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The Nation's Most Advanced Game Crossing System

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On December 11, 2006, in a cooperative effort between Arizona Department of Transportation (ADOT); AZGFD; the Federal Highway Administration, and USDA Forest Service, a new type of game crossing traffic safety system was activated.

The goal of the system is to minimize collisions between motorists and elk along State Route (SR) 260 east of Payson, Arizona. Presently, this system is the most advanced in the U.S., employing thermal imaging for detection and electric fencing for channeling of game, radio networking and solar-powered controls. We will examine this system from the game management aspect and a systems level overview.

Traffic patterns at the site

Arizona's population has grown dramatically in the past few years with a significant increase in traffic. For those living in the metropolitan Phoenix area, a two to four hour drive to the Arizona Rim country and the White Mountains provides a cool respite from the heat of the desert. During the winter months, there are many recreational opportunities including skiing.

The primary conduit for this traffic has been SR260 from Payson to Show Low: a two-lane highway with occasional passing lanes and a speed limit of 55mph. For the past several years, ADOT has been engaged in a long term build-out to expand a 17-mile stretch of SR260 to a four-lane highway with a median thus improving access to these recreational areas. Expansion work on the first three of five planned sections is complete, prioritized on the incidence of wildlife-vehicle collisions. The posted speed on the upgraded highway remains 55mph but may be raised depending on conditions.

Advance solar-powered flasher for wildlife crossings.

Traffic surveys have disclosed that speeding is a problem on many stretches of the highway. Counts have shown many vehicles travel at speeds well above the posted speed limit; some have been measured at over 100mph. Obviously, a hazardous condition exists and one compounded by wildlife entering the road at any time.

Game crossing issues

Arizona has a large elk population in the higher elevations, spanning from Williams southeastward to the New Mexico border at Alpine. As in all states vehicle-game collisions take their toll annually. Along this upgraded 17-mile stretch, over 100 wildlife-vehicle collisions were documented in 2001; 73 involving 600-pound-plus elk which can cause substantial vehicle damage and serious human injury.

To date, seven of 11 wildlife underpasses have been installed as part of the roadway improvement project, along with six completed bridges. The underpasses were designed large enough to allow elk to pass without issue.

These underpasses were supplemented with 8-foot high game fences to funnel the wildlife to and through the underpasses. To date, AZGFD has recorded over 9,000 animals by video surveillance at six of the underpasses; more than half have passed under SR260 without endangering motorists. On one upgraded section completed in 2004, 50 percent of the length was strategically fenced based on elk crossing patterns determined from Global Positioning System (GPS) telemetry.

In the year after the section was opened to traffic, before fencing was erected, 52 elk-vehicle collisions were recorded. In the two years since fencing, only 11 collisions with elk occurred each year, or a nearly 80 percent reduction. What's more, the fencing actually improved the ability of elk to get across the highway. The elk passage rate increased 60 percent with fencing that serves to funnel elk to the underpasses where they can cross SR260 unimpeded below grade.

On the first upgraded section of SR260, the Preacher Canyon section, only 13 percent of the 3-mile section was originally fenced when it was reconstructed in 2001. Though this fencing funnels elk and other animals toward two underpasses, the elk-vehicle collision rate has not declined from pre-upgrade levels (averaging 12 per year). As such, AZGFD and ADOT pursued an enhancement grant to fence the remaining 2.7 miles of the section to reduce (or even eliminate) wildlife-vehicle collisions. However, at the far west end of the project, the terrain was not conducive to the construction of an underpass. Since the fencing could potentially create an "end run" situation where wildlife had to cross the road at grade, sensor-activated warning beacons and variable message signs were installed in an effort to warn motorists of wildlife within the detection zone.

System/site configuration

The basic traffic control equipment for the system consists of two video processor/ detection locations, two solar-powered flasher assemblies and two variable message sign units (VMS). Figure 1 shows a block diagram of the system layout. The towers with the cameras are located approximately 100 feet from the actual detection zone. The solar flashers are located about 50 feet in advance of the actual crossing and the VMS units are approximately 500 feet in advance of the crossing. It should be noted that the VMS units are trailer mounted so they can be moved during the two-year testing period if their current location proves unacceptable.

