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4.20 CONSTRUCTION IMPACTS

INTRODUCTION

This section identifies the impacts that would be expected during the construction phase of any selected alternative and the suggested mitigation measures to address them. Specific construction methods will be addressed during development of the final construction plans for the recommended alternative if a build alternative is selected. In general, highway construction includes mobilization, utility relocation and adjustments, demolition and site preparation, earthwork, paving, and structure construction.

Construction sequencing strategies would be required for a project of this size and would take into account minimization of related impacts, as well as other important considerations such as funding and coordination with local communities.

Public concerns expressed through the public involvement process regarding construction impacts include noise, visual, and traffic impacts. These concerns are addressed in **Section 4.20.2**, **Section 4.20.3**, and **Section 4.20.4**.

4.20.1 CONSTRUCTION OVERVIEW

This section identifies the various construction activities that would be required to complete this project as well as the construction scheduling and phasing.

4.20.1.1 CONSTRUCTION ACTIVITIES

All of the proposed build alternatives would include the following construction activities: mobilization, utility relocation, demolition and site preparation, lane construction, and interchange and structure construction.

MOBILIZATION

Mobilization would be the first step to be taken in the construction process. Mobilization consists of transporting all necessary construction equipment to the project site, transporting construction materials to the project site, setting up staging areas, and erecting all equipment including cranes. Cranes are usually erected at either end of a structure using the future roadway, or off to one side of the structure if conditions permit. The location of cranes is critical so that impacts to the surrounding area are minimized. Consideration of buildings, traffic, pedestrians, and the environment must be taken into account to find the optimal location for crane erection and operation.

UTILITY RELOCATION

Utility relocation would begin in the first quarter of the construction phase or sooner. Utility relocation is necessary in all locations where the construction of roadway features interferes with existing utilities.

DEMOLITION AND SITE PREPARATION

One of the first action items for construction would be the removal and demolition of the existing roadways, bridge structures, and miscellaneous structures. There are several ways the demolition could occur. The following is a description of general practices for removing physical features within a corridor.

Pavement Removal

Asphalt and concrete pavement removal can be removed in chunks using front-end loaders with blades, or similar equipment. The rubble is then loaded into large trucks and hauled away for disposal. CDOT specifications do allow for some of the pavement to be disposed of in the lower parts of large fills, thereby reducing travel distance. Public traffic must be rerouted from the area where pavement is being removed in large chunks or whole sections due to the sizeable (4- to 12-inches or more) drop-offs next to the driving lane. It should be required that the removal area be protected with barriers. Traffic cannot be allowed to reuse the removal area until new pavement has been installed.

Another approach to remove asphalt is to use large mobile equipment that removes layers of asphalt through grinding. Grinding removes small layers (2 inches or less) at a time and allows for the traveling public to use the pavement area after grinding operations have stopped. Since there is no adverse drop between the lanes of travel and the grinding area, separation for the traveling public can be done with portable drums. Grinding allows for greater flexibility in traffic control.

Structure Removal

Large structures consisting of concrete and steel, including bridges, retaining walls, and box-culverts, are demolished in several ways. The most common is to use mobile equipment affixed with large plier-type claws that cut through concrete and steel, taking "bites" out of the existing structure. The large pieces of construction debris are then loaded onto trucks to be hauled away. These pieces are either hauled away for burial in offsite landfills or buried on site at least two feet below the surface in project fill embankments.

Structures can also be removed by using explosives to break the structures into manageable pieces. The use of explosives must be planned carefully and requires coordinated clean-up efforts for the removal of all debris. The use of explosives has the potential for air blast, over blast, flying debris, noise, and vibration. For these reasons, their use can be problematic near residences, urban areas, and high traffic areas. The potential for over blast and noise can be mitigated by the use of heavy blankets, but due to the large scale of most bridges, this is not always practical. Other issues with blasting relate to the damage to the roadway and structures below. Soil is frequently used as a blanket to mitigate the impacts, thereby protecting the roadway below from falling debris. Explosives should not be used to remove structures over creeks due to the possibility of debris falling into the creek. A Bridge Demolition Permit should be obtained from the Air Pollution Control Division (APCD) of the Colorado Department of Public Health and Environment (CDPHE).

Steel structures or steel components should be removed in pieces and stored in accordance with CDOT specifications. CDOT's *Standard Specifications for Road and Bridge Construction*, Section 250.04, covers the requirements for dealing with heavy metal-based paints (CDOT, 2005). Painted steel members should be tested for heavy metal paint and, if it is present, would require proper hazardous material handling (see **Section 4.15**). Non-hazardous material should be hauled offsite to an acceptable recycling and/or disposal location. No improper handling, storage, or disposal of hazardous materials is allowed by CDOT.

