

FINAL Alternatives Development and Analysis Report



I-70 & Kipling Interchange | PEL Study



Submitted to:



Submitted by:



In conjunction with:



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Looking north along Kipling Street towards I-70

Introduction

Alternatives Development and Analysis Report

This report documents the development and analysis of alternatives for improvement of the Interstate 70 (I-70) and Kipling Street (State Highway 391) interchange. The Colorado Department of Transportation (CDOT) initiated a Planning and Environmental Linkages (PEL) Study to develop a range of improvements to reduce congestion and improve operations and safety at the I-70 and Kipling Street interchange. A thorough and inclusive technical

and public process helped to identify and screen a wide range of improvement alternatives.

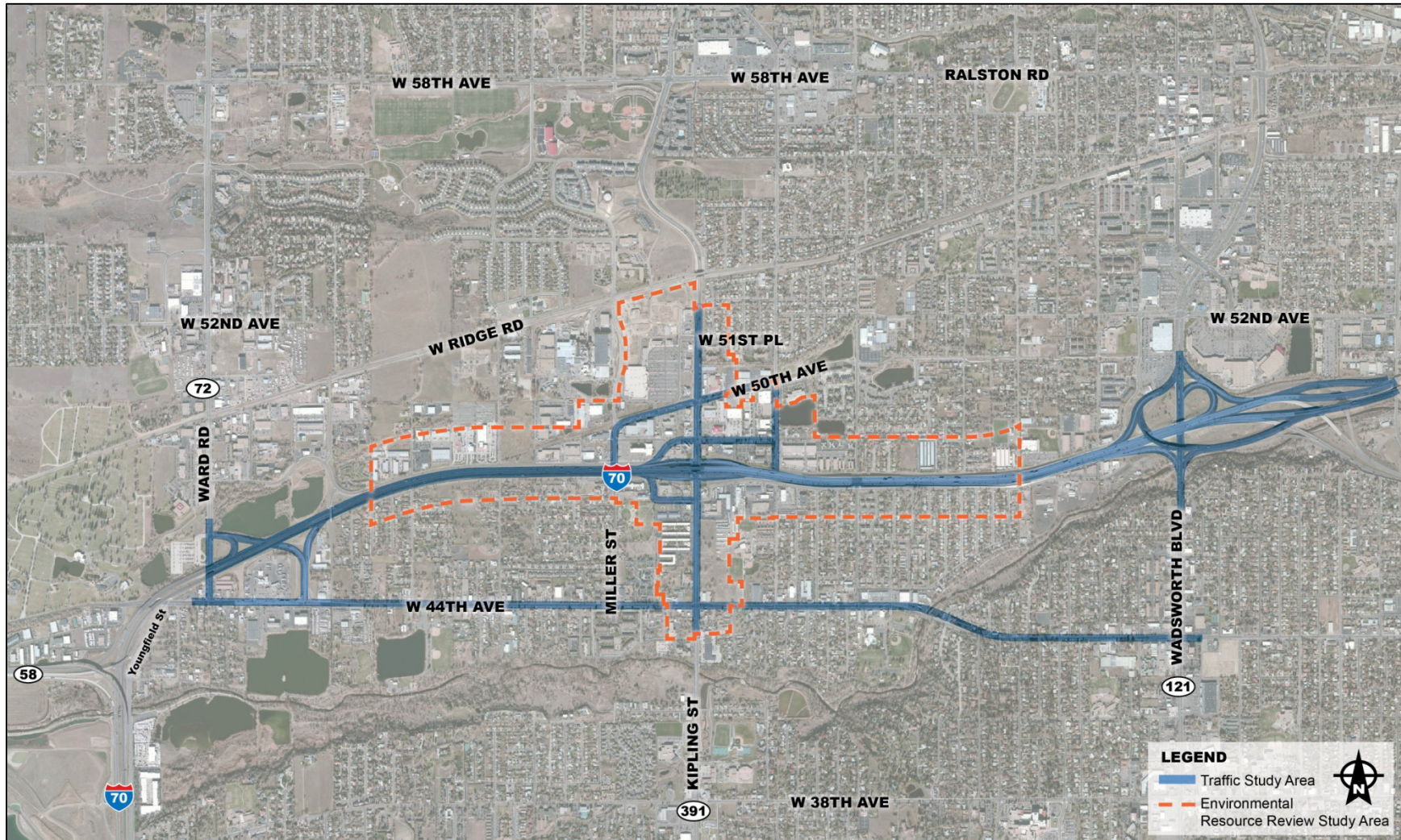
This study was conducted following Federal Highway Administration (FHWA) PEL guidance regarding the integration of transportation planning and the National Environmental Policy Act (NEPA) process, which encourages the use of planning studies to provide information for incorporation into future NEPA documents. The goal of these early integrated planning efforts is to streamline subsequent alternatives analysis during the NEPA process(es).

Study Area

The study area, illustrated in **Figure 1**, is focused around the area of most likely physical impacts of interchange improvements. The I-70 and Kipling Street interchange is located within the City of Wheat Ridge in Jefferson County. The boundary for the City of Arvada is located immediately north of the interchange between the 50th Avenue and 51st Avenue intersections. The project study limits include I-70 from Ward Road to Wadsworth Boulevard. On Kipling Street, the project limits are 44th Avenue to 51st Place.

The interchange is located in a predominantly urban area and provides access to well-established commercial, residential and light industrial areas, as well as areas identified for urban renewal and new transit-oriented development in Wheat Ridge and Arvada.

Figure 1: Study Area





Kipling Street and Westbound I-70 Ramps intersection

Purpose and Need

CDOT in cooperation with local communities and other agencies is preparing this PEL study to identify and assess potential transportation improvements at the I-70 and Kipling Street interchange. A key element of the PEL study is to document the study process, findings, and recommendations to NEPA standards, so information developed in this study can be appended or referenced in

future NEPA documentation. This Purpose and Need was developed in coordination with agency stakeholders with review by the general public.

The specific needs, summarized below and in **Figure 2**, are based on the analysis and findings documented in this report and in separate documents prepared as part of this project, including the *Existing Transportation Conditions Report* (May 2012) and *Purpose and Need Statement* (May 2012).

Purpose of the Project

The purpose of the I-70 and Kipling Street interchange project is to reduce congestion, optimize operations, improve safety, and accommodate multimodal connections at the I-70 and Kipling Street interchange.

Need for Interchange Improvements

The existing design and configuration of the interchange no longer accommodates travel demands. Kipling Street is an important transportation corridor supporting mobility and economic activity in Jefferson County, including the cities of Wheat Ridge and Arvada. Improvements are needed to:

- Meet current and future traffic demands
- Improve operational efficiency of the interchange
- Improve traveler safety through the interchange
- Accommodate multimodal connections

Capacity and Operations

High traffic volumes and frequent congestion issues occur within the study area on Kipling Street north of the interchange and on I-70 east of the interchange. I-70 carries approximately 147,000 vehicles daily east of the Kipling Street interchange as measured by traffic counts taken in 2010. Existing daily traffic on Kipling Street collected for this project south of I-70 is approximately 42,000 vehicles, while north of I-70 the existing daily traffic is about 48,000 vehicles. By 2035, the average daily traffic (ADT) on I-70 is expected to increase about 25% to approximately 184,000 vehicles east of the Kipling Street interchange and the ADT on Kipling Street is expected to increase about 15% to about 55,000 vehicles north of I-70.

The interchange at I-70 and Kipling Street was constructed in 1967. Although it served the communities and traffic conditions when it was constructed, the tight diamond configuration with closely-spaced frontage road intersections can no longer effectively handle current or future traffic demands.

Existing traffic operations in the study area were evaluated to determine the level of congestion during the morning and evening hours of peak traffic use. Existing traffic volumes at the interchange create operating conditions characterized by restricted movements and recurring back ups. Specific movements that currently exhibit operational problems include the peak turning movements from the Westbound I-70 off ramp and the AM peak traffic backs up along Kipling Street on the southbound approaches to the interchange.

Approximately 15% of drivers making the right turn from the Westbound I-70 off ramp desire to turn left at the Kipling Street and 49th Avenue/North Frontage Road intersection, located 375 feet north of the ramp. There are currently signs that indicate the right turn lane as a continuous acceleration lane, but there are right turning drivers that stop in the continuous flow lane in order to wait for a gap in traffic to get to the northbound left turn lane at 49th Avenue. This reduces the capacity of the ramp signal and causes traffic to queue up the off ramp and onto the I-70 mainline.

Close spacing between frontage road intersections and interchange ramps does not provide adequate distance between traffic signals for traffic to progress through the interchange. Because of the relatively high overall intersection volumes, turn phases and a long signal cycle length are needed during the peak hours. These required signal operations combined with the over-capacity traffic volume conditions create vehicle queues that spill back from the I-70 ramp signals through the adjacent intersections at the frontage roads. Traveling through the four ramp and frontage road traffic signals with queues backing up through intersections requires drivers to slow their speeds through the interchange area, which further limits the capacity of the entire interchange area and adversely affects through traffic on Kipling Street.

South of I-70, the numerous driveways and unrestricted median encourages uncontrolled turns across Kipling Street that both increase potential for conflicts (and crashes) and disrupt traffic flow. Side-by-side opposing left turn lanes introduce multiple conflict points and create confusion because of the uncertainty of when and where drivers will enter the median lanes. In addition, drivers stopped

Problems at the interchange have the potential to redirect traffic and create operational and capacity issues on other local roadways.

in the turn lanes block the view of traffic in the through lanes, resulting in drivers making unsafe turns across through traffic. All of these conditions contribute to turbulence in the Kipling Street traffic flow and reduce its capacity.

Safety

The proposed action is needed to improve traveler safety through the interchange, including vehicles, pedestrians, and bicyclists.

Traffic Safety

The segment of I-70 at the Kipling Street interchange is above the average expected crash rate for the given average annual daily traffic (AADT). The occurrence of rear end crashes on I-70 in the vicinity of the interchange is closely tied to the heavy peak hour traffic volumes on the freeway. Over a three year period from 2008 through 2010, the majority of crashes on the four interchange ramps occurred on the eastbound on ramp and the westbound off ramp and the majority of the crashes were rear end crashes during the PM peak hour. On the westbound off ramp, the majority of the crashes occurred at or near the free flow right turn lane from the off ramp to northbound Kipling Street when the lead vehicle did not utilize the free flow acceleration lane but instead stopped to yield to traffic on Kipling Street. The following vehicle then struck the lead vehicle.

Many of the crashes along Kipling Street in the study area occur because of congestion.

On Kipling Street, rear end crashes are the predominant crash type followed by approach turn crashes and broadside crashes. The following list describes the crash types that occur more frequently than expected in the study area and the potential cause:

- Rear-end crashes – related to congestion and frequent traffic signals through the corridor
- Approach turn and broadside – related to congested intersections, signal phasing, and signal head visibility
- Sideswipes when both vehicles are moving in the same direction – related to short weaving and lane-changing maneuvers

Pedestrian and Bicycle Safety

High traffic volumes and deficient pedestrian and bicycle facilities create safety concerns for pedestrians and bicyclists traveling through the study area. The interchange presents a particular challenge. The sidewalk on both sides of Kipling Street under the I-70 bridge is uncomfortable to use because of the proximity to the bridge piers and congested traffic lanes. The sidewalk on the west side of Kipling Street under the bridge also has steep sidewalk grades.

Over a three year period from 2008 through 2010, along Kipling Street in the study area, there were three crashes involving pedestrians and three crashes involving bicycles. One of the pedestrian and one of the bicycle crashes occurred at the Kipling Street and 44th Avenue intersection. Two of the crashes involving bicycles occurred at the Kipling Street and South Frontage Road intersection. One of the pedestrian crashes occurred at the Westbound I-70 Ramps intersection.

The lack of access control along Kipling Street contributes to pedestrian and bicycle safety concerns. Along Kipling Street, pedestrians and bicyclists must cross many driveways where turning drivers are focused on entering or exiting Kipling Street and are not attentive to potential pedestrian conflicts.

Multimodal Connections

Automobiles, trucks, pedestrians, bicyclists, and buses travel through the I-70 interchange and Kipling Street lacks adequate facilities to accommodate effective connections. Effective multimodal connections provide links between facilities, such as existing sidewalks and multiuse paths, as well as accommodate efficient connections between modes, such as sidewalks at bus stops or multiuse paths leading to/from a rail station.

Transit Operations

Existing transit service on I-70 and Kipling Street in the study area includes local and express bus routes operated by the Regional Transportation District (RTD). RTD also plans to implement commuter rail transit along Ridge Road as part of the Gold Line commuter rail project, planned for completion in 2015. A commuter rail station with associated transit-oriented development is planned at Ridge Road west of Kipling Street. With the opening of the commuter rail as currently planned, the proposed local bus service will remain the same as today. However, ridership for the bus route on Kipling Street serving the new rail station is expected to increase.

Buses, like other vehicles, will experience increased delays traveling through the interchange I-70 and Kipling Street interchange area as traffic volumes increase. Buses also contribute to congestion by regularly stopping in the outside through-traffic lane, causing a temporary reduction in roadway capacity.

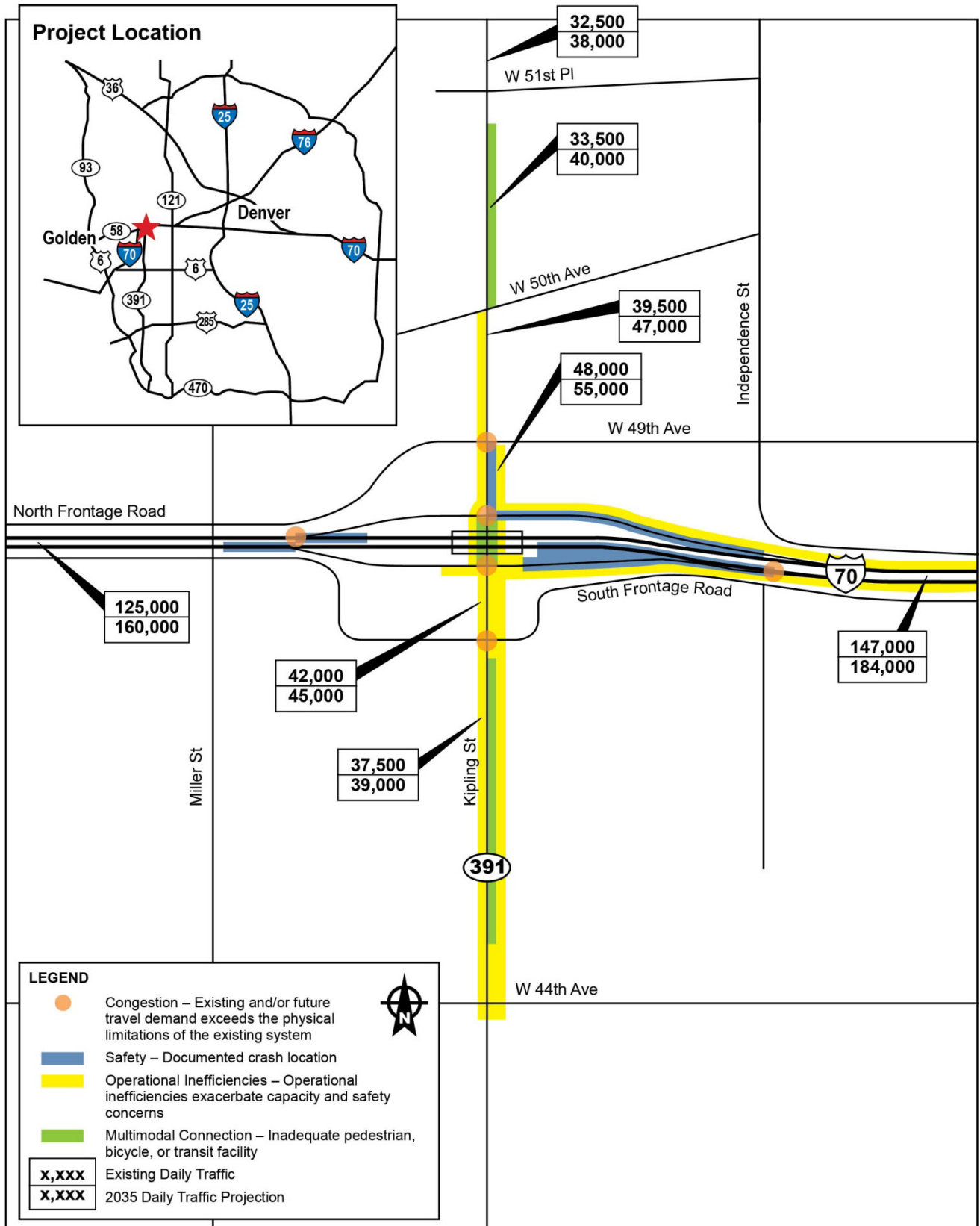
Pedestrian and Bicycle Facilities

Local and regional plans identify the need for pedestrian and bicycle improvements to the Kipling Street corridor and its crossing of I-70. These needs will become more critical as the volume of pedestrian and bicycle travel is anticipated to increase after the opening of the Gold Line commuter rail station at Ridge Road.

Most of the existing sidewalks within the study area are attached to the roadway curb, not buffered from travel lanes, and are often too narrow to accommodate both pedestrian and bicycle use. The sidewalk on both sides of Kipling Street under the I-70 bridge is perceived to be unsafe by pedestrians because of the proximity to the bridge piers and congested traffic lanes. A segment of sidewalk between 44th Avenue and the South Frontage Road on the east side is attached, with narrow asphalt pavement in poor condition. There is no sidewalk on the east side of Kipling Street between 50th Avenue and 51st Place.

Pedestrian and bicycle connections will become more critical with the opening of the Gold Line commuter rail station north of the study area.

Figure 2: Summary of Interchange Needs





Looking south along Kipling Street towards I-70

Alternatives Evaluation Process

An objective in pursuing this study was to work with stakeholders to analyze and develop a range of short- and long-term improvements to reduce congestion and improve operational performance and safety at the interchange. The alternatives development and

evaluation process included developing screening criteria based on the project Purpose and Need, developing a reasonable range of conceptual alternatives, and documenting the elimination of flawed alternatives to limit the need for consideration during future NEPA process(es).

General alternative concepts were developed and subjected to a Level 1 “fatal flaw” screening. Those alternatives that were carried forward for further evaluation were compared to each other in a Level 2 evaluation. The alternatives remaining after the Level 2 evaluation will be further refined through conceptual design in Level 3 for final recommendation in the project PEL Study Report. The final recommendations may include large-scale improvements with short- and long-term elements, as well as separate, short-term improvements.

During the project initiation period, baseline data were collected for the physical, operational, and environmental conditions of the area surrounding the I-70 and Kipling Street interchange. This information led to the development of the project Purpose and Need, presented earlier in this report.

Evaluation criteria were established for the Level 1 and Level 2 screening, prior to the development of alternatives. These criteria were developed by CDOT based on the project Purpose and Need. The project Technical Team, comprised of FHWA, RTD, Denver Regional Council of Governments (DRCOG), and the local agencies, were consulted during the development of evaluation criteria and ultimately concurred with the evaluation criteria in accordance with the chartering agreement established at the beginning of the PEL process. Technical Team members also concurred with the Purpose and Need.

Agency and Public Coordination

Understanding the ideas, perspectives, and needs of key stakeholders in the interchange area is critical to building broadly supported decisions and solutions. In an effort to gain as much community input as possible, public and local agency participation was emphasized throughout the study process. It was important that all participants, including potential users of the interchange and roadways in the vicinity, clearly understand the details of each alternative design. Specific tasks were included in the project for creation of a project website and graphics to illustrate proposed improvement alternatives, operational characteristics, appearance, impacts, and costs.

CDOT provided multiple opportunities for the local jurisdictions, regional partners, resource agencies, and general public to engage and inform the study.

This study held two public meetings to introduce the project and discuss interchange travel conditions and the need for improvement, and to present alternatives and preliminary analysis results. A final public notice is planned to describe the recommended improvements and document final public comment on study recommendations.

Community Focus Groups were formed to advise the project team of the concerns of various groups of stakeholders in the area. Three separate focus groups were formed, including representatives from:

- Businesses surrounding the interchange area
- Residents and homeowners' associations
- Multimodal groups

The project team, comprised of CDOT and project consultant staff, met with each focus group two times during the alternatives evaluation to review proposed improvement alternatives and evaluation criteria and to discuss likely impacts of improvements and possible mitigation or resolution techniques.

The study was coordinated with State and Federal resource agencies with an introduction to the PEL process and requests for input on the existing conditions and concerns within the study area. Recommendations for interchange improvements will be also coordinated to identify potential resource impacts and next steps required for future NEPA process(es).

The study included the formation of a Technical Team that met frequently with the project team to provide technical input. The Technical Team included staff from CDOT, the cities of Arvada and Wheat Ridge, Jefferson County, Denver Regional DRCOG, RTD, and FHWA. The Technical Team was heavily involved in shaping the alternatives evaluation criteria and performance measures, as well as the alternatives that were considered. Members of the Technical Team kept their respective elected officials updated and brought elected official feedback to the project team. The evaluation criteria, performance measures, alternatives development, and alternatives screening were reviewed and approved by the Technical Team throughout the study agency coordination process.

Initial Alternatives Development

The set of reasonable alternatives were developed to address the interchange's largest issues identified in the Purpose and Need, including the close signal spacing

along Kipling Street, the weave movement between the ramp and frontage road intersections, the queuing conditions on the Westbound I-70 Off Ramp, and the merging conditions for the Eastbound I-70 On Ramp. Managed lane configurations were not considered because the scope of this study does not include through capacity improvements to I-70 or Kipling Street.

The initial improvement alternatives considered for the I-70 and Kipling Street interchange were developed based on input from the Technical Team, public input, and the technical input of the project team. Overall, the potential options discussed focused on interchange alternatives that accommodate high traffic volumes and improve safety within a developed urban area with limited right-of-way. The design concepts included concepts that project staff, based on experience with similar projects, determined could meet transportation needs.

No Action Alternative

The No Action alternative does not meet the Purpose and Need. The No Action alternative is included as a baseline for comparison to the action alternatives. Under the No Action alternative, only improvements that are already planned and funded by CDOT, the County, or cities would be completed. There are no current transportation improvement projects within the area immediately adjacent to the I-70 and Kipling interchange. However, there are a number of engineering and planning efforts taking place in the near term within the larger area surrounding the interchange. Each of these programmed improvements with committed funding sources is shown in **Figure 3**. Although some of these projects are outside the defined study area, they will impact regional travel through the interchange, which is considered as part of the No Action alternative.

