April 28, 2014

A Sustainable Transportation Investment Generating Economic Recovery Project

# C-470 Tolled Express Lanes Project

**Applicant - Colorado Department of Transportation**
in partnership with:

**C-470 Coalition**

Arapahoe County
Douglas County
Jefferson County
City of Centennial
City of Lakewood
City of Littleton
City of Lone Tree
Highlands Ranch Metropolitan District

**PROJECT TITLE:**

C-470 TOLLED EXPRESS LANES PROJECT

**LOCATION:**

DENVER METROPOLITAN AREA, COLORADO;
THROUGH PARTS OF ARAPAHOE, DOUGLAS, AND JEFFERSON COUNTIES

**APPLICATION TYPE:**

CAPITAL—Urban Highway

**APPLICANT TYPE:**

STATE GOVERNMENT:
COLORADO DEPARTMENT OF TRANSPORTATION

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Colorado Department of Transportation
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DUNS/CCR NUMBER: 960738771

**AMOUNT OF TIGER FUNDS REQUEST:**

$15 MILLION

COLORADO
Department of Transportation
Office of the Executive Director
4201 East Arkansas Ave, Suite 262
Denver, CO 80222

April 24, 2013

The Honorable Anthony Foxx
Secretary
Office of the Secretary
U.S. Department of Transportation
1200 New Jersey Avenue, SE
Washington, D.C. 20590

Dear Secretary Foxx,

The Colorado Department of Transportation, in partnership with the counties, cities, towns and other members of the C-470 Corridor Coalition, respectfully submits the C-470 Tolled Express Lanes Project for TIGER Discretionary Grant funding consideration. A $15 million TIGER grant will complete the $230 million funding package for this critical project. This 12-mile project will result in numerous benefits to the Denver metropolitan area:

**State of Good Repair**: The project will rehabilitate and improve existing 30 year old pavement reducing the need for overlays as temporary fixes to a long-term pavement problem.

**Economic Competitiveness**: The C-470 is critical for regional mobility and connects people to major employment centers and economic opportunities. Employment within one mile of C-470 is projected to increase by 56,500 jobs between 2010 and 2035. Without adequate mobility in the corridor, the Denver region may lose this opportunity for job growth.

**Quality of Life**: Over 100,000 motorists use the busiest portion of C-470 daily, and this will increase more than 40% by 2035. A commuter traveling on C-470 during peak times could experience nearly 70 minutes of delay each day. The new express lanes will offer a reliable trip choice and congestion relief on this key metro commuter corridor.

**Environmental Sustainability**: An Environmental Assessment approved by FHWA found minimal impacts, with none to threatened or endangered species or Section 4(f) resources.

**Safety**: A 33% reduction of accidents is expected as a result of the improvements, equating to a $47.4 million net present value to the region. It will also improve safety through the addition of managed lane direct connections between I-25 and C-470 while providing a reliable trip choice around an area heavily congested due to closely spaced interchanges.

**Innovation**: Involves innovative financing with user fees projected to support $103 million in toll revenue bonds and will be delivered with design-build contracting.

**Partnership**: The C-470 Coalition of local governments has committed over $30 million to this project. The project traverses three counties and several municipalities.

**Project Readiness**: The $100 million in "RAMP" funds were allocated to C-470 by the Colorado Transportation Commission on the condition that they are spent by the end of 2017, sooner than TIGER requires.

**Cost/Benefit**: A positive ratio of project benefits for the Denver region's economy.

If you have any questions about this application, please contact Herman Stockinger, Director of Policy & Government Relations, at (303) 757-9077.

Sincerely,

Donald E. Hunt
Executive Director

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# EXECUTIVE SUMMARY

The Colorado Department of Transportation (CDOT), in collaboration with the counties, cities and towns in the southwestern quadrant of the Denver metropolitan area, is requesting $15 million in USDOT TIGER grant funds to complete the $230 million funding package for the C-470 Tolled Express Lanes project.

Severe traffic congestion and unreliable travel times have made the four-lane C-470 freeway unusable as a transit route. RTD buses now use nearby arterial streets instead.

## PROJECT OVERVIEW

C-470 is 26-mile four-lane freeway in the southwestern portion of the Denver metropolitan area through Arapahoe, Douglas and Jefferson Counties, connecting Interstate 70 (I-70) on the west to Interstate 25 (I-25) on the south. C-470 connects to private toll highway E-470 which continues eastward and then northward to Denver International Airport, thence westward to the northwestern quadrant of the metropolitan area.

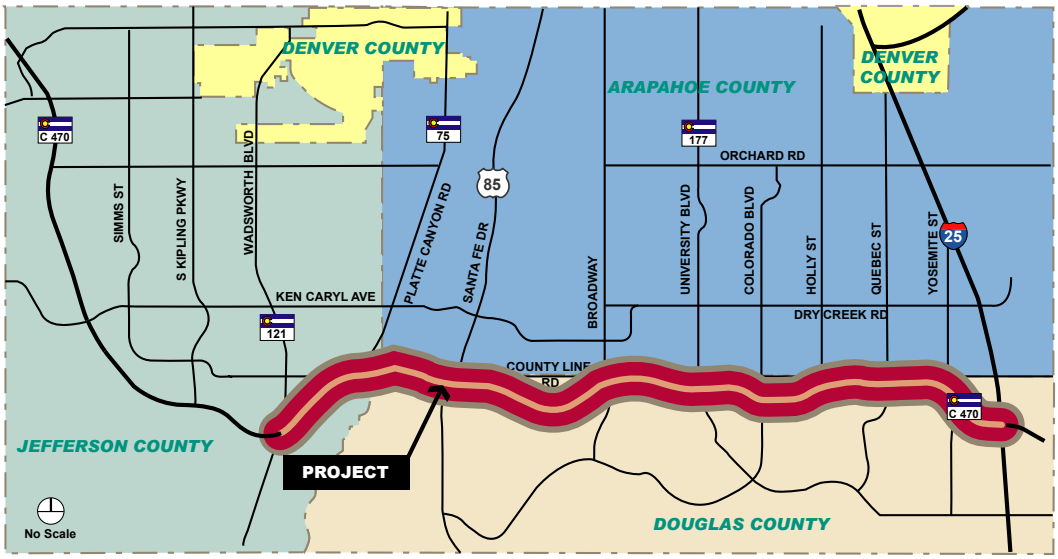
In 2004, C-470 was congested, carrying 80,000 vehicles per day. Today it is even more congested, carrying over 100,000 vehicles daily. For well over a decade the four-lane C-470 freeway has operated at failing levels of service. The highway's degraded travel time reliability led the Regional Transportation District (RTD) to take drastic action and cease bus service operations along the corridor. By 2035, traffic is projected to increase by another 40%, and a commuter traveling during peak times could experience nearly 70 minutes of delay each day on C-470.

This very important project will provide much-needed congestion relief, a reliable travel choice, critical safety improvements and address aging infrastructure. The C-470 Tolled Express Lanes project will:

- Add one Tolled Express Lane eastbound from Platte Canyon Road to I-25 (12 miles)
- Add two Tolled Express Lanes westbound from I-25 to Colorado Boulevard (3.8 miles) and one lane continuing to Wadsworth Boulevard (8.2 miles)
- Add auxiliary lanes in select locations
- Add new direct-connect ramps at the I-25/C-470 Interchange to enable motorists to access the Tolled Express Lanes without having to merge across several lanes of congested traffic
- Replace two bridges built in 1968 across the South Platte River with new bridges that accommodate the toll lanes while also improving substandard design of a major regional greenway trail that crosses beneath them
- Widen 16 other structures to reduce throw away and remain budget conscious
- Correct roadway geometry to address safety concerns
- Reconstruct approximately 7 miles of pavement due to poor substructure
- Capitalize on previous investments in the C-470 multi-use trail by providing grade separations at two interchanges where the trail crosses arterial streets at grade

- Provide noise barriers where reasonable and feasible for residential areas that are already impacted by noise from existing freeway traffic volumes
- Install Intelligent Transportation Systems (ITS) technology to monitor and enhance traffic flow

C-470 traverses three counties and various cities and towns in the southwestern quadrant of the Denver metropolitan area. Local governments along the corridor now unanimously support the Tolled Express Lanes project.




The existing four lanes of C-470 are free, general-purpose lanes and will remain so.

## PROJECT BACKGROUND

Nearly a decade ago, CDOT identified the need for improvements on the C-470 corridor. Even then, peak hour operations ranged from a Level of Service C to F. In just another 10 years, it is estimated that all of C-470 will operate at Level of Service F during peak hour. To address the congestion problem, CDOT and the Federal Highway Administration in 2006 approved the C 470 Environmental Assessment which identified tolled express lanes as its preferred alternative. This alternative was selected not only for the congestion relief and travel reliability managed lanes provide but also because traditional Federal and State funding sources were not available to fund a project of this magnitude.

Local governments, however, strongly objected to the 2006 preferred alternative due to the controversial proposal to charge tolls on the new lanes. The heated controversy left C-470 in political and operational gridlock for many years. After watching the success of the region's US 36 corridor project which received a TIGER I grant in 2009, the C-470 jurisdictions recognized the need to form a coalition and reach consensus on an acceptable project funding mechanism. In February 2013, the previously opposed jurisdictions gave their **unanimous support** "to advance adding tolled express lanes" on C-470.

## KEY PROJECT BENEFITS

C-470 is critical for regional mobility and connects people to major employment centers and economic opportunities. The C-470 Tolled Express Lane project enables people to grab a rung on a ladder of opportunity by providing a reliable and congestion-free transportation option. This project also provides the opportunity to reintroduce bus service on the corridor which was stopped due to unreliable travel times created by the severe congestion. The resulting travel time improvement equates to as much as $435 million in economic benefits.

This project also addresses aging infrastructure by replacing two bridges and widening 16 others, as well as reconstructing over 7 miles of pavement that has poor substructure.

The project will also result improve safety on the corridor. A 33% reduction of accidents is expected as a result of the improvements, equating to a $47.4 million net present value to the region. As part of these totals, the I-25 and C-470 interchange direct-connect ramps are projected to reduce rear-end crashes by 52% and sideswipe crashes by 44%, providing $8 million in crash cost savings over the next 20 years.

The C-470 Tolled Express Lanes project will provide system continuity with the existing and planned tollway facilities that will complete a loop around the Denver metro area.

### PROJECT FUNDING AND PARTNERSHIPS

The current funding package for the $230 million project is a total of $215 million, detailed below, leaving a need for $15 million in TIGER grant funds. The proposed funding package is as follows:

| | |
|---|---|
| Toll Revenue Bonds | $103 million |
| Federal Funds | $80 million |
| State Funds | $22 million |
| Local Funds | $10 million |
| TIGER VI Funds | $15 million |
| **TOTAL** | **$230 million** |

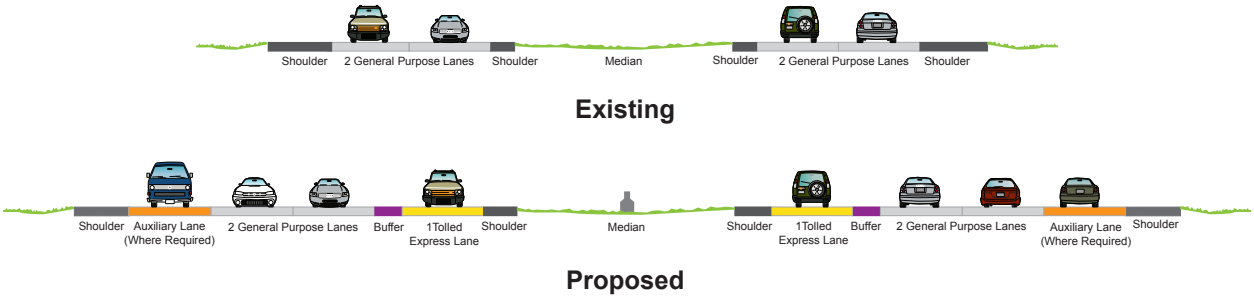
In addition to developing consensus around the proposed action, the eight-jurisdiction C-470 Corridor Coalition has already funded $15 million of C-470 interchange improvements and $5 million of environmental study, revenue analysis and preliminary design. This $20 million contribution already made is in addition to the $10 million local match committed for construction of the TIGER VI project.

## I. PROJECT DESCRIPTION

The requested $15 million TIGER grant for this project will complete the funding package to implement a $230 million Tolled Express Lane project on the easternmost 12 miles (roughly half) of C-470, a four-lane freeway in the southwestern portion of the Denver metropolitan area through Arapahoe, Douglas and Jefferson Counties. C-470 is critical for regional mobility as it links Interstate 70 and Interstate 25. C-470 currently serves a regional population of 2.8 million residents, and by 2035 that population will grow to 4 million residents. More than half the regional population lives in the three counties through which C-470 passes.

The existing C-470 highway includes two general purpose lanes in each direction with a depressed median, for a typical cross section approximately 110 feet wide. This width expands near grade-separated interchanges to include off-ramps, on-ramps, and in some cases, auxiliary lanes. The new 154-foot typical section will add one express lane in each direction and reserve a median that will accommodate future expansion. Beyond the current Tolled Express Lanes project, it is anticipated that a second tolled express lane will be added as a future project when demand warrants.

**Existing and Proposed Typical Section**

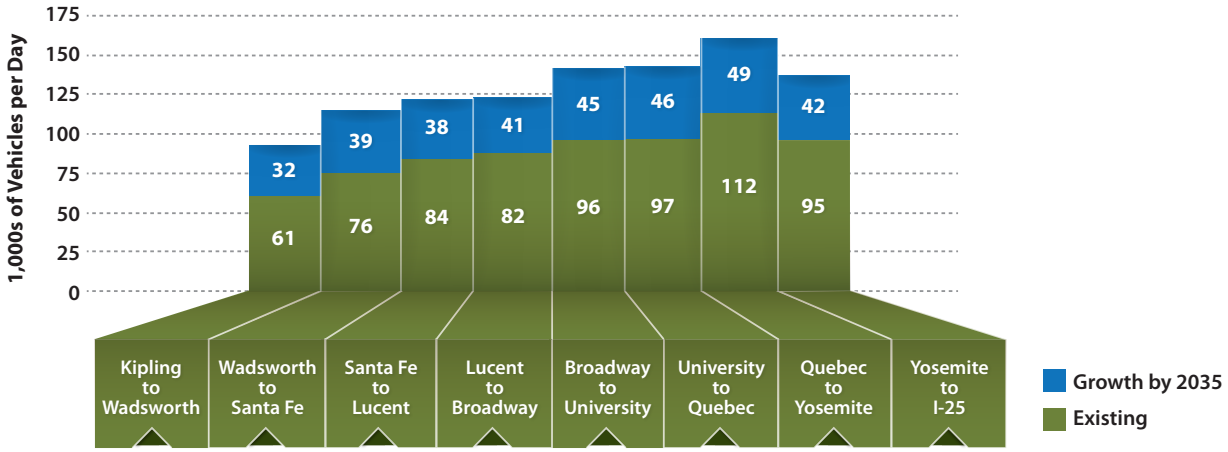



## TRANSPORTATION CHALLENGES TO BE ADDRESSED

This project will reduce traffic congestion, reduce traveler delay, and improve travel time reliability for corridor users. The project will also address long standing pavement deterioration issues significantly reducing long term maintenance costs. The project will provide reliable travel choices to accommodate an expected increase in the intensity and duration of congestion forecasted for the design year 2035.

C-470 carries more than 100,000 vehicles on an average weekday, near its eastern end at Interstate 25, gradually declining to 60,000 vehicles daily about 13 miles west, near Kipling Boulevard. Traffic will increase more than 40% by the year 2035, as seen in the following chart.

**C-470 Average Weekday Traffic Volumes, by Location**




The project will address these and other key challenges with the following project elements:

### MOBILITY: PROVIDING CONGESTION RELIEF AND RELIABLE TRAVEL

#### Tolled Express Lanes

This project will add two tolled express lane serving westbound traffic for 3.8 miles between I-25 and Colorado Boulevard, and one westbound express lane continuing for another 8.2 miles to Wadsworth Boulevard. Eastbound, the project will provide one tolled express lane for 10.8 miles between Platte Canyon Road and I-25. On a typical workday, a motorist who chooses to use the Tolled Express Lanes for the length of the corridor to and from an employment center will have a travel time savings of 70 minutes. Toll rates will vary by time of day to ensure that the managed lanes provide reliable free-flow travel. The Tolled Express Lanes will operate 24 hours a day, 7 days a week.

### Auxiliary Lanes

Auxiliary lanes will be added between interchange ramps in the eastern portion of the corridor, where interchanges are spaced closely together. This will improve traffic flow and improve safety by reducing sideswipe and rear-end collisions.

### Enhancements to the C-470/I-25/E-470 Interchange

At its eastern end, the project will construct direct access ramps between Interstate 25 and C-470 westbound. This feature will allow I-25 motorists wishing to use the new lanes to avoid a traverse across all travel lanes in a severely congested highway section where simultaneously many other lane changes occur. Without these direct-connect ramps, the freeway-to-freeway interchange will bog down, and managed lane users will lose significant travel time value. The direct-connect ramps are both operationally necessary and will significantly increase managed lane use and toll revenues.

At this interchange, C-470 accepts westbound traffic from the existing E-470 tollway. Traffic on E-470 can continue on the C-470 Tolled Express Lanes without having to mix with general purpose traffic. Westbound E-470 traffic will also be given the opportunity to access the general purpose lanes via a braided ramp at this location.

## AGING INFRASTRUCTURE

### Bridges and Pavement

This project will replace two bridges that were built over the South Platte River in 1968. The new structures will improve C-470 horizontal curvature (highway safety), accommodate passage of maximum releases from the Chatfield Dam, improve substandard vertical clearance and sight distance for a major regional trail, and improve the wildlife crossing opportunities for the C-470 corridor's most important riparian area. Additionally, 16 bridges will be widened to minimize throw away of previous work and create project cost efficiencies.

Pavement testing conducted in conjunction with the design of the C-470 Tolled Express Lanes project revealed that the highway structural support is substandard, thus necessitating total reconstruction of the approximately 7 miles of existing general purpose lane pavement. This reconstruction will significantly reduce future life-cycle maintenance costs.

## SAFETY

### Improving Corridor Geometry

Originally designed as a State Highway, C-470 has frequent horizontal and vertical alignment angulations and many geometric deficiencies. Many areas of this rolling and swinging highway do not meet currently required design criteria. These areas of concern will be flattened and straightened enough to bring the facility up to meet modern design standards for the posted speed limit of 65 miles per hour.

The C-470/I-25/E-470 interchange improvements described above will have important safety benefits and could receive funding under the federal Highway Safety Improvement Program. CDOT will aggressively pursue this possible funding source.

Per Tolled Express Lanes national best practices, the project includes an additional lane for merge/diverge movement into and out of the express lanes. These merging areas will be provided at a limited number of access locations along the corridor.

## TRANSPORTATION CHOICES

### C-470 Multi-Use Path

Running along C-470 is a paved, 26-mile multi-use path that provides a facility for non-motorized travel. This bike path connects job centers and recreation areas along and adjacent to C-470. CDOT and area communities recognized the importance of this path by investing over $32 million of Federal economic stimulus funds into rehabilitating portions of the path. The 2014 TIGER project will build on this investment by providing grade separations for the C-470 Regional Trail at two interchanges (Quebec Street and Colorado Boulevard) where trail users currently cross arterial roadways at grade. These improvements will enhance the connectivity of the path as well as safety for users.

Former Transportation Secretary LaHood and former Colorado Governor Bill Ritter at a ground-breaking ceremony for the C-470 Bike Path Project. (June 30, 2009)

## INNOVATION

### Intelligent Transportation Systems (ITS)

The project will install state-of-the-art tolling and ITS equipment and integrate it with CDOT's traffic operation center. The tolling system will include toll collection both by transponder and license plate detection. Ramp metering and variable message signs exist along the corridor today and will be adjusted and enhanced as needed.

## ENVIRONMENTAL MITIGATION

### Noise Walls

The C-470 Tolled Express Lanes project will provide noise barriers where reasonable and feasible for residential areas that are impacted by noise from existing freeway traffic volumes. Absent this project, no mechanism exists to address this problem.

### Water Quality

Since C-470 opened in 1990, Federal and State water quality regulations have been strengthened considerably. The C-470 Tolled Express Lanes project will comply with the newer, tighter regulations, and thus provide additional mitigation features not included in the highway's original construction. These features will result in a net improvement for water quality for 12 miles of C-470.

## CONSISTENCY WITH THE REGIONAL TRANSPORTATION SYSTEM

The entire C-470 freeway extends for approximately 26 miles from Interstate 70 on the west to Interstate 25 on the south. C 470 connects to the E-470 toll highway operated by a separate public highway authority which continues eastward and then northward to Denver International Airport, thence westward to the northwestern quadrant of the metropolitan area. The region's adopted long-range transportation plan envisions future continuation of the tollway system to complete a loop around the metropolitan area. Without the Tolled Express Lanes, C-470 would remain as the only sector of the loop without some tolled element.

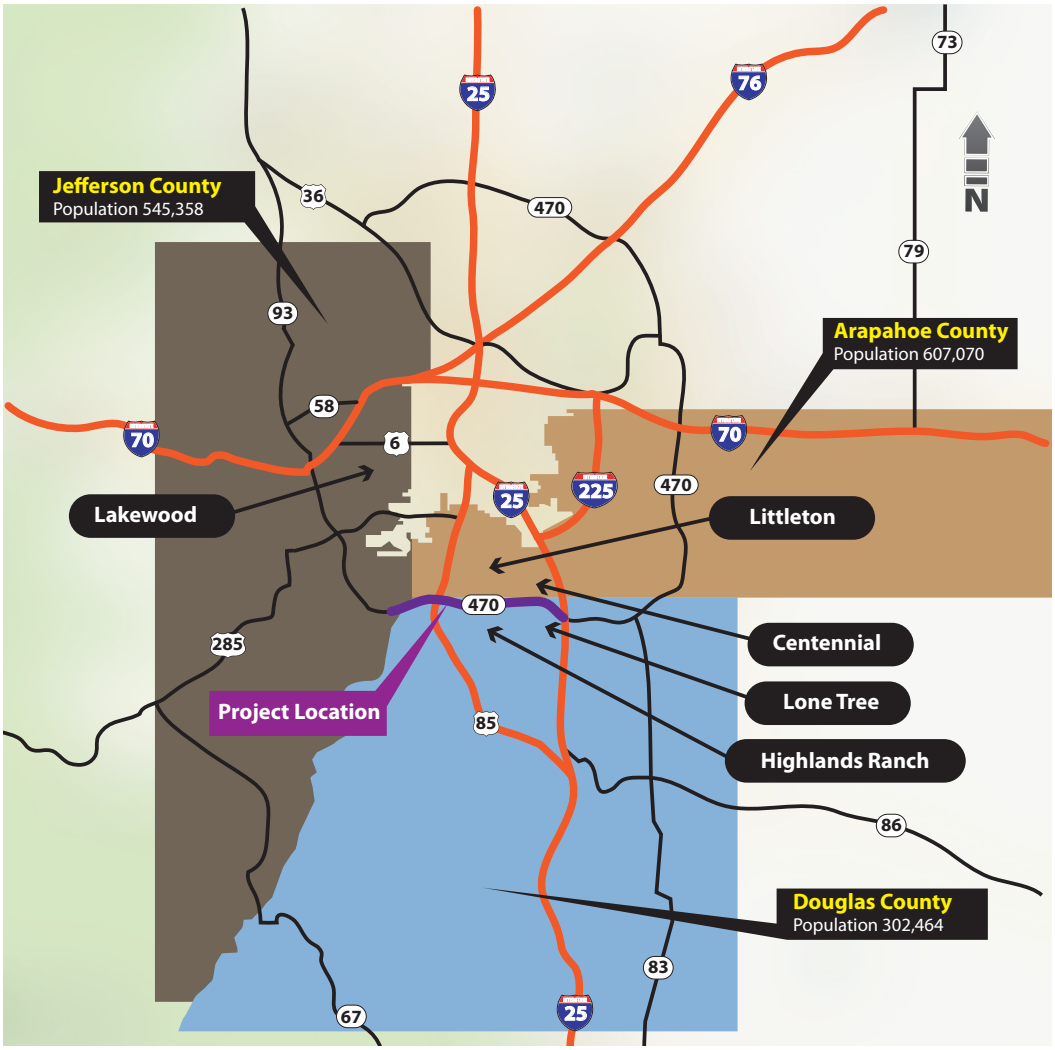
### VULNERABILITY TO CLIMATE-RELATED WEATHER AND INCIDENTS

C-470's location along the Rocky Mountain Front Range makes it the southernmost major roadway serving the Denver metropolitan area, close to mountainous wooded areas vulnerable to wildfires. Huge wildfires in Colorado over the past several years have prompted mandatory evacuations of tens of thousands of residents. Partly due to forest damage by pine beetles (a consequence of climate change), Colorado faces the threat of catastrophic wildfires for many years to come. Twelve miles southwest of C-470, the June 2013 Lime Gulch Fire fortunately was contained quickly. If this fire had escaped containment, C-470 would have been the primary evacuation route for the southwestern portion of the Denver metropolitan area. Additional lanes on C-470 would enhance the highway's capacity as an evacuation route, thus greatly improving public safety.

## II. PROJECT PARTIES

The Colorado Department of Transportation (CDOT) is the applicant for the TIGER grant requested in this application. CDOT is working in partnership on this project with the numerous governmental members of the C-470 Corridor Coalition. Additional details about the C-470 Corridor Coalition are provided in the "Partnership" discussion later in this grant application.

**C-470 Corridor Coalition Member Jurisdictions**



# III. GRANT AMOUNT AND SOURCES/USES OF FUNDS

CDOT requests a TIGER grant in the amount of $15 million from the US Department of Transportation in 2014.

## AVAILABILITY AND COMMITMENT OF FUNDS

The largest share of project resources will come from the planned sale of revenue bonds. Interest rates remain low at this time, providing an advantageous opportunity to finance the project with a relatively modest cost of capital. Based on the Level 2 Traffic and Revenue analysis results developed to date, future toll collection revenues appear sufficient to repay the $103 million projected level of bond debt.

Anticipated funding for the C-470 Tolled Express Lanes project will come from the following sources:

| Funding Source | Amount (millions) | Percent of Total |
|---|---|---|
| Toll Revenue Bonds | $103 | 45% |
| CTC 2013 Allocation | $100 | 43% |
| Local (Douglas County) | $10 | 4% |
| CDOT FASTER Program | $2 | 1% |
| TIGER grant funds | $15 | 7% |
| **TOTAL** | **$230** | **100%** |

In October 2013, the Colorado Transportation Commission allocated $100 million to the C-470 project under its Responsible Acceleration of Maintenance and Partnerships (RAMP) program. Reflecting the importance of C-470 to the State Highway System, this was the largest allocation made to any project under its competitive statewide process. These funds are available now and must be spent by December 31, 2017.

The local funding contribution of $10 million, or 4% of the project total, will come from Douglas County. In addition, Douglas County has already spent $15 million for corridor improvements, studies and project design. C-470 corridor improvements are vital to the mobility and quality of life for Douglas County residents and the county has committed its resources to this effort which amply demonstrates its importance to the local communities along the corridor. Douglas County has been one of the fastest growing counties in the U.S. for the past several decades.

TIGER grant funds of $15 million will account for 6.5% (rounded to 7%) of total project funding and CDOT expects it will obligate and expend these funds quickly. Total project costs have been estimated in year-of-expenditure dollars, as follows:

| Funding Uses | Amount (millions) | Percent of Total |
|---|---|---|
| Construction | $178.3 | 77% |
| CDOT Engineering | $39.4 | 17% |
| Right-of-Way | $6.7 | 3% |
| Procurement & Level 3 T&R* | $5.6 | 3% |
| **TOTAL** | **$230** | **100%** |

*Investment-grade Traffic and Revenue Study

For project delivery, CDOT currently foresees selecting a design/build contractor who will take the project's preliminary design, refine it to final construction plans, and build the project. CDOT Engineering will provide coordination and oversight of the design and construction process. CDOT will conduct the contractor procurement process, preparing the detailed request for qualifications and for proposals, as well as the investment-grade Level 3 Traffic and Revenue Study, and through its High Performance Transportation Enterprise will arrange for the sale of revenue bonds for the project and/or a TIFIA loan for the project.

For simplicity of accounting, CDOT is willing to apply all TIGER grant funds to project construction, as reflected below.

**Percentage of Project Costs Funded with TIGER Discretionary Grant Funds**

| Funding Sources | TIGER Amount ($ millions) | Other Sources ($ millions) | Total Costs ($ millions) | % TIGER share by cost type |
|---|---|---|---|---|
| Construction | 15 | 163 | 178 | 8% |
| CDOT Engineering | 0 | 40 | 40 | 0% |
| Right-of-Way | 0 | 7 | 7 | 0% |
| Procurement and Level 3 T&R | 0 | 5 | 5 | 0% |
| **TOTAL** | **15** | **215** | **230** | **7%** |

# IV. SELECTION CRITERIA

## A. PRIMARY SELECTION CRITERIA

### A-1. STATE OF GOOD REPAIR

C-470 was originally constructed in the 1980s. The pavement is asphalt from Wadsworth Boulevard to Santa Fe Drive (approximately 3 miles), and concrete from Santa Fe Drive to I-25 (approximately 9 miles). Both sections have exceeded their service life. Due to pavement deterioration, the majority of the concrete portion has been overlaid with asphalt. Although substantial rehabilitation treatments performed in the past have somewhat extended the service life of the pavement, more frequent and expensive treatments are forecast as traffic on the facility continues to increase.

Further exacerbating the pavement issues is the finding of pavement testing that was conducted in conjunction with the design of the C-470 Tolled Express Lanes project. This testing revealed that the highway does not have adequate levels of structural support in a number of areas. Consequently, total pavement reconstruction is now required in some areas where less expensive approaches were under consideration. A detailed analysis of the C-470 Tolled Express Lanes project costs has determined that $77 million (approximately one-third) of the total $230 million cost is attributable to reconstruction of existing roadway, with the remaining $153 million attributable to the Tolled Express Lanes.

#### Consistency with Regional Efforts

The amount of toll-based debt expected for this project ensures that future toll revenues collected on C-470 will be sufficient to not only repay initial construction bonds, but also to ensure that the highway is maintained in good repair. Availability of this dedicated funding stream for C-470 maintenance will put this State Highway in the advantageous position of not depending on chronically tight CDOT maintenance budgets.

### Future Facility Condition Impacts

For optimal long-term asset management, the C-470 pavement will eventually need reconstruction. Done in conjunction with the addition of Tolled Express Lanes, horizontal and vertical curvature issues can be fixed, maintenance of traffic can be accomplished much more easily, and substantial cost savings are achieved through economies of scale by accomplishing all objectives with a single project. Thus, it is proposed that the reconstruction effort be undertaken in conjunction with the addition of the Tolled Express Lanes.

### Capitalization Optimizes Cost Structure

All aspects of the C-470 Tolled Express Lanes project have been designed and coordinated for the purpose of achieving the project's purpose and need while also optimizing the facility's long-term cost structure. The pavement reconstruction approach discussed above reduces both maintenance and construction costs, while the toll revenues will provide a committed funding source to ensure proper maintenance is performed. Designing the current project to accommodate future expansion will minimize the need for future reconstruction.

### Improved Ability of C-470 to Withstand Natural Disasters

The Tolled Express Lanes project will replace two C-470 bridges built in 1968 across the South Platte River adjacent to the Chatfield Dam. Replacement is necessary to accommodate improved horizontal alignment and the added lanes. The new structures will also improve clearance for a major greenway trail that crosses under these bridges. The new bridges will accommodate the maximum dam releases anticipated by the U.S. Army Corps of Engineers (USACE). In 2013, USACE completed a Final Environmental Impact Statement for its proposal to double the storage capacity of Chatfield Reservoir. CDOT's new bridge designs will be consistent with the dam's purpose of regional flood control.

C-470 is the main transportation route for getting to Chatfield State Park, which attracts more than 1.6 million visitors each year.

### Project's Contribution to Improving Multimodal Transportation System Reliability

The region's transit provider is RTD, which operates light rail, fixed route bus service, park-and-ride lots and other transit services. RTD operates various bus routes within the C-470 project area and a few of these routes cross C-470. RTD has intentionally planned its routes along arterial streets that do not have C-470 interchanges, to avoid congestion and maintain acceptable schedule performance. RTD previously operated a bus route on C 470 but discontinued it due to unacceptable travel time reliability. C-470 congestion was simply too heavy and unstable to allow RTD buses to adhere to a fixed schedule. RTD's letter of support for the C-470 project indicates that commuter bus service on C-470 could be viable in the future when trip reliability is improved.

There are several RTD park-and-ride lots along the C-470 corridor, as well as light rail stations near C 470's I-25 and Santa Fe Drive interchanges. These facilities allow commuters and others to access transit services once they get to these locations. C-470 is a key route used for the automobile portion of multimodal RTD trips.

The C-470 Tolled Express Lanes will also provide grade-separated crossings at two locations where the 26-mile C-470 Trail adjacent to the freeway currently crosses major arterial streets at grade

(Quebec Street and Colorado Boulevard). This will be a major safety improvement for bicyclists and pedestrians, as well as for motorists at these two C-470 interchanges.

## A-2. ECONOMIC COMPETITIVENESS

C-470 is critical for regional mobility and connects people to major employment centers and economic opportunities. The C-470 Tolled Express Lanes project enables people to grab a rung on a ladder of opportunity by providing a reliable, congestion-free transportation opportunity.

The C-470 project will improve the long-term efficiency and reliability of travel times for employees accessing their jobs and for consumers moving to retail stores, health care, and other facilities in this corridor and adjacent areas.

Due to high levels of continued regional growth, current reliability problems on the C-470 corridor will worsen dramatically. The Metro Vision 2035 Regional Transportation Plan provided the following data for the 26-mile C-470 corridor for the years 2006 and 2035, assuming that the C-470 project is not implemented.

**Existing and Future No-Build Conditions for the 26-Mile C-470 Corridor**

| Performance Characteristics | Congestion Metric | 2006 | 2035 |
|---|---|---|---|
| Reliability | Travel Time Variation (Ratio of peak hour to non-peak hour travel time) | 1.44 | 2.93 |
| Duration | Daily Congestion (hours per day) | 1-2 | 3-4 |
| Severity | % of Peak Travel Time in Delay | 21% | 49% |
| Delay | Vehicle Delay (hours per day) | 6,650 | 41,940 |

Eight years ago, peak-hour travel times already exceeded off-peak speeds by 44%. By 2035, this will increase to the point where the peak-period trip takes about three times as long as the future off-peak trip.

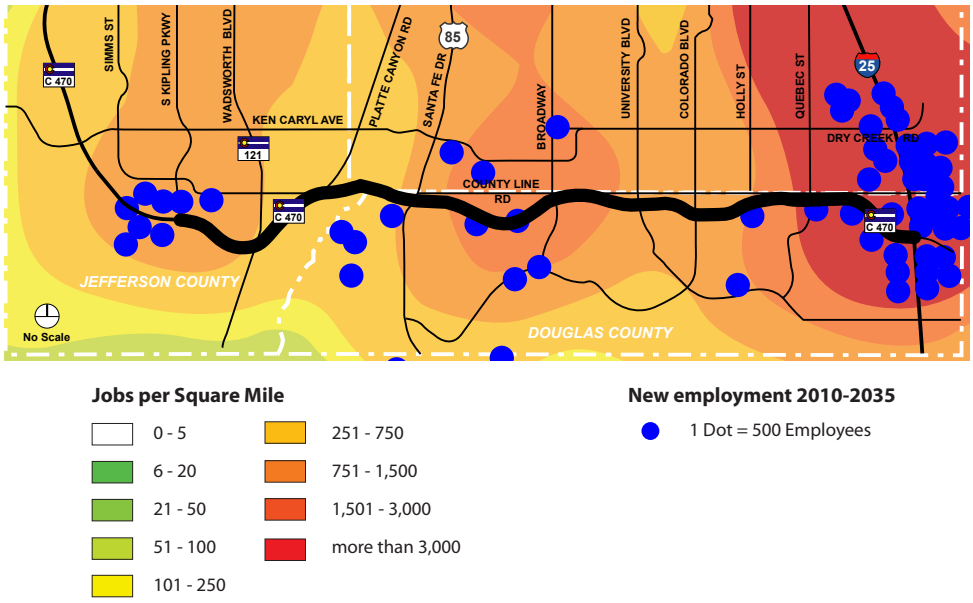
Unreliable travel times on a major regional travel route jeopardize the ability of workers to arrive at their place of employment on time, which has ripple effects upon productivity for these workers as well as their coworkers and consumers who will avoid using services or shopping in areas where severe congestion exists.