Smaller structures are generally removed with mobile equipment or handheld jackhammers or other devices to break them apart. This allows for the removal of smaller pieces that can be handled by small equipment or individuals. Jackhammers or other such devices can be a problem in urban areas because of their need to meet the local construction and noise requirements.

LANE CONSTRUCTION

Earthwork and Sub-grade

Earthwork construction would require the use of truck hauling equipment and graders. The use of this equipment in an urban and suburban area can result in added noise and airborne dust impacts. Water and other solutions are used to wet the earth to reduce the amount of airborne particles. In more open areas where the excavation source is close to the fill areas, scrapers can be used to remove, haul, and then fill in the embankment. This allows for continuous operation of equipment that moves dirt more efficiently than a loader and truck operations. Even with the use of scrapers, soils are continually wetted to reduce fugitive dust.

All of the build alternatives have about twice as much fill material requirements as would be produced from local cut-embankment situations; therefore, borrow sites would need to supply the additional material needs. This would result in offsite impacts. These impacts should be addressed during the contractor's permit process as outlined in the CDOT *Standard Specifications for Road and Bridge Construction* (2005), due to CDOT's policy of not identifying borrow sources for contractors.

In deep fill or cut areas where the existing traffic is close to the earthwork site, temporary retaining walls should be used. Shoring temporary excavated areas could be done with metal, wood, or synthetic material supports to assure slope competency.

Paving

Paving is accomplished with track-mounted paving machines. The machines lay down either asphalt or concrete in layers and smooth the pavement surface in continual operations (see **Figure 4.20-1**). Large trucks or mixers are used to haul the concrete or asphalt material from the plant to the site. Since this project is located in the Denver metro area where there are multiple sources for asphalt and concrete a project-specific plant site may not be identified. Paving material haulage can create additional traffic and noise impacts. As with the earthen fill material, the paving materials should come from sources identified by the contractor. These impacts should be addressed during the contractor's permit process as outlined in the CDOT *Standard Specifications for Road and Bridge Construction* (2005).

Figure 4.20-1 Asphalt Paving

INTERCHANGE AND STRUCTURE CONSTRUCTION

Foundations and Substructures

Foundations required for bridges and walls can be of several varieties. This project could require the use of spread footings with or without pilings. Pilings can be hammered into the ground or predrilled to avoid the potential for noise, vibration, or bending of the piles. Caissons may also be used in some foundations for walls or bridges. Caissons are generally used for deep foundations and require no hammering but can require dewatering in case of ground water infiltration. Produced water is either used for dust suppression or sent to a detention pond for sediment removal prior to discharge to local drainages. A Construction Dewatering Permit should be obtained from the Water Quality Control Division (WQCD) of CDPHE.

Walls

Various types of retaining walls would be used on this project. Retaining walls can be of poured concrete with spread footers. Depending on the subgrade strength, pilings may also be required to steady the spread foundation. Retaining walls can also be mechanically stabilized earth (MSE) walls. These walls consist of stacked blocks or concrete panels that are tied back into the slopes with tieback rods or geo grids. These walls require a smaller footprint impact outside the roadway. If the wall is needed to support a slope next to the roadway, slope tieback systems can require additional right-of-way for their construction (see **Figure 4.20-2**).

Superstructures

The appearance of bridges can vary greatly. The design of the structures has not been considered at this phase of the project, but would be decided in later design phases. However, it is likely that piers would be concrete with the type and style to be matched to existing architectural features within the corridor to the extent possible. Bridge types would dictate the methods of construction. Bridges similar in size to those in this corridor would tend to be cast-in-place or pre-cast/steel girder systems. Cast-in-place bridges require shoring and bracing to hold up the formwork needed to pour the concrete into the girder and deck system. This requires adequate clearance below as the shoring and bracing reduce the finished or design vertical clearance. This can also be problematic where disturbance to the ground below is not desired. Pre-cast or steel girder systems can be erected with cranes and have less impact on the ground below because no shoring or formwork is needed for temporary structures. Areas close to the job site are needed to erect the cranes (see **Figure 4.20-3**).

Figure 4.20-2 Structure Construction - Retaining Walls

Figure 4.20-3 Structure Construction – Superstructure-Bridge

Traffic Signals

The biggest impact from the construction of traffic signals is the drilling of the caissons to support the large poles and mast arms. Caisson drilling can require utility adjustments and dewatering. Dewatering can cause water quality issues if improperly conducted. CDOT's *Standard Specifications for Road and Bridge Construction*, Section 107.25 (2005), sets forth the requirements for the proper dewatering of caisson holes. A Construction Dewatering Permit should be obtained from CDPHE-WQCD.

