CHAPTER 3
AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1 INTRODUCTION AND OVERVIEW

This chapter provides a description of the existing social, physical, and biological environment of the C-470 Corridor and discloses the environmental effects that may occur by implementing the No-Action, Eight-Lane General Purpose Lanes with Auxiliary Lanes, or tolled Express Lanes Alternatives. For simplicity, these alternatives in this chapter are described as the No-Action Alternative, the GPL Alternative, and the EL Alternative, respectively. As discussed in **Chapter 2**, the EL Alternative was identified as the Preferred Alternative. However, both action alternatives as well as the No-Action Alternative are evaluated in this chapter to disclose the differences between the two with regard to environmental effects. Alternatives are compared to each other based on mitigated packages. Therefore mitigation commitments are part of each alternative. This chapter is organized by resource, such that the affected environment, environmental consequences, and mitigation measures are discussed sequentially under each resource heading. Resource topics are broken down into the social, physical, and biological environments. Following the resource discussions, effects and mitigation measures are summarized in **Tables 3-45** and **3-46**. A cumulative effects discussion follows the summary tables in **Section 3.6.**

The project area evaluated for direct and indirect effects includes 13 miles of C-470 from Kipling Parkway to the I-25 interchange. Direct effects for all environmental resources are summarized in **Table 3-45**. The cumulative effects assessment included broader spatial and temporal boundaries, as discussed in **Section 3.6.1**. Data used for the effects analysis were collected from a variety of sources including Arapahoe, Douglas, and Jefferson Counties and federal, state, and local resource agencies. From August 2003 to September 2004, field delineation was completed for social, physical, and biological environment components using global positioning systems.

3.2 SOCIAL ENVIRONMENT

The social environment of the C-470 project area consists of the people and businesses that exist within one mile of the highway. Transportation improvements can affect the social environment both positively and negatively by altering economic development plans and patterns, changing land use, changing growth patterns, relocating homes or businesses, or dividing communities. Effects to the social environment were evaluated for demographics; environmental justice; housing and community facilities; economics; land use; parks and recreation; and right-of-way (ROW).

3.2.1 Demographics

For the purpose of this demographic analysis, U.S. Census Bureau census block group data from the 2000 Decennial Census were used to describe the social characteristics of the population living within the project area. The project area population consists of individuals living within approximately one mile of C-470. This area is composed of 65 census block groups. Population density, historical and projected population, and age composition data are compared for the project area population, and for Arapahoe, Douglas, and Jefferson Counties. Minority and income population characteristics are described in **Section 3.2.2**.

3.2.1.1 General Population Characteristics

The 2000 population within the project area was 103,467; the combined total of Arapahoe, Douglas, and Jefferson Counties was 1,190,789. The project area contains 37,337 households. The July 2003 estimated population for the three Counties is Arapahoe County (516,060), Douglas County (223,471), and Jefferson County (528,563). Among the incorporated cities within the project area, the estimated July 2003 population is Centennial (98,586), Littleton (40,599), and Lone Tree (7,600). The average population density within the project area (65 block groups) is approximately 2,600 persons per

square mile. As shown in **Figure 3-1**, population density varies through the project area. Generally, the density is relatively low, which is consistent with the suburban nature of the Corridor.

Table 3-1 shows the population and its change from 1990 to 2000 for the project area and for Arapahoe, Douglas, and Jefferson Counties. All three counties had robust population growth between 1990 and 2000. Douglas County had the distinction of being the fastest growing county in the United States during the 1990s, with a 191.0 percent population growth rate. Arapahoe and Jefferson Counties had population growth rates that were considerably lower for the decade, at 24.6 percent and 20.2 percent, respectively. In terms of the numeric change in population, however, these two counties added almost as many people during the decade as did Douglas County. Almost 26,000 people were added to the project area during the 1990s, representing 33 percent growth. These growth rates were higher than those of Arapahoe and Douglas Counties, but considerably lower than that of Douglas County.

Table 3-2 shows the projected population from 2000 to 2030 for the three counties, all of which are expected to grow more slowly than during the 1990s. The average annual percent change in population from 1990 to 2000 was 2.2 percent for Arapahoe County, 11.3 percent for Douglas County, and 1.9 percent for Jefferson County. Generally, the population growth rates are expected to increase, but at decreasing rates for each subsequent decade. Arapahoe and Jefferson Counties have similar projected population growth from 2000 to 2030, at 36.5 percent and 34.7 percent, respectively. These two counties are also expected to add approximately 180,000 people each during the 30-year period. Douglas County is expected to grow at 150.1 percent from 2000 to 2030, which is a substantially higher rate than the other two counties. Douglas County is expected to add almost 264,000 people during the 30-year period.

Table 3-3 shows year 2000 age composition data for the project area and for Arapahoe, Douglas, and Jefferson Counties. The age compositions of the three counties and the project area are relatively similar, with like percentages of population within age cohorts. In 2000 the median age in the project area was 36.3, which is older than that of Arapahoe County (34.5 years)

Table 3-1
Population Change 1990 to 2000

Location	Population		% Change
	1990	2000	
Project Area	77,772	103,467	33.0
Arapahoe County	391,511	487,967	24.6
Douglas County	60,391	175,766	191.0
Jefferson County	438,430	527,056	20.2

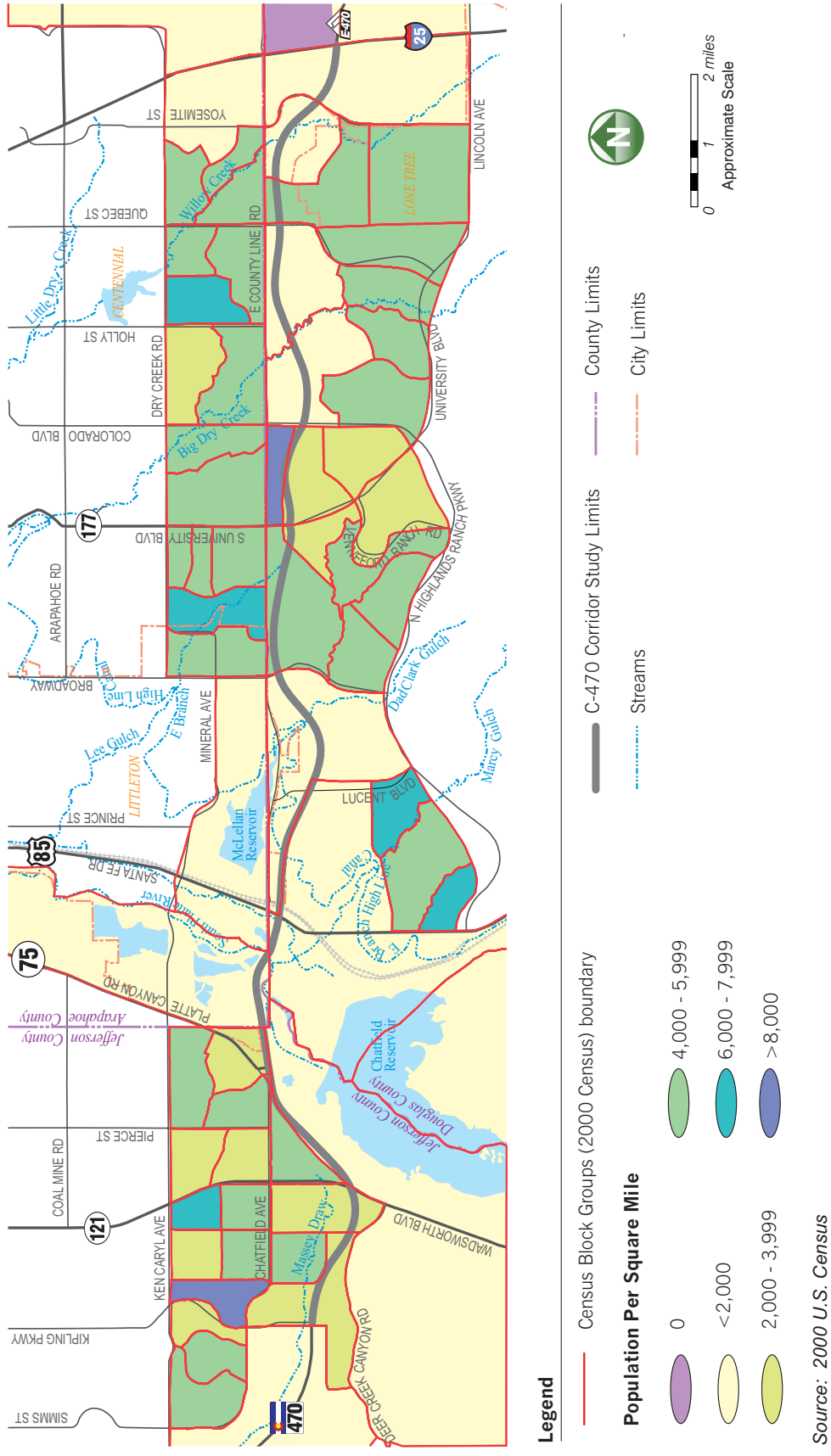
Source: 2000 U.S. Census

Table 3-2
Projected Population Growth

	Population				% Change in Population			
County	2000	2010	2020	2030	2000 to 2010	2010 to 2020	2020 to 2030	2000 to 2030
Arapahoe	487,967	560,698	621,884	666,262	14.9	10.9	7.1	36.5
Douglas	175,766	274,921	364,876	439,585	56.4	32.7	20.5	150.1
Jefferson	527,056	576,784	647,332	709,958	9.4	12.2	9.7	34.7

Sources: 2000 U.S. Census
Projected numbers by the Colorado Department of Local Affairs, 2004

Figure 3-1
Population Density



and Douglas County (33.7 years) but slightly less than that of Jefferson County (36.8 years). Over 50 percent of the population within the study area is between 30 and 64 years old. Another nearly 25 percent are children between 5 and 17 years, leaving some gap in the population distribution between 18 and 29 years and over 65 years. This provides some indication that residents of the corridor consist of working age families and their children.

Neighborhoods

The majority of the neighborhoods that have evolved around C-470 were either under construction or built following the initial construction of the highway. Neighborhoods, as they are traditionally known, evolved from subdivision enclaves. Therefore, the existing neighborhoods are identified by the names of their respective subdivisions. Generally, single-family residential development is offset from the highway 300 to 500 feet, with the exception of those subdivisions developed prior to C-470, and a group of apartment complexes between University and Colorado Boulevards. Due to the suburban nature of the existing neighborhoods and development timeframe, all neighborhoods are self-contained. Access from each neighborhood to nearby commercial development and community facilities is provided via collector streets and major arterials crossing C-470 at one to three mile increments. The neighborhoods adjacent to the highway are identified from west to east, on either side of C-470.

The Chatfield Bluffs neighborhood lies south of C-470, immediately east of Kipling Parkway. Continuing east of Chatfield State Park, Highlands Ranch comprises the majority of the suburban development south of the highway, between Santa Fe Drive and Quebec Street. The majority of this portion of Highlands Ranch adjacent to C-470 is comprised of single-family homes, with the exception of the Shadow Ranch condominiums, currently under construction, and the Palomino Park apartments between Colorado Boulevard and Quebec Street. East of Quebec Street follows the Acres Green neighborhood and the Park Meadows commercial development. All these neighborhoods were built after C-470.

North of C-470, commercial development is located along Kipling Parkway, followed by the

Table 3-3
Year 2000 Age Composition by County and Project Area

Age	Project Area		Arapahoe County		Douglas County		Jefferson County	
	Population	% of Total	Population	% of Total	Population	% of Total	Population	% of Total
Under 5	7,839	7.6	33,720	6.9	16,950	9.6	1,723	7.2
5 to 17	22,956	22.2	96,634	19.8	38,527	21.9	5,182	21.6
18 to 21	3,519	3.4	22,742	4.7	4,981	2.8	934	3.9
22 to 29	8,043	7.8	56,738	11.6	15,035	8.6	2,142	8.9
30 to 39	18,020	17.4	79,928	16.4	36,866	21.0	4,317	18.0
40 to 49	20,676	20.0	84,284	17.3	32,693	18.6	4,629	19.3
50 to 64	16,521	16.0	71,992	14.8	23,392	13.3	3,721	15.5
65 and Up	5,893	5.7	41,929	8.6	7,322	4.2	1,332	5.6
Total	103,467	100.0	487,967	100.0	175,766	100.0	23,980	100.0

Source: 2000 U.S. Census

Deer Creek Condominiums and the Wingate neighborhood. Meadowbrook Heights, Herrick-Dale Acres, and Columbine Hills neighborhoods were developed prior to C-470 and are the oldest residential neighborhoods along the Corridor. Continuing east of the Kiewit gravel pits and South Platte Park, the Wolhurst Community lies in the southwest quadrant of the Santa Fe Drive interchange. Land previously part of the Bowen Farm lies east of Santa Fe Drive. This land was recently acquired by a developer and will be constructed as a mixed-use development north and south of C-470. The Bluffs Apartments are located immediately west of Broadway, surrounded by open space adjacent to the High Line Canal trail. Between Broadway and University Boulevard, commercial development exists between County Line Road and C-470. Several apartment and condominium complexes – Autumn Chase, Traditions, and Copper Canyon apartments, followed by Canyon Ranch Condominiums – are located from west to east along C-470 between University and Colorado Boulevards, with access from County Line Road. All remaining development immediately adjacent to C-470 is commercial in nature.

3.2.1.2 Environmental Consequences

No-Action Alternative

The No-Action Alternative would require no new ROW, and would require no business or residential relocations. However, increased traffic congestion on C-470 may shift forecasted population growth to other portions of the three county area, outside the immediate project area. Demand for community facilities, services, and housing would increase in response to the projected population growth. The locations of these resources would generally follow development and land use plans identified by the counties and cities. This alternative would not bisect any existing neighborhoods or create a barrier effect between residential and commercial community areas. For additional discussion about effects to land use patterns, see **Section 3.2.5**.

General Purpose Lanes Alternative

The GPL Alternative would require partial acquisition of several parcels to accommodate ROW needs, but it would require no business or residential relocations. The GPL Alternative may provide opportunities for projected development to occur more quickly in the project area, in response to capacity improvements on C-470 and a corresponding congestion decrease. While populations in these counties are projected to grow regardless of the study alternatives, transportation improvements may affect the timing of this growth. With the GPL Alternative, demand for community facilities, services, and housing would increase at a rate that is consistent with projected population growth. The locations of these resources would generally follow development and land use plans identified by the counties and cities.

This alternative would not bisect any existing neighborhoods or create a barrier effect between residential and commercial community areas. By adding three grade separated trail crossings at Santa Fe Drive, Colorado Boulevard, and Quebec Street, the GPL Alternative improves east to west pedestrian travel where the C-470 trail crosses major arterial roadways.

Express Lanes Alternative (Preferred Alternative)

The EL Alternative would require partial acquisition of several parcels to accommodate ROW needs, but it would require no business or residential relocations. This alternative would neither divide nor isolate any particular neighborhood nor separate residents from community facilities.

Like the GPL Alternative, the EL Alternative may also provide opportunities for development to occur more quickly in the project area. While populations in these counties are expected to grow, transportation improvements may affect the timing of this growth. With the EL Alternative, demand for community facilities, services, and housing would increase at a rate that is constant with projected population

growth. The locations of these resources would generally follow development and land use plans identified by the counties and cities.

This alternative would not bisect any existing neighborhoods or create a barrier effect between residential and commercial community areas. By adding three grade separated trail crossings at Santa Fe Drive, Colorado Boulevard, and Quebec Street, the GPL Alternative improves east to west pedestrian travel where the C-470 trail crosses major arterial roadways.

3.2.1.3 Mitigation

No mitigation measures are anticipated for changes to the demographic composition of the project area. Because land use is guided by local government zoning, these agencies should consider the community's transportation and infrastructure needs and the impacts of the land use on the existing transportation infrastructure when considering changing land use zoning patterns. Local governments should examine the results of the transportation study to see what land use decisions may be consistent with the alternatives.

3.2.2 Environmental Justice

In February 1994, President Clinton issued Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority and Low-Income Populations*. The EO states, "To the greatest extent practicable and permitted by law, … each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations." The EO also requires that, "Each Federal agency shall work to ensure that public documents, notices, and hearings relating to human health or the environment are concise, understandable, and readily accessible to the public."

In April 1997, the U.S. Department of Transportation (DOT) issued DOT Order 5610.2 on Environmental Justice to develop and implement procedures to ensure compliance with the EO. In December 1998, the Federal Highway Administration (FHWA) subsequently established guidelines (Order 6640.23 Actions to Address Environmental Justice in Minority and Low-Income Populations) to implement DOT Order 5610.2 and EO 12898.

3.2.2.1 Affected Environment

To determine the presence of minority or low-income populations along the C-470 Corridor, 2000 Census data was analyzed. Percentages of minority and low-income residents in each Census block group were compared to the county-wide averages for Jefferson, Arapahoe, and Douglas Counties. Percentages greater than county averages were analyzed using Geographic Information System (GIS). GIS mapping was then used to present the demographic data within the project area block groups. As discussed in the following sections, the effects of each alternative were compared to the identified block groups of low-income and minority populations. Environmental effects analyzed include ROW acquisition, traffic, air quality, noise, and aesthetics. Lastly, avoidance and minimization measures and mitigation measures are presented for each alternative. A detailed analysis of the project area's minority and low-income populations is in the *Environmental Justice Technical Report* (March 2004). This report also documents steps taken to avoid adverse effects to identified populations subject to EO 12898 and the public process undertaken to provide opportunity for meaningful involvement from these communities.

Minority Populations

The U.S. DOT Order 5610.2 defines "minority" as "A person who is (1) Black (a person having origins in any of the black racial groups of Africa); (2) Hispanic (a person of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race); (3) Asian American (a person having origins in any of the original peoples of the Far East, Southeast

Asia, the Indian subcontinent, or the Pacific Islands); or (4) American Indian and Alaskan Native (a person having origins in any of the original people of North America and who maintains cultural identification through tribal affiliation or community recognition)." And, "Minority Population means any readily identifiable groups of minority persons who live in geographic proximity, and if circumstances warrant, geographically dispersed/transient person (such as migrant workers or Native Americans) who will be similarly affected by a proposed DOT program, policy or activity."

It is important to note that the Census Bureau definition of race (including White, Black/African American, American Indian and Alaska Native, Asian, Native Hawaiian and other Pacific Islander, or other race) is separate and distinct from Hispanic or Latino, which is considered an ethnicity. Because the Hispanic or Latino category is considered a minority category under EO 12898, the race and ethnicity data are combined in this evaluation of minority populations.

Percentages of minority households in each of the census block groups in the project area were compared to the averages for Arapahoe, Douglas, and Jefferson Counties. **Table 3-4** shows year 2000 race and ethnicity data for the project area and the three counties. Generally, the project area and the three counties have low percentages of minority population. Minorities compose only 10.4 percent of the project area population. Arapahoe, Douglas, and Jefferson Counties contain 26.1, 10.3, and 15.1 percent minority populations, respectively. As shown in **Figure 3-2**, 14 block groups in Douglas County have a percentage of minority households greater than the minority percentage of total population for the entire county. No block groups in the project area in Arapahoe or Jefferson Counties have a percentage of minority households greater than the minority percentage of the counties' total population.

Low-Income Populations

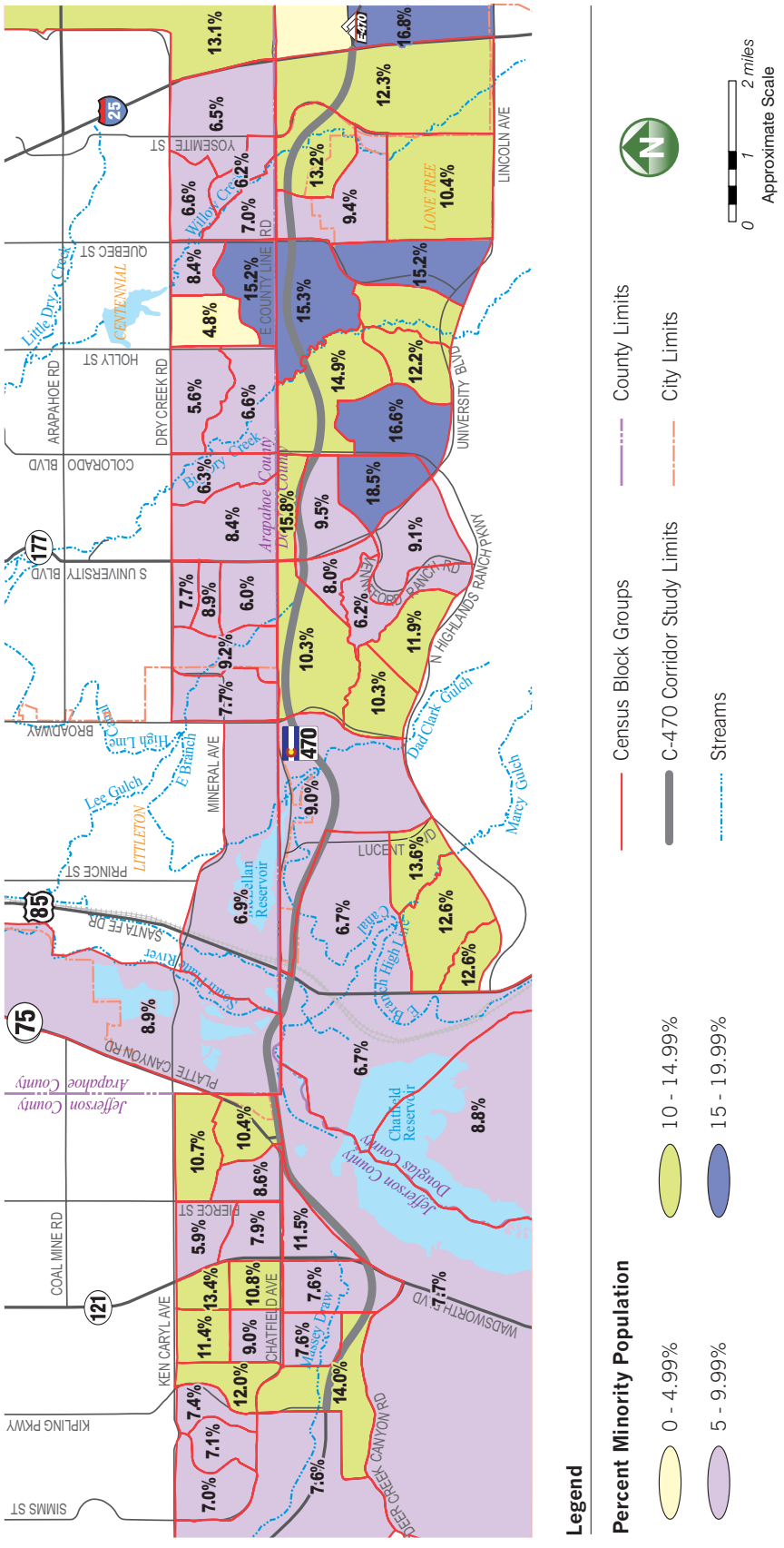
The U.S. DOT Order 5610.2 defines low-income as "a household income at or below the Department of Health and Human Services poverty guidelines." A "Low-Income Population means any readily identifiable group of low-income persons who live in geographic proximity, and, if circumstances warrant, geographically dispersed/transient person (such as migrant workers or Native Americans) who would be similarly affected by a proposed the FHWA program, policy, or activity." The HHS national poverty level for 2000 was $17,050. Because this income level is too low to accurately reflect low-income in many Colorado communities, the Colorado Department of Transportation (CDOT) developed and adopted

Table 3-4
Year 2000 Project Area and Three-County Race and Ethnicity

	Project Area Population		Arapahoe County Population		Douglas County Population		Jefferson County Population	
	Number	% of Total	Number	% of Total	Number	% of Total	Number	% of Total
Caucasian	92,736	89.6	360,744	73.9	157,686	89.7	447,416	84.9
African-American	944	0.9	36,254	7.4	1,596	0.9	4,312	0.8
Other Race	4,690	4.5	33,357	6.8	7,598	4.3	22,879	4.3
Hispanic or Latino	5,097	4.9	57,612	11.8	8,886	5.1	52,449	10.0
Minority	10,731	10.4	127,223	26.1	18,080	10.3	79,640	15.1
Total Population	103,467	100.0	487,967	100.0	175,766	100.0	527,056	100.0

Source: 2000 U.S. Census

Figure 3-2
Minority Populations by Block Group



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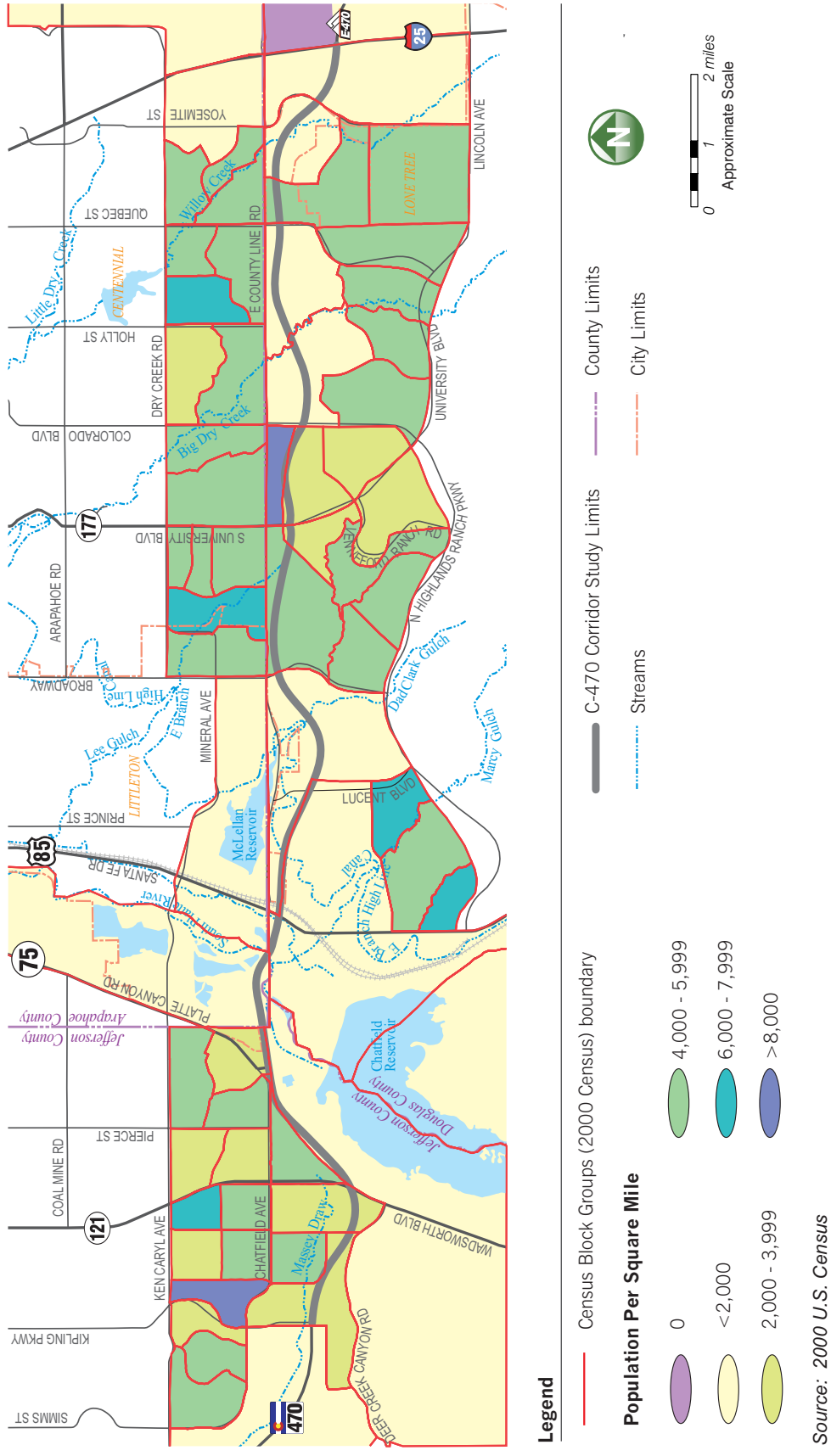

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North of C-470, commercial development is located along Kipling Parkway, followed by the

Table 3-3
Year 2000 Age Composition by County and Project Area

Age	Project Area		Arapahoe County		Douglas County		Jefferson County	
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22 to 29	8,043	7.8	56,738	11.6	15,035	8.6	2,142	8.9
30 to 39	18,020	17.4	79,928	16.4	36,866	21.0	4,317	18.0
40 to 49	20,676	20.0	84,284	17.3	32,693	18.6	4,629	19.3
50 to 64	16,521	16.0	71,992	14.8	23,392	13.3	3,721	15.5
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Deer Creek Condominiums and the Wingate neighborhood. Meadowbrook Heights, Herrick-Dale Acres, and Columbine Hills neighborhoods were developed prior to C-470 and are the oldest residential neighborhoods along the Corridor. Continuing east of the Kiewit gravel pits and South Platte Park, the Wolhurst Community lies in the southwest quadrant of the Santa Fe Drive interchange. Land previously part of the Bowen Farm lies east of Santa Fe Drive. This land was recently acquired by a developer and will be constructed as a mixed-use development north and south of C-470. The Bluffs Apartments are located immediately west of Broadway, surrounded by open space adjacent to the High Line Canal trail. Between Broadway and University Boulevard, commercial development exists between County Line Road and C-470. Several apartment and condominium complexes – Autumn Chase, Traditions, and Copper Canyon apartments, followed by Canyon Ranch Condominiums – are located from west to east along C-470 between University and Colorado Boulevards, with access from County Line Road. All remaining development immediately adjacent to C-470 is commercial in nature.

3.2.1.2 Environmental Consequences

No-Action Alternative

The No-Action Alternative would require no new ROW, and would require no business or residential relocations. However, increased traffic congestion on C-470 may shift forecasted population growth to other portions of the three county area, outside the immediate project area. Demand for community facilities, services, and housing would increase in response to the projected population growth. The locations of these resources would generally follow development and land use plans identified by the counties and cities. This alternative would not bisect any existing neighborhoods or create a barrier effect between residential and commercial community areas. For additional discussion about effects to land use patterns, see **Section 3.2.5**.

General Purpose Lanes Alternative

The GPL Alternative would require partial acquisition of several parcels to accommodate ROW needs, but it would require no business or residential relocations. The GPL Alternative may provide opportunities for projected development to occur more quickly in the project area, in response to capacity improvements on C-470 and a corresponding congestion decrease. While populations in these counties are projected to grow regardless of the study alternatives, transportation improvements may affect the timing of this growth. With the GPL Alternative, demand for community facilities, services, and housing would increase at a rate that is consistent with projected population growth. The locations of these resources would generally follow development and land use plans identified by the counties and cities.

This alternative would not bisect any existing neighborhoods or create a barrier effect between residential and commercial community areas. By adding three grade separated trail crossings at Santa Fe Drive, Colorado Boulevard, and Quebec Street, the GPL Alternative improves east to west pedestrian travel where the C-470 trail crosses major arterial roadways.

Express Lanes Alternative (Preferred Alternative)

The EL Alternative would require partial acquisition of several parcels to accommodate ROW needs, but it would require no business or residential relocations. This alternative would neither divide nor isolate any particular neighborhood nor separate residents from community facilities.

Like the GPL Alternative, the EL Alternative may also provide opportunities for development to occur more quickly in the project area. While populations in these counties are expected to grow, transportation improvements may affect the timing of this growth. With the EL Alternative, demand for community facilities, services, and housing would increase at a rate that is constant with projected population

growth. The locations of these resources would generally follow development and land use plans identified by the counties and cities.

This alternative would not bisect any existing neighborhoods or create a barrier effect between residential and commercial community areas. By adding three grade separated trail crossings at Santa Fe Drive, Colorado Boulevard, and Quebec Street, the GPL Alternative improves east to west pedestrian travel where the C-470 trail crosses major arterial roadways.

3.2.1.3 Mitigation

No mitigation measures are anticipated for changes to the demographic composition of the project area. Because land use is guided by local government zoning, these agencies should consider the community's transportation and infrastructure needs and the impacts of the land use on the existing transportation infrastructure when considering changing land use zoning patterns. Local governments should examine the results of the transportation study to see what land use decisions may be consistent with the alternatives.

3.2.2 Environmental Justice

In February 1994, President Clinton issued Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority and Low-Income Populations*. The EO states, "To the greatest extent practicable and permitted by law, … each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations." The EO also requires that, "Each Federal agency shall work to ensure that public documents, notices, and hearings relating to human health or the environment are concise, understandable, and readily accessible to the public."

In April 1997, the U.S. Department of Transportation (DOT) issued DOT Order 5610.2 on Environmental Justice to develop and implement procedures to ensure compliance with the EO. In December 1998, the Federal Highway Administration (FHWA) subsequently established guidelines (Order 6640.23 Actions to Address Environmental Justice in Minority and Low-Income Populations) to implement DOT Order 5610.2 and EO 12898.

3.2.2.1 Affected Environment

To determine the presence of minority or low-income populations along the C-470 Corridor, 2000 Census data was analyzed. Percentages of minority and low-income residents in each Census block group were compared to the county-wide averages for Jefferson, Arapahoe, and Douglas Counties. Percentages greater than county averages were analyzed using Geographic Information System (GIS). GIS mapping was then used to present the demographic data within the project area block groups. As discussed in the following sections, the effects of each alternative were compared to the identified block groups of low-income and minority populations. Environmental effects analyzed include ROW acquisition, traffic, air quality, noise, and aesthetics. Lastly, avoidance and minimization measures and mitigation measures are presented for each alternative. A detailed analysis of the project area's minority and low-income populations is in the *Environmental Justice Technical Report* (March 2004). This report also documents steps taken to avoid adverse effects to identified populations subject to EO 12898 and the public process undertaken to provide opportunity for meaningful involvement from these communities.

Minority Populations

The U.S. DOT Order 5610.2 defines "minority" as "A person who is (1) Black (a person having origins in any of the black racial groups of Africa); (2) Hispanic (a person of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race); (3) Asian American (a person having origins in any of the original peoples of the Far East, Southeast

Asia, the Indian subcontinent, or the Pacific Islands); or (4) American Indian and Alaskan Native (a person having origins in any of the original people of North America and who maintains cultural identification through tribal affiliation or community recognition)." And, "Minority Population means any readily identifiable groups of minority persons who live in geographic proximity, and if circumstances warrant, geographically dispersed/transient person (such as migrant workers or Native Americans) who will be similarly affected by a proposed DOT program, policy or activity."

It is important to note that the Census Bureau definition of race (including White, Black/African American, American Indian and Alaska Native, Asian, Native Hawaiian and other Pacific Islander, or other race) is separate and distinct from Hispanic or Latino, which is considered an ethnicity. Because the Hispanic or Latino category is considered a minority category under EO 12898, the race and ethnicity data are combined in this evaluation of minority populations.

Percentages of minority households in each of the census block groups in the project area were compared to the averages for Arapahoe, Douglas, and Jefferson Counties. **Table 3-4** shows year 2000 race and ethnicity data for the project area and the three counties. Generally, the project area and the three counties have low percentages of minority population. Minorities compose only 10.4 percent of the project area population. Arapahoe, Douglas, and Jefferson Counties contain 26.1, 10.3, and 15.1 percent minority populations, respectively. As shown in **Figure 3-2**, 14 block groups in Douglas County have a percentage of minority households greater than the minority percentage of total population for the entire county. No block groups in the project area in Arapahoe or Jefferson Counties have a percentage of minority households greater than the minority percentage of the counties' total population.

Low-Income Populations

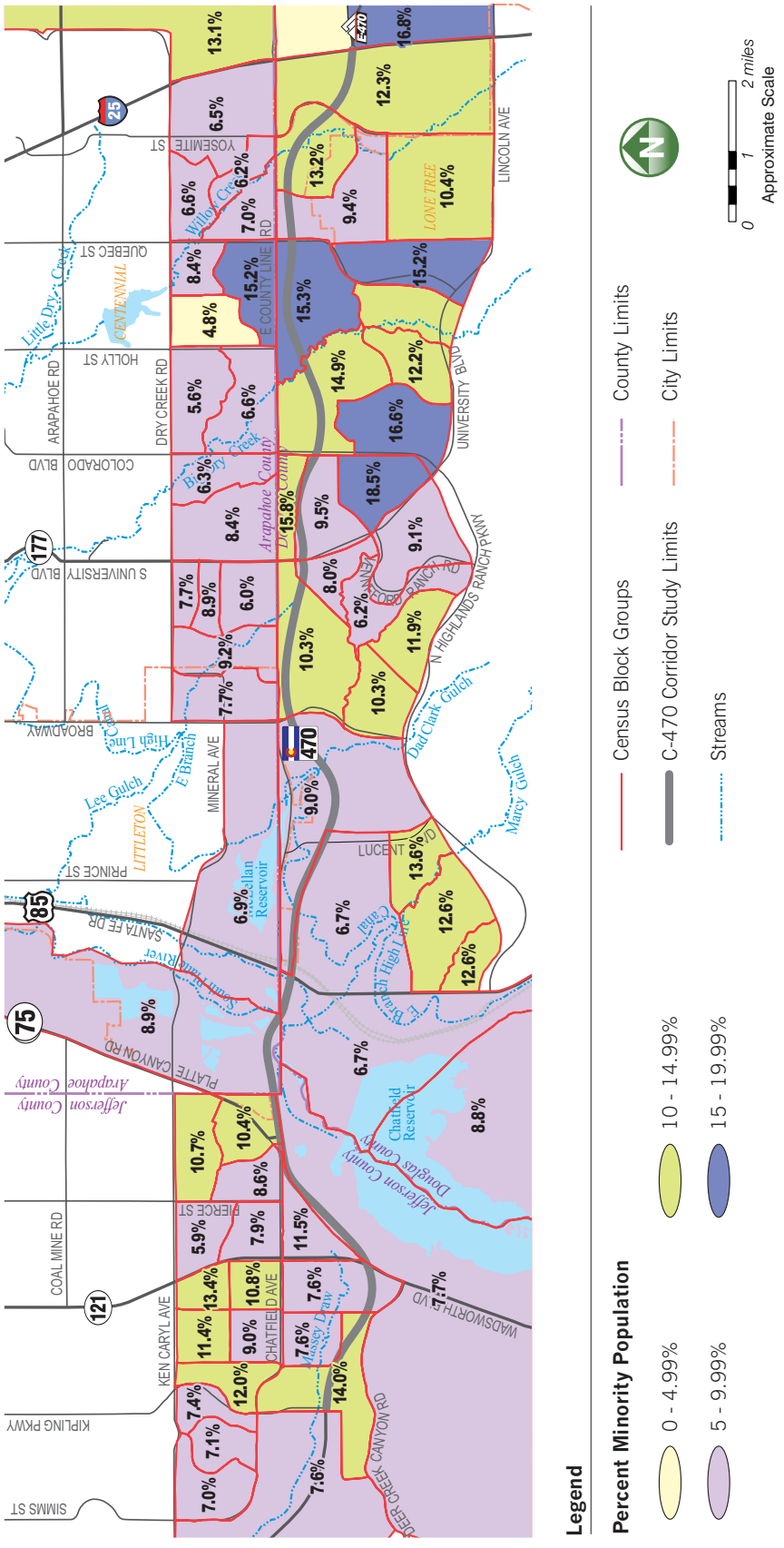
The U.S. DOT Order 5610.2 defines low-income as "a household income at or below the Department of Health and Human Services poverty guidelines." A "Low-Income Population means any readily identifiable group of low-income persons who live in geographic proximity, and, if circumstances warrant, geographically dispersed/transient person (such as migrant workers or Native Americans) who would be similarly affected by a proposed the FHWA program, policy, or activity." The HHS national poverty level for 2000 was $17,050. Because this income level is too low to accurately reflect low-income in many Colorado communities, the Colorado Department of Transportation (CDOT) developed and adopted

Table 3-4
Year 2000 Project Area and Three-County Race and Ethnicity

	Project Area Population		Arapahoe County Population		Douglas County Population		Jefferson County Population	
	Number	% of Total	Number	% of Total	Number	% of Total	Number	% of Total
Caucasian	92,736	89.6	360,744	73.9	157,686	89.7	447,416	84.9
African-American	944	0.9	36,254	7.4	1,596	0.9	4,312	0.8
Other Race	4,690	4.5	33,357	6.8	7,598	4.3	22,879	4.3
Hispanic or Latino	5,097	4.9	57,612	11.8	8,886	5.1	52,449	10.0
Minority	10,731	10.4	127,223	26.1	18,080	10.3	79,640	15.1
Total Population	103,467	100.0	487,967	100.0	175,766	100.0	527,056	100.0

Source: 2000 U.S. Census

Figure 3-2
Minority Populations by Block Group



their own more inclusive methodology in *Environmental Justice in Colorado's Statewide and Regional Planning Process Guidebook* (December 2003). The methods described in that publication are more representative of particular sub-areas of the state than using poverty guidelines established by the Department of Health and Human Services. The Colorado Guidebook states, "… income thresholds used in determining the allocation of Colorado Community Development Block Grant (CBDG) funds were selected for environmental justice mapping." These methods include using a low-income threshold that equals 30 percent of the area median income (AMI) for each metropolitan statistical area (MSA). The AMI for the Denver MSA, including Arapahoe, Douglas, and Jefferson Counties for 2000 was $62,100 for a four-person household. The 30 percent AMI low-income threshold is then $18,630. This threshold was used to evaluate household income data for the project area, as compared to the average for each respective county in the project area.

The low-income populations for Arapahoe, Douglas, and Jefferson Counties are 11.76, 4.45, and 10.83 percent, respectively. **Figure 3-3** shows individual block groups with household percentages below the 30 percent AMI low-income threshold within the C-470 project area.

Based on U.S. Census data alone, several block groups appear to have higher percentages of households below the $18,630 low-income threshold, as compared to the three-county area. However, in order to determine whether this data represented actual low-income populations, as defined by the DOT Order, additional data was evaluated. Douglas and Jefferson County planning departments indicated that no low-income populations were known to exist within the C-470 project area. Statistics were evaluated to determine the percentage of students attending area schools that were eligible for reduced-price or free lunches. These percentages for schools within the project area were below six percent. Housing authorities in Douglas County and the City of Littleton revealed that while Section 8 housing vouchers were distributed to households within their jurisdictions, none were for areas within the C-470 project area, except for the Wolhurst Community, hereafter referred to as "Wolhurst."

While analysis of census data indicated that low-income populations might be present in other portions of the project area, additional analysis indicated that Wolhurst might also be low income. For this reason, a neighborhood survey of Wolhurst was conducted. This community spans the border of Arapahoe and Douglas Counties, and is composed of 272 units. The community is currently expanding to accommodate 29 additional units. Residents lease lots from the community's owner, Wolhurst Adult Community, Incorporated.

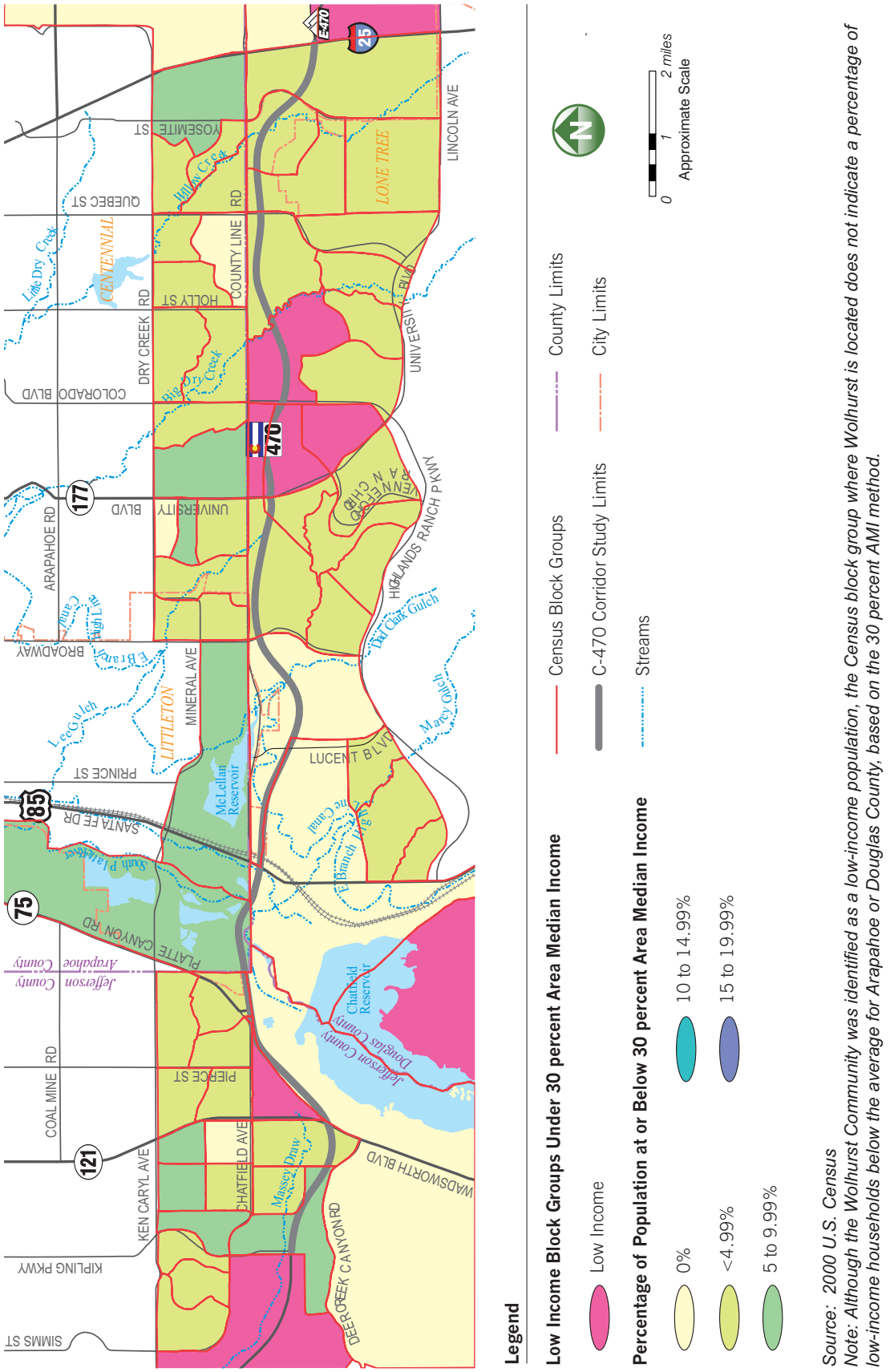
In September 2003, a community survey was developed and distributed to all 272 households in Wolhurst and nearly 50 percent of the surveys were returned. Based on the survey results, approximately 30 percent of the community has a household income at or below $18,630. This is higher than the county averages for both Arapahoe and Douglas Counties of 11.76 and 4.45 percent low-income, respectively. These two counties were used as comparisons, since Wolhurst is located in both counties.

CDOT has identified Wolhurst as a low-income population because reported income levels from the community survey indicate a substantially higher percentage of households meets the low-income threshold than both the Arapahoe and Douglas County averages.

3.2.2.2 Environmental Consequences

The FHWA Order 6640.23, *FHWA Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (December 1998) states, "It is the FHWA's longstanding policy to actively ensure nondiscrimination in federally funded activities. Furthermore, it is the FHWA's continuing policy to identify and prevent discriminatory effects by actively administering its programs, policies,

Figure 3-3
Percentages of Households Below 30 Percent AMI



Source: 2000 U.S. Census
Note: Although the Wolhurst Community was identified as a low-income population, the Census block group where Wolhurst is located does not indicate a percentage of low-income households below the average for Arapahoe or Douglas County, based on the 30 percent AMI method.

and activities to ensure that social impacts to communities and people are recognized early and continually throughout the transportation decision making process—from early planning through implementation. Should the potential for discrimination be discovered, action to eliminate the potential shall be taken."

Effects resulting from the three alternatives being evaluated in the EA are described in the following sections.

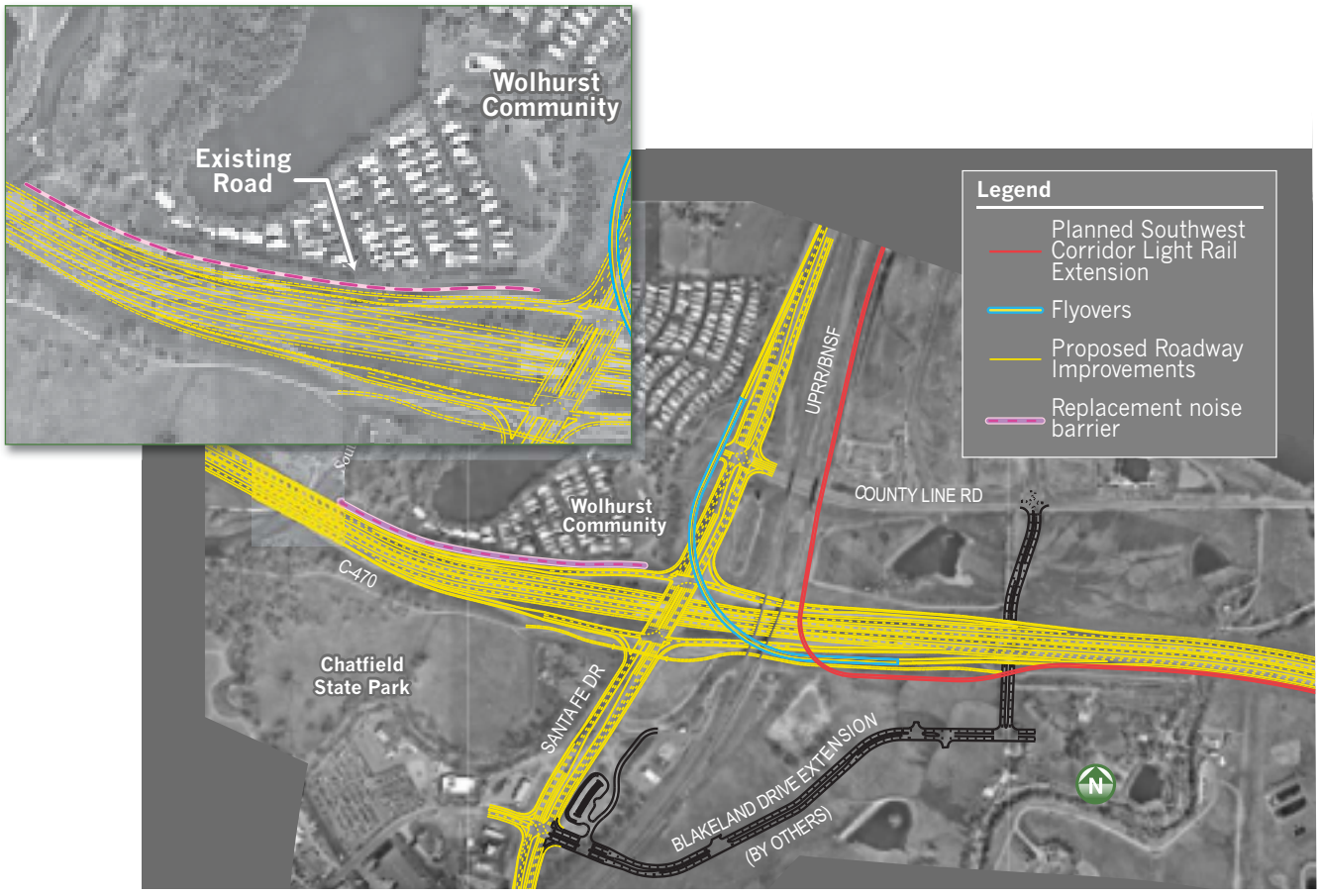
No-Action Alternative

The No-Action Alternative includes only minor safety and maintenance improvements along C-470, such as resurfacing and re-striping. As such, these activities would result in negligible effects to Wolhurst or to any other residential population in the project area. Similarly, because no new ROW would be required, no particular social group would be affected. In general, the effects of this alternative on the population living within the project area are negligible.

General Purpose Lanes Alternative

The GPL Alternative includes widening existing C-470 and Santa Fe Drive, both of which border Wolhurst. These improvements would require ROW acquisition from Wolhurst. The existing noise barrier along the southern border of the property would also be affected by highway widening and interchange improvements. A replacement noise barrier would be re-located within CDOT ROW parallel to C-470 , approximately 50-90 feet closer to the interior road than the existing barrier. **Figure 3-4** shows the design concept for the interchange improvement in proximity to Wolhurst.

Figure 3-4
Santa Fe Drive Interchange at Wolhurst



Improvements to the Santa Fe Drive interchange would also require complete reconstruction of the bridge over C-470 and the addition of a flyover to accommodate the high-volume movement from southbound Santa Fe Drive to eastbound C-470, as shown in **Figure 3-4.** This interchange is described in more detail in **Section 2.4.2.2**. The flyover would be constructed so that the ramp would begin its ascent north of the signalized entrance to Wolhurst at the Santa Fe Drive/County Line Road intersection. The flyover would be above this existing intersection. Effects to Wolhurst have been identified with respect to ROW, traffic, noise levels, air quality, and aesthetics.

ROW. Additional ROW necessary to construct improvements to Santa Fe Drive, the Santa Fe Drive interchange, and C-470 itself would require approximately 2.1 acres of property from Wolhurst. The land required for acquisition is located on the east and south side of the community immediately adjacent to the existing access road and highway. This ROW acquisition would not require changes to the existing access road along the southern property boundary, nor would it require any residential relocations. However, the improvements would result in traffic lanes, including the flyover ramp, which would be 140 feet closer to residential homes than they are today. As discussed in **Section 3.2.7**, Wolhurst is one of many areas where additional ROW would be required.

TRAFFIC. Capacity improvements to Santa Fe Drive, County Line Road, and the C-470 ramp terminal intersections would improve travel conditions. A dedicated southbound right-turn lane from Santa Fe Drive into Wolhurst would facilitate free movement into the community. The flyover ramp would improve the conditions at the Santa Fe Drive/County Line Road intersection, which also serves as the entrance to Wolhurst by removing southbound traffic headed for eastbound C-470. It will not interfere with the existing access to Wolhurst. Traffic exiting Wolhurst headed for eastbound C-470 would turn right out of the community and left onto the eastbound C-470 entrance ramp, just as they do today. The westbound County Line Road approach to the Santa Fe Drive intersection would include an exclusive right-turn-only lane, two left-turn lanes, and a dedicated through lane into Wolhurst, improving traffic operations at this intersection. A more detailed discussion of traffic operations for the Santa Fe Drive interchange complex is discussed in **Section 3.3.1.2**.

AIR QUALITY. As part of the air quality modeling for the project area, hot-spot analyses for carbon monoxide emissions were conducted for the ramp intersection of Santa Fe Drive and the westbound C-470 entrance and exit ramps. As discussed in **Section 3.3.2**, the emission levels for this intersection are below the national standard for carbon monoxide and would decrease as a result of improved traffic operations for the GPL Alternative. Other air pollutants attributable to highway traffic (such as particulate matter and ozone) were also evaluated on a corridor-wide basis and found to not exceed national standards. Within the 2025 planning year horizon, air pollutants will rise slightly, but will remain below national standards.

NOISE. As a result of the C-470 widening, the existing noise wall that borders Wolhurst on the south would be relocated north to accommodate the new interchange configuration. The widening of Santa Fe Drive, plus the flyover ramp, would result in higher noise levels than the existing or No-Action condition, exceeding CDOT's 66 dBA threshold at two locations in Wolhurst. These are on the south side, where adverse noise effects are currently mitigated with a noise barrier, and the east side, north of Wolhurst Drive. **Section 3.3.3** provides more detail regarding noise effects.

AESTHETICS. The addition of the flyover along Santa Fe Drive would introduce an adverse visual effect to Wolhurst. Construction of a retaining wall along the portion of the flyover that extends north of the community entrance would block views from the community to Santa Fe Drive and the railroad corridor. The wall would also block eastern sunlight entering the community. It would cast shadows to varying degrees depending on the time of year during the morning hours. The combination of travel lanes closer to the community, an elevated structure adjacent to and above the property, and a retaining wall along the northern portion of the flyover structure would create a more urban context to the community than current conditions. These effects are discussed in **Section 3.3.14.2**.

Express Lanes Alternative (Preferred Alternative)

The EL Alternative would have the same design footprint as the GPL Alternative, with a few minor exceptions. These differences in the width and effects to the environment would not be relevant to Wolhurst. The proximity of improvements from the EL Alternative to Wolhurst would be the same as in the GPL Alternative. The difference for the EL Alternative is a function of the express lanes themselves. Because direct access to the express lanes would not be provided at the Santa Fe Drive interchange, eastbound traffic from Wolhurst would turn left from southbound Santa Fe Drive onto the eastbound entrance ramp and enter C-470 in the general purpose lanes. Traffic would then merge into the express lanes at a slip ramp located between the Lucent Boulevard and Broadway interchanges. Westbound Wolhurst traffic in the express lanes would merge out of the express lanes and into the general purpose lanes at a slip ramp between the Broadway and Lucent Boulevard interchanges and then exit at Santa Fe Drive and turn into Wolhurst using the same travel pattern as currently exists. This access configuration would be the same for all traffic entering or exiting the express lanes or general purpose lanes to or from Santa Fe Drive. The benefit provided by the EL Alternative would be the travel time savings for trips made in the express lanes, as these lanes would be less congested than the general purpose lanes.

ROW, air quality, noise, and aesthetic effects to Wolhurst would be the same for the EL Alternative as discussed for the GPL Alternative, since the Santa Fe Drive interchange improvements consist of the same elements for both alternatives. The effects to air quality for both action alternatives would be positive. Because the EL Alternative would require a toll to enter the facility, this could be considered an economic disadvantage to low-income individuals, if they could not afford to pay the tolls. While this was a consideration during the alternatives evaluation, statistics from other toll facilities such as the EL Alternative have demonstrated that individuals from all income levels use the express lanes. While lower-income individuals may not use the facility as frequently as those with higher incomes, this data suggest that the imposition of tolls does not preclude low-income individuals or households from using the facility at times when minimizing traffic delay is of importance.

In summary, no disproportionate impacts to low income and minority populations are anticipated with either the No-Action or the action alternatives.

3.2.2.3 Mitigation

Wolhurst residents have been involved in many of the mitigation discussions. Through an open public involvement program, CDOT has met with community members to discuss effects and mitigation measures. Residents were asked what mitigation measures could make these adverse effects less intrusive on their community.

Noise impact mitigation was one of the most important community issues. This input led to additional noise analysis in this area, including the new residential sites currently under development. Based on the additional analysis, noise

abatement was determined reasonable and feasible for both affected locations. The noise barrier along the southern border of the community would be reconstructed and possibly extended to a maximum height of 20 feet. The northern portion of the flyover ramp would be constructed either with a new retaining wall or with a separate noise wall north of the Wolhurst entrance. The wall type will be determined during final design. This wall would effectively reduce noise levels one to four dBA to levels of 62 to 63 dBA. A detailed discussion of noise effects and mitigation strategies is included in **Section 3.3.3**.

Mitigation for construction impacts such as noise, vibration, and air quality would be similar to those for such impacts in other areas of the corridor where impacts occur. The contractor would be required to monitor noise levels and develop a mitigation plan, such as installing temporary noise barriers; enforcing more restrictive work hours; and limiting weekend work. Attempts would be made to schedule vibration-causing operations during daytime hours. A fugitive particulate emissions control plan would also be required. Additional detail on construction mitigation measures is discussed in **Section 3.3.17.3**.

To improve the aesthetic character, Wolhurst residents expressed interest in trees and other landscaping around their community. Trees, earthen berms, and landscaping elements would be added under and adjacent to the flyover, within the CDOT ROW. The berms would provide additional noise benefit to the southeastern border. A landscape median would also be added to the community entrance to minimize U-turns at this intersection. CDOT would work with the community and property owner to place landscaping elements in aesthetically desirable locations. Additional public involvement opportunities would be offered during final design to allow residents the opportunity to provide input on landscaping elements.

Wolhurst residents also suggested adding aesthetic treatments to the retaining walls on the northern portion of the flyover. Because this wall would serve as the eastern viewshed to the community, an aesthetically pleasing treatment for this structure would improve the appearance of this eastern view. CDOT will work with Wolhurst to enhance the texture and color treatments on the retaining walls and the interior face of the relocated southern noise wall to provide a pleasing view from within the community. Additional public involvement opportunities will be offered during final design so that residents have an opportunity to provide input on the structure treatments.

3.2.2.4 Wolhurst Public Involvement Program

So that Wolhurst residents had ample opportunities to become involved in project planning during the EA process, three community meetings were held at the Wolhurst Clubhouse to disseminate study information, gather input from residents, explain the alternatives under consideration, and discuss effects to Wolhurst. This forum was also used to answer questions and obtain input on mitigation options. A detailed discussion of the public involvement process is located in **Chapter 4**.

3.2.3 Housing and Community Facilities

Schools, housing, and public safety aspects of the project area were analyzed with respect to the three alternatives under consideration. The project area for this evaluation is consistent with the same census block groups as discussed in **Section 3.2.1**.

3.2.3.1 Affected Environment Schools

Thirteen schools (kindergarten through 12th grade) were identified within the project area of which eight are public and five are private. They are located in three school districts: Douglas County Region One (seven schools), Jefferson County R-1 (five schools), and Littleton 6 (one school).

Housing

The year 2000 Decennial Census published by the U.S. Bureau of Census identified 38,647 housing units within the project area, of which 82.4 percent were owner-occupied housing units. This rate of owner-occupancy is slightly lower than that of Arapahoe and Jefferson Counties and slightly higher than that of Douglas County. The percentage of vacant housing units within the project area is slightly lower than in Arapahoe and Douglas Counties, and higher than in Jefferson County. **Table 3-5** shows housing unit data for Arapahoe, Douglas, and Jefferson Counties and for the project area. Growth forecasts show a 37 percent increase in housing units above existing conditions by the year 2025.

Public Safety Services

The project area is served by several fire districts and multiple fire stations. The fire districts are Littleton Fire Rescue, South Metro Fire Rescue, and West Metro Fire/Rescue. The Cities of Littleton and Lone Tree; Arapahoe, Douglas and Jefferson Counties; and the Colorado State Patrol provide law enforcement service within the project area. Littleton and Lone Tree are the only incorporated cities, and they operate their own police departments within their service areas. The City of Centennial contracts police services through the Arapahoe County Sheriff's office. The respective county sheriff departments and Colorado State Patrol serve unincorporated portions of the project area.

The eastern end of the project area is served by Sky Ridge Medical Center. Sky Ridge is a regional medical facility with a hospital providing a level III trauma center and 335 beds. The project area is also served by Littleton Adventist Hospital. Littleton Adventist provides a level II trauma center and 175 beds.

3.2.3.2 Environmental Consequences

The effects evaluation for housing and community facilities includes changes in school attendance areas, growth patterns that would require new school facilities, changes in housing development patterns, and corresponding needs for public safety and facilities.

No-Action Alternative

The No-Action Alternative may shift population growth to areas outside the project area, as traffic congestion on C-470 and local arterial streets increases. Demand for community facilities, services, and housing would follow population growth, meaning that new community facilities may be located outside the immediate project area. However, locations of these resources would generally follow development and land use plans identified by the counties and cities.

Table 3-5
2000 Housing Unit Data

Location	Housing Units						
	Total	Owner Occupied		Renter Occupied		Vacant	
		Number	Percent	Number	Percent	Number	Percent
Arapahoe County	12,781	10,644	83.3	1,600	12.5	537	4.2
Douglas County	17,069	13,555	79.4	2,890	16.9	624	3.7
Jefferson County	8,797	7,666	87.1	982	11.2	149	1.7
Project area	38,647	31,865	82.4	5,472	14.2	1,310	3.4

Source: 2000 U.S. Census

The No-Action Alternative would not alleviate existing and future traffic congestion within the project area. With an expected increase in population, the project area traffic volumes would also increase, which poses problems both economically (employees unable to get to work) and with emergency vehicle response times. School attendance areas would not be expected to change, nor would the need for additional public facilities or services.

General Purpose Lanes Alternative

Effects to community cohesion resulting from the GPL Alternative would be minimal, as most improvements would occur within existing ROW. No new access points would be provided under the GPL Alternative. Access improvements at the Santa Fe Drive interchange would result from a realigned interchange to improve traffic flow. This alternative would not limit nor remove any existing access to C-470.