- **Kipling Multi-Use Path, 32nd Avenue to 44th Avenue** - Project includes the construction of a new detached, multi-use trail on the east side of Kipling Street.
- **Kipling Trail, 58th Avenue to Ridge Road** - The project includes construction of a new detached, multi-use trail connection on the west side of Kipling Street as part of the TOD Access Plan for the Gold Line Arvada Ridge rail station.
- **Ridge Road Bike/Pedestrian Improvements** - The project includes widening Ridge Road to provide an improved bicycle and pedestrian connection to the Gold Line Arvada Ridge rail station.
- **RTD Gold Line** - The commuter rail project includes future parking and transportation connection improvements at three stations surrounding the I-70 and Kipling interchange, at the Arvada Ridge Station (at Kipling Street and Ridge Road), Ward Road Station, and Olde Town Station.
- **Van Bibbler Trail Underpass** - This includes an underpass of Kipling Street at 56th Place connecting the residential areas east of Kipling to the recreational areas and Van Bibbler Trail west of Kipling.
- **Ralston Road Corridor Plan** - This planning project includes preliminary design for multimodal transportation improvements along Ralston Road between Kipling Street and Wadsworth Bypass.

Figure 3: Area Transportation Projects in No Action Alternative



Level 1 (Purpose and Need) Alternatives Screening

Level 1 screening identified a range of interchange improvements that could meet the project Purpose and Need, while eliminating concepts from detailed consideration that had “fatal flaws” (that were not reasonable or did not meet Purpose and Need). During the Level 1 screening, design concepts were evaluated qualitatively primarily using professional judgment of the project engineering and planning staff.

Level 1 screening was supported by the baseline data collected at the initiation of the study.

Level 1 screening criteria were developed to screen concepts in the following areas: traffic operations, safety, and multimodal connections. Alternative concepts were evaluated with a “Yes” or “No” answer to the following questions to demonstrate each alternative’s ability to meet the project Purpose and Need.

- Traffic Operations:
 - Can the alternative meet current and future traffic demands?
 - Does the alternative improve operations by addressing the interaction of the Kipling interchange with the frontage road intersections?
- Safety:
 - Does the alternative improve existing conditions that contribute to higher than expected crash rates?
- Multimodal Connections:
 - Can the alternative accommodate bicycle, pedestrian, and transit connections through the interchange?

An alternative with a “No” answer to any of the above questions was considered to not meet the project Purpose and Need and was eliminated as a stand-alone solution. At this level of screening, it was determined that some small-scale alternatives eliminated as a stand-alone alternative could be included as elements of larger-scale alternatives in Level 2 screening.

Level 2 Alternatives Screening

The purpose of the Level 2 evaluation was to compare how well each alternative would perform and what impacts each alternative would have. The Level 2 evaluation expanded measures for each of the criteria from Level 1 screening and provided a method for comparing alternatives.

Alternatives carried forward from the Level 1 screening were reviewed and refined to add more definition to the proposed improvements, to better understand the operational benefits and costs of the alternatives, and to provide information for further assessment in the Level 2 evaluation. The Level 2 screening was a more detailed evaluation of the conceptual alternatives that passed the Level 1 screening.

The alternatives were compared to determine how each alternative met the following evaluation criteria:

- Optimize operations and reduce congestion
 - Measures considered improvements to operations and reduction in congestion on I-70, Kipling Street, and the ramps through the interchange
- Improve traveler safety
 - Measures considered the ability to improve multimodal safety within the interchange area by addressing the weave movement between the ramp and frontage road intersections, the queuing conditions on the Westbound I-70 Off Ramp, and the merging conditions for the Eastbound I-70 On Ramp
- Accommodate multimodal connections
 - Measures addressed the relative level of accommodation for multimodal connections through the interchange
- Avoid and minimize environmental impacts
 - Measures considered the magnitude of anticipated environmental impacts, such as noise receptors, hazardous material sites, and community resources
- Avoid and minimize community impacts
 - Measures considered the magnitude of anticipated community impacts, such as right-of-way needed, property impacts, access and circulation, and conformance with local plans
- Maximize constructability
 - Measures addressed the practicability for implementation when considering constructability issues, cost, phasing, maintenance, and foreseeable funding for short- and long-term improvements

Specific performance measures were developed to compare each alternative against the evaluation criteria. These performance measures, described in the Level 2 Screening section of this report, are a mix of qualitative and quantitative assessments, based on the criteria and the availability of data at this stage of development.

Level 3 Alternatives Refinement

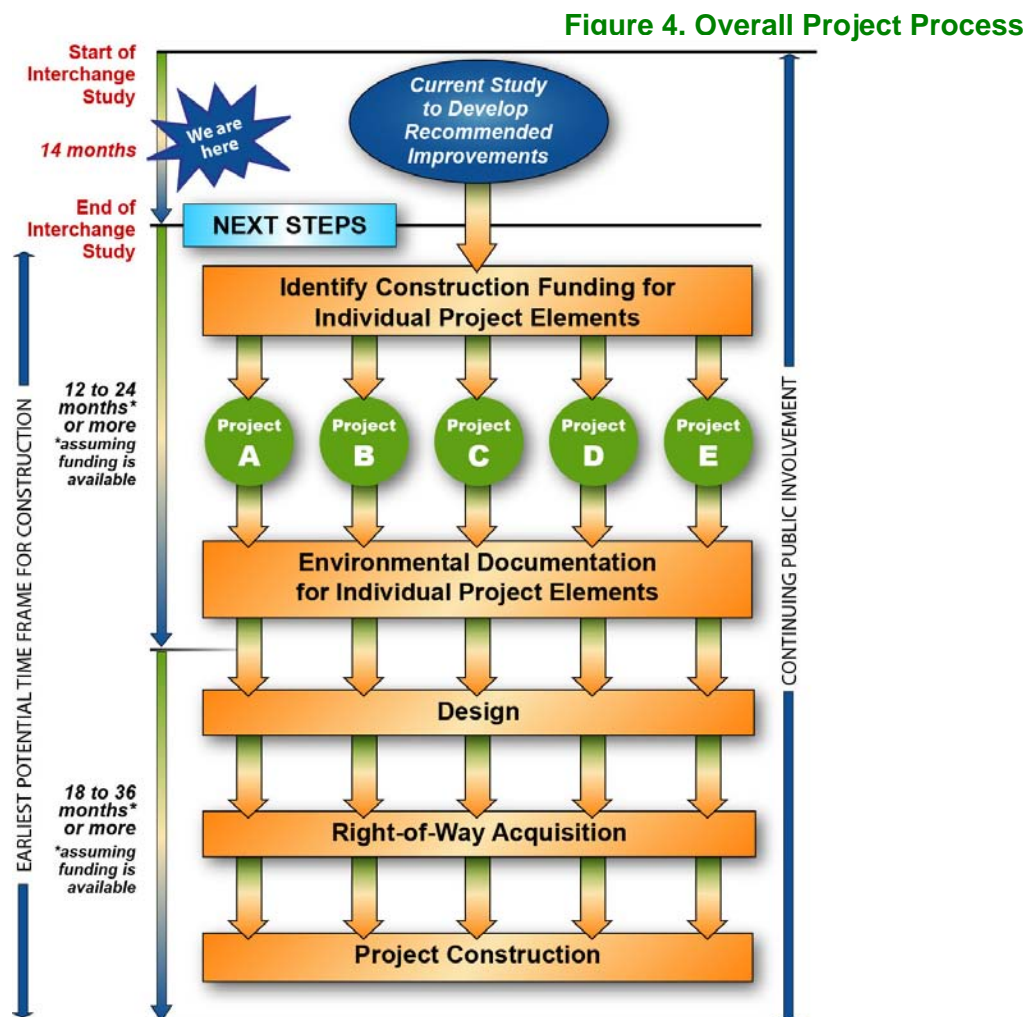
Further steps are being taken to refine the conceptual design elements of the alternative(s) carried forward, considering design solutions to minimize costs and community impacts and maximize operational benefits. This third level of screening considers the overall interchange operations and impacts to identify recommended alternative(s) to move forward within future NEPA process(es).

The final PEL study recommendations will include large-scale improvements and/or separate, short-term improvements. Long-term recommendations will likely have short-term project elements identified as phases or stand-alone projects.

Next Steps

Following completion of this Alternatives Development and Analysis Report, review by the Technical Team and resource agencies, and receipt of public input at the second public meeting, a PEL Report will be prepared. This report will document the final interchange improvement recommendations, prioritization of improvements, and funding considerations. The final PEL study recommendations will be presented in a final public project newsletter. Comments received from the final public notice will be documented so that remaining public concerns can be addressed in conjunction with subsequent environmental clearances.

Individual projects may be initiated as funding becomes available for elements of the recommended alternative. It is anticipated that these improvement projects could move forward with individual NEPA processes, with this PEL Study providing the documentation of the intent to implement the full set of interchange improvements over time, as funding becomes available. **Figure 4** illustrates this overall project process.





Kipling Street at eastbound I-70 ramps intersection

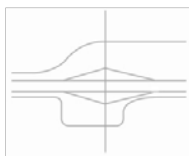
Level I Alternatives Screening

The initial range of improvement options included changes in interchange layout as well as small-scale lane configurations and multimodal-focused enhancements. A variety of alternatives were identified for consideration, focusing on the interchange’s largest issues identified in the Purpose and Need, including the close signal spacing along Kipling Street, the weave movement between the ramp and frontage road intersections, the queuing conditions on the Westbound I-70 Off Ramp, and the merging conditions for the Eastbound I-70 On Ramp. Managed lane configurations were not considered because the scope of this study does not include through lane capacity improvements to I-70 or Kipling Street.

Level I Alternatives

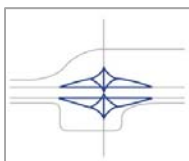
Given the interchange setting and the largest needs, the following concepts, in addition to the No Action alternative, were considered as described and illustrated.

No Action

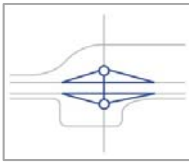


The No Action alternative is included as a baseline for comparison to the action alternatives. Under the No Action alternative, only programmed improvements that are planned and funded by CDOT, the County, or cities would be completed, as described earlier in this report.

Alternative I – Single Point Urban Interchange (SPUI)

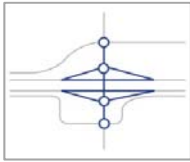


This alternative was considered because it may address issues associated with the close signal spacing on Kipling Street by eliminating one traffic signal. It consists of a new interchange configuration with diamond type ramps that intersect at a single signalized intersection on Kipling Street serving all movements to/from the I-70 ramps and the Kipling Street through movements.



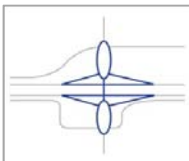
Alternative 2 – Diamond with Roundabouts at Ramps

This alternative was considered because it may address the issues associated with the close signal spacing on Kipling Street by eliminating two traffic signals. It consists of a new interchange configuration with diamond type ramps and two multilane roundabouts on Kipling Street at the ramp intersections. The frontage road intersections remain as signalized intersections.



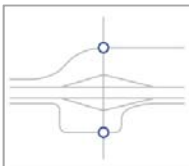
Alternative 3 – Diamond with Roundabouts at Ramps & Frontage Roads

This alternative was considered because it may address issues associated with the close signal spacing on Kipling Street by eliminating four traffic signals. It consists of a new interchange layout with diamond type ramps and a series of four multilane roundabouts on Kipling Street at the ramps and frontage road intersections.



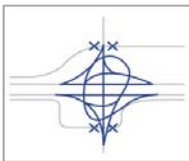
Alternative 4 – Diamond with Six-Leg Roundabout at Ramps & Frontage Rds

This alternative was considered because it may address issues associated with the close signal spacing on Kipling Street by eliminating four traffic signals. It consists of a new interchange layout with diamond type ramps and two multilane roundabouts on Kipling Street providing movements for the ramps and frontage roads.



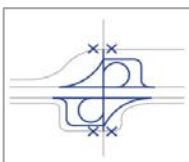
Alternative 5 – Diamond with Roundabouts at Frontage Roads

This alternative was considered because it may address the issues associated with the close signal spacing on Kipling Street by eliminating two traffic signals. It consists of a new interchange configuration with diamond type ramps and two multilane roundabouts on Kipling Street at the frontage road intersections. The ramp intersections remain as signalized intersections.



Alternative 6 – Fully Directional

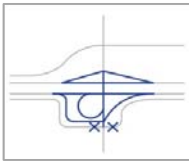
This alternative was considered because it may address the queuing conditions on the Westbound I-70 Off Ramp and eliminates the weave movement between the ramp and frontage road intersections. It consists of a new interchange configuration with multiple levels of directional ramps and no signals for ramp movements. The frontage road intersections would require some modification.



Alternative 7 – Partial Cloverleaf with Loops SW & NE Quadrants

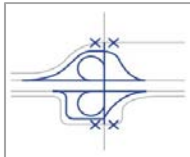
This alternative was considered because it may address the issues associated with the close signal spacing on Kipling Street by eliminating two traffic signals and eliminates the weave movement between the ramp and frontage road intersections. It consists of a new interchange configuration with a loop ramp in the southwest and northeast quadrants providing free-flow operations for the left turn movements from Kipling Street to eastbound and westbound I-70. The frontage road intersections would require some modification.

Alternative 8 – Partial Cloverleaf with Loop SW Quadrant



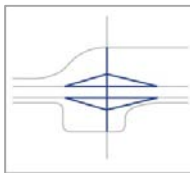
This alternative was considered because it may address issues associated with close signal spacing on Kipling Street by eliminating one traffic signal. It consists of a new interchange layout with a loop ramp in the southwest quadrant providing free-flow operations for the left turn movement from southbound Kipling Street to eastbound I-70. The South Frontage Road intersection would require some modification.

Alternative 9 – Partial Cloverleaf with Loops SW & NW Quadrants



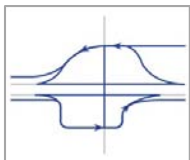
This alternative was considered because it may address issues associated with close signal spacing on Kipling Street by eliminating two traffic signals and eliminates the weave movement between the ramp and frontage road intersections. It consists of a new interchange configuration with a loop ramp in the southwest quadrant providing free-flow operations for the left turn movement from southbound Kipling Street to eastbound I-70 and a loop ramp in the northwest quadrant providing free-flow operations for the left turn from the westbound off ramp to southbound Kipling Street. The frontage road intersections would require some modification.

Alternative 10 – Improved Tight Diamond with Lanes on Kipling & Ramps



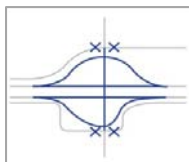
This alternative was considered because it may address the queuing conditions on the Westbound I-70 Off Ramp and other congested movements through the interchange. It consists of the current diamond interchange configuration with diamond type ramps and four signalized intersections on Kipling Street with additional turn lanes on the ramps and on Kipling Street through the interchange.

Alternative 11 – Texas Frontage Road Diamond



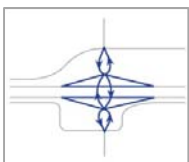
This alternative was considered because it may address issues associated with close signal spacing on Kipling Street by eliminating two traffic signals and eliminates the weave movement between the ramp and frontage road intersections. It consists of a new interchange configuration with diamond type ramps and frontage road access provided directly to/from the freeway ramps for full access to Kipling Street.

Alternative 12 – Traditional Diamond

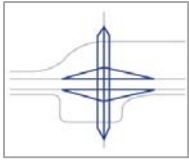


This alternative was considered because it may address issues associated with close signal spacing on Kipling Street by increasing traffic signal spacing and/or eliminating traffic signals at the frontage roads. It consists of the current diamond interchange configuration with diamond type ramps and two signalized intersections on Kipling Street serving the ramps with increased spacing between the ramp traffic signals. The frontage road intersections would require some modification.

Alternative 13 – Double Crossover Diamond

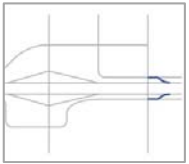


This alternative was considered because it may address the queuing conditions on the Westbound I-70 Off Ramp. It consists of a new interchange configuration with diamond type ramps and the Kipling Street movements shifted to the other side of the street under the bridge to allow left turn movements that do not cross traffic.



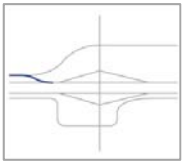
Alternative 14 – Three-Level Diamond

This alternative was considered because it may address the queuing conditions on the Westbound I-70 Off Ramp and other congested movements through the interchange. It consists of a new interchange layout with diamond ramps and multiple levels to separate the Kipling Street through movements from the ramp and frontage road intersections.



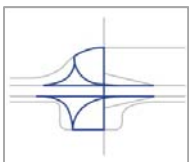
Alternative 15 – Half Diamond to East at Garrison

This alternative was considered because it may address the queuing conditions on the Westbound I-70 Off Ramp. It consists of the existing diamond interchange with new diamond type ramps added at Garrison Street for Westbound I-70 Off Ramp and Eastbound I-70 On Ramp movements. No other changes are made to the existing interchange.



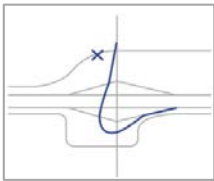
Alternative 16 – New WB Off Ramp West of Kipling

This alternative was considered because it may address the issues associated with the weave movement between the Westbound I-70 Off Ramp and North Frontage Road intersection. It consists of the existing diamond interchange with a new diamond ramp added west of Kipling Street for the Westbound I-70 Off Ramp movement northwest of the interchange. No other changes are made to the existing interchange.



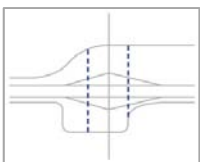
Alternative 17 – Button Hook Ramps

This alternative was considered because it may address the issues associated with the close signal spacing on Kipling Street by eliminating two traffic signals, may address queuing conditions on the Westbound I-70 Off Ramp, and eliminates the weave movement between the ramp and frontage road intersections. It consists of a new interchange layout with the I-70 ramp intersections on the frontage roads and access to Kipling Street via the frontage road traffic signals. The existing ramps on the east side of Kipling Street remain.



Alternative 18 – SB to EB Flyover Ramp

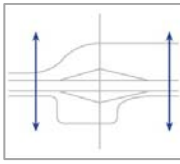
This alternative was considered because it may address the queuing conditions on the Westbound I-70 Off Ramp and southbound Kipling Street approaching the interchange. It consists of the existing diamond interchange with diamond type ramps and four signalized intersections on Kipling Street with a flyover ramp serving the heavy movement from southbound Kipling Street to eastbound I-70. No other changes are made to the existing interchange.



Alternative 19 – Bike Path I-70 Grade Separations at Interchange

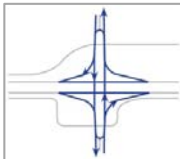
This alternative was considered because it provides multimodal connection enhancements. It consists of the existing diamond interchange with grade-separated multiuse path connections at the interchange east and west of Kipling Street. No other changes are made to the existing interchange.

Alternative 20 – Local Road I-70 Grade Separation at Miller & Independence



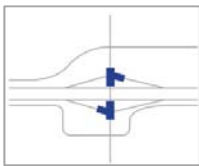
This alternative was considered because it provides multimodal connection enhancements. It consists of the existing diamond interchange with grade-separated street connections at Miller Street and Independence Street east and west of Kipling Street. No other changes are made to the existing interchange at Kipling Street.

Alternative 21 – Michigan Lefts for Ramps



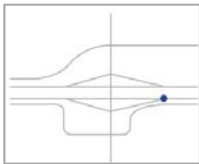
This alternative was considered because it may address the queuing conditions on the Westbound I-70 Off Ramp and other congested movements through the interchange. It consists of a new interchange configuration with diamond type ramps and left turns restricted at the ramp intersections, so drivers must turn right then do a U-turn at the frontage road intersection.

Alternative 22 – Added Turn Lanes for Ramps



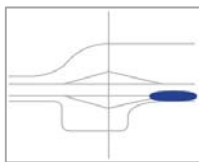
This alternative was considered because it may address queuing conditions on the Westbound I-70 Off Ramp and other congested movements through the interchange. It consists of the existing diamond interchange with added turn lanes at the ramp intersections. No other changes are made to the existing interchange.

Alternative 23 – Ramp Meter Modifications



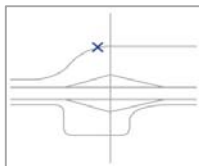
This alternative was considered because it may address issues with the merging conditions for the Eastbound I-70 On Ramp. It consists of the existing diamond interchange with changes at the eastbound I-70 ramp meter, consisting of added lanes at the ramp meter. No other changes are made to the existing interchange.

Alternative 24 – EB Ramp Merge Lane Modifications



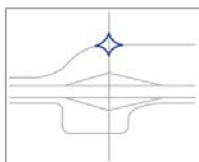
This alternative was considered because it may address the issues associated with the merging conditions for the Eastbound I-70 On Ramp. It consists of the existing diamond interchange with changes at the eastbound I-70 ramp merge, consisting of a longer merge lane. No other changes are made to the existing interchange.

Alternative 25 – Close West Side of 49th Ave

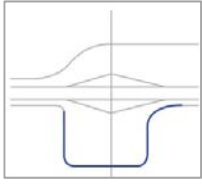


This alternative was considered because it may address issues from the weave movement from the Westbound I-70 Off Ramp to North Frontage Road intersection. It consists of the existing diamond interchange and closing the west side of the North Frontage Road intersection. No other changes are made to the interchange.

Alternative 26 – Remove 49th Ave Signal

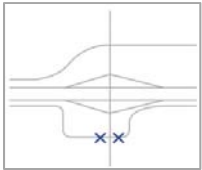


This alternative was considered because it may address issues from the weave movement from the Westbound I-70 Off Ramp to North Frontage Road intersection. It consists of the existing diamond interchange and removing the North Frontage Road traffic signal. Right-in and right-out movements are provided at the intersection. No other changes are made to the existing interchange.



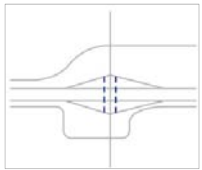
Alternative 27 – Realign South Frontage Road Further South

This alternative was considered because it may address issues associated with close signal spacing on Kipling Street. It consists of the existing diamond interchange and realigning the South Frontage Road further south, at least 600 feet from the eastbound I-70 ramp. No other changes are made to the existing interchange.



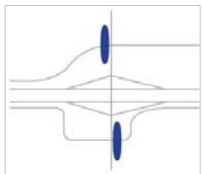
Alternative 28 – Close South Frontage Road at Kipling

This alternative was considered because it may address the issues associated with close signal spacing on Kipling Street by eliminating one traffic signal. It consists of the existing diamond interchange with the South Frontage Road closed at Kipling Street. No other changes are made to the existing interchange.



