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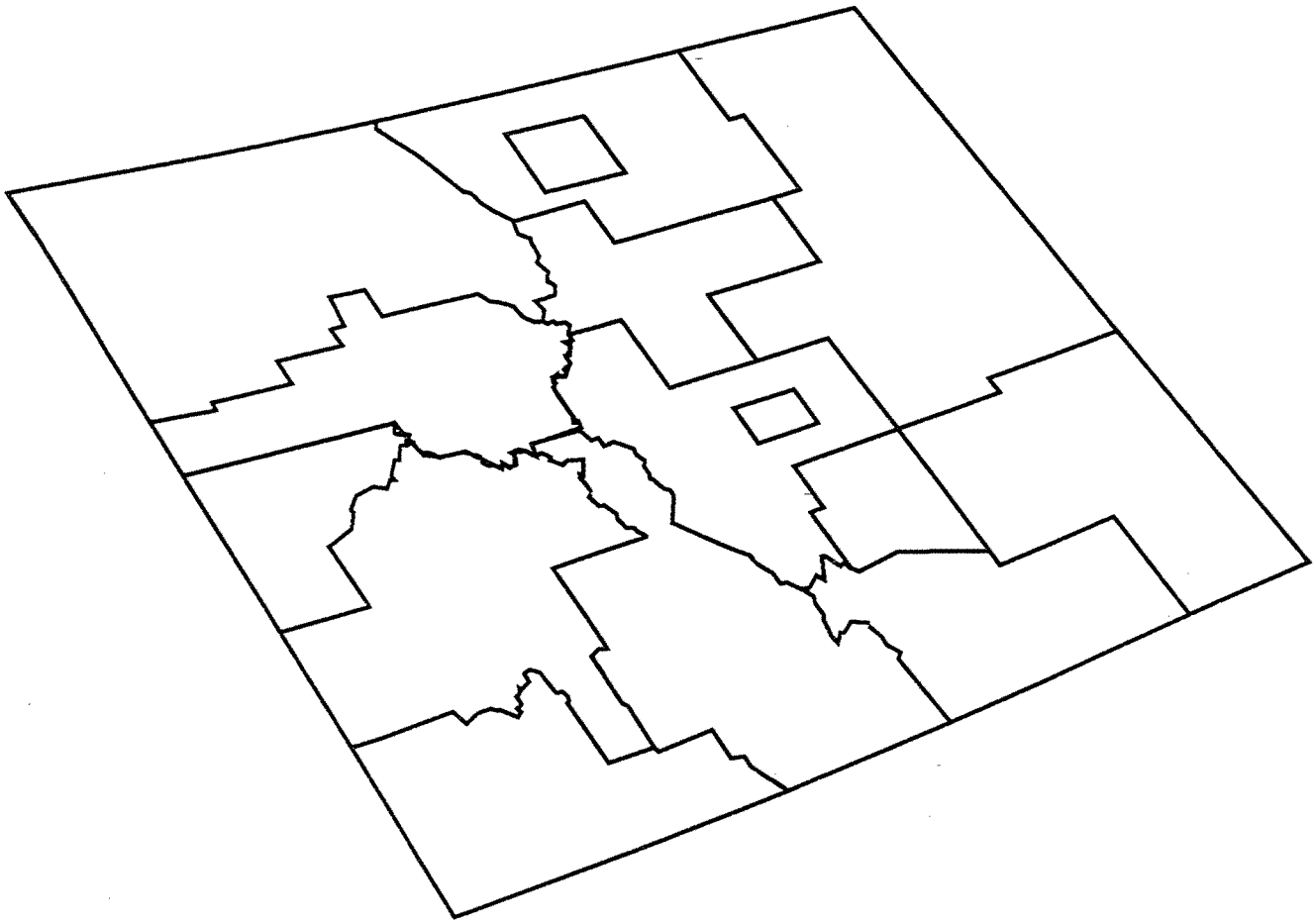
COLORADO'S 20 YEAR TRANSPORTATION PLAN



TECHNICAL REPORT NUMBER 2
THE STATE OF THE TRANSPORTATION SYSTEM

COLORADO DEPARTMENT OF TRANSPORTATION
FEBRUARY 1995

A Report on the State of the Transportation System

Technical Report #2

Prepared by the
Colorado Department of Transportation
Division of Transportation Development

February, 1995

COLORADO'S 20 YEAR TRANSPORTATION PLAN
Technical Reports

Colorado's Transportation Plan has been developed through a broadly participative, multimodal regional and statewide planning process. The Plan envisions a future transportation system to accommodate the growing needs of Colorado. The Plan advocates strategies and alternatives for achieving that vision of the transportation system as an integral aspect of Colorado's high quality of life. Such a system is necessarily mindful of the financial, environmental, economic development, growth, and technological challenges that will be a part of 21st Century life.

The background data to support this ambitious plan is incorporated in a series of Technical Reports released by the Colorado Department of Transportation (CDOT) in late 1994. The reports set the context in which the planning process occurs, describe the state's transportation system, and the conditions that must be met, now and in the future. CDOT hopes these reports provide useful information to planners, local governments, and other decision makers, as well as interested members of the general public during this important time of collectively choosing our best possible future.

Developing a Customer Focus (University of Colorado at Denver)		
	Survey of Colorado Households and Transportation Officials	August 1994
	Summary of Citizen Focus Groups	August 1994
	Summary of Official, Business, Elderly and Disabled Focus Groups	August 1994
Smart Path: The Intelligent Transportation System in Colorado	(Castle Rock Consultants & Centennial Engineering, Inc.)	October 1994
Technical Report #1	Summary of Regional Transportation Plans	August 1994

Technical Report #2

The State of the Transportation System **February 1995**

Technical Report #3	Colorado Economic and Demographic Report	November 1994
Technical Report #4	The Planning Context	January 1995
Technical Report #5	Environmental	January 1995
Technical Report #6	Financial Overview	To Be Released
Technical Report #7	Issues of State Significance	To Be Released

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Executive Summary

Introduction

This report has been prepared to support the development of Colorado's 20 Year Transportation Plan. In developing the 20 Year Transportation Plan, it is important to have a good understanding of the status of the existing transportation system and its condition within Colorado and how this system is performing. With such an assessment in hand we may better determine what strategies and solutions best address Colorado's future needs.

Below is a brief summary of the key findings of this report:

- **Public Roadway Network**
  - *Centerline and Lane Miles*

    In 1992, Colorado's public roadway system consisted of 77,890 centerline miles. Of this total only 9,165 miles or 12% of the total was on the State Highway System. The remaining public roadway miles were local roadways under the jurisdiction of cities and counties.

  - *Travel on the State Highway System*

    Although most of the public roadway system consists of local roadways, the vast majority of travel occurs on the State Highway System. In 1992 vehicle miles of travel (VMT) on all Colorado roads was approximately 30.2 billion of which 63% occurred on the State Highway System. Of this travel on the State Highway System, the greatest amount of travel (approximately 24%) occurred on the Interstate system.

    Since 1970 there has been an increase in VMT on the State Highway System of 116%, from 8.6 billion to 19.0 billion VMT in 1992. This overall growth in travel may be attributed to several key factors: increased population, increased vehicle trip length, reduction in vehicle occupancy, increased person trips per capita, and increased recreation and tourism traffic.

  - *Urban vs. Rural Travel*

    Emulating the population shift within Colorado over the past twenty years, VMT, which were once predominantly on rural state highways have shifted to the point where most VMT now occurs on urban highways. In 1970 rural state highways comprised 60% of the state highway VMT, while in 1992 rural roadways only carried 41%.

  - *Surface Condition of the State Highway System*

    Surface condition on the State Highway System has been deteriorating over the past several years. In 1993 64% of all miles on the State Highway System were deemed to be in poor condition. This compares to 20% of the State Highway System in poor condition in 1988. This trend is in contrast with a national trend which has witnessed the percentage of pavements in poor condition either decreasing or at least remaining stable on all functional systems, both rural and urban. The drop in surface condition may be attributed, in part, to an aging highway system reaching the end of its design life and an increased number of trucks with heavier loads. Preliminary 1994 data shows a reversal of this trend because of the renewed interest in resurfacing as reflected in CDOT's budget.

- *Lane Width and Roadway Alignment*

  Most substandard lane widths on the Public Roadway System are on lower functionally classified roadways such as major and minor collectors. Primarily those roadways with substandard widths of less than 9 feet are located in rural areas. In 1992 only 4% of all public roadway miles were less than 9 feet in width. Alignment of a highway may also greatly affect the speed and safety at which vehicles may travel. Horizontal alignment affects speed and sight distance while vertical alignment primarily impacts safety. Although specific information relating to this area was not readily available, it is perceived that the miles of roadway on the State Highway System with alignment problems have been steadily decreasing with the reconstruction of old roadways which are rebuilt to current design standards.

- *Bridges*

  At the end of Fiscal Year 1993, there were 8,030 bridges on Colorado's public road system. Of this number, 3,671 or 46% of all bridges, were on the State Highway System with the remaining structures on county roads or city streets.

  Of the 8,030 bridges on the public road system, 19.5% or 1,564 bridges, are categorized as functionally or structurally deficient. This compares to 1,851 deficient bridges in 1991. Thus over the last several years, even with an increasing number of bridges on the public roadway network, Colorado has made significant gains in reducing the number of deficient structures.

- *Safety*

  Over the last several years there has been a significant reduction in the number of fatalities associated with vehicle-related crashes on the State Highway System. In 1987 there were 591 fatalities due to traffic crashes. In 1992 the number of fatalities had dropped to 522, representing an 11.6% decline. Corresponding with the decline in fatalities has been a dramatic drop in the fatality rate (the number of fatalities per 100 million vehicle miles) within Colorado. In 1987 the fatality rate was 2.19. In 1992 this rate had fallen to 1.65, a 25% reduction.

- **Mass Transit**
  - *Public Transit Coverage*

    In 1992, Colorado's public transportation systems, operating 1,377 vehicles, traveled more than 45 million miles and provided more than 76 million passenger trips. The majority of these trips were provided by the Regional Transportation District (RTD) which serves the Denver Metropolitan Area. Colorado's thirty public transportation operators operate in thirty-nine of Colorado's 63 counties, though in most cases the service is not available in all areas of a county.

  - *Public Transit Ridership and Service in Urbanized Areas*

    Public transportation ridership in the urbanized areas of Colorado has increased by more than 8.5 million trips or 15.6% from 1987 through 1992. Associated with this added ridership has been an increase in service in urbanized areas. Since 1988 vehicle service miles increased by 9.4% which translated into additional areas served within these urbanized areas as well as more service on existing routes. Growth in transit ridership in Colorado has been even more impressive in light of the fact that transit ridership on a national basis has been relatively stable during the same period.

- *Special Transit Operators*
  Currently, there are 45 special transit operators in Colorado who primarily serve the elderly and disabled populations. Twenty-two of the operators, from whom data is readily available, traveled over 2.7 million miles and provided more than 565,000 passenger trips in 1992.

- *Commercial Operators*
  There are more than 125 commercial operators in the state. The number of operators has grown slightly, particularly in response to the advent of low stakes gambling in certain communities in the state and in anticipation of the new Denver International Airport.

- *Intercity Bus Service*
  Colorado's only intercity bus service is provided by Greyhound Lines and its subsidiary, TNM&O Coaches. In Colorado their routes are operated on Interstate highways 25, 70, and 76 and U.S. Highways 40, 50, 85, 160, 285, 287, and 550.

- *Light Rail Service*
  Colorado's first light rail line opened on October 7, 1994. RTD's Metro Area Connection (MAC) system operates eleven rail cars covering 5.3 miles. Although the projected daily ridership was 14,000, initial ridership figures have exceeded this figure with a current daily ridership of over 15,000. The south end of the line is located at Interstate 25 and Broadway in Denver. From there it runs north along an old railroad right-of-way purchased by RTD onto the Auraria campus and downtown Denver; the line then runs to its northern terminus in the Five Points area of Northeast Denver.

- *Bus/High Occupancy Vehicle (HOV) Lanes*
  Bus and high occupancy vehicle (HOV) lanes are traffic lanes reserved specifically for buses or high occupancy vehicles such as vanpools or carpools (vanpools and carpools must carry three persons or more to use these lanes). Currently, most of the bus and HOV lanes are located in the Denver Metropolitan Area. These facilities include: US 36 from Sheridan Boulevard to I-25, North I-25 from downtown Denver to 70th Ave., and Santa Fe Drive from Mississippi Ave. to Evans. Additional routes under consideration in the Denver Metropolitan Area include: I-225 from Parker Road to the I-70 interchange, I-70 from Denver Union Terminal in lower downtown Denver to Denver International Airport, and I-25 from Broadway to Lincoln Ave in Douglas County.

- *Passenger Rail Service*
  Passenger rail service in Colorado is very limited and is primarily oriented toward longer cross country trips rather than intrastate trips. This service is exclusively provided by AMTRAK. In addition several small railroads throughout the state provide limited service primarily geared toward tourism.

- **Freight Movement**
  Overall it was estimated that in 1990 approximately 73 million tons of freight were transported inbound and outbound in Colorado. Of this amount 84% of all freight was transported by truck with the remaining 16% shipped by rail.

- **Rail**
  - *Rail Service*

    Ten separate rail lines crisscross Colorado which allows for most of the State to be served by freight rail lines. However, the extreme southwest and northwest portions of the State, as well as the Gunnison Valley area, are not served.

  - *Freight/Commodity Shipments*

    Most of the freight (almost 83%) transported by rail is carried on two railroads, the Southern Pacific and the Burlington Northern.

    Class One railroads handled approximately 120 million gross tons of freight in 1990, and generated over $2 billion of operating revenues. Forty-one million gross tons of this freight originated and terminated in Colorado in 1990.

    Commodities carried by the four major railroads are identified as coal, farm products, food, waste scrap, stone and clay, petrol, nonmetal and other commodities. Coal, farm products, and food and related products amounted to more than 76% of the total freight in 1990. Coal represents the largest shipments, accounting for 57.6%, while farm products were 7.8% and food was 11%.

  - *Proposed Rail Abandonments*

    Although there are many reasons for abandonments, the main reason is that a railroad believes that a particular line or branch is no longer profitable. Proposed rail line abandonments have significantly increased since 1985. In 1985 total mileage in all proposed abandonment categories totaled 55.7 miles. In 1991 proposed rail line abandonments were almost double that figure rising to 101.2 miles.

- **Commercial Vehicle**
  - *Truck Travel*

    Commercial vehicles constitute almost 12% of all vehicle miles traveled within the state. Predominantly, trucks travel on the Interstate System particularly on the rural portion of this system where trucks constitute almost 21% of all vehicle miles traveled. Between 1988 and 1992 truck travel on the state highway system, as measured by vehicle miles traveled, increased by 31.2%. During the same period overall vehicle miles traveled on the state highway system increased by 15.5%.

  - *Commercial Vehicle Freight Trends*

    Corresponding with an increase in truck traffic has been an even greater increase in freight carried by truck. Between 1982 and 1990 freight carried by truck increased by 28.1% or 17.8 million tons.

    As to service categories, according to American Trucking Association Foundation (ATAF), 35% of all trucks in Colorado were used in agriculture, 23% in construction, 13% in trade activities, 13% in service industries, 3% in for-hire trucking, 3% in manufacturing and 10% in all other activities. These industries encompassed over 46,000 businesses and employed over 113,000 workers.

- **Intermodal Activities**
  - *Current Intermodal Freight Activities*

    Privately owned railroads and trucking companies are realizing the efficiencies of each mode and are realizing the benefits of intermodal transportation services and are developing partnerships to provide very efficient service to their freight customers. Currently, four Class 1 railroads in Colorado, the Burlington Northern, Southern Pacific, Union Pacific, and Atchison, Topeka and Santa Fe all have intermodal facilities in the Denver Metropolitan Area.

    The volume of air freight shipments in Colorado does not approach the volume of rail/truck intermodal but it is growing rapidly. Overnight and other express package deliveries of high value and time-critical freight items are leading the surge in this type of freight business.

  - *Current Intermodal Passenger Activities*

    Intermodal facilities to serve passengers have existed for some time in Colorado. The most common form of passenger intermodal facility is the park-and-ride lot which is used by single-occupant vehicle operators as a location for transferring to a transit bus. Although these facilities are primarily an interface between single occupancy vehicles and buses, several of these lots have been equipped with bicycle racks to accommodate cyclists. Further many of these park-and-ride lots are used by individuals in carpools as an assembly point. Most of the park and ride lots within the state exist in the Denver Metropolitan Area, Colorado Springs, and Pueblo areas with several smaller facilities serving certain resort areas. Due to the success of this concept and the need to reduce automobile travel in urbanized areas, it is anticipated that park-and-ride lots will significantly increase in the future.

    Public transit terminals as well as intercity bus, passenger rail (AMTRAK) and airport terminals also represent intermodal facilities that now exist in Colorado. The intermodal linkage to these sites is essential to the success of each of these individual modes.

  - *Possible Intermodal Projects in Colorado*

    The use of intermodal facilities is expected to increase greatly in the future. The passage of ISTEA has created an awareness of these facilities and a potential funding source for such activities. CDOT is currently utilizing ISTEA funding in conjunction with other public and private sector interests in studying the feasibility of converting existing Denver Union Station into an intermodal passenger facility. Another passenger intermodal facility being considered is at the "Hogback" on I-70 at US 40 near Golden. This site could serve as a major transit connection for operators serving the gaming areas of Black Hawk and Central City, various ski areas and intercity bus services.

    In regard to intermodal freight projects, an example of such planning could be the creation of a consolidated hub intermodal freight facility in the Denver Metropolitan Area.

- **Bicycling/Pedestrian Activities**
  - *Pedestrian Activities*

    Over the years the pedestrian transportation component has been underemphasized. Although the pedestrian mode has historically been better integrated into the design and construction of highway projects than the bicycle element, missing sidewalk links, lack of curbcuts, poor maintenance, and obstructions on walkways such as utility poles and boxes still exist which impede efficient pedestrian movement. With the new Americans with Disabilities Act (ADA), the walking environment is expected to be much improved as all government agencies are

mandated to provide accessible walkways and facilities. This includes curbcuts at intersections, handrailings on bridges, and the absence of obstructions on walkways.

