

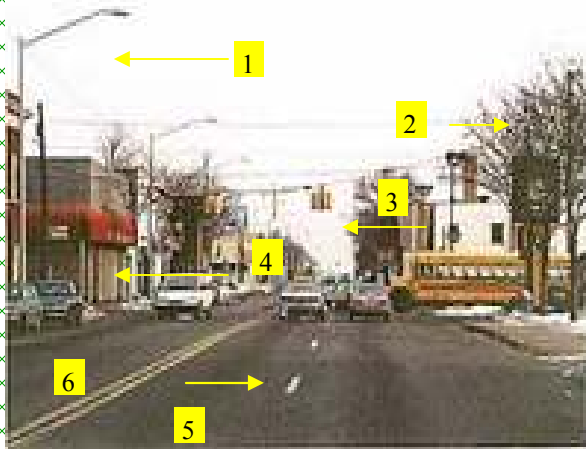
ROAD SAFETY AUDIT (RSA)

Road Safety Audit (RSA) is a process for systematically checking the safety of existent or future road transportation projects (sections, segments, isolated intersections, urban corridors, crossings of highways with lines of trains, highways in school zones, etc) based on road safety engineering principles and undertaken from the road users' perspective (urban corridors, crossings of highways with lines of trains, highways in school zones, etc). A Road Safety Audit provides an independent assessment of the "anticipated" safety performance of a road transportation project at predetermined intervals by road safety specialists. It is duly noted that the project design team remains ultimately responsible for the design.

The Federal Highway Administration (FHWA), the Institute of Transportation Engineers (ITE) and the Association of Australian and New Zealand Road Transport and Traffic Authorities (Austroads) have defined Road Safety Audit essentially considering these elements.

The objectives of a road safety audit are:

- To ensure a high level of safety for all new roads and traffic schemes (main objective).
- To reduce the whole life-cost of a scheme; unsatisfactory design can be expensive to correct after they have been built.
- To minimize the risks of crashes on the adjacent road network particularly at tie-ins, as well as on the new road scheme.
- To enhance the relevance of road safety engineering in road and traffic scheme design work.
- To promote the consideration of safety of all road users in all new and existing schemes.



**Intersection before an Audit performed
at Grand Rapids, Michigan**
Courtesy of AAA Michigan.
<http://www.roadwaysafetyaudits.org>

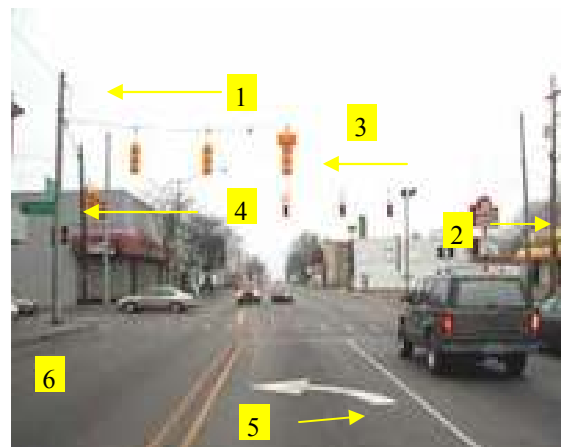
The following images shows a Road Safety Audit in an urban intersection in Grand Rapids, Michigan.

The picture on the left shows different geometric and operational problems that must be attended.

1. Deficient lighting
2. Trees are inside the drivers' visual triangle.
3. A single traffic light Controls all moments.
4. Inexistent Guide Signs.
5. Two ways lanes. No "ONLY" lanes.
6. Roadside Parking

The picture on the right shows alterations done to the intersection after the audit. The modifications are mentioned bellow:

1. A change in geometry and post elevation.
2. Removal of the tree to the shore of the route. They must comply with the environmental procedure established by the State.
3. Traffic light change from one phase to three phases.
4. MUTCD compliant guide signs.
5. ONLY lane arrow in the pavement indicating turns to the left side.
6. Parking is prohibited at the roadside.