### Increased Productivity of Land, and Impacts for Economically Distressed Areas

Two of the three counties (Arapahoe and Jefferson) through which C-470 passes have designated Economically Distressed Areas (EDAs), and there are numerous other EDAs in the Denver metropolitan area. C-470 provides a critical link for the transport of workers and goods throughout the region. The current socio-economic forecasts of the Denver Regional Council of Governments (DRCOG) indicate that between 2010 and 2035, an additional 56,500 new jobs are expected within one mile of C-470. Implementing the C 470 Tolled Express Lanes project will provide the needed mobility to ensure that traffic congestion does not cause those jobs to shift elsewhere.

Additionally, construction of the C-470 project will create jobs in the short term. It has been estimated that 10.55 jobs are created for every $1 million invested in transportation improvements (NCHRP, 2012). A jobs creation analysis provided in Appendix F indicates that the construction of the Tolled Express Lanes has potential to create over 2,400 short-term jobs.

Location of existing employment and projected employment increases through 2035.

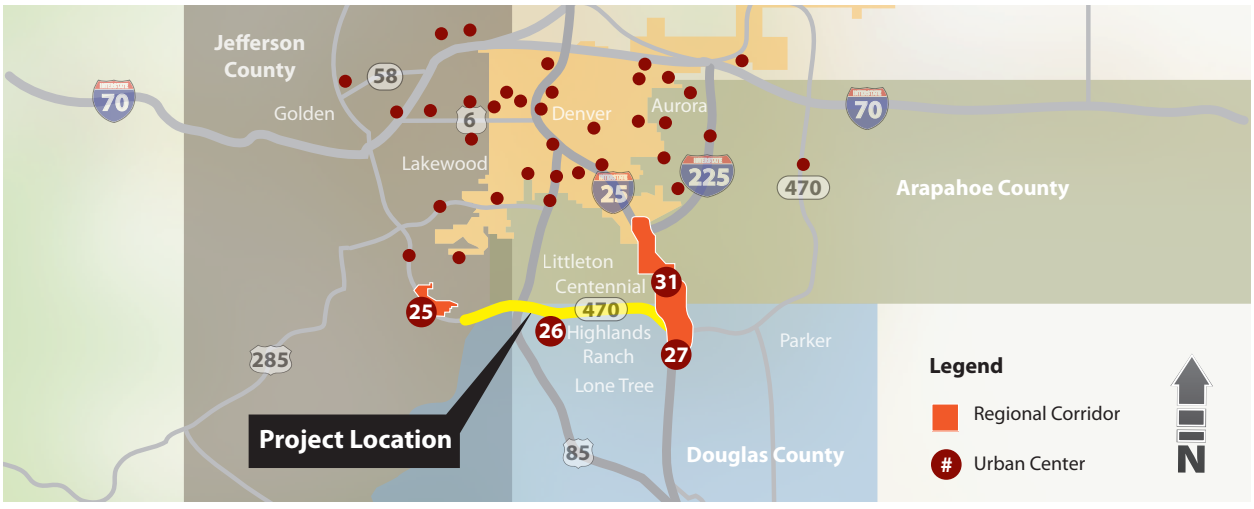



## A-3. QUALITY OF LIFE

Maintaining or enhancing quality of life is a top priority of DRCOG. DRCOG performs integrated planning functions including socioeconomic forecasts, land use, transportation and air quality. Two key documents relevant to the C-470 TIGER grant application are the Metro Vision 2035 Plan (addressing growth and development issues, including sustainability land use), and the Metro Vision 2035 Regional Transportation Plan (RTP).

The land-use oriented Metro Vision 2035 Plan adopted by DRCOG established a Regional Growth Boundary and sustainability goals for increasing development density and transportation alternative mode use. Within the Urban Growth Boundary, it has identified 67 designated Urban Centers, intended as existing or planned activity centers, most involving mixed-use land development, which reduces the need to make commuting trips.

By mutual agreement among the member governments, regional transportation infrastructure investments will be made in support of this integrated land use concept. The figure below shows the location of the four DRCOG-designated urban centers in the southern part of the metropolitan area.




DRCOG - designated Urban Centers in the southern part of the Denver metropolitan area.

C-470 is the major transportation facility that links designated urban centers. Notably, these are:

| # | Urban Center Name | Size | Served by C-470 | Light Rail |
|---|---|---|---|---|
| 25 | C-470 Regional Corridor | 826 acres | Yes | None planned |
| 26 | Highlands Ranch Town Center | 165 acres | Yes | Planned |
| 27 | Lincoln Station Development | 61 acres | Yes | Existing |
| 28 | I-25 Regional Corridor | 5,956 acres | Yes | Existing |

Some urban centers are linked together by existing or planned light rail, but not all of them. Where light rail is not available, highways play the important role of linking the activity centers to keep them productive and sustainable. Centers lacking adequate transportation infrastructure are at a competitive disadvantage and are not sustainable. By providing reliable travel times, the C-470 project will enables commuters and commercial users to access good, services, and jobs in activity center destinations. Without the C-470 project, no such option will exist. The project will also make possible resumption of substantial bus transit service in the corridor.

## A-4. ENVIRONMENTAL SUSTAINABILITY

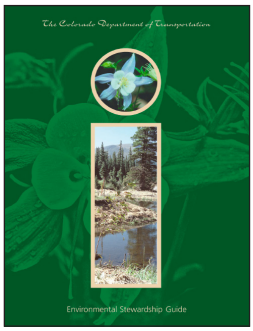
The FHWA approved the C-470 project's Environmental Assessment in 2006. This assessment was performed in accordance with the National Environmental Policy Act of 1969 (NEPA). This EA is eight years old and therefore currently under revision but timely approval of this update is expected since the project itself and its environmental impacts are already well known, through past efforts with extensive public involvement.

### Water Pollution and Air Pollution

C-470's construction was completed in 1990, prior to development of Colorado's current stormwater management regulations. Thus the drainage system of the existing highway does not incorporate best management practices to capture and treat stormwater runoff prior to discharge into local waterways. CDOT is responsible for stormwater runoff under the terms of its Municipal Separate Stormwater Systems (MS4) permit from the Colorado Department of Public Health and Environment (delegated from the U.S. Environmental Protection Agency). The C-470 project provides an otherwise unfunded opportunity to implement BMPs in the C-470 corridor, not only mitigating impacts of new transportation infrastructure, but also managing and treating stormwater runoff from the existing freeway.

DRCOG's latest (2014) regional air quality conformity analysis for the 2035 Regional Transportation Plan, which includes the C-470 Tolled Express Lanes project, passes all conformity emission budget tests for all analysis years (DRCOG, 2014). Energy and air quality benefits will result from the reduction of unnecessary delays on C-470, attributable to traffic congestion. Earlier this application noted that in the absence of the C-470 project, DRCOG projected that the 26-mile corridor would experience approximately 42,000 vehicle hours of delay on an average weekday in 2035. About half of this total congestion is predicted to occur on the easternmost 12 miles of the corridor which this project will address. Each minute of vehicle delay results in increased fuel consumption, additional emissions of various air pollutants, and increases in carbon dioxide (CO2) and other greenhouse gases. Long-term emission reductions are quantified in the Benefit-Cost Analysis for this TIGER grant application.

### Avoidance of Adverse Environmental Impacts




CDOT's Environmental Stewardship Guide

The 2006 C-470 Environmental Assessment was developed in accordance with CDOT's Environmental Stewardship Guide (CDOT, 2005). FHWA has recognized this guide as an innovative and successful approach for environmental commitment implementation (see http://www.environment.fhwa.dot.gov/strmlng/domscanrpt/appb.asp). CDOT's policy is to go above and beyond minimal required efforts to meet federal environmental regulations. This approach is reflected in the 2006 EA and also in the EA revision currently being completed.

The Proposed Action as approved in the 2006 EA was expected to have permanent impacts on just 1.81 acres of wetlands, as well as temporary impacts on an additional 0.31 acre. CDOT committed to replace all permanently impacted wetlands on a 1:1 basis to achieve no net loss. The Revised EA is expected to show a similar result.

The C-470 project will have no adverse effect on any federally listed threatened or endangered species. The EA includes efforts to minimize impacts to the Black-tailed prairie dog which is not endangered but is considered a Species of Concern by the State of Colorado. Colonies of this species are present within CDOT's C-470 right-of-way. Mitigation for impacts to black-tailed prairie dogs in the study area will follow the 2009 CDOT Impacted Black-tailed Prairie Dog Policy.

### Providing Other Environmental Benefits

Stormwater mitigation, reduced air pollution, and reductions in energy usage are all important benefits of the C-470 project already discussed above. Two additional environmental benefits include enhanced wildlife connectivity and highway noise mitigation.

The C-470 bridges over the South Platte River will be replaced with longer bridges. The regionally important Mary Carter Greenway Trail crosses under C-470 at this location, leaving minimal natural ground for wildlife to cross the highway. The proposed new C-470 bridges will accommodate a wildlife movement buffer, as well as improving substandard design (sight distance and vertical clearance) for users of the greenway trail.

The C-470 Tolled Express Lanes project will replace these bridges built in 1968 that cross the South Platte River and the Mary Carter Greenway Trail.

Regarding traffic noise, the 2006 EA identified a number of residential areas along C-470 that will be impacted by highway noise. Implementing the Proposed Action offers the opportunity to implement noise mitigation for these impacted residences.

### Improving the Resilience of C-470 as a Transportation Asset

Several aspects of the C-470 Tolled Express Lanes project will enhance the resiliency of this critical transportation asset. Collection of toll revenues that are legally required to be kept within the corridor will ensure long-term availability of funding for corridor maintenance and operations. The reconstruction of the existing general purpose lanes will address their structural deficiencies and greatly extend the useful life of the highway. Providing reliable travel times will make resumption of commuter transit service viable, thus improving the efficiency of the multimodal transportation system.

### A-5. SAFETY

Based on a review of accident records for the five years from 2008 to 2012, about 300 accidents occur annually on the C-470 mainline, and this number has increased over time. Slightly over half the mainline accidents are rear-end collisions. This accident type is normally attributable to traffic congestion, and 70% of the C-470 rear-end accidents occurred during weekday peak commuter periods. The C-470 Tolled Express Lanes project will reduce congestion and thus greatly reduce the number of rear-end collisions.

Overall, the C-470 Tolled Express Lanes project is expected to reduce accidents by approximately one third, from 300 accidents per year to 200 per year. Using FHWA-approved methods and calculations, the Benefit-Cost Analysis for this project indicates that this would equate to a $47.4 million net present value to the region. In the next 20 years, the direct-connects alone at the I-25 and C-470 interchange are projected to reduce rear-end crashes by 52% and sideswipe crashes by 44% providing $8 million in crash cost savings.

Due to traffic congestion, the 5pm to 6pm hour has by far the most rear-end collisions on C-470.

*Photo Credit: Denver Post*

The C-470 project will also remedy substandard horizontal curves on C-470 at several locations. C-470 was originally proposed as an Interstate Highway in the 1970s, but was built as a State Highway and the interstate design standards were not used. The C-470 project offers an opportunity to reconstruct substandard sections so they can safely handle the highway's posted speed limit of 65 miles per hour.

#### Project's Impact Regarding Unintended Releases of Hazardous Materials

C-470 is a designated truck route for hazardous materials, as such the proposed improvements will improve safety for all travelers, including hazmat operators. Two known hazmat spills in recent memory took place as follows:

- In 2008, a Jeep Cherokee sideswiped a tanker truck, rupturing its cargo tank causing a fuel spill on a ramp at the C-470/Santa Fe intersection.
- In July 2013, a semi truck crashed into a cable rail, which ruptured a saddle tank, spilling the truck's own fuel (not cargo) in the C-470 median between Broadway and Lucent Boulevard.

Of course, every one of the 300 accidents on the C-470 mainline each year has the potential to result in spilling a small amount of hazardous materials such as gasoline, motor oil, or other vehicle fluids.

## B. SECONDARY SELECTION CRITERIA

### B-1. INNOVATION

#### Innovative Technology

CDOT will incorporate state-of-the-art tolling technology on the C-470 corridor. The toll pricing structure will provide an incentive for motorists to obtain a transponder for their vehicle, with each toll deducted from a prepaid account balance. For motorists not obtaining a transponder, video

license plate surveillance will be used and a bill for the toll will be mailed to the vehicle's registered owner. Compatible toll collection systems are used on Tollway E-470, which connects to C 470 at I 25 and serves the southeastern and northeastern quadrants of the Denver metro area. By State law, compatible systems must be used on all tolled facilities.

Critical to the success of the new lanes is ensuring that they do not carry so much traffic that they also become congested. Tolls will vary by time of the day, with higher tolls charged during hours of higher demand, to ensure that the managed lanes run smoothly. Variable message signs will communicate the toll cost in advance of ingress points so that the motorist can make an informed decision of whether or not to enter the lane. Notification and collection systems will be adaptable to fully dynamic pricing (responsive to real-time conditions) if needed to maintain travel time reliability.

### Innovative Funding

The C-470 project relies upon innovative funding. It has been in limbo for the past eight years precisely because sufficient traditional funding for a project of this magnitude was simply not available. More than 40% of project funding ($103 million) will come from toll revenue which is pledged to repay either bonds or a TIFIA loan. A portion of the proceeds of these financial transactions will provide up front capital for project construction with the balance used to fund the operation and maintenance of the facility.

Another 45% or so will come from a Colorado Transportation Commission allocation which also consists of innovative financing. The State of Colorado recently restructured the way it manages transportation funds. CDOT is shifting from encumbrance based budgeting to cash flow budgeting. This creates a one time opportunity to fund additional projects (approximately $900 million of projects) with C-470 receiving the largest single allocation in the program.

The $10 million commitment from Douglas County is itself rather unusual as a local government is helping to pay for improvements on a major State highway. Significantly, Douglas County also was innovative as it took the initiative to commence the Traffic and Revenue study effort, preliminary design, and other elements of the preparatory process such as engaging consultants to facilitate the establishment of the C-470 Corridor Coalition.

### Innovative Contracting and Management

CDOT intends to implement the C-470 project using design-build project delivery, which typically offers potential savings in time and dollars compared with the traditional design-bid-build process. CDOT has extensive experience with design-build and other alternative procurement practices, and has determined that this approach best suits the circumstances of the C-470 project. Additionally, the Level 2 T&R study indicates that toll revenues will be sufficient to repay bonded construction financing costs and to pay for ongoing maintenance and operations.

## B-2. PARTNERSHIP

CDOT has worked closely with all affected stakeholders along the C-470 corridor. This is a true "bottoms up" stakeholder effort with the bulk of the impetus for this project generated by the C-470 Corridor Coalition. Given how well this partnership has proceeded to date it is anticipated that it will remain equally successful throughout project design, construction and operation.

### Jurisdictional and Stakeholder Collaboration

The C-470 Tolled Express Lanes project is moving forward due to the strong united support it has received from every affected local government jurisdiction in the project area. As noted earlier, the Coalition's formal members are:

| | |
|---|---|
| Arapahoe County | City of Lakewood |
| Douglas County | City of Littleton |
| Jefferson County | City of Lone Tree |
| City of Centennial | Highlands Rand Metropolitan District |

Additionally, the C-470 Corridor Coalition includes affiliate members from other local entities and private sector groups in the region (City of Greenwood Village, Towns of Castle Rock, Parker, Bow Mar, Denver South Economic Development Partnership, Chambers, etc.). Staff from State / Federal affiliate members have been participating at the Policy Committee meetings and Technical Working Group meetings since the Coalition was formed. These agencies include the Federal Highway Administration, CDOT, CDOT's High Performance Transportation Enterprise (HTPE), the Regional Transportation District (regional transit provider) and the DRCOG.

Additionally the U.S Army Corps of Engineers (USACE) is a Cooperating Agency for the C-470 Revised Environmental Assessment. C-470 exists on an easement from USACE, rather than on CDOT-owned right-of-way for approximately three miles from Santa Fe Drive to Wadsworth Boulevard. CDOT and FHWA coordinated with USACE previously on the approved 2006 C-470 EA. Improvements to C-40 on this easement will not occur without USACE approval, and C-470 improvements will stay within this easement to avoid any need for easement modification.

### Inter-Jurisdictional Collaboration to Achieve National, Regional, or Metropolitan Benefits

C-470 is part of the FHWA-designated National Highway System and was originally planned as an Interstate Highway (I-470), so its designation as a State Highway does not necessarily reflect its actual importance to the transportation system of Colorado's largest metropolis or to the regional transportation system. Significant volumes of traffic transition between I-70 and I-25 using this route bypassing the highly congested actual intersection between these two interstates in downtown Denver.

The project is the product of a decade of close collaboration between CDOT and all of the affected local government jurisdictions, which include three counties, multiple cities and towns, and various metropolitan improvement districts. Local jurisdictions have devoted hundreds or thousands of staff hours to development of the project and have contributed millions of dollars to the development of the project design and its environmental assessment.

The project will occur in part on Federal land (the Chatfield Dam USACE easement), and improvements on this Federal land will comply rigorously to the needs and specifications of USACE. Water quality mitigation efforts will ensure that the project does not adversely affect several threatened or endangered species hundreds of miles downstream.

### Incentives to Ensure Long-Term Asset Performance

CDOT will select a contractor to implement innovative design and project delivery. During the design process, the contractor will have the opportunity to identify methods and materials that save

time and money for the public. The contractor will be incentivized in this process to increase value for the taxpayer and the toll payer.

Under Colorado law, toll highway facilities are centrally planned and administered by CDOT's High Performance Transportation Enterprise (HTPE), which operates as a government-owned business. HPTE has specialized financial, analytical and legal expertise created for the purpose of evaluating toll road proposals and determining how best to implement them. Long-term asset management, including maintenance and operations, is a key consideration in HPTE's work. HTPE has begun the process of preparing a Value for Money Study to determine the optimal manner in which to operate the C-470 Express Lanes project.

### Disciplinary Integration

DRCOG Metro Vision 2035 Plan

The coordination of transportation needs with economic development, housing and land use policies for the Denver metropolitan area occurs in part through the Metro Vision 2035 Plan adopted by the DRCOG. That plan features urban growth boundaries and environmental sustainability goals (including energy conservation and greenhouse gas emission reductions). Public infrastructure investments, including transportation improvements, focus on ensuring attractive levels of mobility and other public services to ensure the success of this effort. Inclusion of the C-470 project in the Metro Vision 2035 Regional Transportation Plan reflects the collective judgment of all the region's counties and municipalities that the project is consistent with the adopted Metro Vision development goals. Providing reliable transportation to urban centers will support and reinforce their sustainability.

### Environmental Efficiency

CDOT has met with the various governmental jurisdictions along the corridor to explore opportunities for shared facilities to handle stormwater runoff detention and treatment. In the past, water quality mitigation for transportation has occurred within the right-of-way, with the creation of a separate, self-contained system that might be redundant with adjacent facilities outside the right-of-way. The Colorado Department of Public Health and Environment is actively encouraging cooperative efforts to achieve improved efficiency and effectiveness in stormwater management, and this approach is being used in the design of the C-470 improvements. CDOT will implement shared water quality mitigation facilities wherever possible on the C-470 corridor.

## C. RESULTS OF BENEFIT-COST ANALYSIS

A benefit-cost analysis (BCA) was conducted for the C-470 Tolled Express Lanes to support this application to the TIGER VI program. The analysis was conducted in accordance with the benefit-cost methodology as recommended by the U.S. DOT in the Federal Register (79 FR 11854) for a 30-year analysis period after operations begin in 2017. The complete Benefit-Cost Analysis is contained in Appendix B, being made available to USDOT reviewers online (for access information please see the final page of this narrative). Key findings of the analysis are summarized on the following page.

The Tolled Express Lanes will provide significant regional benefits to Arapahoe, Douglas, and Jefferson counties, the greater Denver Metropolitan Area, and the state of Colorado by:

1. Decreasing peak period congestion and travel time, which will significantly reduce vehicle hours and passenger hours of travel time;
2. Increasing average driver speeds, thereby reducing emissions; and,
3. Improving driver safety by reducing congestion and improving the roadway's operations, thereby reducing fatalities, injuries and property damage-only accidents

Overall, the Tolled Express Lanes will improve travel conditions for thousands of commuters, shoppers, and tourists in the southwestern part of the metro area. The total cost, including all capital costs, operating costs, and rehab and recovery costs (also accounting for the residual value of physical assets) are expected to be $225.2 million in undiscounted 2013 dollars through 2046. There are additional capital costs, such as right-of-way acquisition costs, that are considered non-depreciating assets, which can be transferred at full value at the end of a project's useful life. For BCA purposes, these and certain other costs of are excluded, rendering an effective capital cost used in this BCA of $153 million. Overall, net benefits exceed net costs at both the 3 percent and 7 percent discount rates, and seen in the following table.

**Project Costs, Net Benefits and BCA Results**

| Project Costs | (2013 $) | Costs (2013 $) (Discounted at 7%) | Costs (2013 $) (Discounted at 3%) |
|---|---|---|---|
| Capital Costs | $153,000,000 | $129,264,900 | $142,116,900 |
| Operations & Maintenance | $108,101,300 | $35,223,300 | $63,680,100 |
| Rehab & Recovery | $21,375,000 | $6,495,000 | $12,619,800 |
| Residual Value | ($57,100,000) | ($3,673,900) | ($12,916,900) |
| **TOTAL COSTS** | **$225,376,300** | **$167,309,300** | **$205,499,900** |

| Project Net Benefits | Net Benefits (2013 $) (Discounted at 7%) | Net Benefits (2013 $) (Discounted at 3%) |
|---|---|---|
| **TOTAL BENEFITS** | **$183,284,600** | **$364,847,200** |

| | | |
|---|---|---|
| **Net Present Value** | **$15,975,300** | **$159,347,300** |
| **Benefit / Cost Ratio** | **1.1** | **1.8** |

*Source: Colorado Department of Transportation, Parsons Brinckerhoff 2014*

1 The $153 million capital cost figure for the Tolled Express Lanes excludes the cost to reconstruct portions of the parallel general purpose lanes estimated at approximately $77 million. The aggregate C-470 project capital cost is estimated at $230 million in 2013 dollars.

# V. PROJECT READINESS

## A. TECHNICAL FEASIBILITY

Design for the C-470 Tolled Express Lanes Project has advanced to the 30% design level, meeting the needs of the Revised Environmental Assessment and also providing a basis for an expeditious design-build procurement process to commence once funding and financing is finalized. The 30% Conceptual Design plans identify horizontal and vertical alignments, pavement widths, bridge dimensions, and key features such as managed lane access and egress areas and toll-related signage needs. Utility relocation needs are known and their costs estimated. An adequate contingency is included in the project budget, based on professional engineering judgment, to account for potential inflation in the costs of materials and labor.

The toll collection approach and technology planned for C-470 is already successfully in use on the road's continuation, the E-470 tollway, under identical climate conditions and a similar socio-economic context. This aspect of the project adds minimal risk and instead offers opportunities for cost reductions through system sharing agreements and economies of scale. For example, it is anticipated that the E-470 public highway authority will provide toll collection services for all tolled facilities in the region.

## B. FINANCIAL FEASIBILITY

The addition of tolled express lanes on the C-470 corridor has been studied for more than a decade, including a thorough examination of engineering and environmental feasibility, with extensive public involvement. No major engineering or environmental challenges are foreseen, and there is a strong consensus of support by the local governments that comprise the C-470 Corridor Coalition. Revenue studies have evaluated and identified significant potential revenues from tolls, but tolls alone are not sufficient to implement the improvements. The recent allocation of $100 million for this project by the Colorado Transportation Commission fills most of this gap, leaving only the small portion for which this TIGER application is submitted to complete a full funding package. It is critical to take advantage of this one-time opportunity, which carries tight deadlines for use of the funds to implement the project.

### Reliable Capital and Operating Fund Commitments Sufficient to Cover Estimated Costs

The costs of the C-470 project have been estimated diligently with the inclusion of appropriate contingency costs to ensure against budget overruns. The Level 2 Traffic and Revenue study concluded that the future revenues will be fully adequate for bond repayment as well as ongoing maintenance and operations. In accordance with State law, any excess revenues will remain within the corridor.

### Managing Risk Pertaining to Forecasted Revenues

CDOT has insisted upon diligent design and conservative cost estimation throughout the process because all financial stakeholders have critical interests in minimizing risks to ensure the success of the project. CDOT and the local governments must ensure that their limited resources produce mobility benefits in a timely manner, and the investment community needs strong certainty that the long-term use of the facility will be sufficient to justify their upfront provision of capital. The USDOT similarly faces the need to ensure that its TIGER grant investment can produce reliable transportation and economic benefits.

CDOT is in the process of procuring a Level 3 Traffic and Revenue study that will provide increased detail and certainty for revenue forecasts. CDOT also has retained an independent financial consultant to provide third-party review of all traffic and revenue forecasts. Adequate debt coverage ratios will be required to minimize risk regarding future revenues.

### CDOT's Financial Condition and Grant Management Capabilities

CDOT administers hundreds of millions of dollars in Federal Aid each year. CDOT was successful in obligating and spending all ARRA funds within the required timeframe and has obligated timely all funds of previous TIGER awards.

### Detailed Project Costs

Detailed C-470 project cost estimates have been prepared based on engineering conceptual design. The table on the following page indicates the total cost of $230 million, which not only adds the new facilities for tolled express lanes but also includes reconstruction of the existing highway as needed to both accommodate the new lanes and to address existing deficiencies.


This C-470 Trail grade separation was recently constructed over Erickson Boulevard, just east of Santa Fe Drive. Grade separations will be provided at two additional locations as part of the C-470 improvement project.

**C-470 Project Detailed Budget**

| Cost Item | Budget Component | Reconstruction Costs | New Facilities Costs | Total Project Costs |
|---|---|---|---|---|
| 1 | Pavement removal | $2,447,450 | $30,298 | $2,477,748 |
| 2 | Excavation, fill , grading | $4,546,611 | $15,807,696 | $20,354,307 |
| 3 | Pavement underlay materials | $6,198,886 | $17,586,366 | $23,785,252 |
| 4 | Pavement | $11,400,336 | $10,264,682 | $21,665,018 |
| 5 | Pipes, inlets, manholes (split) | $1,754,800 | $1,754,800 | $3,509,600 |
| 6 | Guardrail systems | 0 | $4,397,213 | $4,397,213 |
| 7 | Trail relocation | 0 | $886,253 | $886,253 |
| 8 | Utilities | $544,700 | $783,440 | $1,328,140 |
| 9 | Drainage | $381,290 | $548,408 | $929,698 |
| 10 | Erosion control | $762,580 | $1,096,816 | $1,859,396 |
| 11 | Removals/resets | $571,935 | $822,612 | $1,394,547 |
| 12 | Landscaping | $381,290 | $548,408 | $929,698 |
| 13 | Signing/striping/lighting | $1,906,450 | $2,742,476 | $4,648,981 |
| 15 | Traffic control | $4,085,250 | $5,875,800 | $9,961,050 |
| 16 | Mobilization | $1,906,505 | $2,742,476 | $4,468,490 |
| 17 | Water quality features | 0 | $1,350,000 | $1,350,000 |
| 18 | Retaining walls | 0 | $7,895,482 | $7,895,482 |
| 19 | New bridges | $2,444,000 | $9,494,160 | $11,938,160 |
| 20 | Bridge widening | 0 | $8,838,333 | $8,838,333 |
| 21 | Culvert extension | 0 | $300,000 | $300,000 |
| 22 | Trail grade separations | $2,800,000 | 0 | $2,800,000 |
| 23 | Interchange street lighting | $25,000 | 0 | $25,000 |
| 24 | Noise barriers (split) | $5,659,000 | $5,659,000 | $11,318,000 |
| 25 | Tolling infrastructure | 0 | $3,400,000 | $3,400,000 |
| 26 | Intelligent Transp. Systems (ITS) | 0 | $3,285,000 | $3,285,000 |
| **A** | **QUALITY ITEMS ROUNDED SUBTOTAL** | **$48,704,000** | **$94,555,000** | **$143,259,000** |
| 27 | Force account/unspecified (20%) | $8,692,000 | $15,245,000 | $23,937,000 |
| 28 | Design-Builder engineering (7%) | $3,751,000 | $7,281,000 | $11,032,000 |
| **B** | **TOTAL CONSTRUCTION ROUNDED SUBTOTAL** | **$61,200,000** | **$117,100,000** | **$178,300,000** |
| 31 | Right-of-way acquisition | 0 | $6,000,000 | $6,000,000 |
| 32 | Procurement and Level 3 Traffic/Revenue | $1,716,209 | $3,283,791 | $5,000,000 |
| 33 | Indirect costs for right-of-way and T&R | $188,783 | $1,021,217 | $1,210,000 |
| 34 | CDOT engineering | $13,525,200 | $25,879,100 | $39,404,300 |
| **C** | **ROUNDED TOTAL PROJECT COST** | **$77,000,000** | **$153,000,000** | **$230,000,000** |
| | % due to reconstruction or new construction | 33.5% | 66.5% | 100.0% |

## C. PROJECT SCHEDULE

Provided below is a summary of the project schedule, simplified to a quarterly view from much more detailed schedule information that CDOT has developed and is continually updating. The more detailed schedule is provided online as Appendix D.

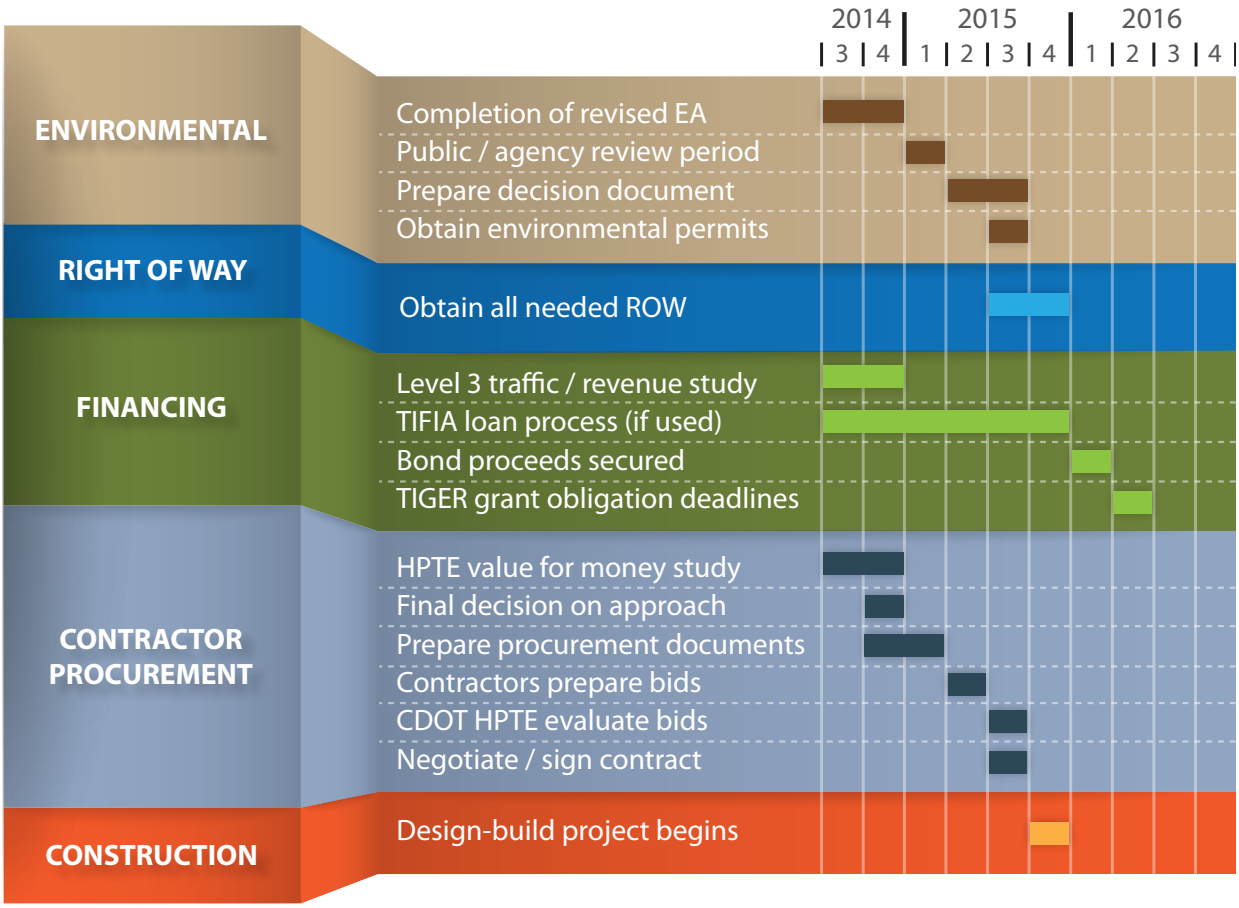
### Expeditious Project Commencement and Use of TIGER Funds

CDOT is under tight deadlines to use its $100 million allocation from the Colorado Transportation Commission. CDOT has proposed to use its TIGER grant funds on construction only, to simplify USDOT accounting efforts, but offers to use some of the funds earlier for right-of-way and engineering efforts if USDOT prefers to have the grant funds expended even sooner.

### Expeditious Acquisition of Needed Right-of-Way

Right-of-way needs for the C-470 project have been identified through the environmental process. CDOT is prepared to proceed with advanced acquisition with State-only funds upon completion of right-of-way plans in 2014.

**Detailed C-470 Project Schedule**



## D. ASSESSMENT OF PROJECT RISKS AND MITIGATION STRATEGIES

As an important part of its mission, CDOT plans, designs and constructs transportation infrastructure improvements, including federally funded projects that involve environmental clearances, right-of-way acquisition, and procurement of construction contractor services. CDOT is confident in its ability to manage and control the risk aspects of the C-470 project.

### Risk Pertaining to Environmental Clearances

CDOT and FHWA approved an Environmental Assessment for essentially this same project in 2006. This EA is being revised in 2014 to reflect the necessary updates in design and adjustments such as the direct connections. As this is only a revision to an EA, substantial delays for environmental reasons are not anticipated.

### Risk Pertaining to intergovernmental Consultation

Approximately three miles of the C-470 project is located on an easement granted to CDOT by the U.S. Army Corps of Engineers (USACE), from its property containing the Chatfield Dam. CDOT consulted with USACE in the development of its C-470 Proposed Action for the 2006 C 470 EA, and has consulted with USACE again for the Revised C-470 EA in 2014. USACE has agreed to act as a Cooperating Agency for the Revised C-470 EA. To date, USACE has not identified any new concerns or requirements that would cause project delays for C-470.

### Risks Pertaining to Right-of-Way Acquisition

CDOT routinely acquires right-of-way for federally funded transportation projects and has experienced in-house specialists who accomplish this process in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended. CDOT is also fully familiar and experienced with U.S. DOT advanced right-of-way acquisition policies.

### Risks Pertaining to Procurement of Construction Contractor Services

CDOT expects to undertake this project using a design-build delivery process. CDOT has extensive experience in performing design-build contractor procurement, and will use a two-step process (request for qualifications and request for proposal) to ensure only highly qualified contractors advance to the RFP stage. Accordingly the department does not envision it will encounter any delays or problems associated with the use of the design build delivery approach. In addition, CDOT has developed standard contract language for design-build contracts that includes extensive bonding and other forms of surety to ensure project completion.

## E. ENVIRONMENTAL AND OTHER APPROVALS

### E-1. NEPA DOCUMENTATION

Tolled Express Lanes were the proposed action identified and examined in the C-470 Corridor Environmental Assessment that was approved by CDOT and the Federal Highway Administration in 2006. It has taken eight years since then to put together the funding needed to implement the project and thus, some of the environmental documentation needs to be updated. Accordingly, a Revised EA has been under preparation and will be completed in 2014. The 2014 proposed action is similar to what was proposed previously, and the affected environment has not changed substantially, so the prospects for the 2014 EA to be smoothly and expeditiously completed are excellent. A public hearing on the Revised EA is anticipated for early 2015.