- *Bicycle Operations*

  With the advent of mountain biking and the rise in popularity of cycling and walking for health, recreation, transportation, and environmental concerns, non-motorized modal use has exploded in Colorado in the last two decades. Colorado ranks fourth in the nation as a cycling destination, behind only Utah, Vermont, and Virginia. According to Coloradans in the "Lifestyle Market Analyst, 1992" cycling is the third ranked sports/leisure activity, with skiing and health club/physical fitness activities ranked one and two respectively.

- *Bike Safety*

  With increased interest in bicycling, there has unfortunately been an increase in the number of bicycle crashes with motor vehicles and also the number of fatalities. Bicycle crashes with motor vehicles increased by over 20% from 1989 to 1992.

  Although bicycle crashes have increased, the injury rate since 1989 has dropped. In contrast though during that same period the fatality rate has increased. Fatalities associated with bicycle crashes appear to be clustered in the 5-15 year old age bracket and the 21-44 age group. Currently Colorado is ranked 9th in the nation regarding cycling fatalities per capita.

- **Aviation**
  - *Overview of Statewide Air Service*

    There are currently 384 aviation landing facilities within Colorado including civil and joint use airports, heliports, and other aviation facilities. Of this number 94 are public use airports with 65 of them being operated by city or county governments. Only 17 of these airports provide regularly scheduled commercial flights. Aviation planning is organized into five geographic regions:

    - *Western Slope*

      On the Western Slope there is a total of 32 airports ranging from the dirt strip at Naval State Park to Walker Field at Grand Junction. In 1992, the western slope system had 688,931 commercial passengers from 10 airports. In 1995, the region is forecast to have 921,529 passengers.

    - *San Luis Valley*

      The San Luis Valley region has the fewest airports (8) and the least activity of the regions. In 1990, the enplaned passengers totaled 9,450. The predictions for 1995 are 19,000 passengers and 20,000 for the year 2000. The based aircraft were 99 in 1990. The forecast for based aircraft is 102 for 1995 and 103 for the year 2000.

    - *Eastern Plains*

      The Eastern Plains region encompasses parts of the Front Range and all of the area east of the front range. The 32 airports range in size from Ft. Collins-Loveland to Eads. As in the other regions, we see a wide variety of uses. The commercial enplanements for 1990 for the region totaled 86,320. The expected total for 1995 is 196,000 and the total expected for the year 2000 is 226,000. In 1991, the region had 758 based aircraft. In 1995 and 2000, the forecasts increase to 856 and 912.

- *Denver Metropolitan Area*

  The airports within the Denver Metropolitan Area, defined as the Denver Regional Council of Governments (DRCOG) area, include Boulder, Tri-County, Longmont, Aurora, Front Range, Centennial, Jeffco, and Stapleton. Most of the traffic at these airports is general aviation traffic, while Stapleton handles the commercial traffic for the area. In 1993, the total general aviation traffic activity count was 896,551 operations. The commercial passenger enplanement count for Stapleton was 16,320,472. The regional plan is being updated by DRCOG and while general aviation counts are expected to rise, there are no current forecasts of future activity. Denver International Airport is expected to have over 17,000,000 commercial enplanements in its first year of operation.

- *Pikes Peak Area*

  The Pikes Peak region, as defined by the Pikes Peak Area Council of Governments consists of Colorado Springs Municipal Airport, Meadow Lake/Falcon and Ellicot. Commercial enplanements for Colorado Springs for 1993 were 759,707. The forecast for 1995 is 812,886. There are no operations counts available for Meadow Lake or Ellicot.

- *Airport Condition*

  There are numerous other indicators used to assess the status of airports in the state. One frequently used indicator is Pavement Condition Index (PCI) which is an evaluation of the condition of the pavement of runways. Pavement condition at airports throughout the state is evaluated on a three-year cycle. Based on the most recent report, 43% of all runway pavements are identified as excellent while only 5% are defined as in poor condition.

- **Intelligent Transportation System (ITS)**
  - *Potential of ITS Technology*

    The Intelligent Transportation System concept is based on the use of advanced computer, electronics and communications technologies to increase the effectiveness of the entire surface transportation system. Many of these technologies have already advanced other modes of transportation, such as aviation, and are now beginning to be used in surface transportation. Colorado is actively pursuing many of these advanced systems to obtain maximum utilization of the existing infrastructure, improve safety, and increase overall productivity.

- **Travel Demand Management (TDM)**
  - *Overview of TDM*

    With the passage of the ISTEA Act and new Clean Air Act, there has been greater attention to reducing overall vehicle miles traveled. This has fostered a series of strategies known as travel demand management (TDM). TDM includes telecommuting, ridesharing, parking management, variable work schedules, bicycling and transit.

  - *Telecommuting - Current Activities*

    Telecommuting is now practiced by approximately 2% of the US labor force and is already a fact of life for many businesses and individuals. Employee gains in flexibility and quality of life can often be matched by corporate benefits of higher productivity and a more loyal and motivated work force. As a result, this phenomenon is currently growing at about 20% annually. Potentially 5% to 10% of the overall work force could be telecommuting by the year 2002.

- *Potential Benefits*

  Telecommuting could potentially reduce vehicle miles traveled by commuters by upward to 35 billion miles nationally by the year 2002 translating into a net overall VMT savings of over 1%. Based on current VMT in Colorado, a shift to telecommuting of this magnitude could translate into a reduction of 270 million vehicle miles. Such a shift would result in substantial energy savings and reductions in mobile emissions.

- *Current Ridesharing Programs*

  In the Denver Metropolitan Area the Denver Regional Council of Governments (DRCOG) is the lead agency for implementing a travel demand management program. Its RideArrangers program is built upon its rideshare program which was established over 20 years ago during the energy crisis. RideArrangers has enrolled 661 employers and approximately 35,000 employees in this cooperative program. Currently, a number of employers in the Denver Area sponsor vanpool programs. In addition to these efforts GO Boulder initiated a vanpool program in 1992. This vanpool program, consisting initially of ten vans, is providing a commuting alternative which is open to the general public.

  In addition to the DRCOG program for the Denver Area, ridesharing programs now exist in Colorado Springs (RideFinders) and Fort Collins (Commuter Pool).

- *Impact of Ridesharing Programs*

  In 1980 it was estimated that 19% of all work trips in the U.S. were made in carpools. In 1990 the number of work trips made by carpool dropped to 14%. Major reasons for this drop include changes in employee lifestyles and working arrangements which have made carpooling more difficult.

- *Variable Work Schedules*

  Currently many employers in the state offer variable work schedule programs. Probably the largest employers offering such programs include the State of Colorado and the Federal Government. Many of the employers offering such programs are based in the urbanized areas of the state. Both employers and employees benefit from such programs. Employees enjoy greater flexibility in their schedules while employers benefit from a more satisfied work force. Finally, the community may greatly benefit as such programs reduce the demand for new and expanded transportation facilities and also may reduce overall travel and in turn automobile emissions.

- *Impact of Variable Work Schedules*

  Various studies have found that compressed work weeks could translate into a significant VMT reduction. An example of the effectiveness of such strategies was the implementation of a compressed work week at the Denver Federal Center with 9,000 employees of 42 federal agencies participating. In this project a VMT reduction of 15% for the overall work force was realized. In addition the program flattened arrival times spreading the peak hour traffic.

Public Roadway Network

Introduction

Colorado's public roadway system is an essential component of Colorado's overall transportation system. The vast majority of passenger and freight trips move over this system on a daily basis.

Realizing the importance of this network, the overall condition of this roadway network has a significant impact on Colorado's economy and the well-being of its residents.

Overall the public roadway system consists of 77,890 miles of public roadways and 8,030 bridges. Although the vast majority (88%) of centerline miles are local roadways under the jurisdiction of city and county governments, most travel occurs on the state highway system.

This area of the report is divided into four sections. The first section is an overview of the public roadway system including the state highway system and the county and city roadway network. The second section covers the operating characteristics of the state highway system. The third section addresses the physical condition of the state highway system. The final section deals with highway safety.

Public Roadway System

The public roadway system consists of the State Highway System and all city streets and county roads which are maintained by those jurisdictions.

Highway Functional Classification

Functional classification is the process by which streets and highways are grouped into classes, or systems, according to the character of service they are intended to provide. Basic to this process is the recognition that individual roads and streets do not serve travel independently in any major way. Rather, most travel involves movement through a network of roads. It becomes necessary then to determine how this travel can be channeled within the network in a logical and efficient manner. Functional classification defines the nature of this channelization process by defining the part that any particular road or street should play in serving the flow of trips through a highway network. Public streets and highways have two basic service functions: (1) To provide access to property; and, (2) to move traffic. While most streets and highways serve both functions, the arterial functional system generally provides for traffic service and the local functional system provides for access. Between the arterial and local functional systems is the collector system which provides a fairly equal balance between traffic service and land access. Certainly, most highway facilities serve both functions to some extent.

The Federal Highway Administration (FHWA) guidelines, entitled "Highway Functional Classification--Concepts, Criteria and Procedures" are used by the State in the functional classification effort. The guidelines set forth individual procedures for rural areas, small urban areas, and urbanized areas.

The functional categories are as follows:

Rural Areas	Small Urban/Urbanized Areas
Interstate	Interstate
Principal Arterials	Other Freeways & Expressways
Minor Arterials	Other Principal Arterials
Major Collectors	Minor Arterials
Minor Collectors	Collectors
Local Roads	Local Streets

The guidelines suggest several analytical procedures be used in arriving at the above functional classifications. Mileages within each functional classification are to be within the percentages contained in the guidelines for statewide totals; however, there can be variations within individual counties or urban areas. The functional classification process begins at the principal arterial level and works down through the collector systems. The remaining miles are classified as local.

State Highway System

The State Highway System in 1992 consisted of 9,165 miles and 22,565 lane miles. Lane miles represent the sum of the lengths of all single driving lanes of the highway system. Lane miles represent a better indicator of the maintenance requirements of the state's highway system than mere centerline miles.

The current state highway system is shown on the attached map (Figure 1). The distribution by functional classification (divided into rural and urban) is shown in Table 1.

Table 1

Miles by Functional Classification - 1992
State Highway System

Rural	Miles	Urban	Miles
Interstate	768	Interstate	185
Principal Arterial	2,201	Freeways and Expressways	201
Minor Arterial	3,536	Other Principal Arterial	477
Major Collector	1,463	Minor Arterial	158
Minor Collector	139	Collector	8
Local	27	Local	2
Total	*8,134*	*Total*	*1,031*

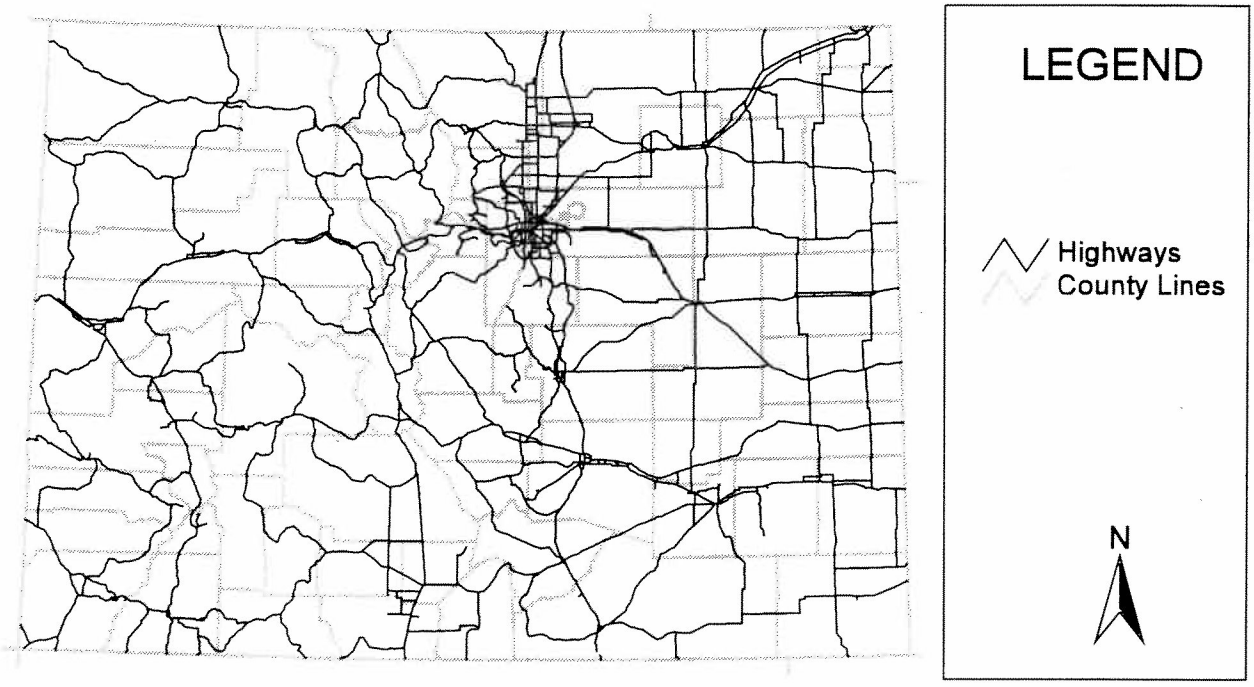
Source: Colorado Department of Transportation

City and County Street & Road Systems

Over 68,000 miles of public roadways in Colorado are either city streets or county roads. The following table (Table 2) shows the statewide functional classification mileage distribution of: (1) City Streets and (2)

Figure 1

Map of the State Highway System



County Roads. This information is from the recently completed functional reclassification of all public roads and streets in Colorado. Because of the definitions used in the reclassification (i.e., urbanized areas have a population of 50,000 or more; small urban areas have a population of 5,000 to 49,999; and, the rural areas are those areas outside the urban and urbanized areas), some rural functional classification mileage is shown under the city street category. Likewise, some urbanized and small urban functional classification mileage is shown under the county road category.

Table 2

Mileage by Functional Classification of City Streets and County Roads - 1992

City Streets				
	Urbanized	Small Urban	Rural	Total
Principal Arterial	268	9	0	277
Minor Arterial	713	167	0	880
Collector	771	139	420*	1,330
Local	5,532	957	1,641	8,130
Subtotal	7,284	1,272	2,061	10,617
County Roads				
	Urbanized	Small Urban	Rural	Total
Principal Arterial	65	5	0	70
Minor Arterial	211	113	127	451
Collector	211	113	13,588*	13,912
Local	1,885	513	41,282	43,680
Subtotal	2,372	744	54,997	58,113

*Includes major and minor collector mileage in rural area.
Source: Colorado Department of Transportation

Functional Reclassification and the National Highway System

With the passage of the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 a National Highway System was established. This system would consist of the Interstate Highway System, a substantial percentage of the urban and rural principal arterial system, and certain other routes for national defense purposes. Prior to designating the NHS, the individual states conducted a functional reclassification of roads and streets, and submitted a report to FHWA. The functional reclassification results formed the basis for the proposed NHS. The reclassification effort was done by the Colorado Department of Transportation in cooperation with appropriate local and regional officials as well as

appropriate federal agencies in the case of roads in areas under federal jurisdiction or on tribal reservations.

Public meetings to discuss the NHS and obtain appropriate input were held throughout the state. Toward defining this system, FHWA furnished special instructions to the states for selecting the NHS routes in accordance with the ISTEA legislation. These instructions included NHS mileage "targets," which for Colorado was 2,308 miles for the rural area and 668 miles for urban areas resulting in a total NHS mileage of 2,976. The FHWA permitted the states to submit requests for routes above the target mileage; however, sufficient justification was required to permit FHWA to evaluate the relative importance of the routes and whether they meet the objectives of the NHS. The result of this process was an NHS network for Colorado of approximately 3,379 total miles which was submitted to Congress by the U.S. Department of Transportation on December 9, 1993. Congress has until September 30, 1995 to designate the final NHS. Overall the proposed NHS will consist of about 4% of the total nationwide mileage, but it is anticipated that it will carry about 40% of the total traffic.

Figure 2 reflects the proposed NHS for Colorado.

In addition to the NHS, the results of functional classification studies have been used to assign jurisdictional responsibility (i.e., county, city or State), for streets and highways, in fiscal planning, establishing needs and setting design standards.

Operating Characteristics

The operation of the system may be best measured by assessing travel on the system along with the level of congestion that exists throughout the network.

Travel on the State Highway System

Traffic has risen substantially on both urban and rural roadways. Vehicle miles of travel (VMT) measures the amount of use of the roadway system. In 1992 the state highway system carried about 63 percent of the total statewide VMT (30.2 billion) while it made up only about 12 percent of the total statewide road/street system. Since 1987, VMT on state highways has increased 15.8%, from 16.4 billion VMT to 19.0 billion VMT in 1992.

