Using INVEST to Bridge Sustainability and Transportation Needs in the Denton Greenbelt

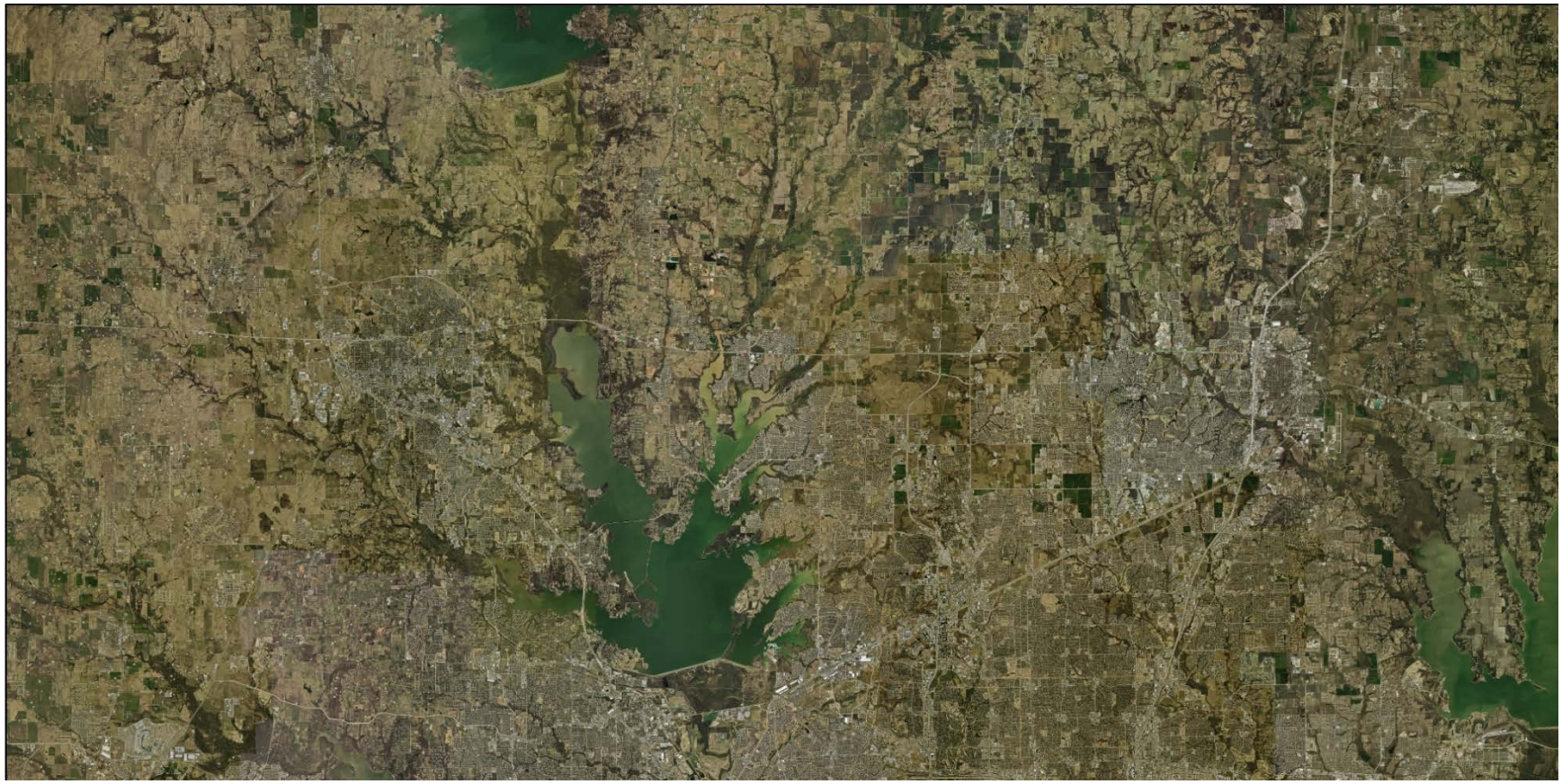
INVEST Summary Report
March 2019

North Central Texas
Council of Governments

Contents

Executive Summary 2
Key Outcomes 3
Objectives 4
Background on Planning and Environment Linkages/Feasibility Studies 6
Work Performed 8
Selection of Criteria 9
Additional Work Performed 11
Stakeholder and Community Outreach 11
Stakeholder Comments 14
Feasibility Study 14
Regional Ecosystem Framework Analysis 17
Scoring 18
Analysis 31
Criteria Data Sources 57
Costs and Benefits 57
Next Steps 63
Lessons Learned 64
Potential of the Project to Serve as National Case Study 77
Recommendations 78
Improving Use of the Tool 79
Improving Outcomes of the Tool 81
Appendices 82

Executive Summary



Extraordinary population growth in the Dallas-Fort Worth region can create sustainability challenges where the need for an expanded transportation system meets the need for conservation. The North Central Texas Council of Governments (NCTCOG) sought to incorporate sustainability best practices into a feasibility study for the Denton Greenbelt Corridor.

Staff modified System Planning for Regions and Project Development criteria from the Federal Highway Administration's Infrastructure Voluntary Evaluation Sustainability Tool (INVEST) to develop sustainability criteria appropriate to corridor planning. These criteria were used to score an existing feasibility study and were incorporated as NCTCOG conducted the Denton Greenbelt Corridor Feasibility Study. NCTCOG's corridor-scale menu could serve as a starting point for developing a new INVEST module.

NCTCOG engaged stakeholders through meetings, a community festival, and a webinar as it developed the feasibility study.

Key Outcomes

Reduced silos: The project brought together NCTCOG staff with a range of expertise. This core group met 11 times. These interactions generated robust discussion that helped familiarize the group with each other's responsibilities and perspectives.

Corridor-scale sustainability module: NCTCOG's Draft Feasibility Study Sustainability Menu provides 61 criteria in 18 categories. The menu also identifies corridor characteristics, such as "Natural or Scenic," for which the criteria are most appropriate.

Robust stakeholder outreach: Criteria in the Draft Feasibility Study Sustainability Menu led NCTCOG to implement stakeholder outreach with community members, conservationists, cities, users of park recreational facilities, active transportation advocates, transportation partners, federally recognized tribal nations, and resource and regulatory agencies. Their comments were included in the final feasibility study and should yield information that will inform and streamline future environmental studies.

New feasibility study content: The draft criteria led NCTCOG to include in the Denton Greenbelt Corridor Feasibility Study content that had not been included in past feasibility studies. This included the use of a tool to identify priority ecological areas; identification of sites that could be affected by light pollution; the use of NCTCOG's Environmental Justice Index; efforts to inform stakeholders how their comments would be used; data on factors affecting infrastructure resiliency; and the inclusion of information about the quality of data used in the feasibility study.

Need to coordinate with transportation partners: NCTCOG identified a need to coordinate more closely with transportation partners, including the Texas Department of Transportation, to ensure the content of the feasibility studies informs future project planning and development. NCTCOG staff plan to meet with transportation partners to discuss this need.

Objectives

In 2016, stewards of a conserved greenbelt invited transportation planners to tour the land, which flanks the Elm Fork of the Trinity River in Denton, Texas. These community members had formed the nonprofit Greenbelt Alliance to protect the land and river, which are part of the second-most widely visited state park in Texas. The greenbelt is crossed by a two-lane road that provides access to hiking, biking, equestrian, and paddling trails. A historic bridge runs parallel to the road; deeper into the greenbelt, a dilapidated bridge rumored to have been traveled by Bonnie and Clyde hangs over the river. The park is quiet enough that the sounds of birds and insects dominate.

Transportation plans recommended the two-lane road be expanded to a six-lane controlled-access facility with six lanes of frontage roads. The populations of Denton and Collin counties were expected to grow by 54 percent and 64 percent, respectively, by 2040. A study completed in 2011 indicated a need for additional transportation infrastructure to serve this growing population.

This confluence of transportation and conservation needs made the proposed Denton Greenbelt Corridor an excellent candidate for a tool promoting sustainability best practices in transportation planning. The North Central Texas Council of Governments (NCTCOG) Transportation Department which, along with the Regional Transportation Council, serves as the metropolitan planning organization for the Dallas-Fort Worth region, had already used the Infrastructure Voluntary Evaluation Sustainability Tool (INVEST) to improve the region's long-range transportation plan. The tool resulted in the following additions to future plans' content:

- NCTCOG's Regional Ecosystem Framework was better integrated into the plan. The Regional Ecosystem Framework promotes the use of an ecosystem approach to help restore and sustain the region's ecological condition.
- Major roadway and transit recommendations underwent an environmental scoring process.
- NCTCOG's Environmental Justice Index became a factor in project prioritization.
- Efforts were identified to improve the existing transportation infrastructure without widening existing facilities or constructing new facilities.
- The resiliency of infrastructure in the face of extreme weather patterns was addressed.

NCTCOG sought to similarly improve its process to develop feasibility studies at the corridor scale. The metropolitan planning organization conducts feasibility studies in support of its transportation partners, including the Texas Department of Transportation (TxDOT) and the North Texas Tollway Authority. These studies help expedite critical regional projects through development, approval, and implementation. The goal of NCTCOG's participation in these studies is to help reduce cost escalation due to inflation, alleviate congestion at an earlier date, and assist in meeting air quality goals. As regional transportation projects continue

to increase in complexity, scope, and impacts, the NCTCOG Transportation Department has identified a need to expand its involvement beyond its current planning and programming functions to improve project implementation in the region.

The Texas Department of Transportation describes a feasibility study as a report that identifies whether a recommended project should move forward into project development after analyzing:

- Project benefits and costs
- Effectiveness
- Analysis of alternatives
- Environmental effects
- Public opinions[1]

Background on Planning and Environment Linkages/Feasibility Studies

NCTCOG used the Planning and Environment Linkages (PEL) concept to conduct the Denton Greenbelt Corridor Feasibility Study. The Federal Highway Administration (FHWA) describes this concept as "a collaborative and integrated approach to transportation decision making that [considers] benefits and impacts of proposed transportation system improvements to the environment, community, and economy during the transportation planning process."[2] A PEL approach is justified because of the recommended roadway's location surrounded by conserved land in a state park.

By using the PEL concept, NCTCOG hoped to:

- Improve the sharing of information on environmental concerns with stakeholders and resource agencies
- Provide information that could be integrated into National Environmental Policy Act documents
- Build stronger relationships through early communication with the Texas Parks & Wildlife Department (TPWD) and the US Army Corps of Engineers (USACE) lake managers and recreation staff
- Identify potential impacts through early consultation with residents, TPWD, and USACE
- Streamline delivery of the planned roadway in the Denton Greenbelt Corridor
- Meet transportation needs while reducing environmental impacts and maintaining appropriate access to the state park

[1] Texas Department of Transportation, *TxDOT Glossary*, http://onlinemanuals.txdot.gov/txdotmanuals/glo/f.htm
[2] Federal Highway Administration, *Planning and Environment Linkages - Questions and Answers November 2, 2016*, https://www.fhwa.dot.gov/hep/guidance/pel/pelfaq16nov.cfm

Environmental and community considerations have influenced the process of past feasibility studies conducted by NCTCOG. Environmental and demographic data has been included to identify existing conditions and to guide outreach efforts if the study included public involvement. In a past study, some alignments were removed because of the potential for impacts to historic properties. If an environmental justice analysis identified a presence of residents with limited proficiency in English, translation services may have been required. Despite these influences on process, environmental and community considerations had been reported but not analyzed because feasibility studies may cover a larger number of alignments than a National Environmental Policy Act study. Analyses and cost-benefit considerations had not been conducted in a way that would influence the selection of an alignment.

NCTCOG staff expected that the integration of PEL and the INVEST criteria would provide an opportunity to quantify and compare the environmental, community, and economic costs of alignments.

The PEL-related feasibility study for the Denton Greenbelt Corridor identified a purpose and intent for the project; screened alternative alignments; and analyzed travel demand, land use, population and employment, potential environmental effects, and potential need for mitigation. Stakeholders were engaged early in the feasibility study process.

Work Performed

FHWA's INVEST was developed to best suit long-range plans and project development phases or operations and maintenance that required an alignment or construction. NCTCOG's decision to apply INVEST to a corridor-scale feasibility study meant existing INVEST criteria couldn't necessarily be used as written. A core team of transportation planners participated in a kickoff meeting and four workshops to select and modify criteria from the System Planning for Regions and Project Development modules. The criteria selection team included planners and engineers with the following areas of expertise:

- Asset and congestion management
- Corridor studies
- Environmental coordination
- Environmental justice
- Environmental streamlining
- Long-range planning
- Project engineering
- Roadway planning
- Sustainable development

Selection of Criteria

Based on the discussion generated in the workshops, criteria were either included as written, modified to be applicable to a corridor-scale feasibility study, or excluded from consideration. The criteria that were included or modified from each module were then combined and reviewed to remove the duplication of subject matter. The results included sustainability criteria NCTCOG staff would use to score an existing feasibility study.

Typical modifications of System Planning for Regions criteria included changing references to "goals and objectives" to language more suitable to a corridor-scale feasibility study that will support PEL efforts, such as "purpose and need." Criteria referring to "the agency" were replaced with references to "the study." Some of these modifications required additional research. For example, references to collaboration in the development of the State Strategic Highway Safety Plan were modified to query whether the feasibility study addresses emphasis areas and strategies from the state plan that the criteria selection team deemed applicable to a feasibility study.

Some criteria were modified to provide a means to weigh alignments against each other. For example, SPR-16.1 was modified from: "Has the agency developed goals and objectives consistent with partner agencies for infrastructure resiliency in transportation planning documents?" to "Does the study address the potential infrastructure resiliency or threats to resiliency for different alignments?" Under this criterion, for example, an alignment on soil with a lower shrink-swell potential could be more favorable than an alignment on soil with a higher shrink-swell potential.

Criteria from the System Planning for Regions module were typically excluded if they referred to performance measures or tracking, because these efforts can only be undertaken following implementation of the project.

Typical modifications of the Project Development criteria allowed the criteria to address the feasibility study phase rather than a later phase of project development. For example, PD-03.6 was modified from "Did the project remove objectionable or distracting views?" to "Were alignments identified that remove objectionable or distracting views?"

Criteria from the Project Development module were typically excluded if they were most relevant to the construction phase, including those addressing tracking of environmental commitments, repurposing of materials, and construction noise mitigation.

Some criteria required feedback from planners with expertise beyond that of the criteria selection team. For example, air quality planners were able to provide information on tools that could compare the emissions generated during construction of alternative alignments or that could compare alignments that incorporate multimodal strategies.

After criteria from the two modules were included as written, modified, or excluded, the modules were merged. This introduced duplication of content for some subjects, so the criteria were further refined.

Appendix 1 includes the original wording of each System Planning for Regions and Project Development criterion; whether each criterion was included, modified, or excluded from the new menu; the reasons this decision was made; and the new wording of each modified criterion. Appendix 1 serves as the interview notes from the four workshops to select and modify criteria.

These resulting criteria were reorganized. The System Planning for Regions and Project Development prefixes were replaced with an interim Corridor Studies prefix. The resulting interim Corridor Studies module was used to score the 2011 Regional Outer Loop Corridor Feasibility Study.[3] Results are addressed in the "Scoring of Feasibility Study" section of this report.

Additional Work Performed

NCTCOG staff supplemented work using INVEST by engaging stakeholders and the public and completing the feasibility study. Some of this work was funded by other sources.

Stakeholder and Community Outreach

NCTCOG staff engaged stakeholders from the community, transportation partners, federally recognized tribal nations, and resource and regulatory agencies throughout the project. Several of the stakeholder meetings were held at locations near the corridor. To engage stakeholders, NCTCOG contacted local landowners, members of the Greenbelt Alliance, equestrians who frequent the park's trails, cities, including those with an interest in the reservoirs' water quality, the local water district, TPWD, and USACE, which holds conservation easements on the land adjacent to the right-of-way of the existing two-lane road, FM 428.

During the initial stakeholder meeting in June 2017, the project team described the metropolitan planning organization's role in transportation planning and the forecasted population growth that was identifying a need for a wider roadway in northeast Denton County. INVEST and NCTCOG's plans to use the tool to address sustainability and environmental stewardship in the corridor were described. Stakeholders were then invited to describe their interests and concerns about the corridor.

The Denton Greenbelt's role as recreation center and a wildlife corridor dominated the discussion. The stakeholders, some of whom had sought grants to repair and maintain flood-damaged trails in the past, emphasized the need to keep trails open during construction. Safety and parking for horse trailers also was a priority, as these vehicles have slower acceleration and deceleration rates and larger turning radii than passenger vehicles. The trailhead accessed by FM 428 currently serves as the "gateway" to the park, so the aesthetics of this access point were important to the stakeholders, who requested context sensitive solutions. The Denton Greenbelt provides a wildlife corridor between Lewisville Lake and Ray Roberts Lake, and stakeholders identified a need

[3] North Central Texas Council of Governments, *Planning and Environmental Linkages*, INVEST, https://www.nctcog.org/trans/quality/environmental-coordination/planning-and-environmental-linkages

for a wildlife crossing both to benefit wildlife and prevent animal-vehicle collisions. Stakeholders also requested information on the outcome of similar roadway projects elsewhere.

The footprint of the roadway also was addressed in the first stakeholder meeting. The historic Elm Fork Bridge is located within the right-of-way, and USACE holds conservation easements in perpetuity to the edge of the right-of-way. It was noted that the exact width of the right-of-way was not certain.

Following this first community stakeholder meeting, the North Central Texas Council of Governments was invited to the annual meeting of the Lake Ray Robert's Equestrian Trail Association in July 2017. This group brings together equestrians who ride the trails surrounding Lake Ray Roberts, including those in the Denton Greenbelt. The trail association collaborates with the Greenbelt Alliance to preserve the Greenbelt and promote public support and recreational opportunities. The trail association's almost 70 members raise money to help maintain the trails by hosting competitive trail events and receiving grants from TPWD. One staff member attended the annual meeting and provided a brief overview of the planned Denton County Outer Loop/Greenbelt Parkway and efforts to incorporate sustainability into the feasibility study process. Trail association members and TPWD staff attended the meeting. One attendee stressed the importance of maintaining access to equestrian trails by citing horses as a characteristic that makes Texas unique.

NCTCOG also met with stakeholders from USACE and TPWD in August 2017 to identify the agencies' concerns in greater detail. The possibility of elevating the roadway to provide a wildlife crossing and accommodate a 100-year flood was discussed. The restrictions that resulted from the conservation easements also were discussed. The project also would likely trigger section 4(f) of the Department of Transportation Act of 1966 and Section 106 of the National Historic Preservation Act. TPWD representatives requested that in lieu of signing off on 4(f) during the environmental process, they would request a more finalized design be provided before they sign off. Attendees also expressed concerns about the conservation needs of freshwater mussels and the threats posed by zebra mussels and other invasive species.

The project team sought to address the agencies' concerns by describing design techniques that could be implemented to restrict the planned roadway to the existing right-of-way. It was noted that by addressing environmental concerns early in the planning process, mitigation to enhance the park could be identified.

NCTCOG sought to reach a broader group than the community stakeholders because the project could affect residents and travelers beyond those interested in the Greenbelt. East of the Denton Greenbelt, the planned roadway would travel north of the

city of Aubrey, which is home to 3,126 residents.[4] The project team staffed an outreach booth at the Aubrey Peanut Festival in October 2017. Organizers say the festival, which has taken place since 1986, can draw thousands of attendees. Maps and fliers were presented to festival-goers, 23 of whom discussed the roadway with the project team. Some attendees supported the plans, given the projections for population growth in the area. Others were concerned about the loss of property neighboring the project.

Also in October 2017, NCTCOG staff met with transportation staff from the city of Denton. Discussions included plans to expand a facility parallel to the Denton Greenbelt Corridor. Also discussed was a route that would become Alignment 1 in the feasibility study.

During the second community stakeholder meeting, held in December 2017, NCTCOG responded to stakeholder interest during the June meeting by presenting five case studies of roadway projects elsewhere that affected parks, natural areas, or wildlife. These case studies are included in Appendix 5.

Two additional meetings were held with transportation stakeholders. In January 2018, a representative from Denton County provided support for Alignment 2, which matches the alignment included in the county's 2017 thoroughfare plan. Also discussed were easement negotiations for another roadway project, FM 2499. In October 2018, a final stakeholder meeting with transportation partners was held. Stakeholders voiced support for Alignment 2 and called for consideration of an east-west transit route and a mixed-use path following the roadway. Also discussed was the possibility of relocating the historic bridge to allow for a wider roadway, because the historic bridge is located within the existing right-of-way.

A draft of the feasibility study was provided to stakeholders, including federally recognized tribal nations, in December 2018. NCTCOG had previously coordinated with FHWA and the Texas Department of Transportation and received permission to contact tribal nations with an interest in North Central Texas. NCTCOG received comments on the draft study from three tribal nations.

The city of Aubrey reached out to NCTCOG in December 2018 after the distribution of the Draft Denton Greenbelt Corridor Feasibility Study. NCTCOG staff met with these stakeholders in January 2019 to discuss their concerns about the four-lane facility proposed for the Greenbelt crossing and safe access to the park for horse trailers. Several stakeholders had engaged a consulting firm to design conceptual maps of wider facilities and a cloverleaf design that would provide safe acceleration and deceleration opportunities for horse trailers. City staff communicated expectations for Aubrey to increase in population to 50,000 residents, far

[4] 2013-2017 American Community Survey 5-Year Estimates

greater than NCTCOG projections. These stakeholders sought for NCTCOG to include their proposed wider facility in the final feasibility study.

Two community stakeholder meetings were held in January 2019 to seek comments on the draft feasibility study. One meeting was held in person at a location in the corridor; another meeting was a webinar with call-in opportunity provided for stakeholders located a distance from the corridor. At these meetings, NCTCOG reviewed the feasibility study process, the use of INVEST to address sustainability issues, and communicated to stakeholders how their feedback would be used. Stakeholders provided comments, including hopes for mitigation in the form of trail improvements.

Finally, one NCTCOG staff member attended the Lake Ray Robert's Equestrian Trail Association annual meeting in February 2019.

Meeting summaries are found in the Denton Greenbelt Corridor Feasibility Study (Chapter 6 and Appendix F).

NCTCOG leveraged Transportation Planning Funds and the agency's Environmental Stewardship Program to help fund stakeholder engagement and outreach.

Stakeholder Comments

Comments received from stakeholders were incorporated into the final Denton Greenbelt Corridor Feasibility Study. All comments are included in Appendix F of the study. As appropriate, comments were included in the Next Steps chapter. Contents of this chapter are recommendations for the Texas Department of Transportation to pursue in future phases of planning, including during environmental studies to fulfill requirements of the National Environmental Policy Act. NCTCOG is seeking to stay involved in future phases of planning. This would allow staff to provide support for contents within the feasibility study and Next Steps chapter.

Feasibility Study

A PEL feasibility study was conducted on the corridor. The feasibility study team included:

- Bicycle and pedestrian planners
- Environmental streamlining/National Environmental Policy Act practitioners
- GIS analysts
- Project engineers

- Traffic modelers
- Transportation planners

The study team participated in the INVEST criteria selection and scoring workshops, and they developed the methods to implement the criteria. The majority of the Corridor Study INVEST criteria developed by NCTCOG staff were addressed in the feasibility study. In a few cases, staff found they could not implement the criteria as they had hoped, and these criteria were excluded. For example, the Dallas-Fort Worth Regional Travel Model for the Extended Area was unable to model changes at the fine scale of Transportation System Management & Operations strategies and it was determined that identifying the profile and terrain of the alignments was more appropriate for future phases of planning.

The feasibility study describes the transportation planning process and where the feasibility falls within this process. The history of the 2011 Regional Outer Loop Corridor Feasibility Study was presented. While this study found a complete regional outer loop to be unwarranted, it did identify a transportation need in some segments studied, including the Denton Greenbelt Corridor. The feasibility study notes that the Denton Greenbelt Corridor[5] is included in Mobility 2045, the current long-range transportation plan for the Dallas-Fort Worth region. The roadway project also is included in the Denton County Thoroughfare Plan adopted in 2017.

The Need and Intent section of the feasibility study identifies future population and employment growth as the source of need for the Denton Greenbelt Corridor. The section identifies several intents for the roadway, including improving mobility options in northern Denton County, managing congestion expected to result from growth, accommodating multiple modes of travel, and integrating with current and proposed land uses.

The Affected Environment chapter integrates:

- Information on the legal and regulatory context for the study
- Existing environmental, social, and historical conditions in the corridor
- Geographic Information Systems modeling of environmental, social, and historical conditions in the two alignments

While much of the content in the Affected Environment chapter is content that would typically appear in a PEL study, some additional content was included as a result of the INVEST criteria. This content includes:

[5] The project is listed as the Denton County Outer Loop in Mobility 2045.

- TxDOT's Potential Archeological Liability Maps data
- Congestion Management Program projects by alignment
- Identification of light-sensitive areas
- Ecological connectivity locations identified using the National Ecological Framework created by the Environmental Protection Agency
- Requests for site-specific ecological assessments during future environmental studies
- Expanded resiliency considerations
- Hazard vulnerability planning considerations
- Use of NCTCOG's Environmental Justice Index

The Transportation System chapter describes the transportation system. Planned improvements are discussed, including the potential for expanding bicycle and pedestrian facilities in the Denton Greenbelt Corridor. The need to evaluate these modes is called for by the INVEST criteria, although addressing this need was already standard in the North Central Texas Council of Governments' feasibility studies. Capacity and level-of-service analyses are included as standard content for feasibility studies.

The Stakeholder Involvement chapter results from fulfilling INVEST criteria calling for engaging the community, using inclusive public involvement techniques, providing education, promoting sustainability, and engaging project "champions." NCTCOG's feasibility study process does not require formal public meetings for these studies, although they may be conducted. In the Denton Greenbelt Corridor, NCTCOG staff's fulfillment of the INVEST criteria led to robust stakeholder engagement. Staff invited the participation of stakeholders associated with hazard vulnerability to fulfill an additional INVEST criterion.

The Corridor Development and Evaluation conducted for the feasibility study fulfilled INVEST criteria addressing multimodal transportation and health, transit facilities, optimizing assets, and linking planning and the National Environmental Policy Act. Much of this content would be standard for a feasibility study, particularly a PEL study.

The Next Steps chapter of the feasibility study addresses INVEST criteria related to context sensitive solutions, integrating stakeholder feedback, and identifying the need for site-specific ecological assessments.

The Denton Greenbelt Corridor Feasibility Study is included as Appendix 6.

Work on the feasibility study was funded in part by Transportation Planning Funds.

Regional Ecosystem Framework Analysis

NCTCOG completed an analysis of the alignments using the agency's Regional Ecosystem Framework. The analysis method was first developed in 2015 using grant funds from FHWA. The Regional Ecosystem Framework is a preliminary screening tool that identifies areas of relative ecological importance in the Dallas-Fort Worth region.

The results of the Regional Ecosystem Framework analysis are described in Appendix 3. The analysis identified little difference between the alignments included in the feasibility study. These results are similar to those found using the INVEST criteria as described in the Next Steps section of this report.

Scoring

NCTCOG staff used the staff-developed interim Corridor Studies module criteria to score the 2011 Regional Outer Loop Corridor Feasibility Study. The Regional Outer Loop would have encircled the Dallas-Fort Worth area, the fourth-largest metropolitan area in the US. The loop would be composed of separate limited-access facilities linked to provide connectivity that bypassed the core of the region.

The 2011 study found traffic projections did not warrant a continuous outer loop. However, several of the separate limited-access facilities were recommended for further study, including facilities in Denton and Collin counties.[6]

Scoring the 2011 study required expertise beyond that of the INVEST criteria selection team. Appropriate criteria were provided to NCTCOG staff with expertise in:

- Air quality
- Asset and congestion management
- Corridor studies
- Environmental coordination
- Environmental justice
- Environmental streamlining
- Freight
- Long-range planning
- Project engineering
- Transit
- Transportation system safety
- Sustainable development

These staff scored the 2011 feasibility study on whether the interim criteria were addressed. Some staff provided additional comments. Scores were provided on a dichotomous scale, with a 0 score indicating the criteria was not addressed and a 1 score indicating the criteria was addressed. Some criteria were preceded by "gateway" questions where a "yes" response led the scorer to answer subsequent related questions or a "no" response that led the scorer to score all the subsequent related questions with a 0.

[6] North Central Texas Council of Governments, *Regional Outer Loop Corridor Feasibility Study*, Executive Summary, https://www.nctcog.org/nctcg/media/Transportation/DocsMaps/Quality/Environ/ROL_Executive-Summary-Nov2011.pdf

While the original INVEST tool weighted some criteria with the possibility of scoring higher than 1, NCTCOG's intent in scoring the 2011 study was to identify criteria that would be included in future studies. The agency did not plan to score the future study and compare this score to that of the 2011 study; therefore, a simple 0 or 1 score was all that was necessary.

Scores of the 2011 Regional Outer Loop Corridor Feasibility Study varied from interim criteria to interim criteria, and even within interim criteria. For example, reviewers who scored CS-01 Planning for Economic Development and Land Use found the criteria were not applicable or the reviewers could not answer the questions the criteria raised. One reviewer noted that a quantitative analysis was not conducted in the 2011 study. Scorers of CS-02 Planning for the Natural Environment generally found that efforts to address the natural environment and engage appropriate stakeholders were evident in the 2011 study. However, reviewers of CS-03 Data Evaluation for the Natural Environment found that some of the data sources addressed in the criteria were not included in the 2011 study or were not available at that time. The reviewer of CS-12 Pedestrian Facilities found that the 2011 study did not address any of the criteria and questioned whether this was appropriate content for a feasibility study. Reviewers of CS-15 Freight and Goods Access & Mobility, however, found that all criteria had been addressed in the 2011 study. The Regional Outer Loop was planned as a truck/freight bypass route around Dallas and Fort Worth for freight not destined for the region. This resulted in the thorough coverage of freight issues in this study. Including the freight criteria in the Draft Feasibility Study Sustainability Menu is worthwhile to ensure freight issues are addressed, even in feasibility studies where freight is not a key factor in the Need and Purpose of the document. Reviewers of CS-20 Infrastructure Resilience noted that none of these criteria had been addressed in the study. Transportation system resiliency was expanded as a metropolitan planning organization responsibility with the Fixing America's Surface Transportation Act in 2015,[7] increasing this criteria's applicability in NCTCOG's feasibility study process.