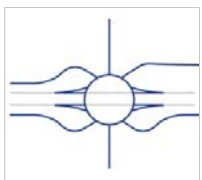
Alternative 29 – Widen/Improve Paths under I-70 Bridge

This alternative was considered because it provides multimodal connection enhancements. It consists of the existing diamond interchange with improved sidewalks under the bridge. No other changes are made to the existing interchange.



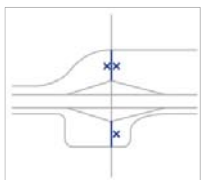
Alternative 30 – Bus Pullouts

This alternative was considered because it provides multimodal connection enhancements. It consists of the existing diamond interchange with bus pullouts provided at the transit stops north and south of the interchange. No other changes are made to the existing interchange.



Alternative 31 – Single Roundabout Interchange

This alternative was considered because it may address queuing conditions on the Westbound I-70 Off Ramp and eliminates the weave movement between the ramp and frontage road intersections. It consists of a new interchange layout with a single roundabout providing one-way movements at the ramps and frontage roads.



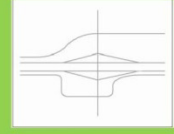
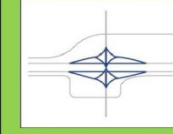
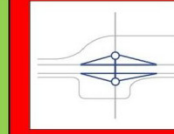
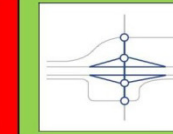
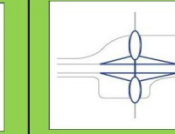
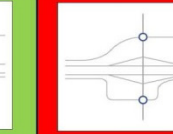
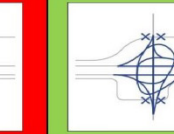



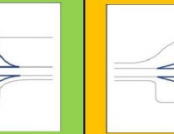
Alternative 32 – Close Driveways between Ramps and Frontage Roads

This alternative was considered because it provides multimodal connection enhancements. It consists of the existing diamond interchange with closing the driveways between the ramps and frontage roads north and south of the interchange. No other changes are made to the existing interchange.

Level I Screening Evaluation

The wide range of alternatives developed were evaluated against the Level 1 screening criteria to identify fatal flaws related to the project Purpose and Need. Alternatives that received a fatal flaw rating on any of the criteria elements (that is, one or more “No” responses) were eliminated from further consideration as a stand-alone alternative. The Level 1 Screening and Analysis Matrix is shown in **Figure 5** on the following pages. The reasons for elimination related to the Purpose and Need are shown in the summary of results.

Figure 5. Level 1 Screening Matrix

Category	Level 1 Screening Criteria	NA	1	2	3	4	5	6	7	8	9	10
		No Action 	Single Point Urban Interchange (SPUI) 	Diamond with Roundabouts at Ramps 	Diamond with Roundabouts at Ramps & Frontage Roads 	Diamond with Six-Leg Roundabout at Ramps & Frontage Roads 	Diamond with Roundabouts at Frontage Roads 	Fully Directional 	Partial Cloverleaf with Loops SW & NE Quadrants 	Partial Cloverleaf with Loop SW Quadrant 	Partial Cloverleaf with Loops SW & NW Quadrants 	Improved Tight Diamond - Added Lanes on Kipling & Ramps 
Traffic Operations	Can the alternative meet current and future traffic demands?	NO does not meet current and future traffic demands at the interchange	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
	Does the alternative improve operations by addressing the interaction of the Kipling interchange with the frontage road intersections?	NO operational issues from close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	YES	NO operational issues from weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	YES	YES	NO operational issues from weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	YES	YES	NO operational issues from weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	YES	NO operational issues from close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd remain
Safety	Does the alternative improve existing and future No Action conditions that contribute to higher than expected crash rates?	NO safety issues from close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	YES	NO safety issues from weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	YES	YES	NO safety issues from weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	YES	YES	NO safety issues from weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	YES	NO safety issues from close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd remain
Multimodal Connections	Can the alternative accommodate bicycle, pedestrian, and transit connections through the interchange?	NO No change to inadequate connections through the interchange	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
SUMMARY OF RESULTS		Carried Forward: Baseline Comparison	Carried Forward	Eliminated: Does not address the operational and safety issues of the weave movement between WB I-70 Off Ramp and N. Frontage Rd	Carried Forward	Carried Forward	Eliminated: Does not address the operational and safety issues of the weave movement between WB I-70 Off Ramp and N. Frontage Rd	Carried Forward	Carried Forward	Eliminated as a Stand-Alone: Does not address the operational and safety issues of the weave movement between WB I-70 Off Ramp and N. Frontage Rd	Carried Forward	Eliminated as a Stand-Alone: Does not address operational and safety issues of close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd
NOTES			Addresses issues associated with the close signal spacing on Kipling by eliminating one signal		Addresses issues associated with the close signal spacing on Kipling by eliminating four signals and addresses safety issues from weave movement between WB I-70 Off Ramp and N. Frontage Rd	Addresses issues associated with the close signal spacing on Kipling by eliminating four signals and addresses safety issues from weave movement between WB I-70 Off Ramp and N. Frontage Rd		Addresses the queuing conditions on the WB I-70 Off Ramp and may eliminate the weave movement between WB I-70 Off Ramp and N. Frontage Rd	Addresses issues associated with close signal spacing on Kipling by eliminating two signals and eliminates the weave movement between WB I-70 Off Ramp and N. Frontage Rd	May be carried forward as an element of another alternative; Addresses issues associated with close signal spacing on Kipling by eliminating one signal	Addresses issues associated with close signal spacing on Kipling by eliminating two signals and eliminates the weave movement between WB I-70 Off Ramp and N. Frontage Rd	May be carried forward as an element of another alternative; May address queuing conditions on the WB I-70 Off Ramp

Green = Carried Forward
 Yellow = Eliminated as a Stand-Alone Alternative
 Red = Eliminated

Figure 5. Level 1 Screening Matrix (continued)

Category	Level 1 Screening Criteria	11	12	13	14	15	16	17	18	19	20	21
		Texas Frontage Road Diamond	Traditional Diamond	Double Crossover Diamond	Three-Level Diamond	Half Diamond to East at Garrison	New WB Off Ramp West of Kipling	Button Hook Ramps	SB to EB Flyover Ramp	Bike Path I-70 Grade Separations at Interchange	Local Road I-70 Grade Separation at Miller and Independence	Michigan Lefts for Ramps
Traffic Operations	Can the alternative meet current and future traffic demands?	YES	YES	YES	YES	NO does not meet current and future traffic demands at the interchange	NO does not meet current and future traffic demands at the interchange	YES	YES	NO does not meet current and future traffic demands at the interchange	NO does not meet current and future traffic demands at the interchange	YES
	Does the alternative improve operations by addressing the interaction of the Kipling interchange with the frontage road intersections?	YES	YES	NO operational issues from close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	NO operational issues from close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	NO operational issues from close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	NO operational issues from close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	YES	NO operational issues from close signal spacing remain	NO operational issues from close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	NO operational issues from close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	YES
Safety	Does the alternative improve existing and future No Action conditions that contribute to higher than expected crash rates?	YES	YES	NO safety issues from close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	NO safety issues from close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	NO safety issues from close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	NO safety issues from close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	YES	NO safety issues from close signal spacing remain	NO safety issues from close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	NO safety issues from close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	YES
Multimodal Connections	Can the alternative accommodate bicycle, pedestrian, and transit connections through the interchange?	YES	YES	YES	YES	NO No change to inadequate connections through the interchange	NO No change with connections through the existing interchange	YES	NO No change with connections through the existing interchange	YES	NO No change with connections through the existing interchange	YES
SUMMARY OF RESULTS		Carried Forward	Carried Forward	Eliminated as a Stand Alone: Does not address operational and safety issues of close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd	Eliminated: Does not address the operational and safety issues of the close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd	Eliminated: Does not address the operational and safety issues of the close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd and does not provide adequate multimodal connections	Eliminated: Does not address the operational and safety issues of the close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd and does not provide adequate multimodal connections	Carried Forward	Eliminated as a Stand Alone: Does not address operational and safety issues of close signal spacing and does not provide adequate multimodal connections	Eliminated as a Stand Alone: Does not address operational and safety issues of close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd	Eliminated: Does not address the operational and safety issues of the close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd and does not provide adequate multimodal connections	Carried Forward
NOTES		Addresses issues associated with close signal spacing on Kipling by eliminating two signals and eliminates the weave movement between WB I-70 Off Ramp and N. Frontage Rd	Addresses issues associated with close signal spacing on Kipling by increasing signal spacing and/or eliminating signals at the frontage road	May be carried forward as an element of another alternative; May address queuing conditions on the WB I-70 Off Ramp	Removing minor amount of through traffic on Kipling does not substantially reduce intersection volumes at the ramps and frontage roads	Removing minor amount of local traffic to/from east of Kipling does not substantially reduce interchange volumes	Removing minor amount of WB I-70 traffic bound for west of Kipling does not substantially reduce interchange volumes	Addresses issues associated with close signal spacing on Kipling by eliminating two signals and eliminates the weave movement between WB I-70 Off Ramp and N. Frontage Rd	May be carried forward as an element of another alternative; May address queuing conditions on the WB I-70 Off Ramp	May be carried forward as an element of another alternative; May address multimodal connection enhancements		Addresses issues associated with close signal spacing on Kipling by eliminating two signals and addresses queuing conditions on WB I-70 Off Ramp and other congested movements through the interchange

Green = Carried Forward
 Yellow = Eliminated as a Stand-Alone Alternative
 Red = Eliminated

Figure 5. Level 1 Screening Matrix (continued)

Category	Level 1 Screening Criteria	22	23	24	25	26	27	28	29	30	31	32
		Added Turn Lanes for Ramps	Ramp Meter Modifications	EB Ramp Merge Lane Modifications	Close West Side of 49th Avenue	Remove 49th Avenue Signal (closure or RIRO)	Realign South Frontage Road Further South	Close South Frontage Road at Kipling	Widen/Improve Paths Under I-70 Bridge	Bus Pullouts	Single Roundabout Interchange	Close Driveways Between Ramps and Frontage Roads
Traffic Operations	Can the alternative meet current and future traffic demands?	YES	NO does not meet current and future traffic demands at the interchange	NO does not meet current and future traffic demands at the interchange	NO does not meet current and future traffic demands at the interchange	NO does not meet current and future traffic demands at the interchange	NO does not meet current and future traffic demands at the interchange	NO does not meet current and future traffic demands at the interchange	NO does not meet current and future traffic demands at the interchange	NO does not meet current and future traffic demands at the interchange	YES	NO does not meet current and future traffic demands at the interchange
	Does the alternative improve operations by addressing the interaction of the Kipling interchange with the frontage road intersections?	NO operational issues from close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	NO operational issues from close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	NO operational issues from close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	YES	YES	NO operational issues from weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	NO operational issues from weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	NO operational issues from close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	NO operational issues from close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	YES	NO operational issues from close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd remain
Safety	Does the alternative improve existing and future No Action conditions that contribute to higher than expected crash rates?	NO safety issues from close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	NO safety issues from close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	NO safety issues from close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	NO safety issues from close signal spacing and queuing condition on WB I-70 Off Ramp remain	NO safety issues from close signal spacing and queuing condition on WB I-70 Off Ramp remain	NO safety issues from weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	NO safety issues from weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	NO safety issues from close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	NO safety issues from close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd remain	YES	NO safety issues from close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd remain
Multimodal Connections	Can the alternative accommodate bicycle, pedestrian, and transit connections through the interchange?	NO No change with connections through the existing interchange	NO No change with connections through the existing interchange	NO No change with connections through the existing interchange	NO No change with connections through the existing interchange	NO No change with connections through the existing interchange	NO No change with connections through the existing interchange	NO No change with connections through the existing interchange	YES	YES	YES	YES
SUMMARY OF RESULTS		Eliminated as a Stand Alone: Does not address the operational and safety issues of the close signal spacing and weave between WB I-70 Off Ramp and N. Frontage Rd and does not provide adequate multimodal connections	Eliminated as a Stand Alone: Does not address the operational and safety issues of the close signal spacing and weave between WB I-70 Off Ramp and N. Frontage Rd and does not provide adequate multimodal connections	Eliminated as a Stand Alone: Does not address the operational and safety issues of the close signal spacing and weave between WB I-70 Off Ramp and N. Frontage Rd and does not provide adequate multimodal connections	Eliminated as a Stand Alone: Does not address safety issues of close signal spacing and queuing conditions on WB I-70 Off Ramp and does not provide adequate multimodal connections	Eliminated as a Stand Alone: Does not address safety issues of close signal spacing and queuing conditions on WB I-70 Off Ramp and does not provide adequate multimodal connections	Eliminated as a Stand Alone: Does not address the operational and safety issues of the weave movement between WB I-70 Off Ramp and N. Frontage Rd and does not provide adequate multimodal connections	Eliminated as a Stand Alone: Does not address the operational and safety issues of the weave movement between WB I-70 Off Ramp and N. Frontage Rd and does not provide adequate multimodal connections	Eliminated as a Stand Alone: Does not address operational and safety issues of close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd	Eliminated as a Stand Alone: Does not address operational and safety issues of close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd	Carried Forward	Eliminated as a Stand Alone: Does not address operational and safety issues of close signal spacing and weave movement between WB I-70 Off Ramp and N. Frontage Rd
NOTES		May be carried forward as an element of another alternative; May address queuing conditions on the WB I-70 Off Ramp	May be carried forward as an element of another alternative; May address merging conditions on the EB I-70 On Ramp	May be carried forward as an element of another alternative; May address merging conditions on the EB I-70 On Ramp	May be carried forward as an element of another alternative; May address issues with weave movement between WB I-70 Off Ramp and N. Frontage Rd	May be carried forward as an element of another alternative; May address issues with weave movement between WB I-70 Off Ramp and N. Frontage Rd	May be carried forward as an element of another alternative; May address issues with close signal spacing on Kipling	May be carried forward as an element of another alternative; May address multimodal connection enhancements	May be carried forward as an element of another alternative; May address multimodal connection enhancements	Address queuing conditions on the WB I-70 Off Ramp and eliminates the weave movement between WB I-70 Off Ramp and N. Frontage Rd	May be carried forward as an element of another alternative; May address multimodal connection enhancements	

Green = Carried Forward
 Yellow = Eliminated as a Stand-Alone Alternative
 Red = Eliminated

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Level I Screening Results

Six alternatives were eliminated from further consideration because they are not reasonable alternatives that meet the Purpose and Need for reasons stated in Figure 5 in the “summary of Results” row. These are illustrated in **Figure 6**.

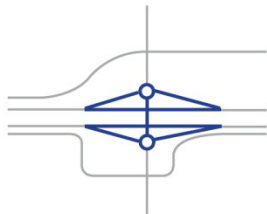
It was determined that some small-scale alternatives eliminated as a stand-alone alternative could be included as elements of larger-scale alternatives in Level 2 screening. The 15 alternatives eliminated from consideration as stand-alone alternatives are shown in **Figure 7**. These relatively small-scale improvements may provide benefit as elements of large-scale improvements in Level 2 screening.

The 12 alternatives carried forward for consideration in Level 2 screening (including the No Action alternative) are shown in **Figure 8**.

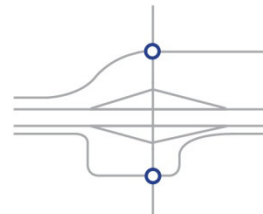
Figure 6. Alternatives Eliminated from Further Consideration

Alternatives Eliminated

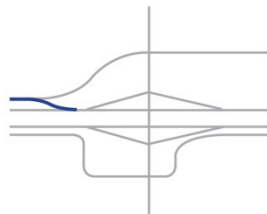
The following alternatives do not meet the purpose and need of the project and will not be carried forward for further evaluation.



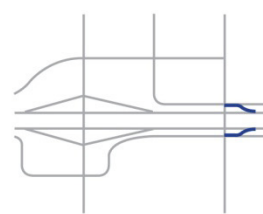
Diamond with Roundabouts at Ramps
(Alternative 2)



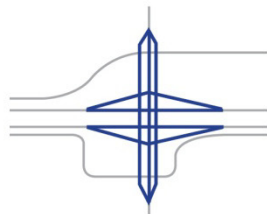
Diamond with Roundabouts at Frontage Roads
(Alternative 5)



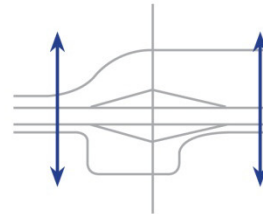
New WB Off Ramp West of Kipling
(Alternative 16)



Half Diamond to East at Garrison
(Alternative 15)



Three-Level Diamond
(Alternative 14)



Local Road I-70 Grade Separation at Miller and Independence
(Alternative 20)

Figure 7. Alternatives Eliminated as a Stand-Alone Alternative

Alternatives Eliminated as a Stand-Alone Alternative

The following alternatives do not meet the purpose and need of the project as a stand-alone alternative, but could be included as part of other larger alternatives.

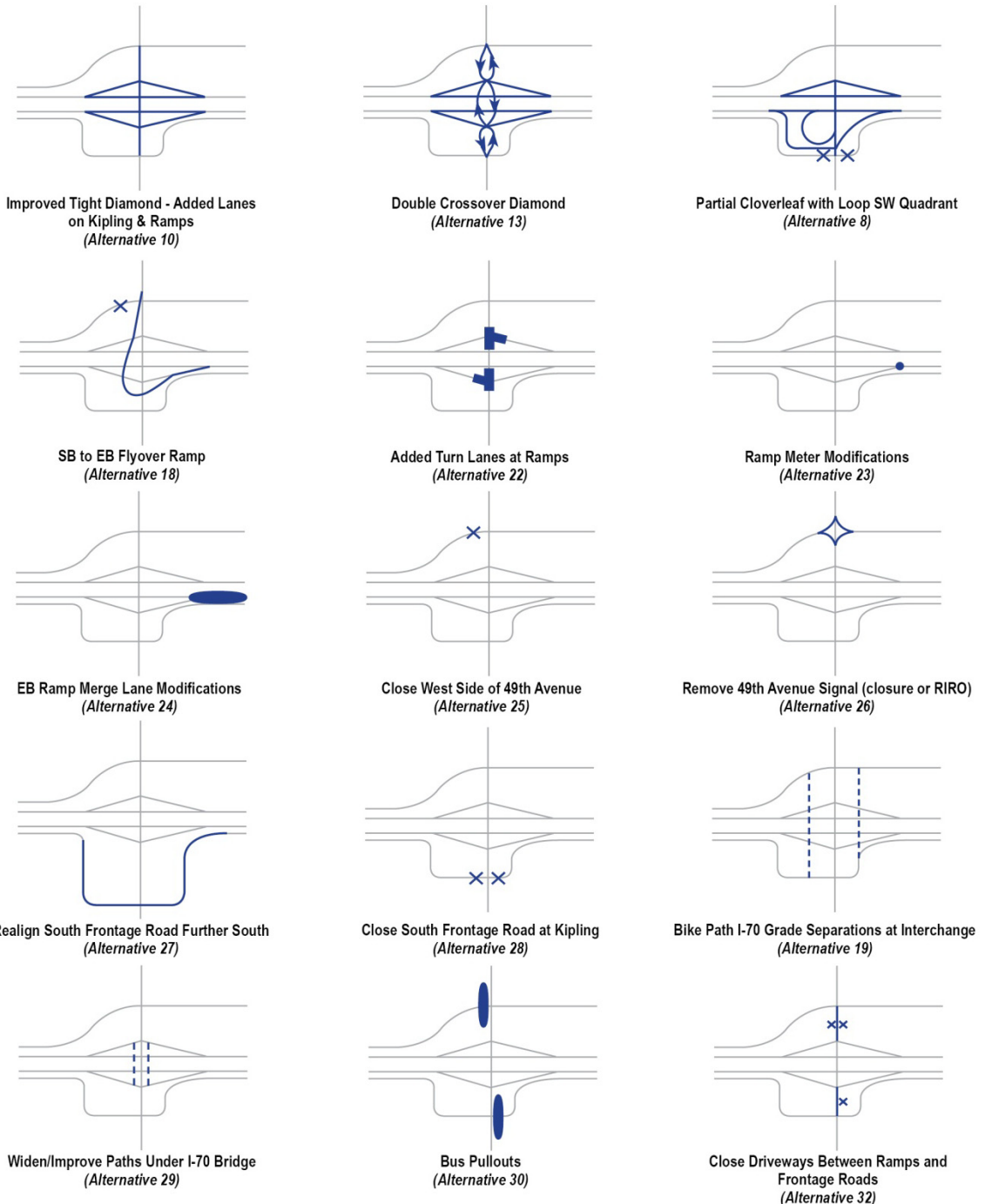
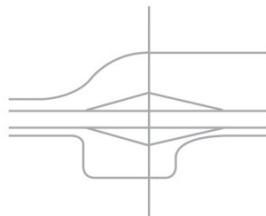


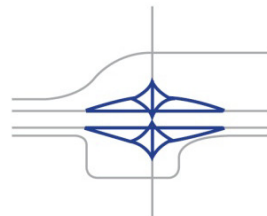
Figure 8. Alternatives Carried Forward

Alternatives Carried Forward

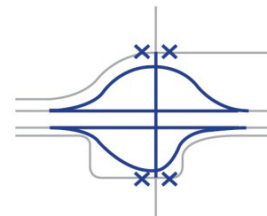
The following alternatives will be further defined and carried forward for further evaluation in Level 2 screening.