Figure 2

Map of the Proposed National Highway System

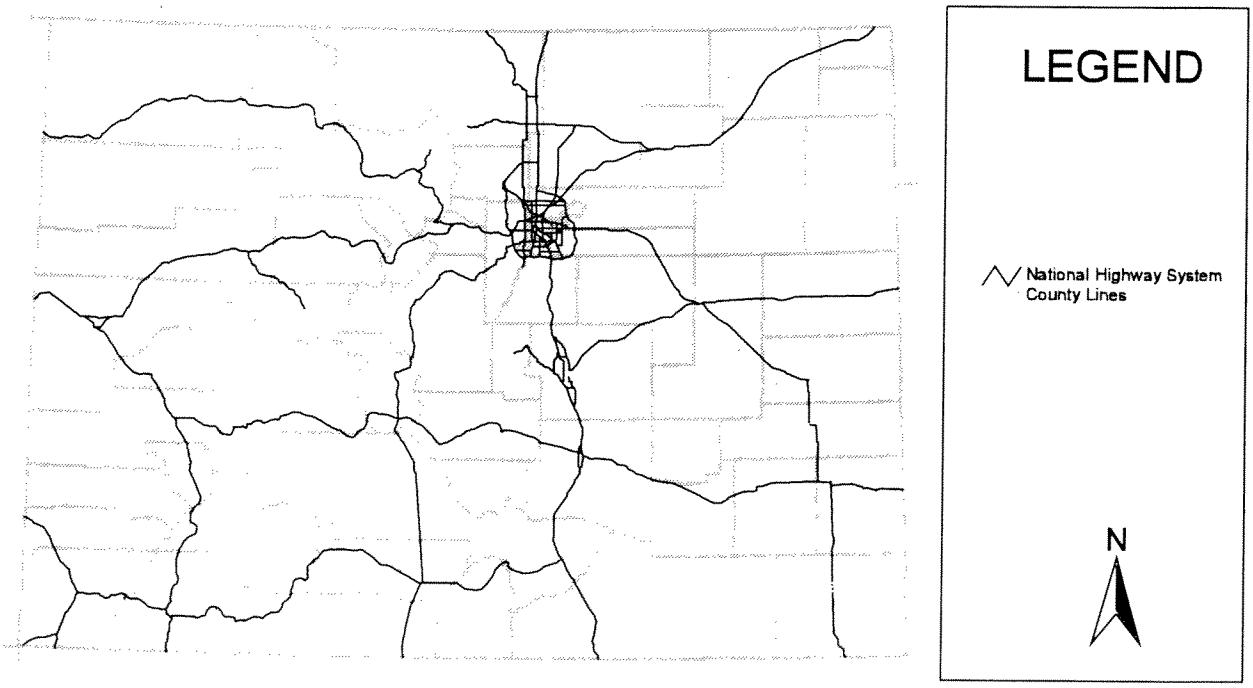


Table 3

Annual Vehicle Miles Traveled (VMT) - 1992
State Highway System

Year	VMT State Highways (in Billions)	VMT County/City (in billions)	VMT Total (in billions)
1987	16.4	10.6	27.0
1988	16.5	11.1	27.6
1989	17.1	10.5	27.6
1990	17.7	9.8	27.5
1991	18.2	10.2	28.4
1992	19.0	11.2	30.2

Source: Colorado Department of Transportation Overview

Relative to other growth such as population and employment, travel on the State Highway System has increased at a much more rapid pace. As noted earlier travel on the state highway system has increased by 12.3% while population has grown by 6.3% and the labor force has risen by only 3.9%. The substantial growth in travel may be attributed to several key factors: increased population, increased tourism, increased vehicle trip length, reduced vehicle occupancy, and increased person trips per capita.

In regard to travel there has been a distinct shift in VMT distribution where a greater level of travel is now occurring in urban areas. As witness to this fact, in 1970, rural state highways accounted for 60% of the total state VMT. In 1992 the rural share fell to 41% of all VMT. This trend parallels the rapid growth experienced in the urban areas of Colorado.

VMT is not proportional to the number of miles in a given highway category. For example, although the Interstate system accounts for only 10% of the public roadway system mileage, 24% of the travel takes place on these roadways.

Table 4 shows the breakdown of 1992 lane-miles and the daily vehicle miles traveled (DVMT) for the State Highway System by functional classification.

Another indicator of travel on the highway system is Annual Average Daily Traffic (ADT). This is an assessment of the traffic volume on a route or segment of highway for a 24 hour period averaged for the year. The average daily traffic is calculated through the use of continuous counting equipment and coverage counts which consist of short term counts of either 24 or 48 hours in duration.

ADT is important for planning, design and maintenance activities. ADT is a major determinant as to highway capacity needs, resurfacing and maintenance requirements and bridge needs.

Table 4

Daily Vehicle Miles of Travel (DVMT) - 1992
by Functional Classification
State Highway System

Functional Classification	Lane Miles	DVMT
Rural		
Interstate	3,244	9,873,577
Principal Arterial	4,484	7,080,053
Minor Arterial	4,047	4,473,205
Major Collector	7,114	3,898,077
Minor Collector	242	103,849
Local	26	11,727
Subtotal	19,157	25,440,488
Urban		
Interstate	746	9,759,127
Principal Arterial	641	4,882,580
Other Principal Arterial	1,821	9,198,333
Minor Arterial	189	536,099
Collector	11	26,358
Local	0	0
Subtotal	3,408	24,402,497
TOTAL	22,565	49,842,985

Source: Colorado Department of Transportation

Level of Service (LOS) and Congestion

Level of service describes the operational conditions of the highway system in terms of speed and travel time, freedom to maneuver in traffic, traffic interruptions, comfort, and safety as perceived by motorists. Six levels of service are defined for every facility and are given designations ranging from "A" (the best) to "F" (the worst). A roadway operating at a level of service A represents free flowing traffic operations where vehicles can travel unimpeded. In contrast a roadway with a level of service F represents a gridlock condition with generally long streams of vehicles operating in a stop and go manner.

In particular, level of service (LOS) may be used to identify bottlenecks within the highway system as well as identifying areas of congestion. Heavily congested roadways may act to exacerbate certain air quality problems as vehicles remain in traffic longer and in turn release more emissions. To address such congestion requires either roadway capacity improvements or alternative measures to address transportation demand.

Traditionally within Colorado, a LOS "D" has been defined as the threshold for congestion in urban areas and "C" in rural areas. This volume of traffic is less than the maximum that can be accommodated on a roadway but is great enough to induce stop and go conditions translating into significantly lower travel speeds.

Severely congested roadways, or those roadways which may be classified as LOS "E", are becoming more prevalent within Colorado. As shown in Table 5, the number of miles, designated as severely congested, has been increasing for virtually all categories of roadways since 1987. In 1987, the number of overall severely congested miles (those roadways operating at a LOS "E" with a volume to service flow ratio of .95) was 298. By 1992 this number had risen to 485 miles. Primarily, this 62% increase in congested miles may be attributed to a significant increase in overall traffic while there has been only a minimal increase in system capacity. With only limited capacity improvements programmed over the next several years and only limited success to date in regard to alternative mode use, it is anticipated that this problem will increase in the coming years.

Although most of the severely congested roadways are interstate highways, other freeways, and major arterials in urban areas, congestion is not limited to only such roadways. Certain rural arterials such as SH 82 between Glenwood Springs and Aspen almost mirror the characteristics of congested urban roadways during peak periods. In addition many other rural roadways, such as I-70 near the Eisenhower Tunnel, experience congestion at various times of the year primarily coinciding with tourism or special events.

Table 5

Severely Congested Highways (LOS "E") Mileage by Functional Classification(1)

Functional Classification	1987	1988	1989	1990	1991	1992
Rural						
Interstate	24	20	17	57	106	109
Other Principal Arterial	37	8	6	13	18	27
Major Arterial	2	14	7	4	4	9
Major Collector	6	1	0	1	5	5
Minor Collector	0	0	0	0	1	0
Subtotal	69	43	30	75	134	150
Urban						
Interstate	47	45	48	55	56	56
Freeway/Expressway	16	24	16	19	21	36
Other Principal Arterial	131	120	109	163	209	142
Minor Arterial	35	33	18	14	40	88
Collector	0	2	10	7	12	13
Subtotal	*229*	*224*	*201*	*258*	*338*	*335*
Total	298	267	231	333	472	485

1. *Severely congested mileage represents those roadways with a LOS "E" with a volume/surface flow ratio of .95 or greater.*

Source: FHWA Highway Statistics Reports 1987 through 1992

Physical Condition

Within this section we address the current physical condition of the state highway system. This includes a review and summary of surface and bridge conditions.

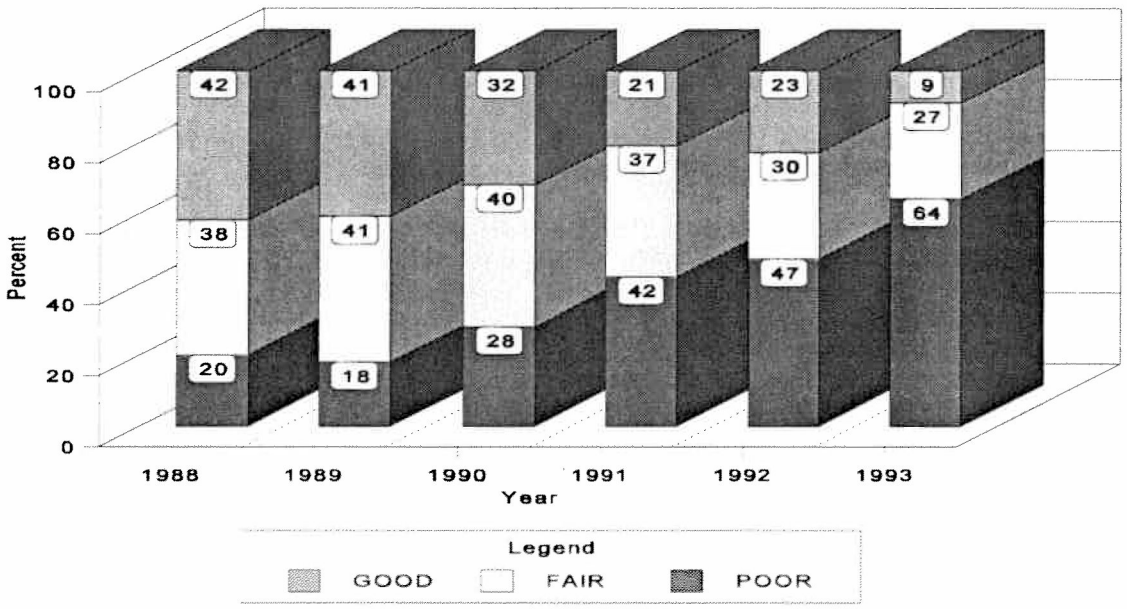
Surface Condition

Surface condition represents a barometer as to the overall status of a pavement as determined by several factors including roughness, cracking, and patching. Based on these factors each section of roadway is classified either good, fair, or poor.

As may be seen in Table 6, pavement condition on the state highway system has been deteriorating over the past five years. In 1993, 64% of all miles on the state highway system were deemed to be in poor condition. This compares to 20% of the state highway system in poor condition in 1988. This trend is in contrast with a national trend which witnessed the percentage of pavements in poor condition either decreasing or at least remaining stable during this period.

Table 6

Surface Condition
State Highway System
1988-1993



Based on center line miles (primary direction only)
Source - Colorado Department of Transportation

The drop in surface condition may be attributed to many factors, two of which are design life and heavier vehicle loadings. First, the overall highway system is aging and reaching the end of its design life. Nearly 75% of the current interstate was built prior to 1970. Because the design life for these highways generally was 20 years, many of these roadways now require either reconstruction or extensive repairs. Another factor affecting pavement condition has been an increased number of trucks as well as heavier loads transported by these vehicles. Whereas the maximum weight for a truck on the Interstate Highway was 72,800 lbs. in the 1970s, current legislation now permits trucks to carry up to 80,000 lbs. Many of the highways were not designed for this heavy truck traffic and this has translated into a more rapid deterioration of pavements.

To address the issue of pavement condition, the State Transportation Commission has established a goal that no more than 40% of Colorado's highways would be in poor condition. Along these lines the Transportation Commission has dedicated an increased amount of CDOT's budget to resurfacing so as to reverse the current trend regarding pavement condition. Preliminary information relating to pavement condition for 1994 indicates that the percentage of roadways in poor condition has dropped due to this increased commitment on CDOT's part.

Alignment and Lane Width

In addition to pavement condition, other physical factors may substantially affect roadway performance. In particular, lane width and alignment adequacy may substantially affect the safety of the roadway as well as the level of service.

Substandard lane widths reduce the carrying capacity of a roadway and adversely affect safety. In particular adequate lane widths are important for higher functionally classified roadways.

As may be seen in Table 7, most of the roadway miles with substandard lane widths on the Public Roadway System are on lower functionally classified roadways such as major and minor collectors. Primarily those roadways with substandard widths of less than 9 feet are located in rural areas. In 1992 only 4% of all public roadway miles were less than 9 feet in width.

Alignment of a roadway may also greatly affect the speed and safety at which vehicles may travel. Horizontal alignment affects speed and sight distance while vertical alignment primarily impacts safety. To assess alignment FHWA has developed a rating system. In this system, values range 1 through 4 with lower values representing good alignment and higher values constituting poor alignment. Similar to lane width problems, alignment problems primarily exist on lower functionally classified rural roadways. Roadways with low alignment ratings (3 or 4) are significantly below current design standards for new highways. Although specific information relating to this area was not readily available, it is perceived that the miles of roadway on the Public Roadway System with alignment problems has been steadily decreasing with the reconstruction of old roadways which are rebuilt to current design standards.

Table 7

Lane Width by Functional Classification for the Public Roadway System* - 1992 (mileage in centerline miles)

Functional Classification	< 9 Feet	9 Feet	10 Feet	11 Feet	12 or more	Total
Rural						
Interstate	0	0	0	0	768	768
Other Principal Arterial	0	0	44	297	1,813	2,154
Major Arterial	0	0	298	531	2,905	3,734
Major Collector	55	59	943	1,199	3,438	5,694
Minor Collector	1,007	493	1,387	1,757	4,733	9,377
Subtotal	1,062	552	2,672	3,784	13,657	21,727
Urban						
Interstate	0	0	0	0	185	185
Freeway/Expressway	0	0	0	10	200	210
Other Principal Arterial	0	0	60	83	677	820
Minor Arterial	0	3	85	197	1,078	1,363
Collector	2	42	165	208	848	1,265
Subtotal	2	45	310	498	2,988	3,843
TOTAL	1,064	597	2,982	4,282	16,645	25,570

** Does not include roadways functionally classified as Local.*
** Includes State Highway and City and County Roadways*
Source: FHWA Highway Statistics Reports 1992

Bridges

At the close of Fiscal Year 1993 there were 8,030 bridges on Colorado's public road system. Of this number, 3,671 or 46% of all bridges were on the State Highway System with the remaining structures on county roads or city streets. This compares to 7632 bridges on the public road network at the close of FY 1991 which translates into a net increase of 3%.

Bridge conditions are based on three sets of criteria including load capacity, physical characteristics (lane width, vertical clearances, and horizontal clearances), and the bridge condition rating. If a bridge is deficient by any one of these criteria, it may be identified as being either structurally or functionally deficient.

Load capacity indicates the structural integrity of the bridge to accommodate loads as anticipated for that particular highway. A structurally deficient bridge would be one not designed to carry such loads. Most bridges in this category would likely be load-posted and would not permit trucks over certain weights.

Physical characteristics, including clearances, determine whether a structure may accommodate the required number and size of vehicles safely. This factor affects the functional capability of the bridge and one is deemed functionally obsolete if it is deficient in this category.

Finally the condition rating of the deck, superstructure, and substructure are factors in determining the remaining life for the bridge and when rehabilitation or replacement may be required.

As may be seen in Table 8, of the 8,030 bridges on the public road system, 19.5% or 1,564 bridges are categorized as being functionally or structurally deficient. This compares to 1,851 deficient bridges in FY 1991. (Due to a change in the bridge coding guide in 1988, which altered the number of deficient bridges, comparisons prior to 1990 are not valid.) Overall those roadways which have higher functional classifications, such as Interstate, have fewer deficient bridges. Thus over the last several years, even with an increasing number of bridges on the public roadway network, Colorado has made significant gains in reducing the number of deficient structures.

The reduction in deficient bridges may be attributed to an aggressive bridge replacement program which has led to the replacement and repair of several hundred structures over the past several years. In addition, CDOT has implemented improved maintenance systems and programs.

Table 8
Deficient Bridges on Colorado Roadways
1991-1993

Year	Total Bridges	Structurally Deficient	Functionally Deficient	Total Deficient	Percent Deficient
1991	7802	1256	595	1851	23.7
1992	7825	969	643	1612	20.6
1993	8030	879	685	1564	19.5

Source - Colorado Department of Transportation

Highway Safety

Probably one of the greatest areas of concern in transportation is safety. Of the 140,000 deaths by injury annually in this country, approximately 30% of those deaths are due to traffic crashes.

Over the past two decades Colorado has witnessed substantial improvement in the area of highway safety which has translated into a significant reduction in the crash rate per mile and the number of fatalities associated with vehicle-related crashes on the State Highway System. In 1987 there were 591 fatalities due to traffic crashes. In 1992 the number of fatalities had dropped to 522 representing an 11.6% decline. This reduction in traffic fatalities may be attributable to a number of factors including stiffer fines and penalties

for intoxicated drivers, improved roadway design, greater use of seatbelts and shoulderbelts, improved vehicle features including airbags, better enforcement, and increased educational programs.
An even better gauge as to overall safety for the State Highway System may be the fatality rate which represents a ratio of the number of fatalities per 100 million vehicle miles traveled. As may be seen in Table 9, the fatality rate has dropped dramatically over the years. In 1987 the fatality rate was 2.19. In 1992 this rate had fallen to 1.65, translating into a 25% reduction.

Table 9

Colorado Traffic Fatality Rate
1987-1992

Year	Number of Fatalities	Colorado Fatality Rate
1987	591	2.19
1988	497	1.80
1989	528	1.91
1990	544	2.00
1991	480	1.73
1992	522	1.65

Source: FHWA Highway Statistics Reports 1987 through 1992.

Transit Service

Introduction

Transit operations within Colorado encompass a variety of services including public transportation, which may take the form of conventional fixed route services or fixed guideway system such as Denver's new light rail system or paratransit operations, specialized transportation which addresses the specific needs of certain transit dependent groups. In addition to public transportation services, transit within Colorado includes commercial services in the form of intercity bus operations, taxi service, shuttle and charter services.

Public Transportation Services

Public transportation is defined as a service that is available to any person of any age in the general public, and which is operated by public agencies or at least supported with public funds. Public transportation can operate either on a fixed route and fixed schedule basis or on a demand responsive (door-to-door advanced reservation) basis. There are 34 public transportation operators in Colorado (see Figure 3). Of these, 17 primarily provide fixed route service, 7 in urbanized areas (over 50,000 population) and 13 in resort or gaming areas. The remaining 14 primarily provide demand responsive service, mostly in rural areas. Colorado's 34 public transportation operators serve 39 of Colorado's counties, though in most cases the service is not available in all areas of a county. Figure 4 depicts the counties being served at least in part by public transportation.