After staff scored the 2011 feasibility study, the INVEST team reconvened during five workshops to discuss the scores and further delve into the viability of adding the 0-scoring interim criteria to future feasibility studies. The scoring also identified duplication that had not been apparent earlier. Some criteria were found to be unclear and in need of further modification. Others were found to be more applicable to future phases and were removed.

For example, Air Quality staff had provided a criterion to use the Environmental Protection Agency's Motor Vehicle Emission Simulator modeling system to compare criteria. However, INVEST team with experience conducting feasibility studies noted that the time needed to conduct this modeling was not viable when studying multiple alignments.

[7] US Department of Transportation, Federal Highway Administration, *Metropolitan Planning*, https://www.fhwa.dot.gov/fastact/factsheets/metropolitanplanningfs.pdf

In another example, several scorers sought clarification about language that broadly referred to "current requirements." These requirements may have been more applicable to the phase for which the original FHWA INVEST criteria were written.

All scorers were asked to score the interim CS-24 Analysis Methods criteria as they applied to content in the 2011 feasibility study related to the scorers' area of expertise. These criteria generated some confusion because many made reference to actions undertaken by the agency. The 2011 feasibility study did not cite NCTCOG's quality control efforts for using and updating data, methods, or models. However, the agency's Transportation and Research and Information Services departments coordinate to ensure that data is the best available, is updated and reviewed on a regular schedule, and is adequately funded. The INVEST team noted that communicating this information in a feasibility study could support the credibility of the study.

Appendix 2 includes the scores and workshop comments for each of the interim criteria. This appendix serves as the meeting notes from the staff scoring efforts and five INVEST team workshops to score the interim criteria. Because the INVEST team included staff from a variety of areas of expertise, the insight gained during these workshops will be applied in planning efforts beyond feasibility studies.

Following the scoring workshops, the interim criteria underwent some further refinement, and a Draft Feasibility Study Sustainability Menu was developed (Exhibit 1). Not all criteria categories from the scoring process were included in the final menu, and some similar categories were combined. This resulted in "Corridor Study" numbers for criteria in the draft menu that may not correspond with interim "Corridor Study" numbers used during scoring. The criteria from the draft menu were implemented during the feasibility study for the Denton Greenbelt Corridor.

Each criterion on the menu may not be appropriate for all feasibility studies. For example, a criterion addressing wildlife corridors would not be applicable in an entirely urban corridor. The term "menu" was used to invite planners to select those criteria that are most appropriate to each corridor-scale feasibility study.

The menu includes checkboxes identifying whether the criteria are applicable to all studies, or whether they may only be applicable in corridors that travel through natural or scenic areas, environmental justice communities, or are smaller-scale facilities. The menu addresses CS-20 Analysis Methods (formerly interim CS-24) with one summarizing criteria.

Exhibit 1. Draft Feasibility Study Sustainability Menu

Criteria		Corridor Applicability			
		All	Natural or Scenic	EJ Communities	Smaller-Scale Facility
CS-01 Economic Development and Land Use	CS-01.1 In purpose and need, identify how the transportation need can meet economic development and land use planning.	✓			
	CS-01.2 As applicable, engage land use and economic development agencies via stakeholder meetings and agency working groups while developing the study.	✓			
	CS-01.3 Analyze and compare how alignments overlay with land uses, in terms of acreage of each land use. Use standardized width for transportation features.	✓			
	CS-01.4 Consider existing comprehensive plans and thoroughfare plans when analyzing alignments.	✓			
	CS-01.5 Consider expanding or modifying existing facilities instead of creating new facilities, if appropriate.	✓			
CS-02 Natural Environment	CS-02.1 For alignments that may be located in or near environmentally sensitive areas, engage natural resource and regulatory agencies via NCTCOG's Planning and Environment Linkages stakeholder group.		✓		
	CS-02.2 Quantify the overlay of alignments and aquatic resources.	✓			
	CS-02.3 Quantify the overlay of alignments with hubs, corridors, and auxiliary areas in the Environmental Protection Agency's National Ecological Framework.		✓		
	CS-02.4 Identify which alignments may require a site-specific ecological assessment to be conducted during studies under the National Environmental Policy Act.		✓		

Criteria		Corridor Applicability			
		All	Natural or Scenic	EJ Communities	Smaller-Scale Facility
CS-03 Scenic, Natural, or Recreational Qualities	CS-03.1 As applicable, identify whether alignments maintain existing access to scenic, natural, or recreational qualities.	✓			
	CS-03.2 As applicable, identify whether alignments overlay scenic, natural, or recreational qualities.	✓			
CS-04 Historical, Archaeological, and Cultural Preservation	CS-04.1 As applicable, identify whether alignments overlay historic cemeteries, National Register Districts, National Register Properties, modeled or surveyed archeological sites, or parcels with buildings age 50 or older.	✓			
	CS-04.2 If applicable, identify whether alignments overlay a State Scenic Trail or route designated or officially recognized as significantly historical, cultural, or archaeological.	✓			
	CS-04.3 Engage community stakeholders to assist in identifying whether any part of the project or corridor is recognized by the community as having historic, cultural, and/or archeological significance to the community.	✓			
CS-05 Light Pollution	CS-05.1 Identify which alignments overlay areas that may be negatively affected by light pollution, including uplighting, backlighting, and glare.	✓			

Criteria		Corridor Applicability			
		All	Natural or Scenic	EJ Communities	Smaller-Scale Facility
CS-06 Social Considerations	CS-06.1 Engage community stakeholders to identify the community's vision for sustainability in the corridor.	✓			
	CS-06.2 Engage a diverse range of stakeholders and public participants that includes, at a minimum, all interested parties, in addition to all other parties potentially affected by changes to the transportation system.	✓			
	CS-06.3 Where environmental justice, Title VI, and transportation-disadvantaged groups are affected, use a diverse and innovative range of public involvement techniques to ensure the engagement process is inclusive.			✓	
	CS-06.4 During stakeholder and public meetings, provide education about the transportation planning process and how public input can improve the process.	✓			
	CS-06.5 Promote and educate the public about environmental, social, or economic sustainability as appropriate to the corridor by developing a project website, creating a stakeholder guide, or giving presentations.	✓			
	CS-06.6 Use a transparent process to inform stakeholders how their input will be used and follow through accordingly.	✓			
	CS-06.7 Demonstrate to stakeholders how their input was used to inform and affect transportation planning decisions and document the input's impact in the feasibility study.	✓			
CS-07 Context Sensitive Solutions	CS-07.1 As applicable, identify alignments where needs for context sensitive solutions should be addressed during the National Environmental Policy Act process.		✓	✓	✓
	CS-07.2 Include multimodal, multijurisdictional, and multidisciplinary members on the feasibility study team.	✓			
	CS-07.3 Engage external "champions" for the project in the affected community to support the project.		✓	✓	✓
	CS-07.4 Seek acceptance among project stakeholders on the problems, opportunities, and needs that the project should address and the resulting vision or goals for addressing them.	✓			

Criteria		Corridor Applicability			
		All	Natural or Scenic	EJ Communities	Smaller-Scale Facility
CS-08 Access and Affordability	CS-08.1 Where applicable, analyze the equity of physical access for the corridors.			✓	
	CS-08.2 Where applicable, for projects with a tolled component, identify specific populations or areas where affordability may be an issue, including what portion of a low-income household's income may be spent on tolls if the facility is constructed.			✓	
	CS-08.3 Where applicable, document targeted, enhanced outreach, or communication that has been used to engage populations or areas where affordability may be an issue.			✓	
CS-09 Safety	CS-09.1 Address applicable emphasis areas and strategies in the State Strategic Highway Safety Plan listed below. • Increase the installation of engineering countermeasures known to reduce distracted driving • Use technology to reduce distracted driving crashes, serious injuries, and fatalities • Improve mobility options for impaired road users • Consider alternative design strategies for improving intersection safety • Improve pedestrian safety at intersections with high probability of crashes • Increase driver awareness of intersections • Design and operate roadways to meet the needs of older road users • Reduce bicycle/pedestrian crashes on urban arterials and local roadways • Improve bicyclists'/pedestrians' visibility at crossing locations • Improve bicycle/pedestrian networks • Improve bicycle/pedestrian involved crash reporting • Keep vehicles from encroaching on the roadside or opposite lane • Minimize the consequences of vehicles leaving the road • Minimize the likelihood of crashing in adverse conditions • Use the concept of establishing a target speed limit and road characteristics to reduce speeding	✓			

Criteria		Corridor Applicability			
		All	Natural or Scenic	EJ Communities	Smaller-Scale Facility
	CS-09.2 Address safety concerns in the corridor as identified by the long-range plan or 10-year plan.	✓			
	CS-09.3 Identify potential contributing factors to crashes (on existing facilities that are included in the study) and identify the need to build awareness among the public.	✓			
	CS-09.4 Include explicit consideration of safety using quantitative methods for each alternative.	✓			
CS-10 Multimodal Transportation and Health	CS-10.1 Compare the alignments' opportunity to enhance the extent and connectivity of multimodal infrastructure, including bicycle and pedestrian connectivity.				✓
	CS-10.2 Engage public health and active-mode stakeholders.				✓
	CS-10.3 Identify opportunities to integrate transit, pedestrian, bicycle, and roadway modes.		✓		✓
	CS-10.4 Identify how chosen alignment/s promote public health through improving congestion, safety, and opportunities for active transportation.	✓			
	CS-10.5 Where applicable, identify the need for sidewalks to allow pedestrian connections to Veloweb access points.		✓		✓
CS-11 Transit Facilities	CS-11.1 Identify the need, purpose, and appropriateness for transit access within the project footprint.	✓			

Criteria		Corridor Applicability			
		All	Natural or Scenic	EJ Communities	Smaller-Scale Facility
CS-12 Freight and Goods Access and Mobility	CS-12.1 In corridors where freight is applicable, identify opportunities for maintaining and improving freight reliability and connectivity between modes and to freight generators for both inter- and intra-city freight.	✓			
	CS-12.2 If the alignments are near freight facilities, consider multimodal freight mobility needs, such as intermodal facilities and the siting of freight facilities.	✓			
	CS-12.3 If applicable, utilize the Regional Freight Advisory Committee to engage stakeholders, including freight service providers, workers, representatives, and neighbors that surround freight facilities.	✓			
	CS-12.4 Assess freight accessibility and mobility, such as freight movements, turning radius, adequate capacity or restricted capacity, and land use ordinances that minimize freight effects on the surrounding areas.	✓			
	CS-12.5 If applicable, assess freight reliability by identifying opportunities for infrastructure that supports supply chain movements, including truck parking with amenities for drivers and the corridor's capacity for safe and efficient movement of freight.	✓			
CS-13 Travel Demand Management	CS-13.1 Identify strategies to reduce trips during peak periods and demonstrate that strategies cannot reduce demand enough to eliminate the need for the alignment.	✓			
	CS-13.2 Analyze effectiveness of strategies to improve parallel facilities in lieu of building the new facility.	✓			

Criteria		Corridor Applicability			
		All	Natural or Scenic	EJ Communities	Smaller-Scale Facility
CS-14 Air Quality and Emissions	CS-14.1 Identify alignments where temporary construction impacts and long-term impacts may affect air quality.	✓			
	CS-14.2 Engage air quality stakeholders, including the Texas Commission on Environmental Quality and the Environmental Protection Agency.	✓			
	CS-14.3 Identify alignments' ability to reduce congestion, including on parallel and connecting facilities.	✓			
	CS-14.4 If the facility is on or connects within 5 miles of an Energy Corridor, identify locations and/or density of electric vehicle charging stations and identify the need for charging stations on alignments.	✓			
CS-15 Optimizing Assets	CS-15.1 Identify opportunities to maximize existing transportation system capacity (including bridges) before considering major capital infrastructure investment, in keeping with policy in the long-range transportation plan. These opportunities include minor-, medium-, and major-scale improvements.	✓			
	CS-15.2 Where partner agencies maintain asset management data and economic analysis, incorporate this information into the feasibility study process.	✓			
	CS-15.3 Conduct a high-level analysis of how alignments may utilize current stormwater assets.	✓			
	CS-15.4 Compare alignments' travel time savings.	✓			
CS-16 Operational Efficiency	CS-16.1 Identify strategies to increase efficiency via other modes or alternatives to single occupant vehicles.	✓			
	CS-16.2 Conduct post-process calculations for the No-Build scenario and alignments to identify benefits of Transportation System Management & Operations strategies identified in the long-range transportation plan.	✓			
	CS-16.3 Compare alignments' access to fiber networks or other sufficient infrastructure for connected automated vehicles.	✓			

Criteria		Corridor Applicability			
		All	Natural or Scenic	EJ Communities	Smaller-Scale Facility
CS-17 Infrastructure Resiliency	CS-17.1 Compare alignments' susceptibility or impact to environmental factors related to extreme weather, including reduction in local tree canopy, shrink-swell potential for soils, low-water crossings, flooding potential greater than that documented by the Federal Emergency Management Agency to account for increasing impervious surfaces, and vulnerability to large water releases from dams.	✓			
	CS-17.2 Determine how alignments are compatible with the hazard mitigation plans of state and local agencies and jurisdictions.	✓			
	CS-17.3 Engage stakeholders associated with hazard mitigation, including the US Army Corps of Engineers, Texas Water Development Board, Texas Commission on Environmental Quality, Environmental Protection Agency, counties, and local officials.	✓			
CS-18 Earthwork Balance	CS-18.1 Identify the profile (preliminary engineering schematic) and terrain of alignments to incorporate grade into feasibility considerations.	✓			
CS-19 Linking Planning and NEPA	CS-19.1 Implement Planning and Environment Linkages best practices, including: • National Environmental Policy Act tiering • Purpose and need statements • Scoping and alternatives identification • Analysis or baselining of environmental condition • Evaluation and/or elimination of alternatives • Multimodal analysis • Context sensitive design considerations • Indirect and cumulative impacts assessment • Preparatory analyses for permitting	✓			

Criteria		Corridor Applicability			
		All	Natural or Scenic	EJ Communities	Smaller-Scale Facility
	CS-19.2 Structure the document in a format compatible with the National Environmental Policy Act.	✓			
	CS-19.3 Summarize National Environmental Policy Act-related content in the introduction and/or recommendations.	✓			
	CS-19.4 Consult National Environmental Policy Act practitioners during the study.	✓			
CS-20 Analysis Methods	CS-20 Describe the agency's policies related the following as they apply to data used in the study: • Quality control • Frequency of updates • Adequate funding	✓			

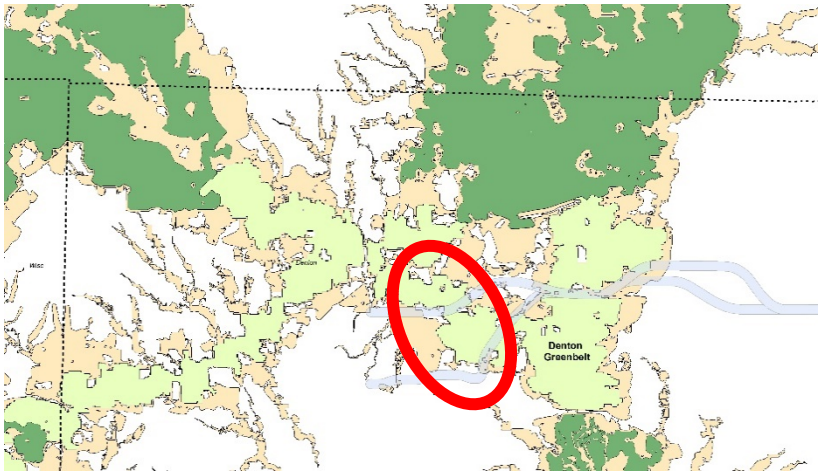
Analysis

The most robust sustainability improvement resulting from the criteria was engagement of stakeholders. Stakeholders from nonprofit groups and resource and regulatory agencies provided a wealth of knowledge about the corridor. The stakeholders were able to identify historic, environmental, and recreational concerns. NCTCOG staff learned early in the planning process that the current roadway is flanked by USACE-held conservation easements that will limit the roadway's expansion. This knowledge will streamline the project development process. Without this knowledge, alignments with a wider right-of-way may have been carried into the National Environmental Policy Act process. The stakeholders also provided a request for potential mitigation activities that can be further evaluated.

Stakeholders and INVEST criteria also highlighted the need for context sensitive solutions. This will allow project development to consider the need of horse trailers to enter and exit the roadway from the park. This also will promote consideration of bike lanes or other means to connect the city of Aubrey with the bike trails in the park.

Analysis using the Environmental Protection Agency's National Ecological Framework demonstrated something NCTCOG already knew – that the Denton Greenbelt is an important connection for wildlife between two reservoirs. But it also showed the western portions of the alignments cross a wildlife corridor that ultimately links the Denton Greenbelt through northwestern Denton County to the Lyndon B. Johnson National Grassland. The grassland, managed by the US Forest Service, is located in northern Wise County. The connection is seen in light green in Exhibit 2.

Exhibit 2. National Ecological Framework



Implementation of the criteria varied. The INVEST team found some criteria would be best addressed by narrative in the feasibility study. Others required spatial data that could be analyzed using Geographic Information Systems to compare the roadway alternatives being studied. The results for each criterion are included in this section of the report. Results also were incorporated into appropriate sections of the feasibility study.

The need to address new technology during planning also was identified by the criteria. The corridor lacks fiber networks and electrical vehicle charging stations because of the corridor's rural location. The area is rapidly growing and addressing these needs during project development could improve operational efficiency and promote operational efficiency and sustainable vehicle technology.

The methodology and results of each criterion as applied to the feasibility study are described here:

CS-01 ECONOMIC DEVELOPMENT AND LAND USE

CS-01.1 The feasibility study Need and Intent section identifies how the transportation need can meet economic development and land use planning by citing forecasts for employment growth and referencing city future land use plans that call for growth in the Denton Greenbelt Corridor. These plans assume the construction of the corridor.

CS-01.2 The following agencies and individuals relevant to land use and economic development in the corridor were engaged during stakeholder meetings: city of Aubrey, city of Denton, Denton County, town of Prosper, Texas Parks & Wildlife Department, US Army Corps of Engineers, and private land owners and developers.

CS-01.3 The feasibility study process already addressed the overlay of alignments with different land uses. The results are found in Exhibit 3.

Exhibit 3. Land Use Comparison

Land Use Type	Alignment			
	1		2	
	Acres	Percent	Acres	Percent
Commercial	70.6	1.2%	21.7	0.4%
Dedicated	32.0	0.6%	34.3	0.6%
Industrial	0	0.0%	4.4	0.1%
Infrastructure	8.2	0.1%	6.7	0.1%
Institutional	177.3	3.1%	18.7	0.3%
Residential	396.9	6.9%	425.7	7.7%
Farmland/Ranchland	2971.1	51.9%	3608.3	65.6%
Acreage (improved/residential)	1240.4	21.7%	1029.7	18.7%
Timberland	252.9	4.4%	89.7	1.6%
Vacant	129.4	2.3%	49.9	0.9%
Water	66.6	1.2%	34.4	0.6%
Total	**5724.9**	**100.0%**	**5503.4**	**100.0%**

CS-01.4 Consideration of existing comprehensive plans and thoroughfare plans was already part of the feasibility study process. The precursor to the Denton County Outer Loop/Greenbelt Parkway, the Regional Outer Loop, is included as a Planned Transportation Improvement in the Denton County Thoroughfare Plan from 2017. The corridor is also included in the Collin County Thoroughfare plan as a part of the Collin County Outer Loop Project in 2016 and 2018.

Exhibit 4. Inclusion in Municipality Planning Documents

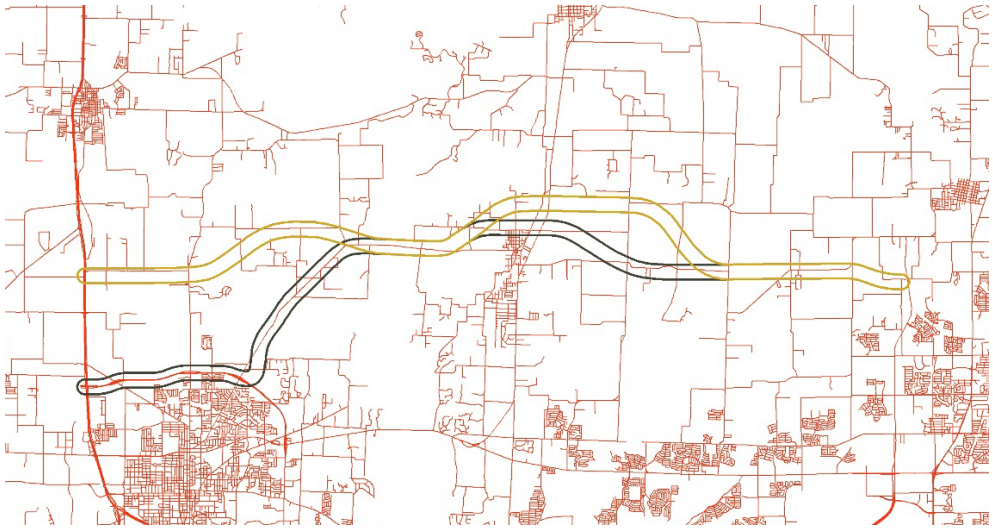
Municipality	Date of Latest Plan	Inclusion in Comprehensive Plan, Land Use, and Zoning Plans
Aubrey	2015	Yes
Celina	2018	Yes
Denton	2016	No

Source: City of Aubrey, 2015, City of Celina 2015, 2018, and City of Denton, 2015, 2016.

As seen in Exhibit 4, the Denton Greenbelt Corridor was included in the city of Aubrey's land use and thoroughfare plans. It was also included in the city of Celina's comprehensive and thoroughfare plan. The city of Denton did not include the corridor in its 2015 Mobility Plan or in Denton Plan 2030, the city's long-range comprehensive plan. However, the comprehensive plan did recognize the value of the Denton Greenbelt recreation area to the city and the need to maintain its conservation and access by citizens.

CS-01.5 Some segments of the alignments were already an expansion of existing facilities, fulfilling this criterion, as seen in Exhibit 5.

Exhibit 5. Existing Facilities



CS-02 NATURAL ENVIRONMENT

CS-02.1 NCTCOG initiated efforts to engage natural resource and regulatory agencies through stakeholder meetings and an additional meeting with TPWD and USACE. Details on these meetings are included in the Denton Greenbelt Corridor Feasibility Study (Chapter 6 and Appendix F). The INVEST project also was discussed during the environmental coordination meeting for Mobility 2045, NCTCOG's current long-range transportation plan.

CS-02.2 Quantifying the overlay of alignments and aquatic resources was already included in the typical feasibility study process. The results are found in Exhibits 6 through 9.

Exhibit 6. Aquifers within the Proposed Alignment Areas

Alignment	Trinity Aquifer		Woodbine Aquifer	
	Area within Alignment (square miles)	Percent of Alignment	Area within Alignment (square miles)	Percent of Alignment
1	8.6	100.0%	4.9	54.2%
2	8.6	100.0%	5.1	59.1%

Exhibit 7. FEMA 100-Year Floodplains within the Alignment Areas

Alignment	Acres within 100-Year Floodplain	Percent of Alignment within 100-Year Floodplain
1	199.8	3.5%
2	274.8	5.0%

Exhibit 8. Named Streams within the Alignment Areas

Stream	Named Stream Length within Proposed Alignments (miles)	
	Alignment 1	Alignment 2
Aubrey Branch	1.7	1.6
Cooper Creek	0.2	0
Culp Branch	0.5	0.6
Little Elm Creek	0.6	0.6
Milam Creek	0	0.4
Mustang Creek	0.9	1.3
Pecan Creek	0.7	0.7

Exhibit 9. Wetlands within the Alignment Areas

Alignment	Total Wetlands (acres)
1	75.5
2	63.4

CS-02.3 The overlay of alignments with ecologically important areas and their connections as identified in the Environmental Protection Agency's National Ecological Framework was calculated for the feasibility study. The framework identifies priority ecological areas (hubs), the computer-based least-cost paths (corridors) that link the hubs, and additional terrestrial and hydrological connections (auxiliary connections). The framework can be used in planning to prevent fragmentation and maintain ecologically viable systems. Prioritizing these areas for conservation may help to increase ecological connectivity and decrease ecological disturbance. The results are found in Exhibit 10.

Exhibit 10. Alignment Areas Overlaid with National Ecological Framework

Alignment	Hubs		Corridors		Auxiliary Connections	
	Number	Acres	Number	Acres	Number	Acres
1	0	0	2	874.3	13	1110.4
2	0	0	2	871.3	19	1266.4

CS-02.4 Both alignments may require a site-specific ecological assessment during the National Environmental Policy Act process. This assessment may be required because the alignments cross a state park and conserved area that serve as a wildlife corridor between two reservoirs.

CS-03 SCENIC, NATURAL, OR RECREATIONAL QUALITIES

CS-03.1 Both alignments overlay a state park and border conservation easements as they cross the Denton Greenbelt. One alignment overlays an amusement park and stadium/arena. These results are shown in Exhibit 11. Therefore, they both overlay scenic, natural, or recreational qualities.

Exhibit 11. Parklands and Recreation Area by Alignment

Type	Count of Recreation of Parkland	
	Alignment 1	Alignment 2
State Park	1	1
Amusement Park	1	0
Stadium/Arena	1	0
Conservation Easement	1	1

CS-03.2 Both alignments follow an existing crossing of a state park; the current crossing includes access to parking and trailheads. Any redesign of this access will take place during future phases of project development. The feasibility study calls for access to community resources, including parks or recreational areas, to be maintained. Specifically, the study calls for construction of acceleration and deceleration lanes that allow for vehicular safety for trucks towing horse trailers. This content is found in the Next Steps chapter.

CS-04 HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL PRESERVATION

CS-04.1 Identifying historic cemeteries, National Register Districts, or National Register Properties within the corridor was already part of the feasibility study process. This criterion added a requirement to address archeological sites and parcels with buildings age 50 or older. One historic cemetery is located in Alignment 2. No nationally registered districts or properties exist in the alignments. The Potential Archeological Liability Maps from the Dallas District of the Texas Department of Transportation estimates the potential for archeological sites at shallow (less than one meter) and deep (more than one meter) depths. These

results are found in Exhibit 12. The number of structures constructed 50 or more years before the corridor's expected construction year are shown in Exhibit 13; no structures predate 1900.

Exhibit 12. Potential Archeological Liability Maps Overlay

Alignment	Potential	Shallow (Acres)	Deep (Acres)
1	Low	3174.9	3944.1
	Moderate	1563.2	960.2
	High	932.5	766.3
2	Low	2676.8	3543.3
	Moderate	1808.4	1124.3
	High	976.89	794.5

Exhibit 13. Number of Potentially Historic Structures

Years	Number of Structures by Alignment	
	1	2
1900 to 1910	0	1
1911 to 1920	0	1
1921 to 1930	0	1
1931 to 1940	0	1
1941 to 1950	7	3
1951 to 1960	7	10
1961 to 1970	159	14
1971 to 1980	43	22
1981 to 1987	58	30

Source: 2017 Parcel Data for Denton County

CS-04.2 Both alignments overlay the Texas Lakes Trail, a State Scenic Trail that travels along the planned corridor as it crosses the Denton Greenbelt. This trail is identified by the website America's Scenic Byways, https://scenicbyways.info/byway/11273.html.

CS-04.3 Stakeholders identified a bridge that is a Recorded Texas Historic Landmark and is located parallel to the alignments. This discussion is included in the Denton Greenbelt Corridor Feasibility Study (Chapter 6 and Appendix F). A wooden bridge rumored to have been traveled by Bonnie and Clyde also was identified deeper into the park.

CS-05 LIGHT POLLUTION

CS-05.1 Both alignments overlay Ray Roberts Lake State Park, which could be negatively affected by light pollution.

CS-06 SOCIAL CONSIDERATIONS

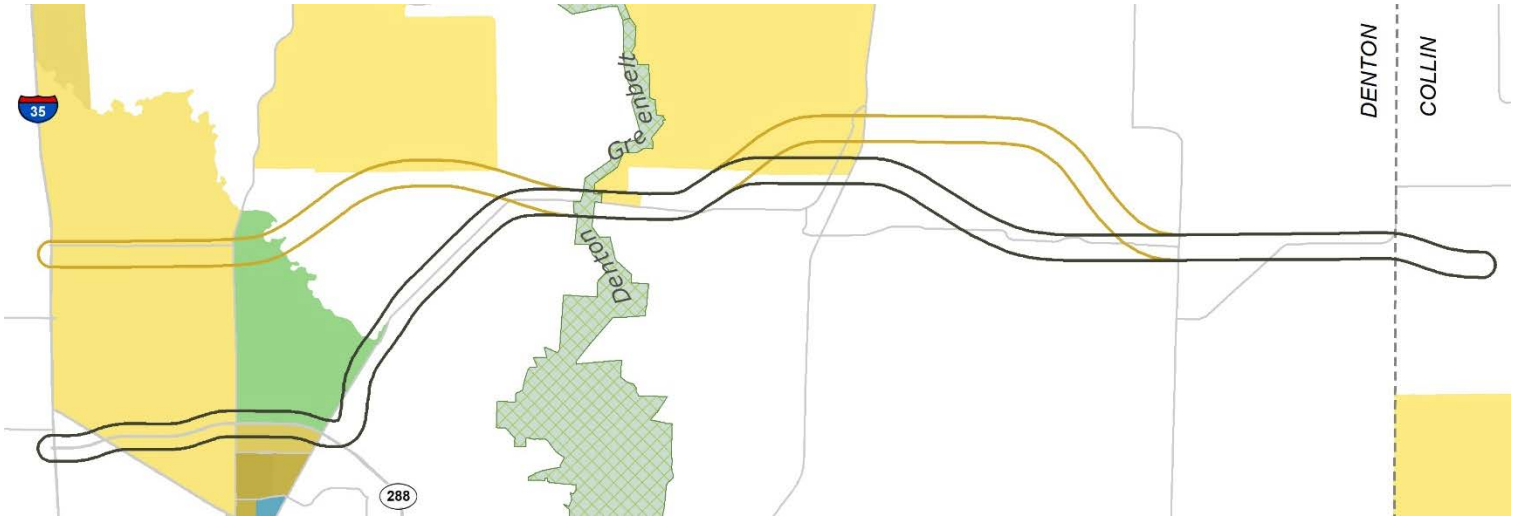
CS-06.1 Community stakeholders participated in stakeholder meetings organized by NCTCOG and provided a list of mitigation priorities for the corridor. More information is available in the Denton Greenbelt Corridor Feasibility Study (Chapter 6 and Appendix F). It's important to note that not every stakeholder had the same vision for the corridor. While protection of the park was a priority, some stakeholders were more supportive than others of development outside the park boundaries.