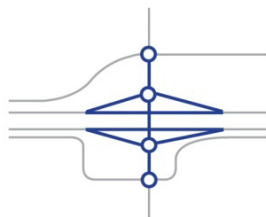
No Action



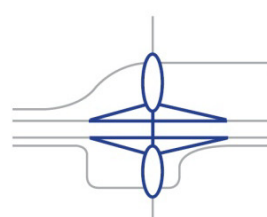
Single Point Urban Interchange (SPUI)
(Alternative 1)



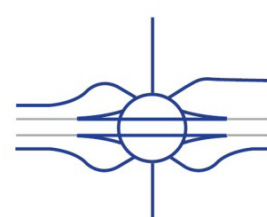
Traditional Diamond
(Alternative 12)



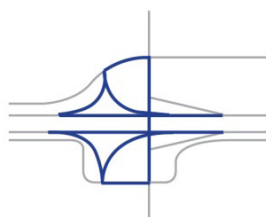
Diamond with Roundabouts at
Ramps & Frontage Roads
(Alternative 3)



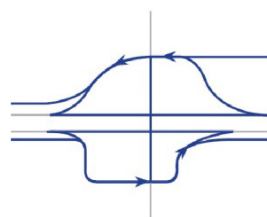
Diamond with Six-Leg Roundabout
at Ramps & Frontage Roads
(Alternative 4)



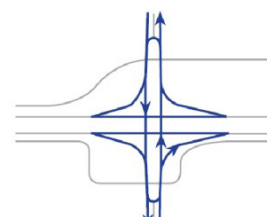
Single Roundabout Interchange
(Alternative 31)



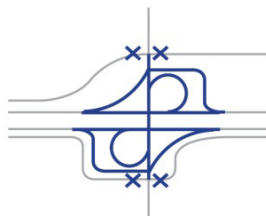
Button Hook Ramps
(Alternative 17)



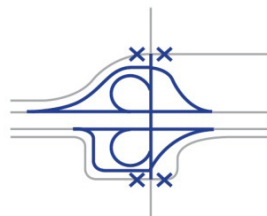
Texas Frontage Road Diamond
(Alternative 11)



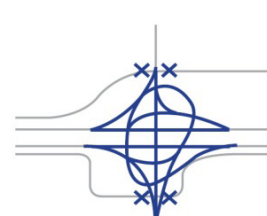
Michigan Lefts at Ramps
(Alternative 21)



Partial Cloverleaf with Loops
SW & NE Quadrants
(Alternative 7)



Partial Clover Leaf with Loops SW & NW
(Alternative 9)



Fully Directional
(Alternative 6)



Kipling Street and South Frontage Road intersection

Level 2 Alternatives Screening

Alternatives from the Level 1 screening that were recommended for further evaluation were refined to add more definition of the proposed improvements, to better understand the operations and costs of the alternatives, and to provide information for further assessment in the Level 2 evaluation. The Level 2 screening is a more detailed evaluation of the conceptual alternatives that passed the Level 1 screening.

Level 2 Alternatives

In addition to the 12 interchange configuration alternatives carried forward from Level 1 screening, the following four alternatives were added for consideration in the Level 2 screening based on public and Technical Team input for combining elements of other alternatives. With these additional alternatives, 16 alternatives (including the No Action alternative) were considered in the Level 2 screening.

Alternative 33 – Loop SW Quadrant & Improved WB Ramps

This alternative was considered because it may address issues associated with close signal spacing on Kipling Street by eliminating one traffic signal and eliminate the weave movement between the ramp and frontage road intersections. It consists of a new interchange layout with a loop ramp in the southwest quadrant providing free-flow operations for the left turn movement from southbound Kipling Street to eastbound I-70 and diamond type ramps with frontage road access directly to/from the freeway ramps on the north side of the interchange.

This alternative combines the benefits of eliminating the weave movement within the relatively small footprint of the Texas Frontage Road ramp configuration on the north side of the interchange with the safety and capacity benefits of the southwest

quadrant loop ramp for the heavy southbound Kipling Street to eastbound I-70 left turn movement.

Alternative 34 – Improved Tight Diamond with SB to EB Flyover

This alternative was considered because it may address the queuing conditions on the Westbound I-70 Off Ramp, southbound Kipling Street approaching the interchange, and other congested movements through the interchange by providing capacity through both ramp intersections. It consists of the current diamond interchange configuration with diamond type ramps with additional turn lanes on the ramps and Kipling Street through the interchange and a flyover ramp serving the heavy movement from southbound Kipling Street to eastbound I-70.

This alternative combines the capacity benefits of the southbound Kipling Street flyover ramp with added turn lane capacity at both ramp intersections.

Alternative 35 – Double Crossover Diamond Interchange

This alternative was considered because it may address issues associated with close signal spacing on Kipling Street by eliminating two traffic signals and the queuing conditions on the Westbound I-70 Off Ramp and other congested movements through the interchange. It consists of a new interchange configuration with diamond type ramps and the Kipling Street movements shifted to the other side of the street under the bridge to allow left turn movements that do not cross traffic, plus the removal of the frontage road traffic signals with right-in and right-out movements only at those intersections.

This alternative fixes the capacity limitations of the previously-considered double crossover diamond layout by removing the adjacent frontage road traffic signals.

Alternative 36 – Button Hook Ramps South & Improved WB Ramps

This alternative was considered because it may address issues associated with close signal spacing on Kipling Street by eliminating two traffic signals and eliminate the weave movement between the ramp and frontage road intersections. It consists of a new interchange configuration with the eastbound I-70 ramp terminal intersection on the South Frontage Road and diamond type ramps with frontage road access directly to/from the freeway ramps on the north side of the interchange.

This alternative combines the benefits of eliminating the weave movement within the relatively small footprint of the Texas Frontage Road ramp configuration on the north side of the interchange with the capacity and direct access benefits of the button hook ramps on the south side of the interchange.

Alternative Conceptual Layout

The Level 2 alternative concepts were developed at a conceptual design level of detail using the applicable CDOT and Wheat Ridge design standards. The design parameters followed for the conceptual design of the alternative interchange improvements are listed in **Appendix A**.

Shared use path – A hard surface path for pedestrians and bicyclists that is at least eight feet wide and is physically separated from motor vehicle traffic.

In order to fairly compare the impacts of alternatives through the Level 2 screening process, key design elements were assumed as part of the conceptual layout for all alternatives.

In order to accommodate multimodal connections, a bi-directional shared use path is assumed to run on both sides of Kipling Street in all alternatives, consistent with local agency planning. This path is eight feet wide, following the CDOT minimum standard width. The opportunity to reduce the width of the shared use path to a sidewalk on one side of Kipling Street to mitigate property impacts may be considered during the future NEPA process(es).

In order to accommodate multimodal connections, an on-street bicycle lane is assumed on Kipling Street in all alternatives, consistent with the *Jefferson County Bicycle Plan*. The bike lanes are six feet wide, following the CDOT recommended width. A decision to not include on-street bike lanes along Kipling Street to mitigate property impacts may be considered during the future NEPA clearance process(es).

The scope of this project does not include additional through lane capacity on I-70 or Kipling Street. Various alternatives include additional lanes through the interchange and/or at intersections, but all of the alternatives assume there is no widening of I-70 or Kipling Street outside of the interchange area included in the project. The bridge structure and ramps will be designed to tie-in to the potential future widening of I-70.

Level 2 Performance Measures

The following evaluation criteria and performance measures were developed to compare how each alternative meets the Purpose and Need and goals of the project. These performance measures are a mix of qualitative and quantitative assessments, based on the criteria and the availability of data at this stage of development. The color ratings shown with the performance measures are related to the colors provided in the Level 2 Screening Matrix in **Appendix B**.

Optimize operations and reduce congestion

Intersection peak hour Level of Service and delay (2035 overall intersection)

- Overall intersection Level of Service (LOS) and delay (seconds/vehicle) for the ramp and frontage road intersections for the AM and PM peak hour.
- Analyzed with Synchro 8 (Build 802, Revision 685) and reported as Highway Capacity Manual (HCM) 2010 results.
- Rating:
 - Black = LOS D or better
 - Red = LOS E or F

Peak hour queue lengths approaching interchange

- Queue lengths (feet) approaching the interchange for southbound Kipling Street, northbound Kipling Street, and Westbound I-70 Off Ramp for the AM and PM peak hour.

- For southbound and northbound Kipling Street, queue length reported as back-up from the first ramp intersection encountered. For southbound Kipling Street, the queue length is reported from the Westbound I-70 Off Ramp intersection. For northbound Kipling Street, the queue length is reported from the Eastbound I-70 Off Ramp intersection.
- If the reported queue backs up through the upstream intersection (i.e., the frontage road intersection), the queue from that intersection is added to provide the full queue drivers encounter approaching the interchange.
- Analyzed with Synchro 8 (Build 802, Revision 685).
- Acceptable queue for alternatives assumed to be 600 feet, which represents distance between signals.
- Rating:
 - Red = Queue longer than No Action or 600 feet, whichever is greater

Volume-to-Capacity ratio

- Overall intersection Volume-to-Capacity ratio for the ramp and frontage road intersections for the AM and PM peak hour.
- Analyzed with Synchro 8 (Build 802, Revision 685).
- Rating:
 - Red = V/C at 1.00 or more

Perceived driver expectancy measured on a scale of easy, moderate, difficult

- Driver perception of difficulty to navigate the interchange area, including movements between Kipling Street, the I-70 ramps, and frontage roads.
- Rating:
 - Easy (Green) = typical configuration and directional turn movements
 - Moderate (Black) = some out-of-direction turn movements, but typical configuration
 - Difficult (Red) = unusual configuration; unexpected decision points; unusual out-of-direction turn movements (i.e., must turn left to go right)

Improve traveler safety

Expected change in number of crashes within the interchange area

- Rating:
 - Decrease (Green) = expected from reduced congestion (based on operations evaluation results) and less conflict points
 - Minimal change (Black) = expected from small decrease in congestion (based on operations evaluation results) or reduction offset by geometric concern
 - Increase (Red) = expected from additional congestion (based on operations evaluation results) and no change in number of conflict points

Reduction in multimodal conflict points at ramps and frontage roads

- Vehicular conflict points counted at frontage road and ramp intersections based on intersection typical of 32 points for a four-way intersection and eight points for roundabout.
- Number of pedestrian and bicycle crossings evaluated qualitatively.
- Differentiating characteristics of pedestrian and bicycle conflict points noted as crossings of high-volume and high-speed right turns.
- Rating:
 - Green = Reduction from No Action greater than 50%
 - Black = Reduction from No Action of 10-50%
 - Red = Reduction from No Action less than 10%

Accommodate multimodal connections

Missing sidewalk or path links/out-of-direction travel

- Out-of-direction travel (i.e., must cross street or turn to go straight) for pedestrians and/or bicycles based on alternative conceptual layout.
- Noted if bicyclists in bike lane on Kipling Street must transition to/from shared use path, based on alternative conceptual layout.
- Rating:
 - Green = Little or no out-of-direction travel for pedestrian and bicyclists through the interchange
 - Black = Some out-of-direction travel for pedestrians
 - Red = Substantial out-of-direction travel for pedestrians and/or bicycles; No bike lanes on Kipling Street

Accommodation of transit connections (e.g. bus pull-outs, transit stop connections)

- Transit stops may require relocation or may be able to remain in current location based on alternative conceptual layout.
- Noted impacts to signalized Kipling Street pedestrian crossing for transit users to access transit stop.
- Rating:
 - Green = Transit stops are able to remain in current location
 - Black = Transit stops require relocation; Limited connections for transit users to access transit stop

User perception of comfort and safety of pedestrian and bicycle movements (easy, moderate, difficult)

- Configurations that meet drivers' expectations for encountering pedestrians or bicyclists (e.g., roadside area for pedestrians, striped bike lanes) feel safer to negotiate.
- Shorter crossing paths (fewer lanes, smaller corner radii) are more comfortable for pedestrians and bicyclists to cross.

- High-volume, high-speed movements that are not comfortable for pedestrians and bicyclists to cross.
- Transitions between a bike lane and a shared use path are not comfortable for bicyclists traveling along the bike lane or pedestrians on the shared use path.
- Large intersection footprints or complicated routing for the bicycle lane and/or shared use path is intimidating for pedestrians and bicyclists to travel through the interchange.
- Rating:
 - Easy (Green) = Alternative generally feels comfortable for pedestrians and bicycle movements
 - Moderate (Black) = One key characteristic makes the alternative feel uncomfortable or intimidating
 - Difficult (Red) = Several characteristics make the alternative feel uncomfortable or intimidating

Avoid and minimize environmental impacts

Potentially impacted noise receptors

- Potential noise receptors impacted with alternative conceptual layout, based on changes in elevation (such as new elevated ramps) or roadways/ramps moving closer to potential noise receptors.
- Potential noise receptors as identified in the Environmental Scan Report.
- Rating:
 - Green = Minor or moderate decrease from reduced congestion and no discernable change in footprint based on alternative conceptual layout
 - Black = Slight increase or reduction from change in congestion
 - Red = Minor or moderate increase from elevated ramps or roadways moving closer to potential noise receptors based on alternative conceptual layout

Potentially impacted hazardous material sites

- Properties with potential hazardous material sites impacted with partial or full takes from the alternative conceptual layout.
- Rating:
 - Green = Four or less sites impacted
 - Black = Five to six sites impacted
 - Red = Seven or more sites impacted

Potentially impacted parks and recreation areas

- Noted potential impact to the Kipling Trail (west side of Kipling Street, north of 50th Avenue) and/or Fruitdale Park (southwest of interchange) as community resources based on alternative conceptual layout.

- Rating:
 - Green = No impact expected
 - Black = Slight, potentially avoidable impact expected
 - Red = Minor or major impact expected

Avoid and minimize community impacts

Right-of-way required

- Number and acres of properties with full take of property expected to be required based on alternative conceptual layout.
- Number and acres of properties with partial take of property expected to be required based on alternative conceptual layout.
- Rating:
 - Green = No full acquisitions expected
 - Black = Four or less full acquisitions expected
 - Red = Five or more full acquisitions expected

Number of property accesses impacted (existing and potential future accesses)

- Number of property accesses (driveways) that are expected to be closed or changed to limited movements based on alternative conceptual layout.
- Rating:
 - Green = Six or less accesses expected to be impacted
 - Black = Seven to 12 accesses expected to be impacted
 - Red = 13 or more accesses expected to be impacted

Number of buildings impacted (commercial, residential)

- Number of buildings that are expected to be directly impacted (i.e., demolished) based on alternative conceptual layout.
- Commercial versus residential buildings noted.
- Rating:
 - Green = Two or less buildings expected to be directly impacted
 - Black = Three to five buildings expected to be directly impacted
 - Red = Six or more buildings expected to be directly impacted

Business property impacts for partial acquisitions (e.g. parking, landscaping)

- Noted type and level of impact for properties expected to be partial takes based on alternative conceptual layout.
- Type of impacts considered potential changes to parking, landscaping, and internal site circulation.
- Rating:
 - Green = Minor impacts to properties
 - Black = Moderate and minor impacts in several quadrants or major impacts limited to one quadrant

- Red = Major impacts to properties in all quadrants of the interchange

Increase in traffic traveling through neighborhoods

- Traffic that may cut-through neighborhood to avoid the interchange if there is increased congestion.
- With closure or limited turns at a frontage road intersection, traffic will need to divert to other streets to access Kipling Street. The street for the potential traffic diversion is based on the alternative conceptual layout.
- Rating:
 - Green = No increase expected
 - Black = Potential increase based on possible increase in congestion
 - Red = Potential increase based on change to frontage road intersection movements

Perceived difficulty to access area businesses measured on a scale of easy, moderate, and difficult

- Focused on circulation to access businesses located off Kipling Street and along I-70 in quadrants of the interchange.
- Rating:
 - Easy (Green) = typical configuration and full access to frontage roads
 - Moderate (Black) = limited access to frontage roads; full access, but unusual configuration
 - Difficult (Red) = out-of-direction turn movements to get to frontage roads

Consistency with established local plans and visions

- Local plans include interchange improvements.
- Full access to frontage roads provides flexibility for local area businesses and land use plans.
- Roundabouts are not consistent with plans for Kipling as a major arterial.
- Fully directional interchange not consistent with arterial-to-freeway interchange.
- Rating:
 - Green = Consistent
 - Red = Non consistent

Maximize Constructability

Conceptual-level probable construction costs on a scale of low, moderate, high, very high

- General evaluation based on amount and size of structures and overall footprint of alternative conceptual layout.

- I-70 bridge replacement and associated profile change and ramp reconstruction is common to all alternatives, so it was not considered in comparison of general cost evaluation.
- Rating:
 - Low (Green) = Typical construction and minimal right-of-way costs
 - Moderate (Black) = Typical construction with moderate right-of-way costs
 - High (Red) = Substantial construction with moderate right-of-way costs
 - Very high (Red) = Substantial construction with substantial right-of-way costs

Ease and cost of maintenance measured on a scale of easy, moderate, difficult

- Evaluation based on amount of infrastructure to maintain (including structures, traffic signals, and increased lane-miles) and accessibility to perform maintenance.
- Rating:
 - Easy (Green) = Reduced infrastructure and relatively easy maintenance access
 - Moderate (Black) = Typical increase in infrastructure with some access constraints
 - Difficult (Red) = Increase in specialized infrastructure with tight access constraints

Constructability measured on a scale of easy, moderate, and difficult

- Considered general construction complexity, utility impacts, difficulty from contractor perspective (e.g., staging area, length of construction).
- I-70 bridge replacement and associated profile change and ramp reconstruction is common to all alternatives, so it was not considered in comparison of general constructability evaluation.
- Rating:
 - Easy (Green) = Typical construction mostly outside of existing roadway area
 - Moderate (Black) = Moderate construction within tight area
 - Difficult (Red) = Major construction complexity and staging area issues within tight area

Assessment of impacts of construction phasing based on roadway/lane closures and local access impacts on a scale of easy, moderate, and difficult

- Considered potential for required lane closures, general duration of construction, and traveling public impacts.
- Rating:
 - Easy (Green) = Minor impacts to traveling public with most construction outside of roadway

- Moderate (Black) = Moderate impacts to traveling public with lane closures and full night closures
- Difficult (Red) = Major impacts to traveling public expected due to phasing and duration

Ability to construct in phased projects measured on a scale of easy, moderate, difficult

- Considered if the function of the alternative be implemented in usable pieces.
- Considered if phases could be built initially with narrow lanes or deferred turn lanes.
- Rating:
 - Easy (Green) = Opportunity for areas (ramps, quadrants, or halves) to be implemented separately
 - Moderate (Black) = Requires all Kipling Street construction at once; bridge replacement may be deferred
 - Difficult (Red) = Usable elements cannot be implemented in pieces (all construction at one time)

Level 2 Screening Results

The alternatives were measured and compared to determine how each concept met the Level 2 evaluation criteria for the project. The detailed Level 2 Screening Matrix providing the analysis of the alternatives is in **Appendix B**. Key features and critical considerations related to each alternative are summarized in the figures on the following pages.

Discussion of alternative screening results references the alternative numbers and titles, which are shown in the following figures and the Level 2 Screening Matrix. Advantages and disadvantages of each alternative are summarized in the figures on the following pages, in order of the alternative number. A disadvantage shown in bold text indicates a disadvantage that makes the alternative not reasonable, leading to the elimination of that alternative.

The initial evaluation showed that none of the alternatives clearly performed better than others in all criteria categories; some performed better on some measures and worse on others. However, several alternatives performed poorly in almost all criteria categories. As shown in the Level 2 Screening Matrix, the three roundabout alternatives (Alternatives 3, 4, and 31) performed poorly in the operations, multimodal connections, community impacts, and constructability criteria. Therefore, they are not reasonable alternatives and were eliminated from further consideration.

As shown in the Level 2 Screening Matrix, the Fully Directional Interchange alternative (Alternative 6) had poor performance in all criteria categories. Therefore, it is not a reasonable alternative and was eliminated from further consideration.

As shown in the Level 2 Screening Matrix, the Partial Cloverleaf with Loops SW and NW Quadrants alternative (Alternative 9) provides operational benefits by removing the two heaviest left turn movements in the interchange area. However, these benefits were similar to the operational improvements of several other alternatives, including the Button Hook Ramps and other partial cloverleaf interchange alternatives. The free-flow loop ramp movement in the northwest quadrant creates safety concerns with the area of weaving traffic along Kipling Street leading to the free-flow loop ramp in the southwest quadrant. Because there were similar operational benefits provided with other alternatives without these concerns, this alternative is not reasonable and was eliminated from further consideration.

While the Texas frontage road diamond ramps configuration would provide access between I-70, Kipling Street, and the frontage roads, FHWA expressed substantial concern for potential safety issues with the speed differential of freeway and local traffic on ramps and difficulty for drivers to negotiate unusual movements through the interchange. This safety concern is noted as a disadvantage for all with the Texas frontage road diamond ramps in the following figures. Other alternatives without this safety concern offered similar operational benefits. Therefore, the alternatives with the Texas frontage road diamond ramps (Alternatives 11, 33, and 36) are not reasonable and were eliminated from further consideration.

The Michigan Lefts for Ramps alternative (Alternative 21) and Double Crossover Diamond alternative (Alternative 35) performed poorly with multimodal connection and constructability criteria and had concerns with perceived driver expectancy as shown in the Level 2 Screening Matrix. Other alternatives offered similar operational benefits, so the benefits did not outweigh these disadvantages. Therefore, these alternatives are not reasonable and were eliminated from further consideration.

The Improved Tight Diamond with SB to EB Flyover alternative (Alternative 34) performed relatively poorly with constructability criteria, as shown in the Level 2 Screening Matrix. Also, the one out-of-direction movement with an unexpected early decision point may be moderately difficult for drivers to negotiate. Other alternatives offered more operational benefits without these issues, so this alternative is not reasonable and was eliminated from further consideration.

In the Level 2 screening, 11 alternatives were eliminated from further consideration. Five alternatives (including the No Action alternative) were carried forward for further consideration. The four improvement alternatives best met the project evaluation criteria with fewer impacts to natural and community resources.

The improvement alternatives carried forward from Level 2 screening were:

- Alternative 1 – Single Point Urban Interchange (SPUI)
- Alternative 7 – Partial cloverleaf with Loops SW & NE Quadrants
- Alternative 12 – Traditional Diamond Interchange
- Alternative 17 – Button Hook Ramps

The summaries of the critical considerations for these alternatives are included with the figures on the following pages.

No Action

The No Action alternative is included as a baseline for comparison to the action alternatives. Under the No Action alternative, only programmed transportation improvements (with committed funding sources) would be completed, including:

- Kipling Shared Use Path, 32nd Ave to 44th Ave – new detached shared use path on east side of Kipling St
- Kipling Trail, 58th Ave to Ridge Rd – new detached shared use path on west side of Kipling St
- Ridge Rd Bike/Pedestrian Improvements – improved bicycle/pedestrian connection to Gold Line station
- RTD Gold Line Commuter Rail – commuter rail with station at Kipling St and Ridge Rd
- Van Bibber Trail Underpass – new underpass of Kipling St at 56th Pl

Operations and Safety

- Peak hour delay increase experienced at ramp and frontage road intersections.
- Southbound Kipling Street peak hour queues leading to the interchange back up through the 50th Avenue intersection.
- Peak hour queues on the Westbound I-70 Off Ramp extend back to the mainline freeway.
- Increase in crashes expected due to additional congestion as traffic volumes increase.

Multimodal Connections

- Only narrow sidewalk provided directly through the interchange and no bicycle lanes on Kipling Street.

Environmental and Community Impacts

- Limited property impacts.
- Minimal environmental impacts expected with increase in noise and degraded air quality from congestion.
- Increased congestion during peak hours may increase traffic traveling through the surrounding neighborhoods.

Constructability

- No construction or right-of-way cost.