The GPL Alternative would require little additional ROW, and would have minor effects on adjacent property owners; no residential or business relocations would be required. Future property values are speculative and may be affected by many market factors including proximity to C-470. Increased development opportunities that may arise more quickly as a result of the GPL Alternative would not likely change school attendance areas, or the need for additional schools. This alternative would reduce congestion, and improve access and response times for police, fire, and emergency vehicles, while improving access to and from community facilities such as schools, churches, civic buildings, recreational areas, and retail areas. This alternative would also improve travel time to work for commuters who use C-470. No new public facilities or services are anticipated as a result of the GPL Alternative.

Express Lanes Alternative (Preferred Alternative)

As discussed in **Chapter 2**, the EL Alternative would add tolled express lanes to the existing facility. Because toll fees would be charged only for those traveling in the express lanes, the traveling public would always have the option to travel in the general purpose lanes. ROW effects would be minimal, as most improvements would occur within existing ROW.

The EL Alternative would provide a new access point to C-470 at Colorado Boulevard for the express lanes only. Improved access at the Santa Fe Drive interchange would occur from improvements made to accommodate the additional lanes.

The EL Alternative would require little new ROW, and would have little effect on adjacent property owners. No residential or business relocations would be required. Future property values are speculative and would be affected by many market factors including proximity to C-470. Increased development opportunities that may arise more quickly as a result of the EL Alternative would not likely change school attendance areas, or the need for additional schools. This alternative would reduce congestion and therefore improve access and response times for police, fire, and emergency vehicles; improve access to and from community facilities such as schools, churches, civic buildings, recreational areas, and retail areas.

This alternative would also improve traffic flow in the project area while providing a funding source to offset construction and implementation costs. It would provide a safe, efficient, and convenient travel option. Public safety would also improve, since emergency response times would decrease. No new public facilities or services are anticipated as a result of the EL Alternative.

3.2.3.3 Mitigation

No mitigation measures for housing or community facilities are anticipated to be necessary.

3.2.4 Economics

As with previous analyses, census block group data from the 2000 Census was used to describe economic characteristics of the population living

within the project area. Woods and Poole Economics data was also used for analysis of income and earnings for the project area. In this section, employment and earnings data were compared for the project area population and for the populations of Arapahoe, Douglas, and Jefferson Counties.

Table 3-6 provides 2000 labor force and unemployment data for Arapahoe, Douglas, and Jefferson Counties and for the project area. In 2000 the project area had 56,976 workers (age 16 and over) and 1,330 unemployed workers. The unemployment rate for the project area in 2000 was slightly lower than that of Arapahoe County, twice as high as that of Douglas County, and the same as Jefferson County. Future forecasts indicate that employment is projected to increase 44 percent by 2025.

Table 3-7 shows historic and forecasted total earnings for each county within the study area. All three counties experienced greater earnings growth than population growth, demonstrating that either jobs were created at higher salaries or existing jobs received larger salary increases. The disparity in total earnings by county is evidenced that Douglas County has the lowest total earnings. This is indicative of Douglas County's smaller population base, as compared to Arapahoe and Jefferson Counties. However, it also indicates that a higher proportion of the

Table 3-6
Year 2000 Labor Force and Unemployment Rates

Location	Workers (Age 16 and Over)		Unemployment Rate (%)
	Number	Number of Unemployed	
Project area	56,976	1,330	2.3
Arapahoe County	372,885	8,773	2.4
Douglas County	125,260	1,706	1.4
Jefferson County	409,449	9,546	2.3

Source: 2000 U.S. Census (in $ 2000)

Table 3-7
Total Earnings by County

County	1990	2000	2010	2020
Arapahoe County	$7,656	$18,269	$24,898	$34,376
Douglas County	$510	$2,458	$4,077	$6,330
Jefferson County	$6,808	$10,369	$13,764	$17,576

Source: Woods & Poole Economics (in $ 2000)

Table 3-8
Per Capita Income by County

County	1990	2000	2010	2020
Arapahoe County	$30,712	$45,768	$51,521	$58,355
Douglas County	$31,157	$35,090	$36,021	$41,131
Jefferson County	$26,769	$37,080	$42,423	$47,801

Source: Woods & Poole Economics (in $2000)

population lives in Douglas County and commutes to another location, such as Arapahoe, Jefferson, or other counties. Forecasted earnings show healthy growth for all three counties in the study area.

Purchasing power of the population can be measured in per capita income, as shown in **Table 3-8**. Personal income divided by population equals per capita income. In 2000, Arapahoe County had the highest per capita income, at $45,768, while Douglas County had the lowest, at $35,090. In terms of general income levels this spread is relatively small, which indicates that income within the study area is homogeneous. Income levels are forecasted to climb in all three counties of the study area, with annual growth rates at approximately 1.2 percent per year.

3.2.4.1 Environmental Consequences

No-Action Alternative

The No-Action Alternative would have a negative effect on the local economy within the study area and within Arapahoe, Douglas, and Jefferson Counties. Traffic congestion imposes an unavoidable cost in terms of increased travel time. Travel time evaluation is discussed in more detail in **Section 3.3.1**. With no improvements to C-470, the economic costs of congestion would continue to increase. Congestion costs could affect business location decisions and individual home rental/purchase decisions. As demonstrated in **Tables 3-7** and **3-8**, the study area is forecasted to continue growing in both earnings and per capita income. However, with increased congestion costs, this growth may be concentrated in other, less congested parts of the three county area. With respect to municipal well being, no property would be removed from the tax rolls because no new ROW would be required. Therefore, the tax base would not be affected.

General Purpose Lanes Alternative

The overall economic effect of implementing the GPL Alternative would be positive with respect to municipal health and the local economy. The GPL Alternative would require some additional ROW. Property acquisitions would include 16.68 acres that would be removed from the tax rolls, resulting in a minor effect on the tax base of local jurisdictions. However, no business or residential relocations would be necessary. During project construction, Arapahoe, Douglas, and Jefferson Counties would have an increase in construction employment and local purchases of construction materials. As construction dollars are spent locally, there would be a beneficial effect on local economic output, income, and employment in the area.

With added capacity, congestion costs would decrease in response to a decrease in travel time for the corridor. Because the demographic composition of the study area and the surrounding counties as a whole is relatively homogeneous, and the additional capacity is provided for all users, decisions concerning business or choice of residential location would not be negatively affected. Increased capacity could also have the effect of advancing existing development plans and promoting economic development at a higher rate than if no improvements were made to the corridor. Retail health would be positively affected for businesses within the study area, as additional capacity would provide congestion relief for shoppers with destinations in the area. Because no access restrictions exist for the GPL Alternative, all three counties within the study area would receive equal economic benefit from the additional capacity.

This alternative would have short-term effects to access near the proposed construction locations. Vehicular, pedestrian, and bicycle access would be affected during the construction period, which could change shopping patterns in areas where construction activity makes business access more difficult. Roadway construction, however, would be conducted in such a way as to minimize travel delay, and access to and from area businesses would be maintained. Temporary construction effects are discussed in **Section 3.3.17.**

Express Lanes Alternative (Preferred Alternative)

The economic effects of implementing the EL Alternative would also be positive with regard to the local economy and municipal health. The EL Alternative would require some additional ROW. Private property acquisitions would include approximately 20 acres that would be removed from the tax rolls, resulting in a minor effect to the tax base of local jurisdictions. However, no business or residential relocations would be necessary. During project construction, Arapahoe, Douglas, and Jefferson Counties would have an increase in construction employment and local purchases of construction materials. As construction dollars are spent locally, this alternative would result in a beneficial effect on local economic output, income, and employment in the area.

Added capacity in the express lanes would allow commuters to choose the physical time cost associated with congestion or pay a toll to avoid congestion. Because the demographic composition of the study area and the three county area as a whole is relatively homogeneous with regard to per capita income, this suggests that a toll facility would not appreciably alter decisions concerning business or choice of residential location within the three county area or Denver. Retail health would be positively affected for businesses within the study area, as congestion relief would provide shoppers a less congested alternative to travel to shopping destinations in the area. Because express lane access is provided to all three counties within the study area in response to forecasted travel demand, no one part of the study area would receive more or less economic benefit from access to the additional capacity. Additional information with regard to economic effects of the EL Alternative can be found in *Economic Analysis for Express Lanes on C-470* (July 2005).

This alternative would have short-term effects to access near the proposed construction locations. Vehicular, pedestrian, and bicycle access would be temporarily affected during the construction period, which could change shopping patterns in areas where construction activity makes business access more difficult. Roadway construction would, however, be conducted in such a way as to minimize travel delay, and access to and from area businesses would be maintained.

Once the capital construction cost of this alternative is paid back, tolls from express lane users would continue to be collected. These revenues would be used to pay for continuous operation and maintenance of the express lanes, and possibly to pay for upgrades or expansion of the express lanes on C-470.

3.2.4.2 Mitigation

No mitigation measures are anticipated for permanent effects. Temporary negative effects from construction activities would be mitigated by maintaining access or providing a temporary or alternative access to area businesses during construction. In addition, roadway construction would be conducted in such a way as to minimize travel delay. See **Section 3.3.17.3**, which describes mitigation for construction effects.

3.2.5 Land Use

Land uses along C-470 generally consist of residential, recreational, commercial and office uses. Because much of the development along C-470 has occurred immediately before or after highway construction, development has evolved to accommodate the highway, allowing adequate buffers between the highway and residential or commercial structures. The land use evaluation for this EA is based on a review of existing and projected land use and an assessment of potential sensitivity to changes in land uses in areas affected by the alternatives, including:

- Consistency or compliance with existing land use plans or policies
- Preclusion of the viability of existing land use

- Preclusion of continued use or occupation of an area

- Compatibility with adjacent land use to the extent that public health or safety is threatened

3.2.5.1 Existing and Future Land Use

Land use descriptions are codified in local zoning laws and are within the purview of local jurisdictions within the C-470 project area. A variety of land uses exist within each local jurisdiction and are represented by the categories of residential, commercial, industrial, agricultural, institutional, and recreational. Eight agencies have land use jurisdictional responsibilities within project area: Douglas County, Lone Tree, Littleton, Centennial, Arapahoe County, and Jefferson County, Colorado Department of Parks and Recreation, and the U.S. Army Corps of Engineers (USACE). These agencies were integral in the land use evaluation. Local master or comprehensive plans, specific site plans, zoning maps, and regulations for each participating jurisdiction were referenced in the land use evaluation and growth projections for the area. In particular, the following documents, along with field review, were used to review and refine the Denver Regional Council of Governments (DRCOG) 2025 socio economic data and local land use information utilized in this evaluation:

- *Denver Regional Council of Governments 2025 Fiscally Constrained Regional Transportation Plan* (April 2002)

- *Douglas County 2020 Transportation Plan* (April 2004)

- *US 85 Access Management Plan, South I-25 Corridor and US 85 Corridor Environmental Impact Statement* (March 2001)

- *County Line Road, I-25 to Santa Fe Drive EA and Section 4(f) Evaluation* (1998)

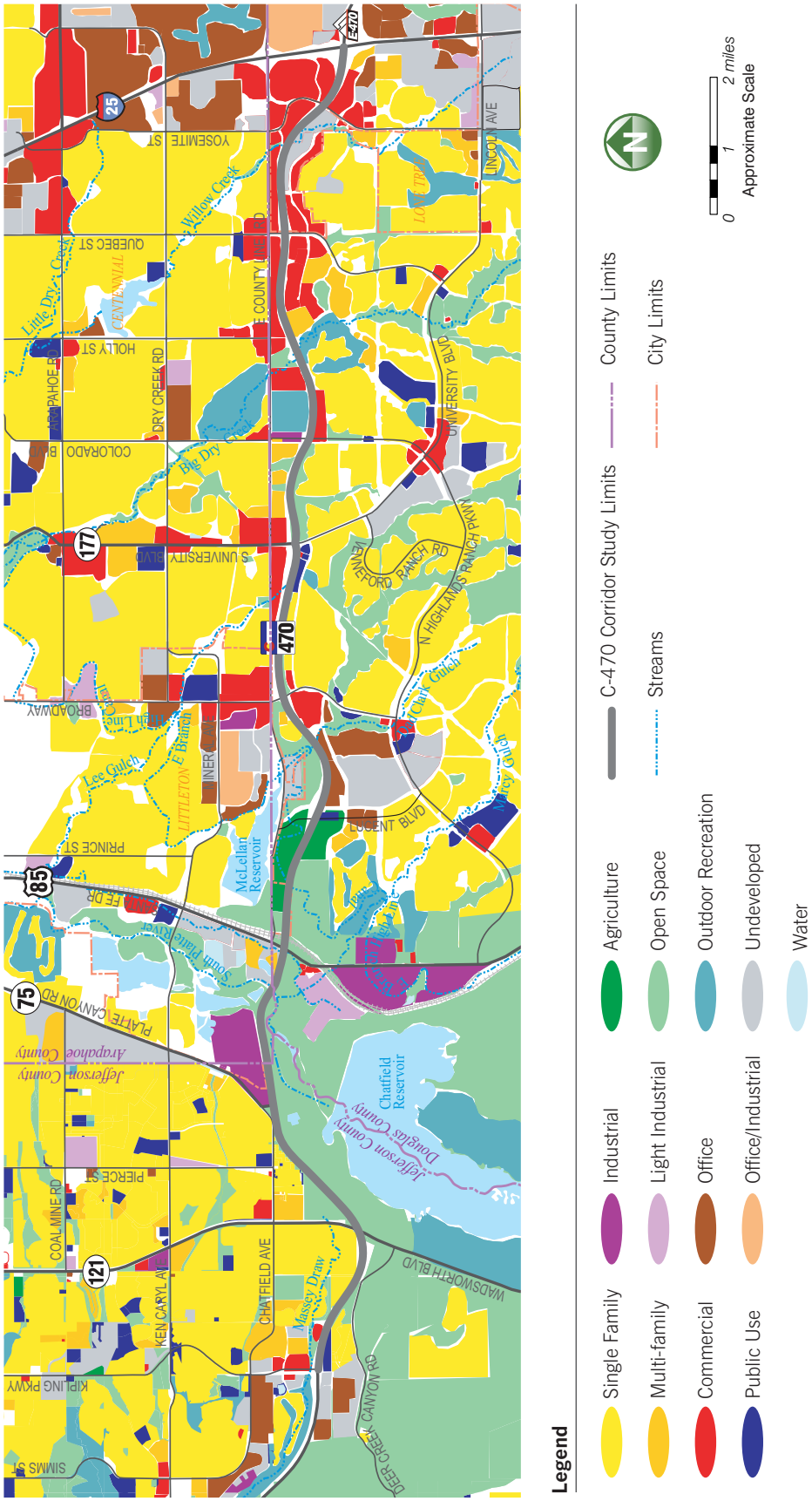
- *Douglas County Capital Improvement Projects* (2004)

Much of the C-470 project area has experienced significant growth over the last twenty years. Based on the DRCOG socio economic data, local jurisdictional input and local land use assessment, the corridor is expected to see some additional growth in the coming years. The majority of this growth, however, is anticipated to occur over the next ten to fifteen years, slowing before the year 2025. So while the level of planned future growth is substantial, it is not expected to continue indefinitely over the next twenty years. **Figure 3-5** shows the land uses for jurisdictions in the project area.

The review of C-470 corridor existing land use indicates that the majority of this growth has occurred south of C-470 in the Lone Tree, Highlands Ranch and Douglas County areas, along with pockets of new development west of Santa Fe Drive along the corridor. The highest-intensity land uses are located closer to the I-25 corridor between Lincoln Avenue and County Line Road, east of Quebec Street. The Denver Technological Center (DTC) area along I-25 north of C-470 is roughly 60 percent completed, and the Meridian office park south of the DTC at Lincoln and I-25 is just over 30 percent completed. East of I-25, outside the project area, significant office and residential development continues, especially east on Lincoln Avenue toward the town of Parker.

Lone Tree, located west of I-25 and south of C-470, has undergone substantial residential and retail growth in and around the Park Meadows retail and entertainment district, located south of Park Meadows mall along Yosemite Street. The commercial densification in the entertainment district is anticipated to continue in the short term, along with the build out of single-family residential use in the area. The Ridgegate development, also located in Lone Tree, south of Lincoln Avenue is expected to continue growing over the next 40 years. As a planned unit development, the land uses and future development

Figure 3-5
Existing Land Use



patterns for Ridgegate have already been determined. While the I-25 Corridor and Lone Tree have the highest potential for growth in the project area, this growth has been accounted for with additional highway and transit capacity currently under construction or in the planning stages.

The Highlands Ranch development, located in northern Douglas County bordering C-470 west of Lone Tree, is approximately 80 percent completed, with the remaining residential and retail/office growth projected to occur by 2010. Highlands Ranch is also a planned unit development, with the future development patterns determined. The dispersed land use patterns in this suburban area reflect a low-density mix of residential development, with pockets of commercial and office use at major arterial intersections. Full development is anticipated to occur over the next ten to fifteen years.

The communities north of C-470 and to the west of Santa Fe are generally older and more established and are now undergoing some infill or redevelopment. With the exception of the DTC, Littleton, Centennial, and Greenwood Village are nearing build-out and are now experiencing a turnover in housing stock or retail/commercial uses, typically of slightly higher density.

The Santa Fe Drive corridor north of C-470 in the City of Littleton is part of a specific redevelopment plan to increase mixed-use development and create stronger connections between land uses and the existing Southwest Corridor light rail service.

Other land uses in the area are comprised of public property such as Chatfield State Park, owned by the USACE and operated by Colorado State Parks. The USACE constructed the Chatfield Reservoir to control flooding in the South Platte River basin. The USACE leases the land surrounding the reservoir to Colorado State Parks, which operates the Chatfield State Park Recreation Area. Denver Water uses its own water rights to fill and maintain water volumes in the reservoir, manage the water supply for municipal needs, and maintain sufficient water levels for recreational purposes. Chatfield State Park also includes camping, a full-service livery, hiking and biking trails, the Chatfield marina, and a hot-air balloon launch area.

3.2.5.2 Environmental Consequences

No-Action Alternative

The No-Action Alternative would be consistent with both existing and future local land uses within the C-470 project area. Because this alternative would not result in any ROW acquisition or change the access to and from C-470, it would not require a direct change in land use plans, zoning, or land use types within the project area.

Ultimately, changes in land use are guided by zoning of local governments. Local governments should consider the community's transportation and infrastructure needs and the impacts of the land use on the existing transportation infrastructure. The No-Action Alternative could shift projected development and population growth to areas outside of the project area. However, as traffic congestion on C-470 increases, local arterial congestion will also increase. Ease of access to land uses along these local arterials could be indirectly affected by increased congestion and increased travel time. As such, the No-Action Alternative could potentially reduce the viability of land for commercial or new home development and subsequently impact the timing of land development decisions and growth patterns. Indirectly, these factors may result in future modifications to land use or re-zonings by local jurisdictions in accordance with market demand.

General Purpose Lanes Alternative

The GPL Alternative would not affect changes to existing land use patterns, particularly for land that is already developed. However, it may provide opportunities for development to occur more quickly due decreased congestion. The highway improvements support current local land use objectives for property adjacent to C-470 and are consistent with long-range plans

to increase travel capacity and provide access to existing development. Because the GPL Alternative would occur largely within the CDOT ROW, it would not require changes in local agency zoning codes or site-specific zoning.

Modifications in land uses adjacent to C-470, while not required by the GPL Alternative, are within the purview of local land use agencies. As discussed in **Section 3.2.4**, the economic benefits of decreased travel times associated with the GPL Alternative may provide better market conditions through improved transportation access, and provide opportunity for development to occur more quickly within the project area than it would under the No-Action Alternative. Local development plans can be influenced by better transportation access and different market conditions. Minor variations in land use development could include higher or lower densities or different mix of uses. As such, while much of the project area is expected to reach build-out over the next 10 to 15 years, the GPL Alternative improvements may support build-out quicker than the No-Action Alternative, possibly as soon as seven to ten years from now.

These effects on land use could mean that local jurisdictions find opportunities to accommodate higher-intensity uses, or increase the density of existing uses at certain high-demand locations. For example, Douglas County or the City of Littleton's development plans at Santa Fe Drive and C-470 could reflect higher density uses not only at this site but also further north and south along Santa Fe Drive, once increased capacity and accessibility to C-470 are realized at this interchange. While transportation improvements at the Santa Fe Drive interchange may effect development decisions to promote higher density development along the Santa Fe Corridor, this redevelopment is already happening in response to the success of the existing Southwest LRT Corridor. Future expansion of this LRT line into Douglas County, with a potential station near C-470 and Lucent Boulevard, as proposed in RTD's FasTracks Plan would provide an intermodal link between Douglas County and northern portions of the Santa Fe Corridor. Land use density, intensity or pace of development could also occur along the I-25 Corridor, Lone Tree, and Highlands Ranch.

The GPL Alternative improvements would not require the conversion of land use types or the displacement of existing land uses or structures along C-470. All partial ROW acquisitions are unimproved portions of already developed land. However, the properties are zoned for particular uses. While the partial acquisitions would not result in an actual change in existing use, it would result in a direct effect on the existing zoned use of the parcel and its allowable future use.

Temporary construction effects to land use may include changes in access and route alignments for recreational facilities. In addition, construction effects may include temporary adverse noise effects. Access to the Chatfield State Park Recreational Area would be maintained.

Express Lanes Alternative (Preferred Alternative)

The EL Alternative would not affect changes to existing land use patterns, particularly for land that is already developed. This alternative supports current local agency land use objectives for property adjacent to C-470 and is consistent with local agency interests and long-range plans to increase travel capacity and access to local land use. As with the GPL Alternative, the EL Alternative would occur largely within CDOT ROW and would require no changes in local agency zoning codes.

Modifications in land uses adjacent to C-470, while not required by the EL Alternative, are within the purview of the local land use agencies. Local development plans can change and be influenced by better transportation access and different market conditions. While some areas can expect minor variations that could include higher or lower densities or a

slightly different mix of uses, the overall land use patterns are not expected to change from the existing, planned uses. As with the GPL Alternative, the EL Alternative improvements may provide better market conditions through improved transportation access, and provide opportunity for development to occur more quickly within the project area than it would under the No-Action Alternative. The EL Alternative improvements may support development completion in as few as seven to 10 years.

The effects of the EL Alternative on land use are similar to those for the GPL Alternative for all four of the areas containing undeveloped land within the project area, including the I-25 Corridor, Lone Tree, Highlands Ranch, and the Santa Fe Drive Corridor. However, implementation of the EL Alternative would result in redirecting traffic to locations where express lane access to C-470 is provided, specifically at Kipling Parkway, Wadsworth Boulevard, Lucent Boulevard, and Colorado Boulevard. This could mean that local jurisdictions would find opportunities to modify zoning, accommodate higher intensity uses, or increase the density of existing uses at these locations.

The EL Alternative improvements would neither require the conversion of land use types nor the displacement of general land uses. All partial ROW acquisitions are currently vacant and contain no structures or active uses. However, the properties are zoned for particular uses - commercial, residential, or other. While the taking of a portion of the parcel would not result in an actual change in use, it would result in a direct effect on the existing zoned use of the parcel and its allowable future use.

Temporary construction effects to land use would be the same as for the GPL Alternative.

3.2.5.3 Mitigation

No mitigation measures are anticipated for permanent effects. Temporary construction effects to land use would be mitigated with the use of alternative and temporary access to existing development and the use of clear detour signing for trails. Other construction mitigation measures are described in **Section 3.3.17.3**.

Since local governments are responsible for approving changes to local zoning, it is imperative that land use and rezoning decisions made at the local level take into consideration the effect to the adjacent transportation system.

3.2.6 Parks & Recreation

The C-470 Corridor provides access to many popular parks and recreation areas within and beyond the project area. These include several neighborhood parks, Chatfield State Park, South Platte Park, Bear Creek Lake Park in Lakewood, and other recreation opportunities in the foothills to the west of the project area.

3.2.6.1 Affected Environment

Outdoor recreation is a popular activity in the Denver area. As a result, numerous recreation areas exist along the C-470 Corridor within the project area to support the growing population base. Governmental agencies, private citizens, and local organizations have made concerted efforts to preserve and improve existing recreational opportunities and plan for future opportunities. Existing parks and recreation facilities include state and local parks, trails, community swimming pools, and golf courses. There are also open space properties that exist within the project area, but are not open to public recreation. For the purposes of this analysis of parks and recreation areas, only those areas within and adjacent to the project area have been reviewed. These are listed in **Table 3-9** and shown in **Figure 3-6**.

3.2.6.2 Environmental Consequences

Minor effects to parks and recreational resources are anticipated as a result of the action alternatives under consideration. These effects include higher noise levels, changes to vehicle access, and changes to view sheds from recreation areas. In addition to the effects discussion in this section, noise and visual effects are also

discussed in **Sections 3.3.3** and **3.3.14**, respectively. The likelihood of adverse effects is evaluated based on the proximity of the roadway to the parks and recreational resources. Correspondence and other documentation related to parks and recreational effects are included in **Appendix B**.

No-Action Alternative

The No-Action Alternative would have no direct effects to recreational areas within the project area. With increased traffic and congestion on C-470, recreation areas within and adjacent to the project area would be indirectly affected by increased noise levels. Access to and from these parks and recreation areas would also become more difficult as a result of increased delay from congested conditions on C-470 and the surrounding arterial street network.

General Purpose Lanes Alternative

Due to the highway's close proximity to some of the parks and recreational resources in the project area, additional direct and indirect effects from the GPL Alternative are likely, as described in the following sections.

CHATFIELD STATE PARK. Noise levels at the northern perimeter of Chatfield State Park would increase as a result of the GPL Alternative. Five active use locations in the park were evaluated. Noise modeling

Table 3-9
Recreation Resources Within or Adjacent to the Project Area

Resource Name	Recreation Use
Meadows Golf Course	Private golf course
Deer Creek Park & Pool	Public pool
Wingate South Park	Public park
Centennial Reservoir*	Drinking water source and recreation area
Chatfield State Park	State park and recreation area
South Platte Park	Public park and natural area
Mission Viejo Buffer/High Line Canal Trailhead	Open space/trailhead
High Line Canal Trail	Recreational trail
Links Golf Course	Private golf course
David A. Lorenz Regional Park	Public park

** This is the current site of the Kiewit gravel pits. Future use as a water supply reservoir and passive recreation is planned by Centennial Water and South Suburban Parks and Recreation District*

Table 3-10
Noise Level Evaluation at Chatfield State Park

Location	Impact Threshold (dBA)	Existing/No-Action Noise Level (dBA)	GPL Alternative Noise Level (dBA)	EL Alternative Noise Level (dBA)
USACE offices east of Wadsworth	71	70/71	73*	74*
Picnic area at dam	66	58/59	61	62
C-470 trail at closest location to highway	66	70/71	74*	74*
Interpretive off-leash area	66	59/60	62	62
Park permit office	71	64/65	68	68

** These locations exceed CDOT's noise abatement criteria*

Figure 3-6
Parks and Recreation Resources

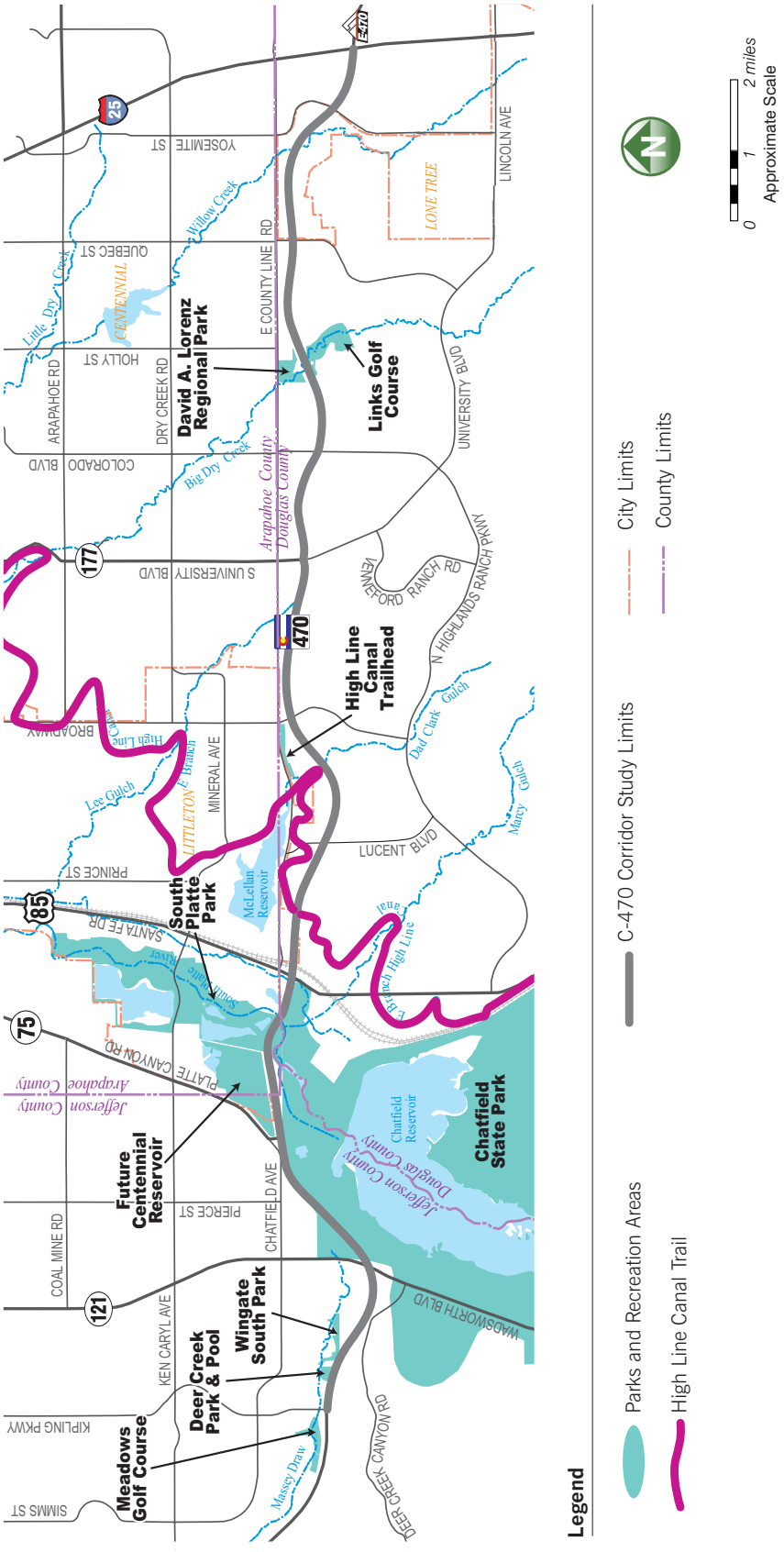
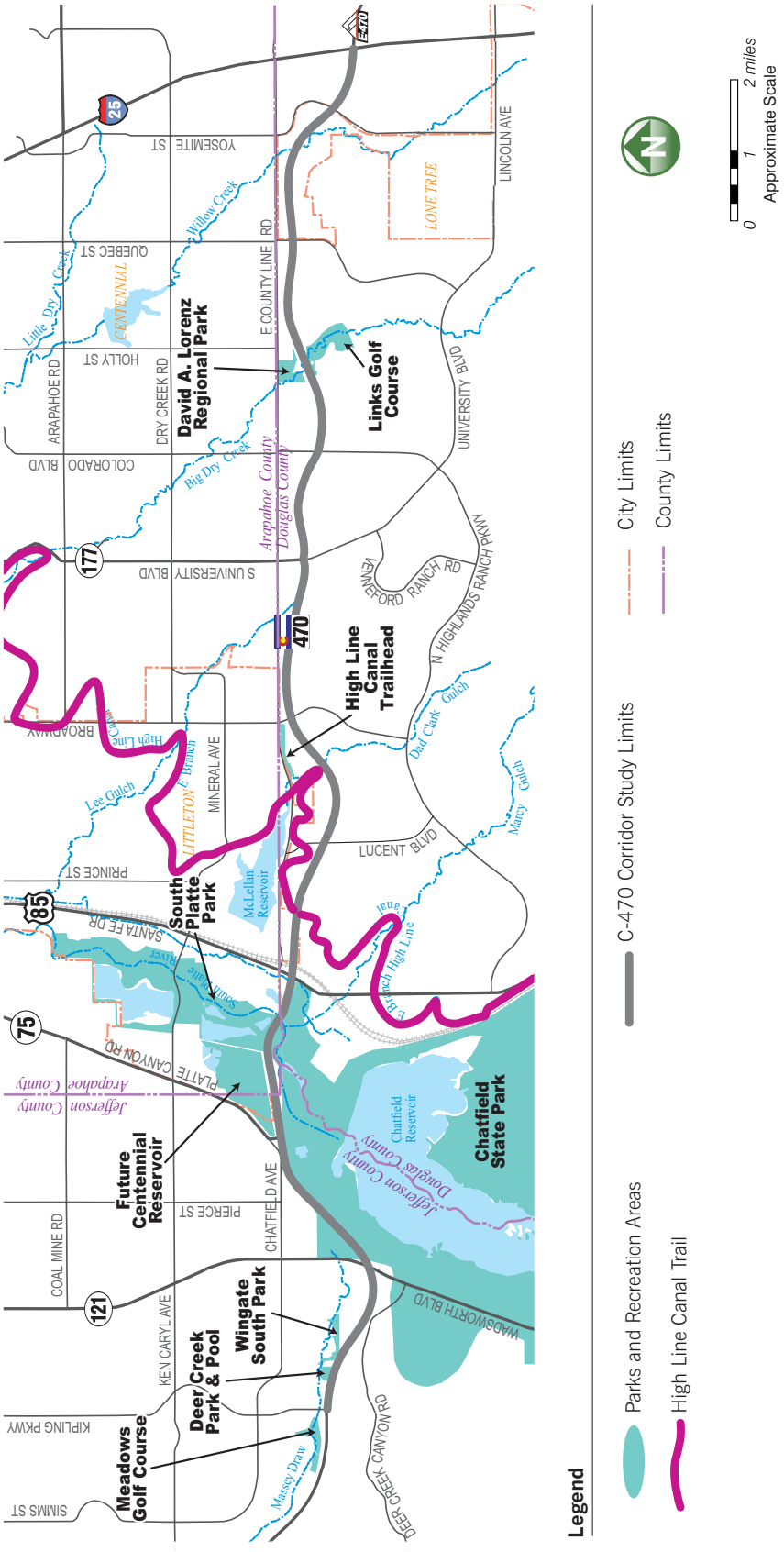


Figure 3-6
Parks and Recreation Resources



indicated that the noise levels at these locations would increase between two and five decibels over the No-Action Alternative, as shown in **Table 3-10**. Two of the locations evaluated are projected to have higher noise levels than the established impact threshold, based on CDOT noise abatement criteria. These locations include the USACE office buildings east of Wadsworth Boulevard and a portion of the C-470 trail. Therefore, in accordance with *CDOT Noise Analysis and Abatement Guidelines*, these locations would be considered for mitigation. Additional detail on noise analysis is discussed in **Section 3.3.3**.

Improvements to the Santa Fe Drive interchange require the closure of the southbound right-in right-out access from Santa Fe Drive to the Chatfield State Park permit office located in the southwest quadrant of the interchange. This existing access currently requires a sharp right hand turn into the driveway to the park permit office, and must be closed due to proximity to the new interchange. The signalized Blakeland Drive intersection would operate better due to increased capacity at the Santa Fe Drive interchange. This would result in better operational access to the permit office. The Blakeland Drive intersection would improve from a level of service (LOS) E to C in the PM peak hour, while the AM peak hour operations would remain the same at LOS C.

The addition of four retaining walls along portions of the northern and eastern perimeter of the park would alter the views from inside Chatfield State Park looking out. An example of one of these walls is shown in **Figure 3-31**. These walls would be most closely visible from the park permit office in the southwest quadrant of the Santa Fe Drive interchange and from bicyclists and pedestrians traveling on the C-470 trail that passes through Chatfield State Park parallel to C-470.

HIGH LINE CANAL TRAIL. The High Line Canal trail runs coincident with the C-470 trail from the point at which it crosses under C-470 east of Santa Fe Drive to the trailhead on County Line Road, west of Broadway. Due to the widening of the roadway, the box culvert through which the High Line Canal trail passes under C-470 would have to be lengthened as a result of this alternative. This action would not alter the trail itself. However, the distance the trail would be covered under C-470 would increase. Construction activity at this location would require a temporary detour around the work site.

LINKS GOLF COURSE. The GPL Alternative design requires acquisition of 0.16 acre of the private Links Golf Course property for additional right-of-way to construct a water quality pond. Water quality ponds are necessary part of the roadway design to help filter pollutants from stormwater runoff before the water flows into nearby waterways. The function of these ponds is discussed in more detail in **Section 3.3.4**.

Express Lanes Alternative

The EL Alternative would have the same impacts to recreational properties as those described for the GPL Alternative, with a few minor exceptions. As shown in **Table 3-10**, the EL Alternative would result in slightly higher noise levels at the interpretive off-leash area and on the C-470 trail in Chatfield State Park. The culvert extension for the High Line Canal would likely be longer for the EL Alternative, due to the slightly wider typical section through this area of the Corridor. The EL Alternative would require acquisition of 0.03 acre more of the private Links Golf Course property than the GPL Alternative.

3.2.6.3 Mitigation

Of the area within Chatfield State Park that is directly adjacent to C-470, the only fixed use facility that would experience noise impacts would be portions of the bike/pedestrian trail. In determining mitigation feasibility and reason-

ableness, several factors are considered in CDOT's procedures. Overall, while mitigation measures could be constructed that provide a substantial noise reduction on the trail, the total cost of those mitigation measures would be very high when compared to the overall benefit that would be provided. This is primarily due to the fact that the use of the trail is intermittent and that there are no fixed facilities along the trail, such as picnic areas. As a result, noise mitigation is not reasonable for the bike trail and is not recommended. The USACE offices east of Wadsworth Boulevard are commercial use facilities and do not have any active outdoor use areas. Thus mitigation of this location is not considered reasonable and is not recommended.

While the right-in, right-out access to the Chatfield State Park permit office would be eliminated with both action alternatives, the operational improvements at the Blakeland Drive intersection would provide better access from all directions. Therefore, no mitigation measures are recommended.

Construction activity near the High Line Canal trail would require temporary detour routes. A minimum two-week notice would be provided, and detour routes would be posted and presented to trail user groups to keep them informed of the construction activity as it relates to the High Line Canal trail. The trail would remain open during construction.

Right-of-way acquisition at the Links Golf Course would be conducted in accordance with the *Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970*. This law is discussed further in **Section 3.2.7**. CDOT would coordinate with golf course owners during final design to further avoid and minimize necessary acquisition.

3.2.7 Right-of-Way and Relocations

ROW is the land on which a highway is constructed and includes ramps, medians, shoulders, drainage ditches, and adjacent land interests owned for highway-related purposes.

All highway elements must be located within state-owned ROW or other property under easement or leased to the state. All land necessary for highway improvements must be purchased from existing property owners in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646), as amended, and the Uniform Relocation Act Amendments of 1987 (Public Law 100-17), hereinafter referred to as the Uniform Act.

The law is designed to ensure just compensation for all acquired properties and to minimize effects on property owners and tenants. Acquisition costs are based on fair market value appraisals of the parcels required to accommodate final design limits. Additional information regarding C-470 ROW is located in *Right-of-Way and Relocations* (July 2005).

3.2.7.1 Affected Environment

The existing C-470 ROW is generally 300 feet wide along the mainline and varies at interchanges to accommodate the wider footprint. This entire ROW is owned by CDOT, with the exception of the section from Wadsworth Boulevard to Santa Fe Drive. In this section, C-470 crosses property owned by the USACE under an easement granted to CDOT for the specific purpose of transportation use.

The easement on USACE property is approximately 300 feet wide, totaling 124 acres. The easement allows use of the property for transportation and requires approval of all activity and any proposed changes. As long as the transportation improvements stay completely within the easement, no amendment to the easement is required. However, if additional property is required, or if the activity within the easement is substantially different than the original easement, an amendment would be required. The USACE has full jurisdiction in determining whether an amendment to the easement is necessary.

3.2.7.2 Environmental Consequences

Based on conceptual design, the analysis completed for this EA estimated the necessary ROW acquisition for each of the alternatives under consideration, as shown in **Appendix D**. The evaluation identified potentially affected parcels. Property owners and tenants were notified of these potential effects to allow them to be involved during project planning. This process was followed to determine whether any encumbrances or liabilities might exist on potentially affected property, which could have an effect on the development or selection of an alternative. Through this ROW evaluation, design decisions were made that avoided and minimized adverse effects to adjacent parcels, thereby reducing the amount of additional ROW acquisition required.

No-Action Alternative

The No-Action Alternative would require no ROW acquisitions or modifications to USACE easement.

General Purpose Lanes Alternative

Partial acquisition of 49 parcels would be required for the GPL Alternative. The total area of these acquisitions would be 16.68 acres. These acquisitions are needed for roadway widening, water quality ponds, drainage ditches, culvert extensions, ramp reconstruction, trail reconstruction, and the Santa Fe Drive interchange improvements. The affected parcels consist of five land use types: government, residential, commercial, agricultural, and undeveloped land. No residential or commercial structure relocations would be required. These potential acquisitions are unimproved portions of already-developed land. In some cases the potential acquisitions would include parking spaces or landscaping along the highway. Individually, these acquisitions would range from less than one tenth of an acre to approximately two acres. **Table 3-11** summarizes the ROW impacts for the GPL Alternative. The "unknown" land use classification refers to parcels that did not have a land use specified in the county parcel information used for this analysis.

Express Lanes Alternative (Preferred Alternative)

Partial acquisition of 55 parcels would be required for the EL Alternative. The total area of these acquisitions would be 20.25 acres. These acquisitions are needed for roadway widening and to construct and maintain water quality ponds, drainage ditches, and culvert extensions, ramp reconstruction, trail reconstruction, the Santa Fe Drive interchange improvements, and direct express lane access at Colorado Boulevard and Quebec Street. The affected parcels consist of five land use types: government, residential, commercial, agricultural, and undeveloped land. No residential or commercial structure reloca-

Table 3-11
General Purpose Lanes Alternative
Affected Right-of-Way Summary

Land Use Type	Affected Parcels	Affected Owners
Government	13	4
Residential	5	3
Commercial	14	12
Agricultural	3	3
Undeveloped	6	5
Unknown	8	8
Total	49	35

Table 3-12
Express Lanes Alternative
Affected Right-of-Way Summary

Land Use Type	Affected Parcels	Affected Owners
Government	15	4
Residential	6	4
Commercial	16	14
Agricultural	3	3
Undeveloped	6	5
Unknown	9	9
Total	55	39

tions would be required. These acquisitions are unimproved portions of already developed land. In some cases the potential acquisitions would include parking spaces or landscaping along the highway. Individually, these acquisitions range from less than one tenth of an acre to approximately two acres. **Table 3-12** summarizes the ROW impacts for the EL Alternative. The "unknown" land use classification refers to parcels that did not have a land use specified in the county parcel information used for this analysis.

3.2.7.3 Mitigation

Mitigation for the GPL and EL Alternatives would consist of avoiding and minimizing ROW acquisitions. Property owners would be compensated for the value of the land acquired through the ROW acquisition process.

During the concept design process, efforts were made to avoid and minimize ROW effects. This was accomplished by investigating the optimal horizontal and vertical alignment, and by incorporating retaining walls, curbs, barriers, and steeper side-slopes and back-slopes into the design to limit the required ROW width.

Upon identifying potential ROW acquisition, affected property owners and tenants were invited to attend public open house meetings. Owners and tenants were informed of the potential effects to their properties and were given the opportunity to comment on the alternatives under consideration. CDOT ROW staff was available to answer questions about the property acquisition process and their rights under the Uniform Act. All property acquisition would be conducted in compliance with the Uniform Act. CDOT will continue to work with affected property owners through final design to further avoid and minimize the need for ROW acquisition. Adequate lead time for the ROW acquisition process will be planned and programmed into the study schedule. CDOT will allow adequate time to accomplish the steps necessary to negotiate the purchase of the required property needed to build the project.

3.3 PHYSICAL ENVIRONMENT

The physical environment of the C-470 project area includes the non-living features of the environment that can be affected by transportation projects. Effects to the physical environment evaluated in this EA include transportation and traffic; air quality; noise; water quality; hydrology and hydraulics; floodplains; historic resources; Section 4(f) properties; archaeological resources; paleontological resources; geology and soils; hazardous materials; visual character; and utilities. The C-470 trail and temporary effects during construction were also evaluated with respect to the three alternatives.

3.3.1 Transportation and Traffic

The C-470 mainline, ramps, arterial street network, and the C-470 trail, compose the multimodal C-470 transportation corridor. This section addresses the existing and forecasted future traffic volumes and operations of these elements of the transportation system.

Traffic forecasts were performed using the 2025 DRCOG travel demand model. Traffic, circulation, and safety aspects of the three alternatives were evaluated using a traffic micro-simulation model. Potential capacity improvements to the C-470 mainline were evaluated with respect to their potential to affect the ramp terminal intersections and other arterial streets. As more traffic is accommodated by mainline C-470, the potential exists to increase traffic on the arterial street system.

In the interest of conserving space in the document, much of the analysis and data is summarized in this section. Detailed methodologies, analysis, data, and conclusions can be found in the *Alternatives Screening Technical Report* (March 2005).

3.3.1.1 Existing Traffic Volumes and Operations

During 2003, weekday AM and PM peak hour traffic counts were collected on C-470 and intersecting arterial streets in the project area. The

Figure 3-7a
Existing (2003) Traffic Volumes

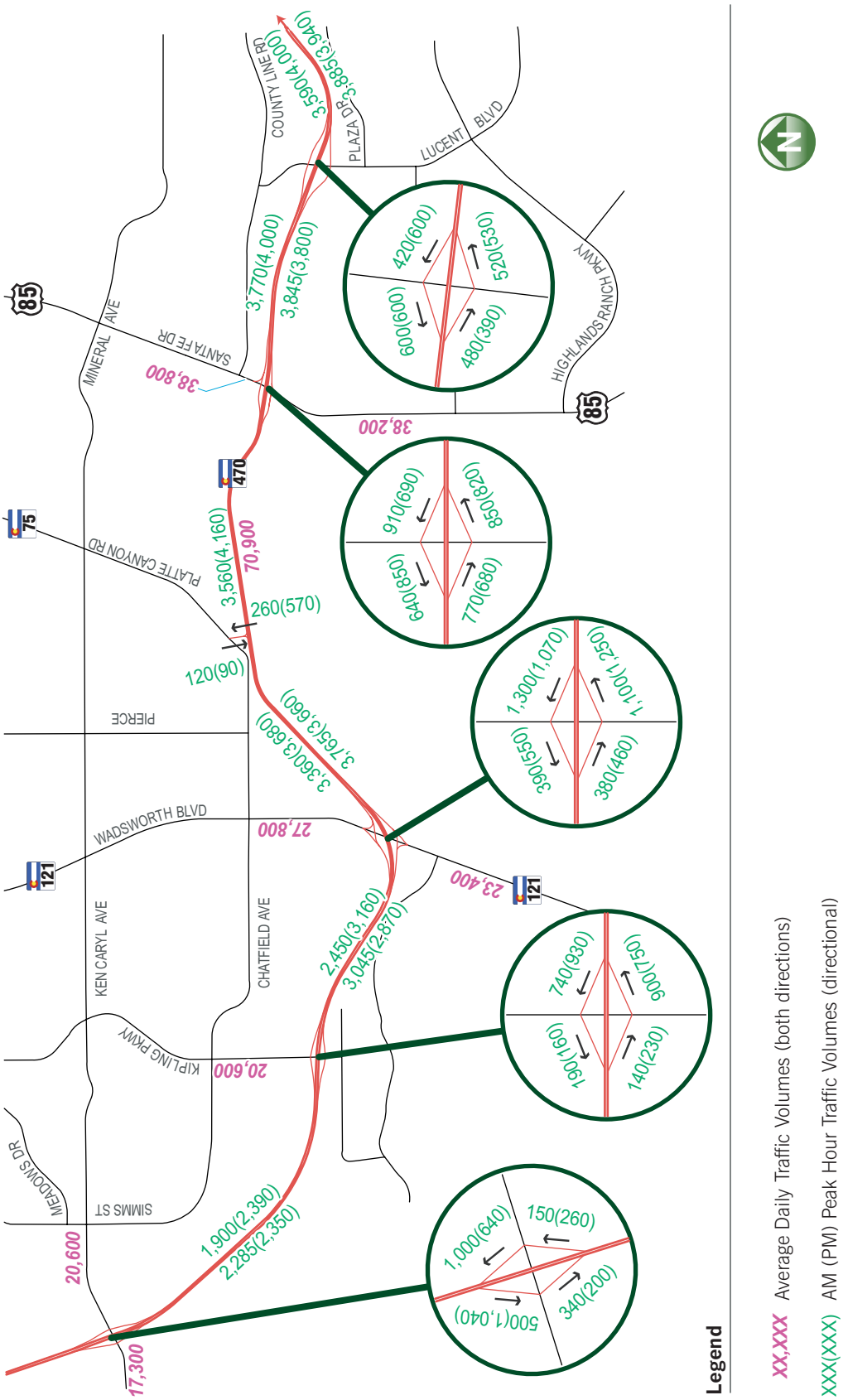
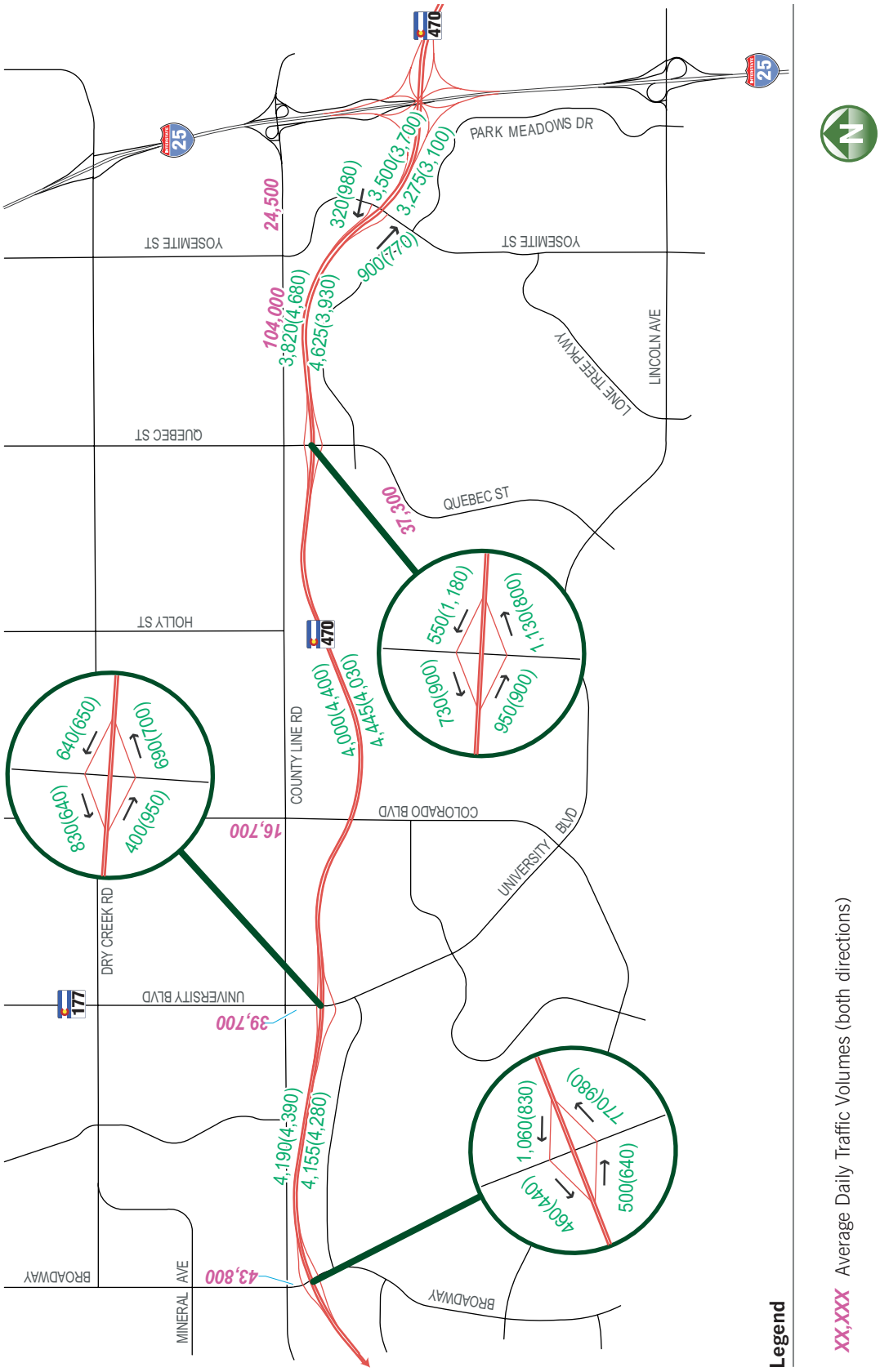


Figure 3-7b
Existing (2003) Traffic Volumes



existing count volumes are shown on **Figures 3-7a** and **3-7b**.

Daily traffic volumes on C-470 range from approximately 60,000 vehicles per day east of Kipling Parkway to 104,000 vehicles per day west of Yosemite Street. The predominant traffic volumes are observed traveling eastbound during the morning peak hour and westbound during the evening peak hour.

Travelers on C-470 currently experience congestion and delay during peak travel periods. Travel times are unreliable as they can vary greatly throughout the day and from day to day. These conditions form the basis for this study's purpose and need, as discussed in **Chapter 1** of this EA. The following sections describe the traffic characteristics that contribute to the congestion, delay, and reliability problems on C-470.

Existing traffic operations were analyzed to characterize the level of current deficiencies on C-470 and to provide a baseline for assessing future traffic operations. The operations analyzed include freeway, interchange, and intersection level of service (LOS).

Freeway

Freeway traffic operations are expressed in terms LOS, as defined by the *2000 Highway Capacity Manual* (HCM). Operational LOS is a congestion measure used to describe service quality and is related to the density of the traffic stream. Free-flow conditions with no restrictions are described as LOS A. LOS B through D conditions demonstrate progressively worse traffic conditions. LOS F represents a breakdown in traffic flow, characterized by the familiar traffic jam.

The entire section of C-470 between Wadsworth Boulevard and I-25 generally operates at LOS E/F in both directions during the AM and PM peak hours. However, from Ken Caryl Avenue to Wadsworth Boulevard, C-470 generally operates at LOS C or better during the peak hours.

Given the high level of congestion during peak hours, and increasingly during off-peak hours as well, traffic flow conditions frequently break down to LOS F conditions.

Interchanges and Arterial Intersections

Interchange ramp terminals and arterial intersection operations in the project area were evaluated using existing signal timing and current intersection geometry.

Results of the existing intersection operational analysis are presented in **Table 3-13**. The results show that all of the project area intersections currently operate at an acceptable LOS (LOS D or better for urban conditions) during the peak hours, with the exception of a few intersections along County Line Road, Santa Fe Drive, and Quebec Street. Vehicle queue at closely spaced intersections were observed during field observations. Queues that extend the entire distance between two intersections can temporarily worsen the operations.

Peak Hour Directional Variations

Existing hourly traffic volumes on C-470 west of Yosemite Street are shown in **Figure 3-8**. AM traffic volumes are the highest between 8:00 and 9:00, with the highest PM volumes occurring between 5:00 and 6:00.

Travel Time

Travel times were collected to determine current weekday peak and off-peak travel times on C-470. **Table 3-14** summarizes existing travel times and delay in the peak and off-peak periods.

Vehicle Classification

Vehicle classification data was collected during the peak hours in the summer of 2003. As shown in **Table 3-15**, truck traffic within the project area composes less than four percent of the total traffic during the AM and PM peak hours, while bus traffic composes less than one percent.

Table 3-13
Existing (2003) Peak Hour Intersection LOS and Delay

Intersection	AM Peak Hour		PM Peak Hour	
	LOS	Average Delay (seconds)	LOS	Average Delay (seconds)
Ken Caryl Avenue/West Ramps	B	19.1	C	24.9
Ken Caryl Avenue/East Ramps	B	10.3	B	10.6
Ken Caryl Avenue/Simms Street	B	18.3	B	19.3
Ken Caryl Avenue/Kipling Parkway	C	29.8	D	36.3
Chatfield Avenue/Kipling Parkway	B	19.7	C	32.8
Kipling Parkway/North Ramps	A	8.6	C	26.6
Kipling Parkway/South Ramps	B	16.2	C	26.7
Ken Caryl Avenue/Wadsworth Boulevard	C	27.4	C	33.8
Chatfield Avenue/Wadsworth Boulevard	C	30.5	D	39.1
Wadsworth Boulevard/North Ramps	C	30.5	D	46.4
Wadsworth Boulevard/South Ramps	C	26.9	C	23.5
Ken Caryl Avenue/Pierce Street	C	22.8	C	25.1
Chatfield Avenue/Pierce Street	B	13.1	B	12.8
Ken Caryl Avenue/Platte Canyon Drive	C	33.5	C	24.4
Santa Fe Drive/Mineral Avenue	**E**	66.7	**F**	91.0
Santa Fe Drive/County Line Road	**F**	>100.0	**F**	>100.0
Santa Fe Drive/North Ramps	B	13.8	C	30.3
Santa Fe Drive/South Ramps	D	40.8	D	52.7
Santa Fe Drive/Blakeland Drive	C	22.7	B	16.6
Santa Fe Drive/Town Center Drive	B	19.5	C	20.9
Santa Fe Drive/Highlands Ranch Parkway	B	18.2	D	42.8
Lucent Boulevard/County Line Road	A	7.2	B	13.6
Lucent Boulevard/North Ramps	B	15.1	C	22.4
Lucent Boulevard/South Ramps	A	6.4	B	14.2
Lucent Boulevard/Plaza Drive	D	51.5	D	38.2
Lucent Boulevard/Town Center Drive	B	17.5	C	22.8
Lucent Boulevard/Highlands Ranch Parkway	C	25.1	C	23.1
Broadway/Dry Creek Road	B	10.9	C	24.4
Broadway/Mineral Avenue	C	27.2	C	33.3

Table 3-13
Existing (2003) Peak Hour Intersection LOS and Delay (continued)

Intersection	AM Peak Hour		PM Peak Hour	
	LOS	Average Delay (seconds)	LOS	Average Delay (seconds)
Broadway/County Line Road	C	24.2	D	49.1
Broadway/North Ramps	B	17.7	B	15.9
Broadway/South Ramps	B	11.7	C	24.5
Broadway/Dad Clark Drive	C	28.0	C	25.5
Broadway/Plaza Drive	C	23.0	C	23.1
Broadway/Highlands Ranch Parkway	C	31.6	C	33.8
University Boulevard/Dry Creek Road	C	30.3	D	43.2
University Boulevard/County Line Road	C	29.4	D	51.5
University Boulevard/North Ramps	D	36.2	C	25.2
University Boulevard/South Ramps	B	18.7	C	31.1
University Boulevard/Dad Clark Drive	B	13.2	B	18.9
University Boulevard/ Highlands Ranch Parkway	D	36.6	D	44.6
Colorado Boulevard/Dry Creek Road	C	24.2	D	37.2
Colorado Boulevard/County Line Road	C	30.5	D	43.2
Holly Street/Dry Creek Road	C	30.5	C	33.3
Holly Street/County Line Road	C	31.8	**E**	74.0
Quebec Street/Dry Creek Road	D	33.1	**E**	69.2
Quebec Street/County Line Road	C	34.4	**E**	60.6
Quebec Street/North Ramps	C	21.1	C	27.1
Quebec Street/South Ramps	C	23.0	C	23.7
Quebec Street/Park Meadows Drive	C	39.6	C	34.2
Quebec Street/Lincoln Avenue	C	34.7	**E**	76.0
Yosemite Street/Dry Creek Road	C	21.3	D	38.6
Yosemite Street/County Line Road	C	32.5	D	36.1
Yosemite Street/North Ramps	B	13.1	C	20.7
Yosemite Street/South Ramps	B	14.7	B	14.7
Yosemite Street/Park Meadows Drive	C	20.6	C	24.0
Yosemite Street/Lincoln Avenue	C	22.4	C	28.6

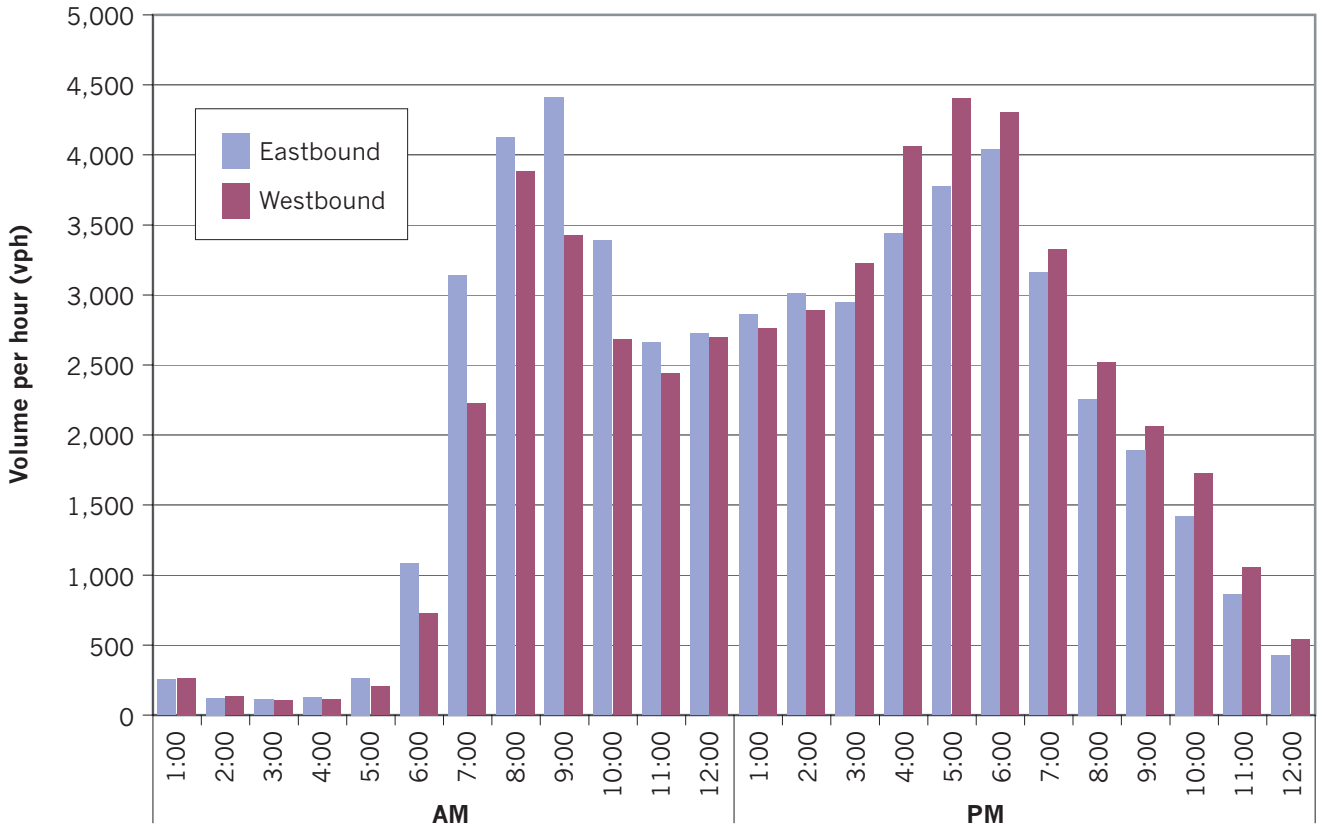
Table 3-14
Existing (2003) Travel Time and Delay

		Average Travel Time (Minutes)		Average Delay (Minutes)	
		Eastbound	Westbound	Eastbound	Westbound
Existing	AM Peak Hour	24-25	19-20	11	6
	PM Peak Hour	19-20	30-32	6	18
	Off-Peak	13-14	13-14	N/A	N/A

Table 3-15
Existing (2003) Heavy Vehicle Percentages

	AM Peak Hour		PM Peak Hour	
Vehicle Type	Eastbound	Westbound	Eastbound	Westbound
Truck	3.2%	2.5%	0.7%	1.9%
Bus	0.1%	0.1%	0.4%	0.1%

Figure 3-8
Existing (2003) Hourly Traffic Volumes
(West of Yosemite Street)



Accident History

An accident history analysis was conducted for approximately 16 miles of C-470 from the Ken Caryl Avenue interchange to the I-25 interchange. The entire safety study can be found in the *Safety Chapter for the C-470 Corridor Environmental Assessment* (March 2005). The study evaluated accident history on C-470 between January 1, 2000, and December 31, 2002. This section of C-470 is classified as a Federal Aid Primary urban expressway. Approximately 1,565 accidents occurred within the project area during the three-year study period. Accidents on the cross streets and interchange ramps within the project area are included in this total. Accidents of the property-damage-only category composed 1,140 of the total accidents, or 73 percent, while 417 accidents (27 percent) involved injuries. One-half percent of all accidents during this period were fatal. **Figures 3-9** and **3-10** show accident types and proportions identified over the three-year study period. **Figure 3-9** presents the distribution profile by accident type for mainline C-470, while **Figure 3-10** shows the types of accidents occurring on interchange cross streets and ramps.