### E-2. LEGISLATIVE APPROVALS

No new legislation is needed to implement the C-470 Tolled Express Lanes project.

### E-3. STATE AND LOCAL PLANNING

The Colorado Transportation Commission allocated $100 million to the C-470 Tolled Express Lanes project in October 2013, and CDOT immediately began the process to include the project in the DRCOG Regional Transportation Plan (RTP) and the Transportation Improvement Program (TIP). DRCOG received all required information and accepted the project as part of its Cycle 2 amendments process, for air quality conformity analysis. That analysis was completed, resulting in findings that all air quality requirements would be met. A public hearing on the proposed amendments was held on April 16, 2014 and final approval action is now scheduled for May 21, 2014.

The project is included in Colorado's Statewide Transportation Improvement Program. In the STIP it is identified as project #SDR 6641.

## VI. FEDERAL WAGE RATE CERTIFICATION

Please see Appendix E, available online.

## APPENDICES

The following supporting materials are available for US DOT inspection online:

| | |
|---|---|
| Appendix A | References |
| Appendix B | Benefits-Cost Analysis |
| Appendix C | Letters of Support |
| Appendix D | Detailed Project Schedule |
| Appendix E | Federal Wage Rate Certification |
| Appendix F | Short-Term Economic Impacts Attributed to Construction Expenditure |

## ACCESSING THE APPENDICES ONLINE

| | |
|---|---|
| URL: | http://ftp.wilsonco.com |
| Username: | **USDOT** |
| Password: | **TIGER** |

# Appendix A: References

# APPENDIX A: REFERENCES

Colorado Department of Transportation, 2006. Environmental Stewardship Guide. http://www.coloradodot.info/us50e/documents/esguide5-12-05ebook.pdf

Colorado Department of Transportation, 2006. C-470 Environmental Assessment, I-25 to Kipling Parkway. http://www.coloradodot.info/projects/c470/environmental-assessment.html

Denver Regional Council of Governments, 2013. 2012 Annual Report on Traffic Congestion in the Denver Region. http://www.drcog.org/agendas/2012%20CMP%20Report%2-%20May%202%20.pdf

Denver Regional Council of Governments, 2011. Metro Vision 2035 Plan. http://www.drcog.org/documents/2011%20MV%202035%20Plan%20for%20Web5-12-11.pdf

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NCHRP, 2012. NCHRP 08-36, Task 103, Mining Recovery Data for Opportunities to Improve the State of Practice for Overall Economic Impact Analysis of Transportation Investments. http://statewideplanning.org/wp-content/uploads/gravity_forms/2a8f91d1dfdc8d3cc6740e3bc4513c39f/2012/01/NCHRP08-36103_FR.pdf

# Appendix B: Benefit-Cost Analysis

PARSONS BRINCKERHOFF

# C-470 Tolled Express Lanes Project Benefit-Cost Analysis

Prepared for the Colorado Department of Transportation (CDOT)

April 24, 2014

CDOT COLORADO Department of Transportation

# Contents

## Executive Summary

A benefit-cost analysis (BCA) was conducted for the C-470 Tolled Express Lanes (Tolled Express Lanes) for submission to the U.S. Department of Transportation (U.S. DOT) as a requirement of a discretionary grant application for the TIGER VI program. The analysis was conducted in accordance with the benefit-cost methodology as recommended by the U.S. DOT in the Federal Register (79 FR 11854) for a 32-year analysis period beginning with capital outlays in 2015 and 2016 and operations between 2017 and 2046.

The Tolled Express Lanes will be constructed on an approximately 12-mile stretch of the southeastern portion of Colorado State Highway 470 (C-470). C-470 is a regional controlled access highway, connecting residents and businesses in the southwestern portion of the Denver metropolitan area with two major interstates, I-25 and I-70. The Tolled Express Lanes will address congestion on the currently free C-470 from Kipling Parkway on the west to I-25 on the east, reducing traveler delay, and improve travel time reliability for users.

A C-470 Environmental Assessment approved in 2006 by CDOT and FHWA indicate an unacceptable Level of Service (E or F). Projected population, employment and vehicle travel growth will exacerbate the already unsatisfactory travel conditions. Travel demand analysis performed as part of the Level II Traffic Revenue Study in 2013 and 2014 showed that the Tolled Express Lanes would significantly reduce travel times in the corridor and reduce VHT regionally.

The proposed Tolled Express Lanes will add one additional lane both westbound and eastbound, on C-470 between I-25 and Wadsworth Boulevard, an approximately 12-mile stretch, as detailed in the C-470 TIGER VI application. The Tolled Express Lanes will provide significant regional benefits by:

1) Decreasing peak period congestion and travel time, which will significantly reduce vehicle hours and passenger hours of travel time;

2) Increasing average driver speeds, thereby reducing emissions; and,

3) Improving driver safety by reducing congestion and improving the roadway's operations, thereby reducing fatalities, injuries and property damage-only accidents

This segment of C-470 connects Arapahoe, Douglas and Jefferson Counties. The residents and business throughout these counties will realize significant benefits, as will the residents of the Denver Metropolitan Area and Colorado due to the regional connectivity that will be provided between I-25 (north / south) and I-70 (west). Overall, the proposed Tolled Express Lanes will improve travel conditions for thousands of commuters, shoppers, and tourists in the southwestern part of the metro area.

The total cost of the Tolled Express Lanes over their life, including all capital costs, operating costs, rehab and replacement costs as well as the residual value of physical assets are expected to be $225.4m in undiscounted 2013 dollars through 2046 (Table 1). Right-of-Way acquisition costs are considered non-depreciating assets, which can be transferred at full value at the end of a project's useful life. For BCA

purposes, these costs are therefore excluded, and the effective capital cost used in this BCA is $153m.[1] At a 7 percent discount rate, the total costs are $167.3m. At a 3 percent discount rate, the total costs are $205.5m.

Table 1: Tolled Express Lanes Capital Costs (numbers rounded to nearest hundred)

| Capital Cost Category | Costs (2013 $) | Costs (2013$) (Discounted at 7%) | Costs (2013$) (Discounted at 3%) |
|---|---|---|---|
| Capital Costs | $153,000,000 | $129,264,900 | $142,116,900 |
| Operations & Maintenance | $108,101,300 | $35,223,300 | $63,680,100 |
| Rehab & Recovery | $21,375,000 | $6,495,000 | $12,619,800 |
| Residual Value | ($57,100,000) | ($3,673,900) | ($12,916,900) |
| **Total** | **$225,376,300** | **$167,309,300** | **$205,499,900** |

*Source: Colorado Department of Transportation*

In real 2013 dollars, the Tolled Express Lanes creates $183.3m in present value benefits when discounted at 7 percent or $364.8m when discounted at 3 percent. The overall benefit matrix can be seen in Table 2.

Table 2: C-470 Tolled Express Lanes Impact and Benefits Matrix

| Type of Impact | Population Affected by Impact | Economic Benefit | Savings / (Costs) (7% discount rate) | Savings / (Costs) (3% discount rate) |
|---|---|---|---|---|
| Reduced congestion and wait times | Auto and truck drivers with reduced wait time and faster speeds | Travel time savings | $182.8m | $370.5m |
| Increase in auto and truck VMT | Auto drivers and truck drivers/companies in study region | Fuel savings | $(12.2m) | $(23.6m) |
| Increase in auto and truck VMT | Society | Oil import savings | $(1.2m) | $(2.2m) |
| Overall increase in auto and truck VMT | All drivers in study region | Reduction in driver O&M costs, non-fuel | $(15.9m) | $(31.1m) |

[1] The $153m capital cost figure also excludes the cost to reconstruct portions of the general purpose lanes estimated at approximately $77m. The total C-470 program capital cost is estimated at $230m in 2013 dollars.

| Type of Impact | Population Affected by Impact | Economic Benefit | Savings / (Costs) (7% discount rate) | Savings / (Costs) (3% discount rate) |
|---|---|---|---|---|
| Net effect of increase in system-wide VMT and safety improvements | All drivers in study region and society | Reduction in accidents | $28.0m | $47.4m |
| Net effect of faster speeds and increase in system-wide VMT | Society and surrounding communities | Reductions in emissions | $1.9m | $4.2m |
| Increase in auto and truck VMT | Surrounding communities | Increase in noise | $(0.1m) | $(0.2m) |
| Increase in auto and truck VMT | Government and society | Increase in pavement damage | $(0.1m) | $(0.2m) |
| **TOTAL BENEFITS** | | | **$183.3m** | **$364.8m** |

*Source: Parsons Brinckerhoff, 2014*

As illustrated by Table 3 below, benefits from the Tolled Express Lanes are concentrated in travel time savings, safety improvements and emission reductions. The projected decrease in VHT and increase in average driver speed over the time period analyzed drive these benefits. The overall impacts can be seen in Table 3, which shows the magnitude of change and direction of the various impact categories.

It is important to note that tolls are not included in the benefits, but are treated as an economic transfer from toll lane users to the project owner. Tolls are used to maintain the facility and finance the initial capital investment. An additional benefit of tolling that is not quantified in this BCA is the provision tolling provides as a tool to optimize the efficiency of the highway, as compared with a general purpose non-toll lanes.

Table 3: Impacts of the C-470 Tolled Express Lanes Cumulative 2017-2046

| Category | Quantity |
|---|---|
| Vehicle-miles traveled (VMT) | ▲ 355.1m |
| Vehicle-hours traveled (VHT) | ▼ 25.5m |
| Fuel consumed (gal.) | ▲ 12.1m |
| Oil imported (gal.) | ▲ 11.5m |
| Fatalities (number) | ▼ 6.3 |
| Injury accidents (number) | ▼ 80.5 |
| Property damage only accidents (number) | ▼ 2,830.9 |

| | |
|---|---|
| CO2 Emissions (tons) | ▼ 0.1m |
| NOX emissions (tons) | ▲ 9 |
| PM10 (tons) | ▲ 16 |
| SOX (tons) | ▼ 1 |
| VOC (tons) | ▲ 8 |

*Source: Parsons Brinckerhoff, 2014*

Table 4 below shows the overall results of the BCA. At a 7 percent discount rate, the Tolled Express Lanes yields a benefit-cost ratio of 1.1 over a 30 year analysis period, and using a 3 percent discount rate, a benefit-cost ratio of 1.8.

Table 4: Benefit Cost Analysis Summary Results

| Scenario | Net Present Value (2013$) | Benefit Cost Ratio |
|---|---|---|
| **Case A (7 percent discount rate)** | $15,975,300 | 1.1 |
| **Case B (3 percent discount rate)** | $159,347,300 | 1.8 |

*Source: Parsons Brinckerhoff, 2014*

Sensitivity tests were conducted utilizing a range of valuations for benefit categories and impacts (described further in this analysis). While the results displayed are the baseline and most likely numbers, further statistical analysis was conducted to meet the U.S. DOT's recommendations of a thorough sensitivity analysis.

Using PRISM™ sensitivity analysis, it was found that there is at least a 75% chance of the benefit-cost ratio exceeding 1.0 at a 7 percent discount rate, and greater than a 99% chance of the benefit-cost ratio exceeding 1.0 at a 3 percent discount rate.

# Introduction

A benefit-cost analysis (BCA) was conducted for the C-470 Tolled Express Lanes (Tolled Express Lanes) for submission to the U.S. Department of Transportation (U.S. DOT) as a requirement of a discretionary grant application for the TIGER VI program. The analysis was conducted in accordance with the benefit-cost methodology as recommended by the U.S. DOT in the Guide to Preparing Benefit-Cost Analyses for TIGER Grants[2] and the Notice of funding availability (79 FR 11854).

# Analytical Assumptions

## Discount Rates

For project investments, dollar figures in this analysis are expressed in constant 2013 dollars. In instances where certain cost estimates or benefit valuations were expressed in dollar values in other (historical) years, the U.S. Bureau of Labor Statistics' Consumer Price Index for Urban Consumers (CPI-U) was used to adjust them.[3]

The real discount rates used for this analysis were 3.0 and 7.0 percent, consistent with U.S. DOT guidance for TIGER VI grants[4] and OMB Circular A-4.[5].

## Evaluation Period

The evaluation period includes the relevant construction period during which capital expenditures are undertaken, plus 30 years of operations beyond the Tolled Express Lanes completion within which to accrue benefits.

For the purposes of this study, it has been assumed that construction of the Tolled Express Lanes begins in 2015. The construction period continues through 2016, and operations will begin in 2017. The analysis period, therefore, begins with the first expenditures in 2015 and continues through 30-years of operations, or through 2046.

All benefits and costs are assumed to occur at the end of each year, and benefits begin in the calendar year immediately following the final construction year.

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[2] TIGER 2014 NOFA: Benefit-Cost Analysis Guidance, Updated March 14, 2014; http://www.dot.gov/tiger/guidance

[3] U.S. Bureau of Labor Statistics. Consumer Price Index, All Urban Consumers, U.S. City Average, Motor Fuel. Series CUUR0000SETB. 1982-1984=100

[4]TIGER 2014 NOFA: Benefit-Cost Analysis Guidance, Updated March 14, 2014;http://www.dot.gov/tiger/guidance; http://www.dot.gov/policy-initiatives/tiger/tiger-2013-nofa-benefit-cost-analysis-guidance

[5] White House Office of Management and Budget, Circular A-94, *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs* (October 29, 1992). (http://www.whitehouse.gov/omb/circulars_a094).

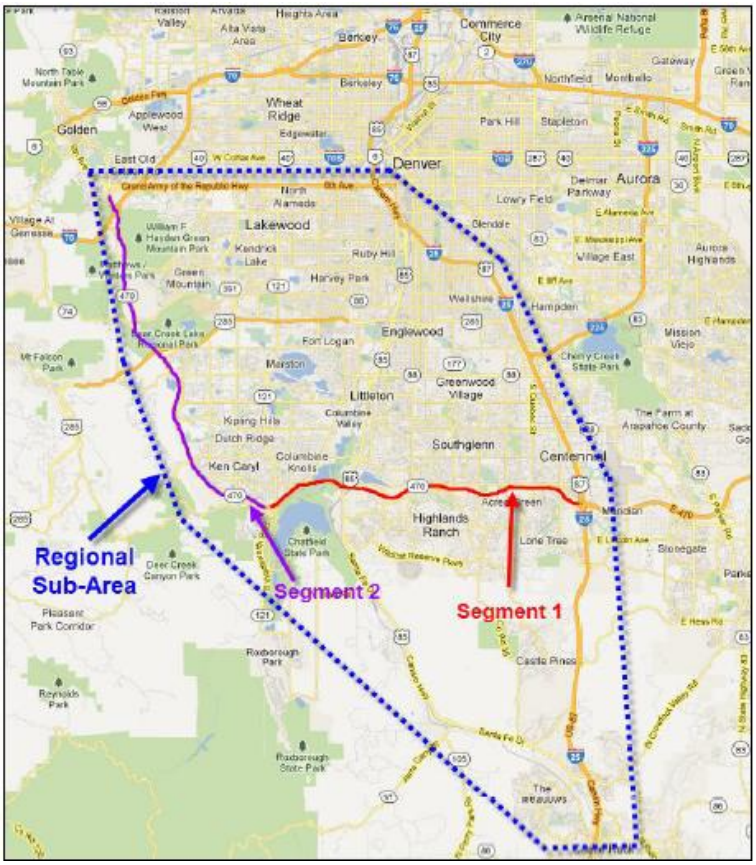
## Annualizing Factor Assumptions

Travel demand models produce outputs on daily or sub-daily basis. The Cambridge Systematics (CS) report, "C-470 Corridor, Kipling to I-25 Traffic Modeling: Level II Traffic and Revenue" (Level II Analysis) details the methodology and results of their study. CS modeled AM Weekday peak projections (6 a.m. to 1 p.m.) and PM weekday peak projections (1 p.m. to 8 p.m.) to estimate a Daily Weekday traffic. CS assumed Weekday Off-Peak (8 p.m. to 6 a.m.) traffic is negligible and Daily Weekend output is 78.1% of Daily Weekday. Annualization factors (252 for Daily Weekday travel and 113 for Daily Weekend travel) were used to convert the daily travel demand outputs into annual values.

## Modeled Region

The entire C-470 freeway extends for approximately 26 miles from I-70 on the west to I-25 on the south. It was planned to be part of the Interstate Highway System as I-470 in the 1970s, but was built in the 1980s and completed in 1990 as a State Highway. C-470 also connects to a toll highway (E-470) at the south end, which continues eastward and then northward to Denver International Airport, thence westward to the northwestern quadrant of the metropolitan area via the Northwest Parkway, another fully tolled highway. The region's adopted long-range transportation plan envisions future continuation of the tollway system to complete a loop around the metropolitan area. C-470 is currently the only un-tolled sector of the loop.

Figure 1: Regional Sub-Area (travel demand-modeled area)



The Tolled Express Lanes will be built along the red portion of the roadway illustrated in the map as Segment 1. The geographic sub-area analyzed (for travel demand purposes) encompasses the dense business and residential area north of C-470 and rural areas to the south, enclosed by the blue dotted line. I-25 borders the eastern side of the sub-area, and the western part of the C-470 beltway (Segment 2) runs along the west side of the sub-area.

## Travel Demand Sources and Forecast Years for Highway Benefits

The travel demand data used in this BCA was extracted from the Level II Analysis completed in January 2014. The model's base year was 2010 and produced raw VMT and VHT projections in 2025 and 2035. Base year travel demand relies on the Denver Regional Council of Governments FOCUS model, which is the region's state-of-the-art multimodal travel demand model and is utilized in regional and sub-regional studies. Travel demand, in the form of origin-destination matrices (ODs) within the larger regional study area, were based on the FOCUS model. To better match the observed traffic data, these ODs were calibrated to observed traffic counts.

Even though only the trips within the simulated area are utilized for the revenue and operational analysis, the decision to calibrate the demands within the larger regional area was based on the need to be able to capture regional diversion dynamics associated with the proposed Tolled Express Lanes. As previously mentioned, C-470 is part of a regional highway network and that intersects with I-70, I-25, and E-470 at various points around the Denver metropolitan area. Calibrating the demands within this larger regional area is based on the idea that the design and operations of the C-470 facilities will impact regional travelers' decisions with regard to route choice. The inclusion of a regional network affords travelers that option.

Future demand projections accounted for time-of-day pricing in the tolled express lanes, pre-trip, and en route decisions based on behavioral responses in the region to the Tolled Express Lanes. After all of the changes to the model inputs associated with the future year scenarios are incorporated into the regional model dataset, the regional model was used to forecast future year traffic flows in a manner consistent with the base year for each scenario. Incremental growth for every OD pair was added to the base year calibrated trips.

VMT/VHT projections for this BCA analysis come from the sub-area outlined by the map above. To estimate annual VMT/VHT output, we interpolated annual results between 2010, 2025 and 2035 and extended the growth rate between 2025 and 2035 through 2046.

In addition to the assumptions about travel demand data listed above, this analysis utilizes PRISM™ sensitivity analysis to test a +/- 25 percent sensitivity on all travel demand figures.

## PRISM™

This benefit cost analysis was done using PRISM™ (http://prism.pbworld.net/), a benefit cost analysis tool that uses a methodology consistent with the most recent guidelines developed by USDOT. The tool determined benefits according to the following five categories: State of Good Repair; Economic Competitiveness; Livability; Sustainability; and Safety. In addition, PRISM's risk analysis capabilities (using Monte Carlo simulations) provided statistically derived 'high' and 'low' scenarios for the benefit cost ratio – e.g., 95% confident that the benefit cost ratio will fall between X and Y.

PRISM™ is designed to take into account the difficulty in determining the "true value" of a given impact by allowing for a range of per unit values: low, likely, and high. The range established by the low, likely, and high values allow PRISM™ to run Monte Carlo simulations, which create a probability distribution function. The probability distribution functions are created according to the function described in the Beta distribution.[6] Details of the distribution as it is employed in PRISM™ are found in the betaPert (Open Pert) documentation, which uses the modified PERT distribution, a type of Beta distribution.[7]

# Economic Benefits Included

The following identifies and groups the benefits that are included in the BCA for the Tolled Express Lanes. While this section discusses the valuations used for each benefit category specifically, a model output summary of all valuations as used in PRISM™ sensitivity analysis, with statistical details, are available in Appendix C.

## Economic Competitiveness

### Travel Time Savings

Travel time savings includes in-vehicle travel time savings for auto drivers and passengers as well as truck drivers. Travel time is considered a cost to users, and its value depends on the disutility that travelers attribute to time spent traveling. A reduction in travel time would translate into more time available for work, leisure, or other activities.

#### *Value of Time Assumptions*

Travel time savings must be converted from hours to dollars in order for benefits to be aggregated and compared against costs. This is performed by assuming that travel time is valued as a percentage of the average wage rate, with different percentages assigned to different trip purposes (Table 5).

Values are broken down as low, likely and high for use in PRISM™ sensitivity analysis based on the percentages in Table 5, as recommended by U.S. DOT. [8] A table containing the actual values of time follows.

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[6] http://www.itl.nist.gov/div898/handbook/eda/section3/eda366h.htm

[7] http://code.google.com/p/openpert/downloads/detail?name=openpert_reference_guide.pdf

[8] Office of the Secretary of Transportation. (2011). *Revised Departmental Guidance: Valuation of Travel Time in Economic Analysis,* p. 11-12. (http://ostpxweb.dot.gov/policy/reports/vot_guidance_092811c.pdf)

Table 5: U.S. DOT Recommended Values of Time Person-Hour as a Percentage of Total Earnings

| Category | Surface Modes (Except High-Speed Rail) Low | Likely | High |
|---|---|---|---|
| **Local Travel** | | | |
| Personal | 35% | 50% | 60% |
| Business | 80% | 100% | 120% |
| **Intercity Travel** | | | |
| Personal | 60% | 70% | 90% |
| Business | 80% | 100% | 120% |
| **Vehicle Operators** | | | |
| **All** | 80% | 100% | 120% |

*Source: Office of the Secretary of Transportation, 2011.*

Table 6: U.S. DOT Recommended Values of Time, 2013

| **Category** | **Values of time (2013 U.S $ per person-hour) Low** | **Values of time (2013 U.S $ per person-hour) Likely** | **Values of time (2013 U.S $ per person-hour) High** |
|---|---|---|---|
| **Surface (except High-Speed Rail)** | | | |
| Local Travel | | | |
| Personal | $8.98 | $12.64 | $15.40 |
| Business | $19.89 | $24.87 | $29.84 |
| All Purposes | $9.49 | $13.20 | $16.07 |
| Intercity Travel | | | |
| Personal | $14.92 | $17.70 | $22.38 |
| Business | $19.89 | $24.87 | $29.84 |
| All Purposes | $15.98 | $19.23 | $23.98 |
| **Air and High-Speed Rail** | | | |
| Intercity Travel | | | |
| Personal | $27.24 | $33.63 | $36.07 |
| Business | $49.45 | $61.81 | $74.17 |
| All Purposes | $36.21 | $45.01 | $51.46 |
| **Other** | | | |
| Truck Drivers | $20.96 | $26.21 | $31.45 |
| Bus Drivers | $21.73 | $27.16 | $32.30 |

*Source: Office of the Secretary of Transportation, 2011.*

The division between personal and business travel was evaluated in the C-470 travel demand model and found to be almost identical to the national averages, therefore the national averages reflected in the table above for "all purposes" are used. These represent a weighted average of the personal and

business values of time according to national proportions of personal and business as calculated by the U.S. DOT.[9]

The Tolled Express Lanes are expected to handle a higher than average percentage of intercity trips due to the fact that they connect two major interstate highways (I-25 and I-70) and would be the shortest route for movements from the south going west and vice versa. However, the C-470 travel demand model's sub-area analysis could not quantify these longer (intercity) trips, therefore a conservative approach to estimating intercity travel, using a national average, was used. Based on the 2001 SHTS study, an assumption that 8.1% of corridor traffic was "intercity" was incorporated.[10] Together, these allocations result in a blended "Likely All Purposes" value of time of $14.35 (2013).

U.S. DOT guidance accepts the use of a real growth rate of 1.6 percent a year for the value of time.[11] This real growth rate was thus applied for values of time in the years after 2013.

### *Average Vehicle Occupancy*

Because travel time savings are incurred per individual and not per vehicle, it is necessary to identify the number of person-hours traveled as well as the vehicle-hours traveled.

In order to do this, this analysis assumes an average vehicle occupancy (AVO) rate of 1.4 persons per vehicle for all trips. This AVO rate is adopted from the National Household Travel Survey 2009's data for Colorado for all trips.[12]

### Reductions in Vehicle Operating Costs

Vehicles have operating costs beyond fuel costs that will be addressed in this report. These costs include maintenance and repair, replacement of tires, and the depreciation of the vehicle over time. The per-VMT factors of these costs were estimated by a Minnesota DOT study, [13] and used in this analysis (see the table below). Since the original study estimated the likely range for these values in 2003 dollars, the values for this analysis have been updated to 2013 dollars using a CPI adjustment.[14]

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[9] Ibid.

[10] 2001 NHTS (Hu, P. S. and T. R. Reuscher, Summary of Travel Trends, 2001 National Household Travel Survey, Prepared by Oak Ridge National Laboratory, Submitted to the Federal Highway Administration, Washington, DC, November 2004.)

[11] Office of the Secretary of Transportation. (2011). *Revised Departmental Guidance: Valuation of Travel Time in Economic Analysis,* p. 14. (http://ostpxweb.dot.gov/policy/reports/vot_guidance_092811c.pdf)

[12] Federal Highway Administration. (2009). National Household Travel Survey (Online Database). from U.S. Department of Transportation. (http://nhts.ornl.gov/tools.shtml)

[13] Minnesota Department of Transportation. (2003). *The Per-mile Costs of Operating Automobiles and Trucks.* (MN/RC 2003-19), p.22, Table 4.2. (http://www.lrrb.org/pdf/200319.pdf).

[14] Bureau of Labor Statistics, Consumer Price Index, All Urban Consumers, US City Average, All Items, Series CUSR0000SA0.

Table 7: Non-Fuel Vehicle O&M Costs Automobile

| Cost Category | Automobile (2013 $ / VMT) Low | Automobile (2013 $ / VMT) Likely | Automobile (2013 $ / VMT) High |
|---|---|---|---|
| Maintenance / Repair | 0.0405 | 0.0481 | 0.0506 |
| Tires | 0.0114 | 0.0114 | 0.0139 |
| Depreciation | 0.0785 | 0.0937 | 0.0988 |
| **Total** | **0.1304** | **0.1532** | **0.1633** |

*Source: Minnesota Department of Transportation, 2003; Parsons Brinckerhoff, 2014*

Table 8: Non-Fuel Vehicle O&M Costs Commercial Truck

| Cost Category | Commercial Truck (2013 $ / VMT) Low | Commercial Truck (2013 $ / VMT) Likely | Commercial Truck (2013 $ / VMT) High |
|---|---|---|---|
| Maintenance / Repair | 0.1329 | 0.1532 | 0.1659 |
| Tires | 0.0444 | 0.0443 | 0.0557 |
| Depreciation | 0.1013 | 0.1165 | 0.1266 |
| **Total** | **0.2787** | **0.3140** | **0.3482** |

*Source: Minnesota Department of Transportation, 2003; Parsons Brinckerhoff, 2014*

### *Vehicle Operating Costs – Fuel*

#### *Fuel Prices*

Fuel efficiency values were derived from the U.S. Energy Information Administration (EIA), which provides estimates for the of fuel efficiency through 2035. The values used to calculate fuel efficiency can be found in the table published by EIA titled "Transportation Sector Key Indicators and Delivered Energy Consumption."[15] The following fuel efficiency values were used for the different vehicle classes:

- "Light Duty Stock" energy efficiency (mpg) for passenger vehicles.
- "Freight truck" energy efficiency (mpg) for trucks.

All dollars were reported in real 2011 dollars by the EIA. These dollar amounts were subsequently converted to real 2013 dollars using the U.S. Bureau of Labor Statistics Consumer Price Index adjustment for "motor fuel" between 2011 and 2013.[16]

Because fuel taxes are considered a pecuniary benefit, or transfer payment, they cannot be accurately included in benefit calculations of a BCA. Thus, the federal and state taxes estimated by the EIA are subtracted out of the end user fuel prices.

[15] Energy Information Administration. (2012). Annual Energy Outlook 2013. *Components of Selected Petroleum Product Prices, United States, Reference case.* [Microsoft Excel] (http://www.eia.gov/oiaf/aeo/tablebrowser/)
[16] U.S. Bureau of Labor Statistics. Consumer Price Index, All Urban Consumers, U.S. City Average, Motor Fuel. Series CUUR0000SETB. 1982-1984=100, 2010=240.724; 2011=301.448

Table 9: Fuel Efficiency (miles per gallon) EIA reference Case

| Fuel Type | 2012 | 2020 | 2030 | 2040 | 2050 |
|---|---|---|---|---|---|
| Automobiles (Light Duty Stock) | 20.89 | 24.08 | 31.33 | 35.10 | 42.37 |
| Trucks (freight truck) | 6.67 | 7.33 | 7.89 | 7.94 | 8.43 |

*Source: U.S. Energy Information Administration, 2013; Parsons Brinckerhoff, 2014*

Finally, the EIA provides estimates low likely and high fuel price estimates through 2040; however the analysis period relevant for this project stretches beyond this timeframe and thus estimated fuel prices in those future years are also necessary. In order to do estimate fuel prices that extend beyond 2040, the compound annual growth rate (CAGR) for 2011-2040 was calculated and then used to continue the series through the end of the analysis period.

The following table provides the range of fuel prices, in real 2013 dollars, and a breakdown of values used for PRISM™ sensitivity analysis, for selected years.

Table 10: Fuel Prices (real 2013 $ / gallon)

| Fuel Type | 2013 | 2020 | 2030 | 2040 | 2050 |
|---|---|---|---|---|---|
| Motor Gasoline Low | $2.83 | $2.23 | $2.23 | $2.31 | $2.11 |
| Motor Gasoline Likely | $2.83 | $2.93 | $3.30 | $3.97 | $4.30 |
| Motor Gasoline High | $2.83 | $3.90 | $4.53 | $5.50 | $6.64 |
| Diesel Low | $2.90 | $2.28 | $2.46 | $2.55 | $2.38 |
| Diesel Likely | $2.90 | $3.21 | $3.83 | $4.58 | $5.11 |
| Diesel High | $2.90 | $4.37 | $5.37 | $6.45 | $8.02 |

*Source: U.S. Energy Information Administration, 2013; Parsons Brinckerhoff, 2014*

To account for change in the cost of fuel overtime, this analysis used the average fuel cost across the time period of the analysis, from 2017-2046, for each fuel type. This will overestimate the cost in the short term but will underestimate it in the long term balancing this effect out.

### Oil Import Costs

Fuel consumption has a cost beyond the actual operating costs and environmental costs of the consumption, and this additional cost is expressed as the economic cost of oil imports. This concept reflects two ideas: a monopsony component and a price shock component.

The monopsony component derives from the following logic; because the U.S. is such a large consumer of oil an increase in U.S. demand for oil will lead to higher fuel prices (based on supply and demand relationships). The price shock component comes from the fact that when there is a reduction in oil supplies this leads to higher oil prices which in turn reduce the level of U.S. economic output. As a consequence, reducing oil imports by consuming less fuel reduces the impact of these costs on the U.S.

economy. The National Highway Traffic and Safety Administration estimates that each gallon of fuel saved reduces total U.S. imports of refined fuel or crude oil by 0.95 gallons. [17]

The likely value for NHTSA's estimate of the per-gallon cost of oil imports (both the monopsony and price shock components combined) is $0.285 per gallon (2005 $). When converted to 2013 dollars using the CPI adjustment,[18] this value is $0.340 per gallon (2013 $). For the range of values estimated by NHTSA as adjusted to 2013 dollars, see Table 11.

Table 11: Cost of Oil Imports

| | Low | Likely | High |
|---|---|---|---|
| **Cost of Oil Imports (2013 $)** | $0.138 | $0.340 | $0.582 |

*Source: NHSTA 2009, Parsons Brinckerhoff 2014*

## Safety

### Accident Cost Savings

The BCA projects accident cost savings through several mechanisms. First, it assumes constant accident rates for the "Build" and "No Build" scenarios. As a result, one change in the number of accidents depends on changes in VMT, which increases over time, not of structural changes to the safety conditions on the roadway network. Based on VMT alone, therefore, accident rates will increase.

This approach captures accident changes on the network as a whole, but does not account for increased safety expected from the type of road improvements in the "Build" scenario. A report, "Traffic Safety Chapter for the C-470 Corridor Environmental Assessment, Project No. NH 4701-103," prepared by CDOT Region 6 in February 2005 discusses safety improvements that accompany adding capacity to a four lane highway facility such as C-470. It states:

> "…in the urban freeway environment, widening from 4 to 6 lanes is expected to yield an overall reduction in collisions of up to 25% at an ADT of 70,000 vehicles per day"
>
> And
>
> "…at an average ADT of 70,000, studies indicate that up to 20% of severe injury and fatal accidents occurring on the present 4-lane configuration may be prevented."

Given these findings and historical accident data on C-470 for the past five years, estimates of the safety improvements that will accrue once the managed capacity enhancements are presented in the following table:

[17] National Highway Traffic and Safety Administration. (2009). Corporate Average Fuel Economy for MY 2011 Passenger Cars and Light Trucks, Final Regulatory Impact Analysis, p.viii-22 – viii-27.

[18] Bureau of Labor Statistics, Consumer Price Index, All Urban Consumers, US City Average, All Items, Series CUSR0000SA0.

Table 12: Accident Reduction on C-470

| | Annual Average by Type (2008-2012) | Reduction Rate | Annual Average Accident Reduction |
|---|---|---|---|
| Fatality | 1.6 | 20% | 0.3 |
| Injury | 23.0 | 20% | 4.6 |
| PDO | 268.4 | 25% | 67.1 |
| **Total** | **293.0** | | **72.0** |

*Source: CDOT, Parsons Brinckerhoff 2014*

Further, additional savings can be expected from the "direct-connect" improvements planned for the I-25 to C-470 westbound flyover ramps. Thirty-seven (37) PDO rear-end accidents and 16 PDO sideswipe accidents occur on the existing ramps each year. Based on FHWA crash reduction factors under an increase in number of lanes, CDOT found that rear ends accidents are expected to decrease 52% and sideswipes by 44% with the addition of these direct-connect ramps.

To estimate overall accident reductions, the increase in accidents projected by the increase in VMT is reduced by the aggregate accident savings from the mainline and direct-connect flyover ramps found in the tables above. In total, this results in a net positive safety impact from the Tolled Express Lanes, since VMT increases are relatively small.

An additional safety aspect of the Tolled Express Lanes is that two grade separated bicycle overpasses will be constructed on the corridor to allow bicyclists to safely cross over C-470. While bicyclists are legally forbidden to cross the highway, such crossings do occur and the overpasses will provide a safe new alternative.

The cost savings that arise from the reduction in the number of accidents include direct savings (e.g., reduced personal medical expenses, lost wages, and lower individual insurance premiums), as well as significant avoided costs to society (e.g., second party medical and litigation fees, emergency response costs, incident congestion costs, and litigation costs). The value of all such benefits – both direct and societal – could also be approximated by the cost of service disruptions to other travelers, emergency response costs to the region, medical costs, litigation costs, vehicle damages, and economic productivity loss due to workers' inactivity.

Accident rates for this analysis were derived from the Roadway Safety Technical Report for the C-470 Corridor from November 2013, which provided accident rates for 2012 collected by the Colorado DOT as the most recent available data. Data was provided based on fatalities, injuries, and property damage only (PDO) rates.

In order to convert these accident rates into the appropriate AIS scale for calculating benefits, national statistics from the National Highway Traffic and Safety Administration were used. [19] By using the

[19] National Highway Traffic Safety Administration (2002), The Economic Impact of Motor Vehicle Crashes, 2000, p. 9, Table 3 "Incidence Summary – 2000 Total Reported and Unreported Injuries."

national statistics, it was possible to derive the distribution of total injuries into their respective AIS categories, as indicated in the following table which lists each AIS category as a proportion of all possible injuries.

