placeways enables stakeholders, government agencies, and community members to better communicate and understand the outcomes of a proposed project or future growth and development in their area.

Project Overview

Project Components
The project consisted of three main components:

- Building a NatureServe Vista project populated with biological/environmental, land use, and transportation data layers for delivery to the FHWA and partners.
- Building a regional land use visualization tool for delivery to the FHWA and partners.
- Using the combined data and analysis tools to conduct regional environmental analysis.

Project Tasks
Specific tasks for the project were as follows. Detailed descriptions follow.

Task 1. Kickoff meeting
The project Kick-off meeting was held June 7, 2007 from 1:00 to 4:00 p.m. at the Pike's Peak Area Council of Government's (PPACG) offices, Colorado Springs.

CNHP, NatureServe, and Placeways met with the FHWA, CDOT, PPACG, and PACOG and other partners to review Vista and CommunityViz functionality, overall project goals, outline specific project objectives, develop project timeline, and formalize any data sharing agreements needed. Project data requirements were also discussed, such as, establishment of the final biological targets list, determination of other specific appropriate environmental data layer inputs, development of the list of impact analyses to be conducted using CommunityViz, as well as identification of relevant transportation, infrastructure, utilities, and socioeconomic data (state demographic data and forecasts, municipal schools data, municipal services data and costs, etc.) available.

Task 2. Gather and prepare relevant data for input to Vista and CommunityViz tools

The CNHP and Placeways worked with PPACG and PACOG to gather and prepare all relevant data for input into Vista and CommunityViz. These data included CNHP element occurrence and potential conservation area data, non-CNHP environmental data, transportation data, land use data, and demographic data and forecasts. The CNHP and Placeways also worked with PPACG and PACOG to define transportation and/or land use scenarios for the analysis.

All data provided by PPACG, PACOG, FHWA, or other local entity under the auspices of this project are considered confidential and for internal use only by CNHP, NatureServe, and Placeways. These data will not be re-distributed to any other entity other than to the FHWA and its partners. Additionally, the data provided by the CNHP and Placeways as deliverables for this project are considered confidential and for internal use only. Please see Appendix D for a copy of the full text of the data license and use agreement for details.

Task 3. Build Vista analysis project and CommunityViz tool

The Vista and CommunityViz projects were populated with all pertinent data gathered during Task 2. See the respective "Data gathering and preparation" sections for NatureServe Vista and CommunityViz below.

Task 4. Perform Vista and CommunityViz analyses

Vista and CommunityViz analyses were performed to identify key conservation and mitigation sites in light of current land use, policies, and planned transportation projects in El Paso and Pueblo Counties. These analyses included:

1) Determination of viability for each occurrence of each conservation target over the study area.

2) Summarizing the conservation value of different locations throughout the study area. GIS layers were produced that show where areas of greatest conservation concern for rare and imperiled species (CNHP High Value) and areas with either species with regulatory mandates/protection or other managed species (Legal Concern) See details in the "Conservation Value Summaries" section below.

3) Evaluating current or proposed planning scenarios as defined during Task 2 to determine where such plans may negatively impact conservation targets. For legally protected and otherwise imperiled resources, any impact was identified.

4) Developing GIS layers to show where potential conflicts occur.

Task 5. Interim results review

The interim results review meeting was held December 13, 2007 from 1:00 to 4:00 p.m. at the Pike's Peak Area Council of Government's (PPACG) offices, Colorado Springs. Interim results were presented in order to identify any changes or refinements needed.

Task 6. Perform revised Vista and/or CommunityViz analyses (if needed)

Revised Vista and CommunityViz analyses were performed based on input received at interim results review meeting. This included the incorporation of additional local knowledge and assigning new land use compatibility designations. See specific methods sections for more details.

Task 7. Document final results
This report, along with the electronic deliverables described in Task 8, constitutes the documentation of the final results. This report addresses methods, results, discussion, recommendations, and interpretation/implications of results.

Task 8. Build electronic Vista and CommunityViz tool deliverables
The CNHP and NatureServe prepared an electronic Vista project identical to the one used for the analyses, with the exception that location-generalized data (Level 2) have been substituted in place of exact location data (Level 1). Additionally, an ArcGIS project containing the result grids from the Level 1 data analysis is also provided.

Placeways prepared a file geodatabase of the CommunityViz project which contains the analysis of the three scenarios.

Please see the Electronic Deliverables section below for detailed descriptions of these files. These electronic deliverables include the accompanying Federal Geographic Data Committee (FGDC) standard metadata, documentation of data sources, and justification of all analysis parameter values.

Task 9. Final results review
The final results review meeting was held December 13, 2007 from 1:00 to 4:00 p.m. at the Pike's Peak Area Council of Government's (PPACG) offices, Colorado Springs.

Task 10. Follow-up consultation (as requested and as time and funding allow)
Any requests received from the FHWA, PPACG, or PACOG for follow-up consultation regarding aspects of Vista and/or CommunityViz data delivered in Task 8 will need to be arranged separately, as time and funding have expired on this project.

Project Workflow Overview

The following flowcharts provide an overview of the workflow for the project.
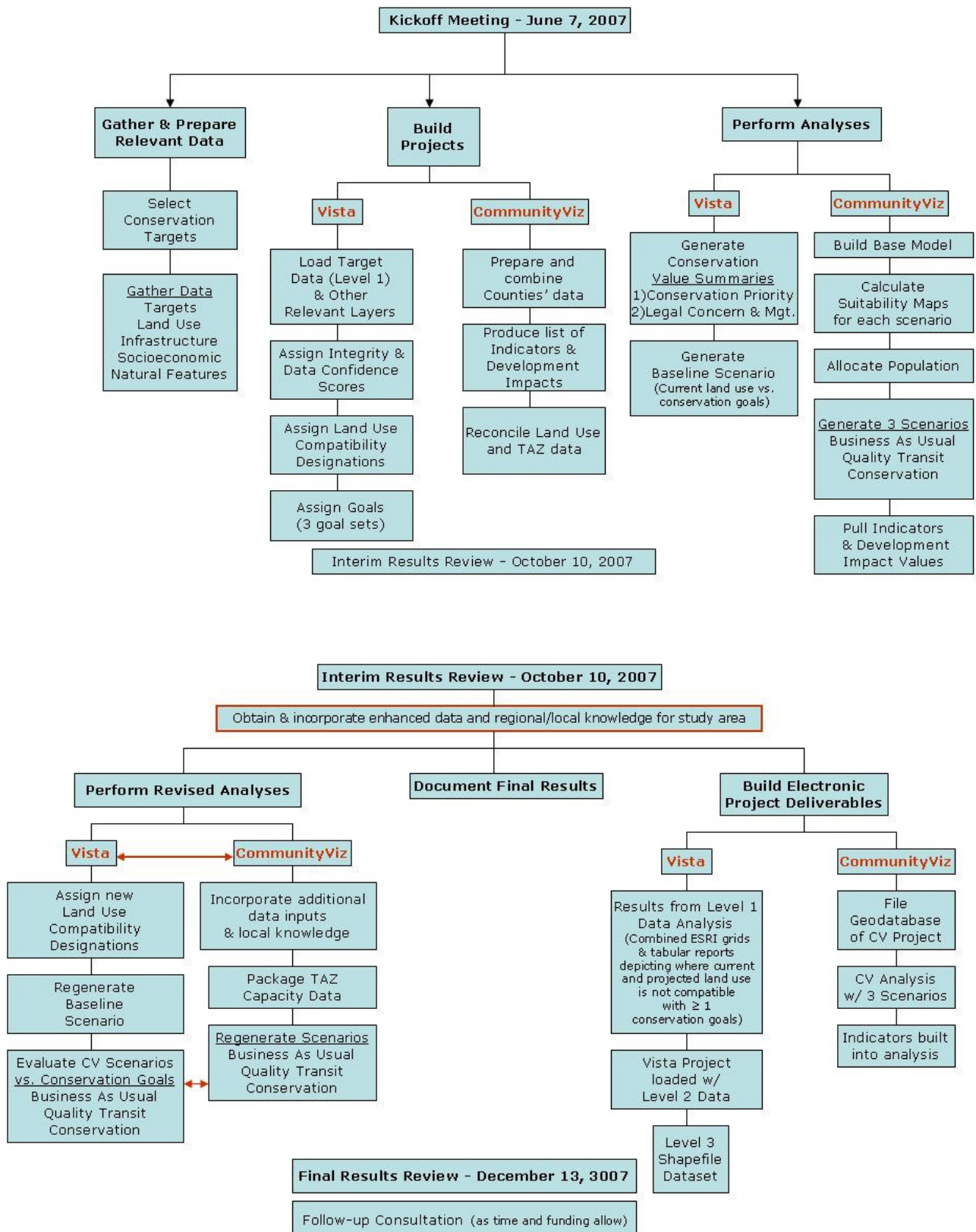
Diagram depicting iterative interactions between NatureServe Vista and Placeways CommunityViz.
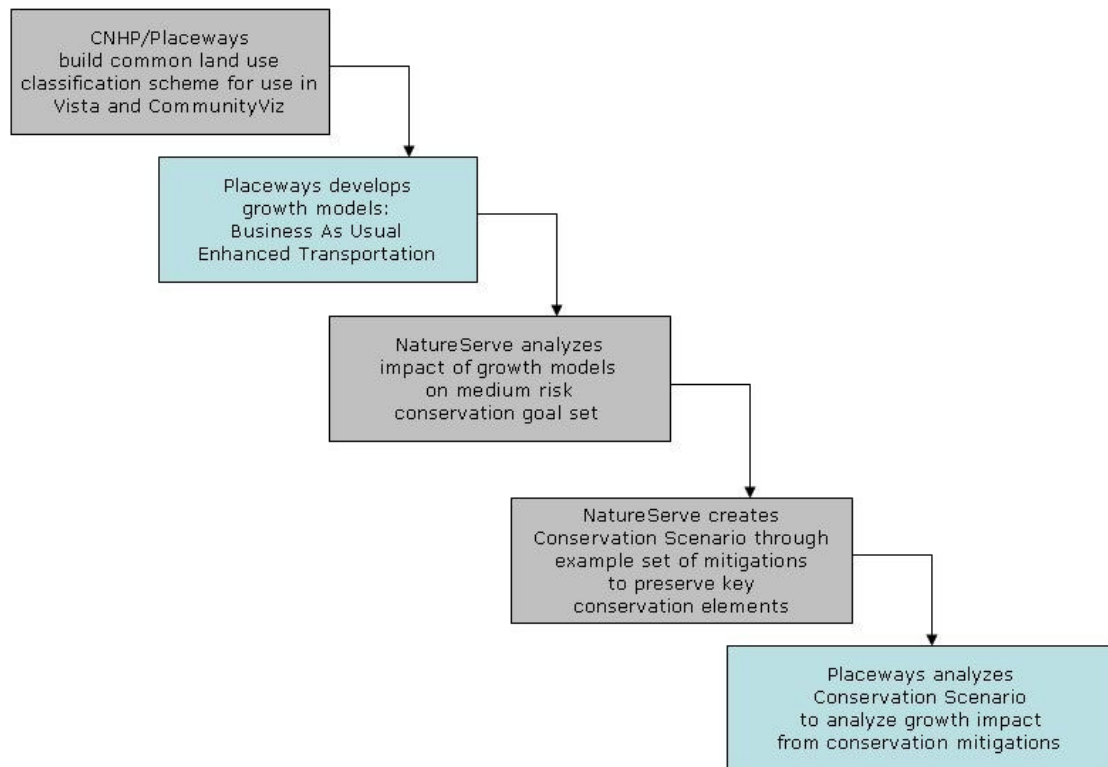
NatureServe Vista

Data gathering and preparation

Land Use Classification

Spatial data depicting land use and ownership was received from PPACG and PACOG for El Paso and Pueblo counties. For analysis purposes it was important to develop a two-tiered common land use classification system for the combined two-county study area. CNHP worked with Placeways to produce a single land use classification scheme that would meet all analysis needs. The system categorized each zoning code into a major and a minor category for both counties. (Table 1; See Appendix A for definitions and full crosswalk with original data). For use in Vista, additional information on protected public and private lands was added from the Colorado Ownership Management and Protection (COMaP) layer, created by Wilcox et al. (2007).

Table 1. Land use classification scheme.

Major Category	Minor Category
Government	Large Military Installations
	Other Government
General Urbanization	Commercial
	Industrial
	Mixed Use
	Office
	Community/ Public Buildings
	Infrastructure/General Urbanization
Residential	High Density Urban
	Medium Density Urban
	Low Density Urban
	Suburban to Exurban
	Exurban to Rural
	Residential Mixed Use
	Undeveloped Private
Parks, Recreation, Greenbelt	Park/Greenbelt
	Protected Open Space
Agriculture*	
Unknown or Road	

*Due to limitations of the source data, "Agriculture" is assumed to include both cultivated land and open rangeland.

GIS Layer Inputs:
- El Paso County 2005 Land Use
- Pueblo County Future Land Use
- Federal Lands in Pueblo County
- State Lands in Pueblo County
- COMaP v. 6

Biological Conservation Target Selection

A total of 59 conservation targets were chosen for the project (Table 2): 23 plants, 2 amphibians, 3 reptiles, 12 mammals, 9 birds, 3 fish, 5 insects, 1 mollusk, plus CNHP Potential Conservation Areas (PCAs). Most targets were chosen based on their previous selection in one or more other conservation planning efforts, such as The Nature Conservancy's ecoregional plans or the Colorado Department of

Transportation's Shortgrass Prairie Initiative. Several targets, such as the six big game species, were included at the request of PPACG and PACOG, and the PCAs were used in lieu of good data on quality wetlands. A PCA is defined by CNHP to be the best estimate of the area necessary to support long-term (100+ years) survival of populations of target species or natural communities. A PCA may require management or restoration to ensure their long-term persistence and functionality, but they do not necessarily preclude other human activities within the area (CNHP 2007a).

Most of the data used to represent target occurrences and viability were derived from CNHP's Biodiversity Tracking and Conservation System (BIOTICS) Element Occurrence, Observation, and Potential Conservation Area datasets (CNHP 2007b). Data that were considered historic or of poor precision were not used. Big game data, and some supplemental raptor data, came from the Colorado Division of Wildlife's Wildlife Resource Information System (CDOW 2006). Additional fish locations were provided by PPACG from their Fountain Creek Watershed Study (URS 2006). Precise location polygons were used when available. When only point data were available, the points were buffered by 1/10 mile (160 m) in accordance with standard CNHP natural heritage methodology. CNHP data are precise locations, whereas WRIS data for the most part represent broader seasonal distributions of species. WRIS distributions that blanketed the entire study area were not included, because they did not contribute information as to the critical areas to conserve within the two counties. The remaining distributions were combined in an additive manner, resulting in a single layer with ranked areas of importance to each big game species.

[NOTE: The absence of data in any particular geographic area does not necessarily mean that species or ecological communities of concern are not present. These data should not be regarded as a substitute for on-site surveys required for environmental assessments.]

Table 2. Conservation targets used in this project.