In addition there are two automatic exit gate points in the system which allow animals a means to exit the roadway area if they become trapped. The exit gates are equipped with sensors and solar-powered gate opening units which open when an animal is detected on the roadway side of the fence.

Electrobraid fencing

Since there is no way to funnel animals either over or under the road at the west end of the project zone, it was decided to use an active, pedestrian crosswalk system. (See References Note 1.) However, the challenge to the system design was to get the animals to cross at a specific point on the highway.

Electrobraid game fencing was installed from the natural underpass at the Preacher Canyon Bridge to the roadway crossing point. The Electrobraid fencing material is unique. It is produced from a stranded nylon material which includes strands of conductive material in the weave, is highly visible due to its thickness and has a breaking strength of at least 1000 pounds (more details at Electrobraid Web site). The fencing is easier to work with than single-strand steel wire conductors which are typically used in electric

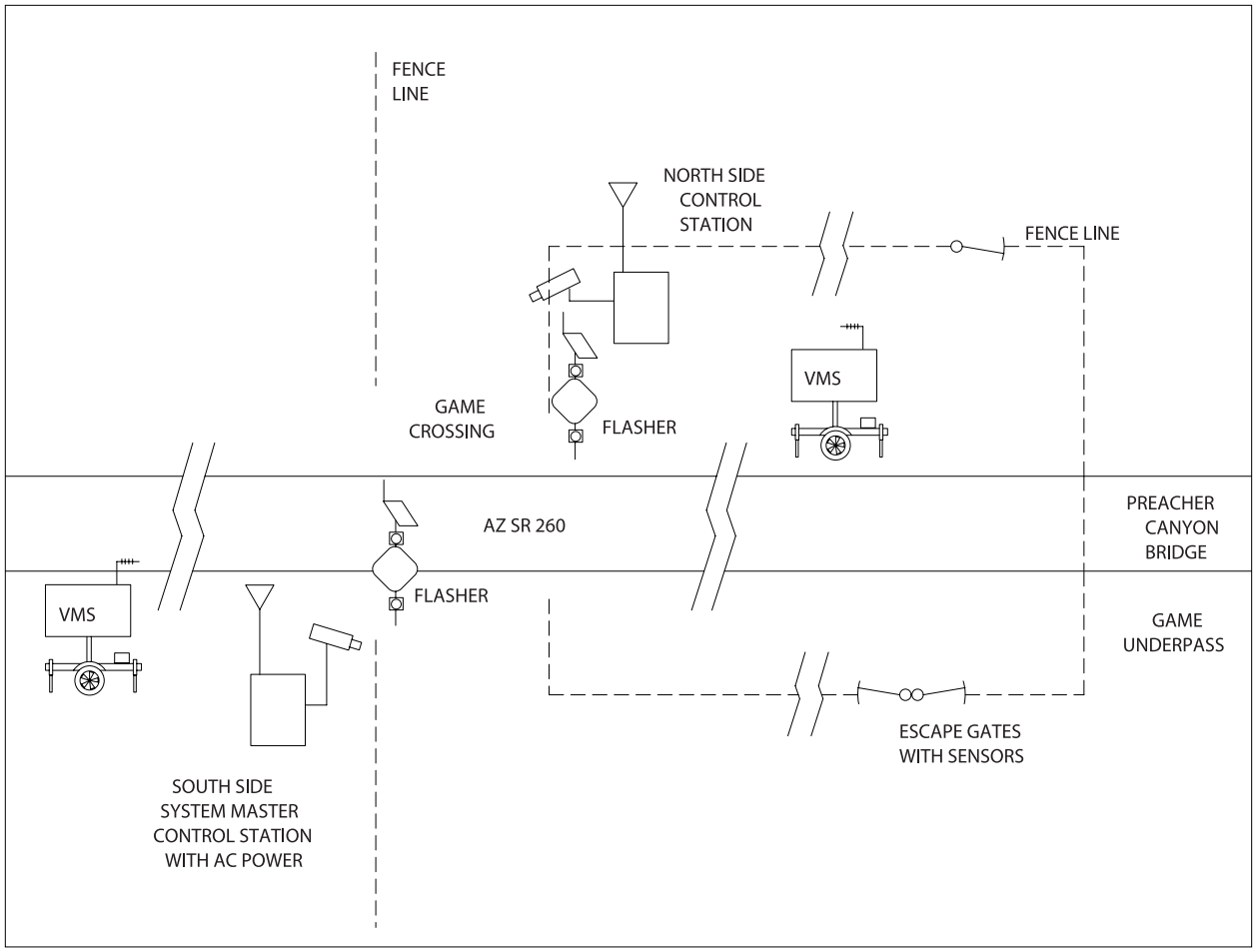

Figure 1.

fencing situations. The 8-foot high fence is designed to channel any large game animals to the highway crossing: the only entry-exit point in the system.