The 1990 Census indicates that the national transit industry is drawing fewer riders overall and losing its market share to the automobile. However, Colorado transit systems have acted to buck this national trend: ridership is increasing for the majority of Colorado transit operators. In 1992, Colorado's public transportation systems, operating 1,377 vehicles, traveled over 45 million miles and provided more than 76 million passenger trips. The majority of these trips were provided by Denver's large Regional Transportation District (RTD) system, but the ridership of other operators is also significant in proportion to their population.

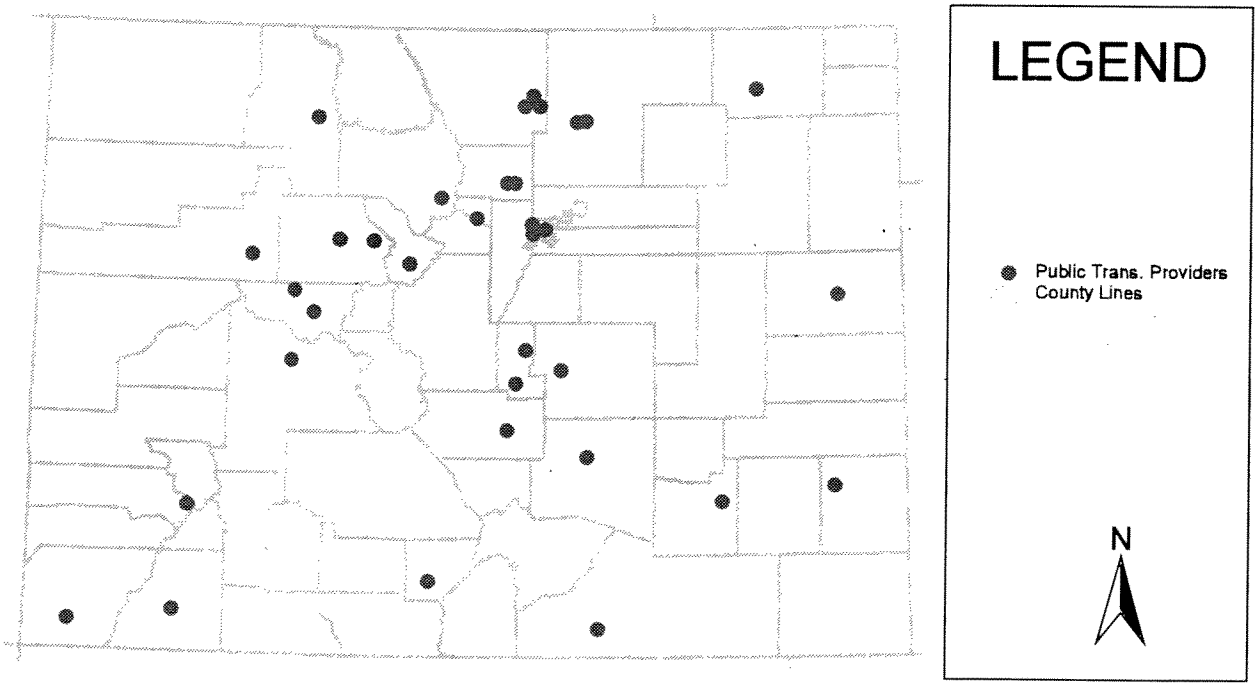
In some urbanized areas and resort communities there has been an emphasis on building park-and-ride facilities to serve those from more distant points with low population densities. In some cases park-and-ride lots are not specifically constructed, but instead develop informally in parking lots or on open land.

The urbanized and resort area transit systems primarily operate 30 to 40 foot transit coaches. Many of them are aging and are reaching their federally-established 12 year useful life standard. Unfortunately, the amount of discretionary Federal Transit Administration (FTA) funding available for bus replacements is very limited and has been increasingly earmarked by Congress for specific areas and projects rather than made available on a merit basis. Over the years Colorado has not been as successful in such political earmarking because the vast majority of funds go toward transit systems in the country's largest cities.

Public transportation operators in non-resort rural and non-urbanized areas (under 50,000 population) usually provide demand responsive service and operate 10 to 25 passenger vans and minibuses. The majority of riders on these systems are elderly, disabled or low income. The general public is a lesser portion of the ridership because the services aren't available on a fixed route and are not geared to work trips. Ridership is increasing at a modest pace but is very sensitive to funding availability. That is, a fixed route system's costs are relatively predictable; the goal is to encourage people to use what's available; but the cost of providing demand responsive transit fluctuates according to average trip length, the total number of people requesting service, the time needed to board frail passengers and wheelchairs, etc.

Figure 3

Map of
Public Transportation Operators



Thanks to the requirements of the Federal Transit Administration's Section 15 Uniform Reporting System, good operating data exists regarding urbanized transit operations. Since no such requirements apply to rural and non-urbanized transit operators or for those not receiving federal assistance, it is difficult to provide a comprehensive view of the condition of rural and non-urbanized transit operations within Colorado. Based on a review of certain select rural and non-urbanized transit operators, both ridership and service levels have been increasing

In assessing the condition of public transportation services within Colorado, several performance indicators may be examined. First, overall ridership levels on public transportation systems provide a good assessment as to public acceptance. As may be seen in Table 10, public transportation ridership in the urbanized areas of Colorado has increased by over 8.5 million trips, representing a 15.6% change since 1987. Associated with this added ridership has been an increase in service in urbanized areas. Since 1988 vehicle service miles increased by 9.4% which translated into additional areas served within these urbanized areas as well as more service on existing routes. Growth in transit ridership in Colorado has even been more impressive in light of the fact that transit ridership on a national basis has been relatively stable during the same period.

Although ridership patronage gains were made in the area of public transportation, it should also be noted that this growth was far less in proportion to the overall growth in vehicle miles traveled. This would appear to indicate that transit ridership as a proportion of overall trips has declined.

Table 10

Colorado Transit Performance Indicators for Urbanized Areas 1987-1992

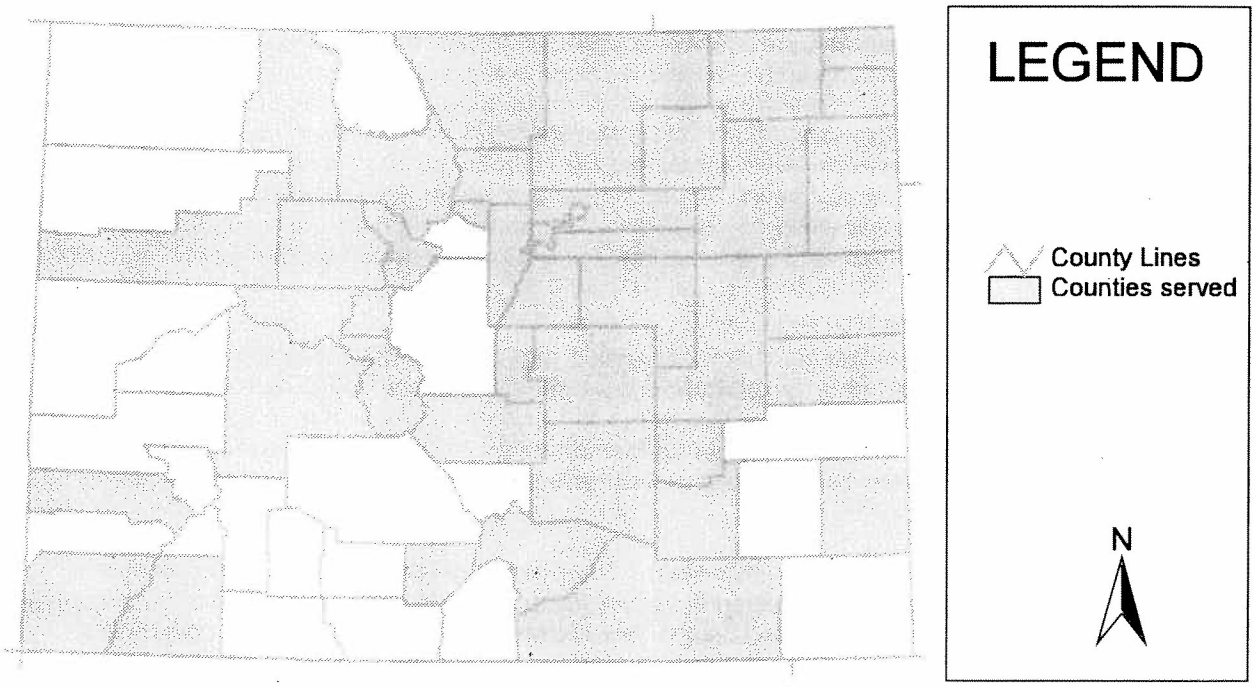
Year	Annual Rev Passengers	Annual Rev Vehicle Miles	Total Estimated Operating Costs	Percent Fare Rev	Operating Cost per Passenger
1987	54,925,000	--	--	--	--
1988	--	26,696,192	--	14%	--
1989	55,354,866	26,337,391	110,411,178	19%	$1.99
1990	56,113,214	27,134,750	118,669,935	20%	$2.11
1991	61,857,661	28,279,649	118,766,777	20%	$1.91
1992	63,511,911	29,237,882	124,988,654	19%	$1.96

Source: AASHTO Public Transportation Annual Report 1987-1992

To measure the efficiency of public transportation service, the percent of operating costs made up by farebox revenue, as well as the operating cost per passenger, may serve as performance measures. As shown in Table 10 above, operating costs for urbanized transit operations have risen over the past several years. These increased costs though have been offset by additional farebox revenues. Thus the percent of operating costs covered by farebox revenues has been relatively stable over the past four years (ranging from 19% to 20%) and the average operating cost per passenger has ranged from $1.91 to $2.11.

Figure 4

Map of
Counties Served by Public Transportation



Specialized Transit Service

Specialized transit is generally defined herein as service that is provided for a variety of trip purposes, open to any elderly, disabled or low income person in need of transportation, and not offered to the general public (except on an incidental basis). There are forty-five (45) specialized transit operators in the state, and all primarily provide demand responsive service. Most are private nonprofit organizations but receive some public sector support.

Many of these operators do not receive funding through CDOT and in turn do not need to comply with certain reporting requirements as mandated for those receiving grant funds. Thus, only limited data is available on those operators. The information that is available on such operators is obtained from the Colorado Association of Transit Agencies (CASTA). The 22 operators from whom data is readily available report traveling over 2.7 million miles and providing more than 565,000 passenger trips in 1992. These operators range from fleets of over thirty vehicles serving urbanized areas to systems operating less than three vehicles using volunteer drivers. Nearly every county in the state has some level of specialized service.

There is another group of transportation providers which serve elderly or disabled persons but which are not included within the above definition. These organizations provide transportation on an incidental basis to a specific clientele, such as residents of a housing facility, clients of an agency serving the developmentally disabled, patients of a particular clinic, etc. They are distinguished from specialized operators by not usually offering service to any person in need and/or by limiting trip purpose. Common examples of "incidental transit operators" are mental health centers, Head Start programs and nursing homes. It is not possible to provide an accurate assessment of these operators because they do not report to CDOT. Currently, CDOT is aware of at least fifty such operators, but the actual number probably exceeds 200.

Commercial Transit Operators

Commercial transit operators are defined as those providing passenger transportation on a "for hire," for-profit basis. This category includes taxi, limousine, charter, contract, and scheduled shuttle services. Commercial operators are generally distinguished by the fact they do not receive public operating subsidies. Some commercial operators do receive public funds to provide the type of service described in the two categories described above; however, when they do so they are providing service under contract, they are not receiving a public subsidy.

There are over 125 commercial operators in the state. The number of operators has grown slightly, particularly in response to the advent of gaming in certain communities in the state and in anticipation of the Denver International Airport. More common, though, have been mergers and buy outs of operating authority. Commercial operators providing service across state boundaries or making direct interstate service connections at commercial airports are regulated by the federal Interstate Commerce Commission (ICC); those operating only within the state and not making airport connections are regulated by the Colorado Public Utilities Commission (PUC).

ICC regulation is considered less restrictive than PUC regulation and generally allows any interested party to enter the market. The extent of regulatory oversight by the PUC is based on the type of service provided. For example, taxi operators are more regulated than luxury limousines, while charter buses with 32 or more seats have been deregulated.

Reliable information relative to passenger miles, fleet size/age/condition or ridership is not available for commercial operators, since this information is generally considered proprietary.

Intercity Bus Service

Intercity bus service is defined as regularly scheduled service for the general public which operates with limited stops over fixed routes and makes meaningful connections with scheduled intercity bus service to more distant points. Colorado's intercity bus service is provided only by Greyhound Lines and its subsidiary, TNM&O Coaches. In Colorado their routes are operated on Interstate highways 25, 70, and 76 and U.S. highways 40, 50, 85, 160, 285, 287, and 550. Figure 5 depicts existing intercity bus routes. Information relative to passenger miles, fleet size/age/condition or ridership is not available, since this information is considered proprietary. For the most part though service is limited to one trip per day for most communities in Colorado while those communities on interstate highways may receive two to three roundtrips.

During the 1980s the intercity bus industry abandoned a number of routes in Colorado, eliminating service to a number of smaller communities. Further abandonments occurred in the 1990s during a strike by Greyhound employees. Greyhound service now seems to be more stable, operating over only the most populated routes. While the intercity bus industry is not expected to thrive, it is expected to survive and is not likely to abandon any routes, though it might reduce the number of runs on a particular route. Any reductions in service though will further adversely affect those who still depend on this service to travel to regional centers for services.

Light Rail

RTD's Metro Area Connection (MAC) system began operation on October 7,1994 using eleven rail cars. The length of this section of the MAC rail system is 5.3 miles. The projected daily ridership was 14,000 but initial ridership has been averaging 15,000 passengers per day. The south end of the line is located at Interstate 25 and Broadway. From there it runs north along an old railroad right-of-way purchased by RTD, then onto the Auraria campus and into downtown Denver; the line then runs to its northern terminus in the Five Points area in Northeast Denver.

A major goal of the route is to speed the movement of passengers into downtown and to relieve downtown traffic by removing buses. Many express and local buses that now travel from southeastern and southwestern areas into downtown unload at the I-25 and Broadway station, where passengers transfer to the MAC; MAC is expected to get passengers into downtown faster, better disperse traffic on the 16th Street Mall shuttles, and keep some southeastern and southwestern buses off downtown streets.

Recently, funding was earmarked in Congress to provide funds to allow RTD to pursue extending the light rail line to the southwest Denver Metropolitan Area. Along with this action RTD also received the support of the Denver Regional Council of Governments (DRCOG) to pursue the southwest corridor along the Santa Fe Drive alignment. To facilitate the development of this extension of the system, RTD's Board of Directors has authorized funding to conduct preliminary engineering for the corridor. The proposed rail line would be 8.7 miles long and if final design and construction funding is obtained, 21 to 35 rail cars would be purchased for the new line. Projected ridership is 9,000 per day.

Bus/High Occupancy Vehicle (HOV) Lanes

Bus and high occupancy vehicle (HOV) lanes are traffic lanes reserved specifically for buses or high occupancy vehicles such as vanpools or carpools (vanpools and carpools must carry three persons or more to use these lanes). The purpose of such lanes is to reduce travel time for such vehicles and in turn make such modes more attractive to commuters.

Currently, most of the bus and HOV lanes are located in the Denver Metropolitan Area. These facilities include: US 36 from Sheridan Boulevard to I-25, North I-25 from downtown Denver to 70th Ave., and Santa Fe Drive from Mississippi Ave. to Evans. Construction is now underway or planned to extend each of these.

Other routes being considered in the Denver Metropolitan Area in the near-term for bus or HOV lanes include: I-225 from Parker Road to the I-70 interchange and I-25 from Broadway to Lincoln Ave. in Douglas County.

In addition to the above-noted highways there are three streets in Denver which have designated bus lanes. These streets include the 16th Street Mall which is restricted at all times to only RTD shuttle buses, and parts of Lincoln St. and Broadway which have a lane restricted for buses during peak travel hours.

Some resort areas also have restricted certain roadways transit vehicles usage on either a year-round or seasonal basis. In these areas safety, aesthetic or environmental issues, have arisen which have warranted such facilities. These areas include the Maroon Bell Wilderness Area, the Town of Vail, Beaver Creek Ski Area, and the Copper Mountain Ski Area.

Passenger Rail Programs

Rail passenger service in Colorado is very limited and is primarily oriented toward longer cross country trips rather than intrastate trips. Passenger service is almost exclusively provided by AMTRAK with the exception of several small railroads throughout the state which primarily serve tourism.

The major corridor for AMTRAK service is east and west through Denver. The AMTRAK California Zephyr enters Colorado at the Nebraska state line east of Wray, Colorado and operates on the Burlington Northern trackage between western Nebraska and Denver. This route provides daily service east from Chicago through Omaha to Denver. From Denver west, service is provided on the trackage of the Southern Pacific Railroad through Grand Junction, Salt Lake City and to the West Coast.

The AMTRAK Southwest Chief operates daily between Chicago and Los Angeles and enters Colorado on ATSF trackage at the Kansas state line east of Lamar and leaves the state at the New Mexico state line south of Trinidad.

AMTRAK also provides tri-weekly passenger service north of Denver through Greeley to Cheyenne, Wyoming. This route continues through western states and ultimately ends in Seattle.

Figure 6 displays AMTRAK's rail service in Colorado.