Taxonomic Group	Latin Name	Common Name	G-Rank	S-Rank	USESA*	State Listing **	FedSens †	Reason for including ‡	Data Source ††
Amphibians	*Rana blairi*	Plains Leopard Frog	G5	S3		SC	BLM USFS	CSP fine filter	EO
	Rana pipiens	Northern Leopard Frog	G5	S3		SC	BLM USFS	CSP fine filter, CDOT BMP	Obs
Birds	*Aimophila cassinii*	Cassin's Sparrow	G5	S4B			USFS	CSP fine filter, CDOT BMP	Obs
	Athene cunicularia	Burrowing Owl	G4	S4B		ST	USFS	CSP fine filter, CDOT BMP	Obs
	Buteo regalis	Ferruginous Hawk	G4	S3B, S4N		SC	BLM USFS	CSP fine filter, CDOT BMP	EO + Obs
	Calcarius mccownii	McCown's Longspur	G4	S2B			USFS	CSP fine filter, CDOT BMP	EO
	Charadrius montanus	Mountain Plover	G2	S2B		SC	BLM USFS	CSP fine filter, CDOT BMP	EO
	Falco peregrinus anatum	American Peregrine Falcon	G4T3	S2B		SC	USFS	CSP fine filter	EO + WRIS
	Haliaeetus leucocephalus	Bald Eagle	G5	S1B, S3N	Delisted 08/08/2007	ST		CSP fine filter, CDOT BMP	EO, Obs, WRIS
	Numenius americanus	Long-billed Curlew	G5	S2B		SC	BLM USFS	CSP fine filter, CDOT BMP	EO

Taxonomic Group	Latin Name	Common Name	G-Rank	S-Rank	USESA*	State Listing **	FedSens †	Reason for including ‡	Data Source ††
	Strix occidentalis lucida	Mexican Spotted Owl	G3T3	S1B, SUN	LT	ST		CSP fine filter	EO
Fish	*Etheostoma cragini*	Arkansas Darter	G3 G4	S2	C	ST		CSP fine filter, CDOT BMP	EO, URS
	Oncorhynchus clarkii stomias	Greenback Cutthroat Trout	G4T2 T3	S2	LT	ST		CSP fine filter	EO, URS
	Phoxinus erythrogaster	Southern Redbelly Dace	G5	S1		SE	USFS	CSP fine filter, CDOT BMP	EO
Insects	*Amblyscirtes simius*	Simius Roadside Skipper	G4	S3				CDOT BMP	EO
	Callophrys mossii schryveri	Moss's Elfin	G4T3	S2S3				CSP fine filter	EO
	Celastrina humulus	Hops Feeding Azure	G2 G3	S2				CDOT BMP	EO
	Cicindela nebraskana	A Tiger Beetle	G4	S1?				CSP fine filter	EO
	Euphilotes rita coloradensis	Colorado Blue	G3G 4T2 T3	S2				Globally rare	EO
Mammals	*Antilocapra americana*	Pronghorn	G5	S4				PPACG request	CDOW WRIS
	Cervus elaphus	Elk	G5	S5				PPACG request	CDOW WRIS
	Conepatus leuconotus	Common Hog-nosed Skunk	G4	S1			USFS	CSP fine filter	EO
	Cynomys gunnisoni	Gunnison's Prairie Dog	G5	S5			USFS	CSP fine filter	EO
	Cynomys ludovicianus	Black-tailed Prairie Dog	G4	S3		SC	USFS	CSP fine filter, CDOT BMP	EO
	Odocoileus hemionus	Mule Deer	G5	S4				PPACG request	CDOW WRIS
	Odocoileus virginianus	White-tailed Deer	G5	S5				PPACG request	CDOW WRIS
	Ovis canadensis	Big Horn Sheep	G4	S4				PPACG request	CDOW WRIS
	Plecotus townsendii pallescens	Townsend's Big-eared Bat Subsp	G4T4	S2		SC	BLM USFS	CSP fine filter	EO
	Ursus americanus	Black Bear	G5	S5				PPACG request	CDOW WRIS
	Vulpes velox	Swift Fox	G3	S3		SC	USFS	CSP watchlist	EO
	Zapus hudsonius preblei	Preble's Meadow Jumping Mouse	G5T2	S1	LT, PDL	ST		CSP fine filter	EO
Mollusks	*Anodonta grandis*	Giant Floater	G5	S2				CSP watchlist, CDOT BMP	EO
Reptiles	*Aspidoscelis neotesselata*	Triploid Colorado Checkered Whiptail	G2 G3	S2		SC		CSP fine filter	EO

Taxonomic Group	Latin Name	Common Name	G-Rank	S-Rank	USESA*	State Listing **	FedSens †	Reason for including ‡	Data Source ††
	Phrynosoma cornutum	Texas Horned Lizard	G4 G5	S3			BLM	CSP fine filter, CDOT BMP	EO
	Sistrurus catenatus	Massasauga	G3 G4	S2	C	SC	BLM USFS	CSP fine filter, CDOT BMP	EO
Vascular Plants	*Ambrosia linearis*	plains ragweed	G3	S3				CSP fine filter	EO
	Aquilegia chrysantha var. rydbergii	golden columbine	G4 T1Q	S1			BLM USFS	Globally rare	EO
	Aquilegia saximontana	Rocky Mountain columbine	G3	S3				SRM target	EO
	Asclepias uncialis ssp. uncialis	dwarf milkweed	G3G4T2 T3	S2			BLM USFS	CSP fine filter	EO
	Astragalus sparsiflorus	Front Range milkvetch	G3?	S3?				CSP fine filter	EO
	Bolophyta tetraneuris	Barneby's fever-few	G3	S3				CSP fine filter, CDOT BMP	EO
	Botrychium lineare	narrowleaf grapefern	G1	S1	C		USFS	SRM target	EO
	Carex oreocharis	a sedge	G3	S1				CSP fine filter	EO
	Chenopodium cycloides	sandhill goosefoot	G3 G4	S1			USFS	CSP fine filter	EO
	Commelina dianthifolia	birdbill day-flower	G5	S1?				CSP fine filter	EO
	Draba crassa	thick-leaf whitlow-grass	G3	S3				Globally rare	EO
	Heuchera hallii	Front Range alum-root	G3	S3				CSP fine filter	EO
	Lesquerella calcicola	Rocky Mountain bladderpod	G2	S2				CSP fine filter	EO
	Nuttallia chrysantha	golden blazing star	G2	S2			BLM	CSP fine filter, CDOT BMP	EO
	Nuttallia speciosa	jeweled blazingstar	G3?	S3?				CSP fine filter	EO
	Oenothera harringtonii	Arkansas Valley evening primrose	G2	S2			USFS	CSP fine filter, CDOT BMP	EO
	Oonopsis sp. 1	Pueblo goldenweed	G2	S2				CSP fine filter, CDOT BMP	EO
	Oreoxis humilis	Pikes Peak spring parsley	G1	S1			USFS	SRM target	EO
	Oxybaphus rotundifolius	round-leaf four-o'clock	G2	S2				CSP fine filter, CDOT BMP	EO
	Potentilla ambigens	southern Rocky Mountain cinquefoil	G3	S1S2				CSP fine filter	EO
	Ptilagrostis	Porter	G2	S2			BLM	SRM target	EO

Taxonomic Group	Latin Name	Common Name	G-Rank	S-Rank	USESA*	State Listing **	FedSens †	Reason for including ‡	Data Source ††
	porteri	feathergrass					USFS		
	Stellaria irrigua	Altai chickweed	G4?	S2				SRM target	EO
	Telesonix jamesii	James' telesonix	G2	S2				SRM target	EO & Obs
Potential Conservation Areas			All B1-B3 & B4 & B5 related to wetlands					High conservation value landscape	PCA

Natural Heritage Network Ranking System (for more information, see NatureServe 2002):
G/S1   Critically imperiled globally/state because of rarity, or because some factor of its biology makes it especially vulnerable to extinction.
G/S2   Imperiled globally/state because of rarity, or because other factors demonstrably make it very vulnerable to extinction throughout its range.
G/S3   Vulnerable through its range or found locally in a restricted range.
G/S4   Apparently secure globally/state, though it may be quite rare in parts of its range, especially at the periphery.
G/S5   Demonstrably secure globally/state, though it may be quite rare in parts of its range, especially at the periphery.
G/S#?   Indicates uncertainty about an assigned global or state rank.
G/SU   Unable to assign rank due to lack of available information.
G#T#   Trinomial rank (T) is used for subspecies or varieties. These taxa are ranked on the same criteria as G1-G5.
S#B   Refers to the breeding season imperilment of elements that are not residents.
S#N   Refers to the migratory or winter season imperilment of elements that are not residents.
SNA   Not Applicable. A conservation status rank is not applicable because the species is not a suitable target for conservation activities.

* U.S. Endangered Species Act		** Colorado Endangered Species List		† Federal Agency Sensitive Species Listing	
LE	Listed Endangered	SE	State Endangered	BLM	Bureau of Land Management
LT	Listed Threatened	ST	State Threatened	USFS	U.S. Forest Service
PDL	Potential Delisting soon	SC	State Candidate		
C	Candidate (former)				

‡ Source of Conservation Target
CSP   The Nature Conservancy's Central Shortgrass Prairie ecoregional assessment
SRM   The Nature Conservancy's Southern Rocky Mountains ecoregional assessment
CDOT BMP   Colorado Department of Transportation's Best Management Practices list for their Shortgrass Initiative project

†† Source of spatial data
EO   CNHP Element Occurrence in BIOTICS
Obs   CNHP Observation Database
PCA   CNHP Potential Conservation Area in BIOTICS
CDOW WRIS   Colorado Division of Wildlife, Wildlife Resource Information System
URS   Fountain Creek Watershed Study

GIS Layer Inputs:
- CNHP Element Occurrence Records
- CNHP Site Records
- CNHP Observation Records
- Fountain Creek Watershed Study Fish Sampling Locations (FCWS)
- CDOW Wildlife Resource Information System Layers (WRIS)

Building the Vista project

Overview of NatureServe Vista

NatureServe Vista is a relatively new decision-support tool for land use and conservation evaluation and planning. Its primary purposes are to identify high-priority areas for conservation, to evaluate competing land use plans, to identify land uses that are in conflict with conservation goals, and to compare different stakeholder values and visions in order to highlight areas of agreement or conflict (Natureserve 2006). Vista operates as an extension to the Environmental Systems Research Institute, Inc. (ESRI) software ArcGIS version 9.x, which runs on Microsoft Windows.

As with all computer modeling and analysis tools, the outputs generated are only as good as the input data. Ecological systems are complex and comprehensive data is sorely lacking. NatureServe Vista is a support tool only aimed at general planning where rules of thumb approaches are employed. It cannot make decisions for the user, only highlight areas of perceived importance for further consideration and research. Additionally, Vista does not take into account important ecological issues such as species demographics or seasonality, either in regards to a species' use of an area or to fluctuating recreational or traffic volume.

Target Integrity and Data Confidence Scores

In addition to species distribution, NatureServe Vista also accommodates information on the quality of each target species location and on the confidence in data used. These scores are ranked from 0.0 to 1.0 and can be incorporated in Vista's Conservation Value Summaries. Each target polygon was ranked as to its quality and level of data confidence. Table 3 shows how quality was ranked and translated into scores from 0 to 1. For CNHP Element Occurrences (EO), EO-Rank, a measure of the ecological quality of the occurrence, was used. Observation data quality was ranked according to Use Class, big game data were ranked as to quality based on the number of overlapping WRIS distributions, and PCAs were ranked based on their Biodiversity Ranking. The fish locations from the Fountain Creek Watershed study were given a single, medium-rank of quality due to lack of information. Data confidence ranks (Table 4) were based on mapping precision of EO and Observations, mapping status for PCAs, and single values for WRIS and Fountain Creek Watershed Study data as general indicators of perceived data accuracy.

Table 3. Occurrence viability rankings.

Data Source	Quality Measure	Rank	Definition	Vista Viability Score
CNHP Element Occurrence	EO-Rank	A	Excellent	1.00
		AB		0.95
		B	Good	0.90
		BC		0.75
		C	Fair	0.60
		E or Unranked	Extant or Unranked	0.60
		CD		0.40
		D	Poor	0.20
CNHP Observation	Use Class	nest or other quality observation		1.00
		blank		0.60
CNHP Potential Conservation Area	Biodiversity Ranking	B1	Outstanding significance (irreplaceable)	1.00
		B2	Very high significance (nearly irreplaceable)	0.90
		B3	High significance	0.80
		B4	Moderate significance	0.70
		B5	General or local significance	0.60
WRIS species distributions	number of overlapping distributions	varied from 1-2 through 1-6 for each species		1 = 0.5 max = 1.0 in-between values linearly interpolated
FCWS	single value			0.60

Table 4. Data confidence scores assigned to each target occurrence.

Data Source	Confidence Measure	Rank	Definition	Vista Confidence Score
Element Occurrence	Mapping Precision plus EO-Rank completeness		Mappable to within approx. 3 arc seconds of latitude and longitude; essentially an "X" marks the spot"	
		Seconds		1.00
		Seconds, if EO-Rank 'E' or blank		0.80
		Minutes	Mappable to within approx. 1 mile in any direction	0.80
		Minutes, if EO-Rank 'E' or blank		0.60
		General	Locational uncertainty exceeds approx. 1 mile	data not used
Observation	Mapping Error	Negligible	Location is precisely known	1.00
		Aerial Estimated or Imprecise Location	Location is generally known	0.80
Potential Conservation Area	Site Map Completed	Yes		1.00
		Partial		0.80
WRIS species distributions	single value			0.75
FCWS	single value			0.50

Land Use Compatibility Designations

A matrix was created to describe the compatibility of each conservation target with each land use class (Appendix B). Literature review and expert opinion were used to create the compatibility designations. NatureServe Vista supports various ways of assigning how an element's viability is expected to respond to individual land uses. Because of time and resource constraints, we used the simplest approach which considers land use as being either compatible or incompatible with each conservation target of concern Therefore, it is necessary to classify various land uses in such a way that is meaningful to the conservation of each target in this project. The dichotomy of having to designate all land uses as either compatible or incompatible to the persistence of a species or landscape can be limiting depending upon the ecology of targeted species, especially if all relevant land uses can not be reliably mapped over the project area. A primary example of this is the difference between rangeland and agriculture. Many species are compatible with open rangeland, and very few are compatible with active cultivation of cropland. However, these two land uses could not be reliably distinguished with the available data for the two counties, and so had to be lumped into one "Agriculture" category, thereby weakening the power of the land use scenario evaluation.

Conservation Goal Sets

Conservation goals were based on the Natural Heritage Network Ranking System (NatureServe 2002), taking into account both Global and Subnational ranks (also known as "G rank" and "S rank" – see definitions under Table 2) in creating three separate goal sets that convey a level of risk as to conservation effectiveness (Table 5). If met, the low risk goal set provides a much better chance of effectively conserving the targets within the project area than the high risk goal set, but requires that almost all known occurrences of each target be protected. The moderate risk goal set balances the risk of failing to adequately conserve a target with the chance of protecting more than is absolutely necessary. It is important to note, however, that these are broadly applied goals based on a simplified ranking system. Effective conservation of any specific population in a specific area cannot be guaranteed through the use of these goal sets. On the ground inventory and monitoring is the only way to assure the effectiveness of conservation efforts for any particular species.

Table 5. Conservation goals for each target, expressed as a percentage of the current number of occurrences in the project area.

Taxonomic Group	Latin Name	Common Name	Rounded G-Rank	S-Rank	# occ†	High Risk	Mod. Risk	Low Risk
Amphibians	*Rana blairi*	Plains Leopard Frog	G5	S3	2	50%	50%	100%
Amphibians	*Rana pipiens*	Northern Leopard Frog	G5	S3	47	50%	66%	75%
Birds	*Aimophila cassinii*	Cassin's Sparrow	G5	S4B	80	10%	33%	50%
Birds	*Athene cunicularia*	Burrowing Owl	G4	S4B	61	10%	33%	50%
Birds	*Buteo regalis*	Ferruginous Hawk	G4	S3B,S4N	5	50%	66%	75%
Birds	*Calcarius mccownii*	McCown's Longspur	G4	S2B	4	75%	100%	100%
Birds	*Charadrius montanus*	Mountain Plover	G2*	S2B	23	50%	66%	75%
Birds	*Falco peregrinus anatum*	American Peregrine Falcon	T3	S2B	4	75%	100%	100%
Birds	*Haliaeetus leucocephalus*	Bald Eagle	G5	S1B,S3N	10	100%	100%	100%
Birds	*Numenius americanus*	Long-billed Curlew	G5	S2B	3	66%	100%	100%
Birds	*Strix occidentalis lucida*	Mexican Spotted Owl	T3	S1B,SUN	3	100%	100%	100%
Fish	*Etheostoma cragini*	Arkansas Darter	G3**	S2	8	100%	100%	100%
Fish	*Oncorhynchus clarkii stomias*	Greenback Cutthroat Trout	T2	S2	7	75%	100%	100%
Fish	*Phoxinus erythrogaster*	Southern Redbelly Dace	G5	S1	1	100%	100%	100%
Insects	*Amblyscirtes simius*	Simius Roadside Skipper	G4	S3	1	100%	100%	100%
Insects	*Callophrys mossii schryveri*	Moss's Elfin	T3	S2S3	1	100%	100%	100%
Insects	*Celastrina humulus*	Hops Feeding Azure	G2	S2	2	100%	100%	100%
Insects	*Cicindela nebraskana*	A Tiger Beetle	G4	S1?	2	100%	100%	100%
Insects	*Euphilotes rita coloradensis*	Colorado Blue	T2	S2	3	66%	100%	100%
Mammals	*Antilocapra americana*	Pronghorn	G5	S4	1,063,224	10%	33%	50%
Mammals	*Cervus elaphus*	Elk	G5	S5	1,176,092	5%	10%	33%
Mammals	*Conepatus leuconotus*	Common Hog-nosed Skunk	G4	S1	1	100%	100%	100%
Mammals	*Cynomys gunnisoni*	Gunnison's Prairie Dog	G5	S5	3	33%	33%	33%
Mammals	*Cynomys ludovicianus*	Black-tailed Prairie Dog	G4	S3	74	50%	66%	75%
Mammals	*Odocoileus hemionus*	Mule Deer	G5	S4	538,223	10%	33%	50%
Mammals	*Odocoileus virginianus*	White-tailed Deer	G5	S5	170,101	5%	10%	33%
Mammals	*Ovis canadensis*	Big Horn Sheep	G4	S4	272,641	10%	33%	50%
Mammals	*Plecotus townsendii pallescens*	Townsend's Big-eared Bat Subsp	T4	S2	1	100%	100%	100%
Mammals	*Ursus americanus*	Black Bear	G5	S5	1,075,273	5%	10%	33%
Mammals	*Vulpes velox*	Swift Fox	G3	S3	5	50%	66%	75%