CS-06.2 A diverse range of stakeholders and public participants were engaged, including local residents, conservationists, developers, equestrian trail users, water quality specialists, representatives of a bicycle-pedestrian group, representatives of cities and counties, and staff from resource and regulatory agencies. More information is available in the Denton Greenbelt Corridor Feasibility Study (Chapter 6 and Appendix F).

CS-06.3 The alignments are outlined in gold and black in Exhibit 14. The eastern half of the northern and southern alignments overlaid Census block groups below the region's percentage for low-income populations and for minority populations, based on NCTCOG's Environmental Justice Index as seen in Exhibit 14. Portions of the western half of both alignments (shaded in blue) overlaid block groups above the region's percentage for low-income populations (shaded in yellow – darker shades indicate higher population density) and for block groups above the region's percentage for both low-income and minority populations (shaded in green). A review of aerial imagery identified few properties in the northern alignment as it traveled through these block groups. Several of the properties had swimming pools, making it unlikely these were low-income households. The western portion of the southern alignment travels along the existing Loop 288. While the stakeholder engagement efforts were not formal public involvement, techniques such as visualizations (presentations and large map

displays) were employed and meetings were held within the corridor. NCTCOG sought to reach a broader range of stakeholders by attending the Aubrey Peanut Festival. Information about the INVEST project was posted on NCTCOG's website.

Exhibit 14. NCTCOG Environmental Justice Index by Alignment Areas



CS-06.4 Presentations during stakeholder meetings provided education about the transportation planning process and how public input can improve the process. More information is included in the Denton Greenbelt Corridor Feasibility Study (Chapter 6 and Appendix F).

CS-06.5 The North Central Texas Council of Governments promoted sustainability within the corridor through a project website, publications for stakeholders, and presentations that discussed the INVEST project. Stakeholders were already involved in conservation of the Greenbelt and were able to present their own priorities for sustainability. More information is included in the Denton Greenbelt Corridor Feasibility Study (Chapter 6 and Appendix F).

CS-06.6 Stakeholders were provided a draft of the feasibility study more than 30 days before the final stakeholder meeting, which was held January 22, 2019. A webinar with call-in opportunity was provided on January 23, 2019 for those who wanted

to provide comment but could not attend a meeting in person. Stakeholders were informed that the final meeting would be an opportunity to provide comments on the study. During the final stakeholder meeting, the study team discussed how the comments would be addressed in the final feasibility study. More information is included in the Denton Greenbelt Corridor Feasibility Study (Chapter 6 and Appendix F).

CS-06.7 During the final stakeholder meeting, stakeholders were shown how the Next Steps section of the study incorporated some of the mitigation priorities they had provided to the study team. They also were told how the right-of-way was reduced where the roadway traveled between conservation easements. Stakeholders were informed of NCTCOG's desire to stay involved in the corridor throughout project development. This involvement could help keep mitigation concerns in the forefront as project planning transitioned to the Texas Department of Transportation. More information is included in the Denton Greenbelt Corridor Feasibility Study (Chapter 6 and Appendix F).

CS-07 CONTEXT SENSITIVE SOLUTIONS

CS-07.1 The study team identified a need for context sensitive solutions throughout the entire project, with an emphasis on the crossing of the Denton Greenbelt. This crossing provides access to the Ray Roberts Lake State Park. This portion of the roadway called for an approach that highlighted the importance of the Greenbelt in the region; preserved the historic, ecological, and recreational value of the park; and maintained the ability for horse trailers to safely enter and leave the park. The study recommendations note the need to exclude continuous frontage roads at the Denton Greenbelt crossing to respect the current conservation easements and historic Elm Fork Bridge. The study team involved a range of stakeholders, an interdisciplinary study team, and researched solutions from other roadway projects constructed in conserved areas. Stakeholders included those seeking bicycle or pedestrian access to Ray Roberts Lake State Park.

CS-07.2 Roadway, bicycle-pedestrian, engineering, and environmental staff comprised the study team. Transportation partners from multiple jurisdictions and modes were engaged. More information is included in the Denton Greenbelt Corridor Feasibility Study (Chapter 6 and Appendix F).

CS-07.3 The project was initiated at the request of external "champions" who approached NCTCOG, recognizing a need for increased mobility while maintaining the historic, ecological, and recreational value of the park.

CS-07.4 Stakeholder meetings included dialogue with community members, park users, city and county staff, and resource and regulatory agencies to identify the problems, opportunities, and needs that the project should address. Stakeholders provided the study team with a list of mitigation priorities; the highest priorities are included in the study's Next Steps section. More information is included in the Denton Greenbelt Corridor Feasibility Study (Chapter 6 and Appendix F).

CS-08 ACCESS AND AFFORDABILITY

CS-08.1 This criterion calls for analysis of the equity of physical access for the corridors. The alignments will include frontage roads except where the corridor crosses the Denton Greenbelt and the US 377/Texas & Pacific Railroad crossing. The frontage roads provide equitable physical access to all users of the roadway. The study also notes the Denton Greenbelt Corridor is an appropriate corridor to implement a Regional Veloweb trail. The Regional Veloweb is a network of off-street shared-use paths that would provide access to bicyclists and pedestrians.

CS-08.2 This criterion is not applicable because the Denton County Outer Loop/Greenbelt Parkway does not have a tolled component.

CS-08.3 This criterion is not applicable because affordability is not a concern.

CS-09 SAFETY

CS-09.1 This criterion, which calls for addressing specific safety strategies, may be more applicable to the design phase of a roadway project.

CS-09.2 The Denton Greenbelt Corridor is included in both the region's 10-Year Plan of Projects and Mobility 2045. Selection criteria for projects in the 10-year plan include Moving Ahead for Progress in the 21st Century Act goals, Texas Bill 20 Criteria, and Mobility 2040 Performance Measure Criteria, all of which include safety or crash rate.

Mobility 2045[8] includes several safety-related analyses. Through the Regional Safety Information System, NCTCOG completes an analysis on crash rate by county and for the region. The results show Denton County, where a majority of the alignment

[8] NCTCOG, 2018. Mobility 2045. www.nctcog.org/mobility2045

areas are located, had a crash rate of 71.54 crashes per 100 million vehicle miles traveled. Collin County had a crash rate of 50.23. As the regional crash rate was 71, Denton County was higher than average, while Collin County was below average.

Mobility 2045 also analyzes the density of bicycle and pedestrian crashes in the region from 2012 to 2016. Approximately 3.30 miles of Alignment 1 from east of Bonnie Brae Street along Loop 288 to north of Hartlee Field Road along FM 428 are in a low crash density zone. The other portions of either alignment within an urbanized area did not have a measurable crash density. It is important to note that this analysis was only completed for the urbanized area, which a majority of both alignments fall outside of. As a result, the density of crashes in the rural portions of the alignments are not accounted for in these analyses. Bicycle and pedestrian crashes are also more likely to occur in areas with business or employment centers and along major arterial roadways. With the increase in development expected in the region, including in Denton and Collin counties, there is potential for the bicycle and pedestrian crash density to increase.

CS-09.3 Using 2010-2018 Texas Department of Transportation Crash Records Information System data,[9] the number of and primary contributing factor for crashes from 2010 to 2018 in the alignment areas were identified. Alignment 1, of which the western portion travels through a more urban area, has almost 1,000 more crashes compared with Alignment 2. The most common reason for crashes was improper driving, accounting for 38 percent of the reason in Alignment 1 and 35 percent of the reason in Alignment 2. Improper driving includes factors such as disregard for signs and following too closely, as well as improper turns, parking, passing, and speed.

Because crash rates in the alignment areas are relatively low as described in CS-09.2. and general safety campaigns already exist such as NCTCOG's Look Out Texans, no need for a safety public awareness campaign was identified for the corridor.

CS-09.4 Quantitative methods identified the number of and primary contributing factors for crashes in the alignment areas. These results are seen in Exhibit 15.

9 TxDOT, 2010-2018. Crash Records Information System. Collin and Denton Counties. https://cris.dot.state.tx.us/public/Query/app/public/welcome

Exhibit 15. Contributing Factors to Crashes

Primary Contributing Factor	Alignment 1	Alignment 2
Animal on Road	12	9
Distracted Driving[1]	68	25
Improper Driving [2]	484	105
Other	23	7
Under the Influence	24	7
Vehicle Issues	7	1
Not Available	653	149
Total	**1271**	**303**

Texas Department of Transportation Crash Records Information System 2010-2018

[1] Includes cellphone use, inattention, fatigue

[2] Includes improper passing/parking/turning, failure to yield, disregard of signs/signals, etc.

CS-10 MULTIMODAL TRANSPORTATION AND HEALTH

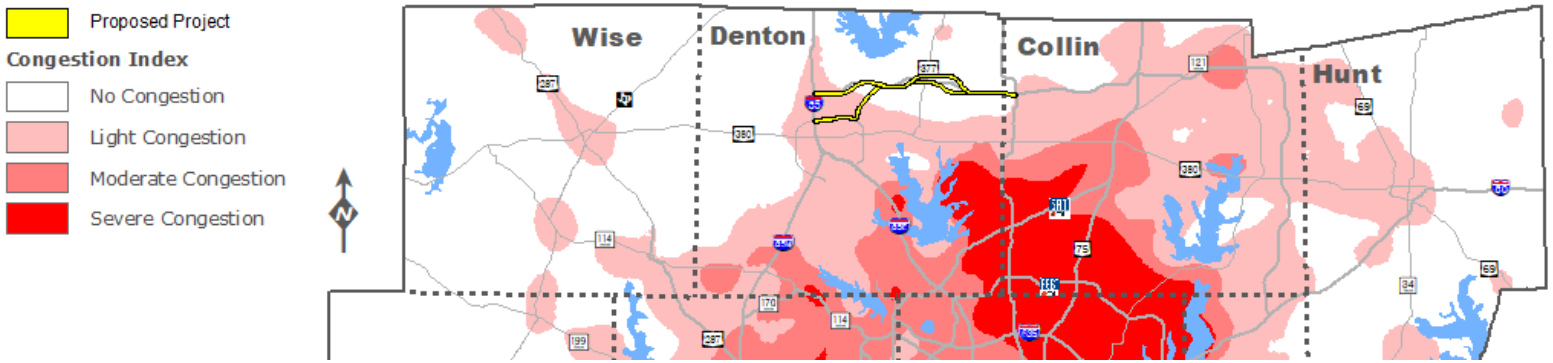
CS-10.1 The study notes the appropriateness of including a Regional Veloweb trail in the Denton Greenbelt Corridor. The Regional Veloweb serves as the regional expressway network for active transportation, and it extends the reach of the region's roadway and passenger rail transit network for non-motorized transportation.

CS-10.2 Active-mode stakeholders, including representatives from the city of Aubrey, a social cycling group, and NCTCOG's bicycle-pedestrian team, participated in stakeholder meetings. More information is included in the Denton Greenbelt Corridor Feasibility Study (Chapter 6 and Appendix F).

CS-10.3 Identifying opportunities to integrate transit, pedestrian, bicycle, and roadway modes is part of the typical feasibility study process. During stakeholder meetings, challenges and opportunities related to integrating these four modes were discussed. Challenges include the limited right-of-way as the roadway crosses the Denton Greenbelt; Regional Veloweb trails should include grade separation whenever crossing major roadways and intersections to avoid safety conflicts with motor vehicles. The design phase of the project will further address integration of these modes.

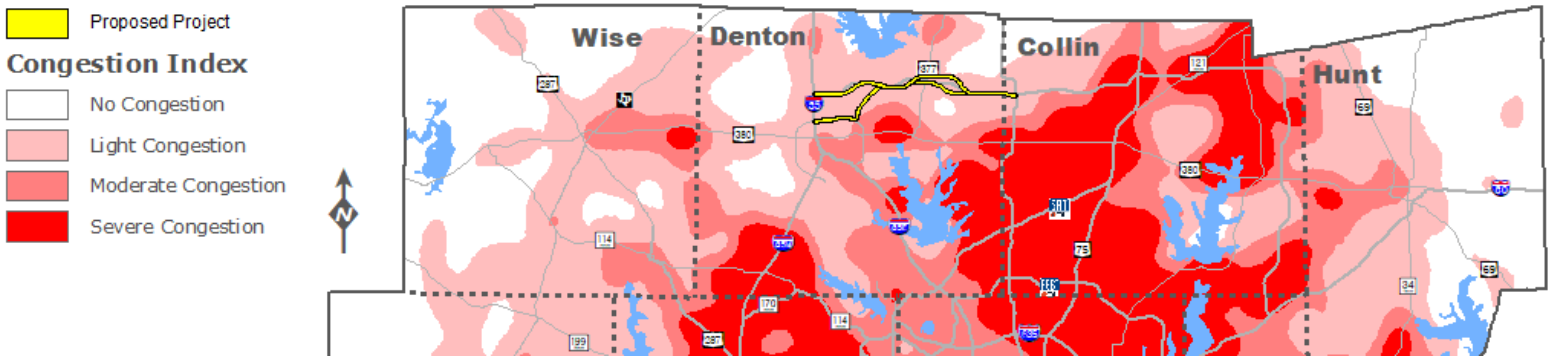
CS-10.4 Improving congestion, safety, and opportunities for active transportation can all promote public health. The study found that in a No-Build scenario, the study area[10] would experience 11,670 vehicle hours of congestion delay per day. Exhibits 16 and 17 illustrate peak-period levels of congestion in the Build and No-Build scenarios, respectively. The Build scenario includes all projects recommended in Mobility 2045, so congestion relief cannot be attributed to only the Denton Greenbelt Corridor project.

Exhibit 16. 2045 Congestion Build Scenario



[10] The study area is composed of traffic survey zones used in the Dallas-Fort Worth Regional Travel Model for the Extended Area. Traffic survey zones in rural areas can be geographically large. This resulted in the inclusion of some roadways in the study area that are a distance from the proposed alignment areas.

Exhibit 17. 2045 Congestion No-Build Scenario



The study calls for addressing the vehicular safety of trucks towing horse trailers, because the Denton Greenbelt Corridor provides access to widely used equestrian trails. Because crash rates in the alignment areas are relatively low as described in CS-09.2 and general safety campaigns already exist, such as NCTCOG's Look Out Texans, no need for a safety public awareness campaign was identified for the corridor. Opportunities for active transportation were included in the study, as discussed in CS-10.1

CS-10.5 While the study did address an opportunity for a shared-use path (CS-10.1), it did not address the need for sidewalks.

CS-11 TRANSIT FACILITIES

CS-11.1 The inclusion of transit facilities was discussed during the transportation stakeholders' meeting. A representative from the Denton County Transit Authority expressed interest in an east-west route for a designated bus lane that could later be converted to a rail facility. Opportunities and challenges along the Denton Greenbelt Corridor and a parallel facility were discussed. More information is included in the Denton Greenbelt Corridor Feasibility Study (Chapter 6 and Appendix F).

CS-12 FREIGHT AND GOODS ACCESS AND MOBILITY

CS-12.1 The corridor includes a freight truck stop at IH 35, and it crosses the Texas & Pacific Railroad at US 377. These two facilities, however, are not locations of connectivity between modes. Therefore, this criterion was not addressed in the study.

CS-12.2 The need for intermodal freight facilities was not addressed in the study.

CS-12.3 A member of NCTCOG's freight team attended the transportation stakeholders' meeting and noted the corridor would be used for freight and should be designed to accommodate this use. The need for future discussion about hazardous materials was noted. More information is included in the Denton Greenbelt Corridor Feasibility Study (Chapter 6 and Appendix F). Additional freight stakeholders were not utilized during the study.

CS-12.4 Freight accessibility and mobility were not addressed in the study. However, the study noted the high use of equestrian recreation on the Greenbelt Trail may necessitate a classification of the park traffic as freight, which would result in the construction of acceleration and deceleration lanes for entrance to the Greenbelt Trail Park.

CS-12.5 Support for supply chain movement was not addressed during the study.

CS-13 TRAVEL DEMAND MANAGEMENT

CS-13.1 The Denton Greenbelt Corridor is included in Mobility 2045, the current metropolitan transportation plan for North Central Texas. As described in the Introduction of the feasibility study, transportation projects included in Mobility 2045 follow a prioritization process that includes efforts to improve efficiency and remove trips from the system prior to investing in infrastructure. The only major east-west infrastructure in Denton County is US 380, which is experiencing increased travel times and congestion. US 380 is five miles south of the Denton Greenbelt Corridor and a parallel facility. The Denton Greenbelt Corridor would provide a crucial east-west facility linking five major facilities, as demonstrated in the Need and Intent of the feasibility study.

CS-13.2 Plans already exist to improve US 380, a parallel facility to the Denton Greenbelt Corridor. Despite these plans, an expansion in the Denton Greenbelt Corridor is needed to relieve forecasted congestion on US 380. The corridor will provide the only major east-west facility for inter-suburban travel in northern Denton County. Expansion of a parallel facility north of the corridor is unlikely, given the location of population growth and limitations created by that facility's proximity to a dam.

CS-14 AIR QUALITY AND EMISSIONS

CS-14.1 NCTCOG spatial data did not identify any potential sensitive receptors within 600 feet of the alignments, a distance identified by the Environmental Protection Agency as relevant for air quality analyses. Therefore, no sensitive receptors would be affected by temporary construction impacts and long-term construction impacts in the future within either alignment.

CS-14.2 NCTCOG did not engage air quality stakeholders. The alignments' similarity created little opportunity to discuss the difference in their air quality impacts.

CS-14.3 The alignments' ability to reduce congestion is illustrated in Figures 2-1 through 2-3 of the feasibility study. Ability to reduce congestion is not expected to vary between the studied alignments given their similarity.

CS-14.4 The Denton Greenbelt Corridor connects to IH 35, an Energy Corridor. Because the study corridor is in a largely rural area, no vehicle charging stations are located within the alignments. However, with growth expected in the cities of Aubrey, Denton, and Celina, potential need exists for infrastructure to support electric vehicle technology.

CS-15 OPTIMIZING ASSETS

CS-15.1 Opportunities to maximize existing transportation system capacity were discussed in the study. The Need and Intent section notes that no major east-west facility exists in northern Denton County. An expansion of US 380 to the south is already being studied. Therefore, no other opportunities exist that could eliminate the need for major capital infrastructure investment; however, much of the length of the studied alignments are an expansion of existing roadways.

CS-15.2 The Texas Department of Transportation maintains asset management data for interstates and on-system roadways. Because asset management data is not maintained for off-system roadways, this information served little use in comparing alignments in the corridor. Data was only available for segments of Alignment 1 that run along TX 288 and one segment of FM 428 northeast of the interchange with TX 288. Using 2017 Pavement Management Information System data for TX 288, the majority of segments rated "fair" for International Roughness Index, "good" for cracking, and "good" for faulting. Using 2016 Pavement Management Information System data for FM 428, the segment was rated "fair" for cracking and "good" for rutting.

No economic analysis associated with the corridor's asset management was available. But TRIP, a non-profit national transportation research group, estimates drivers in the Dallas-Fort Worth-Arlington area incur $508 yearly in vehicle operating costs as a result of poor pavement conditions.[11]

CS-15.3 Information on stormwater assets in the corridor was available through a city of Denton ArcGIS website and spatial data provided by Denton County.

City of Denton: In the western portion of Alignment 1, an inlet and an outfall are located on Loop 288 near the intersection with Sherman Road. Traveling northeast along Sherman Road, several inlets exist at an athletic complex. Farther northeast along Sherman Road, several drainage streams occur. In the western portion of alignment 2, two outfalls exist south of the intersection of IH 35 and Milam Road. Traveling east on Milam Road, several drain streams are located near the corridor. Where both alignments intersect the Denton Greenbelt, a drainage stream exists.

Denton County: In the western portion of Alignment 2, a culvert exists along Milam Road just east of IH 35. In both alignment areas, a culvert exists north of FM 428 and west of Aubrey before the alignments diverge.

CS-15.4 The Dallas-Fort Worth Regional Travel Model for the Extended Area (DFX) is unable to compare travel time savings on a corridor scale. However, no real differences are expected given the two alignments' similarity.

CS-16 OPERATIONAL EFFICIENCY

CS-16.1 Strategies to increase efficiency via other modes or alternatives to single-occupant vehicles are more appropriately analyzed during the National Environmental Policy Act process and the Congestion Management process. However, the Denton County Transportation Authority participated in the transportation stakeholders meeting and expressed an interest in developing an east-west transit corridor in the county. Additionally, the corridor was identified as an appropriate location of a shared-use path that would be included in the Regional Veloweb. More information is included in the Denton Greenbelt Corridor Feasibility Study (Chapter 6 and Appendix F).

[11] TRIP, 2014. Texas Transportation By the Numbers: Meeting the State's Need for Safe and Efficient Mobility. http://www.tripnet.org/docs/TX_Transportation_by_the_Numbers_TRIP_Report_July_2014.pdf

CS-16.2 The DFX is unable to model changes at the fine scale of Transportation System Management & Operations strategies. The model could analyze the use of a peak-period shoulder, but this strategy would not be needed given traffic volumes in the corridor, and model results would not vary between the alignments, which are similar.

CS-16.3 Because the Denton Greenbelt Corridor is in a largely rural area, no fiber networks were identified within the alignments. However, with expected growth in the cities of Aubrey, Celina, and Denton, potential exists for increased infrastructure to support automated vehicle technology.

CS-17 INFRASTRUCTURE RESILIENCY

CS-17.1 The alignments' susceptibility or impact to environmental factors related to extreme weather was analyzed using data on tree canopy, low-water crossings, shrink-swell potential of soils, and flood risk. The acreage of tree canopy in both alignments covers less than 15 percent of each area, with Alignment 1 having more canopy than Alignment 2. This result reflects ranch and farmland as the dominant land use in the area. These results are shown in Exhibit 18.

Exhibit 18. Tree Canopy in Alignment Areas

Alignment	Acres	Percent of Alignment
1	721.1	12.6%
2	466.3	8.5%

National Land Cover Database, 2011

NCTCOG data found no low-water crossings present in either alignment.

The shrink-swell potential of soils in the alignments was evaluated using Natural Resources Conservation Service Web Soil Survey. The linear extensibility percent was used to determine the shrink-swell potential of soils. Linear extensibility percent is the change in length as the moisture content of a soil changes from a moist to dry state. A higher linear extensibility percent indicates a higher potential for shrink-swell in soils. This is closely linked to the percentage of clay in soil, with a higher percent indicating a higher potential for shrink-swell. The shrink-swell potentials and association with clay are shown in Exhibit 19.

Exhibit 19. Shrink-Swell Potential

Shrink-Swell Potential	Linear Extensibility Percent	Percent Clay
Low	<3.0	<25
Moderate	3.0- 5.9	25-35
High	6.0-8.9	35-45
Very High	≥9.0	>45

National Soil Handbook, NRCS June 2018

The Natural Resources Conservation Service data found some variation in the distribution of shrink-swell potential of soils within the alignments. For both alignments, over 40 percent of the area had soils of low shrink-swell potential, with most of these soils falling in the center of the alignments. Another approximately 40 percent had high or very high potential, with the remaining approximately 14 percent of soils having moderate shrink-swell potential. The acres of shrink-swell potential of soils is summarized in Exhibit 20.

Exhibit 20. Shrink Swell Potential in Alignment Areas

Alignment	Shrink-Swell Potential	Acres
1	Low	2541.4
	Moderate	829.1
	High	1374.9
	Very High	979.7
2	Low	2327.1
	Moderate	769.3
	High	1428.3
	Very High	978.7

NRCS, 2018

The potential for flooding should also be evaluated when considering infrastructure resiliency within the alignment. Exhibit 21 indicates that approximately 3.5 percent and 5.0 percent of Alignments 1 and 2, respectively, are within the 100-year floodplain. The alignments are also located downstream of Lake Ray Roberts Dam.

Exhibit 21. Flood Risk within the Alignment Areas

Alignment	Acres within FEMA 100- Year Floodplain	Percent of Alignment within 100-Year Floodplain
1	199.8	3.5%
2	274.8	5.0%

Source: NCTCOG, March 2014

CS-17.2 The Denton County, Texas Hazard Vulnerability Analysis 2010[12] identifies strategies to address hazards that create risks in the county. The alignments included in the feasibility study are largely located in Denton County. Some of the hazards and strategies addressed in the plan have implications for transportation infrastructure:

- Development resulting from projected population increases will require the county to address land use and the impact of hazards.
- The county's Flood Damage Prevention Ordinance identifies five methods to reduce flood losses; all of the methods are applicable to transportation infrastructure. The methods address impacts on flood heights or velocities, land uses that are vulnerable to floods, alterations of floodplains and stream channels, dredge and fill that could increase flooding, and the construction of barriers that divert flood waters.
- Texas Department of Transportation can sand state highways and interstates during winter storms.
- Close supervision of construction digging can prevent ruptures of oil and gas pipelines.
- Hazardous materials can travel the county's roads, even though the county has no hazardous material roadway routes. The Hazard Vulnerability Analysis identifies a 1,000-foot risk zone on the sides of roadways and a 3,000-foot risk area for large spills of dangerous goods and hazardous materials.

[12] Denton County, Texas. 2010. Denton County, Texas Hazard Vulnerability Analysis (HVA) 2010 https://dentoncounty.com/-/media/Departments/Emergency-Services/Emergency-Services/PDFs/2010HVA-FINAL-withhighresmaps.pdf?la=en

The Collin County Hazard Mitigation Action Plan[13] from 2015 covers the city of Celina, part of the Denton County Outer Loop corridor. The plan cites the hazards of expansive soils and winter storms as having implications for roads. Roads and other impervious surfaces are identified as factors affecting flash floods.

The alignments' compatibility with these considerations varies:

- Development: The Denton County Outer Loop/Greenbelt Parkway will meet traffic demands generated by expected development. However, the roadway may generate additional changes in land use, creating a hazard mitigation concern.
- Flooding: Appropriate stormwater infrastructure and compensatory mitigation will be necessary to mitigate impacts to flood heights or velocities, alterations of floodplains and stream channels, dredge and fill, the construction of barriers, and effects on flash floods.
- Water quality: Appropriate stormwater infrastructure will be necessary to mitigate for sanding during winter storms.
- Oil and gas pipelines: Pipelines are present in both alignment areas. Alignment 1 includes 6.5 miles of pipeline; Alignment 2 includes 10.7 miles of pipeline. The pipelines' locations should be considered during project development.
- Hazardous materials: Roadways designed with modern safety considerations could reduce the risk of accidents that could cause hazardous material spills. Stormwater management structures are not designed to treat the volume of hazardous materials that could be spilled during an accident.[14]
- Expansive soils: Design and construction phases will need to consider the presence of high and very high shrink-swell potential in the soil underlying the alignments.

CS-17.3 NCTCOG provided a draft of the feasibility study to hazard mitigation stakeholders and invited them to the January 2019 stakeholders meeting and call-in opportunity. The draft and meeting invitation were provided to hazard mitigation representatives from the Texas Floodplain Management Association, Texas Water Development Board, Federal Emergency Management Agency, Texas Commission on Environmental Quality, Railroad Commission of Texas, Denton County, and the Natural Resources Conservation Service.

[13] Collin County, Texas. 2015. Collin County Hazard Mitigation Action Plan. http://sire.friscotexas.gov/sirepub/cache/2/lrnlu3kaclsygevggxzfpjpe/676685082020180419285 81.PDF
[14] Texas Tech University. 2011. Analysis of the Occurrence and Statistics of Hazardous Materials Spill Incidents along Texas Highways and Suggestions for Mitigation of Transport-Related Spills to Receiving Waters. https://library.ctr.utexas.edu/hostedpdfs/techmrt_0-5200-1.pdf

CS-18.1 Profile grades were not available for the corridor. The feasibility study recommends identifying the profile and terrain of the alignments during the engineering phase for the corridor.

CS-19 LINKING PLANNING AND NEPA

CS-19.1 The feasibility study was conducted as a Planning and Environment Linkages study. It includes a need and intent statement, identifies alternatives, provides baselines of environmental conditions, evaluates alternatives, analyzes the feasibility of multiple modes, and considers context sensitive design.

19.2 The sections of the feasibility study are formatted to be compatible with the National Environmental Policy Act.

19.3 The Denton Greenbelt Corridor Feasibility Study is a Planning and Environment Linkages study, resulting in the entire document being related to the National Environmental Policy Act. The Executive Summary serves as a summary of National Environmental Policy Act-related content.

19.4 A National Environmental Policy Act practitioner was involved in the feasibility study and participated on the INVEST team.

CS-20 Analysis Methods

20.1 The Denton Greenbelt Corridor Feasibility Study reflects the best and most recently available data. Data sources, their creation date, and their update frequency are described below. The sources include federal, state, and local data.

