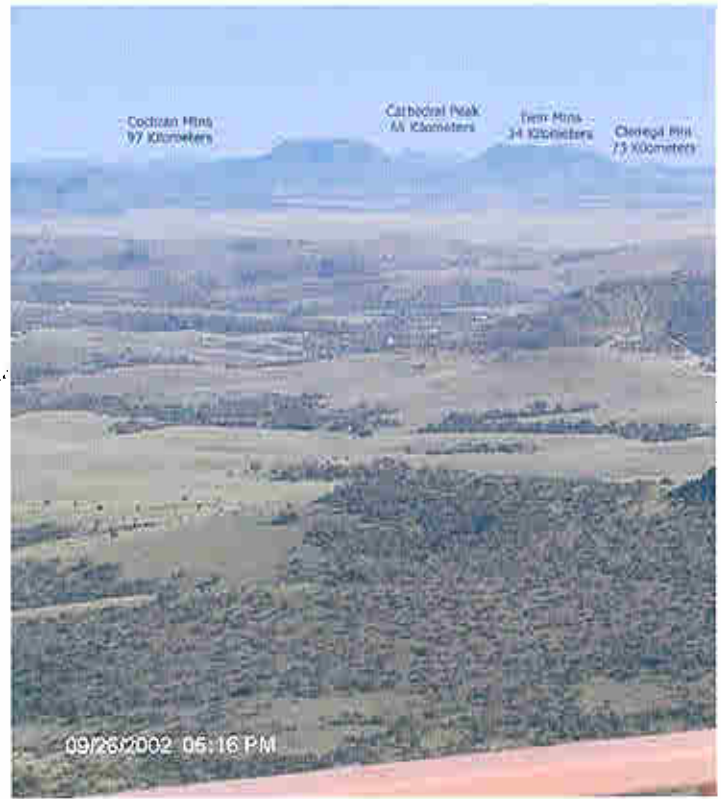
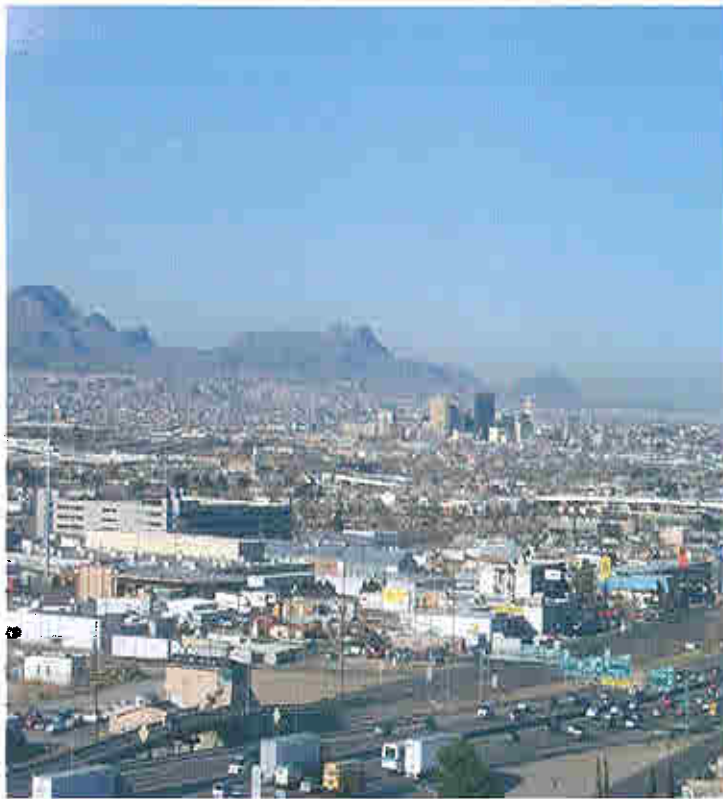


**Visibility Research with the Texas Commission on Environmental
Quality Camera Systems in the Paso del Norte and West Texas Regions
2001-2002**



**FINAL REPORT FOR PROJECT 582-2-48680
FY 2002**

**to the
Texas Commission on Environmental Quality
(formerly Texas Natural Resource Conservation Commission)
Technical Analysis Division**

**submitted by
N. J. Parks, R.W. Gray, W.W. Li, R.R.Sawant,
Center for Environmental Resource Management
and
Department of Civil Engineering
University of Texas at El Paso
El Paso, TX 79968**

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Executive Summary

Nine digital image systems operating under the auspices of the Texas Commission on Environmental Quality (TCEQ) are now deployed and are continuously acquiring and transmitting images to the University of Texas Regional Haze archive server (See Fig E.1). This program is presently archiving five sets of daily images from the Paso del Norte urban network and 4 sets of daily images from sites in west Texas. In north to south order, the west Texas sites are Odessa (Permian Basin), Guadalupe Mountain National Park, Carlsbad Caverns National Park, an interstitial area surveyed from The McDonald Observatory atop Mt. Locke near Ft. Davis, TX, and Big Bend National Park (the view extends to the Sierra del Carmen in Mexico).