Taxonomic Group	Latin Name	Common Name	Rounded G-Rank	S-Rank	# occ†	High Risk	Mod. Risk	Low Risk
Mammals	*Zapus hudsonius preblei*	Preble's Meadow Jumping Mouse	T2	S1	49	100%	100%	100%
Mollusks	*Anodonta grandis*	Giant Floater	G5	S2	1	100%	100%	100%
Reptiles	*Aspidoscelis neotesselata*	Triploid Colorado Checkered Whiptail	G2*	S2	9	50%	66%	75%
Reptiles	*Phrynosoma cornutum*	Texas Horned Lizard	G4	S3	1	100%	100%	100%
Reptiles	*Sistrurus catenatus*	Massasauga	G3	S2	4	75%	100%	100%
Plants	*Ambrosia linearis*	plains ragweed	G3	S3	46	50%	66%	75%
Plants	*Aquilegia chrysantha var. rydbergii*	golden columbine	T1	S1	6	100%	100%	100%
Plants	*Aquilegia saximontana*	Rocky Mountain columbine	G3	S3	8	50%	66%	75%
Plants	*Asclepias uncialis ssp. uncialis*	dwarf milkweed	T2	S2	5	75%	100%	100%
Plants	*Astragalus sparsiflorus*	Front Range milkvetch	G3	S3?	2	50%	50%	100%
Plants	*Bolophyta tetraneuris*	Barneby's fever-few	G3	S3	23	50%	66%	75%
Plants	*Botrychium lineare*	narrowleaf grapefern	G1	S1	2	100%	100%	100%
Plants	*Carex oreocharis*	a sedge	G3	S1	1	100%	100%	100%
Plants	*Chenopodium cycloides*	sandhill goosefoot	G3	S1	7	100%	100%	100%
Plants	*Commelina dianthifolia*	birdbill day-flower	G5	S1?	4	100%	100%	100%
Plants	*Draba crassa*	thick-leaf whitlow-grass	G3	S3	1	100%	100%	100%
Plants	*Heuchera hallii*	Front Range alum-root	G3	S3	2	50%	50%	100%
Plants	*Lesquerella calcicola*	Rocky Mountain bladderpod	G2	S2	14	100%	100%	100%
Plants	*Nuttallia chrysantha*	golden blazing star	G2	S2	13	100%	100%	100%
Plants	*Nuttallia speciosa*	jeweled blazingstar	G3	S3?	2	50%	50%	100%
Plants	*Oenothera harringtonii*	Arkansas Valley evening primrose	G2*	S2	10	50%	66%	75%
Plants	*Oonopsis sp. 1*	Pueblo goldenweed	G2	S2	14	100%	100%	100%
Plants	*Oreoxis humilis*	Pikes Peak spring parsley	G1	S1	5	100%	100%	100%
Plants	*Oxybaphus rotundifolius*	round-leaf four-o'clock	G2	S2	22	100%	100%	100%
Plants	*Potentilla ambigens*	southern Rocky Mountain cinquefoil	G3	S1S2	2	100%	100%	100%
Plants	*Ptilagrostis porteri*	Porter feathergrass	G2	S2	1	100%	100%	100%
Plants	*Stellaria irrigua*	Altai chickweed	G4	S2	1	100%	100%	100%
Plants	*Telesonix jamesii*	James' telesonix	G2	S2	9	100%	100%	100%
		Potential Conservation Areas			57	33%	50%	100%

†Because of their wide-ranging nature, goals for big game species are measured in acres, not number of discrete occurrences (cells shaded in light gray).

Initial Goal Scheme Rules (low, moderate, high):
G1-G2 at 100% regardless of goal set
G3+ S1 at 100% regardless of goal set
G3+ S2 75%, 100%, 100%
G3+ S3 50%, 66%, 75%
G3 S4 33%, 50%, 66%
G4+ S4 10%, 33%, 50%
G3 S5 10%, 33%, 50%
G4+ S5 5%, 10%, 33%
PCAs 33%, 50%, 100%

Modified due to pending ranking changes:
*treat as G3/S3
**treat as G2/S2

These initial goals were then modified to make them divisible by the number of occurrences in project area if number of occurrences is 3 or less. (i.e., targets with 1 occurrence will always have goal of 100%, 2 occurrences will either be 50% or 100%, 3 occurrences will be either 33%, 66%, or 100%.)

Conservation analyses using Vista

Overview of Methodology

There are two main outputs from NatureServe Vista: Conservation Value Summaries and Scenario Evaluations. A Conservation Value Summary uses the distribution and quality of the conservation targets of concern to identify the relative conservation value (low to high) of different areas in the planning area. It is a general screening tool used to direct intensive land use away from high value locations to low value locations based on various conservation planning concepts. Scenario Evaluations indicate areas with compatible land use and adequate protection policies to meet target conservation goals (NatureServe 2006). Evaluations allow quantitative comparison of scenarios and guide creation of alternatives for land use that increase compatibility with conservation goal achievement.

Conservation Value Summaries

Conservation Value Summaries (CVS) can be a straightforward account of species richness in a particular area, or can further summarize overall conservation value of an area by integrating occurrence viability, data confidence, and any number of subjective weights and filters based on user needs and project objectives. For this project, two weighted CVS were run, one based on CNHP conservation priorities and the other on legal protection and management of target species, in order to emphasize the value of locations containing these groups of elements.

For the CNHP conservation priority summary, each target was ranked by its assigned S-Rank, except for PCAs, which do not have an S-Rank. These areas are already identified as important to conservation of rare and imperiled species and natural communities and were therefore given the highest weight possible. Table 6 lists the ranks used. Because NatureServe Vista analysis is based on values ranging from 0 to 1, the highest possible rank is a 1.0.

Table 6. CNHP conservation priority weights.

S-Rank	Weight
S1	1.00
S2	0.95
S3	0.80
S4	0.66
S5	0.10
SU	0.50
SNR	0.50
SNA	0
SX	0
SH	0
PCAs	1.00

See footnote of Table 2 for explanation of S-Rank scores.

For the legal concern and management summary, each target was ranked based on its level of legal protection, if any, or other level of government mandated management concern. The U.S. Endangered Species Act takes precedence, followed by the Colorado Endangered Species List, then the Migratory Bird Treaty Act, then USFS & BLM Sensitive Species Lists, and finally management of game species (Table 7). These ranks are not cumulative. If a species is protected under more than one mandate, then it was assigned the highest weight it could receive. Because PCAs do not receive any legal protection, they were given a weight of zero, which effectively removes them from the summary evaluation. All insects, the one mollusk species, and about half of the plant species on the target list also have no protection and so did not contribute to this summary.

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Table 7. Legal concern and management weights.

Category	Weight
USESA	
Endangered	1.00
Threatened	1.00
Candidate	0.70
State Listing	
Endangered	1.00
Threatened	1.00
Candidate	0.70
Migratory Birds	0.80
Sensitive Species Lists	
BLM/USFS	0.60
BLM	0.50
USFS	0.50
Big Game	0.125

The result of a Conservation Value Summary in Vista is a floating point grid that ranges in value from zero to a maximum that depends on the number of overlapping targets, each multiplied by their weights, viability scores, and data confidence scores (if used). The results tend to be difficult to interpret because the values are relative rather than having any absolute meaning, so the raw output of each CVS was reviewed and refined by CNHP ecologists in order to create discrete polygons representing ecologically relevant areas of conservation importance. The reason for this was to provide a more actionable input to CommunityViz for guiding land use away from high value areas. The process for creating the polygons of conservation importance was as follows:

Each raw CVS grid was classified into discrete levels of conservation importance (Table 8). The value thresholds for these categories were based on relating each combination of target weight and viability score back to CNHP's own ranking methodologies.

Table 8. Conversion of summarized conservation value into discrete categories.

CNHP High Value CVS	Legal Concern CVS	Category
0 - <0.6	0 - <0.6	not of immediate conservation importance
0.6 - <1.0	0.6 - <0.8	important for conservation
1.0 and greater	0.8 and greater	extremely important for conservation

Polygons were then manually drawn around all areas of extreme importance while trying to include as many areas of "regular" importance as possible. These delineated polygons may be larger or smaller than the actual "hotspot" areas shown by the CVS grid. All of the areas represented in these two datasets are considered to be of importance to conserving either rare and imperiled species (CNHP High Value) or legally protected species (Legal Concern). However, the polygons have been further subdivided into "tiers". Tier 1 polygons are those considered to be of critical importance, Tier 2 polygons are not critical, but are nevertheless important and should not be disregarded. Zonal statistics were run on the final polygons using the original CVS grid as the value layer. The results were appended to the attribute table of the polygon layers, and those polygons that fell within the top 20% of the Zonal Sum value were attributed as Tier 1 polygons, and the remainder was assigned as Tier 2.

Reasonable effort was made to represent areas that are both ecologically meaningful and practical for conservation planning, but no guarantee is made that these areas fully meet either condition. Element Occurrence and observation data (on which the CVS grid is largely based) are precise locations and do

not necessarily reflect the full area required for a population or dependent community to persist. These areas are based on best professional judgment given the time and information available, but are not guaranteed to represent either necessary or sufficient habitat for functioning populations of the target species. For full disclaimers, please see the metadata accompanying these spatial layers.

These two summaries, "CNHP High Value" and "Legal Concern," are two different ways of viewing the same data. This information was given to Placeways, who utilized in the CommunityViz growth models (see the CommunityViz portion of the report below).

Baseline Scenario

A Baseline Scenario was created to represent current land use as a "baseline" to compare with evaluations of other alternative scenarios. As described in the Data Gathering and Preparation section above, the first step was to build a land use classification scheme that could be used as a common language between the various data layers, Vista, and CommunityViz. CNHP oversaw this process to ensure the biological relevance of these classifications. Each land parcel was attributed with one of these land use classifications to create the Baseline land use layer utilized in both Vista and CommunityViz (Figure 1).

This land use layer was input into NatureServe Vista using Vista's *Override* functionality. This functionality creates a single raster layer that describes only one land use present in any one cell rather than representing overlapping land uses. In cases where overlapping land uses exist, a system of precedence can be used to determine the dominant land use for evaluation. We believe this approach is adequate for regional long range planning. For more precise scenario evaluation, it would be relatively easy to develop more complex "multi-attribute" scenarios of overlapping land use. After the Baseline Scenario was generated, this raster layer was then passed to Placeways for use in growth modeling in CommunityViz (see below).

Figure 1. Example of land use input data.
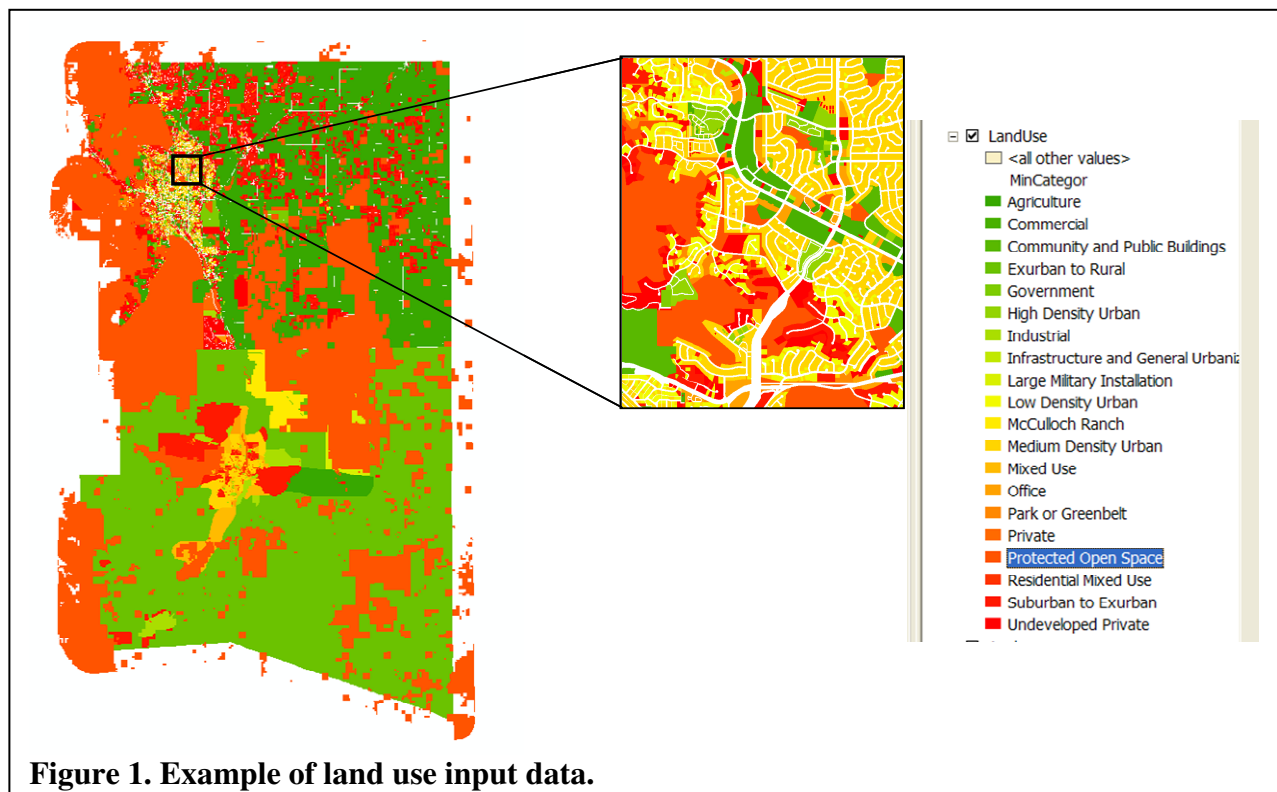
Scenario Evaluations

A Scenario Evaluation models the impact that a particular set of land uses, or "scenario," has on conservation targets and how these impacts affect the achievement of conservation goals. After the compatibility of each land use with each conservation target is assessed over the extent of the land use spatial layer, the number of target occurrences within compatible land uses are compared against a goal set. The goal sets used for this project are described in the "Building the Vista project" section above. They describe goals that pose either a High, Medium, or Low risk to achieving successful conservation of targets.

Three scenarios were evaluated. In addition to the Baseline Scenario, Placeways generated two future scenarios based on growth models generated in CommunityViz, a "Business As Usual" scenario and an "Enhanced Transportation" scenario. See the "Impact analyses using CommunityViz" section below for more details on these scenarios.

