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FHWA STUDY TOUR FOR ROAD SAFETY AUDITS PART 1 - FINAL REPORT

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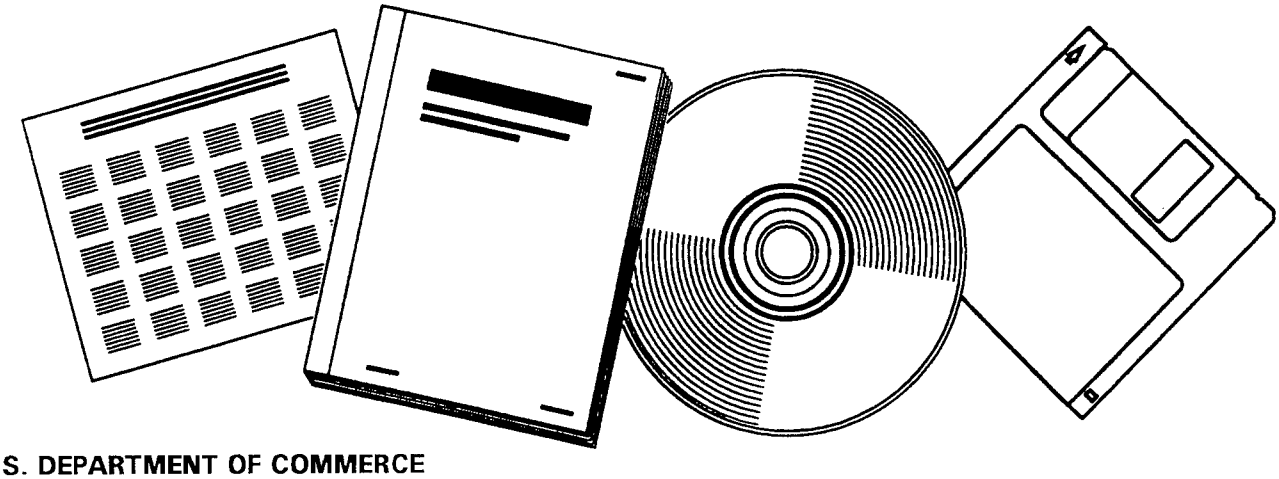

U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

FHWA Study Tour for
Road Safety Audits
Part 1—Final Report

FHWA's
Scanning Program

U.S. Department of Transportation
Federal Highway Administration

December 1997

NOTICES

The contents of this report reflect the views of the authors, who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official policy of the Department of Transportation.

The metric units reported are those used in common practice by the persons interviewed. The United States equivalents to the foreign currency amounts appearing in this report are based on the rates of exchange in effect at the time of the study.

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FHWA Study Tour for

ROAD SAFETY AUDITS
Part 1

Prepared by the Scanning Team:

Michael Trentacoste
FHWA Team Leader

Patti Boekamp
City of San Diego

Leanna Depue
Central Missouri State University

Martin E. Lipinski
University of Memphis

David Manning
Wisconsin DOT

Greg Schertz
FHWA, Region 8

James Shanafelt
Washington State DOT

Thomas Werner
New York State DOT

Eugene M. Wilson
University of Wyoming

and by

American Trade Initiatives, Inc.

Prepared for:
Federal Highway Administration
U.S. Department of Transportation

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FHWA International Technology Exchange Programs

The FHWA's international programs focus on meeting the growing demands of its partners at the Federal, State, and local levels for access to information on state-of-the-art technology and the best practices used worldwide. While the FHWA is considered a world leader in highway transportation, the domestic highway community is very interested in the advanced technologies being developed by other countries as well as innovative organizational and financing techniques used by the FHWA's international counterparts.

International Technology Scanning Program

The International Technology Scanning Program accesses and evaluates foreign technologies and innovations which could significantly benefit U.S. highway transportation systems. This approach allows for advanced technology to be adapted and put into practice much more efficiently without spending scarce research funds to recreate advances already developed by other countries.

Access to foreign innovations is strengthened by U.S. participation in the technical committees of international highway organizations and through bilateral technical exchange agreements with selected nations. The program is undertaken cooperatively with the American Association of State Highway Transportation Officials and its Select Committee on International Activities, and the Transportation Research Board's National Highway Research Cooperative Program (Panel 20-36), the private sector, and academia.

Priority topic areas are jointly determined by FHWA and its partners. Teams of specialists in the specific areas of expertise being investigated are formed and sent to countries where significant advances and innovations have been made in technology, management practices, organizational structure, program delivery and financing. Teams usually comprise Federal and State highway officials, private sector and industry association representatives as well as the academic community.

The FHWA has undertaken over 20 of these reviews and disseminated results nationwide. Topics have covered pavements, bridge construction and maintenance, contracting, intermodal transport, organizational management, winter road maintenance, safety, intelligent transportation systems, planning, and policy. Findings are recommended for follow-up with further research and pilot or demonstration projects to verify adaptability to the United States. Information about the scan findings, and results of pilot programs are then disseminated throughout the country to State and local highway transportation officials and the private sector for implementation.

This program has resulted in significant improvements and savings in road program technologies and practices throughout the United States, particularly in the areas of structures, pavements, safety, and winter road maintenance. Joint research and technology-sharing projects have also been launched with international counterparts, further conserving resources and advancing the state-of-the-art.

For a complete list of International Technology Scanning topics and to order free copies of the reports, please see the inside back cover of this publication.

Website: www.international.fhwa.dot.gov **E-Mail: international@fhwa.dot.gov**

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1.0 INTRODUCTION

1.1 Background

As society approaches the next century, the challenge of enhancing traffic safety is a formidable one. The toll from traffic crashes remains a major health and economic problem in the United States. Each year more than 40 thousand people are killed and 3 million are injured. The estimated societal cost of these crashes is more than US$150 billion each year. Fatality and injury rates, both on the bases of population and vehicle kilometers of travel (VKT), have plateaued for the past several years. This in spite of improvements in vehicle design, including occupant protection, and advances in highway design, specifically the focus on improving the roadside environment.

Other key factors influencing the efforts to improve safety include the following:

- Changing investment strategies, as evidenced by the establishment of the National Highway System. Over one-half of all fatalities occur on this network of streets and highways.

- A shrinking crash-records base as an increasing number of jurisdictions are no longer including property damage in their records systems.

- Declining resources, in terms of both personnel and financial support, at all levels of government.

Confronting the challenge of safety requires proactive strategies that treat the root causes of crashes and levels of severity before they occur. Figure 1 illustrates the relationships among the three primary factors—human, vehicle, and road environment—that contribute to road crashes.[1] Several countries have taken innovative approaches to break the crash-causation chain by focusing on one or more of the factors.

1.2 Purpose and Scope

In 1994, the Federal Highway Administration (FHWA) sponsored an international technology scanning review that focused on Japan, Australia, and New Zealand. Its purpose was to review the application of safety management systems. One of the primary findings was that safety audits were effective in improving highway safety in the countries where they are implemented, specifically Australia and New Zealand. In addition, the Institute of Transportation Engineers (ITE) has included several presentations on safety audits in recent meetings, and the World Bank uses safety audits in its projects. Based on the recommendation of the FHWA study, a follow-up scanning review on highway safety audits was undertaken from October 21 to 31, 1996.

The mission of the safety audits scanning team was to review and document international efforts to enhance highway safety and safety management systems through implementation of safety audit initiatives. The panel researched the processes, policies, and procedures developed and utilized by other countries at various stages of project and program development. In addition, the panel shared information with international counterparts on policies and programs related to safety initiatives in the United States.

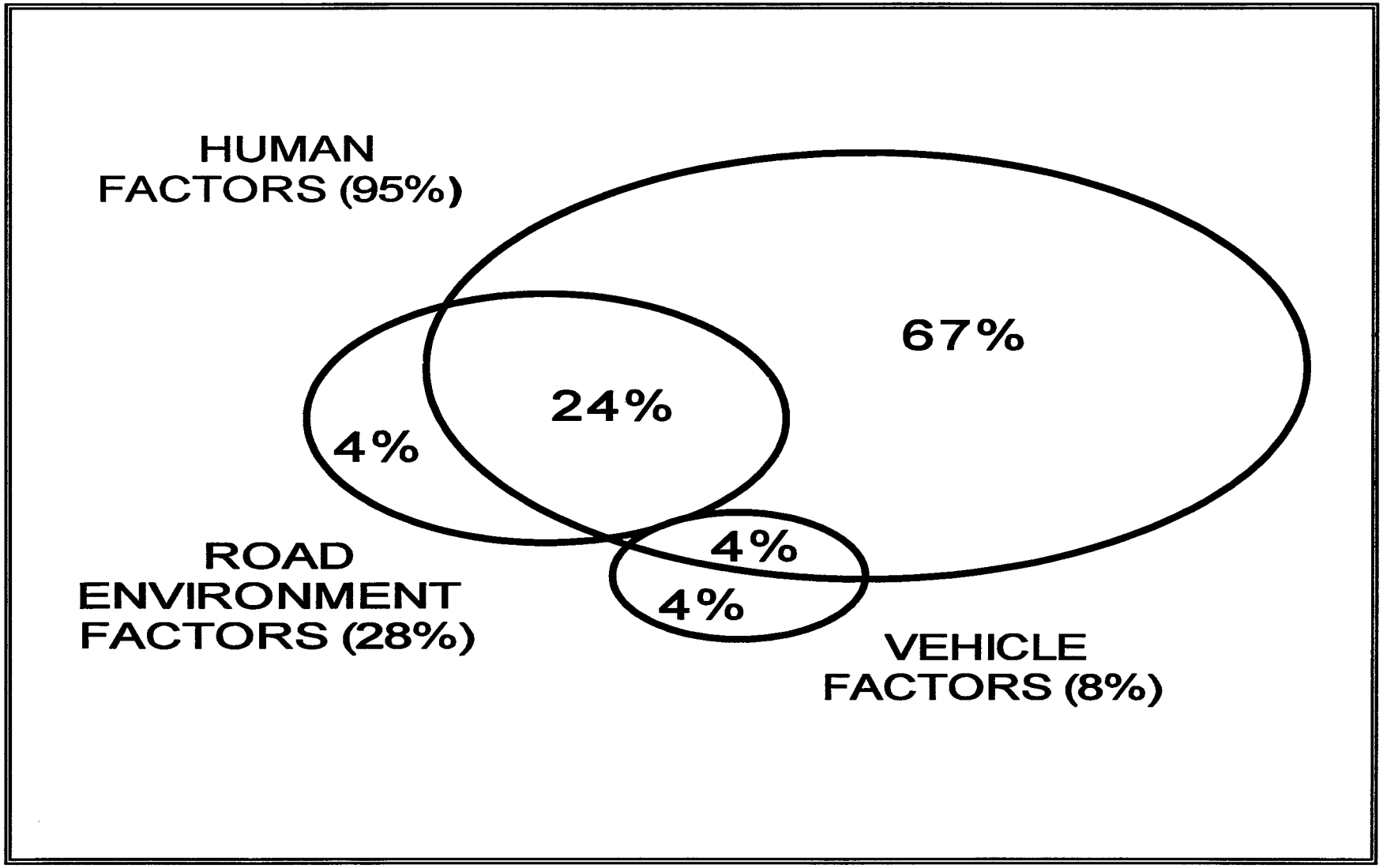

Figure 1. Factors Contributing to Road Crashes
Source: *Road Safety Audits*, Austroads, 1994.