As noted earlier, recreational railroads provide primarily provide service for tourism purposes. Many of these railroads have certain historical significance and also provide service to scenic points in the state. These railroads include the following:

Cripple Creek and Victor Railroad - Cripple Creek to Victor
Cumbres and Toltec Scenic Railroad - Antonito to Chama
Ansco Investment Company - Ski Train, Denver to Winter Park
Durango and Silverton - Durango to Silverton
Georgetown-Silver Plume Narrow Gauge - Georgetown to Silver Plume
Leadville, Colorado and Southern Railroad - Leadville to Fremont Pass area

Figure 5

Map of
Intercity Bus Services

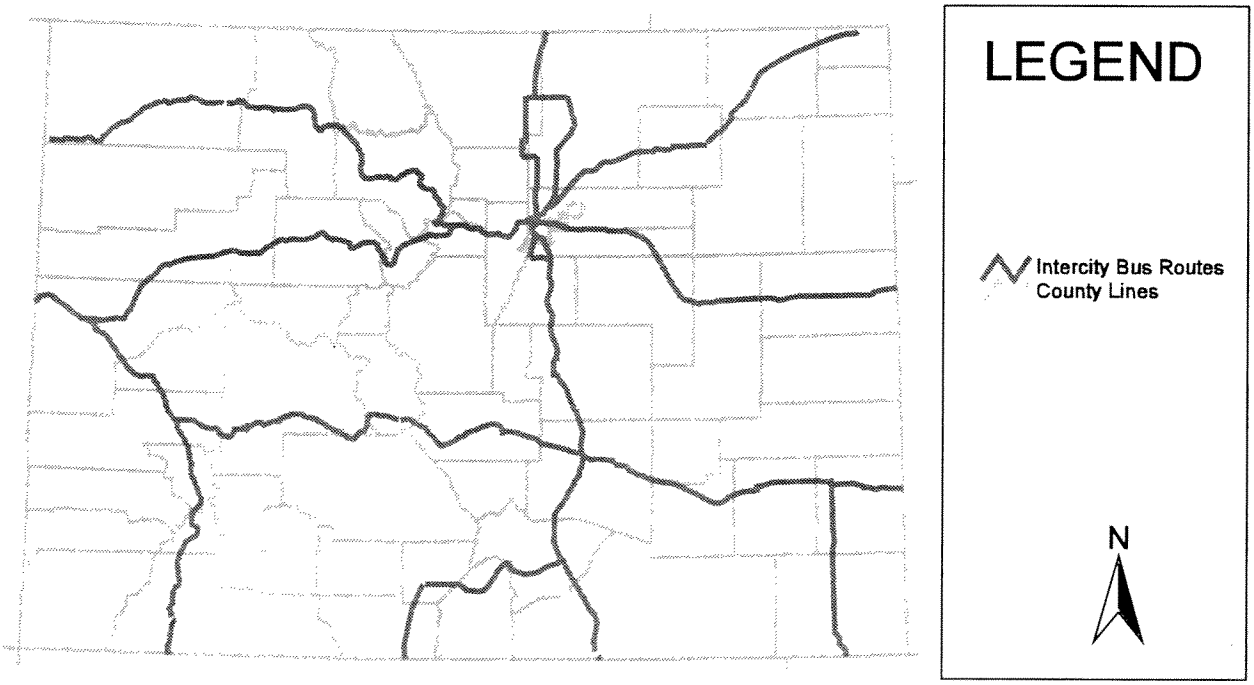
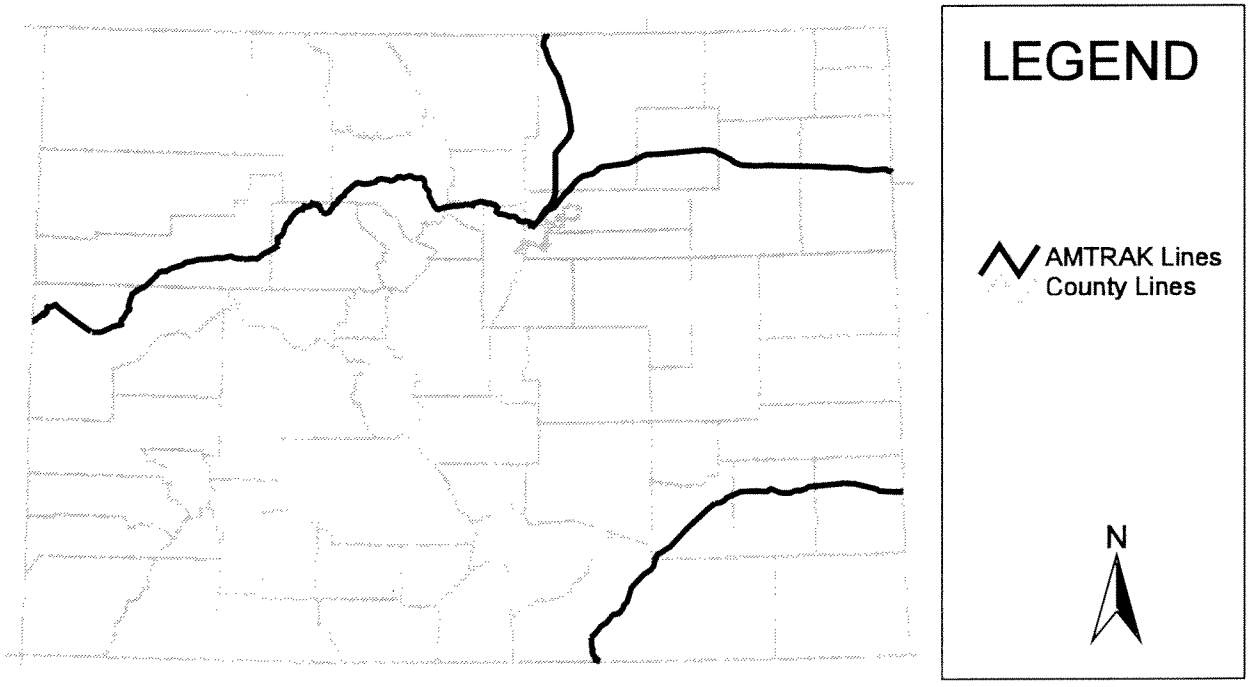


Figure 6

Map of
AMTRAK Service



Freight Movement

Introduction

Freight movement as defined in this section refers to the surface transportation of goods, products, and commodities by both rail and truck. Overall it was estimated that in 1990 approximately 73 million tons of freight were transported inbound and outbound in Colorado. Of this amount 84% of all freight was transported by truck with the remaining 16% shipped by rail.

Rail Operations

Approximately 16% of total inbound and outbound freight in Colorado is shipped by rail. Most of this freight (almost 83%) is carried on two railroads, the Southern Pacific and the Burlington Northern. The two remaining major rail operators the Union Pacific and Atchison, Topeka, and Santa Fe account for the majority of the remaining rail shipments.

There are ten railroad companies operating in the State. Most of the State is served by freight rail lines; however, the extreme southwest and northwest portions of the State, as well as the Gunnison Valley area, are not served. Figure7 shows the location and names of these ten freight railroads.

When evaluating freight movements by rail in Colorado, it should be noted that most of the railroads that operate in the state transport freight that originates or is destined to markets in other states.

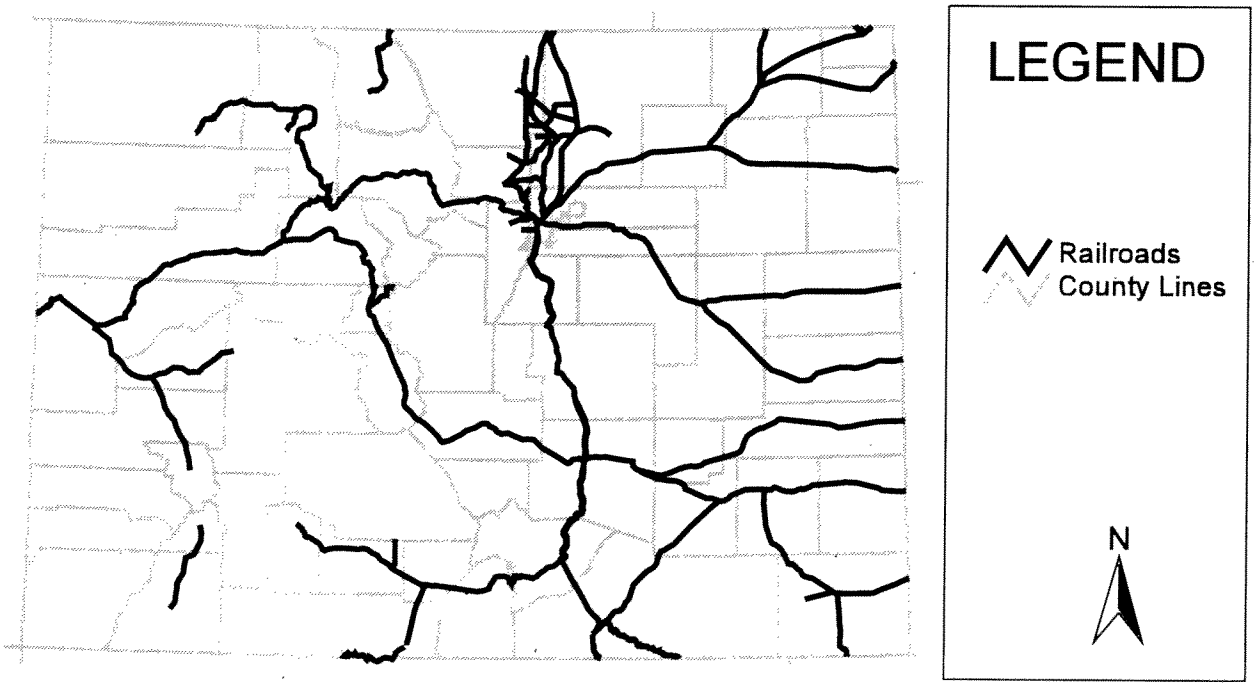
The description of the condition for freight rail within this section includes the identification of existing lines and their respective classes; miles of freight rail lines; operating characteristics (including freight movement, tonnage, and commodities); performance measures such as abandoned lines and rights of way, and safety; and, opportunities and constraints for freight rail in the State.

Classes of Railroads Serving Colorado

There are generally three classes of railroads identified by the rail industry. A Class One railroad is a railroad with gross operating revenues of $50 million or more annually. A Class Two railroad has gross operating revenues of between $10 million and $50 million or more annually, and a Class Three railroad has gross operating revenues of less than $10 million annually. Colorado is served by Class One and Class Three railroads. There are no Class Two railroads operating in the state.

Figure 7

Map of
Railroads in Colorado



Currently, Colorado is served by four Class One railroads. Following are the names and service area description of each Class One railroad in the State:

Atchison, Topeka, and Santa Fe Railroad (ATSF)

The Atchison, Topeka, and Santa Fe Railroad (ATSF) operates a mainline between Albuquerque, New Mexico and Kansas City, Missouri, through the southeastern part of Colorado. This is part of their Chicago and West Coast service. Denver is connected in La Junta through Pueblo.

Burlington Northern Railroad

The Burlington Northern Railroad (BN) serves the eastern part of the State. BN operates three mainlines in this area. One of the lines runs in an east-west direction, connecting Denver to major midwestern markets. Another line connects the first line at Brush with a line entering Nebraska. The third line runs through Colorado from southeast Wyoming to Texas.

Southern Pacific Railroad

In 1988, the Denver and Rio Grande Western Railroad (DRGW) was acquired by the Southern Pacific Railroad (SP), giving it a national perspective. The DRGW was a regional railroad connecting Utah with Denver and Pueblo. The SP also provides branch line service into several areas of western Colorado. To access its lines to the east, SP utilizes the Union Pacific (UP) line from Pueblo to Kansas.

Union Pacific Railroad

The Union Pacific Railroad (UP) serves as a bridge railroad between Utah and Nebraska. It carries traffic between San Francisco, California and Chicago, Illinois. Denver is connected with the mainline south from Cheyenne, Wyoming, through Denver and east into Kansas. Also, with the purchase of the Missouri Pacific Railroad (MP), the UP provides service from Kansas to Pueblo over MP trackage.

Colorado is served by six Class Three railroads. Following are the names and service area description of each Class Three railroad in the State:

Trinidad Railway Company

The Trinidad Railway Company (TR) is owned by the C.F.&I. Steel Co. which operates freight service from Jansen to Allen Mine, west of Trinidad, Colorado. TR also operates within the C.F.&I. mill at Pueblo. Connections are made with the ATSF, SP, and the BN Railroads. Traffic is mainly coal, ore, and steel products.

Great Western Railway Company

The Great Western Railway Company (GW) operates freight service from Longmont to Loveland, and from Eaton to a connection east of Loveland in Colorado. Also, GW operates a branch line from Milliken to Welty. Connections are made with the BN and UP Railroads. Traffic is mainly lumber, corn products, fertilizer, and agricultural products.

Kyle Railway Incorporated

The Kyle Railway Inc. (KYLE) owns no trackage in Colorado.

However, it is under contract with the owner, Mid-States Port Authority, to provide services from Limon, Colorado east into Kansas.

San Luis Central Railroad Company

The San Luis Central Railroad Company (SLC) operates freight service from a connection with the SP at Monte Vista, Colorado to Center. The railroad carries such commodities as wheat, barley, and fertilizer. Pea Vine Corporation owns the capital stock of this railroad.

Southern San Luis Valley Railroad Company

The Southern San Luis Valley Railroad Company (SSLV) operates freight service from a connection with the SP at Blanca, Colorado to McClintock. Irregular service is provided and stone is the only commodity shipped.

Wyoming and Colorado Railroad

The Wyoming and Colorado Railroad (WC) operates freight service from Walden, Colorado to Cowdrey, and then north to Centennial, Wyoming and finally to Laramie, Wyoming. This line service carries coal, wood chips, and mineral resources out of Walden to Laramie.

Table 11 depicts the freight railroad mileage for each railroad, as well as for each railroad by Class. The percent of the total railroad miles for the State is also shown for each railroad.

Table 11

Railroad Mileage in Colorado - 1990

Railroad	Miles	Percent of Total Miles
ATSF	481	16.8%
BN	566	19.8%
SP	1,163	40.6%
UP	655	22.8%
Total Class One	2,865	100.0%
TR	31	14.7%
GW	56	26.5%
KYLE *	89	42.2%
SLC	12	5.7%
SSLV	1	0.0%
WC	22	10.4%
Total Class Three	211	100.0%
Grand Total	3,076	

** Tracks owned by Mid-States Port Authority*
Source: Colorado Department of Transportation

The Local Rail Freight Assistance (LRFA) program of the Federal Railroad Administration (FRA) provides funds for railroad improvements, rehabilitation, and other rail activities. These funds apply to carriers that have certified rail lines as having carried three million gross ton miles per mile or less during the prior year. These lines are referred to as light density lines.

There are 919 miles of Class One - light density lines in Colorado. Following are the miles of light density lines attributed to the Class One railroads:

ATSF	47 miles
BN	47 miles
SP	312 miles
UP	513 miles

Rail Operating Characteristics

Denver is a major hub for railroads in the Rocky Mountain area. Many products and resources are shipped by rail in, out, and through the State. Gross tons, or the traffic density of railroad freight traffic, is the amount of gross ton miles per mile per year. According to the Colorado State Rail Plan 1991 Update, the Class One railroads handled approximately 120 million gross tons of freight in 1990, and generated over $2 billion of operating revenues. These figures represent freight that originated, terminated, or passed through the State. Of the overall total tonnage, forty one million gross tons of freight originated and terminated in Colorado in 1990. Commodities carried by the four major railroads are identified as coal, farm products, food, waste scrap, stone and clay, petrol, nonmetal and other commodities. Coal, farm products, and food and related products amounted to more than 76% of the total freight in 1990. Coal shipments were the largest, accounting for 57.6%, while farm products were 7.8% and food was 11%.

In 1990, approximately 5% more coal originated than terminated in the State, indicating that Colorado is a net exporter of coal. 59.1% more farm products originated than terminated in the State, and 235.3% more food and related products originated than terminated.

Also in 1990, 67.7% of the coal shipments originating and terminating in Colorado were moved by SP. The BN moved 70.5% of the food and related products originating and terminating in the State, as well as 42.2% of the farm products movement. The combined tonnage of these three commodities amounted to 76.4% of the total rail freight movements originating and terminating in Colorado.

The SP originated 88.7% of all coal loadings for rail in Colorado, and handled 45.7% of all rail freight terminations. The BN handled 76.5% of all originating food and related products shipments, followed by UP with 50.5%. The BN also leads in terminating shipments with 50.5%, and UP handles 33.1% of terminations.

Railroad Abandonments

The Railroad Revitalization and Regulatory Reform (4R) Act of 1976 requires each railroad to file a map annually of its rail system with the Interstate Commerce Commission (ICC), the Governor, and appropriate agencies. In Colorado, those agencies are the Public Utilities Commission (PUC) and the Colorado Department of Transportation (CDOT). These system diagram maps classify all lines into one of five categories. The first three are usually those referred to as potentially subject to abandonment. The five categories are listed below.

Category 1 - All lines which the carrier will seek to abandon within three years.

Category 2 - All lines under study which may be subject to future abandonment application.

Category 3 - All lines for which abandonment application is pending before the ICC.

Category 4 - All lines that are being operated under the rail service continuation provisions of the 3R and 4R Acts.

Category 5 - All other lines.

Table 12 lists the locations and miles of railroad lines in Colorado currently appearing on the carrier's 1994 system diagram maps that have been placed in one of the first three categories. In reviewing this chart one

Table 12

Rail Lines Potentially Subject to Abandonment (Categories 1, 2, and 3 - As of December, 1991)

Location	Mileage	Category
ATSF		
BN		
Denver Market/Blake Street Line	2.5	1
Burns Junction to Lafayette	6.4	1
Denver Trackage	0.3	3
Denver East Side Line	1.2	3
Denver West Side Line	3.3	3
Fort Collins to La Porte	4.0	3
SP		
Templeton Gap Spur	3.0	1
RTD Corridor	2.3	1
UP		
Weld/Morgan County Line to Union	40.5	1
Boulder Branch line	37.7	1
Category 1	92.4	
Category 2		
Category 3	8.8	
TOTAL	101.2	
Total mileage in categories 1, 2, and 3		
1984	72.7	
1985	55.7	
1991	101.2	

Source: Colorado Department of Transportation, Intermodal Branch

may see that proposed line abandonments have significantly increased since 1985. In 1985 total mileage in all abandonment categories totaled 55.7 miles. In 1991 proposed line abandonments were almost double that figure rising to 101.2 miles.