Summary of Critical Considerations

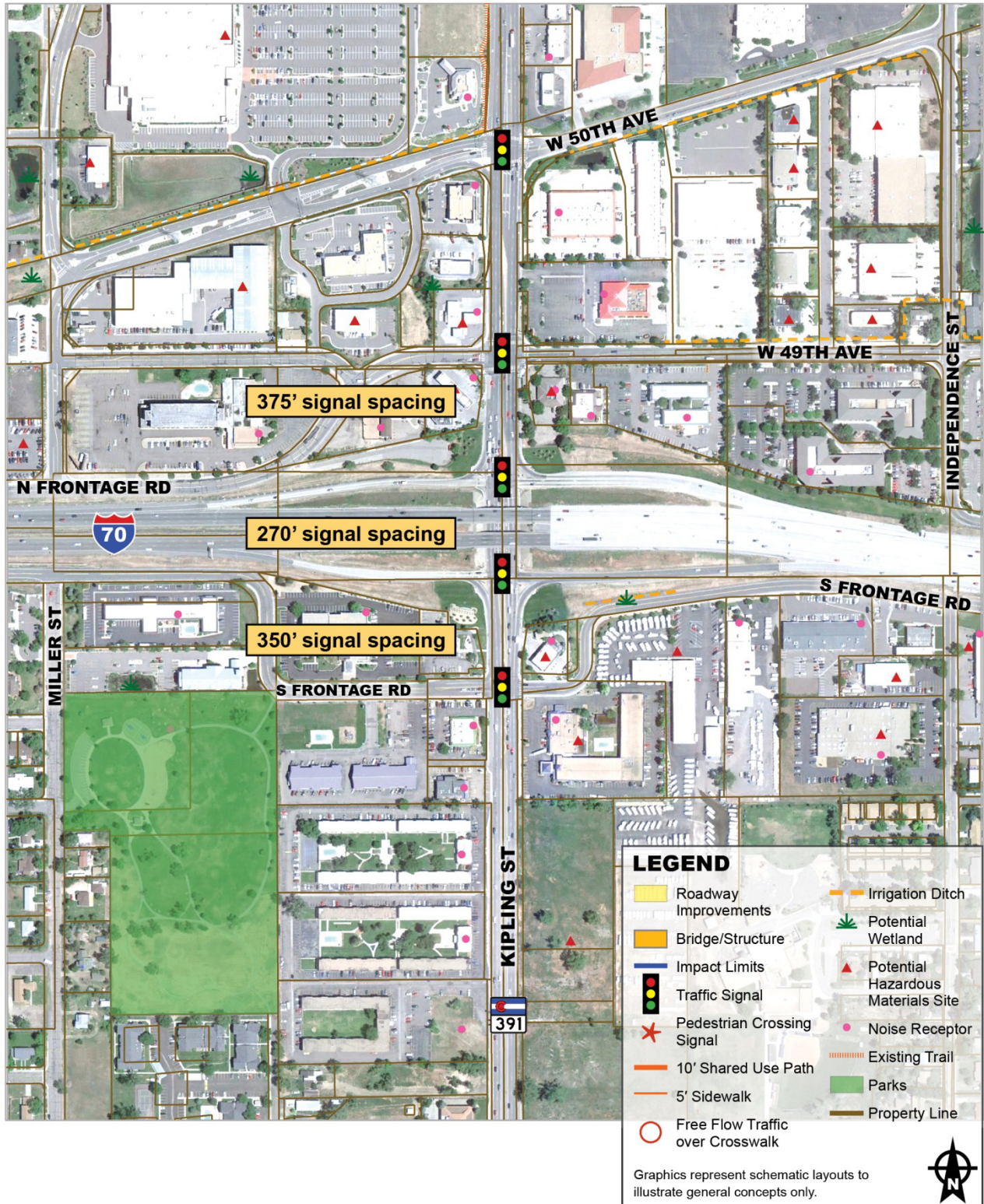
Advantages	Disadvantages
<ul style="list-style-type: none"> • No construction or right-of-way costs 	<ul style="list-style-type: none"> • Degraded peak hour vehicular operations • Increased safety issues due to congestion • Substandard multimodal connections

Recommendation:

CARRIED FORWARD

Further analysis required for comparison

No Action



Single Point Urban Interchange (SPUI) Alternative I

This interchange consists of a single signalized intersection on Kipling Street serving all movements to/from the I-70 ramps and the Kipling Street through movements.

The alternative provides a compact layout, eliminates one signal on Kipling Street, and increases signal spacing on Kipling Street.

Operations and Safety

- Westbound I-70 Off Ramp delay reduced by 30% from the No Action alternative in the PM peak hour.
- Peak hour queues on the Westbound I-70 Off Ramp are reduced by almost 75%.
- Greater intersection spacing and directional interchange layout is easy for drivers to negotiate.

Multimodal Connections

- Shared use path and bicycle lanes are provided directly through the interchange.
- The large single intersection may be intimidating for bicyclists and pedestrians to negotiate.

Environmental and Community Impacts

- Minimal environmental impacts expected.
- Interchange estimated to directly impact five properties with partial acquisition (total = 0.2 acres).
- No increase in traffic traveling through the surrounding neighborhoods expected.

Constructability

- Clear-span bridge for I-70 over Kipling Street is required, which creates difficult traffic impacts during construction and limited opportunities to construct in phases.
- Typical construction costs expected with minimal right-of-way costs. (\$) - relative low costs)

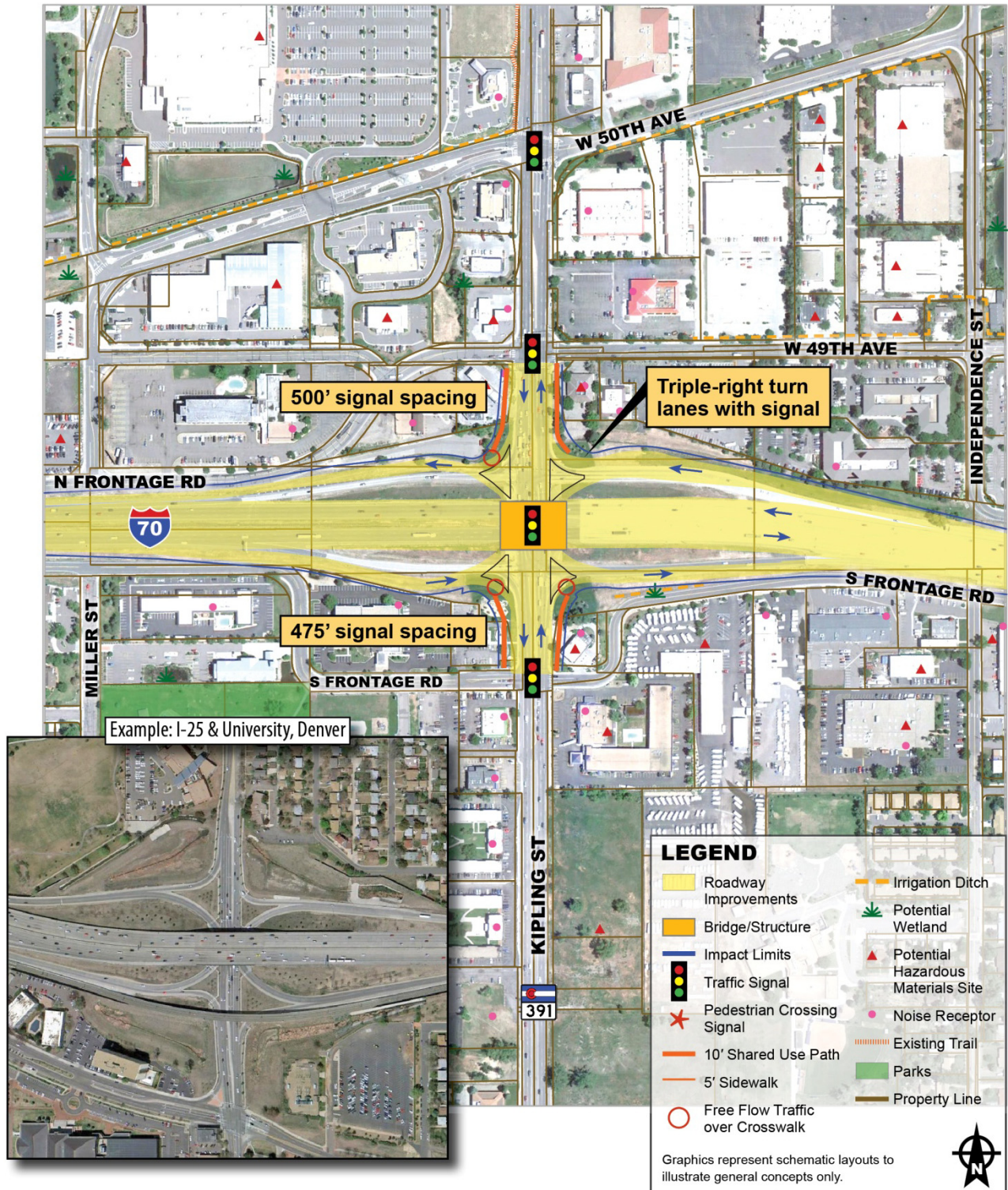
Summary of Critical Considerations

Advantages	Disadvantages
<ul style="list-style-type: none"> • Improved vehicular operations • Easy perceived driver expectancy • Direct multimodal connections through interchange • Minor right-of-way impacts • No change to current frontage road access • Typical construction and minimal right-of-way costs 	<ul style="list-style-type: none"> • Pedestrian crossings of high-speed right turns • Relatively difficult construction impacts compared to other alternatives • Limited opportunities to construct in phases

Recommendation:

CARRIED FORWARD

Single Point Urban Interchange (SPUI) Alternative I



Diamond with Roundabout at Ramps & Frontage Road Alternative 3

This interchange consists of a series of four roundabouts on Kipling Street at the ramps and frontage road intersections. Signalized pedestrian crossings are provided at multilane roundabout approaches. The alternative eliminates four traffic signals on Kipling Street and reduces traffic speeds on Kipling Street.

Operations and Safety

- Peak hour delay increase experienced at ramp and frontage road intersections.
- Southbound and northbound Kipling Street peak hour queues leading to the interchange substantially increased.
- Peak hour queues on the Westbound I-70 Off Ramp are reduced by 45%.
- Movements through closely-spaced multilane roundabouts may be difficult for drivers to understand.

Multimodal Connections

- Due to roundabout spacing, no pedestrian crossing of Kipling Street provided at the ramp intersections.
- Bicycle lanes transition to/from shared use path through the interchange area.
- Transit stops must move north and south of roundabouts.

Environmental and Community Impacts

- Interchange estimated to directly impact 14 properties with three full and 11 partial acquisitions (total = 2.6 acres).
- Increased congestion during peak hours may increase traffic traveling through the surrounding neighborhoods.

Constructability

- Difficult to maintain traffic on Kipling Street with roundabout construction and limited opportunities for to construct in phases.
- Typical construction costs expected with moderate right-of-way costs. (\$\$ - relative moderate costs)

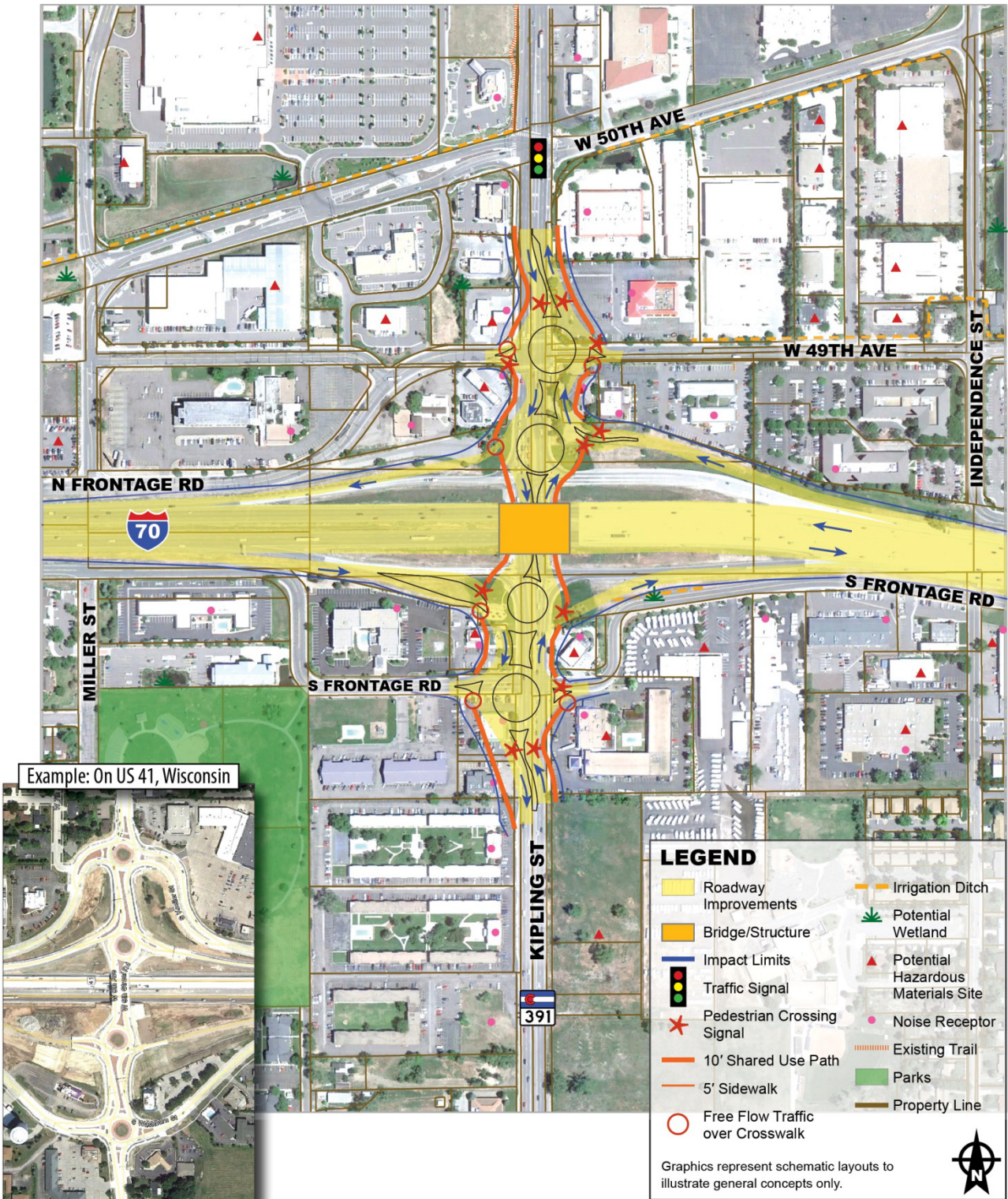
Summary of Critical Considerations

Advantages	Disadvantages
<ul style="list-style-type: none"> • Reduced speed during off-peak hours 	<ul style="list-style-type: none"> • Degraded peak hour vehicular operations • Difficult perceived driver expectancy • Out-of-direction multimodal connections • Relatively difficult construction impacts compared to other alternatives • Limited opportunities to construct in phases

Recommendation:

ELIMINATED

Diamond with Roundabout at Ramps & Frontage Road Alternative 3



Diamond with Six-Leg Roundabout at Ramps & Frontage Roads Alternative 4

This interchange consists of two roundabouts on Kipling Street providing movements at the ramps and frontage road intersections. Signalized pedestrian crossings are provided at the roundabout approaches. The alternative eliminates four traffic signals on Kipling Street and reduces traffic speeds on Kipling Street.

Operations and Safety

- Peak hour delay increase experienced at ramp and frontage road intersections.
- Southbound and northbound Kipling Street and Westbound I-70 Off Ramp peak hour queues leading to the interchange substantially increased.
- Movements through closely-spaced multilane roundabouts may be difficult for drivers to understand.

Multimodal Connections

- Due to roundabout spacing, no pedestrian crossing of Kipling Street provided at the ramp intersections.
- Bicycle lanes transition to/from shared use path through the interchange area.
- Transit stops must move north and south of roundabouts.

Environmental and Community Impacts

- Interchange estimated to directly impact 11 properties with three full and eight partial acquisitions (total = 2.5 acres).
- Increased congestion during peak hours may increase traffic traveling through the surrounding neighborhoods.

Constructability

- Difficult to maintain traffic on Kipling Street with roundabout construction and limited opportunities for to construct in phases.
- Typical construction costs expected with moderate right-of-way costs. (\$\$ - relative moderate costs)

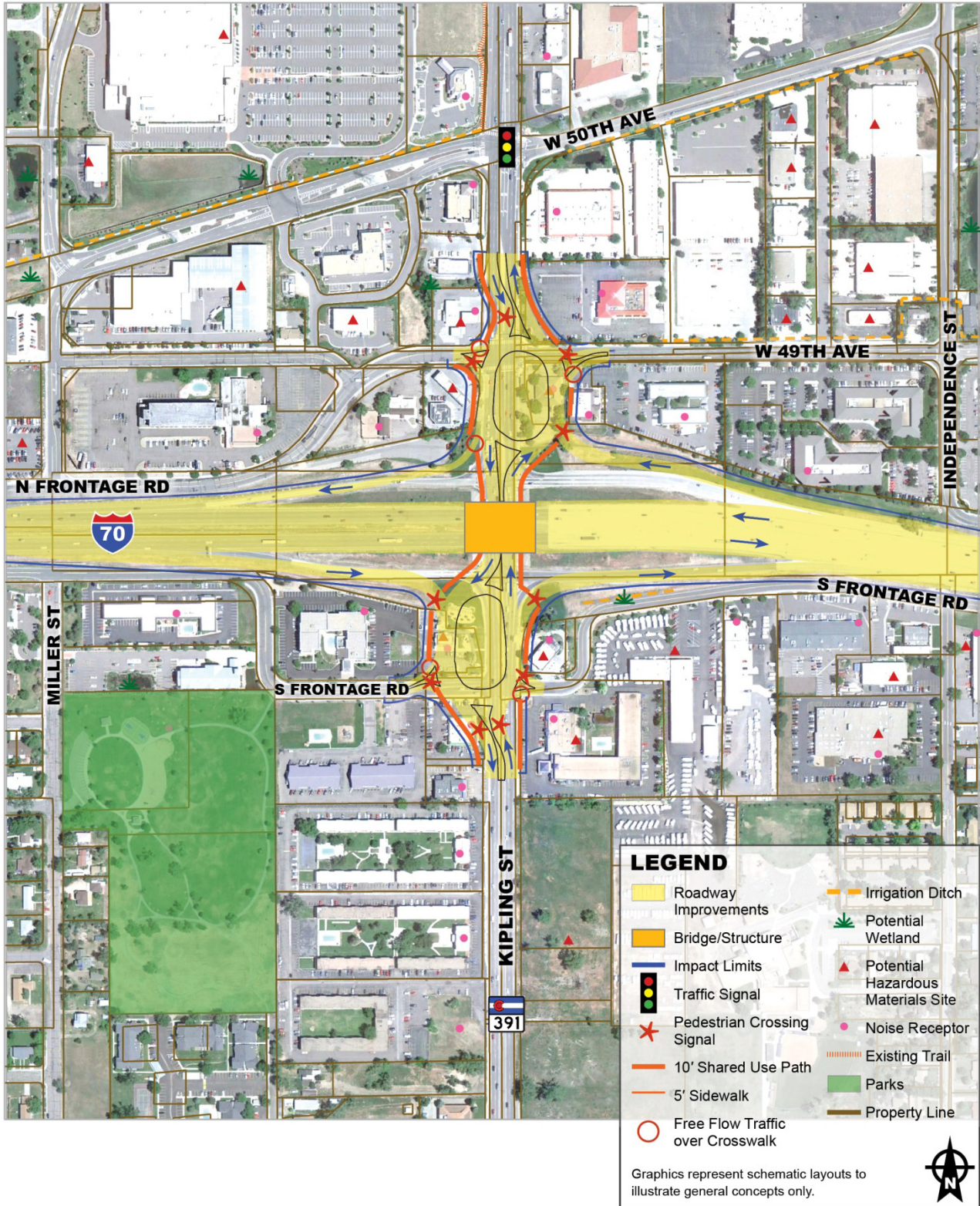
Summary of Critical Considerations

Advantages	Disadvantages
<ul style="list-style-type: none"> • Reduced speed during off-peak hours 	<ul style="list-style-type: none"> • Degraded peak hour vehicular operations • Difficult perceived driver expectancy • Out-of-direction multimodal connections • Relatively difficult construction impacts compared to other alternatives • Limited opportunities to construct in phases

Recommendation:

ELIMINATED

Diamond with Six-Leg Roundabout at Ramps & Frontage Roads Alternative 4



Fully Directional Interchange Alternative 6

This interchange consists of four levels of directional ramps with no signals for ramp movements. The frontage road traffic signals remain open under flyover ramps without access between the ramps and frontage roads.

The alternative maximizes the interchange vehicular traffic capacity.

Operations and Safety

- Southbound and northbound Kipling Street peak hour queues leading to the interchange are reduced by up to 70% in the peak hours.
- Peak hour queues on the Westbound I-70 Off Ramp are reduced by 80% in the PM peak hour.
- Safety concerns with higher speed differential on Kipling Street with directional ramp connections to a lower speed arterial.

Multimodal Connections

- Shared use path provides grade separated crossings through the interchange area, but with some out-of-direction travel required.
- Bicycle lanes cross high-speed ramp movements on and off Kipling Street.

Environmental and Community Impacts

- Interchange estimated to directly impact 38 properties with 13 full and 25 partial acquisitions (total = 18.2 acres).
- Limited access between ramps and frontage roads may increase traffic traveling through the surrounding neighborhoods.