In evaluating the various scenarios, NatureServe found a clear tipping point between High and Moderate risk goal sets, but no real difference in evaluation results between Moderate and Low risk goal sets. Because of this finding and the project's time constraints, NatureServe concentrated on evaluating just the Moderate risk goal set against the three scenarios. However, all three goal sets are included in the electronic deliverable for future use by FHWA, PPACG, and PACOG.
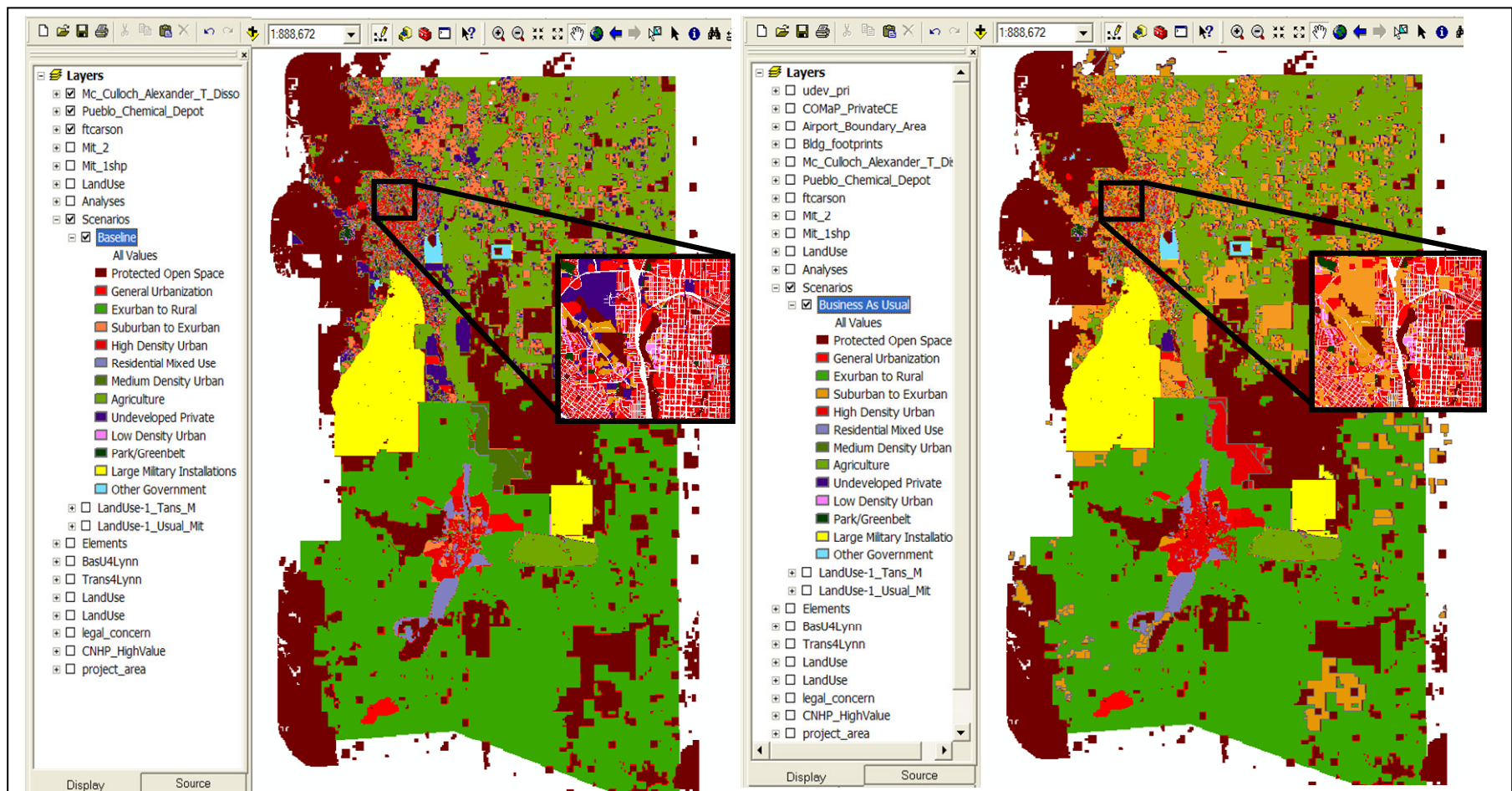
Figure 2. Baseline Land Use versus Business As Usual Land Use.

Results

<u>Baseline</u>

When NatureServe ran a Scenario Evaluation to evaluate the Baseline Scenario (Figure 2) against the Moderate risk goal set, 39 out of 59 (66%) of the conservation targets met the Moderate risk conservation goals (Table 9). Two additional targets, the swift fox (*Vulpes velox*) and Rocky Mountain columbine (*Aquilegia saximontana*), came within 90% of the stated goals. Those targets meeting less than 90% of the Moderate risk goal, marked in red in the table below, are species (or areas, in the case of PCAs) that are already under strain from existing land uses and therefore raise particular concern in this scenario. This includes all of the federally listed species —Mexican Spotted Owl (*Strix occidentalis lucida*), greenback cutthroat trout (*Oncorhynchus clarkii stomias*), and Preble's meadow jumping mouse (*Zapus hudsonius preblei*)— that occur in the study area. This is to be expected, because if they were not threatened by human activities they would not be federally listed, but this analysis also points out all of the other species that are threatened that are not yet listed. Of particular note are the four species that have no occurrences at all on compatible lands. These are the Colorado blue butterfly (*Euphilotes rita coloradensis*), the hog-nosed skunk (*Conepatus leuconotus*), the Front Range alum-root (*Heuchera hallii*), and the Pikes Peak spring parsley (*Oreoxis humilis*).

The data used to develop Vista's initial Baseline Scenario is very important. These data determine the resolution and accuracy of all future Scenario Evaluations. Therefore, it is very important that Baseline Scenario input data are as robust and accurate as possible. As is the case for any model, the more Vista Scenarios reflect reality, the more accurate the results will be. The layer representing the results from this evaluation is titled *base_m* in the electronic deliverable.

Table 9. Results of the Baseline Scenario Evaluated Against Moderate Risk Goals.

Latin Name	Common Name	# occurrences in project area†	Goal (% of occurrences)	Occurrences in scenario†	Percent of goal met
Rana blairi	Plains Leopard Frog	2	50%	2	200%
Rana pipiens	Northern Leopard Frog	47	66%	44	142%
Aimophila cassinii	Cassin's Sparrow	80	33%	69	261%
Athene cunicularia	Burrowing Owl	61	33%	58	288%
Buteo regalis	Ferruginous Hawk	5	66%	5	152%
Calcarius mccownii	McCown's Longspur	4	100%	4	100%
Charadrius montanus	Mountain Plover	23	66%	23	152%
Falco peregrinus anatum	American Peregrine Falcon	4	100%	1	25%
Haliaeetus leucocephalus	Bald Eagle	10	100%	10	100%
Numenius americanus	Long-billed Curlew	3	100%	3	100%
Strix occidentalis lucida	Mexican Spotted Owl	3	100%	1	33%
Etheostoma cragini	Arkansas Darter	8	100%	5	63%
Oncorhynchus clarkii stomias	Greenback Cutthroat Trout	7	100%	2	29%
Phoxinus erythrogaster	Southern Redbelly Dace	1	100%	1	100%
Amblyscirtes simius	Simius Roadside Skipper	1	100%	1	100%
Callophrys mossii schryveri	Moss's Elfin	1	100%	1	100%
Celastrina humulus	Hops Feeding Azure	2	100%	2	100%
Cicindela nebraskana	A Tiger Beetle	2	100%	1	50%
Euphilotes rita coloradensis	Colorado Blue	3	100%	0	0%
Antilocapra americana	Pronghorn	1,063,224	33%	948,122	270%
Cervus elaphus	Elk	1,176,092	10%	864,272	735%

Latin Name	Common Name	# occurrences in project area†	Goal (% of occurrences)	Occurrences in scenario†	Percent of goal met
Conepatus leuconotus	Common Hog-nosed Skunk	1	100%	0	0%
Cynomys gunnisoni	Gunnison's Prairie Dog	3	33%	3	303%
Cynomys ludovicianus	Black-tailed Prairie Dog	74	66%	68	139%
Odocoileus hemionus	Mule Deer	538,223	33%	415,414	234%
Odocoileus virginianus	White-tailed Deer	170,101	10%	141,106	830%
Ovis canadensis	Big Horn Sheep	272,641	33%	31,628	35%
Plecotus townsendii pallescens	Townsend's Big-eared Bat Subsp	1	100%	1	100%
Ursus americanus	Black Bear	1,075,273	10%	703,150	654%
Vulpes velox	Swift Fox	5	66%	3	91%
Zapus hudsonius preblei	Preble's Meadow Jumping Mouse	49	100%	44	90%
Anodonta grandis	Giant Floater	1	100%	1	100%
Aspidoscelis neotesselata	Triploid Colorado Checkered Whiptail	9	66%	8	135%
Phrynosoma cornutum	Texas Horned Lizard	1	100%	1	100%
Sistrurus catenatus	Massasauga	4	100%	3	75%
Ambrosia linearis	plains ragweed	46	66%	42	138%
Aquilegia chrysantha var. rydbergii	golden columbine	6	100%	6	100%
Aquilegia saximontana	Rocky Mountain columbine	8	66%	5	95%
Asclepias uncialis ssp. uncialis	dwarf milkweed	5	100%	5	100%
Astragalus sparsiflorus	Front Range milkvetch	2	50%	2	200%
Bolophyta tetraneuris	Barneby's fever-few	23	66%	13	86%
Botrychium lineare	narrowleaf grapefern	2	100%	2	100%
Carex oreocharis	a sedge	1	100%	1	100%
Chenopodium cycloides	sandhill goosefoot	7	100%	7	100%
Commelina dianthifolia	birdbill day-flower	4	100%	4	100%
Draba crassa	thick-leaf whitlow-grass	1	100%	1	100%
Heuchera hallii	Front Range alum-root	2	50%	0	0%
Lesquerella calcicola	Rocky Mountain bladderpod	14	100%	12	86%
Nuttallia chrysantha	golden blazing star	13	100%	7	54%
Nuttallia speciosa	jeweled blazingstar	2	50%	2	200%
Oenothera harringtonii	Arkansas Valley evening primrose	10	66%	9	136%
Oonopsis sp. 1	Pueblo goldenweed	14	100%	12	86%
Oreoxis humilis	Pikes Peak spring parsley	5	100%	0	0%
Oxybaphus rotundifolius	round-leaf four-o'clock	22	100%	17	77%
Potentilla ambigens	southern Rocky Mountain cinquefoil	2	100%	2	100%
Ptilagrostis porteri	Porter feathergrass	1	100%	1	100%
Stellaria irrigua	Altai chickweed	1	100%	1	100%
Telesonix jamesii	James' telesonix	9	100%	5	56%
	Potential Conservation Areas	57	50%	31	109%

†Because of their wide-ranging nature, goals for big game species are measured in acres, not number of discrete occurrences (cells shaded in light gray).

Green = goal was met (100% or greater)

Yellow = goal was almost met (90%-99%)

Red = goal not met

Business As Usual

When NatureServe ran a Scenario Evaluation to evaluate Placeways' Business as Usual Scenario (Figure 2) against the Moderate risk goal set, 29 out of 59 (49%) of the conservation targets met the Moderate risk conservation goals (Table 10). Two additional targets, the Mountain Plover (*Charadrius montanus*) and Barneby's fever-few (*Bolophyta tetraneuris*), came within 90% of the stated goals. Those targets that are most at risk in this scenario are the simius roadside skipper (*Amblyscirtes simius*), Gunnison's prairie dog (*Cynomys gunnisoni*), Townsend's big-eared bat (*Plecotus townsendii pallescens*), Front Range milkvetch (*Astragalus sparsiflorus*), Front Range alum-root (*Heuchera hallii*), and Porter feathergrass (*Ptilagrostis porteri*). These six species did not have any of their known occurrences within areas of compatible land use. The layer representing the results from this evaluation is titled *usual_m* in the electronic deliverable.

Table 10. Results of the Business As Usual Future Scenario Evaluated Against Moderate Risk Goals.

Latin Name	Common Name	# occurrences in project area†	Goal (% of occurrences)	Occurrences in scenario†	Percent of goal met
Rana blairi	Plains Leopard Frog	2	50%	2	200%
Rana pipiens	Northern Leopard Frog	47	66%	22	71%
Aimophila cassinii	Cassin's Sparrow	80	33%	51	193%
Athene cunicularia	Burrowing Owl	61	33%	53	263%
Buteo regalis	Ferruginous Hawk	5	66%	4	121%
Calcarius mccownii	McCown's Longspur	4	100%	3	75%
Charadrius montanus	Mountain Plover	23	66%	15	99%
Falco peregrinus anatum	American Peregrine Falcon	4	100%	4	100%
Haliaeetus leucocephalus	Bald Eagle	10	100%	8	80%
Numenius americanus	Long-billed Curlew	3	100%	3	100%
Strix occidentalis lucida	Mexican Spotted Owl	3	100%	2	67%
Etheostoma cragini	Arkansas Darter	8	100%	3	38%
Oncorhynchus clarkii stomias	Greenback Cutthroat Trout	7	100%	4	57%
Phoxinus erythrogaster	Southern Redbelly Dace	1	100%	1	100%
Amblyscirtes simius	Simius Roadside Skipper	1	100%	0	0%
Callophrys mossii schryveri	Moss's Elfin	1	100%	1	100%
Celastrina humulus	Hops Feeding Azure	2	100%	2	100%
Cicindela nebraskana	A Tiger Beetle	2	100%	1	50%
Euphilotes rita coloradensis	Colorado Blue	3	100%	1	33%
Antilocapra americana	Pronghorn	1,063,224	33%	891,050	254%
Cervus elaphus	Elk	1,176,092	10%	992,875	844%
Conepatus leuconotus	Common Hog-nosed Skunk	1	100%	1	100%
Cynomys gunnisoni	Gunnison's Prairie Dog	3	33%	0	0%
Cynomys ludovicianus	Black-tailed Prairie Dog	74	66%	49	100%
Odocoileus hemionus	Mule Deer	538,223	33%	419,859	236%
Odocoileus virginianus	White-tailed Deer	170,101	10%	127,312	748%
Ovis canadensis	Big Horn Sheep	272,641	33%	123,921	138%
Plecotus townsendii pallescens	Townsend's Big-eared Bat Subsp	1	100%	0	0%
Ursus americanus	Black Bear	1,075,273	10%	610,102	567%
Vulpes velox	Swift Fox	5	66%	2	61%
Zapus hudsonius preblei	Preble's Meadow Jumping Mouse	49	100%	36	73%
Anodonta grandis	Giant Floater	1	100%	1	100%
Aspidoscelis neotesselata	Triploid Colorado Checkered Whiptail	9	66%	7	118%
Phrynosoma cornutum	Texas Horned Lizard	1	100%	1	100%

Latin Name	Common Name	# occurrences in project area†	Goal (% of occurrences)	Occurrences in scenario†	Percent of goal met
Sistrurus catenatus	Massasauga	4	100%	2	50%
Ambrosia linearis	plains ragweed	46	66%	20	66%
Aquilegia chrysantha var. rydbergii	golden columbine	6	100%	3	50%
Aquilegia saximontana	Rocky Mountain columbine	8	66%	6	114%
Asclepias uncialis ssp. uncialis	dwarf milkweed	5	100%	5	100%
Astragalus sparsiflorus	Front Range milkvetch	2	50%	0	0%
Bolophyta tetraneuris	Barneby's fever-few	23	66%	14	92%
Botrychium lineare	narrowleaf grapefern	2	100%	2	100%
Carex oreocharis	a sedge	1	100%	1	100%
Chenopodium cycloides	sandhill goosefoot	7	100%	7	100%
Commelina dianthifolia	birdbill day-flower	4	100%	3	75%
Draba crassa	thick-leaf whitlow-grass	1	100%	1	100%
Heuchera hallii	Front Range alum-root	2	50%	0	0%
Lesquerella calcicola	Rocky Mountain bladderpod	14	100%	10	71%
Nuttallia chrysantha	golden blazing star	13	100%	6	46%
Nuttallia speciosa	jeweled blazingstar	2	50%	2	200%
Oenothera harringtonii	Arkansas Valley evening primrose	10	66%	8	121%
Oonopsis sp. 1	Pueblo goldenweed	14	100%	10	71%
Oreoxis humilis	Pikes Peak spring parsley	5	100%	2	40%
Oxybaphus rotundifolius	round-leaf four-o'clock	22	100%	18	82%
Potentilla ambigens	southern Rocky Mountain cinquefoil	2	100%	1	50%
Ptilagrostis porteri	Porter feathergrass	1	100%	0	0%
Stellaria irrigua	Altai chickweed	1	100%	1	100%
Telesonix jamesii	James' telesonix	9	100%	8	89%
	Potential Conservation Areas	57	50%	21	74%

†Because of their wide-ranging nature, goals for big game species are measured in acres, not number of discrete occurrences (cells shaded in light gray).
Green = goal was met (100% or greater)
Yellow = goal was almost met (90%-99%)
Red = goal not met

Enhanced Transportation

When NatureServe ran a Scenario Evaluation to evaluate Placeways' Enhanced Transportation Scenario against the Moderate risk goal set, 28 out of 59 (47%) of the conservation targets met the Moderate risk conservation goals (Table 11). Differences between this scenario and the Business As Usual scenario are slight. The one target that did not meet goals in this scenario is the Ferruginous Hawk (*Buteo regalis*), which went from 4 occurrences (121% of goal) on compatible land uses to 3 (91%). The layer representing the results from this evaluation is titled *transp_m* in the electronic deliverable.

Table 11. Results of the Enhanced Transportation Future Scenario Evaluated Against Moderate Risk Goals.