Rear-end collisions are the predominant accident type on both the mainline and interchange locations in the project area. Collisions of this type typically imply the existence of congested traffic resulting from capacity limitations on the existing highway. The higher portion of approach turn and broadside-type accidents also reflect intersection-related conflicts associated with ramp intersections at interchanges.

Most mainline sections of C-470 operate with better than expected safety performance when compared with similar facilities throughout the state. Closer review indicates that short sections near the Santa Fe Drive and Lucent Boulevard interchanges exhibit recent total accident frequency levels which are slightly worse than expected for this type of highway. Analysis of accident data for injury and fatal accidents indicates that the majority of the corridor operates with lower-than-expected accident frequency when compared with similar facilities around the state. Highway sections near the Santa Fe Drive and Lucent Boulevard interchanges experience higher than expected injury and fatality-related crashes.

Interchange accidents along the Corridor can similarly be attributed to congestion and backups during periods of high traffic volumes. The following interchanges are worthy of noting because they experience higher than expected crashes:

- Santa Fe Drive – Approximately 158 accidents occurred in the immediate interchange vicinity on Santa Fe Drive and on the entrance/exit ramps to C-470. Rear-end and approach turn collisions together made up nearly 75 percent of these crashes. At the signalized ramp intersection on the north side of the bridge structure, over half of the accidents were approach turns. These crashes involved northbound vehicles on Santa Fe turning left onto the westbound C-470 entrance ramp colliding with southbound Santa Fe traffic. The frequency of these accidents is increased by periodic volume congestion and the limited storage capacity of the current northbound to westbound left turn lane configuration

  The south ramp intersection includes a double left turn lane for vehicles making the southbound to eastbound turn movement. This movement requires drivers to execute a turn through more than 90 degrees due to interchange skew. Approximately eleven same-direction sideswipe accidents are noted in these lanes. Ensuring that durable pavement markings are used and maintained for the turn lane stripe extensions into the intersection can help mitigate this type of accident

Figure 3-9
C-470 Mainline Highway Accident Type Distribution
January 1, 2000 to December 31, 2002

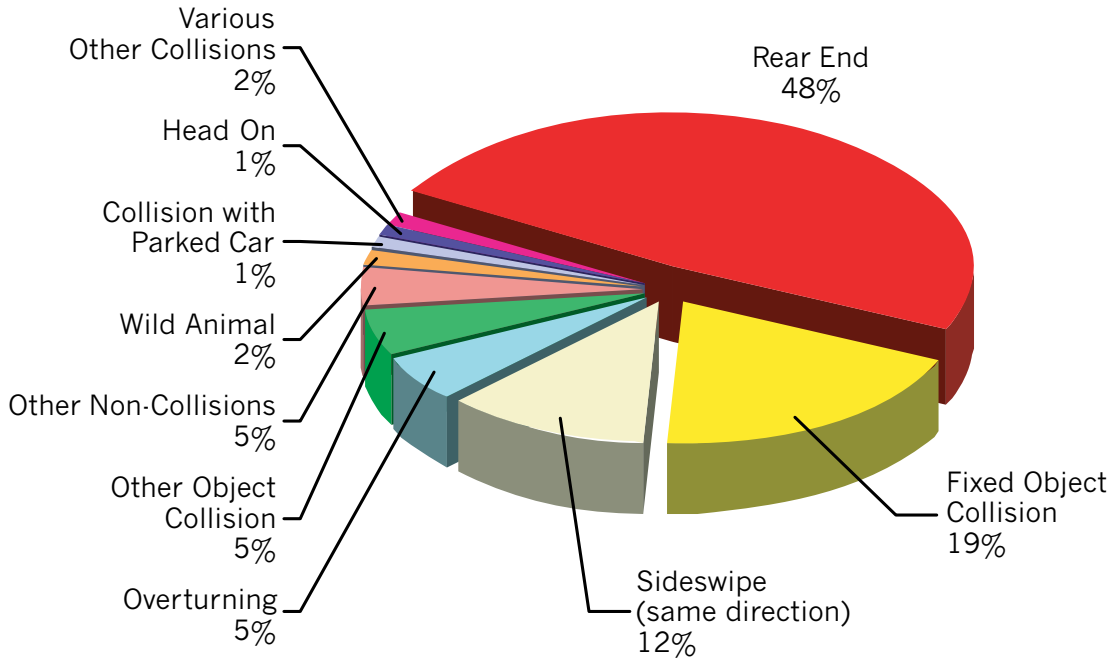
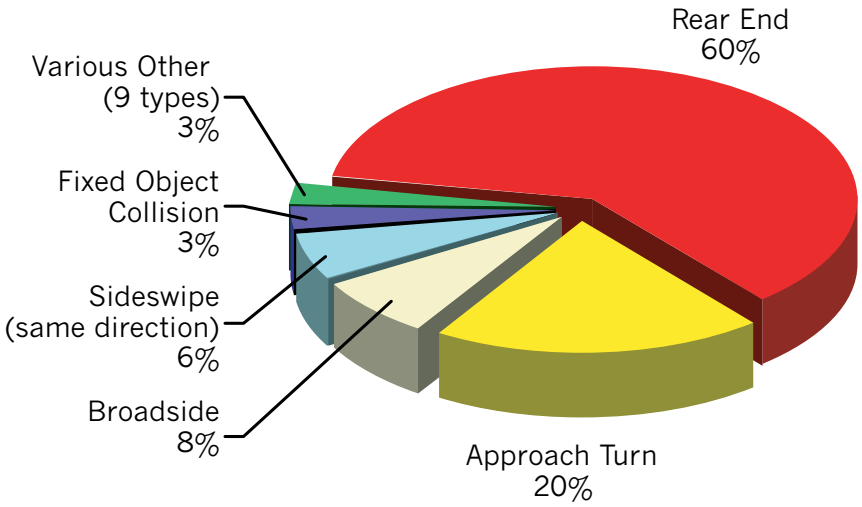


Figure 3-10
C-470 Interchange Accident Type Distribution
January 1, 2000 to December 31, 2002



- Lucent Boulevard – 47 crashes occurred on Lucent Boulevard and the ramps during the three year study period. Of these, 45 percent were approach turn collisions and 19 percent were rear end collisions. An elevated frequency of approach turn collisions was noted at the north ramp intersection

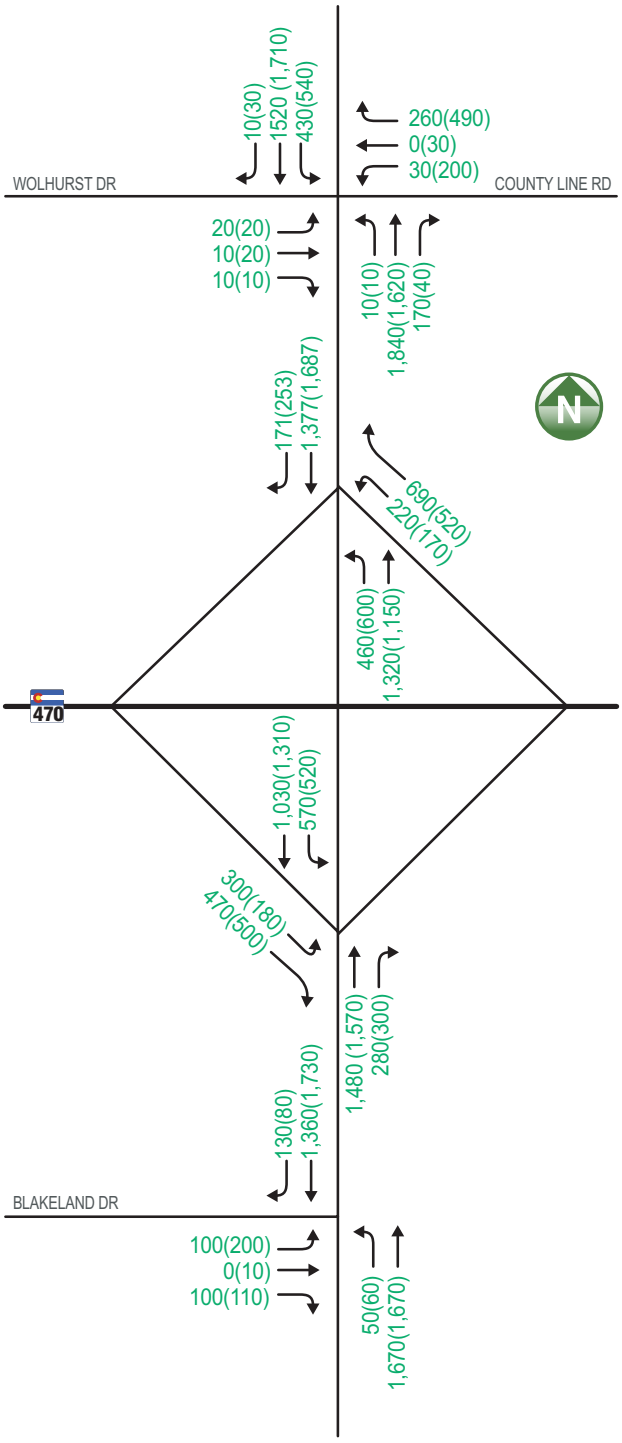
- Broadway – 233 accidents occurred at the Broadway interchange during the study period. Of these, 24 percent were approach turn collisions. Both north and south ramp intersections exhibited these collisions. Rear end collisions occurred with moderate frequency (55 percent) in the channelized right turn lanes from the freeway off-ramps to north- and southbound Broadway

- University Boulevard – over 150 accidents occurred in the University Boulevard interchange area during the study period. Of these, 69 percent were rear end collisions and 18 percent were approach turn collisions. Approach turn collisions were prevalent at the north ramp intersection, and rear end collisions were predominant in the channelized right turn lanes from the westbound freeway off-ramps to northbound University Boulevard

- Quebec Street – 295 accidents occurred during the study period, of which 72 percent were rear ends and 18 percent were approach turn collisions. The north ramp intersection had a high approach turn collision frequency involving northbound vehicles on Quebec Street turning left. At both north and south ramp intersections, numerous rear end collisions occurred in the channelized right turn lanes. A high number of rear end crashes also occurred along Quebec Street itself. Periodic congestion may be a contributing factor to this condition

- Yosemite Street – this location did not exhibit unusual accident frequency, with

Figure 3-11
Existing (2003) Santa Fe Drive Traffic Volumes



Legend

XXX(XXX) 2025 AM (PM) Peak Hour Traffic Volumes

Source: 2003 traffic counts

51 collisions during the study period. Rear end collisions were most common, accounting for 50 percent of the total, followed by approach turn crashes at 25 percent of the total. Most of the approach turn collisions take place at the north ramp intersection

Santa Fe Drive Interchange Operations

Santa Fe Drive carries a significant volume of traffic into the Denver metropolitan area. Its interchange with C-470 is an important connector that warrants deeper study, especially due to its higher levels of congestion and accident history.

TRAFFIC VOLUMES AND OPERATIONS.

Santa Fe Drive is a regional facility that extends from downtown Denver south to the Town of Castle Rock. In the vicinity of C-470, Santa Fe Drive is a four-lane facility, currently carrying between 35,000 and 40,000 vehicles per day.

Existing peak hour traffic counts were collected at the Santa Fe Drive interchange and at the County Line Road and Blakeland Drive intersections with Santa Fe Drive. **Figure 3-11** shows traffic counts collected in the vicinity of the Santa Fe Drive interchange.

Peak hour operations for intersections in the Santa Fe Drive interchange area are shown in **Table 3-16**. The analysis shows that current LOS at the interchange ramp intersections and at the Blakeland Drive/Santa Fe Drive intersection are at LOS C or better. LOS F was calculated for the Santa Fe Drive/County Line Road intersection for the peak hours.

I-25 Interchange Operations

The I-25 interchange operates at an acceptable level of service, with a few exceptions including the northbound I-25 to westbound C-470 ramp and mainline I-25 between the C-470 /E-470 and Lincoln Avenue interchanges. The northbound I-25 to westbound C-470 ramp is a left-hand side merge that ends in a lane drop, which leads to slower operating speeds and safety concerns on C-470. In addition, traffic must weave onto I-25 between C-470 and Lincoln in the northbound and southbound directions due to lane drops at the Lincoln and C-470/E-470 interchanges, which lead to slower operating speeds and reduced safety on I-25.

3.3.1.2 Environmental Consequences

The DRCOG regional travel demand model, calibrated with existing peak hour traffic counts on C-470 and the adjacent arterial streets, was used to develop 2025 peak hour traffic forecasts for all three alternatives considered in the EA.

An AIMSUN micro-simulation model was then used for refined traffic forecasting and alternatives analysis for the three alternatives. Year 2025

Table 3-16
Existing (2003) Santa Fe Drive Intersection Delay and Level of Service

Intersection	AM Peak Hour		PM Peak Hour	
	Average Delay (seconds)	LOS	Average Delay (seconds)	LOS
Santa Fe Drive and C-470 eastbound	32.5	C*	24.4	C
Santa Fe Drive and C-470 westbound	22.9	C*	22.6	C*
Santa Fe Drive and County Line Road	>100	F*	>100	F*
Santa Fe Drive and Blakeland Drive	22.7	C*	16.6	B

** LOS represents operations assuming each intersection is isolated. These intersections are routinely affected by excessive left turn and through queues from adjacent intersections resulting in poorer operations than indicated*

traffic volume projections from the regional travel demand model were incorporated into the micro-simulation model for the project area to produce refined forecasts.

The 2025 No-Action and build alternatives' networks for the project area included existing roadway facilities plus committed projects on fiscally constrained regional transportation plans within the project area. These plans include:

- *Denver Regional Council of Governments 2025 Fiscally Constrained Regional Transportation Plan* (April 2002)
- *Douglas County 2020 Transportation Plan* (April 2004)
- *US 85 Access Management Plan, South I-25 Corridor and US 85 Corridor Environmental Impact Statement* (March 2001)
- *County Line Road, I-25 to Santa Fe Drive EA and Section 4(f) Evaluation* (1998)
- *Douglas County Capital Improvement Projects* (2004)

No-Action Alternative

FREEWAY VOLUMES AND OPERATIONS. The No-Action Alternative AM and PM peak hour volumes on C-470 and the adjacent arterial street system are shown in **Figure 3-12a** and **Figure 3-12b**. Under the No-Action Alternative, the facility is expected to generally operate at LOS F both eastbound and westbound during both peak periods. **Tables 3-17a** and **3-17b** show the AM and PM freeway levels of service for the 2025 No-Action Alternative, and compare them to the GPL and EL Alternatives. GPL and EL Alternative operations are discussed in their respective sections.

Due to the limited capacity on C-470 under the No-Action Alternative, severe congestion on C-470 constrains the amount of traffic that can get to and from the arterial street system during the peak hours. Therefore, the unmet peak hour travel demand would spread into adjacent hours resulting in an increase in the number of hours that peak period congestion would occur. The duration of congestion in 2025 would be approximately 10 hours long, based on AM and PM operations of LOS E or worse. **Table 3-18** shows the expected peak period lengths for the No-Action Alternative, and compares these to the GPL and EL Alternatives. GPL and EL Alternative peak hour spreading is discussed in their respective sections.

FREEWAY TRAVEL TIMES. Existing travel time and delay are shown in **Table 3-19**. **Table 3-19** shows the No-Action Alternative travel time and delay, and compares them to those of the GPL and EL Alternatives. These data indicate an increase in travel time of approximately 10 minutes over existing conditions. GPL and EL Alternative travel time and delay are discussed in their respective sections.

FREEWAY VEHICLE MILES OF TRAVEL AND VEHICLE HOURS OF TRAVEL. The miles traveled along a roadway can be measured in terms of vehicle miles of travel (VMT), which represents the total number of miles traveled by all vehicles along a roadway for a given period of time. Vehicle hours of travel (VHT) represents the total time spent by vehicles traversing a roadway during a given period of time.

Table 3-20 presents VMT and VHT for the No-Action Alternative, and compares them to the GPL and EL Alternatives GPL and EL Alternative VMT and VHT are discussed in their respective sections.

TRAVEL PATTERNS. C-470 and most of the adjacent arterial facilities are currently congested during peak hours. Most of the arterial street infrastructure within the project area has already been completed, and development has occurred adjacent to these

Figure 3-12a
2025 No-Action Alternative Traffic Volumes

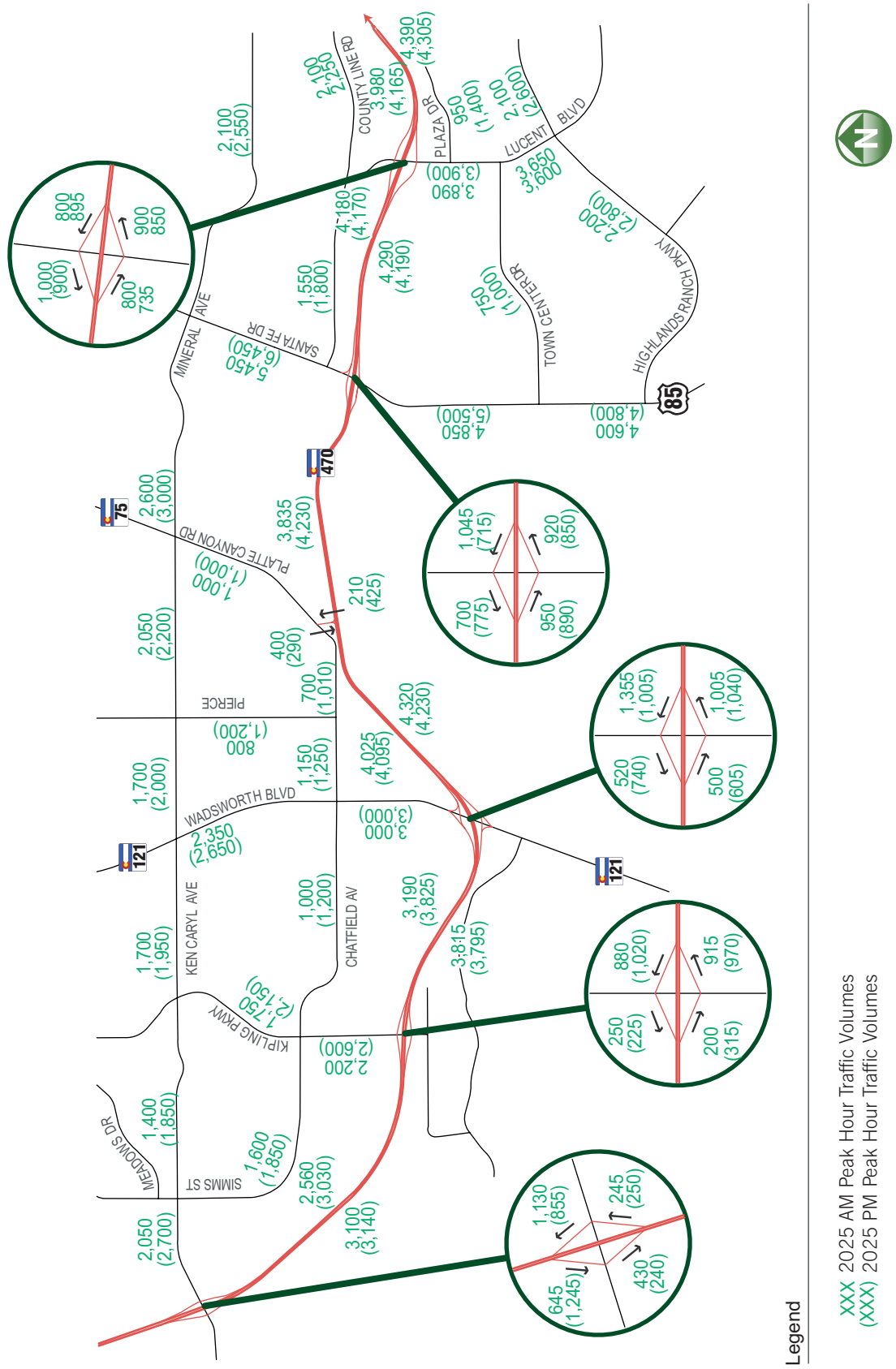


Figure 3-12b
2025 No-Action Alternative Traffic Volumes

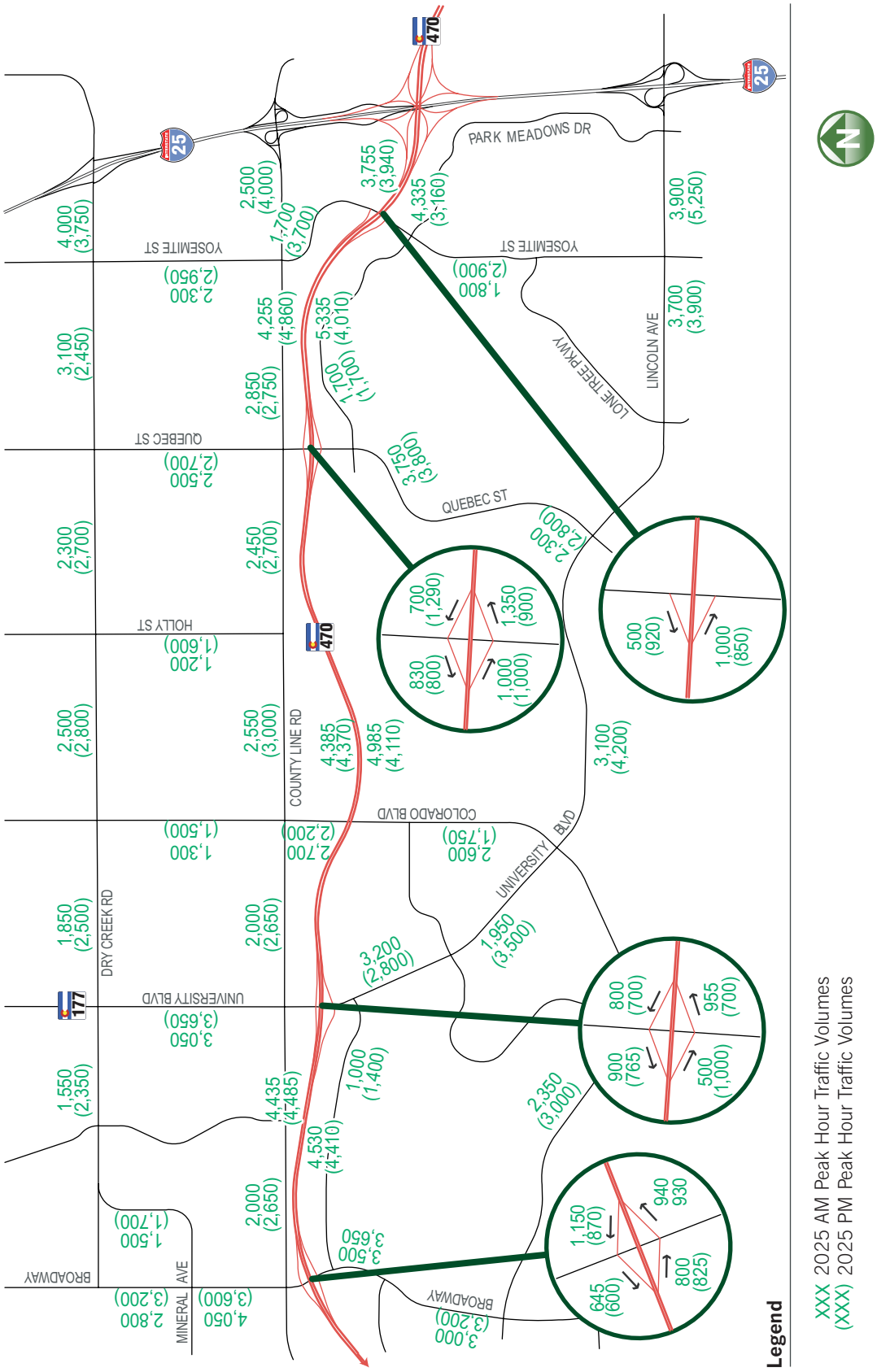


Table 3-17a
Comparison of 2025 AM Peak Freeway Level of Service

Section	No-Action Alternative LOS		GPL Alternative LOS		EL Alternative LOS			
					GPL Section		EL Section	
	EB	WB	EB	WB	EB	WB	EB	WB
Ken Caryl Avenue to Kipling Parkway	C/D	C	D	C	E	C	-	-
Kipling Parkway to Wadsworth Boulevard	F	D	C	C	E	D	C	A
Wadsworth Boulevard to Platte Canyon Road	F	E	C	B/C	F	D	C	A
Platte Canyon Drive to Santa Fe Drive	F	D	C	B/C	F	A	C	A
Santa Fe Drive to Lucent Boulevard	F	E	C	B/C	F	F	C	A
Lucent Boulevard to Broadway	F	D	C	B/C	F	F	B	A
Broadway to University Boulevard	F	F	C/D	C/D	F	F	B	B
University Boulevard to Colorado Boulevard	F	F	C	C	E	E	B	B
Colorado Boulevard to Quebec Street	F	F	C	C	E	E	C	B
Quebec Street to Yosemite Street	D	F	C	C	D	C	C	A
Yosemite Street to I-25	C	F	C	C	F	A	C	A

Table 3-17b
Comparison of 2025 PM Peak Freeway Level of Service

Section	No-Action Alternative LOS		GPL Alternative LOS		EL Alternative LOS			
					GPL Section		EL Section	
	EB	WB	EB	WB	EB	WB	EB	WB
Kipling Parkway to Wadsworth Boulevard	F	E	C	C/D	F	F	B	C
Wadsworth Boulevard to Platte Canyon Road	F	E	C	C	F	D	A	B
Platte Canyon Drive to Santa Fe Drive	F	F	C	C	F	F	A	B
Santa Fe Drive to Lucent Boulevard	F	F	C	C	D	F	A	B
Lucent Boulevard to Broadway	F	F	D	C	F	F	A	C
Broadway to University Boulevard	F	F	C/D	C/D	F	F	A	C
University Boulevard to Colorado Boulevard	F	F	C	C	E	F	A	C
Colorado Boulevard to Quebec Street	F	F	C	C	E	F	B	C
Quebec Street to Yosemite Street	B	F	C	D	D	F	B	C
Yosemite Street to I-25	B	F	C	E	C	C	B	C

Table 3-18
Duration of Peak Periods in 2025

	No-Action Alternative	GPL Alternative	EL Alternative
Number of hours over capacity on mainline (LOS E or worse)	10 hours	0 hours	0 hours (express lanes section)
			5 hours (general purpose lanes section)

facilities. Therefore, many of these facilities cannot be practically expanded beyond the existing laneage without resulting in adverse effects. Land uses within the project area are mostly built out, and the type and density of additional development is expected to be consistent with existing conditions. Under the No-Action Alternative, no capacity or operational improvements would be implemented. Therefore, as traffic volumes increase within the project area, both C-470 and the surrounding arterial system would become increasingly more congested. This would result in an increase in the hours of traffic congestion. The No-Action Alternative would not result in a change in existing traffic patterns because no capacity improvements are provided on C-470 or the adjacent arterial system.

INTERCHANGE AND ARTERIAL INTERSECTION OPERATIONS.

The majority of intersections in the 2025 No-Action Alternative would operate at

Table 3-19
Comparison of 2025 Travel Time and Delay

		Average Travel Time (Minutes)				Average Delay (Minutes)			
		Eastbound		Westbound		Eastbound		Westbound	
No Action Alternative	AM Peak Hour	34-35		31-32		20-21		17-18	
	PM Peak Hour	29-30		35-36		15-16		21-22	
	Off-Peak	13-14		13-14		N/A		N/A	
GPL Alternative	AM Peak Hour	15-16		15-16		1-2		1-2	
	PM Peak Hour	17-18		18-19		3-4		4-5	
	Off-Peak	13-14		13-14		N/A		N/A	
EL Alternative		ELs	GPLs	ELs	GPLs	ELs	GPLs	ELs	GPLs
	AM Peak Hour	13-14	28-29	11-12	22-23	1-2	17-18	0	11-12
	PM Peak Hour	11-12	26-27	12-13	31-32	0	15-16	1-2	20-21
	Off-Peak	11-12	11-12	11-12	11-12	N/A	N/A	N/A	N/A

Table 3-20
Comparison of 2025 Vehicle Miles Traveled and Vehicle Hours Traveled

	No-Action Alternative	GPL Alternative	EL Alternative
2025 AM Peak Hour VMT	106,000	171,000 (+61% from No-Action)	168,000 (+58% from No-Action)
2025 AM Peak Hour VHT	3,900	3,000 (-23% from No-Action)	4,000 (-3% from No-Action)
2025 PM Peak Hour VMT	108,000	174,000 (+61% from No-Action)	171,000 (+58% from No-Action)
2025 PM Peak Hour VHT	4,300	3,000 (-30% from No-Action)	4,000 (-7% from No-Action)

LOS D or better during the AM peak hour, with the exception of intersections along County Line Road and Dry Creek Road. During the PM peak hour, operations at 34 of the 57 signalized intersections analyzed would operate at LOS D or better. Most of the intersections operating at LOS E or worse would be along County Line Road and Dry Creek Road.

SAFETY. As traffic volumes increase without any improvements under the No-Action Alternative, accidents would generally be expected to increase as well.

SANTA FE DRIVE INTERCHANGE. **Tables 3-21a** and **3-21b**, present the No-Action Alternative operations for intersections in the Santa Fe Drive interchange area, and compare to those of the GPL and EL Alternatives. As shown, there is a wide range of operations at the Santa Fe Drive intersections for both the AM and PM peak hours, depending on which alternative is under consideration. The No Action alternative operates at mainly LOS E/F during both peak hours. The GPL Alternative operates at mainly LOS C/D during both peak hours, with one exception – Santa Fe Drive/ Highlands Ranch Parkway operates at LOS F during both peak hours. The EL Alternative operates at mainly LOS C/D during both peak hours. Operations of these intersections for the GPL and EL Alternatives are discussed in those respective sections.

I-25 INTERCHANGE OPERATIONS. Under the No-Action Alternative, the I-25 interchange would have capacity deficiencies at two locations. The single-lane exit ramp from northbound I-25 to C-470/E-470 would operate at LOS F with forecasted traffic volumes. The single-lane eastbound C-470/ westbound E-470 entrance ramp to southbound I-25 is also projected to operate at LOS F by 2025 due to lack of capacity.

General Purpose Lanes Alternative

Capacity and operational improvements included in this alternative would decrease congestion and delay on C-470 and improve the reliability of the highway facility.

FREEWAY VOLUMES AND OPERATIONS. The GPL Alternative freeway peak hour traffic volumes would exceed those shown for the No-Action Alternative by approximately 15 to 25 percent on portions of the corridor west of Santa Fe Drive, and 30 to 35 percent on portions of the corridor east of Santa Fe Drive during the AM peak. The PM peak hour traffic volumes would exceed the No-Action Alternative by approximately 10 to 25 percent west of Santa Fe Drive, and 30 to 50 percent east of Santa Fe Drive.

The 2025 AM and PM peak hour C-470 freeway LOS operations for the GPL Alternative were determined based on the traffic volumes reported from the micro-simulation model. The GPL Alternative 2025 traffic volumes are shown in **Figure 3-13a** and **Figure 3-13b**. The freeway LOS analysis indicates that C-470 is projected to operate generally at LOS D or better in both the eastbound and westbound directions during the AM peak hour. C-470 is projected to operate generally at LOS D or better during the PM peak hour, with the exception of westbound C-470 between I-25 and Yosemite Street, where LOS E operations are forecasted, as shown in **Tables 3-17a** and **17b**. Based on the operational forecasts for C-470 in 2025, the congestion period is anticipated to be less than one hour during the AM and PM peak hour. (**Table 3-18** summarizes the duration of peak periods in 2025.)

FREEWAY TRAVEL TIMES. 2025 peak hour travel times on eastbound and westbound C-470 are shown in **Table 3-19**. The AM peak hour total average travel times between Ken Caryl Avenue and I-25 would be 15 to 16 minutes in both directions. During the PM

Table 3-21a
Santa Fe Drive Interchange Area
Comparison of 2025 AM Peak Intersection Delay and Level of Service

Intersection	No-Action Alternative		GPL Alternative		EL Alternative	
	Average Delay (seconds)	LOS	Average Delay (seconds)	LOS	Average Delay (seconds)	LOS
Santa Fe Drive/Mineral Avenue	55.4	E	60.6	E	52.8	D
Santa Fe Drive/County Line Road	>100.0	F	33.1	C	41.9	D
Santa Fe Drive/North Ramps	88.8	F	29.1	C	32.4	C
Santa Fe Drive/South Ramps	>100.0	F	37.1	D	45.5	D
Santa Fe Drive/Blakeland Drive	28.1	C	22.0	C	27.1	C
Santa Fe Drive/Town Center Drive	22.2	C	23.2	C	22.7	C
Santa Fe Drive/Highlands Ranch Parkway	98.4	F	87.5	F	55.8	E

Table 3-21b
Santa Fe Drive Interchange Area
Comparison of 2025 PM Peak Intersection Delay and Level of Service

Intersection	No-Action Alternative		GPL Alternative		EL Alternative	
	Average Delay (seconds)	LOS	Average Delay (seconds)	LOS	Average Delay (seconds)	LOS
Santa Fe Drive/Mineral Avenue	63.2	E	66.5	E	62.6	E
Santa Fe Drive/County Line Road	>100.0	F	42.1	D	24.8	C
Santa Fe Drive/North Ramps	61.7	E	25.8	C	36.7	D
Santa Fe Drive/South Ramps	96.1	F	24.4	C	32.4	C
Santa Fe Drive/Blakeland Drive	75.1	E	34.3	C	33.0	C
Santa Fe Drive/Town Center Drive	21.1	C	17.5	B	12.8	B
Santa Fe Drive/Highlands Ranch Parkway	>100.0	F	>100.0	F	64.8	E

Figure 3-13a
2025 General Purpose Lanes Alternative Traffic Volumes

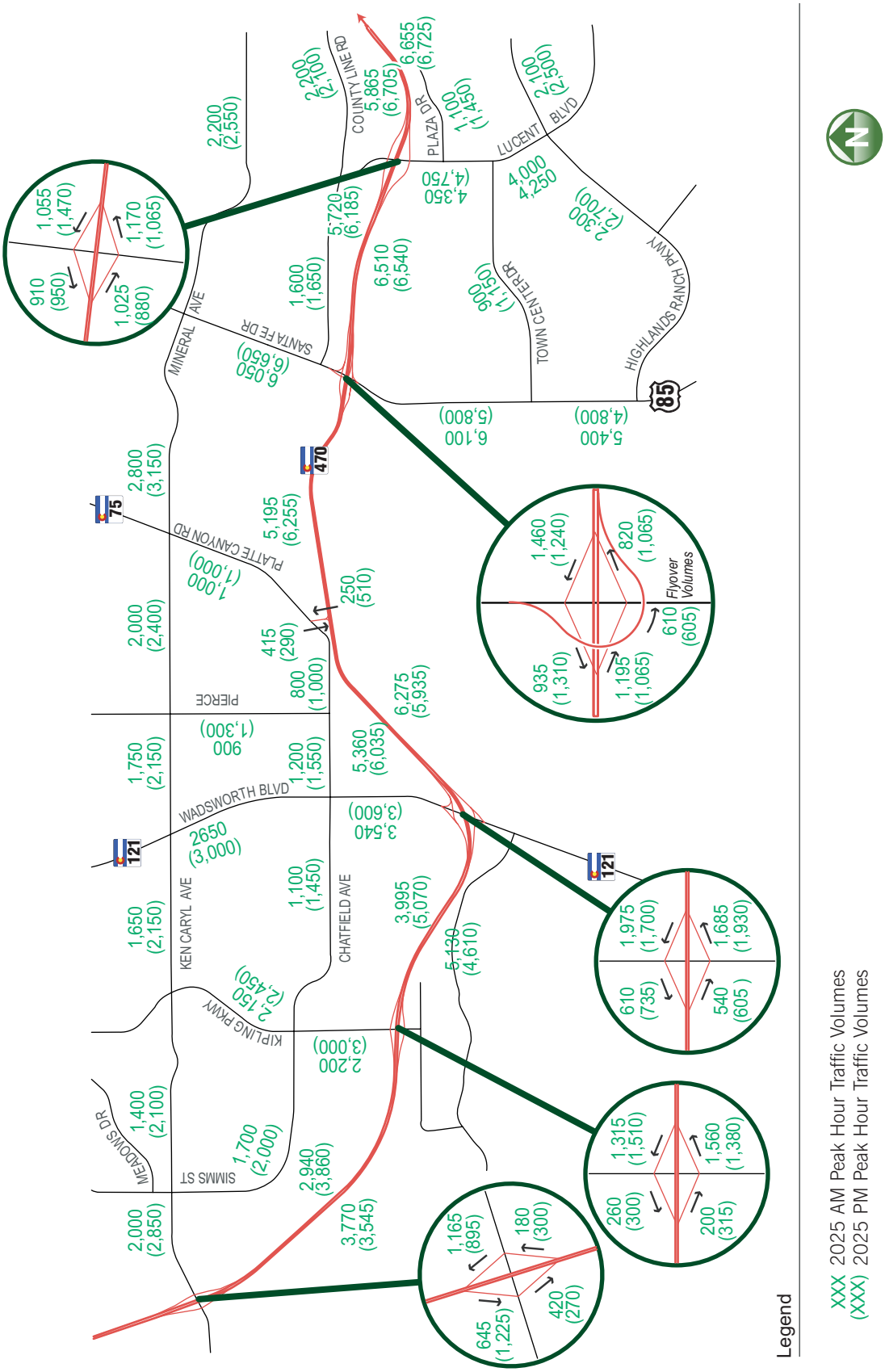
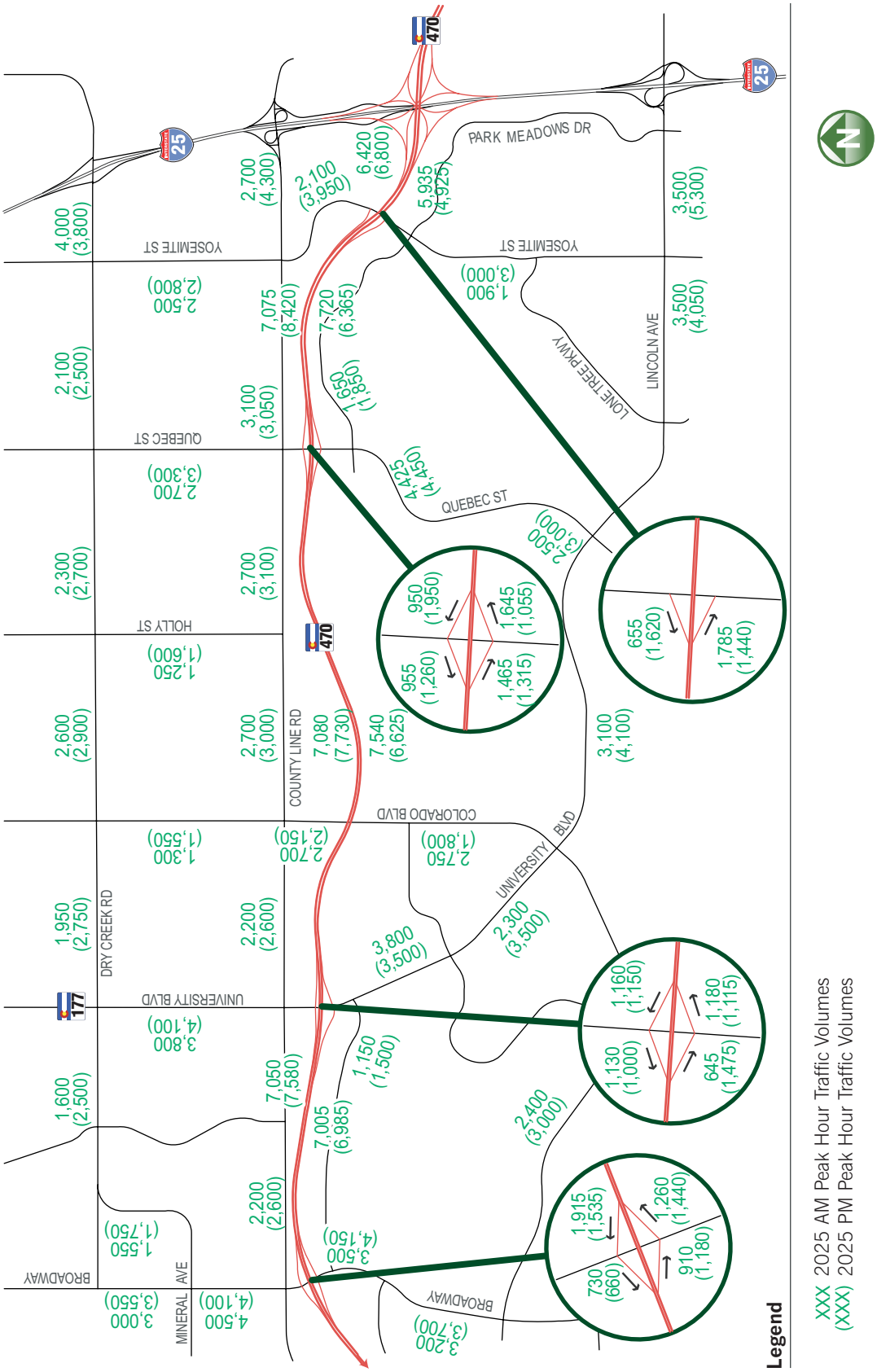


Figure 3-13b
2025 General Purpose Lanes Alternative Traffic Volumes



peak hour, average travel times are predicted to be 17 to 19 minutes. The GPL Alternative demonstrates a travel time reduction of 16 to 19 minutes during the AM peak hour and 12 to 17 minutes during the PM peak hour compared to the No-Action Alternative in 2025. The projected future travel times under the GPL Alternative also demonstrate a four- to nine-minute travel time reduction during AM peak hour, and a two- to 12-minute reduction during the PM peak hour compared to existing peak hour travel times.

FREEWAY VEHICLE MILES OF TRAVEL AND VEHICLE HOURS OF TRAVEL. The reported VMT and VHT for each peak hour is shown in **Table 3-20**.

With the increased capacity of the GPL Alternative, peak hour VMT would increase by 61 percent over the No-Action Alternative. However, peak hour VHT would decrease by 23 percent in the AM peak hour and 30 percent in the PM peak hour. Even though C-470 traffic would increase with the GPL Alternative, overall improvement in capacity and freeway speeds with this alternative would result in less time spent on the freeway.

TRAVEL PATTERNS. The additional capacity provided by the GPL Alternative would result in a higher-intensity peak period, but for a shorter amount of time for both the freeway and arterial street system as compared to the No-Action Alternative. This effect would provide reasonable and reliable traffic operations along C-470 as compared to the No-Action Alternative. The additional capacity provided is not expected to substantially change travel patterns within the project area compared to the No-Action Alternative. The limitation on arterial street capacity influences the ability of traffic to redistribute, and constrains the amount of traffic that can get to and from C-470.

Compared to the No-Action Alternative, the traffic volumes on the arterial street system would be 15 to 20 percent higher on Wadsworth Boulevard, Kipling Parkway, and sections of Chatfield Avenue. On Broadway, the GPL Alternative PM peak hour traffic volumes are projected to be approximately 10 to 15 percent higher, on Lucent Boulevard 18 to 22 percent higher, and on University Boulevard 10 to 30 percent higher. Volumes for the GPL Alternative are projected to be 10 to 20 percent greater than the No-Action Alternative on County Line Road and Quebec Street.

INTERCHANGE AND ARTERIAL INTERSECTION OPERATIONS. In evaluating the effects of the GPL Alternative on interchanges and other arterial intersections in the study area, there are many intersections that must be considered. Analysis was performed on all these locations in the study area to determine the effects that would be caused by the build alternatives. The discussion herein focuses primarily on those locations that experienced adverse effects requiring mitigation.

In making the determination of whether mitigation is required, consistency among projects in the Denver region was important. Planners must try to attribute long-term intersection improvements to the subject project versus other factors that contribute to traffic growth over time.

In order to determine whether adverse effects of this project would require mitigation, performance criteria were developed that are considered to be consistent with the approach taken by other projects in the Denver region. Consideration of potential effects was limited to ramp terminal intersections and one adjacent intersection on either side of the C-470 mainline. The resulting LOS that would be associated with each build alternative was then compared to that which would have existed

Table 3-22
Performance Criteria for Determining Effects Caused by Project

2025 No Action Condition	Build Alternative Condition	Resulting Action
LOS F	LOS F plus 20 seconds delay more than No Action	mitigation required
LOS F	LOS A – E, or LOS F with delay no greater than 19 seconds more than No Action	no mitigation required
LOS E	LOS F	mitigation required
LOS E	LOS A – E	no mitigation required
LOS A – D	LOS E – F	mitigation required
LOS A – D	LOS A – D	no mitigation required

Table 3-23a
Interchange and Arterial Intersections with Mitigation
Comparison of 2025 AM Peak Delay and Level of Service

Intersection	No-Action Alternative		GPL Alternative		EL Alternative	
	Average Delay (seconds)	LOS	Average Delay (seconds)	LOS	Average Delay (seconds)	LOS
Lucent Boulevard/County Line Road	22.2	C	23.4	C	30.0	D
Broadway/County Line Road	49.5	D	80.0	E/F	84.6	F
University Boulevard/ County Line Road	44.7	D	60.6	E	63.8	E
Colorado Boulevard/ County Line Road	50.8	D	50.3	D	66.8	E
Quebec Street/County Line Road	45.1	D	57.0	E	70.3	E

Table 3-23b
Interchange and Arterial Intersections with Mitigation
Comparison of 2025 PM Peak Delay and Level of Service

Intersection	No-Action Alternative		GPL Alternative		EL Alternative	
	Average Delay (seconds)	LOS	Average Delay (seconds)	LOS	Average Delay (seconds)	LOS
Lucent Boulevard/County Line Road	25.2	C	27.1	C	34.5	C
Broadway/County Line Road	83.7	F	>100.0	F	91.7	F
University Boulevard/County Line Road	72.5	E	>100.0	F	>100.0	F
Colorado Boulevard/County Line Road	55.3	E	65.9	E	69.1	E
Quebec Street/County Line Road	>100.0	F	>100.0	F	>100.0	F

without the improvement. **Table 3-22** describes the magnitude of change between the No-Action condition and the build condition that requires mitigation.

Tables 3-23a and **3-23b** present those intersections which meet the performance criteria for requiring mitigation for either of the two build alternatives, and compare them to conditions that would exist under the No-Action condition. Of the 55 signalized intersections where traffic operations were evaluated for the GPL Alternative, 44 intersections would operate at LOS D or better during the AM peak hour, and 38 intersections during the PM peak hour would operate at LOS D or better. Those intersections projected to operate at LOS E or worse are located along County Line Road from Broadway to Yosemite Street, and along Dry Creek Road from University Boulevard to Yosemite Street. Projected intersection operations are generally consistent between the No-Action and GPL Alternatives. From this assessment, it can be concluded that the intersections affected by the GPL Alternative are County Line Road at Lucent Boulevard, Broadway, University Boulevard, Colorado Boulevard, and Quebec Street. Discussion regarding EL Alternative effects can be found in that section.

SAFETY. Capacity improvements included in the GPL Alternative would result in significant safety benefits in addition to the targeted operational improvements. Generally, freeway facilities of six or more lanes are expected to have fewer accidents than four-lane facilities carrying the same amount of traffic. This can possibly be explained by increased gap availability for weaving, merging, and diverging. Increased capacity, therefore, also yields a safety dividend. Although data establishing the safety benefits of corridor expansion from six to eight lanes are not readily available in Colorado, a conservative estimate of 10 percent reduction in accidents may be a reasonable assumption, as explained in the *Safety Chapter for the C-470 Corridor Environmental Assessment* (February 2005). Therefore, the GPL Alternative which would expand C-470 from four lanes to eight lanes is expected to yield a total reduction in overall, mainline vehicular collisions of approximately 30 percent. As explained in the *Safety Chapter for the C-470 Corridor Environmental Assessment* (February 2005), a 20 percent reduction would be achieved by increasing laneage from four to six lanes, and another 10 percent reduction by increasing laneage from six to eight lanes. The GPL Alternative is also expected to address geometric problems at interchanges identified in the existing conditions analysis.

SANTA FE DRIVE INTERCHANGE. Improvements to the Santa Fe Drive interchange were included as part of the GPL Alternative. These improvements consist of an improved diamond interchange with one flyover. The southbound to eastbound flyover from Santa Fe Drive would allow for vehicles to enter C-470 at 45 mph and then merge onto eastbound C-470 past the steep incline section east of Santa Fe Drive. Another benefit of the flyover is that approximately 1,000 vehicles during the peak hours would not have to travel through the Santa Fe Drive/County Line Road or the C-470 ramp terminal intersections. These vehicles would be accommodated by the southbound to eastbound flyover, thereby reducing vehicle demand at these intersections.

As shown in **Tables 3-21a** and **3-21b**, the interchange intersections along Santa Fe Drive are projected to operate at LOS D or better during 2025 peak hour conditions with the GPL Alternative with the exception of Highlands Ranch Parkway intersection projected to LOS F. The northbound through-vehicle queues at the County Line Road/ Santa Fe Drive intersection are projected to extend south past the C-470 north ramp

terminal intersection under this alternative during the PM peak hour.

I-25 INTERCHANGE. The I-25 interchange would accommodate 35 to 50 percent higher volumes on most ramps in the GPL Alternative compared to the No-Action Alternative. As a result, the northbound I-25 to C-470/E-470 and the C-470/E-470 to southbound I-25 ramps would operate at LOS F due to lack of capacity. This would cause vehicle queuing, delays at the interchange and on mainline I-25, C-470, and E-470. Weave movements on I-25 between the C-470/E-470 interchange and the Lincoln Avenue interchange are projected to operate at LOS F and affect adjacent interchanges in addition to mainline I-25 operations. More information on I-25 interchange design and operations can be found in *I-25 Lane Configuration – County Line to Lincoln,* (February 9, 2005) as discussed in **Chapter 5**.

Express Lanes Alternative (Preferred Alternative)

Capacity and operational improvements included in this alternative decreased congestion and delay on C-470 and improved the reliability of the highway facility.

FREEWAY VOLUMES AND OPERATIONS. Similar to the GPL Alternative freeway volumes, the EL Alternative AM peak hour volumes would be higher than for the 2025 No-Action Alternative volumes by 15 to 25 percent in portions of the corridor west of Santa Fe Drive and by approximately 30 to 35 percent east of Santa Fe Drive. The EL Alternative PM peak hour volumes would be higher than the No Action volumes by 15 to 30 percent west of Santa Fe Drive and by 40 to 60 percent east of Santa Fe Drive. Similarly, the EL Alternative PM peak hour volumes would be higher than those for the No-Action Alternative volumes by 10 to 25 percent west of Santa Fe Drive and by 30 to 50 percent east of Santa Fe Drive. 2025 AM and PM peak hour traffic volumes on C-470 and the surrounding arterial street system for the EL Alternative are shown in **Figure 3-14a** and **Figure 3-14b**.

With the EL Alternative, the tolled express lanes section and the general purpose lanes section of the facility would be barrier-separated and have different operational characteristics. The express lanes section is predicted to operate at LOS D or better in the peak direction and at LOS C or better in the off-peak direction. (**Table 3-18** summarizes the duration of peak periods in 2025.) The congestion period in the express lanes would last for under one hour. The general purpose lanes section is projected to operate at LOS E or F in the AM and PM peak periods in both directions. The duration of congestion in the general purpose lanes section would last for approximately five hours. Forecasted 2025 traffic operations are summarized in **Tables 3-17a** and **3-17b**.

FREEWAY TRAVEL TIMES. The travel time in the express lanes section from Kipling Parkway to I-25 would be approximately 11-14 minutes in the peak direction. Travel time in the general purpose lanes section for the same stretch is 28 to 32 minutes in the peak direction. Travel times in the express lanes section of the EL Alternative would be 18 to 23 minutes lower than the No-Action Alternative. Travel times in the general purpose lanes section would be three to nine minutes lower than in the No-Action Alternative. The forecasted AM and PM peak-hour travel times are shown in **Table 3-19**.

FREEWAY VEHICLE MILES OF TRAVEL AND VEHICLE HOURS OF TRAVEL. VMT and VHT for each peak hour are reported in **Table 3-20**.

VMT for the EL Alternative would increase by approximately 58 percent, compared to the No-Action Alternative. However, peak hour VHT would decrease by approximately three percent in the AM and PM peak hours.

Figure 3-14a
2025 Express Lanes Alternative Traffic Volumes

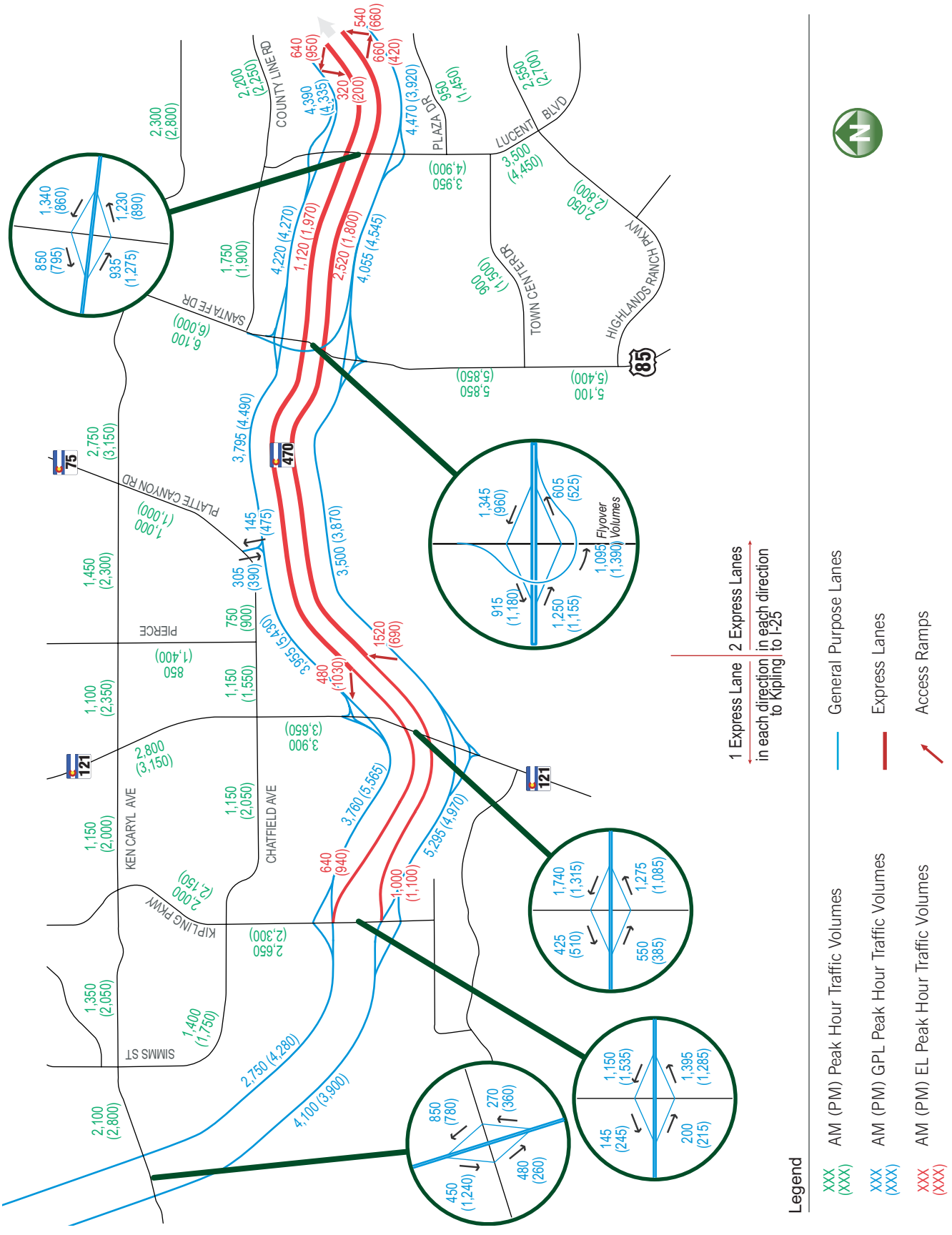
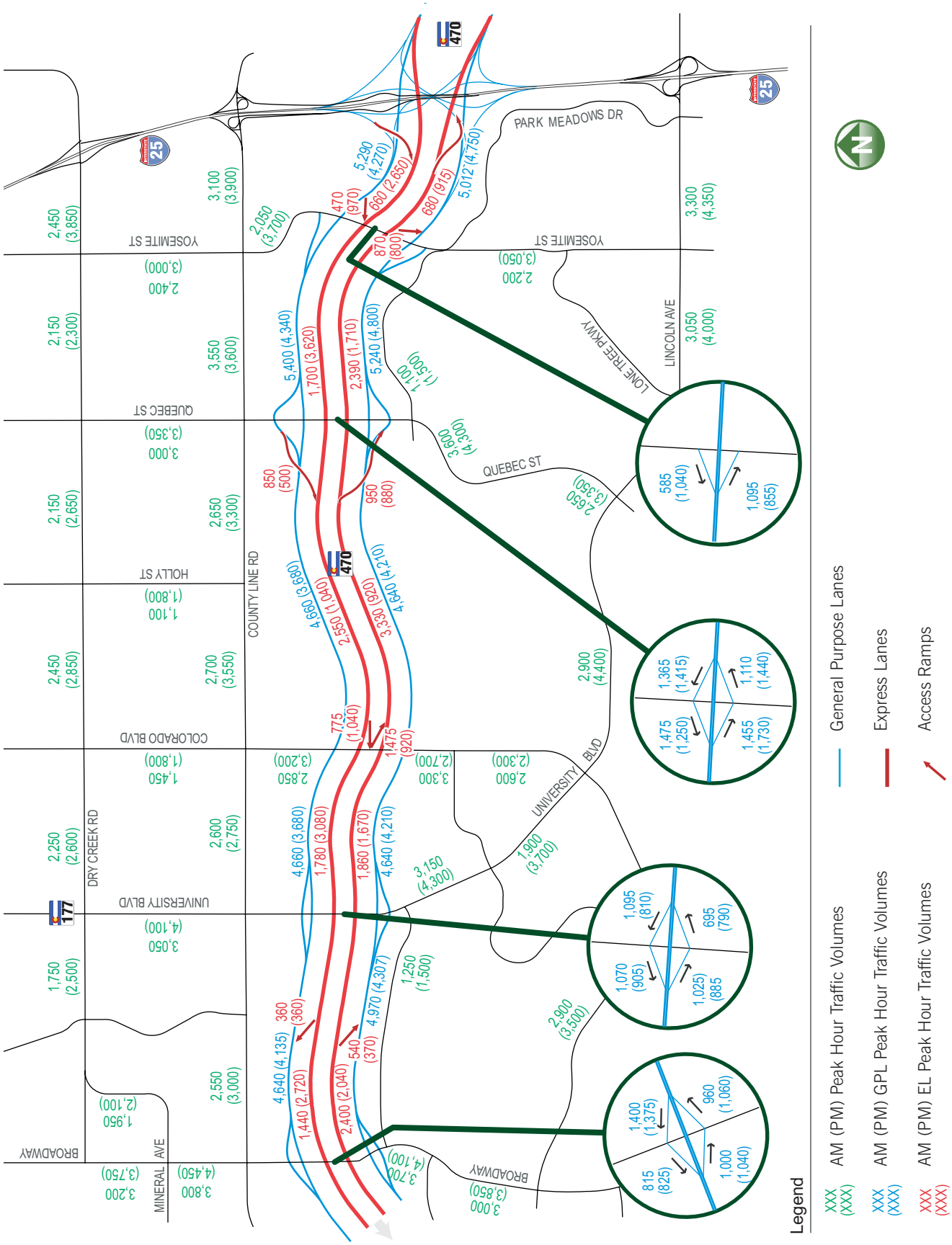


Figure 3-14b
2025 Express Lanes Alternative Traffic Volumes



These results indicate that the performance of the overall system improves for the EL Alternative, as compared to the No-Action Alternative because it serves more vehicles while reducing the overall time drivers spend on the facility.

TRAVEL PATTERNS. The additional capacity provided by the EL Alternative would result in a higher-intensity peak period, but for a shorter amount of time for both the freeway and arterial system, as compared to the No-Action Alternative. The EL Alternative could accommodate additional demand from the adjacent arterial streets that could not be accommodated in the No-Action Alternative. This is observed at Colorado Boulevard where the proposed express lane access reduces the demand on adjacent interchanges by serving trips oriented to and from the adjacent communities.

Figure 3-12a, **Figure 3-12b**, **Figure 3-13a**, **Figure 3-13b**, **Figure 3-14a**, and **Figure 3-14b** show the volumes derived from the AIMSUN micro-simulation model for the No-Action, GPL, and EL Alternatives, respectively. Compared to No-Action, the EL Alternative traffic volumes would be 18 to 22 percent higher on Wadsworth Boulevard and 10 to 20 percent higher on sections of Chatfield Avenue.

Other differences between the EL and No-Action alternatives would occur on Santa Fe Drive north of County Line Road (seven percent decrease with EL Alternative); Broadway (10 to 25 percent increase with EL Alternative); sections of County Line Road; and along Town Center Drive (50 percent increase with EL Alternative). These differences in the projected EL Alternative traffic volumes can be attributed to the proposed locations of C-470 express lane access between Lucent Boulevard and University Boulevard.

Traffic volume differences between the EL Alternative and the No-Action Alternative on County Line Road (20 to 30 percent increase), Quebec Street (15 to 20 percent increase), and Colorado Boulevard (20 to 30 percent increase) can be attributed to the proposed express lanes access at Colorado Boulevard and between Quebec Street and Yosemite Street.

INTERCHANGES AND ARTERIAL INTERSECTION OPERATIONS. Intersection delays were evaluated to determine the LOS for arterial intersections for 2025 volumes. Overall, projected intersection operations are generally consistent between the No-Action and EL Alternatives. The EL Alternative is expected to provide slightly better intersection operations at the Wadsworth Boulevard interchange than the No-Action Alternative. The intersection of Chatfield Avenue and Platte Canyon Road is projected to operate under severely congested conditions. The LOS analysis indicates that 56 of the 67 intersections operate at LOS D or better during the AM period, and 45 intersections operate acceptably for the PM peak period. Most of the intersections with congested operations are in the eastern section of the project area. Analysis results for the intersections requiring mitigation are shown in **Tables 3-23a** and **3-23b**. Due to the express lane access at Colorado Boulevard, the EL Alternative would increase intersection delay at the Colorado Boulevard intersections with County Line Road and Dry Creek Road.

The EL Alternative would result in the same effects to the local street system as the GPL Alternative.