Although there are many reasons for abandonments, the main reason is that a railroad believes that a particular line or branch is no longer profitable. Abandonment of railroad lines and rights of way can cause economic hardship to a community that has historically depended upon rail service, or that may want to use the fact that rail service is potentially available for their industrial park. Any loss of service should be weighed against possible alternatives such as subsidies, capital grants for rail rehabilitation, or other remedial actions to the line if it is deemed critical. Safety issues related to freight rail include equipment safety, driver/operator skill development, loading and unloading sites, hazardous material movement, and rail-highway grade crossings.

Commercial Vehicle Operations

Introduction

Commercial vehicles, or trucks, are generally defined as any vehicle with a gross vehicle weight rating of over 10,000 pounds and used for the purpose of carrying freight. These vehicles represent an important transportation mode in the movement of goods within and through Colorado. Virtually every type and quantity of freight is moved by commercial vehicles. On average every product in Colorado travels five to seven times in a truck during its manufacturing and distribution cycle. In particular, certain sectors of Colorado's economy including agriculture, oil and gas production, and manufacturing depend greatly on commercial vehicles for interstate and intrastate movement.

To operate in Colorado commercial vehicles must obtain a variety of permits and credentials and pay the necessary fees associated with such credentials. These include vehicle registration, fuel taxes, extra-legal size and weight, hazardous materials, special mobile machinery, longer vehicle combinations, farm products, safety, etc. Revenues from these fees are utilized to support various transportation related activities and to off-set the transportation-related impacts of trucks.

From the viewpoint of the state, commercial vehicles are important for several reasons. First, these vehicles are key to the movement of goods and services from one point to another. Along these lines it is essential that the state provide an adequate transportation system to insure efficient transport of goods. Second, this industry is a major employer within Colorado and a key industry within the state. Finally, commercial vehicles due to their size and weight have a significant effect as to pavement design, capacity needs, and safety considerations. As an example of the effect of commercial vehicles on the State Highway System, a single five axle combination truck weighing 80,000 pounds causes roadway damage roughly equivalent to 9,600 passenger cars. Overall increases in either weight or the number of vehicles act to accelerate the road surface and bridge fatigue factors. Through an extensive monitoring program of truck size, weight and configuration, the Department of Transportation seeks to quantify these impacts for our planning activities. As truck traffic grows, so do the challenges. Highways have a normal design life, but exactly how long they last and how fast they deteriorate depends on roadway design, and weight and frequency of traffic.

Commercial Vehicle Use

Trucks transported approximately 84%, or over 62 million tons, of Colorado's total inbound and outbound freight in 1992. The trucking industry is also the sole method of freight transportation for 72% of Colorado's communities where there is no rail service available.

With an increasing population and a strong economy over the past several years, there has been a substantial increase in demand for goods and services. Along with this increased service demand, the trucking industry also has been undergoing substantial changes related to the delivery of goods and products. Rather than maintain large on-site inventories, many manufacturers and distributors are implementing "just in time" shipping practices where only a limited supply of parts or materials are kept on-site, possibly only enough materials for several days. New supplies and materials are then sought on an "as needed" basis. This new approach translates into more truck shipments materials with a great emphasis on "on-time" delivery.
In 1991 there were 2390 for-hire and private trucking companies in Colorado. These firms employed approximately 115,000 Colorado workers.

As to service categories, according to American Trucking Association Foundation (ATAF), 35% of all trucks in Colorado were used in agriculture, 23% in construction, 13% in trade activities, 13% in service industries, 3% in for-hire trucking, 3% in manufacturing and 10% in all other activities.

Commercial Vehicle Travel

As may be seen in Table 13, commercial vehicles constitute almost 12% of all vehicle miles traveled within the state. Predominantly, trucks travel on the Interstate system particularly on the rural Interstate where trucks constitute almost 21% of all vehicle miles traveled. Between 1988 and 1992 truck travel on the State Highway System, as measured by vehicle miles traveled, has increased by 31.2%. During the same period overall vehicle miles traveled on the State Highway System increased by 15.5%.

Figure 8 reflects a measure of the density of commercial vehicle usage on the State Highway System displaying those state highway routes with greater than 10% commercial vehicle traffic.

TABLE 13

Colorado Truck Travel
Vehicle Miles Traveled (VMT) by Truck Type
for State Highway System
1988-1992
(VMT in Millions)

Year	Single Unit VMT	Combination VMT	Total Truck VMT	% of Total S.H. VMT
1988	544	1,144	1,688	10.22%
1989	476	1,177	1,653	9.68%
1990	709	1,375	2,084	11.78%
1991	657	1,583	2,240	12.32%
1992	617	1,599	2,216	11.65%

Source: Colorado Department of Transportation, Intermodal Branch

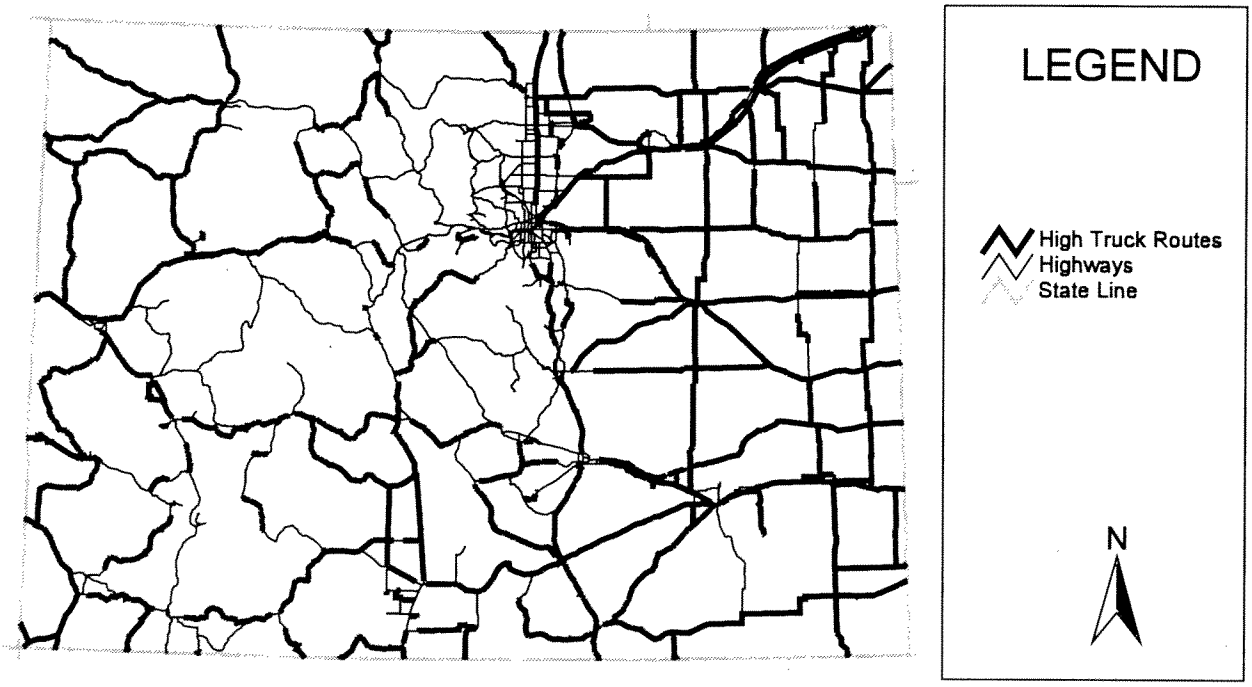
With the passage of the North American Free Trade Agreement (NAFTA) it is anticipated that truck travel will significantly increase in the future, particularly on the I-25 corridor. With exports to Canada expected to rise by 24% and exports to Mexico anticipated to increase by 70%, the I-25 corridor will be an important conduit for trade traffic.

Improving the Operating Environment for Commercial Vehicles

The trucking industry faces a myriad of different permit practices and fees throughout the country. These fees are levied at both state and local levels. The different fees and permit restrictions can be confusing to operators. Concerted efforts at the national, and state levels are creating many improved and uniform practices. These changes will take time, but will enhance the overall Commercial Vehicle Operations (CVO) environment. Colorado has been working on many new ways to improve the environment for commercial vehicle operations. New concepts for CVO can bring benefits to the industry as well as the state. Along these lines Colorado has been exploring the utilization of Intelligent Transportation Systems (ITS) technologies toward streamlining administrative procedures, improving commercial vehicle safety and enhancing productivity for both industry and state regulatory personnel. These new technologies include improved traffic monitoring systems, streamlined credential acquisition processes, vehicle tracking, weigh-

Figure 8

Map of
Corridors with Greater than 10% Truck Travel



in-motion, vehicle identification, and many others. These technologies represent advances in computer technology, communications networks, information management systems, and a partnership between industry and the public sector to improve goods movement and increase the efficiency of commercial vehicles.

As an example of the deployment of ITS technology, the state has constructed a 'Model Port of Entry' on I-25 near Trinidad, Colorado. In contrast to other Port of Entry stations in the state, for which commercial vehicles must enter the port to have their weight and credentials checked, this port is equipped with advanced technologies which allows Port personnel to weigh trucks and check their credentials while the vehicle is in-motion on the highway. This allows commercial vehicles enrolled in the program, which are of legal weight and possessing proper credentials, to bypass the port. This new concept is likely to be the future of port operations.

Intermodal Programs

Introduction

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) brought into focus the concept of intermodalism. The ISTEA legislation recommended the creation of an intermodal transportation system which would include "all forms of transportation in a unified, interconnected manner." Thus rather than being merely the physical means for connecting various modes, intermodalism is a process that deals with the interactions and linkages between all transportation modes.

Historically in Colorado, the term, intermodalism, has dealt specifically with freight movement between trucks and railroads such as the transport of truck trailers on rail flat cars (TOFC or piggyback). While this particular movement is continuing to evolve utilizing more efficient technology and expanding in popularity among freight shippers, the new definition of intermodal also includes personal travel between more than one mode as part of an individual's trip. This would suggest that the transfer of a person from one bus to another bus is not intermodal. Also, the micro level activity of walking from a residence to a bus, or to a parking lot will not be considered intermodal for the purposes of this report. Intermodal facilities, both freight and passenger, are found throughout the State. Obviously the larger volumes of freight and passenger interaction at these facilities will take place within or near the large metropolitan areas.

A key term in the acceptance and use of intermodal facilities is the concept of a "seamless" trip. This term is normally applied to passenger trips, but certainly has applications to freight as well. A trip is considered to be seamless if it minimizes time between linkages. Also, the conditions encountered during any waiting period also contribute to a trip's degree of seamlessness. A seamless trip is crucial in a passenger's choice of transportation mode/modes as well as in a shipper's choice of an intermodal trip for its products.

Overview of Intermodal Operations

Due to the limited information that now exists regarding intermodal operations in Colorado, this section focuses on existing intermodal facilities and the potential for additional intermodal facilities that could be considered in Colorado's 20 year Transportation Plan.

Freight Facilities

Rail/Truck

This is the most common and most heavily utilized form of intermodal freight. The traditional truck trailer on rail flat car (TOFC) is now evolving to container on flat car (COFC). COFC operations account for approximately half of rail intermodal loadings and the share is growing. The privately owned railroads and trucking companies are realizing the efficiencies of each mode and are developing partnerships to provide very efficient service to their freight customers. The four Class 1 railroads in Colorado, the Burlington Northern (BN), Southern Pacific (SP) Union Pacific (UP), and Atchison, Topeka and Santa Fe (ATSF) all have intermodal facilities in the Denver Metropolitan area. The BN's intermodal facility, the third largest of the BN's United States facilities, is by far the largest in Colorado. It accomplishes 180,000 lifts (containers or trailers) per year. The "double stacking" of containers reduces the costs of shipments by as much as 40 percent; making it a very attractive shipping option for the freight carrier and customer. The freight does not impact the InterState Highway System for the predominant length of the trip, yet has the door-to-door service capabilities provided by trucks at the origin and destination.

Another form of Rail/Truck intermodal terminal is the bulk transfer facility. These facilities allow for the transfer of bulk materials from truck to rail for shippers not having direct access to a rail line. An inventory of these facilities does not currently exist but they are located throughout the State.

Air/Truck

The volume of air freight shipments does not approach the volume of rail/truck intermodal but it is growing at a remarkable rate. Overnight and other express package deliveries of high value and time-critical freight items are leading the surge in this type of freight business. The combination of surface delivery/air provides the most efficient door-to-door service for the freight customer requiring this particular type of intermodal service. Therefore, every commercial airport that has this type of express package service becomes an intermodal freight facility, as well as intermodal passenger facility. The more obvious intermodal freight facilities are the major air cargo centers at the large airports.

Passenger Facilities

Park-and-Ride Lots

This is the most common form of passenger intermodal facility. These are normally constructed as an integral part of a fixed route transit system within large urbanized areas. Park-and-Rides are normally used by single-occupant vehicle operators as a location for changing mode to a transit bus. However, they can also be used to change to another type of high occupant vehicle (HOV) such as a carpool or vanpool.

In addition to automobiles, park-and-ride lots may also serve bicyclists. In many cases bicycle racks or secured lockers are provided to accommodate bicyclists. Currently RTD in the Denver area already provides bike racks and buses capable of accommodating bicycles at a limited number of locations. Bicycle use can further be encouraged if buses serving such sites are equipped with bicycle racks.

Intercity Bus and Intercity Rail Stations

The linkage between the private automobile and both the intercity bus and AMTRAK services exists within Colorado. There are three different AMTRAK routes throughout the State and several intercity bus routes. The nature of these long distance forms of transportation requires automobile parking as well as utilization of taxi services. In the future we may also see joint facilities such as Union Station in Washington, D.C. which links intercity bus with intercity rail operations.

Public Transit Terminals

The traditional transit terminal would provide a transfer opportunity from one bus to another. As an example, the Regional Transportation District (RTD) in Denver has a somewhat unique situation on its 16th Street Mall. Mall shuttle buses, bicyclists and pedestrians all utilize the transit stations at the ends of the 16th Street Mall (Market Street Station and Broadway Station) making these stations truly intermodal.

Airport Terminals

Airports are truly intermodal passenger facilities. The varying transportation requirements of arriving passengers are serviced by not only public transit services but even to a greater extent by the private sector. The prominence of hotel vans and shuttles as well as private shuttles to off-site parking lots are an increasing element of intermodal activity at airports. Rental car agencies also are key players in the intermodal function of airports. All of these elements provide critical transportation to and from airports with regularly scheduled passenger service.

Possible Intermodal Projects in Colorado

The use of intermodal facilities is expected to increase greatly in the future. The passage of ISTEA has created an awareness of these facilities and a potential funding source for such activities. As documentation of success stories from major passenger intermodal facilities such as Union Station projects in Washington D.C., Chicago, and Portland becomes available, the efficiencies of such facilities will be desired in numerous other locations. CDOT is currently utilizing ISTEA funding in conjunction with other public and private sector interests in studying the feasibility of converting existing Denver Union Station into a truly intermodal passenger facility. This facility would take advantage of the linkages between rail, local bus, intercity bus, taxi, and other transportation modes and the other dynamics of lower downtown Denver. ISTEA funding could also be utilized for construction related to any publicly owned intermodal passenger facility.

Another passenger intermodal facility being considered is at the "Hogback," located at I-70 and US 40 in the foothills on the western edge of the Denver metropolitan area. As envisioned, this site could serve as a major intermodal transfer center serving the gaming areas of Black Hawk and Central City, various ski areas, intercity bus services and the western portion of the Denver area.

ISTEA funding for freight intermodal facilities planning is also available to the extent that such improvements would benefit public transportation facilities. An example of such planning could be the creation of a consolidated hub intermodal freight facility, bringing together all the railroad and trucking intermodal activities, perhaps even in the vicinity of Denver International Airport (DIA). This would allow for a further intermodal linkage with the air cargo element at DIA. However, due to the benefit to private sector interests, ISTEA funding for most of the capital improvements involved in such a project would at this time be limited. A critical issue facing freight intermodal planning will be overcoming the obstacle posed by the confidentiality of much freight data.

Bicycle/Pedestrian Services

Introduction

Colorado has enjoyed the reputation of a premier cycling state for many years. With the advent of mountain biking and the rise in popularity of cycling and walking for health, recreation, transportation, and environmental concerns, non-motorized modal use has exploded in Colorado in the last two decades. Colorado ranks fourth in the nation as a cycling destination, behind only Utah, Vermont, and Virginia. According to Coloradans in the "Lifestyle Market Analyst, 1992" cycling is the third ranked sports/leisure activity, with skiing and health club/physical fitness activities ranked one and two respectively.

Bicycling and walking have also become increasingly popular for commuting to work and other transportation-related trips. According to the 1990 Census, 80,000 Coloradans bicycle or walk to work. Bike Week, the Clean Air Campaign, and other promotional events have contributed to increased public awareness of bicycling and walking as a way of personally contributing to the reduction in traffic congestion and air pollution, and by providing a more livable community while increasing one's own health and quality of life.

The Pedestrian Mode

Walking and the physical environment associated with this activity is mainly a local issue because transportation trips by foot are usually one mile or less and such trips are usually confined to urban and suburban areas. The pedestrian focus for CDOT is to provide pedestrian walkways along urban highways, access across state-owned bridges and other structures, and walkways within state right of way where a locality deems it necessary.

Over the years the pedestrian transportation component has been underemphasized. Although the pedestrian mode has historically been better integrated into the design and construction of highway projects than the bicycle element, missing sidewalk links, lack of curbcuts, poor maintenance, and obstructions on walkways such as utility poles and boxes still exist which impede efficient pedestrian movement. With the new Americans with Disabilities Act (ADA), the walking environment is expected to be much improved as all government agencies are mandated to provide accessible walkways and facilities. This includes curbcuts at intersections, handrailings on bridges, and the absence of obstructions on walkways.