Latin Name	Common Name	# occurrences in project area†	Goal (% of occurrences)	Occurrences in scenario†	Percent of goal met
Rana blairi	Plains Leopard Frog	2	50%	2	200%
Rana pipiens	Northern Leopard Frog	47	66%	22	71%
Aimophila cassinii	Cassin's Sparrow	80	33%	49	186%
Athene cunicularia	Burrowing Owl	61	33%	53	263%
Buteo regalis	Ferruginous Hawk	5	66%	3	91%

Latin Name	Common Name	# occurrences in project area†	Goal (% of occurrences)	Occurrences in scenario†	Percent of goal met
Calcarius mccownii	McCown's Longspur	4	100%	3	75%
Charadrius montanus	Mountain Plover	23	66%	15	99%
Falco peregrinus anatum	American Peregrine Falcon	4	100%	4	100%
Haliaeetus leucocephalus	Bald Eagle	10	100%	8	80%
Numenius americanus	Long-billed Curlew	3	100%	3	100%
Strix occidentalis lucida	Mexican Spotted Owl	3	100%	2	67%
Etheostoma cragini	Arkansas Darter	8	100%	3	38%
Oncorhynchus clarkii stomias	Greenback Cutthroat Trout	7	100%	4	57%
Phoxinus erythrogaster	Southern Redbelly Dace	1	100%	1	100%
Amblyscirtes simius	Simius Roadside Skipper	1	100%	0	0%
Callophrys mossii schryveri	Moss's Elfin	1	100%	1	100%
Celastrina humulus	Hops Feeding Azure	2	100%	2	100%
Cicindela nebraskana	A Tiger Beetle	2	100%	1	50%
Euphilotes rita coloradensis	Colorado Blue	3	100%	1	33%
Antilocapra americana	Pronghorn	1,063,224	33%	888,645	253%
Cervus elaphus	Elk	1,176,092	10%	992,235	844%
Conepatus leuconotus	Common Hog-nosed Skunk	1	100%	1	100%
Cynomys gunnisoni	Gunnison's Prairie Dog	3	33%	0	0%
Cynomys ludovicianus	Black-tailed Prairie Dog	74	66%	49	100%
Odocoileus hemionus	Mule Deer	538,223	33%	419,350	236%
Odocoileus virginianus	White-tailed Deer	170,101	10%	126,400	743%
Ovis canadensis	Big Horn Sheep	272,641	33%	123,921	138%
Plecotus townsendii pallescens	Townsend's Big-eared Bat Subsp	1	100%	0	0%
Ursus americanus	Black Bear	1,075,273	10%	608,912	566%
Vulpes velox	Swift Fox	5	66%	2	61%
Zapus hudsonius preblei	Preble's Meadow Jumping Mouse	49	100%	36	73%
Anodonta grandis	Giant Floater	1	100%	1	100%
Aspidoscelis neotesselata	Triploid Colorado Checkered Whiptail	9	66%	7	118%
Phrynosoma cornutum	Texas Horned Lizard	1	100%	1	100%
Sistrurus catenatus	Massasauga	4	100%	2	50%
Ambrosia linearis	plains ragweed	46	66%	20	66%
Aquilegia chrysantha var. rydbergii	golden columbine	6	100%	3	50%
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Asclepias uncialis ssp. uncialis	dwarf milkweed	5	100%	5	100%
Astragalus sparsiflorus	Front Range milkvetch	2	50%	0	0%
Bolophyta tetraneuris	Barneby's fever-few	23	66%	14	92%
Botrychium lineare	narrowleaf grapefern	2	100%	2	100%
Carex oreocharis	a sedge	1	100%	1	100%
Chenopodium cycloides	sandhill goosefoot	7	100%	7	100%
Commelina dianthifolia	birdbill day-flower	4	100%	3	75%
Draba crassa	thick-leaf whitlow-grass	1	100%	1	100%
Heuchera hallii	Front Range alum-root	2	50%	0	0%
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Nuttallia speciosa	jeweled blazingstar	2	50%	2	200%
Oenothera harringtonii	Arkansas Valley evening primrose	10	66%	8	121%
Oonopsis sp. 1	Pueblo goldenweed	14	100%	10	71%
Oreoxis humilis	Pikes Peak spring parsley	5	100%	2	40%
Oxybaphus rotundifolius	round-leaf four-o'clock	22	100%	18	82%
Potentilla ambigens	southern Rocky Mountain cinquefoil	2	100%	1	50%
Ptilagrostis porteri	Porter feathergrass	1	100%	0	0%
Stellaria irrigua	Altai chickweed	1	100%	1	100%
Telesonix jamesii	James' telesonix	9	100%	8	89%
	Potential Conservation Areas	57	50%	21	74%

†Because of their wide-ranging nature, goals for big game species are measured in acres, not number of discrete occurrences (cells shaded in light gray).
Green = goal was met (100% or greater)
Yellow = goal was almost met (90%-99%)
Red = goal not met

Example Conservation Mitigation

Vista's Site Explorer tool is an interactive conservation planning tool that allows users to understand the element and land use content of a site and the relative importance of the site to goal achievement for its elements. The user can point-and-click on land parcels within the project area and view a large variety of information such as the amount of each element and land use mapped within it, the response of each element to the land uses and the quantitative contribution of the site to the elements' goals. "Site" units are determined by designating the spatial layer to use on the Scenario Evaluation interface and can be any polygon layer selected by the user e.g., parcels, watersheds, etc.. After identifying the properties of conservation targets within the parcels, Site Explorer allows users to develop mitigations by changing the land use in a parcel to a use that supports the health and persistence of that target (i.e., a land use that has been designated as "compatible"). These land use changes, or mitigations, can be exported as shapefiles and incorporated into permanent scenarios. One limitation is that the new land use designation will apply to the entire site so it is important to choose site layers with this in mind and to use the scenario definition functions for "override" with other land use layers to only affect the areas desired.

To demonstrate the functionality of the Site Explorer tool in Vista, NatureServe also created an example Conservation Mitigation Scenario and evaluated it against the Moderate risk conservation goal set. This was built by using Vista's Site Explorer tool and the Business As Usual scenario (Figure 3; the bar chart in the Site Explorer interface indicates in light green and red the overall goal achievement (green) or conflict (red) for each element overall. The dark green and read areas indicate the site's specific contributions (green) or conflict (red) to meeting the element's goals. Site with large dark red bars indicate opportunities for meeting large portions of those element's goals). NatureServe staff selected parcels with high concentrations of conservation targets and changed them to various compatible land uses. These conservation parcels were exported out of Site Explorer and built into a new Conservation Mitigation Scenario. When this example scenario was evaluated, the number of conservation targets that met the Moderate risk conservation goals increased to 30.

The decision to select one land use parcel over another for a particular conservation mitigation effort requires local expert judgment. This requires detailed knowledge of the project landscape as well as an understanding of the political and economic realities of the region. Because NatureServe staff did not

have adequate familiarity with the practical and legal aspects of acquiring certain parcels for conservation in the project area, this mitigation layer should only be used as a guideline or example of the method that may be used to create future mitigations. It does not represent the "best" or "only" option for conservation mitigation within the project area.

Figure 3. Screenshot of NatureServe Vista Site Explorer.
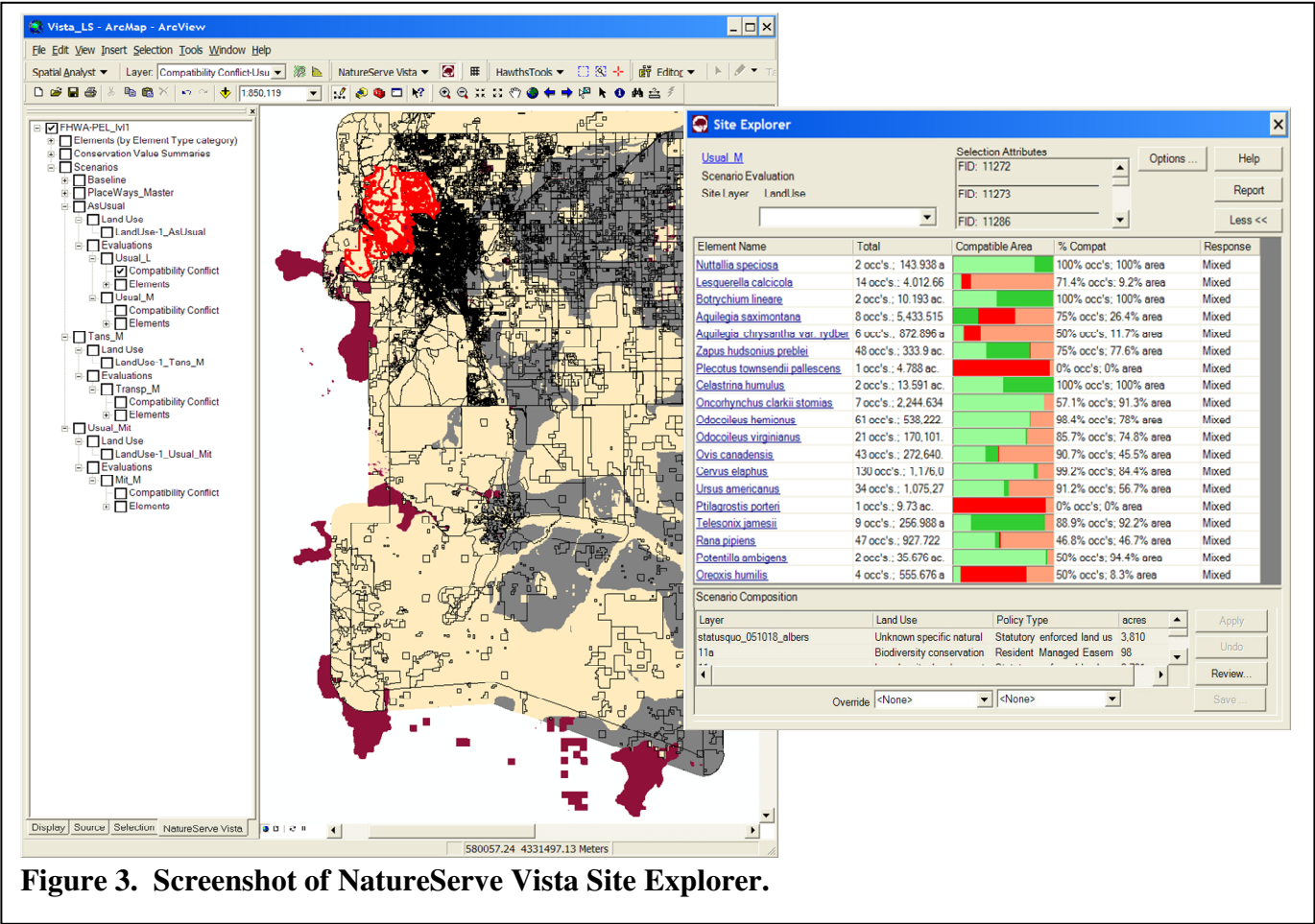
Placeways CommunityViz

Data gathering and preparation

Land Use Classification
CommunityViz used the two-tiered common land use classification system developed for the combined two-county study area as described in the "Land Use Classification" section under Vista above.

Infrastructure
The project's growth models required spatial data representing transportation networks and infrastructure in the project area. This includes roads and public transit routes. Roads data were provided by the PPACG and PACOG, but were found to be somewhat incomplete. Additional roads were added from TIGER/Line (USCB 2005). All roads data were compiled and corrected by CNHP in order to create a single roads layer with associated metadata.

The transportation growth model included the installation of a bus rapid transportation system in the cities of Colorado Springs and Pueblo as well as a commuter rail that ran through both cities along existing rail lines. Route and station layers for each transportation system were created; a bus rapid transit system for the cities of Colorado Springs and Pueblo and a commuter rail system running north south through the region. The route corridors for Colorado Springs' four bus rapid transit lines were obtained from the Colorado Springs Rapid Transit Feasibility Study and System Master Plan (Parsons Transportation Group et al. 2004) and enhanced with input from the transportation staff at PPACG. The four corridors (Table 12) were selected on the basis of overall feasibility, ridership, environmental impact, and cost.

Table 12. Potential Rapid Transit Corridors Incorporated into the Transportation Growth Model.

Corridor	Location
Corridor A	Woodmen to Academy/Fort Carson
Corridor B	Garden of the Gods/30th Street to Woodmen Road
Corridor C	Briargate Boulevard to Drennan
Corridor D	Downtown to Academy

The bus rapid transit route corridors for the City of Pueblo were generated by the staff at PACOG. The route corridors were chosen by attempting to connect population centers to employment centers in the city of Pueblo. The station stops for the high-speed commuter rail route were located along the Burlington Northern Santa Fe track. The high-speed commuter rail route is part of a potential project that would connect Casper, Wyoming to Albuquerque, New Mexico through Colorado Springs and Pueblo along the I-25 corridor. Station stops for the commuter rail were selected by staff at PACOG based on current intersections of transportation networks, downtowns, and population centers. Shapefiles for routes and stations were created for each transportation system.

GIS Layer Inputs:
- Compiled Roads
- Bus Rapid Transit Route – Colorado Springs
- Bus Rapid Transit Stations – Colorado Springs
- Bus Rapid Transit Route – Pueblo
- Bus Rapid Transit Stations – Pueblo
- Commuter Rail Route – El Paso and Pueblo Counties
- Commuter Rail Stations – El Paso and Pueblo Counties

Socioeconomic

Population and employment data were provided by each county. PPACG provided the Small Area Forecast (SAF) for El Paso County. The forecast projected population and employment numbers in five year intervals by Transportation Analysis Zone (TAZ) through 2030. The accompanying shapefile for the data was not spatially referenced and thus required editing. It was important to use this shapefile as the number of TAZs in this layer directly corresponded to the number of TAZs in the SAF while TAZ shapefiles available through the Census Bureau website and other online locations did not have the same corresponding number of TAZs. PACOG provided two shapefiles with employment and population forecasts for forty Census zones in Pueblo County through 2035. A Census zone is similar to a Census tract except that one Census zone could be a combination of a couple Census tracts in areas where population is small.

GIS Layer Inputs:
- Population Forecast 2005-2035 (Pueblo County)
- Employment Forecast 2005-2035 (Pueblo County)
- Adopted Forecast Excel file
- TAZ shapefiles: 2005, 2010, 2015, 2020, 2025, 2030

Natural Features

The CommunityViz analyses included the following natural features: protected land, steep slopes, and the proposed Fort Carson conservation buffer. COMaP (Wilcox et al. 2006) data were used to represent protected lands in the study area. Additionally, Pueblo and El Paso counties elected not to include land that had a slope of ten percent or greater in the analysis. To accomplish this, a slope layer of land with a 10 percent or greater slope was created and incorporated as a mask into the analysis. The result was that each polygon was attributed so that land with a 10 percent or greater slope was not included in the land suitable for development. Finally, the Fort Carson military base is attempting to deter development within a two mile radius of the base. A two-mile buffer layer was created for the analysis.

GIS Layer Inputs:
- COMaP v. 6
- Slope
- Fort Carson Conservation Buffer

Local Knowledge

Once the growth models were set up, it was important to collect local knowledge that might not be reflected in other input data. Placeways met with staff from both PPACG and PACOG to discuss and gather relevant knowledge that could be utilized in the analyses. Local knowledge included natural, social, and political determinants of development, mixed use zoning densities, enhanced transit routes and station locations, and overall development potential. The information was applied to each relevant growth model. For example, mixed use zoning densities specific to station stops and along bus rapid transit corridors were applied to the transportation scenario only.

Building the CommunityViz project

Overview of CommunityViz

CommunityViz is a GIS extension to ESRI's ArcGIS software that enables stakeholders, government agencies, and community members to better communicate and understand the outcomes of a proposed project or future growth and development in their area. It is produced by the Orton Family Foundation in partnership with Placeways, LLC. For the FHWA PEL project, CommunityViz produced custom impact measurements and a visual representation of each future scenario to provide a method of comparison between scenarios.

Indicators and Development Impacts

Indicators are impact or performance measures that can reference datasets anywhere in a scenario. They are used to provide an overall measurement and they apply to an entire scenario. Indicators can help determine which scenarios best match the desired outcomes or objective for a study area. In addition, they provide a method for comparing one scenario to another. An indicator might be used to evaluate costs, revenues, average household size, "community benefit", or total daily auto trips. For this study, indicators were used to compare the differences between each scenario (Table 13). Each indicator is calculated based on a default value which is then adjusted to the user's desire. For more information on the default values, see the citation and source for each Indicator in the CommunityViz software program.

Table 13. List of Indicators and Development Impacts Used in CommunityViz

Indicator
Capacity
Remaining Capacity
Acres in Conservation
BRT Transit Miles
Annual CO Auto Emissions
Annual CO_2 Auto Emissions
Annual Hydrocarbon Auto Emissions
Annual NO_x Auto Emissions
Labor Force Population
Population
Residential Dwelling Units
Residential Energy Use
Residential Water Use
School Children
Vehicle Trips per Day
New Acres Consumed by Development

Reconciliation of Transportation Analysis Zones, Census Zones, and Land Use Data

NatureServe Vista required different geographic demarcation units for analysis and results than did PPACG and PACOG. For layers created for use by Vista, each polygon was attributed by land use type. However, PPACG and PACOG desired to show the results on the basis of TAZs and Census Zones, respectively. To satisfy all data requirements, the TAZ, Census Zone, and land use layers were combined into one "analysis" layer using the ArcToolBox Union tool where the resulting polygons were attributed by TAZ or Census Zone number as well as by land use type.

