

Chapter 4. Cumulative Impacts Analysis

4.1 What is in Chapter 4?

Chapter 4 describes the approach used to assess cumulative impacts for the project and presents the results of this analysis. The chapter provides information describing the impacts of past and present actions on resources of concern, along with the possible future impacts of other reasonably foreseeable future actions, both with and without I-70 Mountain Corridor improvements.

4.2 What are cumulative impacts and why are they important?

Federal regulations in 40 Code of Federal Regulations 1508.7 define cumulative impacts as those that:

- Result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions.
- Can result regardless of what agency (federal or non-federal) or person undertakes such other actions.
- Can result from individually minor but collectively significant actions taking place over a period of time.

It is difficult to predict future conditions because of unforeseen events and changes in technologies and evolving economic cycles. The Colorado Department of Transportation (CDOT) examines cumulative impacts to determine if any resources are reaching a level where there may be a fundamental change in the health of the resource because of its overall capacity to support a population (from a biological standpoint), its ability to rejuvenate itself, or its ability to serve in the same role it has in the past.

This analysis examines direct and indirect actions occurring as a result of the proposed actions and how they affect the resources of concern. These impacts are additive and do not always result in a one-to-one relationship but rather can compound the degree of effect.

The focus of this first tier assessment is to evaluate the inter-relationships between the transportation network and community values and environmental resources within the Corridor and surrounding counties, National Forests, and watersheds; and to identify possible cumulative impacts that may result from reasonably foreseeable future actions, from project alternatives, and from both of those combined.

This cumulative impact assessment describes possible future land use and socioeconomic growth scenarios that alternatives could impact, including the potential environmental consequences of inducing growth beyond local agency planning and the population and employment projections for the Corridor.

This is not a standard cumulative impact analysis approach; however, due to the overarching concern about induced growth and its contribution to cumulative effects, this analysis focused on the effects to resources from travel demand, population increases, and development associated with the Action Alternatives.

Additional and more localized cumulative impact assessments will be completed during Tier 2 processes.

4.3 What resources are examined as part of the cumulative effect analysis?

Lead agencies examined the resources during the 2000 and 2001 project scoping, which is a part of the National Environmental Policy Act (NEPA) process when project-critical issues are identified. **Table 4-1** includes information on the resources of concern identified during scoping. A primary concern was the potential for the Action Alternatives to induce growth or increase the potential for development and population increases to occur.

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Table 4-1. Cumulative Impacts Issues

Resource	Cumulative Impact Concerns
Air Quality	<ul style="list-style-type: none"> • Increased emissions due to increased congestion and/or vehicles in the Corridor • Increase in dust and particulates from winter maintenance and sanding in the Corridor • Increased emissions due to possible induced growth • Impacts of global climate change
Biological Resources	<ul style="list-style-type: none"> • Fragmentation of habitat resulting from induced growth • Hindrance of wildlife movement due to barriers • Habitat loss due to planned development • Disturbance of habitat and wildlife from collisions and winter maintenance • Negative effects on “high-value” fisheries as defined by the Colorado Division of Wildlife
Wetlands	<ul style="list-style-type: none"> • Direct and/or indirect loss of wetlands due to the construction of additional travel lanes, winter maintenance, and induced growth. • Decrease in the functional value of wetlands in the Corridor due to the construction of additional travel lanes, winter maintenance, and induced growth. Wetland functions in the Corridor include, but are not limited to, groundwater recharge, wildlife habitat, flood control, bank stabilization, and water quality protection.
Water Resources	<ul style="list-style-type: none"> • Decrease in water quality due to winter roadway maintenance, stormwater runoff from development and highways, and historic mining activities • Demands on water supply from growth • Physical impacts on streams (for example, changes to stream form and structure, encroachment, channelization) • Impacts on stream hydrology and habitat
Social and Economic Values and Land Use	<ul style="list-style-type: none"> • Effects on the regional economy from induced growth or development • Growth-related impacts on local communities • Impact of decreased water quantity and quality on future growth
Recreation	<ul style="list-style-type: none"> • Increased access to recreational areas and associated effects to natural resources • Increased pressure for visitations to National Forests
Visual Resources	<ul style="list-style-type: none"> • Changes in views and the “rural character” of the landscape for travelers, recreational users, and residents
Historic Communities	<ul style="list-style-type: none"> • Increased access to and pressure on historic areas and communities (National Historic Landmark District, Historic Districts, and potential historic areas)

Issues raised that were not included in the Cumulative Impact Analysis include geologic hazards, paleontological resources, and energy. While geologic hazards, including rock fall areas, are of considerable concern in the Corridor, they were not included in the cumulative impact analysis because CDOT has implemented extensive mitigation programs to reduce the risks of these hazards. Paleontological resources were not included due to federal laws and state regulations protecting fossils, and standard mitigation procedures required during construction activities. Energy related issues were evaluated with a greenhouse gas emissions analysis included in **Section 3.1, Air Quality**.

4.4 What is the geographic scope for cumulative impact analysis?

Figure 4-1 shows the geographic scope of the cumulative impact analysis. The study area encompasses portions of the Eagle River, Blue River, and Clear Creek watersheds that are adjacent to the Corridor, as well as future development areas, based on a review of local zoning and future land use plans. This watershed-based approach allows for assessment based on natural (rather than political) boundaries and makes it possible to connect upstream impacts to downstream effects.

4.5 What is the time frame for cumulative impact analysis?

The time frame begins from the period well before construction of the I-70 highway (in the 1960s) and extends to 2050. This duration includes the influences of historic mining in Clear Creek County, as well as impacts that have persisted from the period before the Corridor was built to the projected horizon year time frame of 2050.

By 2050, various global, national, and regional trends could result in changes in current conditions that could affect travel in the Corridor. Climate change, population growth, changing demographics, and availability of fossil fuels are major trends with potentially far-reaching results. Climate change could have the following potential effects:

- Increased demands for water for agriculture and increased potential for drought, along with nonrenewable groundwater supply shortages, which could combine to create a water gap that could potentially result in noticeably slowing the rate of future development in the Corridor. *Water and the Colorado Economy* (Front Range Water Council, December 2009).
- Increased water temperatures and changes in the patterns of precipitation, which could increase sediment load in surface waters. *Climate Change in Colorado* (University of Colorado, 2008).
- An increase in the likelihood of insect outbreaks and invasive plant species. *Climate Change and Aspen: An Assessment of Impacts and Potential Responses* (Aspen Global Change Institute, July 2006). The outbreak of mountain pine beetle is an example of this outcome, along with associated subsequent major changes in plant and animal communities, rates of surface water runoff, and degradations of water quality.
- Potential effects to economic conditions due to reduced snow pack and a decreased length of the skiing season, including reductions in skier visits. This could result in reductions in direct ski operations, businesses serving the ski industry, and residential investments (second homeowners).
- Higher summertime temperatures in the Denver metropolitan area could increase demand for access to the mountain areas and their cooler temperatures.
- Higher stream temperatures and low instream flows, which could affect aquatic ecosystems and recreational fisheries.

Ongoing population growth could place further strains on water supply, water quality, natural plant and animal communities, and Corridor recreation resources. Population growth also places increasing demands on resources outside of Colorado, which can affect natural systems in the Corridor, such as dust from energy development in eastern Utah. The changes in demographics occurring now have already affected skier visits and changed recreational patterns.

The decreased availability of fossil fuels is likely to affect travel by 2050. A potential effect is a change of fuel type, resulting in more hybrids and electrically powered vehicles. Reductions in supply could also result in changes in public policy, such as a carbon tax or vehicle miles traveled fee, which could decrease travel overall. Reductions in supply could also result in dramatically increased fuel costs, which could decrease travel overall.

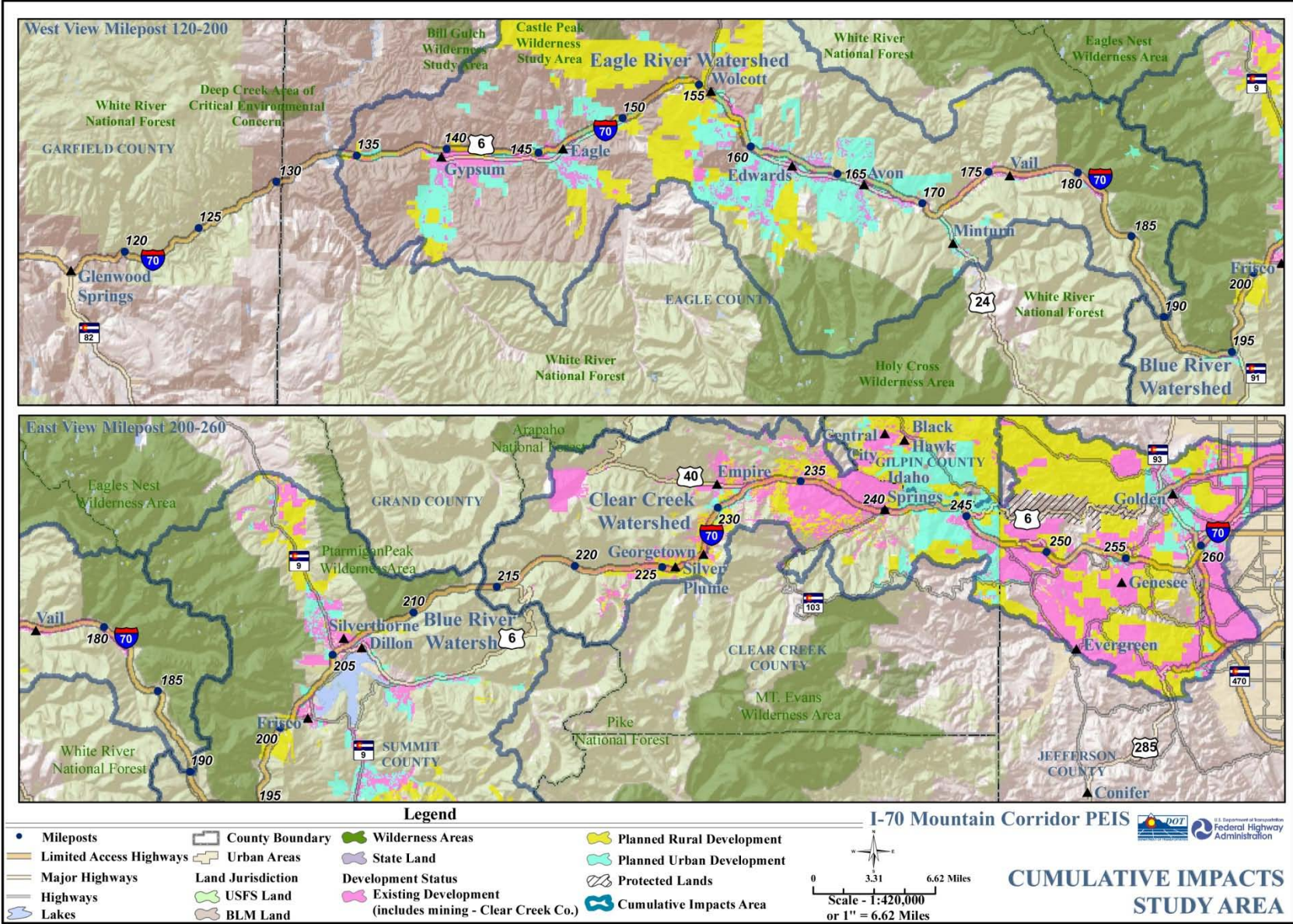
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The effectiveness of fuel and vehicle emissions controls could reach their peak in 2035; resulting in emissions of many air pollutants by 2050 that are more directly related to the number of vehicles and the amount of travel overall, rather than the effectiveness of emissions controls.