Currently, the CDOT Bicycle/Pedestrian Program provides a pedestrian component in its education program, and provides support and resource assistance on individual pedestrian-related projects and issues. In the future the program plans to thoroughly emphasize safe walking by developing policies, projects, and promotions which better integrate walking into the overall state transportation system.

The Bicycle Mode

Colorado has approximately 380 retail stores and shops which sell bicycles. In 1991 and 1992 alone, approximately 118,500 units were sold at a total cost of $20,737,500, with an additional $11,850,000 spent on bicycle parts and supplies. There are approximately 25 touring/recreational and 60 racing clubs in the state, and 10 bicycle advocacy organizations, with more groups forming all the time. The state also has a 30 member governor-appointed bicycling advisory board and Bicycle Colorado, a non-profit bicycle tourism information clearinghouse. In addition to the CDOT Bicycle/Pedestrian Program Manager, there are full-time bicycle coordinators throughout the state: Steamboat Springs, Fort Collins, Boulder, Boulder County, and Denver, and part-time staff in Pueblo and Colorado Springs. Even without bicycle coordinators there is a great deal of community and governmental cycling interest and activity in Mesa County, Durango, Crested Butte, Salida, Glenwood Springs, Summit County, suburban Denver communities, Clear Creek County, Sterling, Greeley, Loveland, Ouray and Montrose Counties, and the Northwest planning region.

Bicycle tourism, including both road and mountain biking, is a substantial part of Colorado's tourism industry. One county that is experiencing increased bicycle tourism is Summit County. According to the Summit County 1991 Recreation Trail Survey, the number of pathway users has increased an average of 28% annually from 1987 to 1991. An estimated $4.3 million is spent seasonally by visitors to the county who use the pathway system.

In addition to tourism and recreation, bicycles are currently an important part of the transportation system in serving commuters for work purposes. An increasing number of individuals are choosing to cycle to work and in turn are making residential choices based on the proximity and accessibility to bikeways. State law recognizes the value of bicycles for these purposes and recognizes bicycles as "vehicles" with the same rights and responsibilities to use public roadways as automobiles and other motorized forms of transport. In the future bicycles are envisioned to play an even more important role in serving commuter trips.

Colorado has a good start in becoming a truly "bicycle-friendly" state. The cycling population is certainly present in Colorado, and though the CDOT's bicycle program only began in late 1989, Colorado is still ahead of most states in their attitudes about cycling and making the necessary adjustments to provide for cycling as a truly valid mode of transportation and recreation.

Physical Characteristics

The bicycle system throughout Colorado, including state and local facilities, is fragmented with many shoulderless highways and county roads, and only bits and pieces of designated bikeways in many towns and cities. Except for a few municipalities, informational and directional bikeway signage is rare. Numerous municipalities are currently developing or implementing their own bikeway plans, and the state bicycle plan will be interconnecting the various towns and regions with information from each of the regional plans. In addition to these efforts CDOT is currently developing a series of detailed bikeway corridor maps.

The goal of the CDOT bicycle program is to develop a statewide bicycle system which cyclists can safely and efficiently bicycle from place to place anywhere in the state and to adjacent states. This system will include on-road and off-road facilities. Non-restricted areas of the existing highway system which have paved, maintained shoulders 4 ft. or wider are considered usable bikeways.

Colorado State Parks & Outdoor Recreation has a recreational trails plan for the state. The trails plan includes existing and proposed trails, which is a mix of primitive or non-paved multi-use recreational trails as well as paved urban trails. CDOT's transportation-oriented bicycle plan will be linked with the state trails plan to ensure access to recreational trailheads and for transportation access on suitable trails. CDOT's bicycle plan will contain mainly on-road and paved trail facilities.

Performance and Condition of Bikeway System

Though Colorado has a cycling reputation, much needs to change in order for the state to be considered truly "bike-friendly". Much data is lacking. The number of cyclists, vehicle miles traveled by bicycle, user counts on most major facilities, and the number of total miles of bikeways in Colorado are just a few examples of data which is not available.

One area where there is a significant amount of data is in regard to safety. As may be seen in Table 14, with additional interest in bicycling, unfortunately there has been an increase in the number of bicycle crashes with motor vehicles and also the number of fatalities. Bicycle crashes with motor vehicles increased by over 20% from 1989 to 1992.

Although bicycle crashes have increased, the injury rate (crashes per 1,000 population) since 1989 has

dropped. In contrast though during that same period the fatality rate (fatalities per 1,000 population) has increased. Fatalities associated with bicycle crashes appear to be clustered in the 5-15 year old age bracket and the 21-44 age group. Currently, Colorado is ranked 9th in the nation regarding cycling fatalities per capita.

Table 14

Bicycle Crashes
1989-1992

	1989	1990	1991	1992
Crashes with Motor Vehicles	1,005	1,088	1,177	1,226
Injuries	849	932	1,008	959
Injury Rate (1)	.31	.33	.35	.28
Fatalities	12	10	14	14
Fatality Rate (2)	.0037	.0030	.0042	.0042

1. Injury rate is crashes per 1,000 population
2. Fatality rate is crashes per 1,000 population
Source: Colorado Department of Transportation - Office of Transportation Safety

Aviation

Introduction

There are currently 384 aviation landing facilities within Colorado including civil and joint use airports, heliports, and other aviation facilities. Of this number 94 are public use airports with 65 of them being operated by city or county governments (see Figure 9). Only 17 of these airports provide regularly scheduled commercial flights.

Currently, for planning purposes, the state is divided into five regions. These regions are geographical by definition, and are listed as the Western Slope, the San Luis Valley, and the Eastern Plains. In addition, the Denver Regional Council of Governments and the Pikes Peak Area Council of Governments provide aviation system planning for the airports within their regions. Each region has unique aviation demands and capabilities. This summary will address the general aviation and commercial service airports.

Current Services

Western Slope

The Western Slope aviation element is composed of the general aviation and commercial service airports west of the Continental Divide. There are a total of 32 airports in this region ranging from the dirt strip at Naval State Park to Walker Field at Grand Junction. In 1992, the western slope system had 688,931 commercial passengers from 10 airports. In 1995, the region is forecast to have 921,529 passengers and 1,108,817 in the year 2000. This equates to an annual growth of 4.15%. Based aircraft give an indication of general aviation levels in a region. In 1990, the region had 859 based aircraft. The forecast for 1995 is 900 aircraft with 944 predicted in the year 2000.

San Luis Valley

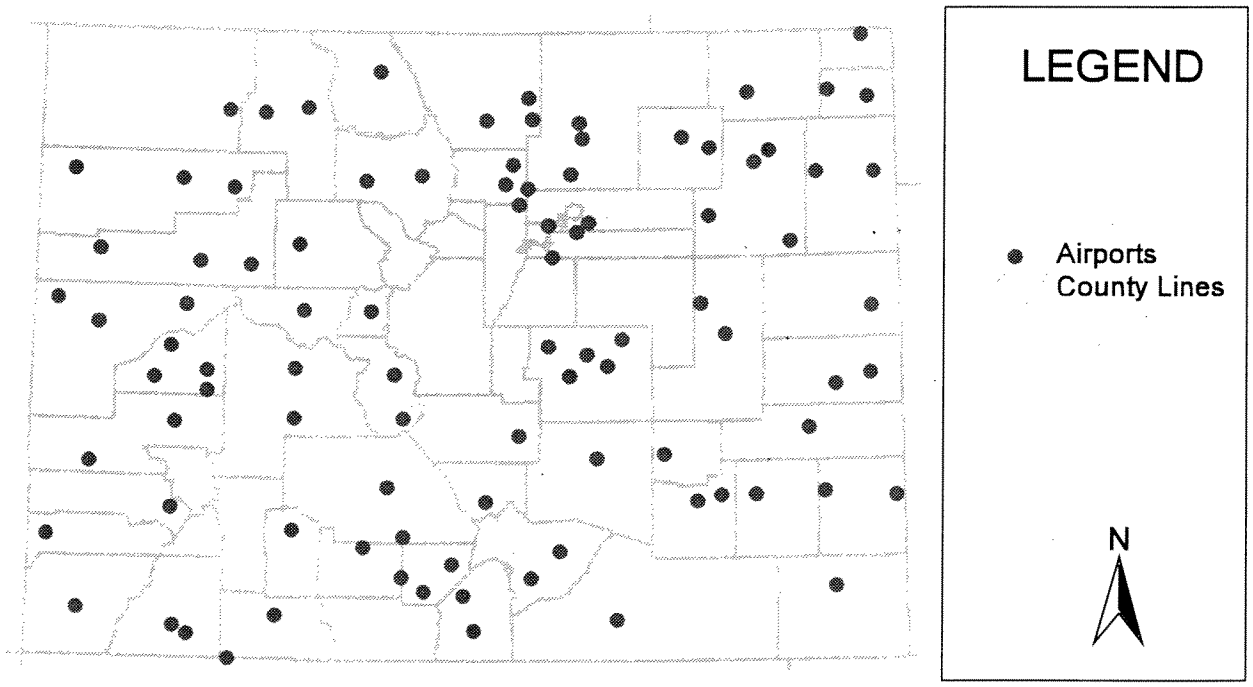
The San Luis Valley region has the fewest airports (8) and the least activity of the five regions. In 1990, the enplaned passengers totaled 9,450. The predictions for 1995 are 19,000 passengers and 20,000 for the year 2000. The based aircraft were 99 in 1990. The forecast for based aircraft is 102 for 1995 and 103 for the year 2000.

Eastern Plains

The Eastern Plains region encompasses parts of the Front Range and all of the area east of the front range. The 32 airports range in size from Ft. Collins-Loveland to Eads. As in the other regions, we see a wide variety of uses. The commercial enplanements for 1990 for the region totaled 86,320. The expected total for 1995 is 196,000 and the total expected for the year 2000 is 226,000. In 1991, the region had 758 based aircraft. In 1995 and 2000, the forecasts increase to 856 and 912.

Figure 9

Map of
Colorado Airports



Denver Metropolitan Area
The airports within the Denver Metropolitan Area, defined as the Denver Regional Council of Governments (DRCOG) area, include Boulder, Tri-County, Longmont, Aurora, Front Range, Centennial, Jeffco, and Stapleton. Most of the traffic at these airports is general aviation traffic, with the exception of Stapleton which handles the commercial traffic for the area. In 1993, the total general aviation traffic activity count was 896,551 operations. The commercial passenger enplanement count for Stapleton was 16,320,472. The regional plan is being updated by DRCOG and while general aviation counts are expected to rise, there are no current forecasts of future activity. Denver International Airport is expected to have over 17,000,000 commercial enplanements in 1995.

Pikes Peak Area
The Pikes Peak region, as defined by the Pikes Peak Area Council of Governments consists of Colorado Springs Municipal Airport, Meadow Lake/Falcon and Ellicot. Commercial enplanements for Colorado Springs for 1993 were 759,707. The forecast for 1995 is 812,886. There are no operations counts available for Meadow Lake or Ellicot.

There are numerous other indicators used to assess the status of airports in the state. One frequently used is an evaluation of the condition of pavement on the airport or Pavement Condition Index (PCI). The Division of Aeronautics maintains a database for most of the general aviation airports and some of the commercial service airports. The state is divided into an eastern region and a western region. Currently, the pavement throughout the state is evaluated on a three year cycle. The overall state conditions are as follows:

Excellent	43%
Very Good	17%
Good	15%
Fair	18%
Poor	5%
Very Poor	1.5%
Failed	0.5%

Currently, the State Aviation System receives funding from local revenues, the state aviation fuel tax and grant funds from the Federal Aviation Administration. The levels of these funds vary widely based on economic and legislative variables. Present annual funding from the state aviation fuel tax is approximately $10.1 million. These funds are distributed through monthly entitlement refunds and annual discretionary grants by the Colorado Aeronautical Board. If federal legislation is passed in 1994, federal discretionary funds for Colorado general aviation airports would be approximately $4.5 million. There are other federal funds available for commercial service airports and associated projects. Funding amounts and availability though vary widely by year. Realizing the significant demands for such funds and their limited availability, competition for such funding is substantial.

Intelligent Transportation System (ITS)

Introduction

The Intelligent Transportation System (ITS) program is modeled after the national program that is outlined in the Federal transportation legislation, Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). The national ITS program includes major private industry involvement and advancements for motor vehicles coupled with major government involvement for compatible highway enhancements to achieve its objectives.

The Intelligent Transportation System concept is based on the use of advanced computer, electronics and communications technologies to increase the effectiveness of the entire surface transportation system. Many of these technologies have already advanced other modes of transportation, such as aviation, and are now beginning to be used in surface transportation.

Some technology, especially in the traffic management, public transportation, traveler information, and commercial vehicle operations areas, is available for implementation today. Some of the more advanced vehicle control technologies require substantial research and testing. The ITS program will be a major contributor in creating the level of highway safety and operational efficiency needed for the U.S. in the 21st century.

Applications of ITS in Colorado

Traffic congestion, air quality, and lack of connectivity in public transit are just a few of the major issues affecting transportation in Colorado today. Mobility and a balanced transportation system are critical if Colorado is to preserve a good quality of life in Colorado in the future.

ITS will not be able to solve all of our transportation problems, but it can provide considerable improvements to aid the motorists in making better choices. Some of the areas where ITS technologies can improve transportation in Colorado include:

Safety

By increasing information to the driver and increasing driver control of the vehicle, ITS can decrease traffic incidents and fatalities. Features include warning systems that activate when cars get too close to another vehicle or the edge of the road and enhanced traffic control systems that decrease stops and speed variations, reducing the number of accidents. Expected breakthroughs in collision-avoidance technology could substantially reduce entire classes of crashes.

Congestion Management

ITS technologies will reduce congestion through rapid detection and clearing of incidents that cause delays; enhanced public transit systems will reduce highway traffic and real-time traffic control systems will adapt automatically to changing conditions and will improve the flow of traffic.

Energy Efficiency and Environmental Quality

ITS will provide travelers with information to support decisions that will smooth out highway demand and reduce travel time and vehicle emissions by providing opportunities to use high occupancy vehicles or public transit or to mitigate the need for travel.

Economic Productivity

Congestion costs the US nearly $100 billion yearly in lost productivity. Traffic crashes cost roughly an

additional $140 billion annually in lost wages and other direct costs. Together these total nearly 5% of the gross national product. Nearly $7 billion is spent by government and truckers to obtain credentials and comply with commercial vehicle regulations. ITS will improve transportation system efficiency through better routing of vehicles, automated toll collection, safety enhancements and streamlining commercial vehicle regulatory enforcement and compliance.

ITS Activities in Colorado

In regard to ITS, Colorado has clearly recognized the potential benefits offered by these advanced technologies. Along these lines Colorado is pursuing a number of initiatives toward implementing ITS in Colorado. Currently, the Colorado DOT along with other governmental agencies and private sector parties are engaged in a number of studies and projects in the area of ITS.

Technical Studies

C-STAR, Colorado's Strategic Intelligent Vehicle Highway System (IVHS) Plan

This document outlines a long term plan for research, development, operational evaluation and implementation of IVHS technologies in Colorado. This plan presents a new way of thinking in the area of surface transportation. The plan was completed in March 1993 and will continue to be updated to keep current with advancing and changing technologies.

I-70 Rural IVHS Corridor Planning and Feasibility Analysis

The Colorado Department of Transportation has identified the I-70 corridor from Denver to Glenwood Springs as a high priority corridor that can benefit from the opportunity to implement IVHS technologies for improving safety and mobility for the traveling public. The mountainous passage and unpredictable weather patterns create traveling hazards that are difficult to remedy. Deliverables for this project include an Early Action Plan, an Implementation Plan, a Business Plan, and a Marketing Plan.

Denver Metro Area IVHS Master Plan

The Master Plan outlines the near term and long term IVHS implementation plans for the Denver metro area including: traffic data collection, computerized data handling and monitoring systems, incident management, communications network, and dissemination of travel information. The focus of the master plan is the conceptual design of a Traffic Operations Center (TOC) for the Denver area.

Traffic Operations Center (TOC)

Included as one of the phases of the Denver IVHS Master Plan, CDOT has initiated the design of a traffic operations center for the Denver Metro area to monitor and manage traffic flows on area freeways and ultimately influence traffic flows on the arterial street network. The Denver Traffic Operations Center (TOC) will link with the existing Tunnel Operations Centers at the Eisenhower and Hanging Lakes Tunnels on I-70.

The TOC is planned to be a multi-jurisdictional facility with space provided for CDOT, Colorado State Patrol personnel as well as public and private sector staff including traffic engineers from cities and counties in the Denver area, media, traffic information services, law enforcement and fire agencies, and emergency medical response organizations.

Multi-State ITS Studies

The ENTERPRISE Program

ENTERPRISE (Evaluating New Technologies for Road Program Initiatives in Safety and Efficiency) is a

forum for collaborative ITS research, development and deployment ventures reflecting the interests of multi-state, international, and private sector cooperation. It was established by a group of states through the mechanism of a Federal-State Planning and Research pool fund. The program is currently supported by the following U.S., Canadian, and European member agencies:

Arizona DOT	Colorado DOT
Dutch Ministry of Transport	Iowa DOT
Michigan DOT	Minnesota DOT
North Carolina DOT	Ontario MOT
Washington State DOT	Federal Highway Admin.
Transport Canada	

COVE - Commercial Vehicles Institutional Issues Study

The Colorado DOT in conjunction with six other states has conducted a study to examine institutional barriers relating to the free flow of commercial vehicles with in and between the states in the Southwest. This study outlines strategies toward implementing ITS activities within each state and the region as well as improving the overall regulatory climate for commercial vehicles.

HELP Inc.

Colorado is a member of HELP Inc. which represents a consortium of states in the west along with FHWA and the motor carrier industry. The purpose of this consortium is to move toward "transparent borders" for commercial vehicles. To accomplish this, the consortium is implementing various ITS technologies which will benefit both the trucking industry and the states involved.