Impact analyses using CommunityViz

Overview of Methodology

The impact analyses require three main inputs: a desirability map, land suitable for development, and the projected population increase from 2005 to 2035. First a desirability map was created to calculate each polygon's attractiveness to growth and development given no natural, zoning, or capacity constraints. This map gives a desirability score to each polygon based on a number of inputs. The inputs are factors that influence growth and can be weighted in relation to one another. The inputs for the desirability map are listed in Table 14 below. Each input was either an attractor or detractor to growth and was then weighted according to its believed impact on growth.

Table 14. Growth Influence Factors Used in CommunityViz.

| | | Weight | | |
| | | Base Model | Transportation | Conservation |
Input	Influence			
Downtown Centers	Attractor	8	8	8
McCulloch Ranch	Attractor	7	7	7
Road Density (measured in miles of road within a polygon)	Attractor	7	7	7
Fort Carson Conservation Buffer	Detractor	3	3	3
Employment Centers	Attractor	7	7	7
Open Space	Attractor	3	3	3
Existing Households	Attractor	7	7	7
Transportation Stops	Attractor	0	6	0
Transportation Corridors (0 4 0)	Attractor	0	4	0

Next, the buildable land in the counties was determined by eliminating water, protected lands, military installations, and roads from the area in which populations could be placed. This input acts as a mask, preventing growth from occurring in these areas. The zoned capacity of the remaining land area was then calculated based on the acreage and allowed dwelling units per acre. To calculate the remaining capacity of each land use polygon, the existing population was divided by the average household size for each county and then subtracted from the zoned capacity.

The final step was to allocate the expected population increase to the land use polygons based on the desirability map. The population is allocated so that the most desirable places fill up first and so that population cannot exceed the zoned capacity.

Base Model

The analysis evaluated three different growth and development models: Business As Usual, Enhanced Transportation, and Conservation. The Business as Usual model is the default, or base model, which assumes that the Colorado Springs region continues to develop in the same pattern, density, and speed that it currently demonstrates. The Enhanced Transportation and Conservation model were created by making alterations to this base model. For the Enhanced Transportation model, bus rapid transit and commuter rail routes and stations were added to the analysis. The zoned density around these areas was increased to allow for more population to be placed near public transportation. For the Conservation model, the land determined by CNHP to be areas of high conservation value were rezoned to "Conservation," thus preventing development in these areas during the allocation process.

Desirability Maps

A separate desirability map was created for each model. While the Business As Usual and Conservation desirability maps were based on the same inputs, the enhanced transportation scenario added attraction inputs for the Bus Rapid Transit stations and corridors as well as the commuter rail stations.

Population Allocation

The CommunityViz Allocator Wizard is a decision tool that performs the common planning function of allocating demand for buildings across the available supply of potential building locations. Buildings are placed according to the desirability and remaining capacity of each land use area. The allocation can be run using strict ordering, in which the most desirable areas are always filled up first, or probability-based ordering, in which the probability that a location is used is based on its relative desirability. This analysis used a probability-based ordering.

Results

Model Evaluations

The Business As Usual model produced a growth pattern that resembled an extension to the growth pattern that currently exists in the region. The resulting scenario (Figure 4) predicts that development will continue to grow outward from the cities of Colorado Springs and Pueblo. The Enhanced Transportation model demonstrated a growth pattern that was more compact in comparison to Business As Usual. Densification appears most notably around the nodes and corridors of the bus rapid transit systems (Figure 5). The Conservation model produced a similar scenario as the Business As Usual model, with the growth pattern appearing like an extension to the current growth pattern (Figure 6).

Colorado Springs

Pueblo

**Population Increase:
Weighted by Area**

Low

High
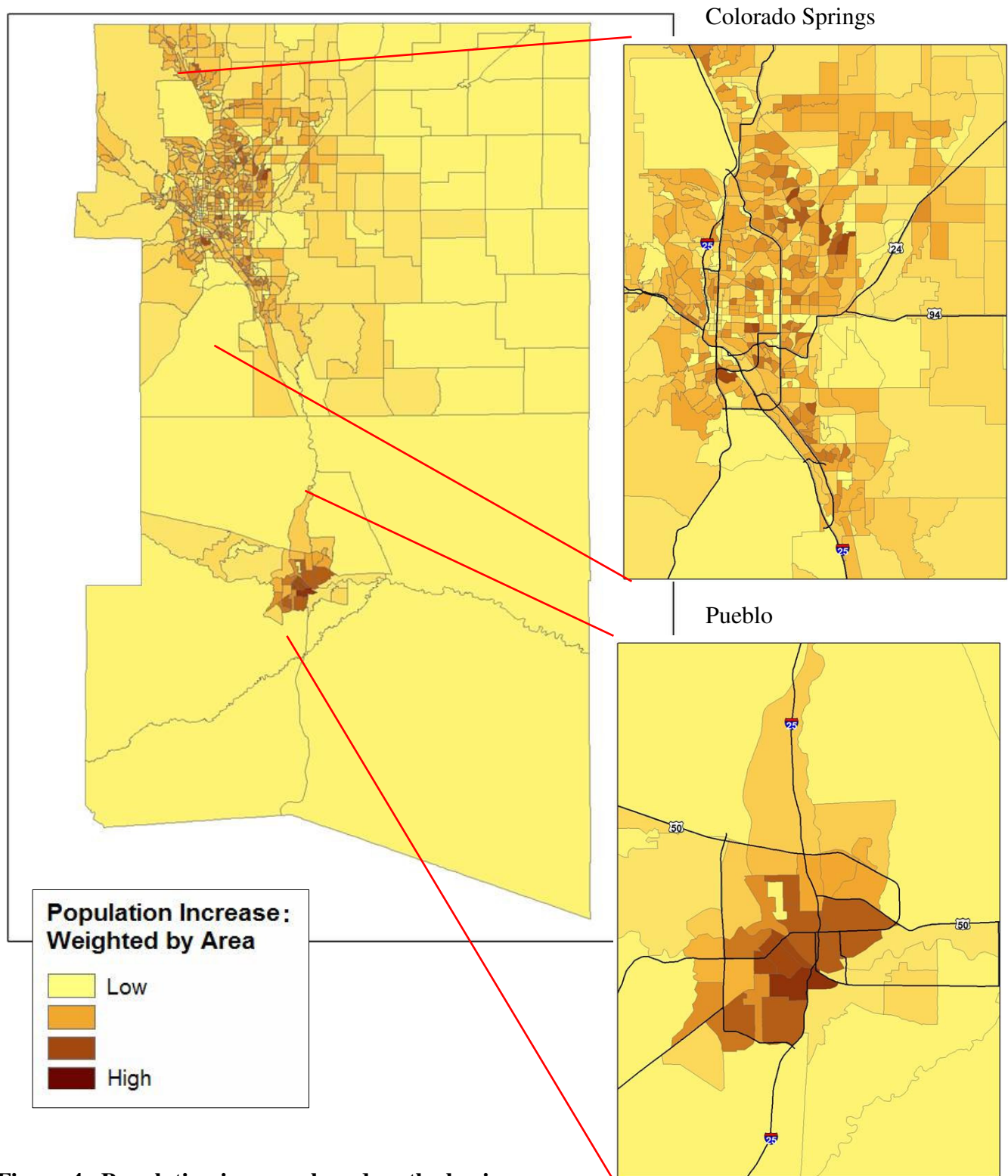
**Figure 4. Population increase based on the business as
usual population allocation.**

Colorado Springs

Pueblo

Population Increase: Weighted by Area

Low

High
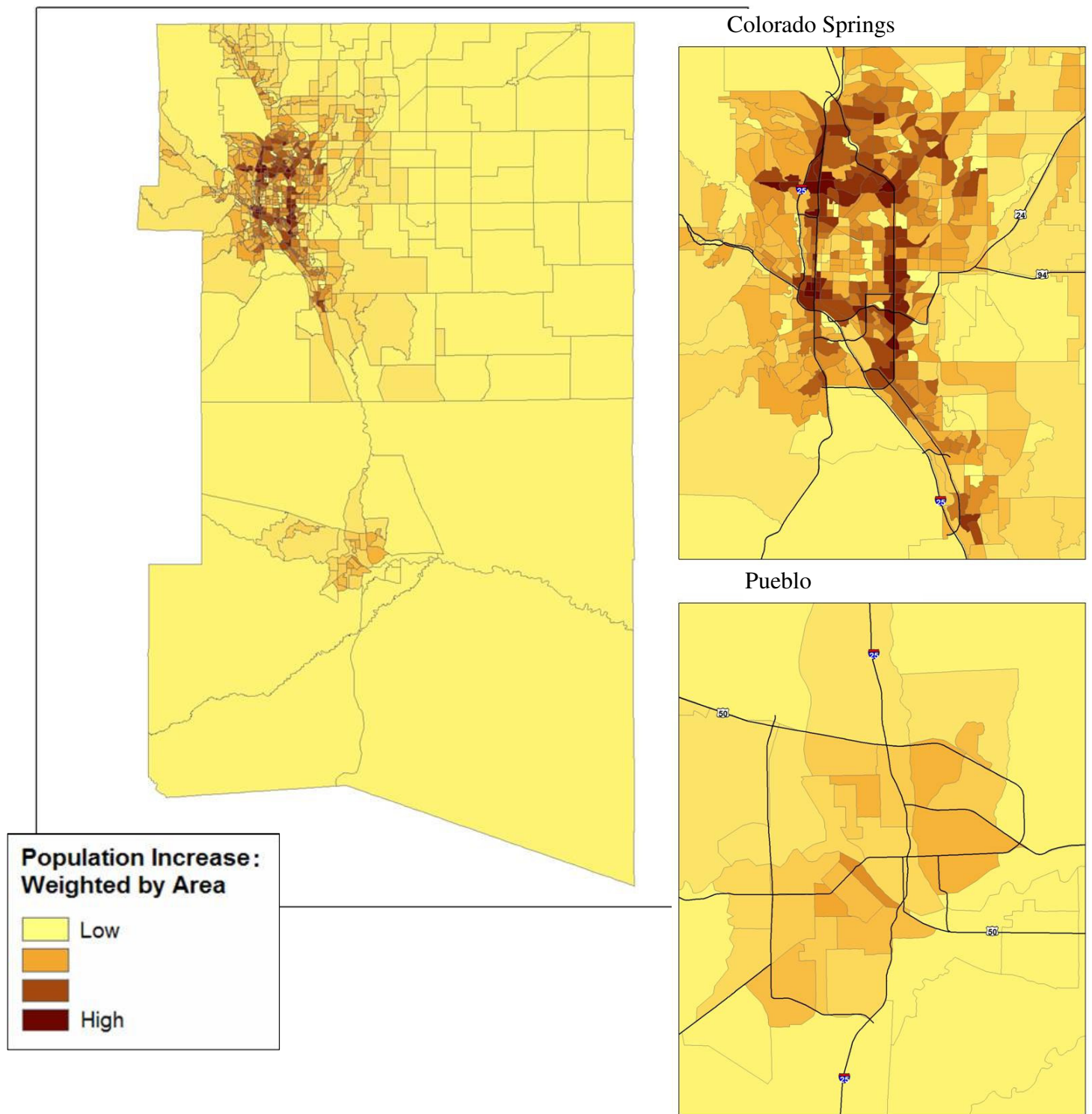
Figure 5. Population increase based on the transportation population allocation.

Colorado Springs

Pueblo

**Population Increase:
Weighted by Area**

Low

High
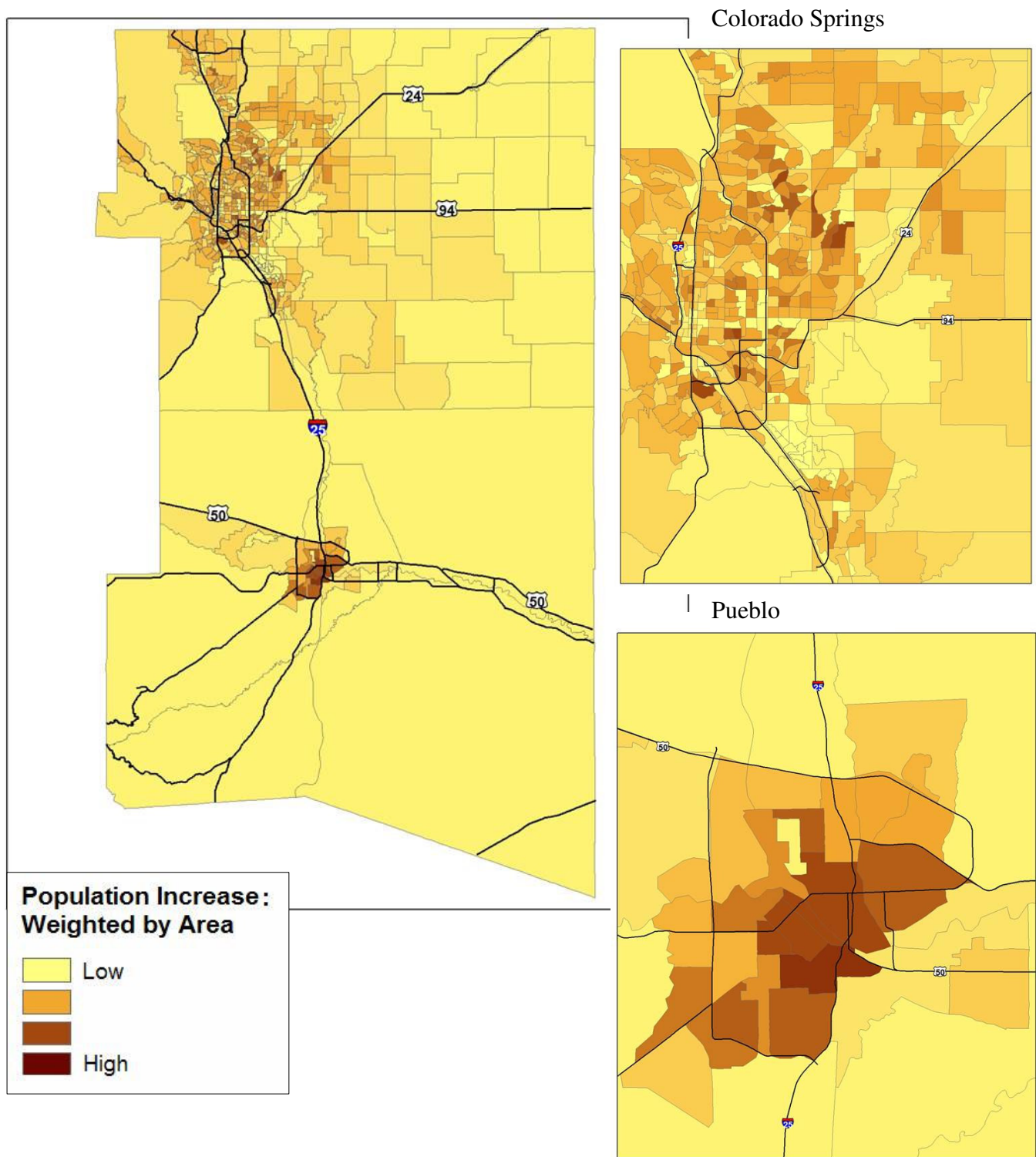
Figure 6. Population increase based on the conservation population allocation.

Discussion

This project demonstrates the iterative use of NatureServe Vista and CommunityViz. Areas of greatest conservation value and regulatory concern were initially identified in Vista. These areas were refined by ecologists and then entered into CommunityViz growth models as areas where new or continued growth is undesirable. The growth models produced future scenarios which were then passed back into Vista for evaluation against conservation goals. And, while the Mitigation Scenario produced by NatureServe was just an example, it demonstrates how Vista can take scenarios generated by CommunityViz growth models and manually change the land use designations of individual parcels to refine planning objectives to best meet conservation goals.

The analyses in CommunityViz showed two key factors in the growth and development pattern of the study area. First, it showed that a bus rapid transit system does have the potential to concentrate growth around city centers. It also showed that a conservation plan could be applied in conjunction with a transportation plan. In the Conservation scenario, development was shown to leap frog land that was removed from development for conservation purposes thus producing little change from the Business As Usual scenario. A combined transportation and conservation plan would have the potential to focus development around city centers while relieving development pressure on land that is necessary to meet conservation goals. Site Explorer is an ideal tool for making these scenario adjustments. Combining local knowledge with the predictions of goal achievement for target species can yield results that are informed by ecologic and economic models, as well as an *in situ* understanding of realistic pressures and opportunities across the project area.