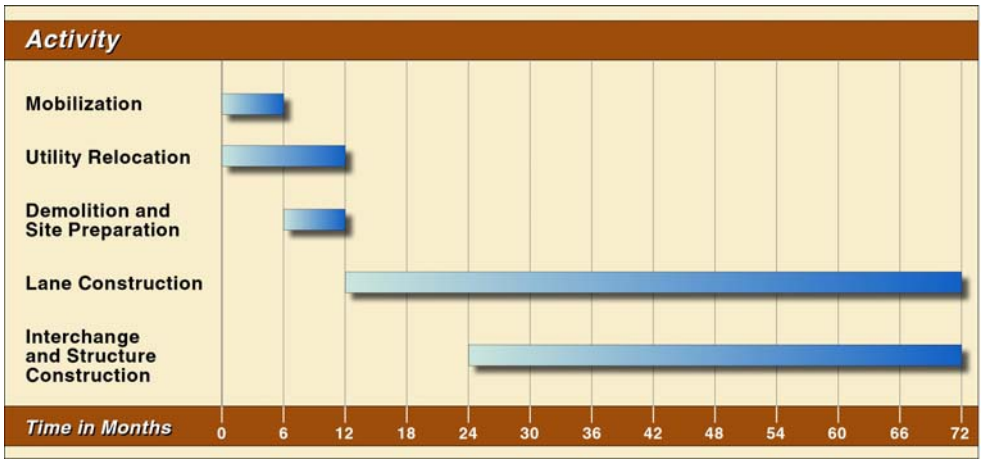
4.20.1.2 Construction Scheduling and Phasing

The approximate construction schedule for the project under ideal conditions and the possibility of project phasing are described in this section.

Approximate Best-Case Construction Schedule

For all of the build alternatives, the construction schedule is expected to be similar and has been estimated to be 60 to 72 months in a best-case scenario. The schedule takes into account various construction activities grouped into the categories of: mobilization, utility relocation, demolition and site preparation, lane construction, and interchange and structure construction. The time required to complete activities for each of these categories as well as the relative timing of the activities during the course of the project has been estimated (see **Figure 4.20-4**).

Figure 4.20-4 Approximate Best-Case Construction Schedule for All Build Alternatives



Source: FHU, 2006.

CONSTRUCTION PHASING

If full funding is not available at the time of construction for the project, portions of the project will need to be constructed in phases based on priority. For all of the build alternatives, there is the possibility that the construction would need to be divided into three phases. These phases would include the northern portion of the project, the central portion of the project, and the southern portion of the project. The northern portion consists primarily of commercial development in the Interlocken area. This area includes various office buildings, Flatiron Crossing shopping mall, and other commercial outlets surrounding the mall. The central portion of the project is mainly undeveloped land with some industrial and commercial development. The southern portion of the project consists of primarily residential development in the Golden area. This area also has some commercial outlets. For the Combined Alternative (Reocommended Alternative), an additional principal arterial along Indiana Street and McIntyre Street must also be constructed. It is important that this alignment not be built during the same phase as the alignment through the Golden area because both of these routes are major north-south arterials and cannot be impacted simultaneously without causing major local congestion.

4.20.2 AFFECTED ENVIRONMENT

The study area consists of many different land uses. Construction will impact these different areas in vastly different ways and magnitudes. The northern portion of the study area is a commercial area consisting of a shopping mall and several office buildings and retail outlets. The central portion of the study area primarily consists of undeveloped land with very few residential, commercial, and industrial developments. The southern portion of the study area is primarily residential development through the City of Golden. Golden also contains some commercial developments along the alignments. The Combined Alternative (Recommended Alternative) contains an additional principal arterial along Indiana and McIntyre Streets. Development in this area is a mixture of both residential and commercial.

4.20.3 ENVIRONMENTAL CONSEQUENCES

Construction activities associated with the No Action Alternative and each of the build alternatives would have temporary impacts on the study area. The build alternatives would have impacts that are common to all of them and would also have impacts that are specific to each of them.

4.20.3.1 No Action Alternative

The No Action Alternative would involve no additional construction over what is currently programmed, approved, and funded to support the growing population of the area. Therefore, the No Action Alternative would result in no construction or utility impacts aside from those associated with the programmed projects (see **Chapter 2**).