Elected officials representing the I-70 Mountain Corridor communities have recognized these trends and have already started altering some policies (such as programs to support local transit, promote energy efficiency, and reduce emissions, waste, and consumption) to respond to them. By 2050 changes in policies at the statewide or local jurisdiction level are expected to include policies to conserve water, increase water infrastructure projects, encourage more clustering of development, protect water quality, protect rural mountain character and historic integrity, control or slow development trends, or develop other “sustainable” policies.

Chapter 3 further discusses possible changes by 2050 to specific resources assessed in this chapter.

Figure 4-1. Cumulative Impacts Study Area



4.6 What methods were used to estimate cumulative impacts?

Historical (1957) aerial photographs show changes to communities and resources in the Corridor. As an example, the two aerial photos in **Figure 4-2a** and **Figure 4-2b** illustrate changes in the Georgetown area caused by the development of the I-70 highway to its current state (in 2000). Photos shown in **Figure 4-3** illustrate changes to the Georgetown area from 1901 to the present. The *I-70 Mountain Corridor PEIS Cumulative Impacts Technical Report* (CDOT, March 2011) has photo illustrations of other areas.

Because the development of the Corridor has influenced development patterns in the Corridor over the past 30 years, the cumulative analysis focused on how different alternatives would continue to affect these patterns. This involved assessing the different types of changes the alternatives would have on travel demand, population increases, and development.

The Colorado Department of Transportation gathered information from the various local jurisdictions along the Corridor on reasonably foreseeable future projects, as well as information on planned future build-out development. Reasonably foreseeable future projects are those that are sufficiently likely to occur, that a person of ordinary prudence would take into account in making a decision. Possible future projects that are considered too speculative were not included. The planned future build-out gave an estimate of a maximum area of future physical disturbance, which would encompass the reasonably foreseeable future project's impacted area.

The *I-70 Mountain Corridor PEIS Cumulative Impacts Technical Report* (CDOT, March 2011) has detailed descriptions about how the lead agencies assessed the induced growth effects of the various alternatives.

Various time frames were used to collect and analyze data describing the affected environment and to project future conditions. Specific assumptions by resource can be found in the following sections of this document:

- Land Use (see **Section 3.7**)
- Biological Resources (see **Section 3.2**)
- Wetlands (see **Section 3.3**)
- Water Resources (see **Section 3.4**)
- Social and Economic Values (see **Section 3.8**)
- Recreation Resources (see **Section 3.12**)
- Visual Resources (see **Section 3.11**)
- Historic Resources (see **Section 3.13**)
- Air Quality (see **Section 3.1**)

Figure 4-2a. Changes That Have Occurred in the Georgetown Area with the Development of the I-70 Highway to Its Current State (in 2000)

Georgetown - 1957



- Structures Lost Within or Adjacent to I-70 Footprint
- Approximate Location of I-70 Disturbance

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Figure 4-2b. Changes That Have Occurred in the Georgetown Area with the Development of the I-70 Highway to Its Current State (in 2000)

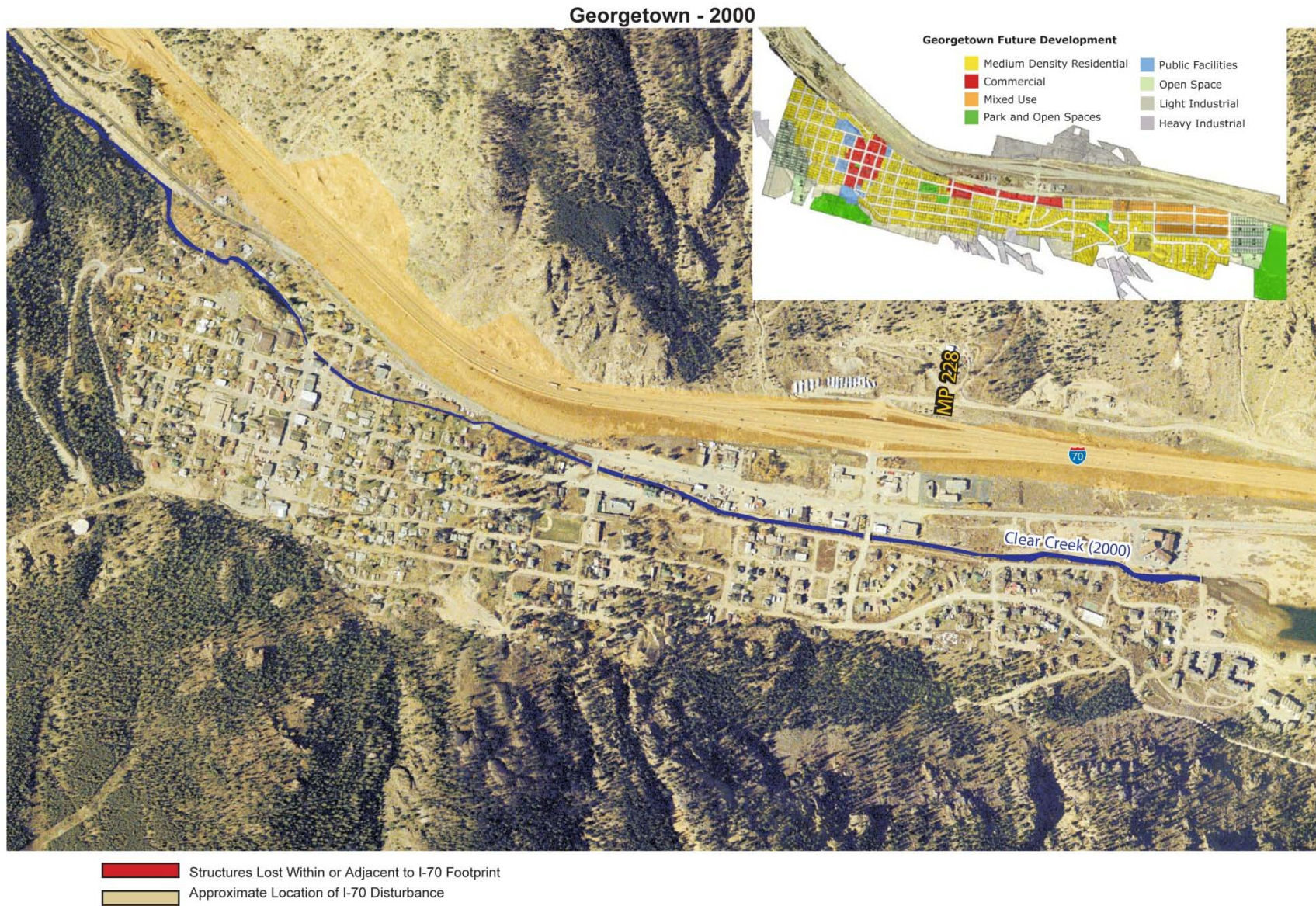
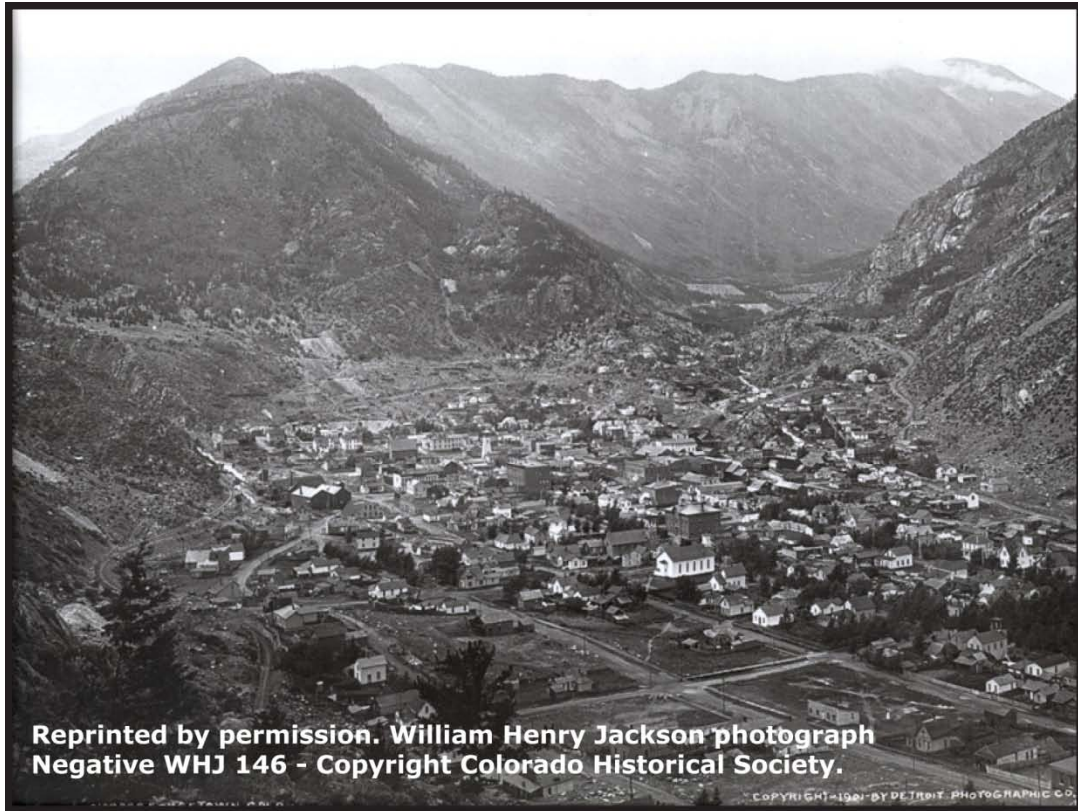
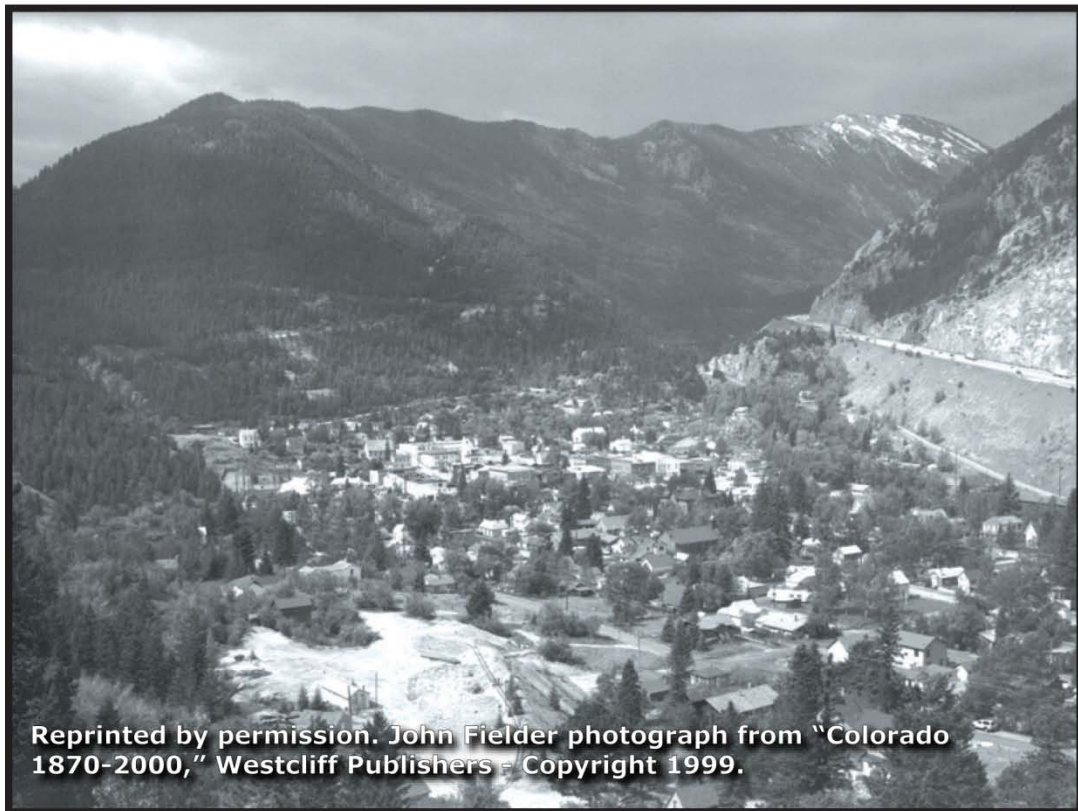