Road safety audits were first introduced and continue to be used in the United Kingdom (U.K.), but the scanning team visited Australia and New Zealand only. In these countries, safety audit concepts have been expanded and integrated into the overall safety programs at the federal and state levels. Because practices varied among agencies, it was possible to review several different approaches to the planning and application of road safety audits.

1.3 Definition

As defined by Austroads, a road safety audit is *"... a formalized examination of an existing or future road or traffic project or any project which interacts with road users, in which an independent, qualified examiner reports on the project's accident potential and safety performance."*[2] Austroads is the counterpart of the American Association of State Highway and Transportation Officials (AASHTO).

1.4 History

The development of roadway audits is generally attributed to Malcolm Bulpitt of the United Kingdom. In the 1980's, Bulpitt applied safety audit concepts that were originally introduced on railroad networks during the Victorian Period. At that time, the government appointed officers to inspect all aspects of a new railway line before it could be opened for use. Bulpitt applied the concept of independent checking to improve operational safety on road projects carried out by the Highways and Transportation Department of the Kent County Council.[3]

Safety audit procedures were developed by other county councils and metropolitan governments. The Scottish Development Department made the procedures operational one year earlier than the equivalent English agency. The Institution of Highways and Transportation published "Guidelines for the Safety Audit of Highways" in 1990.[4] By April 1991, the U.K. Department of Transport made safety audits mandatory for all national trunk roads and motorways (freeways) over a specified cost.[5]

Road safety audits were introduced in the State of New South Wales (NSW), Australia, in 1990, when the audit of the Pacific Highway used specially prepared checklists. (It is interesting to note that NSW began with an audit of an existing roadway, not a proposed scheme.) In 1994, the Austroads guide *Road Safety Audit* was published.

Transit New Zealand was created in 1989, and, in 1990, the first safety audit manager was appointed to conduct postconstruction safety audits. In 1992–93, pilot audits were conducted on state highway projects, and by 1993 a set of policies and procedures was developed and implemented.[6]

1.5 Overview of Report

This report is a summary of the findings of the FHWA scanning team that visited Australia and New Zealand in October 1996. The objective of the document is to provide an overview of the organization and application of road safety audits. It is not the purpose of the report to serve as a handbook or guide for using road safety audits; it is a collection of observations that describe the applications of the process, the framework in which audits are applied, and the policy context in which audits are conducted. Examples and brief descriptions of audits are also presented. Part 2 of this report is a separate volume that contains examples of

actual road safety audits and specific safety audit procedures and checklists.

Part 1 of the report has five main sections:

1. Introduction

2. Overview of Countries and Safety Organizations

3. The Road Safety Audit Process

4. Summary of Scanning Team Findings

5. Strategies for Advancing Road Safety Audits in the United States

1.6 Scanning Team Members

The scanning team consisted of the following representatives of FHWA, States, cities, and academe:

Michael F. Trentacoste, Team Leader
Director, Office of Highway Safety
Federal Highway Administration

Patti Boekamp
Deputy Director, Engineering & Capital Projects
City of San Diego

Leanna Depue
Director, Missouri Safety Center
Central Missouri State University

Martin E. Lipinski, Report Facilitator
Professor and Chair, Department of Civil Engineering
University of Memphis

David Manning
Director, Transportation Safety Office
Wisconsin DOT

Greg Schertz
Regional Safety Engineer
Federal Highway Administration, Region 8

James Shanafelt
Assistant State Traffic Engineer
Washington State DOT

Thomas Werner
Director, Traffic Engineering and Safety
New York State DOT

Eugene M. Wilson
Director, Wyoming T^2 Center
University of Wyoming

The team developed a list of technical questions that were distributed to the hosting organizations in advance of the team's visit. Appendix A is the list of questions, which were grouped into four categories:

1. Institutional/Organizational Issues

2. Implementation Strategies and Issues

3. Informational and Data Requirements

4. Identification and Quantification of Benefits

Appendix B is a list of the names, titles, addresses, and phone numbers of the individuals in Australia and New Zealand who participated in the discussions.

1.7 Comparison of Demographics

The demographics of the countries visited and, for comparative purposes, the United States are summarized in Table 1. This table also contains separate data for Victoria and New South Wales, the most populous states in Australia. Safety programs in these states

were reviewed during the tour. Table 2 summarizes crash statistics for the countries visited, the United States, and the States of Victoria and New South Wales.

1.7.1 United States of America

The United States has a population of about 260 million, living in an area of 9,158,404 km^2. The National Highway System consists of 250,000 km of roadways, of which 68,395 km are interstate highways. There are approximately 1.5 million km of state primary and secondary highways and 4.8 million km of local roads and streets. For the past 5 years, the number of motor vehicle-related fatalities has remained at approximately 40 thousand per year (41,798 in 1995), and the average fatality rate per 100 million VKT is 1.1.

1.7.2 Australia

The area of Australia is 7,700,000 km^2, similar to that of the continental United States. Its population of 18.1 million is concentrated along the coasts—40 percent live in the two cities of Melbourne and Sydney. Melbourne is in the State of Victoria, and Sydney is in the State of New South Wales. The road system consists of 810,000 km of roads, of which only 18,500 km are in the National Highway System. About 2,000 people are killed each year in roadway crashes, with a corresponding fatality rate of 1.7 per 100 million VKT.

1.7.3 New Zealand

New Zealand is similar in size to the State of Colorado. Its north and south islands comprise an area of 278,000 km^2. The population of 3.6 million is concentrated on the North Island in the cities of Auckland and Wellington, which is the capital. New Zealand has 91,864 km of roads, of which 10,400 are classified as national (state) roads. The remaining are local roads; as the country is not divided into states. There were 581 fatalities in 1995, with fatality rates of 2.5 per 10,000 vehicles. The estimated fatality rate per 100 million VKT is 1.8.

Table 1. Comparison of Country and State Demographics

Characteristic	United States	Australia	State of Victoria	State of New South Wales	New Zealand*
Area (km^2)	9,158,408	7,686,850	227,600	801,600	278,000
Population (millions)	260	18.1	4.5	6.1[1]	3.6
Population Density	28.4	2.4	19.8	7.6	12.9
Motor Vehicles	202	10.95[2]	2.87[2]	3.33[2]	2.49
Total Roads (km)	6,319,276	810,000	161,130	184,239	91,876
Federal Roads (km)	277,000	18,500	944	3,028	n.a.
State Roads (km)	1,291,000	152,000	21,772	36,322	10,453
Local Roads (km)	4,720,000	639,500	138,384	144,889	n.a.
Urban Roads (km)	1,319,000	n.a.[3]	28,809	n.a. [3]	15,286
Rural Roads (km)	4,977,000	n.a.[3]	132,321	n.a. [3]	66,137

(1) Population as of June 30, 1995.
(2) Vehicles registered in 1995, including motorcycles, excluding trailers.
(3) No uniform definition exists for the urban/rural split. Victoria figures based on 300 largest urban areas.

Table 2. Crash Statistics

Statistic	United States	Australia	State of Victoria	State of New South Wales	New Zealand*
Fatalities (per 100,000 of population)	15.9	11.2	9	10.14	15.9
Fatalities (per 100 million km of travel)	1.1	1.7	1	1.5	1.8
Fatalities and Injuries (per 100,000 population)	1,304	n.a.[1]	523	435	not available
Fatalities and Injuries (per 100 million km of travel)	88.6	n.a.[1]	540	490	not available
Total Crashes	10,700,000	n.a.[1]	41,000	52,120[1]	34,525
Fatalities	39,000	1,825 (2,018)[2]	371 (418)[2]	620	581
Injuries	1,400,000	n.a.[1]	16,898 (23,686)[3]	19,223[1]	16,870

(1) Australia-wide injury figures are not available because there is no standard definition for "injury" levels. Similarly, figures for Victoria and New South Wales cannot be directly compared.
(2) First figure is number of crashes in which a death occurred. Figure in parentheses is number of persons killed.
(3) First figure is number of crashes in which at least one person was injured. Figure in parentheses is number of persons injured.

* Figures provided by LTSA

2.0 OVERVIEW OF COUNTRIES AND SAFETY ORGANIZATIONS

2.1 Introduction

In both Australia and New Zealand, the introduction of audits was an element of comprehensive programs to improve roadway and traffic safety. In each country, an environment was created that recognized the importance of cooperative efforts among government, industry, the public, and safety advocacy groups to achieve safety objectives. The establishment of a "safety culture," evident in both countries, was accomplished through broad approaches that included marketing strategies, sound funding bases, and commitment from the highest levels of government.

It is important to note that the commitment to roadway safety was being made as both countries were implementing quality management philosophies into both private and public administrative practices. Thus, safety objectives and the overall safety programs were crafted within frameworks that emphasized all aspects of quality-improvement programs and the formalized process that accompanied the quality philosophy.

This section provides an overview of the organizations and structures of transportation and road safety-related activities in the countries and states visited by the scanning team. More detailed descriptions of the functions of individual agencies and the development of safety policies are in Part 2. Supplemental information pertaining to general road safety activities in Australia and New Zealand can be found in the summary reports prepared by two previous FHWA scanning tours.[7 8]

2.2 Australia

2.2.1 Transportation and Road Safety Organizations

The cabinet-level organization responsible for transportation is the Department of Transport and Regional Development (DTRD). DTRD is structured along modal lines, much like the US DOT. In Australia, the states and territories generate most of the initiatives relating to the roadway transportation system and its safety. DTRD is responsible for the National Highway, a system of 18,500 km of roads that links the major cities and is the backbone of the freight transportation system.

The Federal Government spends about A$800 million (US$640 million) per year on construction and maintenance of the National Highway. Funding is provided directly to states and territories.