4.20.3.2 Temporary Impacts Common To All Build Alternatives

Construction of any build alternative would create various temporary impacts within the study area. Some of these impacts would be common to all of the build alternatives.

Land Use

Construction of any of the build alternatives would temporarily affect the different land uses within the study area throughout the duration of the project. These impacts would mostly be limited to areas that are in close proximity to large-scale construction activities, generally not greater than 300 feet outside of the work areas.

Economic Conditions

By implementing any of the build alternatives, the economic benefit of additional employment within the study area due to construction would be evident. This additional employment includes both the jobs created that are directly related to the project and the jobs created that are indirectly related to the project. The jobs created that are directly related to the project would include all of the jobs that pertain to the actual construction activities of the project. The jobs created that are indirectly related to the project would include positions that would help support the construction efforts by supplying goods and services to the construction workers on the project as well as the project itself. Restricted access to businesses located adjacent to the alignments during construction could have the potential of negatively impacting the performance of some of the businesses.

Right-of-Way

Some additional land would be required in areas adjacent to the alignments for construction staging purposes. These staging areas would be used to store equipment and materials and would also be used to provide parking for construction workers. These necessary parcels should be purchased or leased prior to the start of construction.

Air Quality

Without mitigation, excavation, grading, and fill activities could increase local fugitive dust emissions. Fugitive dust is airborne particulate matter, generally of a relatively large size (greater than 100 microns in diameter). Because of their large size, these soil particles typically settle within 30 feet of their source. Smaller particles could travel as much as several hundred feet, depending on winds. Mitchell Elementary School is located approximately 190 feet from the proposed alignments and Golden Pond retirement/assisted living community is located approximately 1,200 feet from the proposed alignments. These facilities have the potential to experience impacts to air quality. Through the use of suggested mitigation measures described later in this section, fugitive dust emissions would be controlled by the use of dust suppressants and BMPs.

Noise and Vibration

Construction noise would present the potential for short-term impacts to those receptors located along the corridor and along the designated construction access routes. The primary source of construction noise is expected to be diesel-powered equipment, such as trucks and earth-moving machinery.

The municipal code of the City of Golden related to noise does not apply to sound emitted from construction equipment operated between the hours of 7:00 a.m. and 10:00 p.m. as long as the noise does not exceed 88 dbA at 25 feet. The City of Arvada exempts construction activities for public roads and streets in their jurisdiction, and the City of Broomfield has a code similar to that of Golden. The full codes are available from the municipalities (Arvada, 2005; Broomfield, 2005; and Golden, 2005).

Demolition and pile driving could be the loudest construction operations. Demolition of structures, such as existing bridges, is generally conducted at night because of safety issues requiring full or partial closure of the highway and local streets. Piles could be required at most major bridge installations and could have both noise and vibration impacts. Alternative construction methods such as the use of caissons or pre-drilling for piling could replace pile driving in noise sensitive locations. The majority of noise receptors are located greater than 50 feet from areas where pile driving or other high-noise activities are expected. Major noise impacts are expected to occur only in discontinuous areas along the study area (see **Section 4.7**). These impacts would occur primarily in the southern portion of the study area.

Vibration caused by construction activities would present the potential for short-term impacts in areas where pile driving and compaction equipment are being used. The potential for building damage from pile driving vibration is estimated to exist only within about 50 feet of the activity. Vibration from compaction equipment is less severe because it does not propagate through the lower soil layers like pile driving does. Construction activities in close proximity to buildings (i.e., within 50 feet) should be sensitive to vibration damage potential. Concern about vibration near historic buildings is usually greater due to the lack of sufficient building codes in the past. Extra care would be necessary when in close proximity to buildings. Details would be developed during subsequent design efforts.

Mitchell Elementary School is located approximately 190 feet from any of the build alternatives and Golden Pond retirement/assisted living community is located approximately 1,200 feet from any of the build alternatives. These facilities both have the potential to experience both noise and vibration impacts with Mitchell Elementary School having greater potential impacts because of its shorter distance from the alignments. Due to the use of these facilities and the residents who utilize them, specific mitigation measures should be implemented to reduce the impacts.

WATER RESOURCES

During construction, stormwater runoff could present the potential for violations of water quality standards if discharge occurs without the application of BMPs. Without mitigation measures, stormwater runoff could cause erosion and sedimentation, and transport spilled fuels or other hazardous materials off the construction site. The project crosses several drainage basins in its 20+ miles. Groundwater could be encountered during relocation of deep utilities, excavation, and construction of tunnels and below-grade roadways. Dewatering and treatment could be required where groundwater is present. Suggested mitigation measures for contaminated groundwater potentially encountered during construction are discussed (see **Section 4.15**). Section 107.25 of CDOT's *Standard Specifications for Road and Bridge Construction* (2005) deals with the contractor's requirements for water quality control.