Figure 4-3. Changes to the Georgetown Area from 1901 to the Present



1901 View



Existing Conditions

4.7 What past, present, and reasonably foreseeable future actions were considered?

What past actions were considered?

Past actions considered include historic mining, ski area development, and residential and commercial development. Lead agencies assessed past actions in relation to their effects on environmental resources of concern, such as historic mining effects on water quality. Past transportation actions included the original I-70 highway construction and Central City Parkway construction, notably through and adjacent to historic communities in Clear Creek County. In the Clear Creek watershed, the Corridor was constructed through mineral deposits and mine waste residuals using cut-and-fill methods, creating the potential for pollutants (e.g., metals) entering Clear Creek from stormwater runoff.

The Corridor is located within the Southern Rockies Ecoregion, an ecological network of lands through portions of Wyoming, Colorado, and New Mexico. Past actions have influenced the natural function of the Southern Rockies Ecoregion, resulting in the following situations:

- Loss and decline of native species, along with invasion by exotic plants and animal species.
- Loss and degradation of terrestrial and aquatic ecosystems.
- Loss and fragmentation of wildlife habitat.
- Pollution and climate change.
- Loss and decline of wetlands.

The Southern Rockies Ecosystem Project compiled mapping to show past and expected growth patterns from 1960 to 2050. See the *I-70 Mountain Corridor PEIS Cumulative Impacts Technical Report* (CDOT, March 2011) for additional information about the Southern Rockies Ecosystem Project findings.

What present actions were considered?

The Colorado Department of Transportation examined these present actions to determine their effect on the resources of concern: existing land use and development, the Corridor as it exists today (including maintenance operations on the I-70 highway), current recreational usage of the National Forests, and the current condition of biological resources.

What reasonably foreseeable future actions were considered?

Examples of reasonably foreseeable future actions that may affect the resources include these major projects in and adjacent to the Corridor:

- Airport expansions (such as Eagle County Regional Airport)
- Ski area expansions at four of the ski areas
- Transportation projects in addition to the proposed construction on the Corridor (such as Bus Rapid Transit improvements planned along State Highway [SH] 82)
- New I-70 Mountain Corridor planned interchanges (such as the interchange planned east of Eagle)
- Large residential and commercial developments (such as Battle Mountain Planned Development)
- United States Forest Service recreation development and energy development along the Western Slope

Ski resort expansions are planned for:

- Breckenridge
- Keystone
- Vail
- Winter Park

In addition, there are future maintenance activities that may affect resources along the Corridor.

Zoning and future land use maps from the local governments within the cumulative study area (as defined in **Figure 4-1**) identify areas designated for future development. **Figure 4-1** includes major, reasonably foreseeable developments, such as ski area expansions. Collectively, the past, present, and reasonably foreseeable future projects make up the baseline for this analysis. This baseline does not include the I-70 Mountain Corridor Action Alternatives nor how they could affect environmental resources or alter the type and extent of future development. Future land use maps and zoning provide the most up-to-date compilation of long-range planning for the cumulative impacts study area. It should be noted that there is no single comprehensive land use plan for the cumulative study area.

4.8 What are the anticipated cumulative impacts?

Chapter 3 presents direct and indirect impacts to the environmental resources studied as part of this cumulative analysis. Also, the *I-70 Mountain Corridor PEIS Water Resources Technical Report* (CDOT, March 2011) has a discussion on indirect and cumulative impacts to water resources, including the impact of planned land use on water quality and changes in stream flow or channelization. The *I-70 Mountain Corridor PEIS Land Use Technical Report* (CDOT, March 2011) discusses water quality and availability issues specific to county and municipal planning and growth.

For each of the three watersheds shown in **Figure 4-1**, the analysis included resource effects from baseline conditions (i.e., effects from past, present, and reasonably foreseeable future projects) to implementation of the Action Alternatives. Induced growth differs by alternative in two fundamental ways—the amount of growth and how that growth is distributed, including the following conclusions:

- No Action and Minimal Action Alternatives have the potential to suppress or slow population growth in the region.
- Transit alternatives concentrate induced growth in urban areas surrounding transit centers in areas of existing or planned urban development primarily in Eagle County, including Eagle, Avon, and Vail.
- Highway alternatives distribute growth based on existing trends for urban/rural development in each county, resulting in increased densities in rural areas of the Eagle and Blue River watersheds.
- Combination alternatives distribute induced growth equally between the above transit and highway distribution scenarios, resulting in increased growth in both urban and rural areas in Eagle and Summit counties.
- The Preferred Alternative initially induces growth in a manner similar to the Transit alternatives; growth is concentrated in urban areas surrounding transit stations, primarily in Eagle County. If fully implemented, the Preferred Alternative induces growth in a manner more similar to the Combination alternatives; growth pressures occur primarily in both urban and rural areas in Eagle and Summit counties.

Coordination with local county planners indicated that the distribution of growth would vary along the Corridor. The planners do not expect Clear Creek County to experience a measurable amount of induced growth compared to Summit and Eagle Counties, partly because of topographic constraints (see **Section 3.7**).

The sections below summarize the results for each resource.

What are the land use cumulative impacts?

The development of the Corridor has influenced land use patterns in the Corridor over the past 30 years, and a relationship between growth in traffic and population in the Corridor region (past 30 years) suggests that changes in travel demand in the future also will affect growth in the region. The analysis of induced

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growth from alternatives is tied to past relationships of the I-70 highway traffic and land use. The potential influence of induced or suppressed travel demand on land use development patterns, population, and employment projections in the Corridor region vary by alternative and by Corridor county and watershed.

The “green” section of the bar chart illustrated in **Chart 4-1** indicates indirect impacts on land use associated with induced growth from alternatives. This estimate of induced growth provided the basis for quantifying the effects of induced growth on wildlife habitat, wetlands, water resources, social and economic values, and visual resources. In contrast, the “blue” section of the bar chart reflects cumulative impacts due to the change from existing to planned land use.

Chart 4-1 illustrates the impacts of the different distribution of population resulting from Transit, Highway, and Combination alternatives. Although Transit alternatives would have the potential to induce more population growth than the Highway alternatives, it is assumed that growth would take place in urban areas and would result in fewer acreage impacts. The Combination alternatives would have the potential to increase developed land by approximately 18 percent beyond planned growth by 2035. Highway alternatives would have the potential to increase developed land by 9 percent, and Transit alternatives by almost 3 percent. Note that the likelihood of such impacts occurring would depend on factors such as local planning and land use restrictions and infrastructure limitations. The Preferred Alternative would result in a range of potential impacts, from 3 percent to 18 percent by 2035. Additional information about the effects of the Action Alternatives on land use is contained in **Section 3.7, Land Use and Right-of-Way**.