Data sourced from NCTCOG is developed in coordination with member jurisdictions. Population and employment forecasts are developed using a control total of households, population, and employment. Land use and urban growth models are applied, and model results are reviewed by local entities to ensure their consistency with local plans. More information on this methodology can be found at http://data-nctcoggis.opendata.arcgis.com/. Spatial data such as features and developments have been collected via surveys and site visits and are updated continuously using data in publications and websites or by direct contact with developers, property managers, or employers. Land use inventories are developed using parcel data, orthophotos, and other sources. Additional information on this methodology also is available at http://data-nctcoggis.opendata.arcgis.com/.

The Dallas-Fort Worth Regional Travel Model for the Extended Area (DFX) software application is the travel demand model for North Central Texas, providing analytical tools for travel forecasting. DFX is a collection of components that implements a trip-based four-step travel demand model on the TransCAD platform.

DFX accepts the following input files: demographic data, roadway network including toll roads and HOV, transit supply system including rail and park-and-ride, airport enplanements, external stations forecasts, and special generator information. It produces traffic volumes and speeds on roadways and transit usage data on the transit system. In addition to flexible coding tools, a smooth menu system for performing model runs, and extensive reports, the software provides a comprehensive file management system for the organization of input and output data.

The parameters, coefficients, and models in this application are calibrated based on the following data sources:

- 2015 Dallas/Fort Worth International Airport and Dallas Love Field Airport originating passenger surveys
- 2012 Commercial Vehicle Survey
- 2016 External Traffic Study
- 2009 National Household Travel Survey
- 2014 North Central Texas Transit Travel Survey
- 2012 Workplace and Special Generator survey
- 2014 National Performance Management Research Data Set (NPMRDS)
- 2014 traffic counts

The regional travel model has been calibrated to match 2014 observed data. The model is periodically validated based on updated observed data. The official validation occurs every five years; however, small validations usually happen in between. Subarea or corridor analysis frequently provide new data and validation opportunities for the regional model within the five-year interval.

Criteria Data Sources

Some INVEST criteria required data or other reference material. Sources for that information are found throughout the feasibility study and in the data sources and bibliography appendices.

Costs and Benefits

NCTCOG identified the costs and benefits to the agency of implementing each criterion focus area developed in the Draft Feasibility Study Sustainability Menu. Also identified were benefits to roadway users and which factor of the sustainability triple bottom line the criteria realized. This information is provided in Exhibit 22.

Exhibit 22. Costs and Benefits of Implementing INVEST

Criteria	Agency Cost	Agency Benefit	User Benefit	Type of Benefit
CS-01 Economic Development and Land Use	Some staff time, staff already does some of this work	• Save time through early identification of areas of concern, land use agencies, jurisdictions, and other appropriate stakeholders to coordinate with. • Stakeholder meetings or working groups may also help to inform the development of the feasibility study. • Early identification could benefit transportation partners by preventing duplication of effort.	• Potential to reduce the impact to existing or planned land use through use of existing facilities or avoidance. • Coordination of land use and economic plans with the corridor could lead to increased mobility and access.	Economic Environment Social
CS-02 Natural Environment	Some staff time, staff already does some of this work	• Save time through early identification of areas of environmental concern, regulatory agencies, and other appropriate stakeholders to coordinate with. • Early identification could benefit transportation partners by preventing duplication of effort.	• Potential to reduce the impact to the natural environment through avoidance, stewardship measures, or context sensitive design. • Stewardship/avoidance measures could provide economic benefits through prevented costs. • Reducing the impact may result in enhanced and/or preserved natural resources for users of and the community surrounding the corridor. • Early identification and coordination may reduce construction delays.	Economic Environment Social
CS-03 Scenic, Natural, or Recreational Qualities	None, staff already does this work	• Save time through early identification of areas of concern and appropriate stakeholders to coordinate with. • Early identification could benefit transportation partners by preventing duplication of effort.	• Potential to reduce the impact to the scenic, natural, or recreational qualities through avoidance or context sensitive design. • Reducing the impact may result in enhanced and/or preserved scenic and recreational resources for users of and the community surrounding the corridor. • Early identification and coordination may reduce construction delays.	Environment Social

Criteria	Agency Cost	Agency Benefit	User Benefit	Type of Benefit
CS-04 Historical, Archaeological, and Cultural Preservation	None, staff already does this work	• Save time through early identification of areas of cultural or historic concern and appropriate stakeholders, including regulatory stakeholders, to coordinate with. • Early identification could benefit transportation partners by preventing duplication of effort.	• Potential to reduce the impact to historical, archeological, and cultural resources through avoidance or context sensitive design. • Reducing the impact may result in enhanced and/or preserved historical and cultural resources for users of and the community surrounding the corridor. • Early identification and coordination may reduce construction delays.	Social
CS-05 Light Pollution	Staff time	• Save time through early identification of areas of concern, jurisdictions, and other appropriate stakeholders to coordinate with. • Early identification could benefit transportation partners and prevent duplication of effort.	• Potential to reduce the effect of light pollution to wildlife and communities in the project area. • Reducing light pollution may result in enhanced and/or preserved dark sky resources for users of and the community surrounding the corridor.	Environment Social
CS-06 Social Considerations	Staff time	• Use of a transparent and educational process may build trust among stakeholders. • Save time through early identification of: - Areas of social concern, including disadvantaged populations that may be impacted. - Appropriate stakeholders to coordinate with. - Appropriate methods of communication and outreach. • Early identification could benefit transportation partners by preventing duplication of effort.	• Ensures full and fair participation of all stakeholders and communities, so the project equitably distributes benefits and burdens. • Early identification and coordination may reduce construction delays. • Enhanced quality of life of users and the community surrounding the corridor.	Social

Criteria	Agency Cost	Agency Benefit	User Benefit	Type of Benefit
CS-07 Context Sensitive Solutions	Staff time resulting from including a multi-disciplinary team on the feasibility study team.	• Save time through early identification of areas of concern and appropriate stakeholders to coordinate with. • Early identification could benefit transportation partners by preventing duplication of effort.	• May result in a corridor that is designed for the specific conditions and location, enhancing current resources while meeting needs. • Project may also have lasting benefit to the community, the environment, and the wider transportation system.	Environment Social
CS-08 Access and Affordability	Staff time	• Save time through early identification of: - Areas of social concern, including populations that may be impacted. - Appropriate stakeholders to coordinate with. - Appropriate methods of communication and outreach. • Early identification could benefit transportation partners by preventing duplication of effort.	• Economic benefits through increased access to jobs/services. • Ensures physical and financial access for all users. • Early identification and coordination may reduce construction delays. • Enhanced quality of life of users and the community surrounding the corridor.	Social Economic
CS-09 Safety	Staff time	• Save time through early identification of contributing factors and areas of safety concern. • Early identification could benefit transportation partners by preventing duplication of effort.	• Save users time from reduction of potential travel delays. • Save users costs associated with safety incidents, including medical and vehicle damages. • Enhanced quality of life of users and community surrounding the corridor.	Economic Social
CS-10 Multimodal Transportation and Health	Some staff time, staff already does some of this work	• Save time through early identification of areas of concern, public health, active-mode, transit agencies, jurisdictions, and other appropriate stakeholders to coordinate with. • Early identification could benefit transportation partners by preventing duplication of effort.	• May increase mobility options for the corridor. • Save users time from reduction in traffic congestion. • Promote health of users and the community surrounding the corridor.	Social Economic

Criteria	Agency Cost	Agency Benefit	User Benefit	Type of Benefit
CS-11 Transit Facilities	None, staff already does this work	• Save time through early identification of partner transit agencies and stakeholders to coordinate with. • Early identification could benefit transportation partners by preventing duplication of effort.	• Potential increase in transit accessibility for users. • Save users time from reduction in traffic congestion.	Social Economic
CS-12 Freight and Goods Access and Mobility	Some staff time, staff already does some of this work	• Save time through early identification of areas of concern and appropriate freight stakeholders to coordinate with. • Early identification could benefit transportation partners by preventing duplication of effort.	• Improve freight reliability and connectivity. • Reduce the negative impacts that freight may have on the corridor, including capacity, land used, and turning. • Reduce fuel consumption.	Economic Environmental
CS-13 Travel Demand Management	None, staff already does this work	• Save time though early identification of current assets and strategies that have the potential to accommodate travel demand. • Early identification could benefit transportation partners by preventing duplication of effort.	• Save users time from reduction in traffic congestion. • Save users time though increased corridor reliability.	Economic Environmental Social
CS-14 Air Quality and Emissions	Staff time	• Save time through early identification of areas of concern, regulatory air quality agencies, and stakeholders to coordinate with. • Early identification could benefit transportation partners by preventing duplication of effort.	• Promote health of users and the community surrounding the corridor resulting from improved air quality. • Environmental benefit of reduced emissions. • Connectivity for future and current fuel technologies.	Economic Social Environment
CS-15 Optimizing Assets	None, staff already does this work	• Save time though early identification of current assets that could be maximized, as well as utilizing data and analyses from partner agencies. • Early identification could benefit transportation partners by preventing duplication of effort.	Users may benefit from saved funding that could be utilized on other projects or on other aspects of the existing project.	Economic

Criteria	Agency Cost	Agency Benefit	User Benefit	Type of Benefit
CS-16 Operational Efficiency	Staff time	• Save time through early identification of appropriate stakeholders to coordinate with. • Early identification could benefit transportation partners by preventing duplication of effort.	• Ability to easily integrate automated vehicles or future technology into the corridor for future use. • Save users time though increased corridor reliability and efficiency.	Economic
CS-17 Infrastructure Resiliency	Staff time	• Save time through early identification of appropriate regulatory and municipality officials to coordinate with. • Early identification could benefit transportation partners by preventing duplication of effort.	• Save users time and costs of having to replace/rebuild infrastructure. • Increased safety of infrastructure in the corridor • Save users time though increased corridor reliability and efficiency	Economic
CS-18 Earthwork Balance	Staff time	• Save time through early identification of where earthwork balance could be incorporated. • Early identification could benefit transportation partners by preventing duplication of effort.	• Decrease the environmental impact for users and the surrounding community of the corridor.	Economic Environmental
CS-19 Linking Planning and NEPA	None, staff already does this work	• Save time by creating a document that: - Identifies areas of concern and begins consultation with appropriate stakeholders before the formal National Environmental Policy Act process. - Is compatible with the National Environmental Policy Act and may prevent duplication of effort. • Early identification could benefit transportation partners by preventing duplication of effort.	• Allows users to be consulted and provide comments/concerns early in the planning process. • May result in a corridor that has adequately considered and mitigated for social and environmental concerns. • Early consultation and consideration may result in reduced construction delays. • Enhanced quality of life of users and the community surrounding the corridor.	Economic Environmental Social
CS-20 Analysis Methods	Staff time	Save agency time from having to duplicate work or seek additional funding, because ensuring quality control, adequate funding, and consistent updates may result in defensible and reliable analysis and data methods.	A corridor created with defensible, reliable, and quality data may result in a safe, efficient, and reliable corridor for users.	Economic

Next Steps

Next steps emerging from the INVEST project evolved from the original System Planning for Regions and Project Development criteria.

The North Central Texas Council of Governments will consider whether to further develop the feasibility study structure to include sustainability recommendations. This change could promote sustainable outcomes in future phases of project development and streamline the National Environmental Policy Act process.

Such efforts would require collaboration with transportation partners that implement those future phases, including the Texas Department of Transportation and the North Texas Tollway Authority. This collaboration could be part of broader efforts to promote the involvement of environmental justice populations and tribal nations. Beginning discussions on these efforts are expected to be held with the Texas Department of Transportation Fort Worth and Dallas Districts in 2019.

NCTCOG may consider monitoring how well feasibility study recommendations are addressed by the Texas Department of Transportation. The agency also will consider developing a policy to encourage in-house feasibility studies for projects that travel through environmentally sensitive areas or environmental justice communities.

NCTCOG will consider researching existing successes, such as the Colorado Department of Transportation's US 285 feasibility study and coordination efforts.

NCTCOG is working to identify funding that would allow the agency to continue collaboration with stakeholders to identify mitigation in the Denton Greenbelt. Tentative plans include planning charrettes with stakeholders to support development of a high-level site plan for mitigation. This site plan would be provided to the Texas Department of Transportation to strengthen the link between planning and project development.

Lessons Learned

Several criteria called for engaging stakeholders from the community and resource agencies and for identifying project champions. These stakeholders provided valuable information that NCTCOG was able to address early in the transportation planning process. These efforts will streamline future planning in the Denton Greenbelt Corridor. NCTCOG should make note of these benefits and increase existing efforts to engage stakeholders – beyond municipalities, counties, and transportation partners -- on other projects.

Incorporating the Corridor Studies criteria considerably increased the quality of the Denton Greenbelt Corridor Feasibility Study. However, despite several stages of refinement as the criteria were developed, some of the criteria were not appropriate for a feasibility study and would be better addressed in future planning or engineering phases.

Many of the criteria did not yield quantifiable or other results that would allow a comparison of the two alignments in the feasibility study. This should not discourage INVEST users, because these criteria improved the feasibility study process. As FHWA notes, "The value of INVEST lies more in the process of evaluation and working towards improving sustainability outcomes rather than focusing solely on the score itself."[15]

Of those criteria that did yield results that would allow a comparison of the two alignments, five criteria favored Alignment 1 and three criteria favored Alignment 2. The similarity of the alignments may have reduced the value of using the criteria. A comparison of outcomes per alignment is shown in Exhibit 23. Orange shading indicates a criterion could not determine a benefit between the alignments. Green shading indicates one alignment may be favorable when compared with the other alignment. Pink shading indicates one alignment may not be favorable when compared with the other alignment.

[15] Federal Highway Administration. n.d. Relating INVEST to Other Sustainability Tools. https://www.sustainablehighways.org/1470/relating-invest-to-other-sustainability-tools.html

Exhibit 23. Comparison of Criteria Outcomes

Criteria			Alignment	Outcome	Comments
CS-01 Economic Development and Land Use	**CS-01.1** In purpose and need, identify how the transportation need can meet economic development and land use planning.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
	CS-01.2 As applicable, engage land use and economic development agencies via stakeholder meetings and agency working groups while developing the study.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
	CS-01.3 Analyze and compare how alignments overlay with land uses, in terms of acreage of each land use. Use standardized width for transportation features.		1	+	Results of this criterion depends on land use priorities in the corridor. Alignment 2 has greater potential to affect residential and farmland/ranchland uses; it aligns with a smaller acreage of existing infrastructure and vacant land than Alignment 1. However, if water and timberland are the priority land use, the + and – outcomes could easily be reversed. Therefore, this criterion may not be decisive between the two alignments.
			2	–	
	CS-01.4 Consider existing comprehensive plans and thoroughfare plans when analyzing alignments.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
	CS-01.5 Consider expanding or modifying existing facilities instead of creating new facilities, if appropriate.		1	+	A greater proportion of Alignment 1 follows existing facilities.
			2	–	

Criteria			Alignment	Outcome	Comments
CS-02 Natural Environment	CS-02.1 For alignments that may be located in or near environmentally sensitive areas, engage natural resource and regulatory agencies via NCTCOG's Planning and Environment Linkages stakeholder group.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
	CS-02.2 Quantify the overlay of alignments and aquatic resources.		1	+	Alignment 2 has higher acreage in the Woodbine Aquifer, a greater presence in the 100-year floodplain, and a greater length of named streams within its alignment area, but Alignment 2 has fewer acres of wetlands in its alignment area. Local priorities could result in a different outcome for this criterion.
			2	–	
	CS-02.3 Quantify the overlay of alignments with hubs, corridors, and auxiliary areas in the Environmental Protection Agency's National Ecological Framework.		1	+	While Alignment 1 affects 3 more acres of ecological corridors than Alignment 2, it affects 156 fewer acres of auxiliary connections.
			2	–	
	CS-02.4 Identify which alignments may require a site-specific ecological assessment to be conducted during studies under the National Environmental Policy Act.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
CS-03 Scenic, Natural, or Recreational Qualities	CS-03.1 As applicable, identify whether alignments maintain existing access to scenic, natural, or recreational qualities.		1	–	
			2	+	
	CS-03.2 As applicable, identify whether alignments overlay scenic, natural, or recreational qualities.		1	Y	
			2	Y	

Criteria			Alignment	Outcome	Comments
CS-04 Historical, Archaeological, and Cultural Preservation	CS-04.1 As applicable, identify whether alignments overlay historic cemeteries, National Register Districts, National Register Properties, modeled or surveyed archeological sites, or parcels with buildings age 50 or older.		1	+	Alignment 1 has fewer acres with moderate or high potential archeological liability and has the potential to affect fewer potentially historic structures.
			2	–	
	CS-04.2 If applicable, identify whether alignments overlay a State Scenic Trail or route designated or officially recognized as significantly historical, cultural, or archaeological.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
	CS-04.3 Engage community stakeholders to assist in identifying whether any part of the project or corridor is recognized by the community as having historic, cultural, and/or archeological significance to the community.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
CS-05 Light Pollution	CS-05.1 Identify which alignments overlay areas that may be negatively affected by light pollution including uplighting, backlighting, and glare.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	

Criteria			Alignment	Outcome	Comments
CS-06 Social Considerations	CS-06.1 Engage community stakeholders to identify the community's vision for sustainability in the corridor.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
	CS-06.2 Engage a diverse range of stakeholders and public participants that includes, at a minimum, all interested parties, in addition to all other parties potentially affected by changes to the transportation system.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
	CS-06.3 Where environmental justice, Title VI, and transportation-disadvantaged groups are affected, use a diverse and innovative range of public involvement techniques to ensure the engagement process is inclusive.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
	CS-06.4 During stakeholder and public meetings, provide education about the transportation planning process and how public input can improve the process.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
	CS-06.5 Promote and educate the public about environmental, social, or economic sustainability as appropriate to the corridor by developing a project website, creating a stakeholder guide, or giving presentations.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
	CS-06.6 Use a transparent process to inform stakeholders how their input will be used and follow through accordingly.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
	CS-06.7 Demonstrate to stakeholders how their input was used to inform and affect transportation planning decisions and document the input's impact in the feasibility study.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	

Criteria			Alignment	Outcome	Comments
CS-07 Context Sensitive Solutions	CS-07.1 As applicable, identify alignments where needs for context sensitive solutions should be addressed during the National Environmental Policy Act process.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
	CS-07.2 Include multimodal, multijurisdictional, and multidisciplinary members on the feasibility study team.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
	CS-07.3 Engage external "champions" for the project in the affected community to support the project.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
	CS-07.4 Seek acceptance among project stakeholders on the problems, opportunities, and needs that the project should address and the resulting vision or goals for addressing them.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
CS-08 Access and Affordability	CS-08.1 Where applicable, analyze the equity of physical access for the corridors.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
	CS-08.2 Where applicable, for projects with a tolled component, identify specific populations or areas where affordability may be an issue, including what portion of a low-income household's income may be spent on tolls if the facility is constructed.		1	N/A	This criterion was not applicable to the Denton Greenbelt Corridor.
			2	N/A	
	CS-08.3 Where applicable, document targeted, enhanced outreach, or communication that has been used to engage populations or areas where affordability may be an issue.		1	N/A	This criterion was not applicable to the Denton Greenbelt Corridor.
			2	N/A	

Criteria			Alignment	Outcome	Comments
CS-09 Safety	CS-09.1 Address applicable emphasis areas and strategies in the State Strategic Highway Safety Plan listed below. • Increase the installation of engineering countermeasures known to reduce distracted driving. • Use technology to reduce distracted driving crashes, serious injuries, and fatalities. • Improve mobility options for impaired road users. • Consider alternative design strategies for improving intersection safety. • Improve pedestrian safety at intersections with high probability of crashes. • Increase driver awareness of intersections. • Design and operate roadways to meet the needs of older road users. • Reduce bicycle/pedestrian crashes on urban arterials and local roadways. • Improve bicyclists'/pedestrians' visibility at crossing locations. • Improve bicycle/pedestrian networks. • Improve bicycle/pedestrian involved crash reporting. • Keep vehicles from encroaching on the roadside or opposite lane. • Minimize the consequences of vehicles leaving the road. • Minimize the likelihood of crashing in adverse conditions. • Use the concept of establishing target speed limit and road characteristics to reduce speeding.		1	N/A	This criterion may be more applicable to the design phase of a roadway project.
			2	N/A	
	CS-09.2 Address safety concerns in the corridor as identified by the long-range plan or 10-year plan.		1	Y	
			2	Y	

Criteria			Alignment	Outcome	Comments
	CS-09.3 Identify potential contributing factors to crashes (on existing facilities that are included in the study) and identify the need to build awareness among the public.		1	–	Alignment 1 has almost 1,000 more crashes compared with Alignment 2, but this is likely because part of Alignment 1 follows SH 288.
			2	+	
	CS-09.4 Include explicit consideration of safety using quantitative methods for each alternative.		1	–	Alignment 1 has almost 1,000 more crashes compared with Alignment 2, but this is likely because part of Alignment 1 follows SH 288
			2	+	
CS-10 Multimodal Transportation and Health	**CS-10.1** Compare the alignments' opportunity to enhance the extent and connectivity of multimodal infrastructure, including bicycle and pedestrian connectivity.		1	Y	
			2	Y	
	CS-10.2 Engage public health and active-mode stakeholders.		1	Y	
			2	Y	
	CS-10.3 Identify opportunities to integrate transit, pedestrian, bicycle, and roadway modes.		1	Y	
			2	Y	
	CS-10.4 Identify how chosen alignments promote public health through improving congestion, safety, and opportunities for active transportation.		1	Y	
			2	Y	
	CS-10.5 Where applicable, identify the need for sidewalks to allow pedestrian connections to Veloweb access points.		1	N/A	This criterion was not addressed.
			2	N/A	
CS-11 Transit Facilities	**CS-11.1** Identify the need, purpose, and appropriateness for transit access within the project footprint.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	

Criteria			Alignment	Outcome	Comments
CS-12 Freight and Goods Access and Mobility	CS-12.1 In corridors where freight is applicable, identify opportunities for maintaining and improving freight reliability and connectivity between modes and to freight generators for both inter- and intra-city freight.		1	N/A	This criterion was not addressed.
			2	N/A	
	CS-12.2 If the alignments are near freight facilities, consider multimodal freight mobility needs, such as intermodal facilities and the siting of freight facilities.		1	N/A	This criterion was not addressed.
			2	N/A	
	CS-12.3 If applicable, utilize the Regional Freight Advisory Committee to engage stakeholders, including freight service providers, workers, representatives, and neighbors that surround freight facilities.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
	CS-12.4 Assess freight accessibility and mobility, such as freight movements, turning radius, adequate capacity or restricted capacity, and land use ordinances that minimize freight effects on the surrounding areas.		1	N/A	This criterion was not addressed.
			2	N/A	
	CS-12.5 If applicable, assess freight reliability by identifying opportunities for infrastructure that support supply chain movements, including truck parking with amenities for drivers and the corridor's capacity for safe and efficient movement of freight.		1	N/A	This criterion was not addressed.
			2	N/A	
CS-13 Travel Demand Management	CS-13.1 Identify strategies to reduce trips during peak periods and demonstrate that strategies cannot reduce demand enough to eliminate the need for the alignment.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
	CS-13.2 Analyze effectiveness of strategies to improve parallel facilities in lieu of building the new facility.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	

Criteria			Alignment	Outcome	Comments
CS-14 Air Quality and Emissions	**CS-14.1** Identify alignments where temporary construction impacts and long-term impacts may affect air quality.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
	CS-14.2 Engage air quality stakeholders, including Texas Commission on Environmental Quality and Environmental Protection Agency.		1	N/A	This criterion was not addressed.
			2	N/A	
	CS-14.3 Identify alignments' ability to reduce congestion, including on parallel and connecting facilities.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
	CS-14.4 If the facility is on or connects within 5 miles of an Energy Corridor, identify locations and/or density of electric vehicle charging stations and identify the need for charging stations on alignments.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
CS-15 Optimizing Assets	**CS-15.1** Identify opportunities to maximize existing transportation system capacity (including bridges) before considering major capital infrastructure investment, in keeping with policy in the long-range transportation plan. These opportunities include minor-, medium-, and major-scale improvements.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
	CS-15.2 Where partner agencies maintain asset management data and economic analysis, incorporate this information into the feasibility study process.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
	CS-15.3 Conduct a high-level analysis of how alignments may utilize current stormwater assets.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
	CS-15.4 Compare alignments' travel time savings.		1	N/A	This criterion was not addressed.
			2	N/A	

Criteria			Alignment	Outcome	Comments
CS-16 Operational Efficiency	CS-16.1 Identify strategies to increase efficiency via other modes or alternatives to single occupant vehicles.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
	CS-16.2 Conduct post-process calculations for the No-Build scenario and alignments to identify benefits of Transportation System Management & Operations strategies identified in the long-range transportation plan.		1	N/A	This criterion was not addressed.
			2	N/A	
	CS-16.3 Compare alignments' access to fiber networks or other sufficient infrastructure for connected automated vehicles.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
CS-17 Infrastructure Resiliency	CS-17.1 Compare alignments' susceptibility or impact to environmental factors related to extreme weather, including reduction in local tree canopy, shrink-swell potential for soils, low-water crossings, flooding potential greater than that documented by the Federal Emergency Management Agency to account for increasing impervious surfaces, and vulnerability to large water releases from dams.		1	Y	Alignment 1 has the potential to affect more acreage of tree canopy, but it has fewer acres in the 100-year floodplain and fewer acres on soil with high or very high shrink-swell potential. Therefore, the aggregate results do not differ between alignments.
			2	Y	
	CS-17.2 Determine how alignments are compatible with the hazard mitigation plans of state and local agencies and jurisdictions.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
	CS-17.3 Engage stakeholders associated with hazard mitigation, including the US Army Corps of Engineers, Texas Water Development Board, Texas Commission on Environmental Quality, Environmental Protection Agency, counties, and local officials.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	

Criteria			Alignment	Outcome	Comments
CS-18 Earthwork Balance	CS-18.1 Identify the profile (preliminary engineering schematic) and terrain of alignments to incorporate grade into feasibility considerations.		1	N/A	This criterion was not addressed.
			2	N/A	
CS-19 Linking Planning and NEPA	CS-19.1 Implement Planning and Environment Linkages best practices, including: • National Environmental Policy Act tiering • Purpose and need statements • Scoping and alternatives identification • Analysis or baselining of environmental conditions • Evaluation and/or elimination of alternatives • Multimodal analysis • Context sensitive design considerations • Indirect and cumulative impacts assessment • Preparatory analyses for permitting		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
	CS-19.2 Structure the document in a format compatible with the National Environmental Policy Act.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
	CS-19.3 Summarize National Environmental Policy Act-related content in the introduction and/or recommendations.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	
	CS-19.4 Consult National Environmental Policy Act practitioners during the study.		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	

Criteria			Alignment	Outcome	Comments
CS-20 Analysis Methods	CS-20 Describe the agency's policies related to the following as they apply to data used in the study: • Quality control • Frequency of updates • Adequate funding		1	Y	The criterion was addressed, but results did not differ between alignments.
			2	Y	

Potential of the Project to Serve as National Case Study

This project has good potential to serve as a national case study because of its applicability to corridor-scale planning, its timeliness as cities seek to address population growth while maintaining quality of life, and its successful example of stakeholder engagement.

Multiple state departments of transportation have expressed interest in INVEST criteria that better suit corridor planning. The Draft Feasibility Study Sustainability Menu could be customized by other agencies to meet their needs. FHWA could evaluate and modify the criteria to provide an official INVEST Corridor Studies module.

The project also demonstrates successful planning efforts at the intersection of the natural environment and extraordinary population growth. The city of Aubrey is located just east of conserved lands and a widely visited state park. The city, which had a population of about 3,000 in 2017, plans to grow to 50,000 or as many as 150,000 residents.[16] Two reservoirs, a dam, and conservation easements restrict potential for developing east-west roadways in the county. These potential conflicts can only be resolved by engaging a wide array of stakeholders in dialogue.

[16] Such growth is not unprecedented in the NCTCOG region. The population of the city of Frisco, in Collin County, grew from 3,414 to 177,281 from 1980 to 2017, according to the Census and American Community Survey.

Recommendations

The INVEST team met a final time to discuss how the tool could be improved. Comments focused on two areas: improving the use of the tool and improving outcomes after using the tool.

Improving Use of the Tool

Discussion on improving use of the tool addressed scoring, the creation of new modules, cost savings resources, and links with other tools.

Scoring: NCTCOG staff would appreciate guidance on how to include additional criteria in a scoring process that generates a final score of Platinum, Gold, Silver, or Bronze. While NCTCOG retained or lightly rewrote some criteria from the System Planning for Regions and Project Development modules, the agency's Draft Feasibility Study Sustainability Menu contained a number of new criteria.

INVEST current methodology allows for three "Innovative Criteria" per scorecard with a maximum of 10 bonus points going toward the final score. This could discourage agencies from customizing criteria to meet their circumstances. The Illinois Tollway encountered the same problem when it developed additional criteria while using INVEST v1.0.[17]

Guidance on weighting the new criteria also would be appreciated. NCTCOG chose to limit scoring to 0 points if a criterion was not addressed and 1 point if a criterion was addressed in the 2011 Regional Outer Loop Corridor Feasibility Study. Because time and funding prevented the INVEST team from scoring the 2019 Denton Greenbelt Corridor Feasibility Study for comparison, the team was comfortable with the scoring limitations. But future use of the NCTCOG-developed Corridor Studies module could benefit from more nuanced scoring.

Creation of new modules: NCTCOG's Draft Feasibility Study Sustainability Menu serves as a recommendation to improve INVEST by adding a Corridor Studies module. The INVEST team hopes FHWA will further develop and test this module and ultimately provide a new module to tool users. NCTCOG efforts to develop the new module could have benefited if the INVEST website provided resources describing whether and how other agencies have created their own modules. The Washington Department of Transportation applied INVEST to three corridor studies but used System Planning criteria. The agency noted its efforts to use these criteria for corridor studies would have benefited from generalized scoring requirements, alternative scoring requirements,

[17] Illinois Tollway. 2015. Implementation Report: The Illinois Tollway's Implementation of INVEST. https://www.sustainablehighways.org/files/3450.pdf

or the removal of scoring requirements not applicable to corridor studies.[18] NCTCOG's new module addresses some of these concerns.