Table 13. U.S. AIS Categories as Proportion of All Non-fatal Injuries.

| Injury Type | Proportion |
|---|---|
| AIS 5 | 0.18% |
| AIS 4 | 0.69% |
| AIS 3 | 2.39% |
| AIS 2 | 8.28% |
| AIS 1 | 88.46% |
| All Injuries | 100% |

*Source: NHTSA, Parsons Brinckerhoff, 2014*

The following table lists all accident rates in the report and subsequently converted into AIS standards:

Table 14: Accident Rates per 100 million VMT in Colorado, 2012

| Accident Type | Accident Rate (per 100 million VMT) |
|---|---|
| Fatality | 1.55 |
| AIS 5 | 0.06 |
| AIS 4 | 0.25 |
| AIS 3 | 0.85 |
| AIS 2 | 2.95 |
| AIS 1 | 31.50 |
| Property Damage Only | 323.00 |

*Source: Colorado Department of Transportation, Parsons Brinckerhoff, 2014*

Monetized values for fatalities, and accidents categorized on the AIS scale are reported in the U.S. DOT's guidance for "Treatment of the Economic value of a Statistical Life"[20] – this includes low and high ranges used for PRISM™ sensitivity analysis. Values pertaining to property damage only accidents were reported by the National Highway Traffic and Safety Administration,[21] and have subsequently been updated to 2012 dollars by the U.S. DOT.[22] Since the likely range for these values were estimated in 2012

[20] Office of the Secretary of Transportation, *Guidance on Treatment of the Economic Value of a Statistical Life in U.S. Department of Transportation Analyses* (2013 update), Guidance on Treatment of the Economic Value of a Statistical Life in U.S. Department of Transportation Analyses.

[21] National Highway Traffic Safety Administration (2002*), The Economic Impact of Motor Vehicle Crashes, 2000,* p. 62, Table 3.

[22] U.S. Department of Transportation (2014), *Tiger Benefit-Cost Analysis (BCA) Resource Guide*, p.3. (http://www.dot.gov/tiger/docs/tiger-12_bca-resourceGuide.pdf).

dollars, the values for this analysis have been updated to 2013 dollars using a CPI adjustment. The following table lists the range of values used for PRISM™ sensitivity analysis for each accident type:

Table 15: Monetized Accident Values

| Accident Type | Unit Value (2013 $) Low | Unit Value (2013 $) Likely | Unit Value (2013 $) High |
|---|---|---|---|
| Fatality | $5,200,000 | $9,200,000 | $12,900,000 |
| AIS 5 | $3,083,600 | $5,455,600 | $7,649,700 |
| AIS 4 | $1,383,200 | $2,447,200 | $3,431,400 |
| AIS 3 | $546,000 | $966,000 | $1,354,500 |
| AIS 2 | $244,400 | $432,400 | $606,300 |
| AIS 1 | $15,600 | $27,600 | $38,700 |
| Property Damage Only | $3,540 | $3,934 | $4,327 |

*Source: U.S. DOT, 2008, 2011 and, 2013 update; NHTSA, 2002; Parsons Brinckerhoff, 2014*

## Sustainability

### Emissions

The Tolled Express Lanes will create environmental and sustainability impacts relating to air pollution associated with automobile and commercial truck travel. Five forms of emissions were identified, measured and monetized, including: nitrous oxide, particulate matter, sulfur dioxide, volatile organic compounds, and carbon dioxide.

#### *Emission Rates*

Per-mile emissions rates were derived from the California Department of Transportation's California Lifecycle Benefit-Cost Analysis Tool (CAL B/C).[23] This tool provides emissions rates for exactly two different years: 2011 and 2031. In order to develop emissions rates for years within this interval as well as beyond 2031, it was necessary to use certain growth rate assumptions.

Per mile emissions factors differ depending on vehicle, fuel efficiency, average speed, and driving conditions. This BCA used the California Department of Transportation's emissions factors from the California Life-Cycle Benefit-Cost Analysis Model (Cal B/C)[24] which provides emissions factors for automobiles, trucks, and buses at varying speeds, and applies a dynamic model. In general, at slower speeds vehicles emit pollutants at a greater rate.

It is important to note that a unique set of emissions factors exists at each speed. Thus, the emissions data set consists of emissions factors for each emissions type, by year, and by speed.

[23] California Department of Transportation (2010) California Life-cycle Benefit/Cost Analysis Model v4.1 [Microsoft Excel]. http://www.dot.ca.gov/hq/tpp/offices/eab/benefit_files/Cal-BCv4-1.xls

[24] California Department of Transportation (2010). *California Life-Cycle Benefit-Cost Analysis Mode.*. Cal-BCv4-1.xls. [Microsoft Excel] (http://www.dot.ca.gov/hq/tpp/offices/ote/benefit_files/Cal-BCv4-1.xls). Tab "Parameters", Cells BG7:CA250.

The CAL B/C documentation[25] indicates that growth rates for CO, $NO_X$, $PM_{10}$, and VOC are exponential, so the 2011 to 2031 compound annual growth rate (CAGR) was used to interpolate and extrapolate as necessary.

Growth for $SO_X$ and $CO_2$ were shown by CAL B/C to exhibit linear growth. Thus, a linear rate is used for these two emissions categories.

Finally, after 2031, emissions rates are assumed "flat-line." The flat-line represents both a leveling out of emissions rates, as well as a prudent observation of the uncertainty in estimating rates that far into the future.

The following tables show per-mile emissions rates at 35 mph for select years:

Table 16: Auto Emissions Rates (grams per vehicle-mile traveled), assuming 35 mph

| Emissions Type | 2011 | 2031 |
|---|---|---|
| $NO_X$ | 0.2672 | 0.0767 |
| PM | 0.0481 | 0.0468 |
| $SO_X$ | 0.0037 | 0.0037 |
| VOC | 0.2231 | 0.0701 |
| $CO_2$ | 351.97 | 344.48 |

*Source: California Department of Transportation, 2011; Parsons Brinckerhoff, 2014*

Table 17: Truck Emissions Rates (grams per vehicle-mile traveled), assuming 35 mph

| Emissions Type | 2011 | 2031 |
|---|---|---|
| $NO_X$ | 0.9024 | 0.2301 |
| PM | 0.0560 | 0.0528 |
| $SO_X$ | 0.0057 | 0.0057 |
| VOC | 0.2373 | 0.1160 |
| $CO_2$ | 546.04 | 550.73 |

*Source: California Department of Transportation, 2011; Parsons Brinckerhoff, 2014*

### *Value of Non-CO2 Emissions Costs*

The values of $PM_{10}$ emissions are derived from a report published by the National Cooperative Highway Research Program[26].

The likely values for $NO_x$, $SO_x$, and VOC were derived from a National Highway Traffic and Safety Administration's CAFE standards for MY2012-MY2016[27]. These are consistent with USDOT guidelines.

[25] California Department of Transportation. (2009). California Life-cycle Benefit/Cost Analysis Model, Technical Supplement to User's Guide (Vol. 3). Sacramento: California Department of Transportation.

[26] NCHRP Project 08-36, Task 61: Monetary Valuation per Dollar of Investment in Different Performance Measures (2007) http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP08-36%2861%29_FR.pdf

The remaining low and high values used in PRISM™ sensitivity analysis for non-GHG emissions come from Technical Supplement to the CAL B/C tool[28]. The resulting values are shown in the table below.

Table 18: Non-$CO_2$ Emissions Costs (2013 $ / metric ton)

| Emissions Type | Emissions Costs Low | Emissions Costs Likely | Emissions Costs High |
|---|---|---|---|
| $NO_X$ | $2,463 | $7,890 | $36,261 |
| PM | $1,659 | $3,634 | $8,655 |
| $SO_X$ | $14,881 | $46,635 | $141,110 |
| VOC | $239 | $2,002 | $2,463 |

*Source: NHTSA, 2010, Cal-B/C, 2013, Parsons Brinckerhoff, 2014*

### *Value $CO_2$ Emissions Costs*

The per-ton costs of carbon emissions were derived from the Interagency Working Group on the Social Cost of Carbon[29] as well as the analysis conducted by the US DOT in the Tiger Benefit –Cost Analysis Resource Guide.[30] The values used for this analysis were discounted at a 3 percent rate as recommended by the U.S. DOT.

Next the social cost of carbon was converted from 2007 dollars to 2013 dollars using a CPI adjustment.[31] Finally, values beyond year 2050 were extrapolated using the compound annual growth rate (CAGR) from 2040 to 2050. The table below shows the low, likely, and high social costs of carbon for selected years as used for PRISM™ sensitivity analysis. Low and high values are derived from the same Interagency Working Group study, which reports a range for the social cost of carbon.

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[27] National Highway Traffic and Safety Administration (March 2010), *Corporate Average Fuel Economy for MY2012-MY2016 Passenger Cars and Light Trucks*, page 403, Table VIII-8, "Economic Values for Benefits Computations (2007 Dollars)", http://www.nhtsa.gov/staticfiles/rulemaking/pdf/cafe/CAFE_2012-2016_FRIA_04012010.pdf

[28] California Life-Cycle Benefit/Cost Analysis Model (Cal-B/C) Technical Supplement to the User's Guide, Chapter 5. http://www.dot.ca.gov/hq/tpp/offices/eab/benefit_files/tech_supp.pdf

[29] U.S. Environmental Protection Agency, Interagency Working Group on Social Cost of Carbon (2010), *Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866,* p.2., Table 19, (http://www.epa.gov/oms/climate/regulations/scc-tsd.pdf).

[30] U.S. Department of Transportation, *Tiger Benefit-Cost Analysis (BCA) Resource Guide*, p.6. (http://www.dot.gov/tiger/docs/tiger-12_bca-resourceGuide.pdf)

[31] U.S. Bureau of Labor Statistics. Consumer Price Index, All Urban Consumers, U.S. City Average, Motor Fuel. Series CUUR0000SETB. 1982-1984=100, 2010=239.178; 2011=302.619.

Table 19: Social Cost of Carbon at 3 percent Discounting (2013 $)

| | 2013 | 2020 | 2030 | 2040 | 2050 |
|---|---|---|---|---|---|
| Social Cost of $CO_2$ Low | $5.95 | $7.64 | $10.94 | $14.27 | $17.64 |
| Social Cost of $CO_2$ Likely | $25.62 | $29.55 | $36.85 | $44.04 | $50.45 |
| Social Cost of $CO_2$ High | $41.57 | $46.85 | $56.18 | $64.60 | $73.03 |

*Source: U.S. EPA, 2010; Parsons Brinckerhoff, 2014*

For present value calculations, the social cost of carbon was discounted at a 3 percent discount rate, consistent with the US DOT's guidance.[32]

To account for change in the social cost of carbon overtime the average cost across the time period of the analysis, from 2017-2046, for each case. This will overestimate the cost in the short term but will underestimate it in the long term balancing this effect out.

### Noise Pollution

Reducing VMT creates environmental benefits to society in the form of noise reduction. On a per-VMT basis, these values were estimated based on a Federal Highway Administration cost allocation study report.[33]

The high and low values for the cost of urban automobile noise are calculated as +/- 25 percent of the likely case. As the likely cost of rural automobile noise is so low (one one hundredth of a cent), reducing it to arrive at a low value would not yield a meaningful figure. Therefore, in this case the low and likely values are the same. Similarly a 25 percent increase of such a small number would not be significant and the likely value was doubled to create a conservative high value.

When calculating the impact of truck noise, the 40 kip[34] 4-axle single unit trucks were used for the low value, 60 kip 4-axle single unit trucks for the likely value and 60 kip 5-axle combination units for the high case.

An urban/rural split of 55% percent to 45% percent was used to create a weighted average of the FHWA values for those environments. The urban/rural split resulted from an analysis of Census Tracts along the C-470 Corridor. Approximately 5.5 of the 12.3 miles of the C-470 roadway dedicated to this Tolled Express Lanes fall in Census Tracts that include areas deemed "rural" by the US Census. An aerial view of these miles confirmed the land surrounding this section of roadway is vacant of development and will not be development due to permanent open space and drainage/utility easements.

[32] U.S. Department of Transportation (2011), *Tiger Benefit-Cost Analysis (BCA) Resource Guide*, p.7-9. (http://www.dot.gov/tiger/docs/tiger-12_bca-resourceGuide.pdf)

[33] Federal Highway Administration, *Addendum to the 1007 Federal Highway Cost Allocation Study,* Table 13. (http://www.fhwa.dot.gov/policy/hcas/addendum.htm).

[34] A kip is a unit of mass, equal to 1,000 pounds, i.e. one half of a short ton and is used as a unit of deadweight to compute shipping charges.

All FHWA values were adjusted from the study's 2000 values to 2013 dollars using a CPI adjustment.[35] See Table 20 for the range of values used in the PRISM™ sensitivity analysis.

Table 20: Noise Costs, Auto and Truck, 55-45 Urban-Rural Split, 2013 $

| | Noise Costs per VMT Low | Noise Costs per VMT Likely | Noise Costs per VMT High |
|---|---|---|---|
| Auto | 0.00073 | 0.00073 | 0.00146 |
| Truck | 0.01171 | 0.01317 | 0.02150 |

*Source: FHWA, Parsons Brinckerhoff, 2014*

## State of Good Repair

As with noise pollution, increases in VMT lead to societal costs in the form of increased costs of pavement damage. Increased vehicle-miles traveled lead to a higher cost to maintain roads. The per-mile costs of these values were estimated based on the same Federal Highway Administration cost allocation study report that reported estimations of the cost of noise pollution.[36]

When calculating the impact of truck pavement maintenance effects, the 40 kip[37] 4-axle single unit trucks were used for the low value, 60 kip 4-axle single unit trucks for the likely value and 60 kip 5-axle combination units for the high case.

The high and low values for the cost of urban automobile pavement maintenance effects are calculated as +/- 25 percent of the likely case.

The same urban/rural split used in the noise pollution calculations of 55% percent to 45% percent were used to create a weighted average of the FHWA values. All values were adjusted from the FHWA study's 2000 values to 2013 dollars using a CPI adjustment.[38] See Table 21 for the range of values used in the PRISM™ sensitivity analysis.

[35] Bureau of Labor Statistics, Consumer Price Index, All Urban Consumers, US City Average, All Items, Series CUSR0000SA0.

[36] Federal Highway Administration, *Addendum to the 1007 Federal Highway Cost Allocation Study,* Table 13. (http://www.fhwa.dot.gov/policy/hcas/addendum.htm).

[37] A kip is a unit of mass, equal to 1,000 pounds, i.e. one half of a short ton and is used as a unit of deadweight to compute shipping charges.

[38] Bureau of Labor Statistics, Consumer Price Index, All Urban Consumers, US City Average, All Items, Series CUSR0000SA0.

Table 21: State of Good Repair Values, Auto and Truck, 55-45 Urban-Rural Split, 2013 $

| | Pavement Damage Cost per VMT Low | Pavement Damage Cost per VMT Likely | Pavement Damage Cost per VMT High |
|---|---|---|---|
| Auto | 0.00073 | 0.00073 | 0.00146 |
| Truck | 0.00137 | 0.01220 | 0.03069 |

*Source: FHWA, Parsons Brinckerhoff, 2014*

## Livability

### Active Life Style Benefits

Increases in physical activity are linked to improved health. This improved health, in turn, produces societal benefits in two ways. First, the individual experiences private benefits in his or her own extended life expectancy, reductions in certain diseases such as heart disease and type II diabetes, and the medical expenses the individual will pay. Further, there are external benefits from the improved health of the individual because of reduced costs in subsidized medical care, emergency room visits, and marginal reductions group health insurance rates.

The Victoria Transportation Institute has accordingly monetized these benefits, thus estimating the external health cost savings to society that result from more active lifestyles.[39] The following table illustrates the range of values walking and biking health benefits used in the PRISM™ sensitivity analysis, and all values were adjusted to 2013 dollars using a CPI adjustment:[40] The range of low and high values were also derived from the range reported by the Victoria Transportation Institute.

Table 22: Non-Fuel Vehicle O&M Costs

| Category | 2013 $ per mile Low | 2013 $ per mile Likely | 2013 $ per mile High |
|---|---|---|---|
| Cycling Health Benefits | $0.090 | $0.100 | $0.110 |
| Walking Health Benefits | $0.490 | $0.540 | $0.590 |

*Source: Victoria Transportation Policy Institute, 2011, Parsons Brinckerhoff, 2014*

The bicycle element of the Tolled Express Lanes noted above (grade separated crossovers linking the southern side of C-470 to the northern side) will enhance the recreation and commutation utility of the corridor bike trail network. Analysis estimating the number of additional people / bike miles traveled on this network was not available for the BCA, however, it is expected that material health benefits will accrue to residents of the corridor who will cycle more frequently, either recreationally or as a substitute to commuting by automobile to work.

[39] Victoria Transport Policy institute (2005), *Transportation Cost Benefit Analysis,* P. 5.3-48, (http://www.vtpi.org/tca/tca0503.pdf)

[40] Bureau of Labor Statistics, Consumer Price Index, All Urban Consumers, US City Average, All Items, Series CUSR0000SA0.

## Economic Costs Included and Assumptions

In the benefit-cost analysis, the term "cost" refers to the additional resource costs or expenditures required to implement, and maintain the investments associated with the Tolled Express Lanes.

The BCA uses project costs that have been estimated for the Tolled Express Lanes on an annual basis. Operations and maintenance costs and rehabilitation costs were initially expressed in real dollars while the capital costs were initially expressed in real 2013 dollars. All costs were converted to real 2013 dollars based on CPI-U adjustments.[41]

### Initial Tolled Express Lanes Investment Costs

Initial project investment costs include engineering and design, construction, real estate services, vehicles, other capital investments, and contingency factors. The total Tolled Express Lanes cost is $153m. Capital costs are incurred beginning in 2015 and ending at the end of 2016. The facility is expected to be operational in 2017.

Outlays for the acquisition of real assets (right of way) are excluded from total costs in this BCA. This is because when the government acquires a real asset, it is classified as an asset purchase and not a cost. The Colorado Department of Transportation would be in possession of tangible assets that, at least historically, had not depreciated in value. Other capital costs related to the reconstruction of existing general purpose lanes in the corridor, totaling approximately $77M were also excluded from the capital cost for purposes of the BCA, as this reconstruction will not change the roadways functionality or capacity.

### Annual Operating and Maintenance Costs

The annual costs of operating and maintaining the proposed Tolled Express Lanes are included in the analysis.

The cost to operate a tolled express lane facility consists of all administrative and oversight functions within the organization, customer service, insurance, safety patrols, payment processing, marketing, and policing, among other things. For planning purposes, the majority of these costs can be expressed in a cost per transaction, which covers payment processing, customer service, and other "back office" administrative items. Payment processing for transponder transactions is highly automated relative to photo tolling transactions, and is therefore much less costly. Our analysis assumes $0.19 per transaction for transponders and $0.64 for photo tolls based on industry experience with similar toll facilities (2013 unit costs).

Additional operating costs deducted from Adjusted Gross Revenues are approximately $400,000 annually to fund CDOT in its oversight role and $135,000 annually for the Colorado State Highway Patrol to provide safety and enforcement on the facility (2013 unit costs).

[41] Bureau of Labor Statistics, Consumer Price Index, All Urban Consumers, U.S. City Average, All Items, Series CUSR0000SA0.

Based on CDOT experience in the corridor and studies performed for other similar facilities, a comprehensive roadway maintenance unit cost of $17,100 per lane mile (2013) was used to calculate the tolled express lane annual maintenance cost. This includes minor crack and pothole repair, sign and guardrail repair, mowing, snow removal, and other items. The Tolled Express Lanes includes approximately 32.5 lane miles of mainline and ramps, requiring annual O&M funding of about $3.6M (2013).

The O&M costs reported are the marginal operating costs, or the costs above and beyond those expected in the "no build" scenario. Operating and maintenance costs are assumed to begin in 2017 and continue for 30 years (through 2046).

## Periodic Capital Equipment Replacement Costs and Major Rehabilitation

Several types of initial asset investments will need to be replaced or rehabilitated during the evaluation period. To account for this, the financial analysis includes a schedule of rehabilitation and associated costs. These costs include roadway repaving every 15 years and toll equipment replacement every 10 years. From these R&R costs and schedules, the BCA analysis assumes toll equipment replacement costs of $5.0m in 2026 and 2036 as well as road repaving costs of $11.4m in 2031 (all 2013 $).

## Residual Value

The Tolled Express Lanes pavement sections are assumed to have a 30- year life, after which they will be in need of replacement. This occurs in year 2046, which is year 30 of operations. While this portion of the Tolled Express Lanes will be fully depreciated in 2046, structures, noise walls, and retaining walls will be built with a 75-year useful life, and will therefore have 45 years of residual value at the end of the BCA analysis period.

Specifically, the structures have a capital cost of $27.2m and a residual value in 2046 of $1.8m at a 7% discount rate and $6.2m at a 3% discount rate. The capital cost of the retaining walls total $12.3m, which have a residual value after 2046 of $0.8m at a 7% discount rate and $2.8m at a 3% rate. Finally, the capital cost of the noise walls is $17.6m. After 2046, the residual value of these walls is $1.1m at a 7% discount rate and $4.0m at a 3% discount rate. A summary of residual values can be found in Table 23 below.

Table 23: Residual Value Summary

| Asset | Capital Cost (not discounted) | Lifespan of Asset | Residual Value (at 7% discount) | Residual Value (at 3% discount) |
|---|---|---|---|---|
| **Bridges** | $27,200,000 | 75 years | $1,750,100 | $6,153,100 |
| **Retaining Walls** | $12,300,000 | 75 years | $791,400 | $2,782,500 |
| **Noise Walls** | $17,600,000 | 75 years | $1,132,400 | $3,981,400 |
| **TOTAL** | **$57,100,000** | | **$3,673,900** | **$12,917,000** |

The Residual Capital Value (RCV) is calculated by determining the percentage of useful life remaining beyond the analysis period, and multiplying that percentage by the construction cost for that component. This is done using the method recommended by the Minnesota DOT guidance for Benefit Cost Analyses (BCAs),[42] which is a non-linear depreciation method. The remaining capital value is viewed as "negative cost" and is applied to the last year of analysis period as a negative value.

The RCV factor is calculated in the following manner:

Equation 1. Residual Value / Remaining Capital Value Factor

$$RCVF = A \cdot \left(\frac{B - C}{B}\right)$$

$$such\ that$$
$$A = (1 + d)^n$$
$$B = (1 + d)^{l-1} * \frac{1}{d(1 + d)^l}$$
$$C = (1 + d)^{n-1} * \frac{1}{d(1 + d)^n}$$

$$where$$
$$RCVF = Remaining\ Capital\ Value\ Factor$$
$$n = time\ between\ construction\ or\ purchase\ and\ end\ of\ the\ analysis\ period$$
$$l = Expected\ life\ span\ of\ the\ asset$$

## Key Benefit-Cost Evaluation Measures

The benefit-cost analysis converts potential gains (benefits) and losses (costs) from the Tolled Express Lanes into monetary units and compares them. The following two common benefit-cost evaluation measures are included in this BCA.

Net Present Value (NPV): NPV compares the net benefits (benefits minus costs) after being discounted to present values using the real discount rate assumption. The NPV provides a perspective on the overall dollar magnitude of cash flows over time in today's dollar terms.

Benefit Cost (B/C) Ratio: The evaluation also estimates the benefit-cost ratio; the present value of incremental benefits is divided by the present value of incremental costs to yield the benefit-cost ratio. The B/C ratio expresses the relation of discounted benefits to discounted costs as a measure of the extent to which a project's benefits either exceed or fall short of their associated costs.

### Sensitivity Analysis

To test the robustness of the estimated NPV, and B/C ratio, the economic analysis runs PRISM™ sensitivity analysis simulations using the ranges of valuations already discussed, as well as sensitivity on

[42] MnDOT Office of Capital Programs and Performance Measures Benefit-Cost Analysis Standard Value Tables - July 2012 http://www.dot.state.mn.us/planning/program/appendix_a.html

impact and physical units to the degree of +/- 25 percent. For example, tons of carbon emissions were evaluated with PRISM™ sensitivity at a low value of 25 percent less than baseline estimates, and a high value of 10 percent above baseline estimates.

# Benefit-Cost Analysis Results

## Results in Brief

There were two "Cases" conducted for this analysis. Case A assumes a 7.0 percent discount rate, and Case B assumes a 3.0 percent discount rate, as prescribed by the U.S. DOT.

- For the Case A at a 7 percent discount rate, the proposed Tolled Express Lanes investments yield a net present value of $15.98m, and a benefit-cost ratio of 1.1.
- For the Case B at a 3 percent discount rate, the proposed Tolled Express Lanes investments yield a net present value of $159.35m, and a benefit-cost ratio of 1.8.

Table 24 presents the evaluation results for the two cases. All benefits and costs were estimated in constant 2013 dollars over an evaluation period extending 30 years beyond project completion in 2017.

Table 24: Benefit Cost Analysis Summary Results

| Scenario | Net Present Value (2013$) | Benefit Cost Ratio |
|---|---|---|
| **Case A (7 percent discount rate)** | $15,975,300 | 1.1 |
| **Case B (3 percent discount rate)** | $159,347,300 | 1.8 |

## Benefits by Category

Over the entire analysis period, Tolled Express Lanes exhibits increases in VMT and decreases in VHT.

Table 25 below outlines the changes in some of the impact categories. Some categories increased, while others decreased. Overall, the savings in many categories like travel time savings and emissions provided significant benefits from the reduction in VHT, which offsets other categories negative benefits, such as fuel and oil import savings. On net, the Tolled Express Lanes creates significant benefits.

Table 25: Tolled Express Lanes Impacts for Tolled Express Lanes, Cumulative 2017-2046

| Category | Quantity |
|---|---|
| Vehicle-miles traveled (VMT) | ▲355.1m |
| Vehicle-hours traveled (VHT) | ▼25.5m |
| Fuel consumed (gal.) | ▲12.1m |
| Oil imported (gal.) | ▲11.5m |
| Fatalities (number) | ▼6.3 |

| | |
|---|---|
| Injury accidents (number) | ▼80.5 |
| Property damage only accidents (number) | ▼2,830.9 |
| CO2 Emissions (tons) | ▼0.1m |
| NOX emissions (tons) | ▲9 |
| PM10 (tons) | ▲16 |
| SOX (tons) | ▼1 |
| VOC (tons) | ▲8 |

*Source: Parsons Brinckerhoff, 2013*

Over the 30-year analysis period, there are $183.3m in benefits (in 7% discounted 2013 dollars) and $364.8m in benefits (in 3% discounted 2013 dollars). The overall project benefit matrix can be seen in Table 26.

Table 26: Tolled Express Lanes Impact and Benefits Matrix

| Type of Impact | Population Affected by Impact | Economic Benefit | Savings / (Costs) (7% discount rate) | Savings / (Costs) (3% discount rate) |
|---|---|---|---|---|
| Reduced congestion and wait times | Auto and truck drivers with reduced wait time and faster speeds | Travel time savings | $182.8m | $370.5m |
| Increase in auto and truck VMT | Auto drivers and truck drivers/companies in study region | Fuel savings | $(12.2m) | $(23.6m) |
| Increase in auto and truck VMT | Society | Oil import savings | $(1.2m) | $(2.2m) |
| Increase in auto and truck VMT | All drivers in study region | Reduction in driver O&M costs, non-fuel | $(15.9m) | $(31.1m) |
| Net effect of increase in VMT and safety improvements | All drivers in study region and society | Reduction in accidents | $28.0m | $47.4m |

| Type of Impact | Population Affected by Impact | Economic Benefit | Savings / (Costs) (7% discount rate) | Savings / (Costs) (3% discount rate) |
|---|---|---|---|---|
| Net effect of faster speeds and increase in system-wide VMT | Society and surrounding communities | Reductions in emissions | $1.9m | $4.2m |
| Increase in auto and truck VMT | Surrounding communities | Increase in noise | $(0.1m) | $(0.2m) |
| Increase in auto and truck VMT | Government and society | Increase in pavement damage | $(0.1m) | $(0.2m) |
| TOTAL BENEFITS | | | **$183.3m** | **$364.8m** |

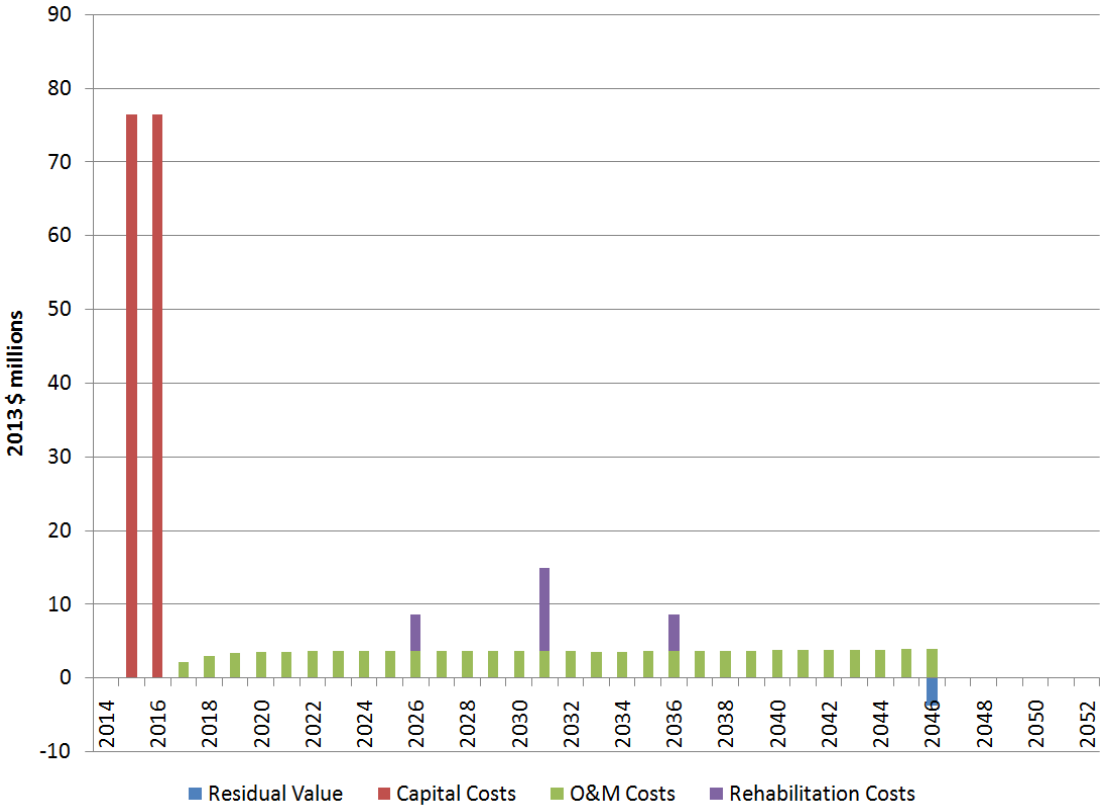
*Source: Parsons Brinckerhoff, 2014*

## Costs over Time

Figure 2 presents the capital expenditures over time, expressed in constant 2013 dollars before discounting. The capital investments ($153m) were assumed to begin in 2015 and conclude by the end of 2016.

Annual O&M costs over the economic evaluation period (2017-2046) are also expressed in constant 2013 dollars before discounting. In real dollars, these costs are expected to remain generally constant through 2046 aside from operating costs, which are driven by an increase in transactions. O&M costs total $108.1m over 30 years. Periodic rehabilitation of the Tolled Express Lanes through 2046 is predicted to total $21.4m.

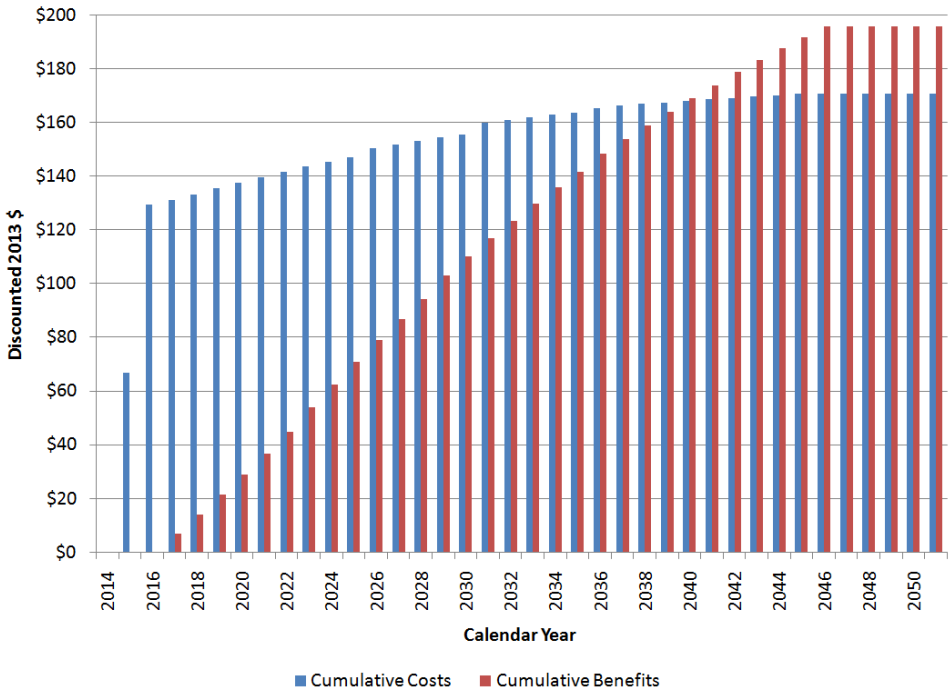
Figure 2: Capital and Rehabilitation Expenditures in 2013 Dollars Before Present Value Discounting




## Cumulative Benefits and Costs

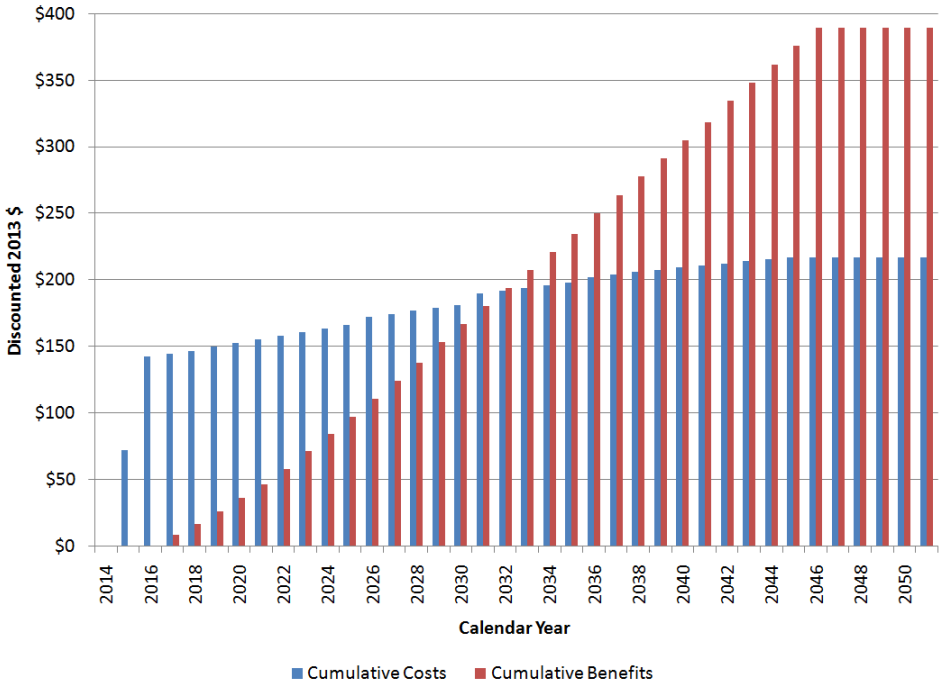
Figure 3 and Figure 4 compare the cumulative present value of benefits with the cumulative present value of costs over time for both cases. The figure shows that the cumulative discounted benefits exceed the cumulative discounted costs by mid-year 2040 with a 7 percent discount rate, and by mid-year 2032 with a 3 percent discount rate.

Figure 3: Cumulative Benefits and Costs in 2013 Dollars (Discounted at 7 percent)




*Source: Parsons Brinckerhoff, 2014*

Figure 4: Cumulative Benefits and Costs in 2013 Dollars (Discounted at 3 percent)




*Source: Parsons Brinckerhoff, 2014*

## APPENDIX A - PRISM™ Sensitivity Analysis

By using PRISM™ sensitivity analysis simulations on both the valuations and impacts it is able to create a 95% confidence interval for both the NPV and B/C ratio. Table 27 reports these ranges at the 7 percent and 3 percent discount rates.