WETLANDS

Temporary impacts to wetlands could occur in instances where structural elements are specified within the drainages of: Goodhue Ditch, Rock Creek, Walnut Creek, Woman Creek, Tucker Ditch, South Boulder Diversion Canal, streambanks adjacent to Ralston and Van Bibber creeks, Tucker Gulch, Church Ditch, Welch Ditch, streambanks adjacent to Clear Creek, Chimney Gulch, an unnamed tributary to Clear Creek, and Kinney Run. These impacts would primarily be from the access of construction equipment in the wetland area. Wetlands should be restored to the extent possible after the equipment is removed (see **Section 4.9**).

BIOLOGICAL RESOURCES

Wildlife habitats adjacent to the alignments would be impacted during construction. Some wildlife would be driven away during construction activities due to the increased noise and activity. These impacts would be primarily in the central portion of the study area in the undeveloped areas, especially around Great Western Reservoir.

VISUAL AND AESTHETIC RESOURCES

Short-term construction-related visual impacts would likely occur as a result of this project. These impacts include the presence of construction equipment and material storage, temporary barriers, guardrail, detour pavement and signs, temporary shoring and retaining walls, lighting for night construction, and removal of

existing vegetative cover in the construction zone. Mitchell Elementary School and Golden Pond retirement/assisted living community are located near the proposed alignments and have the potential to experience temporary impacts to visual and aesthetic resources.

HAZARDOUS MATERIALS

Hazardous materials could be encountered during construction in several ways. The movement of earth, particularly excavation, can uncover sites with hazardous chemicals or petroleum products. Former or current gas stations can frequently contain petroleum contamination that could be encountered during construction. Along Indiana Street, east of the Rocky Flats National Wildlife Refuge, hazardous materials could include radionuclides found in the surrounding soil. Section 107.25 and Section 250 of CDOT's *Standard Specifications for Road and Bridge Construction* (2005) deal with material management methods and what to do if these materials are encountered (see **Section 4.15**). Along Indiana Street, effort would be made to reduce the amount of cut and excavation to avoid the disturbance of known radionuclides. Caisson drilling and foundation work can also result in the encounter of hazardous material in the ground water and matter that is removed from the resulting hole.

UTILITIES

Some utilities would need to be relocated in order to construct any of the build alternatives. The process of relocating these utilities could cause temporary disruptions in service to local residents in the study area. Every effort should be made to assure continued utility service throughout the project.

PARKS AND RECREATION

Parks located adjacent to the alignments would experience temporary impacts during construction. These impacts include: construction noise, dust, visual degradation, and increased traffic congestion.

FARMLANDS

Farmlands adjacent to the alignments would only be impacted if construction activities are required to extend beyond the right-of-way or if access must be modified. The impacted farmlands areas are located mainly in the central portion of the study area where the land is undeveloped or primarily rural.

ENERGY

Construction of any of the build alternatives would require consumption of energy in order to manufacture and install materials, and to operate heavy construction equipment and support vehicles. The total energy cost is dependent on the total construction cost of the project and could range from 1,659,951 million BTUs to 1,909,898 million BTUs (see **Section 4.21**).

TRAFFIC

Construction detours could create short-term impacts on local traffic circulation and congestion. In the more populated areas of Golden and Broomfield, these impacts would be substantial. Delays to the traveling public and inconvenience to corridor residents could occur. A primary goal during construction of the project would be to minimize inconvenience to the public through construction traffic planning during final design and monitoring and adjusting throughout the construction phase. Mitchell Elementary School is located approximately 190 feet from the proposed alignments. The location of Rubey Drive, which is an access to Mitchell Elementary School, could experience traffic impacts due to its location in relation to construction activities.

4.20.3.3 FREEWAY ALTERNATIVE

NORTHERN PORTION

Construction of the pass-through structures adjacent to Interlocken Loop in the northern portion of the Freeway Alternative is a unique situation that requires special consideration. These large, viaduct type structures on each side of Interlocken Loop would require shoring and bracing above existing vehicle and pedestrian traffic. Special protection measures would be required for the safety of pedestrians. Screening or fencing would be used to protect the traveling public below or adjacent to the structures. Access to some businesses in the area may be temporarily impacted during construction of these structures. Other temporary impacts in this area would include visual, noise and vibration, and air impacts.