SAFETY. The EL Alternative is expected to provide similar safety benefits to those described for the GPL Alternative. However, an incremental increase in accident frequency over the GPL Alternative can be expected due to additional turbulence generated in the

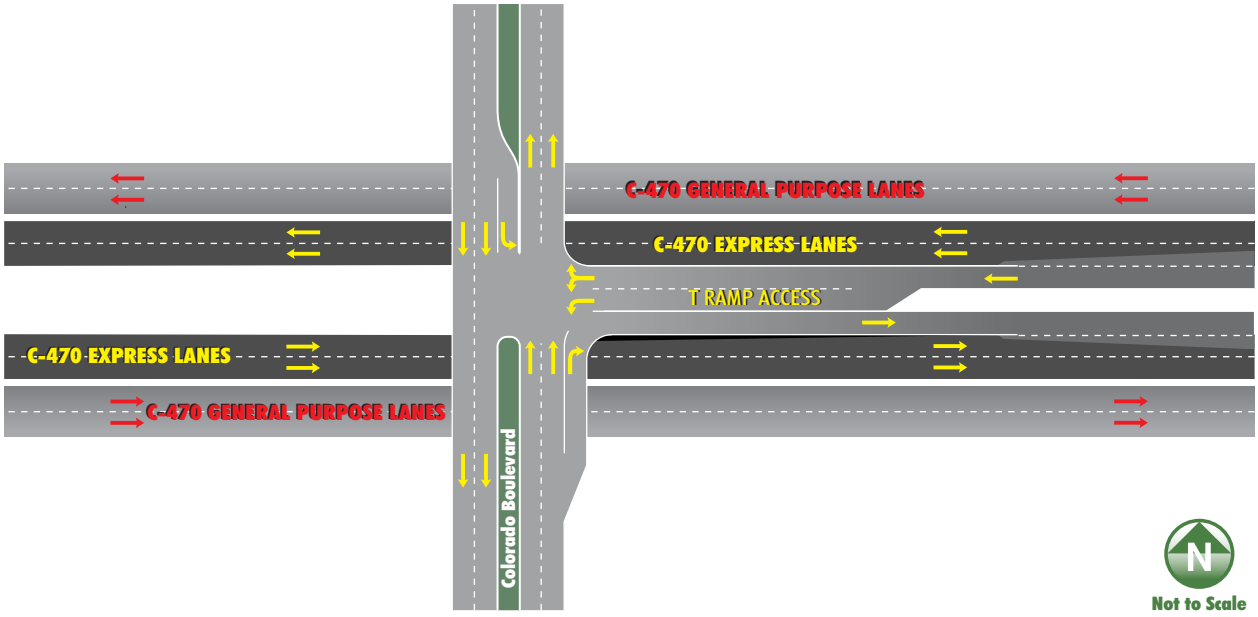
general purpose lanes portion near ingress and egress points to the express lanes. The EL Alternative is also expected to address geometric problems at interchanges identified in the existing conditions analysis.

SANTA FE DRIVE INTERCHANGE OPERATIONS. The Santa Fe Drive interchange under the EL Alternative would have effects similar to the GPL Alternative, as shown in **Tables 3-21a** and **3-21b**. However, the express lane access point between Lucent Boulevard and Broadway carries a portion of Santa Fe Drive-oriented C-470 traffic through Lucent Boulevard and County Line Road, reducing the burden on Santa Fe Drive. This would lead to poorer operations at the Santa Fe Drive/County Line Road intersection for the EL Alternative. As stated previously, the Express Lanes Alternative operates at mainly LOS C/D during both peak hours.

I-25 INTERCHANGE OPERATIONS. Like the GPL Alternative, the I-25 interchange would accommodate 35 to 50 percent higher volumes for the EL Alternative as compared to the No-Action Alternative during peak hours. Also similar to the GPL Alternative, northbound I-25 to C-470/E-470 and the C-470/E-470 to southbound I-25 ramps are expected to operate at LOS F due to high-volume conditions and the unavailability of adequate capacity. This would cause queuing, delays, and LOS F on mainline I-25, C-470, and E-470. Operational problems on C-470 would significantly reduce the desirability of express lanes and adversely influence the arterials and interchanges along C-470. Weave movements on I-25 between C-470/E-470 interchanges and Lincoln Avenue interchange are also projected to operate at LOS F and affect adjacent interchanges and operations on mainline I-25. More information on I-25 interchange design and operations can be found in *I-25 Lane Configuration-County Line to Lincoln* (February 2005).

COLORADO BOULEVARD INTERCHANGE EFFECTS. Express lane T-ramps to and from the east at Colorado Boulevard were identified as an optimal express lane ingress and egress access at this location. The layout for this new interchanges is shown in **Figure 3-15**.

Figure 3-15
Access to Colorado Boulevard From the Express Lanes



A sensitivity analysis was conducted to assess the suitability of providing an express lanes access at Colorado Boulevard. Results of the sensitivity analysis indicated that Colorado Boulevard would be the best express lanes access point that serves the most people. This express lanes access results in increased volumes along Colorado Boulevard, County Line Road, and Highlands Ranch Parkway. However, all the intersections along Colorado Boulevard would operate acceptably (LOS D or better) with reserve capacity to handle additional traffic. In contrast, express lanes access at University Boulevard would place a burden on already-congested intersections on major streets, cause more out-of-direction travel, and create congestion on C-470. These effects would not be offset by the benefits of lower volumes on Colorado Boulevard.

An origin-destination analysis was performed to assess the types and origins of trips that would be served by the express lanes access at Colorado Boulevard. Results of this analysis indicated that this access would be used by residents adjacent to Colorado Boulevard and that it would not create any cut-through trips through adjacent neighborhoods. Moreover, express lane access at Colorado Boulevard would decrease daily trips on some neighborhood streets including Venneford Ranch Road by approximately five percent. A portion of the additional volume on Colorado Boulevard would also affect Dry Creek Road. More information on the sensitivity analysis on Colorado Boulevard can be found in *Assessment of Colorado T-Ramp Access to Express Lanes* (December 2004).

The effects of a potential access to Colorado Boulevard from the express lanes can be summarized as follows:

- Access at this location provides adequate access to traffic oriented to/from the area adjacent to the Colorado Boulevard T-ramps and carry approximately 1800 vehicles in the PM peak hour.
- Intersections adjacent to the T-ramp operate at acceptable levels of service (D or better) despite carrying higher volumes on Colorado Boulevard as compared to the General Purpose Lane or the No-Action Alternative. Colorado Boulevard south of the T-ramps carries high volumes to the residential areas adjacent to Colorado Boulevard and University Boulevard. Residential parcels in the City of Centennial (north of County Line Road) contribute 23-31 percent of the total traffic using the T-ramps. The increase in volume between Dry Creek Road and County Line Road along Colorado can be attributed to trips from these residential areas.
- Trips entering and exiting the express lanes at Colorado Boulevard are primarily residential traffic along with some (10-12 percent) commercial trips. About 80 percent of the additional trips (due to the T-ramps) are contained south of Dry Creek Road. Approximately 50 percent of the PM peak traffic entering the express lanes at Colorado Boulevard are from areas south of C-470 with the other half from north of C-470. Approximately 62 percent of the PM peak traffic exiting the express lanes at Colorado Boulevard travel south of C-470 and the remaining 38 percent travel north on Colorado Boulevard.
- The presence of an access point to the express lanes at Colorado Boulevard provides additional options for traffic traveling west from I-25 to south of C-470 between University Boulevard and Quebec Street. The T-ramps not only provide an alternative route to busy streets like University Boulevard or Quebec Street, but also create additional opportunities for other traffic to share the same route by distributing demand and reducing out-of-direction trips.
- The origin-destination percents for the GPL Alternative as compared to the EL

Alternative would change due to the absence of alternative access to C-470. The origin-destination patterns for the GPL Alternative would be very similar to existing travel patterns in the vicinity of Colorado Boulevard.

- Traffic analysis indicates that most of the trips served by the Colorado Boulevard T-ramps are oriented to/from parcels in the vicinity of Colorado Boulevard and do not induce any "cut-through" or out-of-direction trips.

3.3.1.3 Mitigation

No-Action Alternative

No mitigation measures are anticipated for the No-Action Alternative.

General Purpose Lanes Alternative

To mitigate increased traffic and congestion that would result from the GPL Alternative, intersection improvements would be necessary at the following locations, also shown graphically in **Appendix D**; pages D49-D52.

- Lucent Boulevard/County Line Road – add an additional westbound left turn lane and northbound left turn lane

- Broadway/County Line Road – add a 450-foot right turn acceleration lane on County Line Road west of Broadway; add a 550-foot right turn acceleration lane on County Line Road east of Broadway; add a continuous northbound right turn lane between the C-470 westbound off-ramp and County Line Road; add a 300-foot right turn auxiliary lane on southbound Broadway between County Line Road and C-470

- University Boulevard/County Line Road – add a continuous northbound right turn lane between the C-470 westbound off-ramp and County Line Road; add a 600-foot right turn acceleration lane on University Boulevard south of County Line Road; add a 500-foot right turn deceleration lane for the northbound to eastbound right turn

- Colorado Boulevard/County Line Road – physical constraints prohibit mitigation beyond the County Line Road EA improvements in this area

- Quebec Street/County Line Road – add a continuous southbound right turn acceleration/deceleration lane on Quebec Street north of County Line Road

To mitigate the effects of additional traffic on the I-25 interchange, the GPL Alternative includes four interchange modifications to alleviate these operational deficiencies:

- Westbound C-470 would be modified to receive the left-hand merge from northbound I-25 to westbound C-470 ramp through a lane addition. This modification would provide for higher ramp and merge capacity for the northbound I-25 to westbound C-470 movement

- The C-470/E-470 ramps to the southbound I-25 on-ramp would be converted from a single- to a dual-lane ramp, and I-25 would be reconfigured to receive this ramp through a (fourth) lane addition. The modified design for this ramp would produce better operations for the ramp and subsequently for both C-470 and E-470. The fourth through lane for southbound I-25 would be added at the C-470 ramp gore instead of at the County Line Road ramp, indicating that this lane addition would be more appropriate at I-25 than at County Line Road; the lower traffic volume entering from County Line Road could adequately negotiate a lane drop configuration. The volumes on the C-470/E-470 ramps are significantly higher than the County Line Road ramp. This would also allow the development of a two-lane on-ramp (one lane for the eastbound E-470

ramp and one lane for the westbound E-470 ramp) for the C-470 connection to southbound I-25. The County Line Road ramp would remain a ramp entrance drop as it is today

- This fourth through-lane for southbound I-25 would be carried through the Lincoln Avenue interchange instead of dropping it between the Lincoln Avenue off-ramp and the westbound Lincoln Avenue loop ramp. This would allow a ramp lane (traffic from C-470/E-470) to become the freeway through-lane and eliminates a through-lane drop. The elimination of this lane drop was achieved by maintaining the same configuration of the existing westbound Lincoln Avenue loop ramp. This existing condition is an acceleration lane tapered into the through lanes

- The off-ramp from northbound I-25 to westbound C-470 and eastbound E-470 would be modified from a one-lane to a two-lane ramp, which would facilitate better ramp operations and provide for better operations on I-25 by alleviating some of the weaving intensity on I-25. The modified design for northbound I-25 recommends that the gore of northbound I-25 and the C-470/E-470 ramp be moved farther to the south to allow additional distance from this gore to the gore of the C-470/E-470 ramps. The critical issue of this configuration is that this two-lane ramp splits into one lane for each of the C-470 and E-470 ramps. The existing infrastructure does not allow an additional lane to be continued on either of these ramps. Additional distance between the C-470 and E-470 ramp gores and the I-25 mainline gore would facilitate the signing of the C-470/E-470 ramps and the weaves required to move into the correct lane

Express Lanes Alternative (Preferred Alternative)

Mitigation for the EL Alternative would be the same as for the GPL Alternative.

3.3.2 Air Quality

Federal transportation and air quality conformity regulations were developed during the 1990s to ensure that transportation plans, programs, and projects would not jeopardize attainment of National Ambient Air Quality Standards (NAAQS). These regulations are enforceable through Colorado's State Implementation Plan (SIP) for air quality. Colorado Air Quality Control Commission Regulation No. 10, "Criteria for Analysis of Conformity" enacts the federal conformity requirements as part of Colorado's SIP.

Since 1996, the Denver area had remained free of air quality violations until the introduction of the new eight-hour standard for ozone. This ozone standard was violated in 2002 and 2003.

The Denver area is under an EPA approved Early Action Compact (EAC) that voluntarily imposed control measures to lower eight-hour ozone precursors with the goal to clean the air sooner than required by law. If the EAC is successful in achieving its goals, the Denver area will attain the eight-hour ozone NAAQS in 2007.

Conformity requirements apply to transportation plans and programs that are developed by Metropolitan Planning Organizations (MPO) and also to federal transportation projects. The designated MPO for the Denver metro area is DRCOG. DRCOG has demonstrated conformity for the current, approved long-range transportation plan and TIP for the Denver metro area in the following plans:

- *DRCOG Metro Vision 2030 Regional Transportation Plan* (RTP), adopted by DRCOG in January 2005

- *2005-2010 Transportation Improvement Program* (TIP), adopted by DRCOG on March 17, 2004

However, the RTP and TIP do not reflect capacity improvements on C-470 because funding was not identified for the project at the

time DRCOG completed these plans. CDOT is currently working with DRCOG to amend these plans to include the C-470 project. Once the plans are amended, this project can be approved for implementation.

As part of this EA, air quality quantitative and qualitative analyses were performed to determine whether there were differences between the air quality effects of the alternatives under consideration. As required under federal "conformity" regulations, analysis also was conducted to determine whether any alternative would likely cause a conformity emissions budget to be exceeded, and whether localized hotspot concentrations at worst-case intersections would be likely to cause or contribute to a violation of a standard. This detailed analysis is documented in detail in the *Air Quality Technical Report* (March 2005). The type of analysis and the future years assessed for each type of air pollutant were determined based on interagency consultation involving the FHWA, CDOT, DRCOG, the Colorado Department of Public Health and Environment, and the EPA.

3.3.2.1 Affected Environment

C-470 is within the Denver Metropolitan Air Quality Control Region. This airshed includes the entire City and County of Denver, those portions of Adams and Arapahoe Counties west of Kiowa Creek, Douglas and Jefferson Counties, and all of Boulder County except Rocky Mountain National Park. The attainment status for the region with respect to the NAAQS is shown in **Table 3-24**.

DRCOG's latest conformity findings, based on analysis of the *2005-2010 Transportation Improvement Program and Metro Vision 2030 Regional Transportation Plan* (Metro Vision 2030), demonstrated that emissions from on-road motor vehicles will remain within the applicable conformity budgets through 2030, even as the region's population grows by over one million residents and daily vehicle miles of travel

Table 3-24
Denver Regional Air Quality Status, March 2005

Pollutant and Standard	Plan Status	Comments
Carbon monoxide (CO)	Maintenance Plan approved by EPA effective November 2004	Demonstrates attainment through 2013 with a CO emissions budget of 1,520 tons per day
Ozone 1-hour standard	Maintenance Plan approved by EPA in September 2001	Demonstrates attainment through 2013 with emissions budgets of 119 tons per day for Volatile Organic Compounds (VOC) and 134 tons per day for NOx (summer)
Ozone 8-hour standard	Early Action Compact submitted to EPA in July 2004	Demonstrates attainment by 2007. Does not establish new emissions budget
Particulate matter (PM10)	Maintenance Plan approved by EPA in September 2002	Demonstrates attainment through 2013 with emissions budgets of 119 tons per day for PM10 and 134 tons per day for NOx (winter)
Particulate matter (PM2.5)	No violations recorded. No plan required	Not applicable
Sulfur oxides (SO2)		
Nitrogen dioxide (NO2)		
Lead		

Source: Colorado Department of Health and Environment

increase by 50 percent, from 58 million in 2000 to 104 million in 2030.

The air quality analysis for this EA was prepared prior to the adoption of DRCOG's 2030 RTP. At that time, the adopted transportation plan and conformity analysis extended only through the year 2025. This analysis was prepared based on these then-applicable planning assumptions. The results of this analysis show that the No-Action, GPL, and EL alternatives would meet all air quality requirements for all years analyzed.

Subsequent examination of DRCOG's latest conformity findings indicate that the 2030 plan generally meets the standards by slightly increased margins of safety. For example, regional daily carbon monoxide emissions previously were projected to be 1,395 tons in 2025, some 125 tons below the allowable emissions budget (1,520 tons), and now are projected to be 1,207 tons in 2030, or 313 tons under the limit. Similarly, estimated microscale concentrations of carbon monoxide and PM_{10} in the C-470 corridor were so far below the allowable maximums in 2025 that they would clearly not result in any violations of the standards in 2030 either.

Rather than repeat the analysis to incorporate a 2030 planning horizon, when that effort clearly would not yield any different conclusion about project impacts, this EA presents the more conservative results for the 2025 planning horizon, as was required at the time of the analysis. An updated conformity analysis based on the 2030 RTP will be performed by DRCOG as part of the plan amendment process that is needed to approve any C-470 capacity improvements.

One of the inputs to the air quality analysis was the future traffic volume projections on C-470 and on nearby arterial streets that are affected by C-470 traffic. The projections used in the air quality analysis are shown in **Table 3-25**.

Traffic modeling results were obtained from DRCOG, consistent with the planning assumptions used in the RTP. These volumes were used as input to develop turning movements and LOS analysis for the No-Action Alternative using the AIMSUN traffic model. The AIMSUN model was used to project the traffic changes that would occur in response to adding capacity on C-470. The results in **Table 3-25** represent traffic on 13.75 miles of freeway and approximately 80 miles of surrounding arterial streets.

3.3.2.2 Environmental Consequences

The air quality effects of the three C-470 alternatives are discussed in the following sections. They differ among the three respective alternatives, but air quality modeling results indicate that all three alternatives meet federal requirements for all years that were analyzed. Results of the modeling for carbon monoxide are presented in **Table 3-26**. Results pertaining to ozone are

Table 3-25
Projected Daily Vehicle Travel in the C-470 Project Area

Year	Daily Vehicle Miles of Travel in Millions		
	No-Action Alternative	GPL Alternative	EL Alternative
2003	2.66	2.66	2.66
2013	3.13	3.92	3.94
2020	3.30	4.13	4.16
2025	3.42	4.33	4.37
Increase (%) 2003 to 2025:	28.6%	62.8%	64.3%

Source: Derived from C-470 traffic model results

presented in Table 3-27. Results pertaining to particulate matter are presented in Table 3-28.

The discussion of individual alternatives below are followed by a discussion on effects on transportation control measures (TCMs), since all three alternatives have the same impact on TCMs. Discussion of alternatives collectively, rather than individually, is also provided for mobile source air toxics, under the heading of Hazardous Air Pollutants, at the end of this section.

Table 3-26
Modeling Results for Carbon Monoxide

Year		No-Action Alternative	GPL Alternative	EL Alternative
Regional emissions budget is 1,520 tons per day				
2013	Corridor contribution	45.5	61.9	62.3
	Regional total	1,169	1,185	1186
2020	Corridor contribution	52.1	65.3	65.7
	Regional total	1296	1309	1310
2025	Corridor contribution	54.0	68.4	69.0
	Regional total	1381	1395	1396
Modeled microscale concentrations (8-hour standard is 9.0 parts per million)				
2025	Broadway/County Line Road	6.74	6.74	6.54
2025	Quebec Street/County Line Road	6.03	6.28	6.80
2025	Santa Fe Drive/north (westbound) C-470 ramps	4.74	4.74	4.55

Table 3-27
Modeling Results for Ozone Precursor Emissions

Year		No-Action Alternative	GPL Alternative	EL Alternative
Volatile Organic Compounds (VOC) Regional emissions budget is 119 tons per day				
2013	Corridor contribution	3.4	4.3	4.3
	Regional total	84	85	85
2020	Corridor contribution	3.3	4.1	4.2
	Regional total	80	81	81
2025	Corridor contribution	3.4	4.3	4.3
	Regional total	86	87	87
Ozone-related Oxides of Nitrogen (NO_x) Regional emissions budget is 134 tons per day				
2013	Corridor contribution	3.4	5.1	5.1
	Regional total	96	97	97
2020	Corridor contribution	3.3	4.5	4.6
	Regional total	88	89	89
2025	Corridor contribution	3.8	4.8	4.8
	Regional total	93	94	94

Note: This analysis pertains to the traditional 1-hour ozone standard, not the newer 8-hour standard

No-Action Alternative

Under the No-Action Alternative, traffic will continue to build on C-470 and surrounding arterial streets due to planned growth within the project area. Corridor-wide traffic growth of approximately 37 percent will increase emissions due not only to the increased number of vehicle miles traveled, but also to excess emissions attributable to reduced travel speeds caused by worsened traffic congestion.

Air quality modeling and projections that have been prepared for the region's adopted RTP adequately reflect both the future traffic conditions and the future vehicle-related emissions associated with the No-Action Alternative, because the plan does not include capacity improvements on C-470. Regional emissions projections made for DRCOG's conformity analysis indicate that the region will remain within EPA-approved emissions budgets for the foreseeable future. **Tables 3-26, 3-27**, and **3-28** show the results of the emissions analyses for the No-Action Alternative with respect to the various criteria pollutants.

The microscale "hotspot" analysis conducted for the C-470 EA concludes that the No-Action Alternative would not cause localized violations of the air quality standards for carbon monoxide and particulate matter (PM_{10}) during the next two decades. The hotspot analysis for carbon monoxide was performed using the CAL3QHC dispersion model, while the result for particulate matter was derived qualitatively based on detailed modeling prepared for the region's EPA-approved PM_{10} Maintenance Plan. The results are shown in **Table 3-26** and **Table 3-28**. All hotspot results are well within allowable limits, based on the NAAQS.

General Purpose Lanes Alternative

Under the GPL Alternative, traffic would continue to build on C-470 and surrounding arterial streets due to planned growth along the corridor. Of the 73 percent traffic growth on the corridor, half would be due to planned growth along the corridor and half would be due to the addition of capacity lanes on C-470. This would be comparable to, but just slightly less than, the EL Alternative, because the general purpose lanes on C-470 would attract more traffic than the express lanes.

The GPL Alternative would result in increased corridor-wide motor vehicle emissions, due to

Table 3-28
Modeling Results for Particulate Matter

Year		No-Action Alternative	GPL Alternative	EL Alternative
PM_{10} Regional emissions budget is 51 tons per day				
2020	Corridor contribution	2.0	2.5	2.5
	Regional total	47.3	47.8	47.4
2025	Corridor contribution	3.0	2.6	2.6
	Regional total	50.2	50.8	50.8
NO_x Emissions related to PM_{10} Regional emissions budget is 101 tons per day				
2020	Corridor contribution	3.3	4.1	4.2
	Regional total	86	87	87
2025	Corridor contribution	3.4	4.3	4.3
	Regional total	89	90	90
Worst-case modeled microscale concentrations (24-hour standard is 150 micrograms per cubic meter)				
2025	County Line Road at Quebec Street	117	122	122

the increased number of VMT. Emission rates per mile traveled could decline somewhat, due to elimination of excess emissions attributable to traffic congestion. However, as a conservative modeling assumption, regional average emission rates were used in the analysis of this alternative.

The results of the emissions analyses for the GPL Alternative are shown in **Tables 3-26, 3-27**, and **3-28**. For all years and all pollutants analyzed, emissions under the GPL Alternative would be within the EPA-approved emissions budgets.

As shown in **Table 3-26** and **Table 3-28**, the results of the hotspot analyses conducted for the GPL Alternative are within NAAQS requirements.

Express Lanes Alternative (Preferred Alternative)

Under the EL Alternative, traffic will continue to build on C-470 and surrounding arterial streets due to planned growth along the corridor. Of the 73 percent traffic growth on the corridor, half would be due to planned growth along the corridor and half would be due to the addition of capacity lanes on C-470. Motor vehicle emissions within the corridor would increase due to the increased number of VMT. Emission rates per mile traveled could decline somewhat, due to elimination of excess emissions attributable to traffic congestion. However, as a conservative modeling assumption, regional average emission rates were used to analyze this alternative.

Tables 3-26, 3-27, and **3-28** show the results of the emissions analyses for the EL Alternative. For all years and all pollutants analyzed, emissions under the EL Alternative would be within the EPA-approved emissions budgets.

Hotspot analysis conducted for the EL Alternative indicates that no localized violations of the air quality standards for CO and PM_{10} would be anticipated for the next two decades. These results, presented in **Tables 3-26** and **3-28**, are within NAAQS requirements.

Impact on Transportation Control Measures

Federal transportation conformity regulations require that the FHWA projects which are not from a conforming transportation plan or TIP must not "interfere" with the implementation of any transportation control measure in an applicable air quality implementation plan. The region's applicable air quality plans contain strategies that affect vehicle-related emissions, including compliance with federal tailpipe emissions standards, motor vehicle fuel specifications, and reductions in use of sand for street de-icing. However, because none of these are transportation control measures defined in the regulations, all three C-470 alternatives are in compliance with this conformity requirement. Because they also met the emissions budget tests, all three alternatives meet all applicable conformity requirements for a federal project that is not in a conforming regional transportation plan and TIP.

Hazardous Air Pollutants

In addition to the NAAQS, the EPA also regulates air toxics as discussed in the *Air Quality Technical Report* (March 2005). The Clean Air Act identifies 188 compounds that mostly originate from human-made sources, including on-road mobile sources, non-road mobile sources (e.g., airplanes), area sources (e.g., dry cleaners) and stationary sources (e.g., factories or refineries). Of these compounds, the EPA has identified 21 that are emitted from motor vehicle and are known or suspected to cause cancer or other serious health effects. These compounds, known as Mobile Source Air Toxics (MSATs) include various volatile organic compounds, such as acetaldehyde, benzene, formaldehyde, acrolein, and 1,3-butadiene, as well as metals, diesel particulate matter, and diesel exhaust organic gases. Some of these toxic compounds are present in fuel and are emitted to the air when the fuel evaporates or passes through the engine unburned. Other toxics are emitted from the incomplete combustion of fuels or as secondary combustion products. Metal air toxics result from engine wear or from impurities in oil or gasoline.

The EPA has existing and newly promulgated mobile source control programs that include the reformulated gasoline program, national low emission vehicle standards, Tier 2 motor vehicle emissions standards and gasoline sulfur control requirements, and the proposed heavy duty engine and vehicle standards, and on-highway diesel fuel sulfur control requirements. Between 1990 and 2020, the EPA expects that these programs will reduce on-highway emissions of benzene, formaldehyde, 1,3-butadiene, and acetaldehyde by 67 to 76 percent nationally, and will reduce on-highway diesel particulate matter emissions by 90 percent (16 FR 17229, March 29, 2001).

The analysis of air toxics is an emerging field, however. To date, the EPA – the lead Federal agency responsible for the scientific study of air pollutants and for the development of national air quality standards – has not developed NAAQS for MSATs or national project level guidelines or guidance for studying MSATs under various climatic and geographic situations. The EPA has also not established toxicity factors for diesel particulate matter. Without standards and guidance for MSATs, the FHWA does not feel that accurate and reliable estimates of actual human health or environmental impacts from MSATs that may result from transportation projects are scientifically possible at this time.

However, the U.S. DOT and the FHWA are currently working with the EPA to develop and evaluate the technical tools necessary to perform air toxics analysis, including improvements to emissions models and air quality dispersion models. The FHWA's ongoing work in air toxics includes a research program to determine and quantify the contribution of mobile sources to air toxic emissions, the establishment of policies for addressing air toxics in environmental reports, and the assessment of scientific literature on health impacts associated with motor vehicle toxic emissions.

Although there are quantitative methods that can be used, the FHWA does not consider them appropriate and accurate for estimation of the health impacts of MSATs. However, it is possible to qualitatively assess future MSAT emissions. Since the amount of MSATs emitted are proportional to the amount of vehicle miles traveled, or VMT and congestion, it is possible to compare the difference in VMT and congestion between the GPL and EL Alternatives to the No-Action Alternative and determine which alternative is likely to produce greater MSAT emissions in the future, assuming that other variables, such as the mix of vehicle types and age, are the same. For the DRCOG regional air quality planning area, although it is estimated that VMT in 2030 for the No-Action Alternative will be lower than the GPL or EL Alternatives, congestion in the GPL or EL Alternatives would be lower than the No-Action Alternative. Therefore, total MSAT emissions are likely to be lower in the future for the GPL or EL Alternatives than the No-Action Alternative. Furthermore, regardless of the alternative selected for C-470, regional MSAT emissions will likely be lower in 2030 than they are today. This is due to the implementation of EPA's national control programs that are projected to reduce national MSAT emissions by 67 to 90 percent. Although local conditions, such as the age and type of vehicles in the fleet, VMT growth rates, and local control measures, may differ from those used to derive these national projections, the magnitude of the projected reductions by EPA are so great that MSAT emissions in the region and along the C-470 Corridor are likely to be much lower in the future as well.

The science and modeling of project specific MSAT health impacts has not developed to the point where there is certainty or acceptance by the scientific community. Accordingly, health effects have not been provided for the No-Action or the action alternatives evaluated in this EA, and the means to obtain this information have not been fully developed. When this is the case, Federal regulations require the FHWA to include the following information: "1) A statement that

such information is incomplete or unavailable; 2) a statement of the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment; 3) a summary of existing credible scientific evidence which is relevant to evaluating reasonably foreseeable significant adverse impacts on the human environment, and 4) the agency's evaluation of such impacts based on theoretical approaches or research methods generally accepted in the scientific community" (40 CFR 1502.22(b)). These provisions are addressed as follows:

1. Project specific MSAT analysis is an emerging field and the science has not been fully developed and is therefore unavailable. The FHWA is aware that MSAT releases to the environment may cause some level of pollution. What is not scientifically definable is an accurate level of human health or environmental effects that will result from the construction of new transportation facilities or modification of existing facilities. Project-level MSAT risk assessment involves four major steps: emissions modeling, dispersion modeling in order to estimate ambient concentrations resulting from the estimated emissions, exposure modeling in order to estimate human exposure to the estimated concentrations, and then final determination of health effects based on the estimated exposure. Each of these steps is currently encumbered by technical shortcomings that prevent a formal determination of the MSAT effects of this project. The air quality emissions model (MOBILE 6.2) is based on limited data raising concerns over the accuracy of the final estimates. Further, the particulate emissions rates from MOBILE 6.2 are not sensitive to vehicle speed, which is an important determinant of emissions rates (this is a shortcoming for diesel particulate matter, but not the remaining priority MSATs) or acceleration. Given uncertainties in the emissions estimation process, subsequent calculated concentrations would be equally uncertain. But beyond this, the available dispersion models have not been successfully validated for estimating ambient concentrations of particulate matter or reactive organic MSATs. Available exposure models are not well designed to simulate roadside environments. Finally, the toxicity value of at least one of the priority MSATs, that of diesel particulate matter, has not been nationally established, which would prevent the determination of health impacts of this pollutant even if the other necessary tools were available. Thus, current scientific techniques, tools, and data make it impossible to accurately estimate actual human health or environmental impacts from MSATs that would result from a transportation project.

2. Without this project specific MSATs analysis, it is impossible to quantitatively evaluate the air toxic impacts at the project level. Therefore, this unavailable or incomplete information is very relevant to understanding the "significant adverse impacts on the human environment," since the significance of the likely MSAT levels cannot be assessed.

3. Research into the health impacts of MSATs is ongoing. For different emission types, there are a variety of studies that show that some either are statistically associated with negative health outcomes through epidemiological studies (frequently based on emissions levels found in occupational settings) or that animals demonstrate negative health outcomes when exposed to large doses. There have been other studies and papers that suggest MSATs have health impacts. However, noting that unresolved issues still remain, the Health Effects Institute, a non-profit organization jointly funded by EPA and industry, has undertaken a major series of studies to determine whether MSAT hot spots exist and what the health implications are if they do. The final summary of these studies is not expected to be completed for several more years.

Recent studies have been reported to show that close proximity to roadways is related to negative health outcomes – particularly respiratory problems. Yet these studies are often not specific to MSATs. Instead they have encompassed the full spectrum of both criteria pollutants and other pollutants. Thus it is impossible to determine whether MSATs are responsible for the health outcomes or the criteria pollutants.

There is also considerable literature on the uncertainties associated with the emissions modeling process. The most significant of these is an assessment conducted by the National Research Council of the National Academy of Sciences, entitled "Modeling Mobile-Source Emissions" (2000). This review noted numerous problems associated with then current models, including the predecessor to the current MOBILE 6.2 model. The review found that, "significant resources will be needed to improve mobile source emissions modeling." The improvements cited include model evaluation and validation, and uncertainty analysis to raise confidence in the model's output. While the release of MOBILE 6.2 represents an improvement over its predecessor, the MSAT emission factors have not been fully validated due to limits on dispersion modeling and monitoring data. The MOBILE 6.2 model is currently being updated and its results will not be evaluated and validated for several years.

4. Even though there is no accepted model or accepted science for determining the impacts of project specific MSATs, as noted above, EPA predicts that its national control programs will result in meaningful future reductions in MSAT emissions, as measured on both a per vehicle mile and total fleet basis. The FHWA believes that these projections are credible, because the control programs are required by statute and regulation. Also, since the congestion for both the action alternatives will be lower than the No-Action Alternative, the FHWA is confident that MSAT emissions will also be lower in the project area in the design year (2025). There could be slightly elevated but unquantifiable increases in MSATs to residents and others in a few localized areas where VMT increase, which may be important particularly to any members of sensitive populations. Because MSAT emissions on a per VMT basis are expected to decline due to EPA's control program, the FHWA does not believe that there will be significant adverse impacts on the human environment.

3.3.2.3 Mitigation

No permanent air quality effects were identified for which mitigation would be required. During construction, CDOT would require contractor-implementation of dust control practices in accordance with *Colorado Air Quality Control Commission Regulation No. 1* on fugitive emissions. Temporary air quality effects related to construction are discussed further in **Section 3.3.17**.

3.3.3 Highway Noise

The FHWA has developed methods and procedures for the evaluation and mitigation of highway noise for federal aid projects in the CFR Title 23, Section 772. The FHWA's requirements for highway noise analysis are implemented on CDOT projects using *CDOT Noise Analysis and Abatement Guidelines* (December 2002). These guidelines define criteria for what is considered a noise impact and how mitigation measures should be evaluated. The guidelines state that a noise impact occurs when a noise-sensitive receptor (such as a residence, park, or business) is subjected to noise levels equal to or exceeding CDOT's noise abatement criteria (NAC), as shown in **Table 3-29.** Noise mitigation must be considered for all impacted areas. The guidelines also state that an impact is considered to occur at receptors where predicted noise levels for future conditions are greater than existing noise levels by 10 dBA or more. This is referred to as the Increase Criterion.

Noise levels are measured in decibels (dB). For most environmental noise measurements, including highway noise, the measured levels are filtered such that they more accurately represent what the human ear hears. This process is known as A-weighting. A-weighted decibels are abbreviated dBA; all A-weighted noise readings in this EA are shown as dBA levels.

The components of highway traffic noise include noise from vehicle engines, vehicle exhaust, and tire/pavement interaction. How highway noise is propagated to an adjacent noise receptor, such as a residence, depends on the distance and the path the noise must travel. If terrain or some type of solid barrier blocks the noise path, this level is generally reduced by 5 to 10 dBA. Topography also affects the propagation by absorbing some of the noise if the terrain is grassy, or by reflecting the noise if it is hard pavement or water. Noise is a subjective topic, as some types are considered to be more irritating or noticeable to some than others. Typically, a change of 3 dBA in traffic noise levels is needed for most individuals to notice a difference. A 5 dBA change is typically always noticed, and if a 10 dBA change occurs, most perceive the noise to be doubled (or cut in half).

3.3.3.1 Affected Environment

A noise analysis was conducted for the C-470 Corridor from Ken Caryl Avenue to I-25. Existing noise levels were determined through a combination of measurements and predictions, and the noise levels from the No Action, EL, and GPL Alternatives were predicted. The predicted levels were compared to CDOT's NAC and Increase Criterion to determine impact.

Existing noise levels within the project area were determined through a combination of measurements and predictions. The purpose of these measurements was to determine the current day-to-day noise trends and to validate the computer noise model for the corridor. Noise levels were measured for approximately one week at each of the 11 locations listed in **Table 3-30**. The table shows the measured loudest hour noise level at each location.

A computer model of noise conditions along C-470 was developed using STAMINA (v2.0). The model was validated by comparing measured and predicted noise levels at the 11

Table 3-29
CDOT Noise Abatement Criteria

Activity Category	L_{eq} (1),(2) (dBA)	Description of Activity Category
A	56 (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose
B	66 (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals
C	71 (Exterior)	Developed lands, properties, or activities not included in Categories A or B above
D	--	Undeveloped lands
E	51 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals and auditoriums

(1) Hourly A-weighted equivalent level for the noisiest hour of the day in the design year
(2) CDOT noise impact criteria are 1 dBA lower (more stringent) than the FHWA values in 23 CFR 772, to identify noise levels that "approach" the FHWA criteria

locations. Results were compared using both traffic monitored during the noise measurements and typical loudest hour traffic volumes. Field investigations and analyses concluded that conditions exist along portions of the corridor that result in higher measured than predicted noise levels which could be due to the rolling topography, typical wind conditions, and the worn concrete pavement. As the STAMINA noise model does not account for all of these conditions, it was determined that a correction factor was needed for locations east of Kipling Parkway in which C-470 was the primary noise source. As a result, a positive 3 dBA correction factor was added to all predicted noise levels in this study. The *Noise Analysis Technical Report* (July 2005) describes the analysis and result in detail.

3.3.3.2 Environmental Consequences No-Action Alternative

Noise levels from C-470 will change between existing and 2025 no build conditions, primarily due to changes in traffic volume and speed. Traffic noise is loudest when significant amounts of traffic travel at relatively high speeds; this is referred to as LOS C/D conditions. When more traffic is added to the flow, noise levels will increase as long as there is no decrease in speed. As is the case in many sections of the existing highway, the peak period traffic volumes exceed highway capacity, resulting in a decrease in speeds and noise levels. Therefore, the loudest hour occurs just before and just after periods of congestion.

For nearly the entire project area, the rush hour periods are congested. Additional traffic, with no increase in capacity, will increase the amount of congestion each day. During these times, noise levels will decrease by as much as 5 to 10 dBA compared to the noise level of free-flow traffic. The loudest hour will shift in time, but will not get louder. Thus, the No-Action (2025) loudest hour is equivalent to the existing conditions (2003). When the highway is not congested, noise levels will increase by 1 to 2 dBA, since there will be an increase in volume with no decrease in speed.

Table 3-30
Existing Measured Loudest-Hour Noise Levels

Location	Distance to C-470 (Feet)	Measured Loudest Hour Noise Level (dBA)
Crest Apartments at C-470/I-25	420	64
Canyon Ranch Apartments/north of C-470 at Colorado Boulevard	330	72
Highlands Ranch homes south of C-470, east of University Boulevard	430	71
Highlands Ranch homes between Dad Clark Drive and C-470	350	69
Kensington Ridge Neighborhood/north of County Line Road	320	66
Bluffs Apartments/north of C-470	200	73
Bowen Farms/ South of C-470	340	70
Gleneagles Village/ second row of homes south of C-470	640	62
Willow Creek Neighborhood/north of County Line Road	1,000	65
Chatfield Bluffs residences/south of C-470	250	64
Meadowbrook Heights/north of C-470	290	64
Average	~400	~64

General Purpose Lanes Alternative

For the GPL Alternative, noise levels are predicted to range from 55 dBA to 74 dBA at the residential areas, an increase of 1 and 6 dBA over existing conditions. A total of 28 residential locations and 15 commercial locations exceed the NAC.

For this alternative, the mainline traffic volumes are greater, Colorado Boulevard volumes are less, and ramp traffic from C-470 to I-25 southbound is further away than for the EL Alternative. Overall, the GPL Alternative would be 1 dBA louder than the EL Alternative.

All noise effects are due to exceeding the NAC under Category B or C, as listed in **Table 3-29**. For the GPL Alternative, one additional residential impact would occur when compared to the EL Alternative, due to Province Center and Hunting Hill being impacted only under the GPL Alternative, and the Crest Apartment Homes only being impacted under the EL Alternative. In accordance with CDOT's *Noise Analysis and Abatement Guidelines* (2002), all impacted locations are required to be analyzed for potential noise mitigation, as described in **Section 3.3.3.3**.

Express Lanes Alternative (Preferred Alternative)

For the EL Alternative, noise levels are predicted to range from 54 dBA to 74 dBA at the residential areas located within the corridor. Noise levels are predicted to increase by 1 dBA to 5 dBA over existing conditions. A total of 27 residential locations and 15 commercial locations exceed the NAC.

The primary differences in noise between the two action alternatives are that the mainline traffic volumes would be greater for the GPL Alternative; Colorado Boulevard volumes would be greater for the EL Alternative; and ramp traffic from C-470 to I-25 southbound would be shifted closer to the nearby residences for the EL Alternative. Overall, the EL Alternative is 1 dBA quieter than the GPL Alternative; however, this difference would not be distinguishable to the human ear.

Noise effects were assessed by comparing the predicted noise levels and noise level increases to CDOT criteria. The impacted Category B (residential type) locations are shown in **Figure 3-16** and are listed in **Table 3-31** for the No-Action, GPL, and EL alternatives. A summary of the NAC C (commercial type) impacted locations is in **Table 3-32**. An overall comparison of all three alternatives is in **Table 3-33**.

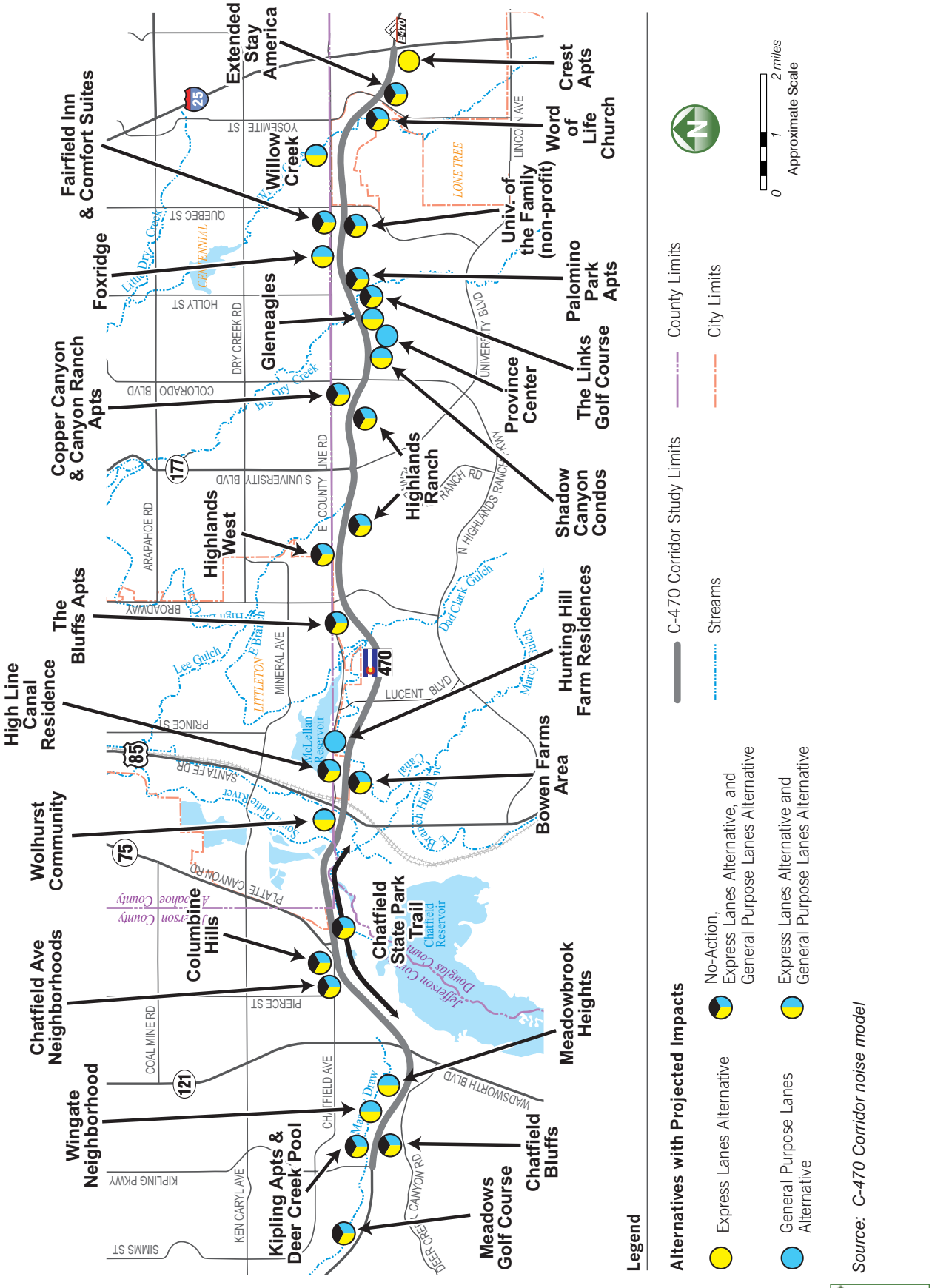
As the maximum noise increase is less than 10 dBA, all noise effects are due to exceeding the NAC. The differences in effects between the action alternatives are that the Province Center and Hunting Hill Farm Residences are impacted only under the GPL Alternative, and the Crest Apartment Homes are impacted only under the EL Alternative. In accordance with CDOT *Noise Analysis and Abatement* Guidelines (2002), all impacted locations are required to be analyzed for potential noise mitigation.

3.3.3.3 Mitigation

To be included in a project, a proposed noise mitigation measure must first be found to be feasible; this process involves reviewing the issues described below:

- The proposed mitigation measure must be predicted to achieve at least 5 dBA of noise reduction at front row receptors
- The proposed mitigation measure must not create any fatal flaw safety or maintenance issues such as reduced sight distances, shadowing of ice-prone areas, and interference with snow/debris removal
- If a barrier, it must be possible to construct it in a continuous manner, as gaps in noise barriers (e.g., for driveways) significantly degrade their performance

Figure 3-16
NAC B (Residential Type) Noise Impact Locations



Source: C-470 Corridor noise model

Table 3-31
NAC B (Residential Type) Impact Summary

Impacted Location	Property Type	Alternative Affected
Meadows Golf Course	Golf course	EL, GPL, No-Action
Kipling Apartments and Deer Creek Pool	Multi-family homes and public facility	EL, GPL, No-Action
Wingate Neighborhood	Single-family homes	EL, GPL
Chatfield Bluffs Neighborhood	Single-family homes	EL, GPL, No-Action
Meadowbrook Heights	Single-family homes	EL, GPL
Chatfield Avenue Neighborhoods	Single-family homes	EL, GPL, No-Action
Columbine Hills	Single-family homes	EL, GPL, No-Action
Chatfield State Park	Park	EL, GPL, No-Action
Wolhurst Community	Single-family homes	EL, GPL
Bowen Farms Area	Single-family homes	EL, GPL, No-Action
High Line Canal Residence	Single-family home	EL, GPL, No-Action
Hunting Hill Farm Residences	Single-family homes	GPL
The Bluffs Apartments	Multi-family homes	EL, GPL, No-Action
Highlands West	Single-family homes	EL, GPL, No-Action
Highlands Ranch - Broadway to University Boulevard	Single-family homes, school, ball field, church	EL, GPL, No-Action
Canyon Ranch and Copper Canyon Apartments	Multi-family homes	EL, GPL, No-Action
Highlands Ranch - west of Colorado	Single-family homes	EL, GPL, No-Action
Shadow Canyon Condominiums (under construction)	Multi-family homes	EL, GPL
Province Center	Single-family homes	GPL
Links Golf Course	Golf course	EL, GPL, No-Action
Gleneagles Village	Single-family homes	EL, GPL
Palomino Park Apartments	Multi-family homes	EL, GPL, No-Action
Foxridge	Single-family homes	EL, GPL
Fairfield Inn and Comfort Suites Hotels	Hotel	EL, GPL, No-Action
Willow Creek	Single-family homes	EL, GPL
University of the Family	Church	EL, GPL, No-Action
Word of Life Christian Center Church	Church	EL, GPL, No-Action
Extended Stay America Hotel	Hotel	EL, GPL, No-Action
Crest Apartment Homes	Multi-family homes	EL

Table 3-32
NAC C (Commercial Type) Impact Summary

Impacted Location	Property Type	Alternative Affected
Southwest Kipling Parkway - W. Toller Drive	Office buildings	EL, GPL
Southeast Kipling Parkway - W. Ute Drive	Office buildings	EL, GPL, No-Action
Southeast Wadsworth Boulevard - Chatfield State Park Offices	Office buildings	EL, GPL
Southeast Lucent Boulevard - Plaza Drive	Office buildings	EL, GPL
Southwest Broadway - Centennial Boulevard	Office buildings	EL, GPL
Northwest Broadway - County Line Road	Office buildings	EL, GPL
County Line Road - Clarkson Street to University Boulevard	Office buildings, storage, retail	EL, GPL
Northeast Colorado Boulevard	Retail	EL, GPL
County Line Road - Holly Street to Niagara Street	Offices, retail, storage	EL, GPL, No-Action
Northwest Quebec Street	Retail	EL, GPL
Southwest Quebec Street - Business Center	Offices, retail	EL, GPL
Southeast Quebec Street - Park Meadows	Retail	EL, GPL
East Parkway Drive - Quebec Street to Yosemite	Retail, auto dealership	EL, GPL
Southwest Yosemite Street - Park Meadows	Retail, miniature golf	EL, GPL
Northeast Yosemite Street - Park Meadows	Retail	EL, GPL

Table 3-33
Comparison of Future (2025) Noise Impacts between the Alternatives

Comparison	No-Action Alternative	EL Alternative	GPL Alternative
Average Noise Level Increase (dBA)	0	3	4
Maximum Noise Level Increase (dBA)	0	5	6
Number of Residential Type Impact Locations* (NAC B)	19	27	28
Number of Commercial Type Impact* (NAC C)	2	15	15
Total Impact Locations* (NAC B and C)	21	42	43

** The above represents the number of impacted locations. However, each location can represent more than one residence. These values are recommended only for comparative purposes between the alternatives*

If a mitigation measure is found to be feasible, it is then analyzed for its "reasonableness."

Reasonableness criteria are:

- The cost benefit index of the proposed measure should not exceed $4,000 per dB of reduction per benefited receptor
- The predicted design year noise levels should equal or exceed the noise abatement criteria
- At least 50 percent of the affected properties should approve of the proposed measure
- Land use in the affected area should be at least 50 percent Category B

In accordance with the FHWA and CDOT noise guidelines, the feasibility and reasonableness of providing noise mitigation was analyzed at each impacted area shown in **Table 3-34**. Mitigation is not recommended for any of the impacted commercial receptors because none of these appear to have active outdoor use. If it is determined that outdoor use does occur or the property owner desires noise mitigation at impacted commercial sites, CDOT's feasible and reasonable test would be applied to determine if mitigation meets the approved criteria.

The most common way to mitigate highway noise is to use noise walls and earthen berms. Other mitigation measures include shifting the highway (vertical and horizontal), restricting trucks, reducing speed limits, or acquiring buffer lands. These other strategies are not considered practical for this project. Potential noise mitigation locations are shown in **Figure 3-17** and summarized in **Table 3-34**. These locations are identical for both the GPL and EL Alternatives, except for the Province Center and Crest Apartment Home locations. In determining the cost benefit of proposed mitigation, costs were calculated using $30 per square foot for walls and $10 per cubic yard for berms using 3:1 slopes. For some proposed mitigation locations, the noise barrier needs to be located beyond the planned ROW acquisitions to be considered feasible. Additional ROW costs were approximated using $6.50 per square foot. No utility conflicts were investigated as part of this analysis. This noise mitigation analysis will be revisited during final design when more accurate information is available.

Potential noise mitigation is considered both feasible and reasonable for approximately 40 percent of the impacted Category B areas. No noise mitigation is recommended for any of the impacted commercial locations, as none appear to have active outdoor use, nor do they typically desire noise mitigation that would block their exposure to the highway. Overall, approximately 30,000 linear feet of noise wall, 3,200 linear feet of noise berm, and 1,500 linear feet of safety barrier are being recommended for inclusion in the project. As most of the analysis sites were done independent of one another, some of the potential noise mitigation for one site overlaps with other sites, thus the actual linear feet of mitigation should be slightly less.

All potential noise mitigation recommendations noted in **Table 3-34** will be reviewed during final design to ensure their validity. For locations that currently have noise mitigation recommended, these should stand, provided there are no flaws in the analysis, unforeseen additional costs, or other environmental issues. All noise mitigation heights represent the maximum height analyzed, and the actual constructed heights will vary depending on re-analysis during final design and input to be solicited from affected property owners. Thus, for some locations where a 20-foot tall wall is shown as reasonable, a shorter wall may also be reasonable and more desirable by either the affected property owners or the project. Similarly, the actual lengths and locations of the recommended mitigation may vary depending on terrain, utilities, property owner desires or easements.

Table 3-34
Summary of the NAC B (Residential Type) Noise Mitigation Analyses

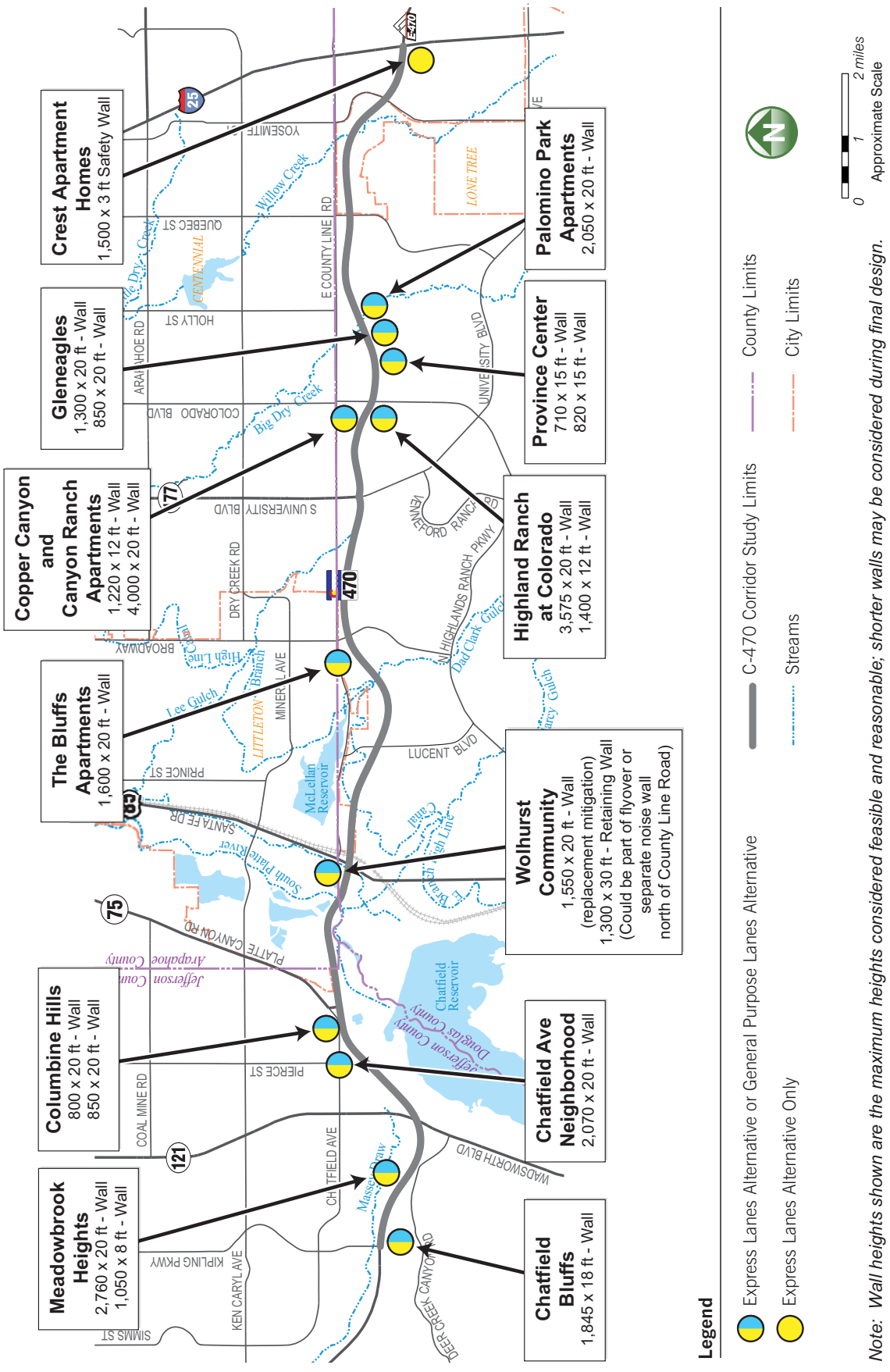
Mitigation Location	Mitigation Type	Mitigation Size Length x Height (feet)[1]	Cost-Benefit Without Additional Right-of-Way Costs ($/dB/Receptor)	Cost-Benefit With Additional Right-of-Way Costs ($/dB/Receptor)	Mitigation Recommendation (Yes/No)
Meadows Golf Course [2]	None	n/a	n/a	n/a	No
Kipling Apartments and Deer Creek Park n Pool	Wall	1,950 x 15	$7,020	n/a	No
Wingate Neighborhood	Wall	2,290 x 20	$6,123	n/a	No
Chatfield Bluffs Neighborhood	Wall	1,845 x 18	$2,731	$4,272	Yes
Meadowbrook Heights	Wall Wall Wall	1,700 x 20 460 x 12 1,605 x 5	$3,070	$3,574	Yes
Chatfield Avenue Neighborhoods	Wall	2,070 x 20	$4,210	n/a	Yes
Columbine Hills	Wall Berm	800 x 20 850 x 20	$4,376	n/a	Yes
Chatfield State Park [3]	None	n/a	n/a	n/a	No
Wolhurst Community [4]	Wall Retaining Wall	1,550 x 20 1,300 x 30	n/a	n/a	Yes
Bowen Farms Area [5]	None	n/a	n/a	n/a	No
High Line Canal Residence [6]	Wall	n/a	n/a	n/a	No
Hunting Hill Farm Residences [7]	Wall	n/a	n/a	n/a	No
The Bluffs Apartments [8]	Wall	1,600 x 20	$2,963	n/a	Yes
Highlands West [7]	None	n/a	n/a	n/a	No
Highlands Ranch - Broadway to University Boulevard[9]	Wall	5,600 x 20	$5,185	$12,593	No

Table 3-34
Summary of the NAC B (Residential Type) Noise Mitigation Analyses (continued)

Mitigation Location	Mitigation Type	Mitigation Size Length x Height (feet)(1)	Cost-Benefit Without Additional Right-of-Way Costs ($/dB/Receptor)	Cost-Benefit With Additional Right-of-Way Costs ($/dB/Receptor)	Mitigation Recommendation (Yes/No)
Canyon Ranch and Copper Canyon Apartments	Wall Wall	1,220 x 12 4,000 x 20	$4,078	$4,394	Yes
Highlands Ranch west of Colorado	Wall Wall	1,400 x 12 3,575 x 20	$4,430	$4,875	Yes
Shadow Canyon Condominiums (5)	None	n/a	n/a	n/a	No
Province Center	Berm Berm	710 x 15 820 x 15	$3,146	$5,448	Yes
Gleneagles Village	Wall Berm	1,300 x 20 850 x 20	$3,795	$4,713	Yes
Palomino Park Apartments	Wall	2,050 x 15	$2,997	$3,189	Yes
Foxridge (7)	None	n/a	n/a	n/a	No
Fairfield Inn and Comfort Suites Hotels (10)	None	n/a	n/a	n/a	No
Willow Creek (10)	None	n/a	n/a	n/a	No
University of the Family (10)	None	n/a	n/a	n/a	No
Word of Life Christian Center Church (10)	None	n/a	n/a	n/a	No
Extended Stay America Hotel (10)	None	n/a	n/a	n/a	No
Crest Apartment Homes (EL Alternative Only)	Safety barrier	1,500 x 3	n/a	n/a	Yes

(1) Wall heights shown are the maximum heights considered feasible and reasonable; final wall dimensions will be determined during final design
(2) Mitigation for the golf course is not reasonable per CDOT criteria
(3) Mitigation for the C-470 trail is not feasible or reasonable for CDOT criteria
(4) The existing noise wall on the south end of Wolhurst will be replaced. Final configuration of the flyover retaining wall will be determined and additional noise analysis will be conducted during final design.
(5) New development not eligible for noise mitigation as a part of this study
(6) Excessively high cost benefit for low number residences
(7) Primarily impacted from County Line Road and addressed by County Line Road EA
(8) Does not include additional ROW cost if applicable
(9) Noise mitigation for this location is not recommended at this time. However, a commitment will be made to perform a full noise analysis during final design to determine if feasibility and reasonableness criteria can be met
(10) No active outdoor use areas. Interior noise levels do not exceed impacts level

Figure 3-17
Potential Noise Mitigation Locations



Note: Wall heights shown are the maximum heights considered feasible and reasonable; shorter walls may be considered during final design.

3.3.4 Water Quality

Federal water quality requirements were first instituted by the Federal Water Pollution Control Act (FWPCA) in 1972. Title IV of the FWPCA created the system for permitting wastewater discharges known as the National Pollutant Discharge Elimination System (NPDES) permit program. These permits place limits on the amount of pollutants that may be discharged to waters of the U.S. The limits are set at levels to protect aquatic life in the waters that receive the discharge, and human health. The first NPDES permits required non-municipal industrial facilities with point source discharges to meet technology-based limits (based on the ability of dischargers in the same industrial category to treat wastewater) or water quality-based limits (if technology-based limits are not sufficient to provide protection of the water body). Best available water quality technologies and cost were considered to form the basis of permit compliance. In 1977, legal challenges forced the reorganization of the FWPCA into what is now known as the Clean Water Act (CWA). These acts established water quality standards that tend to consist of three primary elements:

- Determination of the designated beneficial use or uses of a water body or section of a water body
- Determination of the water quality criteria necessary to protect the use or uses of that particular water body
- Determination of an anti-degradation policy

Many aspects of existing bodies of water are considered including naturally occurring pollutants, low-flow levels, and hydrologic modification.

The NPDES is currently contained under Section 402 of the CWA. Under the current NPDES program, all facilities that discharge pollutants from any point source into waters of the U.S. are required to obtain an NPDES permit. The State of Colorado was granted authority from the EPA to issue these permits and manage the NPDES program through the Colorado Department of Public Health and Environment's (CDPHE) Water Quality Control Division (WQCD). In Colorado, NPDES requirements are implemented through Colorado Regulation 61, Colorado Discharge Permit System Regulations (CDPS).

Development and implementation of a storm-water management plan (SWMP) is one of the main permit requirements. The SWMP contains structural and non-structural BMPs, which are an important component of the CDPS permit. Inclusion of BMPs on construction sites prevents most projects from exceeding state and federal sedimentation and water quality standards.

Another recently enacted permit requirement requires operators of regulated small municipal separate storm sewer systems (MS4) to obtain a CDPS permit and develop a SWMP designed to prevent harmful pollutants from being washed by stormwater runoff into the MS4 (or from being dumped directly into the MS4) and then discharged from the MS4 into local water bodies. The SWMP must address discharges during construction and after a facility is constructed. This permit requirement set forth immediate and stringent controls on construction activity discharges by requiring construction projects one acre or larger in size to secure a CDPS permit for stormwater discharges during construction.

Colorado Regulation Number 93, 2004 Section 303(d) List Water-Quality-Limited Segments Requiring Total Maximum Daily Loads, fulfills section 303(d) of the federal Clean Water Act and requires the WQCD to submit to the EPA a list of those state waters (or state water segments) for which technology-based effluent limitations and other required controls are not stringent enough to implement water quality standards set for use classifications under Regulation 31.

The total maximum daily load (TMDL) process is designed by the Federal Water Pollution Control Act (Clean Water Act) to ensure that all sources

of pollutant loading are accounted for when developing strategies to meet water quality standards. The TMDL itself is an estimate of the greatest amount of a specific pollutant that a water body or stream segment can receive without violating water quality standards. This amount includes a margin of safety, waste load allocation (for point sources), and a load allocation (for non-point sources and natural background). The TMDL process analyzes pollution sources and allocates responsibility among those sources.