**Intersection after an Audit have been performed
at Grand Rapids, Michigan**
Courtesy of AAA Michigan.
<http://www.roadwaysafetyaudits.org>

THE SAFETY PROBLEM.

Road accidents are a serious problem throughout the world, in social, health and economic terms. It is said that road accidents commonly is the second largest cause of deaths for economically active people (5-44 years) in many countries, and is by the World Bank considered to be of endemic proportions. Between 50 and 200 people are killed each year for each million habitants in most developed as well as developing countries.

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The brightness of the sun dazzles drivers

Road safety audits originated in the United Kingdom in 1980, making use of extensive Accident Investigation and Prevention (AIP); experience in that country and in response to the requirements of successive legislation for highway authorities to take steps to reduce the possibility of accidents on their roads. AIP teams in county councils, initially investigate accident problems on existing roads with great success, using that experience to assess designs for new road schemes.

AUDITS IN UNITED STATES

“RSAs were introduced in the United States in 1996 as a result of an FHWA sponsored scanning tour of Australia and New Zealand. The FHWA contacted all state departments of transportation (DOT) to observe the interest in applying the concepts as a pilot study. In 1997, it sponsored a workshop in St. Louis to discuss the practice and pilot activities. Thirteen states and two local governments participated in this project, marking the beginning of U.S. practice.”

In 2004, Wilson and Lipinski elaborated a survey as part of a published study NCHRP 336 of the Transportation Research Board (TRB) to national level that possessed the collaboration of 38 states. Only 10 states in the whole nation use Audits from the stage of design or in existing routes, but not both. 22 of 50 States do not realize any type of Audit.

The states that performs RSA or RSAR are:

- | | |
|-------------------|------------------|
| 1. Pennsylvania | 6. Alabama |
| 2. South Dakota | 7. Massachusetts |
| 3. Michigan | 8. Kentucky |
| 4. New York | 9. Louisiana |
| 5. South Carolina | 10. Iowa |

AUDITS IN PUERTO RICO

In the Puerto Rico Highway and Transportation Authority exists the Division of Road Safety Audit. This office takes charge performing safety audits in existing Highways and solving safety highway problems in segments and intersections.

Six (6) typical stages of an audit are:

1. Feasibility
2. Preliminary design
3. Detailed design
4. Pre-opening
5. Roadwork traffic
6. Road Safety Audit Review (RSAR)

Road Safety Audits Reviews are in use for identifying the deficiencies and danger zones in the road and then the improvements are programmed or performing corrective cost-effective treatments.

This Audit is proactive and does not answer necessarily to the statistics of accidents.

Steps Description

The steps to continuing in a Road Safety Audit Review are the following:

- Auditor team selection.
- It must include two or more professionals trained and experienced on the transportation area, among others.
- The team must be independent from the project to be analyzed.



**Team with safety devices
to work at night**

Abundant vegetation in the roadside camouflaging a previously impacted guardrail

As it is observed in the picture on the right, the vegetation camouflages the semi rigid barrier that already has been impacted, consequently, it is not operational.

Treatments:

- ♣ Apply herbicides or environmentally acceptable treatments.
- ♣ Aggressive roadside maintenance program to address high rainfall season.



Abundant vegetation on the roadside

Possible Team Members

Depending on the type of Audit that is going to be performed, the team could be between 3 and 5 members.

- Transportation engineer (highway safety)
- Design engineer (geometric design)
- Construction manager engineer
- Environmental engineer
- Attorney
- Psychologist
- Sociologist
- One or two additional members with Relative knowledge to the audit phase.

The Attorney traditionally is not in the team that does the evaluation on the field.

Costs and Benefits

There are a number of costs that can be attributed to a Safety Audit. First, is the cost of the audit itself. This cost is related to the time spent to complete it, rather than the cost of the scheme itself. It takes less time to audit a scheme involving a new road with simple connections at each end, with auditing a complex traffic signal intersection in an urban area.

It is difficult to identify the benefits of performing a Safety Audit on a scheme in a quantitative way.

When an Audit has been performed, the scenarios are:

- Either the recommendations are implemented or they aren't;
- keeping record of accidents that can be examined later,
- only one of the scenarios can be evaluated.
- It is not possible to compare how an individual scheme draft that has been audited, if the audit wasn't performed.