The Federal Office of Road Safety (FORS) is the agency within the DTRD that is responsible for road safety. Its mission is to reduce road trauma. FORS has two major branches, whose responsibilities are shown in the box on the following page.

FORS is only one of many organizations involved in setting the National Road Safety Policy. The Ministerial Council for Road Transport consists of the Ministers of Transport from each of the six states, the two territories, and the Commonwealth Minister of Transport. These same entities also form another group, the Australian Transport Council, which is responsible for implementing the national road safety strategy.

Branches of FORS	
Road User	Motor Transport
Strategies & Black Spots	Client Operations
Road Transport Regulations	International Projects
Statistical Analysis	Vehicle Standards, R&D
Research	Policy & Emissions
Public Education & Liaison	----------

In 1992, the National Road Transport Commission was formed to develop nationally consistent standards and regulations for road transport. It provides information and research and drafts road-related laws for consideration by the Transport Council.[9] The Commission receives input from a variety of advisory groups and other entities, including state transport agencies, Austroads, and ARRB Transport Research, Ltd. (ARRB TR), formerly the Australian Road Research Board. Austroads is an organization similar to AASHTO. ARRB TR conducts research of national interest for the Commonwealth, for the states and territories, individually or collectively (through Austroads), and is increasingly seeking private work.

2.2.2 National Road Safety Strategy

The National Road Safety Strategy was developed in 1992 and was Australia's first national, comprehensive approach to reduce traffic fatalities. It was formulated at a time when road fatalities were decreasing, but during a period when data indicated that

- Australia was in a period of economic recovery,
- population was growing,
- vehicle fleet was growing, and
- greater use of automobiles was projected.

The document set forth objectives, through the year 2000, to reduce road trauma and was prepared with contributions from more than 70 stakeholders. These included federal, state, and local governments, business concerns, and community organizations.

2.2.3 Safety Audits

Road safety audits are part of the National Road Safety Strategy. The audit process is addressed in one of the objectives—safer vehicles, safer roads, and safer road users. FORS identified road safety audits as one of the national "best practices" that could be implemented to meet safety objectives, and the Austroads publication, *Road Safety Audit*,[10] is used as a guide to good practice. FORS supports a proactive, rather than reactive, approach to road safety and serves as coordinator of the process, bringing all parties together. The states and territories are responsible for implementing and monitoring road safety audits.

2.2.4 Road Safety Funding

In 1993–94, the level of federal road funding was A$1,532 million (US$1,226 million), and it has been increasing at approximately 2 percent per year. About A$800 million (US$640 million) of these funds are designated as direct funding for the National Highway System. From 1993–94 to 1996, A$6 million (US$4.8 million) was allocated as direct funding to the states and territories for road safety. The remaining funding is distributed to the states and territories for national arterials and local roads. Starting in fiscal 1996, A$36 million (US$28.8 million) was earmarked directly for a hazard elimination (black spot) program.

2.3 Victoria

In Victoria, the primary government responsibility for road safety lies with the Ministry of Roads and Ports. The principal transportation agency for the state is the Victoria Roads Corporation, known as VicRoads. VicRoads is a statutory corporation formed by parliament in July 1989, during a period of privatization of government services. It was created from two acts: the Transport Act, which identified the road and transportation management functions; and the Road Safety Act, which focused on vehicle registration, driver licensing, and traffic regulations.

VicRoads is organized into four divisions:

- Road Safety
- Road Systems Management
- Traffic and Road Use Management
- Registration and Licensing

Each division is headed by a general manager, who reports to the chief executive. Under each general manager are regional and project managers to supervise individual programs and projects. For example, the Road Safety section is responsible for road safety audits, black spot programs, speed management, and elimination of hazardous roadside obstacles.

2.3.1 Road Safety Strategy

In 1995, the Victoria government developed a comprehensive strategy, known as "Safety First." Safety First was designed to build on successful programs and specify areas for action in the following five years. The primary objective of the strategy is to further reduce the incidence, severity, and cost to the community of road crashes. These goals will be achieved through improved research and education, continued media campaigns that focus on attitudes and behaviors, attention to design and safety features of roads and vehicles, stringent enforcement of road laws, and coordination of efforts by all related agencies.[11]

2.3.2 Road Safety Audits

Road safety audits have been under development in Victoria for three years. VicRoads considers audits to be a critical element in the quality management process and a chance to improve quality with little increase in cost. All projects that cost more than A$5 million (US$4 million) at all stages are subject to safety audits. Twenty percent of all other projects are audited randomly at one or more of the project stages. Safety audits in Victoria are conducted by independent contractors selected by VicRoads.

2.4 New South Wales

The Roads and Traffic Authority (RTA) has executive responsibility for road safety in New South Wales. RTA works with other stakeholders such as police, local government, and the community to carry out the safety agenda.

Management of RTA is decentralized, though it should be noted that RTA is not as privatized as VicRoads and is a more traditional government structure. RTA has programs and services in six regions in the state, and each region has primary responsibility for implementing road safety programs in its area. Programs are based on

regional as well as overall state safety objectives to ensure that local issues are addressed. Links between the RTA and professional organizations, community groups, and other government units are provided through the Roads and Traffic Advisory Council, the Road Safety Advisory Council, and the Road Safety Forum.

2.4.1 Road Safety Strategy

In 1991, NSW developed a road safety strategic plan, "Road Safety 2000." The plan identified six key strategic issues:

1. Community involvement
2. Transport and land-use planning and management
3. Safer people
4. Safer roads
5 Safer vehicles and equipment
6. Strategic coordination

2.4.2 Road Safety Funding

Funding for RTA safety programs exceeded A$80 million (US$64 million) in 1995. Of that total, A$30 million (US$24 million) was used to fund road safety development programs, such as community-based initiatives, enforcement, and information programs. An additional A$30 million (US$24 million) funded the Road Environment Safety Program.

2.4.3 Road Safety Audits

Road safety audits are addressed specifically under the "safer roads" objective in the Road Safety 2000 Strategic Plan. The plan states that the application of the safety audit process to all roads in NSW will ensure that safety aspects are properly addressed in all development activities.[12]

Road safety audits began in NSW in 1990, and, by the middle of 1991, RTA developed a road safety audit manual. Road safety audits are sold as part of the overall quality management approach in the state—the emphasis is on safety in all aspects of a project. Each year 20 percent of the existing roadways in each region are audited, and approximately 20 other design audits are conducted. The goal was to cover the entire state roadway network in five years.

2.5 New Zealand

In 1989, the government underwent massive reorganization, based on a commitment to quality concepts and privatization of its functions. The State Sector Act of 1988 provided for the reorganization of government into "crown agencies." Crown agencies are government corporations that are headed by chief executives, who are responsible to Crown Authorities. Six crown entities report to the Minister of Transport. They are

- Civil Aviation Authority,
- Maritime Safety Authority,
- Land Transport Safety Authority,
- Transport Accident Investigation Commission,
- Transfund New Zealand, and
- Transit New Zealand.

2.5.1 Management of Road Safety

The main agencies responsible for road safety in New Zealand are as follows:

- Ministry of Transport is responsible for provision of overall policy advice to the Minister, in addition to legislation and long-term strategy development.

- Land Transport Safety Authority (LTSA) is responsible for establishing standards for entry to the system and for monitoring adherence to them, reviewing the Land Transport system and investigating crashes. It is also responsible for managing the Safety (Administration) Programme (S(A)P).

- New Zealand Police is responsible for traffic law enforcement, driver testing, and heavy vehicle regulation enforcement.

- Transit New Zealand (TNZ) is responsible for managing the state network.

- Transfund New Zealand is responsible for the allocation of monies from the National Roads Account to road and other agencies to achieve a safe and efficient road system.

Funding for safety programs is provided through two main mechanisms: the Safety (Administration) Programme and the National Roadway Program (NRP). (The NRP was formerly referred to as the Land Transport Programme.) S(A)P is managed by LTSA and funds police road safety programs, community projects, and the LTSA. NRP is administered by Transfund New Zealand, which funds highway maintenance and construction and provides financial support to local authorities.

At the national level, there are several bodies that coordinate safety. The National Road Safety Committee is composed of the chief executives of the national government agencies involved in road safety, and the National Road Safety Advisory Group includes representation from many national agencies and organizations interested in road safety. At the local level, regional councils are responsible for developing the 14 Regional Land Transport Strategies, which include safety components.

2.5.2 Road Safety Strategy

New Zealand has a National Road Safety Plan that was instituted in 1990 and revised in 1995. It is administered by the National Safety Road Advisory Group and includes a safer roads priority area, of which road safety audits are a part. Safety audits are identified as a policy and procedure of TNZ and are indirectly linked to the National Road Safety Plan.

2.5.3 Road Safety Funding

As mentioned earlier, LTSA admisiters the S(A)P, which focuses on regulatory and behavioral issues. The program includes more than NZ$25 million (US$18.25 million) for dissemination of safety information, monitoring safety activities, and auditing commercial vehicle fleets. These audits, known as performance audits, are evaluations of the functions and services delivered, and not road safety audits. The program also includes about NZ$188 million, including GST, (US$137.25 million) for police activities.

2.5.4 Road Safety Audits

Road safety audits were introduced in New Zealand in 1990. In 1993, TNZ published "Safety Audit Policy and Procedures," which stated that all projects costing more

than NZ$5 million (US$3.65 million) would be audited at all stages of project development. Smaller projects are only audited at later stages.

TNZ implements the policy based on a 20-percent sample of state highways, but with no guidelines as to which ones should be included in the sample. Transfund New Zealand provides the funding for the safety audit program.

3.0 THE ROAD SAFETY AUDIT PROCESS

3.1 Introduction

The widespread growth in the use of road safety audits is due to two factors: the concern with improving road safety and the application of quality-assurance principles to road projects. At all agencies visited by the scanning team, at the national level in Australia and New Zealand and in Victoria and New South Wales, comprehensive strategies to reduce the crash toll have identified safety audits as a part of the overall strategic approach. In both countries, a safety culture has been established. The safety culture is embraced by national, state (in Australia), regional, and local governments, and it requires an unequivocal commitment to safety, starting at the top and filtering down through an organization. It includes emphasis on prevention as well as corrective action and requires high levels of coordination among all entities with safety concerns—engineers, police, educators, community groups, and others.

The establishment of a safety culture is tied directly to the application of quality principles. In both countries, quality-assurance principles are central to the evolution and reorganization of government functions, especially with respect to privatization of activities. As agencies shift focus from operations to policy and management, evaluation of the quality delivered is gauged by measuring safety accomplishments. Continual improvement is a key concern. The road safety audit is a snapshot in time that checks to see if the quality is being implemented. Safety audits are considered an integral and necessary component of a quality road safety management program.