Section 303(d) of the Clean Water Act requires states to identify waters that do not or are not expected to meet applicable water quality standards with technology-based controls alone. This identification of water quality-limited waters is presented in a document called the 303(d) list, updated biennially. The 303(d) list identifies specific components (such as nitrate, copper, or sediment) and further identifies the specific water quality problem for that segment. TMDLs are required for all components listed for each stream segment on the 303(d) list.

Implementation of the TMDL process is the final step. The TMDL requires participation from all the stakeholders, as TMDLs are not self implementing. The Waste Load Allocation portion of the TMDL can be implemented through effluent limits in discharge permits. In the case of non-point sources, voluntary controls or locally enacted controls are necessary to implement the load allocations. The state must rely on authority already granted by the Clean Water Act to implement TMDLs.

3.3.4.1 Affected Environment

The South Platte River originates in the mountainous region of central Colorado at altitudes greater than 14,000 feet above sea level and flows generally eastward for 270 miles through the Front Range, the C-470 project area, and across Colorado's eastern plains. Numerous tributaries join the South Platte as it flows north and eastward toward the plains. The South Platte River basin covers over 23,900 square miles.

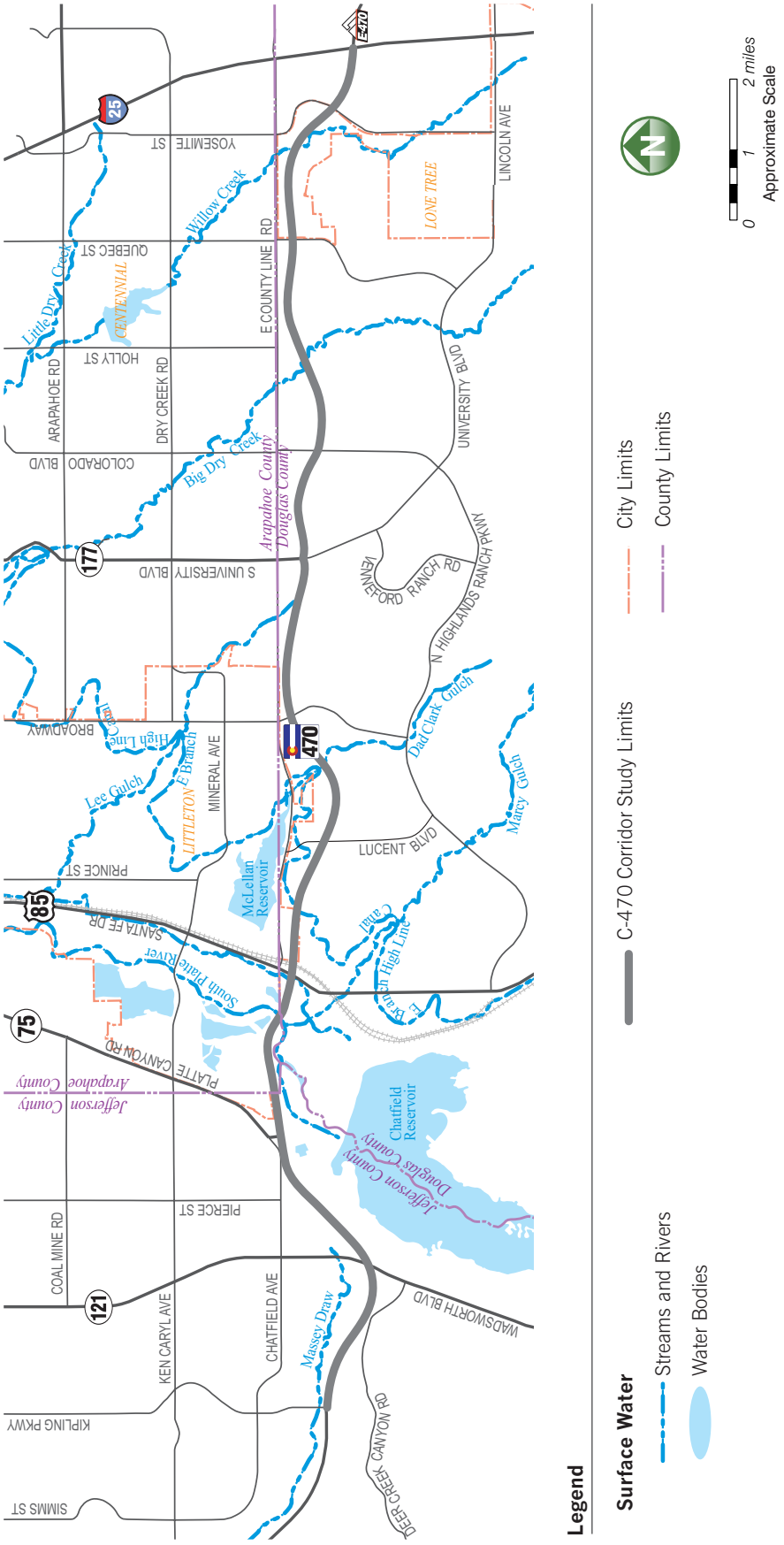
The C-470 project area is located in the Upper South Platte watershed. This watershed is characterized by high plains and rolling foothills, with elevations ranging from approximately 4,800 feet to 8,300 feet above mean sea level. The watershed is highly urbanized with little natural ground cover. The ground cover that does exist is mainly grass with some forested areas. Existing drainages can be characterized as sandy washes that flow intermittently, in response to spring snowmelt or high-intensity precipitation events. Permanent water flows in the South Platte River are a result of upstream dams.

Water quality conditions were investigated for the surface water resources in the project area including Massey Draw, South Platte River, Marcy Gulch, Chatfield Reservoir, McClellan Reservoir, Big Dry Creek, Dad Clark Gulch, and Willow Creek. Surface waters within the project area are shown in **Figure 3-18**. None of the surface water resources in the project area were listed as having water quality impairments based on the most recent CDPHE listing of impaired waters as of May 31, 2004. However, the South Platte River segment from Bowles Avenue to Burlington Ditch is on Colorado's Monitoring and Evaluation List for copper. This segment is located immediately downstream of segment 6c with the project area.

Surface Waters

Chatfield Reservoir is owned and operated by the USACE. It was built as a flood control reservoir on the South Platte in response to the floods of 1965 that caused millions of dollars of damage in the Denver area. The land surrounding Chatfield Reservoir is leased to the Colorado State Parks, which operates the Chatfield State Park Recreation Area. Denver Water uses its own water rights to fill and maintain water in Chatfield. Pursuant to an agreement with the State of Colorado, Denver Water manages its water to supply water for municipal needs, while also maintaining water levels for recreation.

Figure 3-18
Surface Water Resources



Source: U.S. Geological Survey

McClellan Reservoir is a man-made water storage facility located north of C-470 between Santa Fe Drive and Broadway. The reservoir acts as a drinking water supply for the City of Englewood and Highlands Ranch. The City of Englewood and Centennial Water and Sanitation District pump water directly from McClellan Reservoir to supply water to Highlands Ranch.

Chatfield Reservoir, the South Platte River, and McClellan Reservoir are classified by the CDPHE as Aquatic Life Cold Water 1, Recreation 1a, Water Supply, and Agriculture, as discussed in the following sections.

AQUATIC LIFE COLD WATER 1. These are waters that are currently capable of sustaining a wide variety of cold water biota, including sensitive species, or that could sustain such biota but for correctable water quality conditions. Waters shall be considered capable of sustaining such biota where physical habitat, water flows or levels, and water quality conditions result in no substantial impairment of the abundance and diversity of species.

RECREATION 1a. Recreation surface waters are those suitable for or intended to become suitable for recreational activities in or on the water when the ingestion of small quantities of water is likely to occur. Such waters include but are not limited to those used for swimming, rafting, kayaking, and water skiing.

WATER SUPPLY. Water supply surface waters are those suitable or intended to become suitable for potable water supplies. After receiving standard treatment (defined as coagulation, flocculation, sedimentation, filtration, and disinfection with chlorine or its equivalent), these waters would meet Colorado drinking water regulations.

AGRICULTURE. Agriculture surface waters are those suitable for or intended to become suitable for crop irrigation. These water sources are not considered hazardous for livestock.

Massey Draw, Marcy Gulch, Dad Clark Gulch, Big Dry Creek, and Willow Creek originate from snow melt and high precipitation events and possess the characteristics (meandering, reduced velocity, intermittent flows, and sandy substrate) of a high plains stream. These streams are tributaries to the South Platte River and are classified by the CDPHE as Aquatic Life Warm Water 2, Recreation 1a, and Agriculture. The Aquatic Life Warm Water 2 category consists of waters that are not capable of sustaining a wide variety of warm water biota due to physical habitat, water flows or levels, or uncorrectable water quality conditions that result in substantial impairment of the abundance and diversity of species. The recreation and agriculture categories are the same as discussed in previous sections.

Several irrigation ditches and canals are also located in the project area. These waterways are not considered drainage ways and are not subject to the same water quality standards as natural surface waters. The High Line Canal supplies water to several metropolitan parks and lakes. It is also used as irrigation water. Nevada Ditch is used for irrigation only.

The Centennial Water and Sanitation District plans to construct the Centennial Reservoir north of C-470 between Platte Canyon Road and the South Platte River. The site is currently being mined as an aggregate quarry to create the reservoir. The reservoir is anticipated to contain 6,400 acre-feet of storage. Mining of the quarry is expected to cease upon expiration of the lease at the end of 2006. Other site improvements and filling the reservoir continues in 2007, and all construction is estimated to be complete in 2007.

Groundwater Resources

Groundwater is water that flows or seeps downward and saturates soil or rock, supplying springs and wells. According to the U.S. Geological Survey (USGS), the primary source of groundwater for the Denver metro area is

supplied by the Denver Basin aquifer system. No groundwater well head protection areas are located in the project area.

Much of the project area is contained within the Willows and Centennial groundwater classification area in Arapahoe and Douglas Counties. This area contains the Dawson, Denver, Arapahoe, and Laramie-Fox Hills aquifers and is used for both domestic drinking and agricultural uses.

Domestic Drinking Water Systems

The Centennial Water and Sanitation District provides water to most of the C-470 project area. The water is supplied through a conjunctive system (both surface and groundwater). Water supplies in the northern portion of the project area are provided by both Denver and Aurora Water, which primarily gain water through surface waters located outside of the project area. No water from the South Platte River below Chatfield Reservoir is used for drinking water supply.

3.3.4.2 Environmental Consequences

Potential effect to water resources from all of the action alternatives would occur from bridge reconstruction, culvert extensions, and overall increases in highway runoff. Direct effects are most likely to occur during construction activities. These potential effects would be reduced by the implementation of permanent and temporary BMPs as specifically described in the following sections.

No-Action Alternative

The No-Action Alternative would neither improve nor degrade current water quality conditions in the C-470 project area. Current streams and their courses would not be altered. The amount of impervious surface would remain the same, at 135 acres. However, the No-Action Alternative would not involve actions to improve water quality.

General Purpose Lanes Alternative

Impervious surface area would increase from 135 acres to 300 acres. The increase in impervious surface from the highway widening would cause greater volumes of water to runoff into receiving waters. Average daily traffic on C-470 will increase with the GPL Alternative from an existing range of 54,000 to 104,000 to about 78,000 to 175,000 in 2025. Chemical pollutants resulting from increased impervious surface and traffic would wash into water quality facilities. However, these facilities would be effective in preventing chemicals from entering the receiving waters within the project area.

The GPL Alternative includes water quality ponds to meet MS4 requirements. These ponds would collect the "first flush" of storm runoff and thus improve water quality as compared to existing conditions. These water quality ponds will settle out the total suspended solids (TSS) and improve water quality. The ponds are proposed along the entire length of C-470 to provide a detention time of 40 hours for the water quality capture volume (WQCV) for the roadway. Pond locations are illustrated for both action alternatives in **Appendix D**. The surface runoff would exit the ponds through an outlet structure and small storm sewer to a roadside ditch that conveys the runoff to the ultimate receiving waters.

None of the surface waters in the project area are listed as impaired. However, the South Platte River stream segment from Bowles Avenue to Burlington Ditch (downstream from the project area) is on Colorado's Monitoring and Evaluation List for copper. Copper is a common pollutant of roadway runoff, but effects related to copper are not expected. Water quality ponds will be effective at holding copper in stormwater runoff and preventing it from entering streams and groundwater. Pond maintenance will include routine sediment disposal in a landfill, as necessary.

Express Lanes Alternative (Preferred Alternative)

As discussed under the GPL Alternative, none of the surface waters in the project area are listed as impaired. However, the South Platte River stream segment from Bowles Avenue to Burlington Ditch (downstream from the project area) is on Colorado's Monitoring and Evaluation List for copper. The EL alternative is not expected to result in runoff that would contribute to elevated copper levels in surface waters. Because the water quality ponds included in the EL Alternative are similarly designed to those in the GPL Alternative, they will also be effective at retaining copper in the first flush of stormwater runoff and preventing it from entering streams and groundwater. Pond maintenance will include routine sediment disposal in a landfill, as necessary.

The EL Alternative includes water quality ponds to meet MS4 requirements. These ponds would collect the "first flush" of storm runoff and thus improve water quality as compared to existing conditions. These water quality ponds will settle out the total suspended solids (TSS) and improve water quality. The ponds are proposed along the entire length of C-470 to provide a detention time of 40 hours for the water quality capture volume (WQCV) for the roadway. The surface runoff would exit the ponds through an outlet structure and small storm sewer to a roadside ditch that conveys the runoff to the ultimate receiving waters. Impervious surface area would increase from 135 acres to 322 acres. The increase in impervious surface from the highway widening would cause greater volumes of water to runoff into receiving waters. Average daily traffic on C-470 will increase with the EL Alternative from an existing range of 54,000 to 104,000 to about 85,000 to 171,500 in 2025. Chemical pollutants resulting from increased impervious surface and traffic would wash into water quality facilities. However, these facilities would be effective in preventing chemicals from entering the receiving waters within the project area.

3.3.4.3 Mitigation

To meet the MS4 Permit requirements, BMPs were evaluated and recommended for each of the action alternatives. A number of possible options were examined for the action alternatives. The CDOT MS4 Permit Program was consulted to identify and evaluate alternative BMPs to meet the water quality requirements.

Grassed swales and vegetated filter strips would be used for pretreatment wherever possible along the highway. Since the swales or strips would not be relied on to achieve the requirements of the MS4 permit, these water quality BMPs can be accomplished by seeding the shoulders of the road. The swales would be used to carry runoff from the roadway to the water quality ponds and carry the outfall from the water quality ponds to the receiving waters. Although dense grass or vegetation would not likely occur in the grassed swales and filter strips, the vegetation that does grow would help to slow down the runoff and give more time for settling out particulates, even before the runoff reaches the water quality ponds. This BMP would provide a benefit to water quality and should also save project costs.

Extended detention basins (water quality ponds) would also be incorporated into both the GPL and EL Alternatives to meet the MS4 requirements of the EPA. Fifty-three water quality ponds would be placed along C-470 at strategic locations. These water quality ponds would settle out a minimum of 80 percent TSS. This meets the requirements of the MS4. Likewise, it is important for improving water quality because smaller elements in the water, such as heavy metals, attach to suspended particulate matter and settle out of the runoff before entering the main water course. The ponds are proposed along the entire length of C-470 to provide a detention time of 40 hours for the Water Quality Capture Volume (WQCV) from an average storm event for the roadway. A closed storm sewer system with curb, gutter, and inlets would also be implemented in areas where water quality ponds cannot fit in the ROW or be

accommodated due to adverse effects to other environmental resources. Detail on the specific locations of these water quality ponds is in the *Water Quality Technical Report* (July 2005) and shown in **Appendix D**. Efforts would be made during final design to match the pond shapes to existing contour lines as much as possible to achieve a natural appearance.

Large ponds were recommended for use along the entire length of C-470 except through Chatfield State Park. The larger basins would limit the number of ponds that require maintenance. This would allow for easier and more timely removal of sediments from the water quality ponds, which is an important consideration when determining the effectiveness of the BMP. Smaller ponds were recommended through Chatfield State Park. These smaller ponds would be used through this area to stay completely within the existing CDOT easement across USACE property, thus avoiding the need for acquiring property at Chatfield State Park. These small ponds would be located closer to the roadway to allow easier maintenance access, and would provide the same benefit as the larger ponds. Additional details on the screening process for MS4 BMPs and their inclusion in the alternatives can be found in the *Water Quality Technical Report* (July 2005).

In addition to these structural BMPs that would be implemented for either of the action alternatives, other non-structural BMPs are currently being regularly employed by CDOT in an attempt to minimize degradation of water quality system-wide. These strategies include limiting the use of deicer, discontinuing the use of fertilizer, and timely sweeping of roadways after snow events. These strategies would continue and become a part of all three alternatives.

3.3.5 Hydrology and Hydraulics

Hydrologic and hydraulic analysis for the study consisted of two elements: regional hydrology and cross culverts carrying regional drainages under C-470, and roadway drainage carrying storm runoff from the roadway itself. The regional assessment was conducted to check cross culverts for adequate hydraulic capacity and, in some cases, for other considerations such as roadway profile changes, trail underpasses, and wildlife passage. The roadway storm drainage system was designed at a conceptual level to assess their affect on the conceptual water quality pond design and to identify their potential cost.

3.3.5.1 Affected Environment

The major streams and drainages in the project area include Massey Draw, South Platte River, Marcy Gulch, Dad Clark Gulch, Big Dry Creek, and Willow Creek, as shown previously in **Figure 3-18**. Massey Draw flows through a double box culvert under C-470 between Wadsworth Boulevard and Santa Fe Drive. The existing bridge at the South Platte River is a three-span bridge. Marcy Gulch joins the South Platte upstream of the project area. Dad Clark Gulch crosses C-470 through an existing water quality detention outlet structure. A bridge carries C-470 across Big Dry Creek. Willow Creek crosses under C-470 in an existing box culvert. Flows in existing culverts are shown in **Table 3-35**. Detail on stream flows is in the *Hydrology/Hydraulics Technical Report* (March 2005).

One area of hydraulic importance is the South Platte River crossing, just west of Santa Fe Drive. This crossing is immediately downstream of the Chatfield Reservoir dam and spillway. The Chatfield Dam outlet permits a maximum flow of 8,000 cfs, but the actual discharge permitted is currently limited to 5,000 cfs by state statute. However, the USACE is currently conducting a reallocation study for Chatfield Reservoir to increase its storage capacity. That study is anticipated to propose an increase in the maximum allowable discharge rate to 7,000 cfs. While the reallocation study is not yet complete, indications from the USACE are that it will be approved. If this change occurs, then the water surface elevation would rise as a result of the additional 2,000 cfs in the river. No other

changes are being considered that would affect the downstream channel crossing C-470.

The existing 72-inch culvert east of Spring Creek is undersized and cannot pass the 100-year storm. It can only pass 336 cfs at a headwater to diameter ratio of 1.5, but needs to pass 490 cfs for the 100-year storm. Roadway improvements over Spring Creek would require a larger culvert to meet Corridor design standards, and to pass the 100-year storm.

Currently, ditches handle all existing roadway storm drainage. Therefore, no storm sewers are present except at low points that require outlets to the roadside ditches or receiving water-courses.

3.3.5.2 Environmental Consequences

No-Action Alternative

No changes to the existing hydrology or hydraulics would result from the No-Action Alternative.

General Purpose Lanes Alternative

HYDROLOGY AND MAJOR DRAINAGEWAY CROSSINGS. The cross drainages were analyzed using master plans and drainage studies that cover the project area and by delineating basins that contribute runoff to culverts that are 48 inches in diameter and larger. Basins were analyzed further if no published information was available on the basin and/or culvert crossing. The culverts were then sized for

Table 3-35
Existing Cross Culvert Design Flows

Drainageway	Location	Structure No.	Structure Type*	100-year Design Flow (cfs)	Dimensions - Layout			Comments
					Span/ Width Diameter (ft)	Height (ft)	Cells/ Piers	
Massey Draw	100 ft. west of Kipling	F-16-ST	RCP		5			Outside study limits
Massey Draw	2500 ft. east of Wadsworth	F-16-HY	CBC	3,799	12	10	2	Restoration of low flow conveyance capacity
South Platte River	2200 ft west of Santa Fe	F-16-HV	Bridge	7,000	70		2	Bridge replacement for trail
City Ditch	730 ft. west of Santa Fe		HERCP	-	-	-		36” x 58” HERCP
Local drainage	200 ft. west of Santa Fe		HERCP	141	-	-		36” x 60” HERCP
Local drainage	1800 ft. east of Santa Fe		RCP	255	5			
Outfall local detention	1200 ft. west of Lucent		RCP	155	4.5			
High Line Canal	3200 ft. east of Santa Fe	F-16-KP	CBC	-	20	8		
Outfall local detention	800 ft. west of Lucent		RCP	126	3		2	

Table 3-35
Existing Cross Culvert Design Flows (continued)

Drain-ageway	Location	Structure No.	Structure Type*	100-year Design Flow (cfs)	Dimensions - Layout			Comments
					Span/ Width Diameter (ft)	Height (ft)	Cells/ Piers	
Local drainage	1300 ft. east of Lucent		RCP	1,129	6.5		2	
Dad Clark Gulch	2900 ft. west of Broadway		CBC	3,881	6	6		Existing water quality outlet structure to remain
Lee Gulch	2800 ft. west of University		RCP	158	4.5			
Local drainage	900 ft. west of University		RCP	274	4			
Local drainage	700 ft. west of University		RCP	274	3.5			
Local drainage	2400 ft. east of University		RCP	76	3.5			
Big Dry tributary	1600 ft. west of Colorado		RCP	171	4.5			
Big Dry tributary	1100 ft. west of Colorado		RCP	334	5.5			
Big Dry tributary	1500 ft. east of Colorado		CBC	666	8	8		
Local drainage	4400 ft. east of Colorado		CBC	255	6	5		
Big Dry Creek	4900 ft. east of Colorado	F-17-HT	Bridge	3,477	50			Use existing bridge
Local drainage	2700 ft. west of Quebec		RCP	117	4			
Spring Creek	1200 ft. west of Quebec		CBC	1,150	6	8	2	
Local drainage	680 ft. east of Acres Green		RCP	490	7			Replace existing
Local drainage	1700 ft. east of Acres Green		HECMP	65	-	-		58” x 36” CMP
Local drainage	3100 ft. west of Yosemite		CMP	142	5			
Willow Creek	2700 ft. west of Yosemite	F-17-IC	CBC	3,900	12	12	3	

** RCP – reinforced concrete pipe; CBC – concrete box culvert; HERCP – horizontal elliptical reinforced concrete pipe; HECMP – horizontal elliptical corrugated metal pipe; CMP – corrugated metal pipe*

capacity using Haestad Methods Culvert Master to determine whether they could pass the peak 100-year design storm event. Bridge openings have been sized with open channel hydraulics principles using Manning's equation to determine the flow conditions through the proposed bridge openings. For simplicity, a trapezoidal channel was selected as the typical cross section through the bridges.

With the exception of Spring Creek, all existing cross culverts would be retained with this alternative. An existing 72-inch-diameter corrugated steel culvert east of Spring Creek would be replaced with an 84-inch-diameter reinforced concrete pipe culvert to allow for adequate passage of the estimated 100-year frequency design flows. Most culverts along C-470 would be extended to accommodate the wider typical section. The outlets are generally still within the existing ROW, but in cases where they would not fit, additional ROW would be acquired as part of the alternative.

Culvert headwater depths have been calculated to determine if the culverts along C-470 have adequate capacity to pass the 100-year storm event and meet CDOT criteria for this project. These calculations were also used, along with the topographic maps and aerials to determine if any structures might be at risk from lengthening the cross culverts. Based on this initial review no existing buildings would be impacted by any changes in headwater elevations at the culvert crossings.

The existing bridge over the South Platte River would be replaced to improve the horizontal and vertical geometry of the crossing. This replacement would also provide increased flow capacity, improved trail geometry, and enhanced wildlife movement under the bridge. The waterway would have a 100-foot-wide channel bottom. The bridge opening has been sized to pass 7,000 cfs, in accordance with the expected approval of the Chatfield Reservoir Reallocation Study.

There would be no direct effects to Marcy Gulch, as the confluence of Marcy Gulch and the South Platte River is upstream of the study improvements. Dad Clark Gulch would continue to flow under C-470 in the existing water quality detention outlet structure that would remain in place. The bridges over Big Dry Creek would simply be widened while no changes would be made to the channel. The box culvert carrying Willow Creek under C-470 would be extended on the south side to accommodate the wider highway.

ROADWAY STORM DRAINAGE.

The GPL Alternative consists of paving the existing open median and installing a center concrete barrier between directions of travel (the roadway is also widened to the outside). Although generally a storm drainage system would not be required for the majority of the corridor, it would be necessary in a few locations where the horizontal curvature of the highway pavement would be sloped toward the center barrier. The closed storm drainage system would then discharge to roadside ditches to be carried to the nearest watercourse.

With the GPL Alternative, the impervious area increases from 135 acres to 300 acres. This change from pervious to impervious surface would result in increased runoff volume and peak flow rates from the highway. The flow rate increases may cause erosion along ditches and downstream drainageways and could impact water quality.

Express Lanes Alternative (Preferred Alternative)

The analysis of the hydrologic and hydraulic capacity for the EL Alternative was the same as for the GPL Alternative. The existing 72-inch-

diameter corrugated steel culvert east of Spring Creek would be replaced with an 84-inch-diameter reinforced concrete pipe culvert to allow for adequate passage of the estimated 100-year frequency design flows. The existing bridge over the South Platte River would be replaced to improve both horizontal and vertical geometry of the crossing.

With the EL Alternative, the impervious area increases from 135 acres to 322 acres. This change from pervious to impervious will result in an increase of runoff, both in volume and peak flow rates. This increase will result in increased surface water runoff from the site. The increase is not large in regard to the receiving waters. These increases in flow may result in additional erosion along ditches, and downstream drainageways and could impact water quality.

3.3.5.3 Mitigation

To correct the flooding that occurs at the culvert east of Spring Creek, the culvert would be replaced with an 84-inch-diameter reinforced concrete pipe culvert to allow for adequate passage of the estimated 100-year frequency design flows.

Water quality ponds are included in the alternative as permanent BMPs to improve water quality of storm runoff, as discussed in **Section 3.3.4**.

3.3.6 Floodplains

Executive Order 11988, Floodplain Management, requires federal agencies to avoid direct or indirect support of floodplain development whenever a practicable alternative exists. The base flood (100-year flood) is the regulatory standard used by federal agencies and most states to administer floodplain management programs. Flood insurance rate maps (FIRM) from the Federal Emergency Management Agency (FEMA) were used to identify drainages with 100-year floodplains within the C-470 project area.

3.3.6.1 Affected Environment

C-470 intersects five drainages with 100-year floodplains including Massey Draw, the South Platte River, Dad Clark Gulch, Big Dry Creek, and Willow Creek. Flood Hazard Area Delineations (FHAD), Master Plans, and Outfall Planning Studies are available for these drainages and their tributaries through the Urban Drainage and Flood Control District (UDFCD). The floodplains have regulated flood-water elevations (base flood elevations) and regulations on development established by FEMA. Flood insurance rates apply in those areas. Locations of the floodplains are shown in relation to C-470 in **Figure 3-19**.

Flooding in the C-470 project area is typically due to short-duration, high-intensity events from May to September. Since Chatfield Reservoir is immediately upstream of C-470 on the South Platte River, the flow rates passing under the C-470 bridge are controlled by the Chatfield Dam outlet works.

3.3.6.2 Environmental Consequences

No-Action Alternative

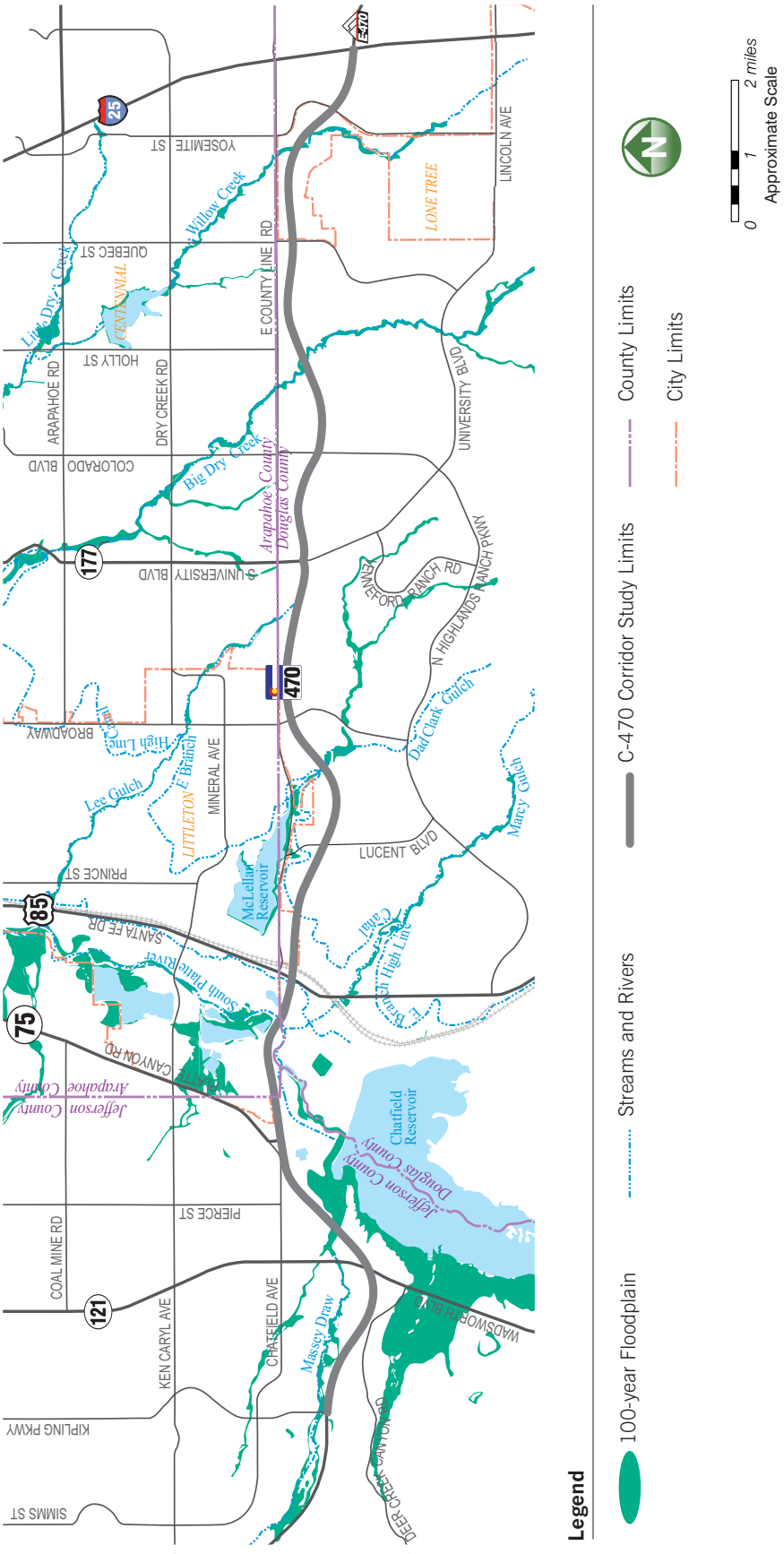
The No-Action Alternative results in no effects to the regulated 100-year floodplains within the project area.

General Purpose Lanes Alternative

Based on the evaluations undertaken, and with proper hydraulic design, effects to the floodplains crossing C-470 would be within acceptable limits, meaning that the flood elevation would not rise or fall more than one foot above or below existing elevations. These changes would not likely change insurance rates for properties within the flood zone near the project area.

Willow Creek has the potential for the water surface to rise as a result of improvements included in the GPL Alternative. The creek runs parallel to the roadway for approximately 1,500 feet upstream of the crossing. Retaining walls are designed into the alternative to minimize encroachment into the floodplain. However,

Figure 3-19
Floodplain Locations



there would still be some rise in the water surface elevation, as shown in **Table 3-36**.

Widening the typical section for the GPL Alternative causes a slight rise in floodwater surface elevations above existing conditions for the regulated floodplains. The rise in floodplain water surface is a result of extending existing cross culverts for the wider typical section. These extensions, projected at the existing grade of the culvert, minimally raise the invert elevation, and the headwater is raised accordingly. However, because the flood elevations would not be raised or lowered more than one foot as a result of the GPL Alternative, it is anticipated that FEMA would not require changes to the FIRMs.

Express Lanes Alternative (Preferred Alternative)

Based on the evaluations undertaken, and with proper hydraulic design, the effects to the floodplains that cross C-470 would be within acceptable limits (within one foot of existing conditions). No changes to insurance rates are anticipated for properties within the flood zone near the project area.

Willow Creek has the potential for the water surface to rise as a result of study improvements. The creek generally runs parallel to the roadway for approximately 1,500 feet upstream of the crossing. Retaining walls have been designed into the alternative to minimize encroachment into the floodplain; however, there will still be a minor rise in the water surface elevation. This effect is the same as demonstrated for the GPL Alternative, as shown in **Table 3-36**.

Widening the typical section for the EL Alternative would cause a slight rise in floodwater surface elevations above existing conditions for the regulated floodplains. The rise in floodplain water surface is a result of extending existing cross culverts for the wider typical section. These extensions, projected at the existing grade of the culvert, minimally raise the invert elevation and the headwater is raised accordingly. However, because the flood elevations would not be raised or lowered more than one foot as a result of the EL Alternative, it is anticipated that FEMA would not require changes to the FIRMs.

3.3.6.3 Mitigation

Although the FIRM shows floodplains as Zone A for four of the five drainages crossing C-470, studies have been approved since the maps were produced that have elevations for the floodplains. Zone A is the flood insurance rate Zone that corresponds to the 100-year floodplain, as determined by approximation methods. Therefore base flood elevations are not shown on the FIRM for Zone A. Once preliminary design and floodplain analysis is completed, this information would be presented to the floodplain administrator to determine if the FEMA regulatory process is necessary to change the FIRMs.

Retaining walls were included in the alternatives at Dad Clark Gulch and Willow Creek to keep

Table 3-36
Forecasted Flood Elevations

FEMA Floodplain	Anticipated Change in 100-year Floodwater Elevation
Massey Draw	No rise. Culvert would not to be extended if retaining walls are used
South Platte River	0.17 foot drop (with additional 2,000 cfs release + new bridge)
Dad Clark Gulch	No rise. Water quality outlet would remain undisturbed
Big Dry Creek	0.68 foot rise
Willow Creek	0.57 foot rise

the roadway fill out of this drainage. The existing water quality structure on Dad Clark Gulch would remain intact without change.

3.3.7 Historic Resources

Section 106 of the National Historic Preservation Act (NHPA), as amended on August 5, 2004, regulations set forth by the Advisory Council on Historic Preservation, and the State Register Act (CRS 24-80.1) require that federal actions must consider any effects to state or federally listed or eligible properties to the National or State Register of Historic Places. A historic resource inventory and eligibility determination was completed as part of this EA.

3.3.7.1 Affected Environment

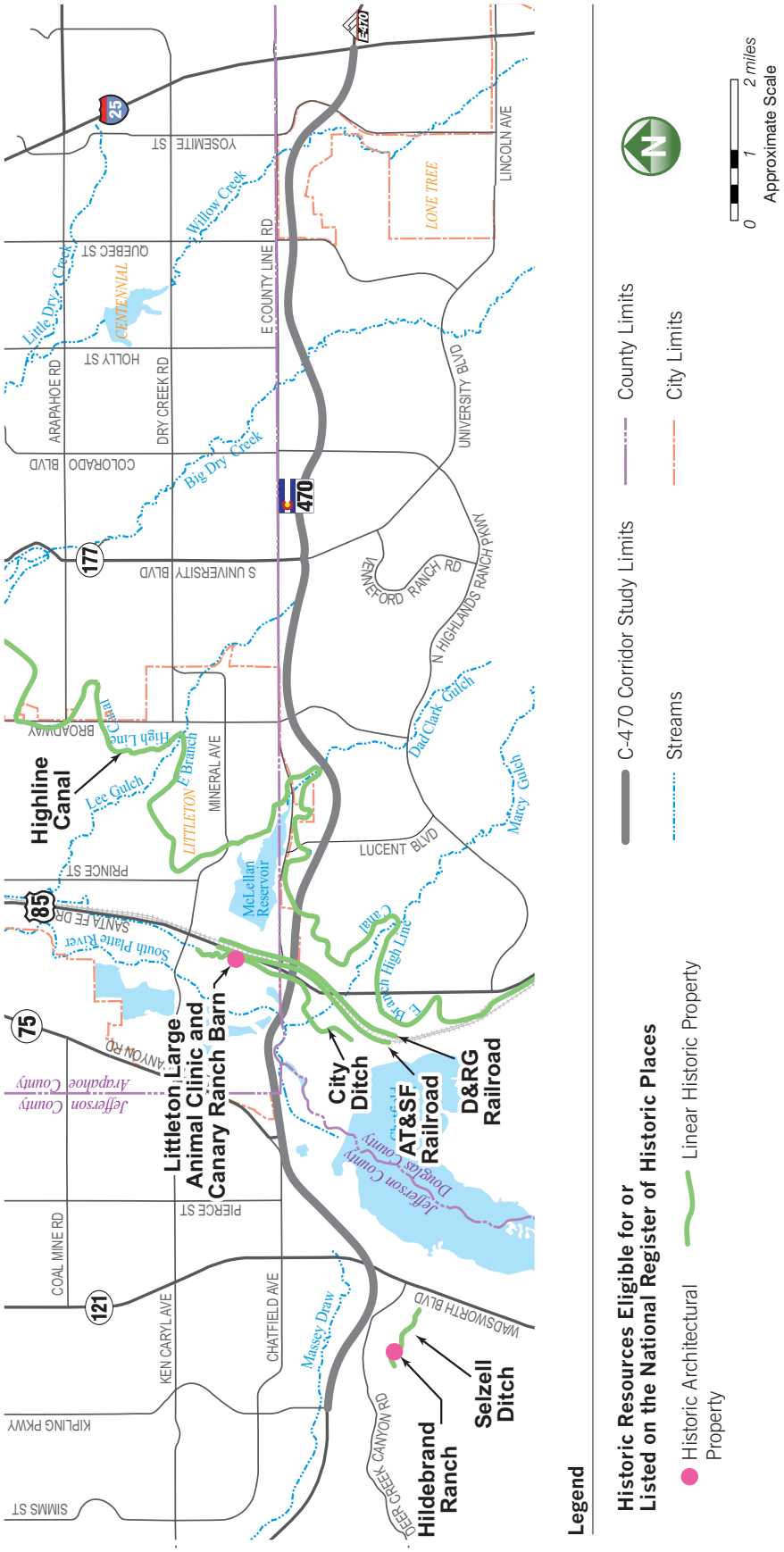
Historic resources were inventoried and evaluated for the Area of Potential Effect (APE), as defined by the FHWA and CDOT with concurrence from the State Historic Preservation Officer (SHPO). The APE was defined as approximately 150 feet on either side of the existing C-470 centerline from Kipling Parkway to I-25, with additional width identified at interchanges, and locations where historic resource property boundaries were known to occur within the project area. In August 2003, a file search was conducted at the Colorado Historical Society's Office of Archaeology and Historic Preservation (OAHP) to identify historic resources. Field surveys were also conducted to identify historic properties in the project area. The *Historic Resource Survey: C-470 Kipling Parkway to I-25* (August 2004) contains details regarding the historic context and all historic resources within the project area. This documentation was submitted to the SHPO in August 2004. The SHPO concurred in September 2004 with Determinations of Eligibility for historic resources in the project area. **Table 3-37** lists properties identified as officially eligible or on the National Register of Historic Places (NRHP) according to their location from west to east along C-470. Locations of these historic resources are shown in **Figure 3-20.**

Table 3-37
Officially Eligible or Listed Historic Properties within the Project Area

Site Number	Site Name	Location	NRHP Eligibility and Date Determined
5JF188	Hildebrand Ranch	8500 Deer Creek Road	National Register (1975)
5JF2613	Selzell Ditch	8500 Deer Creek Road	Officially Eligible (2004)
5AH254.7	City Ditch	Arapahoe County	Officially Eligible (1979)
5DA987.1	City Ditch	Douglas County	Officially Eligible (1979)
5AH732	Littleton Large Animal Clinic and Canary Ranch Barn	8025 Santa Fe Drive, Littleton	Officially Eligible (2004)
5AH255.5	D&RG Railroad	Arapahoe County	Officially Eligible (2004)
5AH256.4	AT&SF Railroad	Arapahoe County	Officially Eligible (1995)
5DA922.1	AT&SF Railroad	Douglas County	Officially Eligible (1990)
5DA922.2	AT&SF Railroad	Douglas County	Officially Eligible (1995)
5AH255.2	D&RG Railroad	Arapahoe County, Littleton	Officially Eligible (1995)
5DA921.1	D&RG Railroad	Douglas County	Officially Eligible (1990)
5AH388	High Line Canal	Arapahoe County	Officially Eligible (2000)
5DA600.3	High Line Canal	Douglas County	Officially Eligible (2004)

Source: Historic Resource Survey: C-470 Kipling Parkway to I-25 (August 2004)

Figure 3-20
Historic Resources



Source: C-470 Corridor Historic Resource Survey, *August 2004*

Hildebrand Ranch Historic District (5JF188)

After the post-Civil War influx of people into the Chatfield Basin area, the Hildebrand Ranch, located at 8500 Deer Creek Road, was established in what is now known as Jefferson County. Frank and Elizabeth Hildebrand settled at the head of Deer Creek Canyon when they purchased the property in 1866 and built a log cabin, slowly developing their ranch. Little is known about the family's antecedents. This property is historically significant as one of the earliest agricultural operations in South Jefferson County. The site is currently interpreted with the assistance of the Denver Botanic Garden, and the site is located within the boundaries of the Denver Botanic Garden at Chatfield. The Hildebrand Ranch was listed on the National Register of Historic Places in 1975 under Criterion A and C for its historic association with domestic agriculture in the Rocky Mountain region prior to the advent of Colorado's railroad era, its continuous operation for over a century by a single family, and its nineteenth-century historical integrity. Today the ranch is part of the Denver Botanic Gardens at Chatfield.

Selzell Ditch (5JF2613)

Selzell Ditch is located near the Denver Botanic Gardens at Chatfield, a nature preserve in southern Jefferson County. Ranchers Peter Selzell and Frank Hildebrand constructed the ditch in 1868 by drawing water from nearby Deer Creek to irrigate their farm and grazing lands. During the period of establishing legal water priorities, Peter Selzell appeared as a witness at an 1883 adjudication hearing for water rights on the Selzell Ditch. Today it is associated with the Hildebrand Ranch National Register District. Selzell Ditch was determined eligible for listing on the NRHP under Criterion A for its association with water rights and irrigation and its contribution to early agricultural and ranching development in Jefferson County, Colorado.

City Ditch (5AH254.7 and 5DA987.1)

The entire City Ditch was determined officially eligible to the NRHP under Criterion A for its historical significance in engineering and irrigation on the Plains and its association with Early High Plains Irrigation and Farming to 1900. The two segments within the APE lack historical integrity, meaning that these segments have been altered from their original form to the point that they no longer meet the criteria for which the entire resource was determined eligible for listing on the NRHP. These segments are considered non-contributing due to the realignment and routing of the ditch into pipes during the construction of C-470 between 1985 and 1990.

Littleton Large Animal Clinic and Canary Ranch Barn (5AH732)

The Littleton Large Animal Clinic and Canary Ranch Barn, located at 8025 South Santa Fe Drive, Littleton, was determined eligible for listing on the NRHP under Criterion C for the Canary Ranch Barn. The barn has a distinctive type of architectural construction – a Bank Barn with dual-level access. The Canary Ranch Barn is located on property that was once associated with the Littleton Large Animal Clinic, but eventually was separated from the property when the land it is situated on was sold to Green Valley Turf Farm. Barns of this age, and especially this design, are growing increasingly rare in urban settings; this may be one of the last of its style in Littleton.

Atchison, Topeka and Santa Fe Railroad (5AH256.4 and 5DA922.1 and 5DA922.2)

The Atchison, Topeka and Santa Fe Railroad (AT&SF RR) in Arapahoe and Douglas Counties was determined eligible for listing on the NRHP eligible under Criterion A for its significant contribution to the expansion of the West and Colorado during the railroad-building era and its role in settlement and community building. All three segments within the APE have historical integrity. The AT&SF Railroad was one of the largest in the United States. It was chartered in Kansas, but did not reach solid footing until after its reorganization in 1863. During Colorado's railroad-building era, the AT&SF managed to stay afloat as others failed. The railroad played an important role in the state's history and devel-

opment connecting the state and its cities to the region.

Denver and Rio Grande Railroad (5AH255.2 and 5AH255.5 and 5DA921.1)

The Denver and Rio Grande Railroad (D&RG RR) in Arapahoe and Douglas Counties was determined eligible for listing on the NRHP under Criterion A for its significant contribution to the expansion of the West and Colorado during the railroad-building era and its role in settlement and community building. It is also eligible under National Register Criterion C for engineering. All three segments within the APE have historical integrity. Following the construction of the First Territorial Road between Denver and Colorado City, a similar north-south route along the foothills was surveyed for the site of the first narrow-gauge railroad in the United States. General William Jackson Palmer and the National Land and Improvement Company provided the funds to construct the railroad between Denver and Colorado Springs.

High Line Canal (5AH388 and 5DA600.3)

The High Line Canal was determined officially eligible for listing on the NRHP under Criterion A for its association with Colorado's early agricultural development. The segments evaluated within the APE have historical integrity. In 1880 plans were completed for the canal, and construction crews began work on the High Line Canal. It would reportedly extend for 70 miles with several laterals. At its head was an intake dam in the South Platte River Canyon in the foothills. The dam was not to store water, but actually to divert water. It was reportedly completed in 1883. The canal was used extensively by farmers and ranchers in northern Douglas County. By 1887 a series of droughts initiated local water rights battles, which later were carried to the Colorado state courts. Eventually in 1924, it became the property of Denver. Today the water flow through the canal is erratic, depending upon water levels of the South Platte River and the needs of water rights owners.

3.3.7.2 Environmental Consequences

Effects to historic resources, as described in this section, were documented in *Historic Resource Effects and Mitigation: C-470 Kipling Parkway to I-25* (March 2005) and concurred upon by the SHPO in April 2005. Douglas County also concurred on the report findings in correspondence from May 2005. Records of this correspondence can be found in **Appendix B**. A summary of the effects determination is provided in **Table 3-38**. Although there are no adverse effects to both City Ditch and the High Line Canal, a finding of de minimis impact under Section 4(f) has been completed. **Section 3.3.8** discusses Section 4(f) resources and the finding of *de minimis* for these historic resources. Correspondence with the SHPO to satisfy the new Section 4(f) requirements for historic resources under SAFETEA-LU can also be found in **Appendix B**.

No-Action Alternative

The No-Action Alternative would not impact historic resources.

General Purpose Lanes Alternative

The GPL Alternative would not cause the highway to encroach on property associated with the Denver Botanic Gardens at Chatfield and the Hildebrand Ranch National Register District or Selzell Ditch, as improvements in this area would be constructed within the existing center median, and would not extend beyond the existing CDOT ROW. At its closest point, the limits of construction would be approximately 1,950 feet from the National Register District and 1,640 feet from Selzell Ditch. No visual or noise effects are expected. This alternative would result in no historic properties affected with regard to the Hildebrand Ranch National Register District or Selzell Ditch.

The portion of City Ditch located under C-470 in the vicinity of the Santa Fe Drive interchange would be re-aligned and re-constructed as the highway is reconstructed as part of the GPL Alternative. During the initial construction of this section of C-470 between 1982 and 1985,

these sections of City Ditch were significantly altered when they were re-aligned and put into pipes south of C-470, under the highway, and north of the highway along Santa Fe Drive. As a result, the City Ditch in this area lacks historical integrity. Therefore, reconstruction of the ditch's pipeline would result in no adverse effect with regard to the City Ditch.

The GPL Alternative would include the addition of a deceleration lane from Santa Fe Drive for access to the southbound flyover ramp to eastbound C-470 in conjunction with the Santa Fe Drive interchange reconstruction. The deceleration lane would be added to the west of the existing edge of pavement and would not require property acquisition from the Littleton Large Animal Clinic. The limits of construction extend to within 12 feet of the Littleton Large Animal Clinic property boundary and 781 feet of the Canary Ranch Barn. Design modifications were implemented specifically to avoid direct effects to this property. Temporary effects such as higher noise levels could occur during construction. However, there are no long term effects. Therefore, there would be no historic properties affected with regard to the Littleton Large Animal Clinic.

Both the D&RG (5AH255.2, 5AH255.5, and 5DA921.1) and AT&SF (5AH256.4, 5DA922.1, and 5DA922.2) Railroads run parallel to Santa Fe Drive within the APE. The widening of Santa Fe Drive as part of the interchange improvements would result in no historic properties affected with regard to any of the referenced segments of these railroads.

During the initial construction of C-470, the section of the High Line Canal within the APE (5AH388 and 5DA600.3) was put in a low, concrete-box culvert to allow the highway to cross over the ditch and not interrupt the flow of water. Despite the widening of the highway, there would be no need to extend the existing box culvert. As part of the GPL Alternative, a concrete retaining wall would be extended from the edge of the pavement down the slope to within 15 feet of the box culvert on both the north and south sides. The concrete wall would stabilize the earthen slope protecting the High Line Canal from erosion associated with the highway. An earthen slope would continue from the edge of the wall down to the head wall of the box culvert. There would be no adverse effect to this historic resource.

Table 3-38
Effects Determination

Site Number	Site Name	No-Action Alternative	GPL Alternative	EL Alternative
5JF188	Hildebrand Ranch	No historic properties affected	No historic properties affected	No historic properties affected
5JF2613	Selzell Ditch	No historic properties affected	No historic properties affected	No historic properties affected
5AH254.7 and 5DA987.1	City Ditch	No historic properties affected	No adverse effect	No adverse effect
5AH732	Littleton Large Animal Clinic and Canary Ranch Barn	No historic properties affected	No historic properties affected	No historic properties affected
5AH255.5, 5AH255.2, and 5DA921.1	D&RG Railroad	No historic properties affected	No historic properties affected	No historic properties affected
5AH256.4, 5DA922.1, and 5DA922.2	AT&SF Railroad	No historic properties affected	No historic properties affected	No historic properties affected
5AH388 and 5DA600.3	High Line Canal	No historic properties affected	No adverse effect	No adverse effect

Source: Historic Resource Effects and Mitigation: C-470 Kipling Parkway to I-25 (March 2005)

Express Lanes Alternative (Preferred Alternative)

The EL Alternative would not cause the highway to encroach on property associated with the Denver Botanic Gardens at Chatfield and the Hildebrand Ranch National Register District or Selzell Ditch, as the improvements in this area would be constructed within the existing center median, and would not extend beyond the existing CDOT ROW. At its closest point, the limits of construction would be approximately 1,950 feet from the National Register District and 1,640 feet from Selzell Ditch. No visual or noise effects are expected. As a result, there would be no historic properties affected with regard to the Hildebrand Ranch National Register District or Selzell Ditch.

The portion of City Ditch located under C-470 in the vicinity of the Santa Fe Drive interchange would be re-aligned and re-constructed as the highway is reconstructed as part of the EL Alternative. During the initial construction of this section of C-470 between 1982 and 1985, these sections of City Ditch were significantly altered when they were re-aligned and put into pipes south of C-470, under the highway, and north of the highway along Santa Fe Drive. As a result, the City Ditch in this area lacks historical integrity. Therefore, the reconstruction of the ditch's pipeline as a result of implementing the EL Alternative would result in no adverse effect to this historic property.

The EL Alternative would include the addition of a deceleration lane from Santa Fe Drive for access to the southbound flyover ramp to eastbound C-470 in conjunction with the Santa Fe Drive interchange reconstruction. The deceleration lane would be added to the west of the existing edge of pavement and would not require property acquisition from the Littleton Large Animal Clinic. The limits of construction extend to within 12 feet of the Littleton Large Animal Clinic property boundary and 781 feet of the Canary Ranch Barn. Design modifications were implemented specifically to avoid direct effects to this property. Temporary effects such as higher noise levels could occur during construction. However, there are no identified long-term effects. Therefore, there would be no historic properties affected with regard to this linear resource.

Both the D&RG and AT&SF railroads run parallel to Santa Fe Drive within the APE. The widening of C-470 or Santa Fe Drive as part of the interchange improvements would not directly or indirectly impact either of these railroads. The bridges were built between 1982 and 1985 and do not meet the minimum 50-year age requirement for eligibility to the NRHP. The C-470 road surface under the railroad overpasses would be reduced to a buffer separation between the general purpose lanes and the express lanes at this location, instead of a barrier separation due to the restricted distance between the bridge piers. Flared, poured-concrete barriers would abut and protect the current bridge piers. These barriers would remain permanently in place as part of the EL Alternative only. The wing walls under the overpasses on either side of the highway would be expanded, but expansion would result in no historic properties affected with regard to either of these two linear resources.

During the initial construction of C-470, the section of the High Line Canal within the APE was put in a low, concrete-box culvert to allow the highway to cross over the ditch and not interrupt the flow of water. Despite the widening of the highway, there would be no need to extend the existing box culvert. As part of the EL Alternative, a concrete retaining wall would be extended from the edge of the pavement down the slope to within 15 feet of the box culvert on both the north and south sides. The concrete wall would stabilize the earthen slope protecting the High Line Canal from erosion associated with the highway. An earthen slope would continue from the edge of the wall down to the head wall of the box culvert. There would be no adverse effect to this historic resource.

3.3.7.3 Mitigation

No mitigation measures for historic resources are anticipated.

3.3.8 Section 4(f) Properties

Section 4(f) was created when the United States Department of Transportation (USDOT) was formed in 1966. It was initially codified at Title 49 United States Code (USC) Section 1653(f) (Section 4(f) of the USDOT Act of 1966). Later that year, Title 23 USC Section 138 was added. Section 138 states: "The Secretary shall not approve any program or project (other than any project for a park road or parkway under Section 204 of this title) which requires the use of any publicly owned land from a public park, recreation area, or wildlife and waterfowl refuge of national, State, or local significance as determined by the Federal, State, or local officials having jurisdiction thereof, or any land from an historic site of national, State, or local significance as so determined by such officials unless (1) there is no feasible and prudent alternative to the use of such land, and (2) such program includes all possible planning to minimize harm to such park, recreational area, wildlife and waterfowl refuge, or historic site resulting from such use." In 1983, Section 1653(f) was reworded and recodified at Title 49 USC Section 303. These two statutes have no real practical distinction and are still commonly referred to as "Section 4(f)".

There would be no publicly-owned lands from parks, recreation areas, or wildlife and waterfowl refuges that would be converted to a transportation use by the GPL Alternative or the tolled EL Alternative. However, as discussed in **Section 3.3.7**, there are seven historic properties eligible for the NRHP in the area of potential effect. One property, the City Ditch (5AH254.7 and 5DA987.1), would require that land from the property be converted to a transportation use for the GPL and EL Alternatives. The entire City Ditch was determined officially eligible to the NRHP under Criterion A for association with irrigation on the Plains and Early High Plains Irrigation and Farming to 1900. Two segments of the ditch were evaluated for this project and were found to lack sufficient integrity to support the overall eligibility of the entire ditch.

3.3.8.1 The Preferred Alternative

The tolled EL Alternative would add up to four express lanes to the existing four general purpose lanes, from Kipling Parkway to I-25, improve ramps for the general purpose lanes, and reconstruct the Santa Fe Drive interchange. This alternative also includes the addition of slip ramps to access the express lanes; the addition of direct access ramps to the express lanes at Colorado Boulevard, Quebec Street, and I-25; and widening or new construction of existing bridges to accommodate an increased number of lanes, which includes but is not limited to the South Platte River, Broadway, University Boulevard, Acres Green Drive, and Yosemite Street bridges.

The existing Santa Fe Drive interchange is currently a substandard diamond interchange with one-lane ramps and two through-lanes in each direction on Santa Fe Drive over C-470. The EL Alternative at the Santa Fe Drive interchange would improve geometric conditions of the standard diamond and add an unsignalized movement with a flyover from south-bound Santa Fe Drive to eastbound C-470 within the limits of the existing interchange.

City Ditch

The portion of City Ditch located under C-470 in the vicinity of Santa Fe Drive interchange would be re-aligned and re-constructed as the highway is reconstructed as part of the EL Alternative. During the initial construction of the section of C-470 between 1982 and 1985, these segments of City Ditch were signficantly altered when they were realigned and put into pipes south of C-470. As a result, these two segments lack sufficient integrity to support the overall eligibility of the entire ditch. Although the work will directly affect the City Ditch, the work will only affect segments of ditch that have already been altered and lack integrity.

3.3.8.2 Finding of De Minimis

Congress amended Section 4(f) when it enacted the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (Public Law 109-59, enacted August 10, 2005) (SAFETEA-LU). Section 6009 of SAFETEA-LU added a new subsection to Section 4(f), which authorizes the FHWA to approve a project that results in a de minimis impact to a Section 4(f) resource without the evaluation of avoidance alternatives typically required in a Section 4(f) Evaluation. Under the "FHWA Guidance for Determining De Minimis Impacts to Section 4(f) Resources" dated December 13, 2005, the SHPO must concur in writing with the Section 106 "no adverse effect" determination and must be informed that the FHWA intends to make a de minimis finding based on the Section 106 effect determination. Consulting parties under Section 106 must also be informed of the de minimis finding.

Because "no adverse effect" determinations under Section 106 have been made by the FHWA for the historic sites impacted by the C-470 Corridor Environmental Assessment project under the preferred EL Alternative, the FHWA, with the concurrence of the Colorado SHPO, has made a finding that the proposed EL Alternative will result in only a de minimis impact to historic sites. This determination, and SHPO's concurrence are documented in **Appendix B** and satisfy the requirements of section 4(f).

3.3.8.3 Coordination and Consultation

In correspondence dated April 8, 2005, the FHWA and CDOT determined that there would be no adverse effect to the City Ditch as a result of the EL Alternative. The SHPO concurred with this finding in correspondence dated April 14, 2005. The Douglas County Historic Preservation Board, the Arapahoe County Board of Commissioners, and the Jefferson County Historic Preservation Committee were also contacted regarding the determinations of effect for this project in correspondence dated April 8, 2005. The Douglas County Historic Preservation Board responded in correspondence dated May 5, 2005 and agreed with the determinations of effect for the project. The other parties listed above did not comment on the project.

The Colorado SHPO concurred with the finding of de minimis on December 5, 2005. The Douglas County Historic Preservation Board was afforded an opportunity to comment on the de minimis finding in correspondence dated December 12, 2005, and responded that they did not object to the de minimis finding, in a email dated December 28, 2005. Copies of the Section 106 and de minimis correspondence are included in **Appendix B**.

3.3.9 Archaeological Resources

In July and August 2004, CDOT archaeologists completed archival research for the project area. This research involved investigating the site and study files housed at the Colorado Office of Archaeology and Historic Preservation and reviewing CDOT records. The entire length of C-470 between I-25 and I-70 was initially inventoried for archaeological resources by the Colorado Department of Highways in 1976, as part of the Section 106 compliance process that preceded highway construction (*The Archaeological Survey of I-470 – Southwest Circumferential. Highway Salvage Report No. 14, 1976*). The parcel within the current project area located east of I-25, along the E-470 alignment, was surveyed under the auspices of the E-470 Authority in 1987 (*Final Report of Cultural Resource Inventory for the Proposed E-470 Corridor, Douglas, Arapahoe and Adams Counties, Colorado, 1988*). From the late 1970s to early 2000s, a number of additional cultural resource studies included portions of C-470, some of which were transportation-related, while others were undertaken as a result of ancillary developments. No additional field survey to identify archaeological sites was necessary for the current study.

3.3.9.1 Affected Environment

The file search identified eight prehistoric sites located completely or partially within the 1000-foot wide APE established for the archaeological resources assessment (500-feet on either side of

the highway centerline). All eight sites were documented during the mid- to late 1970s, well before C-470 was constructed. However, official determinations of National Register eligibility were never completed for many of these resources, a task ultimately undertaken by CDOT for this study. The eight sites have been entirely or partially destroyed by transportation, residential, or commercial construction activities such that they no longer retain physical integrity and/or exhibit the potential to contain significant buried cultural deposits. In September 2004, the SHPO concurred with the FHWA and CDOT evaluations of not eligible for listing on the NRHP for all archaeological sites within the project area. Records of agency correspondence are located in **Appendix B**.

3.3.9.2 Environmental Consequences

No archaeological sites listed on or eligible for the NRHP are located within the project area. As such, the No-Action, GPL, or EL Alternatives would have no effect on this type of historic properties. In the event archaeological remains are exposed during any phase of construction associated with the study, the CDOT Senior Staff Archaeologist will be contacted to evaluate the discovery and coordinate appropriate Section 106 compliance actions with the SHPO and other agencies or entities, as necessary.

3.3.9.3 Mitigation

In the event archaeological remains are exposed during any phase of construction associated with the study, the CDOT Senior Staff Archaeologist will be contacted to evaluate the discovery and coordinate appropriate Section 106 compliance actions with the SHPO and other agencies or entities, as necessary.

3.3.10 Native American Consultation

Section 106 of the National Historic Preservation Act (as amended) and the Advisory Council on Historic Preservation regulations (36 CFR 800.2[c][2][ii]) mandate that federal agencies coordinate with interested Native American tribes in the planning and environmental process for federal undertakings. Consultation with Native American tribes recognizes the government-to-government relationship between the United States government and sovereign tribal groups, and federal agencies must be sensitive to the fact that historic properties of religious and cultural significance to one or more tribes may be located on ancestral, aboriginal, or ceded lands beyond modern reservation boundaries.

Consulting tribes are offered the opportunity to identify concerns about cultural resources and comment on how the project might affect them. If it is found that the project would impact cultural resources that are eligible for inclusion on the NRHP and are of religious or cultural significance to one or more consulting tribes, their role in the consultation process could also include participation in resolving how best to avoid, minimize, or mitigate those effects. By describing the proposed undertaking and the nature of known cultural sites, and consulting with the interested Native American community, the FHWA and CDOT strive to effectively protect areas important to American Indian people. The USACE administers properties within the project area, and as such, that agency has an interest in, and responsibility for, Section 106 compliance and the tribal consultation process. The USACE delegated all tribal consultation responsibilities for the study to the FHWA, the lead agency, but in so doing did not relinquish its obligations, as mandated by federal statute. The USACE maintained an active role and was involved in all facets of the consultation process.

In March 2004, the FHWA contacted 15 federally recognized tribes with an established interest in Arapahoe, Douglas and Jefferson Counties, and invited them to participate as consulting parties. These parties are: Ute Mountain Ute Tribe (Colorado), Southern Ute Indian Tribe (Colorado), Ute Tribe of the Uintah and Ouray Agency ("Northern" Ute) (Utah), White Mesa Ute Tribe (Utah), Cheyenne River Sioux Tribe (South Dakota), Crow Creek Sioux Tribe (South Dakota), Oglala Sioux Tribe (South Dakota),

Rosebud Sioux Tribe (South Dakota), Standing Rock Sioux Tribe (North Dakota), Cheyenne and Arapaho Tribes of Oklahoma (two tribes administered by a unified tribal government), Pawnee Nation of Oklahoma, Comanche Nation of Oklahoma, Kiowa Tribe of Oklahoma, Northern Arapaho Tribe (Wyoming), and Northern Cheyenne Tribe (Montana).

Four tribes responded to the invitation in writing (Northern Arapaho, Southern Ute, Pawnee Nation, and Standing Rock Sioux), of which two (Northern Arapaho and Southern Ute) expressed the desire to be consulting parties for the study. The record of this correspondence is located in **Appendix B**. Neither of the two consulting tribes raised specific issues of concern regarding the proposed undertaking in the context of places of religious or cultural significance.

Each consulting tribe will continue to receive information about the study as it becomes available, and every opportunity will be taken to involve them in the planning and environmental process. In so doing, the FHWA and CDOT have fulfilled their legal obligations for tribal consultation under federal law.