CHECK LIST

To be able to perform a Road Safety Audit, the inspection needs to be complemented with check lists of the principal elements of the system, which help to identify the problems and possible corrective policies that can be applied to the segment or intersection of a route. In the figures shown below appear some aspects that must be evaluated in an Audit, for example condition: Good (G), Regular (R), Poor (P) and possible corrective policies complementing with a photography of the inspection day.

Element	ROADSIDE Condition (G, R, P)	Corrective Measure
1. Guard rail	P	Replace
2. Drop off	R	Level
3. Loose Gravel	P	Clean
4. Vegetation	R	Trim
5. Tree	R	Trim
6. Gutter	G	N/A
7. Clear zone	P	Install guard



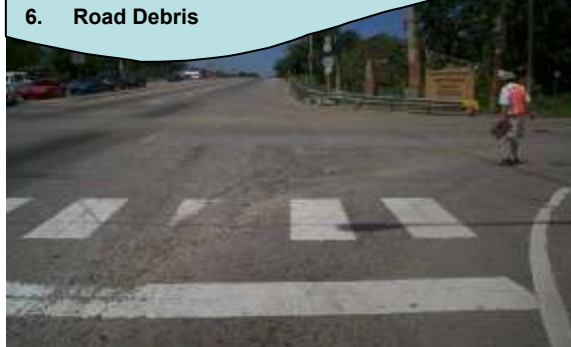
Element	CURVES Condition (G, R, P)	Corrective Measure
1. Visibility	R	Remove obstruction
2. Design speed	G	N/A
3. Speed limit	R	Reduce
4. Right of way	G	N/A
5. Sign		
6. Drainages		



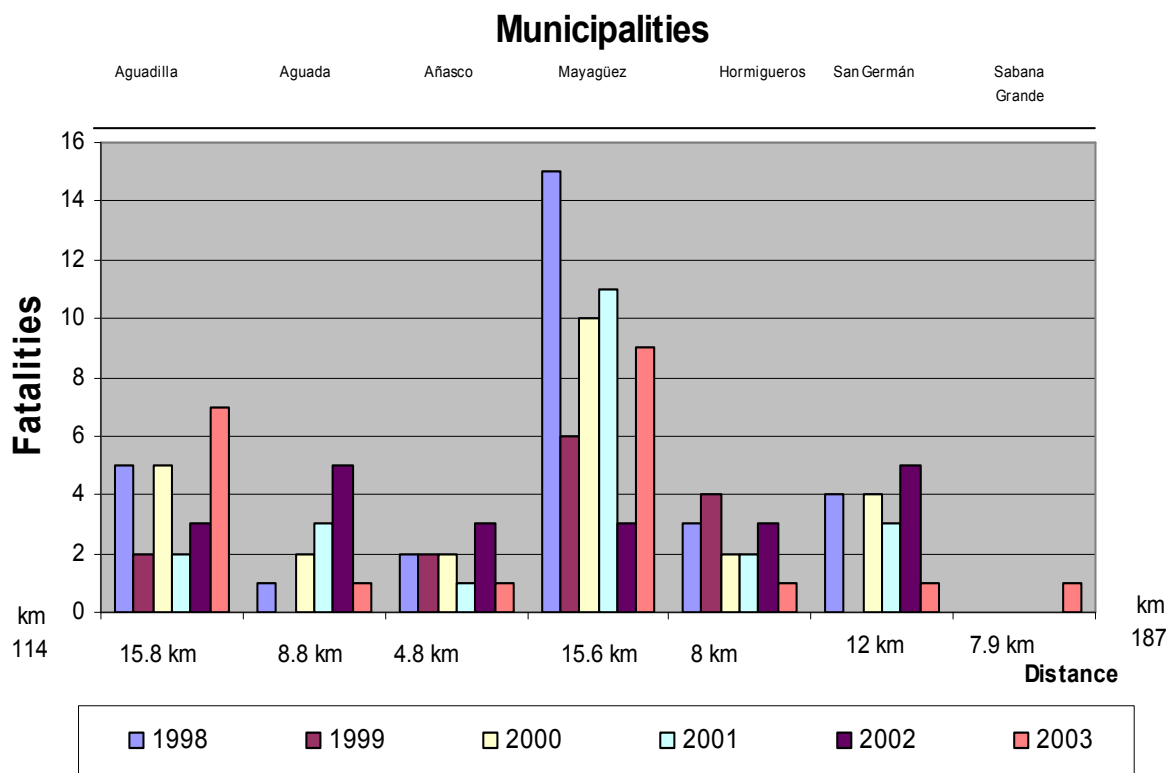
Element	PAVEMENT Condition (B, R, D)	Corrective Measure
1. Roughness	G	N/A
2. Materials	G	N/A
3. Pavement marking	R	Paint, install reflective
4. Drop off	P	Paving
5. Drainages	P	Install
6. Holes	R	