Table 27: NPV and B/C Ratio, 95% Confidence Interval, 7% and 3% Discount Rates

| Case | Low | Likely | High |
|---|---|---|---|
| **Case A (7 percent discount rate)** | | | |
| B/C-Ratio | 0.9 | 1.1 | 1.3 |
| Net Present Value | $(16.7m) | $15.9m | $46.3m |
| **Case B (3 percent discount rate)** | | | |
| B/C Ratio | 1.4 | 1.8 | 2.1 |
| Net Present Value | $93.5m | $159.3m | $215.1m |

Furthermore, according to PRISM™ sensitivity analysis, there is over a 75% chance that the B/C ratio is above 1.0 at a 7 percent discount rate, and greater than a 99% chance that the B/C ratio is above 1.0 at a 3 percent discount rate.

Figure 5: PRISM™ Histogram for Benefit-Cost Ratio at 7% Discount Rate

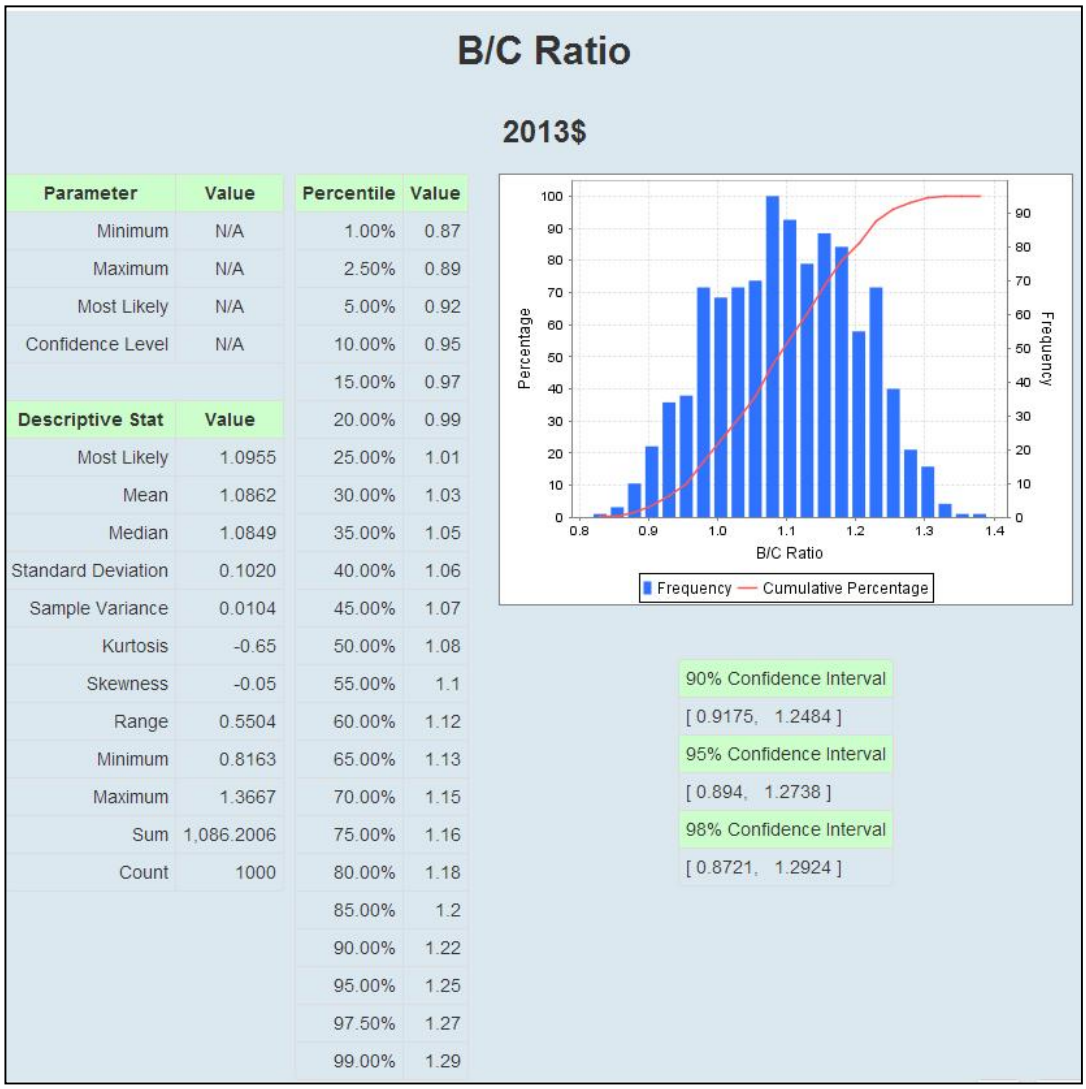


Figure 6: PRISM™ Histogram for Benefit-Cost Ratio at 3% Discount Rate

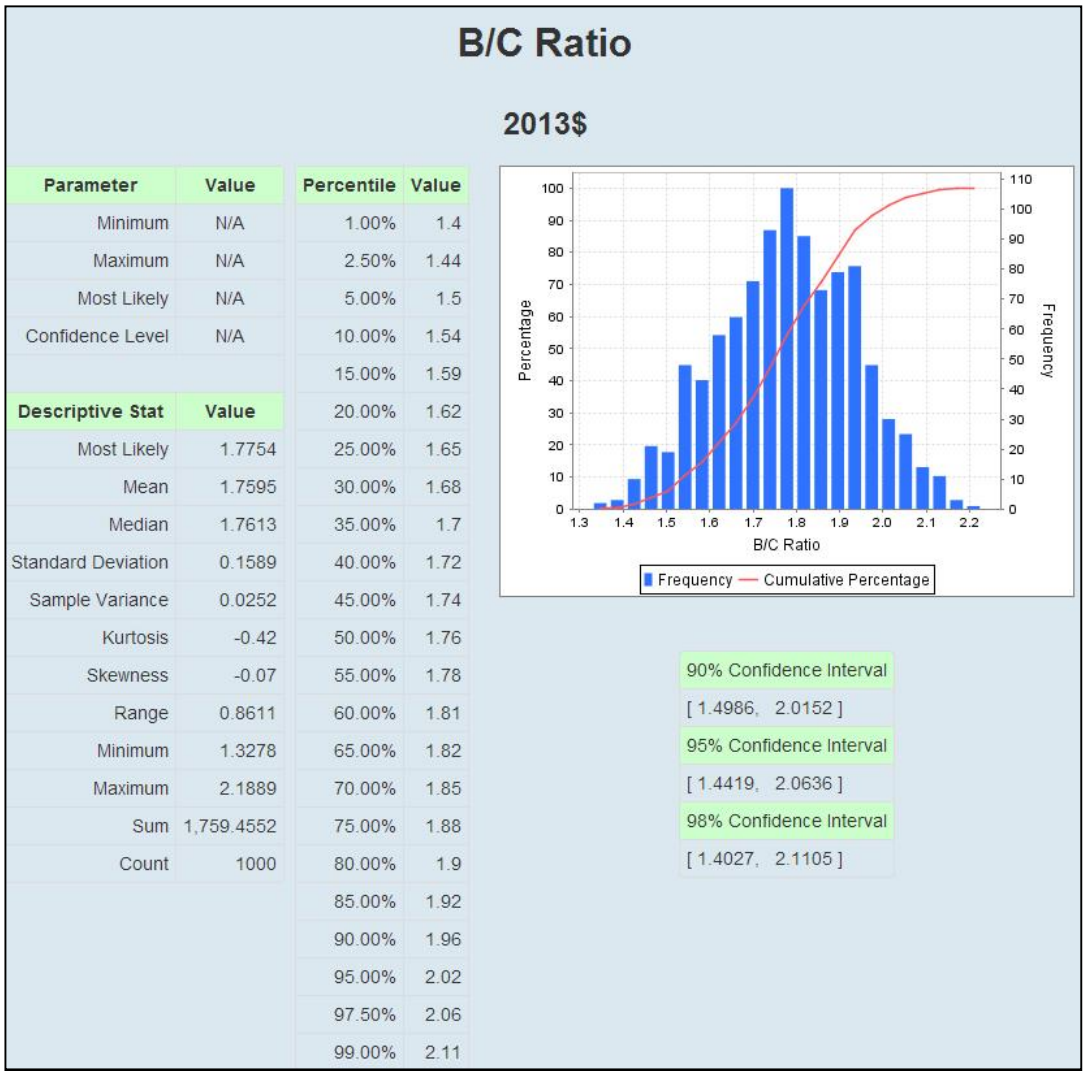


Figure 7: PRISM™ Histogram for Net Present Value at 7% Discount Rate

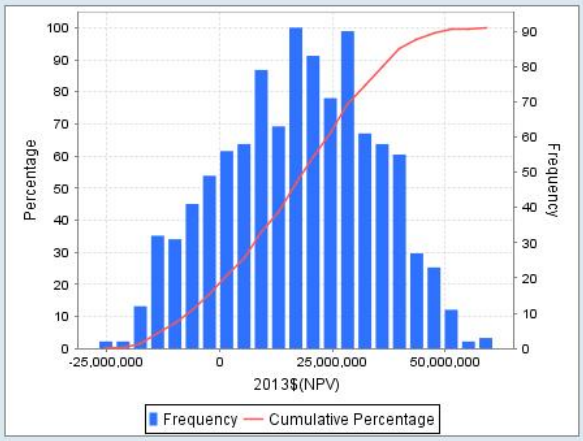
## Distribution

### 2013$

| Parameter | Value |
|---|---|
| Minimum | N/A |
| Maximum | N/A |
| Most Likely | N/A |
| Confidence Level | N/A |

| Descriptive Stat | Value |
|---|---|
| Most Likely | 15,975,339 |
| Mean | 15,507,341 |
| Median | 16,212,741 |
| Standard Deviation | 16,813,437 |
| Sample Variance | 282,691,676,911,948 |
| Kurtosis | -0.68 |
| Skewness | -0.11 |
| Range | 84,301,500 |
| Minimum | -27,186,673 |
| Maximum | 57,114,827 |
| Sum | 15,507,340,610 |
| Count | 1000 |

| Percentile | Value |
|---|---|
| 1.00% | -18,695,201.22 |
| 2.50% | -16,709,820.89 |
| 5.00% | -13,548,480.63 |
| 10.00% | -8,301,819.85 |
| 15.00% | -3,730,436.06 |
| 20.00% | -442,229.23 |
| 25.00% | 3,420,259.96 |
| 30.00% | 6,451,760.69 |
| 35.00% | 8,865,874.52 |
| 40.00% | 11,862,401.52 |
| 45.00% | 13,874,657.24 |
| 50.00% | 16,212,741 |
| 55.00% | 18,208,777.68 |
| 60.00% | 20,729,358.76 |
| 65.00% | 23,324,361.36 |
| 70.00% | 25,987,310.02 |
| 75.00% | 28,003,214.65 |
| 80.00% | 30,918,286.77 |
| 85.00% | 34,050,347.67 |
| 90.00% | 37,260,614.57 |
| 95.00% | 42,065,150.59 |
| 97.50% | 46,301,399.09 |
| 99.00% | 49,659,187.75 |




| 90% Confidence Interval |
|---|
| [ -13,548,481, 42,065,151 ] |
| 95% Confidence Interval |
| [ -16,709,821, 46,301,399 ] |
| 98% Confidence Interval |
| [ -18,695,201, 49,659,188 ] |

Figure 8: PRISM™ Histogram for Net Present Value at 3% Discount Rate

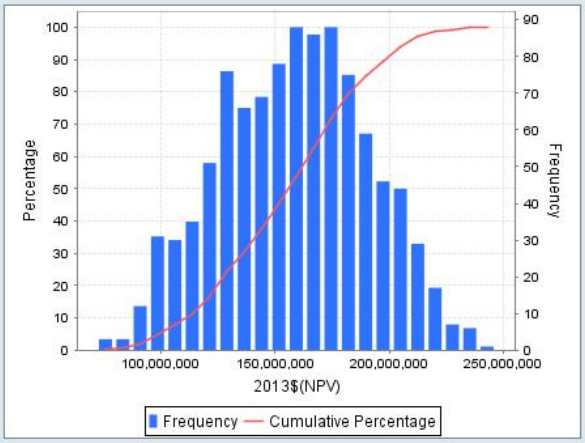
# Distribution

## 2013$

| Parameter | Value |
|---|---|
| Minimum | N/A |
| Maximum | N/A |
| Most Likely | N/A |
| Confidence Level | N/A |

| Descriptive Stat | Value |
|---|---|
| Most Likely | 159,347,339 |
| Mean | 154,518,734 |
| Median | 155,338,383 |
| Standard Deviation | 32,509,864 |
| Sample Variance | 1,056,891,235,885,224 |
| Kurtosis | -0.58 |
| Skewness | -0.04 |
| Range | 167,168,881 |
| Minimum | 71,891,317 |
| Maximum | 239,060,199 |
| Sum | 154,518,733,535 |
| Count | 1000 |

| Percentile | Value |
|---|---|
| 1.00% | 85,311,844.94 |
| 2.50% | 93,468,327.49 |
| 5.00% | 98,620,167.59 |
| 10.00% | 111,163,215.02 |
| 15.00% | 118,315,839.51 |
| 20.00% | 124,149,386.54 |
| 25.00% | 130,350,092.6 |
| 30.00% | 135,252,538.82 |
| 35.00% | 140,982,657.24 |
| 40.00% | 146,479,651.23 |
| 45.00% | 151,234,560.03 |
| 50.00% | 155,338,383.44 |
| 55.00% | 160,115,855.38 |
| 60.00% | 164,859,826.58 |
| 65.00% | 168,735,275.12 |
| 70.00% | 173,096,277.57 |
| 75.00% | 177,525,670.34 |
| 80.00% | 183,085,833.57 |
| 85.00% | 189,904,370.66 |
| 90.00% | 197,904,171.72 |
| 95.00% | 207,792,982.35 |
| 97.50% | 215,127,313.73 |
| 99.00% | 223,894,668.02 |




| 90% Confidence Interval |
|---|
| [ 98,620,168, 207,792,982 ] |
| 95% Confidence Interval |
| [ 93,468,327, 215,127,314 ] |
| 98% Confidence Interval |
| [ 85,311,845, 223,894,668 ] |

# APPENDIX B - Benefit-Cost Model Detail Tables

Table 28: Detailed Travel Demand and Travel Time Savings

| | VMT Change | VHT Change | VHT Change | Value of Travel Time Savings Discounted at 7% | Value of Travel Time Savings Discounted at 3% |
|---|---|---|---|---|---|
| | Vehicle-miles | Vehicle-hours | Person-hours | 2013$, disc. 7% | 2013$, disc. 3% |
| 2008 | - | - | - | $ - | $ - |
| 2009 | - | - | - | $ - | $ - |
| 2010 | - | - | - | $ - | $ - |
| 2011 | - | - | - | $ - | $ - |
| 2012 | - | - | - | $ - | $ - |
| 2013 | - | - | - | $ - | $ - |
| 2014 | - | - | - | $ - | $ - |
| 2015 | - | - | - | $ - | $ - |
| 2016 | - | - | - | $ - | $ - |
| 2017 | (4,588,066) | 326,235 | 451,731 | $ 5,073,027 | $ 5,908,176 |
| 2018 | (5,308,516) | 379,226 | 525,089 | $ 5,599,667 | $ 6,774,776 |
| 2019 | (6,046,127) | 433,936 | 600,823 | $ 6,084,402 | $ 7,647,108 |
| 2020 | (6,801,214) | 490,410 | 678,993 | $ 6,529,483 | $ 8,525,202 |
| 2021 | (7,574,098) | 548,691 | 759,661 | $ 6,937,055 | $ 9,409,088 |
| 2022 | (8,365,105) | 608,824 | 842,888 | $ 7,309,160 | $ 10,298,797 |
| 2023 | (9,174,565) | 670,857 | 928,739 | $ 7,647,749 | $ 11,194,357 |
| 2024 | (10,002,815) | 734,837 | 1,017,279 | $ 7,954,677 | $ 12,095,801 |
| 2025 | (10,850,196) | 800,812 | 1,108,575 | $ 8,231,713 | $ 13,003,158 |
| 2026 | (11,081,948) | 815,217 | 1,128,414 | $ 7,957,774 | $ 13,058,606 |
| 2027 | (11,316,775) | 829,860 | 1,148,581 | $ 7,692,741 | $ 13,113,930 |
| 2028 | (11,554,713) | 844,744 | 1,169,081 | $ 7,436,331 | $ 13,169,129 |
| 2029 | (11,795,797) | 859,874 | 1,189,919 | $ 7,188,274 | $ 13,224,203 |
| 2030 | (12,040,064) | 875,254 | 1,211,101 | $ 6,948,308 | $ 13,279,155 |
| 2031 | (12,287,549) | 890,888 | 1,232,633 | $ 6,716,175 | $ 13,333,984 |
| 2032 | (12,538,289) | 906,778 | 1,254,519 | $ 6,491,627 | $ 13,388,690 |
| 2033 | (12,792,322) | 922,931 | 1,276,766 | $ 6,274,426 | $ 13,443,275 |
| 2034 | (13,049,684) | 939,349 | 1,299,379 | $ 6,064,337 | $ 13,497,737 |
| 2035 | (13,310,414) | 956,037 | 1,322,363 | $ 5,861,136 | $ 13,552,079 |
| 2036 | (13,574,550) | 972,999 | 1,345,725 | $ 5,664,600 | $ 13,606,300 |
| 2037 | (13,842,131) | 990,239 | 1,369,471 | $ 5,474,521 | $ 13,660,400 |
| 2038 | (14,113,195) | 1,007,762 | 1,393,606 | $ 5,290,691 | $ 13,714,381 |
| 2039 | (14,387,782) | 1,025,572 | 1,418,138 | $ 5,112,909 | $ 13,768,241 |
| 2040 | (14,665,933) | 1,043,674 | 1,443,071 | $ 4,940,984 | $ 13,821,983 |
| 2041 | (14,947,687) | 1,062,072 | 1,468,412 | $ 4,774,727 | $ 13,875,606 |
| 2042 | (15,233,085) | 1,080,771 | 1,494,168 | $ 4,613,955 | $ 13,929,111 |
| 2043 | (15,522,168) | 1,099,776 | 1,520,346 | $ 4,458,494 | $ 13,982,498 |
| 2044 | (15,814,978) | 1,119,091 | 1,546,951 | $ 4,308,173 | $ 14,035,768 |
| 2045 | (16,111,557) | 1,138,721 | 1,573,991 | $ 4,162,824 | $ 14,088,921 |
| 2046 | (16,411,948) | 1,158,672 | 1,601,472 | $ 4,022,289 | $ 14,141,957 |
| **Total** | **(355,103,273)** | **25,534,109** | **35,321,885** | **$ 182,822,229** | **$ 370,542,417** |

Table 29: Detailed Additional Benefits at a 3% Discount Rate

| | Passenger O&M Savings (Fuel) | Passenger O&M Savings (Non-Fuel) | Safety Benefits | Emissions Benefits | Oil Import Savings | Noise Reduction Benefits | Pavement Damage Benefits |
|---|---|---|---|---|---|---|---|
| | 2013$, disc. 3% | 2013$, disc. 3% | 2013$, disc. 3% | 2013$, disc. 3% | 2013$, disc. 3% | 2013$, disc. 3% | 2013$, disc. 3% |
| 2008 | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| 2009 | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| 2010 | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| 2011 | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| 2012 | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| 2013 | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| 2014 | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| 2015 | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| 2016 | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| 2017 | $ (520,102) | $ (637,959) | $ 3,019,292 | $ (73,847) | $ (60,696) | $ (4,019) | $ (3,937) |
| 2018 | $ (582,886) | $ (716,685) | $ 2,858,591 | $ (85,145) | $ (67,069) | $ (4,517) | $ (4,425) |
| 2019 | $ (642,133) | $ (792,545) | $ 2,703,008 | $ (95,387) | $ (72,846) | $ (5,000) | $ (4,898) |
| 2020 | $ (697,449) | $ (865,616) | $ 2,552,398 | $ (105,584) | $ (78,006) | $ (5,465) | $ (5,353) |
| 2021 | $ (748,506) | $ (935,969) | $ 2,406,624 | $ (115,750) | $ (82,535) | $ (5,913) | $ (5,792) |
| 2022 | $ (795,872) | $ (1,003,678) | $ 2,265,551 | $ (125,894) | $ (86,516) | $ (6,346) | $ (6,216) |
| 2023 | $ (838,576) | $ (1,068,810) | $ 2,129,044 | $ 1,451,063 | $ (89,866) | $ (6,763) | $ (6,624) |
| 2024 | $ (877,694) | $ (1,131,435) | $ 1,996,981 | $ (148,181) | $ (92,722) | $ (7,164) | $ (7,017) |
| 2025 | $ (912,765) | $ (1,191,619) | $ 1,869,232 | $ (158,449) | $ (95,054) | $ (7,551) | $ (7,395) |
| 2026 | $ (896,069) | $ (1,182,252) | $ 1,796,311 | $ (159,617) | $ (91,967) | $ (7,537) | $ (7,378) |
| 2027 | $ (880,756) | $ (1,172,742) | $ 1,725,815 | $ (160,808) | $ (89,090) | $ (7,519) | $ (7,358) |
| 2028 | $ (866,794) | $ (1,163,101) | $ 1,657,669 | $ (162,016) | $ (86,408) | $ (7,498) | $ (7,335) |
| 2029 | $ (854,239) | $ (1,153,337) | $ 1,591,798 | $ 2,353,696 | $ (83,923) | $ (7,474) | $ (7,309) |
| 2030 | $ (842,993) | $ (1,143,461) | $ 1,528,131 | $ (168,220) | $ (81,619) | $ (7,447) | $ (7,281) |
| 2031 | $ (833,130) | $ (1,133,480) | $ 1,466,604 | $ (169,511) | $ (79,494) | $ (7,418) | $ (7,250) |
| 2032 | $ (824,542) | $ (1,123,406) | $ 1,407,145 | $ (171,031) | $ (77,534) | $ (7,386) | $ (7,217) |
| 2033 | $ (817,258) | $ (1,113,246) | $ 1,349,693 | $ (172,540) | $ (75,733) | $ (7,353) | $ (7,182) |
| 2034 | $ (811,142) | $ (1,103,009) | $ 1,294,185 | $ (174,037) | $ (74,077) | $ (7,317) | $ (7,145) |
| 2035 | $ (806,003) | $ (1,092,702) | $ 1,240,558 | $ (175,681) | $ (72,539) | $ (7,278) | $ (7,105) |
| 2036 | $ (801,979) | $ (1,082,333) | $ 1,188,757 | $ 2,182,567 | $ (71,130) | $ (7,238) | $ (7,065) |
| 2037 | $ (798,802) | $ (1,071,910) | $ 1,138,721 | $ (182,509) | $ (69,820) | $ (7,195) | $ (7,021) |
| 2038 | $ (796,444) | $ (1,061,438) | $ 1,090,396 | $ (184,002) | $ (68,604) | $ (7,151) | $ (6,976) |
| 2039 | $ (794,830) | $ (1,050,928) | $ 1,043,731 | $ (185,487) | $ (67,473) | $ (7,106) | $ (6,931) |
| 2040 | $ (793,877) | $ (1,040,382) | $ 998,670 | $ (186,961) | $ (66,415) | $ (7,058) | $ (6,883) |
| 2041 | $ (784,219) | $ (1,029,809) | $ 955,165 | $ (15,730) | $ (64,649) | $ (7,009) | $ (6,834) |
| 2042 | $ (774,610) | $ (1,019,214) | $ 913,165 | $ 2,132,610 | $ (62,923) | $ (6,959) | $ (6,784) |
| 2043 | $ (765,053) | $ (1,008,602) | $ 872,625 | $ (195,567) | $ (61,238) | $ (6,907) | $ (6,732) |
| 2044 | $ (755,551) | $ (997,980) | $ 833,497 | $ (197,037) | $ (59,591) | $ (6,855) | $ (6,680) |
| 2045 | $ (746,107) | $ (987,354) | $ 795,736 | $ (198,498) | $ (57,983) | $ (6,801) | $ (6,626) |
| 2046 | $ (736,724) | $ (976,726) | $ 759,299 | $ (199,950) | $ (56,413) | $ (6,745) | $ (6,571) |
| **Total** | **$ (23,597,105)** | **$ (31,051,728)** | **$ 47,448,392** | **$ 4,152,497** | **$ (2,243,933)** | **$ (203,989)** | **$ (199,320)** |

Table 30: Detailed Additional Benefits at a 7% Discount Rate

| | Passenger O&M Savings (Fuel) | Passenger O&M Savings (Non-Fuel) | Safety Benefits | Emissions Benefits | Oil Import Savings | Noise Reduction Benefits | Pavement Damage Benefits |
|---|---|---|---|---|---|---|---|
| | 2013$, disc. 7% | 2013$, disc. 7% | 2013$, disc. 7% | 2013$, disc. 7% | 2013$, disc. 7% | 2013$, disc. 7% | 2013$, disc. 7% |
| 2008 | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| 2009 | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| 2010 | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| 2011 | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| 2012 | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| 2013 | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| 2014 | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| 2015 | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| 2016 | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| 2017 | $ (446,583) | $ (547,781) | $ 2,592,501 | $ (63,408) | $ (52,117) | $ (3,450) | $ (3,380) |
| 2018 | $ (481,782) | $ (592,374) | $ 2,362,758 | $ (70,378) | $ (55,435) | $ (3,734) | $ (3,658) |
| 2019 | $ (510,912) | $ (630,587) | $ 2,150,640 | $ (75,893) | $ (57,960) | $ (3,978) | $ (3,897) |
| 2020 | $ (534,179) | $ (662,978) | $ 1,954,891 | $ (80,866) | $ (59,746) | $ (4,185) | $ (4,100) |
| 2021 | $ (551,852) | $ (690,064) | $ 1,774,337 | $ (85,339) | $ (60,850) | $ (4,359) | $ (4,270) |
| 2022 | $ (564,838) | $ (712,321) | $ 1,607,884 | $ (89,348) | $ (61,402) | $ (4,504) | $ (4,412) |
| 2023 | $ (572,897) | $ (730,188) | $ 1,454,519 | $ 991,336 | $ (61,394) | $ (4,620) | $ (4,525) |
| 2024 | $ (577,206) | $ (744,076) | $ 1,313,293 | $ (97,451) | $ (60,977) | $ (4,712) | $ (4,615) |
| 2025 | $ (577,830) | $ (754,360) | $ 1,183,326 | $ (100,308) | $ (60,174) | $ (4,780) | $ (4,681) |
| 2026 | $ (546,055) | $ (720,451) | $ 1,094,653 | $ (97,269) | $ (56,044) | $ (4,593) | $ (4,496) |
| 2027 | $ (516,659) | $ (687,941) | $ 1,012,378 | $ (94,331) | $ (52,261) | $ (4,410) | $ (4,316) |
| 2028 | $ (489,461) | $ (656,779) | $ 936,051 | $ (91,487) | $ (48,793) | $ (4,234) | $ (4,142) |
| 2029 | $ (464,338) | $ (626,918) | $ 865,252 | $ 1,279,397 | $ (45,618) | $ (4,063) | $ (3,973) |
| 2030 | $ (441,095) | $ (598,315) | $ 799,593 | $ (88,021) | $ (42,707) | $ (3,897) | $ (3,810) |
| 2031 | $ (419,638) | $ (570,921) | $ 738,712 | $ (85,381) | $ (40,040) | $ (3,736) | $ (3,652) |
| 2032 | $ (399,787) | $ (544,694) | $ 682,267 | $ (82,926) | $ (37,592) | $ (3,581) | $ (3,499) |
| 2033 | $ (381,442) | $ (519,590) | $ 629,948 | $ (80,530) | $ (35,347) | $ (3,432) | $ (3,352) |
| 2034 | $ (364,434) | $ (495,566) | $ 581,458 | $ (78,191) | $ (33,281) | $ (3,287) | $ (3,210) |
| 2035 | $ (348,587) | $ (472,582) | $ 536,528 | $ (75,981) | $ (31,373) | $ (3,148) | $ (3,073) |
| 2036 | $ (333,882) | $ (450,599) | $ 494,905 | $ 908,650 | $ (29,613) | $ (3,013) | $ (2,941) |
| 2037 | $ (320,126) | $ (429,577) | $ 456,352 | $ (73,141) | $ (27,981) | $ (2,883) | $ (2,814) |
| 2038 | $ (307,250) | $ (409,479) | $ 420,651 | $ (70,984) | $ (26,466) | $ (2,759) | $ (2,691) |
| 2039 | $ (295,164) | $ (390,267) | $ 387,596 | $ (68,880) | $ (25,056) | $ (2,638) | $ (2,574) |
| 2040 | $ (283,789) | $ (371,908) | $ 356,998 | $ (66,833) | $ (23,742) | $ (2,523) | $ (2,460) |
| 2041 | $ (269,858) | $ (354,367) | $ 328,683 | $ (5,413) | $ (22,246) | $ (2,412) | $ (2,352) |
| 2042 | $ (256,586) | $ (337,610) | $ 302,481 | $ 706,418 | $ (20,843) | $ (2,305) | $ (2,247) |
| 2043 | $ (243,947) | $ (321,605) | $ 278,248 | $ (62,360) | $ (19,526) | $ (2,203) | $ (2,147) |
| 2044 | $ (231,910) | $ (306,323) | $ 255,834 | $ (60,479) | $ (18,291) | $ (2,104) | $ (2,050) |
| 2045 | $ (220,450) | $ (291,731) | $ 235,112 | $ (58,649) | $ (17,133) | $ (2,010) | $ (1,958) |
| 2046 | $ (209,541) | $ (277,802) | $ 215,963 | $ (56,871) | $ (16,045) | $ (1,918) | $ (1,869) |
| **Total** | **$ (12,162,078)** | **$ (15,899,754)** | **$ 28,003,812** | **$ 1,925,083** | **$ (1,200,053)** | **$ (103,471)** | **$ (101,164)** |

## Table 31: Detailed Costs

| | Capital Costs, Less ROW | Net O&M Costs | Rehabilitation Costs | Total Undiscounted Costs | Total Discounted Costs Discounted at 7% | Total Discounted Costs Discounted at 3% |
|---|---|---|---|---|---|---|
| | 2013$, undiscounted | 2013$, undiscounted | 2013$, undiscounted | 2013$, undiscounted | 2013$, disc. 7% | 2013$, disc. 3% |
| 2008 | $ - | $ - | $ - | $ - | $ - | $ - |
| 2009 | $ - | $ - | $ - | $ - | $ - | $ - |
| 2010 | $ - | $ - | $ - | $ - | $ - | $ - |
| 2011 | $ - | $ - | $ - | $ - | $ - | $ - |
| 2012 | $ - | $ - | $ - | $ - | $ - | $ - |
| 2013 | $ - | $ - | $ - | $ - | $ - | $ - |
| 2014 | $ - | $ - | $ - | $ - | $ - | $ - |
| 2015 | $ 76,500,000 | $ - | $ - | $ 76,500,000 | $ 66,818,063 | $ 72,108,587 |
| 2016 | $ 76,500,000 | $ - | $ - | $ 76,500,000 | $ 62,446,788 | $ 70,008,337 |
| 2017 | $ - | $ 2,162,568 | $ - | $ 2,162,568 | $ 1,649,813 | $ 1,921,414 |
| 2018 | $ - | $ 2,979,563 | $ - | $ 2,979,563 | $ 2,124,388 | $ 2,570,198 |
| 2019 | $ - | $ 3,442,295 | $ - | $ 3,442,295 | $ 2,293,747 | $ 2,882,868 |
| 2020 | $ - | $ 3,564,906 | $ - | $ 3,564,906 | $ 2,220,044 | $ 2,898,594 |
| 2021 | $ - | $ 3,588,834 | $ - | $ 3,588,834 | $ 2,088,734 | $ 2,833,059 |
| 2022 | $ - | $ 3,612,763 | $ - | $ 3,612,763 | $ 1,965,104 | $ 2,768,882 |
| 2023 | $ - | $ 3,636,691 | $ - | $ 3,636,691 | $ 1,848,710 | $ 2,706,040 |
| 2024 | $ - | $ 3,660,620 | $ - | $ 3,660,620 | $ 1,739,134 | $ 2,644,510 |
| 2025 | $ - | $ 3,654,208 | $ - | $ 3,654,208 | $ 1,622,512 | $ 2,562,988 |
| 2026 | $ - | $ 3,647,795 | $ 5,000,000 | $ 8,647,795 | $ 3,588,528 | $ 5,888,728 |
| 2027 | $ - | $ 3,641,383 | $ - | $ 3,641,383 | $ 1,412,191 | $ 2,407,383 |
| 2028 | $ - | $ 3,634,970 | $ - | $ 3,634,970 | $ 1,317,481 | $ 2,333,149 |
| 2029 | $ - | $ 3,628,558 | $ - | $ 3,628,558 | $ 1,229,118 | $ 2,261,197 |
| 2030 | $ - | $ 3,622,146 | $ - | $ 3,622,146 | $ 1,146,679 | $ 2,191,458 |
| 2031 | $ - | $ 3,615,733 | $ 11,375,000 | $ 14,990,733 | $ 4,435,217 | $ 8,805,476 |
| 2032 | $ - | $ 3,609,321 | $ - | $ 3,609,321 | $ 998,007 | $ 2,058,345 |
| 2033 | $ - | $ 3,602,908 | $ - | $ 3,602,908 | $ 931,060 | $ 1,994,843 |
| 2034 | $ - | $ 3,596,496 | $ - | $ 3,596,496 | $ 868,601 | $ 1,933,294 |
| 2035 | $ - | $ 3,621,722 | $ - | $ 3,621,722 | $ 817,470 | $ 1,890,149 |
| 2036 | $ - | $ 3,647,199 | $ 5,000,000 | $ 8,647,199 | $ 1,824,100 | $ 4,381,465 |
| 2037 | $ - | $ 3,672,932 | $ - | $ 3,672,932 | $ 724,106 | $ 1,806,839 |
| 2038 | $ - | $ 3,698,922 | $ - | $ 3,698,922 | $ 681,523 | $ 1,766,626 |
| 2039 | $ - | $ 3,725,172 | $ - | $ 3,725,172 | $ 641,458 | $ 1,727,343 |
| 2040 | $ - | $ 3,751,684 | $ - | $ 3,751,684 | $ 603,760 | $ 1,688,967 |
| 2041 | $ - | $ 3,778,462 | $ - | $ 3,778,462 | $ 568,289 | $ 1,651,478 |
| 2042 | $ - | $ 3,805,507 | $ - | $ 3,805,507 | $ 534,913 | $ 1,614,853 |
| 2043 | $ - | $ 3,832,823 | $ - | $ 3,832,823 | $ 503,507 | $ 1,579,072 |
| 2044 | $ - | $ 3,860,412 | $ - | $ 3,860,412 | $ 473,954 | $ 1,544,115 |
| 2045 | $ - | $ 3,888,276 | $ - | $ 3,888,276 | $ 446,145 | $ 1,509,962 |
| 2046 | $ - | $ 3,916,420 | $ - | $ (53,183,580) | $ (3,253,885) | $ (11,440,326) |
| **Total** | **153,000,000** | **108,101,290** | **21,375,000** | **225,376,290** | **$ 167,309,259** | **$ 205,499,893** |