The Vista analyses highlight species that are threatened, either by existing or potentially planned development. In doing so, it not only highlights threats to listed species, but also brings attention to the potential threats to non-listed species, i.e., those that are not yet federally listed under the Endangered Species Act, that might otherwise be overlooked in the planning process. This sort of information can help planners be pro-active in their development plans and reassure regulatory entities that conservation values are being taken seriously and incorporated upfront. Clearly, the Business As Usual and Transportation Growth scenarios created undesirable impacts on conservation targets as compared to the Baseline scenario. These changes are in essence opportunities for conservation action. By focusing on species most heavily impacted by the growth projections, substantial gains can be made for conservation targets.

Of particular concern in this case is the Townsend's big-eared bat, which is a candidate species for state listing and is considered imperiled in the state of Colorado (S2), and the Porter feathergrass, which occurs only in Colorado and is also considered imperiled. Neither of these species is currently threatened within Pueblo and El Paso counties (as modeled by the Baseline Scenario), but both become highly threatened in all of the future scenarios considered. Several other species and the Potential Conservation Areas follow this same pattern, which is also a concern, but the Townsend's big-eared bat and Porter feathergrass are the most vulnerable of these targets in the state.

Another point to note is that conservation goals were not met for a full third of the targets in the Baseline Scenario, which represents existing conditions. This indicates that there may already be serious concerns about the long-term viability of a number of rare and imperiled species in Pueblo and El Paso counties, and that continued urban development can be expected worsen to the situation, unless pro-active and carefully considered steps are taken now.

Recommendations

The authors of this report would like to emphasize that all results given here and in the accompanying electronic data are preliminary and based entirely on available spatial data, which may not accurately reflect conditions on the ground. Consultation with appropriate state and federal regulatory agencies is still required, and planners are urged to have on-the-ground biological and reconnaissance surveys, conducted, and to solicit public comment before finalizing any plans. More detailed or up-to-date data may significantly change the results of these initial growth models and scenario evaluations.

This project's greatest value can only be realized by using the databases, methods and expert knowledge hand in hand. The general trends identified in this project are predictable: a loss of conservation targets due to increased growth. However, the spatial analyses in this project provide probable causes and locations for the loss of specific target species. With this precious information planners can identify 'problem spots' and focus attention to those areas containing the species of greatest concern. As land use changes are made, planners can then reevaluate the status of conservation targets, getting quantitative feedback about the impact of their decisions. The first and most productive initial step may be simply to identify those locations where species are incompatible with the land use, and local knowledge suggests that there is an opportunity to modify that land use.

Specific recommended actions

- Update current land cover to distinguish important differences in agricultural land cover types in particular.
- Identify a set of species for which to develop predictive habitat distribution maps. These maps could significantly improve the results by identifying likely occupied habitat not currently mapped and therefore not considered in the analyses.
- Conduct conservation optimization analyses that can attempt to meet conservation goals while avoiding high value areas for other land use types.
  - NatureServe Vista interoperates with two similar conservation optimization tools—Marxan and SPOT which can be used to more efficiently select a set of sites to meet conservation goals at least cost or conflict with other land use objectives. Once a result is generated by either of those tools, it can be imported back into Vista and used to guide alternative scenario development.
- Review the optimization results in NatureServe Vista's Site Explorer with PPACG and PACOG planners to assign appropriate compatible land use and implementation mechanisms using local expertise (possibly do this for a subregion pilot area to reduce the project complexity and scope).

Citations

Colorado Division of Wildlife (CDOW). 2006. Colorado Species Distributions. Colorado Division of Wildlife, Fort Collins, CO. 10/30/2006. http://ndis.nrel.colostate.edu/ftp/index.html

Colorado Natural Heritage Program (CNHP). 2007a. Site methodology manual for Potential Conservation Areas, Networks of Conservation Areas, Sites of Local Significance. Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO. Revised October, 2007.

Colorado Natural Heritage Program (CNHP). 2007b. Biodiversity Tracking and Conservation System (BIOTICS). Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.

NatureServe. 2002. Element Occurrence Data Standard. NatureServe, in cooperation with the network of Natural Heritage Programs and Conservation Data Centers.

NatureServe. 2006. NatureServe Vista On-line Help Documentation, version 2006-02-28. http://support.natureserve.org/Vista/.

Parsons Transportation Group, PRACO Ltd., Michael Baker Jr., Inc., Manuel Padron and Associates, and Felsburg Holt and Ullevig. 2004. City of Colorado Springs Rapid Transit Feasibility Study and System Master Plan: Final Report. Parsons Transportation Group, Denver, CO. http://www.springsgov.com/units/transit/finalreport.pdf.

URS Corporation. 2006. Fountain Creek Watershed study. Final report for the U.S. Army Corps of Engineers. March 2006.

U.S. Census Bureau (USCB). 2005. U.S. Census Bureau TIGER/Line files, 2005 first edition. More information available online at: http://www.census.gov/geo/www/tiger/.

Wilcox, G., D. M. Theobald, and J. Whisman. 2007. Colorado Ownership, Management, and Protection V6. http://www.nrel.colostate.edu/projects/comap/contact.html

Appendices

Appendix A. Land Use Classification Scheme.

Major Category:	Government		General Urbanization					
Minor Category:	Large Military Installations	Other Government	Commercial	Industrial	Mixed Use	Office	Community/ Public Buildings	Infrastructure/ General Urbanization
El Paso County land use categories	Fort Carson	Airport/ Military Installation	General Commercial	General Industrial		Office High	Hospital	Parking lot/ black top
	Pueblo Ordnance Depot	Detention Center	Highway Oriented Commercial	Mining		Office Low	Library	Parking structure
	Air Force Academy	Fire Station	Neighborhood Commercial			Office Medium	Major Public Assembly	Undefined street ROW
		Police	Warehouse/ Wholesale			Office-Industrial Park/ R&D	Minor Public Assembly	Arterial Street ROW
		Utility Easement/ ROW/Facility	Commercial Services			Unspecified Office	Museum	Other Public Street ROW
			Community Commercial				Primary/ Secondary School	Undefined Street ROW
							Sports Complex	Basic
							Undefined Public Use	Cemetery
							University/ Conference Center	Unspecified Density
Pueblo County land use categories				Employment Center - Industry	Institutional Mixed Use	Employment Center - Office Park		
				Employment Center - Light Industry Mixed	Special Development Area			
					Arterial Commercial Mixed Use			

Appendix A. (continued)

Major Category:	Residential						
Minor Category:	**High Density Urban (8.0-25+ DU/acre)**	**Medium Density Urban (3.5-7.99 DU/acre)**	**Low Density Urban (2.0-3.49 DU/acre)**	**Suburban to Exurban (0-1.99 DU/acre)**	**Exurban to Rural (2DU/35 acre or less and no water service)**	**Residential Mixed Use (specified DU/acre and FAR)**	**Undeveloped Private**
El Paso County land use categories	8.0-11.99	3.5-7.99	2.0-3.29	0-1.99			Undefined Institutional Use
	12.0-24.99	Condo/ Townhome		N/A			Vacant Developable
	25+						Vacant Land
Pueblo County land use categories	High Density Residential	Urban Residential		Country Residential	Rural/Ranch	Urban Mixed Use	McCulloch Ranch*
				Country Village			
				Suburban Residential			

* This area of land is currently undeveloped, but is slated for residential development in the near future.

Appendix A. (continued)

Major Category:	Parks, Recreation, Greenbelt		Agriculture
Minor Category:	**Park/ Greenbelt**	**Protected Open Space**	**Agriculture**
El Paso County land use categories	Common Residential Area	Open Space	Agriculture†
	Community Park	Regional Park	
	Drainage Easement	SLB	
	Golf Course	Total Unusable Land	
	Neighborhood Park	Unspecified ROW/Easement	
	Trail	Exempt & Undefinable	
	Undefined Park	NF	
Pueblo County land use categories		Large Parks, Open Space, River Corridors	Production Agriculture

† Lands in agricultural production in El Paso county are not distinguished from rangeland or fallow fields.

Appendix B. Conservation Target – Land Use Compatibility Matrix

Common Name	Government — Large Military Installations	Government — Other Government Facilities	General Urbanization (all categories)	Residential — High Density Urban (8.0-25+ DU/acre)	Residential — Medium Density Urban (3.5-7.99 DU/acre)	Residential — Low Density Urban (2.0-3.49 DU/acre)	Residential — Suburban to Exurban (0-1.99 DU/acre)	Residential — Exurban to Rural (2DU/35 acre or less and no water service)	Residential — Residential Mixed Use (specified DU/acre and FAR)	Parks, Recreation, Greenbelt — Park/Greenbelt	Parks, Recreation, Greenbelt — Protected Open Space	Agriculture	Undeveloped Private	Unknown or Road
Plains Leopard Frog	C						C	C		C	C	C	C	
Northern Leopard Frog	C						C	C		C	C	C	C	
Cassin's Sparrow	C							C			C	C	C	
Burrowing Owl	C	C	C			C	C	C	C	C	C	C	C	
Ferruginous Hawk	C							C			C	C	C	
McCown's Longspur	C							C			C	C	C	
Mountain Plover	C							C			C	C	C	
American Peregrine Falcon	C	C	C	C			C	C		C	C	C	C	
Bald Eagle	C							C			C	C	C	
Long-billed Curlew	C							C			C	C	C	
Mexican Spotted Owl											C		C	
Arkansas Darter	C							C		C	C	C	C	
Greenback Cutthroat Trout	C							C			C		C	
Southern Redbelly Dace	C						C	C		C	C	C	C	
Simius Roadside Skipper	C							C			C	C	C	
Moss's Elfin	C							C			C	C	C	
Hops Feeding Azure	C							C			C	C	C	
A Tiger Beetle	C							C			C	C	C	
Colorado Blue								C			C	C	C	
Common Hog-nosed Skunk	C						C	C			C	C	C	
Gunnison's Prairie Dog	C						C	C			C	C	C	
Black-tailed Prairie Dog	C						C	C			C	C	C	
Townsend's Big-eared Bat Subsp	C							C			C	C	C	
Swift Fox	C							C			C	C	C	
Preble's Meadow Jumping Mouse	C							C			C	C	C	
Big Horn Sheep	C										C		C	
Black Bear	C										C	C	C	
Elk	C						C	C		C	C	C	C	
Mule Deer	C					C	C	C		C	C	C	C	
Pronghorn	C							C			C	C	C	
White-tailed Deer	C							C			C	C	C	
Giant Floater	C	C			C	C	C	C	C	C	C	C	C	
Triploid Colorado Checkered Whiptail	C						C	C			C	C	C	
Texas Horned Lizard	C							C			C	C	C	
Massasauga	C							C			C	C	C	

Common Name	Government		General Urbanization (all categories)	Residential						Parks, Recreation, Greenbelt				
	Large Military Installations	Other Government Facilities		High Density Urban (8.0-25+ DU/acre)	Medium Density Urban (3.5-7.99 DU/acre)	Low Density Urban (2.0-3.49 DU/acre)	Suburban to Exurban (0-1.99 DU/acre)	Exurban to Rural (2DU/35 acre or less and no water service)	Residential Mixed Use (specified DU/acre and FAR)	Park/ Greenbelt	Protected Open Space	Agriculture	Undeveloped Private	Unknown or Road
plains ragweed	C							C			C	C	C	
golden columbine	C							C			C	C	C	
Rocky Mountain columbine	C										C	C	C	
dwarf milkweed	C							C			C	C	C	
Front Range milkvetch	C							C			C	C	C	
Barneby's fever-few	C							C			C	C	C	
narrowleaf grapefern	C							C			C	C	C	
a sedge	C										C	C	C	
sandhill goosefoot	C							C			C	C	C	
birdbill day-flower								C			C	C	C	
thick-leaf whitlow-grass								C			C	C	C	
Front Range alum-root								C			C	C	C	
Rocky Mountain bladderpod								C			C	C	C	
golden blazing star	C							C			C	C	C	
jeweled blazingstar								C			C	C	C	
Arkansas Valley evening primrose								C			C	C	C	
Pueblo goldenweed							C	C			C	C	C	
Pikes Peak spring parsley								C			C	C	C	
round-leaf four-o'clock								C			C	C	C	
southern Rocky Mountain cinquefoil								C			C	C	C	
Porter feathergrass								C			C	C	C	
Altai chickweed								C			C	C	C	
James' telesonix								C			C	C	C	
Potential Conservation Areas	C							C			C	C	C	

Appendix C. List of Electronic Deliverables

All spatial data are in the coordinate system UTM, Zone 13, NAD83. Metadata is included with the spatial files in both .xml and .html format. Data received from PPACG and PACOG did not have metadata, and so none is included for those datasets. Many spatial layers have accompanying legend (.lyr) files that represent appropriate symbolization for that data.

ArcGIS Project with Vista Level 1 analysis scenarios

\L1_analysis_results\Level1_Results.mxd (created in ArcMap 9.2)

> This project contains the following data:

- Project_area (\Background GIS data\project_area.shp) – El Paso and Pueblo counties, buffered by 5 km.
- Project_area_roads (\Background GIS data\project_area_roads.shp) – combined roads layer for entire project area.
- Pueblo_ElPaso_hydroline (\Background GIS data\Pueblo_ElPaso_hydroline.shp) – USGS National Hydrography Dataset high resolution polyline hydrology.
- Pueblo_ElPaso_hydropoly (\Background GIS data\Pueblo_ElPaso_hydropoly.shp) – USGS National Hydrography Dataset high resolution polygon hydrology.
- Baseline – Moderate Risk Goals (\L1_analysis_results\Scenario Eval Layers\Base_Evals\Baseline_M\base_m) – Baseline Scenario Evaluation against Moderate Risk Goal Set.
- Business As Usual – Moderate Risk Goals (\L1_analysis_results\Scenario Eval Layers\As_Usual_Evals\Usual_M\usual_m) – Business As Usual Scenario Evaluation against Moderate Risk Goal Set.
- Transportation – Moderate Risk Goals (\L1_analysis_results\Scenario Eval Layers\Trans_Evals\Transp_M\transp_m) – Transportation Scenario Evaluation against Moderate Risk Goal Set.
- Conservation mitigation - one possibility, many exist (\L1_analysis_results\Scenario Eval Layers\Usual_Mit_Eval\Mit_M\example_m) – Example Mitigation Scenario Evaluation against Moderate Risk Goal Set.
- CNHP_HighValue (\L1_analysis_results\CNHP_HighValue.shp) – Areas of high conservation value around El Paso and Pueblo Counties, CO.
- Legal_concern (\L1_analysis_results\legal_concern.shp) – Important areas for the conservation of legally protected and managed species around El Paso and Pueblo Counties, CO.

Vista project with Level 2 data

\Vista_FHWAPELVistaLvl2\FHWA-PEL_Vista_lvl2.mxd, …\FHWAPELVistaLvl2.mdb, and …\FHWAPELVistaLvl2Inventory.mdb (created in ArcMap 9.2, NatureServe Vista 2.0)

NOTE – Level 2 data is for INTERNAL USE ONLY. Do not distribute or display this data to others. Use the provided Level 3 data for display.

Land use and future scenario layers loaded into project:
- Pueblo Land Use (\Vista_FHWAPELVistaLvl2\Scenario_input\Baseline layers\Future_Land_Use_Corrected_MR.shp) – Land use data supplied by PACOG.
- Additional_Protected_Lands (\Vista_FHWAPELVistaLvl2\Scenario_input\Baseline layers\Additional_Protected_Lands.shp) Additional protected lands not included in the main county land use datasets provided by PPACG and PACOG.
- El Paso Land Use (\Vista_FHWAPELVistaLvl2\Scenario_input\Baseline layers\Landuse2005_utm_Dissolve_rasters) – 16 rasters representing each category of land use supplied by PPACG. Original shapefile was landuse2005.shp, but data had to be separated, dissolved, and rasterized before Vista would accept it.
- Business As Usual (\Vista_FHWAPELVistaLvl2\Scenario_input\BusinessUsual.shp) – The Business As Usual future land use scenario as created in CommunityViz growth model.
- Transportation (\Vista_FHWAPELVistaLvl2\Scenario_input\Transportation.shp) – The Transportation future land use scenario as created in CommunityViz growth model.