Constructability

- Relatively difficult to construct with multiple flyover ramps.
- Ramps have opportunity to be constructed and opened in separate phases.
- Substantial construction expected with substantial right-of-way costs. (\$\$\$\$ - relative very high costs)

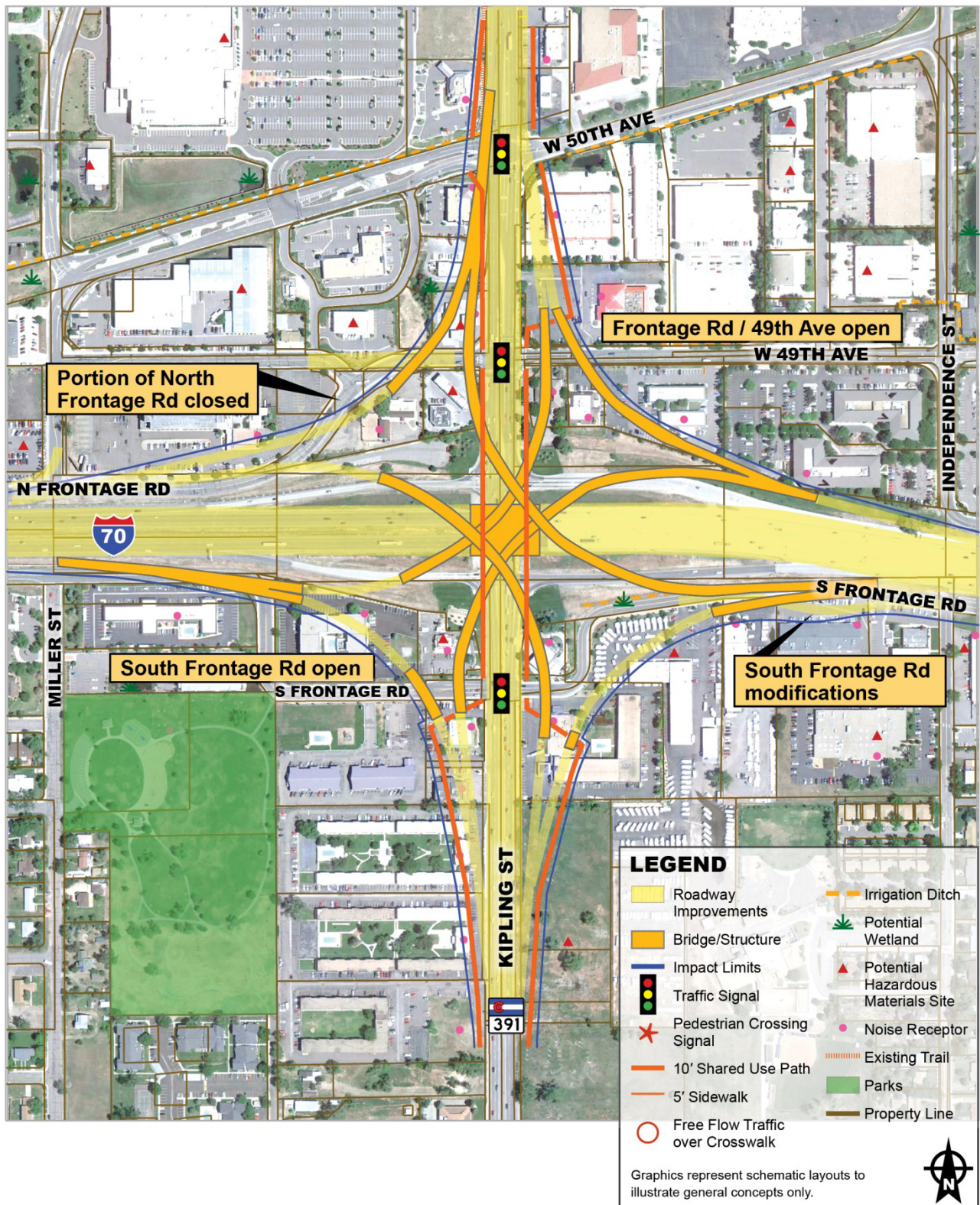
Summary of Critical Considerations

Advantages	Disadvantages
<ul style="list-style-type: none"> • Improved peak hour vehicular capacity 	<ul style="list-style-type: none"> • Safety concerns with speed differential • Bicycle lanes crossing high-speed ramp movements • Major community and right-of-way impacts • Very high construction cost

Recommendation:

ELIMINATED

Fully Directional Interchange Alternative 6



Partial Cloverleaf with Loops Southwest & Northeast Quadrants Alternative 7

This interchange consists of a loop ramp in the southwest and northeast quadrants providing free-flow operations for the left turn movements from Kipling Street to eastbound and westbound I-70. South Frontage Road is relocated with a traffic signal on Kipling Street south of the interchange with location depending on local land use plans.

The alternative eliminates two traffic signals by removing the left turn movements onto the I-70 ramps and increases signal spacing on Kipling Street.

Operations and Safety

- Westbound I-70 Off Ramp delay reduced by 75% from the No Action alternative in the PM peak hour.
- Peak hour queues on the Westbound I-70 Off Ramp are reduced by almost 70%.
- Greater intersection spacing and typical urban interchange layout is moderately easy for drivers to negotiate.
- Safety/operational concerns with radius and design speed of the loop ramps with area truck traffic.
- Safety/operational benefit with removal of high volume left turn conflicts for Westbound I-70 Off Ramp and Eastbound I-70 On Ramp.

Multimodal Connections

- Shared use path and bicycle lanes are provided directly through the interchange.
- Shared use path and bicycle lanes cross free-flow loop ramp movements.

Environmental and Community Impacts

- Interchange estimated to directly impact 18 to 20 properties with seven to nine full and 11 partial acquisitions (total = 14.3 to 21.2 acres), depending on South Frontage Road relocation.
- Potential increase in traffic traveling on Independence Street in northeast quadrant expected due to closure of direct access to frontage road.

Constructability

- Relatively easy to construct with areas outside Kipling Street and opportunities to construct in phases.
- Typical construction costs expected with moderate right-of-way costs. (\$\$ - relative moderate costs)

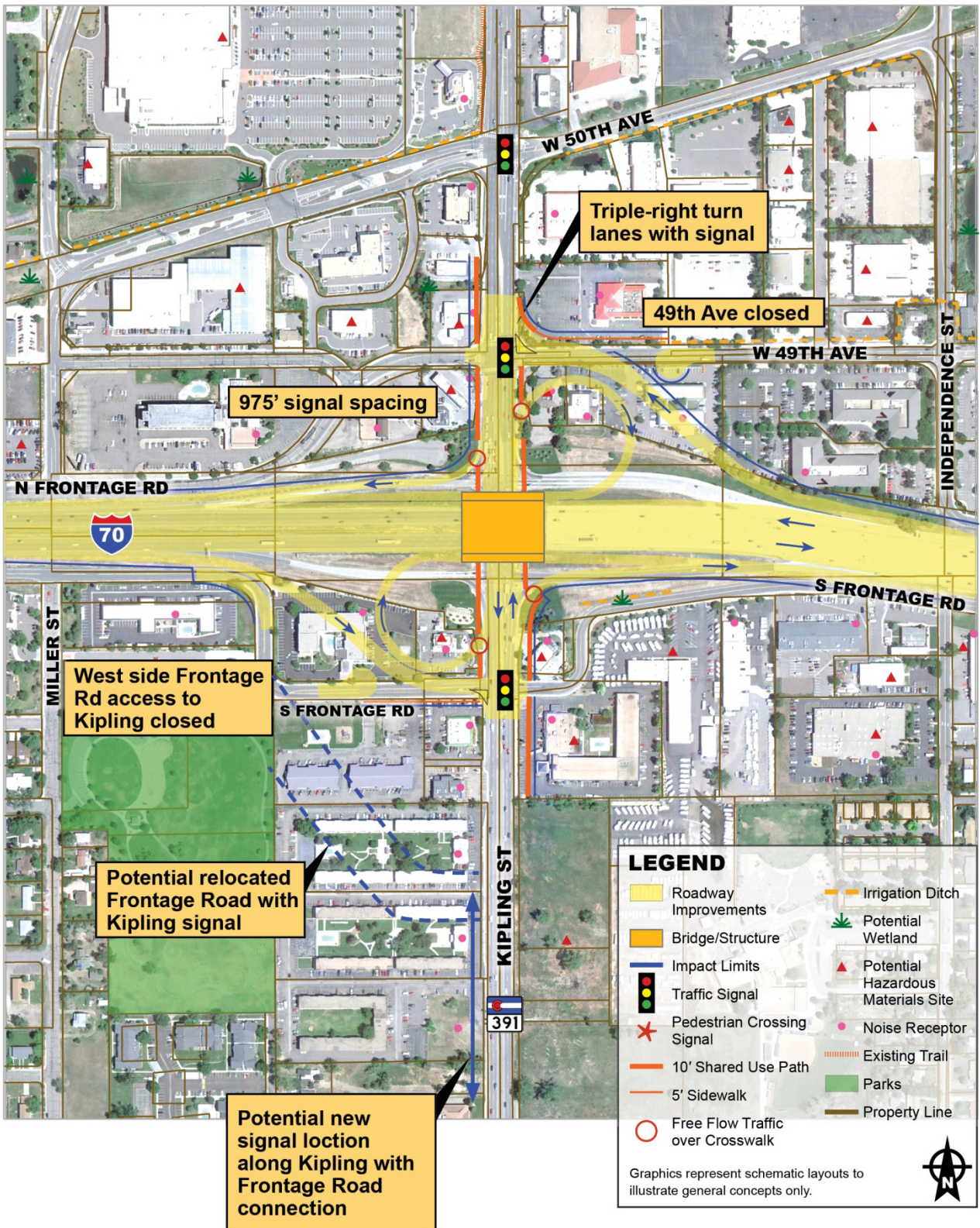
Summary of Critical Considerations

Advantages	Disadvantages
<ul style="list-style-type: none"> • Improved vehicular operations • Moderately easy perceived driver expectancy • Direct multimodal connections through interchange • Opportunities to construct in phases 	<ul style="list-style-type: none"> • Pedestrian crossings of free-flow ramp movements • Frontage road access to northeast quadrant closed • Moderate right-of-way impacts

Recommendation:

CARRIED FORWARD

Partial Cloverleaf with Loops Southwest & Northeast Quadrants Alternative 7



Partial Cloverleaf with Loops Southwest & Northwest Quadrants Alternative 9

This interchange consists of a loop ramp in the southwest quadrant providing free-flow operations for the left turn movement from southbound Kipling Street to eastbound I-70 and a loop ramp in the northwest quadrant providing free-flow operations for the left turn from the westbound off ramp to southbound Kipling Street. South Frontage Road is relocated with a traffic signal on Kipling Street south of the interchange with the location depending on local land use plans.

The alternative eliminates two traffic signals by eliminating the two heaviest left turn movements in the interchange area and increases signal spacing on Kipling Street.

Operations and Safety

- Westbound I-70 Off Ramp delay reduced by 70% from the No Action alternative in the PM peak hour.
- Southbound Kipling Street peak hour queues leading to the interchange are reduced by about 70%.
- Westbound I-70 Off Ramp are free-flow movements merging onto Kipling Street without signals.
- Safety/operational concerns with radius and design speed of the loop ramps with area truck traffic.
- Safety/operational benefit with removal of high volume left turn conflicts for Westbound I-70 Off Ramp and Eastbound I-70 On Ramp.
- Safety concerns with loop ramp serving traffic exiting freeway and area of weaving traffic along Kipling Street between the loop ramps.

Multimodal Connections

- Grade separated crossings of loop ramps provided for shared use path, but with some out-of-direction travel required.
- Bicycle lanes transition to/from shared use path on west side of Kipling Street to avoid weaving area.

Environmental and Community Impacts

- Interchange estimated to directly impact 19 to 21 properties with six to eight full and 13 partial acquisitions (total = 12.9 to 19.8 acres), depending on South Frontage Road relocation.
- Direct access to west side of frontage road in northwest quadrant is closed.

Constructability

- Relatively easy to construct with areas outside Kipling Street and opportunities to construct in phases.
- Typical construction costs expected with moderate right-of-way costs. (\$\$ - relative moderate costs)

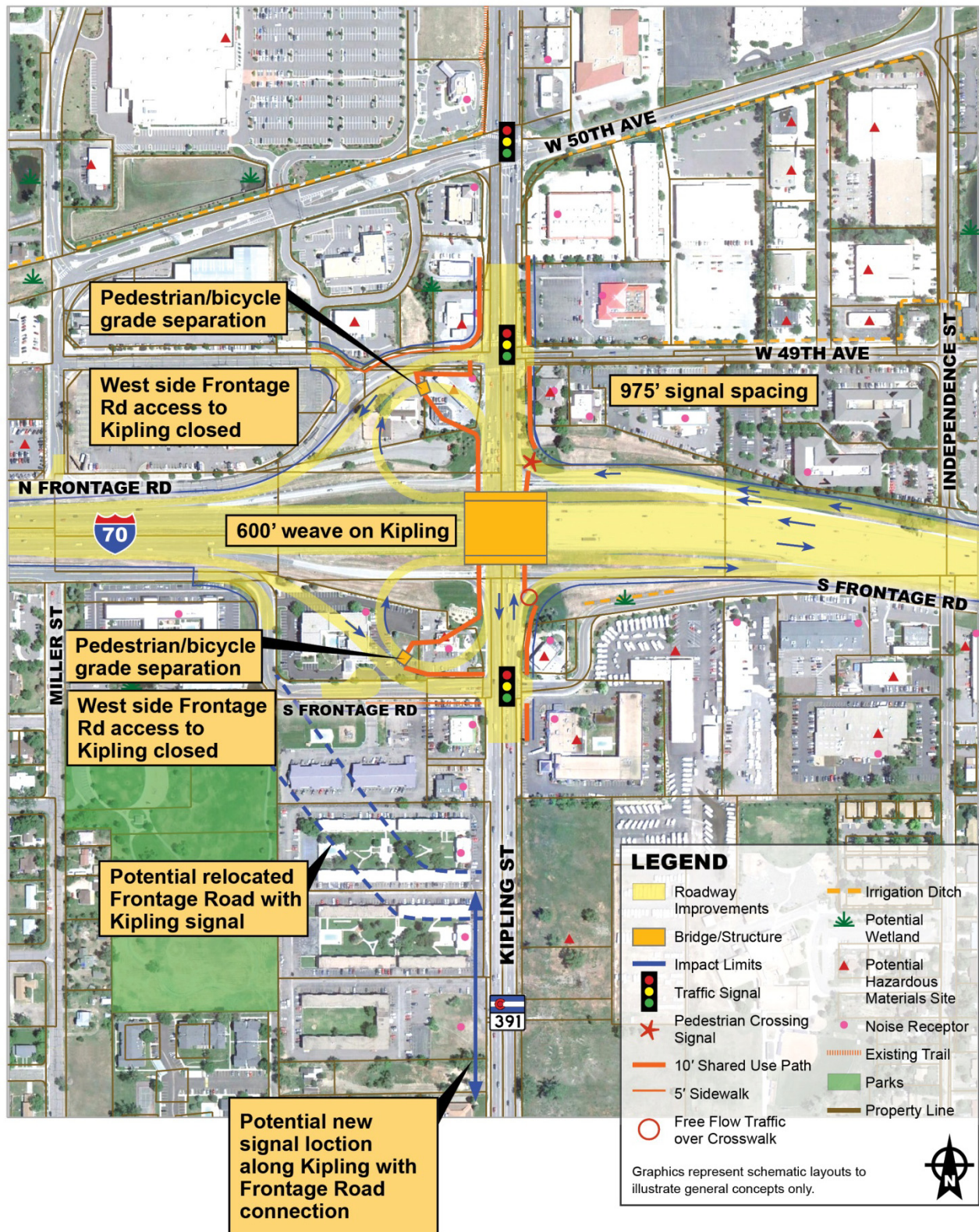
Summary of Critical Considerations

Advantages	Disadvantages
<ul style="list-style-type: none"> • Improved vehicular operations • Moderately easy perceived driver expectancy • Opportunities to construct in phases 	<ul style="list-style-type: none"> • Out-of-direction multimodal connections • Safety concerns with weave area along Kipling Street between loop ramps • Frontage road access to northwest quadrant closed • Moderate right-of-way impacts

Recommendation:

ELIMINATED

Partial Cloverleaf with Loops Southwest & Northwest Quadrants Alternative 9



Texas Frontage Road Diamond Alternative II

This interchange consists of a diamond interchange with frontage road access provided directly to/from the freeway ramps. The frontage road intersections from the ramps may be a roundabout (shown in the northwest quadrant), stop-controlled (shown in the southeast quadrant), or merging operations. The existing frontage road intersections on Kipling are unsignalized with limited movements. The South Frontage Road is relocated with a traffic signal on Kipling Street south of the interchange with the location depending on local land use plans.

The alternative eliminates two traffic signals on Kipling Street and provides access between I-70 and the frontage roads.

Operations and Safety

- Westbound I-70 Off Ramp delay reduced by 60% from the No Action alternative in the PM peak hour.
- South Frontage Road experiences increase in delay at unsignalized access.
- Southbound Kipling Street peak hour queues leading to the interchange are reduced by about 45%.
- Peak hour queues on the Westbound I-70 Off Ramp are reduced by almost 70%.
- Safety concerns with speed differential of freeway and local traffic on ramps and difficulty for drivers to negotiate unusual movements through interchange.

Multimodal Connections

- No pedestrian crossing of Kipling Street provided at unsignalized frontage road intersection, so out-of-direction travel required.
- Bicycle lanes are provided along Kipling Street directly through the interchange.

Environmental and Community Impacts

- Interchange estimated to directly impact 20 to 26 properties with three to eight full and 17 to 18 partial acquisitions (total = 8.2 to 23.3 acres), depending on South Frontage Road relocation.
- No increase in traffic traveling through neighborhoods expected.

Constructability

- Moderately difficult to construct within tight interchange area with opportunities to construct in phases.
- Typical construction costs expected with moderate right-of-way costs. (\$\$ - relative moderate costs)

Summary of Critical Considerations

Advantages	Disadvantages
<ul style="list-style-type: none"> • Full access between ramps and frontage roads • Opportunities to construct in phases 	<ul style="list-style-type: none"> • Safety concerns with freeway and local traffic mix on ramps and unusual interchange movements • Moderate right-of-way impacts with South Frontage Road relocation

Recommendation:

ELIMINATED

Texas Frontage Road Diamond Alternative II



Traditional Diamond Interchange Alternative 12

This interchange consists of two signalized intersections on Kipling Street serving the I-70 ramps with increased spacing between the signals and the existing frontage road intersections are unsignalized and limited to right-in/right-out movements. The South Frontage Road is relocated with a traffic signal on Kipling Street south of the interchange with the location depending on local land use plans.

The alternative eliminates two signals on Kipling Street and increases signal spacing.

Operations and Safety

- Westbound I-70 Off Ramp delay reduced by 45% from the No Action alternative in the PM peak hour.
- Southbound Kipling Street peak hour queues leading to the interchange are reduced by about 75%.
- Peak hour queues on the Westbound I-70 Off Ramp are reduced by about 90%.
- Greater intersection spacing and directional interchange layout is easy for drivers to negotiate.

Multimodal Connections

- Shared use path and bicycle lanes are provided directly through the interchange.
- Pedestrians and bicyclists cross ramp intersections at signals.

Environmental and Community Impacts

- Interchange estimated to directly impact 20 to 22 properties with five to seven full and 15 partial acquisitions (total = 7.3 to 19.8 acres), depending on South Frontage Road relocation.
- Potential increase in traffic traveling on Independence Street in northeast quadrant expected due to limitation of left turns at access to frontage road.

Constructability

- Relatively easy to construct with areas outside Kipling Street and opportunities to construct in phases.
- Typical construction costs expected with moderate right-of-way costs. (\$\$ - relative moderate costs)

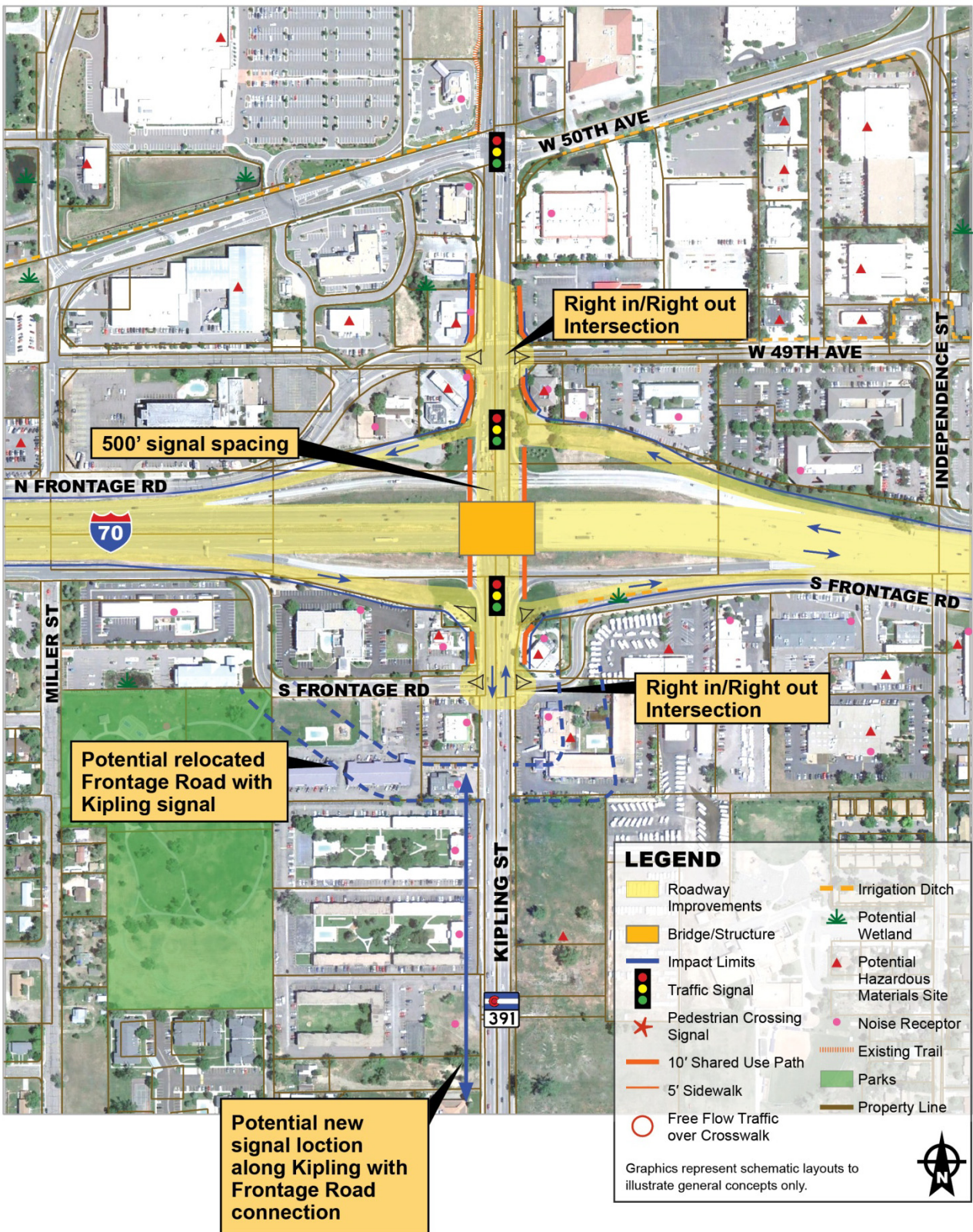
Summary of Critical Considerations

Advantages	Disadvantages
<ul style="list-style-type: none"> • Improved vehicular operations • Easy perceived driver expectancy • Direct multimodal connections through interchange • Opportunities to construct in phases 	<ul style="list-style-type: none"> • Existing frontage road access limited to right-in/right-out movements • Moderate right-of-way impacts with South Frontage Road relocation

Recommendation:

CARRIED FORWARD

Traditional Diamond Interchange Alternative 12



Button Hook Ramps Alternative 17

This interchange consists of a loop ramp in the southwest quadrant providing free-flow operations for the left turn movement from southbound Kipling Street to eastbound I-70 and a loop ramp in the northwest quadrant providing access from the westbound off ramp to southbound Kipling Street with direct access to the frontage road in the northwest quadrant.