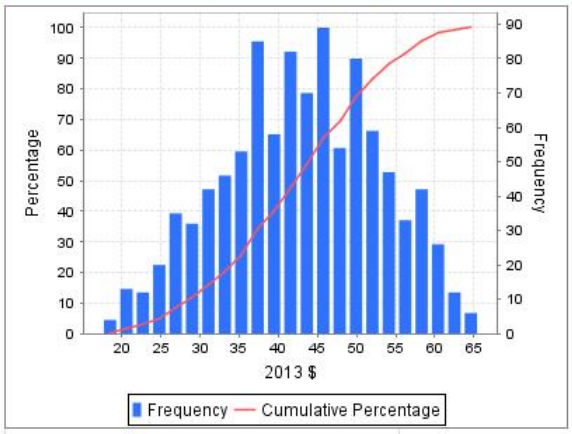
Table 32: Detailed Cost/Benefit Summary

| | Total Discounted Costs Discounted at 7% 2013$, disc. 7% | Total Discounted Costs Discounted at 3% 2013$, disc. 3% | Total Discounted Benefits at 7% 2013$, disc. 7% | Total Discounted Benefits at 3% 2013$, disc. 3% | Total Net Benefits Discounted at 7% 2013$, disc. 7% | Total Net Benefits Discounted at 3% 2013$, disc. 3% |
|---|---|---|---|---|---|---|
| 2008 | $ - | $ - | $ - | $ - | $ - | $ - |
| 2009 | $ - | $ - | $ - | $ - | $ - | $ - |
| 2010 | $ - | $ - | $ - | $ - | $ - | $ - |
| 2011 | $ - | $ - | $ - | $ - | $ - | $ - |
| 2012 | $ - | $ - | $ - | $ - | $ - | $ - |
| 2013 | $ - | $ - | $ - | $ - | $ - | $ - |
| 2014 | $ - | $ - | $ - | $ - | $ - | $ - |
| 2015 | $ 66,818,063.00 | $ 72,108,587.00 | $ - | $ - | $ (66,818,063.00) | $ (72,108,587.00) |
| 2016 | $ 62,446,788.00 | $ 70,008,337.00 | $ - | $ - | $ (62,446,788.00) | $ (70,008,337.00) |
| 2017 | $ 1,649,813.00 | $ 1,921,414.00 | $ 6,548,809 | $ 7,626,908.00 | $ 4,898,996.00 | $ 5,705,494.00 |
| 2018 | $ 2,124,388.00 | $ 2,570,198.00 | $ 6,755,064 | $ 8,172,640.00 | $ 4,630,676.00 | $ 5,602,442.00 |
| 2019 | $ 2,293,747.00 | $ 2,882,868.00 | $ 6,951,815 | $ 8,737,307.00 | $ 4,658,068.00 | $ 5,854,439.00 |
| 2020 | $ 2,220,044.00 | $ 2,898,594.00 | $ 7,138,320 | $ 9,320,127.00 | $ 4,918,276.00 | $ 6,421,533.00 |
| 2021 | $ 2,088,734.00 | $ 2,833,059.00 | $ 7,314,658 | $ 9,921,247.00 | $ 5,225,924.00 | $ 7,088,188.00 |
| 2022 | $ 1,965,104.00 | $ 2,768,882.00 | $ 7,480,219 | $ 10,539,826.00 | $ 5,515,115.00 | $ 7,770,944.00 |
| 2023 | $ 1,848,710.00 | $ 2,706,040.00 | $ 8,719,980 | $ 12,763,825.00 | $ 6,871,270.00 | $ 10,057,785.00 |
| 2024 | $ 1,739,134.00 | $ 2,644,510.00 | $ 7,778,933 | $ 11,828,569.00 | $ 6,039,799.00 | $ 9,184,059.00 |
| 2025 | $ 1,622,512.00 | $ 2,562,988.00 | $ 7,912,906 | $ 12,499,557.00 | $ 6,290,394.00 | $ 9,936,569.00 |
| 2026 | $ 3,588,528.00 | $ 5,888,728.00 | $ 7,623,519 | $ 12,510,097.00 | $ 4,034,991.00 | $ 6,621,369.00 |
| 2027 | $ 1,412,191.00 | $ 2,407,383.00 | $ 7,345,201 | $ 12,521,472.00 | $ 5,933,010.00 | $ 10,114,089.00 |
| 2028 | $ 1,317,481.00 | $ 2,333,149.00 | $ 7,077,486 | $ 12,533,646.00 | $ 5,760,005.00 | $ 10,200,497.00 |
| 2029 | $ 1,229,118.00 | $ 2,261,197.00 | $ 8,188,013 | $ 15,063,415.00 | $ 6,958,895.00 | $ 12,802,218.00 |
| 2030 | $ 1,146,679.00 | $ 2,191,458.00 | $ 6,570,056 | $ 12,556,265.00 | $ 5,423,377.00 | $ 10,364,807.00 |
| 2031 | $ 4,435,217.00 | $ 8,805,476.00 | $ 6,331,519 | $ 12,570,305.00 | $ 1,896,302.00 | $ 3,764,829.00 |
| 2032 | $ 998,007.00 | $ 2,058,345.00 | $ 6,101,815 | $ 12,584,719.00 | $ 5,103,808.00 | $ 10,526,374.00 |
| 2033 | $ 931,060.00 | $ 1,994,843.00 | $ 5,880,681 | $ 12,599,656.00 | $ 4,949,621.00 | $ 10,604,813.00 |
| 2034 | $ 868,601.00 | $ 1,933,294.00 | $ 5,667,826 | $ 12,615,195.00 | $ 4,799,225.00 | $ 10,681,901.00 |
| 2035 | $ 817,470.00 | $ 1,890,149.00 | $ 5,462,920 | $ 12,631,329.00 | $ 4,645,450.00 | $ 10,741,180.00 |
| 2036 | $ 1,824,100.00 | $ 4,381,465.00 | $ 6,248,107 | $ 15,007,879.00 | $ 4,424,007.00 | $ 10,626,414.00 |
| 2037 | $ 724,106.00 | $ 1,806,839.00 | $ 5,074,351 | $ 12,661,864.00 | $ 4,350,245.00 | $ 10,855,025.00 |
| 2038 | $ 681,523.00 | $ 1,766,626.00 | $ 4,891,713 | $ 12,680,162.00 | $ 4,210,190.00 | $ 10,913,536.00 |
| 2039 | $ 641,458.00 | $ 1,727,343.00 | $ 4,715,926 | $ 12,699,217.00 | $ 4,074,468.00 | $ 10,971,874.00 |
| 2040 | $ 603,760.00 | $ 1,688,967.00 | $ 4,546,727 | $ 12,719,077.00 | $ 3,942,967.00 | $ 11,030,110.00 |
| 2041 | $ 568,289.00 | $ 1,651,478.00 | $ 4,446,762 | $ 12,922,521.00 | $ 3,878,473.00 | $ 11,271,043.00 |
| 2042 | $ 534,913.00 | $ 1,614,853.00 | $ 5,003,263 | $ 15,104,396.00 | $ 4,468,350.00 | $ 13,489,543.00 |
| 2043 | $ 503,507.00 | $ 1,579,072.00 | $ 4,084,954 | $ 12,811,024.00 | $ 3,581,447.00 | $ 11,231,952.00 |
| 2044 | $ 473,954.00 | $ 1,544,115.00 | $ 3,942,850 | $ 12,845,571.00 | $ 3,468,896.00 | $ 11,301,456.00 |
| 2045 | $ 446,145.00 | $ 1,509,962.00 | $ 3,806,005 | $ 12,881,288.00 | $ 3,359,860.00 | $ 11,371,326.00 |
| 2046 | $ (3,253,885.00) | $ (11,440,326.00) | $ 3,674,206 | $ 12,918,127.00 | $ 6,928,091.00 | $ 24,358,453.00 |
| **Total** | **167,309,259** | **205,499,893** | **183,284,604** | **364,847,231** | **$ 15,975,345** | **$ 159,347,338** |

# APPENDIX C – Monetization Values and Ranges Used in PRISM™ Sensitivity Analysis

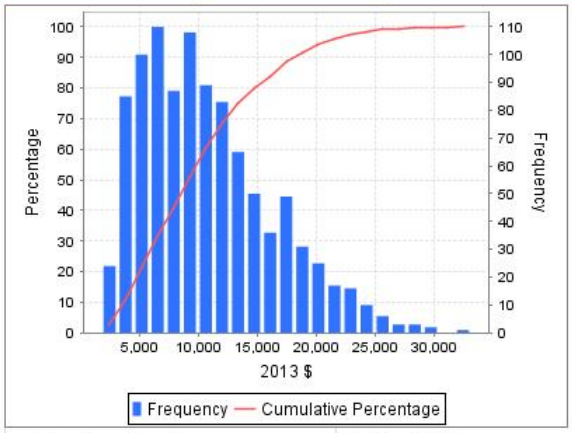
Figure 9: Monetization Values and Ranges Used in PRISM™ Sensitivity Analysis at 7%

| | Present Value (Most) | Present Value (Low) | Present Value (High) |
|---|---|---|---|
| **Environment** | | | |
| Emissions - CO2 | $43 | $13 | $66 |



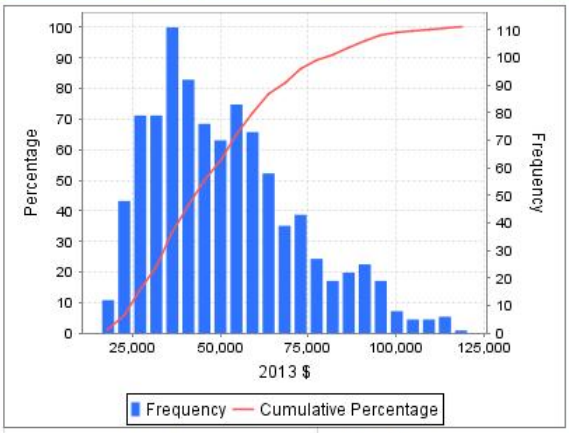

| | |
|---|---|
| 90% Confidence Interval | [ 25, 58 ] |
| 95% Confidence Interval | [ 22, 60 ] |
| 98% Confidence Interval | [ 20, 62 ] |

| | | | |
|---|---|---|---|
| Emissions - NOX | $5,862 | $1,659 | $36,261 |



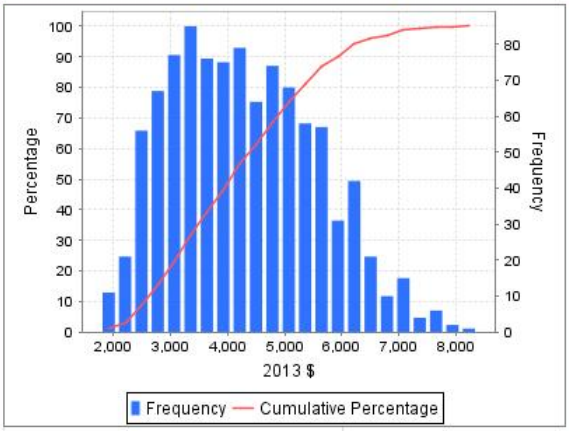

| | |
|---|---|
| 90% Confidence Interval | [ 2,933, 20,622 ] |
| 95% Confidence Interval | [ 2,439, 22,883 ] |
| 98% Confidence Interval | [ 2,076, 25,454 ] |

| Emissions - SOX | $34,286 | $14,881 | $141,110 |
|---|---|---|---|



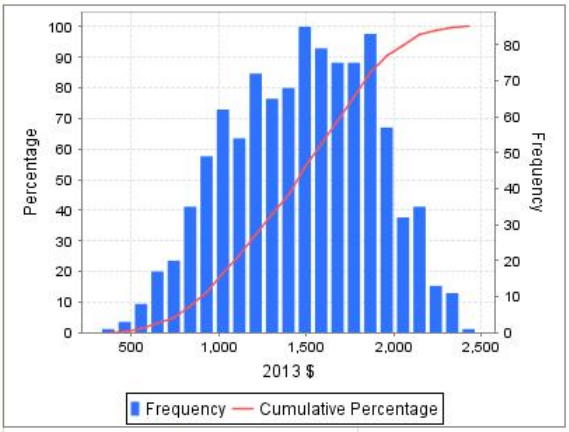

| | |
|---|---|
| 90% Confidence Interval | [ 21,671, 90,552 ] |
| 95% Confidence Interval | [ 19,204, 96,406 ] |
| 98% Confidence Interval | [ 17,442, 107,110 ] |

| Emissions - PM | $3,637 | $1,659 | $8,655 |
|---|---|---|---|



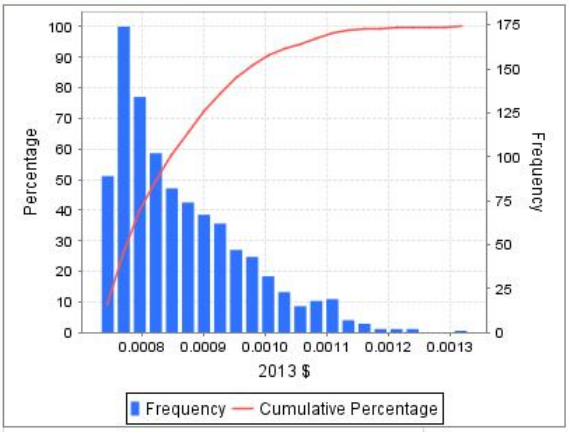

| | |
|---|---|
| 90% Confidence Interval | [ 2,318, 6,368 ] |
| 95% Confidence Interval | [ 2,180, 6,904 ] |
| 98% Confidence Interval | [ 1,904, 7,281 ] |

| | | | |
|---|---|---|---|
| Emissions - VOC | $1,438 | $239 | $2,463 |



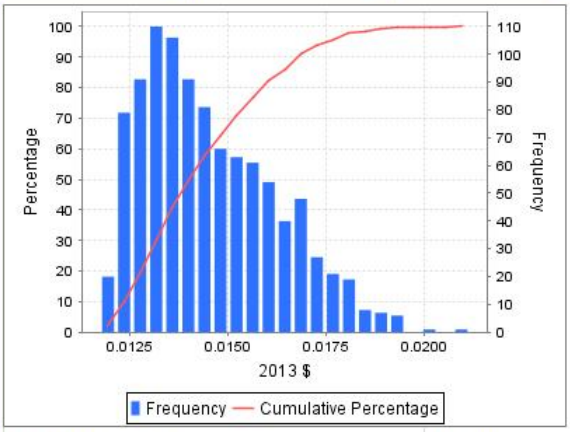

| | |
|---|---|
| 90% Confidence Interval | [ 748, 2,078 ] |
| 95% Confidence Interval | [ 623, 2,149 ] |
| 98% Confidence Interval | [ 527, 2,276 ] |

| | | | |
|---|---|---|---|
| Noise - Auto | $0 | $0 | $0 |



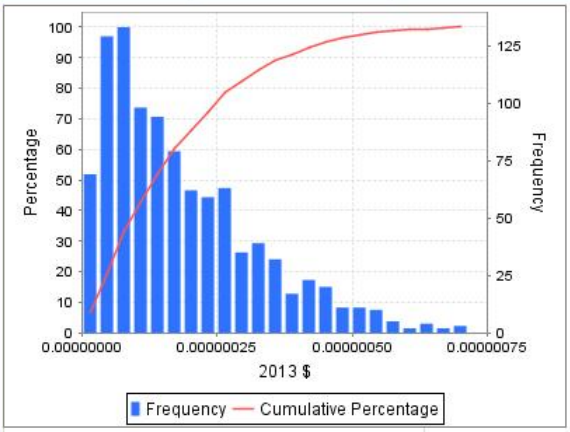

| | |
|---|---|
| 90% Confidence Interval | [ 0, 0 ] |
| 95% Confidence Interval | [ 0, 0 ] |
| 98% Confidence Interval | [ 0, 0 ] |

| | | | |
|---|---|---|---|
| Noise - Truck | $0 | $0 | $0 |



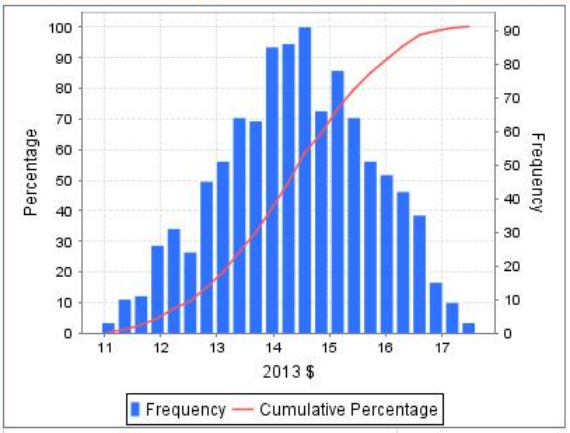

| | |
|---|---|
| 90% Confidence Interval | [ 0, 0 ] |
| 95% Confidence Interval | [ 0, 0 ] |
| 98% Confidence Interval | [ 0, 0 ] |

| | | | |
|---|---|---|---|
| Emissions - CO | $0 | $0 | $0 |



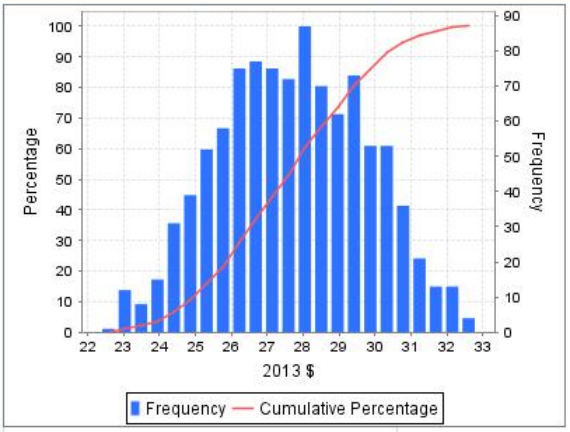

| | |
|---|---|
| 90% Confidence Interval | [ 0, 0 ] |
| 95% Confidence Interval | [ 0, 0 ] |
| 98% Confidence Interval | [ 0, 0 ] |

| Economic | | | |
|---|---|---|---|
| Travel Time Savings - Auto | $14 | $11 | $18 |



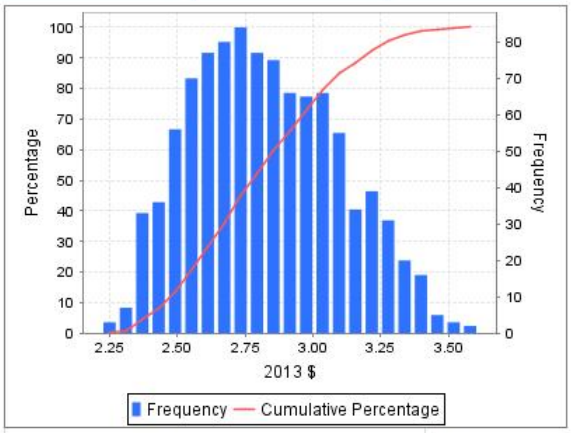

| | |
|---|---|
| 90% Confidence Interval | [ 12, 16 ] |
| 95% Confidence Interval | [ 12, 17 ] |
| 98% Confidence Interval | [ 11, 17 ] |

| Travel Time Savings - Truck | $27 | $22 | $33 |
|---|---|---|---|



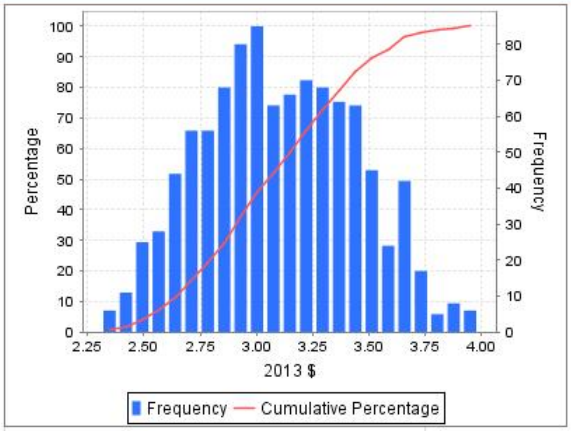

| | |
|---|---|
| 90% Confidence Interval | [ 24, 31 ] |
| 95% Confidence Interval | [ 24, 32 ] |
| 98% Confidence Interval | [ 23, 32 ] |

| Fuel Savings - Auto | $3 | $2 | $4 |
|---|---|---|---|

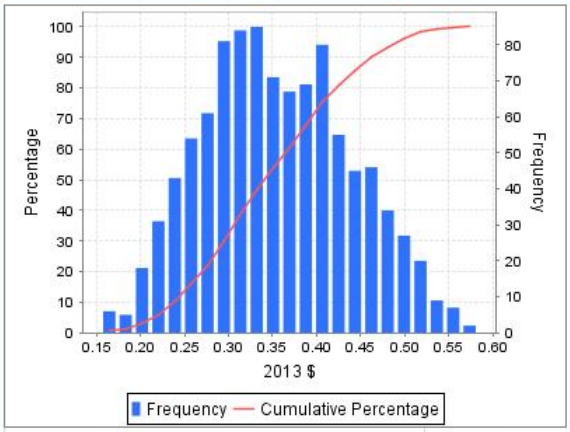


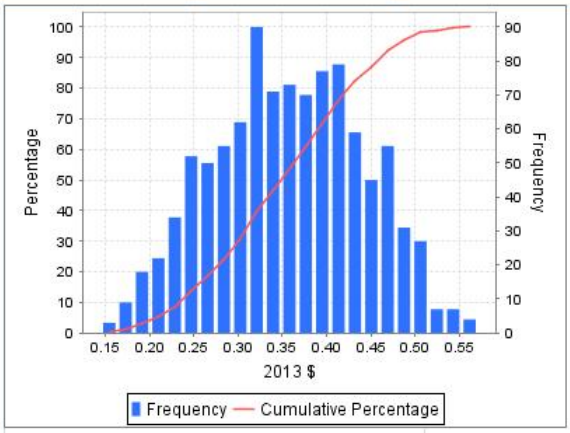

| | |
|---|---|
| 90% Confidence Interval | [ 2, 3 ] |
| 95% Confidence Interval | [ 2, 3 ] |
| 98% Confidence Interval | [ 2, 3 ] |

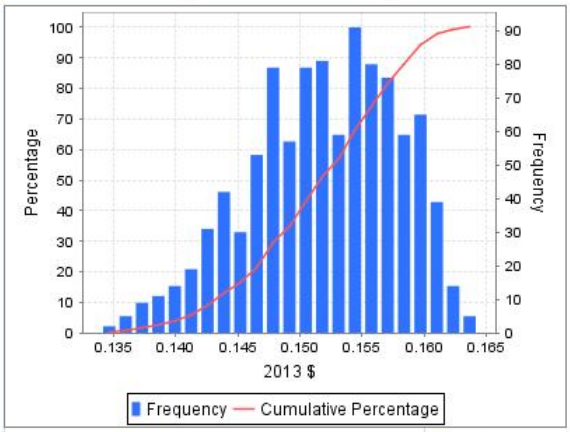
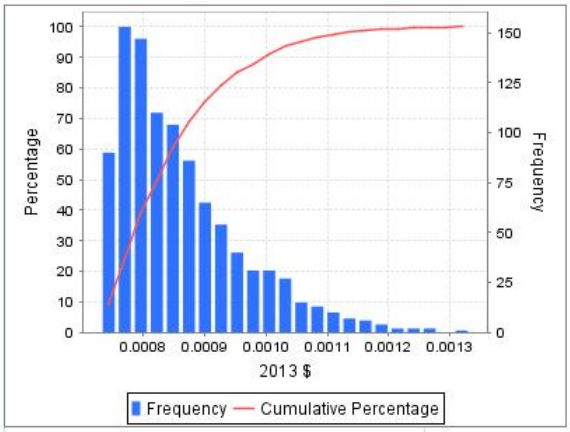
| Fuel Savings - Truck | $3 | $2 | $4 |
|---|---|---|---|

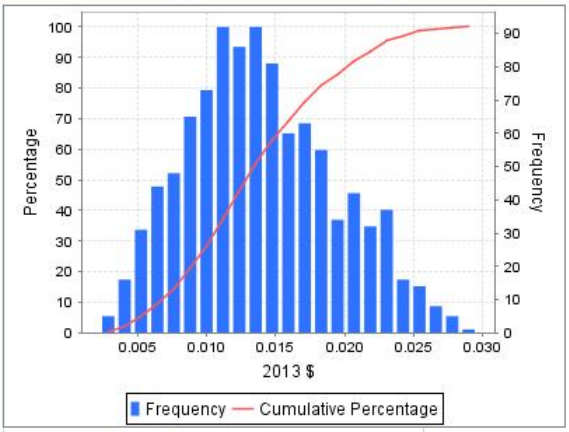
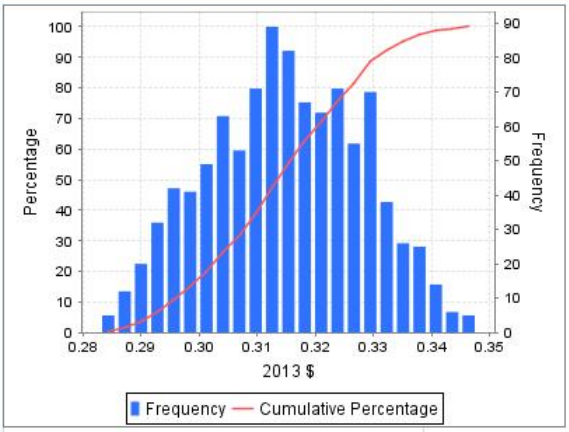



| | |
|---|---|
| 90% Confidence Interval | [ 3, 4 ] |
| 95% Confidence Interval | [ 2, 4 ] |
| 98% Confidence Interval | [ 2, 4 ] |

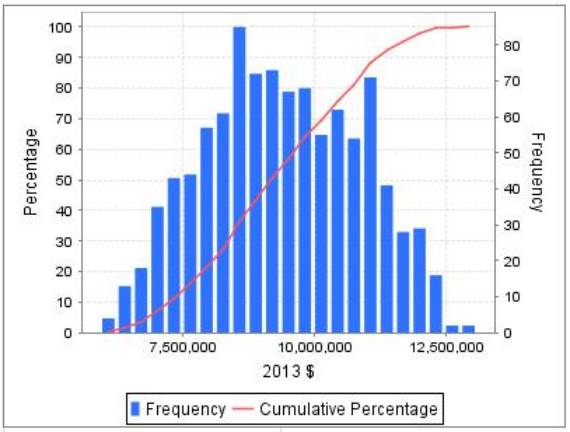
| Oil Imports - Auto | $0 | $0 | $1 |
|---|---|---|---|
|  | | | |
| 90% Confidence Interval | [ 0, 0 ] | | |
| 95% Confidence Interval | [ 0, 1 ] | | |
| 98% Confidence Interval | [ 0, 1 ] | | |

| Oil Imports - Truck | $0 | $0 | $1 |
|---|---|---|---|
|  | | | |
| 90% Confidence Interval | [ 0, 0 ] | | |
| 95% Confidence Interval | [ 0, 1 ] | | |
| 98% Confidence Interval | [ 0, 1 ] | | |

| | | | |
|---|---|---|---|
| Vehicle O&M Costs - Auto | $0 | $0 | $0 |
| |  | | |
| | 90% Confidence Interval | [ 0, 0 ] | |
| | 95% Confidence Interval | [ 0, 0 ] | |
| | 98% Confidence Interval | [ 0, 0 ] | |
| Pavement Damage - Auto | $0 | $0 | $0 |
| |  | | |
| | 90% Confidence Interval | [ 0, 0 ] | |
| | 95% Confidence Interval | [ 0, 0 ] | |
| | 98% Confidence Interval | [ 0, 0 ] | |

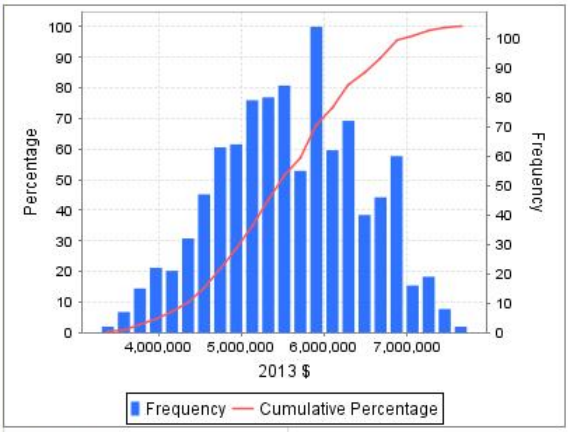
| | | | |
|---|---|---|---|
| Pavement Damage - Trucks | $0 | $0 | $0 |
| |  | | |
| | 90% Confidence Interval | [ 0, 0 ] | |
| | 95% Confidence Interval | [ 0, 0 ] | |
| | 98% Confidence Interval | [ 0, 0 ] | |
| Vehicle O&M Costs - Truck | $0 | $0 | $0 |
| |  | | |
| | 90% Confidence Interval | [ 0, 0 ] | |
| | 95% Confidence Interval | [ 0, 0 ] | |
| | 98% Confidence Interval | [ 0, 0 ] | |

| Social | | | |
|---|---|---|---|
| Safety - Fatality | $9,233,412 | $5,276,235 | $13,089,123 |



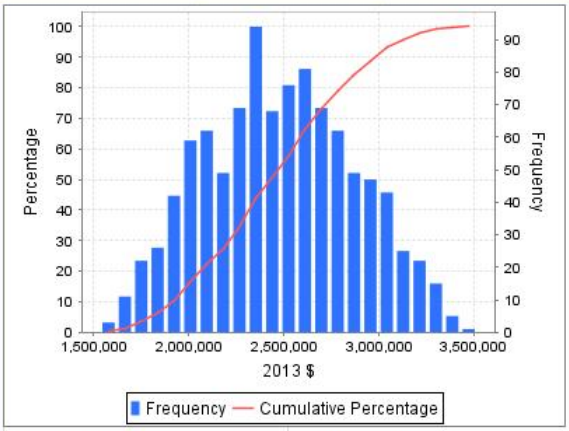

| | |
|---|---|
| 90% Confidence Interval | [ 6,837,643, 11,675,019 ] |
| 95% Confidence Interval | [ 6,561,124, 11,966,195 ] |
| 98% Confidence Interval | [ 6,165,358, 12,155,415 ] |

| | | | |
|---|---|---|---|
| Safety - MAIS 5 | $5,475,413 | $3,128,808 | $7,761,850 |



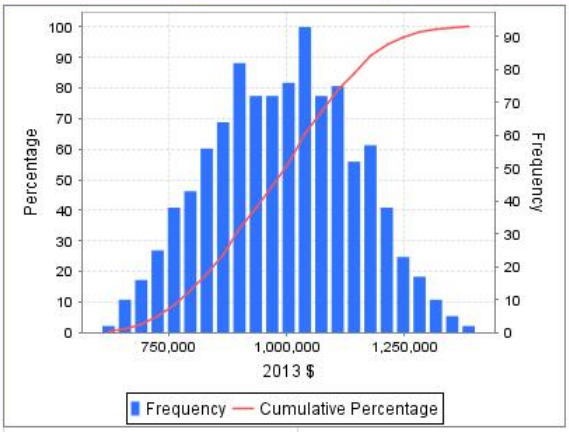

| | |
|---|---|
| 90% Confidence Interval | [ 4,051,119, 6,844,674 ] |
| 95% Confidence Interval | [ 3,779,466, 7,122,260 ] |
| 98% Confidence Interval | [ 3,605,516, 7,290,568 ] |

| | | | |
|---|---|---|---|
| Safety - MAIS 4 | $2,456,088 | $1,403,479 | $3,481,707 |



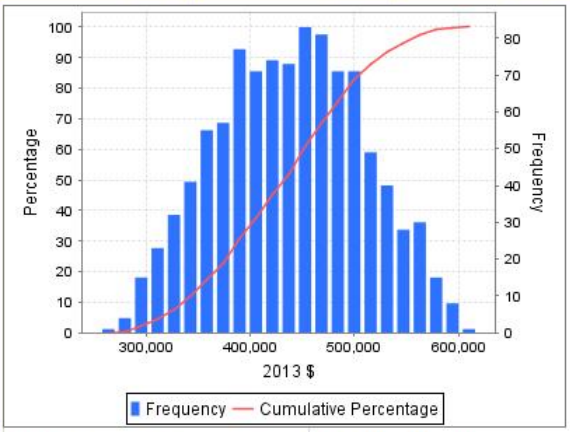

| | |
|---|---|
| 90% Confidence Interval | [ 1,798,796, 3,097,177 ] |
| 95% Confidence Interval | [ 1,704,980, 3,199,560 ] |
| 98% Confidence Interval | [ 1,634,976, 3,289,873 ] |

| | | | |
|---|---|---|---|
| Safety - MAIS 3 | $969,508 | $554,005 | $1,374,358 |



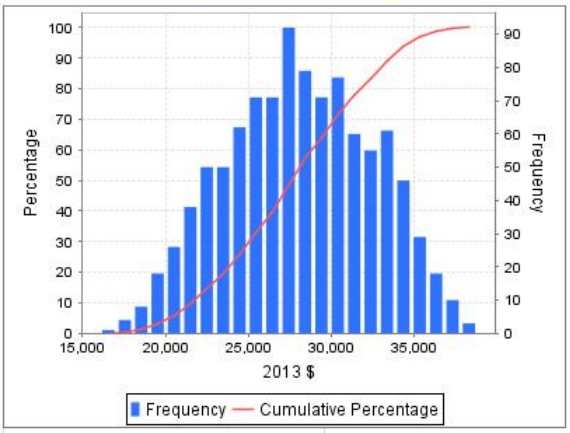

| | |
|---|---|
| 90% Confidence Interval | [ 721,364, 1,218,508 ] |
| 95% Confidence Interval | [ 684,799, 1,266,539 ] |
| 98% Confidence Interval | [ 650,735, 1,303,088 ] |

| | | | |
|---|---|---|---|
| Safety - MAIS 2 | $433,970 | $247,983 | $615,189 |



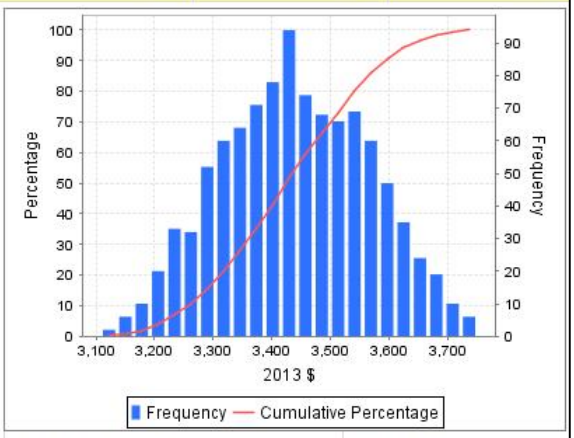

| | |
|---|---|
| 90% Confidence Interval | [ 317,747, 548,347 ] |
| 95% Confidence Interval | [ 298,082, 562,187 ] |
| 98% Confidence Interval | [ 289,305, 576,520 ] |

| | | | |
|---|---|---|---|
| Safety - MAIS 1 | $27,700 | $15,829 | $39,267 |



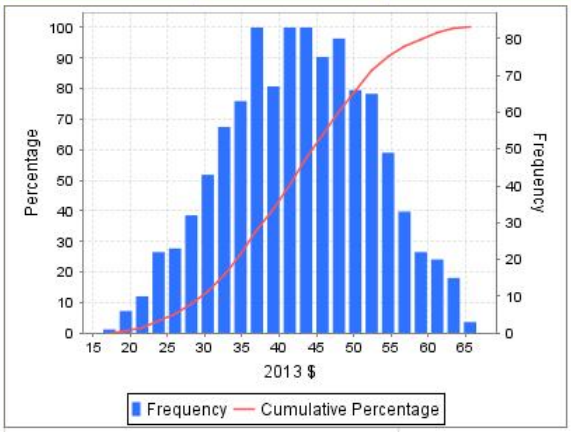
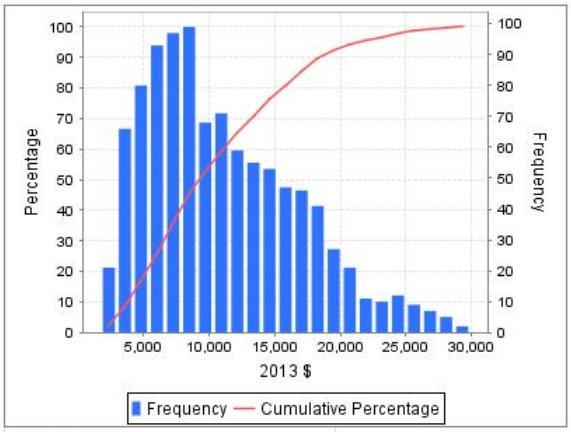

| | |
|---|---|
| 90% Confidence Interval | [ 20,286, 34,580 ] |
| 95% Confidence Interval | [ 19,013, 35,751 ] |
| 98% Confidence Interval | [ 18,369, 36,339 ] |

| | | | |
|---|---|---|---|
| Safety - PDO | $3,425 | $3,083 | $3,76 |

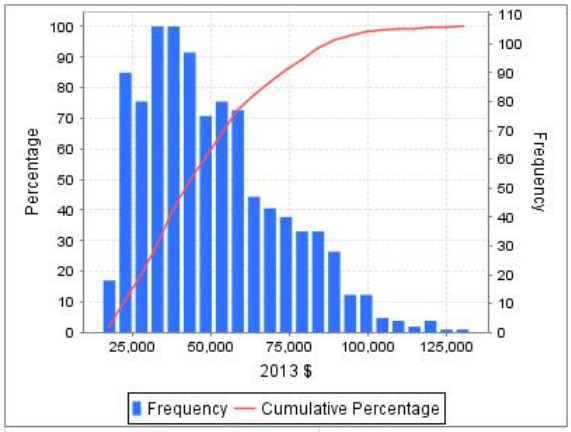



| | |
|---|---|
| 90% Confidence Interval | [ 3,215, 3,634 ] |
| 95% Confidence Interval | [ 3,186, 3,664 ] |
| 98% Confidence Interval | [ 3,158, 3,697 ] |