3.3.11 Paleontological Resources

Paleontological resource compliance is mandated by the Colorado Historical, Prehistorical, and Archaeological Resources Act of 1973. In September 2004, the CDOT paleontologist completed archival research for the study area. A literature survey was conducted to evaluate the potential for scientifically substantial paleontological resources within the geologic units of the study area.

3.3.11.1 Affected Environment

The geologic units mapped within the EA study area limits, from youngest to oldest, are shown in **Table 3-39**.

Because of heavy residential and commercial development along C-470 in recent years, there are no potentially fossiliferous bedrock exposures within the study area that merit on-the-ground reconnaissance for paleontological resources. Therefore, no additional field survey to identify paleontological sites was necessary for this EA.

Table 3-39
Geologic Units

Geological Unit	Age
Post-Piney Creek alluvium	Holocene
Piney Creek Alluvium	Holocene
Unnamed colluvium	Holocene and Pleistocene
Unnamed eolian sand	Holocene and Pleistocene
Unnamed loess	Late Pleistocene
Broadway Alluvium	Late Pleistocene
Louviers Alluvium	Late Pleistocene
Slocum Alluvium	Late Pleistocene
Verdos Alluvium	Middle Pleistocene
Dawson Arkose	Late Paleocene to early middle Eocene
Denver Formation	Late Cretaceous to early Paleocene
Laramie Formation	Late Cretaceous
Fox Hills Sandstone	Late Cretaceous
Pierre Shale	Late Cretaceous

3.3.11.2 Environmental Consequences

No-Action Alternative

The No-Action Alternative would have no affect on paleontological resources.

General Purpose Lanes and Express Lanes Alternative (Preferred Alternative)

Construction activity at or above the present ground surface will have no affect on scientifically important paleontological resources. However, potentially fossiliferous units found in pre-Holocene and Pleistocene, Late Cretaceous and Paleocene formations mapped within the EA study area have produced scientifically important fossils within a few miles of the EA study area. These units are not, for the most part, well-exposed naturally, but could be encountered during excavation associated with roadway depression or highway widening within the existing ROW. Subsurface excavation associated with either of the two action alternatives could have an affect on scientifically important paleontological resources, but it is impossible at this time to determine which potentially fossiliferous deposits, if any, would be affected. Most of the known fossil localities within a few miles of the EA study area were uncovered during earth-moving activities associated with sand and gravel mining, housing and commercial development, and highway and railroad construction.

3.3.11.3 Mitigation

CDOT is committed to having a qualified paleontologist on site during major construction excavation to monitor for buried paleontological resources where known fossiliferous deposits are mapped, but not currently exposed at the ground surface.

3.3.12 Geology and Soils

Geologic conditions present within the C-470 project area were identified using information from geologic maps, topographic maps, USGS reports, Colorado Geological Survey publications, United States Department of Agriculture soil survey reports, and geotechnical reports. This information was supplemented with field reconnaissance and communications with local engineering and planning personnel. Evaluation of existing geologic conditions was based on proximity to the corridor, history of occurrence, and effect of occurrence on transportation and mobility. Additional details regarding geotechnical analysis can be found in the *Geology Technical Report* (March 2005). Anticipated effects of the three alternatives as a result of existing geology and soils are described in **Section 3.3.12.2**. Mitigation of geological conditions to the constructed roadway alternatives is then described in **Section 3.3.12.3**.

3.3.12.1 Affected Environment

Regional Geology

The geologic units along the C-470 corridor range from recent unconsolidated river deposits to sedimentary bedrock between 55 and 70 million years old and are directly related to the formation of the Rocky Mountains located west of the highway. Much of the mountainous terrain associated with the Rocky Mountains began during a mountain building event known as the Laramide Orogeny, which began near the end of the Cretaceous Period about 72 million years ago. The mountain building process in Colorado occurred from this time to 65 million years ago, with the last of the major uplifts occurring as recently as the Eocene Epoch, around 50 million years ago. Bedrock found at the northwestern portion of the highway were folded and faulted during these tectonic episodes as the Rocky Mountains formed.

Bedrock along the C-470 Corridor typically consists of hard sedimentary rock, exposed at or near the surface at the western end of the corridor. These rock formations are the oldest at the western end of the corridor, with the younger formations exposed progressively to the east. These sedimentary rocks represent former environments and conditions that existed along the Front Range during the Cretaceous and early Tertiary geologic time periods. These environments include shallow inland seaways, near shore and terrestrial streambed conditions. Closer to the mountain front, the sedimentary

units are tilted up on end, creating a zone of steeply dipping bedrock. The clays and claystones of the bedrock formations underlying the corridor and surficial soils derived from the bedrock typically exhibit erratic swell potential.

Overlying the bedrock formations are deposits of surficial material. These surficial deposits are the result of geomorphic activity that has shaped the present landforms and vary considerably in depth. This activity is primarily related to processes involving wind and water including former and modern streams and rivers. The surficial deposits are younger than the bedrock and are unconsolidated and loose by comparison.

Artificial fill is also found at various locations along the corridor ranging from zero to 15 feet above ground and is used for highway and other road fills, flood control, canal embankments, trash dumps, and sanitary landfills. This material is composed of various amounts of clay, silt, sand, gravel, concrete, brick, and trash. For construction purposes, it is assumed that this material is not suitable unless it can be removed and re-compacted to specified CDOT standards.

A chronological list of geologic units found within the C-470 project area are listed previously in **Table 3-39**, and summarized in the following sections.

POST-PINEY CREEK ALLUVIUM. This geologic formation can be found 1.2 miles west of the Santa Fe Drive interchange and stretches for about 2000 feet. It is light brown to tan silty sand and fine gravel that occurs in modern stream channels, floodplains, and alluvial fills. Generally it is five to ten feet thick. Possible unstable slopes could occur in some cut areas within this geologic unit.

PINEY CREEK ALLUVIUM. Alluvium in this geologic formation can be up to 20 feet thick and consists of dark-gray clayey silt and sand with particles up to cobble size. Due to its formation of terraces just above existing streams, this unit may be subject to seasonal flooding. The highway corridor lies within this formation, approximately 200 feet east of Kipling Parkway for 2000 feet and for 800 feet at a point 1600 feet west of Santa Fe Drive. Possible unstable slopes could occur in some cut areas within this geologic unit.

UNNAMED COLLUVIUM. This geologic unit can be found at many sporadic locations along the corridor. It is composed of brown to light brown sand, sandy silt, and clay. In places it may contain pebbles and cobbles. Generally, colluvium is less than five feet thick. Geologic hazards and constraints associated with this geologic unit include expansive and corrosive soils.

UNNAMED EOLIAN SAND AND SILT. Windblown sand and silt deposits cross C-470 approximately 1000 feet west of Wadsworth Boulevard for one half mile, and again approximately one mile east of the Santa Fe Drive interchange. This wind-deposited, fine to medium sand and silt is grayish-orange to light-brown and five to 25 feet thick. It may contain some loose, unconsolidated zones that are prone to settlement and hydro-compaction when saturated. The density can be determined from blow counts from future subsurface drilling, which will assist in determining the potential effect of construction along this section of C-470.

UNNAMED LOESS. This geologic unit can be found throughout the corridor and is generally 10 feet thick. It is composed of light brown to tan sandy silt deposited by wind. Loess occurs on upland surfaces and is hard when dry, but slightly sticky when wet. Geologic hazards and constraints associated with this geologic unit include expansive and collapsible soils.

BROADWAY ALLUVIUM. This geologic unit is found approximately 800 feet west of the Santa Fe Drive interchange and 1000 feet west of Holly Street, and is generally 10-25 feet thick. It consists of yellowish-orange to

reddish-brown clayey silt and sand, with sections of cobbles, pebbles, and gravel, and serves as an excellent source of gravel for concrete aggregate.

LOUVIERS ALLUVIUM. This geologic unit is found west of the Santa Fe Drive interchange, continuing approximately one mile east, and can be up to 25 feet thick. It consists of reddish-brown pebbly to bouldery material, with manganese and iron staining as well as calcium carbonate coatings. It is often used as a source of gravel for concrete aggregate.

SLOCUM ALLUVIUM. Grayish brown to yellowish brown stratified pebbly clay, silt, sand, and gravel compose this 15-20 feet thick unit. A strongly developed calcium carbonate enriched zone occurs in the upper part of the deposit. This unit can be found for 1000 feet either side of the Wadsworth Boulevard interchange and one mile west of Santa Fe Drive for approximately 1500 feet.

DAWSON/DENVER FORMATION. The Dawson/Denver Formation typically consists of a blend of bluish-gray to olive gray claystones and siltstones and lighter colored sandstones and conglomerates that are variably cemented. The varying degree of cementation affects the hardness and stability of the rock. This formation is exposed for approximately 500 feet at a point 3000 feet west of the Wadsworth Boulevard interchange and can be up to 1000 feet thick. Geologic hazards and constraints associated with this geologic unit include expansive bedrock and corrosive soils.

LARAMIE FORMATION. The Laramie Formation can be found approximately 4500 feet west of the Wadsworth Boulevard interchange, extending for about 1000 feet. The material is composed of freshwater deposits of olive-gray siltstone and claystone, and yellowish-gray sandstone with local deposits of coal and can be up to 600 feet thick. Geologic hazards and constraints associated with this geologic unit include expansive bedrock and corrosive soils.

FOX HILLS SANDSTONE. The Fox Hills Sandstone consists of greenish-tan to yellow fine or medium sized grains of quartz and mica. It contains hard limy sandstone concretions as large as four feet in diameter and can serve as a local aquifer. This geologic unit can be up to 300 feet thick and is exposed for approximately 500 feet, approximately one mile west of the Wadsworth Boulevard interchange.

PIERRE SHALE. A small section of C-470 lies on Pierre Shale, beginning at the Kipling Parkway interchange, extending east for about 300 feet, and again, one half mile east of this intersection for 1500 feet. The Pierre Shale can be up to 8000 feet thick and is a marine shale consisting of olive-gray to tan clayey shale with some siltstone, silty sandstone and limestone. In areas where Pierre Shale is exposed, swell potential could be high. Further evaluation of the site would be necessary to determine the swell potential in the field area and then determine the appropriate mitigation measure.

Chemical treatment may be a feasible option for dealing with the potential swell problems in this area. Either lime treatment or fly ash may be used as treatment. In some cases, over-excavation of this material is recommended in areas underlain by the Pierre Shale. The depth of over excavation is based on swell potential and the proposed development (retaining walls, pavement, etc.). In addition to high swell potential clays, the Pierre Shale is steeply dipping in this area. This indicates additional mitigation measures may be necessary for differential movement within the geologic units in this area.

3.3.12.2 Environmental Consequences

No-Action Alternative

The No-Action Alternative would not disturb existing soils and geological conditions.

Therefore, no effects to the existing roadway from geologic and soil conditions are anticipated.

General Purpose Lanes and Express Lanes Alternative (Preferred Alternative)

Both action alternatives were evaluated. The existing geological conditions and soils would have the same effects to each of the action alternatives. Geologic conditions and soils generate risks to project design and construction and include: expansive soils and bedrock, corrosive soils, steeply dipping bedrock, collapsible soils, and unstable slopes. None of these geologic conditions would result in effects that would alter the location of either of the alternatives. Effects to geology and soils from construction of the alternatives would be in the form of excavation, construction disturbance, and exposure of previously buried and stable geological and soil units to precipitation, air, and weathering.

Expansive soils and bedrock and corrosive soils may cause increasing damage to transportation system components over a period of years. Differential movement in steeply dipping bedrock has damaged local pavement and transportation structures. Collapsible soils could also damage the highway infrastructure by either large settlement areas or differential settlement. Unstable slopes could also cause failure at cut and fill areas.

3.3.12.3 Mitigation

Mitigation of geological and soil conditions for the constructed roadway alternatives is described in terms of engineering design solutions. Expansive soils and bedrock as well as collapsible soils would be mitigated at structure locations by designing deep foundation systems, such as driven H-piles or drilled piers. Foundation pads would also be designed to form a raft across any swelling or collapsing materials. Floating floor slabs would be designed instead of slab-on-grade construction. Structural retaining walls, such as soil nail walls, ground anchors, mechanically stabilized earth walls, cantilever walls, or reinforced soil slopes would be built to stabilize slopes when cut or fill slopes require steep gradients greater than 3:1, or where potential slope failures may occur due to the presence of water and loose material.

Expansive subgrade soils under pavement sections would be stabilized with chemicals (lime or fly ash), removed and recompacted, or removed and replaced with imported structural fill of better quality. For planning purposes, preliminary evaluations indicate the corridor would require up to four feet of over-excavation, moisture treatment and recompaction with up to 12-inch lime stabilization.

Collapsible subgrade materials under pavement sections would be mitigated by over-excavation prior to embankment placement or additional loading with a thicker section of embankment material.

Steeply dipping bedrock areas require alternative practices such as over-excavation with refill and compaction to remove the conditions that perpetuate heaving. A barrier between the subgrade material and the pavement section would be constructed out of imported structural fill materials that range in thickness of three to five feet. Under structures, this depth of sub-excavation and replacement could be as much as 10 feet under the base of the shallow foundation footer.

The collection and diversion of surface drainage away from paved areas is critical to pavement performance. Proper design of drainage would prevent water from ponding immediately adjacent to pavement. All landscape sprinkler heads and lines adjacent to pavement areas would be frequently checked for leaks and maintained in good working order. It is also imperative that surface and subsurface water conditions be addressed in the design of any retaining wall systems. Any design would consider diverting and controlling surface water around or away from the wall areas and the wall designs should incorporate an internal drainage system. Horizontal drains may increase slope stability by reducing the seepage and freezing pressure acting

within fractures in rock and within zones of weakness in the soil. Slopes and other stripped areas would be protected against erosion by re-vegetation or other methods.

A Stormwater Management Plan that prescribes best management practices to minimize potential soil erosion, and includes prescriptions for monitoring of conditions before and after the completion of work (and for immediate post-restoration site stabilization) would be prepared and implemented. Measures that would be required are typical of erosion control procedures used in highway construction projects. The methods for controlling erosion are described in the CDOT's *Standard Specifications for Road and Bridge Construction*.

In addition to designing the appropriate mitigation measures, proper maintenance of the new roadway sections is critical. Surface and underground drainages would be properly maintained to keep water flowing away from the roadway.

3.3.13 Hazardous Materials

Hazardous materials are any product that is flammable, corrosive, or toxic. Hazardous material sites are found in association with a variety of industrial, mining, and municipal land uses. Hazardous material sites located adjacent to the highway ROW could result in project delays and increased cost if contaminated soils or groundwater are exposed during construction activity, particularly if they have not been identified prior to construction.

Two federal acts that can potentially affect transportation projects are the Resource Conservation Recovery Act (RCRA) and the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), or Superfund. RCRA regulates substances that can be defined as hazardous materials and focuses on preventing future contamination. CERCLA addresses sites that are contaminated from a past release of hazardous contamination that was uncontrolled at the time of release.

The following concerns would apply for proposed construction areas with soil and/or groundwater contamination:

- Health and safety of workers encountering contaminated material
- Special handling and disposal requirements for contaminated material and a corresponding cost increase
- Inability to reuse contaminated soil as fill in other areas of the construction
- Requirements for special permits

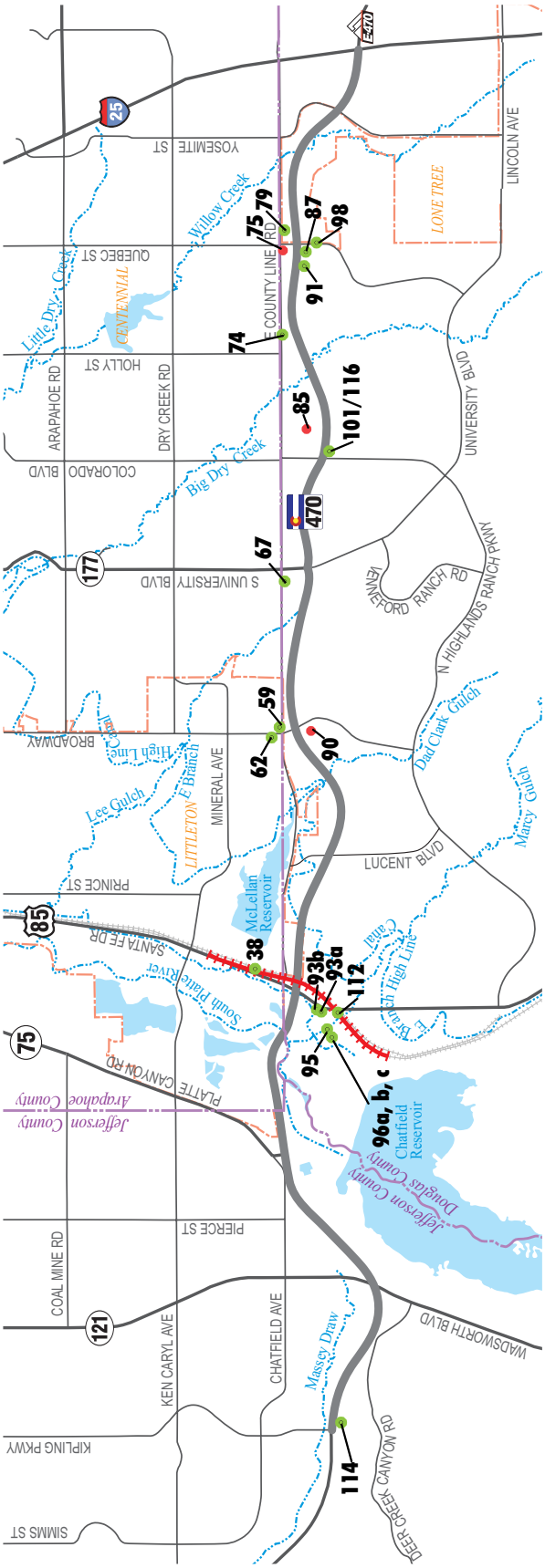
3.3.13.1 Affected Environment

In accordance with the FHWA and CDOT guidance, the potential for highway projects to impact hazardous material sites must be evaluated. A database search was conducted in August 2003 to identify potential hazardous waste sites in the project area. Findings from the database search and information obtained from EPA, Colorado Department of Public Health and Environment, Tri-County Health Department, and the Colorado Department of Labor and Employment Division of Oil and Public Safety (OPS) are summarized in the *Hazardous Waste Technical Report* (March 2005).

Potential ROW acquisition was evaluated to determine the likelihood for encroachment on known hazardous material sites in the project area.

Of the 138 sites initially identified in the project area, 21 sites were considered to have a moderate or high level of concern, based on their distance from the highway, type of release, and direction of groundwater flow. These sites are shown in **Figure 3-21**. Of these, ten sites are active underground storage tank (UST) sites. No tank or line leaks from any of the USTs registered at these sites have ever been reported to the OPS. However, leaks can occur that are often not discovered until tank or line replacement upgrades are made. Because of this uncertainty,

Figure 3-21
Hazardous Material Sites



Source: Hazardous Waste Technical Report, *March 2005*

the potential for undetected contamination is present. Three of the sites are leaking underground storage tanks (LUST) sites with associated soil and groundwater contamination. One RCRA site was also included in the 21 sites identified for further investigation.

3.3.13.2 Environmental Consequences

The hazardous material sites identified as having a high or moderate level of concern were mapped relative to the proposed construction footprint for both the GPL and EL Alternatives. This limit eliminated most of the 21 sites identified in the database search, as it was determined that they would not be affected by potential construction activities or represent a portion of a parcel purchased for ROW. However, since the potential for undetected contamination is still present, it is still possible that hazardous material may be encountered during construction.

No-Action Alternative

The No-Action Alternative would not affect any hazardous material sites identified along C-470.

General Purpose Lanes Alternative

Four hazardous material sites were ranked with a high potential for concern within the C-470 project area. Potential impacts from these sites resulting from the GPL Alternative are shown in **Table 3-40.**

Express Lanes Alternative (Preferred Alternative)

The effects identified for the EL Alternative would be the same as those identified for the GPL Alternative.

3.3.13.3 Mitigation

The hazardous material mitigation measures would be the same for the GPL and EL Alternatives. Currently no sites have been identified that would require long-term soil or

Table 3-40
Hazardous Material Sites

Site ID	Site Name	Location	Ranking	Potential Effects
85	County Line Landfill	Northeast corner of C-470/Colorado Blvd Douglas County	High	Potential for exposure to soil, groundwater contamination from BETX and chlorinated solvents, and presence of methane with lane widening and bridge improvements. Potential for impact from property acquisition adjacent to ROW and landfill
75	Conoco Station	7130 County Line Rd Highlands Ranch 80125	High	Potential for exposure to soil and groundwater contaminated by large fuel release near County Line Road and Quebec Street, approximately 650 feet north of entrance ramp
90	Diamond Shamrock	34 Centennial Blvd Highlands Ranch 80126	High	Potential for exposure to soil and groundwater contaminated by fuel release. Site is located approximately 500 feet from off ramp and hydraulically up gradient of C-470
NA	UP/BNSF Rail Lines	Crosses C-470 near Santa Fe Dr Douglas County	High	Potential for exposure to heavy metals, volatile and semi-volatile organic compounds, and polyaromatic hydrocarbons in soils and groundwater near the UP/BNSF rail lines

groundwater remediation. If site conditions change, long-term effects such as treatment of contaminated soil or groundwater would be identified. Effective environmental planning and engineering controls would be employed at the time of construction to remove contaminated materials from the site and to contain materials from having an impact at other locations.

During final design, soil and groundwater testing would be conducted, if necessary, for all of the hazardous material sites that would be directly impacted by construction. Once the testing results are complete, other mitigation measures would need to be identified to avoid hazardous sites. In cases where total avoidance is not possible, measures would be developed to protect workers during construction, in compliance with environmental regulations.

If bridge, building, guardrails, or sign alteration or demolition is required, an asbestos hazardous materials survey and a lead paint survey would be conducted per CDOT's *Standard Specifications for Road and Bridge Construction* and other relevant Occupational Safety and Health Administration, state, and federal regulatory requirements. Because contaminated soil and groundwater may be encountered along C-470, mitigation measures would include development of a site-specific Materials Handling Plan, in accordance with CDOT's *Standard Specifications for Road and Bridge Construction*.

3.3.14 Visual and Aesthetic Character

During the process of assessing potential changes to the environment, it is important to consider how the proposed C-470 improvements would change the look or visual character of an area. This is done by defining view sheds away from the highway, as a driver would see the views, and towards the highway as a resident would see the highway.

View sheds are defined as being either natural or man-made vistas which are viewed within a given setting or location. Usually outer boundaries for view sheds are apparent, such as the edges of a city's downtown, or the bound limits of a specific park. Outer boundaries can also be expansive, such as the extents to which one can physically see. Within the C-470 project area, five such viewsheds were identified as important for the southwest region of Metropolitan Denver. These viewsheds captured the visual essence of the quality of life people choosing to live in this area value. People are attracted to the natural setting this region offers, with the convenience of being close to the economic vitality of both the Denver Technological Center and Denver's Downtown central business district.

Another important consideration in assessing visual changes is the aesthetic treatment of the highway features. It is CDOT's desire to create a unifying identity for the entire length of C-470 by incorporating consistent themes for structural elements such as bridges and retaining walls and other features including guard rail and landscaping throughout the corridor.

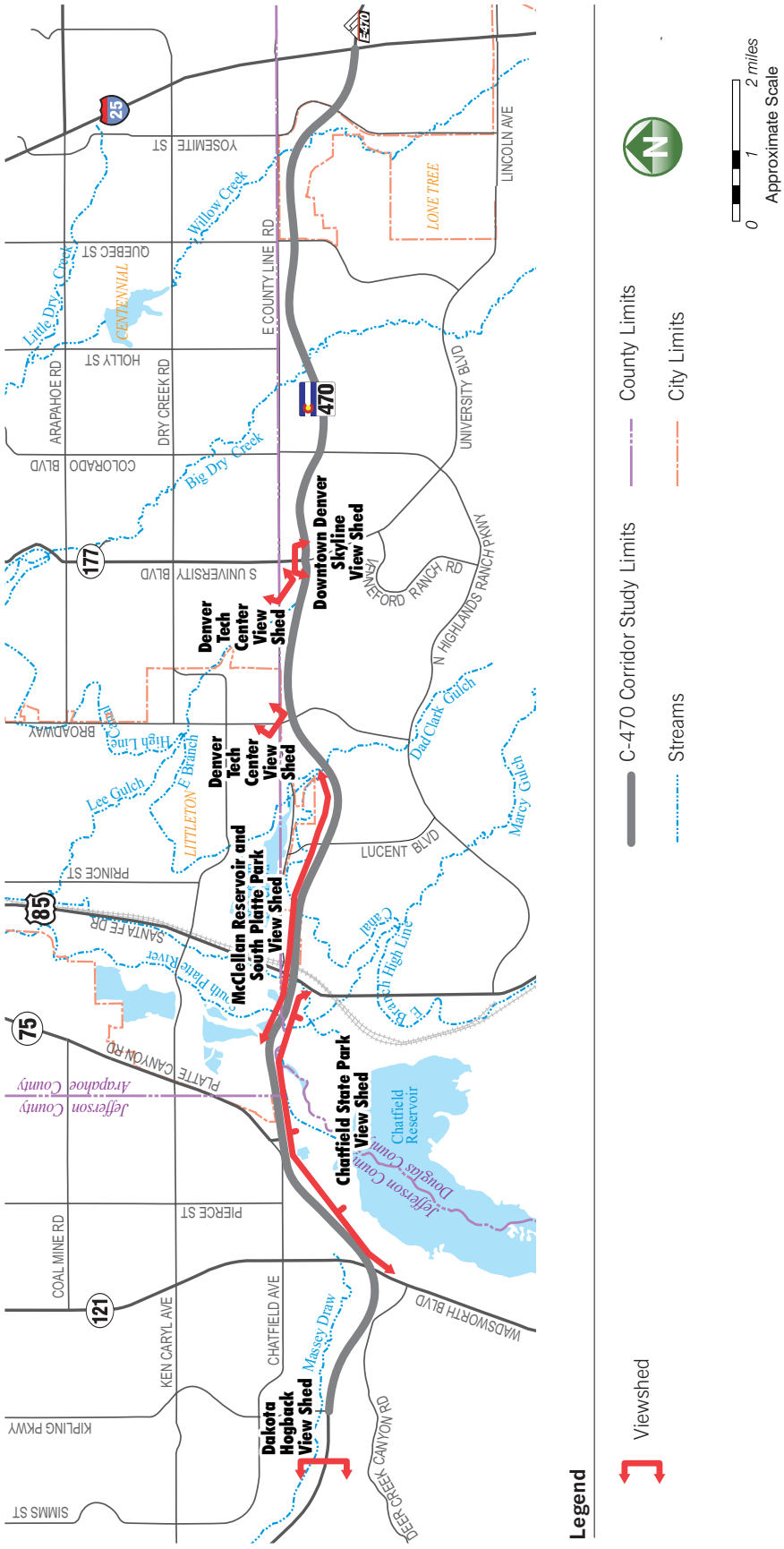
3.3.14.1 Affected Environment

More than 80,000 people drive C-470 every day, taking in the views from the roadway, as well as the character of the highway. Two dominant views from the highway include the Dakota Hogback and Chatfield State Park. Westbound travelers on C-470 view the Dakota Hogback on the western horizon. This view provides visual identity for the Denver metro area, different from other Front Range cities in Colorado.

The views of Chatfield State Park from the roadway, including both the reservoir and the dam, can be seen driving from either direction on C-470 in the southwest section of the project area. Chatfield State Park is a 300-acre recreational facility. Chatfield Reservoir is owned by the USACE and provides flood control for the region. The view of this area provides an attractive expanse of undeveloped land and water, in contrast to the surrounding residential and industrial uses surrounding the Park.

As part of the visual analysis for this EA, five view sheds were defined in the project area by

Figure 3-22
C-470 Corridor View Shed Map



including cultural, natural, and recreational areas, as described in the sections below. Figure 3-22 illustrates these five view sheds with respect to C-470.

Dakota Hogback View Shed

The Dakota Hogback view shed is shown in Figure 3-23 as viewed by westbound travelers on C-470. This view includes the foothills and Rocky Mountains further in the distance extending as far as one can see to the north and south. Mountain views provide visual dimension to the skyline and add depth and driver interest.

Chatfield State Park View Shed

The Chatfield State Park view shed extends from C-470 on the north, to the edges of Chatfield State Park on the south, west, and east. The focal point of this view shed is the Chatfield Reservoir and adjacent dam. The surrounding natural grasslands with low-density forested areas incorporate the remaining stretches of this view shed, as shown in Figure 3-24. The Chatfield State Park view shed is the only view shed on the southern side of C-470, and provides a visual break from the surrounding urban infill. Views of water are highly coveted by residents of Colorado because of water scarcity in a semi-arid ecological zone.

McClellan Reservoir and South Platte Park View Shed

The McClellan Reservoir and South Platte Park view shed extends from just west of Santa Fe Drive to just west of Broadway, on the northern side of the C-470. The focal point of this view shed is the McClellan Reservoir, as shown in Figure 3-25. The surrounding vegetation in South Platte Park contrasts the residential uses in the area. Trails can be seen running through the park and near the reservoir.

Figure 3-23
Dakota Hogback View Shed

Figure 3-24
Chatfield State Park View Shed

Downtown Denver Skyline View Shed

The Downtown Denver Skyline view shed can be viewed as a backdrop to the north, when passing over University Boulevard while traveling on C-470, as shown in **Figure 3-26**. The foreground is filled with commercial and residential units, as well as fully developed urban landscaping. Many of the roadways providing a network to get into and out of downtown Denver can also be seen from this view shed. This view denotes the sense of commerce and activity, leaving the natural mountain and recreational scenes to the west behind.

Denver Technological Center View Shed

The Denver Technological Center view shed can be seen from C-470 by looking northeast when passing over Broadway and University Boulevard. This view includes commercial structures making up the region's southeast business district, as shown in **Figure 3-27**. The foreground is filled with commercial and residential structures and urban landscaping.

In addition to analyzing views from the highway, it is also important to discuss views of the highway features itself, as well as views from the areas nearby towards the highway, as perhaps a resident or trail user may see.

The existing noise walls near Santa Fe Drive and Wadsworth Boulevard were constructed with standard design treatments, using a brown color scheme that is inconsistent the colors on existing C-470 bridges. Most of the bridge, retaining wall,

Figure 3-25
McClellan Reservoir and South Platte Park View Shed

Figure 3-26
Downtown Denver Skyline View Shed

lighting, signing, guardrail, and other design elements also lack consistency or a common theme. As a result, many of these structural elements contain colors, forms, and textures that are not compatible with others within the project area. One notable exception includes the sign structures for overhead signs, which now exhibit the new CDOT standard mono tube sign supports and sign bridges. These inconsistencies stem from the fact that the existing highway was constructed prior to the development of design standards, as described in CDOT's *Urban Design for Region 6.* For more information regarding the application of visual standards to C-470, see the C-470 *Visual and Aesthetic Character* (March 2005).

Several jurisdictions have expressed interest in incorporating interchanges within the project area into gateways to their respective communities. As such, they have requested some flexibility in the design treatments for these interchanges to achieve their community goals. Both Lone Tree and Douglas County use the Quebec Street interchange as gateways to their jurisdictions. Community signs and designation features have been placed on Quebec Street at each gateway, and should be maintained. The City of Littleton has expressed interest in using the Santa Fe Drive interchange, currently a typical diamond configuration, as a gateway to their community. Discussions occurred as to the types of features they would like to see put into place, and these ideas were carried out with the visual analysis. A view of the existing Santa Fe Drive interchange is shown **Figure 3-28**.

Figure 3-27
Denver Technological Center View Shed

Figure 3-28
Existing Santa Fe Drive Interchange

Looking at the roadway from nearby areas such as the Wolhurst Community or Chatfield State Park, the existing view includes a four lane highway, with a large grassy median, as shown in the typical section presented in **Figure 2-5**. Interchanges currently exist at Kipling Parkway, Wadsworth Boulevard, Platte Canyon Road, Santa Fe Drive, Lucent Boulevard, Broadway, University Boulevard, Quebec Street, Yosemite Street, and I-25. A moderate amount of signage is present, mostly directional overhead signs. Several existing noise barriers and retaining walls exist along this stretch of the C-470 Corridor.

3.3.14.2 Environmental Consequences

No-Action Alternative

The No-Action Alternative would result in no visual effects along C-470. This alternative does not provide a means to apply consistent design standards as do the build alternatives, since the highway would not be reconstructed.

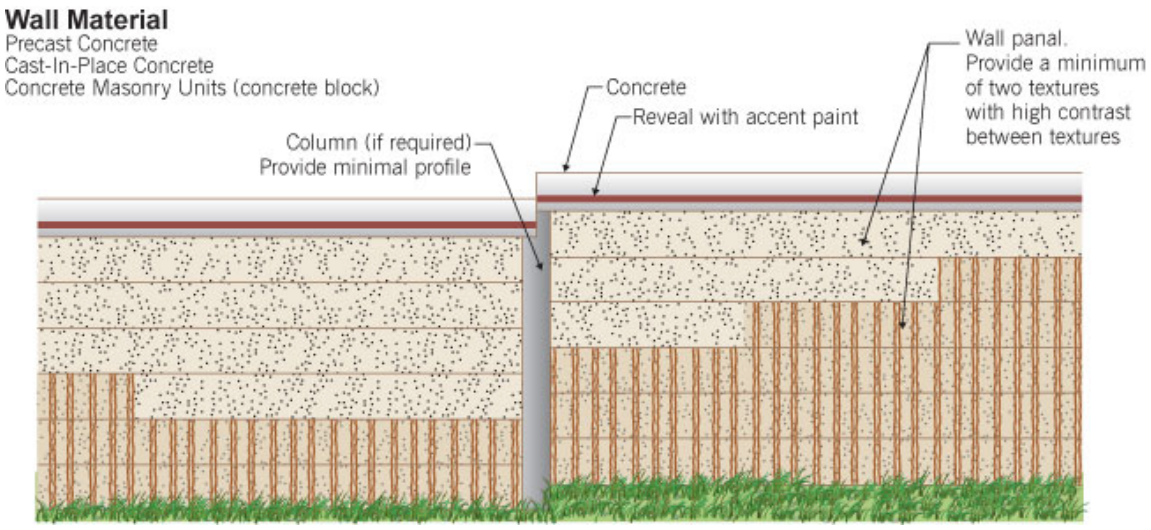
General Purpose Lanes Alternative

Under the GPL Alternative, direct effects would alter the character of the C-470 Corridor. Wider pavement sections would be noticeable with the elimination of the existing grassy median, as shown in the GPL Alternative typical section in **Figure 2-6**. Interchanges would have larger footprints, as the ramps are pulled back for safe geometric design. The longer ramps would result in the need for more retaining walls and barriers near the intersections. These larger interchanges would also require large abutments, and more overhead lighting to ensure safety concerns are met. As discussed in **Section 3.3.3**, noise walls would be constructed at several locations to provide highway related noise abatement along C-470. These additional features (wider pavement, additional lighting, more retaining and noise walls) would be seen from nearby, giving the area an even more developed character and potentially blocking views to the highway. Architectural drawings show examples of these added features in **Figures 3-29** and **3-30**.

Water quality ponds would be constructed along C-470 to mitigate the effects of increased surface runoff from the highway, as discussed in **Section 3.3.4**. These ponds would be visible both to and from the highway but would not obstruct or enhance views to other locations within the project area, as they would be flush with the existing ground level.

The addition of roadside retaining walls as part of the GPL Alternative would be necessary to minimize effects to environmentally sensitive areas, prevent the need for excessive ROW

Figure 3-29
Architectural Treatment on Retaining and Noise Walls



acquisition, and avoid the need to modify CDOT's easement along the northern boundary of Chatfield State Park. Although more retaining walls would be added, the colors and textures would match the highway design standards, therefore blending into the overall design. These retaining walls would be seen from nearby, giving the area a more developed character and may block views to the highway. One such location where retaining walls would be seen is in Chatfield State Park from the C-470 trail. **Figure 3-31** shows a photo simulation of the view looking toward C-470 from within Chatfield State Park.

Figure 3-30
Architectural Treatment on Bridge Abutments

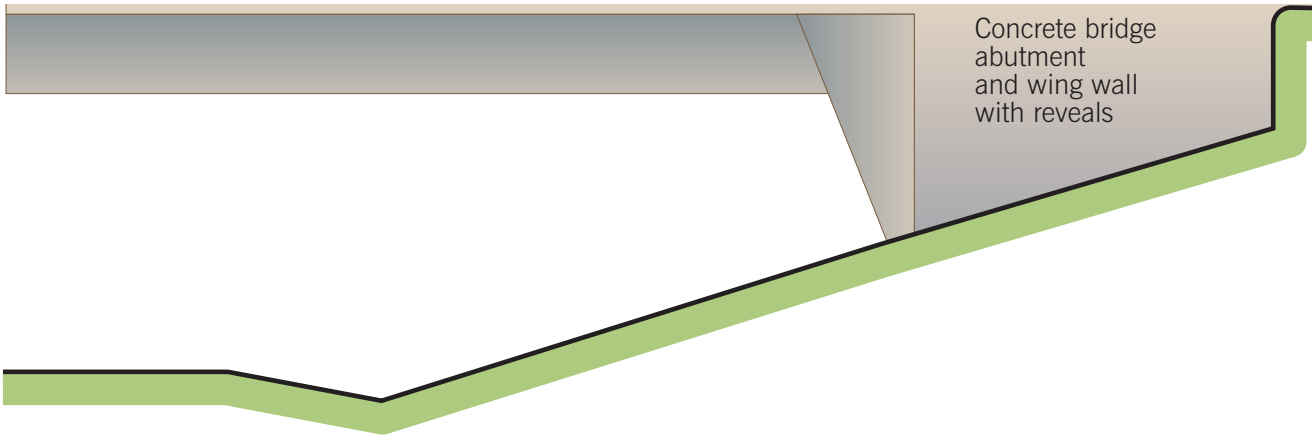
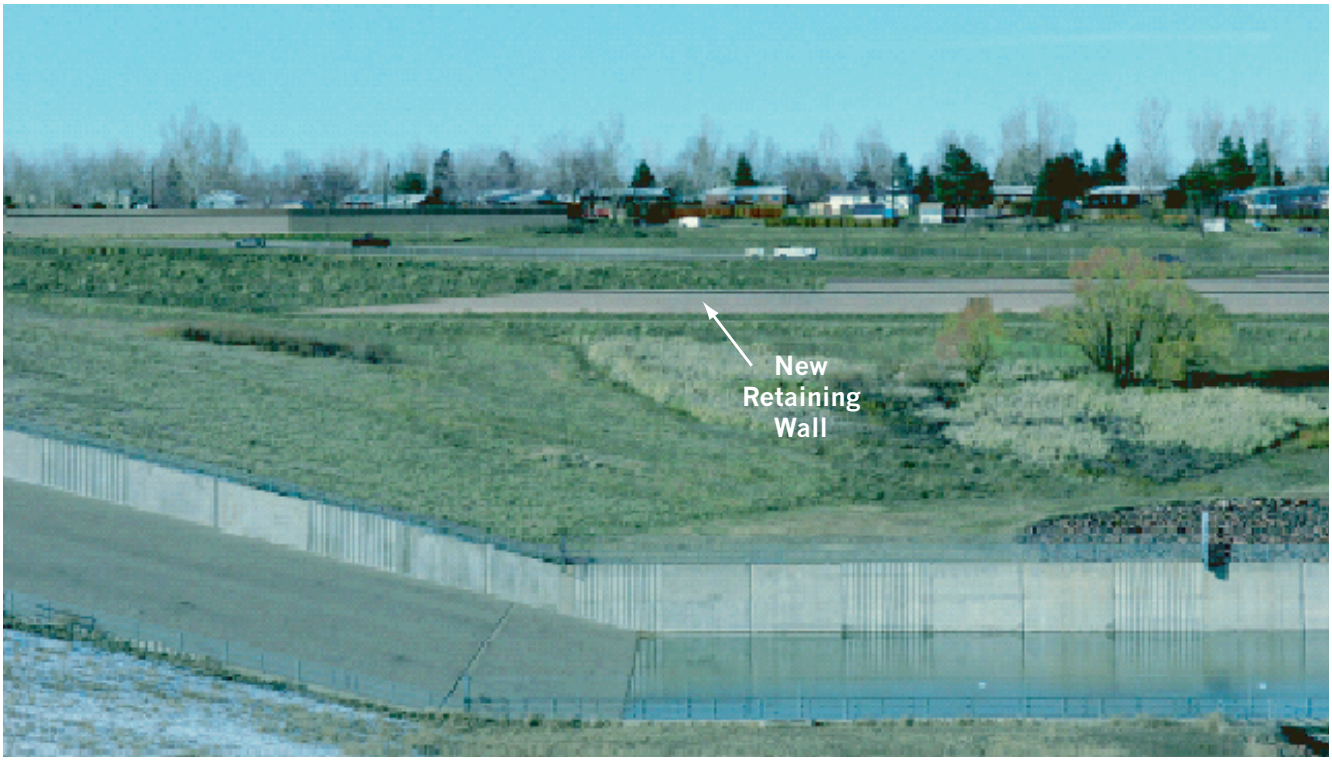


Figure 3-31
Retaining Wall Photo Simulation at Chatfield State Park

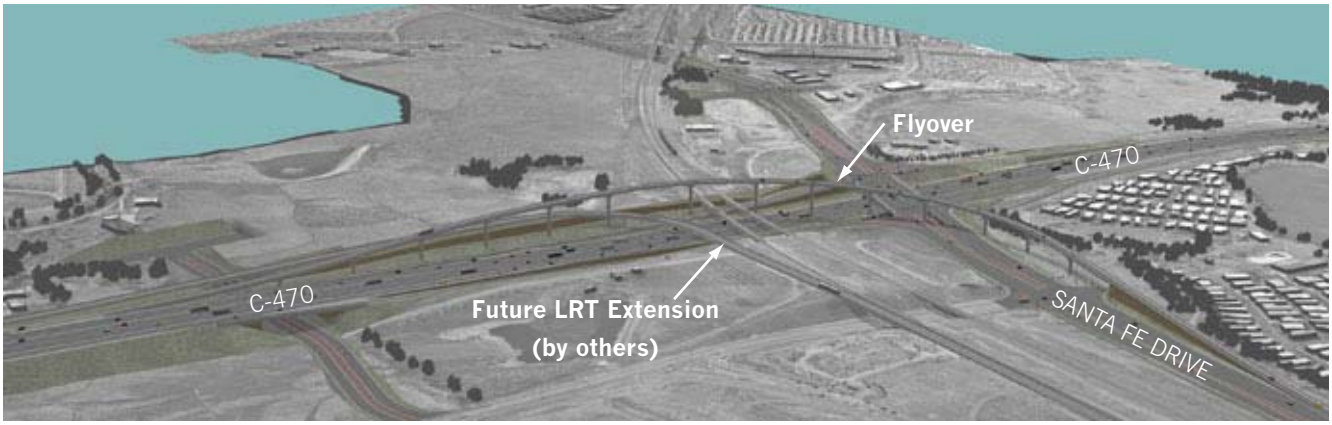


At the Santa Fe Drive interchange, a flyover would be added, rising above the proposed extension of the Southwest Corridor light rail line. The flyover structure would be the most apparent visual effect of this alternative. It would have a minimal effect on views of the Dakota Hogback for westbound travelers, as shown in **Figure 3-32**. As discussed in **Section 3.2.2**, the retaining wall or noise wall necessary to mitigate the noise impacts from the flyover and Santa Fe Drive on the east side of Wolhurst would block the residents' views of Santa Fe Drive and the railroad corridor, as well as of C-470. This retaining wall/noise wall would also indirectly affect Wolhurst by limiting the morning sunlight into the community. **Figure 3-33** shows a three dimensional view of the improved Santa Fe Drive interchange.

With the exception of the improved Santa Fe Drive interchange, specifically the southbound to eastbound flyover effects as mentioned above, the other visual changes from additional retaining walls and noise walls would not have a

Figure 3-32
General Purpose Lanes with Improved Santa Fe Interchange

Figure 3-33
Improved Santa Fe Drive Interchange



large affect on the five viewsheds discussed in **Section 3.14.1**. With only minor effects to these viewsheds, drivers would still have clear views looking out and over the roadsides.

Express Lanes Alternative (Preferred Alternative)

The EL Alternative would have the same visual effects as the GPL Alternative, with some additions as discussed below, associated with the operational characteristics of the express lanes. The width of the typical section for the Express Lanes Alternative would generally be the same as that of the General Purpose Lanes Alternative, as shown in **Figure 2-8**.

As part of the express lanes electronic toll collection system, overhead gantries would be located between every access point. The EL Alternative would also contain a higher concentration of roadside guide signs, since a separate set of signs is required for both the express and general purpose lanes. These additional gantry and signage features would add new elements to the views both to and from the highway at specific locations, causing minor visual distractions as compared to the existing open appearance. Examples of architectural drawings displaying these types of added features can be seen in the *C-470 Express Lanes Feasibility Study Final Report* (June 2005).

At the Santa Fe Drive interchange, the same visual effects would occur for the EL Alternative as did for the GPL Alternative, as the interchange configuration is the same design. **Figure 3-34** shows a photo simulation of the Santa Fe Drive interchange with the EL Alternative.

At Colorado Boulevard, a new T-Ramp into the express lanes would be constructed in the center of the facility. Traffic signals would be constructed at the top of these ramps, creating an

Figure 3-34
Express Lanes with Improved Santa Fe Drive Interchange

additional intersection on Colorado Boulevard. As shown in **Figure 3-35**, the addition of the T-Ramp would block views across the highway for residents and businesses on either side, as well as create minor obstructions when viewing to and from the highway.

At Quebec Street, new braided ramps would be constructed on the west side of the interchange, consisting of flyovers from the existing ramps into the express lanes. As shown in **Figure 3-36**, the addition of braided ramps would block views across the highway for residents and businesses on either side, as well as create minor obstructions when viewing to and from the highway.

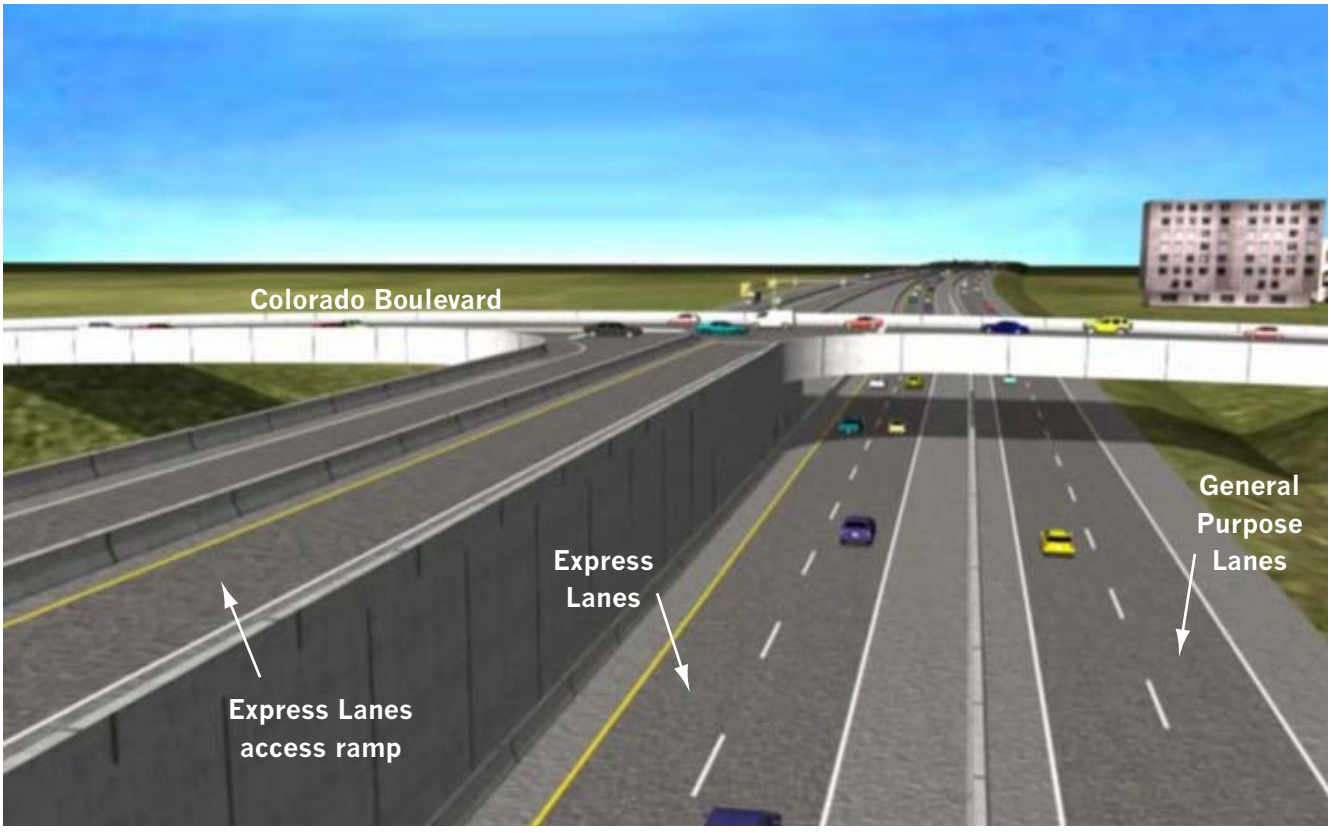
At I-25, additional ramps would be added to the interchange, but since the interchange is already a large visual obstruction to the surrounding environment, views to and from the highway at this location would only change to a minor extent.

The other visual changes from additional retaining walls and noise walls would not have a large affect on the five viewsheds discussed in **Section 3.14.1**. With only minor effects to these viewsheds, drivers would still have clear views looking out and over the roadsides.

3.3.14.3 Mitigation

To mitigate the visual effects resulting from both the GPL and EL Alternatives, corridor-wide standard architectural treatments would be employed to create a more consistent appearance of the corridor, both when looking out from the roadway, and when looking in towards the roadway from nearby. After discussions with adjacent jurisdictions along C-470, design standards were created using existing features and unifying elements. Common themes would

Figure 3-35
Colorado Boulevard Interchange T-Ramp (looking west)



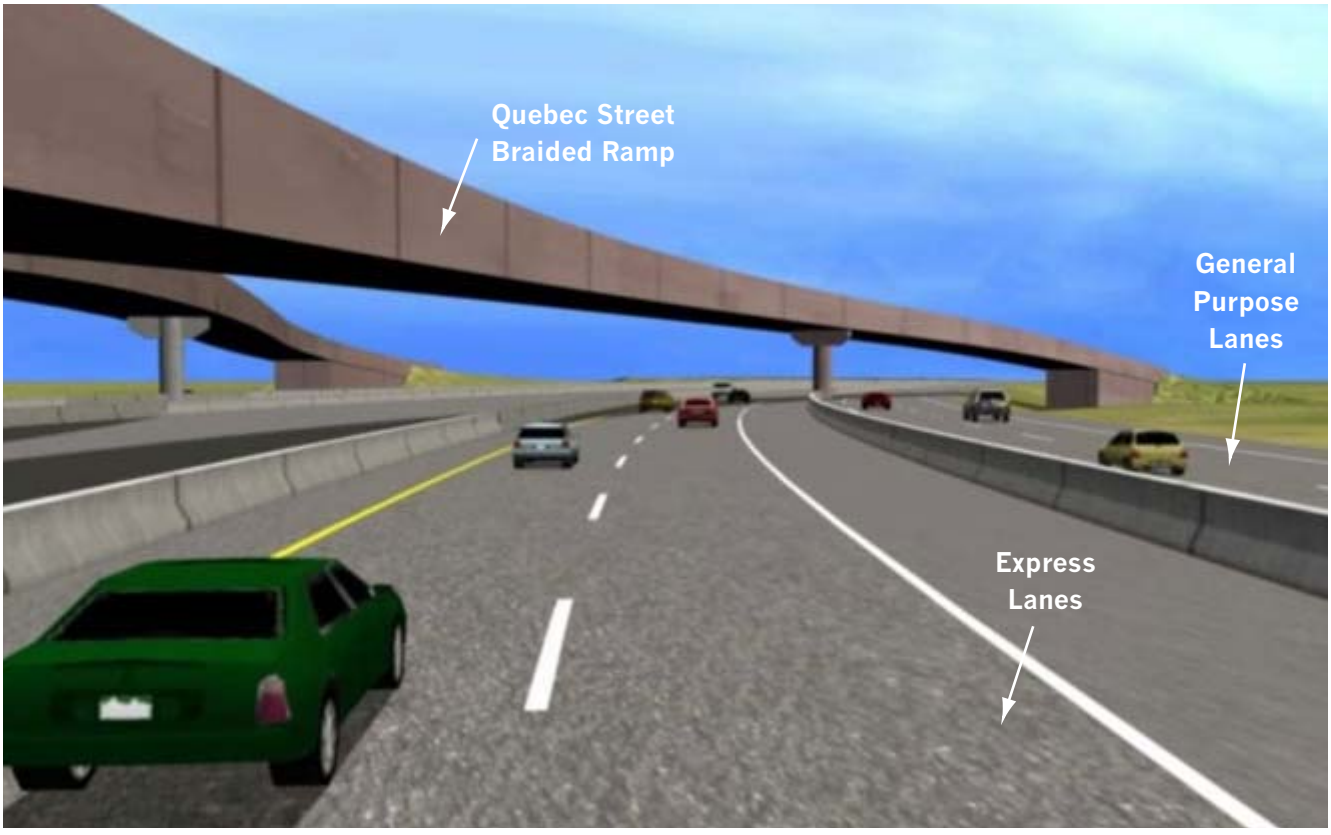
be maintained throughout the project area in order to provide a uniform suburban corridor look. Color would be added where practical, and subtle changes would be made to existing features to avoid reconstruction of the many architectural treatments on the existing highway. New structures would incorporate existing colors on C-470 for bridges, lights, sign structures, sound barriers, retaining walls, and concrete railings. To add more interest, an accent pin stripe would be added to the exterior sides of the new bridge rails and the tops of sound barriers and retaining walls, as previously shown in **Figure 3-29**.

Generally, retaining walls necessary for this project would be constructed with forms and textures consistent with CDOT design standards and existing features along the C-470 Corridor. Retaining walls constructed near Chatfield State Park would be textured and colored to match the existing native grasses in the area in order to create a more natural appearance for trail users and boaters in the Park looking towards the highway. The largest retaining wall near the Chatfield dam would be tiered to provide a visual break in the height of the wall, as shown in **Figure 3-31**. CDOT will continue to work with Chatfield State Park during final design to develop the exact details for the retaining walls in this area.

For the EL Alternative, overhead toll collection devices and signing would follow a region-wide standard for consistent viewing and driver expectancy/recognition, to be set by the CTE at a later date. These standards would remain flexible to comply with statewide unifying elements for other CTE toll facilities, as they are developed.

CDOT will provide visual mitigation for the residents of the Wolhurst Community in the form of retaining and noise wall colors and

Figure 3-36
Quebec Street Interchange Braided Ramps



textures on both sides of the walls running adjacent to their property, with input from the residents. CDOT is also committed to working with the owners and residents of the Wolhurst Community to provide landscaping and improved signage surrounding the entrance to their community.

CDOT will work with adjacent jurisdictions such as Douglas County, Lone Tree, Highlands Ranch, and Littleton to incorporate architectural upgrades to interchanges through the C-470 project area, while maintaining unifying elements with the rest of C-470. Such upgrades will include textured sound walls, landscaping, and bridge identification markings. In some areas, additional community input will be obtained during final design to gain public acceptance of these treatments, such as at the Santa Fe Drive Interchange. To maintain a consistent appearance, an aesthetic treatment plan or menu of design features has been set by CDOT from which stakeholders may select their upgrades. Jurisdictions wishing to upgrade architectural elements would be responsible for funding the construction of their chosen elements.

3.3.15 Utilities

The location of utility lines is an important factor to consider during roadway construction. Major utilities in the project area include water mains 60 inches or greater in diameter; electrical transmission lines; fiber optic lines, including backbone, trunk lines, and fiber considered critical to national security; and large sanitary sewer lines 60 inches or greater in diameter.

3.3.15.1 Affected Environment

Most utility infrastructure is privately owned by corporations providing telephone, communication, electrical, and gas service to communities in the C-470 project area. Local government typically provides public water and sanitary service to its respective jurisdictions. Above ground and overhead infrastructure is present throughout the project area, located within and outside the existing ROW. All major utilities in the project area were inventoried and included in the utility impact analysis.

3.3.15.2 Environmental Consequences

No-Action Alternative

No effects to utilities would occur under the No-Action Alternative.

General Purpose Lanes Alternative

Table 3-41 lists potential effects to utilities from the two action alternatives. Additional detail for each utility and the respective effects can be found in the *Utilities Technical Report* (March 2005).

Express Lanes Alternative (Preferred Alternative)

Potential effects to utilities from the EL Alternative are generally the same as those for the GPL Alternative, except in areas where the EL Alternative is slightly wider between Quebec Street and Colorado Boulevard, where additional telephone, communication, and water utilities may be affected.

3.3.15.3 Mitigation

When a privately owned utility is located within public ROW, the owner company is responsible for relocating the utility to accommodate a public improvement project. This usually applies to telephone and communications and electrical and gas utility infrastructure. Where ROW acquisition is required, or when a publicly held utility must be relocated to accommodate a highway project, it is generally the project's responsibility to fund the related construction for relocation. During excavation for buried utility relocation, precautions would be taken such that soil disturbance would not result in release of potential airborne asbestos.

Utility relocation requirements would be defined during final design. In most cases, private utility companies do not know the depths of their facilities. A method known as potholing would be used to determine the exact depth of utility infrastructure. Potholing uses a machine that is equipped with a high-pressure sprayer and a

Table 3-41
Effects to Utilities

Utility Owner	Type	Buried or Overhead	Utility Location	Potential Effect
City of Englewood	Ditch (City Ditch)	Buried	Crosses C-470 at Santa Fe Dr west ramps	Santa Fe Drive overpass support/C-470 roadway/ ROW
Comcast	Fiber optic cable	Overhead	Crosses C-470 at Garrison Street, on Xcel Energy poles	Possible pole relocation(s)
	Fiber optic cable	Buried	Crosses C-470 at Santa Fe Dr, west ramps	Santa Fe Drive overpass support/ C-470 roadway/ ROW
	Fiber optic cable	Buried	North-south in southbound lanes of Santa Fe Drive; crosses C-470 at Santa Fe Dr, attached to bridge	Santa Fe Drive overpass modifications
	Fiber optic cable	Buried	Parallels C-470 on south side within proposed footprint, on Xcel Energy poles	C-470 roadway/ ROW
	Fiber optic cable	Overhead	Crosses C-470 at High Line Canal tunnel	C-470 roadway/ ROW
	Fiber optic cable	Buried	Crosses C-470 between High Line Canal and Lucent Blvd	C-470 roadway/ ROW
	Fiber optic cable	Buried	Crosses C-470 under Broadway	C-470 overpass support
	Fiber optic cable	Buried	Crosses C-470 under University Blvd	C-470 overpass support
	Two fiber optic cable runs	Buried	Crosses C-470 under Yosemite St	C-470 overpass support
Denver Water	90” raw water main	Buried	Crosses C-470 at Wadsworth Blvd, east ramps	C-470 roadway/ ROW
	Ditch (High Line Canal)	n/a	Crosses C-470 between Santa Fe Dr and Lucent Blvd	C-470 roadway/ ROW

Table 3-41
Effects to Utilities (continued)

Utility Owner	Type	Buried or Overhead	Utility Location	Potential Effect
Denver Water	108” water main	Buried	Crosses C-470 at University Blvd, west ramps; parallels north ROW to east ramps	C-470 roadway/ ROW
	60” water main	Buried	Crosses C-470 at University Blvd. under east ramps; parallels south ROW to Colorado Blvd	C-470 roadway/ ROW
	60” water main	Buried	Parallels C-470 on south side entering and exiting footprint in several locations from east of University Blvd to Quebec Street	C-470 roadway/ ROW
	60” water main	Buried	Crosses C-470 at Quebec Street, west ramps	C-470 roadway/ ROW
Lockheed Martin	Critical fiber optics	Buried	Parallels south C-470 within areas of proposed footprint between Wadsworth Blvd and Platte Canyon Rd	C-470 roadway/ ROW
	Critical fiber optics	Buried	Parallels south C-470 ROW between Platte Canyon Rd and Santa Fe Dr	C-470 roadway/ ROW
	Critical fiber optics	Buried	Crosses C-470 at Santa Fe Dr, attached to bridge	Santa Fe overpass modifications
MCI	Fiber optic communications	Buried	Crosses C-470 on BNSF bridge (easternmost track)	BNSF bridge modifications
Northern Douglas County Water and Sanitation District	Sanitary sewer	Buried	Barely enters footprint on south side, at Dry Creek; golf course	C-470 roadway/ ROW
Qwest Local Area Network	Fiber optic communications	Buried	Crosses C-470 at Ute Ave	C-470 roadway/ ROW
	Fiber optic communications	Buried	Crosses C-470 at Quebec St	Quebec Street overpass modification/C-470 roadway/ ROW

Table 3-41
Effects to Utilities (continued)

Utility Owner	Type	Buried or Overhead	Utility Location	Potential Effect
Qwest Communications	Critical fiber optics	Buried	Crosses C-470 on BNSF bridge (easternmost track)	BNSF bridge modifications
	Critical fiber optics	Buried	Crosses C-470 on west side of Lucent Blvd overpass	Lucent Blvd overpass modifications/ C-470 roadway/ROW
Touch America	Fiber optic communications	Buried	Crosses C-470 in bridge at Colorado Blvd	Colorado overpass modifications
US Sprint	Fiber optic communications	Buried	Crosses C-470 on UPRR bridge (western most track)	UPRR bridge modifications
Xcel	HP gas	Buried	Parallels north C-470 ROW and crosses C-470 at gravel pit between Platte Canyon Rd and Santa Fe Dr; HP line continues east approximately 500 feet beyond crossing	C-470 roadway/ ROW
	Electric transmission	Overhead	Crosses C-470 at Platte River Greenway	Possible pole relocation(s)
	HP gas	Buried	North-south on west side of Santa Fe Dr north of C-470, in southbound lanes south of C-470, crosses C-470 at Santa Fe Dr, west ramps	Santa Fe Drive overpass support/ C-470 roadway/ ROW
	Electric transmission	Overhead	Crosses C-470 west of Broadway	Possible pole relocation(s)
	Electric transmission	Overhead	Crosses C-470 at Quebec St	Possible pole relocation(s)
XO Communications	Fiber optic communications	Buried	Crosses C-470 under Yosemite St	C-470 overpass support

vacuum hose. The sprayer is used to loosen soil from around utilities, and the vacuum hose carries away the loosened material. This is an effective, low-risk method for finding buried utilities.

3.3.16 C-470 Trail

This section discusses the character of the C-470 trail and the role it plays in a multi-modal transportation system, the effects of the alternatives on the trail, and mitigation for these effects.

3.3.16.1 Affected Environment

The C-470 trail is a 10-foot wide concrete trail which runs the entire 26-mile length of C-470 from I-70 to I-25 and is part of a longer trail system that extends into Golden on the west and continues along E-470 on the east. The trail connects to several other trails and bikeways to produce a network of multi-modal transportation access for many types of users, primarily bicycles. It was constructed by CDOT along with C-470 as the backbone of a multi-modal transportation facility. As a component element in a multi-modal transportation system, the trail is not a protected resource under Section 4(f).

Appendix D shows the location of the trail within the EA limits. It is generally within the existing ROW; however, there are two locations where the trail is outside the CDOT ROW. Where C-470 crosses Chatfield State Park, CDOT has been granted an easement for the roadway on USACE property. The trail through this area meanders in and out of the CDOT easement. Although this section of the trail is on USACE property and within Chatfield State Park, CDOT funded and constructed this section of trail and Chatfield State Park maintains it.

East of Santa Fe Drive, the trail diverts from C-470 and follows the High Line Canal easterly to about Broadway, at which point it returns to the CDOT ROW where it continues to I-25 and beyond. The C-470 trail originally followed the High Line Canal trail in order to avoid building a redundant parallel trail and thus save cost.