This project has digitally stored images and analyzed target contrast ratios (CR) from all the visibility imaging sites. The first, and most extensive, results are from the archive of urban Paso del Norte digital images taken at the Chelsea Retirement Home in El Paso with a westerly view of downtown El Paso and the Sierra de Juarez. The last deployed system in August of 2002 was at The McDonald Observatory, Ft. Davis, TX, and introduced a changeover from remote systems using Windows 98 and Kodak DC290 cameras to systems using Windows 2000 and Olympus C2100 cameras. This study found similar image quality for the Kodak DC260 used originally in the Big Bend Regional Aerosol and Visibility Observation (BRAVO) study and currently at BBNP, the Kodak DC290's initially deployed for this project, and the Olympus C2100 recently deployed. Improved reliability of systems (especially those ca. 300 miles from the UTEP laboratories) was the anticipated result of the changeover.

The project has also archived and analyzed for contrast ratios, images of various landmark targets from three cameras in remote West Texas at Guadalupe Mountain National Park, The McDonald Observatory near Ft. Davis, TX, and Big Bend National Park. The last remote digital camera system is deployed north and east of the others in a rural area of the Permian Basin near Odessa, TX at a municipal water reclamation plant.



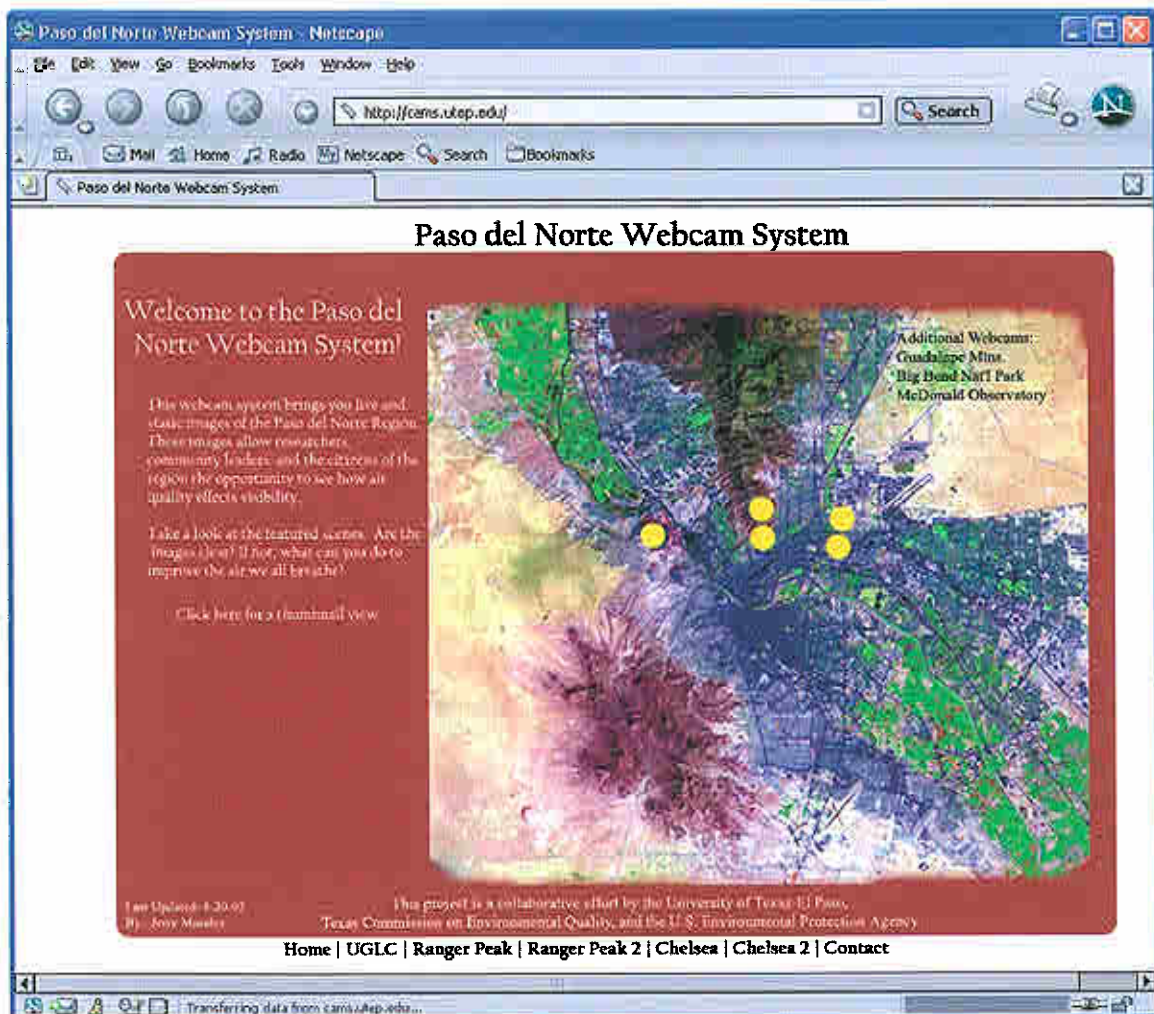
CR values were computed for the downtown target buildings (A;B) located approximately 6 km from the Chelsea site which has been in use as a visibility imaging site in El Paso for over 10 years.