Cost savings resources: Expanded cost savings resources, such as those developed for several criteria and described in Beyond Ratings, Potential Cost Savings of Sustainability Practices,[19] could help encourage INVEST users to analyze costs and benefits of implementing sustainability best practices. FHWA Operations Benefit/Cost Analysis Desk Reference[20] does not provide guidance on many of the environmental and social criteria. Being able to estimate costs and benefits could help metropolitan planning organizations bridge the gap between the planning conducted by their agencies and the project development conducted by state departments of transportation. That would address a concern described in the following section "Improving Outcomes of the Tool."

Links with other tools: The NCTCOG INVEST team would like guidance on linking INVEST to other tools, particularly FHWA's PlanWorks. The INVEST User Guide[21] encourages such efforts in the section titled "Use in Conjunction with Other Tools." However, only a flowchart is provided that describes a seven-step approach to integrating tools, where Step 4 is "Identify a Range of Sustainable Solutions – using multiple sustainability tools." This section could be expanded to help users understand how existing tools could be integrated. For example, PlanWorks encourages scenario planning and collaboration. Could INVEST be integrated into a scenario where the starting point for a long-range plan was meeting transportation needs through the framework of sustainability rather than the framework of mobility? This could shift the discussion from assuming freeways were the solution and assuming the role of the long-range plan is to determine how many lanes were needed to meet the transportation need. Solutions developed through a framework of sustainability could be truly context sensitive. Such a process could shift the long-range planning discussion from a transportation problem to a community problem that has a transportation component.

Integrating the collaboration component of PlanWorks to INVEST also could improve the transition of planning conducted by metropolitan planning organizations to project development conducted by departments of transportation. This could address a concern described in the following section "Improving Outcomes of the Tool."

[18] Washington State Department of Transportation. 2014. Washington State Department of Transportation INVEST Study. https://www.sustainablehighways.org/files/3682.pdf
[19] Federal Highway Administration, n.d. Beyond Ratings, Potential Cost Savings of Sustainability Practices. https://www.sustainablehighways.org/files/1186.pdf
[20] Federal Highway Administration. 2017. Operations Benefit/Cost Analysis Desk Reference. https://ops.fhwa.dot.gov/publications/fhwahop12028/sec1.htm#sec11
[21] Federal Highway Administration, n.d. INVEST User Guide. http://www.sustainablehighways.org/files/3429.pdf

Improving Outcomes of the Tool

The INVEST team discussed how FHWA could improve outcomes following use of the INVEST tool. These discussions focused on coordination across a transportation project's phases, from planning to implementation. Potential techniques include reducing silos and providing incentives.

Reduced silos: While use of INVEST brought together diverse teams within NCTCOG, coordination with other transportation partners is necessary to ensure the benefits of the tool carry forward through project implementation.

NCTCOG suggests FHWA fund a project to bring together metropolitan planning organization staff and department of transportation staff responsible for project development, construction, and operations and maintenance. This collaboration would identify how related criteria evolve across the full life cycle of a project. For example, the project could identify how resiliency criteria in the planning phase could produce economically sustainable outcomes in the operations and maintenance phase. This effort could document time and cost savings, supporting the value of this collaboration as a streamlining tool.

Separately, FHWA could draft a model agreement between agencies. The agreement could outline a department of transportation's commitment to use INVEST in future phases of a project if the metropolitan planning organization's use of INVEST identifies a sustainability need. This agreement could help transportation agencies meet sustainability objectives above and beyond minimum requirements.

Incentives: While the Texas and Ohio departments of transportation have at times required contractors to use INVEST and achieve a minimum score on projects,[22] NCTCOG can't provide the incentive of a contract to motivate transportation partners to use the tool when implementing projects. NCTCOG would appreciate guidance from FHWA on creating an incentive to use the tool or to enter into an agreement as described above.

[22] Federal Highway Administration, n.d. INVEST User Guide. http://www.sustainablehighways.org/files/3429.pdf

Appendices

Appendix 1 – Criteria Selection

Exhibit 1-1. SPR-01

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
SPR-01 Integrated Planning: Economic Development and Land Use (for Regions)	SPR-01.1a	Has the agency developed goals and objectives for the integration of metropolitan and/or statewide transportation planning with economic development and land use planning above and beyond current requirements?	Modified	"Need and purpose" are more relevant to a feasibility/PEL study than goals and objectives. While the MPO cannot control land use, the MPO can encourage land use that allows use of the existing transportation capacity to its fullest extent.	Has the agency developed a purpose and need in the feasibility/PEL study ("study") that integrates transportation planning with economic development and land use planning above and beyond current requirements?
	SPR-01.1b	Are the goals and objectives consistent with applicable economic development and land use plans above and beyond current requirements?	Modified		Are the purpose and need consistent with applicable economic development and land use plans above and beyond current requirements?
	SPR-01.2a	Does the agency regularly engage land use and economic development agencies in its jurisdiction throughout the transportation planning process?	Modified	Land use and economic development agencies are relevant to this kind of study, though their involvement may vary between corridors with different characteristics. Wording was modified to better reflect the type of study being conducted.	Did the agency regularly engage land use and economic development agencies in its jurisdiction as applicable when developing the study?
	SPR-01.2b	Does the agency utilize institutional mechanisms to facilitate the engagement?	Included	Land use and economic development agencies are relevant to this type of study.	
	SPR-01.3	Does the agency use best practice quantitative methods to analyze and evaluate the performance of alternative land use/transportation scenarios?	Modified	Modeling of transportation alternatives takes place during this kind of study, but the MPO does not control or model land use.	Does the agency use best practice quantitative methods to analyze and evaluate the performance of alternative transportation scenarios?

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
	SPR-01.4	Does the agency provide institutional leadership in encouraging transportation planning that is consistent with land use and economic development plans and that supports sustainability principles?	Included	The MPO policy board encourages planning that is consistent with sustainability through policies and incentives.	
	SPR-01.5	Can the agency demonstrate sustainable outcomes?	Excluded	Excluded because only one of the subcriteria was applicable.	
	SPR-01.5a	The LRTP is integrated with land use and economic development plans, and the agency is implementing transportation investments that support sustainability principles.	Modified	The criteria will address the challenge of integrating economic development and sustainability and can create a discussion with local governments about their land use plans. Modified to reflect the type of study.	The study is integrated with land use and economic development plans, and the agency is implementing transportation investments that support sustainability principles.
	SPR-01.5b	The LRTP includes sustainability related performance measures for the integration of transportation planning with economic development and land use planning.	Excluded	Performance measures are not relevant to this phase of planning.	
	SPR-01.5c	Does the agency monitor progress toward goals for at least one year and can the agency demonstrate the achievement of its goals and objectives?	Excluded	Monitoring progress is not relevant to this phase of planning.	

Exhibit 1-2. SPR-02

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
SPR-02 Integrated Planning: Natural Environment (for Regions)	SPR-02.1a	Has the agency developed goals and objectives that meet the requirement for the integration of metropolitan and/or statewide transportation planning with applicable environmental plans, policies, and goals?	Modified	"Need and purpose" are more relevant to a feasibility/PEL study than "goals and objectives."	Has the agency developed a purpose and need for the study that integrates transportation planning with applicable environmental plans, policies, and goals?
	SPR-02.1b	Are the goals and objectives consistent with or surpass local, metropolitan, and/or statewide environmental plans, policies, and goals?	Excluded	This criteria is repetitive of the criteria above as re-written.	
	SPR-02.2a	Does the agency go above and beyond current consultation requirements by regularly engaging natural resource and regulatory agencies?	Included	Consultation is very pertinent to feasibility studies.	
	SPR-02.2b	Does the agency utilize institutional mechanisms to facilitate the engagement?	Included		
	SPR-02.3	Does the agency apply system or landscape scale evaluation techniques using natural resource data?	Modified	This is a common approach to evaluating natural resource data.	Does the study apply system or landscape-scale evaluation techniques using natural resource data?
	SPR-02.4	Can the agency demonstrate sustainable outcomes?	Modified	While feasibility studies don't demonstrate outcomes, they can spur efforts to include sustainability throughout planning and implementation of the project.	Did the study launch efforts to promote sustainable outcomes in project design, implementation, and maintenance?

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
	SPR-02.4a	The LRTP is integrated with applicable environmental plans, policies, and goals; the agency implements transportation investments that support and enhance long-term ecological function.	Modified	The first half of this criteria is repetitive of criteria above; the second half was rewritten to be applicable to a feasibility study while continuing to address ecological function rather than environmental goals.	Did the study identify how alignments may affect long-term ecological function?
	SPR-02.4b	The LRTP includes performance measures for long-term ecological function.	Excluded	Performance measures are not relevant to this phase of planning.	
	SPR-02.4c	Does the agency monitor progress toward goals for at least one year and can the agency demonstrate sustainable outcomes?	Excluded	Monitoring progress is not relevant to this phase of planning.	

Exhibit 1-3. SPR-03

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
SPR-03 Integrated Planning: Social (for Regions)	SPR-03.1	Do the metropolitan and/or statewide transportation planning agencies share the community's vision for overall sustainability efforts; are transportation-related goals and objectives consistent with that vision?	Modified	This criteria creates a process to build consensus and work toward a mutually acceptable vision; however, the parties may have to agree to disagree on some issues.	Does the study include efforts to address the community's vision for overall sustainability efforts and identify opportunities to reach a mutually acceptable vision?
	SPR-03.2	Does the agency successfully identify a diverse range of stakeholders and public participants?	Modified	Stakeholder engagement is relevant to feasibility studies; wording was modified to reference the study instead of the agency.	Does the study successfully identify a diverse range of stakeholders and public participants?
	SPR-03.2a	Does the agency identify a diverse range of stakeholders and public participants, which include, at a minimum, all interested parties (as defined by current regulations), in addition to all other parties potentially affected by changes to the transportation system?	Modified	Stakeholder engagement is relevant to feasibility studies; wording was modified to reference the study instead of the agency.	Does the study identify a diverse range of stakeholders and public participants, which include, at a minimum, all interested parties (as defined by current regulations), in addition to all other parties potentially affected by changes to the transportation system?
	SPR-03.2b	Does the agency give special consideration and attention to the engagement of low-income, minority, disabled, and linguistically isolated populations, and use a diverse and innovative range of public involvement techniques to ensure the engagement process is inclusive?	Modified	Engagement of stakeholders from environmental justice and Title VI populations is relevant to feasibility studies; wording was modified to reference the study instead of the agency.	Does the study give special consideration and attention to the engagement of low-income, minority, disabled, and linguistically isolated populations, and use a diverse and innovative range of public involvement techniques to ensure the engagement process is inclusive?
	SPR-03.2c	Does the agency include an education component so that stakeholders understand the transportation planning process and are able to better provide informed and meaningful input?	Modified	Outreach during a feasibility study is an opportunity to educate stakeholders about transportation planning; wording was modified to reference the study instead of the agency.	Does the study include an education component so that stakeholders understand the transportation planning process and are able to better provide informed and meaningful input?

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
	SPR-03.3a	Does the agency use a transparent process to inform stakeholders how their input will be used and then follow through accordingly?	Modified	Transparency while engaging stakeholders is important to a feasibility study; wording was modified to reference the study instead of the agency.	Does the study use a transparent process to inform stakeholders how their input will be used and then follow through accordingly?
	SPR-03.3b	Does the agency demonstrate to stakeholders how their input was used to inform and affect transportation planning decisions?	Modified	Transportation plans should respond to input from stakeholders; wording was modified to reference the study instead of the agency.	Does the study demonstrate to stakeholders how their input was used to inform and affect transportation planning decisions?
	SPR-03.4	Can the agency demonstrate sustainable outcomes?	Excluded	The supporting criteria were excluded, requiring this gatekeeper question to be excluded.	
	SPR-03.4a	Does the agency implement transportation investments that support the community's vision and goals and help achieve sustainability outcomes?	Excluded	This criteria largely repeats SPR-03.1.	
	SPR-03.4b	Does the LRTP include performance measures to assess the effectiveness of its public involvement process?	Excluded	Performance measures are not relevant to this phase of planning.	
	SPR-03.4c	Does the agency monitor progress toward goals for at least one year and can the agency demonstrate measurable advancement toward goals?	Excluded	Monitoring progress is not relevant to this phase of planning.	

Exhibit 1-4. SPR-04

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
SPR-04 Integrated Planning: Bonus (for Regions)	SPR-04.1	Does the agency's transportation planning occur within an integrated and collaborative planning process?	Excluded	The contents of this criteria are addressed more specifically within other criteria.	

Exhibit 1-5. SPR-05

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
SPR-05 Access and Affordability (for Regions)	SPR-05.1a	Do system planning documents analyze physical access and identify specific population groups or areas where this is an issue?	Modified	Environmental justice is applicable to NEPA and should be incorporated into corridor studies; this criteria could look at affordability from a social standpoint.	Do the study documents analyze physical access and identify specific population groups or areas where this is an issue?
	SPR-05.1b	Do system planning documents analyze access and equity and identify specific populations or areas where this is an issue?	Modified		Do the study documents analyze access and equity and identify specific populations or areas where this is an issue?
	SPR-05.1c	Do system planning documents analyze affordability and identify specific populations or areas where this is an issue?	Modified		Do the study documents analyze affordability and identify specific populations or areas where this is an issue?
	SPR-05.1d	Do system planning documents include documentation of targeted, enhanced outreach, or communication that has been used to engage these population groups or areas in the transportation planning process?	Modified		Do the study documents include documentation of targeted, enhanced outreach, or communication that has been used to engage these population groups or areas in the transportation planning process?
	SPR-05.2a	Does the agency use travel model, census, geospatial, and other data to quantitatively evaluate the nature and distribution of accessibility and affordability concerns in its jurisdiction?	Modified	EJ analyses on affordability are conducted in corridor studies, but only if the facility may be tolled. The effects alternatives have on socioeconomic groups are modeled.	Does the study use travel model, census, geospatial, and other data to quantitatively evaluate the nature and distribution of accessibility and affordability (if a tolled facility) concerns in the corridor?
	SPR-05.2b	Does the agency analyze how its transportation planning documents address or improve issues?	Modified		Does the study analyze how to address or improve issues?
	SPR-05.3a	Does the LRTP include sustainability--related performance measures that can be used to monitor the effects of plan implementation on transportation accessibility and affordability?	Excluded	Performance measures are not relevant to this phase of planning.	

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
	SPR-05.3b	Is the agency monitoring progress against the performance measures and adjusting its efforts as necessary to meet its goals?	Excluded	Corridor studies do not monitor progress.	

Exhibit 1-6a. SPR-06

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
SPR-06 Safety Planning (for Regions)	SPR-06.1	Does the agency collaborate and participate in the development and implementation of the State Strategic Highway Safety Plan?	Modified	Identifying alignments that promote safe travel should be a priority in a feasibility study. Criteria rewritten to be applicable to this type of study.	Does the study address applicable emphasis areas in the State Strategic Highway Safety Plan? See Table SPR-06.1.
	SPR-06.2a	Has the agency incorporated the Toward Zero Death (TZD) vision and implemented TZD as part of its transportation planning activities?	Excluded	TZD strategies, such as technology and education, are more applicable to a later phase of transportation planning.	
	SPR-06.2b	Has the agency developed strategies/plans to support TZD?	Excluded		
	SPR-06.3	Does the agency develop a plan that incorporates safety into short and long-range transportation planning?	Modified	The agency does incorporate safety into short- and long-range plans; a feasibility study should address these concerns at a corridor level.	Does the study address safety concerns in the corridor as identified by the long-range plan or 10-year plan?
	SPR-06.4	Does the agency integrate quantitative safety performance measures into the transportation planning process?	Excluded	Performance measures are not relevant to this phase of planning.	
	SPR-06.5a	Does the agency incorporate and integrate quantitative safety considerations into the selection and evaluation of strategies for different user groups?	Excluded	This criteria is more applicable at design and engineering phases.	
	SPR-06.5b	Does the agency select strategies that include systemic treatments with proven effectiveness in reducing fatalities and serious injuries?	Excluded		
	SPR-06.6	Does the agency integrate statistically sound approaches to determine projected safety performance into the long-range transportation planning process?	Excluded	This criteria is not appropriate at the corridor level.	

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
	SPR-06.7a	Does the agency system plan or program include safety-related performance measures?	Excluded	This criteria is not appropriate at the corridor level.	
	SPR-06.7b	Does the agency monitor progress toward goals for at least one year and can the agency demonstrate measurable advancement toward goals?	Excluded	This criteria is not appropriate at the corridor level.	

Exhibit 1-6b. Table SPR-06.1, Texas Strategic Highway Safety Plan 2017-2022

Emphasis Area	Strategy #	Strategy Description
Distracted Driving	4	Increase the installation of engineering countermeasures known to reduce distracted driving
Distracted Driving	5	Use technology to reduce distracted driving crashes, serious injuries, and fatalities
Impaired Driving	4	Improve mobility options for impaired road users
Intersection Safety	2	Consider alternative design strategies for improving intersection safety
Intersection Safety	3	Improve pedestrian safety at intersections with high probability of crashes
Intersection Safety	4	Increase driver awareness of intersections
Older Road Users	2	Design and operate roadways to meet the needs of older road users
Bicycle/Pedestrian Safety	2	Reduce bicycle/pedestrian crashes on urban arterials and local roadways
Bicycle/Pedestrian Safety	3	Improve bicyclists'/pedestrians' visibility at crossing locations
Bicycle/Pedestrian Safety	4	Improve bicycle/pedestrian networks
Bicycle/Pedestrian Safety	6	Improve bicycle/pedestrian involved crash reporting
Roadway and Lane Departures	2	Keep vehicles from encroaching on the roadside or opposite lane
Roadway and Lane Departures	3	Minimize the consequences of vehicles leaving the road
Roadway and Lane Departures	4	Minimize the likelihood of crashing in adverse conditions
Speeding	1	Use the concept of establishing target speed limit and road characteristics to reduce speeding

Exhibit 1-7. SPR-07

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
SPR-07 Multimodal Transportation and Public Health (for Regions)	SPR-07.1a	Has the agency developed goals and objectives for enhancing the extent and connectivity of multimodal infrastructure within its jurisdiction?	Modified	A feasibility study is the appropriate time to identify different modes for a corridor; these recommendations should be made before NEPA. However, feasibility studies don't have goals and objectives, so this criteria was rewritten.	Does the study identify the opportunity to enhance the extent and connectivity of multimodal infrastructure between the studied alignments?
	SPR-07.1b	Has the agency developed goals and objectives related to active transportation and the improvement of public health?	Modified	Active transportation is a mode of travel, and it should be addressed in a feasibility study.	Does the study identify whether alignments enhance active transportation and improve public health?
	SPR-07.2	Does the agency regularly engage public health and active mode stakeholders?	Modified	Public health and active mode stakeholders are appropriate stakeholders for a feasibility study.	Were public health and active mode stakeholders engaged during the study?
	SPR-07.3a	Does the agency's planning process include and prioritize active, non-motorized transportation projects and programs as a component of the LRTP?	Modified	This criteria supports the Congestion Management Plan and should be considered in feasibility studies.	Does the study address the feasibility of including active, non-motorized transportation in the corridor?
	SPR-07.3b	Does the agency's LRTP integrate transit, pedestrian, bicycle, and roadway networks so that intermodal connections are safe and convenient?	Modified	This criteria supports the Congestion Management Plan and safety goals, and should be considered in feasibility studies.	Does the study integrate transit, pedestrian, bicycle, and roadway modes to that intermodal connections are safe and convenient?
	SPR-07.3c	Has the agency evaluated the health impacts of the LRTP to determine whether the planned transportation investments will help the agency to meet its public health and active transportation goals?	Modified	Transportation planning assumes goals of air quality, safety, and active transportation, which complement public health. Reducing congestion indirectly benefits public health. This criteria has been rewritten to be applicable to corridor studies and to clarify these relationships.	Does the study consider whether alignments promote public health through improving congestion, safety, and opportunities for active transportation?

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
	SPR-07.4	Does the agency evaluate its progress toward meeting its multimodal and public health goals and make adjustments as necessary?	Excluded	Frequently it is local governments that are responsible for implementing and/or operating active transportation components. Also, monitoring progress or performance measures are not relevant to corridor studies. However, a chapter in the study including recommendations for implementing agencies could be warranted.	
	SPR-07.4a	Is the agency implementing transportation investments that expand travel choices and modal options and support and enhance public health?	Excluded		
	SPR-07.4b	Has the agency incorporated multimodal and public health related performance measures into its LRTP and can the agency demonstrate ongoing monitoring of its progress toward meeting its goals?	Excluded		
	SPR-07.4c	Does the agency monitor progress toward goals for at least one year and can the agency show measurable advancement toward goals?	Excluded		

Exhibit 1-8. SPR-08

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
SPR-08 Freight and Goods Access & Mobility (for Regions)	SPR-08.1a	Does the agency include in system plans specific provisions for maintaining and improving freight reliability and connectivity between modes, and to freight generators for both inter and intracity freight, in ways that enhance sustainability?	Modified	Freight considerations are relevant at the corridor scale because they can trigger environmental concerns, and freight is a large component of the economy.	Does the study identify opportunities for maintaining and improving freight reliability and connectivity between modes and to freight generators for both inter and intracity freight, in ways that enhance sustainability?
	SPR-08.1b	Does the agency consider multimodal freight mobility needs in the planning process?	Modified		Does the study consider multimodal freight mobility needs, such as intermodal facilities and the siting of freight facilities?
	SPR-08.2a	Does the agency regularly engage freight service providers, stakeholders, workers, and representative in developing transportation planning documents?	Modified	This criteria falls under the public involvement efforts that should be incorporated into planning studies; however, it may not be applicable to all corridors. In corridors where freight is applicable, siting of freight facilities should be addressed and neighborhoods surrounding freight facilities should be included as stakeholders.	During the study, were freight service providers, stakeholders (including neighborhoods that surround freight facilities), workers, and representatives engaged?
	SPR-08.2b	Does the agency utilize institutional mechanisms to facilitate the engagement of freight stakeholders?	Included	NCTCOG's freight committee doesn't currently function on the corridor scale, but it should.	
	SPR-08.3a	Does the agency include and monitor freight access performance measures in planning documents?	Modified	While performance measures are not relevant to a corridor study, the study can look at whether the corridor increases freight accessibility, mobility, and reliability.	Does the study assess freight access and mobility, such as freight movements, turning radius, adequate capacity or restricted capacity, and land use ordinances that minimize freight effects on the surrounding areas?

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
	SPR-08.3b	Does the agency include and monitor freight mobility performance measures in planning documents?	Modified		Does the study assess freight reliability by identifying opportunities for infrastructure that supports supply chain movements, including truck parking with amenities for drivers and the corridor's capacity for safe and efficient movement of freight?
	SPR-08.4a	Does the agency provide for planning, evaluating, maintaining and improving intermodal freight connectors and linkages to freight generators at all levels?	Excluded	Monitoring progress is not relevant to this phase of planning.	
	SPR-08.4b	Does the agency provide for planning, evaluating, maintaining, and enhancing freight mobility utilizing appropriate quantitative measures and monitoring for freight modes?	Excluded		
	SPR-08.4c	Does the agency monitor progress toward goals for at least one year and show measurable advancement toward goals?	Excluded		

Exhibit 1-9. SPR-09

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
SPR-09 Travel Demand Management (for Regions)	SPR-09.1a	Has the agency developed quantifiable TDM goals and objectives for reducing travel demand for the transportation network within its jurisdiction?	Modified	TDM supports the Congestion Management Process and should be addressed in the agency's planning work, including corridor studies.	Does the study identify TDM strategies for each alignment that are consistent with the region's Congestion Management Process?
	SPR-09.1b	Are the TDM goals and objectives also consistent with relevant state and/or metropolitan goals and objectives for reducing travel demand?	Modified	Because the Congestion Management Process should already be consistent with relevant state or metropolitan goals and objectives, this criteria was modified to include evaluation of a TSM&O/TDM-Only Alternative, as outlined in NCTCOG's Congestion Management Process - 2013 Update.	Does the study analyze a TSM&O/TDM-Only Alternative using the steps described in NCTCOG's Congestion Management Process - 2013 Update?
	SPR-09.2	Is the agency implementing a comprehensive TDM program that includes several of the various types of TDM strategies described?	Excluded	An agency-scale discussion is not appropriate for a corridor study.	
	SPR-09.3	Does the agency have quantifiable TDM performance measures and can the agency demonstrate ongoing monitoring of its TDM program?	Excluded	Performance measures and monitoring are not relevant to this phase of planning.	
	SPR-09.4	Can the agency demonstrate sustainable outcomes?	Excluded	Outcomes of TDM planning will not be evident until after construction.	

Exhibit 1-10. SPR-10

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
SPR-10 Air Quality & Emissions (for Region)	SPR-10.1	Has the agency developed goals and objectives for the reduction of air emissions in transportation planning documents?	Modified	The MPO's goals and objectives for the reduction of air emissions are most applicable to the region. However, planning documents can encourage that these goals be addressed at the corridor level by implementing agencies.	Does the study encourage implementing agencies to compare the emissions generated during construction of alternative alignments by using tools such as the Construction and Maintenance Emissions Calculator?
	SPR-10.2	Does the agency regularly engage partner agencies throughout the transportation planning process?	Modified	Involving air quality stakeholders early in the planning process could help identify technology opportunities to reduce emissions.	Did the study include partner agencies relevant to air quality and emissions during the study?
	SPR-10.3	Is the agency implementing multimodal strategies as part of a transportation plan to reduce emissions?	Modified	This criteria was rewritten to shift from implementing to analysis to be more appropriate to this phase of planning.	Does the study use tools such as MoSVR to compare alignments that incorporate multimodal strategies and proximity to transit as part of a transportation plan to reduce emissions?
	SPR-10.3a	Are transportation demand management strategies implemented?	Excluded	Transportation demand management is covered in depth in separate criteria.	
	SPR-10.3b	Are transportation system management strategies implemented?	Excluded	Transportation system management strategies are covered in depth in separate criteria.	
	SPR-10.3c	Are vehicle technologies implemented?	Modified	This criteria was rewritten to shift from implementing to analysis to be more appropriate to this phase of planning.	Are opportunities for vehicle technologies identified in the study?
	SPR-10.3d	Are fuel technologies and supporting infrastructure implemented?	Modified	This criteria was rewritten to shift from implementing to analysis to be more appropriate to this phase of planning.	Are opportunities for infrastructure that supports fuel technologies, natural gas refueling, or battery charging stations identified in the study?
	204-10.4	Was an emissions analysis performed?	Excluded	Such an analysis is not applicable on the corridor level.	