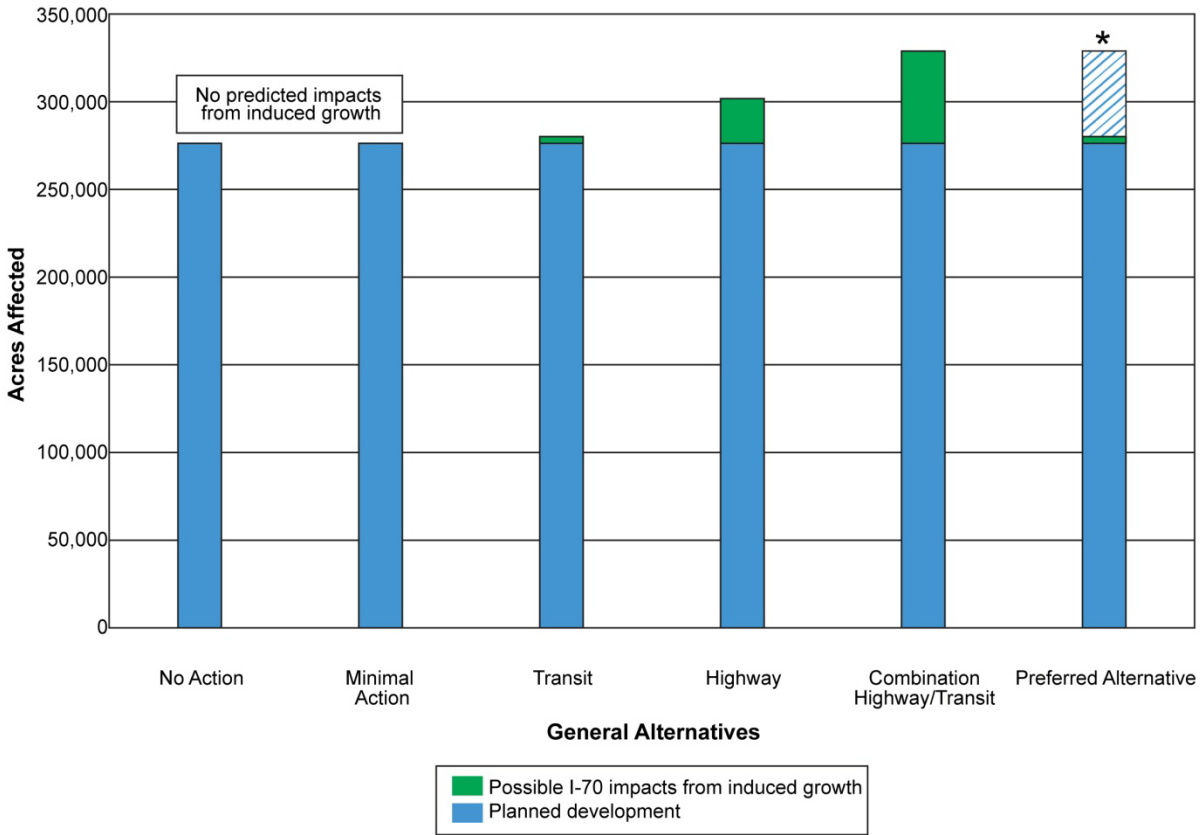
The extent and capacity of public water and wastewater infrastructure, including treatment plants, public water supply systems, and wastewater treatment facilities, also will play a role in future development. The *I-70 Mountain Corridor PEIS Land Use Technical Report* (CDOT, March 2011) and the Water Resources **Section 4.8** of this chapter discuss water quality and availability issues specific to local planning and growth.

In the coming years, water quality and water supply will greatly influence growth and future development.

Summary: The change in land use historically in the Corridor has been one of the most obvious, visible changes. The change in the Corridor from large ranchland adjacent to United States Highway (US) 6 in the 1960s to the many higher-density residential and commercial uses that exist today has transformed the Corridor’s character. Planned Corridor growth without improvements to the I-70 highway is anticipated to affect around 275,000 acres of currently undeveloped land. The Action Alternatives could add an additional 3 percent to 18 percent of developed land to this planned Corridor growth. The effect of this over time (and to 2050) is likely to vary substantially, depending on a number of factors, such as the availability of water, the quality of the water, the health of the recreation resources (dependent on economic conditions, climate change, mountain pine beetle ecological changes, and others), and the overall economic health and character of the local jurisdictions.

When combined with the past, present, and reasonably foreseeable cumulative impacts to land use, the lead agencies expect the transportation improvements to the Corridor to contribute to substantial cumulative changes in land use in the cumulative impacts study area shown in **Figure 4-1**. If local agencies manage land use change in a coordinated manner, these cumulative changes may not be detrimental to the Corridor and could provide benefits to residents and visitors. However, if land use changes occur without effective management or coordinated planning efforts, these cumulative changes could overwhelm Corridor communities and subsequently affect quality of life, community services and infrastructure, and the overall character of the mountain communities. The adaptive management approach of the Preferred Alternative (described in **Section 2.7** of this document) allows transportation improvements to be implemented over time, which may allow communities to appropriately manage the indirect effects associated with those improvements.

Chart 4-1. Corridor Cumulative Impacts on Land Use



* Impacts of the Preferred Alternative are presented as a range, with the solid and hatched bars together representing the full implementation of the Preferred Alternative. The solid bar represented implementation of the Minimum Program of Improvements only. The hatched area is presented as a range because the adaptive management component of the Preferred Alternative allows it to be implemented based on future needs and associated triggers for further action. Section 2.7.2 describes the triggers for implementing components of the Preferred Alternative. For NEPA documentation and analysis purposes and based on information available today, the Preferred Alternative must be fully implemented to meet the 2050 purpose and need. The Minimum Program of Improvements does not meet the 2050 purpose and need.

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What are the biological resources cumulative impacts?

Baseline: The I-70 highway construction, previous and ongoing development, and projected population growth in the Corridor have and will result in habitat loss and fragmentation as well as create barriers to wildlife movement (wildlife linkage interference zones). Evidence suggests that the existing highway's barrier effect impedes traditional wildlife movement through certain corridors. These linkage interference zones affect migration routes, as well as pathways a species uses to access important habitat on a more frequent basis.

Examples of impacts to biological resources include fragmentation of wildlife habitat in Eagle County due to land use growth and the increased incidences of animal/vehicle collisions along the Corridor. The I-70 highway construction and previous and ongoing development also have resulted in adverse effects to aquatic resources, including macroinvertebrates and fisheries.

Ongoing winter maintenance on the Corridor has affected aquatic resources, including "high-value" fisheries, as defined by the Colorado Division of Wildlife.

Planned commercial and residential growth along the Corridor as a result of the baseline condition could increase wildlife habitat loss, with habitat impacts ranging from 100 acres to 8,000 acres. In addition to habitat loss, impacts would include an increase in the barrier effect on wildlife movement and habitat fragmentation. There would be notable reductions in wildlife habitat in the Eagle River and Clear Creek watersheds; habitat reductions in the Blue River watershed would not be as extensive as those in the Eagle River and Clear Creek watersheds. Deer and elk species would experience the greatest habitat losses from growth.

The mountain pine beetle infestation is causing regional habitat losses, which is causing ongoing and expected long-term change in the Corridor's National Forests. Without mitigation, National Forest System lands could reach a point where they would not be able to maintain ecological health, resulting in substantial effects to biological resources.

Alternatives: Direct impacts on key wildlife habitats from the Action Alternatives are limited to approximately 111 to 443 acres (representing 0.02 to 0.3 percent of the total evaluated area). These impacts are relatively minor when compared to baseline conditions; impacts from existing and planned development would affect 10 percent to 49 percent of the total evaluated area. **Table 4-2** shows estimated impacts for the baseline condition and alternatives.

Table 4-2. Cumulative Impacts (acres) on Key Wildlife Habitat in the Corridor

Alternative	Deer	Elk	Bighorn Sheep	Songbird	Total Wildlife	Increase over Baseline (%)
Baseline	45,800	36,600	8,300	20,600	111,300	
No Action	45,800	36,600	8,300	20,600	111,300	0
Minimal Action	45,800	36,600	8,400	20,600	111,400	0
Transit	46,000	36,800	8,500	21,000	112,300	1
Highway	50,000	40,100	8,700	25,000	123,800	11
Combination	53,500	45,000	8,900	29,000	136,400	23
Preferred Alternative	46,000 to 53,500	36,800 to 45,000	8,500 to 8,900	21,000 to 29,000	112,300 to 136,400	1 to 23

Areas of key wildlife habitat, threatened and endangered species movement areas, and linkage interference zones could experience increased pressure from induced development from the Combination and Highway alternatives, due to the considerable induced growth that local planners expect there. (This induced growth is a conservative estimate of a possible future scenario that may not be sustainable.) This is particularly the case in the Eagle River Watershed. The alternatives all include implementation of mitigation strategies to reduce the barrier effect of the Corridor and its improvements. Additional information about the effects of the Action Alternatives on biological resources is contained in **Section 3.2, Biological Resources**.

Summary: Cumulative impacts that could affect threatened and endangered species include increased human intrusion into their habitats, habitat losses, and effects to their movement corridors from land development. Most of the habitat for these species is on National Forest System and Bureau of Land Management lands, which provide some protection from direct habitat losses. However, increased use of these areas for recreation could place additional stress on these species (see recreation discussion below).

The past and present effects of the I-70 highway construction and residential and commercial growth in the Corridor have substantially changed the health of the natural vegetation communities; wildlife; and threatened, endangered, and special status species, resulting in habitat loss and fragmentation. Reasonably foreseeable future actions (such as ski area expansions and ongoing commercial and residential development) are likely to continue to negatively affect Corridor wildlife and fisheries resources. The Action Alternatives result in further impacts to 1 percent to 23 percent of existing acres of wildlife habitat. A Landscape Level Inventory of Valued Ecosystem Components (ALIVE) Memorandum of Understanding, described further in **Sections 3.2.7** and **3.19**, defines actions that could partially mitigate impacts associated with the barrier effect of the Action Alternatives. Recommendations developed by the Stream and Wetland Ecological Enhancement Program (SWEEP) Committee, described further in **Sections 3.2.7** and **3.19**, will help mitigate impacts to riparian areas, wetlands, and streams within the Corridor. The impacts of Corridor improvements are substantial when combined with the past, present, and reasonably foreseeable cumulative impacts to biological resources, and based on the effectiveness of implemented mitigation. Local agencies' adoption of land use policies that preserve open space adjacent to the crossings is a key to effective mitigation of wildlife crossings.