3.2 Definition and Purpose

As stated earlier, Austroads defines a road safety audit as *"... a formalized examination of an existing or future road or traffic project or any project which interacts with road users, in which an independent, qualified examiner reports on the project's accident potential and safety performance."*[13] The definition used by the RTA is *"a means of checking the design, implementation, and operation of roads projects against a set of safety principles as a means of accident prevention and treatment."*[14] The purposes of audits are to identify potential safety problems for all road users and others affected by a road project and to ensure that measures to eliminate or reduce problems are considered fully. Emphasis is placed on preventive measures and building road safety into projects.

Austroads identified the following benefits of conducting road safety audits:

- Reduced likelihood of crashes on the road network.
- Reduced severity of crashes.
- Increased prominence of road safety in the minds of road designers and traffic engineers.
- Reduced need for costly remedial work.
- Reduced total cost of a project to the community, including crashes, disruption, and trauma.[15]

Engineering standards and guidelines form the foundation for the design process. They are, however, developed with many objectives—not just safety—in mind. Strict application of engineering standards may not always result in the safest road environment, and road safety audits focus only on the safety elements. Identifying a problem and making changes to a design is more economical and can result in greater crash reduction than subsequent remedies.

3.3 Relationship of Safety Audits to U.S. Safety Management Practices

In the United States, road safety audits have not been adopted as a formal process. Ross et.al. compared road safety audit practices with safety reviews in the United States, pointing out that both approaches are aimed at achieving the same objective—to prevent crashes by incorporating highway safety principles in the planning, design, construction, and operation of roadways.[16] They also identified some significant differences between the two approaches, particularly that audit procedures are more formalized and structured in conducting reviews and in reporting. They also emphasized the important difference that, in the United States, the approach is to review compliance with standards rather than the interaction of standards in the final design.

Appleton and Jordan point out that the 1991 FHWA publication "Management Approach to Highway Safety: A Compilation of Good Practice" recognizes the need to establish processes to consider safety in the development and construction of highways.[17] Safety audits are not specifically mentioned but, if applied, would satisfy objectives for a comprehensive approach to safety, as outlined in the report. The road safety audit process is a systematic means of dealing with the safe design, construction, and operation of the highway infrastructure.

3.4 Essential Elements of a Road Safety Audit

The essential elements of a road safety audit are that as follows:

- It is a formal process.
- It is an independent process.
- It is carried out by a team or individual with appropriate experience and training.
- It is restricted to road safety issues.
- The outcome is a report that identifies road safety deficiencies and, if appropriate, makes recommendations aimed at removing or reducing deficiencies.
- The report must be formally addressed by the appropriate roadway decision-makers.

3.5 Stages of the Road Safety Audit

There are five stages in which road safety audits can be conducted:

Stage 1: Feasibility
Feasibility-stage audits are conducted in the early planning and project development. These audits evaluate options such as route locations, layouts, treatments, interchange locations and type access control, impacts on the existing road network, and other features. Assessment of the relative safety performance of the proposed project and how it meets the needs of all road users (motorists, pedestrians, bicyclists) is

conducted at this stage. Figure 2 shows a Stage 1 audit in progress, with the audit team and plan layout in the field.

Stage 2: Draft Design

At this stage, sometimes referred to as "preliminary design," general design standards are evaluated. Horizontal and vertical alignment, intersection and interchange type and layout, sight distances, lane and shoulder widths, superelevation, and provisions for pedestrians and bicyclists are some of the factors considered at this stage. Any effects on safety resulting from deviation from standards are noted at this point. After this stage it is very difficult to make changes in alignment, because land acquisition has been finalized. Figure 3 shows an aerial photo of a plan layout.

Stage 3: Detailed Design

All elements of the final design should be in place at this time. A detailed design-stage audit reviews the final geometric design features, traffic signals, signing and marking plans, lighting plans, landscaping, intersection and interchange details, provisions for special users (older pedestrians, the disabled, bicyclists), drainage, guide rails, and other roadside objects. Stage 3 also may involve a review of the plan for traffic control and management during construction (see Figure 4).

Stage 4: Pre-Opening

Pre-opening is a final check, prior to opening, to ensure that the safety concerns of all road users have been addressed and that hazardous conditions have been eliminated. Stage 4 audit should include both day and night checks, evaluations in wet and dry weather, and driving, riding, and walking, if appropriate. A major focus of Stage 4 is to note variations from the original plans that may have been constructed.

Figure 2. Feasibility-Stage Audit

Figure 3. Draft Design-Stage Audit

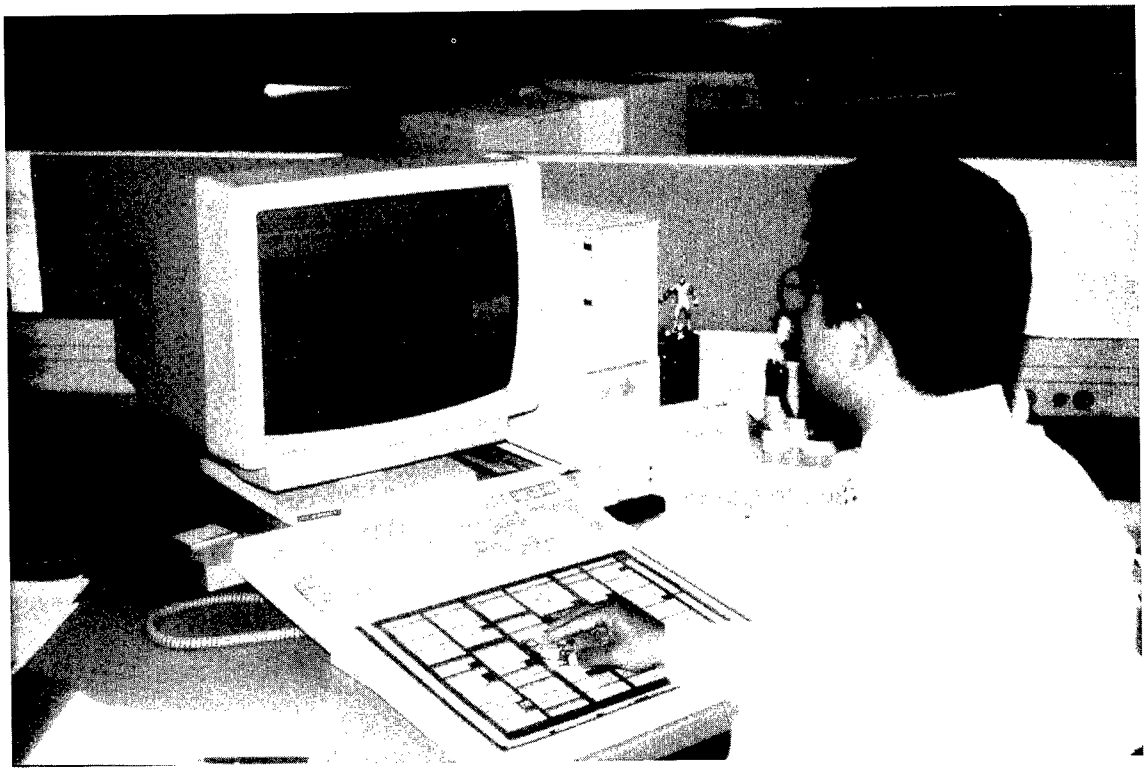

Figure 4. Detailed Design-Stage Audit

(Note that VicRoads identifies the "Construction Audit" as a particular stage performed during the building of a project wherein safety considerations are evaluated as the project is being constructed. Its function is similar to that of a pre-opening audit, but it also may include evaluation of the traffic management and control plans.)

Stage 5: Existing Roads
These audits are performed on existing facilities to ensure that the safety needs of road users are being served. Stage 5 involves recognition that the use of a roadway may change over time. (Note that the Stage 5 audit differs from processes reviewing crash history and treatment of known high-crash locations, referred to as "black spot" programs.) Stage 5 audits may be performed on a road section newly opened to traffic to evaluate its performance or it can be used to identify safety deficiencies on existing roads. Intersections, roadway segments, and roadside features are some of the elements that may be examined in an audit of an existing roadway. (In New Zealand, the audit of existing roads is considered a separate process. Stages 1 to 4 apply to a project, and Stage 5 applies to a network.)

Audits are not conducted at each stage for each project because of limited resources or other considerations. It is, however, recognized that "... the earlier a road is audited within the design and development process, the better."[18] Table 3 contains a listing of reasons why audits should be conducted at each of the five stages of a project.

3.6 Selection of Projects

Road safety audits can be conducted on a variety of projects ranging from construction of new freeways to signal upgrades to roadside improvements. The types of projects audited and the stages at which audits are conducted varied among agencies visited by the scanning team. The following policies were reported during the review:

- VicRoads audits all projects over A$5 million (US$4 million). Projects are audited at all stages. Random samples of 20 percent of other new projects also are audited; these are not audited at every stage. Audits are also recommended for 10 percent of all maintenance works and for the worst 30 percent (based on crash data) of each region's route network.

- In New South Wales, the RTA attempts to audit 20 new construction projects and 20 percent of the existing road network each year.

- The TNZ policy for new projects is to require safety audits at all stages for projects whose costs exceed NZ$5 million (US$3.65 million). For these major projects, the audits and their timing within the development of new projects are strictly defined as shown in Figure 5. For projects in the range of NZ$100,000 to NZ$5 million (US$7,300 to US$3.65 million), audits are required at Stages 3 and 4 and are optional at the other stages.

Table 3. Reasons for Conducting Audits

Stage 1 Feasibility	Stage 2 Draft Design	Stage 3 Detailed Design	Stage 4 Pre-Opening	Stage 5 Existing Roads
Greatest scope to influence safety	May not have audited at Stage 1	Audits may not have been done at previous stages	Audits may not have been done at previous stages	Uses of the road change over time
Input safety into the consideration of options	Identify items missed at Stage 1	Identify items missed in previous stages	Identify items missed in previous stages	Uses next to the road change over time
Avoid "locking in" problems when land is acquired or designs are finalized	Avoid wasting costly design time	Check what standards have been used and departures from standards	Check interrelationships of elements; may look fine on plans but not on site	Attend to changes before they lead to crashes
Identify affected road user groups	Check what standards have been used and departures from standards	Check signing, marking, and landscaping plans	Check project is built as designed	Landscape grows
Check compatibility with road type and user expectations	Check that all likely users have been considered	Check details of operation	Designs and incidentals may get changed, on site	Accepted practices change with experience
Check design standards with road type and user expectations	Check intersection layouts and conflict points	Check interaction of detailed elements	Add or expand landscape	Check consistency of road features
Consider number, spacing, and types of intersections	Alert designers to areas where attention will be needed later	Check details at connections to existing roadways for consistency	Check for nighttime visibility and/or potential confusion	Devices age, over time; possible reduced visibility, reflectivity
Consider effects in transition areas, away from the project—environment, consistency, etc.	Check details at connections to existing roadways for consistency		Unplanned hazards, such as poles, etc.	Devices become damaged or dangerous; maintenance may not result in safety
			Signs may get lost in their backgrounds	Specifically address safety, rather than relying on routine or poor maintenance

Source: Robert Morgan, Informal Notes, October 1996.