CR were also computed for the edge of the Sierra de Juarez for a ridge-sky two target basis (C;D) at ca. 12 km.

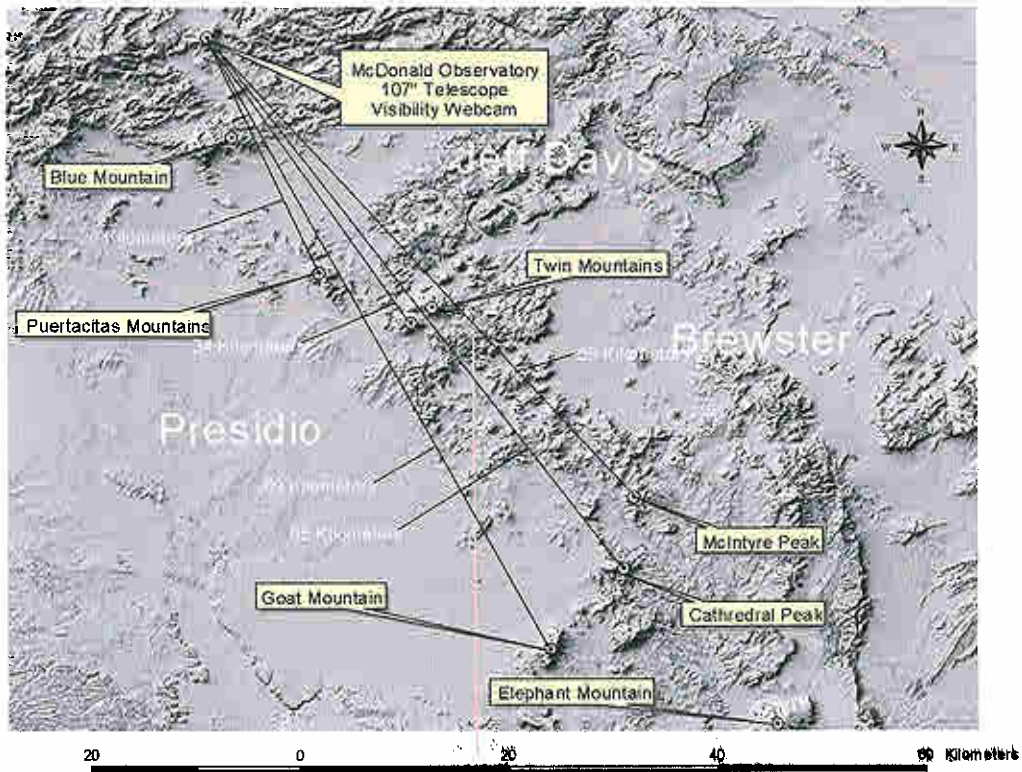
Contrast Variance (CV) was used to look at the spread of grayscale pixel values for urban zones in El Paso (E) and Cd. Juarez (F).

The Data Appendix CD accompanying the report contains the spreadsheets with these data. The CR data for various sites is summarized with bar charts in the report appendix.