CENTRAL PORTION

Construction through the open areas from SH 128 south to Golden Gate Canyon Road would be mostly separated from existing traffic and would be better able to accommodate existing movements and provide a safe construction environment.

SOUTHERN PORTION

The area with the greatest potential construction impacts for the Freeway Alternative is located between Golden Gate Canyon Road and C-470 in the southern portion. The new freeway facility would be constructed on and adjacent to the existing alignment of US 6 and SH 93. A 25 to 30 foot change in the roadway grade is anticipated in this area. Maintaining current traffic while raising or lowering the grade to this extent would result in particularly difficult conditions for construction. Temporary walls would be required to hold back fills or cuts from encroaching on the existing roadway or new construction. Much of this section would require installation of concrete roadway barrier to protect the traveling public from this large vertical differential and to also protect the construction workers next to public traffic. The edge of pavement for this alternative would be approximately 190 feet from Mitchell Elementary School when in its final configuration. It is possible that during construction, equipment and materials may be located slightly closer to the school in order to construct roadway features in the area. Visual, noise and vibration, air, and traffic congestion impacts would arise temporarily from construction in this area. Golden Pond retirement/assisted living community would be located approximately 1,200 feet from the edge of pavement for this alternative. At this distance, temporary impacts from construction should be minimal.

The footprint for detours, connections, and construction would not extend beyond the footprint for the Freeway Alternative; therefore, no additional impacts beyond those noted in this study are anticipated.

4.20.3.4 TOLLWAY ALTERNATIVE

Construction of the pass-through structures adjacent to Interlocken Loop in the northern portion of the Tollway Alternative is a unique situation that requires special consideration. These large, viaduct type structures on each side of Interlocken Loop would require shoring and bracing above existing vehicle and pedestrian traffic. Special protection measures would be required for the safety of pedestrians. Screening or fencing would be used to protect the traveling public below or adjacent to the structures. Access to some businesses in the area may be temporarily impacted during construction of these structures. Other temporary impacts in this area would include visual, noise and vibration, and air impacts.

CENTRAL PORTION

Construction through the open areas from SH 128 south to Golden Gate Canyon Road would be mostly separated from existing traffic and would be better able to accommodate existing movements and provide a safe construction environment.

SOUTHERN PORTION

The area with the greatest potential construction impacts for the Tollway Alternative is located between Golden Gate Canyon Road and C-470 in the southern portion. In this area, the tollway lanes would be located adjacent to existing US 6 and SH 93. Due to the construction of the new toll lanes, a portion of US 6

and SH 93 would be rebuilt at its current grade for non-toll traffic. A temporary detour could be constructed where the ultimate tollway lanes would be located in order to allow for the construction of the new non-tolled lanes of US 6 and SH 93. Once construction of the non-tolled lanes in the center of the tollway is complete, the tollway lanes could be constructed outside of US 6 and SH 93. The phasing of construction in this section would require coordination to maintain traffic, provide adequate separation for safety, and maintain access to and from the existing roadway network. At the cross streets of Heritage Road, 19th Street, US 6/SH 58, Iowa Street, and Washington Avenue, separation in grades between the toll lanes and non-toll lanes would result in particularly difficult conditions for construction. The edge of pavement for this alternative would be approximately 190 feet from Mitchell Elementary School when in its final configuration. It is possible that during construction, equipment and materials may be located slightly closer to the school in order to construct roadway features in the area. Visual, noise and vibration, air, and traffic congestion impacts would arise temporarily from construction in this area. Golden Pond retirement/assisted living community would be located approximately 1,200 feet from the edge of pavement for this alternative. At this distance, temporary impacts from construction should be minimal.

The footprint for detours, connections, and construction would not extend beyond the footprint for the Tollway Alternative; therefore, no additional impacts beyond those noted in this study are anticipated.

4.20.3.5 Regional Arterial Alternative

Northern Portion

Construction in the northern portion of the Regional Arterial Alternative consists of widening the existing Interlocken Loop arterial roadway. Access to some businesses in the area may be temporarily impacted during the widening of Interlocken Loop.

Central Portion

From SH 128 to Golden Gate Canyon Road, construction would be completed along the existing roadway alignments of SH 128, Indiana Street, SH 72, and SH 93. Construction along these existing roadways would require careful planning and consideration with regard to existing traffic, access to local properties, and the safety of the construction crews that would be working close to existing traffic. Access to some residences and businesses in the area may be temporarily impacted during construction of this roadway section.