What are the wetlands cumulative impacts?

Baseline: Baseline conditions include the direct loss of wetlands from previous, ongoing, and future development activities; ski area expansion; and roadway construction. There are already and will continue to be future effects to the valuable functions that wetlands provide to the environment. Also, development activities, roadway construction, and winter maintenance activities can lead to increased sediment and stormwater runoff that, in turn, can degrade wetland water quality and the wildlife habitat that wetlands provide.

Historic information regarding wetlands impacts along the Corridor, especially prior to the construction of the I-70 highway, is largely unavailable. By considering other factors, such as stream impacts, which can be approximated through the interpretation of aerial photography, it is possible to approximate the degree of possible wetland impacts at the watershed level due to past actions. Therefore, analysis of cumulative impacts to wetlands was based on overall impacts to water resources by watershed along the Corridor, based on the assumption that wetlands are part of the water resources generally within the applicable watershed. The trends for impacts to water resources will be similar to the trends for wetland impacts such that, the greater the overall impacts to water resources in a watershed of a given alternative, the greater the wetland impacts.

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Figure 4-1 shows the areas of existing and planned development along the Corridor that covers 25,000 acres of water resources in the Corridor, including wetlands. This accounts for approximately 45 percent of the water resources mapped in the Eagle River watershed. Development covers approximately 30 percent and 62 percent of these resources in the Blue River and Clear Creek watersheds, respectively. These figures provide a snapshot of how much the development areas might affect these resources. Please note that these estimates are conservative and do not account for compliance with wetland regulations that require development projects to avoid and minimize wetland impacts. Also, local governments could implement water resources buffer zones and other land development controls that would further protect wetlands.

Alternatives: Action Alternatives have relatively minor direct impacts to aquatic resources and wetlands (up to 0.3 percent of the developed area) when compared to potential impacts from induced growth and development. In the Eagle River watershed, Transit alternatives increase impacts slightly over baseline conditions (additional increase of approximately 500 acres) because of the ability to concentrate induced growth in urban areas. Highway and Combination alternatives increase impacts by 3,000 acres and 5,000 acres respectively. The Preferred Alternative ranges in impacts from 500 acres to 5,000 acres.

In the Blue River and Clear Creek watersheds, the lead agencies anticipate no increases in impacts with the Transit and Highway alternatives, because the induced growth from these two alternatives would not impact estimated wetland areas. Combination alternatives have the potential to induce growth and development in the Blue River watershed (increasing acreage impacts by approximately 2,200 acres). Preferred Alternative impacts range from no impacts to 2,200 acres. This induced growth is a conservative estimate of a possible future scenario that may not be sustainable. In the Clear Creek watershed, wetland impacts from the Combination alternatives and the Preferred Alternative, if fully implemented, would be limited to direct impacts because no measurable induced growth impacts are anticipated. Additional information about the effects of the Action Alternatives on wetlands and Corridor watersheds is contained in **Section 3.3, Wetlands and Other Waters of the U.S.**

Summary: Nationally and within Colorado there is a loss and degradation of wetlands from development-related impacts and climate change. Reasonably foreseeable future actions without mitigation could continue this existing trend of wetland loss. Although the Action Alternatives increase the amount of Corridor wetland impact in the future, when combined with the past, present, and reasonably foreseeable future cumulative impacts to wetlands, the lead agencies do not expect the Action Alternatives to deviate from the existing trend of wetland loss on the national, state, or Corridor level. (*National Water Summary on Wetland Resources*, United States [U.S.] Geological Survey Water Supply Paper 2425, as found on <http://water.usgs.gov/nwsum/WSP2425> [USGS, 1999].) To minimize the impact of the Action Alternatives on this existing trend, the project will adhere to wetland mitigation guidance/regulation for wetland impacts (see **Sections 3.3.7** and **3.19**).

Within the Corridor the past actions of ski area development, I-70 highway construction, mining activities, and residential and commercial development have all resulted in loss and degradation of Corridor wetlands.

What are the water resources cumulative impacts?

Baseline: There have been adverse effects to the Corridor's water resources due to past activities, such as historic mining, construction of the I-70 highway and other roadways, highway winter maintenance, and urban development. Impacts include impairment to water quality, physical changes to streams (for example, channelization), and adverse effects on stream hydrology and habitat.

Historic mining has affected streams in the Eagle River, Blue River, Clear Creek, and South Platte Headwaters sub-basins. Some of the most substantial impacts to water resources have been along Clear Creek immediately adjacent to the Corridor. Also, construction in the Corridor played a role in the exposure and disturbance of mine waste and mineralized rock, further degrading water resources.

Winter maintenance has and will continue to contribute sand and de-icing chemicals to highway runoff and impair water quality. For example, based on monitoring results since 2001, Black Gore Creek winter chloride concentrations have exceeded water quality standards for several days each winter as a result of Corridor runoff.

Construction of the Corridor has caused up to 35 percent of the stream channelization in the Clear Creek watershed. Most of Lower Clear Creek (Clear Creek from Empire Junction to US 6 interchange) is constrained in a narrow valley or canyon. However, the construction of the US 6, US 40, and I-70 highways has further constricted or channelized streams; and there are many areas today where the embankments between the US 6, US 40, and I-70 highways constrict Clear Creek on both sides.

Planned urban and rural development will cause most future water quality issues, which will increase both point and nonpoint source pollution entering the Corridor's streams and lakes. The measure of increased water pollution is represented by the amount of phosphorus that would enter water resources. Baseline conditions would result in an estimated 42,000 pounds of increased phosphorus in the Corridor per year, mostly from planned development. (These estimates are conservative because they do not account for measures that can be implemented to reduce nonpoint source pollution from stormwater).

Alternatives: Action Alternatives directly impact water resources because they increase stormwater runoff and highway winter maintenance. Possible induced growth causes secondary water quality impacts mostly in Eagle and Summit Counties. Throughout the Corridor, the Transit alternatives and the Preferred Alternative Minimum Program increase phosphorus amounts by 17 percent over baseline conditions. Induced growth in urban areas with transit centers, including Eagle, Avon, and Vail, cause most of these increases.

Pollution originating from a single, identifiable source, such as a discharge pipe from a factory or sewage plant, is called point-source pollution. Pollution that does not originate from a single source, or point, is called nonpoint-source pollution (for example, stormwater runoff).

The Highway and Combination alternatives (including the Preferred Alternative if it is fully implemented) induce dispersed growth in rural areas, which would have the greatest cumulative impacts from new development activities. The Highway and Combination alternatives (including the Preferred Alternative if it is fully implemented) increase phosphorus amounts by an estimated 20 percent and 55 percent, respectively, over baseline conditions.

Phosphorus increases are greatest in the Eagle River watershed due to the extent of induced growth projected. This induced growth is a conservative estimate of a possible future scenario that may not be sustainable. In the Blue River watershed, the Combination alternatives (including the Preferred Alternative Maximum Program) would increase phosphorus over the baseline. The Action Alternatives would not cause measurable induced growth in the Clear Creek watershed; however, construction of Action Alternatives would cause direct impacts. Additional information about the effects of the Action Alternatives on water resources is contained in **Section 3.4, Water Resources**.

Summary: Straight Creek, Black Gore Creek, and upper Clear Creek are impaired streams due to sediment loading, and the first two currently have Sediment Control Action Plans in place. A Sediment Control Action Plan is currently under development for Clear Creek as well. The Colorado Department of Transportation is also continuing a water quality monitoring program for suspended solids, phosphorus, chloride, copper, and zinc; pollutants associated with roadways; and adjusting winter maintenance

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activities to minimize traction sand, sodium chloride, and magnesium chloride impacts from highway runoff on receiving streams. The Action Alternatives would further implement permanent water quality sediment catchment basins along other streams that would help improve the water quality along the Corridor. This would indirectly add benefits to water quality from erosion associated with vegetation losses, which may occur from climate change and from other land use changes. Total phosphorus loads are expected to increase along the Corridor as a result of planned land use changes by 2050 and the Action Alternatives could further increase phosphorus and other pollutant loadings from old mining waste, but the sediment catchment basins will help trap these phosphorus and other pollutant loads and keep them from entering the waterways. Impacts associated with the Action Alternatives could also be mitigated by the implementation of stream restoration and other activities as described in **Section 3.4** and as emphasized by SWEEP to help off-set impacts from the initial construction of the I-70 highway. The No Action Alternative would not include these additional sediment catchment basins or stream restoration activities and would therefore result in the greatest negative impact from a cumulative standpoint.

When combined with the past, present, and reasonably foreseeable future cumulative impacts, the Action Alternatives are not expected to have a noticeably negative impact on water resources and water quality and could actually show a beneficial result to water quality in the Corridor over time.

What are the social and economic values cumulative impacts?

Baseline: While construction of the original Corridor provided economic benefits, it disrupted the fabric of some communities. Clear Creek County's historic mining communities most keenly felt these effects. There were approximately 35 acres of Clear Creek County developed lands lost due to the original Corridor construction (based on 1956 and 1957 photography). Losses for Clear Creek County communities include:

- Idaho Springs: approximately 5 percent of the 161 acres of developed land
- Dumont: approximately 9 percent of the 45 acres of developed land
- Downieville: approximately 38 percent of the 16 acres of developed land
- Lawson: approximately 9 percent lost within 23 acres of developed land
- Georgetown: approximately 5 percent lost within 65 acres of developed land
- Silver Plume: approximately 18 percent lost within 65 acres of developed land

West of the Continental Divide, communities generally developed during and after construction of the Corridor and did not experience similar impacts.

In the coming years, state projections indicate that the Corridor will have considerable population growth. By 2035, the permanent population of the nine Corridor counties is projected to reach almost 420,000, more than doubling the 2000 population.

Economic growth is expected to accompany population growth in the Corridor, with a Gross Regional Product (GRP) increase of over 200 percent anticipated by 2035. This is the case for all Corridor counties with the exception of Clear Creek County. However, as discussed in **Section 3.8**, tourism and second homes drive the Corridor economy. These population and economic projections do not consider the influence of Corridor traffic, although the I-70 highway access is integral to the delivery of goods and services, commuters, tourists, and local business. Continued Corridor congestion during peak weekends and at certain key points along the Corridor is expected to suppress economic growth (see **Section 3.8.5**).