The alternative eliminates two traffic signals on Kipling Street and provides access between I-70 and the frontage roads.

Operations and Safety

- Westbound I-70 Off Ramp delay reduced by 70% from the No Action alternative in the PM peak hour.
- Southbound Kipling Street peak hour queues leading to the interchange are reduced by 85%.
- Peak hour queues on the Westbound I-70 Off Ramp are reduced by 75%.
- Unusual movements for ramp access to/from Kipling Street is relatively difficult for drivers to negotiate.
- Safety/operational concerns with radius and design speed of the loop ramps with area truck traffic.
- Safety/operational benefit with removal of high volume left turn conflicts for Westbound I-70 Off Ramp and Eastbound I-70 On Ramp.

Multimodal Connections

- Shared use path and bicycle lanes are provided directly through the interchange.
- Shared use path and bicycle lanes cross free-flow loop ramp movements.

Environmental and Community Impacts

- Interchange estimated to directly impact 18 properties with four full and 14 partial acquisitions (total = 6.2 acres).
- No increase in traffic traveling through neighborhoods expected.

Constructability

- Relatively easy to construct with areas outside Kipling Street and opportunities to construct in phases.
- Typical construction costs expected with moderate right-of-way costs. (\$\$ - relative moderate costs)

Summary of Critical Considerations

Advantages	Disadvantages
<ul style="list-style-type: none"> • Improved vehicular operations • Direct multimodal connections through interchange • Full access between ramps and frontage roads • Opportunities to construct in phases 	<ul style="list-style-type: none"> • Difficult perceived driver expectancy • Pedestrian crossings of free-flow ramp movements • Moderate right-of-way impacts

Recommendation:

CARRIED FORWARD

Button Hook Ramps Alternative 17



Michigan Lefts for Ramps Alternative 2I

This interchange consists of a diamond interchange with left turns restricted at the ramp intersections, so drivers must turn right then do a U-turn at the frontage road intersection.

The alternative eliminates two traffic signals on Kipling Street.

Operations and Safety

- Westbound I-70 Off Ramp delay reduced by 35% from the No Action alternative in the PM peak hour.
- Southbound Kipling Street peak hour queues leading to the interchange increase.
- Peak hour queues on the Westbound I-70 Off Ramp are reduced by 50%.
- Unusual turn movements for ramp access to Kipling Street is relatively difficult for drivers to negotiate.

Multimodal Connections

- Grade seperated crossing of multilane ramp provided for shared use path, but with some out-of-direction travel required.
- Unusual configuration and vehicular movements may be intimidating for bicyclists and pedestrians to negotiate.

Environmental and Community Impacts

- Interchange estimated to directly impact ten properties with three full and seven partial acquisitions (total = 2.6 acres).
- No increase in traffic traveling through neighborhoods expected.

Constructability

- Difficult to maintain traffic on Kipling Street with construction with opportunities to construct in phases.
- Typical construction costs expected with moderate right-of-way costs. (\$\$ - relative moderate costs)

Summary of Critical Considerations

Advantages	Disadvantages
<ul style="list-style-type: none"> • Opportunities to construct in phases 	<ul style="list-style-type: none"> • Difficult perceived driver expectancy • Out-of-direction multimodal connections • Relatively difficult construction impacts compared to other alternatives • Moderate right-of-way impacts

Recommendation:

ELIMINATED

Michigan Lefts for Ramps Alternative 21



Single Roundabout Interchange Alternative 3I

This interchange consists of a single large roundabout on Kipling Street providing one-way movements at the ramps and frontage road intersections.

The alternative provides access between the I-70, Kipling Street, and the frontage roads with a one-way circle.

Operations and Safety

- Westbound I-70 Off Ramp delay reduced by 25% from the No Action alternative in the PM peak hour.
- Southbound Kipling Street peak hour queues leading to the interchange increase.
- Peak hour queues on the Westbound I-70 Off Ramp are reduced by 60%.
- Unusual series of closely-spaced signals along one-way circle may be difficult for drivers to understand.

Multimodal Connections

- Out-of direction travel required for pedestrians and bicyclists on shared use path due to large circular layout.
- Bicycle lanes transition to/from shared use path through the interchange area.

Environmental and Community Impacts

- Interchange estimated to directly impact 16 properties with six full and ten partial acquisitions (total = 4.8 acres).
- No increase in traffic traveling through neighborhoods expected.

Constructability

- Difficult to construct with long duration for multiple structures and limited opportunities for to construct in phases.
- Substantial construction costs expected with moderate right-of-way costs. (\$\$\$ - relative high costs)

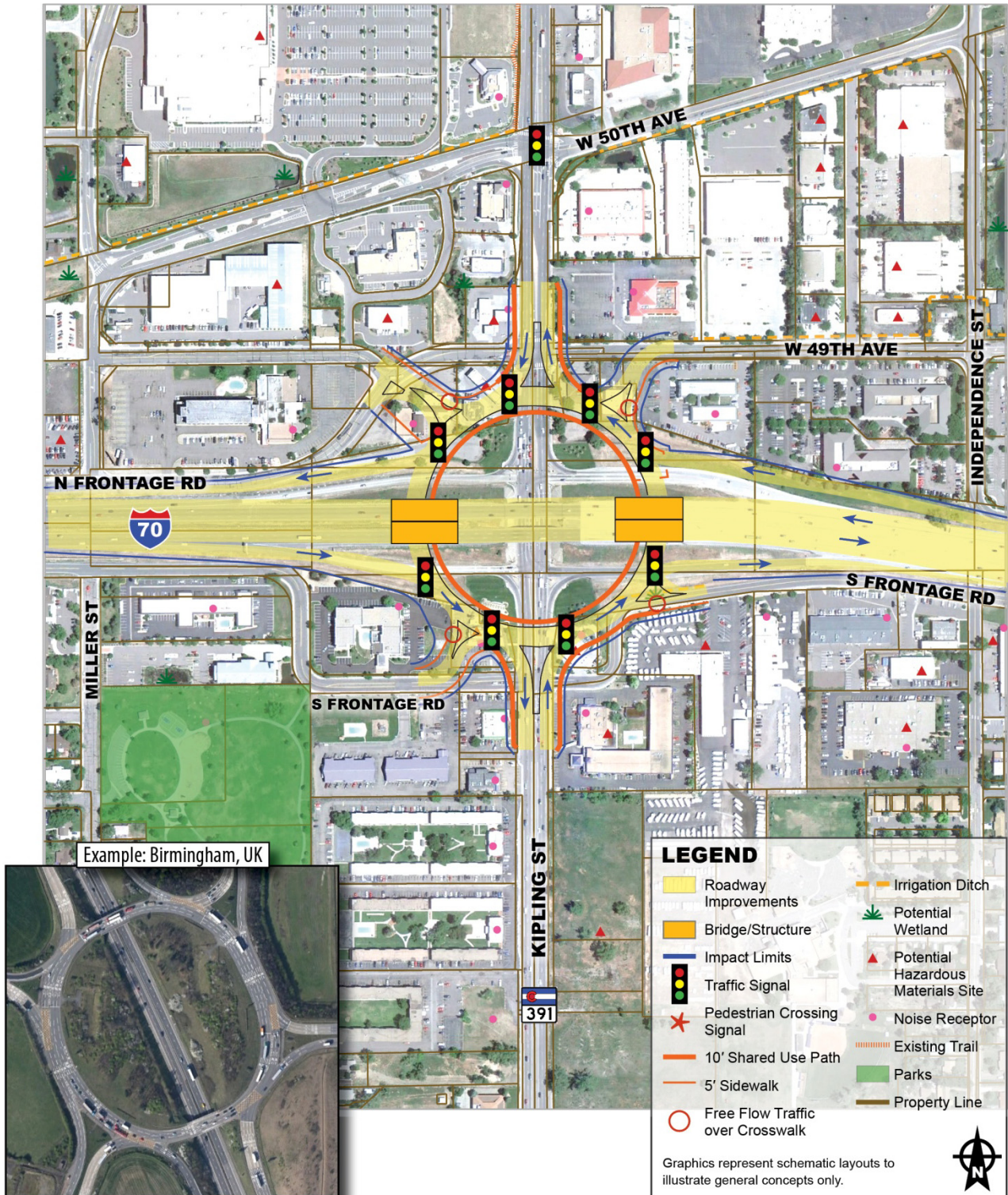
Summary of Critical Considerations

Advantages	Disadvantages
	<ul style="list-style-type: none"> • Difficult perceived driver expectancy • Out-of-direction multimodal connections • Relatively difficult construction impacts compared to other alternatives • Limited opportunities to construct in phases • High construction cost

Recommendation:

ELIMINATED

Single Roundabout Interchange Alternative 3I



Loop Southwest Quadrant & Improved Westbound Ramps Alternative 33

This interchange consists of a loop ramp in the southwest quadrant providing free-flow operations for the left turn movement from southbound Kipling Street to eastbound I-70 and diamond ramps north of I-70 with frontage road access provided directly to/from the freeway ramps. The existing north frontage road intersection is unsignalized with limited movements. The South Frontage Road is relocated with a traffic signal on Kipling Street south of the interchange with the location depending on local land use plans.

The alternative eliminates two traffic signals on Kipling Street, increases signal spacing, and provides access between I-70 and the frontage roads north of I-70.

Operations and Safety

- Westbound I-70 Off Ramp delay reduced by 55% from the No Action alternative in the PM peak hour.
- Southbound Kipling Street peak hour queues leading to the interchange are reduced by 40%.
- Peak hour queues on the Westbound I-70 Off Ramp are reduced by almost 75%.
- Safety concerns with speed differential of freeway and local traffic on ramps and difficulty for drivers to negotiate unusual movements on north side of interchange.
- Safety/operational concerns with radius and design speed of the loop ramp with area truck traffic.
- Safety/operational benefit with removal of high volume left turn conflicts for Eastbound I-70 On Ramp.

Multimodal Connections

- No pedestrian crossing of Kipling Street provided at unsignalized north frontage road intersection, so out-of-direction travel required.
- Bicycle lanes are provided along Kipling Street directly through the interchange.

Environmental and Community Impacts

- Interchange estimated to directly impact 18 to 21 properties with three to four to six full and 14 to 15 partial acquisitions (total = 11.2 to 18.2 acres), depending on South Frontage Road relocation.
- No increase in traffic traveling through neighborhoods expected.

Constructability

- Moderately difficult to construct within tight interchange area with opportunities to construct in phases.
- Typical construction costs expected with moderate right-of-way costs. (\$\$ - relative moderate costs)

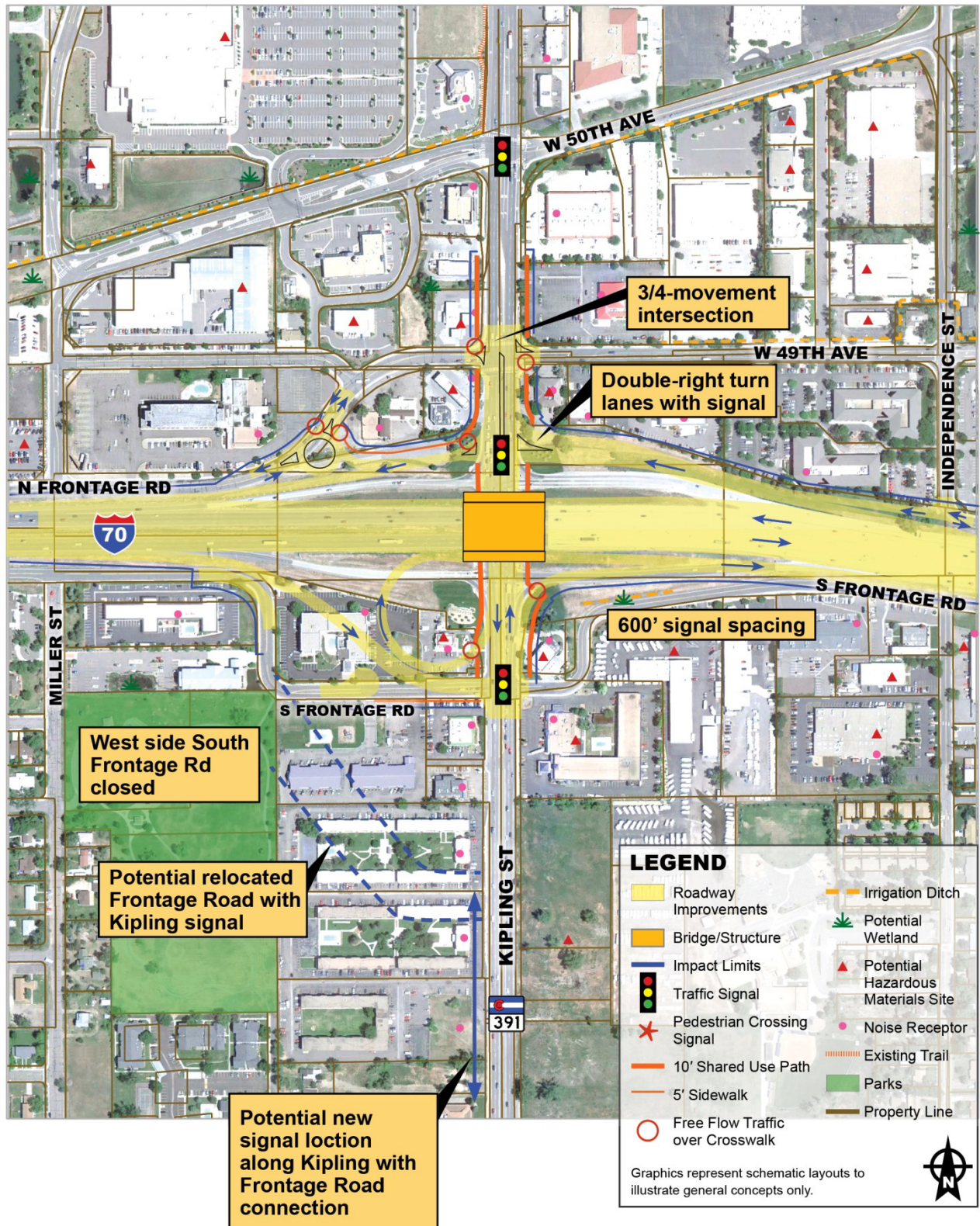
Summary of Critical Considerations

Advantages	Disadvantages
<ul style="list-style-type: none"> • Improved vehicular operations • Opportunities to construct in phases 	<ul style="list-style-type: none"> • Safety concerns with freeway and local traffic mix on ramps and unusual interchange movements • Moderate right-of-way impacts

Recommendation:

ELIMINATED

Loop Southwest Quadrant & Improved Westbound Ramps Alternative 33



Improved Tight Diamond with Southbound to Eastbound Flyover Alternative 34

This interchange consists of current configuration with two tightly-spaced signalized intersections on Kipling Street serving the I-70 ramps and a flyover ramp serving the heavy movement from southbound Kipling Street to eastbound I-70.

The alternative provides a a free-flow movement for the heavy southbound to eastbound movement through the interchange.

Operations and Safety

- Peak hour delays at the 49th Avenue and Kipling Street intersection increase.
- Westbound I-70 Off Ramp delay reduced by 70% from the No Action alternative in the PM peak hour.
- Southbound Kipling Street peak hour queues leading to the interchange are reduced by about 80%.
- Peak hour queues on the Westbound I-70 Off Ramp are reduced by about 70%.
- One out-of-direction movement with an unexpected early decision point may be moderately difficult for drivers to negotiate.

Multimodal Connections

- Shared use path and bicycle lanes are provided directly through the interchange.
- Pedestrians and bicyclists cross ramp intersections at signals.

Environmental and Community Impacts

- Interchange estimated to directly impact seven properties with seven partial acquisitions (total = 0.7 acres).
- Moderate access impacts due to flyover ramp.
- No increase in traffic traveling through neighborhoods expected.

Constructability

- Relatively difficult to construct with multiple flyover ramps.
- Opportunity for flyover ramp to be constructed prior to other interchange phases.
- Typical construction costs expected with moderate right-of-way costs. (\$\$ - relative moderate costs)

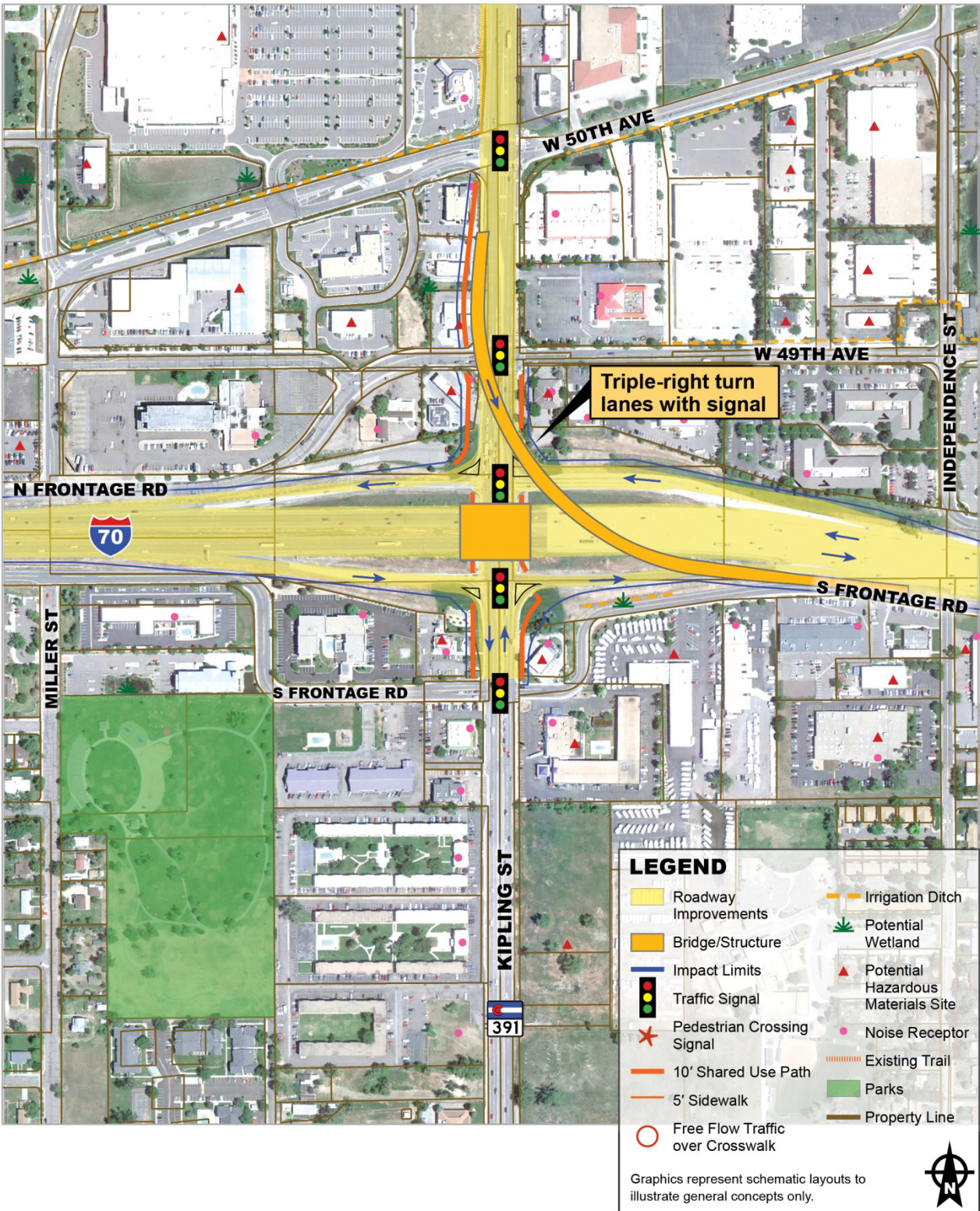
Summary of Critical Considerations

Advantages	Disadvantages
<ul style="list-style-type: none"> • Direct multimodal connections through interchange • Opportunities to construct in phases 	<ul style="list-style-type: none"> • Degraded vehicular operations at 49th Avenue • Moderately difficult perceived driver expectancy • Moderate right-of-way impacts due to access impacts

Recommendation:

ELIMINATED

Improved Tight Diamond with Southbound to Eastbound Flyover Alternative 34



Double Crossover Diamond Interchange Alternative 35

This interchange consists of a diamond interchange with Kipling Street movements shifted to the other side of the street under the bridge to allow left turn movements that do not cross traffic. The existing frontage road intersections are unsignalized and limited to right-in/right-out movements. The South Frontage Road is relocated with a traffic signal on Kipling Street south of the interchange with the location depending on local land use plans.

The alternative eliminates two signals on Kipling Street and increases signal spacing.

Operations and Safety

- Westbound I-70 Off Ramp delay reduced by 45% from the No Action alternative in the PM peak hour.
- Southbound Kipling Street peak hour queues leading to the interchange are reduced by about 65%.
- Peak hour queues on the Westbound I-70 Off Ramp are reduced by about 70%.
- Crossover layout at ramp intersections and unusual turn movements for ramp access to Kipling Street is relatively difficult for drivers to negotiate.

Multimodal Connections

- Shared use path and bicycle lanes are provided directly through the interchange.
- Unusual configuration and vehicular movements may be intimidating for bicyclists and pedestrians to negotiate.

Environmental and Community Impacts

- Interchange estimated to directly impact 17 to 21 properties with three to seven full and 14 partial acquisitions (total = 7.3 to 19.8 acres), depending on South Frontage Road relocation.
- Potential increase in traffic traveling on Independence Street in northeast quadrant expected due to limitation of left turns at access to frontage road.

Constructability

- Difficult to maintain traffic on Kipling Street with construction.
- Typical construction costs expected with moderate right-of-way costs. (\$\$ - relative moderate costs)

Summary of Critical Considerations

Advantages	Disadvantages
<ul style="list-style-type: none"> • Improved vehicular operations 	<ul style="list-style-type: none"> • Difficult perceived driver expectancy • Difficult multimodal movements • Moderate right-of-way impacts with South Frontage Road relocation

Recommendation:

ELIMINATED

Double Crossover Diamond Interchange Alternative 35



Button Hook Ramps South and Improved Westbound Ramps Alternative 36

This interchange consists of a loop ramp in the southwest quadrant providing free-flow operations for the left turn movement from southbound Kipling Street to eastbound I-70 and diamond ramps north of I-70 with frontage road access provided directly to/from the freeway ramps. The existing north frontage road intersection is unsignalized with limited movements.