The trail profile generally follows the same profile as the roadway, with some variation due to horizontal alignment differences. Most of the arterial street crossings are accomplished with at-grade crossings, except at Wadsworth Boulevard and Lucent Boulevard, where the trail passes under the roadway. Several sections of the trail have poor pavement conditions, with cracking or faulting pavement.

3.3.16.2 Environmental Consequences

No-Action Alternative

The No-Action Alternative has no affect on the C-470 trail. At-grade crossings of arterial streets would remain. Existing surface condition problems would also persist.

General Purpose Lanes Alternative

The GPL Alternative would require that 7.5 miles of trail be reconstructed a sufficient distance outward from the new roadway to allow for the widening. The distance the trail would be relocated outward is generally on the order of 45 to 50 feet, but the actual range of displacement varies from 0 feet to 167 feet. Additional ROW acquisition would be required for portions of the trail relocation. **Appendix D** shows the location of the relocated trail relative to the existing and proposed ROW.

The trail would be similar in character to the existing trail, but would be closer to adjacent private property and improvements by the distances noted above. Other than the lateral displacement described above, the general location of the trail would remain the same, as would the profile. The reconstruction of the trail would provide for a new, improved wearing surface.

Express Lanes Alternative (Preferred Alternative)

The EL Alternative would have similar effects as the GPL Alternative, except that 8.1 miles of trail would need to be reconstructed.

3.3.16.3 Mitigation

No-Action Alternative

The No-Action Alternative would not reconstruct any of the existing trail, so all existing trail surface deficiencies and at-grade street crossings would remain.

General Purpose Lanes Alternative

The GPL Alternative would relocate and reconstruct 7.5 miles of the trail with a new surface, correcting the existing surface deficiencies. Three grade separated trail crossings would be constructed to alleviate bicycle/pedestrian interactions with traffic at grade-crossings of arterial streets that intersect C-470. These new grade separations are being proposed at Santa Fe Drive, Colorado Boulevard, and Quebec Street.

- Construction of grade separations with the new Santa Fe Drive interchange at all conflict points, would eliminate the existing at-grade street crossing
- Relocation of the trail under the Colorado Boulevard overpass would eliminate the existing at-grade street crossing
- Relocation of the trail under the Quebec Street overpass and construction of grade separations at ramp conflict points would replace the existing at-grade street crossing

Reconstruction of the trail and proximity to roadway construction would require that detours be provided to ensure uninterrupted service to trail users. CDOT would coordinate with trail user groups to keep them informed of construction activity and detour routes as it relates to the C-470 trail.

Express Lanes Alternative (Preferred Alternative)

The EL Alternative would have similar mitigation as the GPL Alternative, with 8.1 miles of new trail surface. Three grade separated trail crossings would be constructed to alleviate bicycle/pedestrian interactions with traffic at grade-crossings of arterial streets that intersect C-470. These new grade separations would be located at Santa Fe Drive, Colorado Boulevard, and Quebec Street, consistent with the mitigation proposal for the GPL Alternative. Detours would be provided to ensure uninterrupted service to trail users. CDOT would coordinate with trail user groups to keep them informed of construction activity and detour routes as it relates to the C-470 trail.

3.3.17 Construction

Construction-related effects relate to maintenance of traffic during construction, the potential for diversion of traffic onto the arterial street network, relocation of access, temporary construction easements, water quality, noise, air quality, availability of construction materials, and vibration due to construction activities.

3.3.17.1 Affected Environment

Additional highway widening and reconstruction is the major component of the GPL and EL Alternatives presented for C-470. Heavy equipment operation and earth moving machinery creates exhaust emissions, dust, water runoff, traffic congestion, and undesirable noise and vibration. Businesses located near the interchanges along C-470 may be affected by potential access restrictions. CDOT implements a communications program with affected businesses and the public to keep them informed of construction schedules.

While detailed construction phasing plans would not be completed until final design, a phasing scheme was developed as part of the conceptual design for this EA that provides a qualitative assessment of potential effects that might be produced as a result of implementing one of the action alternatives. Because the GPL and EL Alternatives are similar with regard to typical section and width, the same construction phasing scheme is applicable to both alternatives.

Construction Phasing

It is anticipated that the mainline portion of either action alternative would be constructed in three phases. The Santa Fe Drive and I-25 interchanges would require more detailed construction phasing.

A three-phase construction sequence would involve shifting traffic on the existing pavement toward the outside while building a portion of the median area. The second phase would shift traffic to the partially constructed median and construct the outside portion. The final phase would shift traffic to the outside and complete the interior sections.

Final construction phasing and traffic control requirements would be determined during the final design process. To minimize traffic delays and congestion during the construction of either alternative, the following steps would be taken:

- Develop detailed construction phasing and traffic control plans
- Maintain two 12-foot travel lanes in each direction
- Maintain a minimum of two-foot shoulders throughout the construction zone
- Provide emergency pullout areas when shoulders are less than eight feet wide
- Provide a construction zone assistance vehicle to assist motorists with vehicular problems
- Use signing to announce and advertise timing of road closures
- Maintain existing exits and entrances to and from C-470 at all times during morning and evening peak hour traffic

3.3.17.2 Environmental Consequences

No-Action Alternative

The No-Action Alternative would have no construction effects.

General Purpose Lanes Alternative

TRAFFIC DIVERSION ONTO ARTERIAL STREET NETWORK. A qualitative assessment of potential effects was performed to determine areas where traffic diversion may occur during construction. Congestion on C-470 would increase during construction due to slower design speeds and narrower shoulders. As a result, traffic would divert from C-470 to alternative routes to avoid this congestion. Any intersections that are currently at or over capacity and operating at poor levels of service would get worse during construction activity.

The following intersection locations would likely see an increase in traffic during construction, and due to their limited reserve capacity, may present some operational problems:

- Lucent Boulevard/County Line Road
- Broadway/County Line Road
- University Boulevard/County Line Road
- Colorado Boulevard/County Line Road
- Quebec Street/County Line Road
- Yosemite Street/County Line Road
- University Boulevard/Dry Creek Road
- Colorado Boulevard/Dry Creek Road

RELOCATION OF RESIDENTIAL OR BUSINESS ACCESSES. Reconstruction of the Santa Fe Drive interchange and associated work on Santa Fe Drive may require the temporary closure of some access points for reconstruction. A closure without provisions for temporary access would have adverse social and economic effects on the users of these accesses.

TEMPORARY CONSTRUCTION EASEMENTS. Although all permanent improvements would be located on public ROW, often times there is a need to gain access to adjacent property to construct the improvements that are very close to the ROW interface, or which connect to some other improvement on the adjacent property. Temporary easements are obtained to allow access onto the adjacent property for a short duration of time during construction of the improvements. The land so acquired is minimally disturbed and is returned to its original condition prior to the lease termination.

The level of design undertaken for an EA such as the C-470 Corridor EA is usually not detailed enough to identify all the potential temporary easements that might be necessary to construct a project, so it is not possible to identify all the potential temporary easements in this EA document. However, the following temporary easement has been identified.

Construction of the new Santa Fe Drive interchange requires that a retaining wall be built very close to the existing USACE ROW in the southwest quadrant of the interchange. Due to the preliminary nature of ROW information in the EA, the actual location of ROW is subject to change. Based on the best information to date, it is believed that the finished wall will be entirely contained within CDOT's ROW and/or USACE Easement. However, if the ROW location is closer to the wall than expected, construction of the wall may require temporary use of a small portion of USACE property.

Should a temporary easement be required to construct the wall, it would not constitute a 4(f) use in accordance with 23 CFR 771.135, which states, "A temporary occupancy of land is so minimal that it does not constitute a use within the meaning of section 4(f) when the following conditions are satisfied: (i) Duration must be temporary, i.e., less than the time needed for construction of the project, and there should be no change in ownership of the land; (ii) Scope of the work must be minor, i.e., both the nature and the magnitude of the changes to the section 4(f) resource are minimal; (iii) There are no anticipated permanent adverse physical impacts, nor will there be interference with the activities or purpose of the resource, on either a temporary or permanent basis; (iv) The land being used must be fully restored, i.e., the resource must be returned to a condition which is at least as good as that which existed prior to the project; and (v) There must be documented agreement of the appropriate Federal, State, or local officials having jurisdiction over the resource regarding the above conditions."

If such a temporary easement should be needed, CDOT would ensure that the above conditions would be met.

The easement would be used to gain access to the work zone in front of the retaining wall, and for continuous access along the retaining wall for the purpose of stockpiling and accessing materials needed for construction of the wall. The land acquired by this temporary easement would be fenced off from the remainder of Chatfield State Park land and would not be available for use. Construction machinery traveling over this land would cause some minor disturbance of the soil and existing grass.

WATER QUALITY. Due to the nature of disturbing the existing soil for construction purposes, storm runoff has the potential to create erosion and degradation of water quality if proper BMPs are not employed and maintained.

NOISE. Short-term noise may be generated by stationary and mobile construction equipment. Elevated noise levels would be expected to occur in proximity to noise receptors during both day and night. Construction of the project will generate noise from diesel-powered earth moving equipment such as dump trucks and bulldozers, back-up alarms on certain equipment, compressors, and pile drivers (near bridge abutments and retaining walls, if necessary). Construction noise at off-site receptor locations would be dependent on the loudest one or two pieces of equipment operating at any given time. Noise levels from diesel-powered equipment range from 80 to 95 dBA at a distance of 50 feet. Equipment such as rock drills and pile drivers would generate even louder noise levels.

AIR QUALITY. Airborne dust caused by vehicles on dirt and paved roads would be the primary source of PM_{10}, but dust created from active construction sites can also be a main contributor. Increased PM_{10} concentrations due to construction would be temporary. Furthermore, these emissions from numerous mobile and stationary sources are considered during the formulation of the SIP, and therefore have already been accounted for in the air quality modeling for this project.

CONSTRUCTION MATERIAL AVAILABILITY. The availability of construction material would be the same for the EL Alternative as for the GPL Alternative.

VIBRATION. The EL Alternative vibration effects from construction activity would be the same as the GPL Alternative.

C-470 TRAIL. Reconstruction of the trail and proximity to roadway construction would require that detours be provided to ensure uninterrupted service to trail users.

Express Lanes Alternative (Preferred Alternative)

TRAFFIC DIVERSION ONTO ARTERIAL STREET NETWORK. The EL Alternative would have the same affect on the arterial street network as the GPL Alternative, and the same intersections identified for the GPL Alternative would apply to the EL Alternative as well.

RELOCATION OF RESIDENTIAL OR BUSINESS ACCESSES. Closure, temporary access, and restrictions are the same as for the GPL Alternative.

WATER QUALITY. As with the GPL Alternative, storm runoff has the potential to create erosion and degradation of water quality if proper BMPs are not employed.

TEMPORARY CONSTRUCTION EASEMENTS. The EL Alternative would have the same need for temporary construction easements as the GPL Alternative, and would have the same effects as the GPL Alternative.

NOISE. Temporary noise effects generated by stationary and mobile construction equipment are the same as the GPL Alternative.

AIR QUALITY. The EL Alternative will result in similar temporary PM_{10} air emissions as the GPL Alternative.

CONSTRUCTION MATERIAL AVAILABILITY. Because the study is located in the Denver area, construction materials would be

plentiful and readily available. Several aggregate quarries are located within 20 miles of the study site. Highway construction would also be able to take advantage of recycled and reusable materials in the urban area, to preserve available and ultimately limited natural resources for other uses.

VIBRATION. Vibration will occur from certain operations, particularly pile driving for substructure units, and also from general construction equipment usage in proximity to sensitive receptors.

C-470 TRAIL. EL Alternative effects would be the same as the GPL Alternative.

3.3.17.3 Mitigation

Mitigation for both the GPL and EL Alternatives would be similar. CDOT is committed to sustainable construction practice, such as reusing materials and recycling, waste minimization, water and energy conservation, and other measures which can minimize the cumulative effects of the project through resource conservation.

Traffic Diversion onto Arterial Street Network

Mitigation for the projected congestion increase at adjacent arterial intersections would include minor capacity and operational improvements at select locations within the project area. Improvements would be made at locations that provide the greatest congestion relief for the most users.

These improvements are generally considered to be minimal-action improvements, such as restriping to extend turn bay storage, or to extend acceleration/deceleration lanes inside existing ROW without incurring any direct environmental effects, as shown in **Appendix D**, pages D-55 through D-61. Some improvements would be performed prior to implementing traffic control plans on C-470 that would divert traffic onto the arterial street system. The timing of these improvements would be determined during final design.

The recommended intersection improvements are listed here. These actions would improve traffic operations on the arterial street network during construction with minimal effort and expense.

- Lucent Boulevard/County Line Road – restripe to add an additional northbound to westbound left turn lane
- Broadway/County Line Road – extend the existing eastbound to southbound right turn lane to a length of 375 feet; extend the existing eastbound to northbound left turn lane to a length of approximately 450 feet; add a 225-foot southbound to westbound right turn lane
- University Boulevard/County Line Road – extend the existing outside westbound to southbound left turn lane to approximately 375 feet; extend the existing northbound to westbound left turn lane about 200 feet, to provide approximately 500 feet of storage
- Colorado Boulevard/County Line Road – restripe the west leg of County Line Road to provide an additional eastbound to northbound left turn lane which could provide approximately 800 feet of storage; extend the existing southbound to eastbound left turn lane to approximately 400 feet; extend the existing northbound to westbound left turn lane to approximately 300 feet
- Colorado Boulevard/Dry Creek Road – restripe the west leg of County Line Road to provide approximately 600 feet of storage for the eastbound to northbound left turn lane; restripe the south leg of Colorado Boulevard to provide additional storage for the northbound to westbound left turn lane
- Quebec Street/County Line Road – restripe the north leg of Quebec Street to provide approximately 250 feet of storage for the

outside southbound to eastbound left turn lane

- Yosemite Street/County Line Road – restripe the west leg of County Line Road to provide approximately 425 feet of storage for the outside eastbound to northbound left turn lane; restripe the south leg of Yosemite Street to provide approximately 300 feet of storage for the outside northbound to westbound left turn lane storage

In addition to the minor capacity-related improvements described above, CDOT would investigate the practicality of requiring the contractor to:

- Develop a detailed construction phasing plan and an associated traffic control plan for all phases of work, taking into consideration the adjacent local arterial street system in addition to the C-470 mainline
- Ensure that emergency vehicle access will be maintained through all construction phases
- Perform traffic analysis to predict extent of traffic diversion from C-470 onto arterial street system, identify any potential traffic congestion areas on the arterial street system, and implement any appropriate transportation system management (TSM) improvements. These TSM strategies could consist of restriping turn bays or acceleration/deceleration lanes to improve intersection operations; retiming signals to change phasing plans or timing to improve operations; or other minor capacity improvements or management strategies to reduce congestion
- Prohibit long-term closures (beyond a typical nighttime or extended weekend closure) of any C-470 interchanges
- Develop a thorough and detailed detour signing plan for the arterial street system
- Consider restricting the contractor from working on adjacent interchanges concurrently for work that affects traffic operations.
- Restrict contractor from using any daytime closures. Only nighttime closures would be allowed
- Follow CDOT Region 6 Lane Closure Strategy for all lane closure times

Relocation of Residential or Business Accesses

Restrictions will be placed on the contractor to provide a temporary or alternative access during construction, which will minimize effects and inconvenience to the users.

Temporary Construction Easements

Property owners from whom temporary construction easements are obtained would be compensated for use of the property, at a price which is mutually agreeable to CDOT and the owner. After completion of use and prior to termination of the lease, the land would be regraded and reseeded as necessary to restore it to its original condition prior to construction.

Water Quality

The following temporary BMPs would be used during construction of either action alternative to prevent erosion, sediment, and nutrient loading in the watershed:

- Install perimeter erosion control measures prior to grading
- Follow the spill prevention and containment procedures outlined in the spill prevention plan
- Implement stabilization BMPs such as mulching, temporary seeding, and erosion control blankets

- Inspect erosion and sediment control measures at least every 14 days and after every major rain or snow event
- Avoid ground-disturbing activities or work during periods of heavy precipitation
- Till soils that have been compacted by heavy construction equipment to allow for quicker establishment of grass reseeding
- Sequence clearing so that entire site is not disturbed; stabilization of a cleared site would occur as soon as activity is completed
- Utilize a central staging area for all equipment and disposal of waste material; this staging area will not be located near streams or wetland areas
- Manage waste stockpiles of concrete, solid, sanitary/septic materials, liquids, and hazardous materials through implementation of waste management BMPs
- Locate temporary sanitation facilities a significant distance from waterways to prevent releases
- Clean and wash vehicles and equipment prior to arriving on site to avoid the importation of noxious weeds on site
- Wash concrete trucks in designated concrete washout areas at least 50 feet away from surface water sources
- Construct stabilized construction entrances to the site to limit mud and dirt deposition on local roadways
- Follow BMPs appropriate to handle the possibility of deicers used in and around the construction site
- Use erosion prevention measures to prevent the need for extensive erosion control. Erosion prevention measures include staging construction to reduce disturbance; minimizing access areas; temporary seeding; early final grading and seeding of completed areas; and clean water diversions
- Construct temporary and permanent water quality basins. Permanent water quality ponds can be constructed early and used for construction runoff
- Roughen disturbed surfaces throughout construction
- Use certified weed free mulch and hay bales
- Use temporary sediment control features such as silt fence, erosion logs, erosion bales, etc.
- Reseed disturbed areas with a native grass mix that includes forbs and shrubs. The seed mix could include Oats (*Avena sativa*) that will be applied at a low rate to facilitate soil stabilization while native plants are establishing.
- Place permanent native seeding incrementally throughout project
- Place temporary stabilization (mulch and mulch tackifier, soil binder) when native seeding is not allowed due to seasonal constraints
- Stabilize all slopes steeper than 3:1 with erosion control blankets

Noise

The following measures would be considered, where feasible, to reduce the effects of noise during construction:

- Enforce more restrictive work hours, particularly daylight hours, in residential areas

- Discourage weekend work, with the exception of activities best suited for off-peak hours
- Combine noisy operations to occur in the same time period
- Use noise blankets or other muffling devices on equipment and quiet-use generators
- Require contractor to use well-maintained equipment, especially with respect to mufflers
- Conduct noise inspections
- Re-route truck traffic away from residential streets, where possible
- Utilize alternative construction methods, such as sonic or vibratory pile driving in sensitive areas
- Require a noise monitoring and mitigation plan, such as temporary noise barriers

Air Quality

All contractors would be required to obtain a construction permit and develop a fugitive emissions particulate emissions control plan to be implemented during construction in accordance with the Colorado Air Quality Control Commission Regulation No. 1, Part 3D, and Regulation No. 3, Applicable Permit Requirements. The contractor would also be required to minimize airborne dust during construction through construction phasing to prevent exposing bare dirt on the whole site at once; stabilize soils through seeding and mulching; and suppressing dust suppression through regular watering.

Visual

Throughout the final design and construction phases of this project, cities, counties, and public stakeholders will be consulted to minimize temporarily undesirable obstructed views.

Vibration

An attempt will be made to minimize nighttime activities in residential areas. Vibration causing operations would occur in the same time period. Alternative construction methods, such as sonic or vibratory pile driving in sensitive areas, would be utilized whenever possible. Pile driving and other high-noise activities would also occur during daytime hours, where possible.

C-470 Trail

In order to provide uninterrupted service to trail users, various strategies would be employed. In no case would the trail be closed without providing adequate detour routes. Adequate signing of trail closures and detours would be required. A minimum of two week's notice would be provided for potential closures and detours. These detours would be posted and presented to trail user groups. Where possible, the trail would be reconstructed in its new location prior to closing the existing trail. In some locations, a temporary trail surface may need to be provided as a detour around work zones. In other locations, an off-site detour may be required if sufficient room is not available to safely pass through the roadway construction zone.

3.4 BIOLOGICAL ENVIRONMENT

The biological environment within the project area is composed of the natural resources within one mile of C-470. These resources include wildlife, threatened and endangered species, wetlands and waters of the U.S., prime and unique farmlands, and vegetation.

3.4.1 Wildlife

Although much of the project area is highly developed, a large number of wildlife species make use of riparian habitat and undeveloped or protected areas. Most of the species likely to be found in the study are well adapted to human disturbance. Common mammal species include mule deer (*Odocoileus gemionus*), elk (*Cervus elaphus*), coyote (*Canis latrans)*, red fox (*Vulpes vulpes*), raccoon (*Procyon lotor*), cottontail rabbit

(*Sylvilagus sp.*), deer mouse (*Peromyscus maniculatus*), and striped skunk (*Mephitis mephitis*).

Most of the stream crossings along C-470 serve as wildlife corridors under the highway. The most significant wildlife corridors are along the South Platte River and Big Dry Creek, where highway bridges allow for wildlife passage. Other wildlife crossings include Willow Creek, Dad Clark Gulch, and the High Line Canal, where box culverts allow for some wildlife movement. Fifteen culverts have been inventoried along C-470 between Kipling Parkway and Broadway, with an additional eight culverts east of Broadway. The smallest of these is 36 inches in diameter. These culverts often serve as small mammal crossings. **Figure 3-37** shows habitat areas for wildlife species found in the project area.

3.4.1.1 Affected Environment

Mule Deer and Elk

Mule deer (*Odocoileus hemionus*) is an important big game species found in most habitat types in Colorado. They are most common in shrublands on rough, broken terrain that provides abundant browse and cover. Mule deer are especially common along the foothills of the Front Range. Mule deer are likely to occur in and near the western portions of the C-470 project area, especially in the South Platte River floodplain and along the Dakota hogback.

American elk (*Cervus elaphus*) are commonly found in semi-open forest or along forest edges above 6,000 feet. Elk are known to migrate through the Chatfield Basin to the southwest of the C-470 project area and along the Dakota hogback to the west of the project area, and may occasionally venture into the C-470 project area, particularly in the winter.

The existing C-470 highway poses a substantial barrier to movement by both of these species. Mule deer are likely to use the South Platte River and Big Dry Creek bridges as movement corridors, while the likelihood of elk crossing C-470 to the north and east is small due to the absence of suitable habitat in the urbanized areas. Although the South Platte River bridge is likely a major movement corridor, it provides little room for wildlife movement along the river banks due to the existing trail and riprap. An existing chain link fence extending east and west from the South Platte River currently serves as deer fence. Mule deer also may occasionally cross the C-470 surface during low traffic periods. Historic accident data obtained from the *Safety Chapter for the C-470 Corridor Environmental Assessment* (February 2005), indicates that vehicle collisions due to wild animals is slightly below the statewide average for similar type highway facilities.

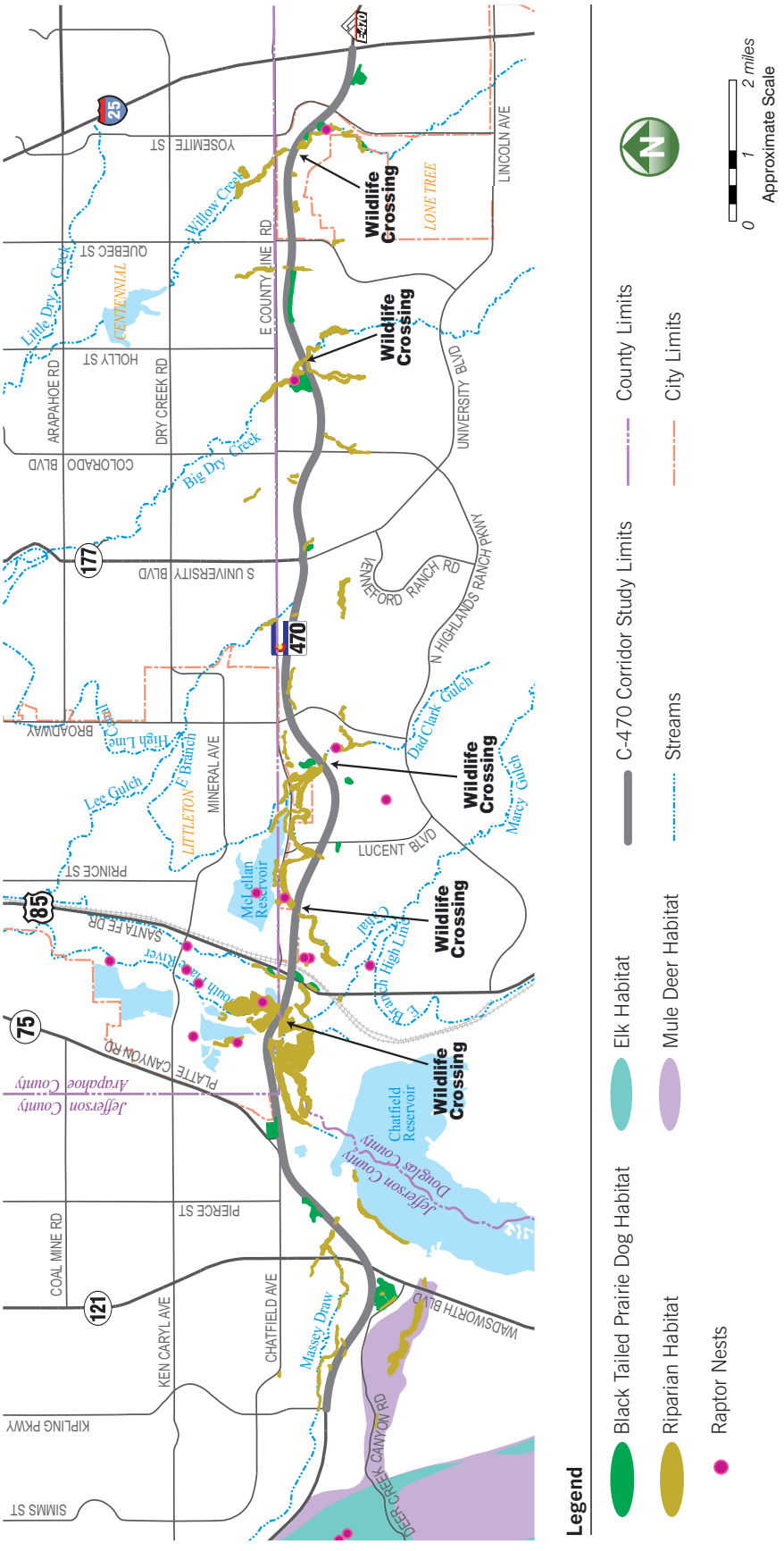
Black-tailed Prairie Dog

During the 2003 field review, 21 black-tailed prairie dog colonies covering about 90 acres were observed on vacant land throughout the C-470 project area. The black-tailed prairie dog (*Cynomys ludovicianus*) is a burrowing mammal that forms large colonies in shortgrass or mixed prairie along the Colorado Front Range. In August 2004, the U.S. Fish and Wildlife Service (USFWS) removed the prairie dog from consideration as a candidate for listing as a threatened species under the Endangered Species Act (ESA). However, the Colorado Division of Wildlife (CDOW) lists it as a state species of special concern. This category does not provide statutory protection. The *CDOT Impacted Black-tailed Prairie Dog Policy* (March 2005) requires implementing conservation measures including avoiding impacts and relocating individuals when possible. Prairie dogs can play an important role in grassland ecosystems by contributing to nutrient cycling and grassland regeneration, and by providing habitat for numerous other vertebrate species.

Raptors

During the 2003 field surveys, six active red-tailed hawk (*Buteo jamaicensis*) nests and one active prairie falcon (*Falco mexicanus*) nest were observed in the C-470 project area. These nests were inactive in 2003, but have been active in the last three years. Known nest sites for great

Figure 3-37
Wildlife Habitat



horned owl (*Bubo virginianus*) and Swainson's hawk (*Buteo swainsoni*) also were observed. Large, mature cottonwood trees near the High Line Canal and South Platte River are known to be winter perch sites for bald eagles (*Haliaeetus leucocephalus)*, while the nearby grasslands provide foraging habitat.

The ferruginous hawk (*Buteo regalis*) is the largest hawk in North America and is also listed as a state species of special concern. This species inhabits open prairie and desert habitats and is strongly associated with primary prey species such as ground squirrels and jackrabbits. Ferruginous hawks are relatively common winter residents in eastern Colorado, particularly in association with the black-tailed prairie dog. This species has been known to breed in scattered locations in eastern Colorado but not near the C-470 project area. Ferruginous hawks may occasionally forage within or near C-470, especially in winter, but are unlikely to nest in the project area.

Other Birds

Most wild birds commonly found in the U.S. are protected by the Migratory Bird Treaty Act (MBTA). This act protects migratory birds and active nests. A variety of bird species occur within the C-470 project area. Mallards (*Anas platyrhynchos*), Canada geese (*Branta canadensis*), and other waterfowl are often found in and around open water habitat. Wetland bird species include red-winged blackbird (*Agelaius phoeniceus*) and song sparrow (*Melospiza melodia*). Common grassland birds include the western meadowlark (*Sturnella neglecta*), vesper sparrow (*Pooecetes gramineus*) and mourning dove (*Zenaida macroura*). Cliff swallows (*Petrochelidon pyrrhonota*) commonly nest beneath bridges and other overhanging structures.

Aquatic Resources

The aquatic habitats within the project area include the South Platte River and its perennial tributaries. Aquatic species are limited in intermittent drainages and ditches by low and irregular flows. Common aquatic macroinvertebrates (aquatic insects) likely include blackflies (family *Simuliidae*), midges (family *Chironomidae*), mayflies (order *Ephemeroptera*), caddisflies (order *Trichoptera*), craneflies (family *Tipulidae*), damselfly larvae (family *Coenagrionidae*), as well as snails (class *Gastropoda*) and amphipods (order *Amphipoda*) (small freshwater crustacean).

Large macroinvertebrates such as crayfish and snails are potentially important prey for fish, waterfowl, and mammal species. The South Platte River and its perennial tributaries contain a variety of stream habitats, varying amounts of habitat modification, and seasonal water flows. Aquatic habitat in the project area has been severely affected by human modifications including Chatfield Reservoir Dam, channelization, impassable drop structures, and reduced riparian vegetation.

In 2003, the CDOW sampled fish in the South Platte River just downstream of the existing C-470 bridge and drop structure. The most common species captured were white sucker (*Catostomus commersoni*) and johnny darter (*Etheostoma nigrum*). Other species captured included longnose sucker (*Catostomus catostomus*), largemouth bass (*Micropterus salmoides*), longnose dace (*Rhinichthys cataractae*), mosquitofish (*Gambusia affinis*), rainbow trout (*Oncorhynchus mykiss*), smallmouth bass (*Micropterus dolomieui*), and walleye (*Stizostedion vitreum*).

3.4.1.2 Environmental Consequences

No-Action Alternative

The No-Action Alternative would have no direct effect on wildlife resources in the project area. Indirect effects could result as traffic volumes increase, making movement across the highway even more difficult. Any adverse effects on aquatic resources from stormwater runoff would continue at historical levels.

General Purpose Lanes Alternative

Because of the current levels of disturbance associated with urban development and the existing highway, substantial existing barriers to

wildlife movement already exist in the project area. Additional travel lanes and a concrete barrier separating directional traffic flow in the GPL Alternative would increase the difficulty of wildlife movement across the highway, but would not appreciably change wildlife movement. While the GPL Alternative would result in lengthening existing culverts and bridges, it would not eliminate any existing wildlife crossings. The reconstruction of the existing bridge over the South Platte River, as part of the GPL Alternative, would benefit a variety of wildlife species by improving its capacity for wildlife movement and enhancing connections between South Platte Park and Chatfield State Park.

MULE DEER AND ELK. The GPL Alternative would result in the minimal loss of marginal foraging habitat areas for mule deer or elk immediately adjacent to the roadway. Increased noise and traffic volumes would also result in creating a larger area around the highway that mule deer and elk would likely avoid, which would reduce the amount of usable habitat. Reconstruction of the existing bridge over the South Platte River would benefit these ungulates by improving the movement corridor between Chatfield State Park and South Platte Park. In other areas of the Corridor, ungulates crossing at-grade would cause safety concerns and potentially increase the number of wildlife vehicle collisions.

BLACK-TAILED PRAIRIE DOG. Many of the prairie dog colonies in the project area are located within or adjacent to the existing ROW. The GPL Alternative would impact 12.5 acres of prairie dog towns. Of these 12.5 acres, 0.3 acre is located in Arapahoe County, 6.2 acres in Douglas County, and 6.0 acres in Jefferson County. These effects would be most substantial between Santa Fe Drive and Wadsworth Boulevard.

RAPTORS. Of the six active red-tailed hawk nests in the project area, four are within ½ mile of C-470. These four nests include two in the southeast corner of the Santa Fe Drive interchange, one along Big Dry Creek on the north side of C-470, and one along Willow Creek on the south side of C-470. While construction activity will not require removal of any of these nests, nesting behavior and productivity may be affected due to the proximity to the limits of construction.

Direct effects to raptors in the project area would include a minor reduction in the foraging habitat in riparian areas immediately adjacent to the highway. The previously mentioned effects to nearby prairie dog towns that support habitat for small mammals such as mice and voles would represent a small reduction in prey for raptors in this area. Temporary behavioral disturbance including changes in foraging or breeding behaviors may also occur during construction activity. However, it is likely that the birds would resume their normal behaviors following construction, having acclimated to the changed environment, and continue to inhabit the area near the highway.

OTHER BIRDS. Bird nests are likely to occur in a variety of habitat types along C-470. Any direct effects to undeveloped habitat areas within the project area would likely impact the birds that depend on those areas for nesting and foraging. The GPL Alternative would reduce low-quality nesting and foraging habitat such as mowed areas of the median and within the existing CDOT ROW. Additional habitat loss would occur where ROW acquisition is necessary on undeveloped parcels along the existing highway.

Cliff swallows are known to nest under the C-470 bridges over Willow Creek and the South Platte River, and may also nest in other locations. These nests would be disturbed by construction of the GPL Alternative, and bridge reconstruction would

require their removal. These effects may adversely affect individual birds and colonies of birds, but would not affect the long-term viability of cliff swallow populations in the area. Under the MBTA, removal of these nests must occur when they are inactive, typically between October and March. If the timing of nest removal is not practicable for the construction schedule, efforts would be made to prevent birds from nesting.

AQUATIC RESOURCES. Both alternatives would likely result in temporary direct effects on aquatic resources during work on culverts or bridge crossings of perennial streams. Breeding and foraging habitat would be affected to a minor extent during construction near culverts and bridges. Downstream turbidity (suspended sediment) would be increased during construction, which could affect downstream fish and invertebrates.

The long-term effect on aquatic resources resulting from both alternatives may be beneficial because the final design will include effective BMPs for improving the quality of stormwater runoff.

Express Lanes Alternative (Preferred Alternative)

The EL Alternative is considered to have similar effects to wildlife habitat as compared to the GPL Alternative. One additional impact associated with the EL Alternative is the added barrier to wildlife movement created by multiple concrete barriers separating the general purpose lanes from the express lanes. These barriers could be impassable to small mammals. Larger mammals could jump over the barriers. However, due to the volume and traffic speeds on the highway, any wildlife attempting to cross the highway would not likely make it across safely. The reconstruction of the bridge over the South Platte River as part of the EL Alternative would increase the capacity for wildlife movement under C-470.

The addition of travel lanes would impact 14.3 acres of black-tailed prairie dog towns, with 0.3 acre in Arapahoe County, 8.1 acres in Douglas County, and 5.9 acres in Jefferson County.

The EL Alternative may temporarily change raptor movement, foraging, or perching behaviors during construction. Cliff swallows known to nest under existing bridges would also be impacted where bridge reconstruction occurs.

Adverse effects associated with the EL Alternative, like those for the GPL Alternative, would increase the effects the existing highway has on wildlife and would result in loss of breeding and foraging habitat. Additional concrete barriers used to separate the express lane facility from the general purpose lanes would exacerbate the safety concern due to vehicle collisions with wildlife attempting to cross the highway at-grade.

3.4.1.3 Mitigation

Although concrete barriers used to separate travel lanes would impede wildlife movement across C-470, improvements to the wildlife underpass at the South Platte River would have a positive overall effect to wildlife movement in the project area.

The most important wildlife movement corridor in the project area is along the South Platte River. Both the GPL and EL Alternatives include the reconstruction of the bridge over the South Platte River. The reconstructed bridge would be wider and taller than the existing bridge and would better accommodate wildlife movement between Chatfield State Park and South Platte Park. A natural substrate would also be provided on the east side of the South Platte River to encourage wildlife movement. Although this corridor would be disrupted during construction, the post-construction condition would be an improved wildlife crossing that would improve the wildlife corridor through this area. Post construction re-vegetation near the bridge would include native riparian shrubs such as skunk brush and willow in attempt to attract ungulates

to cross under C-470. The existing chain link fence that extends from the South Platte River along the north and south side of C-470 would also be replaced to serve as deer fence, directing large mammals to safely cross under C-470 at the South Platte River. Any culverts required to be replaced as part of this project would be maintained at current size or upgraded to a minimum of 24 inches, subject to drainage restrictions, to maintain connectivity across C-470 for small and medium sized mammals.

In addition to improving wildlife movement at the South Platte River, implementing the water quality BMPs outlined in **Section 3.3.4**, would improve wildlife habitat in riparian and aquatic areas.

Raptor Nests

A survey for nesting raptors within one-third mile of the project area would be performed to ensure that nesting raptors would not be disturbed by construction. For the red-tailed hawk, CDOW recommends no surface occupancy from February 15 to July 15 within a one-third mile radius of nest sites and associated alternate nests. The CDOW has developed recommended buffer zones and seasonal restrictions for new surface occupancy within certain distances of nest sites of several raptor species, including the red-tailed hawk. Surface occupancy is defined as human-occupied buildings and other structures such as oil and gas wells, roads, railroad tracks, trails, etc. The USFWS typically considers implementation of the CDOW buffers and seasonal restrictions as adequately complying with the MBTA.

If restricting construction within nest buffers during the breeding season is not practicable, prior to construction CDOT would coordinate with USFWS and CDOW to develop a mitigation strategy to offset potential lost productivity. CDOT would construct new nests in areas that are protected from development and have an adequate prey base. It is possible that nesting pairs may not be adversely affected by construction activity encroaching within nest buffers, and would successfully fledge offspring if construction visibility and noise were screened by vegetation or topography. CDOT would monitor nests to determine if construction effects were more than anticipated and would work with USFWS and CDOW to modify the nest mitigation plan, if appropriate.

Other Bird Nests

In order to comply with the MBTA, prior to construction CDOT would survey areas proposed for disturbance for the presence of migratory bird nests. If nests are present, CDOT would avoid disturbing active nests by removing trees and shrubs during the non-nesting season and timing construction activity to avoid active nests during the nesting season.

Bird nests found under existing bridge structures would be removed after August 15, but prior to April 25 in compliance with the MBTA. To prevent new nests from being constructed, netting would be installed under bridges and culverts during the non-breeding season or new nests under construction would be visited every three to four days to prevent new nests from being completed, unless project construction activity is continuous on a daily basis during active nesting season.

Prairie Dog Colonies

Prairie dog colonies in the areas that would be impacted by either of the two action alternatives would be re-surveyed for any changes in prairie dog activity. Construction would be phased to avoid and minimize direct effects to occupied prairie dog colonies. In areas where avoidance is not possible, CDOT would follow the *CDOT Impacted Black-tailed Prairie Dog Policy* (March 2005). This policy consists of a series of steps which include avoiding and minimizing effects, relocating affected individuals if possible, and coordinating with CDOW on approved removal methods if relocation is not feasible. Some prairie dogs would be relocated to CDOT ROW at C-470 and Quincy Avenue, subject to CDOW guidelines. Additional prairie dogs would be relocated to South Platte Park.

In compliance with 21 CFR 1240, the Food and Drug Administration's November 2003 Final Interim Rule addressing the spread of monkeypox, CDOT would notify the FDA prior to transporting any live or dead prairie dogs.

For those colonies that would be only partially affected, prior to construction a visual barrier would be installed between the burrows that would be impacted and undisturbed portions of the colony. Following barrier installation, burrow openings in the construction area would be collapsed. The visual barrier and collapsed burrows encourage abandonment of burrows that would be affected, which would reduce the likelihood of direct effects to individual prairie dogs.

3.4.2 Federal and State Threatened and Endangered Species

Federally threatened and endangered species are protected under the Endangered Species Act (ESA) of 1973 as amended. Adverse effects to a federally listed species or its designated critical habitat resulting from a federal action requires consultation with the USFWS as required by the ESA. There are no federal regulations that require consultation for effects to candidate species, but if the species were to become listed during construction, consultation with the USFWS would be required. Because the status of candidate species may change during a study, the FHWA and CDOT routinely address candidate species during the environmental clearance process. A detailed analysis of species habitat and potential occurrence within the project area is in the *Threatened and Endangered Species Technical Report* (March 2005). Of the potential species analyzed in this section only the bald eagle and burrowing owl are known to be present in the project area.

3.4.2.1 Affected Environment

The USFWS and CDOW were contacted for a list of federal threatened or endangered species that may occur within the project area and habitat coverages. Study biologists then assessed the project area for the presence of habitat for listed species. **Table 3-42** lists federal threatened and endangered species that could occur in the

Table 3-42
Federally Listed Species Potentially Occurring in the Project Area

Common Name	Scientific Name	Known to Occur in the Project area	Federal Status
Preble's meadow jumping mouse	*Zapus hudsonius preblei*	Nearest occupied habitat is approximately 1.5 miles from C-470	Threatened
Ute ladies'-tresses orchid	*Spiranthes diluvialis*	No	Threatened
Colorado butterfly plant	*Gaura neomexicana* ssp. *coloradensis*	No	Threatened
Bald eagle	*Haliaeetus leucocephalus*	Occasional Occurrence	Threatened
Whooping crane*	*Grus americana*	No	Endangered
Least tern*	*Sterna antillarum*	No	Endangered
Eskimo curlew*	*Numenius borealis*	No	Endangered
Piping plover*	*Charadrius melodus*	No	Threatened
Pallid sturgeon*	*Scaphirhynchus albus*	No	Endangered
Western prairie fringed orchid*	*Platanthera praeclara*	No	Threatened

** Federally-listed species affected by depletions to the South Platte River system*

project area, as provided by USFWS. Habitat for these species identified in the project area is shown in **Figure 3-38**.

Included in **Table 3-42** are species that could potentially be affected by new or continued water depletions to the South Platte River system. Species on this list could be adversely affected by water depletions associated with a variety of project elements including detention ponds and dust abatement.

Preble's Meadow Jumping Mouse

The Preble's meadow jumping mouse (Preble's) is listed as threatened under the ESA. Typically, Preble's is located in low undergrowth consisting of grasses and forbs, in open wet meadows, riparian corridors near forests, or where tall shrubs and low trees provide adequate cover. Along Colorado's Front Range, Preble's is found below 7,600 feet in elevation, generally in lowlands with medium to high moisture along permanent or intermittent streams and irrigation canals.

In 2000, the USFWS established the Preble's Meadow Jumping Mouse Block Clearance Zone. Based on repeated habitat assessment and survey data, the USFWS has assumed an absence of Preble's within this zone. As such, requirements for habitat assessments and trapping surveys in potentially suitable habitat for compliance with the ESA are suspended in this area.

With the exception of the South Platte River floodplain near Santa Fe Drive, the north side of the project area is included in the Preble's Meadow Jumping Mouse Block Clearance Zone for the Denver metro area. Also included is the south side of the project area between I-25 and Santa Fe Drive, leaving Massey Draw south of C-470 and all reaches of the South Platte River within the project area as the only drainages located outside of the Block Clearance Zone. These areas were assessed for the presence of potential habitat and for the likelihood of the presence of Preble's. No Preble's habitat is present on the reach of Massey Draw in the project area south of the Block Clearance Zone due to lack of shrubby, riparian vegetation, and isolation by Chatfield Reservoir from known Preble's populations.

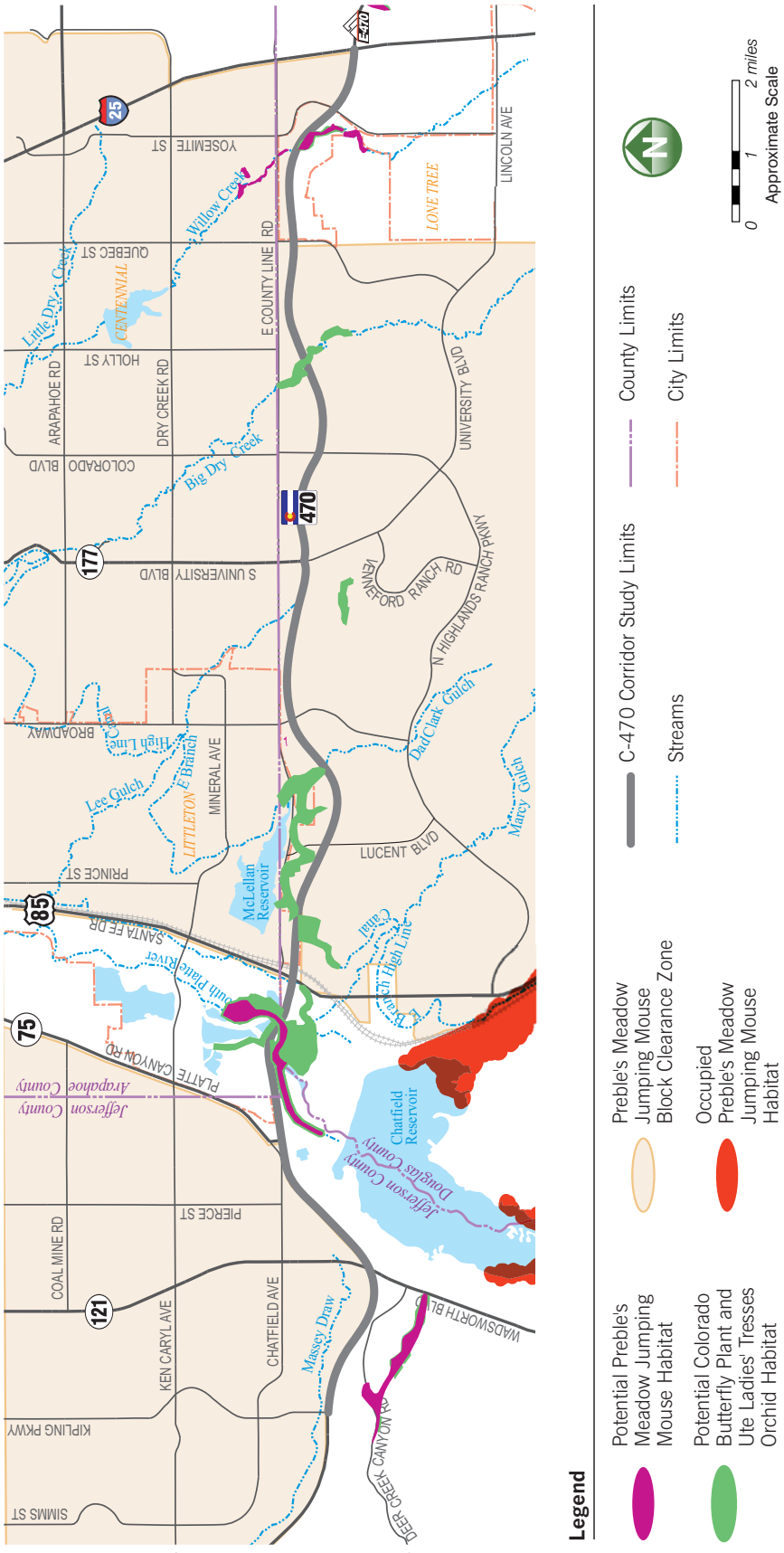
One area of higher-quality potential habitat is the large, mature riparian community on the South Platte River that runs from downstream of Chatfield Reservoir Dam to the north end of South Platte Park. The area contains habitat that may be capable of acting as a movement corridor supporting Preble's. Although shrubby riparian vegetation present along the South Platte River north of Chatfield Dam could support Preble's, disturbance, isolation from known Preble's populations, and several negative presence/absence surveys in and near the project area indicate the likelihood of Preble's being present is low. Based on the disturbance, isolation, and past negative presence/absence surveys, the USFWS has determined that the likelihood of Preble's being present is low enough that a new presence/absence survey would not be required prior to construction of either the GPL or EL Alternatives.

Ute Ladies'-Tresses Orchid

The Ute ladies'-tresses orchid is federally listed as threatened. It occurs at elevations below 6,500 feet in moist to wet alluvial meadows, floodplains of perennial streams, and around springs and lakes. Generally, the vegetative cover is relatively open while dense, overgrown sites are not conducive to orchid establishment. Where the orchid is found, soils are typically alluvial deposits of sandy, gravelly material that are saturated to within 18 inches of the surface for at least part of the growing season. Alkaline or clay soils and regularly disturbed area such as roadside ditches typically preclude presence of the orchid.

Wetlands in the project area meeting USFWS guidelines were assessed for potential orchid habitat during field surveys in August 2004. With the exception of the wetlands associated with the South Platte River, none were deter-

Figure 3-38
Potential Threatened/Endangered Wildlife Locations



mined suitable orchid habitat because of the presence of clay soils and highly disturbed conditions in roadside wetlands. However, most of the South Platte River wetlands are dominated by dense stands of sandbar willow and reed canarygrass, which would typically preclude the orchid. Areas along the South Platte River with more open wetland vegetation were surveyed for the orchid in August 2004, but none were found.

Colorado Butterfly Plant

The Colorado butterfly plant is a short-lived perennial herb found in moist areas of floodplains. This species is federally listed as threatened under the ESA and is found within a small area in southeastern Wyoming, western Nebraska, and north-central Colorado. It occurs on sub-irrigated, alluvial soils on level or slightly sloping floodplains and drainage bottoms at elevations between 5,000 and 6,000 feet. Its habitat is generally considered to coincide with that of the Ute ladies'-tresses orchid.

As is the case with Ute Ladies'-tresses orchid, the Colorado butterfly plant is not likely to be present in the project area because of a lack of suitable habitat. Areas along the South Platte River with more open wetland vegetation were surveyed for the Colorado butterfly plant in August 2004, but none were found.

Bald Eagle

The bald eagle is listed as threatened under the ESA. Its habitat ranges across most of North America near large bodies of open water such as lakes and marshes. In Colorado, bald eagles are often found near reservoirs or other areas where fish are abundant. Their diet consists of fish, injured waterfowl, muskrats, rabbits, and prairie dogs.

Bald eagles are known to frequently fly along the South Platte River and they occasionally forage or perch in the vicinity of the project area. There has been a report of a new bald eagle nest on private land north of South Platte Park. This nest is located approximately one mile from C-470 near Cooley Lake, outside the project area. A young pair of eagles began building onto a red-tailed hawk nest at this location in 2004. However, the pair did not successfully reproduce in 2004. Great horned owls took over this nest during the 2005 nesting season. Observational data indicates that these eagles are feeding on rabbits, unidentified small mammals, waterfowl, and fish.

In addition to the new nest, there are other cottonwood trees in and near the project area large enough to provide suitable nest substrate. No eagles have exhibited nest-building behavior in these trees. Because of the proximity of the new nest, it is unlikely another nesting pair would begin construction along the South Platte River in or near the project area, but it is possible the current pair may abandon the existing nest in favor of an alternative nest site.

Platte River Species

Whooping crane, least tern, Eskimo curlew, piping plover, pallid sturgeon, and western prairie fringed orchid are species that rely heavily on habitat provided by the South Platte River system. None of these species are known to occur in the project area. Any depletion to the South Platte River system will have an adverse affect on these species.

State Listed Threatened and Endangered Species

As part of its wildlife species conservation program, the State of Colorado has developed a list of wildlife species that it considers to be threatened or endangered within Colorado. Federally listed species are also listed by the state, but because the state designation is focused strictly on species' ranges within Colorado, in addition to federally listed species, several state listed species are not federally listed. **Table 3-43** identifies the state listed species and the likelihood of their occurrence in the project area. Of the state listed terrestrial species shown on **Table 3-43,** based on habitat requirements and current distribution, the burrowing

owl is the only terrestrial species likely to occur in the area.

BURROWING OWL. The burrowing owl, a state threatened species, is a small migratory owl that occupies sparsely vegetated areas on the plains (typically prairie dog towns in eastern Colorado) during the summer breeding season. As a bird species, federal and state laws, including the MBTA, prohibit the killing of burrowing owls or destroying their active nests. The owl is active during the day and uses abandoned prairie dog burrows for nesting and roosting. When plague or poisoning kills the prairie dogs in a colony or when the grass around their burrows gets more than ankle high, burrowing owls will abandon their nest burrows. Burrowing owl breeding in Colorado occurs from early May to late August. Burrowing owls are typically present in Colorado until late October, when they migrate south to Mexico and Central America.

During the 2003 field review, 21 black-tailed prairie dog colonies covering a total of about 90 acres were observed on vacant land throughout the project area. The colonies provide potential habitat for the burrowing owl and may support active nests during the breeding season.

STATE LISTED AQUATIC SPECIES. Of the nine state listed fish, only six have habitat present in the South Platte River. These small-bodied fish that occur in rivers, streams, ponds, and lakes in the eastern Colorado plains including the lake chub, northern redbelly dace, common shiner,

Table 3-43
State Listed Threatened and Endangered Species

Species	Status	Likelihood of Occurrence in the Project area
Terrestrial Species		
Boreal toad	State Endangered	Low
Burrowing owl	State Threatened	High
Kit fox	State Endangered	Low
Lesser prairie-chicken	State Threatened	Low
Plains sharp-tailed grouse	State Endangered	Low
River otter	State Threatened	Low
Wolverine	State Endangered	Low
Aquatic Species		
Rio Grande sucker	State Endangered	Low
Lake chub	State Endangered	Low
Plains minnow	State Endangered	Low
Suckermounth minnow	State Endangered	Low
Northern redbelly dace	State Endangered	Low
Southern redbelly dace	State Endangered	Low
Brassy minnow	State Threatened	Low
Common shiner	State Endangered	Low
Arkansas darter	State Threatened	Low

suckermouth minnow, plains minnow, and brassy minnow. None of the species are present in great number in any parts of the state. The known locations of the listed species are limited to reaches of the South Platte River east of Sterling and the upper South Platte River tributary system. The nearest tributary known to support one of the six species (northern redbelly dace) is West Plum Creek above Chatfield Reservoir, which is upstream of the project area. None of the species were captured during fish sampling done by CDOW in 2003 on the South Platte River in or near the project area. Based on available information, it is unlikely the state-listed species are present in the study area and the project would not affect them.

3.4.2.2 Environmental Consequences

In compliance with the ESA, the alternatives under consideration in this EA were evaluated for potential effects to federal threatened or endangered species. Because there would not be depletions to the South Platte River, none of the alternatives would have an effect on listed species affected by depletions. Although potential habitat is present for the Preble's meadow jumping mouse, the Ute ladies'-tresses orchid, and the Colorado butterfly plant, the species are not likely to be present based on habitat assessments and previous surveys. As a result, CDOT and the FHWA have determined that the alternatives would not have an adverse effect on Preble's, the orchid, or the butterfly plant. In a letter dated January 6, 2006 (see **Appendix B**), the USFWS concurred with the determination that the effects of this project are not likely to adversely affect the continued existence of the Preble's, orchid, butterfly plant, or the bald eagle. This letter further provides concurrence that this project would not result in depletions to the Platte River, and would therefore not have an adverse effect on the federally listed Platte River aquatic species. If conditions change, and it is later determined that this project would result in an adverse effect to any of these federally listed species, a formal consultation would be inititated with the USFWS.

The potential effects to the bald eagle, Platte River species, and burrowing owl from each alternative are described in the following sections.

No-Action Alternative

The No-Action Alternative would not involve activity that would have a direct or indirect effect on any federally listed threatened, endangered, or candidate species.

General Purpose Lanes Alternative

BALD EAGLE. The GPL Alternative would not result in permanent damage to any known bald eagle roosts or nests. Loss of black-tailed prairie dogs would result in some reduction to available bald eagle prey. However, the prairie dog colonies impacted within a three-mile radius of the active eagle nest near Cooley Lake, represent only 1.5 percent of the total prairie dog prey base available. In addition, there are other sources of prey in the project area that would be minimally affected by this alternative, such as rabbits, waterfowl, and fish. Construction activity may temporarily change the eagles' movement, foraging, and perching behaviors.

PLATTE RIVER SPECIES. Water quality detention, dust abatement, and wetland mitigation for the GPL Alternative would not result in depletions to the South Platte River system. Therefore, this alternative would not affect any of the federally listed South Platte River aquatic species.

BURROWING OWL. Loss of prairie dog colonies from the GPL Alternative would result in the loss of burrowing owl nesting habitat. Due to the abundance of habitat available along the Front Range, the loss of burrowing owl nesting habitat would have only a minor effect on the burrowing owl.

Express Lanes Alternative (Preferred Alternative)

The EL Alternative is considered to have similar effects to threatened and endangered species as compared to the GPL Alternative. The EL Alternative would not result in permanent damage to any known bald eagle roosts or nests. Loss of black-tailed prairie dogs would result in some reduction to available bald eagle prey. However, there are other sources of prey in the project area that would be minimally affected by this alternative, such as rabbits, waterfowl, and fish. Construction activity may temporarily change the eagles' movement, foraging, and perching behaviors.

Water quality detention facilities, dust abatement, and potential wetland mitigation activities would be the same for the EL Alternative as for the GPL Alternative, and would not result in depletions to the South Platte River system. The EL Alternative would result in loss of burrowing owl nesting habitat when prairie dog colonies are abandoned. However, this would not have an adverse effect on the long-term viability of the burrowing owl.

3.4.2.3 Mitigation

Although they are unlikely to be affected by any of the alternatives, CDOT would confirm the habitat characteristics and status of Preble's meadow jumping mouse habitat, Ute ladies'-tresses orchid, and the Colorado butterfly plant with USFWS within one year prior to construction. If habitat conditions have improved and USFWS requires it, CDOT would survey for Preble's. CDOT would also perform surveys for the orchid and the butterfly plant. In the event any of the species were present, CDOT would coordinate with USFWS to develop a plan to avoid and minimize detrimental effects and mitigate where such effects are unavoidable.

Before construction, the project area and its vicinity would be surveyed again for any additional bald eagle nests. CDOT would also plant vegetation as suitable cover for alternative prey habitat, install perch poles for hunting roosts, a nesting platform, and a nest basket to encourage nesting attempts within the three-mile foraging area of the existing nest. Some of the prairie dogs from the affected colonies would also be relocated within this area.

The project area would also be surveyed for the presence of the burrowing owl according to survey techniques outlined by CDOW. If burrowing owls were present, prairie dog evacuation and initial disturbance of prairie dog colonies would be planned between October 31 and March 1, when burrowing owls would not be present in the project area. CDOT would work with the USFWS and CDOW to develop any additional mitigation measures if seasonal restrictions on construction were not practical.

3.4.3 Wetlands and Waters of the U.S.

In recognition of the ecological value of wetlands and open water, the Federal government has issued two pieces of legislation relevant to this EA. Section 404 of the CWA gives the USACE regulatory authority over the discharge of dredged or fill material into regulated surface water and any associated wetlands. The USACE's jurisdiction applies only to wetlands that have a surface connection to regulated surface water. The 404(b)(1) Guidelines require that effects to all wetlands and waters of the U.S. be avoided or minimized to the best extent possible. Unavoidable effects must be mitigated. The second piece of legislation, Executive Order 11990 Protection of Wetlands, protects isolated wetlands (those not connected to a regulated water of the U.S.) by directing the lead agency, in this case the FHWA, to avoid direct or indirect effects to wetlands wherever there is a practicable alternative for projects with federal funding or oversight. Executive Order 11990 Protection of Wetlands (1977) and Department of Transportation Order 5660.1A, Preservation of the Nation's Wetlands (1978), require the FHWA and CDOT to mitigate for impacts to non-jurisdictional wetlands. For additional information on wetland delineation, see the *Wetland Delineation Report* (February 2005).

In accordance with the USACE delineation manual, *U.S. Army Corps of Engineers Wetlands Delineation Manual* (1987), wetlands were identified and mapped on the basis of three environmental characteristics including the prevalence of wetland vegetation, wetland hydrology, and hydric soils. Wetland, or hydrophytic, vegetation is composed of plants that are adapted to, or tolerant of, wet environments and are able to become established, grow, and reproduce in wet areas. Wetland hydrology is present in areas where water has an overriding influence on characteristics of vegetation and soils. These characteristics are commonly found in areas that are inundated or that have soils saturated continuously for at least five percent of the growing season in most years. For the Denver metro area, an area can be considered to have wetland hydrology if it is inundated or saturated for as few as five consecutive days during the growing season. Hydric soils are soils that contain enough water during the growing season to allow anaerobic conditions and characteristics to develop in the upper layer of the soil. Under anaerobic conditions, changes in soil chemistry produce characteristic wetland indicators such as very dark soil, sulfidic odor, or mottled soil.

Using National Wetland Inventory (NWI) maps and Natural Resource Conservation Service (NRCS) soil maps, the biologists initially identified locations where wetlands were likely to occur within the project area. These areas were then field verified based on the presence of vegetation, hydrology, and soils as outlined in the USACE delineation manual. During August and September 2004, biologists delineated wetlands and open water in the project area. All wetland, open water, and isolated ditch wetland boundaries in the project area were delineated and mapped.

3.4.3.1 Affected Environment

A total of 151 wetland sites totaling 29.4 acres of wetlands were identified and delineated during field investigations of the project area. The areas include both shrub wetlands and herbaceous wetlands. The majority of the wetlands in the project area are adjacent to perennial streams that are tributary to the South Platte River. The principal streams and rivers within the C-470 project area include Massey Draw, the South Platte River, Marcy Gulch, Dad Clark Gulch, Lee Gulch, Big Dry Creek, and Willow Creek. Other wetlands are associated with hillside seeps or with drainage ditches along roads and do not have a surface connection to a regulated water of the U.S. The wetlands identified in the study are shown in **Figure 3-39**. Wetland numbers are identified in Table 1 of the Wetland Finding located in **Appendix C**.

Wetlands found adjacent to open water are typically located on narrow benches or terraces along streams. Many of the streams in the project area are incised and support only narrow fringes of wetland vegetation. Wetland vegetation along streams is dominated by Emory's sedge (*Carex emoryi*), reed canarygrass (*Phalaris arundinacea*), and sandbar willow (*Salix exigua*). Other species that occur less frequently include bulrush (*Scirpus lacustris*), broad-leaf cattail (*Typha latifolia*), Baltic rush (*Juncus balticus*), barnyard grass (*Echinochloa crus-galli*), Canada thistle (*Cirsium arvense*), meadow fescue (*Festuca pratensis*), and curly dock (*Rumex crispus*). Canada thistle is usually found in uplands and meadow fescue can be found in both wetlands and uplands.

Wetlands with no surface connection to a stream or open water are typically located in roadside drainage swales along C-470 or in small depressions in the highway ROW. Vegetation in these wetlands is dominated by foxtail barley (*Hordeum jubatum*), barnyard grass (*Echinochloa muricata*), and meadow fescue (*Festuca pratensis*).

In addition to natural streams, portions of two irrigation waterways, the High Line Canal and City Ditch, pass through the project area. The High Line Canal passes through the project area approximately one mile east of the South Platte River, and again as it crosses Dad Clark Gulch. This canal supplies irrigation water to the plains east of Denver. City Ditch flows through the

project area between the South Platte River and Santa Fe Drive, although the portion that crosses the project area is mostly underground. City Ditch provides irrigation water to Denver's city parks.

Other large water bodies in the vicinity of project area include Chatfield Reservoir, created by an impoundment of the South Platte River, McClellan Reservoir, created by an impoundment of Dad Clark Gulch, and several lakes within the South Platte floodplain that have been created by gravel mining. Smaller bodies of open water in the project area include agricultural irrigation and detention ponds.

Areas of open water include the channels of streams and the High Line Canal, a gravel mine lake, and an apparently permanently ponded detention area, totaling 2.66 acres. These locations are also shown in **Figure 3-39**.

Wetland Functions

Wetland functions are the physical, chemical, and biological processes or attributes vital to the integrity of wetland systems. Wetland functions typically are related to water quality, biodiversity, and hydrological and ecological processes. All wetlands do not perform all functions and wetlands do not perform functions equally.

Wetland values, such as recreation and uniqueness, are attributes not necessarily important to the integrity of wetland systems. However, these attributes are perceived as being valuable to society. Similar to functions, all wetlands do not provide all values and the values that are provided are not provided equally.