Alternatives: The No Action and Minimal Action Alternatives have the greatest impact on the regional economy. Both alternatives suppress economic conditions and decrease the expected growth in GRP by approximately 22 percent. Transit Alternatives and the Preferred Alternative Minimum Program both support the projected growth in GRP, while Combination alternatives and the Preferred Alternative, if fully implemented, supports or could even exceed the expected growth in GRP.

The alternatives have similar impacts on other economic indicators. For example, the No Action and Minimal Action Alternatives might suppress regional personal income as much as 25 percent. Counties with resort destinations that contribute the most to the existing tourism economy (for example, Eagle, Pitkin, Summit, and Grand) would experience the greatest effects.

In Eagle County, the induced growth projected for the Action Alternatives could increase growth pressures and lead to related socioeconomic effects, such as increased property values and increased pressure for the provision of community services. For example, Highway and Combination alternatives (including the Preferred Alternative if fully implemented) are expected to allow some amount of dispersed growth in rural areas and might require increased local planning efforts to address issues related to urban sprawl. Alternatives with transit components are expected to concentrate growth in urban areas with transit centers, including Eagle, Avon, and Vail. Growth in Garfield County is susceptible to changes in Eagle County because of the number of residents commuting to Eagle County for employment.

In Summit County, induced growth from the Combination alternatives and from the Preferred Alternative, if it is fully implemented, could increase growth pressures. Similar to above, alternatives with transit components concentrate growth in urban areas with transit centers including Dillon and Silverthorne. The Highway and Combination alternatives (including the Preferred Alternative if fully implemented) are expected to allow some amount of dispersed growth in rural areas and have related effects. All estimates of induced growth are conservative, projecting one possible future land use scenario that may not be sustainable. Additional information about the socioeconomic effects of the Action Alternatives is contained in **Section 3.8, Social and Economic Conditions**.

Summary: Past actions in the Corridor have had a considerable influence on social and economic values to Corridor communities. The past economic base of mining has been transformed into a social and economic base defined by tourism. Reasonably foreseeable future actions and events (such as changes in fuel types, resource availability, climate change, water availability), when projected to 2050, could substantially affect the social and economic fabric of the Corridor communities. The Action Alternatives could either suppress economic conditions or increase anticipated GRP.

When combined with past, present, and reasonably foreseeable future actions and events, the Action Alternatives, except for the Minimal Action Alternative, would be expected to have a substantially beneficial impact on economic (job and tax) growth in the Corridor for all counties with the exception of Clear Creek County. The growth in Clear Creek County is expected to be minimal, if at all. However, such growth places additional pressure on property values, community services, and other social infrastructure. The Action Alternatives, when combined with past, present, and reasonably foreseeable future actions and events, result in substantial indirect impacts on quality of life, community services, and local infrastructure unless mitigating actions are undertaken by local agencies. The adaptive management approach of the Preferred Alternative (defined in **Section 2.7** of this document) allows agencies to implement transportation improvements over time, which may allow communities to appropriately manage the indirect impacts associated with those improvements.

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What are the recreation resources cumulative impacts?

Baseline: The United States Forest Service has indicated that demand for recreation is such that the agency cannot maintain any additional parking or new trailheads. Recreation use of National Forest System lands is at or over use capacity now. Land managers are struggling to maintain existing trails because of increasing use levels and declining maintenance budgets. Also, there is increased use of backcountry trails and roads not originally designed for intensive uses. The United States Forest Service has granted expansions of the major ski resorts in the Corridor, while participation in other winter activities has grown. Summer visitations also have increased.

Without implementation of mitigation, the ability of the United States Forest Service to maintain the ecological health of the resource while accommodating increased pressure for recreation activity is in jeopardy.

Population increases in the Corridor, combined with increased visitation from nonresidents (primarily Front Range visitors), will continue to strain National Forest amenities. The extent of these effects will depend on United States Forest Service management activities for National Forest System lands, as discussed in **Section 3.12**.

While the economic downturn has slowed tourism in the short term, the outlook is for continued increased growth. The mountain pine beetle infestation, which is causing ongoing change in National Forest conditions, is altering the setting of recreation resources on National Forest System lands.

Alternatives: Because of reduced mobility and access, the No Action and Minimal Action Alternatives might retard the projected increases in National Forest destination trips. Meanwhile, the United States Forest Service has indicated that alternatives with transit components complement their future plans to manage access into the Corridor's National Forests through transit. Therefore, the Transit and Combination alternatives, as well as the Preferred Alternative increase National Forest visitation levels, but are also better able to support United States Forest Service plans to control visitation impacts. Projected changes in National Forest destination trips from alternatives are as follows:

- In the Arapaho and Roosevelt National Forests, Highway alternatives increase winter and summer National Forest destination trips in 2025 by 50,000 annually. In the White River National Forest, increases would be 200,000 and 100,000 annual winter and summer trips, respectively. Visitor use in 2025 was extrapolated from 2010 Arapaho and Roosevelt National Forests and 2020 White River National Forest visitation projections (United States Forest Service, 2000). The projections do not consider the capacity of the Corridor. They are considered to be very general estimates of visitor use. Visitor use estimates were not extrapolated for 2035. United States Forest Service visitor projections have not been updated since year 2000. Extrapolation of visitor use to 2035 would not yield substantially different trends than those extrapolated from 2025 and would not change the results of the analysis.
- In the Arapaho and Roosevelt National Forests, the Transit Alternatives would increase winter and summer trips in 2025 by 200,000 each. In the White River National Forest, increases are 700,000 and 500,000 for winter and summer trips, respectively. These alternatives are more consistent with the United States Forest Service's desire to serve highly used recreation areas with transit and could, therefore, help mitigate and control impacts.
- In the Arapaho and Roosevelt National Forests, the Combination alternatives (including the Preferred Alternative if fully implemented) could increase winter and summer National Forest destination trips in 2025 by

The United States Forest Service has indicated that the alternatives that include transit could assist to mitigate and control impacts because they would concentrate rather than disperse visitors, allowing the United States Forest Service more control over visitor use and associated resource management.

400,000 each. In the White River National Forest, the Combination alternatives increase winter and summer National Forest destination trips by 1.3 million and 1 million, respectively. These alternatives are more consistent with the United States Forest Service's desire to serve highly used recreation areas with transit and could, therefore, help mitigate and control impacts.

Additional information about the effects of the Action Alternatives on recreation resources is contained in **Section 3.12, Recreation Resources and Section 6(f) Discussion**.

Summary: Past and present actions have resulted in demand for recreation resources that are already at or near capacity now. Reasonably foreseeable future actions are likely to further strain National Forest System resources, especially by 2050, such that the ability of the United States Forest Service to maintain the quality of the recreation experience, while accommodating increased demand could surpass the capacity of the resource. While the Minimal Action Alternative likely suppresses projected increases in National Forest destination trips, the remaining Action Alternatives increase annual trips from 400,000 to over 3 million between the two National Forests. When combined with the past, present, and reasonably foreseeable future impacts to recreation resources, the Action Alternatives noticeably diminish the quality of the recreation experience over time, unless the United States Forest Service implements management actions to balance visitor access with the health of the resource. The Colorado Department of Transportation has already been coordinating closely with the United States Forest Service to mitigate any I-70 highway-related impacts and will continue to do so. The adaptive management characteristics of the Preferred Alternative (as defined in **Section 2.7** of this document), when combined with its transit component, present the best potential to alleviate cumulative impacts to recreation resources.

What are the visual resources cumulative impacts?

Baseline: Visual scars from I-70 highway construction remain prominent along several stretches of the Corridor, and are most evident in the canyon environment of Clear Creek County and along Straight Creek, where existing cut-and-fill slopes dominate the setting. Recent construction of the Central City Parkway has also created prominent cut- and fill-slopes.

Existing and historic development has altered the visual setting of the Corridor and changed its rural character. Scarring from mining and Corridor construction is also evident. Planned development would continue the trend of visual character change. Along the entire Corridor, planned development would affect between 7.5 percent and 32 percent of the total acreage visible along the Corridor. All of the viewsheds reflect this percentage increase. The remaining area visible along the Corridor would remain as National Forest System management, recreation, or open space areas.

Alternatives: **Section 3.11** describes direct visual impacts from the alternatives. Induced development contributes to these changes as follows:

- The Transit alternatives (including the Preferred Alternative Minimum Program) have substantial impacts on visual resources due to increased urbanization around transit centers in the Eagle River watershed and due to Advanced Guideway System elevated structural components.
- The Highway alternatives have intermediate impacts on visual resources due to distribution of induced growth based on existing trends in urban and rural development in the Eagle River watershed.
- The Combination alternatives have the greatest potential for inducing growth in the Eagle River and Blue River watersheds and therefore have the greatest cumulative visual impacts of all the alternatives.

The Advanced Guideway System creates a large visual impact because it is planned to be elevated throughout most of its reach.

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- The Preferred Alternative has a range of visual impacts depending on how fully it is implemented.

Additional information about the effects of the Action Alternatives on visual resources is contained in **Section 3.11, Visual Resources**.

Summary: Past actions, including mining, roadway construction, urban development, and ski area development, have produced localized changes in the visual character of the Corridor. Residential and commercial development along the highway has been the primary driver behind the visual change in the Corridor. Currently, 13 percent of the land within the Corridor viewshed is developed, and according to adopted land use plans, it is anticipated that an additional 19 percent of land will be converted from vacant, undeveloped land to developed land. It is expected that reasonably foreseeable future actions of urban development and ski area expansion will continue to alter the visual character, particularly by 2050. Additionally, the ongoing loss of pine forests because of the mountain pine beetle continues to alter the forest landscapes. The Action Alternatives introduce new visual elements into the Corridor, producing substantial visual contrast with the presence of elements such as elevated structures and increased footprint width. Higher than expected growth projections resulting from the implementation of the Preferred Alternative could diminish the visual quality within the Corridor, producing a negative cumulative impact. Commitment to the Engineering Design Criteria and Aesthetic Guidelines identified in the I-70 Mountain Corridor Context Sensitive Solutions process, combined with local planning regulations, will minimize the visual impacts generated by the Corridor.

What are the historic resources cumulative impacts?

Baseline: Numerous communities along the Corridor attest to the 19th and early 20th century history of mineral, milling, timber, and railroad industries in Colorado. Today, most historic resources that remain in the Corridor reflect these industries. Most are located in the Clear Creek Valley, from Idaho Springs to Graymont, where the past influences of mining history and settlement remain evident.