Element	INTERSECTION Condition (B,R,D,)	Corrective Measures
1. Pavement marking	G	N/A
2. Sign distance	R	MUTCD Compliance
3. Traffic signal	R	Change signal array
4. Sign legibility	P	Change
5. Intersection Visibility	G	N/A
6. Road Debris		



It is necessary to indicate that the check lists do not replace the judgment and criteria of the engineer and/or members of the auditor committee.



**Fatalities in the Highway PR-2 in the Puerto Rico West Area
since 1998 to 2003 (not at scale)**

Fatalities between 1998 and 2003 in the highway PR-2, between km 114 at Aguadilla up to km 187 at Sabana Grande, are shown in the figure. This is one of the factors to consider as a part of the Road Audit complemented with other elements illustrated in the check list, where there have been partially mentioned in some of those.

RSAR elements evaluated

- ♣ Concrete rigid barriers (F shape and New Jersey)
- ♣ Semi-rigid guard rails
- ♣ End treatments
- ♣ Pavement conditions
- ♣ Traffic signs (temporary and permanent)
- ♣ Fixed objects in the roadside
- ♣ Geometric design elements
- ♣ Pavement marking
- ♣ Illumination
- ♣ Drainage condition
- ♣ Intersection sight distances
- ♣ Transition tapers
- ♣ Pedestrian facilities
- ♣ Vegetation



**Unacceptable strong post block outs
according to NCHRP 350**

Preliminary Recommendations

1. Promote awareness of Road Safety Audit Review (RSAR) process at the state and local governments.
2. Increase efforts in research and obtain external funds in:
 - High Risk Rural Roads (HRRR)
 - Highway Safety Improvement Program (HSIP)
 - Intersection Treatments
 - Vegetation control
3. Increase training efforts in:
 - MUTCD Part 6 TTC
 - AASHTO Roadside Safety