Functions of wetlands in the project area were evaluated qualitatively based on best professional judgment. Assignment of functions and values considered the size, quality, and hydrologic aspects of the wetland site. The position of the wetland in the landscape (e.g., in an isolated depression, on a slope, or adjacent to a stream or lake) was also considered.

Functions and values assessed include those listed in CDOT's Mitigation Site Selection Form. Functions evaluated include groundwater recharge/discharge, flood flow alteration, streambank stabilization, sediment/toxin retention, nutrient removal/transformation, production export, wildlife habitat and/or travel corridor, fish and/or shellfish habitat, and threatened and endangered species concerns. Values evaluated include recreation, education and/or scientific value, uniqueness or heritage value, visual quality and aesthetics, and economic benefits. For each wetland, ratings of low, moderate, high, or non-applicable were assigned for each function and value.

The highest-rated wetlands in the project area are palustrine wetlands that occur along streams and are supported by surface water. Although some of these wetlands include plant species considered noxious weeds (e.g., Canada thistle), they have a high rating for general wildlife habitat because streams and rivers and their associated riparian communities provide diverse habitat types for a variety of species. Ratings are moderate to low for other functions and values because of the restricted nature of the wetlands. For example, flood flow alteration and stream bank stabilization are low in areas with a wetland fringe only one or two feet wide.

Palustrine wetlands located in roadside ditches have low ratings for all functions and values because of their location adjacent to C-470, their generally small size, and high levels of disturbance associated with highway maintenance activities.

3.4.3.2 Environmental Consequences

During the development and design of proposed alternatives, effects to wetlands and waters of the U.S. were avoided and minimized to the extent practicable. Because wetland locations within the project area were identified early in the study process, and delineated prior to the

completion of quantitative screening, measures were taken to avoid wetland effects by varying widths in sensitive areas and using retaining walls to limit encroachment into wetlands where total avoidance was not possible. The sections below discuss potential effects to wetlands and waters of the U.S. for the three alternatives. For more information on wetland effects and mitigation, see the Wetland Finding, located in **Appendix C**.

No-Action Alternative

The No-Action Alternative would not result in any direct effects to wetlands or waters of the U.S., although indirect effects such as water quality degradation due to untreated stormwater runoff would continue at historical levels.

General Purpose Lanes Alternative

Construction of the GPL Alternative would result in both permanent and temporary wetland effects. Permanent effects would result from placing fill in wetlands or waters of the U.S. due to new bridge construction over streams and canals, stormwater drainage outfalls to streams, and fill placement from construction of detentions ponds, roadway, and interchange improvements. Temporary effects would occur from fill placement for temporary construction access roads or work areas in wetlands. When construction of a particular area is completed, the fill would be removed and the wetland area would be re-graded and re-vegetated to restore the original wetland condition.

The GPL Alternative would result in approximately 1.66 acres of permanent effects to wetlands and waters of the U.S. Of these, 0.47 acre is to jurisdictional wetlands and other waters of the U.S.; 1.19 acres are non-jurisdictional. Temporary effects were estimated at 0.29 acre. These effects are summarized in **Table 3-44**.

Indirect effects to wetlands such as changing drainage patterns, increasing runoff volumes, changing wetland hydrology, and increasing delivery of non-point source pollution such as sediment, de-icer, and petroleum products could result from increasing the impervious surface area of the roadway. These effects will be avoided and minimized by implementing construction and post-construction BMPs as described in **Section 3.3.4** on water quality.

Express Lanes Alternative (Preferred Alternative)

As with the GPL Alternative, construction of the EL Alternative would result in both permanent and temporary effects.

The EL Alternative would result in permanent effects to wetlands and waters of the U.S. of approximately 1.81 acres. Of these, 0.50 acre is to jurisdictional wetlands and other waters of the U.S.; 1.34 acres are non-jurisdictional. Temporary effects were estimated at 0.31 acre. These effects are also summarized in **Table 3-44.**

Table 3-44
Wetland Effects

	General Purpose Lanes Alternative	Express Lanes Alternative
Wetlands		
Permanent	0.44 acre (jurisdictional) 1.19 acres (non-jurisdictional)	0.47 acre (jurisdictional) 1.34 acres (non-jurisdictional)
Temporary	0.06 acre (jurisdictional) 0.23 acre (non-jurisdictional)	0.04 acre (jurisdictional) 0.27 acre (non-jurisdictional)
Other Waters of the U.S. (permanent)	0.03 acre	0.03 acre

Indirect effects to wetlands such as changing drainage patterns, increasing runoff volumes, changing wetland hydrology, and increasing delivery of non-point source pollution such as sediment, de-icer, and petroleum products could result from increasing the impervious surface area of the roadway. These effects will be avoided and minimized by implementing construction and post-construction BMPs as described in **Section 3.3.4.**

3.4.3.3 Mitigation

Despite making every effort during alternative development and conceptual design to avoid and minimize impacts to Section 404 jurisdictional wetlands and waters of the U.S. and non-jurisdictional wetlands, previously described unavoidable impacts would result from implementing either the GPL or EL Alternative. Section 404 of the CWA requires compensatory mitigation for permanent, direct impacts to Section 404 jurisdictional wetlands and waters of the U.S. Additionally, at the direction of Executive Order 11990, Protection of Wetlands (1977), and Department of Transportation Order 5660.1A, Preservation of the Nation's Wetlands (1978), the FHWA and CDOT also mitigate for permanent, direct impacts to non-jurisdictional wetlands. All compensatory wetland mitigation is done on a 1:1 basis.

The Transportation Equity Act for the 21st Century (TEA-21) and subsequent FHWA wetland regulation 23 CFR 777 states that preference should be given to use of mitigation banks through purchasing credits in a USACE approved mitigation bank. Other factors considered during the mitigation analysis include locally important functions and values of mitigation sites, adequacy and reliability of supportive hydrology, location of mitigation sites, and the timing of mitigation construction. Ultimately, the mitigation analysis determined that locally important functions and values are present along existing stream banks, and the reliability of existing stream flows support adequate hydrology resulting in a high likelihood for long-term wetland sustainability. Therefore, on-site mitigation will be implemented for impacts to wetlands along existing stream banks. Based on the TEA-21 preference for use of mitigation banks, CDOT will purchase mitigation bank credits to mitigate for non-streamside wetland impacts.

3.4.4 Prime and Unique Farmlands

Chapter 7 of the Code of Federal Regulation, Part 658 requires the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS), to identify and locate prime and unique farmland. These farmlands are protected in accordance with the Farmland Protection Policy Act of 1981. Prime farmlands are considered to be of national importance and have been defined as being land with the best combination of physical and chemical characteristics for producing feed, forage, fiber, and oilseed crops, and are available for these uses. Unique farmland is land other than prime farmland that is used for the production of specific, high-value crops.

In addition to the prime and unique lands, the Important Farmland Program encourages the identification of farmland of statewide and local importance. Farmlands of statewide importance, while not protected by law, should be given special consideration when planning and evaluating agricultural resources.

3.4.4.1 Affected Environment

Coordination with the NRCS State Soil Scientist and soil mapping available from the NRCS Web site revealed that while soils indicative of prime and unique farmland and farmland of statewide importance have previously existed within the project area, the C-470 project area is already in an urbanized area, such that the land is not usable for farming. By definition as stated in the Farmland Protection Policy Act implementing regulations, 7 CFR 658.2(a), "'farmland' does not include land already in or committed to urban development," which includes lands identified as an urbanized area.

3.4.4.2 Environmental Consequences

Because prime and unique farmlands and farmlands of statewide importance are not present within the project area, there would be no direct or indirect effects to such lands from the No-Action, GPL, or EL Alternatives.

3.4.4.3 Mitigation

No mitigation measures for prime and unique farmland are anticipated.

3.4.5 Vegetation

The term vegetation defines the collective plant cover present in an area. Vegetation communities are classified as distinct grouping of individual species that recur in areas with similar physical environmental characteristics (e.g., climate, moisture availability, and soils). Vegetation communities are also defined by the presence of a few dominant species and their physical appearance.

3.4.5.1 Affected Environment

The project area is located in the western most edge of the plains shortgrass ecosystem. Historically, this ecosystem has been dominated by blue grama and buffalo grass. However, because of the high level of human development within the project area, little of this ecosystem remains. Most of the area is a mixture of commercial and residential uses with parks and open space scattered throughout, especially in the western third of the project area.

Humans have influenced the vegetation to one degree or another, from the highly disturbed commercial areas to the woody riparian banks of the South Platte River.

Grasslands

Portions of the project area, primarily in Chatfield State Park and in undeveloped uplands along drainages, support disturbed native grasslands consisting of species such as western wheatgrass (*Pascopyrum smithii*), green needlegrass (*Stipa viridula*), blue grama (*Bouteloua gracilis*), junegrass (*Koeleria macrantha*), side-oats grama (*Bouteloua curtipendula*), and buffalograss (*Buchloe dactyloides*). Other plants include prickly pear (*Opuntia polyacantha*), yucca (*Yucca glauca*), rabbitbrush (*Chrysothamnus nauseosus*), and fringed sage (*Artemisia frigida*). Non-native grasses such as smooth brome (*Bromus inermis*), annual rye (*Secale cereale*), crested wheatgrass (*Agropyron cristatum*), and noxious weeds such as cheatgrass (*Bromus tectorum*) and field bindweed (*Convolvulus arvensis*) are common within the project area in the C-470 ROW and immediately adjacent areas.

Weeds, such as Canada thistle (*Cirsium arvense*), diffuse knapweed (*Centaurea diffusa*), and field bindweed are also present in varying densities throughout this area. Most of the disturbed native grasslands in the project area have been altered by the combined effects of past agricultural practices and urban development.

Commercial and residential areas, primarily between I-25 and Lucent Boulevard, consist of maintained, irrigated landscape including Kentucky bluegrass (*Poa pratensis*) and planted ornamental trees and shrubs around the buildings.

Riparian Areas

Riparian vegetation within the project area has the highest ecological value of all the vegetation types present. Riparian vegetation is found along most of the principal streams and in drainage ditches, ponds, and other water sources. Riparian areas generally consist of woody vegetation with an understory of grasses and forbs. Dominant vegetation typically includes various species of trees and shrubs including plains cottonwood (*Populus deltoides*), willow (Salix spp.), chokecherry (*Prunus virginiana*), three-leaf sumac (*Rhus trilobata*), and Russian olive (*Elaeagnus angustifolia*) (a non-native weed species). American currant (*Ribes americanum*) occurs in drainages with dense woody vegetation and is listed as rare by the Colorado Natural Heritage Program (CNHP). Most of the riparian areas in the project area, including the South Platte River, provide potential habitat for American currant. Populations of this species are known to occur in

South Platte Park, located on the north side of C-470, just east of Santa Fe Drive interchange in the South Platte River floodplain.

The Colorado Legislature passed Senate Bill 40 (SB40) in order to protect and preserve fish, fishing waters, and all wildlife resources, including riparian vegetation associated with the streams of Colorado. SB40 gives CDOW jurisdiction over impacts to riparian areas and their associated streams resulting from state agency projects.

Noxious Weeds

Noxious weeds are non-native plant species that have been introduced into an environment with few, if any, natural biological controls. This gives them a competitive advantage in dominating and crowding out native plant species and can threaten the integrity of native plant communities. Noxious weeds are aggressive, spread rapidly, reproduce profusely, and resist control and management measures. Noxious weed infestations can degrade wildlife habitat and forage for livestock, and are difficult and expensive to control once they are established. Because of the adverse environmental effects of weeds, both the federal and state governments have issued regulations regarding noxious weeds.

Executive Order 13112 directs federal agencies (including the FHWA) to prevent the introduction of invasive species, control and monitor invasive species, and restore native species and habitats that have been invaded. Additionally, in 1990 the State of Colorado passed the Colorado Noxious Weed Act. As amended in 2003, the Act requires land managers, in this case CDOT, to control certain species of noxious weeds. In order to comply with state and federal regulations, the project area was surveyed for weed species, and a *Noxious Weed Plan* (March 2005) was prepared. This plan identifies and prioritized the targeted noxious weed species and provides recommended treatments for control.

3.4.5.2 Environmental Consequences

No-Action Alternative

The No-Action Alternative would have no affect on vegetation in the project area.

General Purpose Lanes Alternative

Direct effects to vegetation resulting from the GPL Alternative would include construction activities associated with roadway widening, intersection reconfiguration, and bridge construction. Approximately 3.8 acres of riparian habitat would also be affected. In addition to herbaceous vegetation, trees and shrubs likely would be removed during construction. Indirect effects to vegetation include the introduction or spread of noxious weeds. Most of the disturbance would be to areas mapped as maintained uplands, which includes the ROW.

Express Lanes Alternative (Preferred Alternative)

Effects to vegetation associated with the EL Alternative would be very similar to those associated with the GPL Alternative. Effects as a result of the EL Alternative may be slightly greater because of the need for express lane access ramps at Colorado Boulevard and Quebec Street. Direct effects to vegetation resulting from the EL Alternative would include construction activities associated with roadway widening, intersection reconfiguration, and bridge construction. In addition to herbaceous vegetation, trees and shrubs likely would be removed during construction. Approximately 4.1 acres of riparian habitat would also be affected. Indirect effects to vegetation include the introduction or spread of noxious weeds. Most of the disturbance associated with the EL Alternative would be to areas mapped as maintained uplands, which includes the ROW.

3.4.5.3 Mitigation

To minimize the adverse effects of disturbance to all the vegetation types in the project area as a result of either action alternative, CDOT's revegetation practices would be followed. Areas temporarily disturbed during construction would be seeded immediately after construction

with a native seed mix reviewed and approved by a CDOT landscape architect. Seeding would occur during appropriate seasonal timeframes to ensure that seeds have the opportunity to take root and geminate. If out of season, the earth would be temporarily protected from erosion with mulch and mulch tackifier. Permanent seeding would occur throughout the project, and disturbed areas would be completely revegetated as soon as practicable. Trees adjacent to the project area that would not be removed would be protected by erecting plastic barricade fencing to avoid unintentional damage. Removed trees would be replaced on at least a one to one basis.

In order to facilitate compliance with SB40, the Colorado Department of Natural Resources and CDOT entered into a memorandum of agreement in 2005 that requires CDOW to "review plans submitted by state agencies proposing actions with adverse impacts to streams protected under SB40 and grants SB40 Certification for actions that include appropriate measures to eliminate or diminish adverse effects to such streams or their banks or tributaries…" In compliance with the memorandum of agreement, at least 60 days prior to construction CDOT would apply to CDOW for SB40 Certification.

In compliance with Executive Order 13112 and the Colorado Noxious Weed Act, the Weed Management Plan prepared for the project would be implemented. The plan includes a variety of species-specific control methods based on the size of the populations and the surrounding landscape. Some of these methods include cutting and removing the noxious weeds, mowing vegetation in the ROW, and using carefully selected herbicides targeted for the particular species and growth stage. The weed management plan includes the following steps to control weeds in the project area:

- Cleaning of all construction vehicles prior to entering the construction site
- Limiting disturbance to existing vegetation during construction as much as practicable
- Seeding topsoil stockpiles with annual oats, if it remains stockpiled for more than one month
- Using only certified weed-free mulch
- Surveying the construction area before, during, and immediately after construction
- Preparing a detailed Integrated Weed Management Plan within ten days of each survey targeted for the specific noxious weed populations found on the site
- Implementing the Integrated Weed Management Plan within ten days after receipt of the plan

Following construction, the site would be monitored for the need for follow-up weed control at least twice over the first growing season.

3.5 EFFECTS AND PROPOSED MITIGATION SUMMARY

Table 3-45 table summarizes the effects for the No-Action Alternative, GPL Alternative, and EL Alternative, as discussed in **Sections 3.2** through **3.4** of this chapter. Indirect effects are discussed in greater detail in the respective resource sections. Cumulative effects are discussed in **Section 3.6**.

Table 3-46 summarizes the mitigation measures that would be part of the Preferred Alternative. These potential measures are described in detail in the respective sections of **Chapter 3.**

Table 3-45
Direct Effects Summary

Resource	No-Action Alternative Effects	General Purpose Lanes Alternative Effects	Express Lanes Alternative Effects
Housing and Community Facilities	No effects to housing or community facilities	No effects to housing or community facilities	No effects to housing or community facilities
Environmental Justice	No effects to minority or low-income populations	Effects to Wolhurst include right-of-way acquisition, higher noise levels, improved capacity at adjacent intersections, change in visual character with retaining walls/noise walls and flyover at Santa Fe. These effects are not disproportionately high and adverse	Effects to Wolhurst include right-of-way acquisition, higher noise levels, improved capacity at adjacent intersections, change in visual character with retaining walls/noise walls and flyover at Santa Fe. These effects are not disproportionately high and adverse
Economics	Increased cost of travel time due to congestion may affect business location and home rental/purchase decisions	Construction activity would increase temporary employment opportunities; local construction material purchases would benefit local economic income; economic cost of congestion would decrease; retail health would benefit from decreased congestion	Construction activity would increase temporary employment opportunities; local construction material purchases would benefit local economic income; economic cost of congestion would decrease; retail health would benefit from decreased congestion
Land Use	No change in land use pattern. Alternative would continue to support land use patterns that are compatible with local land use plans	No change in land use pattern. Alternative would continue to support land use patterns that are compatible with local land use plans	No change in land use pattern. Alternative would continue to support land use patterns that are compatible with local land use plans
Parks and Recreation	Increased traffic would increase noise levels at adjacent parks and recreation areas; access would become more difficult and time consuming with increased congestion	Noise levels at Chatfield State Park would increase; southbound right-in, right-out access to Chatfield State Park permit office would be eliminated; improved signal timing and intersection operation at Santa Fe Drive/ Blakeland Drive would provide improved access to permit office; new retaining walls would alter views from inside Chatfield State Park looking north; culvert that the High Line Canal trail passes through under C-470 would be lengthened, with no changes to the trail; 0.16 acres acquired from Links Golf Course	Noise levels at Chatfield State Park would increase; southbound right-in, right-out access to Chatfield State Park permit office would be eliminated; improved signal timing and intersection operation at Santa Fe Drive/ Blakeland Drive would provide improved access to permit office; new retaining walls would alter views from inside Chatfield State Park looking north; culvert that the High Line Canal trail passes through under C-470 would be lengthened, with no changes to the trail; 0.19 acres acquired from Links Golf Course
Right-of-Way	No right-of-way acquisition	16.68 acres, 49 partial parcel acquisition	20.25 acres, 55 partial parcel acquisition

Table 3-45
Direct Effects Summary (continued)

Resource	No-Action Alternative Effects	General Purpose Lanes Alternative Effects	Express Lanes Alternative Effects
Transportation and Traffic	Limited available capacity on C-470 would constrain traffic getting to/from the adjacent local arterials and lengthen the peak period	Travel patterns would remain the same as existing conditions. Operations and travel times on mainline C-470 would improve. Several arterial intersections would experience increased traffic that would require mitigation to improve operations. Safety on C-470 would be improved due to reduced congestion and geometric improvements	Travel patterns would change slightly due to the express lanes ingress and egress locations. Increased traffic would likely occur in neighborhoods and around access ramps at the following locations: Kipling Parkway, Wadsworth Boulevard, Lucent Boulevard, and Colorado Boulevard. Operations and travel times on mainline would improve along the express lanes while general purpose lanes would operate at the same level as existing conditions. Several arterial intersections would experience increased traffic that would require mitigation to improve operations. Safety on C-470 would be improved due to reduced congestion and geometric improvements for the express lanes
Air Quality	Carbon monoxide, ozone, and particulate matter levels would be within EPA-approved emission budgets	Carbon monoxide, ozone, and particulate matter levels would be within EPA-approved emission budgets	Carbon monoxide, ozone, and particulate matter levels would be within EPA-approved emission budgets
Highway Noise	21 locations would exceed CDOT Noise Abatement Criteria by the year 2025	43 locations would exceed CDOT Noise Abatement Criteria by the year 2025	42 locations would exceed CDOT Noise Abatement Criteria by the year 2025
Water Quality	135 acres of existing impervious surface area; limited opportunity to decrease highway run-off into adjacent water sources	165 acres of additional impervious surface area; implementing MS4 requirements would improve water quality of highway run-off into adjacent water sources	187 acres of additional impervious surface area; implementing MS4 requirements would improve water quality of highway run-off into adjacent water sources
Hydrology and Hydraulics	No effects to hydrology or hydraulics	Culvert east of Spring Creek and bridge over South Platte River replaced and enlarged; both would provide increased flow capacity. More impervious surface area would cause increased runoff volume and peak flow rates from highway	Culvert east of Spring Creek and bridge over South Platte River replaced and enlarged; both would provide increased flow capacity. More impervious surface area cause increased runoff volume and peak flow rates from highway
Floodplains	No effects to floodplains	Minor changes to flood elevations (under 1 foot)	Minor changes to flood elevations (under 1 foot)
Historic Resources	No historic properties affected	No adverse effects to City Ditch and High Line Canal	No adverse effects to City Ditch and High Line Canal

Table 3-45
Direct Effects Summary (continued)

Resource	No-Action Alternative Effects	General Purpose Lanes Alternative Effects	Express Lanes Alternative Effects
Section 4(f) Properties	No effects to Section 4(f) properties	De minimis effect to City Ditch	De minimis effect to City Ditch
Archaeological Resources	No effects to archaeological resources	No effects to archaeological resources	No effects to archaeological resources
Paleontological Resources	No effects to paleontological resources	No known effects to paleontological resources	No known effects to paleontological resources
Geology and Soils	No geologic effects	Geologic and soil conditions that may effect project design and construction include: expansive soils and bedrock, corrosive soils, steeply dipping bedrock, collapsible soils, and unstable slopes. Effects would be in the form of excavation, construction disturbance, and exposure of previously buried and stable geological and soils units to precipitation, air, and weathering	Geologic and soil conditions that may effect project design and construction include: expansive soils and bedrock, corrosive soils, steeply dipping bedrock, collapsible soils, and unstable slopes. Effects would be in the form of excavation, construction disturbance, and exposure of previously buried and stable geological and soils units to precipitation, air, and weathering
Hazardous Materials	No effects to hazardous material sites	Four hazardous material sites may cause potential soil and groundwater exposure during construction excavation	Four hazardous material sites may cause potential soil and groundwater exposure during construction excavation
Prime and Unique Farmlands	No effects to prime and unique farmland	No prime and unique farmland effects	No prime and unique farmland effects
Visual and Aesthetic Character	No visual effects	Changes to visual character include barrier median, wider typical section, retaining walls/ noise walls, and flyover at Santa Fe	Changes to visual character include additional overhead signage, barrier median, wider typical section, retaining walls/noise walls, braided ramp at Quebec, T-ramp at Colorado, and flyover at Santa Fe
Utilities	No utility effects	Various utility lines would require relocation	Various utility lines would require relocation
C-470 Trail	No affect to the existing trail. Existing at-grade street crossings would remain. Existing surface condition deficiencies would remain.	7.5 miles of trail would be moved outward and reconstructed to allow for the roadway widening. Distance shifted varies from 0 to 167 feet, but is generally 45-50 feet. The trail would be closer to private property by this distance. Existing at-grade street crossings would remain. The sections of relocated trail would have a new wearing surface	8.1 miles of trail would be moved outward and reconstructed to allow for the roadway widening. Distance shifted varies from 0 to 167 feet, but is generally 45-50 feet. The trail would be closer to private property by this distance. Existing at-grade street crossings would remain. The sections of relocated trail would have a new wearing surface

Table 3-45
Direct Effects Summary (continued)

Resource	No-Action Alternative Effects	General Purpose Lanes Alternative Effects	Express Lanes Alternative Effects
Construction	No construction effects	Short-term construction effects include noise, vibration, visual change, temporary soil disturbance. Possible diversion of traffic to arterial streets during construction would degrade operations of several intersections which do not have adequate reserve capacity	Short-term construction effects include noise, vibration, visual change, temporary soil disturbance. Possible diversion of traffic to arterial streets during construction would degrade operations of several intersections which do not have adequate reserve capacity
Wildlife	No wildlife habitat effects or additional opportunity for wildlife crossings	Minor habitat loss for mule deer and elk; additional travel lanes would increase difficulty for wildlife movement across the highway; foraging behaviors for raptors may be temporarily affected; minor reduction to raptor foraging habitat; swallow nests under existing bridges would be disturbed; 12.5 acres of Black-tailed prairie dog habitat would be eliminated; minor, temporary disturbance to aquatic resources during construction; additional wildlife movement opportunity under improved South Platte River bridge	Minor habitat loss for mule deer and elk; additional travel lanes would increase difficulty for wildlife movement across the highway; foraging behaviors for raptors may be temporarily affected; minor reduction to raptor foraging habitat; swallow nests under existing bridges would be disturbed; 14.3 acres of Black-tailed prairie dog habitat would be eliminated; minor, temporary disturbance to aquatic resources during construction; additional wildlife movement opportunity under improved South Platte River bridge
Threatened and Endangered Species	No threatened/ endangered species habitat effects	Loss of black-tailed prairie dog colonies would result in a minor reduction to bald eagle prey and habitat loss for the burrowing owl	Loss of black-tailed prairie dog colonies would result in a minor reduction to bald eagle prey and habitat loss for the burrowing owl
Wetlands and Waters of the U.S.	No wetland effects	0.44 acre permanent effects (jurisdictional) 0.06 acre temporary effects (jurisdictional)	0.47 acre permanent effects (jurisdictional) 0.04 acre temporary impact (jurisdictional)
		1.19 acre permanent effects (non-jurisdictional) 0.23 acre temporary effects (non-jurisdictional)	1.34 acre permanent effects (non-jurisdictional) 0.27 acre temporary effects (non-jurisdictional)
	No open water waters of the U.S. effects	0.03 acre of jurisdictional open water effects	0.03 acre of jurisdictional open water effects
Vegetation	No vegetation effects	3.81 acres riparian habitat	4.10 acres riparian habitat

Table 3-45
Direct Effects Summary (continued)

Resource	No-Action Alternative Effects	General Purpose Lanes Alternative Effects	Express Lanes Alternative Effects
Cumulative Effects	Cost of congestion will continue to increase with congestion, with greater influence on business and residential location decisions; gradual noise level increases would remain unmitigated; increased pollutant levels from stormwater runoff from C-470 would remain untreated, though these are not likely to cause a change in local stream water quality classification	Cumulative effects to the Wolhurst Community would not be disproportionately high and adverse; gradual noise level increases would affect adjacent properties, some of which would be mitigated by this project; compliance with MS4 permit requirements for water quality would result in positive cumulative effects for affected drainage basins; gradual change and growth in the C-470 Corridor would continue to contribute to changes to the visual character, however, most of this change has occurred from past actions; gradual degradation of isolated wildlife habitat would continue until the Corridor is fully built out; cumulative effects to wetlands would result from those unmitigated effects of other projects, since C-470 effects would be fully mitigated; the vegetative landscape would continue to gradually convert from native ground cover to urban coverage	Cumulative effects to the Wolhurst Community would not be disproportionately high and adverse; gradual noise level increases would affect adjacent properties, some of which would be mitigated by this project; compliance with MS4 permit requirements for water quality would result in positive cumulative effects for affected drainage basins; gradual change and growth in the C-470 Corridor would continue to contribute to changes to the visual character, however, most of this change has occurred from past actions; gradual degradation of isolated wildlife habitat would continue until the Corridor is fully built out; cumulative effects to wetlands would result from those unmitigated effects of other projects, since C-470 effects would be fully mitigated; the vegetative landscape would continue to gradually convert from native ground cover to urban coverage

Table 3-46
Mitigation Summary

Resource	Mitigation Measures
Housing and Community Facilities	No mitigation measures are necessary
Environmental Justice	■ Replacement noise barrier along Wolhurst southern border, maximum 20 feet height; retaining wall/noise wall along flyover ramp north of Wolhurst entrance ■ Landscaping elements would include trees and berms along flyover. A landscaped median would be added to the community entrance to minimize U-turns at this location ■ Aesthetic treatments to retaining wall/noise wall on northern portion of flyover ■ All aesthetic treatment and landscaping would be selected with input from Wolhurst residents through a public process that would be conducted during final design ■ Additional community involvement opportunities provided during design and construction

Table 3-46
Mitigation Summary (continued)

Resource	Mitigation Measures
Economics	No mitigation measures are necessary
Land Use	No mitigation measures are necessary
Park and Recreation	■ If construction activity on the culvert for the High Line Canal trail requires temporary trail detours, advance notice would be posted and presented to trail user groups ■ Right-of-way acquisition at the Links Golf Course would be purchased in accordance with the Uniform Relocation and Assistance and Real Property Acquisition Policies Act; CDOT would coordinate with golf course owners during final design to further minimize necessary property acquisition
Right-of-Way	■ Avoidance and minimization measures would include retaining walls, curbs, barriers, and steeper side-slopes and back-slopes ■ CDOT would continue to work with affected property owners during final design to keep them informed of the process prior to property acquisition ■ All right-of-way acquisitions would be purchased under the Uniform Relocation Assistance and Real Property Acquisition Policy Act, as amended
Transportation and Traffic	■ Intersection improvements would be necessary at several arterial intersections for the GPL and EL Alternatives to mitigate the increase in traffic and congestion ■ Interchange modifications at the I-25 interchange would be necessary to mitigate operational deficiencies
Air Quality	No mitigation measures are necessary
Highway Noise	■ Of the 28 residential and 15 commercial impact locations, noise mitigation is recommended for the following 13 residential locations: ■ Chatfield Bluffs Neighborhood – noise wall ■ Meadowbrook Heights Neighborhood – 3 noise walls ■ Chatfield Avenue Neighborhoods – noise wall ■ Columbine Hills Neighborhood – noise wall and berm ■ Wolhurst Adult Community – Replacement noise wall and retaining wall/ noise wall on northern portion of Santa Fe Drive interchange flyover ■ Bluffs Apartments – noise wall ■ Highlands Ranch – Broadway to University Boulevard – noise wall ■ Canyon Ranch and Copper Canyon Apartments – 2 noise walls ■ Highlands Ranch – west of Colorado Boulevard – 2 noise walls ■ Province Center Neighborhood – noise berm ■ Gleneagles Village Neighborhood – noise wall and berm ■ Palomino Park Apartments – noise wall ■ Crest Apartments – safety barrier

Table 3-46
Mitigation Summary (continued)

Resource	Mitigation Measures
Highway Noise (continued)	■ Mitigation is not recommended for any of the impacted commercial receptors because none of these appear to have active outdoor use. If it is determined that outdoor use does occur or the property owner desires noise mitigation at impacted commercial sites, CDOT's feasible and reasonable test would be applied to determine if mitigation meets the approved criteria ■ The Highlands Ranch neighborhood from Broadway to University will undergo a final design noise analysis to determine if noise mitigation at that time will be feasible and reasonable ■ Noise mitigation recommendations would be reviewed during final design to determine final feasibility, reasonableness, and dimensions for each location
Water Quality	■ Grassed swales and vegetated filter strips would be used to pre-treat runoff waters wherever possible along the corridor. Swales would be used to carry runoff from the roadway the outfall from storm sewer systems to the receiving waters ■ CDOT would continue their non-structural BMP practices such as limiting the use of deicer, discontinuing the use of fertilizer, and timely sweeping of roadways after snow events ■ Extended detention basins (water quality ponds) would be used to achieve all MS4 requirements and incorporated into the design to meet the MS4 requirements of the EPA ■ 53 water quality ponds are designed at strategic locations throughout the corridor ■ In addition to water quality ponds, curb and gutter, a closed storm sewer, and grassed swales would be included in the alternative to control stormwater runoff and improve water quality in areas where ponds are not feasible
Hydrology and Hydraulics	■ Efforts would be made during final design to match pond shapes to existing contour lines as much as possible to achieve a natural appearance ■ The culvert east of Spring Creek would be replaced with an 84-inch diameter reinforced concrete pipe culvert to allow adequate passage of the estimated 100-year frequency design flows ■ Water quality ponds are included in the alternative as permanent BMPs to improve water quality of storm runoff
Floodplains	■ Retaining walls are included in the design at Dad Clark Gulch and Willow Creek to minimize encroachment into the floodplain and to keep roadway fill out of the drainageway
Historic Resources	No mitigation measures are necessary
Section 4(f) Properties	No mitigation measures are necessary
Archaeological Resources	No mitigation measures are necessary
Paleontological Resources	■ CDOT is committed to having a qualified paleontologist on-site during major construction excavation to monitor for buried paleontological resources where known fossiliferous deposits are mapped, but not exposed presently at the ground surface

Table 3-46
Mitigation Summary (continued)

Resource	Mitigation Measures
Geology and Soils	■ Structure design for areas with expansive soils, bedrock, or collapsible soils would include foundation systems and floor slabs types appropriate to mitigate the effects of soil conditions ■ Structural retaining walls, such as soil nail walls, ground anchors, mechanically stabilized earth (MSE) walls, cantilever walls, or reinforced soil slopes would be built to stabilize slopes when cut or fill slopes require steep gradients greater than 3 horizontal to 1 vertical, or where potential slope failures may occur due to the presence of water and loose material ■ Expansive subgrade soils under pavement sections would be stabilized with chemicals (lime), removed and recompacted, or removed and replaced with imported structural fill of better quality to minimize soil heaving ■ Embankment material would be stabilized by over excavation prior to embankment placement, or additional loading with a thicker section of embankment material ■ Highway drainage plan would divert surface and subsurface water to prevent ponding of water on or immediately adjacent to pavement areas and retaining walls. All landscape sprinkler heads and lines adjacent to pavement areas would be frequently checked for leaks and maintained in good working order. Slopes and other stripped areas would be protected against erosion by re-vegetation or other methods ■ A stormwater management plan would be developed and implemented that include BMPs to minimize potential soil erosion, and include prescriptions for monitoring of conditions before and after the completion of work (and for immediate post-restoration site stabilization). Measures that would be required are typical of erosion control procedures used in highway construction projects
Hazardous Materials	■ CDOT would identify long-term impacts such as treatment of contaminated soil or groundwater ■ CDOT would conduct soils and groundwater testing for all hazardous materials sites prior to ROW acquisition to determine potential risk. Sampling and laboratory analysis would be required for sites ranked as high potential for concern ■ Engineering controls would be employed at the time of construction to remove contaminated materials from the site and to contain materials from impacting at other locations ■ Where bridge, building, guardrails or sign alteration or demolition would be required, an asbestos hazardous materials survey and a lead paint survey would be conducted, per Section 250 of CDOT Standard Specifications and other relevant OSHA, state and federal regulatory requirements
Visual and Aesthetic Character	■ CDOT would maintain standard architectural treatments to maintain visual consistency for the C-470 Corridor, as described in the CDOT Region Visual Design Standards. Overhead toll collection devises and signage would follow a region-wide standard, set by the CTE prior to or during final design ■ CDOT would work with adjacent jurisdictions such as Douglas County, Lone Tree, Highlands Ranch, and Littleton to incorporate architectural upgrades to structural elements at selected interchanges, while maintaining standard unifying elements with the rest of the C-470 Corridor. Interchange treatment upgrades could include textured walls, landscaping, and bridge identification markings

Table 3-46
Mitigation Summary (continued)

Resource	Mitigation Measures
Visual and Aesthetic Character (continued)	■ The largest retaining wall would be a tiered construction to provide a visual break in wall height ■ Additional community input would be obtained during final design to gain public acceptance of these treatments ■ CDOT would work with Wolhurst residents to incorporate colors and textures on the noise walls surrounding the community
Utilities	■ Utility impacts would be identified in detail during final design. Private utility companies are responsible for relocating the utility lines that occur within the existing ROW. ■ CDOT would relocate publicly owned utility lines and those impacted outside the existing ROW ■ Safety precautions would ensure contained release of potential airborne asbestos
C-470 Trail	■ The GPL Alternative would require reconstruction of 7.5 miles of trail, while the EL Alternative would require reconstruction of 8.1 miles of trail ■ Grade separated trail crossings would be provided at the Santa Fe Drive interchange, Colorado Boulevard, and Quebec Street
Construction	■ CDOT is committed to sustainable construction practice, such as reusing materials and recycling, waste minimization, water and energy conservation, and other measures which can minimize the cumulative effects of the project through resource conservation ■ Minor improvements at several arterial intersections would be performed. These are generally restriping on minor accel/decel lane lengthenings to improve traffic operations ■ CDOT would require the contractor to develop detailed construction phasing and an associated traffic control plan for all phases of work, including emergency vehicle access; prohibit long-term closures; develop detour signing plan for arterial street system; restrict concurrent work on adjacent interchanges; restrict daytime closures; and follow CDOT Region 6 Lane Closure Strategy ■ Water Quality -Temporary BMPs would be used during construction to prevent erosion, sediment, and nutrient loading in the watershed ■ Noise - Enforce more restrictive work hours, use alternative construction methods, and require noise monitoring and mitigation plan ■ Dust - Since the majority of air emissions during construction would be fugitive dust (PM_{10}) from the excavation of soil and backfill. All contractors would be required to obtain a construction permit and develop a fugitive emissions particulate emissions control plan to be implemented during construction in accordance with the Colorado Air Quality Control Commission Regulation No. 1, Part 3D, and Regulation No. 3, Applicable Permit Requirements ■ Visual - Throughout the final design and construction phases of this project, CDOT would work with the involved cities and counties as well as the public stakeholders to minimize temporarily undesirable obstructed views

Table 3-46
Mitigation Summary (continued)

Resource	Mitigation Measures
Construction (continued)	■ Vibration - CDOT would attempt to minimize vibration causing operations during nighttime in residential areas ■ C-470 trail – Detour routes would be provided to avoid closing the trail. Minimum two week notice prior to trail detours would be posted and presented to trail user groups
Wildlife	■ New bridge over the South Platte River would provide a wider crossing under C-470 including a natural substrate on the east side of the river to better accommodate wildlife movement. Post-construction replacement vegetation under the bridge to would serve to attract ungulates to cross under C-470 ■ Existing chain link fence that extends from the South Platte River along the north and south side of C-470 would be replaced to serve as deer fence ■ Project area would be re-surveyed prior to construction to identify raptor or other bird nests within 1/3 mile of the project. If nests are found, construction activity would be restricted within 1/3 mile of the raptor nests during breeding season ■ Bird nests found under existing bridges would be removed during the non-nesting season. Alternately, netting would be installed under bridges to prevent nests from being constructed ■ Design plans would attempt to avoid and minimize impacts to prairie dog colonies. Some prairie dogs would be relocated; others would be removed in accordance to CDOT policy
Threatened and Endangered Species	■ Prior to construction, the project area and its vicinity would be re-surveyed for bald eagle nests. CDOT would install perching posts for hunting roosts, nesting platforms to encourage eagle nesting, and improve habitat for other bald eagle prey sources by planting vegetation to serve as groundcover. Some prairie dogs would also be relocated within the eagles' three-mile foraging area ■ The project area would also be surveyed for burrowing owl presence, following CDOW survey techniques. If burrowing owls were present, construction would be planned to avoid impacting those areas between March 1 and October 31 ■ CDOT would work with the USFWS and CDOW to develop any additional mitigation measures if seasonal restrictions on construction were not practicable
Wetlands	■ Wetland impacts will be mitigated on a 1:1 basis ■ When wetland functions and values can be maintained or enhanced, onsite mitigation is preferred ■ Impacts to wetlands adjacent to streams will be mitigation onsite, as close to the affected location as possible ■ Impacts to wetlands not adjacent to streams will be mitigated through purchase of USACE-approved mitigation bank credits
Prime and Unique Farmlands	No mitigation measures are necessary
Vegetation	■ CDOT's re-vegetation practices would be followed to minimize the adverse effects of disturbance to all the vegetation types in the project area ■ A Noxious Weed Management Plan has been developed for the C-470 Corridor, as part of this EA. CDOT would implement this plan prior to construction
Cumulative Effects	No mitigation measures are necessary

3.6 CUMULATIVE EFFECTS

Regulations implementing NEPA require federal agencies to consider direct, indirect, and cumulative effects of a proposed federal action on the social, physical, and biological environment. Direct and indirect effects are discussed earlier in this C-470 EA. Cumulative effects are discussed in this section.

Cumulative effects result from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over time.

If an individual study has no direct or indirect effects upon a resource, then it also has no cumulative effects upon that resource. According to federal guidance, cumulative effects analysis should focus on resources that are important and relevant.

Table 3-47 summarizes the project effects that were identified in this chapter, providing a rationale for the selection of affected resources that are appropriate for cumulative effects assessment.

On the basis of this screening approach, eleven resources or issues were selected for cumulative effects assessment: environmental justice, economics, transportation, air quality, highway noise, water quality, visual/aesthetic character, wildlife, threatened/endangered species, wetlands, and vegetation. Effects to parks and recreation resources do not merit mitigative action, and therefore were not considered for cumulative effects.

3.6.1 Affected Environment

Important in the consideration of cumulative effects is the selection of the temporal scope (time frame) and spatial (geographic) scope of the analysis. These selections identify the context from which relevant past, present, and reasonably foreseeable actions can be identified.

Past, present, and reasonably foreseeable actions are considered in this analysis. The past year of 1980 was selected for this EA because construction of the existing freeway began at that time, with the first section completed in 1985 and the entire C-470 facility completed in 1990. The reasonably foreseeable future for this analysis is the design year 2025.

Topographic and geopolitical factors place different limits on the area of influence of the C-470 Corridor EA for different resources such as air, water, wildlife, and the human environment. Therefore, the geographic scope for C-470 cumulative effects analysis is variable, dependent on the resource affected by the project. The appropriate geographic scope for cumulative effects analysis for resources and issues pertinent to C-470 are listed below in **Table 3-48**.

Past, present, and reasonably foreseeable actions affecting the C-470 project area are summarized in **Table 3-49**. Additional detail on cumulative effects can be found in the *Cumulative Effects Technical Report* (March 2005).

3.6.2 Environmental Consequences

Cumulative effects are discussed by alternative, with respect to the various resources that would experience direct and/or indirect effects that require mitigation.

3.6.2.1 No-Action Alternative

As indicated in **Table 3-47**, the No-Action Alternative has the potential for cumulative effects with respect to traffic, air quality, highway noise, and water quality. These issues are discussed in the following sections.

Traffic

Under the No-Action Alternative, traffic on C-470 would increase as the result of continued urban development, combined with improvements to connecting facilities (I-25 and Santa Fe Drive). An increase in VMT is expected on C-470

Table 3-47
Identification of Resources for Cumulative Effects

Resource/Issue	Alternative			Cumulative Effects Screening
	No Action	EL	GPL	
Environmental Justice		✓	✓	Considered for cumulative effects
Economics	✓	✓	✓	Considered for cumulative effects
Land Use				No effects
Parks and Recreation		✓	✓	Not considered for cumulative effects
Right-of-Way		✓	✓	No businesses or residences taken
Transportation/traffic	✓	✓	✓	Considered for cumulative effects
Air Quality	✓	✓	✓	Considered for cumulative effects
Highway Noise	✓	✓	✓	Considered for cumulative effects
Water Quality	✓	✓	✓	Considered for cumulative effects
Historic Resources				No adverse effects
Archaeological Resources				No effects
Paleontological Resources				No effects
Geology and Soils		✓	✓	Limited on-site construction effects
Hazardous Materials		✓	✓	Limited on-site construction effects
Prime/Unique Farmlands				No effects
Visual/Aesthetic Character		✓	✓	Considered for cumulative effects
Utilities		✓	✓	Limited construction effects
C-470 Trail		✓	✓	Relocation
Construction		✓	✓	Limited construction effects
Wildlife		✓	✓	Considered for cumulative effects
Threatened/Endangered Species		✓	✓	Considered for cumulative effects
Wetlands		✓	✓	Considered for cumulative effects
Vegetation		✓	✓	Considered for cumulative effects

in the project area, resulting in severe congestion on mainline C-470 during peak periods. Other present and future planned transportation improvements identified in the region, listed in Table 3-49, would improve mobility on nearby facilities. However, these actions would facilitate more traffic flow to C-470, leaving a bottleneck in the transportation network.

Air Quality

Increasingly congested conditions in the future would result in excess air pollution emissions from C-470 traffic, but these emissions have been assessed together with all other emissions in the airshed, and the results are within allowable emissions budgets. Therefore, no cumulative effects with regard to air quality are anticipated.

Highway Noise

Under the No-Action Alternative, due to local and regional growth and improvements to other transportation facilities, 21 locations along C-470 would experience traffic noise in excess of federal and state noise abatement criteria. Past, present, and future actions have also contributed to a gradual increase in noise levels along the Corridor. However, noise mitigation would not be provided at these identified noise impact locations as part of the No-Action Alternative.

Water Quality

With respect to water quality, the No-Action Alternative would not increase the amount of impervious surface within the C-470 right-of-way, but increased traffic would result in increased loading of vehicle-generated water pollutants in stormwater runoff from C-470. This runoff is not captured and treated before discharge in accordance with modern standards because C-470 was built before the current stormwater management requirements went into effect. The receiving waters in the C-470 project area are not impaired at this time, and the increased traffic on C-470 is unlikely to cause a change in local stream classification. Discharges from new development and other forseeable projects in the area would be minimized by compliance with MS4 permit requirements and thus are unlikely to have a cumulative effect on water quality in the affected drainage basins.

3.6.2.2 General Purpose Lanes Alternative

The GPL Alternative would have cumulative effects with respect to the resources identified in Table 3-48. These impacts are discussed in the following sections.

Table 3-48
Areas of Analysis For Cumulative Effects

Resource/Issue	Area of cumulative effects analysis
Environmental Justice	Wolhurst Community at C-470/Santa Fe Drive
Transportation/traffic	C-470, connecting roads, and nearby parallel arterials
Air Quality	DRCOG regional airshed and microscale receptors within the C-470 corridor
Highway Noise	Approximately 500 feet either side of C-470
Water Quality	South Platte River and its tributaries within the C-470 corridor
Visual/Aesthetic Character	Viewsheds affected by the C-470
Wildlife	Habitats and movement corridors contiguous to C-470
Threatened/Endangered Species	Habitats and movement corridors contiguous to C-470
Wetlands	Wetlands in the C-470 corridor, including those associated with the South Platte River and its tributaries
Vegetation	Vegetated area contiguous to C-470

Table 3-49
Past, Present and Reasonably Foreseeable Future Actions

Action	Effects
Past (since approximately 1980)	
Chatfield State Park opened in 1975	Altered flow of South Platte River; replaced prairie with lake ecosystem; attracted vehicular recreation trips from throughout the region
Existing C-470 built in 1980s, opened 1990	Provided main east-west transportation link for high-growth area, replacing prairie habitat and hampering wildlife movement; introduce highway noise to the area; increased vehicle-related air pollution emissions;
Urban growth along C-470, 1980 to 2000 (includes Highlands Ranch development and many others, adding 100,000 residents; as well as the region's largest shopping mall (Park Meadows opened in 1996) and other retail development	Replaced prairie with urban land uses, displacing wildlife and hampering wildlife movement; increased impervious surface, contributing to water pollution; generated major traffic increases and increased air pollution emissions.
E-470 connected to C-470 in 1991	Increased C-470 through traffic, contributing to air and water pollution within the C-470 corridor
Present (2005)	
Road improvements on I-25 (e.g., TREX project) and Santa Fe Drive	When completed, the newly added capacity will enable more vehicles to get to and from C-470, potentially worsening C-470 corridor congestion.
Ongoing urban development along C-470: ■ Multi-family housing at C-470/Colorado Boulevard ■ Rezoning at C-470/Santa Fe Drive from agricultural to commercial	Will generate additional vehicular trips on C-470 and nearby arterial streets thereby increasing noise as well as air and water pollution
Future (to approximately 2025)	
Continued urban development and increased redevelopment along C-470 Corridor	Will generate additional traffic on C-470 and nearby arterial streets, displace remaining fragmented prairie habitat and associated wildlife; increase impervious surface; air and water pollution
RTD "FasTracks" light rail extension to Highlands Ranch	Projected to serve 3,400 to 4,000 trips daily in 2025; may slightly reduce air quality emissions within the corridor
DRCOG Metro Vision planned improvements: ■ Widen I-25 from C-470 to Castle Rock ■ Widen US 85 from C-470 to Castle Rock ■ C-470 interchanges at Alameda, Yale, and I-70	Will carry additional traffic to/from the C-470 corridor and indirectly to nearby arterial streets

Environment Justice

The Wolhurst Community, consisting of 272 households located in the northwest quadrant of the Santa Fe Drive interchange, would be directly affected by the GPL Alternative in a number of ways as discussed in **Section 3.2.2.2**. Access to this low-income neighborhood is provided from Santa Fe Drive, on which traffic has increased due to rapid urban growth in the corridor. Additionally, Santa Fe Drive is expected to be widened to the south (US 85 from C-470 to Castle Rock), as indicated in **Table 3-49**. A planned RTD light rail extension on the east side of Santa Fe Drive will cross C-470 nearby, but not affect Wolhurst. The cumulative effects of all these actions were taken into account to project future traffic volumes at the Santa Fe Drive interchange, which were used as the basis for the interchange design. The interchange design in turn affected visual, noise and air quality impacts. Five public meetings regarding the C-470 project were held at Wolhurst, giving residents ample opportunity to express their concerns, review and comment on alternatives, and to have input into the selection of appropriate mitigation measures. Based on consideration of all these factors, it has been concluded that the cumulative effects upon the Wolhurst Community are not disproportionately high and adverse.

Economics

The GPL Alternative would result in reduced congestion costs due to decreased travel time. This in turn would improve retail health, by providing shoppers a less congested route to shopping destinations. The long-term cumulative effects to the economy from additional growth and other transportation system improvements would result in an improved economic condition, reflecting a return on investment in the local communities and strong economic growth.

Traffic

This alternative would accommodate more than a doubling of current traffic on C-470. Additional capacity under this alternative would provide for acceptable traffic operations on C-470, as compared to the severe congestion expected under the No-Action Alternative. The predicted future traffic levels take into account the past, present and future effects of other actions, including the widening of I-25 and Santa Fe Drive, which will carry more traffic to C-470.

Air Quality

Analysis of air pollution emissions and localized concentrations within the project area was undertaken for the GPL Alternative. This analysis takes into account the effects of past, present and future development, including planned future transportation improvements in the fiscally constrained and air quality conforming *DRCOG 2030 Metro Vision Regional Transportation Plan*. The results show that predicted future emissions would be within allowable emissions budgets. These budgets were developed, taking into account emissions from both transportation-related and non-transportation sources, and are part of EPA-approved plans that demonstrate continued attainment of NAAQS. Predicted microscale concentrations for this alternative are also well within applicable air quality standards. Therefore, no substantial cumulative effects with regard to air quality are anticipated for the GPL Alternative.

Highway Noise

Noise analysis was conducted for adjacent properties along the C-470 corridor based on the GPL Alternative conceptual design and the C-470 projected future traffic volumes that reflect the impacts of past, present and reasonably foreseeable projects. The results of this analysis indicate an expected average noise increase of approximately four decibels (a doubling of noise levels), causing noise levels to exceed abatement threshold levels at 28 residential locations. Note that typically more than one home is impacted at each of these locations. Noise mitigation would be provided at locations where it is found to be both reasonable and feasible, but would not be provided at locations where these criteria are not met. The cumulative effect would be a general increase in noise along the C-470 Corridor.

Water Quality

Large-scale conversion of undeveloped land to urban uses in the C-470 corridor have increased the amount of impervious surfaces within the drainage basin that includes the South Platte River and its tributaries. This has resulted in increased stormwater runoff and increased loading of various water pollutants, including total suspended solids. Increased vehicle travel in the corridor has also increased the concentration of vehicle-related heavy metals in the water. Although none of the surface waters in the study area are officially listed as impaired, the South Platte River stream segment from Bowles Avenue to the Burlington Ditch is on Colorado's Monitoring and Evaluation list for copper.

The GPL Alternative would increase the amount of impervious surface area in the corridor from 135 to 300 acres, and would carry a higher volume of vehicle traffic, but would include important water quality mitigation measures. Compliance with MS4 permit requirements for new development and other foreseeable projects would result in positive cumulative effects for the affected drainage basins.

Visual/Aesthetic Character

The visual character of the C-470 Corridor has been altered dramatically over the past 25 years with the construction of C-470 itself and the urban development that has surrounded it. However, much of the development is offset 300 to 500 feet from the roadway, producing a very open corridor driving experience for the motorist. Various drainages, open spaces and Chatfield State Park also contribute to this visual effect.

The GPL Alternative would introduce additional lanes and a new barrier on C-470 and include modifications to freeway entrance and exit ramps where necessary for safe merging operations. More lanes and more traffic would result in a more urban feel for the motorist, and would also make the roadway more visually apparent from nearby properties. Due to the distance separating C-470 from much of the adjacent development, this would change the midground view (not the foreground or the background) for most views toward the highway.

Over time, continued urban growth would fill up some of the last remaining undeveloped parcels along the corridor, but the overall visual character would not change greatly from the existing situation. One notable exception would be the construction of an RTD light rail bridge over C-470 just east of Santa Fe Drive. The effects of the GPL Alternative would thus be greater than the changes associated with other actions.

Wildlife

Wildlife habitat has been affected greatly over the past 25 years by the conversion of prairie lands to a freeway surrounded by urban land uses. However, as noted in the visual effects discussion, much of the development is offset from C-470 and there are various drainages, open spaces and Chatfield State Park immediately adjacent to the roadway. These areas are important to wildlife habitat, especially the drainages which also serve as movement corridor for wildlife.

Over time, urban development would fill up the last empty parcels in the Corridor, reducing the limited amount of already fragmented habitat that remains today. In addition to the 12.5 acres of affected black-tailed prairie dog habitat, other past, present, and future actions have and will continue to eliminate habitat suitable for these animals.

Increased traffic with the GPL Alternative would make at-grade crossing of C-470 more difficult for wildlife in the future than it is today. This effect represents minimal change from current conditions and is small in comparison to the effects of continued habitat loss and fragmentation due to continuing urban development. A project benefit would be enhanced wildlife movement opportunity due to improvement of the C-470 bridge over the South Platte River.

The overall cumulative effect would be continued slow degradation of isolated wildlife habitat within an urban area.

Threatened/Endangered Species

Recent urbanization of the area surrounding C-470 has had the greatest effect on the bald eagle, largely due to loss of large trees that serve as nesting and roosting habitat. However, Chatfield State Park and the South Platte River continue to provide viable riparian habitat with open prairie, many trees along the river banks, and open water with available prey, allowing bald eagles to thrive in this rapidly urbanizing environment. Although ongoing urban development will continue to eliminate prairie dog habitat that serves as a portion of the eagles' prey, preservation of the existing parklands within the project area continue to serve as protected habitat for this important species. MS4 stormwater requirements for other projects would likely maintain or improve the water quality for existing drainages, ensuring water based prey species would continue to be available. The cumulative effect of improvements to C-470 on the bald eagle would largely be a result of past and future urban development, with C-470 improvements playing a much smaller role in the overall effect.

Wetlands

Rapid urban development over time has diminished the number and degraded the quality of wetlands within the C-470 corridor over time. However, further degradation would slow appreciably as the area approaches build-out, and remaining wetlands are protected to various degrees under various federal laws and regulations. MS4 stormwater management requirements apply to CDOT and the various governmental jurisdictions within the study area, providing some protection from further degradation as a result of governmental projects as well as continued urban development.

Of the 29.1 acres of wetlands delineated within the study area, the GPL Alternative would result in permanent impacts to 0.44 acre of jurisdictional and 1.19 acres of non-jurisdictional wetlands, as well as temporary impacts to 0.06 acre jurisdictional and 0.23 acre non-jurisdictional wetlands. Compensatory mitigation would likely occur within the project area, resulting in no net loss. The overall cumulative affect of this alternative plus other reasonably foreseeable actions would be the affect of those other actions, such as continued minimal wetland losses from the current wetland inventory.

Vegetation

The landscape of the entire C-470 corridor has changed dramatically over the past 25 years, being converted from prairie to urban land uses, including introduction of non-native grasses and trees. The areas immediately adjacent to C-470 consist largely of disturbed grassland which CDOT maintains as a clear zone for accident prevention. Maintenance includes periodic mowing and roadside trash pickup. Additionally, like any other major roadway, the existing C-470 facility is a conduit for the potential spread of noxious weeds, resulting from the transport of seeds by vehicles traveling from other regions.

Added to these overall trends, the GPL Alternative would result in impacts to 3.8 acres of riparian habitat, minimized to the extent feasible in accordance with the provisions of Colorado Senate Bill 40. Soil disturbance during construction would create the potential for introduction of noxious weeds, although CDOT would mitigate for this effect by re-vegetating with a native seed mix and implementation of a weed management plan.

The cumulative effects of the GPL Alternative together with other past, present and reasonably foreseeable actions would be continued gradual conversion of the corridor to a more urban type of vegetation, with the future change being minimal in comparison to the changes that have occurred in the past.

3.6.2.3 Express Lanes Alternative (Preferred Alternative)

The EL Alternative may have cumulative effects with respect to all of the resources identified in **Table 3-48**. These impacts are discussed in the following sections.

Environmental Justice

The Wolhurst Community, consisting of 272 households located in the northwest quadrant of the Santa Fe interchange, would be directly affected by the EL Alternative in a number of ways as discussed in **Section 3.2.2.2**. Access to this low-income neighborhood is provided from Santa Fe Drive, on which traffic has increased due to rapid urban growth in the corridor. Additionally, Santa Fe Drive is expected to be widened to the south (US 85 from C-470 to Castle Rock), as indicated in **Table 3-49**. A planned RTD light rail extension on the east side of Santa Fe Drive will cross C-470 nearby, but not affect Wolhurst. The effects of all these actions were taken into account to project future traffic volumes at the Santa Fe Drive interchange, which were used as the basis for the interchange design. The interchange design in turn affected visual, noise and air quality impacts. Five public meetings regarding the C-470 project were held at Wolhurst, giving residents ample opportunity to express their concerns, review and comment on alternatives, and to have input into the selection of appropriate mitigation measures. Based on consideration of all these factors, it has been concluded that the cumulative effects upon the Wolhurst Community are not disproportionately high and adverse.

Economics

The distinction between the GPL and EL Alternatives from an economic perspective is the personal choice for commuters to pay the time cost associated with congestion or monetary cost for tolls in the express lanes. Like the GPL Alternative, the EL Alternative would positively affect retail health. Cumulatively, past, present, and future actions would result in an improved economic condition, reflecting a return on investment in the local communities and strong economic growth.

Traffic

The EL Alternative would accommodate a substantial increase of traffic on C-470. Provision of additional capacity under this alternative would provide for acceptable traffic operations on C-470, as compared to the severe congestion expected under the No-Action Alternative. The predicted future traffic levels consider the effects of other transportation actions, including the widening of I-25 and Santa Fe Drive, which would be able to carry more traffic to C-470.

Air Quality

Analysis of air pollution emissions and localized concentrations within the project area was undertaken for the EL Alternative. This analysis takes into account the effects of past, present and future development, including planned future transportation improvements in DRCOG's fiscally constrained and air quality conforming RTP. The results show that predicted future emissions would be within allowable emissions budgets. These budgets were developed, taking into account emissions from both transportation-related and non-transportation sources, and are part of EPA-approved plans that demonstrate continued attainment of NAAQS. Predicted microscale concentrations for this alternative are also well within applicable air quality standards.

Highway Noise

Noise analysis was conducted for areas along the C-470 corridor based on the EL Alternative conceptual design and the C-470 projected future traffic volumes that reflect the impacts of past, present and reasonably foreseeable projects, as noted above. The results of this analysis indicate an expected average noise increase of approximately four decibels (a doubling of noise levels), causing noise levels to exceed abatement threshold levels at 25 residential locations. Note that typically more than one home is impacted at each of these locations. Noise mitigation would be provided at locations where it is found to be both reasonable and feasible, but would not be

provided at locations where these criteria are not met. The cumulative effect would be a general increase in noise along C-470 throughout the study corridor.

Water Quality

The EL Alternative would increase the amount of impervious surface area in the corridor from 135 to 322 acres, and would carry a higher volume of vehicle traffic, but would include important water quality mitigation measures. The tough mitigation requirements of CDOT's statewide stormwater control permit (MS4 program) require application of water quality Best Management Practices that would not only address the incremental effects of added pavement and higher traffic, but address all stormwater runoff from the roadway, thus also addressing the contribution of the existing roadway. The net result of the project is expected to be a net improvement in the quality of the water that is discharged from the roadway system to receiving waters in the drainage basin. Based on this beneficial project outcome, the cumulative result is that water quality in the drainage basin is not expected to become impaired in the reasonably foreseeable future.

Visual/Aesthetic Character

In addition to the effects on visual character that were discussed for the GPL Alternative, the EL Alternative would also introduce roadway elements pertaining to toll collection operations. Specifically, this would include lane barriers to separate the express lanes form the general purpose lanes, equipment to detect electronic payment transponders, and signage and merging treatments to facilitate motorists getting into and out of the express lanes at limited locations.

A further difference between the EL Alternative and the GPL Alternative is the provision of access ramps for the tolled express lanes at Colorado Boulevard. Colorado Boulevard would have no access to C-470 under either the GPL or the No-Action Alternative.

As with the GPL Alternative, the EL Alternative would have more lanes and more traffic than C-470 has today, resulting in a more urban feel for the motorist. The addition of toll-related design features and Colorado Boulevard access ramps would accentuate this for the EL Alternative.

Wildlife

The EL Alternative has similar effects to those discussed for the GPL Alternative, with slightly greater habitat loss. Improvements to the bridge over the South Platte River would also continue to benefit wildlife movement under C-470. The cumulative effect on wildlife from the EL Alternative represent minimal change to habitat loss compared to the effects of continued urban development.

Wetlands

The effects to wetlands in the project area would be slightly more for the EL Alternative than the GPL Alternative. However, compensatory mitigation would be provided for these effects. Therefore, the overall cumulative affect to wetlands would be the result of unmitigated actions from the past, present or future.

Threatened/Endangered Species

The effects to the bald eagle as a result of the EL Alternative would be slightly greater than the GPL Alternative due to a slightly larger effect to black-tailed prairie dog habitat. However, the mitigation measures would provide additional prey habitat, nesting, and roosting opportunities for the eagles. Therefore, the cumulative effects to the bald eagle would largely be a result of past and future urban development, with C-470 improvements playing a much smaller role in the overall effect.

Vegetation

The cumulative effects for the EL Alternative together with other past, present, and reasonably foreseeable actions would be continued, gradual conversion of the corridor to include less natural vegetation, with the introduction of landscaping elements and non-native grasses and trees.

Future change to vegetation would likely be minimal in comparison to the changes that have occurred from past actions.

3.6.3 Mitigation

No cumulative effects were identified that would require mitigation above and beyond actions addressing direct and indirect effects. The GPL Alternative and EL Alternative would result in benefits that would not normally occur under the No-Action Alternative including:

- Improved traffic flow on C-470, addressing the cumulative traffic demands resulting from continued urban development and the improvement of major connecting roadways (I-25 and Santa Fe Drive)
- Improved water quality in C-470 stormwater drainage, because original C-470 construction was not regulated by modern MS4 stormwater control requirements. Both the GPL or EL Alternative would improve the quality of stormwater drainage
- Reduced noise for locations having noise effects but would not receive mitigation under the No-Action Alternative. Thus, either of the action alternatives would mitigate for increased C-470 traffic demand that is attributable to foreseeable future actions (ongoing urban development plus improvements to major connecting roadways)

Sustainable practices incorporated into the project planning, construction, and maintenance can minimize resource impacts. As part of its environmental ethic and policy, CDOT encourages its staff, consultants, and contractors to identify and utilize opportunities and methods to reduce the impact of projects and programs on environmental resources through innovative programs and by providing flexibility in project planning and construction for the use of sustainable processes and materials. This may include such concepts as natural resource conservation, waste minimization, materials reuse, minimal use of native virgin materials, conservation and efficient use of water and energy, air pollution prevention, preference for "green" purchasing including recycled, minimally processed and packaged items, and preference for locally-available resources. CDOT encourages the identification and incorporation of proven alternative materials that are as long or longer-lasting, and which require the same or less amount of maintenance, as long as such materials do not impact CDOT's ability to meet its primary obligations for providing a safe and efficient transportation system.