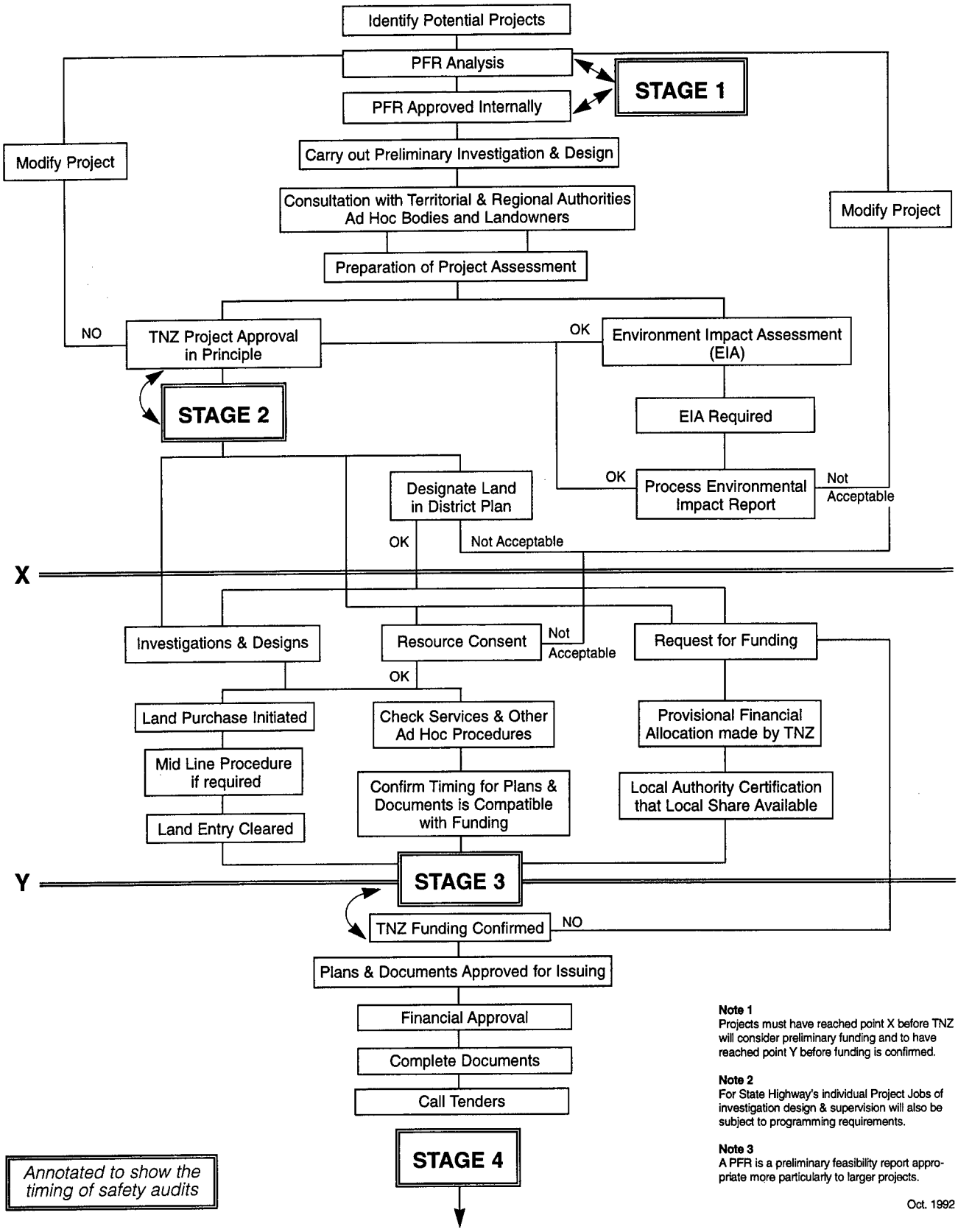

Figure 5. Project Development Requirements

Source: "Safety Audit Policy and Procedure," Transit New Zealand, August 1993.

Reproduced with permission from Transit New Zealand.

Audits are optional at all four stages for projects costing less than NZ$100,000. In addition, policies require audits for a 20-percent sample of projects. In New Zealand, the audit stages are defined slightly differently:[19]

Stage 1: Feasibility (Project Feasibility Report Analysis)

Stage 2: Scheme Assessment (at completion of Project Evaluation)

Stage 3: Final Design (at completion of the design)

Stage 4: Pre-Opening (immediately before "substantial completion" of construction and prior to removal of temporary traffic control)

Selection of the specific projects to be audited is partly a function of an agency's organizational structure. For example, at VicRoads, project supervisors in the regions initiate the audits. The selection of projects to be audited (excluding the required audits for major new projects) is made at the regional level. In New South Wales, RTA also relies on the regional managers to identify projects to be audited. In New Zealand, Transit Regional State Highway Managers select the sample of projects to be audited (again, excluding major new construction).

3.7 Organizing a Road Safety Audit

3.7.1 Auditor Qualifications

A road safety audit is performed by an individual or team with expertise in one or more areas of road safety. Typical backgrounds include traffic or transportation engineering, highway design and construction, crash investigation and analysis, and human factors/road-user behavior. Ideally, it is desirable to have a team of individuals rather than a single auditor for the following reasons:

- Diverse backgrounds and different approaches of different people are beneficial.
- The cross-fertilization of ideas that can result from discussions is helpful.
- More "pairs of eyes" are an advantage.[20]

While it is not always feasible or practical to use a team in conducting audits, it is very important that auditors possess an understanding of traffic engineering and road design techniques and have some experience in crash investigation. An understanding of human factors is also important, because of the strong interaction between road users and road environment.

The scanning team observed that most audits were conducted by individuals with strong backgrounds in traffic engineering or roadway design or were performed by teams led by people with similar backgrounds.

3.7.2 Methods of Organizing a Road Safety Audit

There are three distinct ways of organizing a road safety audit:

- Audit by a specialist auditor or team
- Audit by other road designers
- Audit within the original design team

The first arrangement is preferred. By selecting an outside individual or team, two of the key elements of a road safety audit—independence and the use of experienced and educated auditors—can be controlled. An audit completed by other road designers has the disadvantage of restricting the review to individuals who may not have the breadth of experience to evaluate the project from the perspective of the road user. Having personnel from the original design team conduct the audit has the disadvantage of possible bias. Those involved in the original project may be too familiar with the design to effectively evaluate safety issues without prejudice.

The success of the road safety audit process depends on trust and commitment from all parties. Audits identify deficiencies and may be viewed as threatening to road designers. It is critical that the focus be on the process and not be viewed as criticism of the project or, more importantly, of the skills of the designers. A designer may have legitimate reasons for making decisions that consider factors other than safety in the proposed design, and the compromise could be identified in the audit. Factors influencing a decision would be identified in a response to the safety audit.

3.7.3 Selection of Auditors: Summary of Current Practice

Each agency visited by the scanning team has established its own procedures for selection of road safety audit teams or individuals. The processes of each agency are summarized below.

- VicRoads uses both internal staff and consultants to conduct audits. It has had success using agency staff because a "safety culture" has been created within the organization. Consultants are selected from a list of qualified and interested firms. For major design and construction contracts, VicRoads requires that an independent auditor be hired by the prime contractor to carry out road safety reviews throughout project development and construction.[21]

- In New South Wales, the RTA has road safety audit teams composed of two to four individuals selected from a list of people who are independent of the road or road project being audited. Auditors are chosen from another district, zone, or region, or from corporate directorates. Qualified consultants are also used to conduct audits. (Again, it should be noted that VicRoads has significantly privatized its overall organization, while RTA is a more traditional government.)

- All audits for TNZ are conducted by private-sector consultants. Some local governments (Territorial Local Author-ities, or "TLAs") may use their own staff or private consultants.

3.8 Conducting the Road Safety Audit

3.8.1 The Process

Austroads has identified steps and designated responsibilities for conducting a road safety audit, as shown in the box on the following page.[22]

The Austroads guide,[23] the RTA *Road Safety Audits*,[24] and the TNZ *Safety Audit Policy and Procedures*[25] publications contain

Step	Entity Responsible
Select Auditor	Client or Designer
Provide Background Information	Designer
Hold Commencement Meeting	Client/Designer and Auditor
Assess Documents and Inspect Site	Auditor
Write Report	Auditor
Hold Completion Meeting	Client/Designer and Auditor
Follow Up	Client and Designer

detailed descriptions of issues to be considered in each step of the process.

3.8.2 Data Requirements and Checklists

The core process of the road safety audit is focused on a series of standard checklists. Checklists have been developed by Austroads, by TNZ, and by individual agencies for use by auditors in evaluating safety at each stage of the audit process. Each agency emphasized that checklists should be used to prompt the auditors in their evaluations. Auditors indicate the areas that should be investigated and where further analyses are needed.

The data base for conducting an audit should include plans and drawings; site information, such as detailed crash history and traffic volumes; design standards that have been used; environmental effects; and on-site evaluations, which examine a location from the perspective of the road users (motorists, pedestrians, or bicyclists). This last element is particularly important and should encompass a review of all types of movements, special needs of the elderly or disabled, and weather and environmental problems.

3.8.3 Writing the Report

In writing the report, it is essential to emphasize the purpose of the document. It should identify safety deficiencies, not develop recommended treatments. All agencies that the team visited made it clear that it is very important to focus on the point that the report is not a critique of the original design but is an identification of potentially hazardous conditions. The report may contain recommendations for mitigating problems, but it should not contain detailed descriptions of solutions. TNZ suggests that problems be clearly identified by number and, possibly, by ranking into two or three categories. RTA specifies a "Corrective Action Request" (CAR) that assigns priorities as "immediate," "necessary," or "desirable." VicRoads emphasizes the inclusion of photographs to help readers visualize the problems.

3.8.4 Agency Concerns

The following are some of the key issues relating to the conduct of audits that were identified during the scanning tour:

- VicRoads emphasized the importance of establishing professional relationships among all parties involved in the process. The need to get local agencies to "buy-in" to the audit activity also was stressed.