The initial construction of the I-70 highway directly and indirectly affected many of these historic resources. The Corridor construction caused the loss of approximately 80 historic structures in Clear Creek County. Indirect impacts include increased noise and visual impacts on areas in historic districts and mining-related landmark areas.

Other past actions that have affected historic resources include ski area development and expansion, residential and commercial developments, and roadway construction.

Several recent events regarding Clear Creek County communities emphasize the importance of historical resources along the Corridor:

- Colorado's Most Endangered Places List 2005 included multiple communities in Clear Creek County along the Corridor.
- Georgetown was identified as a Preserve America Community.
- In 2008, the National Park Service (which administers the National and Historic Landmarks Program) identified a threat level of Watch for the Georgetown-Silver Plume National Historic Landmark District that bisects the Corridor. The threat level was due to the possible future adverse effects from the proposed widening of the I-70 highway. This was lifted in 2009 due to the efforts of the lead agencies in developing the Section 106 Programmatic Agreement.

Planned development in the reasonably foreseeable future adds to past and present adverse effects to historical properties. Without adequate consideration, cumulative effects contribute to the loss of integrity of the Georgetown-Silver Plume National Historic Landmark District, affecting its designation. The lead agencies are committed to following the Programmatic Agreement, and the Colorado Department of

Transportation will employ I-70 Mountain Corridor Context Sensitive Solutions process to avoid and minimize their effects.

Alternatives: Induced growth in the Eagle and Blue River watersheds could affect historic properties. However, based on the induced growth analysis and local input, the historic communities in Clear Creek County are not particularly susceptible to similar impacts from induced growth due primarily to topographic constraints. Instead, cumulative impacts for historic properties largely would depend on the lingering effects of the construction of the Corridor transportation improvements, ongoing influences of the Corridor to historic properties, and any added loss of integrity to the historic properties from the Action Alternatives. Types of impacts include direct impacts on historic properties, including loss of structures and property encroachment. Visual impacts from construction of Action Alternatives combined with previous impacts from the initial I-70 highway construction could alter the historic setting within the communities.

Direct impacts from the Action Alternatives on historic properties, as well as visual and audible impacts on the setting, result in cumulative impacts on the Georgetown-Silver Plume National Historic Landmark District, Lawson, Downieville, Dumont historical area, and the Idaho Springs historical areas. A summary of anticipated direct impacts to historic properties associated with the Action Alternatives, a large proportion of which are in Clear Creek County, is provided below. As explained in **Section 3.13**, the actual number of historic properties affected could be higher or lower depending on the final eligibility determinations of these properties, additional properties that may be identified through intensive survey, and measures that are implemented to avoid impacts to properties.

- The Minimal Action Alternative results in direct impacts to 48 historic properties in the Corridor.
- The Transit alternatives have potential direct effects on up to 65 properties in the Corridor.
- The Highway alternatives affect up to 56 historic properties in the Corridor.
- The Combination alternatives have the greatest effect to historic properties because they have the largest footprints. Up to 70 properties in the Corridor are affected by the Combination alternatives.
- The Preferred Alternative falls in the range of impacts of the other Action Alternatives and directly affects between 57 and 67 properties in the Corridor.

Additional information about the effects of the Action Alternatives on historic resources is contained in **Section 3.13, Historic Resources**. The Section 106 Programmatic Agreement (described in more detail in **Section 3.13.7** and included in full as **Appendix B** of this document) identifies specific measures to minimize harm to historic properties, including visual impact, noise abatement, and economic impacts on heritage tourism.

Summary: Past actions, such as mining, road construction, and other transportation improvements, have affected the historical integrity of communities along the Corridor, specifically in Clear Creek County where there is a higher concentration of historic and potentially historic resources. Reasonably foreseeable future actions, such as alternative energy development, planned future commercial and residential development, and some ski resort developments, by 2050 are more likely to affect the western counties along the Corridor, including Summit, Eagle, and Garfield Counties, where this document indicates there is a lower concentration of historic and potentially historic resources compared to Clear Creek County. When combined with past, present, and reasonably foreseeable future actions, the size of the Corridor, geographic constraints, and the concentration of historic and potentially historic resources, the Action Alternatives would have more of an impact in Clear Creek County and less of an impact in the western counties of Summit, Eagle, and Garfield Counties. More localized studies at Tier 2 will refine the potential for cumulative impacts to historic resources.

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What are the air quality cumulative impacts?

The following primary sources in the Corridor can affect air quality:

- Emissions from vehicles on roadways, which can increase due to congestion and induced growth
- Emissions from stationary commercial and industrial facilities (considered minimal in the Corridor)
- Re-entrained dust and particulates from roadway sanding and winter maintenance activities
- Urban area emissions including wood burning and dust from construction sites, which can increase due to induced growth

The Environmental Protection Agency expects air quality to continue to improve as regulations are implemented and states work to meet current and recently revised national air quality standards. As new air quality regulations and cleaner car technologies are implemented, the trend of decreasing air pollutant emissions is expected to continue despite the increase in vehicle travel along the Corridor. However, this trend may slow or reverse as technological advances and regulatory controls reach their limits and can no longer offset increased travel miles in future years. If this occurs, increases in vehicle air pollutant emissions correlate more directly with increased vehicles miles traveled.

Carbon Monoxide (from emissions from vehicles on roadways)

Carbon monoxide (CO) emissions are expected to decrease substantially in the future, as presented in **Section 3.1** of this document. As **Table 3.1-1** shows, CO emissions vary among the project alternatives. Compared to the No Action Alternative, project-related emissions range from a reduction of 9 percent to an increase of 10 percent. Emissions for the Preferred Alternative fall in the middle of this range. Compared to existing emissions, emissions under all alternatives would be substantially less than current day emissions, and none of the alternatives are likely to lead to any violations of the National Ambient Air Quality Standards. Non-vehicle sources of CO in the Corridor are minimal, and cumulative impacts from CO emissions are not indicated.

PM₁₀ (from emissions from vehicles on roadways, re-entrained dust from sanding, plus emissions from wood burning and dust)

Diesel engines are the primary source of particulate matter emissions from transportation, and these emissions are expected to decrease in the future because of national mobile source control programs, including reformulated gasoline and required controls on heavy-duty diesel engines. Control programs have proven effective, and tailpipe particulate matter of 10 microns in diameter or smaller (PM₁₀) emissions from mobile sources are 31 percent lower than in 1970 despite a substantial increase in travel miles (Environmental Protection Agency, 2010). Other sources of PM₁₀ emissions in the Corridor may increase (due to population growth, construction, etc.).

Re-entrained dust impacts are proportional to sanding for winter maintenance. Emission control programs, such as street sweeping, mobile emission control programs, and wood burning controls, are expected to continue to control emissions. Highway maintenance improvements, such as the immediate cleanup of sand following snowmelt and the increased use of deicers in appropriate weather conditions, will reduce emissions. Re-entrained dust and fugitive dust from construction are proportional to the increase in construction related to growth but can be managed by best management practices (see **Section 3.1, Climate and Air Quality**). Fugitive dust from gravel/rock quarries is regulated as a stationary source. Cumulative impacts from re-entrained dust are minimal. Effects of re-entrained dust on visibility are described in the next section.

Visibility (from vehicle emissions, re-entrained dust, wood burning, and dust from construction)

The Colorado Department of Transportation analyzed the visibility impacts of the Action Alternatives comparing future 2035 emissions of motor vehicle pollutants and re-entrained road dust with existing (2000) emissions. Emissions were calculated for particulate matter of 2.5 microns in diameter or smaller (PM_{2.5}), sulfur dioxide (SO₂), and nitrogen oxide (NO_x) (see **Table 3.1-1** and **Section 3.1.5**). The PM_{2.5} emissions include particulates in tailpipe exhaust (carbon and sulfates) as well as brake and tire wear. SO₂ and NO_x are gaseous emissions that contribute to secondary particle formation. Total daily emissions in 2035 of all pollutants contributing to visibility impairment are less in the future due to stricter standards on vehicle emissions, the lower sulfur content of diesel fuel, and other factors. However, dust and micro-particulates from electric generating units, oil and gas development, and other earth disturbance occurring outside of the Corridor may contribute to continuing NO_x emissions that affect visibility.

Nitrogen Deposition

The Colorado Department of Transportation analyzed the potential for nitrogen deposition associated with the Action Alternatives by comparing future emissions of nitrogen with existing (2000) emissions. Emissions of NO_x are 70 to 80 percent lower than 2000 emissions because of stricter standards on vehicle emissions, particularly heavy-duty diesel trucks. According to a recent NO_x emission inventory (Colorado Department of Public Health and Environment, 2007), NO_x emissions are projected to decrease in nearly all categories with especially large decreases (35 to nearly 100 percent) projected for road-related emissions. Future emissions of ammonia (which has nitrogen as one of its components so is a contributor to nitrogen deposition) increase as traffic volumes increase because emission control technology does not reduce ammonia emissions. However, nitrogen emissions from ammonia are only 15 to 20 percent of total motor vehicle nitrogen emissions and are, therefore, offset and not an important contributor to cumulative effects.

Air Toxics

Mobile sources emit higher portions of total air toxics generally in this Corridor because no manufacturing and few stationary sources of air toxics exist in the Corridor. Cumulative impacts are not likely because mobile sources are the primary causes of emissions in the Corridor (that is, other sources do not contribute much), and the Environmental Protection Agency issued regulations to decrease mobile source air toxics (MSATs) by 2020 (see **Section 3.1.5**). As a result of these and other controls, highway emissions nationwide are projected to be reduced by 67 to 76 percent, and highway diesel particulate matter emissions are reduced by 90 percent.

Summary: Traffic volumes and congestion, wood burning from residential development, dust from mine tailings, gravel mining, and road maintenance activities (re-entrained dust) affect air quality in the Corridor. The dry climate throughout the Corridor contributes to windblown dust issues and corresponding particulate matter emissions. However, despite growth in vehicle miles traveled, energy consumption, population, and gross domestic product, emissions of air pollutants have declined steadily since the passage of the Clean Air Act in 1970. For criteria pollutants (See **Section 3.1.1**), the Environmental Protection Agency tracked emissions data show that emissions decreased substantially, from 31 to 79 percent, depending on the type of emissions, between 1980 and 2008 (Environmental Protection Agency, 2010).