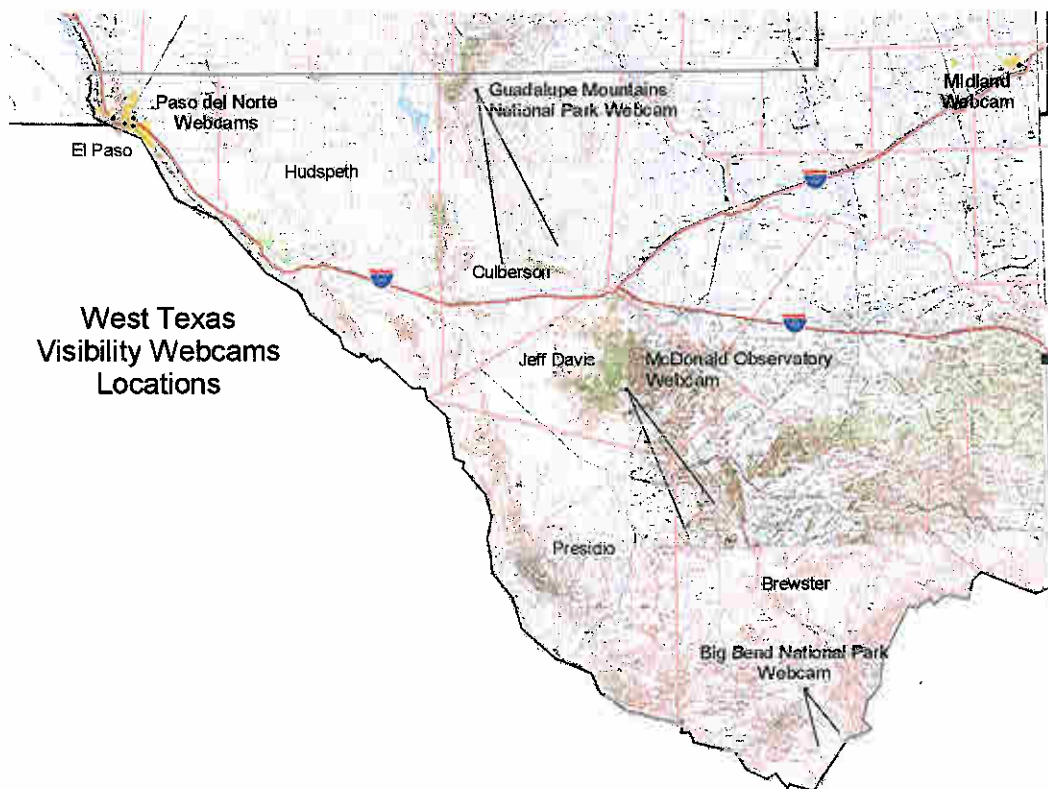
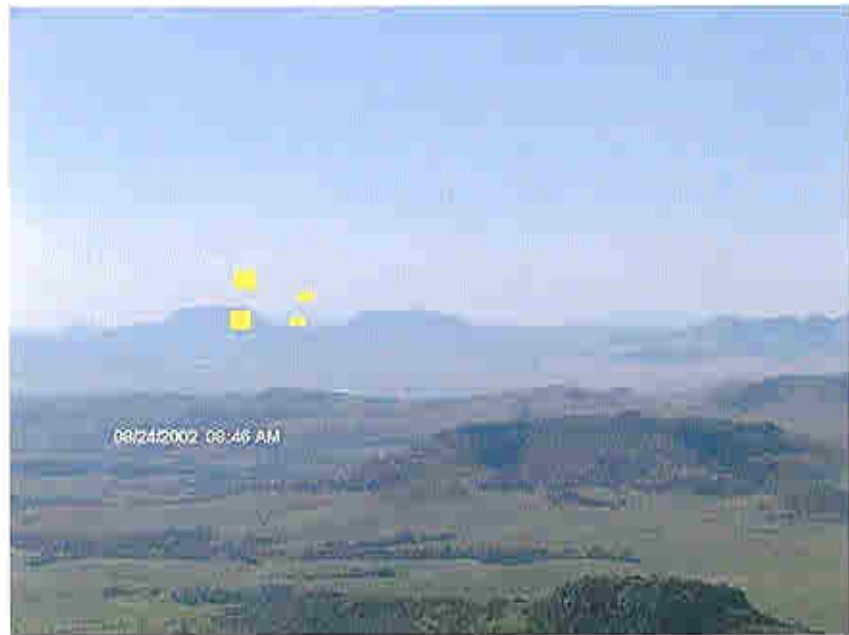
This project has put in place the initial TNRCC web server technology for the Visibility Camera Program. The web page (<http://cams.utep.edu>) shown first in this paragraph features a satellite image of the Paso del Norte Airshed with “active yellow dot” icons, and has been in the process of “debugging” various logistical difficulties in getting images reliably from site location to the server at UTEP. These problems include “dial up” to “point-to-point” servers, cameras “going to sleep” spontaneously, and various stoppages requiring “hands on” restarts when various, state, federal, and local internet services have an interruption. These start up challenges have been surmounted in every case. The variable has been the amount of resources necessary to accomplish the goal.



During this project phase, Geographic Information Systems (GIS) was used to document locations of significant land features and associated distances and directions from the visibility cameras. The resulting distances were used in calculating the digital image derived extinction coefficients (b_{ext}).



Using the distances and contrast ratios between visible peaks and the sky, the digital images were used for quantitative analysis and characterization of haze and visibility in wilderness and urban areas. Using regression analysis, the calculated b_{ext} was found to agree well with that obtained from transmissometer data and the reconstructed equation used in the Big Bend National Park BRAVO study.



At the conclusion of this project, nine haze and visibility cameras were deployed and successfully transmitting current images for access via the Internet and being archived. These systems provide reasonable coverage of the Paso del Norte and West Texas region.