ITS Operational Test Program

The Colorado DOT has been successful in its participation in the US DOT national ITS Operational Test program. Operational tests are needed to evaluate advanced systems in real-world situations to assure public safety benefits, to determine whether the expected public benefit can be achieved at the expected cost, and to heighten awareness and serve to educate the public about the potential of ITS. ITS Operational Test projects taking place in Colorado include:

Dynamic Truck Speed Warning System for Long Downgrades

The safe speed for a large truck varies significantly based upon its weight, and the length and severity of the grade that it is negotiating. This project, through in-pavement sensors, will weigh trucks in motion along with determining the type of truck and its speed. This information will then be fed into an algorithm which will identify the safe descent speed for that vehicle. This safe descent speed will then be communicated to the truck driver via a variable message sign so as to advise the driver whether he is traveling too fast for the grade.

HOGBACK Multimodal Transfer Facility

This project will develop an existing parking lot facility into an innovative intermodal transfer facility on the western edge of Denver at the base of the foothills. The center will include an electronic kiosk capable of providing dynamic information to travelers which will enable them to better link with various transit operators.

Remote Sensing for Emissions Reduction

The primary objective of this test is to evaluate the usefulness and public acceptance of providing real-time emissions information to drivers and education material about fuel savings and air quality benefits of well tuned vehicles. The effectiveness of offering subsidized vehicle tune-ups will also be evaluated.

Southwest States Electronic One Stop Shopping
The primary objective of this test is to streamline the administrative credential process for commercial vehicle operators while also improving data exchange and communications within and among states.

Herald En-route Driver Advisory System
The main concept of this project is to disseminate important traveler information in difficult to reach, remote, rural areas using a subcarrier on an AM broadcast station. The three basic components of Herald: 1) message generation, 2) message transmission; and 3) message reception have been developed under an effort by the multi-state organization called ENTERPRISE. This project will determine the performance of the system and analyze the impacts on broadcasters, travelers and equipment manufacturers.

Colorado Mayday System
This project will evaluate the use of Global Positioning System (GPS) technology for vehicle location and cellular phones for two-way communications in order to provide emergency and non-emergency assistance to travelers operating in rural Colorado. Additionally, this test will identify the necessary structure, responsibilities and service levels of a traveler assistance center necessary to operate such a system commercially.

Other ITS Technologies in Colorado

The following ITS user service categories describe the existing ITS technology elements installed and operating on roadways in Colorado.

Traffic Management Systems
Traffic management systems apply traffic engineering technologies to bring order and efficiency to the movement of highway vehicles. Existing traffic management systems in place include the following:

Ramp Metering
Ramp metering exists in the Denver metro area in 28 locations. It started as a demonstration project back in 1981 and since has blossomed into a successful transportation systems management strategy operating on I-25, I-225, US 6 and I-270. It is now being considered n other parts of the state.

Incident Management
The Colorado Incident Management Coalition (CIMC) was formed in September 1991 to develop recommendations for implementing strategies aimed at reducing congestion and improving traffic flow on the Denver area freeways. The CIMC Task Force recommended the implementation of 26 strategies outlined in the Task Force report, September 1992. Several of the recommendations which have already been implemented include: the creation of a Mile High Courtesy Patrol program for I-25 in the Denver Metropolitan Area; legislation to support incident management activities; and the initiation of three corridor management teams in the Denver area. Two of the corridor management teams are dealing with access to the new Denver International Airport, while the third is focusing on the south I-25 corridor. Teams are developing route diversion plans as well as learning how to work together and share agency resources.

Tunnel Control Systems
CDOT has the responsibility for managing and operating two tunnel control operations centers on Interstate 70. These are the Eisenhower Johnson Tunnel and the Hanging Lakes Tunnel. The monitoring systems necessary to insure traffic flow through these passages in the mountains

include loop detectors, variable message signs, fire control operations, and closed-circuit television cameras. The Eisenhower-Johnson Tunnel sometimes operates one of the travel lanes in the two tunnels as a reversible lane to provide additional capacity in the peak direction. The Hanging Lakes Tunnel has installed motorist aid call boxes where the motorist can call the tunnel operations center for assistance in the event their vehicle becomes disabled.

North I-25 High Occupancy Vehicle Lanes
This project has been a joint effort between CDOT, the Regional Transportation District (RTD), and the City and County of Denver to construct two reversible physically separated high occupancy vehicle lanes in the center of Interstate 25. To control traffic, a traffic management system will be installed which includes electronically controlled gates, variable message signs, and electronic vehicle detectors.

Traveler Information Systems
Traveler information systems are being pursued so as to communicate and present information to assist travelers in moving from their point of origin to a desired destination. These systems will also provide communication between the vehicle and the Traffic Management Systems that provide information to the driver regarding traffic conditions, roadway congestion, and potential alternate routes. Existing traveler information systems in place include the following:

Variable Message Signs
Several of the CDOT Engineering Regions maintain and operate both fixed and portable variable message signs to communicate roadway information to the public. Principal uses of these signs include information regarding road and weather conditions, road closures/detour, hazardous material routing information, rockfall conditions, chain law in effect notification, and construction/maintenance work advisories. Some of the portable signs are equipped with a Highway Advisory Radio where motorists can tune their car radios to 530 AM for more information.

Highway Advisory Radio (HAR)
A Highway Advisory Radio system currently operates in the Denver metro area to provide road closure/ detour route information. Weather information can also be broadcast. This system currently operates with 6 fixed locations, each having the capability to broadcast over a 2 mile range.

Construction Information Hotline (573-ROAD)
A construction information telephone hotline operates in Denver to provide the public with construction/road closure/detour information by dialing 573-ROAD. The number provides a menu where the caller can select the desired information.

Road & Weather Information Hotline
CDOT Public Information Specialists currently have the responsibility for updating the statewide telephone information systems where the public can call in and receive information about road and weather information for various locations throughout Colorado.

SCAN Ice and Snow Detection System
These detector stations are located at various locations throughout the state for the purpose in aiding in collecting weather data including ambient and roadway surface temperatures, wind speed, amount of precipitation, and presence of chemicals on the roadway. This information is extremely helpful in determining when the snowplows should be deployed to optimize salt/sanding operations.

Electronic Clearance Systems

These systems allow trucks, equipped with a special device, which have the proper credentials and are within legal weight limits to bypass the port of entry station. The purpose of this program is to create a "transparent" system for enforcement which will increase productivity for both the state and the trucking industry. Currently, Colorado has one port set-up for electronic clearance. This port, located on I-25 at Trinidad, is a model for other sites in the state.

Travel Demand Management

Introduction

With the passage of the ISTEA Act and new Clean Air Act, there has been greater attention to reducing overall vehicle miles traveled. Along these lines increased emphasis has been placed on trip reduction. This has fostered a series of strategies known as travel demand management (TDM). TDM includes a series of strategies including telecommuting, ridesharing, parking management, flexible work schedules for employees, bicycling, and transit. Because transit and bicycling have been addressed earlier in this report, this section will address only telecommuting, ridesharing, and variable work arrangements.

Travel demand management strategies will be an important part of the state's overall approach to address its future transportation needs. These strategies offer substantial benefits in providing low cost yet effective and proven techniques which may address the state's increasing travel demand.

Telecommuting

Overview of Telecommuting

Telecommuting, now practiced by approximately 2% of the US labor force, is already a fact of life for many businesses and individuals. Employee gains in flexibility and quality of life can often be matched by corporate benefits of higher productivity and a more loyal and motivated work force. As a result, this phenomenon is currently growing at about 20% annually. As may be seen in Table 15, potentially 5% to 10% of the overall work force could be telecommuting by the year 2002.

Table 15

Projected Future for Telecommuting in U.S.

Year	Number of Telecommuters (millions)	Percent of Labor Force	Average Days per Week
1992	2.0	1.6%	1 - 2
1997	3.1 - 6.2	2.3% - 4.6%	2 - 3
2002	7.5 - 15.0	5.2% - 10.4%	3 - 4

Source: U.S. Department of Tramsportation

Estimates based on the technical literature and current travel statistics suggest that significant transportation benefits could be attainable. As shown in Table 16, telecommuting could potentially reduce vehicle miles traveled (VMT) by commuters upward to 35 billion translating into a net overall VMT savings of over 1%. Based on current VMT in Colorado, a 1% shift to telecommuting would translate into a reduction of 270 million vehicle miles. Unlike other modal options this shift could be accomplished without large capital or operating expenditures. As may also be seen in this table, the benefits of such a shift would lead to significant energy savings and reduced air emissions. This information further clarifies the important role that telecommuting could eventually play in addressing

problems of urban congestion, air quality, and energy use, but it is by no means a near-term or complete solution. Its impact in any particular region though will depend on travel demand management measures and other aspects of the local transportation environment.

Table 16

Transportation Impacts of Telecommuting for U.S.

Year	Saving in VMT (billions)	% Savings in Total Passenger VMT	Fuel Savings (millions of Gallons	% Savings in Gasoline	% Savings in CO Emissions
1992	3.7	0.23%	178	0.25%	0.36%
1997	10.0 - 12.9	0.49% - 0.63%	475.9 - 619	0.6% - 0.8%	1.0% - 1.3%
2002	17.6 - 35.1	0.7% - 1.4%	840 - 1,679	1.1% - 2.1%	1.7% - 3.4%

Source: U.S. Department of Transportation

Telecommuting Activities in Colorado

As Colorado's urbanized areas continue to grow, new and innovative programs to help solve our air quality and traffic congestion problems must be tried. Telecommuting is such a strategy to achieve this goal. But telecommuting is not just for our larger cities. Rural communities also receive many benefits from telecommuting (economic development, educational opportunities). A telecommuting program may also help an employer meet the needs of employees with disabilities and assist them in complying with the Americans with Disabilities Act.

The Colorado Chapter of the National Telecommuting Advisory Council (CTAC) is a public/private partnership of employers throughout Colorado interested in promoting the concept of telecommuting through education and the development of telecommuting programs. Members of CTAC include representatives from Apple Computer, AT&T, Cities of Denver, Fort Collins, and Lakewood, Center for the New West, Colorado Advanced Technology Institute, Colorado Departments of Personnel and Transportation, IBM, Denver Regional Council of Governments, and US West.

The majority of members of CTAC have donated many hours towards developing the Colorado Telecommuting Outreach Program (CTOP) educational workshops for attendees representing over 300 employers throughout Colorado. The CTOP workshops have been recognized as one of the leading programs nationally for providing the latest telecommuting information and education for employers. Attendees receive the benefit of leading national and local speakers (who make their presentations either in person or by way of teleconference call), and a training manual complete with forms to assist employers implementing a telecommuting program. To date, seven telecommuting workshops have been held in Colorado.

The Colorado State Personnel Office recently conducted a telecommuting (flexplace) pilot program in the Denver metro area to study the effects of telecommuting on productivity, energy consumption and quality of life in the workforce. A final report is anticipated in the near future.

Following are some Colorado employers that have formal telecommuting programs:

Apple Computer	Digital Equipment Corp
AT&T	Hewlett Packard
Blue Cross/Blue Shield	IBM
City and County of Denver	Rocky Mountain Health Care
City of Fort Collins	Storage Technology
City of Lakewood	TCI
Colorado Dept. of Health	United Bank of Colorado
Confertech International	US West

Ridesharing

Overview of Ridesharing

Carpool and vanpool programs seek to promote the sharing of rides. Carpooling involves sharing rides in a private vehicle among two or more individuals while vanpooling involves a van and generally carries seven or more occupants. Carpooling arrangements involve area wide programs, employer-sponsored programs, and informal arrangements. An area wide program involves the promotion of carpooling and vanpooling through a public or non-profit agency which provides a service to match commuters traveling to common areas or destinations. Interested parties generally either call the service or mail-in an application form and they are then provided a list of names of other commuters with similar commute patterns. Employer sponsored programs represent efforts by larger employers to encourage ridesharing by their employees. Although area-wide and employer sponsored programs represent important efforts in regard to carpooling, informal carpool arrangements among commuters probably make-up the greatest percentage of carpools. These carpools typically consist of household members, relatives, neighbors, and co-workers.

The formal concept of vanpooling was initiated in 1973 by 3M corporation and has since spread throughout the country. Vanpools usually consist of groups of 7 to 15 people traveling in a passenger van on a routine basis. Normally, there is a designated driver who is responsible for organizational and maintenance details for the operation. Vanpool programs may be grouped into three distinct areas. Owner-operator vanpools, which is the simplest and oldest form, involves a van owned or leased by an individual who in turn provides the service for others with some form of remuneration. Employer-sponsored vanpools represent those programs where employers purchase or lease vans for use by their employees. The final group comprises third-party vanpools which involve an arrangement where a third party organization such as a non-profit corporation, private company or transit agency acquires the vans and makes them available to employers or users.

Current Ridesharing Programs

In the Denver Metropolitan Area the Denver Regional Council of Governments (DRCOG)is the lead agency for implementing a travel demand management program. This program is built upon its rideshare program which was established over 20 years ago during the energy crisis.

DRCOG's RideArrangers program concentrates on carpooling but also offers a range of other services which encourage alternative modes of transport. One such effort is the Guaranteed Ride Home program which assures carpool participants that they will be provided a free taxi ride home by their employer in the event they are stranded, experience an illness or emergency, or work late unexpectedly. Another effort is the joint marketing program with RTD to make commuters and employers aware of the RTD Eco Pass and RideArrangers Guaranteed Ride Home programs. This cooperative effort between DRCOG and RTD has presented companies and their employees with a

range of commuting alternatives. As a result, RideArrangers has enrolled 661 employers and approximately 35,000 employees in this cooperative program. Vanpooling in the Denver metropolitan area has also been increasing over the years. Currently, a number of employers in the Denver area sponsor vanpool programs. In addition to these efforts GO Boulder initiated a vanpool program in 1992. This vanpool program, consisting initially of ten vans, is providing a commuting alternative which is open to the general public.

In addition to the DRCOG program for the Denver Area, ridesharing programs now exist in two other areas of the state, Colorado Springs and Fort Collins. In Fort Collins, Commuter Pool provides matching services for interested parties in regard to carpooling and vanpooling. Commuter Pool recently acquired several vans toward initiating a vanpool program targeted at commuters in the region.

Colorado Springs ridesharing program, known as RideFinders, has been in existence since 1979. This program provides both an area wide matching service for commuters as well as an employer-based outreach program to facilitate ridesharing. RideFinders has worked with a number of major employers in the Colorado Springs area over the past several years to promote and encourage the use of alternative modes of transportation.

Impact of Ridesharing Programs

In 1980 it was estimated that 19% of all work trips in the U.S. were made in carpools. In 1990 the number of work trips made by carpool dropped to 14%. Major reasons for this drop include changes in the employee lifestyles and working arrangements which have made carpooling less convenient.

A recent study indicated that area wide rideshare matching programs and promotions could reduce work trip VMT up to 3%. Primarily these programs influence a small but significant proportion of individuals into ridesharing.

Employer-based ridesharing matching and promotion programs have proven more effective than area wide programs. Primarily this is because employers may also offer financial incentives or implement parking management strategies which increase the effectiveness of such programs. Effective employer-based programs may realize a trip reduction of up to 20%.

In the Denver Metropolitan Area, DRCOG's RideArrangers maintains a file of approximately 400 employers who they survey annually for carpool interest. From these surveys RideArrangers processes approximately 19,000 applications for carpool assistance, 2600 requests for vanpool information, and 5,200 requests for transit route information. In a recent survey by RideArrangers, 26% of all applicants join a carpool or vanpool each year. Based on this assumption, this would translate into 4,900 commuters a year switching to higher occupancy vehicles. Utilizing average commute distances for these applicants, RideArrangers estimates a vehicle travel reduction of 26 million miles annually.

Benefits from ridesharing are not only limited to large urbanized areas. RideFinders in Colorado Springs estimated for 1993 a reduction of approximately 1.7 million miles and a fuel savings of approximately 84,000 gallons of gasoline associated with carpool and vanpool efforts in the region.

Variable Work Schedules

Overview of Variable Work Schedules

There are three types of variable work hour policies and programs that may contribute to reducing

travel demand, These are staggered work hours, compressed work weeks and flextime.

Staggered hours represent staged start work times set by employers so as to spread traffic over a wider timeframe and in turn distributing traffic through the peak period. This type of approach can be applied best in offices and certain manufacturing jobs where workers are somewhat independent.

Compressed work weeks involve allowing employees to work more hours in fewer days. A common strategy in this area is where an employee work four 10 hour days a week. This approach both reduces vehicle miles traveled by eliminating one commute trip a week and also encourages employees to arrive/depart outside normal peak hours.

Flextime allows employees to establish their own starting and quitting time. Most of these programs permit employees to arrive within a two to three hour band and depart eight hours later. This approach may affect travel demand from two perspectives. First, it encourages employees to avoid peak driving hours. Second, it permits employees to better match up with other candidates interested in ridesharing.

Currently many employers in the state offer variable work schedule programs. Probably the largest employers offering such programs include the State of Colorado and the Federal Government. Many of the employers offering such programs are based in the urbanized areas of the state. Both employers and employees benefit from such programs. Employees enjoy greater flexibility in their schedules while employers benefit from a more satisfied work force. Finally, the community may greatly benefit as such programs reduce the demand for new and expanded transportation facilities and also may reduce overall travel and in turn automobile emissions.

Impact of Variable Work Schedules

Various studies have found that compressed work weeks could translate into a significant VMT reduction. An example of the effectiveness of such strategies was the implementation of a compressed work week at the Denver Federal Center with 9,000 employees of 42 federal agencies participating. In this project a VMT reduction of 15% for the overall work force was realized. In addition the program flattened arrival times spreading the peak hour traffic.

Probably the greatest impact of other variable work schedules techniques, such as flextime and staggered hours, has been a flattening of the peak period. Although flextime and staggered work hours improve overall capacity for the transportation system by distributing trips over a wider timeframe, such measures have only a limited impact on reducing overall trips and in turn addressing the issue of air quality. In contrast compressed work weeks have been found to have a clear impact on not only reducing work trips but total trips.

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