- RTA mentioned several key points to be considered in monitoring road safety audits:

  ✓ Monitor what is being audited.

  ✓ Keep track at what stages the audits are being performed.

- ✓ Who is doing the auditing? Are they suitable?
- ✓ Are we getting what we are paying for?
- ✓ Are corrections being put in place?
- ✓ Are procedures adequate?
- ✓ Is training sufficient?

- Also at RTA, the importance of the exit meeting was emphasized as a valuable tool to enhance the practice.
- Corrective actions and observations should be well documented, according to RTA.
- At TNZ, a well-defined audit reporting process must be in place. This should involve communications among the client, the consultant, and the auditors. Reasons for rejecting auditors' suggestions should be documented.
- Also at TNZ, continuing assessment of the process is vital. TNZ has prepared several reports reviewing the safety audit program on segments of the roadway network; i.e., rural roads, state highways, existing roads, urban roads, and local road projects.[26 27 28 29 30]

Reports by the agencies visited review all aspects of the road safety audit process, including summaries of what was undertaken, evaluations of the success of the program, and recommendations for improvements. Suggestions cover the entire process, including selection and training of auditors, use of checklists, selection of projects to be audited, contents of final report, and responding to auditors' recommendations.

3.8.5 Implementing Recommendations

The first step toward implementing recommendations of a road safety audit report is to hold a completion meeting. Its purpose is to provide a forum for the presentation of the findings, without being a platform for entertaining debate on the merits of the findings. VicRoads reported the following range of responses to recommendations:

- No response.
- No response—get the auditor out of here.
- Rejection—refusal to change the project.
- Rejection—too difficult or too costly.
- Rejection—project done to standards at the time.
- Rejection—various written reasons.
- Acceptance—what should be done?

Follow-up procedures are necessary to record responses to each recommendation. For those that are accepted, the actions to be taken should be described. For suggestions that are rejected, reasons for the rejection should be fully explained.

Accountability is obviously an important factor in the success of the audit program. VicRoads has established a chain of command, from the project supervisors to the general manager for road safety, for the resolution of disagreements about recommendations. A signature is required at each

level to certify the audit. Similar procedures were in place in New South Wales and New Zealand.

It is not always feasible to implement the recommendations of the auditors. Resource limitations or other factors may preclude corrective action. ***The key factor is that a response be prepared describing the reasons for not implementing change.***

3.9 Training and Accreditation of Auditors

A prime factor identified by Austroads and mentioned in discussion with all agencies was the use of experienced and skilled auditors. This raises the issue of training and possible accreditation. Currently, formal training experiences are varied. VicRoads has conducted an in-house workshop for its staff. FORS has sponsored the development of a road safety audit training course by a university in South Australia and is considering the issue of accreditation. One opinion was that Austroads should manage accreditation issues. RTA has conducted some 2-day workshops in cooperation with the Institute of Municipal Engineers. The program consists of presentations by RTA staff and private consultants, including slide shows and group exercises in the training process.

TNZ began by using a pool of local experts to train auditors on the job. It now has a 5-day safety course, one day of which is devoted specifically to road safety audits. TNZ also has a training process whereby a potential auditor is first an observer on an audit team, then a team member on a group led by an experienced auditor and eventually moves to a team leader position. This is interpreted as an informal accreditation process.

3.10 Examples of Road Safety Audit Findings

Through a combination of site visits and reviews of actual reports, the scanning team was able to observe the results of road safety audits. In Victoria, an audit was being conducted on a freeway section under construction. This audit identified the following types of problems:

- 3:1 side slopes (standards require a minimum of 4:1 slopes).
- Curbs and gutters placed incorrectly and in front of Jersey barriers.
- Inadequate sight distances.
- Inconsistent lane widths.

In NSW, the scanning team visited locations where sight distance deficiencies, improper signing and marking plans, and poor geometrics were recognized in the audits. One site was a new bridge over an inlet to Sydney Harbor where economic and land constraints forced design compromises. Another was an existing location that experienced major traffic volume increases as a result of the opening of the new bridge.

TNZ completed an analysis of the findings of its urban safety audits.[31] Pedestrian issues, signs and markings, signs other than priority, and intersection visibility were the four topics mentioned most often. Part 2 of this report contains a summary of this analysis.

While in New Zealand, the scanning team visited three locations and reviewed the findings of the safety audits. These sites included a suburban area where a new flyover interchange was being proposed, a

roadway relocation project, and an intersection reconstruction.

3.11 Case Studies

The Austroads guide contains examples of Stage 1 to Stage 5 road safety audits. The scanning team was provided with several actual road safety audit reports, excerpts from which are in Part 2 of this report. They contain the following:

- A summary of an audit conducted by TNZ at the site of a new interchange.
- A pre-opening audit of the Glebe Island Bridge conducted by RTA.
- The executive summary of a route audit report for a 30-km section of road, conducted by a private consultant for VicRoads.

3.12 Cost of Conducting Audits

Austroads reports that the cost of auditing a large construction project at all four stages will add from 4 to 10 percent of total project design cost.[32] TNZ found three components to the cost of audits:

1. Consultant's fees.
2. Client's time to manage the audit.
3. Costs associated with implementing recommendations that are adopted.[33]

Additional costs also may result from changes to a project's scope and schedule. TNZ found that fees range from NZ$1,000 to $8,000 (US$730 to $5,840), with most falling in the range of NZ$3,000 to $5,000 (US$2,190 to $3,650). The client's time, while difficult to estimate, averaged about 1 day per audit. Estimated costs of implementing recommendations were not mentioned. RTA indicated that the cost of a road safety audit on a new project was about the same as a geotechnical survey.

3.13 Benefits of Road Safety Audits

The application of road safety audits is in its infancy. Only limited studies have been conducted that have attempted to provide "hard numbers" on the benefits and costs of audits, although reference has been made to studies undertaken in the U.K. that have claimed savings in crash costs.[34] Benefits that have been attributed to road safety audits range from crash reduction and design improvements to enhancement of the corporate safety culture. Austroads lists the following specific benefits:

- Safer new highways through crash prevention and severity reduction.
- Safer road networks.
- Enhancement of road safety engineering.
- Reduction of whole-life costs of road schemes.
- Providing one component of local and state crash-reduction targets.
- Reduced need to modify newly constructed projects.
- Better understanding and documentation of road safety engineering.
- Eventual safety improvements to standards and procedures.

- More explicit consideration of the safety needs of vulnerable road users.

- Encouragement of other personnel in road safety.[35]

Other benefits cited in meetings with road safety officials were that auditing is a pro-active rather than reactive approach, and it is having the effect of moving toward a higher standard of best practices.

3.14 Liability Concerns

In the United States, the liability implications of all government decisions undergo close scrutiny. Thus, there is some concern that a process identifying safety deficiencies would leave an agency vulnerable to litigation. In the Austroads guide, the issue of increased exposure as a result of conducting audits is examined in detail.[36] A party alleging neglect on the part of a public authority must prove that the authority owed a duty of care, failed to act reasonably, and caused the damage. It is acknowledged that a road authority owes a duty of care. Safety audits are a reasonable approach to improving safety; therefore, the law should encourage the use of safety audits. Laws are, however, focused on the end product of the road, not how it is made safe. A road safety audit will help discover deficiencies.

The question arises of whether an agency increases its liability by rejecting an audit recommendation and a crash occurs. This would not necessarily be true, because the plaintiff would still need to prove negligence and that the problem was ignored after it was put on record. Identification of "potential safety areas" should be even less problematic than the identification of "hazardous locations" in the Highway Safety Planning process now used by U.S. states.

New Zealand has a national, fault-free insurance program, and citizens forfeit the right to sue for personal injury. Thus, they don't face the same issues that confront officials in the United States. The same is true in some states in Australia. Legal counsel in New Zealand has advised road officials that implementation of road safety audit procedures does not alter their responsibilities.

In summary, the scanning team does not believe that the use of road safety audits would expose an agency to increased risk, and that highway authorities that fail to adopt the process may not identify defects, and defects contribute to crashes. However, it is important to continue to cooperate with the legal profession to develop procedures to lower risk. The key is to document and address the final actions taken on all of the road safety audit findings.

3.15 Safety Audits and Quality Assurance

During the 1990's, private businesses and government agencies embraced quality management concepts as vital to the conduct of good business. Using terminology like "defining new paradigms" and examining the successes of techniques refined by Japanese businesses, recent focus has been on continual improvement, customer retention, and, in the case of government, on privatization. Road safety audits have been embraced so readily because their application is consistent with the quality philosophy. While quality assurance emphasizes continual improvement and the safety audit

process is a step-by-step activity, both have the underlying theme of "get it right the first time."

All agencies that the team visited were deeply involved in applying quality concepts. This was especially true in New Zealand, where the transportation functions of government shifted from operations to almost exclusive involvement with policy and management. Road safety audits were another application of quality concepts. The same was evident in the discussions with the state and federal organizations in Australia.

The Austroads guide contains a section devoted to discussion of safety audits and quality assurance.

3.16 Obstacles to Implementation

While acceptance of road safety audits has been almost universal in Australia and New Zealand and the use of the process has grown rapidly, some obstacles remain to be overcome. One major issue is the acceptance and application at the local level. Some local agencies are still skeptical, and it is difficult to get them to "buy in" to the process. It also has been difficult to convince local agencies to expend funds for safety audits.

Other major difficulties include getting professionals to accept the reviews of other professionals; selecting auditors on the basis of expertise, rather than low cost (an opinion expressed by consultants that the team met); and finding qualified auditors. A concern of all agencies was finding the resources to expand road safety audit programs.

3.17 Success Factors

During the scanning review, the team met with many individuals, reviewed documents and road safety audit reports, and made several site visits. Based on the visits and observations, the team concluded that many factors have contributed to the success of road safety audit programs in Australia and New Zealand. The factors listed below were identified as key reasons for the widespread use and success of road safety audits:

- Audits are compatible with quality assurance procedures being implemented by the federal and state governments.
- Upper management has endorsed the program. Safety audits are a part of the annual business plan and funds are allocated for conducting audits.
- There is an understanding and agreement at all levels within transportation agencies on the importance of road safety audits.
- There is agreement on the elements of the process. The Austroads guide outlines the step-by-step process.
- There is cooperation among stakeholders to perform the audits and use the results.
- There are strong lines of communication among the groups and individuals involved in the process.
- The concept of the road safety audit has been introduced as nonthreatening and part of a safety culture.

- There is an understanding that safety audits go beyond the strict application of standards by examining the interactions of standards for synergistic impact, either positive or negative.