Figure 10: Monetization Values and Ranges Used in PRISM™ Sensitivity Analysis at 3%

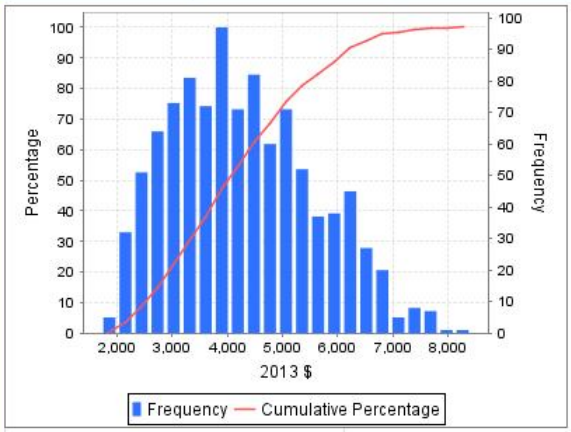
| | Present Value (Most) | Present Value (Low) | Present Value (High) |
|---|---|---|---|
| **Environment** | | | |
| Emissions - CO2 | $43 | $13 | $66 |
| |  | | |
| | 90% Confidence Interval | [ 25, 58 ] | |
| | 95% Confidence Interval | [ 22, 61 ] | |
| | 98% Confidence Interval | [ 21, 63 ] | |
| Emissions - NOX | $5,862 | $1,659 | $36,261 |
| |  | | |
| | 90% Confidence Interval | [ 2,900, 21,074 ] | |
| | 95% Confidence Interval | [ 2,444, 24,284 ] | |
| | 98% Confidence Interval | [ 2,210, 26,310 ] | |

| Emissions - SOX | $34,286 | $14,881 | $141,110 |
|---|---|---|---|



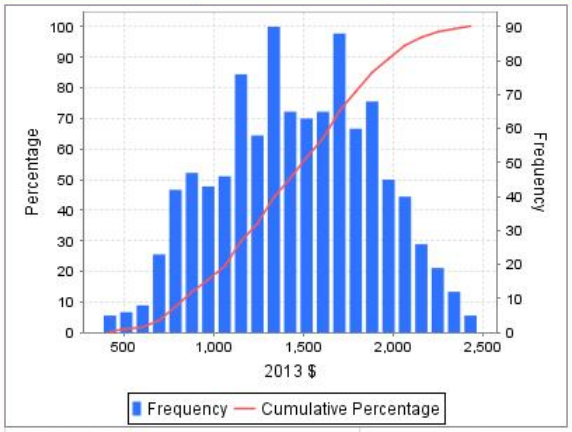

| | |
|---|---|
| 90% Confidence Interval | [ 20,290, 87,134 ] |
| 95% Confidence Interval | [ 17,892, 96,485 ] |
| 98% Confidence Interval | [ 17,039, 107,327 ] |

| Emissions - PM | $3,637 | $1,659 | $8,655 |
|---|---|---|---|



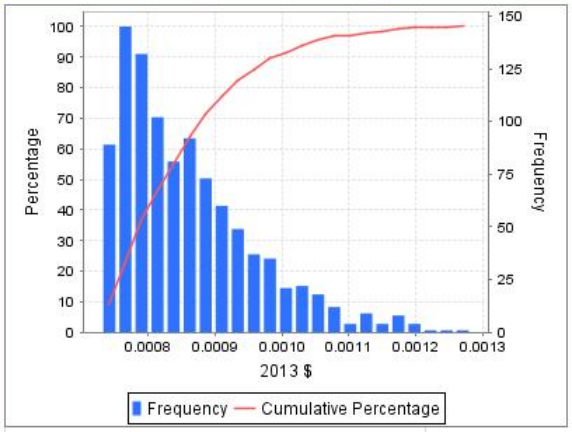

| | |
|---|---|
| 90% Confidence Interval | [ 2,238, 6,462 ] |
| 95% Confidence Interval | [ 2,048, 6,768 ] |
| 98% Confidence Interval | [ 1,917, 7,347 ] |

| | | | |
|---|---|---|---|
| Emissions - VOC | $1,438 | $239 | $2,463 |



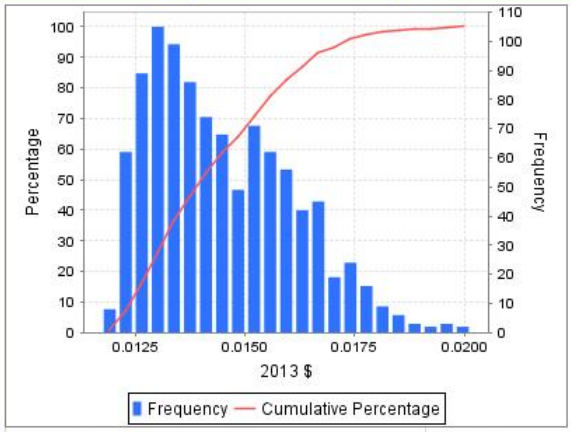

| | |
|---|---|
| 90% Confidence Interval | [ 709, 2,102 ] |
| 95% Confidence Interval | [ 632, 2,207 ] |
| 98% Confidence Interval | [ 487, 2,299 ] |

| | | | |
|---|---|---|---|
| Noise - Auto | $0 | $0 | $0 |



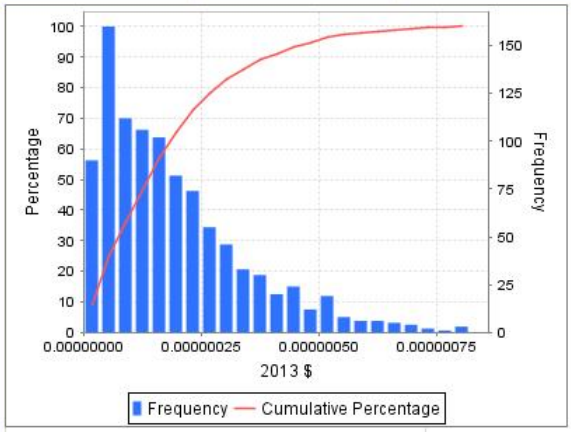

| | |
|---|---|
| 90% Confidence Interval | [ 0, 0 ] |
| 95% Confidence Interval | [ 0, 0 ] |
| 98% Confidence Interval | [ 0, 0 ] |

| Noise - Truck | $0 | $0 | $0 |
|---|---|---|---|



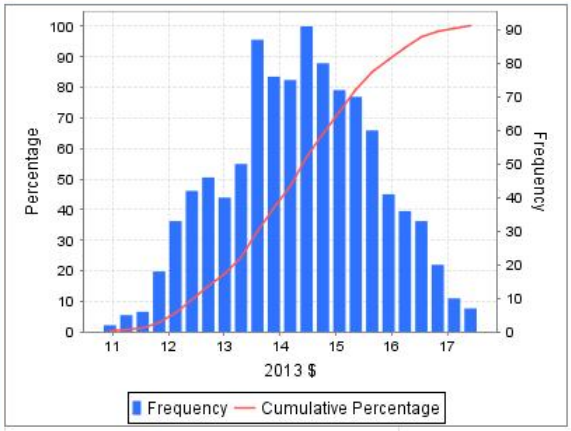

| | |
|---|---|
| 90% Confidence Interval | [ 0, 0 ] |
| 95% Confidence Interval | [ 0, 0 ] |
| 98% Confidence Interval | [ 0, 0 ] |

| Emissions - CO | $0 | $0 | $0 |
|---|---|---|---|



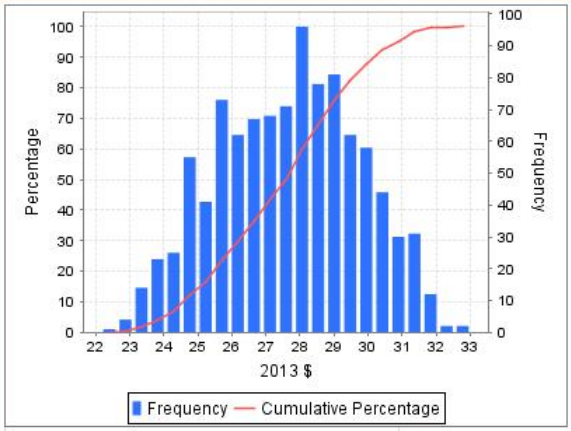

| | |
|---|---|
| 90% Confidence Interval | [ 0, 0 ] |
| 95% Confidence Interval | [ 0, 0 ] |
| 98% Confidence Interval | [ 0, 0 ] |

| Economic | | | |
|---|---|---|---|
| Travel Time Savings - Auto | $14 | $11 | $18 |

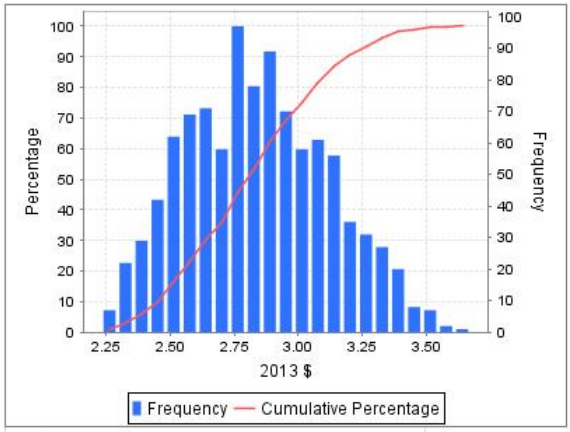
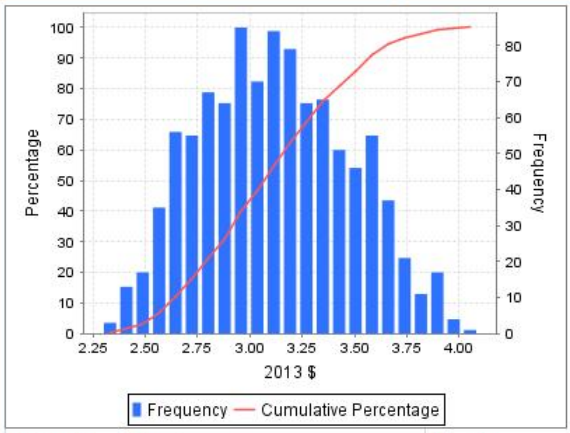


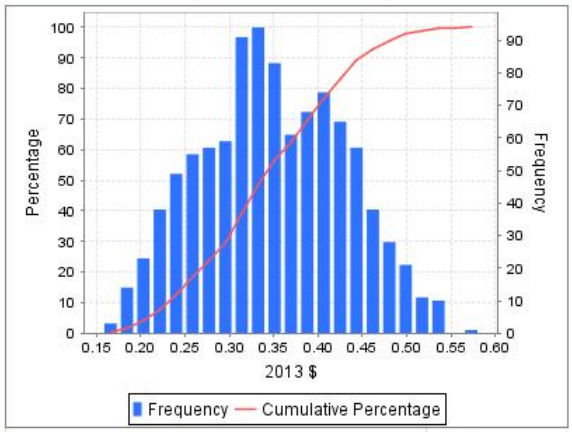
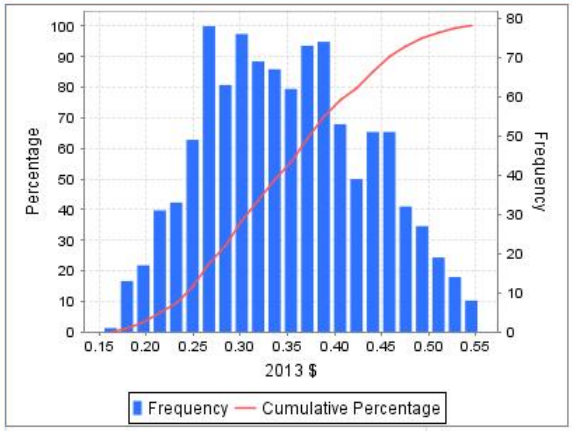

| | |
|---|---|
| 90% Confidence Interval | [ 12, 16 ] |
| 95% Confidence Interval | [ 12, 17 ] |
| 98% Confidence Interval | [ 11, 17 ] |

| Travel Time Savings - Truck | $27 | $22 | $33 |
|---|---|---|---|

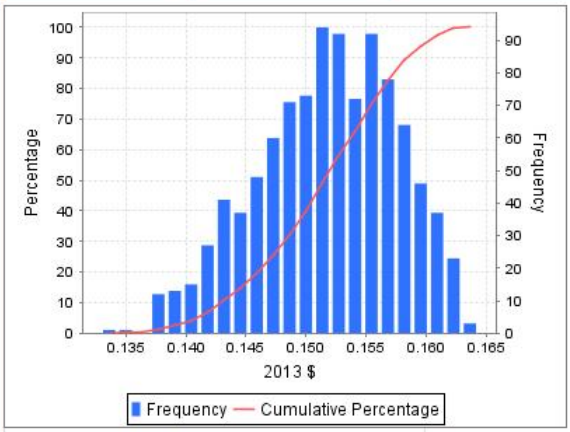



| | |
|---|---|
| 90% Confidence Interval | [ 24, 31 ] |
| 95% Confidence Interval | [ 23, 31 ] |
| 98% Confidence Interval | [ 23, 32 ] |

| Fuel Savings - Auto | $3 | $2 | $4 |
|---|---|---|---|
| |  | | |
| | 90% Confidence Interval | [ 2, 3 ] | |
| | 95% Confidence Interval | [ 2, 3 ] | |
| | 98% Confidence Interval | [ 2, 3 ] | |
| Fuel Savings - Truck | $3 | $2 | $4 |
| |  | | |
| | 90% Confidence Interval | [ 3, 4 ] | |
| | 95% Confidence Interval | [ 2, 4 ] | |
| | 98% Confidence Interval | [ 2, 4 ] | |

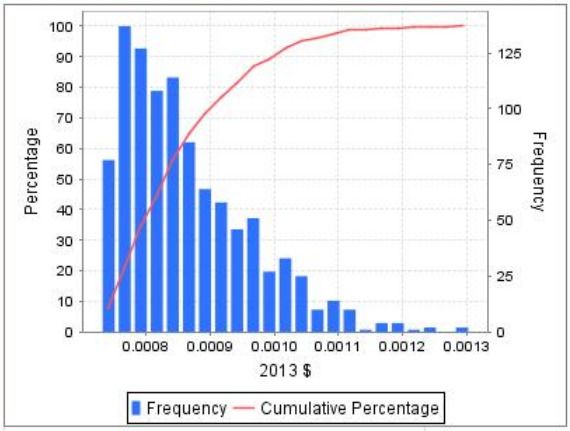
| Oil Imports - Auto | $0 | $0 | $1 |
|---|---|---|---|
| |  | | |
| | 90% Confidence Interval | [ 0, 0 ] | |
| | 95% Confidence Interval | [ 0, 0 ] | |
| | 98% Confidence Interval | [ 0, 1 ] | |
| Oil Imports - Truck | $0 | $0 | $1 |
| |  | | |
| | 90% Confidence Interval | [ 0, 0 ] | |
| | 95% Confidence Interval | [ 0, 1 ] | |
| | 98% Confidence Interval | [ 0, 1 ] | |

| | | | |
|---|---|---|---|
| Vehicle O&M Costs - Auto | $0 | $0 | $0 |

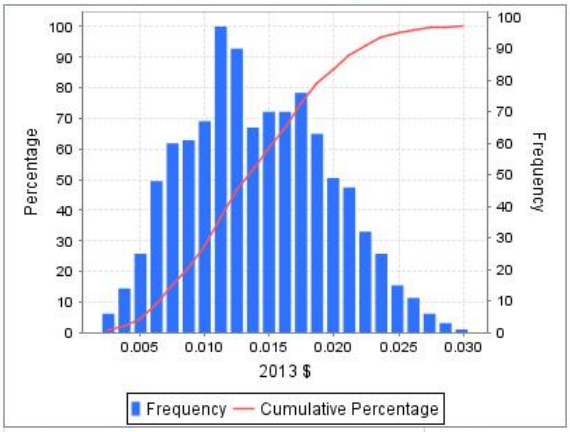
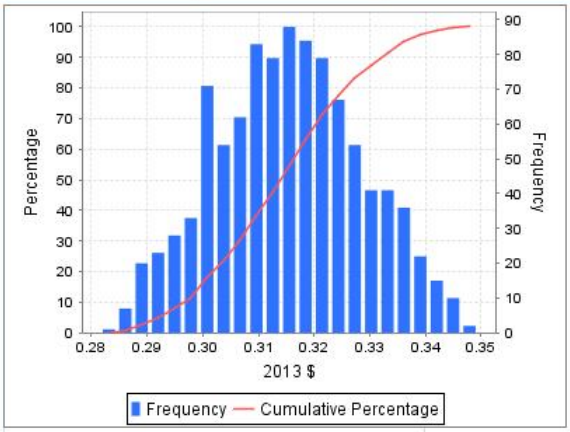



| | |
|---|---|
| 90% Confidence Interval | [ 0, 0 ] |
| 95% Confidence Interval | [ 0, 0 ] |
| 98% Confidence Interval | [ 0, 0 ] |

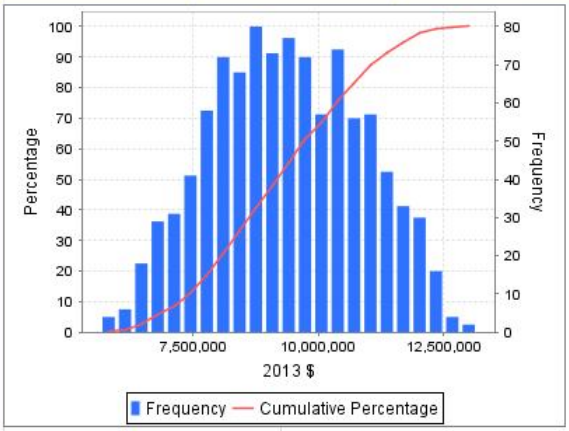
| | | | |
|---|---|---|---|
| Pavement Damage - Auto | $0 | $0 | $0 |




| | |
|---|---|
| 90% Confidence Interval | [ 0, 0 ] |
| 95% Confidence Interval | [ 0, 0 ] |
| 98% Confidence Interval | [ 0, 0 ] |

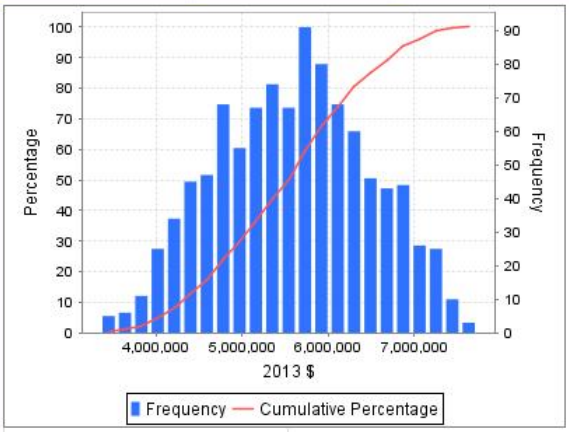
| | | | |
|---|---|---|---|
| Pavement Damage - Trucks | $0 | $0 | $0 |
| |  | | |
| | 90% Confidence Interval | [ 0, 0 ] | |
| | 95% Confidence Interval | [ 0, 0 ] | |
| | 98% Confidence Interval | [ 0, 0 ] | |
| Vehicle O&M Costs - Truck | $0 | $0 | $0 |
| |  | | |
| | 90% Confidence Interval | [ 0, 0 ] | |
| | 95% Confidence Interval | [ 0, 0 ] | |
| | 98% Confidence Interval | [ 0, 0 ] | |

| Social | | | |
|---|---|---|---|
| Safety - Fatality | $9,233,412 | $5,276,235 | $13,089,123 |



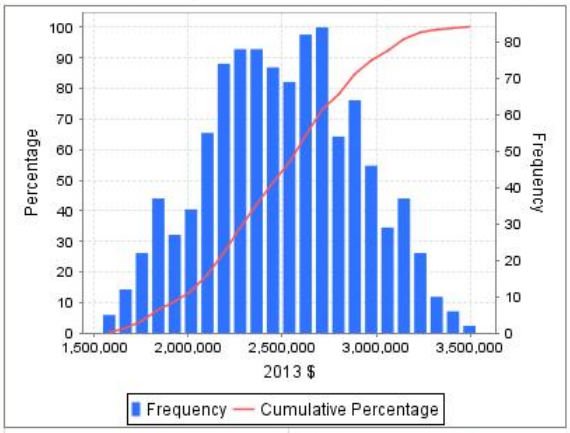

| | |
|---|---|
| 90% Confidence Interval | [ 6,735,717, 11,720,293 ] |
| 95% Confidence Interval | [ 6,398,496, 11,986,397 ] |
| 98% Confidence Interval | [ 6,096,157, 12,257,863 ] |

| | | | |
|---|---|---|---|
| Safety - MAIS 5 | $5,475,413 | $3,128,808 | $7,761,850 |



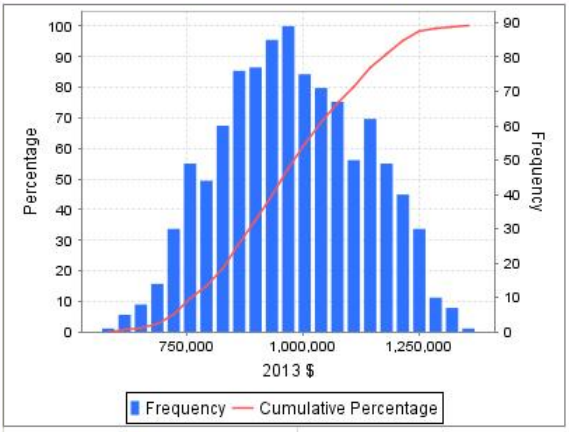

| | |
|---|---|
| 90% Confidence Interval | [ 4,042,487, 6,973,354 ] |
| 95% Confidence Interval | [ 3,841,345, 7,128,889 ] |
| 98% Confidence Interval | [ 3,596,438, 7,305,895 ] |

| | | | |
|---|---|---|---|
| Safety - MAIS 4 | $2,456,088 | $1,403,479 | $3,481,707 |



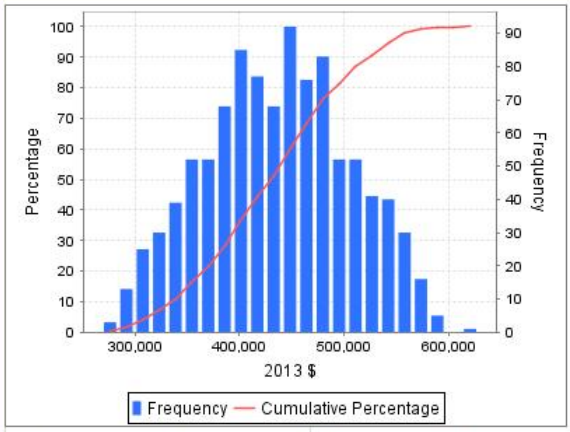

| | |
|---|---|
| 90% Confidence Interval | [ 1,785,052, 3,120,981 ] |
| 95% Confidence Interval | [ 1,701,306, 3,200,475 ] |
| 98% Confidence Interval | [ 1,630,743, 3,298,361 ] |

| | | | |
|---|---|---|---|
| Safety - MAIS 3 | $969,508 | $554,005 | $1,374,358 |



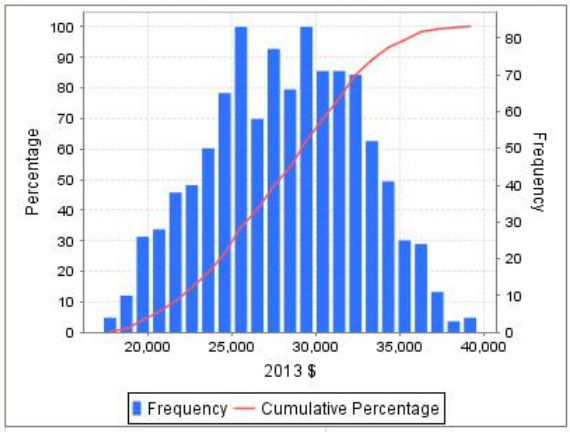

| | |
|---|---|
| 90% Confidence Interval | [ 716,635, 1,211,252 ] |
| 95% Confidence Interval | [ 681,675, 1,246,133 ] |
| 98% Confidence Interval | [ 633,834, 1,278,426 ] |

| | | | |
|---|---|---|---|
| Safety - MAIS 2 | $433,970 | $247,983 | $615,189 |



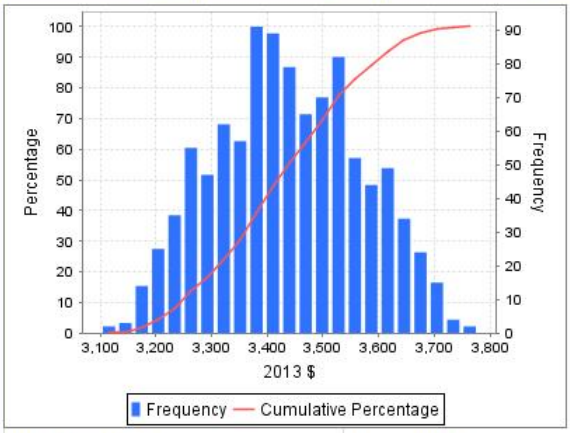

| | |
|---|---|
| 90% Confidence Interval | [ 311,086, 542,894 ] |
| 95% Confidence Interval | [ 300,378, 555,867 ] |
| 98% Confidence Interval | [ 282,949, 568,905 ] |

| | | | |
|---|---|---|---|
| Safety - MAIS 1 | $27,700 | $15,829 | $39,267 |




| | |
|---|---|
| 90% Confidence Interval | [ 19,941, 34,930 ] |
| 95% Confidence Interval | [ 19,158, 35,968 ] |
| 98% Confidence Interval | [ 18,101, 36,789 ] |

| Safety - PDO | $3,425 | $3,083 | $3,768 |
|---|---|---|---|




| | |
|---|---|
| 90% Confidence Interval | [ 3,208, 3,642 ] |
| 95% Confidence Interval | [ 3,181, 3,670 ] |
| 98% Confidence Interval | [ 3,156, 3,694 ] |

# Appendix C: Letters of Support

# APPENDIX C: LETTERS OF SUPPORT

Three letters of support for the C-470 Tolled Express Lanes Project are included in this appendix. These are as follows:

- April 3, 2014 letter to Don Hunt (CDOT Executive Director) from the C-470 Corridor Coalition (2 pages)
- April 14, 2014 letter to Don Hunt from the Denver South Transportation Management Association (2 pages)
- April 17, 2013 letter to Don Hunt from Philip Washington, WHOM, Regional Transportation District (2 pages)

C-470 CORRIDOR COALITION

April 3, 2014

Mr. Don Hunt
Executive Director
Colorado Department of Transportation
4201 East Arkansas Avenue
Denver, CO 80222

Subject: Letter of Support from the C-470 Corridor Coalition for CDOT's application for Transportation Infrastructure Generating Economic Recovery (TIGER) VI Grant Funding for the C-470 Corridor Segment 1 (from I-25 to Kipling) Improvements

Dear Don:

As members of the C-470 Corridor Coalition Steering Committee, please accept our unanimous support for the Colorado Department of Transportation's (CDOT) recent decision to request USDOT, Transportation Infrastructure Generating Economic Recovery (TIGER) VI discretionary grant funding that will be dedicated to implementing C-470 Corridor improvements within Segment 1 (from I-25 to Kipling).

The C-470 Corridor Coalition (the "C-470 Coalition") has come together to afford various public and quasi-public entities a forum for engaging in a coordinated and collaborative process that identifies solutions for the C-470 Corridor; and all recommendations for the corridor are being advanced by the C-470 Coalition by consensus. The C-470 Coalition was initiated by the local agencies in February 2011 and a Charter was adopted December 1, 2011. Presently, the Steering Committee members include the following local agencies:

***Arapahoe County, Douglas County, Jefferson County, the City of Centennial, the City of Lakewood, the City of Littleton, the City of Lone Tree, and the Highlands Ranch Metropolitan District***

Additionally, the C-470 Coalition includes Affiliate members from other local entities and private sector groups (which includes: the City of Greenwood Village, Towns of Castle Rock, Parker, and Bow Mar, the Denver South Economic Development Partnership, and various chambers of commerce) that have participated in the Coalition's efforts. Staff from State / Federal Affiliate members (which includes: CDOT, HPTE, FHWA, RTD and DRCOG) have been participating at the Policy Committee and Technical Working Group meetings since this coalition was formed.

On February 7, 2013, the Policy Committee reached consensus to advance adding ***tolled express lanes*** over a 13 mile long segment of the C-470 Corridor (from I-25 to Kipling). This decision was a result of a two-year process, which developed and adopted a Mission Statement and Goals, and identified technical solutions acceptable to corridor stakeholders. The Coalition evaluated numerous funding options and implemented a robust public involvement process.

The C-470 Coalition has provided over ***$5 million*** in local funding for past and current efforts to reach consensus on the decision to advance the ***tolled express lanes option***, and for the continual advancement of the various project elements, which include: funding for the revised environmental assessment, for the conceptual and preliminary designs, for traffic modeling and preparing a Level 2 Traffic and Revenue Study. Additionally, the C-470 Coalition has committed an additional ***$10 million*** for construction. Furthermore, over the past 5 years, members of this coalition have spent an additional ***$15 million*** in local funds to improve three critical C-470 interchanges within Segment 1, namely at US Highway 85, at Broadway and at Quebec Street.

The C-470 Coalition believes that the C-470 Corridor is an excellent candidate for TIGER VI funding. As you know, the C-470 Corridor is a crucial regionally significant highway, which is on both the ***State's Highway System*** as well as the ***National Highway System***. The C-470 Corridor links ***Interstate 70*** on the west to both ***Interstate 25*** and the ***E-470*** toll road on the east; and it also provides a major connection to ***US Highway 85*** within Segment 1 project limits. Construction funding for this project can be obligated by June of 2016 and TIGER VI grant funding will help ensure that major project elements are constructed by December 2017.

Improving the C-470 Corridor is critical to maintaining ***economic competiveness***, connecting households along the corridor to significant commercial and employment centers in southeast Denver. Adding ***tolled express lanes*** improve corridor users' ***quality of life*** by providing a ***reliable transportation choice and reliable trip time***. Vehicle hours travelled will be reduced in the corridor and the region, resulting in a more ***environmentally sustainable*** system. ***Safety*** will be improved by adding capacity and auxiliary lanes and improving substandard curves. Additionally, CDOT staff has identified the need to replace the majority of the existing pavement, back into a ***state of good repair,*** as it is nearly 30 years old. The C-470 Coalition and CDOT are focusing on utilizes ***innovative financing*** to deliver this critical project by selecting ***tolled express lanes*** as a robust and long-term solution to fund the project, and by using an ***innovative delivery method*** (likely design/build) to implement the project expeditiously.

The C-470 Coalition looks forward to our continued ***partnership*** with CDOT, HPTE and FHWA to advance the proposed corridor improvements. We greatly appreciate the CDOT staff and the Transportation Commission's decision to submit this crucial project for TIGER VI grant funding. Please let us know how we can further support your efforts.

Sincerely,

Jack Hilbert, Coalition Chair,
Douglas County Commissioner

Cathy Noon, Coalition Vice-Chair,
Mayor - City of Centennial

Nancy Sharpe
Arapahoe County Commissioner

Don Rosier
Jefferson County Commissioner

Bob Murphy
Mayor - City of Lakewood

Bruce Beckman
Councilman - City of Littleton

Jim Gunning
Mayor – City of Lone Tree

Allen Dreher
Highlands Ranch Metropolitan District

DENVER SOUTH
TRANSPORTATION MANAGEMENT ASSOCIATION

April 16, 2014

Mr. Don Hunt
Executive Director
Colorado Department of Transportation4201 East Arkansas Avenue
Denver, Co 80222

Subject: Letter of Support for CDOT's application for Transportation Infrastructure Generating Economic Recovery (TIGER) VI Grant Funding for the C-470 Corridor Segment 1 (from I-25 to Kipling) Improvements from the **Denver South Transportation Management Association**.

Dear Mr. Hunt,

The Denver South Transportation Management Association is a public private nonprofit transportation management association dedicated to the improvement of transportation options including interchange access and traffic movement along the south I-25 corridor and the south metro Denver area. We strongly believe that an efficient and effective transportation system, including the interstate system, is critical to the economic vitality of the Denver region and the south metro area. Our organization is comprised of public entities; Arapahoe and Douglas Counties, the cities of Denver, Greenwood Village, Lone Tree and Centennial as well as prominent private businesses along the south I-25 corridor.

The Denver South TMA believes that the C-470 corridor is an excellent candidate for the TIGER VI funding. The C-470 corridor is a critical corridor serving the entire south metro area and is a critical link to the south I-25 corridor, the connecting state highway system and the national highway system. The C-470 corridor links the I-70 corridor to the I-25 corridor and serves over 100,000 trips daily. Construction funding for this project can be obligated by June of 2016 and TIGER VI grant funding will help ensure that major elements are constructed by December 2017.

The Denver South TMA is affiliated with the Denver South Economic Development Partnership which is comprised of the same stakeholders. Our joint mission is to enhance the economic competiveness of the south metro area thru means including transportation advocacy and funding. Both organizations have participated in the C-470 Coalition meetings and are convinced that this project will not only significantly improve a major infrastructure component but also significantly enhance the areas economic competiveness and attractiveness. Whether your destination is the south I-25 business corridor, Aurora, DIA, downtown Denver or the mountains to the west C-470 is often a critical leg of your travel route and very often a daily commuter route for tens of thousands. As such it is critical that it function at a high level.

One of our missions is to recruit new business to the metro area and to work with businesses seeking to expand their operations. In this role we consistently hear that transportation is one of the top three issues of interest to businesses. While mass transit will garner an increasing percentage of commuters, for the foreseeable future the automobile will remain the primary means of commuting to work for the vast majority of employees.

DENVER SOUTH
TRANSPORTATION MANAGEMENT ASSOCIATION

In order to function as the primary commuter route for 100s of thousands every week it must be improved. The Coalition has worked hard to fashion a realistic and workable solution and we endorse their efforts. Please help us by approving the submission of this project for TIGER grant funding. We look forward to continuing our strong working relationship and to seeing C-470 improved in the near future. and we look forward to a collaborative effort to implement these critical improvements that will benefit the Denver Metro Area by building upon the synergy created by past successes and future programmed elements.

Sincerely,

Steve Klausing,
Executive Director, Denver South Transportation Management Association

April 17, 2013

Mr. Don Hunt
Executive Director
Colorado Department of Transportation
4201 East Arkansas Avenue
Denver, CO 80222

**Subject:** **C-470 Corridor Segment 1 (from I-25 to Kipling) RAMP Pre-application – Letter of Support from the Regional Transportation District for RAMP Funding**

Dear Don:

The Regional Transportation District (RTD) supports the C-470 Corridor Coalition's request for CDOT Responsible Acceleration of Maintenance and Partnership (RAMP) Program funding that will be dedicated to implementing improvements for C-470 Corridor Segment 1 (from I-25 to Kipling) Project. On February 7, 2013, the Policy Committee reached consensus to move forward with adding tolled express lanes to the C-470 Corridor for Segment 1 (from I-25 to Kipling). This decision was a result of a two-year process which developed and adopted a Mission Statement and Goals, identified technical solutions acceptable to the corridor stakeholders, investigated and evaluated funding options, and implemented a robust public involvement process. The C-470 Coalition has jointly funded the past two-year effort to reach consensus on their decision to advance the tolled express lanes option. RTD Directors Kent Bagley and Bruce Daly have been involved in this process and support the recommended project.