Detection

Detection of elk or other large game animals is done using thermal imaging techniques. Each side of the road is equipped with a 30-foot tower set back from the crossing zone approximately 100 feet. Each tower is equipped with IR lamp arrays and IR sensitive cameras. Each side contains its own industrial computer unit which includes an image processing card and an Ethernet bridge between the two processors. When a target fitting the software algorithm is seen in the image field the system activates the warning devices, solar flashers and VMS units, via a radio link.

Solar flashers

To warn motorists that elk have been detected at the crossing, dual 8-inch solar flashers, one unit for each approach, were placed approximately 30-feet in advance of the crossing zone. (See Figure 1.) The flasher unit is assembled on a 15-foot ADOT Type A-2 pole with a breakaway base. It includes a 36-inch W11-3A diamond grade sign with an elk symbol on it as well as a W-7 "When Flashing" sign beneath it.

Each pole was outfitted with two Precision Solar Controls Model 1384, 8-inch LED lamps, which ADOT has used on other projects around the state. The controls for the equipment consist of a modified STC Solar Ped-X control. It includes a spread spectrum radio transceiver, programmable logic module and a DPC-2000 integrated charge/flasher control. Since this is a pilot

project, a 2.5-inch LED lamp cluster was placed on the rear of each flasher unit to act as a confirmation lamp and is positioned to be visible to the IR camera.

For design purposes, it was assumed the lamps would not run more than 3 hours per day in the max bright mode. However, since most crossings will not occur during daylight hours, when max bright operation would dominate power consumption, the system can run substantially longer since it will be operating at a dimmer output.

Under normal circumstances the flashers are in standby mode with all the communications and logic active, but the lamps are dark. When a valid target is in the detection zone, the system will be activated from the master computer and a run-time value written to the operating-time register in the logic device. This, in turn, causes the flashers to operate until the operating-time register reaches zero.

Typically elk travel in herds so more than one at a time will be crossing the road. To manage this, the master computer continues to update the operating-time register in the flasher units to keep them flashing as long as a valid target is detected. When no more targets are detected the operating-time register counts down to zero and the flashers go dark and operation reverts to standby mode.

VMS units

In order to provide motorists with as much warning as possible, VMS units have been placed in advance of the crossing. The units selected for the project were purchased from Wanco and feature 18-inch characters. Both units were outfitted with a modified STC Solar Ped-X control package to allow them to function in an identical fashion to the flasher units. Using the Priority Encoded Sensor feature on each trailer allows the Solar Ped-X controls to interface with VMS controls so if the operating-time register value in the logic has a value, the sign will display "Caution Elk Detected Ahead." The word "caution" is set up to blink while the rest of the message remains static. When the operating-time register reaches zero the sign goes blank and remains so until activated again.

"Caution Elk Detected"

Data to be collected

The goal of the project is to alert motorists to the presence of elk and get the drivers to slow down. Currently the project employs two Numetrics Groundhog embedded roadway data collection units to monitor speeds at the crossing. As the project progresses, portable data collection units will be deployed in advance of the VMS units so that speeds approaching the crossing can be checked versus speeds at the crossing. The master control unit has been outfitted with a manual override which will allow AZFGD and ADOT personnel to conduct tests at predetermined times and collect the data to monitor the effectiveness of the system. These data, along with wildlife-vehicle collision monitoring and elk GPS telemetry, will allow AZGFD and ADOT to evaluate the fencing and detection system for potential applications to make Arizona's highways safe for motorists and wildlife.

References:

Note 1: Joseph Wise, ""Wireless Traffic Control Solutions, Case Study: sensor-activated crosswalk flasher" *IMSA Journal*, July/August 2002. STC Web site, Articles / References

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