Southern Portion

The area with the greatest potential construction impacts for the Regional Arterial Alternative is located between Golden Gate Canyon Road and C-470 in the southern portion. Here the new roadway is similar to that of the Freeway Alternative and would be constructed on and adjacent to the existing alignment of US 6 and SH 93. A 25 to 30 foot change in the roadway grade is anticipated in this area. Maintaining current traffic while raising or lowering the grade to this extent would result in particularly difficult conditions for construction. Temporary walls would be required to hold back fills or cuts from encroaching on the existing roadway or new construction. Much of this section would require installation of concrete roadway barrier to protect the traveling public from this large vertical differential and to also protect the construction workers next to public traffic. The edge of pavement for this alternative would be approximately 190 feet from Mitchell Elementary School when in its final configuration. It is possible that during construction, equipment and materials may be located slightly closer to the school in order to construct roadway features in the area. Visual, noise and vibration, air, and traffic congestion impacts would arise temporarily from construction in this area. Golden Pond retirement/assisted living community would be located approximately 1,200 feet from the edge of pavement for this alternative. At this distance, temporary impacts from construction should be minimal.

The footprint for detours, connections, and construction would not extend beyond the footprint for the Regional Arterial Alternative; therefore, no additional impacts beyond those noted in this study are anticipated.

4.20.3.6 COMBINED ALTERNATIVE (RECOMMENDED ALTERNATIVE)

Construction in the northern portion of the Combined Alternative (Recommended Alternative) consists of widening the existing Interlocken Loop arterial roadway. Access to some businesses in the area may be temporarily impacted during the widening of Interlocken Loop.

CENTRAL PORTION

Construction through the open areas from SH 128 south to Golden Gate Canyon Road would be mostly separated from existing traffic and would be better able to accommodate existing movements and provide a safe construction environment.

SOUTHERN PORTION

The area with the greatest potential construction impacts for the Combined Alternative (Recommended Alternative) is located between Golden Gate Canyon Road and C-470 in the southern portion. Here the new roadway is identical to that of the Regional Arterial Alternative and would be constructed on and adjacent to the existing alignment of US 6 and SH 93. A 25 to 30 foot change in the roadway grade is anticipated in this area. Maintaining current traffic while raising or lowering the grade to this extent would result in particularly difficult conditions for construction. Temporary walls would be required to hold back fills or cuts from encroaching on the existing roadway or new construction. Much of this section would require installation of concrete roadway barrier to protect the traveling public from this large vertical differential and to also protect the construction workers next to public traffic. The edge of pavement for this alternative would be approximately 190 feet from Mitchell Elementary School when in its final configuration. It is possible that during construction, equipment and materials may be located slightly closer to the school in order to construct roadway features in the area. Visual, noise and vibration, air, and traffic congestion impacts would arise temporarily from construction in this area. Golden Pond retirement/assisted living community would be located approximately 1,200 feet from the edge of pavement for this alternative. At this distance, temporary impacts from construction should be minimal.

INDIANA STREET/MCINTYRE STREET PORTION

The construction impacts for the principal arterial portion of the Combined Alternative (Recommended Alternative) along Indiana Street and McIntyre Street would require constructing one half of the roadway (southbound or northbound lanes) at a time to avoid conflicts with existing traffic. Existing lanes would be separated from construction areas by drums or barricades to protect the traveling public and the construction workers. Access to some neighborhoods and businesses may be temporarily impacted during certain construction phases in this area. Since this portion of the Combined Alternative (Recommended Alternative) is similar in vertical grade to the existing roadway, the difficulty of maintaining traffic is lessened and would only require two basic phases.

The footprint for detours, connections, and construction would not extend beyond the footprint for the Combined Alternative (Recommended Alternative); therefore, no additional impacts beyond those noted in this study are anticipated.

4.20.4 SUGGESTED MITIGATION

Every effort should be made to use recycled materials for project activities to the extent allowed by good practice and applicable construction specifications. In addition, construction equipment that uses ultra-low sulfur fuels should be used. Retrofitting of existing equipment to use these fuels may be necessary. Depending on the timing of construction for this project, some or all of the construction equipment used would be capable of using ultra-low sulfur fuels.

CDOT's *Standard Specifications for Road and Bridge Construction* (2005) and CDOT's *Construction Manual* (2002) outline basic mitigation measures that contractors are required to take on any construction project (see **Table 4.20-1**). Appropriate application of these mitigation strategies would be defined during the final engineering phase of this project. Additional mitigation measures may be developed during final design, as appropriate.