Likewise, emissions of MSATs declined by 40 percent between 1990 and 2005, and visibility in scenic areas has improved throughout the country (Environmental Protection Agency, 2010). Technological advances and stricter regulations are credited for cleaner air. The Environmental Protection Agency expects air quality to continue to improve as recent regulations are implemented and states work to meet current and recently revised national air quality standards. Reductions in air emissions of common (criteria) and toxic air pollutants in the Corridor are expected to continue through 2035 despite increased

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traffic and development, continued wood burning, dust from past and present mining operations, and loss of forested areas affected by the mountain pine beetle. After 2035, emissions may change to more closely correlate with vehicle miles traveled.

Global Climate Change Cumulative Effects Discussion

The federal government is addressing important national and global concerns about global climate change in several ways. The transportation sector is the second largest source of total greenhouse gases in the United States, and the greatest source of carbon dioxide (CO₂) emissions—the predominant greenhouse gas. In 2004, the transportation sector was responsible for 31 percent of all United States CO₂ emissions. The principal anthropogenic (human-made) source of carbon emissions is the combustion of fossil fuels, which account for approximately 80 percent of anthropogenic emissions of carbon worldwide. The consumption of petroleum products, such as gasoline, diesel fuel, and aviation fuel, accounts for almost all (98 percent) of transportation-sector emissions. Recognizing this concern, the Federal Highway Administration (FHWA) is working nationally with other modal administrations through the Department of Transportation Center for Climate Change and Environmental Forecasting to develop strategies to reduce transportation's contribution to greenhouse gases (particularly CO₂ emissions) and to assess the risks to transportation systems and services from climate changes.

At the state level, there are also several programs underway in Colorado to address transportation greenhouse gases (see **Section 3.1.1**). The Governor's Climate Action Plan, adopted in November 2007, includes measures to adopt vehicle CO₂ emissions standards and to reduce vehicle travel through transit, flex time, telecommuting, ridesharing, and broadband communications. The Colorado Department of Transportation issued a Policy Directive on Air Quality in May 2009. The Colorado Department of Transportation developed this Policy Directive with input from a number of agencies, including the State of Colorado's Department of Public Health and Environment, the Environmental Protection Agency, FHWA, the Federal Transit Administration, the Denver Regional Transportation District, and the Denver Regional Air Quality Council. This Policy Directive addresses unregulated MSATs and greenhouse gases produced from Colorado's state highways, interstates, and construction activities.

Did you know?

An average car emits one pound of carbon dioxide for every mile it is driven. So for every mile you avoid driving, you reduce the carbon dioxide added to the atmosphere by one pound.

As a part of CDOT's commitment to addressing MSATs and greenhouse gases, CDOT conducts the following program-level activities:

- Developing truck routes/restrictions with the goal of limiting truck traffic in proximity to facilities with sensitive receptor populations, including schools. (Note: This activity is a statewide activity and does not apply to the Corridor.)
- Continuing research about pavement durability opportunities with the goal of reducing the frequency of resurfacing and/or reconstruction projects.
- Developing air quality educational materials for citizens, elected officials, and schools that are specific to transportation issues.
- Offering outreach to communities to integrate land use and transportation decisions to reduce growth in vehicle miles traveled, such as smart growth techniques, buffer zones, transit-oriented development, walkable communities, access management plans, etc.
- Committing to research additional concrete additives that would reduce the demand for cement.
- Expanding Transportation Demand Management efforts statewide to better utilize the existing transportation mobility network.

- Continuing to diversify the CDOT fleet by retrofitting diesel vehicles, specifying the types of vehicles and equipment contractors may use, purchasing low-emission vehicles, such as hybrids, and purchasing cleaner burning fuels through bidding incentives where feasible. Incentivizing is the likely vehicle for this.
- Exploring congestion and/or right-lane only restrictions for motor carriers.
- Funding truck parking electrification (note: mostly via exploring external grant opportunities).
- Researching additional ways to improve freight movement and efficiency statewide.
- Committing to incorporating ultra-low sulfur diesel for non-road equipment statewide—likely using incentives during bidding.
- Developing a low volatile organic compound-emitting tree landscape specifications (basically specifying which trees emit fewer volatile organic compounds).

The Colorado Department of Transportation acknowledges that even though climate change is a global issue and no one strategy as described previously will make a noticeable difference, incremental changes such as the ones described above will result in some effect.

Because climate change is a global issue, and the emissions changes due to Action Alternatives are very small compared to global totals, the greenhouse gas emissions associated with the alternatives were not calculated. Because greenhouse gases are directly related to energy use, the changes in greenhouse gas emissions would be similar to the changes in energy consumption presented in **Section 3.16** of this document. **Table 4-3** shows the relationship of current and projected annual Colorado highway emissions to total global CO₂ emissions. Colorado highway emissions are expected to increase by 4.7 percent between now and 2035. The benefits of the fuel economy and renewable fuels programs in the 2007 Energy Bill are offset by growth in vehicle miles traveled; the draft 2035 Statewide Transportation Plan predicts that Colorado vehicle miles traveled will double between 2000 and 2035. This table also illustrates the size of the Corridor relative to total Colorado travel activity.

Table 4-3. Annual Carbon Dioxide Emissions

Global CO ₂ Emissions, 2005, MMT ¹	Colorado Highway CO ₂ Emissions, 2005, MMT ²	Projected Colorado 2035 Highway CO ₂ Emissions, MMT ²	Colorado Highway Emissions, % of Global Total (2005) ²	Project Corridor VMT (Preferred Alternative), % of Statewide VMT (2005)
27,700	29.9	31.3	0.108	6.06

¹EIA, *International Energy Outlook 2007*.

²Calculated by FHWA Resource Center.

Key to Abbreviations/Acronyms

CO₂ = carbon dioxide MMT = million metric tons VMT = vehicle miles of travel

4.9 What are the cumulative benefits?

Implementation of the Action Alternatives, when combined with other reasonably foreseeable actions, provides cumulative benefits, including increased mobility, regional connectivity, and access to recreational amenities. The extent of these benefits varies by alternative. **Section 3.8, Social and Economic Values** discusses the various economic benefits anticipated from the transportation infrastructure investments. Induced growth in Summit and Eagle counties would provide short-term construction employment, indirect jobs stemming from construction, and longer-term tax revenue increases for the area’s local governments. **Section 3.4, Water Resources** includes measures that would be included along with the Action Alternatives to improve water quality.

4.10 What measures will be taken to address issues related to cumulative impacts?

Chapter 3 and **Section 3.19** include mitigation strategies for direct and indirect impacts to the environmental resources studied in this cumulative chapter in their respective sections. To address cumulative impacts, the following mitigation strategies can be considered by CDOT:

- Coordinate with Clear Creek County communities regarding implementation of a marketing program that would include an approach to marketing for historic tourism to address the possible disparate distribution of benefits and impacts from construction activities.
- Follow the processes outlined in the ALIVE Memorandum of Understanding (see **Section 3.2, Biological Resources**) to increase the ability of wildlife, particularly protected species, to cross the highway and transit infrastructure throughout the Corridor.
- Implement the strategies discussed previously to address MSATs and greenhouse gas emissions.
- Implement the SWEEP Memorandum of Understanding and recommendations of the SWEEP Committee to address stream impairment and benefit aquatic resources.
- Implement the mitigation commitment to reduce the effect of the Corridor visual scars from the original I-70 highway construction.
- Implement aesthetic guidelines prepared as part of the I-70 Mountain Corridor Context Sensitive Solutions program for establishing an aesthetically positive visual experience for all viewers.
- To avoid any negative effects of induced growth, Corridor counties could coordinate regional growth management. The *I-70 Mountain Corridor PEIS Land Use Technical Report* (CDOT, March 2011) summarizes all current county and municipal plans including strategies for balancing the impacts of growth with sustaining environmental quality.

The Community Values Issue Task Force recommends that CDOT adopt a policy approach before Tier 2 processes that promotes and assists communities in the adoption of more comprehensive, regional growth management plans that can be applied to Tier 2 processes. The Colorado Department of Transportation has not committed to the adoption of such an approach but will consider the possibility of doing so before Tier 2 processes. The recommendations for this approach include exploring the possibility of creating grants for communities that lack the resources to develop a growth plan; working with local councils of government and the Colorado Department of Local Affairs to assist with funding; and promoting the consideration of open space as community separators, or view sheds distinguishing communities, including studies led by the United States Forest Service and Bureau of Land Management. While CDOT will consider this type of policy approach, efforts to control growth are greatly dependent on local planning and community political direction.

In addition, certain resources of concern could be approaching saturation or tipping points, as discussed previously, and could require more aggressive monitoring and appropriate mitigation strategies as the project moves toward implementation during Tier 2 processes.

4.11 What conclusions can be made?

The focus of this first tier cumulative assessment is to evaluate the inter-relationships between the transportation network, community values, and environmental resources within the Corridor, and to identify possible cumulative impacts and resource vulnerabilities that may result from project alternatives. A key role of this first tier document is to outline a broad framework for cumulative impact mitigation strategies involving interagency and regional coordination.

The information in this chapter indicates that past and present actions in the Corridor have resulted in loss or modification to the area's environmental resources. Reasonably foreseeable future actions, including projected development and other actions, when combined with direct and indirect impacts (including induced growth) from alternatives, would continue to affect resources.

The phased approach allows ongoing opportunities to avoid and minimize environmental impacts, establish effective mitigation, and employ I-70 Mountain Corridor Context Sensitive Solutions.

The phased approach of the Preferred Alternative provides a unique opportunity for adapting transportation solutions to the environmental sensitivity and community values of the Corridor over time.

4.12 What's next and how will analysis differ from Tier 1 to Tier 2?

The Colorado Department of Transportation will promote and assist communities, as possible, in the adoption of more comprehensive, regional growth management plans that can be applied to Tier 2 processes. Cumulative impacts analyses done during Tier 2 will focus on those environmental resources studied that are of most concern in that particular study area and watershed. Further, Tier 2 processes will include the following activities:

- Updated impacts information based on greater design detail and much more localized resource information.
- Revised study area boundaries, as necessary.
- More detailed studies to assess effects to historic properties.
- Development of interagency cumulative impact mitigation plans through regional coordination in conjunction with the implementation plan for the Preferred Alternative.

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