C-470 Corridor Segment 1 Project is an excellent candidate for RAMP funding. The C-470 Corridor is on the State's Highway System and this Project meets the RAMP eligibility criteria for both programs (i.e. the Asset Management and Operational Improvements and Transportation Partnership Fund). Advancing funds in 2013 for pre-construction activities will allow the Project the opportunity to be constructed / implemented by December 2017.

Although RTD has no near-term plans for C-470 bus service, we believe that commuter service on C-470 might be a viable option if (1) congestion levels are sufficiently reduced to permit reliable service to our patrons; (2) sufficient ridership exists to support bus service; and (3) funding becomes available. It is our understanding that the C-470 Coalition is currently exploring a toll structure that would be favorable to RTD (for example, no charge for RTD buses utilizing the express lanes). Similarly, RTD assumes that access to and from the planned express lanes can be accommodated from our key area park-and-ride facilities.

While fixed guideway transit in this corridor is not currently part of RTD's plans, environmental documentation indicates that the C-470 Corridor Segment 1 project will not preclude future rail transit options. As part of the 2004 Master Inter-Governmental Agreement between CDOT and RTD, CDOT will continue to work with RTD and local agencies to accommodate the potential for future light rail in the C-470 Corridor between the future Lucent Station and the existing Lincoln Station.

This project demonstrates the benefit of local, regional, and state governments working together to fine immediate and sustainable transportation solutions in an era of constrained and declining budgets. I encourage your favorable consideration of the project's many merits.

Sincerely,

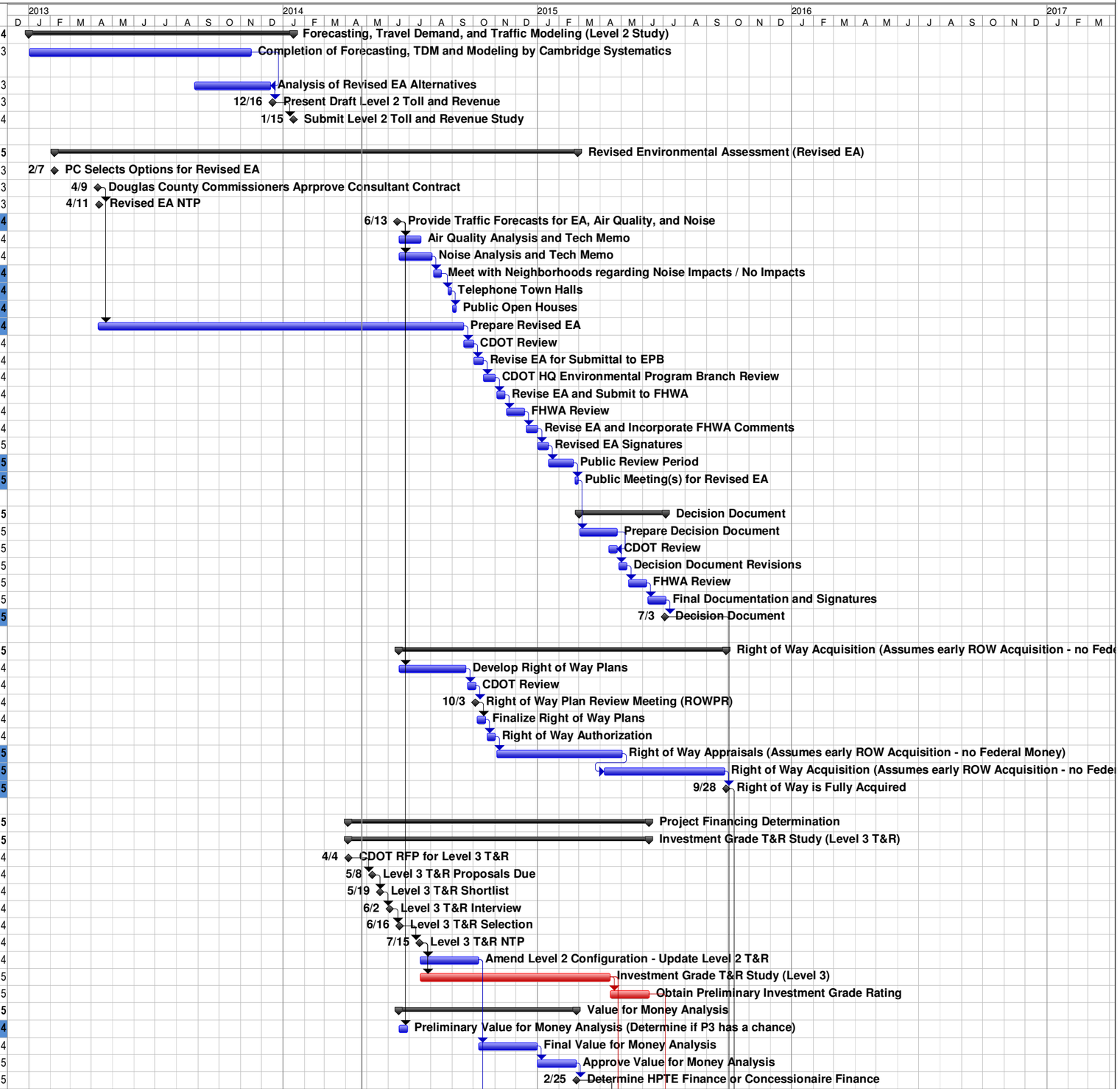
Phillip A. Washington
General Manager and CEO

# Appendix D: Detailed Project Schedule

# C-470 RAMP Project Procurement Schedule - HPTE Finance with Early ROW Acquisition - 1 Phase Project

DRAFT -April 24, 2014

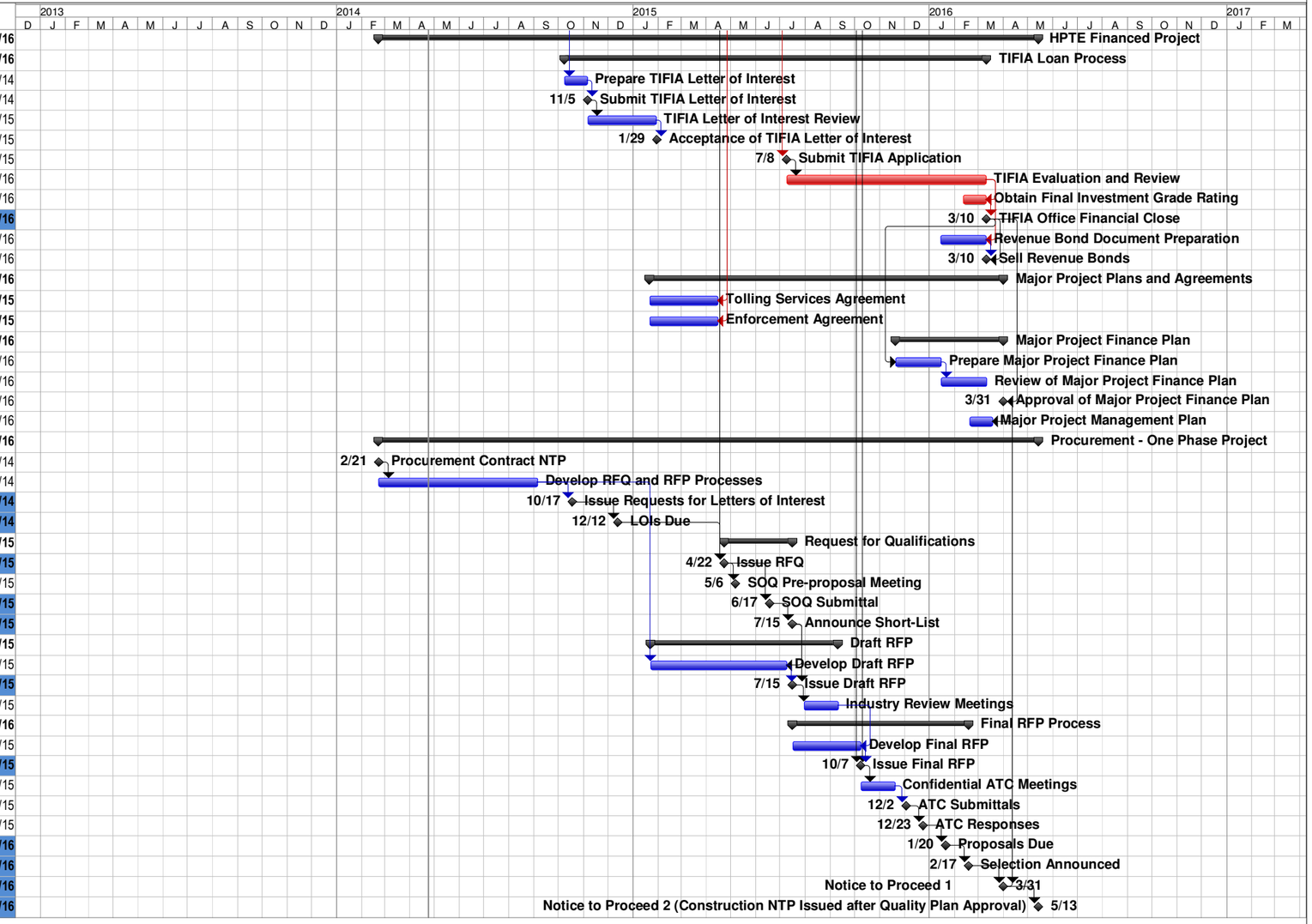
| ID | Task Name | Duration | Start | Finish |
|---|---|---|---|---|
| 1 | **Forecasting, Travel Demand, and Traffic Modeling (Level 2 S** | **272 days** | **Tue 1/1/13** | **Wed 1/15/14** |
| 2 | Completion of Forecasting, TDM and Modeling by Cambridge Systematics | 229 days | Tue 1/1/13 | Fri 11/15/13 |
| 3 | Analysis of Revised EA Alternatives | 80 days | Mon 8/26/13 | Fri 12/13/13 |
| 4 | Present Draft Level 2 Toll and Revenue | 1 day | Mon 12/16/13 | Mon 12/16/13 |
| 5 | Submit Level 2 Toll and Revenue Study | 1 day | Wed 1/15/14 | Wed 1/15/14 |
| 6 | | | | |
| 7 | **Revised Environmental Assessment (Revised EA)** | **537 days** | **Thu 2/7/13** | **Fri 2/27/15** |
| 8 | PC Selects Options for Revised EA | 0 days | Thu 2/7/13 | Thu 2/7/13 |
| 9 | Douglas County Commissioners Aprrove Consultant Contrac | 1 day | Tue 4/9/13 | Tue 4/9/13 |
| 10 | Revised EA NTP | 0 days | Thu 4/11/13 | Thu 4/11/13 |
| 11 | **Provide Traffic Forecasts for EA, Air Quality, and Noise** | **1 day** | **Fri 6/13/14** | **Fri 6/13/14** |
| 12 | Air Quality Analysis and Tech Memo | 23 days | Mon 6/16/14 | Wed 7/16/14 |
| 13 | Noise Analysis and Tech Memo | 35 days | Mon 6/16/14 | Fri 8/1/14 |
| 14 | **Meet with Neighborhoods regarding Noise Impacts / No Ir** | **10 days** | **Mon 8/4/14** | **Fri 8/15/14** |
| 15 | **Telephone Town Halls** | **5 days** | **Mon 8/25/14** | **Fri 8/29/14** |
| 16 | **Public Open Houses** | **5 days** | **Mon 9/1/14** | **Fri 9/5/14** |
| 17 | **Prepare Revised EA** | **375 days** | **Wed 4/10/13** | **Tue 9/16/14** |
| 18 | CDOT Review | 10 days | Wed 9/17/14 | Tue 9/30/14 |
| 19 | Revise EA for Submittal to EPB | 10 days | Wed 10/1/14 | Tue 10/14/14 |
| 20 | CDOT HQ Environmental Program Branch Review | 13 days | Wed 10/15/14 | Fri 10/31/14 |
| 21 | Revise EA and Submit to FHWA | 10 days | Mon 11/3/14 | Fri 11/14/14 |
| 22 | FHWA Review | 20 days | Mon 11/17/14 | Fri 12/12/14 |
| 23 | Revise EA and Incorporate FHWA Comments | 13 days | Mon 12/15/14 | Wed 12/31/14 |
| 24 | Revised EA Signatures | 11 days | Thu 1/1/15 | Thu 1/15/15 |
| 25 | **Public Review Period** | **26 days** | **Fri 1/16/15** | **Fri 2/20/15** |
| 26 | **Public Meeting(s) for Revised EA** | **5 days** | **Mon 2/23/15** | **Fri 2/27/15** |
| 27 | | | | |
| 28 | **Decision Document** | **90 days** | **Mon 3/2/15** | **Fri 7/3/15** |
| 29 | Prepare Decision Document | 40 days | Mon 3/2/15 | Fri 4/24/15 |
| 30 | CDOT Review | 10 days | Mon 4/13/15 | Fri 4/24/15 |
| 31 | Decision Document Revisions | 10 days | Mon 4/27/15 | Fri 5/8/15 |
| 32 | FHWA Review | 20 days | Mon 5/11/15 | Fri 6/5/15 |
| 33 | Final Documentation and Signatures | 20 days | Mon 6/8/15 | Fri 7/3/15 |
| 34 | **Decision Document** | **0 days** | **Fri 7/3/15** | **Fri 7/3/15** |
| 35 | | | | |
| 36 | **Right of Way Acquisition (Assumes early ROW Acquisition -** | **336 days** | **Mon 6/16/14** | **Mon 9/28/15** |
| 37 | Develop Right of Way Plans | 70 days | Mon 6/16/14 | Fri 9/19/14 |
| 38 | CDOT Review | 10 days | Mon 9/22/14 | Fri 10/3/14 |
| 39 | Right of Way Plan Review Meeting (ROWPR) | 0 days | Fri 10/3/14 | Fri 10/3/14 |
| 40 | Finalize Right of Way Plans | 10 days | Mon 10/6/14 | Fri 10/17/14 |
| 41 | Right of Way Authorization | 10 days | Mon 10/20/14 | Fri 10/31/14 |
| 42 | **Right of Way Appraisals (Assumes early ROW Acquisition** | **130 days** | **Mon 11/3/14** | **Fri 5/1/15** |
| 43 | **Right of Way Acquisition (Assumes early ROW Acquisitio** | **125 days** | **Mon 4/6/15** | **Fri 9/25/15** |
| 44 | **Right of Way is Fully Acquired** | **1 day** | **Mon 9/28/15** | **Mon 9/28/15** |
| 45 | | | | |
| 46 | **Project Financing Determination** | **308 days** | **Fri 4/4/14** | **Tue 6/9/15** |
| 47 | **Investment Grade T&R Study (Level 3 T&R)** | **308 days** | **Fri 4/4/14** | **Tue 6/9/15** |
| 48 | CDOT RFP for Level 3 T&R | 1 day | Fri 4/4/14 | Fri 4/4/14 |
| 49 | Level 3 T&R Proposals Due | 1 day | Thu 5/8/14 | Thu 5/8/14 |
| 50 | Level 3 T&R Shortlist | 1 day | Mon 5/19/14 | Mon 5/19/14 |
| 51 | Level 3 T&R Interview | 1 day | Mon 6/2/14 | Mon 6/2/14 |
| 52 | Level 3 T&R Selection | 1 day | Mon 6/16/14 | Mon 6/16/14 |
| 53 | Level 3 T&R NTP | 1 day | Tue 7/15/14 | Tue 7/15/14 |
| 54 | Amend Level 2 Configuration - Update Level 2 T&R | 60 days | Wed 7/16/14 | Tue 10/7/14 |
| 55 | Investment Grade T&R Study (Level 3) | 195 days | Wed 7/16/14 | Tue 4/14/15 |
| 56 | Obtain Preliminary Investment Grade Rating | 40 days | Wed 4/15/15 | Tue 6/9/15 |
| 57 | **Value for Money Analysis** | **183 days** | **Mon 6/16/14** | **Wed 2/25/15** |
| 58 | **Preliminary Value for Money Analysis (Determine if P3 h** | **10 days** | **Mon 6/16/14** | **Fri 6/27/14** |
| 59 | Final Value for Money Analysis | 60 days | Wed 10/8/14 | Tue 12/30/14 |
| 60 | Approve Value for Money Analysis | 40 days | Wed 12/31/14 | Tue 2/24/15 |
| 61 | **Determine HPTE Finance or Concessionaire Finance** | 1 day | Wed 2/25/15 | Wed 2/25/15 |



# C-470 RAMP Project Procurement Schedule - HPTE Finance with Early ROW Acquisition - 1 Phase Project

DRAFT -April 24, 2014

| ID | Task Name | Duration | Start | Finish |
|---|---|---|---|---|
| 62 | **HPTE Financed Project** | **581 days** | **Fri 2/21/14** | **Fri 5/13/16** |
| 63 | **TIFIA Loan Process** | **372 days** | **Wed 10/8/14** | **Thu 3/10/16** |
| 64 | Prepare TIFIA Letter of Interest | 20 days | Wed 10/8/14 | Tue 11/4/14 |
| 65 | Submit TIFIA Letter of Interest | 1 day | Wed 11/5/14 | Wed 11/5/14 |
| 66 | TIFIA Letter of Interest Review | 60 days | Thu 11/6/14 | Wed 1/28/15 |
| 67 | Acceptance of TIFIA Letter of Interest | 1 day | Thu 1/29/15 | Thu 1/29/15 |
| 68 | Submit TIFIA Application | 1 day | Wed 7/8/15 | Wed 7/8/15 |
| 69 | TIFIA Evaluation and Review | 175 days | Thu 7/9/15 | Wed 3/9/16 |
| 70 | Obtain Final Investment Grade Rating | 20 days | Thu 2/11/16 | Wed 3/9/16 |
| 71 | **TIFIA Office Financial Close** | **1 day** | **Thu 3/10/16** | **Thu 3/10/16** |
| 72 | Revenue Bond Document Preparation | 40 days | Thu 1/14/16 | Wed 3/9/16 |
| 73 | **Sell Revenue Bonds** | 1 day | Thu 3/10/16 | Thu 3/10/16 |
| 74 | **Major Project Plans and Agreements** | **312 days** | **Wed 1/21/15** | **Thu 3/31/16** |
| 75 | **Tolling Services Agreement** | **60 days** | **Wed 1/21/15** | **Tue 4/14/15** |
| 76 | **Enforcement Agreement** | **60 days** | **Wed 1/21/15** | **Tue 4/14/15** |
| 77 | **Major Project Finance Plan** | **95 days** | **Fri 11/20/15** | **Thu 3/31/16** |
| 78 | Prepare Major Project Finance Plan | 40 days | Fri 11/20/15 | Thu 1/14/16 |
| 79 | Review of Major Project Finance Plan | 40 days | Fri 1/15/16 | Thu 3/10/16 |
| 80 | Approval of Major Project Finance Plan | 1 day | Thu 3/31/16 | Thu 3/31/16 |
| 81 | **Major Project Management Plan** | 20 days | Fri 2/19/16 | Thu 3/17/16 |
| 82 | **Procurement - One Phase Project** | **581 days** | **Fri 2/21/14** | **Fri 5/13/16** |
| 83 | Procurement Contract NTP | 1 day | Fri 2/21/14 | Fri 2/21/14 |
| 84 | Develop RFQ and RFP Processes | 140 days | Fri 2/21/14 | Thu 9/4/14 |
| 85 | **Issue Requests for Letters of Interest** | **1 day** | **Fri 10/17/14** | **Fri 10/17/14** |
| 86 | **LOIs Due** | **0 days** | **Fri 12/12/14** | **Fri 12/12/14** |
| 87 | **Request for Qualifications** | **60 days** | **Wed 4/22/15** | **Wed 7/15/15** |
| 88 | **Issue RFQ** | **0 days** | **Wed 4/22/15** | **Wed 4/22/15** |
| 89 | SOQ Pre-proposal Meeting | 0 days | Wed 5/6/15 | Wed 5/6/15 |
| 90 | **SOQ Submittal** | **0 days** | **Wed 6/17/15** | **Wed 6/17/15** |
| 91 | **Announce Short-List** | **0 days** | **Wed 7/15/15** | **Wed 7/15/15** |
| 92 | **Draft RFP** | **165 days** | **Thu 1/22/15** | **Wed 9/9/15** |
| 93 | Develop Draft RFP | 120 days | Thu 1/22/15 | Wed 7/8/15 |
| 94 | **Issue Draft RFP** | **0 days** | **Wed 7/15/15** | **Wed 7/15/15** |
| 95 | Industry Review Meetings | 30 days | Thu 7/30/15 | Wed 9/9/15 |
| 96 | **Final RFP Process** | **155 days** | **Thu 7/16/15** | **Wed 2/17/16** |
| 97 | Develop Final RFP | 60 days | Thu 7/16/15 | Wed 10/7/15 |
| 98 | **Issue Final RFP** | **0 days** | **Wed 10/7/15** | **Wed 10/7/15** |
| 99 | Confidential ATC Meetings | 30 days | Thu 10/8/15 | Wed 11/18/15 |
| 100 | ATC Submittals | 0 days | Wed 12/2/15 | Wed 12/2/15 |
| 101 | ATC Responses | 0 days | Wed 12/23/15 | Wed 12/23/15 |
| 102 | **Proposals Due** | **0 days** | **Wed 1/20/16** | **Wed 1/20/16** |
| 103 | **Selection Announced** | **0 days** | **Wed 2/17/16** | **Wed 2/17/16** |
| 104 | **Notice to Proceed 1** | **0 days** | **Thu 3/31/16** | **Thu 3/31/16** |
| 105 | **Notice to Proceed 2 (Construction NTP Issued after Qua** | **1 day** | **Fri 5/13/16** | **Fri 5/13/16** |



# Appendix E: Federal Wage Rate Certification

COLORADO
Department of Transportation
Office of the Executive Director
4201 East Arkansas Ave, Suite 262
Denver, CO 80222

## FEDERAL WAGE RATE CERTIFICATION

I, Donald E. Hunt, on behalf of the Colorado Department of Transportation, applicant for the C-470 Tolled Express Lanes application for the Transportation Investment Generating Economic Recovery (TIGER) VI discretionary grant program, hereby certify that the Colorado Department of Transportation will comply with the requirements of subchapter IV of chapter 31 of title 40, United States Code (federal wage requirements), as required by the FY 2013 Continuing Appropriations Act.

Donald E. Hunt
Executive Director
Colorado Department of Transportation

Date: April 23, 2014

# Appendix F: Short-Term Economic Impacts Attributed to Construction Expenditure

PARSONS BRINCKERHOFF

# Short-Term Economic Impacts Attributed to Construction Expenditure
# C-470 Tolled Express Lanes

Prepared for the Colorado Department of Transportation (CDOT)

April 24, 2014

CDOT COLORADO Department of Transportation

## Introduction

The C-470 Tolled Express Lanes Project (Tolled Express Lanes) is expected to create near-term economic impacts for the state of Colorado. The economic impacts would be driven by an increase in construction spending in the region. These project expenditures would generate a short term increase in demand for engineering and technical services, as well as construction-related labor and materials.

To quantify the near-term economic impacts of this project, this analysis utilized an input-output modeling framework based on multipliers from MIG Inc., the developers of IMPLAN.[1] U.S. National data were selected for the economic profile and multiplier set.

Two types of economic impacts are identified for the purpose of this analysis.

- Direct/Indirect Impacts: Direct impacts represent new spending, hiring, and production by civil engineering construction companies to accommodate the demand for resources in order to complete the project. Indirect impacts result from the quantity of inter-industry purchases necessary to support the increase in production from the construction industry experiencing new demand for its goods and services. All industries that produce goods and services consumed by the construction industry will also increase production and, if necessary, hire new workers to meet the additional demand.
- Induced Impacts: Induced impacts stem from the re-spending of wages earned by workers benefitting from the direct and indirect activity within area. For example, if an increase in demand leads to new employment and earnings in a set of industries, workers in these industries will spend some proportion of their increased earnings at local retail shops, restaurants, and other places of commerce, which would further stimulate economic activity.

This report estimates three types of economic impacts.

- Person years: 100 person-years may translate into 50 jobs supported for 2 years or 100 jobs supported for 1 year.
- Earnings - All forms of employment income, including Employee Compensation (wages and benefits) and Proprietor Income.
- Output: Output represents the value of industry production. For manufacturers this would be sales plus/minus change in inventory. For service sectors production equals sales. For Retail and wholesale trade, output equals gross margin (as opposed to gross sales).

[1] http://implan.com/V4/Index.php

## Costs

The total capital cost of the Tolled Express Lanes is expected to be $153 million (2013 $). Right of way costs are not included because they are considered an economic transfer of wealth from liquidity into real assets, and as such, have no economic impact the way direct spending does. The spending schedule for the project is seen below in Table 1.

Table 1: Capital Costs for Project, less Right of Way Costs (2013 $ millions)

| 2015 | 2016 |
|---|---|
| $76.5 | $76.5 |

*Source: Project Financial Plan, 2014*

## Results

A summary of the short term economic impacts are shown in Table 2.

Table 2: Summary of Near-Term Economic Impacts

| | |
|---|---|
| **Direct + Indirect Impacts** | |
| Employment (Annual Average) | 786 |
| Earnings (2013 $) | $101,180,206 |
| Output (2013 $) | $290,154,096 |
| **Induced Impacts** | |
| Employment (Annual Average) | 455 |
| Earnings (2013 $) | $48,224,015 |
| Output (2013 $) | $141,417,563 |
| **Total Impacts** | |
| Employment (Annual Average) | 1,241 |
| Earnings (2013 $) | $149,404,221 |
| Output (2013 $) | $431,571,660 |

*Source: Parsons Brinkerhoff, 2014*

Assuming the grant is awarded, the construction of the Tolled Express Lanes are expected to generate economic impacts for the region beginning in 2015. In total, the project is projected to create 2,482 job-years of employment, including 1,572 direct/indirect job-years. Table 3 shows the number of persons directly and indirectly employed by the project by year.

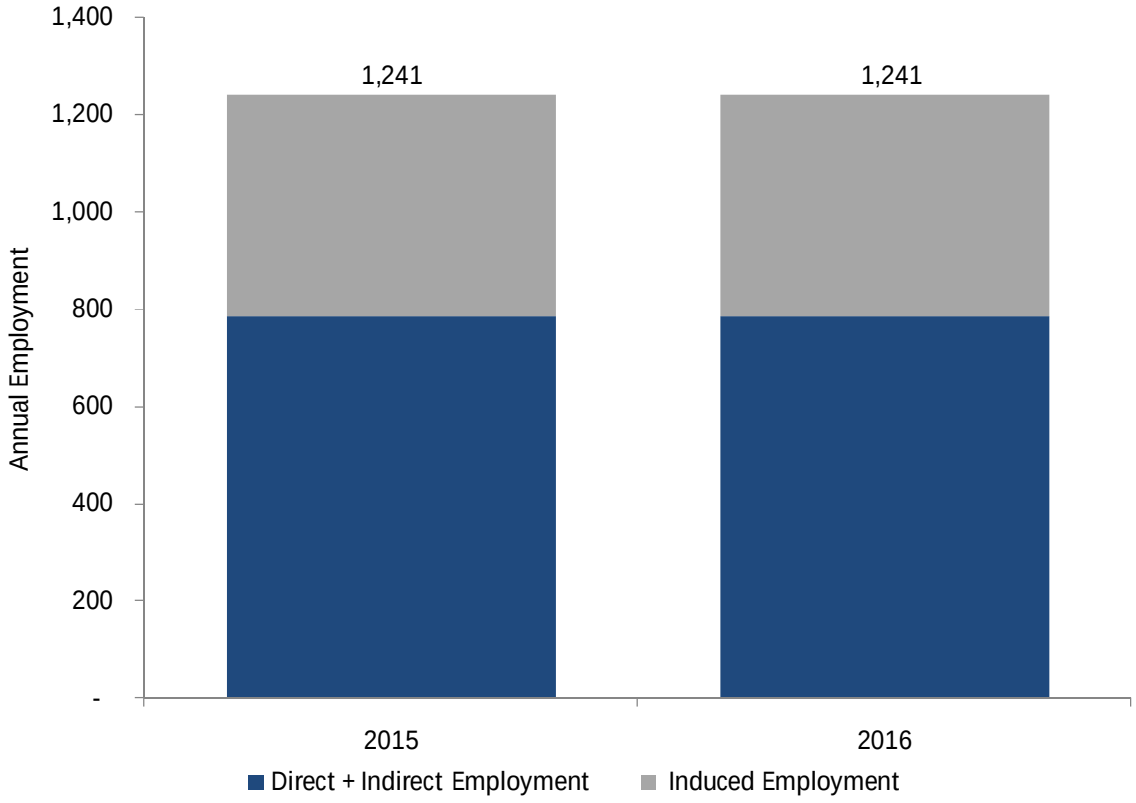
Table 3: Direct and Indirect Jobs by Year

| | 2015 | 2016 |
|---|---|---|
| Direct and Indirect Jobs | 786 | 786 |
| Induced Jobs | 455 | 455 |
| Total Jobs | 1,241 | 1,241 |

*Source: Parsons Brinkerhoff, 2014*

The project will generate an estimated average of 1,241 direct, indirect, and induced jobs per year. This includes 786 direct and indirect jobs, and 455 induced jobs. Figure 1 shows the profile of annual employment generated by the project's expenditures.

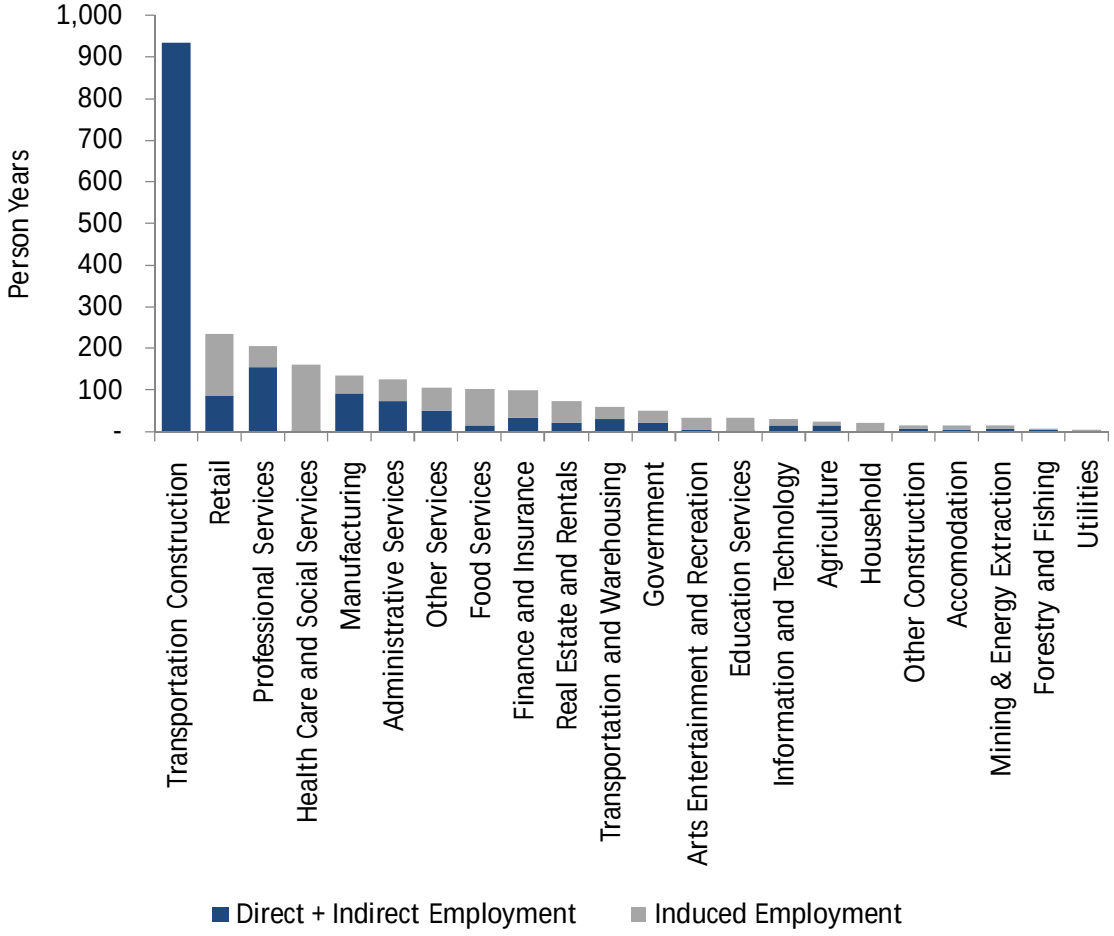
Figure 1: Annual Employment During Construction




*Source: Parsons Brinkerhoff, 2014*

Figure 2 shows the breakdown of jobs created by industry and type of impact. As expected, the civil engineering construction industry is estimated to receive the largest increase in jobs from the project (934 person-years), almost all of which are direct jobs created. The other industries that will see the largest number of jobs created include retail (235 person-years) professional services (205 person-years), health care and social services (162 person-years), manufacturing (135 person-years), and administrative services (125 person-years).

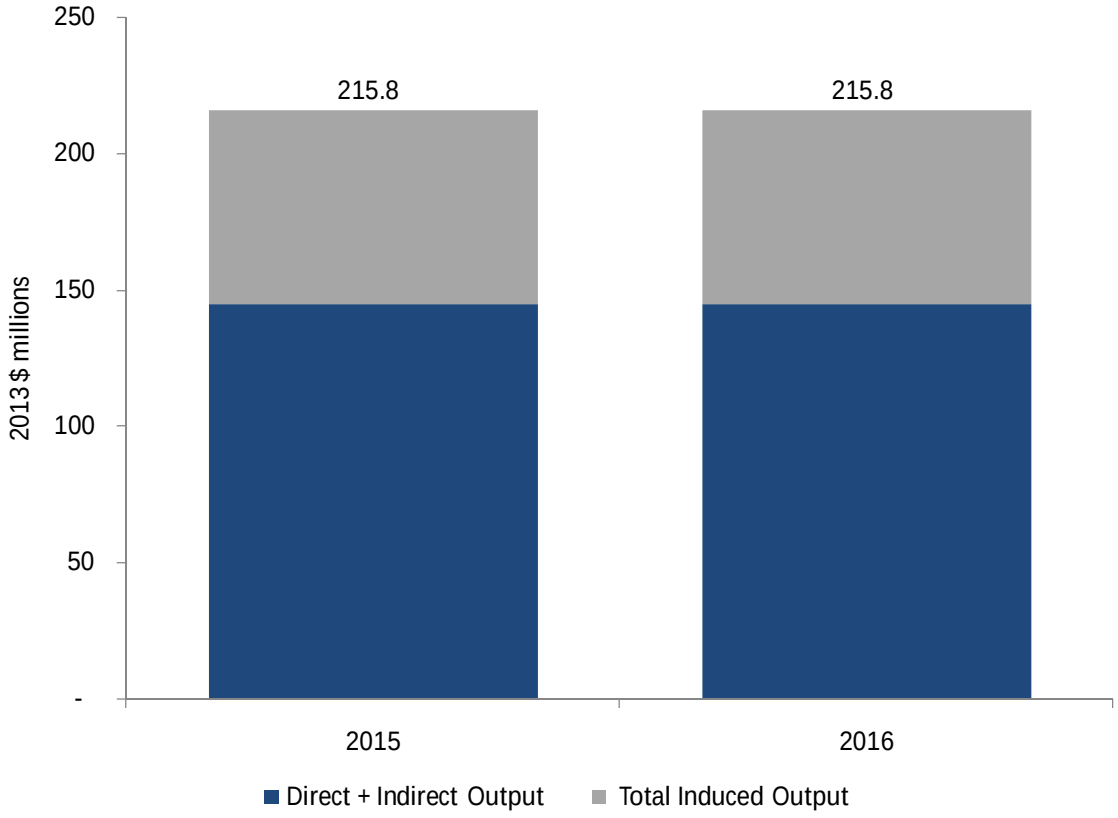
Figure 2: Breakdown of Job Creation by Industry and Type of Impact




*Source: Parsons Brinkerhoff, 2014*

The amount of short-term economic activity generated by the project is shown in Figure 3. In total, the project would generate $431.6 million in real economic output (measured in 2013 dollars), with $215.8 generated in each year.

Figure 3: Breakdown of Economic Output Generated by Contract




*Source: Parsons Brinkerhoff, 2014*