- There is local involvement. Application of the procedures requires that the perspectives of the road users and the community be considered.

- The auditor or audit team brings strong, diverse skills to the process. Traffic engineering, highway design, safety, and behavioral aspects are given strong consideration in the analysis.

- The safety audit reports emphasize problem identification and do not focus on the development of detailed solutions.

- Training programs are in place to ensure that audits are performed by qualified individuals.

- Results of the audits are well documented, including suggestions for appropriate follow-up actions.

- The format of an audit report is brief and to the point. It is readable and easy to understand.

3.18 Future Directions

The use of road safety audits is still in its infancy. Agencies and individuals are continuing to refine the process to improve its application and effectiveness. The following issues were identified as topics that require attention:

- The issues of training and accreditation must be resolved. A process to certify training courses is needed, and accreditation procedures should be established.

- Criteria for selection of a project need to be clarified. This is not a problem for major new construction projects, because all those over A$5 or NZ$5 million are audited. The selection process for existing sites to be reviewed needs to be formalized.

- Evaluation procedures for determining the tangible benefits of road safety audits are necessary.

- A data base of results should be established. This data base should consist of documented evidence of the crash reductions and any cost improvements that result from implementing road safety audit findings.

- The process itself should be subject to continued review. Some issues to be addressed include the use of checklists and the format and language of the written reports.

- A selection process for auditors, especially with respect to evaluation of fees versus qualifications, should be examined.

4.0 SUMMARY OF SCANNING TEAM FINDINGS

The scanning team found that road safety was a high-priority issue for all the transportation agencies that it visited. In both Australia and New Zealand, road safety audits were entrenched as key elements in the overall programs to reduce the crash toll and the efforts to establish a safety culture within the agency. The most significant findings of the group are summarized below.

4.1 Significant Findings

- All transportation agencies visited had *established safety programs and strategic plans to set goals* and monitor progress toward these goals.
- All planning activities were based on the *application of quality principles* that focused on customer service (enhance the safety environment) and continued improvement (set goals to reduce fatalities and injuries and measure the successes).
- *Safety was given prominence* at all levels in an organization, in all stages of a project, and for projects of all sizes.
- Road safety audits were viewed as an *essential element of an agency's overall safety strategy*. They were considered a vital component of marketing safety to the public and were viewed as a necessity, because of the scarcity of resources and the amount of downsizing that has taken place within governments. Audits were a major part of the total risk management program.
- *Benefit/cost ratios for road safety audits were reported to be very high*, although no agency had conducted a formal analysis. This was due to the the relatively low cost (US$800 to $6,500) of the audits, as compared to the problems that were identified. The use of road safety audits resulted in lower project life-cycle costs.
- Road safety audits were an *essential part of the design/construct process*.
- Audits were *used successfully at all stages* in project development.
- *Audits were proactive* about, rather than reactive to, problems.
- Through the audit process, agencies could document deficiencies of opportunities for safety improvement, *without fear of legal implications*.
- The use of road safety audits allows engineers to *look beyond engineering standards* in evaluating projects.
- *Austroads' Road Safety Audits* was identified as *the primary source* for describing the audit process and its benefits. This document provides step-by-step instructions for conducting audits at all stages of a project's development, including detailed checklists that can be used in evaluation.
- The *safety audit process is formal*, independent of the project designers and

contractors, and conducted by individuals and, preferably, teams with appropriate experience.

- *Audit procedures involve a diverse team*: traffic engineers, road designers, and human-behavior specialists.

- Audits can, and should, be *used by local governments*.

- The audit process of *safety decision making* does not require the adoption of all recommendations. The process includes a final step in which auditors' suggestions are reviewed, and the client decides which suggestions can be implemented.

4.2 Transferability

An important concern of the scanning team was whether the techniques used successfully in Australia and New Zealand could be transferred to the United States. Some of the more significant issues are described below:

- In both Australia and New Zealand, the selection of projects to receive funding was based entirely on the project's estimated benefit/cost ratio. Detailed procedures were in place to estimate reductions in crash and road user costs from various treatments. Software has been developed in New Zealand to assist in the process. This approach, which includes evaluation of life-cycle costs, could be a key part of safety management systems in the United States.

- Road safety audits could be integrated into the safety management and quality improvement processes being implemented by transportation agencies in the United States. They include the essential elements: a formalized process, measurement, coordination, and documentation.

- The safety audit process should not hinder and may actually improve an agency's legal liability, particularly if used in the design and construction of new roads. Applicability to the audit of deficiencies on existing roadways may not be as positive, unless it is linked with a process that assesses risk and allocates resources.

- A major factor to be considered is that a significant amount of development has already been completed. Agencies in the United States can take advantage of the experiences of others, both positive and negative, without investing a significant amount of time and money in studies and research and development.

- The concept of safety audits can easily be integrated with existing safety programs. It is compatible with many issues being confronted in the United States, such as limited resources, downsizing, risk assessment, and cost-effectiveness.

5.0 STRATEGY FOR ADVANCING ROAD SAFETY AUDITS IN THE UNITED STATES

The scanning team found that the use of road safety audits could yield safety benefits in the United States. As highlighted in the previous chapter, many of the practices observed in Australia and New Zealand are transferable, in some form, to the United States. As with any new technology, however, an effective marketing program will be needed to convince transportation agencies that audits are affordable and will yield safety benefits.

The benefits must be accepted "from the top, down" to integrate audits into agencies' safety programs. To achieve this, a program will be needed to educate decision makers, market the process to everyone involved, conduct pilots audits, and reevaluate guidelines.

What follows is a proposed strategy for implementing road safety audits in the United States.

Outline of Proposed Implementation Strategy		
Goal 1	**Increase the understanding and awareness of the road safety audit process**	
	1	Develop a joint document, based on this report and the Austroads guide, which can serve as a marketing piece to be distributed throughout the United States.
	2	Promote the process through Federal agencies such as FHWA and the National Highway Traffic Safety Administration (NHTSA).
	3	Promote the concept through the activities of professional organizations, such as ITE, AASHTO, the Transportation Research Board (TRB), the National Association of Governor's Highway Safety Representatives (NAGHSR), and through Technology Transfer Centers (T^2).
	4	Promote through presentation at major national conferences, such as ITE, TRB, AASHTO, NAGHSR, T^2, etc.
	5	Promote through presentations at regional/state safety-related meetings and conferences, such as the American Society of Civil Engineers, State DOTs, and ITE, etc.
Goal 2	**Gain support of key stakeholders**	
	1	Distribute information to key transportation decision makers.
	2	Enlist candidates for conducting pilot road safety audits.

Goal 3	**Conduct pilot road safety audits**	
	1	Conduct road safety audits at all stages for both state and local projects of varying magnitude. This should include both new and existing roads.
	2	Use existing road safety audit materials, principally the Austroads guide, as the blueprint for implementing the audits.
	3	Include an evaluation component in each audit.
Goal 4	**Revise basic road safety audit materials to incorporate knowledge gained from pilot projects and from introducing the concept in the U.S. safety culture**	
	1	Use advisory groups to revise guidelines. Include a global focus by enlisting participation of individuals from Australia and New Zealand.
	2	Distribute revised guidelines to the groups that participated in the pilot audits for their review and comment.
	3	Disseminate information to a larger sample of transportation safety professionals.
Goal 5	**Incorporate the road safety audit process in the "best practices" guidelines**	
	1	Enlist the support of state and Federal officials to prepare best practice summaries.
Goal 6	**Train selected Federal, state, and local personnel to serve as a support group for state and local governments implementing safety audit practices**	
	1	Develop appropriate training materials.
	2	Develop a training course.
	3	Conduct a series of training sessions.
Goal 7	**Develop a national training course**	
	1	Assemble a team of experts.
	2	Develop course materials and the course.
	3	Conduct workshops at regional, state, and local levels.
Goal 8	**Monitor the implementation of the safety audit process**	
	1	Monitor best practices.
	2	Monitor success stories.
	3	Document the implementation process.
Goal 9	**Adopt guidelines and procedures, as necessary**	

APPENDIX A. TECHNICAL QUESTIONS ON ROAD SAFETY AUDITS

I. Institutional/Organizational Issues

1. How does the safety audit process fit into your national/state strategic highway safety plan(s) and which agency(ies) are responsible for implementing the process and monitoring its success?

2. How did you obtain "buy-in" and continued acceptance by management (national and state), project designers, local jurisdictions, and the public to utilize and promote the safety audit process?

3. In view of the many competing needs for finite resources, how are the costs and benefits associated with road safety audits balanced against other public concerns (e.g., environmental, road maintenance, preservation, political pressures, etc.)?

4. What major obstacles or resistance have you encountered to initiating and continuing the safety audit process? Would you do anything differently if you were starting over?

5. Explain your collaboration process involving national, state, and local governments, agencies within a level of government (e.g., engineering, enforcement, etc.), and any public/private participation.

6. What type and level of resources (personnel, money, training, equipment) were required to get the process started and are now needed to keep the process in place?

II. Implementation Strategies and Issues

1. How are audit team members selected? What types of professionals—i.e., law enforcement, emergency medical services, etc.—are involved and what types of training do they receive?

2. Describe the methods, materials, and resources used in safety audits and delineate how consistency is maintained from one audit to another, especially with respect to integration of modes, i.e., bicycles, pedestrians, autos, transit, and the analysis of trade-offs.

3. How do you select and prioritize projects to undergo safety audits?

4. How is private industry involved in the audit process?

5. What guidelines standards, forms, etc., are used to conduct the safety audits?

6. How is safety defined in the safety audit process?

7. Does the safety audit process differ for roadway classes, i.e., urban, rural, low-volume roads, etc.?

8. Describe the safety audit process and how the results are utilized.

9. Who is responsible for implementing the safety audit recommendations and who pays for these improvements?

10. There are many safety tradeoffs among different design alternatives. Does the audit team use its experiences to recommend one option over another, or is there some analytical method utilized (perhaps comparing expected benefit/cost ratios)?

11. Do the auditors recommend anything other than project-specific items (such as additional training for certain designers)? Are any summary reports prepared by the auditors presenting possible policy/standard practice changes?

12. Was any public notice given or public input obtained during the audit process? Were any focus groups formed to obtain input on specific locations?

III. Informational and Data Requirements

1. What criteria are used to select and prioritize your safety investments and locations to be selected for the audit process? Are they prioritized against a set of safety objectives?

2. What types and amount of data—i.e., crash histories, information on special user groups, traffic volumes, etc.—are required to support the audit process?