Exhibit 1-11. SPR-11

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
SPR-11 Energy and Fuels (for Regions)	SPR-11.1a	Has the agency developed energy and/or fossil fuel reduction goals and objectives for the transportation system within its jurisdiction?	Excluded	Local governments typically are responsible for installing infrastructure (such as electric vehicle charging stations) that reduce energy and fossil fuel consumption. This topic should be addressed in a supplemental recommendations chapter in the study.	
	SPR-11.1b	Are the goals and objectives consistent with relevant state and/or metropolitan goals and objectives for reducing energy and fossil fuel consumption?	Excluded		
	SPR-11.2a	Has the agency developed and does the agency maintain a baseline inventory of current energy and/or fossil fuel consumption from transportation?	Excluded	Consumption is analyzed for the region, not for individual corridors. In a new corridor, consumption would automatically increase.	
	SPR-11.2b	Does the agency use an appropriate model or method to forecast energy and fuel consumption associated with its LRTP, including business as - usual and alternative scenarios?	Excluded		
	SPR-11.3	Is the agency developing a plan and implementing strategies to reduce transportation-related energy and/or fossil fuel usage?	Excluded	This criteria also is more relevant at the regional level.	
	SPR-11.3a	Are energy and fossil fuel reduction strategies included in the LRTP, and does the LRTP include a discussion of the impacts of including these strategies?	Excluded		
	SPR-11.3b	Does the agency implement transportation strategies to reduce transportation-related energy and fossil fuel consumption and related emissions?	Excluded		

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
	SPR-11.4	Does the agency develop performance measures, monitor progress, and demonstrate sustainable outcomes?	Excluded	Performance measures and monitoring are not relevant to this phase of planning.	
	SPR-11.4a	Has the agency incorporated energy and fossil fuel reduction performance measures into the transportation planning process?	Excluded		
	SPR-11.4b	Does the agency demonstrate ongoing monitoring of its progress toward reducing energy and fossil fuel consumption?	Excluded		

Exhibit 1-12. SPR-12

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
SPR-12 Financial Sustainability (for Regions)	SPR-12.1	Is an interagency, cooperative approach for advanced revenue forecasting practices used?	Excluded	Financial forecasting criteria are not relevant to a corridor study.	
	SPR-12.1a	Does the agency engage in regular and comprehensive coordination and information sharing among affected agencies during the development of revenue forecasts?	Excluded		
	SPR-12.1b	Does the agency undertake systematic forecast updates?	Excluded		
	SPR-12.1c	Does the agency have established processes for engaging stakeholders in a dialogue about the implications of any changes in revenue forecasts?	Excluded		
	SPR-12.2	Is an interagency, cooperative approach for advanced project estimating practices used?	Excluded	This level of financial planning is not relevant at the feasibility study phase.	
	SPR-12.2a	Does the agency keep accurate records of all changes to the project scope and document their impact on costs?	Excluded		
	SPR-12.2b	Does the agency avoid formula–driven cost estimating procedures in favor of project-specific methods?	Excluded		
	SPR-12.2c	Does the agency complete systematic cost updates regularly?	Excluded		

Exhibit 1-13. SPR-13

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
SPR-13 Analysis Methods (for Regions)	SPR-13.1a	Does the agency demonstrate that the analysis has a strong foundation in observed data suitable for developing tools which model the land use, socioeconomic, transport, and environmental systems?	Modified	This data is available and used in corridor studies.	Does the agency demonstrate that the analysis has a strong foundation in observed data suitable for analyzing land use, socioeconomic, transport, and environmental systems and for modeling transport systems?
	SPR-13.1b	Does the agency demonstrate that the data used in planning analysis are evaluated and updated on a regular basis?	Modified		Does the agency demonstrate that the data used in the study analysis are evaluated and updated on a regular basis?
	SPR-13.2	Does the agency have a current strategic plan, analysis program, or equivalent?	Included	This criteria addresses whether data is available and plans have been made to update the data.	
	SPR-13.2a	Does the program include a specific multiyear development program for maintaining transportation data resources and improving analysis methods?	Included	Having data resources and a means to keep these resources up-to-date is relevant to corridor studies.	
	SPR-13.2b	Does the program include specifications for data resources and methods to explicitly address sustainability principles?	Included		
	SPR-13.2c	Does the program include identification of an adequate level of funding required to implement the data collection and modeling, and is it also reflected in the UPWP?	Included		
	SPR-13.2d	Does the program identify and include resources that include support for experienced technical management and a mix of technical staff and/or contract staff?	Included		

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
	SPR-13.3a	Does the agency's organizational structure include a technical committee to review data collection quality, planning assumptions, and forecasting methods?	Included	Ensuring that data is adequately reviewed is relevant to corridor studies.	
	SPR-13.3b	Has the agency convened a peer review of its analysis methods?	Included		
	SPR-13.3c	Has the agency convened a peer review of its travel demand model?	Included		

Exhibit 1-14. SPR-14

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
SPR-14 Transportation Systems Management and Operations (for Regions)	SPR-14.1a	Has the agency developed clearly defined goals and objectives for improving the efficiency of the transportation system within its jurisdiction?	Modified	A corridor study is an appropriate phase to address travel demand and transportation systems management; related strategies should be consistent with relevant goals and objectives.	Does the study integrate strategies to improve the efficiency of the transportation system?
	SPR-14.1b	Are the goals and objectives also consistent with or do they surpass relevant local, state and/or metropolitan goals and objectives for improving transportation system efficiency?	Modified		Are these strategies consistent with or do they surpass relevant local, state, and/or metropolitan strategies for improving transportation system efficiency?
	SPR-14.2a	Are TSM&O strategies included in the LRTP, or other planning documents, as appropriate?	Modified	Rewritten to reference corridor studies.	Are TSM&O strategies included in the study as appropriate?
	SPR-14.2b	Does the LRTP, or equivalent, include a discussion of the impacts of including TSM&O strategies?	Modified		Does the study include a discussion of the impacts of including TSM&O strategies?
	SPR-14.2c	Are the TSM&O strategies considered and prioritized in the LRTP, or other planning documents?	Modified		Are the TSM&O strategies considered and prioritized in the study?
	SPR-14.3	Has the agency implemented or is the agency funding TSM&O strategies?	Modified	This criteria is not appropriate at the corridor level but was rewritten to encourage a process to help ensure that TSM&O strategies are implemented in future phases of the project.	Does the study feed into a process to encourage the implementation of TSM&O strategies identified in the study?
	SPR-14.4	Does the agency include TSM&O performance measures in planning documents?	Excluded	This criteria is not appropriate at the corridor level.	
	SPR-14.5	Does the agency monitor progress toward goals for at least one year and can the agency show measurable advancement toward goals?	Excluded	This criteria is not appropriate at the corridor level.	

Exhibit 1-15. SPR-15

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
SPR-15 Linking Asset Management and Planning (for Regions)	SPR-15.1	Has the agency developed clearly defined goals and objectives for linking asset management and planning in their planning documents?	Modified	Rewritten to reference corridor studies.	Does the study address the goals and objectives for linking asset management and planning as identified in the long-range transportation plan?
	SPR-15.2	Does the agency cooperate with partner agencies to integrate their asset management data and economic analysis to prioritize investments?	Included	Economic analyses of projects should be a consideration in corridor studies. Cooperating partners is necessary to provide data for these analyses.	
	SPR-15.2a	Does the agency prioritize funding based on a system in which agencies leverage LCCA to evaluate project alternatives and prioritize investments?	Modified	Data to conduct an LCCA is not available to the agency. A criteria was substituted that addresses cost efficiencies.	Does the study evaluate alignments based on their ability to optimize existing assets?
	SPR-15.2b	Does the agency prioritize funding based on a system in which agencies leverage BCA to compare projects and prioritize investments?	Modified	Rewritten to be applicable to a corridor study.	Does the study evaluate alignments based on BCA?
	SPR-15.3	Does the agency leverage performance-based planning and programming components of asset management to analyze and evaluate tradeoffs in long-range transportation planning processes?	Modified	Studies should utilize information from state Transportation Asset Management Plans.	Does the study address performance-based planning and programming components of asset management to analyze and evaluate trade-offs of alignments?
	SPR-15.4a	Does the agency prioritize transportation decisions that support maintenance and good repair of existing transportation assets?	Excluded	These design considerations are not applicable to corridor studies.	
	SPR-15.4b	Does the agency monitor progress toward goals for at least one year and can the agency show measurable advancement toward goals?	Excluded		

Exhibit 1-16. SPR-16

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
SPR-16 Infrastructure Resiliency (for Regions)	SPR-16.1	Has the agency developed goals and objectives consistent with partner agencies for infrastructure resiliency in transportation planning documents?	Modified	NCTCOG has not identified goals and objectives consistent with partner agencies, yet this is an important factor to consider in feasibility studies.	Does the study address the potential infrastructure resiliency or threats to resiliency for different alignments?
	SPR-16.2	Does the agency regularly coordinate with partner agencies within its jurisdiction throughout the transportation planning process to reduce barriers and further the prospects for implementation of strategies to address infrastructure resiliency?	Modified	The feasibility study should result in a project that is resilient. Rewritten to be applicable to a corridor study.	Were partner agencies engaged during the study to reduce barriers and further the prospects for implementation of strategies to address infrastructure resiliency?
	SPR-16.3	Does the agency coordinate with partner agencies to collect infrastructure vulnerability and risk assessments into planning documents and identify and inventory necessary event-based transportation plans that need to be developed as a result?	Modified	The feasibility study should result in a project that is resilient. Rewritten to be applicable to a corridor study.	Does the study integrate infrastructure vulnerability and risk assessments?
	SPR-16.4	Does the agency coordinate with partner agencies to develop appropriate strategies to address transportation events related to hazard events?	Modified	Integrated corridor management is applicable to corridor studies.	Were partner agencies engaged during the study to develop appropriate strategies to address transportation events related to hazard events?
	SPR-16.5	Does the agency have infrastructure resiliency performance measures incorporated into its transportation planning documents?	Excluded	This design consideration is not applicable to a corridor study.	

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
	SPR-16.6	Does the agency monitor progress towards goals for at least one year and can the agency show measurable advancement towards goals?	Excluded	This design consideration is not applicable to a corridor study.	

Exhibit 1-17a. SPR-17

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
SPR-17 Linking Planning and NEPA (for Regions)	SPR-17.1	Has the agency developed landscape-level goals and objectives for linking system and corridor planning with NEPA documentation and implementing PEL best practices?	Modified	All PEL topics are integral to a corridor study. Rewritten to be applicable to a corridor study.	Does the study address goals and objectives for linking system and corridor planning with NEPA documentation and implementing PEL best practices as identified in the long-range transportation plan?
	SPR-17.2	Does the agency have documented procedures that link system-level planning analyses to project-level NEPA analysis?	Modified		Does the agency have documented procedures that link corridor studies with project-level NEPA analysis?
	SPR-17.3	Can the agency document communication from executive management to staff level regarding the agency's commitment to strengthening planning and environmental linkages?	Modified		Does the study incorporate PEL concepts found in Table SPR-17.3?
	SPR-17.4	Are NEPA practitioners consulted during system-level planning?	Modified		Were NEPA practitioners consulted during the study?
	SPR-17.5a	Do planning processes, including long-range, corridor, and subarea studies, feature components that use NEPA principles and methods, including at least four of those listed?	Modified		Does the study feature components that use NEPA principles and methods?
	SPR-17.5b	Does the agency systematically and successfully incorporate information from the system-level planning process into project-level documents?	Modified		Does the study incorporate information from the system-level planning process?
	SPR-17.6a	Do planning and policy documents include PEL implementation performance measures?	Excluded	Corridor studies do not monitor progress.	

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
	SPR-17.6b	Does the agency monitor progress towards goals for at least one year and can the agency show measurable advancement toward goals?	Excluded		

Exhibit 1-17b. Table SPR-17.3, PEL Components to Include in Corridor Studies

Table SPR-17.3
PEL Components to Include in Corridor Studies
NEPA tiering (as described in 40 CFR 1502.20)
Purpose and need statements
Scoping and alternatives identification
Analysis or baselining of environmental conditions or impacts
Evaluation and/or elimination of alternatives
Multimodal analysis
Context-sensitive design considerations
Indirect and cumulative impacts assessment
Preparatory analyses for permitting

Exhibit 1-18. PD-01

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-01 Economic Analyses	PD-01.1a	Was a BCA for the project completed using minimum acceptable industry practices?	Excluded	Costs would be hard to develop in a feasibility study because of the speculative nature of corridors at this phase. Benefits would be difficult to quantify because air quality emissions, travel time, fuel costs, and other items typically included in a benefit analysis can't be modeled at the corridor scale on NCTCOG's travel model.	
	PD-01.1b	Was an EIA completed that meets all the listed requirements?	Excluded		

Exhibit 1-19. PD-02

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-02 Lifecycle Cost Analyses	PD-02.1a	Was an LCCA performed for all pavement structure alternatives in accordance with the method described in FHWA's Technical Bulletin for LifeCycle Cost Analysis?	Modified	This criteria was modified to better fit the corridor study phase, moving away from Lifecycle Cost Analyses but emphasizing a complementary look at asset management into the future.	Did the study analyze how the alignments utilized current roadway/transit infrastructure assets?
	PD-02.1b	Was an LCCA performed for all stormwater infrastructure alternatives considered?	Modified		Did the study analyze how the alignments utilized current stormwater assets?
	PD-02.1c	Was an LCCA performed for the project's major feature (bridges, tunnels, retaining walls, or other items not listed in the preceding options) for each of the alternatives considered?	Modified		Did the study analyze how the alignments utilized existing major features (bridges, tunnels, retaining walls, or other items not listed in the preceding options)?

Exhibit 1-20. PD-03

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-03 Context Sensitive Project Development	PD-03.1	Did the project development process generally follow the six step CSS framework described in NCHRP report 480 and NCHRP report 642, or an equivalent process?	Modified	Designing a facility that is applicable to the community is integral to a feasibility study. Rewritten to better fit this phase of planning.	Did the study evaluate alignments following the 6-step CSS framework described in NCHRP report 480 and NCHRP report 642, or an equivalent process?
	PD-03.2	Did the project development process feature a "cradle-to-grave" project team that included planners, traffic engineers, public involvement specialists, design engineers, environmental experts, safety specialists, landscape architects, right-of-way staff, freight experts, construction engineers, and others to work on projects who worked together to achieve the desired CSS-based vision for the project?	Modified	The MPO does not participate in a "cradle-to-grave" team because the agency does not implement the transportation project. However, the team conducting the study should be multidisciplinary.	Did the study team engage multimodal, multijurisdictional, and multidisciplinary team members and partners to produce a study that can be integrated into project development?
	PD-03.3	As a result of CSS-influenced project development process, were external "champions" for the project created in the affected community who were engaged and proactive in supporting it?	Included	This level of engagement is monitored during the process of a feasibility study.	
	PD-03.4	Was acceptance achieved among project stakeholders on the problems, opportunities, and needs that the project should address and the resulting vision or goals for addressing them?	Included	This is a good goal for stakeholder engagement.	
	PD-03.5	Do project features consider the appropriate scale of the project?	Modified	This topic should be considered when identifying alignments. Rewritten to be appropriate to this phase.	Were alignments identified that consider the appropriate scale of the project?

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
	PD-03.6	Did the project remove objectionable or distracting views?	Modified	This topic should be considered when identifying alignments. Rewritten to be appropriate to this phase.	Were alignments identified that remove objectionable or distracting views?
	PD-03.7	Did the project integrate context sensitive aesthetic treatments?	Modified	Feasibility studies don't address design, so this criteria was rewritten to address potential types and locations of aesthetic treatments. These topics could be further covered in a recommendations chapter.	Did the study identify potential types and locations for context sensitive aesthetic treatments?
	PD-03.8	Were aesthetics for structural items incorporated into the design of the project?	Modified	Feasibility studies don't address design, so this criteria was rewritten to address potential types and locations of aesthetic treatments. These topics could be further covered in a recommendations chapter.	Did the study identify potential structural items that would enable aesthetics to be incorporated into the project?

Exhibit 1-21. PD-04

Original INVEST Criteria						
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	Feedback from Freight/Safety teams	New Wording if Modified
PD-04 Highway and Traffic Safety	PD-04.1	Were human factors considerations incorporated?	Included	This criteria creates a balance between modes and the safety of all roadway users; it helps ensure there is a suitable land use connection. However, it should be noted that "human factors" are not limited to safety.	The safety team would like to note that "human factors" include more than just safety items as described in the reasoning column. The team has no changes to the wording.	
	PD-04.2	Was awareness built among the public regarding contributing factors to crashes?	Modified	Contributing factor data at the regional scale is published annually and data can be provided at the corridor scale, although confidentiality requirements may mean the data provided is generalized. Rewritten to be applicable to this phase.	The safety team publishes regional contributing factor analysis each year in our annual safety report. The team can also provide contributing factor data as requested for corridor projects. The team has no changes to the wording.	Does the study identify potential contributing factors to crashes and identify the need to build awareness among the public?
	PD-04.3	Does the agency conduct explicit consideration of safety using quantitative, scientifically proven methods?	Modified	Safety is an important consideration in feasibility studies. Rewritten to be applicable to this phase.	The safety team uses multiple scientific methods to evaluate roadway safety and will provide safety data to other teams to evaluate according to specific project criteria. The team does not have changes to the new wording without knowing more about what scientifically proven method is needed.	Does the study include explicit consideration of safety using quantitative methods for each alternative?

Original INVEST Criteria						
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	Feedback from Freight/Safety teams	New Wording if Modified
	PD-04.3a	Was the project type established during scoping of project alternatives through a quantitative and statistically reliable process?	Excluded	Project type would be determined by transportation need and is addressed through non-safety criteria.	The safety team agrees that this criteria does not specifically relate to safety.	
	PD-04.3b	Were project design and/or operational alternatives developed and evaluated using explicit consideration of substantive safety through quantitative, statistically reliable methods?	Excluded	This is largely repetitive of PD-04.3 when rewritten for this phase.		
	PD-04.3c	Were quantitative and statistically reliable methods and knowledge used to assess substantive safety performance in the development of preliminary and final design details?	Excluded	This criteria is more applicable to a different phase of project development.		
	PD-04.4	Was a statistically reliable, science-based method used to evaluate the safety effectiveness of the implemented project?	Excluded	This criteria is applicable in the post-construction phase.		

Exhibit 1-22. PD-05

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-05 Educational Outreach	PD-05.1	Did this project incorporate public educational outreach that promotes and educates the public about sustainability by installing or performing a minimum of two different elements from Table PD-05.1.A?	Modified	This criteria ties together stakeholder and public involvement with sustainability efforts. Several but not all of the items in Table PD-05.1.A are relevant to feasibility studies.	Did this project incorporate public educational outreach that promotes and educates the public about sustainability by developing a project website or a stakeholder guide or by giving presentations?

Exhibit 1-23. PD-06

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-06 Tracking Environmental Commitments	PD-06.1a	Was a comprehensive environmental compliance tracking system used for the project and related facilities?	Excluded	This criteria is relevant at the NEPA stage, but not in a pre-NEPA feasibility study.	
	PD-06.1b	Does the environmental tracking system have a formal mechanism to communicate commitments from transportation planning through design, construction, and maintenance?	Excluded		
	PD-06.2	Has the principal project constructor assigned an independent environmental compliance monitor who will provide quality assurance services and report directly to and make recommendations to the regulatory and lead agencies?	Excluded	This criteria is not relevant to a feasibility study.	

Exhibit 1-24. PD-07

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-07 Habitat Restoration	PD-07.1	Was project-specific mitigation or mitigation banking used on this project? Use Table PD-07.1.A to determine the points earned.	Modified	Habitat and aquatic resources are relevant to feasibility studies, but this criteria was rewritten to be relevant to pre-construction project development.	Did the study identify whether the corridor contains habitat or aquatic resources that could require mitigation or mitigation banking?
	PD-07.2	Were high quality aquatic resources (HQAR) avoided or were the impacts minimized on this project? Use Table PD-07.2.A to determine the points earned.	Excluded	Habitat and aquatic resources are relevant to feasibility studies, but the quality of a resource generally cannot be determined during a desktop analysis.	
	PD-07.3	Were high quality environmental resources avoided or were the impacts minimized on this project? Use Table PD-07.3.A to determine the points earned.	Excluded	This criteria is not relevant to pre-construction project development.	

Exhibit 1-25. PD-08

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-08 Stormwater Quality and Flow Control	PD-08.1	Did the project treat at least 80% of the total runoff volume? Use Tables PD-08.1.A and PD-08.1.B to determine points.	Excluded	This criteria is not relevant to pre-construction project development. Modifications to this criteria would not have added value when trying to choose between alternatives in a corridor study.	
	PD-08.2	Did the project manage the flow from at least 80% of the total runoff volume, and is flow control based on controlling peak flows or durations from the project site? Use Tables PD-08.2.A and PD08.1.B to determine points.	Excluded	This criteria is not relevant to pre-construction project development. Modifications to this criteria would not have added value when trying to choose between alternatives in a feasibility study.	

Exhibit 1-26. PD-09

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-09 Ecological Connectivity	PD-09.1P	Was a site-specific ecological assessment of the roadway project using GIS data or regional expertise conducted?	Modified	This criteria was re-written to be relevant to pre-construction project development. The table referred to in PD-09.1 was removed because it was not relevant to this phase. Data sources for ecological connectivity were added.	Did the study determine whether a site-specific ecological assessment of the roadway project should be conducted in a future project development phase?
	PD-09.1	Were methods used to minimize impacts to ecological connectivity? Use Table PD-09.1.A to determine points.	Modified		Did the study identify potential impacts to ecological connectivity by analyzing vehicle-wildlife collision data or the EPA's National Ecological Framework?
	PD-09.2	Did the project team engage natural resource and regulatory agencies throughout the planning process and ensure consistency with broader planning goals and objectives?	Included	Coordination with resource agencies should be documented in feasibility studies.	

Exhibit 1-27. PD-010

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-10 Pedestrian Facilities	PD-10.1P	Were all facilities upgraded to meet ADA standards and do responses below exclude any projects to upgrade facilities to ADA standards?	Modified	Pedestrian facilities should be addressed in a feasibility study. Rewritten to be applicable to this phase of planning.	Does the study identify the potential for facilities that meet ADA standards?
	PD-10.1	Were missing pedestrian connections installed per master plan or other relevant documents?	Modified	A corridor study will address these active transportation needs. Rewritten to be applicable to this phase.	Does the study identify missing pedestrian connections?
	PD-10.2	Were pedestrian features installed that are safe, comfortable, convenient, and connected?	Modified	A corridor study will address these active transportation needs. Rewritten to be applicable to this phase.	Does the study identify opportunities for pedestrian features that are safe, comfortable, convenient, and connected?

Exhibit 1-28. PD-11

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-11 Bicycle Facilities	PD-11.1	Were missing bicycle connections installed per master plan or other relevant documents?	Modified	Bicycle facilities should be addressed in a corridor study. Rewritten to be applicable to this phase of planning.	Does the study identify opportunities for bicycle connections within the corridor and with adjacent corridors?
	PD-11.2	Were bicycle features installed that are safe, comfortable, convenient, and connected?	Modified	Bicycle facilities should be addressed in a corridor study. Rewritten to be applicable to this phase of planning.	Does the study identify opportunities for bicycle features that are safe, comfortable, convenient, and connected?

Exhibit 1-29. PD-12

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included/ Modified/ Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-12 Transit and HOV Facilities	PD-12.1	Were Transit and HOV facilities installed on this project that are consistent with the need, purpose, and appropriateness for transit and HOV access within the project footprint? Use Table PD-12.1.A to determine points.	Modified	Transit and HOV should be addressed in feasibility studies, but the criteria was modified to be relevant to pre-construction project development.	Did the study identify the need, purpose, and appropriateness for transit and HOV access within the project footprint?

Exhibit 1-30. PD-13

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-13 Freight Mobility	PD-13.1	Were freight facilities installed on this project consistent with the need, purpose, and appropriateness for freight mobility within the project footprint? Use Table PD-13.1.A to determine points.	Excluded	This criteria is not relevant at the corridor-study phase; the spirit of this criteria is covered in previous criteria.	

Exhibit 1-31. PD-14

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-14 ITS for System Operations	PD-14.1	Were one or more allowable ITS applications installed? Use Table PD-14.1.A to determine points.	Modified	This criteria was modified to be relevant to pre-construction project development and to include ITS-related data that can be readily incorporated into a corridor study.	Did the study identify access to fiber networks or other sufficient infrastructure for ITS applications?

Exhibit 1-32. PD-15

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-15 Historical, Archaeological, and Cultural Preservation	PD-15.1P	Is any part of the project or resource listed in the NRHP or been determined eligible for the NHRP by a state, local, or Tribal Historic Preservation Officer?	Modified	This criteria was modified so it could be applied to multiple alternatives during the feasibility study and be relevant to pre-construction project development.	Does the study identify whether sites including historic cemeteries, National Register Districts, or National Register Properties exist within the corridor?
	PD-15.1	Has an effort been made to minimize impacts, avoid impacts, or enhance features?	Modified		Has an effort been made to identify alternatives that avoid or minimize impacts?
	PD-15.2P	Is a portion of the project along one of Americas Byways, a State Scenic Byway, an Indian Tribe Scenic Byway, or other route designated or officially recognized as significantly historical, cultural, or archaeological?	Modified	The NCTCOG region does not include any Americas Byways, State Scenic Byways, or Indian Tribe Scenic Byways. However, State Scenic Trails occur in the region.	Does the study identify whether a portion of the project is along a State Scenic Trail or route designated or officially recognized as significantly historical, cultural, or archaeological?
	PD-15.2	Has an effort been made to minimize impacts, avoid impacts, or enhance features?	Modified	This criteria was modified so it could be applied to multiple alternatives during the feasibility study and be relevant to pre-construction project development.	Has an effort been made to identify alternatives that minimize or avoid impacts?
	PD-15.3P	Is any part of the project or resource recognized by the community as having historic, cultural, and/or archeological significance to the community?	Modified	Some minor rewording was done on this criteria. This criteria incorporates cultural issues and public/stakeholder involvement, which are relevant to feasibility studies.	Does the study identify whether any part of the project or corridor is recognized by the community as having historic, cultural, and/or archeological significance to the community?
	PD-15.~~1~~3	Were measures taken to specifically avoid impacts to these features?	Modified	This criteria was modified so it could be applied to multiple alternatives during the corridor study and be relevant to pre-construction project development.	Has an effort been made to identify alternatives that minimize or avoid impacts?

Exhibit 1-33. PD-16

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included/ Modified/ Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-16 Scenic, Natural, or Recreational Qualities	PD-16.1P	Is any portion of the project along one of America's Byways®, a State Scenic Byway, an Indian Tribe Scenic Byway, or other route that was designated or officially recognized as such?	Modified	The NCTCOG region does not include any Americas Byways, State Scenic Byways, or Indian Tribe Scenic Byways. This criteria was modified to address recreational facilities the region does have.	Does any portion of the project intersect or travel along a local, state, or national park; a recognized paddling trail; or a trail designated by the Texas Historical Commission as part of The Texas Heritage Trails Program or other route?
	PD-16.1.a~~2P~~	Was existing access to scenic, natural, or recreational qualities not removed (i.e., maintained) as a part of this project unless it was specifically removed to protect the scenic, natural, and/or recreational qualities themselves?	Modified	This criteria was modified to be applicable to a corridor study. Addressing natural features and parks is relevant to such a study.	Was an alignment identified that maintained existing access to scenic, natural, or recreational qualities unless the access was specifically removed to protect the scenic, natural, or recreational qualities themselves?
	PD-16.1.b~~P~~	Were efforts made to avoid or minimize impacts, or enhance features, of the scenic, natural, and/or recreational qualities?	Modified	This criteria was modified to be applicable to a corridor study. Addressing natural features and parks is relevant to such a study.	Has an effort been made to identify alternatives that minimize or avoid impacts?

Exhibit 1-34. PD-17

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-17 Energy Efficiency	PD-17.1P	Were energy needs evaluated for the project?	Excluded	This criteria would be included in the DOT's construction cost process, and could not be used to identify the merits of different alternatives.	
	PD-17.1	Were alternatives implemented to reduce power consumption while still meeting lighting and safety standards?	Excluded		
	PD-17.2P	Was the energy consumption on the project reduced through the installation of energy efficient lighting and signal fixtures and through the installation of autonomous, onsite, renewable power sources?	Excluded	This criteria is not relevant to pre-construction project development.	
	PD-17.2	Points are awarded based on the percentage of reduced power use. Based on Table PD-17.2.A, how many points did the project earn?	Excluded		
	PD-17.3	Was a plan established for auditing energy use after project completion as part of operations and maintenance?	Excluded	This criteria is not relevant to pre-construction project development.	

Exhibit 1-35. PD-18

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-18 Site Vegetation, Maintenance and Irrigation	PD-18.1P	Does all site vegetation use non-invasive species only, use non-noxious species only, use seeding that does not require consistent mowing for a viable stand of grass, and minimize disturbance of native species?	Excluded	This criteria was not included because it addresses the post-construction phase of project development.	
	PD-18.1P	Based on Table PD-18.1.A, how many points did the project earn?	Excluded		
	PD-18.2	Based on Table PD-18.2.A, how many points did the project earn for vegetative maintenance? Points for features are cumulative; however, this scoring requirement shall not exceed a total of 3 points.	Excluded	This criteria was not included because it addresses the post-construction phase of project development.	

Exhibit 1-36. PD-19

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-19 Reduce, Reuse and Repurpose Materials	PD-19	Points for different methods are cumulative; however, this criterion shall not exceed a total of 12 points. Points exceeding 12 will not contribute to overall score.	Excluded	These criteria were not included because they address the post-construction phase of project development.	
	PD-19.1	Was remaining service life increased through pavement preservation activities? Points are awarded per Table PD-19.1.A.	Excluded		
	PD-19.2	Was the amount of new pavement materials needed reduced? Points are awarded per Table PD-19.2.A.	Excluded		
	PD-19.3	Was remaining service life increased through bridge preservation activities? Points are awarded per Table PD-19.3.A.	Excluded		
	PD-19.4	Was remaining service life increased through retrofitting existing bridge structures? Points are awarded per Table PD-19.3.A.	Excluded		
	PD-19.5	Were existing pavements, structures, or structural elements reused for a new use? Points are awarded per Table PD-19.5.A.	Excluded		
	PD-19.6b	Were industrial byproducts reused in pavement materials, ancillary structures, and other roadway elements?	Excluded		
	PD-19.6a	Were foundry sand or other industrial byproducts used in pipe bedding and backfill?	Excluded		

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
	PD-19.7	Was a project-specific plan for the recycling and reuse plan developed as described?	Excluded		

Exhibit 1-37. PD-20

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-20 Recycle Materials	PD-20	Points for different methods are cumulative; however, this criterion shall not exceed a total of 10 points. Points exceeding 10 will not contribute to overall score.	Excluded	This criteria was not included because it addresses the post-construction phase of project development.	
	PD-20.1	Was RAP or RCA used in new pavement lifts, granular base course, or embankments? Points are awarded per Tables PD-20.1.A or PD-20.1.B.	Excluded		
	PD-20.2	Were pavement materials recycled in place using cold-in-place recycling, hot-in-place recycling, and full depth reclamation methods? Points are awarded per Table PD-20.2.A.	Excluded		
	PD-20.3	Did the project reuse subbase granular material as subgrade embankment or as part of the new subbase? Points are awarded per Table PD-20.3.A.	Excluded		
	PD-20.4	Did the project relocate and reuse at least 90% of the minor structural elements, including existing luminaires, signal poles, and sign structures that are required to be removed and/or relocated onsite?	Excluded		
	PD-20.5	Did the project salvage or relocate existing buildings?	Excluded		

Exhibit 1-38. PD-21

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-21 Earthwork Balance	PD-21.1a	Are the design cut and fill volumes or the actual construction cut and fill volumes balanced to within 10%?	Modified	Design cut and fill criteria were modified and condensed into one criteria that focuses on incorporating grade into studying the feasibility of alignments.	Were the profile (preliminary engineering schematic) and terrain of alternatives identified to incorporate grade into feasibility considerations?
	PD-21.1b	Are the design cut and fill volumes or the actual construction cut and fill volumes balanced to within 10% if construction banking is used?			
	PD-21.2	Has an earthwork management plan been established, implemented, and actively managed on this project?	Excluded	This criteria is applicable during the construction phase.	
	PD-21.3	Has topsoil been preserved or reused on this project?	Excluded	This criteria is applicable during the construction phase.	