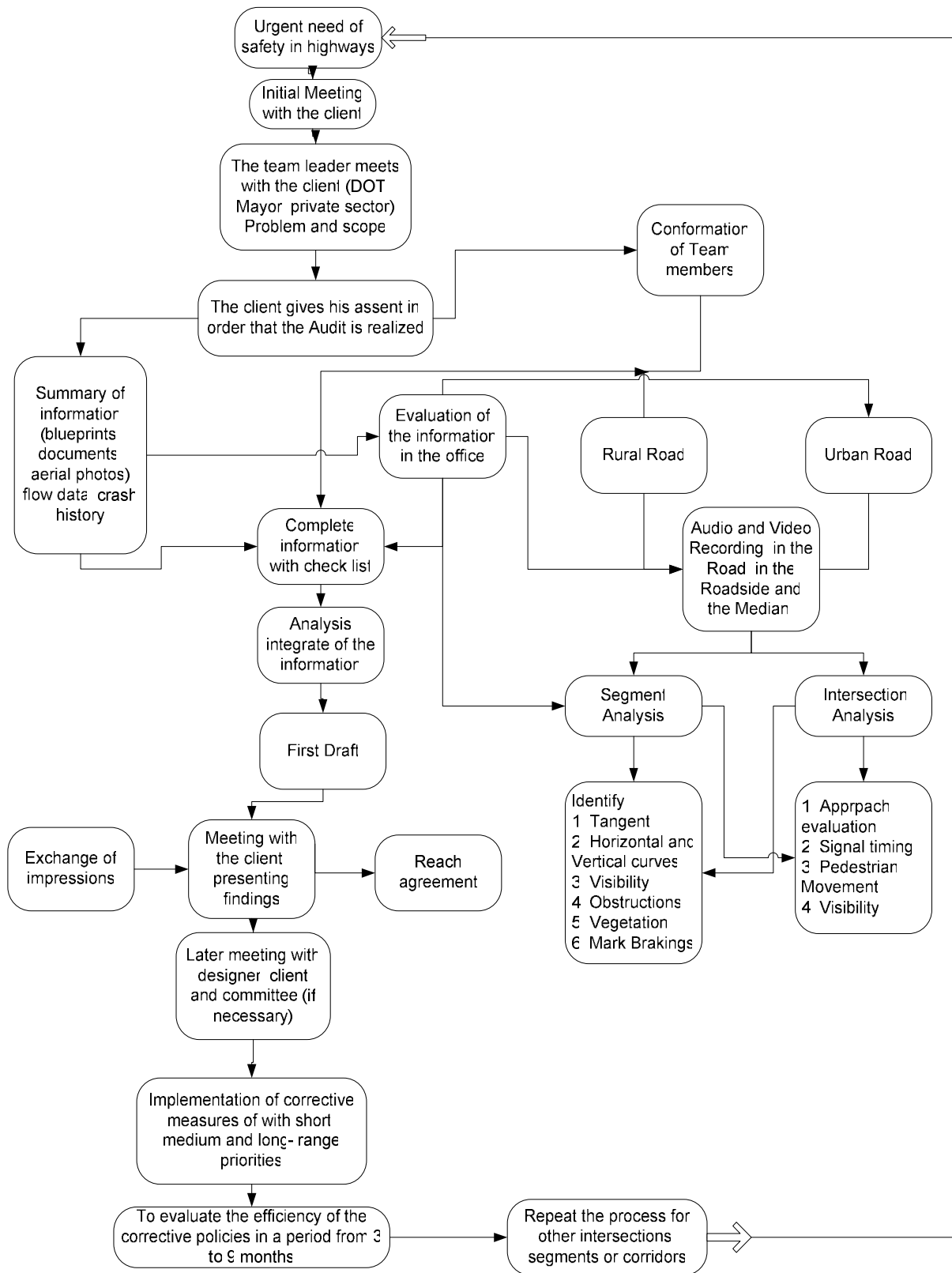
As seen in the picture on the right, the mailboxes have been located over the guard rail barrier, which loses the functionality of redirecting the vehicle in the moment of the crash. As it can be observed the sign next to the barrier and the reflective one are located over the guard-rail. It is also seen in photography the reflective sheets in the median of the road.

All these devices must be evaluated for the team auditor.



In the picture on the left it is observed that the barrier and the end treatment has a color that is not the right one. The auditor team must evaluate these conditions, like the functionality of the barrier, dimensions, and drainages, among other aspects.

**Inadequate color on the barrier
and on the end treatment**



RSA Flow diagram

A possible methodology for the application of Road Safety Audit in Puerto Rico, is described in the above flow diagram. This system needs to be calibrated periodically to maximize efficiency.

NEW FEDERAL LAW THAT SUPPORTS HIGHWAY SAFETY



The legislation SAFETEA - LU (Safe, Accountable, Flexible, Efficient Transportation Equity Act: To Legacy for Users) Is the Public Law 109-59, signed August 10, 2005 by the president of the United States George W. Bush.