Table 4.20-1 Summary of Suggested Construction-Related Mitigation Strategies

Impact	Most Likely Impacted	Recommended Mitigation Strategies
Noise	Local residents and businesses	Methods include use of temporary noise walls/screens, noise blankets on equipment, and quiet-generators. Scheduling construction during less noise-sensitive times and combining noisy operations to occur in the same time period may also be beneficial.
Vibration	Historic Structures	Perform vibration studies for sensitive structures within 50 feet of the roadway or construction activities.
Access	Local residents and businesses, traveling public	Use enhanced signing and alternate access, and do not close multiple interchanges concurrently.
Traffic Detours Lane closures, Congestion, Construction vehicles on local streets, Safety of lane shifts	Local residents and businesses, traveling public	Limit detours and construction traffic, utilizing major arterials where possible. Schedule construction during periods of least traffic. Use intelligent management systems and variable message signs to advise/redirect traffic. Enforce speed restrictions and provide adequate space for enforcement. Use a Courtesy Patrol and enhanced signing. Work with Regional Transportation District to offer enhanced operations during peak construction. Develop traffic management plans to maintain access to local businesses/residences and coordinate with emergency service providers to minimize delay and ensure access to properties.
Modified Pedestrian/Bike Mobility	Local residents, commuters, bicyclists	Provide well defined detours with adequate signing, fencing, and lighting for pedestrians/bicyclists. Comply with American Disability Act requirements. Construct new bike/pedestrian overpass as a detour before old one is demolished.
Radionuclides	Construction workers, downstream water users, local residents and businesses	Same measures noted under Environmental Impacts below. Minimize amount of excavation.

Impact	Most Likely Impacted	Recommended Mitigation Strategies
Environmental Impacts Dust/Air quality, hazardous waste, water quality, resource use/recycling material	Construction workers, downstream water users, local residents and businesses	Use wetting/chemical inhibitors for dust control. Provide early investigation of subsurface conditions and prepare a well-defined materials handling plan. Require prompt and safe disposal of waste products. Prepare a well-defined stormwater management plan and implement water quality best management practices early in project. Minimize off-site tracking of mud and debris by washing construction equipment in contained areas and via temporary access stabilization. Control and prevent concrete washout and construction wastewater. Recycle materials and use recycled materials as possible.

Source: Colorado Department of Transportation, Construction Manual, 2002; Colorado Department of Transportation, Standard Specifications for Road and Bridge Construction, 2005.

4.20.5 SUMMARY

Construction of the build alternatives would cause varying temporary impacts to traffic patterns and congestion, noise and vibration, air quality, and visual presence. These impacts would be short-term and isolated in extent as to the types and location of construction. Through the planning and implementation of mitigation measures during final design of the recommended alternative, these impacts would be minimized.

Each of the build alternatives would have some temporary negative impacts to the environment. The Freeway Alternative and Tollway Alternative would have a similar magnitude of construction impacts that would be greatest overall compared to the other build alternatives. The Tollway Alternative would have the greatest impact through Golden relative to the other build alternatives because of its greater overall footprint width. In this area, the tolled lanes would be constructed adjacent to the existing lanes of US 6 and SH 93 and would require the construction of supplementary walls and structures. To the north of Golden, the Tollway Alternative would not interfere with the alignment of SH 93. The Freeway Alternative would also have impacts through Golden, but not as great as the Tollway Alternative due to a smaller footprint. To the north of Golden, the Freeway Alternative would be constructed in place of SH 93 and would require SH 93 to be realigned and used as a frontage road. Both alternatives would have similar impacts through the Interlocken area with the construction of elevated pass-through structures on each side of Interlocken Loop.

The Regional Arterial Alternative would have the least construction impacts relative to the other build alternatives. This is because the majority of the construction can be completed at the same grade along the existing alignments of Interlocken Loop, SH 128, Indiana Street, SH 72, SH 93, and US 6. This alternative also contains fewer structures and could be phased with much less difficulty.

The Combined Alternative (Recommended Alternative) would have fewer construction impacts than the Freeway Alternative and Tollway Alternative and greater construction impacts than the Regional Arterial Alternative. The Combined Alternative (Recommended Alternative) would have fewer construction impacts than the Freeway Alternative and Tollway Alternative in both Golden and Interlocken because of the implementation of a major regional arterial classification in these areas. The Combined Alternative (Recommended Alternative) would have greater construction impacts than the Regional Arterial Alternative because it includes more structures and has an additional alignment along Indiana Street and McIntyre Street. The additional roadway length along Indiana Street and McIntyre Street is in close proximity to both residential and commercial properties causing local traffic in this area to be impacted. These impacts are in addition to impacts in both the Golden area and the Interlocken area.

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