Exhibit 1-39. PD-22

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-22 Long-Life Pavement	PD-22	Points for different methods are cumulative; however, this criterion shall not exceed a total of 7 points. Points exceeding 7 will not contribute to overall score.	Excluded	Pavement choices are not relevant to the corridor study phase of planning	
	PD-22.1	Which of the following describes how long-life pavement was used on this project?	Excluded		
	PD-22.2	Was the asphalt density of 100% of the total new or reconstructed pavement increased to a minimum of 94%?	Excluded		
	PD-22.3	Was a performance-based pay incentive for pavement smoothness used on this project?	Excluded		

Exhibit 1-40. PD-23

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-23 Reduced Energy and Emissions in Pavement Materials	PD-23	Points for different methods are cumulative; however, this criterion shall not exceed a total of 3 points. Points exceeding 3 will not contribute to overall score.	Excluded	Pavement choices are not relevant to the feasibility study phase of planning.	
	PD-23.1	Was at least 50% of the total project pavement material (by weight) a low--energy material from asphalt production?	Excluded		
	PD-23.1a	Was the warm mix asphalt mixing temperature reduced by one of the following: Less than 30 degrees/a minimum of 30/40/50 degrees from that recommended by the binder supplier.	Excluded		
	PD-23.2	Was at least 50% of the total project pavement material (by weight) a low-energy material from cement production?	Excluded		
	PD-23.3	Was at least 50% of the total project pavement material (by weight) a low--energy material from concrete production?	Excluded		

Exhibit 1-41. PD-24

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-24 Permeable Pavement	PD-24.1 and PD-24.2	Does the project include a maintenance plan for permeable pavements and are permeable pavements placed in areas where no sand will be used for snow and ice control or pavement sealing?	Excluded	This criteria is not applicable to this phase of planning.	
	PD-24.1	Is permeable pavement used on the project?	Excluded		

Exhibit 1-42. PD-25

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-25 Construction Environmental Training	PD-25.1	Did the owner require the contractor to plan and implement a formal environmental awareness training program during construction to ensure the project stay in compliance with environmental laws, regulations, and policies?	Excluded	This criteria is not applicable to this phase of planning.	

Exhibit 1-43. PD-26

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-26 Construction Equipment Emission Reduction	PD-26.1	Were one or more methods implemented to reduce nonroad emissions? Points are awarded per Table PD-26.1.A.	Excluded	This criteria is not applicable to this phase of planning.	

Exhibit 1-44. PD-27

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-27 Construction Noise Mitigation	PD-27.1	Is the contractor required to establish, implement, and maintain a formal NMP during roadway construction?	Excluded	This criteria is not applicable to this phase of planning.	
	PD-27.2	Has the contractor monitored noise and the effectiveness of mitigation measures at the receptors throughout construction to ensure compliance with the NMP?	Excluded		

Exhibit 1-45. PD-28

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-28 Construction Quality Control Plan	PD-28.1	Is the contractor required to plan and implement quality control measures throughout construction with care and for materials above and beyond what is typically required by specifications and regulations?	Excluded	This criteria is not applicable to this phase of planning.	
	PD-28.2	Does the contract leverage the use of Quality Price Adjustment Clauses to link payment and performance of the constructed products?	Excluded		

Exhibit 1-46. PD-29

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-29 Construction Waste Management	PD-29.1	Is the contractor required to establish, implement, and maintain a formal CWMP during roadway construction, or its functional equivalent?	Excluded	This criteria is not applicable to this phase of planning.	
	PD-29.2	Can the owner demonstrate that a percentage of the construction waste has been diverted from landfills?	Excluded		
	PD-29.3	Were excess materials hauled directly to other project sites for recycling on those projects?	Excluded		

Exhibit 1-47. PD-30

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-30 Low Impact Development	PD-30.1	Did the project use effective BMPs or stormwater management techniques that mimic natural hydrology to treat pollutants? Use Tables PD-30.1.A and PD-30.1.B and PD30.1.C to determine points.	Excluded	This criteria is not applicable to this phase of planning.	

Exhibit 1-48. PD-31

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-31 Infrastructure Resiliency Planning and Design	PD-31.1	Did the project incorporate consideration of climate change at a project-specific level in project development and environmental reviews?	Modified	Resiliency factors affect life cycle costs; factors that degrade facilities include weather, environmental impacts, and soil conditions. These should be addressed in a corridor study. For example, is the 25-year flood an appropriate metric for building culverts, or should more stringent recommendations be made?	Does the study incorporate consideration of climate change or extreme weather impacts, such as drainage; the urban heat island effect; the width of the roadway; the shrink-swell potential for soils, which could be affected by precipitation levels; and flooding potential that may be greater than that documented in FEMA flood maps because of increased impervious surfaces over time?
	PD-31.2	Did the project incorporate future consideration of climate change effects in the design process?	Excluded	These are not appropriate for this phase of planning.	
	PD-31.2a	Which of the following options applies?	Excluded		
	PD31.3	Did the project mitigate the effects of GHG emissions through design efforts above and beyond requirements and regulations?	Modified	The MPO cannot identify GHG emissions on the corridor level, but congestion can function as a proxy.	Did the study address potential GHG emissions through reducing congestion?

Exhibit 1-49. PD-32

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-32 Light Pollution	PD-32.1	Were the uplighting ratings met on this project per Table PD-32.1.A?	Modified	This post-construction criteria were rewritten to be applicable to a feasibility study; light pollution is relevant both to drivers and wildlife.	Did the study identify whether the corridor includes factors that may be negatively impacted by light pollution including uplighting, backlighting, and glare?
	PD-32.2	Were the backlighting ratings met on this project per Table PD-32.2.A?	Excluded	This post-construction criteria were rewritten to be applicable to a feasibility study and modified to generate one light pollution criteria.	
	PD-32.3	Were the glare ratings met on this project per Table PD-32.3.A?	Excluded	This post-construction criteria were rewritten to be applicable to a feasibility study and modified to generate one light pollution criteria.	

Exhibit 1-50. PD-33

Original INVEST Criteria					
Criteria Description	Criteria Number	Original Wording	Included Modified Excluded	Reason Selected or Not Selected	New Wording if Modified
PD-33 Noise Abatement	PD-33	Points for different noise abatement methods are cumulative; however, this criterion shall not exceed a total of 5 points. Points exceeding 5 will not contribute to overall score.	Excluded	It would only be possible to look at noise in a very general way in a feasibility study, so this criteria has been excluded.	
	PD-33.1	Was a specialized noise barrier used on this project?	Excluded		
	PD-33.2	Were traffic system management techniques used to reduce existing noise levels?	Excluded		
	PD-33.3	Were buffer zones provided for adjacent noise sensitive receptors?	Excluded		
	PD-33.4	Were quiet pavements used on the project? Use Table PD-33.4.A to determine the points earned.	Excluded		
	PD-33.5	Were plantings used as a sight screen to separate noise receptors from the project?	Excluded		

Appendix 2 – Criteria Scoring

The interim Corridor Study (i-CS) criteria scored were developed by the North Central Texas Council of Governments INVEST team based on existing System Planning for Regions and Project Development criteria from INVEST 1.2 Staff with expertise in the area of the criteria were asked to score the Regional Outer Loop Corridor Feasibility Study completed in 2011. The INVEST team then workshopped those scores, producing a final score, and additional comments.

For an umbrella criterion that ended in "P," a score of No ("N") or Yes ("Y") was initially given. If an "N" was given, the reviewer gave all subcriteria under the umbrella criterion a score of "0" to indicate the study did not address the subcriteria. If a "Y" was given, the reviewer moved on to scoring the subcriteria under the umbrella criterion. For these scorable subcriteria or for a criterion that did not end in "P," a score of "0" was given if the study did not address a criterion. For scorable subcriteria or a criterion that did not end in "P," a score of "1" was given if the study did address a criterion. Reviewers did not attempt to score how well the criteria were addressed. The Regional Outer Loop Corridor Feasibility Study was not given an overall rating of Gold, Silver, etc.

Following the INVEST team workshops, these interim criteria were further refined to combine similar criteria and eliminate criteria that, upon re-evaluation, were not appropriate for a feasibility study. This resulted in the Draft Feasibility Study Sustainability Menu included as Exhibit 1 in the main body of this report. Because of these refinements, the "i-CS" numbers in this appendix do not match the "CS" numbers used in that menu.

Exhibit 2-1. CS-01

INVEST Scorecard for Corridor Studies								
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 1	Comments from Reviewer 1 (optional)	Score from Reviewer 2	Comments from Reviewer 2 (optional)	INVEST Team Workshop	
							Workshop Score	Workshop Comment
CS-01 Planning for Economic Development and Land Use	CS-01.1a	Has the agency developed a purpose and need in the feasibility/PEL study ("study") that integrates transportation planning with economic development and land use planning above and beyond current requirements?		N/A		Unknown. What "current requirements" are they referring to?	0	The original study was developed to be a Planning and Environment Linkages (PEL) study; it looked at economic development and land use. Consider removing reference in criteria to "current requirements." Should the purpose and need integrate the current transportation needs component with economic development and land use?
	CS-01.1b	Are the purpose and need consistent with applicable economic development and land use plans above and beyond current requirements?		N/A		Unknown. What "current requirements" are they referring to?	0	This is an incremental development over the previous criteria; we will combine them.
	CS-01.2a	Did the agency regularly engage land use and economic development agencies in its jurisdiction as applicable when developing the study?		N/A		Unknown	1	The study included counties, economic development corporations from cities, US Army Corps of Engineers, and land developers.
	CS-01.2b	Does the agency utilize institutional mechanisms to facilitate the engagement?		N/A		Unknown	1	Regular stakeholder meetings were held and opportunities for comments were provided.
	CS-01.3	Does the agency use best practice quantitative methods to analyze and evaluate the performance of alternative transportation scenarios?	0	No quantitative analysis occurs, plan only references existing adopted local and county master plans.	0		0	No quantitative analysis was conducted on land use implications.

INVEST Scorecard for Corridor Studies								
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 1	Comments from Reviewer 1 (optional)	Score from Reviewer 2	Comments from Reviewer 2 (optional)	INVEST Team Workshop	
							Workshop Score	Workshop Comment
	CS-01.4	Does the agency provide institutional leadership in encouraging transportation planning that is consistent with land use and economic development plans and that supports sustainability principles?		N/A		Generally, or specifically in reference to this study?	0	A goal was to incorporate existing corridors to provide staging to be consistent with ongoing comprehensive planning and thoroughfare planning.
	CS-01.5	Is the study integrated with land use and economic development plans, and is the agency implementing transportation investments that support sustainability principles?		N/A		These are two separate questions - one about the study, one about the agency.	0.5	These should be broken out into different questions. However, existing studies or plans won't ultimately go forward exactly as planned over time. The 2011 study was integrated with land use and economic development plans. Incorporating existing corridors was an effort to address sustainability.

Exhibit 2-2. CS-02

INVEST Scorecard for Corridor Studies								
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 1	Comments from Reviewer 1 (optional)	Score from Reviewer 2	Comments from Reviewer 2 (optional)	Score from Reviewer 3	Comments from Reviewer 3 (optional)
CS-02 Planning for the Natural Environment	CS-02.1	Has the agency developed a purpose and need for the study that integrates transportation planning with applicable environmental plans, policies, and goals?	1		1		0	The need and intent discuss the MTP's sustainability objective but not how transportation planning in this study will be integrated with applicable environmental plans/policies/goals. The MTP sustainability/environmental objectives are addressed as guiding principles in the corridor selection/evaluation section.
	CS-02.2a	Does the agency go above and beyond current consultation requirements by regularly engaging natural resource and regulatory agencies?	1		1		0	This was only done as a part of TRACES (now PEL) efforts. Staff also participated in an FHWA hosted peer exchange which had resource agency attendees.
	CS-02.2b	Does the agency utilize institutional mechanisms to facilitate the engagement?	1		1		1	Yes, existing TRACES efforts were used. Staff also participated in an FHWA hosted peer exchange which had resource agency attendees.
	CS-02.3	Did the study launch efforts to promote sustainable outcomes in project design, implementation, and maintenance?	0		0	Project design and maintenance were not included.	0	The study talks about sustainable development as a goal of MTP and gives their definition of it but not how they are going to implement it in this study.

INVEST Scorecard for Corridor Studies						
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 4	Comments from Reviewer 4 (optional)	INVEST Team Workshop	
					Workshop Score	Workshop Comment
CS-02 Planning for the Natural Environment	CS-02.1	Has the agency developed a purpose and need for the study that integrates transportation planning with applicable environmental plans, policies, and goals?	0	Need and intent are based on transportation needs, population/ employment growth, system linkages, intermodal connections.	0	The need and purpose is not intended to be an impact analysis or to consider the environment -- it identifies a transportation need and a purpose for the project. The feasibility study process considers environmental impacts. In the 2011 study, the plan was to create as small a right of way as possible and use existing facilities. Transportation projects that relieve congestion do address a need to improve air quality. But MPOs should address air quality in system planning.
	CS-02.2a	Does the agency go above and beyond current consultation requirements by regularly engaging natural resource and regulatory agencies?	0	It's not evident from this study. Maybe so, but this study really talks about R&R who were stakeholders for this study. However, it does mention the TRACES group.	1	There is no requirement for public involvement for feasibility studies. So technically yes, the 2011 study did go above and beyond.
	CS-02.2b	Does the agency utilize institutional mechanisms to facilitate the engagement?	1		1	The 2011 study utilized NCTCOG's TRACES (Transportation Resource Agency Consultation & Environmental Streamlining) group.
	CS-02.3	Did the study launch efforts to promote sustainable outcomes in project design, implementation, and maintenance?	0	The environmental data is provided, but not analyzed or really applied to selecting alignments (other than some built environment issues such as impacting access to existing neighborhoods.	0	The 2011 study did not launch these efforts. A feasibility study is too early in planning process to take this step.

Exhibit 2-3. CS-03

INVEST Scorecard for Corridor Studies								
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 1		Comments from Reviewer 1 (optional)	Score from Reviewer 2		Comments from Reviewer 2 (optional)
CS-03 Data Evaluation for the Natural Environment	CS-03.1P	Does the study apply system or landscape-scale evaluation techniques using natural resource data?	Yes - Proceed to score related criteria			Yes - Proceed to score related criteria		Table 3.35 Acreage of Vegetation Types by Subarea
	CS-03.1a	Did the study identify whether the corridor contains habitat or aquatic resources that could require mitigation or mitigation banking?		0			1	Potential impacts are identified in Appendix A.
	CS-03.1b	Did the study identify potential impacts to ecological connectivity by analyzing vehicle-wildlife collision data or the EPA's National Ecological Framework?		0			0	
	CS-03.2	Did the study determine whether a site-specific ecological assessment of the roadway project should be conducted in a future project development phase?		1			1	
	CS-03.3	Did the study identify how alignments may affect long-term ecological function?		0			0	

INVEST Scorecard for Corridor Studies									
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 3		Comments from Reviewer 3 (optional)	Score from Reviewer 4		Comments from Reviewer 4 (optional)	INVEST Team Workshop
									Workshop Score	Workshop Comment
CS-03 Data Evaluation for the Natural Environment	CS-03.1P	Does the study apply system or landscape-scale evaluation techniques using natural resource data?	Yes - Proceed to score related criteria.		Regional Natural resource data is used from various sources.	Yes - Proceed to score related criteria.			Yes	
	CS-03.1a	Did the study identify whether the corridor contains habitat or aquatic resources that could require mitigation or mitigation banking?		1	The study Identifies the waters of the US (those which may be subject to CWA 404–including streams, lakes and wetlands) that could be impacted by the corridor using existing NLCD data. As there is not alignment, those that would need mitigation or mitigation banking is unknown.		1	IDs streams and wetlands; language on mitigation is boilerplate.	1	Yes - the 2011 study identified aquatic resources, but this is not the phase for identifying mitigation needs. This phase should not commit to a type of mitigation that in the future may not be feasible or appropriate.
	CS-03.1b	Did the study identify potential impacts to ecological connectivity by analyzing vehicle-wildlife collision data or the EPA's National Ecological Framework?		0	The study does not analyze vehicle-wildlife collisions. The study concludes that based on land use data (indicated only 12% of the land is was developed) and aerial photos which show most of the of the land as unfragmented, it could support a high species diversity.		0		0	This dataset was not available during the 2011 study, but the project did look at undeveloped land. Vehicle-wildlife collision data may or may not be available.

INVEST Scorecard for Corridor Studies									
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 3		Comments from Reviewer 3 (optional)	Score from Reviewer 4		Comments from Reviewer 4 (optional)	INVEST Team Workshop
									Workshop Score	Workshop Comment
	CS-03.3	Did the study identify how alignments may affect long-term ecological function?		0	The study identifies environmental resources for each subarea corridor/path options and evaluates each based on presence/potential to impact environmental factors. It doesn't not discuss long term ecological function.		0		0	The study did not identify this, but this is more of a cumulative impact topic, which is not typically done for feasibility studies.

Exhibit 2-4. CS-04

INVEST Scorecard for Corridor Studies										
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 1		Comments from Reviewer 1 (optional)	Score from Reviewer 2		Comments from Reviewer 2 (optional)	Score from Reviewer 3		Comments from Reviewer 3 (optional)
CS-04 Scenic, Natural, or Recreational Qualities	CS-04.1P	Does any portion of the project intersect or travel along a local, state, or national park; a recognized paddling trail; or a trail designated by the Texas Historical Commission as part of The Texas Heritage Trails Program or other route?	Yes - Proceed to score related criteria			Yes - Proceed to score related criteria		Table 3.18 Parklands and Recreation Area by Subarea	Yes - Proceed to score related criteria		Ray Roberts Lake and Greenbelt, many local parks, several historic sites.
	CS-04.1a	Was an alignment identified that maintained existing access to scenic, natural, or recreational qualities unless the access was specifically removed to protect the scenic, natural, or recreational qualities themselves?		0			0			0	Several potential alignments were identified that considered social and environmental factors but access to them was not specifically considered.
	CS-04.1b	Has an effort been made to identify alternatives that minimize or avoid impacts?		1			1			1	Corridor selected considered avoiding and minimizing negative the environmental factors identified in the study.

INVEST Scorecard for Corridor Studies							
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 4		Comments from Reviewer 4 (optional)	INVEST Team Workshop	
						Workshop Score	Workshop Comment
CS-04 Scenic, Natural, or Recreational Qualities	CS-04.1P	Does any portion of the project intersect or travel along a local, state, or national park; a recognized paddling trail; or a trail designated by the Texas Historical Commission as part of The Texas Heritage Trails Program or other route?	Yes - Proceed to score related criteria			Yes	
	CS-04.1a	Was an alignment identified that maintained existing access to scenic, natural, or recreational qualities unless the access was specifically removed to protect the scenic, natural, or recreational qualities themselves?		0	Issues/Concerns are identified for corridors, including impacts to ponds, proximity to floodplains, etc. But access to natural areas not emphasized.	0	The 2011 feasibility study doesn't look at interchanges or direct access to and from any specific locations. But the SH 199 study does look at this. For the new study, we will discuss access to the state park. Inclusion of this criteria will depend on the study/size/length or corridor.
	CS-04.1b	Has an effort been made to identify alternatives that minimize or avoid impacts?		0	I don't think the process to select alignments was that specific when addressing impacts to the natural environment.	1	The 2011 study selected an alignment using an existing crossing of the greenbelt, avoided historic sites, and avoided gas wells.

Exhibit 2-5. CS-05

INVEST Scorecard for Corridor Studies										
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 1		Comments from Reviewer 1 (optional)	Score from Reviewer 2		Comments from Reviewer 2 (optional)	Score from Reviewer 3		Comments from Reviewer 3 (optional)
CS-05 Historical, Archaeological, and Cultural Preservation	CS-05.1P	Does the study identify whether sites including historic cemeteries, National Register Districts, or National Register Properties exist within the corridor?	Yes - Proceed to score related criteria			Yes - Proceed to score related criteria			Yes - Proceed to score related criteria		Cemeteries and National register are both identified
	CS-05.1	Has an effort been made to identify alternatives that avoid or minimize impacts?		1			1			1	Corridor selected considered avoiding and minimizing negative the historic/Archeological/cultural factors identified in the study.
	CS-05.2P	Does the study identify whether a portion of the project is along a State Scenic Trail or route designated or officially recognized as significantly historical, cultural, or archaeological?	Yes - Proceed to score related criteria			Yes - Proceed to score related criteria			No - Give all related criteria a score of "0"		
	CS-05.2	Has an effort been made to identify alternatives that minimize or avoid impacts?		1			1			0	

INVEST Scorecard for Corridor Studies										
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 1		Comments from Reviewer 1 (optional)	Score from Reviewer 2		Comments from Reviewer 2 (optional)	Score from Reviewer 3		Comments from Reviewer 3 (optional)
	CS-05.3P	Does the study identify whether any part of the project or corridor is recognized by the community as having historic, cultural, and/or archeological significance to the community?	Yes - Proceed to score related criteria			Yes - Proceed to score related criteria		Table 3.2 NRHP Listed Districts within the Study Area Table 3.13 NRHP Listed Properties Table 3.14 Museums Table 3.16 Cemeteries Table 3.15 Historical Markers	No - Give all related criteria a score of "0"		The study identifies that the historic, cultural and archeological resource names, locations, dates, but not their significance to community.
	CS-05.3	Has an effort been made to identify alternatives that minimize or avoid impacts?		1			1			0	

INVEST Scorecard for Corridor Studies							
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 4		Comments from Reviewer 4 (optional)	INVEST Team Workshop	
						Workshop Score	Workshop Comment
CS-05 Historical, Archaeological, and Cultural Preservation	CS-05.1P	Does the study identify whether sites including historic cemeteries, National Register Districts, or National Register Properties exist within the corridor?	Yes - Proceed to score related criteria			Yes - Proceed to score related criteria	
	CS-05.1	Has an effort been made to identify alternatives that avoid or minimize impacts?		0	Lists/maps identify historic sites per subarea, but analysis at the scale of alignments is not evident (perhaps occurred but not well documented)?	1	These were all considered in a GIS analysis during the study.
	CS-05.2P	Does the study identify whether a portion of the project is along a State Scenic Trail or route designated or officially recognized as significantly historical, cultural, or archaeological?	No - Give all related criteria a score of "0"			No - Give all related criteria a score of "0"	
	CS-05.2	Has an effort been made to identify alternatives that minimize or avoid impacts?				0	The 2011 study did identify historic and cultural sites, but not sites associated with a trail. A study would not identify that it did *not* involve such a trail.
	CS-05.3P	Does the study identify whether any part of the project or corridor is recognized by the community as having historic, cultural, and/or archeological significance to the community?	No - Give all related criteria a score of "0"			0	The ability to address this criteria depends on the size/length of study and how involved the community is with the study. This would be more applicable to NEPA. But the community may not have a say if something is not officially designated as historic. If it's over 50 years old, it must be reviewed. What is officially historic is different from the work the Texas Historical Commission does. We would rather not impact a feature even if it is unofficially historic. Public involvement comments should be considered.
	CS-05.3	Has an effort been made to identify alternatives that minimize or avoid impacts?		0		0	There has to be no other feasible options that meet purpose and need if you are going to go through officially historic official property.

Exhibit 2.6. CS-06

INVEST Scorecard for Corridor Studies								
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 1	Comments from Reviewer 1 (optional)	Score from Reviewer 2	Comments from Reviewer 2 (optional)	Score from Reviewer 3	Comments from Reviewer 3 (optional)
CS-06 Light Pollution	CS-06.1	Did the study identify whether the corridor includes factors that may be negatively impacted by light pollution including uplighting, backlighting, and glare?	0		0		0	

INVEST Scorecard for Corridor Studies						
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 4	Comments from Reviewer 4 (optional)	INVEST Team Workshop	
					Workshop Score	Workshop Comment
CS-06 Light Pollution	CS-06.1	Did the study identify whether the corridor includes factors that may be negatively impacted by light pollution including uplighting, backlighting, and glare?	0		0	The applicability of this criteria depends on the project. Studies could consider lighting as a visual impact. This was considered on SH 199 because of proximity to homes and the river. This criteria may be applicable in the greenbelt. If a project were near an observatory this would be relevant. Texas has a standard lighting policy. US Coast Guard-regulated river bridges have lighting requirements.

Exhibit 2-7. CS-07

INVEST Scorecard for Corridor Studies					
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 1		Comments from Reviewer 1 (optional)
CS-07 Planning for Social Considerations	CS-07.1	Does the study include efforts to address the community's vision for overall sustainability efforts and identify opportunities to reach a mutually acceptable vision?		1	There is discussion of corridor options being eliminated due to lack of local support, and alternatives were compared to existing regional and local planning documents. This implies that visions for sustainability were addressed, though this is not specifically documented.
	CS-07.2P	Does the study successfully identify a diverse range of stakeholders and public participants?	Yes - Proceed to score related criteria		Stakeholder meetings engaged local government representatives and officials, transportation partners, state government representatives and officials, private landowners, and consultants and developers throughout the study area. There is no documentation of whether underrepresented and underserved groups participated in stakeholder meetings or public meetings.
	CS-07.2a	Does the study identify a diverse range of stakeholders and public participants that includes, at a minimum, all interested parties (as defined by current regulations), in addition to all other parties potentially affected by changes to the transportation system?		1	
	CS-07.2b	Does the study give special consideration and attention to the engagement of low-income, minority, disabled, and linguistically isolated populations, and use a diverse and innovative range of public involvement techniques to ensure the engagement process is inclusive?		0	Provisions made for linguistically isolated populations and people with disabilities. Documented outreach methods are neither diverse nor innovative.
	CS-07.2c	Does the study include an education component so that stakeholders understand the transportation planning process and are able to better provide informed and meaningful input?		1	
	CS-07.2d	Did this project incorporate public educational outreach that promotes and educates the public about sustainability by developing a project website or a stakeholder guide or by giving presentations?		0	There is no documentation of public educational content that was specific to sustainability.
	CS-07.3a	Does the study use a transparent process to inform stakeholders how their input will be used and then follow through accordingly?		0	No documentation to support this statement.
	CS-07.3b	Does the study demonstrate to stakeholders how their input was used to inform and affect transportation planning decisions?		1	Comments and responses are documented. In some instances, comments do appear to have influenced study content and recommendations for future planning work.

INVEST Scorecard for Corridor Studies					
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 2		Comments from Reviewer 2 (optional)
CS-07 Planning for Social Considerations	CS-07.1	Does the study include efforts to address the community's vision for overall sustainability efforts and identify opportunities to reach a mutually acceptable vision?		0	There is no specific discussion about a "community's vision" for overall sustainability. The guiding principles for choosing recommendations were from those of the long-range mobility plan of the time and RTC policies. Accessibility and displacement of communities was considered in the elimination/choosing of corridor alternatives. Opportunities for comment were made available through public meetings and local/stakeholder meetings.
	CS-07.2P	Does the study successfully identify a diverse range of stakeholders and public participants?	Yes - Proceed to score related criteria		
	CS-07.2a	Does the study identify a diverse range of stakeholders and public participants that includes, at a minimum, all interested parties (as defined by current regulations), in addition to all other parties potentially affected by changes to the transportation system?		1	There was a large and diverse group of local municipalities and stakeholders that was consulted in for this study. Aside from stakeholder meetings, several briefings/presentations were also inducted for specific interest groups. Environmental resource agencies were consulted through the TRACES effort and the public were asked for input through standard public meetings. The resource agency and public meetings were not specific to the regional outer loop. The outer loop was just included in the list of topics to cover. It is not clear if public meeting locations/invites were specific to groups that may have been impacted the regional outer loop.
	CS-07.2b	Does the study give special consideration and attention to the engagement of low-income, minority, disabled, and linguistically isolated populations, and use a diverse and innovative range of public involvement techniques to ensure the engagement process is inclusive?		0	Ads were provided in Spanish and English, and sent to local libraries, city halls, courthouses, newspapers, public agencies, representatives of transit and freight, local and state emergency response agencies, airport operators, and resource agencies (land, wildlife, tribal). ADA and language interpreter accommodations were offered. Comments were accepted in multiple forms. Information was provided as apart of already scheduled public meetings. It is unclear if any of the locations were chosen based on the location of the public that would be impacted by the project. The format was standard and did not involve innovative techniques to promote inclusivity.
	CS-07.2c	Does the study include an education component so that stakeholders understand the transportation planning process and are able to better provide informed and meaningful input?		0	
	CS-07.2d	Did this project incorporate public educational outreach that promotes and educates the public about sustainability by developing a project website or a stakeholder guide or by giving presentations?		0	

INVEST Scorecard for Corridor Studies					
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 2		Comments from Reviewer 2 (optional)
	CS-07.3a	Does the study use a transparent process to inform stakeholders how their input will be used and then follow through accordingly?		0	
	CS-07.3b	Does the study demonstrate to stakeholders how their input was used to inform and affect transportation planning decisions?		0	See above.

INVEST Scorecard for Corridor Studies					
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 3		Comments from Reviewer 3 (optional)
CS-07 Planning for Social Considerations	CS-07.1	Does the study include efforts to address the community's vision for overall sustainability efforts and identify opportunities to reach a mutually acceptable vision?		0	The study identifies which communities included the Outer Loop in local plans (such as comprehensive, thoroughfare). However, I don't think this crosses the threshold of meeting a community vision. Does state that future planning efforts should provide "frequent and meaningful opportunities" for resource agencies and community to participate but does not go so far as discussion a greater vision.
	CS-07.2P	Does the study successfully identify a diverse range of stakeholders and public participants?	Yes - Proceed to score related criteria		
	CS-07.2a	Does the study identify a diverse range of stakeholders and public participants that includes, at a minimum, all interested parties (as defined by current regulations), in addition to all other parties potentially affected by changes to the transportation system?		1	Not sure what "defined by current regulations" means beyond EJ/Title VI groups. FHWA, local governments and stakeholders, resource and regulatory agencies, and the public were provided participation opportunities.
	CS-07.2b	Does the study give special consideration and attention to the engagement of low-income, minority, disabled, and linguistically isolated populations, and use a diverse and innovative range of public involvement techniques to ensure the engagement process is inclusive?		0	Traditional public meetings were held - so likely lacking diverse and innovative range of techniques. A sampling of meeting presentations did not show much emphasis on visualizations. However, the project did have a website.
	CS-07.2c	Does the study include an education component so that stakeholders understand the transportation planning process and are able to better provide informed and meaningful input?		1	Public meetings provided a forum for education. Input was responded to.