- This law Provides the funds and improves the necessary investments programs to support and continue the transportation infrastructure growth.
- Attends the principal problems of transportation systems such as improving safety, reducing traffic congestion, improving efficiency in freight movement, increasing intermodal connectivity, and protecting the environment.
- Promotes more efficient and effective Federal Transportation Programs.
- Offers decision flexibility in State and Local transportation helping in the solution of the problems.
- Represents the Nations major investment in terrestrial transportation in history.
- Provides a record level in FTA (Federal Transit Administration) investments, \$52.6 Billions in 6 years, an increase of 46 % on the quantity guaranteed in the TEA 21.
- Increases the annual funds guaranteed of a level of \$7.2 Billions in 2003 (last year of the TEA 21) to \$10.3 Billions in 2009.
- Retains annual funds guaranteed to assure long term fund stability.



This legislation applies to:

1. The 50 States
2. District of Columbia
3. Puerto Rico
4. US Virgin Islands
5. Guam
6. American Samoa
7. Commonwealth of the Northern Mariana Islands



For additional information about SAFETEA-LU please referred to the following links in the internet:
<http://www.fhwa.dot.gov/safetealu/legis.htm>
http://www.apta.com/government_affairs/safetea_lu/index.cfm

FIRST PUERTO RICAN SUMMIT ON HIGHWAY SAFETY

**November 9-10, 2006
Embassy Suites Hotel
Isla Verde, Puerto Rico**

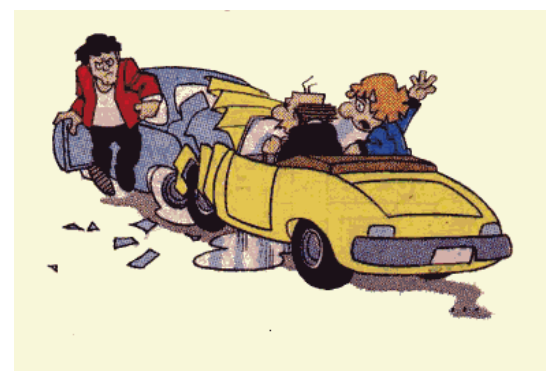
THEME: TOWARDS AN INTEGRATED PREVENTION PUBLIC POLICY

In this event, experts and professionals will participate in panels that integrate topics associated with highway safety in the following areas:

- The Impact of the Increase in the use of Motorcycles in Puerto Rico
- Education and Prevention versus Legislation and Law Implementation
- Traffic Crashes: Public Health Problem or Transportation
- Sociological and Psychological Aspects on Highway Safety in Puerto Rico
- Economic Impact of Highway Crashes
- Highway Safety
- The Concept of Planning and Safety in Highways

In this aspect, that key experts from the academia, the private sector and the government, will contribute with the knowledge and discussion in this area of local, international and global concern of highway safety.

For additional information please contact Felipe Morales Millán, Special Assistant of ACAA. Phone 787-759-8969 ext. 2965, 2970 or Benjamín Colucci Ríos at Puerto Rico Transportation Technology Transfer Center, Department of Civil Engineering and Surveying, Mayagüez Campus, phone 787-834-6385, bcolucci@uprm.edu.



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Actualización de Nuestro Directorio

Ayúdanos a actualizar el directorio del Centro de Transferencia de Tecnología en Transportación completando esta hoja de información y enviándola por facsimil al numero (787) 265-5695. Muchas gracias.

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FUTURE EVENTS



November 9 - 10, 2006

*1st Puerto Rican Summit
of Highway Safety*

*Embassy Suites Hotel
Isla Verde, Puerto Rico*

Sponsor: ACAA

November 14 - 16, 2006

*International Rail Forum (IRF)
Congress and Exhibition on Rails*

Madrid, España

Web Site: www.railforum.net

November 26 - 30, 2006

ALAMYS' XX General Assembly

Buenos Aires, Argentina

Web Site: www.alamys.org

January 21 - 25, 2007

TRB Annual Meeting

Washington, DC,

Contact: Transportation

Research Board

Telephone: (202) 334-2934

Web Site: www.trb.org/

January 28 - 30, 2007

Annual Convention and Traffic Expo

San Antonio, TX,

Contact: American Traffic Safety

Services Association

Telephone: (540) 368-1701

E-mail: general@atssa.com

Web Site: www.atssa.com

The Center staff welcomes your questions and suggestions. To contact the Center, please send all correspondence to the following address:

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