Conservation targets loaded into project:

Input shapefiles (in folder \L2_data\)	Output Conservation Value grids (in folder \Vista_FHWAPELVistaLvl2\GIS_Datasets \Elements\ConservationValue)
L2_Aimophila_cassinii.shp	aimophil
L2_Amblyscirtes_simius.shp	amblysci
L2_Ambrosia_linearis.shp	ambrosia
L2_Anodonta_grandis.shp	anodonta
L2_Aquilegia_chrysantha.shp	aquileg1
L2_Aquilegia_saximontana.shp	aquilegi
L2_Asclepias_uncialis.shp	asclepia
L2_Aspidoscelis_neotesselata.shp	aspidosc
L2_Astragalus_sparsiflorus.shp	astragal
L2_Athene_cunicularia.shp	athene_c
L2_bighorn_sheep.shp	ovis_can
L2_black_bear.shp	ursus_am
L2_Bolophyta_tetraneuris.shp	bolophyt
L2_Botrychium_lineare.shp	botrychi
L2_buteo_regalis.shp	buteo_re
L2_Calcarius_mccownii.shp	calcariu
L2_Callophrys_mossii.shp	callophr
L2_Carex_oreocharis.shp	carex_or
L2_Celastrina_humulus.shp	celastri
L2_Charadrius_montanus.shp	charadri
L2_Chenopodium_cycloides.shp	chenopod
L2_Cicindela_nebraskana.shp	cicindel
L2_Commelina_dianthifolia.shp	commelin
L2_Conepatus_leuconotus.shp	conepatu
L2_Cynomys_gunnisoni.shp	cynomys_
L2_Cynomys_ludovicianus.shp	cynomys1
L2_Draba_crassa.shp	draba_cr
L2_elk.shp	cervus_e
L2_etheostoma_cragini.shp	etheosto
L2_Euphilotes_rita.shp	euphilot
L2_Falco_peregrinus.shp	falco_pe
L2_haliaeetus_leucocephalus.shp	haliaeet
L2_Heuchera_hallii.shp	heuchera
L2_Lesquerella_calcicola.shp	lesquere
L2_Muledeer.shp	odocoil1
L2_Numenius_americanus.shp	numenius
L2_Nuttallia_chrysantha.shp	nuttall1
L2_Nuttallia_speciosa.shp	nuttalli
L2_Oenothera_harringtonii.shp	oenother
L2_Oncorhynchus_clarkii.shp	oncorhyn
L2_Oonopsis_sp1.shp	oonopsis
L2_Oreoxis_humilis.shp	oreoxis_
L2_Oxybaphus_rotundifolius.shp	oxybaphu
L2_PCAs.shp	pca
L2_Phoxinus_erythrogaster.shp	phoxinus
L2_Phrynosoma_cornutum.shp	phrynoso
L2_Plecotus_townsendii.shp	Plecotus
L2_Potentilla_ambigens.shp	potentil
L2_Pronghorn.shp	antiloca
L2_Ptilagrostis_porteri.shp	ptilagro
L2_Rana_blairi.shp	rana_bla
L2_Rana_pipiens.shp	rana_pip

L2_Sistrurus_catenatus.shp	sistruru
L2_Stellaria_irrigua.shp	stellari
L2_Strix_occidentalis.shp	strix_oc
l2_telesonix_jamesii.shp	telesoni
L2_Vulpes_velox.shp	vulpes_v
L2_white-tailed_deer.shp	odocoile
L2_Zapus_hudsonius.shp	zapus_hu

Note that Level 3 data is also supplied. This data is for external display. The Level 3 shapefiles have the same names, but with a prefix of "L3" instead of "L2".

CommunityViz analysis folder and geodatabase
Placeways will supply the CommunityViz analysis folder which will include the data used in the analysis as well as the file geodatabase. The file geodatabase will include the analysis results consisting of three scenarios.

Appendix D. Data License and Use Agreement

DATA LICENSE AND USE AGREEMENT
BETWEEN
Colorado State University – Colorado Natural Heritage Program
& Placeways, LLC
AND
Pikes Peak Area Council of Governments
& Pueblo Area Council of Governments

A. COLORADO NATURAL HERITAGE PROGRAM DATA
The Board of Governors of the Colorado State University System, acting by and through Colorado State University for the use and benefit of the Colorado Natural Heritage Program (CNHP) agrees to provide Data to Pikes Peak Area Council of Governments (PPACG) and Pueblo Area Council of Governments (PACOG), jointly referred to as LICENSEES, for the geographic area encompassed by El Paso and Pueblo Counties, for the stated purposes of conservation and transportation planning, and subject to the terms and conditions set forth herein.

CNHP agrees to provide LICENSEES with the following Data for El Paso and Pueblo Counties: 1) Level 2 Data for **internal use only**; and 2) Level 3 Data for **external use** and/or display.

1. DEFINITIONS:

Element Occurrence (EO). An Element Occurrence represents a location in which an element is, or was, present. An EO has continued (or historic) presence and/or regular recurrence at a given location and has practical conservation value.

Sensitive EO. EOs may be marked sensitive either due to collection value, susceptibility to disturbance, federal status, or other factors (record displays a "Y" in the CNHPSENS field) or due to land status, i.e., private landowner request (record displays a "Y" in the DATASENS field).

Potential Conservation Area (PCA). A PCA represents CNHP's best estimate of the primary area supporting the long-term survival of targeted elements.

Sensitive PCA. A PCA that supports a Sensitive Element or EO <u>and</u> is less than one square mile in size (record displays a "Y" in the SENS field).

Level 2 Data. Dataset provided for all lands within El Paso and Pueblo Counties for **internal use only**. Level 2 dataset includes the following items and file formats:

   a.   EO Spatial Data (Arcview SHP) – Non-sensitive and sensitive EOs that overlap with these lands. Non-sensitive EOs are generalized to 1 sq. mile and sensitive EOs are fuzzed to 4 sq. miles.

   b.   EO Transcription (PDF) – The resolution of location information for EOs listed in EO Reports differs based on EO sensitivity: locations of non-sensitive EOs are reported to PLSS section (1 sq. mile); locations of sensitive EOs are reported to PLSS range (36 sq. miles).

c. PCA Spatial Data (Arcview SHP) – Non-sensitive PCAs only.

d. PCA Transcription (PDF) – PCA Reports for all PCAs provided in the spatial data. Reports will not list Site Directions, Management Comments, or Protection Comments.

Level 3 Data. Dataset provide for all lands within El Paso and Pueblo Counties. Dataset may be used for **external display** of CNHP data. Level 3 dataset includes the following items and file formats:

a. EO Spatial Data (Arcview SHP) – All EOs which overlap these lands. Non-sensitive EOs are generalized to 1 sq. mile and sensitive EOs are generalized to 9 sq. miles.

b. PCA Spatial Data (Arcview SHP) – Non-sensitive PCAs only which overlap these lands.

c. Network of Conservation Areas (NCA) Spatial Data (ArcView SHP) – All NCAs which overlap these lands.

3. LICENSE FEE; FINANCE ADMINISTRATION AND PAYMENT**:** This dataset is being provided as a deliverable as outlined in the scope of work for the project titled, Geospatial Environmental and Community Analyses in El Paso and Pueblo Counties, Colorado (Purchase Order Number DTFH61-07-P-00118 from the Federal Highway Administration).

4. CONFIDENTIALITY AND NON-DISCLOSURE REQUIREMENTS: LICENSEES acknowledges that Level 2 Data provided by CNHP (described above), are considered sensitive and confidential for management and conservation reasons.   Therefore, LICENSEES agrees to strictly adhere to the following requirements with respect to Data being provided by CNHP:

a. Level 2 Data are being provided for **internal use only**. LICENSEES will undertake appropriate measures to ensure that these Data will be accessible only to PPACG and PACOG personnel and to no other entity, nor will these Data be made available for public viewing without prior approval by CNHP.

b. Level 3 Data are being provided for purposes of external CNHP data display, i.e., any printed or electronic items (e.g., maps, tables, charts, graphs, etc.) containing CNHP Data that the licensees wish to publish for public viewing.

c. All CNHP Data are copyrighted and ownership of the Data remains with CNHP. The LICENSEES are being granted use of the Data for the purposes described herein. No interest whatsoever is conveyed to the LICENSEES in right, title, and interest of the Data, the information, and all copyrights (and renewals thereof) secured herein. All publication, dissemination and other rights in the Data are reserved to CSU/CNHP in all languages, formats, and throughout the word for the sole and exclusive use of any other disposition by CNHP or their assignees or grantees at any time and from time to time without any obligation or liability to any Data user.

d. The Data will be used for the requested purposes described above and for no other purpose.

e. The Data may not be transcribed, reproduced in any manner, nor redistributed to any third party, unless authorized in writing by CNHP. Requests for the Data from any other entity will be referred to CNHP.

f. Requests involving biological interpretation or use of the Data beyond the stated purposes will be referred to CNHP.

g. LICENSEE will provide acknowledgement for CNHP Data where appropriate. The correct citation for CNHP Data is as follows:

Colorado Natural Heritage Program. 2007. Biodiversity Tracking and Conservation System. Colorado State University, Ft. Collins, CO. Data exported June 2007.

h. In the event that either LICENSEE receives a demand for disclosure pursuant to applicable law (including, but not limited to, the Colorado Public Records Act, C.R.S. secs. 24-72-201, et seq., as now or hereafter amended), or any lawful order, subpoena, or other process requiring disclosure of the Data, the LICENSEE shall immediately notify CNHP in writing in order to afford CNHP a reasonable opportunity to initiate legal action to enjoin, restrict, or otherwise oppose the disclosure in a court of competent jurisdiction. Such action shall be at the expense of CNHP, but the LICENSEE shall reasonably cooperate with CNHP in seeking protection of the Data.

5. NOTICE REGARDING INFRINGEMENT: LICENSEES shall promptly notify CNHP of any third party that it reasonably believes to be infringing any right of CNHP, and Licensee shall use reasonable efforts to provide to CNHP any information LICENSEE has in support of such belief.

6. DISCLAIMER OF WARRANTIES: LICENSEES acknowledge that CNHP Data require a certain degree of biological expertise for proper analysis, interpretation, and application. Care should be taken in interpreting these Data. These Data are dependent on the research and observations of many scientists and institutions, and reflect our current state of knowledge. Data are acquired from various sources, with varying levels of accuracy, and are continually updated and revised. They are provided for planning purposes only. Many areas have never been surveyed, however, and the absence of Data in any particular geographic area does not necessarily mean that species or ecological communities of concern are not present. These Data should not be regarded as a substitute for on-site surveys required for environmental assessments. Absence of evidence is NOT evidence of absence. Absence of any Data does not mean that other resources of special concern do not occur, but rather CNHP files do not currently contain information to document this presence. If ground-disturbing activities are proposed on a site, CNHP should be contacted for a site-specific review of the project area.

LICENSEES acknowledge that the Data and other Confidential Information provided to LICENSEES by CNHP are provided on an **as-is basis, as-available** basis without warranties of any kind, expressed or implied, **INCLUDING (BUT NOT LIMITED TO) WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT**. Although CNHP maintains high standards of Data quality control, CNHP, Colorado State University, and the State of Colorado further

expressly disclaim any warranty that the Data are error-free or current as of the date supplied. For more information, see the Colorado Natural Heritage Program website at: www.cnhp.colostate.edu.

LICENSEES acknowledge that CNHP shall have no liability or responsibility to the Data users, or any other person or entity with respect to liability, loss, or damage caused or alleged to be caused directly or indirectly by the Data, including but not limited to any interruption of service, loss of business, anticipatory profits or indirect, special, or consequential damages resulting from the use or operation of the Data. LICENSEES hereby agree to hold CNHP, Colorado State University, and the State of Colorado harmless from any claim, demand, cause of action, loss, damage or expense arising from or related to LICENSEES' use of or reliance on the Data, regardless of the cause or nature thereof, and even in the event that such cause is attributable to the negligence or misconduct of CNHP.

7.   CHOICE OF LAW: This Agreement shall be interpreted, construed, and governed by the laws of the State of Colorado, and such laws of the United States as may be applicable.

8.   MODIFICATION AND AMENDMENT OF AGREEMENT: Modifications to this Agreement may be proposed by either party at any time during the period of performance and shall become effective upon written approval by both parties.

B. PPACG AND PACOG DATA

The LICENSEES agree to provide CNHP and Placeways with transportation, infrastructure, and land use, and other relevant data for stated purposes of completing Geospatial Environmental and Community Analyses in Pueblo and El Paso Counties, Colorado as outlined in Purchase Order Number DTFH61-07-P-00118 from the Federal Highway Administration.

1. CONFIDENTIALITY AND NON-DISCLOSURE REQUIREMENTS: CNHP and Placeways acknowledge that data provided by PPACG or PACOG are considered sensitive and confidential. Therefore, CNHP and Placeways agree to strictly adhere to the following requirements with respect to data being provided by PPACG and PACOG:

a. CNHP and Placeways will undertake appropriate measures to ensure that these data are accessible only to CNHP and Placeways personnel and to no other entity, nor will these data be made available for public viewing without prior approval from PPACG and PACOG.

b. CNHP and Placeways are being granted use of these data for the purposes described herein. No interest whatsoever is conveyed to CNHP or Placeways in right or title of the data.

c. These data will be used for the requested purposes described above and for no other purpose.

d. These data may not be transcribed, reproduced in any manner, nor redistributed to any third party, unless authorized in writing by PPACG and/or PACOG. Requests for these data from any other entity will be referred to PPACG and/or PACOG.

e. In the event that CNHP receives a demand for disclosure pursuant to applicable law (including, but not limited to, the Colorado Public Records Act, C.R.S. secs. 24-72-201, et

seq., as now or hereafter amended), or any lawful order, subpoena, or other process requiring disclosure of the data, CNHP shall immediately notify PPACG and/or PACOG in writing in order to afford PPACG and/or PACOG a reasonable opportunity to initiate legal action to enjoin, restrict, or otherwise oppose the disclosure in a court of competent jurisdiction. Such action shall be at the expense of PPACG and/or PACOG, but CNHP shall reasonably cooperate with PPACG and/or PACOG in seeking protection of the data.

REPRESENTATIVES; NOTICE

For purposes of this Agreement, the persons named below are designated the representatives of the parties. All notice required to be given by registered or certified mail, return receipt requested, to the representative named below. The parties may designate in writing a new or substitute representative:

CNHP:
Renée Rondeau, Director
Director, Chief Scientist
Colorado Natural Heritage Program
254 General Services Bldg.
Fort Collins, CO 80523-8002
(970) 491-1309 (Voice)
(970) 491-3349 (Fax)
rjr@lamar.colostate.edu

PPACG:
Craig Casper
Transportation Director
15 South 7th Street
Colorado Springs, CO 80905

(719) 471-7080 (Voice)

ccasper@ppacg.org

Placeways:
Doug Walker
President & CEO
Placeways, LLC
1722 14th Street, Suite 150
Boulder, CO 80302
(303) 442-8800 x100 (Voice)
(303) 449-2487 (Fax)
doug@placeways.com

PACOG:
Bill Moore
MPO Administrator
Pueblo Area Council of Governments
223 North Santa Fe Avenue
Pueblo, CO 81003
(719) 553-2945 (Voice)

Bmoore@pueblo.us

In Witness Whereof, CNHP, Placeways, and the LICENSEES have executed this data license and use agreement as of the last date signed below:

Colorado State University   Pikes Peak Area Council of Governments

By: _____   By: _____
Lynn Johnson   Date   Robert F. MacDonald   Date
Director of Sponsored Programs   Executive Director

Pueblo Area Council of Governments   Placeways, LLC

By: _____   By: _____
Bill Moore   Date   Doug Walker   Date
MPO Administrator   President & CEO

APPROVED:

By: _____   _____
Melissa Landon   Date   Craig Casper   Date
Conservation Data Services Team Leader   Transportation Director
Colorado Natural Heritage Program   Pikes Peak Area Council of Governments
Colorado State University   15 South 7th Street
Campus Delivery 8002   Colorado Springs, CO 80905
Fort Collins, CO 80523-8002
P: (970) 491-0814   P: (719) 471-7080
F: (970) 491-3349
Email: mal@lamar.colostate.edu   Email: ccasper@ppacg.org

APPROVED AS TO FORM:

By: _____
        Robert Schur
        Contracts Counsel
        Colorado State University

AMENDMENT TO

DATA LICENSE AND USE AGREEMENT
BETWEEN
Colorado State University – Colorado Natural Heritage Program
& Placeways, LLC
AND
Pikes Peak Area Council of Governments
& Pueblo Area Council of Governments

Expanded Definition of LICENSEES
The definition of LICENSEES is expanded to include not only Pikes Peak Area Council of Governments (PPACG) and Pueblo Area Council of Governments (PACOG), but also Federal Highways Administration (FHWA).

In Witness Whereof, CNHP, Placeways, and the LICENSEES have executed this amendment as of the last date signed below:

Colorado State University   Pikes Peak Area Council of Governments

By: _____   By: _____
Lynn Johnson   Date   Robert F. MacDonald   Date
Director of Sponsored Programs   Executive Director

Pueblo Area Council of Governments   Placeways, LLC

By: _____   By: _____
Bill Moore   Date   Doug Walker   Date
MPO Administrator   President & CEO

Federal Highway Administration
Office of Project Development and Environmental Review

By: _____
Michael Culp   Date