The alternative eliminates two traffic signals on Kipling Street, increases signal spacing, and provides access between I-70 and the frontage roads north of I-70.

Operations and Safety

- Westbound I-70 Off Ramp delay reduced by 55% from the No Action alternative in the PM peak hour.
- Southbound Kipling Street peak hour queues leading to the interchange are reduced by 50%.
- Peak hour queues on the Westbound I-70 Off Ramp are reduced by 75%.
- Safety concerns with speed differential of freeway and local traffic on ramps and difficulty for drivers to negotiate unusual movements on north side of interchange.
- Safety/operational concerns with radius and design speed of the loop ramp with area truck traffic.
- Safety/operational benefit with removal of high volume left turn conflicts for Eastbound I-70 On Ramp.

Multimodal Connections

- No pedestrian crossing of Kipling Street provided at unsignalized north frontage road intersection, so out-of-direction travel required.
- Bicycle lanes are provided along Kipling Street directly through the interchange.

Environmental and Community Impacts

- Interchange estimated to directly impact 18 properties with two full and 16 partial acquisitions (total = 4.1 acres).
- No increase in traffic traveling through neighborhoods expected.

Constructability

- Moderately difficult to construct within tight interchange area with opportunities to construct in phases.
- Typical construction costs expected with moderate right-of-way costs. (\$\$ - relative moderate costs)

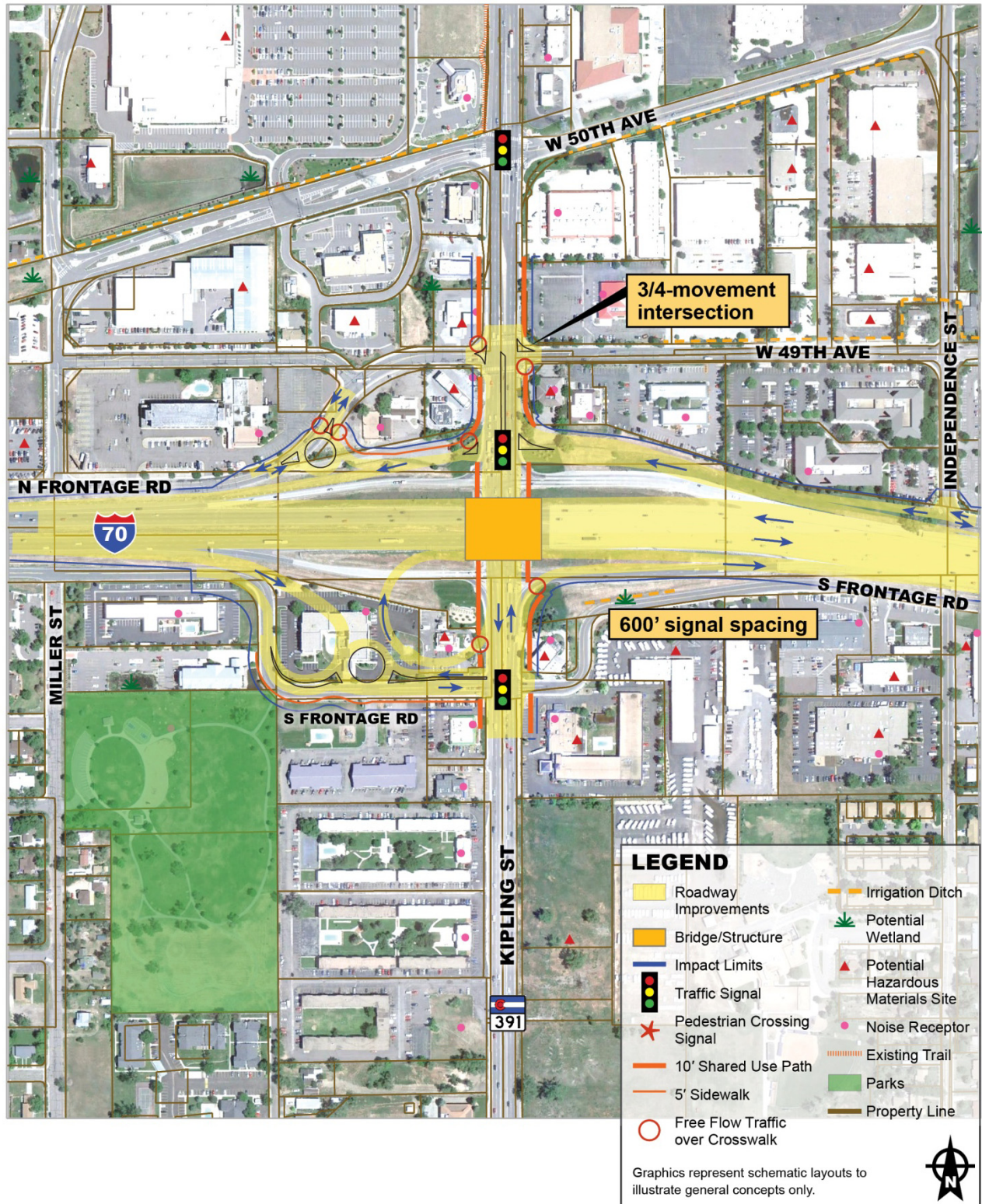
Summary of Critical Considerations

Advantages	Disadvantages
<ul style="list-style-type: none"> • Improved vehicular operations • Direct multimodal connections through interchange • Full access between ramps and frontage roads • Opportunities to construct in phases 	<ul style="list-style-type: none"> • Safety concerns with freeway and local traffic mix on ramps and unusual interchange movements • Moderate right-of-way impacts

Recommendation:

ELIMINATED

Button Hook Ramps South and Improved Westbound Ramps Alternative 36





Westbound I-70 approaching Kipling interchange

Level 3 Alternatives Screening

With the Level 3 alternatives evaluation, steps were taken to further narrow the number of alternatives and to refine the design elements of the alternatives carried forward, considering design solutions to minimize costs and community impacts and maximize multimodal benefits. The final results of the study will identify the recommended alternative(s) to move forward with future NEPA clearances.

Level 3 Alternatives

As described in the previous section of this report, the four improvement alternatives carried forward from Level 2 screening were:

- Alternative 1 – Single Point Urban Interchange (SPUI)
- Alternative 7 – Partial cloverleaf with Loops SW & NE Quadrants
- Alternative 12 – Traditional Diamond Interchange
- Alternative 17 – Button Hook Ramps

Meetings with stakeholders and a public open house were held to present the Level 2 evaluation results and recommendations. Comments from the public and stakeholders indicated concurrence with the Level 2 recommendations with the highest level of support for the SPUI and Traditional Diamond alternatives.

Initial Level 3 Screening

Based on the coordination with the Technical Team, local agencies, area stakeholders, and the general public, an additional decision process was conducted at the beginning of the Level 3 evaluation to evaluate if the alternatives should be

further narrowed prior to refining the conceptual design and traffic operations analysis for the recommended alternative(s).

Priority Criteria Evaluation

The evaluation criteria were prioritized to include the criteria of most concern from comments received during small group meetings with the Technical Team and area stakeholders, presentations to local agency elected officials, and the open house held with the general public. For this level of screening, the criteria of highest priority for the evaluation of interchange alternatives were developed based on stakeholder input. The criteria are:

- Interchange Capacity
- Driver Expectancy
- Pedestrian and Bicycle Crossings
- Property (ROW) Impacts
- Business Access
- Phased Construction Opportunities
- Project Costs

The four remaining alternatives were compared across these seven priority evaluation criteria using the Level 2 analysis results summarized in the Level 2 Screening Matrix in Appendix B. The Partial Cloverleaf alternative (Alternative 7) and Button Hook Ramps alternative (Alternative 17) perform poorly on the majority of these priority criteria, including driver expectancy, pedestrian and bicycle crossings, property impacts, and business access.

The Partial Cloverleaf alternative is worse for driver expectancy because the loop ramps require out-of-direction turn movements (i.e., a driver must turn west to access eastbound I-70 via the loop ramp in the southwest quadrant). The Button Hook Ramps alternative is difficult for driver expectancy because it is an unusual interchange configuration and the unusual movements for ramp access to/from Kipling Street are perceived difficult for drivers to negotiate.

The Partial Cloverleaf and Button Hook Ramps alternatives are worse for pedestrian and bicycle crossings because both configurations include crossings of free-flow loop ramp movements, which are substantially higher speed movements than the free-flow right-right turn movements provided in the SPUI and Traditional Diamond alternatives.

The Partial Cloverleaf and Button Hook Ramps alternatives require notably more ROW than the SPUI and Traditional Diamond alternatives due to the area needed for the loop ramps. The loop ramps of the Partial Cloverleaf alternative also require closing the direct frontage road access in the northeast and southwest quadrants, which impacts access to the surrounding businesses worse than the SPUI alternative.

The Button Hooks Ramp alternative is worse for area business access than the SPUI and Traditional Diamond alternatives due to the unusual interchange configuration

and perceived difficulty for drivers to negotiate through the interchange area via the frontage roads.

Comparatively, the SPUI alternative (Alternative 1) and Traditional Diamond alternative (Alternative 12) ranked highest on the majority of the prioritized criteria.

The Partial Cloverleaf alternative would provide the highest interchange capacity of the four remaining alternatives with the loop ramps providing free-flow operations and simplified signal phasing; however, the SPUI and Traditional Diamond alternatives would also provide traffic operational benefits notably better than level of service standards. The Technical Team determined that the small operational benefits of the Partial Cloverleaf alternative over the SPUI and Traditional Diamond alternatives did not outweigh the additional community impacts due to the greater property and business access impacts.

The SPUI alternative provides the least opportunities for phased construction of the ultimate interchange layout because the freeway bridge and ramps must be constructed with one construction project. The SPUI construction cannot be phased with separate construction projects, which would need less funding at one time. However, comments from the public and stakeholders indicated that the relatively low property impacts of the SPUI are more important than the desire for major construction to occur earlier (which may be possible with a series of smaller funding sources rather than waiting for a single, very large funding source). Also, the SPUI alternative does not preclude short-term improvements that will provide safety and capacity benefits.

After a comparison of the four alternatives across the priority criteria, the Partial Cloverleaf alternative and Button Hook Ramps alternative were eliminated from further consideration because they are not reasonable alternatives based on the performance of the alternatives related to the priority criteria.

Alternatives Refinement

The SPUI and Traditional Diamond alternatives are being evaluated with additional conceptual design information and traffic operations analysis to further define alternative elements. The draft conceptual design alternatives are shown in **Figures 9 and 10**.

Conceptual design details are being evaluated to provide more information on the potential property impacts, including operational challenges with changes in access/driveways. Possible locations for additional infrastructure needs, such as grading, retaining walls, and water quality detention will be identified.

The traffic operations of these two remaining alternatives are being analyzed using VISSIM (Version 5.30-10) traffic simulation software. While the traffic analysis conducted with earlier screening provided comparative information about overall intersection operations and capacity, this analysis will provide additional information on the vehicular interactions and movements through the interchange, as well as the ramp merge and diverge operations on the freeway. The need for additional auxiliary lanes or access restrictions to optimize operations will be identified.

This refinement of the SPUI and Traditional Diamond alternatives will be documented in the final project PEL study report.

Preferred Alternative Selection

The final PEL study recommendations will include large-scale improvements and/or separate, short-term improvements. Long-term recommendations will likely have short-term project elements identified as phases of long-term recommendations or stand-alone projects.

The alternative(s) recommended will include information on conceptual costs and the next steps expected to be completed with the NEPA process.

Figure 9. Alternative 1 – Single Point Urban Interchange

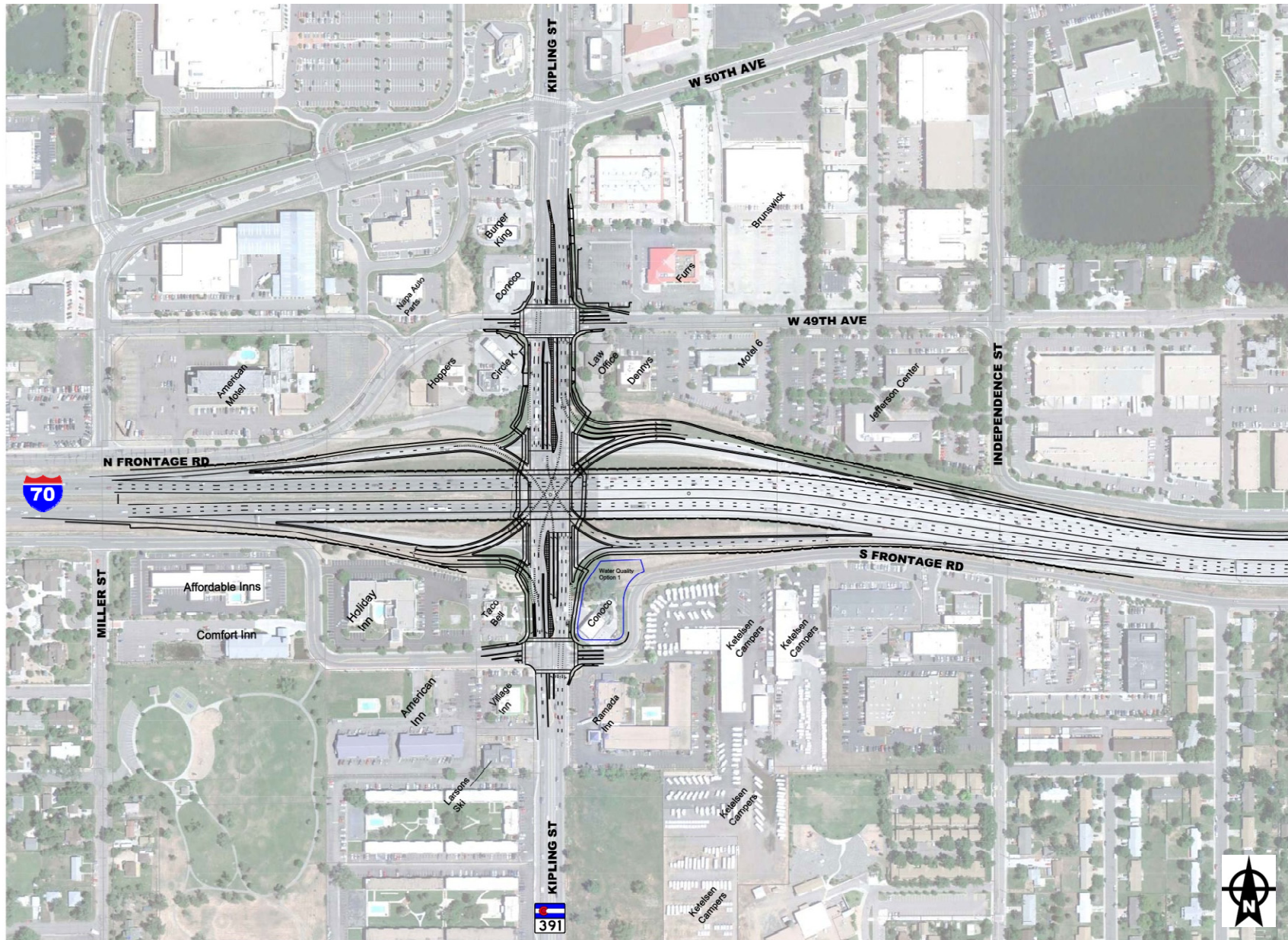
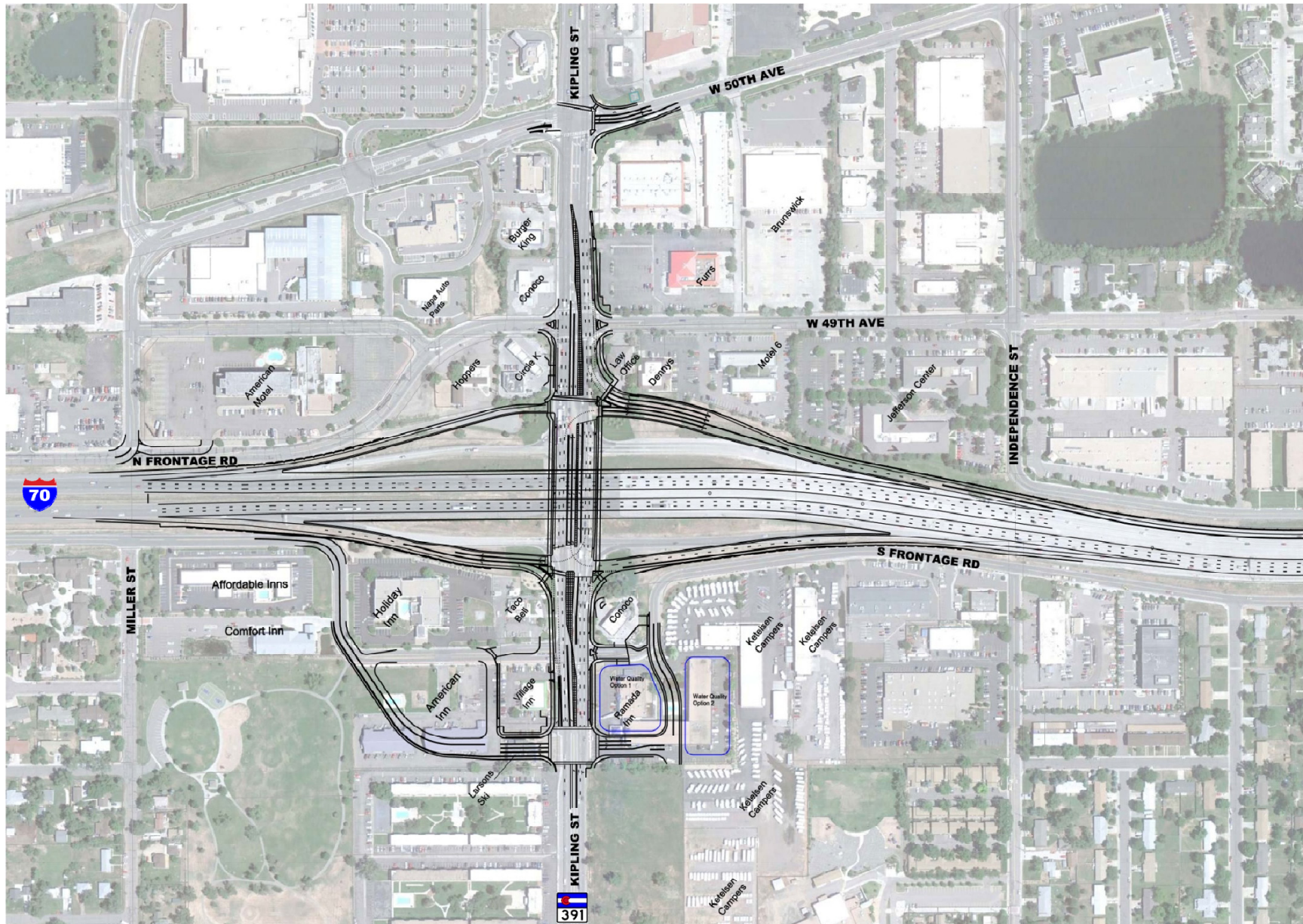


Figure 10. Alternative 12 – Traditional Diamond Interchange



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APPENDIX A

Conceptual Design Parameters

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Conceptual Design Parameters

	CDOT/Wheat Ridge	CDOT/FHWA	CDOT/FHWA
Design Element	Kipling Street (SH 391)	I-70 Mainline	I-70 Ramps
GENERAL			
Functional Classification	Urban Arterial	Interstate	Ramp
Posted Speed Limit / Exit Speed Warning (mph)	45	55	45 / 40
Design Speed	50	60	50 / 45
Loop Ramp			25
Design Vehicle	WB-67	WB-109D	WB-109D
HORIZONTAL ALIGNMENT			
Number of Lanes	4 initial 6 future south of I-70	6 initial 8 future	1 to 2
Horizontal Curve Radius (feet)	1,640	2680 (e=5.4%)	1060 (at 45 mph) 1660 (at 50 mph)
Loop Ramp			167 (at 25mph)
Lane Widths (feet)	12	12	15=1, 12=2
Median Width (feet)	12	N/A	N/A
Min Curb Return Radius (feet)	20	N/A	N/A
Standard Cross Slope	2%	2%	2%
Acceleration Lane Length	550 ft		
Deceleration Lane Length	435 ft		
Accel/Decel Taper Ratio	13.5:1	N/A	N/A
Intersection Minimum Sight Distance (left)	555 ft	N/A	N/A
Intersection Minimum Sight Distance (right)	480 ft	N/A	N/A
Superelevation (e _{max})	6%	8%	6%
Shoulder Widths			
Left Inside (feet) minimum/desirable	N/A	10 / 12	4 / 4
Right Outside (Feet)	N/A	12	8 - 10
VERTICAL ALIGNMENT			
Crest Vertical Curve Rate, Min K	84	151	61 / 84
Sag Vertical Curve Rate, Min K	96	136	79 / 96
Stopping Sight Distance (feet)	425	570	360 / 425
Grade (maximum / minimum)	6% / 1%	4% / 0.5%	Up = 3% / 5% Down = 4% / 6%
Minimum Vertical Clearance at Structures (feet)			
Highways/Streets (feet)		16.5	16.5
Overhead Wires		21.5	21.5
ALTERNATIVE MODES			
Sidewalk Width (feet)	5 - 10	N/A	N/A
On-Street Bike Lanes			
Shared Lane Minimum Width (feet)	14	N/A	N/A
Shoulder Minimum Width (feet)	6	N/A	N/A
Bike Lane Minimum Width (feet)	6	N/A	N/A
Multi-use Path			
Maximum Cross Slope (%)	0.05	N/A	N/A
Design Vehicle	Bicycle	N/A	N/A
Posted Speed (mph)		N/A	N/A
Design Speed (mph)	18	N/A	N/A
Path Width	10 ft	N/A	N/A
Horizontal Minimum Curve Radius (feet)	73	N/A	N/A
Stopping Sight Distance	134	N/A	N/A
Maximum Vertical Grade	0.05	N/A	N/A
Crest Vertical Minimum Curve Length (feet)	180	N/A	N/A
Minimum Vertical Clearance (feet)	10 ft	N/A	N/A
Intersection Minimum Sight Distance (Case B3)	175	N/A	N/A
Intersection Minimum Sight Distance (Case C3)	275 ft	N/A	N/A

APPENDIX B
Level 2 Screening Matrix

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