3. Who is responsible for collecting the data?

4. Are work zone plans addressed in the safety audit process?

IV. Identification and Quantification of Benefits

1. What drawbacks or negative impacts—i.e., increased liability, higher project completion costs, longer project completion times—were experienced on individual projects after implementation of safety audits?

2. Has there been any attempt to quantify the benefits of the audit process using benefit/cost, cost/effectiveness, or other measures? If so, what variables were considered and what were the results?

3. What are the "selling points" of the audit process?

4. What program, design practices, or technologies have been modified or introduced as a result of the audit process?

5. What safety investment levels are used to challenge or verify that adopted standards remain cost-effective?

APPENDIX B. STUDY TEAM INDIVIDUALS CONTACTED

Canberra, Australia					
Name	**Position**	**Agency**	**Address**	**Phone**	**Fax**
Jennifer Moris	Senior Project Manager Policy Development Section	Federal Office of Road Safety Department of Transport & Regional Development	GPO Box 594 Canberra, ACT 2601	(06) 274-7495	(06) 274-7922
Bruce Gemmell	First Assistant Secretary Land Transport Policy Division	Federal Office of Road Safety Department of Transport & Regional Development	GPO Box 594 Canberra, ACT 2601	(06) 274-7819	(06) 274-7819
Dennis O'Leary	Director Public Education & Liaison	Federal Office of Road Safety Department of Transport & Regional Development	GPO Box 594 Canberra, ACT 2601	(06) 274-7420	(06) 274-7477
Allan Armistead	Director, Technical Services Land Transportation Policy Div.	Federal Office of Road Safety Department of Transport & Regional Development	GPO Box 594 Canberra, ACT 2601	(06) 274-7315	(06) 274-7677
Michael McFadden	Statistics and Analysis Section	Federal Office of Road Safety Department of Transport & Regional Development	GPO Box 594 Canberra, ACT 2601	(06) 274-7136	(06) 274-7922
Anthony P. Ockwell	Assistant Secretary	Federal Office of Road Safety Department of Transport & Regional Development	GPO Box 594 Canberra, ACT 2601	(06) 274-7652	(06) 274-7999
Neville Potter	Assistant Secretary Roads Branch	Federal Office of Road Safety Department of Transport & Regional Development	GPO Box 594 Canberra, ACT 2601	(06) 274-7266	(06) 274-7677
Chris Brooks	Director Research	Federal Office of Road Safety Department of Transport & Regional Development	GPO Box 594 Canberra, ACT 2601	(06) 274-7396	(06) 274-7922
Joe Motha	Senior Research Manager	Bureau of Transport & Communications Economics	GPO Box 594 Canberra, ACT 2601	(06) 274-6828	(06) 274-7677
Kevin Rheese	Acting Senior Project Officer Strategies & Black Spots	Federal Office of Road Safety Department of Transport & Regional Development	GPO Box 594 Canberra, ACT 2601	(06) 274-7424	(06) 274-7922
Carol Rowe	Director Strategies & Black Spots	Federal Office of Road Safety Department of Transport & Regional Development	GPO Box 594 Canberra, ACT 2601	(06) 274-7132	(06) 274-7922

New South Wales, Australia					
Name	**Position**	**Agency**	**Address**	**Phone**	**Fax**
Peter Croft	Manager Road Environment Safety	Roads and Traffic Authority	Level 2, Centennial Plaza 260 Elizabeth Street Surrey Hills, NSW 2010 PO Box K198 Haymarket, NSW 2000	(02) 9218-6260	(02) 9218-6745
Fred Schnerring	Leader Road Environment Strategy	Roads And Traffic Authority	Level 2, Centennial Plaza 260 Elizabeth Street Surry Hills, NSW 2010 PO Box K198 Haymarket, NSW 2000	(02) 9218-6405	(02) 9218-6745
Ray Taylor	General Manager Road Safety	Roads and Traffic Authority	Level 2, Centennial Plaza 260 Elizabeth Street Surrey Hills, NSW 2010 PO Box K198 Haymarket, NSW 2000	(02) 9218-3564	(02) 9218-6693
Graham Brisbane	Traffic and Safety Manager Southern Region	Roads and Traffic Authority	PO Box 477 Wollongong East, NSW 2520	(042) 212-460	(042) 273-705
Ken Lysaught	Road Safety Audit Manager Sydney Region	Roads and Traffic Authority	PO Box 558 Blacktown, NSW 2148	(02) 9831-0911	(02) 9831-0926
Kevin Webster	Road Safety Manager Northern Region	Roads and Traffic Authority	Management Directorate PO Box K198 Haymarket, NSW 1238	(02) 9218-6246	(02) 9218-6745

Victoria, Australia					
Name	**Position**	**Agency**	**Address**	**Phone**	**Fax**
John Cunningham	Principal Road Design Engineer	VicRoads	2nd Floor, 3 Prospect Hill Road Camberwell, VIC 3124	(03) 9811-8201	(03) 9811-8200
Robert Morgan	Principal	Traffic Engineering and Road Safety	24 Park Road Surrey Hills, VIC 3127	(03) 9888-8786	(03) 9888-8980
Ken Ogden	Professor (at time of visit) (Since the visit of the scanning team, Mr. Ogden has taken a new position with Royal Auto Club)	Institute of Transport Studies Monash University (At time of publication) Royal Auto Club of Victoria	Royal Auto Club of Victoria 550 Princes Highway Noble Park, VIC 3174	(03) 9790-2923	(03) 9790-2628
David Anderson	General Manager Road Safety	VicRoads	60 Denmark Street Kew, VIC 3101	(03) 9854-2700	(03) 9854-2668
Bill Collins	Manager Design Department	VicRoads	3 Prospect Hill Road Camberwell, VIC 3124	(03) 9811-8363	(03) 9811-8200
Ron Gowan	Senior Engineer Road Environment Safety	VicRoads	60 Denmark Street Kew, VIC 3101	(03) 9854-2645	(03) 9854-2668
John Moylan	Team Leader Western Ring Road, Major Projects	VicRoads	1/144 Melrose Drive Tullamarine, VIC 3043	(03) 9338-4055	(03) 9338-8915
Ted Vincent	Manager, Strategy and Programs Road Safety Department	VicRoads	60 Denmark Street Kew, VIC 3101	(03) 9854-2722	(03) 9854-2668
Richard Warwick	Manager, Construction—Western Ring Road Major Projects	VicRoads	1/144 Melrose Drive Tullamarine, VIC 3043	(03) 9338-4055	(03) 9338-8915
Peter Balfe	Director Major Projects	VicRoads	60 Denmark Street Kew, VIC 3101	(03) 9854-2758	(03) 9854-2500
Andrew P. O'Brien	Managing Director	Andrew O'Brien & Assoc., Pty. Ltd.	59 Avenue Road, Unit 3 Camberwell, VIC 3124	(03) 9882-9955	(03) 9813-2106
Joseph P. Perone	Strategic Transport Planner	City of Melbourne	GPO Box 1603M Melbourne, VIC 3001	(03) 9658-8559	(03) 9650-3572
Henry H. Turnbull	Director	Turnbull Fenner	1st Floor 325 Camberwell Road Camberwell, VIC 3124	(03) 9882-8699	(03) 9882-7219
Robert Stemp	Traffic Engineer	Sinclair Knight Group	222 Kingsway South Melbourne, VIC 3205	(03) 9685-3118	(03) 9670-6846

Wellington, New Zealand					
Name	**Position**	**Agency**	**Address**	**Phone**	**Fax**
Ian Appleton	Safety Audit Manager	Transfund New Zealand	PO Box 2331, Wellington 7th Floor, Investment House II 20-26 Ballance Street	(04) 495-3271	(04) 499-0733
Robin Dunlop	General Manager	Transit New Zealand	PO Box 5084, Wellington 7th Floor, Investment House II 20-26 Ballance Street	(04) 496-6601	(04) 496-6666
Peter Wright	Review and Audit Manager	Transfund New Zealand	PO Box 2331, Wellington 7th Floor, Investment House II 20-26 Ballance Street	(04) 495-3270	(04) 499-0733
Steve Stewart	State Highway Policy Manager	Transit New Zealand	PO Box 5084, Wellington 7th Floor, Investment House II 20-26 Ballance Street	(04) 496-6688	(04) 496-6666
Marten Oppenhuis	Traffic and Safety Manager Policy Division	Transit New Zealand	PO Box 5084, Wellington 7th Floor, Investment House II 20-26 Ballance Street	(04) 496-6665	(04) 496-6666
Stuart Fraser	Training and Education Manager	Transit New Zealand	PO Box 5084, Wellington 7th Floor, Investment House II 20-26 Ballance Street	(04) 496-6698	(04) 496-6666
Fiona Knight	Land Transport Policy Manager	Transit New Zealand	PO Box 5084 Lambton Quay 7th floor, Investment House II, 20-26 Ballance Street	(04) 496-6670	(04) 496-6666
Dave Rendall	Regional State Highway Manager Wellington	Transit New Zealand, Wellington Region	PO Box 27 477	(04) 801-2580	(04) 801-2599
Stanley Chesterfield	Road Safety Engineer Wellington	Transit New Zealand, Wellington Region	PO Box 27 477	(04) 801-2580	(04) 801-2599
Murray Carpenter	Senior Consultant, Road Design	Opus International, Ltd. (former Works Consultant Services)	Majestic Center, 100 Willis St. PO Box 12-003	(04) 471-7392	(04) 471-1397

Wellington, New Zealand (continued)					
Name	**Position**	**Agency**	**Address**	**Phone**	**Fax**
Stewart Milne	Secretary for Transport	Ministry of Transport	38-42 Waring Taylor Street PO Box 3175	(04) 472-1253	(04) 498-0665
Colette L. Kraus	Traffic Engineer Safer Vehicles, Roads, and Rail	Land Transport Safety Authority	7-27 Waterloo Quay PO Box 2840	(04) 494-8600	(04) 494-8604
Reg Barrett	Director	Land Transport Safety Authority	7-27 Waterloo Quay PO Box 2840	(04) 494-8605	(04) 494-8605
Craig Hill	Manager Safer People and Operators	Land Transport Safety Authority Policy and Programmes	7-27 Waterloo Quay PO Box 2840	(04) 494-8704	(04) 494-8608
Rob Martyn	Group Manager Safer Vehicles, Roads, and Rails	Land Transport Safety Authority	7-27 Waterloo Quay PO Box 2840	(04) 494-8600	(04) 472-9939
John P. Edgar	Manager, Policy and Programmes Safer Vehicles, Roads, and Rails	Land Transport Safety Authority	7-27 Waterloo Quay PO Box 2840	(04) 494-8600	(04) 494-8604

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