INVEST Scorecard for Corridor Studies					
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 3		Comments from Reviewer 3 (optional)
	CS-07.2d	Did this project incorporate public educational outreach that promotes and educates the public about sustainability by developing a project website or a stakeholder guide or by giving presentations?		0	EPA gave a presentation about GISST and REAP, which are environmental data sources. But on a whole, sustainability was not emphasized in presentations.
	CS-07.3a	Does the study use a transparent process to inform stakeholders how their input will be used and then follow through accordingly?		0	
	CS-07.3b	Does the study demonstrate to stakeholders how their input was used to inform and affect transportation planning decisions?		1	Feedback from transportation partners and the Corridor Refinement Team influenced alignment choices, so it depends how you define stakeholders. As for other stakeholders, comments are responded to but it's not clear how they influenced the study.

INVEST Scorecard for Corridor Studies				
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	INVEST Team Workshop	
			Workshop Score	Workshop Comment
CS-07 Planning for Social Considerations	CS-07.1	Does the study include efforts to address the community's vision for overall sustainability efforts and identify opportunities to reach a mutually acceptable vision?	0	Communities weren't engaged to address sustainability. They probably should have been. One reviewer said it was implied that this was done, but the study should have more explicitly described these events.
	CS-07.2P	Does the study successfully identify a diverse range of stakeholders and public participants?	Yes - Proceed to score related criteria	
	CS-07.2a	Does the study identify a diverse range of stakeholders and public participants that includes, at a minimum, all interested parties (as defined by current regulations), in addition to all other parties potentially affected by changes to the transportation system?	1	While the study engaged a range of stakeholders and participants, the definition of "current regulations" is not clear.
	CS-07.2b	Does the study give special consideration and attention to the engagement of low-income, minority, disabled, and linguistically isolated populations, and use a diverse and innovative range of public involvement techniques to ensure the engagement process is inclusive?	0	Accommodations were made for persons with disabilities and efforts were made to engage these groups as part of overall input, but no exclusive discussions were held with these groups.

INVEST Scorecard for Corridor Studies				
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	INVEST Team Workshop	
			Workshop Score	Workshop Comment
	CS-07.2c	Does the study include an education component so that stakeholders understand the transportation planning process and are able to better provide informed and meaningful input?	1	During stakeholder and public meetings, the transportation planning process was explained. Also explained was how public input creates a better process.
	CS-07.2d	Did this project incorporate public educational outreach that promotes and educates the public about sustainability by developing a project website or a stakeholder guide or by giving presentations?	0	This was not included in the 2011 study, but it should be depending on the corridor. Alignments could focus on existing plans and closing gaps in existing systems instead of creating new facilities. Comprehensive plans should be reviewed.
	CS-07.3a	Does the study use a transparent process to inform stakeholders how their input will be used and then follow through accordingly?	0	The 2011 study team wrote meeting minutes and tried to respond to specific comments. But it did not document these efforts well in the feasibility study. This should be done more explicitly. The current needs assessment in Collin County has solidified a more transparent process. But NCTCOG's process is implied but not codified -- perhaps INVEST is an opportunity to codify the process.
	CS-07.3b	Does the study demonstrate to stakeholders how their input was used to inform and affect transportation planning decisions?	1	Stakeholder feedback led to elimination of specific alternatives but did not lead to incorporating new ideas or drastically altering concepts. Multiple committees were involved. Stakeholders had influence in eliminating corridors, but the Corridor Review Team conducted the decision-making. Residents had less opportunity for influence than the elected officials who served on committees. Communicating about how feedback was used was done to some extent, but not explicitly.

Exhibit 2-8. CS-08

INVEST Scorecard for Corridor Studies						
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 1	Comments from Reviewer 1 (optional)	INVEST Team Workshop	
					Workshop Score	Workshop Comment
CS-08 Planning for Context Sensitive Solutions	CS-08.1	Did the study evaluate alignments following the six step CSS framework described in NCHRP report 480 and NCHRP report 642, or an equivalent process?	0	NCHRP report 480 ID's six steps "that define complex projects and must be considered with care," (pg. 5), but it is unclear what those six steps are and whether they apply to a CSS process or just all complex projects. The framework in NCHRP report 642 is more comprehensive than six steps (pg. 38). For this analysis, have used framework from NCHRP report 642, to the extent applicable to a feasibility analysis. Note on scoring: the study included no guiding principles/objectives in 6.1 that related to CSS, or nonmotorized transportation, transit, livability, etc., though there were goals/policies that could have been included. This meant that there were no corresponding evaluating criteria in Table 6.2 related to those areas, which means the feasibility of the project as pertains to those areas wasn't considered. The Veloweb is discussed only as existing conditions/plan. The only specific mention of CSS is in 7.3.2 as a recommendation for subsequent environmental/engineering studies.	0	The feasibility study may be too early a phase for CSS, which is more appropriate to NEPA. The framework in the NCHRP report may not be appropriate at this phase. However, it may depend more on size of project than the phase. CSS could be addressed in greenbelt feasibility study.
	CS-08.2	Did the study team engage multimodal, multijurisdictional, and multidisciplinary team members and partners to produce a study that can be integrated into project development?	1		1	The study team did engage multijurisdictional, multidisciplinary, and multimodal team members and partners. The project was originally considered as a rail bypass.

INVEST Scorecard for Corridor Studies						
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 1	Comments from Reviewer 1 (optional)	INVEST Team Workshop	
					Workshop Score	Workshop Comment
	CS-08.3	As a result of a CSS-influenced project development process, were external "champions" for the project created in the affected community who were engaged and proactive in supporting it?		Unknown	0	There were a few people who reached out to NCTCOG and brought staff into communities to ask them to think about the alignments' effect on area/location. NCTCOG staff met with some land owners. But the champions identified themselves, rather than NCTCOG identifying them. During county transportation plans, NCTCOG has asked city officials to champion their own plan. In Hunt County, a committee was tasked with continuing to update the thoroughfare plan to ensure follow through. Counties should build on NCTCOG's efforts.
	CS-08.4	Was acceptance achieved among project stakeholders on the problems, opportunities, and needs that the project should address and the resulting vision or goals for addressing them?		Unknown	1	NCTCOG provided the opportunity for multiple agencies and stakeholders to comment on the study and address needs or gaps. The study found that much of the project was not warranted. Consensus was reached through the corridor development team, but not through resolutions from individual communities.
	CS-08.5	Were alignments identified that consider the appropriate scale of the project?	1	This depends on the definition of "appropriate scale." Appropriate for whom or what? The alignments seemed to be appropriate for a rural outer loop project.	1	The study indicated new location alignments would be ~500 feet wide, consistent with existing plans for the Collin County Outer Loop. But width of roadway varied by segment. When looking at existing facilities, 350' ROWs were considered. This criteria seems to be an integral part of a feasibility study, and not something that needs to be called out separately.
	CS-08.6	Were alignments identified that remove objectionable or distracting views?	0	No, but there were no specific objectionable or distracting views identified. This is a feasibility and study and that specific project level of detail would probably not occur until the environmental/engineering stages.	0	This is more appropriate for the NEPA process; including this in a feasibility study circumvents the NEPA process. Let's remove this one from consideration for our project.
	CS-08.7	Did the study identify potential types and locations for context sensitive aesthetic treatments?	0	No, but this is a feasibility and study and that specific project level of detail would probably not occur until the environmental/engineering stages.	0	This is more appropriate for NEPA generally. But there are exceptions. In the Greenbelt, the need for this is obvious. Can ID the need for CSSS, but not the treatments themselves.

INVEST Scorecard for Corridor Studies						
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 1	Comments from Reviewer 1 (optional)	INVEST Team Workshop	
					Workshop Score	Workshop Comment
	CS-08.8	Did the study identify potential structural items that would enable aesthetics to be incorporated into the project?	0	No, but this is a feasibility and study and that specific project level of detail would probably not occur until the environmental/engineering stages.	0	This is more appropriate for the NEPA process. Going into the 2011 study it was known that Texas Parks and Wildlife Department would be a driver behind this addressing aesthetics.

Exhibit 2-9. CS-09

INVEST Scorecard for Corridor Studies						
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 1	Comments from Reviewer 1 (optional)	Score from Reviewer 2	Comments from Reviewer 2 (optional)
CS-09 Access and Affordability	CS-09.1a	Do the study documents analyze physical access and identify specific population groups or areas where this is an issue?	1	Table 6.15 discusses built environment areas of potential displacement	0	
	CS-09.1b	Do the study documents analyze access and equity and identify specific populations or areas where this is an issue?	0	3.2 - description of minority areas	1	
	CS-09.1c	Do the study documents analyze affordability and identify specific populations or areas where this is an issue?	1	3.2 - description of low-income areas	1	
	CS-09.1d	Do the study documents include documentation of targeted, enhanced outreach or communication that has been used to engage these population groups or areas in the transportation planning process?	0	5.3 - public meetings held to update citizens on plan process	1	
	CS-09.2a	Does the study use travel model, census, geospatial, and other data to quantitatively evaluate the nature and distribution of accessibility and affordability (if a tolled facility) concerns in the corridor?	0		1	
	CS-09.2b	Does the study analyze how to address or improve issues?	0		0	

INVEST Scorecard for Corridor Studies						
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 3	Comments from Reviewer 3 (optional)	Score from Reviewer 4	Comments from Reviewer 4 (optional)
CS-09 Access and Affordability	CS-09.1a	Do the study documents analyze physical access and identify specific population groups or areas where this is an issue?	0		1	Accessibility factored into evaluation of corridor options.
	CS-09.1b	Do the study documents analyze access and equity and identify specific populations or areas where this is an issue?	1	Table 3.6 - 2010 Census Race and Ethnic Composition of Study Area Table II.1 - Census Data for Race and Ethnicity	0	Accessibility is not examined through the lens of equity.
	CS-09.1c	Do the study documents analyze affordability and identify specific populations or areas where this is an issue?	1	Table 3.7 2005-2009 ACS Income Table II.2 - Five-Year Data for Income and Language	0	Affordability is not addressed.
	CS-09.1d	Do the study documents include documentation of targeted, enhanced outreach or communication that has been used to engage these population groups or areas in the transportation planning process?	1	Chapter 5 - Public and Agency Involvement (public meetings, stakeholder meetings, briefings/presentations)	0	
	CS-09.2a	Does the study use travel model, census, geospatial, and other data to quantitatively evaluate the nature and distribution of accessibility and affordability (if a tolled facility) concerns in the corridor?	1		1	Accessibility only
	CS-09.2b	Does the study analyze how to address or improve issues?	0		0	Corridor option analysis considered accessibility but not equity or affordability.

INVEST Scorecard for Corridor Studies						
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 5	Comments from Reviewer 5 (optional)	Score from Reviewer 6	Comments from Reviewer 6 (optional)
CS-09 Access and Affordability	CS-09.1a	Do the study documents analyze physical access and identify specific population groups or areas where this is an issue?	0	Potential Issues/concerns or reasons for elimination are listed for each of the corridors that were chosen or considered including access to certain destinations such as residential properties. The study also discusses the proportion of EJ populations that live in the corridor. However, there is not discussion of a physical access for a specific population.	0	Table 6.5 (Volume 1) identifies why paths were eliminated, including localized accessibility reasons (for example, the path would have impacted access to existing residential developments). The study also identifies the locations of concentrations of low-income and other EJ groups. However, it does not explicitly make a connection between paths and accessibility for EJ groups (I am interpreting this criteria from the EJ perspective). Affordability not addressed.
	CS-09.1b	Do the study documents analyze access and equity and identify specific populations or areas where this is an issue?	0	The study does document that the study area consists of census tracts where EJ populations may reside and mentions "minimize the potential for negative effects to communities and the transitionally underserved" as a guiding principle when choosing corridors but does not discuss access and equity to specific locations.	0	Again, EJ populations are identified, but equity is not analyzed.
	CS-09.1c	Do the study documents analyze affordability and identify specific populations or areas where this is an issue?	0	The study mentions that to "minimize the potential for negative effects to communities and the transitionally underserved" as a guiding principle when choosing corridors. It also identifies where low-income populations are in the study area. It does not discuss affordability.	0	The study makes references to EO 12898 but does not analyze affordability.

INVEST Scorecard for Corridor Studies						
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 5	Comments from Reviewer 5 (optional)	Score from Reviewer 6	Comments from Reviewer 6 (optional)
CS-09 Access and Affordability	CS-09.1d	Do the study documents include documentation of targeted, enhanced outreach or communication that has been used to engage these population groups or areas in the transportation planning process?	0	The only outreach efforts to the public were through the standard NCTCOG public meetings. There was no documented enhanced outreach.	0	
	CS-09.2a	Does the study use travel model, census, geospatial, and other data to quantitatively evaluate the nature and distribution of accessibility and affordability (if a tolled facility) concerns in the corridor?	0		0	Travel model, census, and geospatial data are used in the study, but an analysis is not really done that connects the dots.
	CS-09.2b	Does the study analyze how to address or improve issues?	0		0	Traffic issues and land-use compatibility issues are considered when eliminating paths. But nothing addresses how to improve accessibility for EJ groups.

INVEST Scorecard for Corridor Studies						
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 7	Comments from Reviewer 7 (optional)	INVEST Team Workshop	
					Workshop Score	Workshop Comment
CS-09 Access and Affordability	CS-09.1a	Do the study documents analyze physical access and identify specific population groups or areas where this is an issue?	0	Potential Issues/concerns or reasons for elimination are listed for each of the corridors that were chosen or considered including access to certain destinations such as residential properties. The study also discusses the proportion of EJ populations that live in the corridor. However, there is not discussion of a physical access for a specific population.	0	The study did analyze physical access because access cannot be denied to communities, but it did not identify groups where access was an issue.
	CS-09.1b	Do the study documents analyze access and equity and identify specific populations or areas where this is an issue?	0	The study does document that the study area consists of census tracts where EJ populations may reside and mentions "minimize the potential for negative effects to communities and the transitionally underserved" as a guiding principle when choosing corridors but does not discuss access and equity to specific locations.	0	Tables identified EJ populations, but access and equity are not analyzed.
	CS-09.1c	Do the study documents analyze affordability and identify specific populations or areas where this is an issue?	0	The study mentions that to "minimize the potential for negative effects to communities and the transitionally underserved" as a guiding principle when choosing corridors. It also identifies where low-income populations are in the study area. It does not discuss affordability.		The study identifies household income and low-income population data, but analyzing affordability requires an economic analysis and would not be conducted until NEPA.

INVEST Scorecard for Corridor Studies						
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 7	Comments from Reviewer 7 (optional)	INVEST Team Workshop	
					Workshop Score	Workshop Comment
	CS-09.1d	Do the study documents include documentation of targeted, enhanced outreach or communication that has been used to engage these population groups or areas in the transportation planning process?	0	The only outreach efforts to the public were through the standard NCTCOG public meetings. There was not document enhanced outreach	0	Targeted outreach was not conducted for this study but has been in other studies. Facilities for meetings should be easily accessible by transit. Trying to use existing transportation facilities means the facility will not be tolled under Regional Transportation Council policy; however, this doesn't directly address this criteria. But during a Major Investment Study for Loop 12, outreach was conducted specifically for a low-income apartment complex. Targeted outreach has also been conducted at the needs assessment phase. The need for this will be study by study.

INVEST Scorecard for Corridor Studies						
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 7	Comments from Reviewer 7 (optional)	INVEST Team Workshop	
					Workshop Score	Workshop Comment
CS-09 Access and Affordability	CS-09.2a	Does the study use travel model, census, geospatial, and other data to quantitatively evaluate the nature and distribution of accessibility and affordability (if a tolled facility) concerns in the corridor?	0		1	Technical reports not published with the study cover how the travel demand model work was done for both accessibility and affordability. This issue is also covered in the Regional Tolling Analysis and EJ analysis in NEPA. Feasibility studies could include a simplistic analysis comparing free vs. tolled facilities and what portion of a low-income household's income could be spent on tolls. This should be conducted in a feasibility study if it's a tolled facility in a low-income area. The travel demand model reroutes the driver's trip if the cost-time savings show the tolled route doesn't provide worthwhile travel-time savings.
	CS-09.2b	Does the study analyze how to address or improve issues?	0		0	The feasibility study could identify issues/impacts but mitigating those impacts should be addressed in NEPA.

Exhibit 2-10. CS-10

INVEST Scorecard for Corridor Studies						
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 1	Comments from Reviewer 1 (optional)	INVEST Team Workshop	
					Workshop Score	Workshop Comment
CS-10 Safety Planning	CS-10.1	Does the study address applicable emphasis areas in the State Strategic Highway Safety Plan? See Table CS-10.1 in the Safety Table tab of this Excel file.	0	The study addresses most of the emphasis areas, but not all of them. For instance: distracted driving, planning for older drivers, and impaired driving are not discussed.	0	The 2011 study did not even have accident data. Using modern standards for roadway design. We could use accident data in the current study. But to address these strategies, we can cite how modern design addresses them.
	CS-10.2	Does the study address safety concerns in the corridor as identified by the long-range plan or 10-year plan?	1		1	The 2011 study did look at these.
	CS-10.3	Were human factors considerations incorporated?	1	Additional human factors could be considered in the safety section, as mentioned in CS-10.1	1	Again, the strategies in 10.1 were not well addressed, but could be better addressed in future studies.
	CS-10.4	Does the study identify potential contributing factors to crashes and identify the need to build awareness among the public?	0	Did not see this mentioned in the text. This is something that could be provided for future studies	0	This was not done for 2011 study.
	CS-10.5	Does the study include explicit consideration of safety using quantitative, scientifically proven methods for each alternative?	0	The study discusses some of our applicable safety programs, but does not mention methodology	0	The 2011 study was quite large and did not address safety data.

Table CS-10.1 Texas Strategic Highway Safety Plan 2017-2022

Emphasis Area	Strategy #	Strategy Description
Distracted Driving	4	Increase the installation of engineering countermeasures known to reduce distracted driving
Distracted Driving	5	Use technology to reduce distracted driving crashes, serious injuries, and fatalities
Impaired Driving	4	Improve mobility options for impaired road users.
Intersection Safety	2	Consider alternative design strategies for improving intersection safety
Intersection Safety	3	Improve pedestrian safety at intersections with high probability of crashes
Intersection Safety	4	Increase driver awareness of intersections
Older Road Users	2	Design and operate roadways to meet the needs of older road users
Bicycle/Pedestrian Safety	2	Reduce bicycle/pedestrian crashes on urban arterials and local roadways
Bicycle/Pedestrian Safety	3	Improve bicyclists'/pedestrians' visibility at crossing locations
Bicycle/Pedestrian Safety	4	Improve bicycle/pedestrian networks
Bicycle/Pedestrian Safety	6	Improve bicycle/pedestrian involved crash reporting
Roadway and Lane Departures	2	Keep vehicles from encroaching on the roadside or opposite lane
Roadway and Lane Departures	3	Minimize the consequences of vehicles leaving the road
Roadway and Lane Departures	4	Minimize the likelihood of crashing in adverse conditions
Speeding	1	Use the concept of establishing target speed limit and road characteristics to reduce speeding

Exhibit 2-11. CS-11

INVEST Scorecard for Corridor Studies								
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 1	Comments from Reviewer 1 (optional)	Score from Reviewer 2	Comments from Reviewer 2 (optional)	Score from Reviewer 3	Comments from Reviewer 3 (optional)
CS-11 Multimodal Transportation and Public Health	CS-11.1a	Does the study identify the opportunity to enhance the extent and connectivity of multimodal infrastructure between the studied alignments?	1	The plan recognized a Veloweb alignment and possible connections to other trails as planned by local jurisdictions.	0		0	
	CS-11.1b	Does the study identify whether alignments enhance active transportation and improve public health?	1	Yes, however the relationship to public health is not strong	1	Probably yes, since it will provide an alternative route around the region and help reduce the congestion in the active system.	0	
	CS-11.2	Were public health and active mode stakeholders engaged during the study?		Unknown. The plan largely references potential access to health care facilities, and some air quality impacts by the project.	1	Probably yes, if public health includes impact of noise, congestion and safety.	0	The mailing list for the public meetings included "representatives of users of pedestrian walkway and bicycle transportation facilities" (Volume IV, section 4.0), but the official stakeholders list did not include anyone specifically representing active modes.
	CS-11.3a	Does the study address the feasibility of including active, non-motorized transportation in the corridor?	1	the plan includes a Veloweb alignment	1	Veloweb, bike/ped	1	Vol II 6.3.2 proposes corridors wide enough for active, non-motorized options.
	CS-11.3b	Does the study integrate transit, pedestrian, bicycle, and roadway modes so that intermodal connections are safe and convenient?	1	Yes, at a high level however since the area is predominately rural and there has been no actual design it cannot be determined how well these elements would be connected in a safe and convenient manner.	1	Probably yes. It does look at the different modes within study area.	0	

INVEST Scorecard for Corridor Studies								
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 1	Comments from Reviewer 1 (optional)	Score from Reviewer 2	Comments from Reviewer 2 (optional)	Score from Reviewer 3	Comments from Reviewer 3 (optional)
	CS-11.3c	Does the study consider whether alignments promote public health through improving congestion, safety, and opportunities for active transportation?	0	Unknown. It is not clear if the study considered the potential trip reductions that could result from implementing a comprehensive active transportation network.	1	It is supposed to be, but it depends on the travel demand model forecast result.	0	The purpose of the study is mainly focused on reducing congestion for its own sake. Perhaps an interest in public health is implicit, but the interest doesn't really extend to consideration of safety and active transportation.

INVEST Scorecard for Corridor Studies						
Criteria Description – Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 4	Comments from Reviewer 4 (optional)	INVEST Team Workshop	
					Workshop Score	Workshop Comment
CS-11 Multimodal Transportation and Public Health	CS-11.1a	Does the study identify the opportunity to enhance the extent and connectivity of multimodal infrastructure between the studied alignments?	1		1	This was not done for all alignments, but was done once the number of alignments was refined. The study noted on-street opportunities for bike and pedestrian. It looked at incorporating future freight and passenger rail in the median.
	CS-11.1b	Does the study identify whether alignments enhance active transportation and improve public health?	0		0	This study was not intended to enhance active transportation - the facility was a regional loop. Including this criteria would depend on the scale of the study. For example, this was included in the SH 199 feasibility study.
	CS-11.2	Were public health and active mode stakeholders engaged during the study?	0		1	They were contacted but did not participate. Again, the need for this will be dependent on the scale of project.
	CS-11.3a	Does the study address the feasibility of including active, non-motorized transportation in the corridor?	1	Maps of planned facilities and transit lines are included	1	This largely duplicates CS-11.1b.
	CS-11.3b	Does the study integrate transit, pedestrian, bicycle, and roadway modes so that intermodal connections are safe and convenient?	0		0	This was not done but should be looked at a high level. However, the SH 199 study did look at this in detail. Including this criteria is project dependent. In some cases, this is better addressed in NEPA design. Being cognizant of this need can change designs; in the greenbelt we know we will have to address horse and paddling trails. This lets us know we will have to change the design.
	CS-11.3c	Does the study consider whether alignments promote public health through improving congestion, safety, and opportunities for active transportation?	0			Feasibility studies will pick the alignment with the least congestion and best mobility. But the 2011 study did not explicitly equate this to public health. Dropping volumes on existing facilities does improve safety. Future studies should be explicit about this as a selling point for the chosen alignment.

Exhibit 2-12. CS-12

INVEST Scorecard for Corridor Studies						
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 1	Comments from Reviewer 1 (optional)	INVEST Team Workshop	
					Workshop Score	Workshop Comment
CS-12 Pedestrian Facilities	CS-12.1	Does the study identify the potential for facilities that meet ADA standards?		Unknown. ADA standards would generally not be addressed with an alignment study	0	This was not addressed in the 2011 study and is not appropriate for feasibility studies. This may even be too specific for NEPA study. Any TxDOT study would have to comply with ADA.
	CS-12.2	Does the study identify missing pedestrian connections?	0	Generally, no, since this is an alignment study through a rural area. However pedestrian accommodations should be considered in the context of planning for appropriate connections when future development occurs.	0	This was not addressed in the 2011 study, but it is another context sensitive criteria. Pedestrian connections recommendations were made in the SH 199 study.
	CS-12.3	Does the study identify opportunities for pedestrian features that are safe, comfortable, convenient, and connected?	0	Generally, no, since this is an alignment study through a rural area. However pedestrian accommodations should be considered in the context of planning for appropriate connections when future development occurs.	0	This was not addressed in the 2011 study. It is appropriate for NEPA or post-NEPA activities. A city would implement these with their enhancement funds and would coordinate with TxDOT.

Exhibit 2-13. CS-13

INVEST Scorecard for Corridor Studies						
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 1	Comments from Reviewer 1 (optional)	INVEST Team Workshop	
					Workshop Score	Workshop Comment
CS-13 Bicycle Facilities	CS-13.1	Does the study identify opportunities for bicycle connections within the corridor and with adjacent corridors?	1	Yes	1	The 2011 study talked about connections to the regional Veloweb trail system.
	CS-13.2	Does the study identify opportunities for bicycle features that are safe, comfortable, convenient, and connected?	0	Generally, no, since this is an alignment study through a rural area. However, bicycle accommodations should be considered in the context of planning for appropriate connections when future development occurs.	0	This is appropriate for NEPA or post-NEPA activities. A city would coordinate with TxDOT and implement these with their enhancement funds.

Exhibit 2-14. CS-14

INVEST Scorecard for Corridor Studies										
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 1	Comments from Reviewer 1 (optional)	Score from Reviewer 2	Comments from Reviewer 2 (optional)	Score from Reviewer 3	Comments from Reviewer 3 (optional)	INVEST Team Workshop	
									Workshop Score	Workshop Comment
CS-14 Transit Facilities	CS-14.1	Did the study identify the need, purpose, and appropriateness for transit access within the project footprint?	0		0	There's a lot of talk about the existing transit options and what transit services are being planned, and even some expressions of aspirational transit goals; but no effort is made to see if the goals of the Outer Loop could be achieved in whole or in part using transit.	0		1	This *was* done as part of the study, but the study itself did not do a good job of communicating that it was done. The study looked at a blank slate of what is needed in the corridor: transit, auto, freight, etc.

Exhibit 2-15. CS-15

INVEST Scorecard for Corridor Studies								
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 1	Comments from Reviewer 1 (optional)	Score from Reviewer 2	Comments from Reviewer 2 (optional)	Score from Reviewer 3	Comments from Reviewer 3 (optional)
CS-15 Freight and Goods Access & Mobility	CS-15.1a	Does the study identify opportunities for maintaining and improving freight reliability and connectivity between modes and to freight generators for both inter and intracity freight, in ways that enhance sustainability?	1		1		1	
	CS-15.1b	Does the study consider multimodal freight mobility needs, such as intermodal facilities and the siting of freight facilities?	1		1		1	
	CS-15.2a	During the study were freight service providers, stakeholders (including neighborhoods that surround freight facilities), workers, and representatives engaged?	1		1		1	
	CS-15.2b	Does the agency utilize institutional mechanisms to facilitate the engagement of freight stakeholders?	1		1		1	
	CS-15.3a	Does the study assess freight accessibility and mobility, such as freight movements, turning radius, adequate capacity or restricted capacity, and land use ordinances that minimize freight effects on the surrounding areas?	1		1		1	
	CS-15.3b	Does the study assess freight reliability by identifying opportunities for infrastructure that supports supply chain movements, including truck parking with amenities for drivers and the corridor's capacity for safe and efficient movement of freight?	1		1		1	

INVEST Scorecard for Corridor Studies				
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	INVEST Team Workshop	
			Workshop Score	Workshop Comment
CS-15 Freight and Goods Access & Mobility	CS-15.1a	Does the study identify opportunities for maintaining and improving freight reliability and connectivity between modes and to freight generators for both inter and intracity freight, in ways that enhance sustainability?	1	The Outer Loop was originally looked at just as a rail bypass for freight, so this was definitely addressed in the 2011 study. But again, the need for this criteria is context sensitive. This may need a gateway question about whether freight is an issue in a corridor. For example, in Wise County the #1 concern is gravel trucks. Freight needs can be as simple as width of driveways and turning radii. These may be looked at the final design, PS&E phase.
	CS-15.1b	Does the study consider multimodal freight mobility needs, such as intermodal facilities and the siting of freight facilities?	1	The 2011 study did. But this is context sensitive; the Outer Loop corridor was near freight facilities.
	CS-15.2a	During the study were freight service providers, stakeholders (including neighborhoods that surround freight facilities), workers, and representatives engaged?	1	During the 2011 study, the study team met with the inland port multiple times and other freight facilities. This is another context sensitive criteria.
	CS-15.2b	Does the agency utilize institutional mechanisms to facilitate the engagement of freight stakeholders?	1	This wasn't done for the 2011 study but could be done via NCTCOG's Regional Freight Advisory Committee.
	CS-15.3a	Does the study assess freight accessibility and mobility, such as freight movements, turning radius, adequate capacity or restricted capacity, and land use ordinances that minimize freight effects on the surrounding areas?	1	While this level of detail may not be appropriate for bike-ped considerations, it is appropriate for freight because it affects the roadway itself. The 2011 study also looked at city ordinances that prevent/allow truck routes on certain roads.
	CS-15.3b	Does the study assess freight reliability by identifying opportunities for infrastructure that supports supply chain movements, including truck parking with amenities for drivers and the corridor's capacity for safe and efficient movement of freight?		The 2011 study talked about safe and efficient movement of freight because of roadway design itself, and it talked about connecting to the inland port via the supply chain. These needs were considered during planning for the feasibility study and affected recommendations for roadway sizing. But they did not address parking, etc. This criteria is also context sensitive. In the Wise County thoroughfare study, staff looked at the effect of truck stops; trucks leaving existing truck stops have to travel uphill in this county, and this slows traffic. Caltrans studies have looked at availability of restrooms and trash receptacles. TxDOT has redesigned rest stops so they cater more to freight.

Exhibit 2-16. CS-16

INVEST Scorecard for Corridor Studies						
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 1	Comments from Reviewer 1 (optional)	INVEST Team Workshop	
					Workshop Score	Workshop Comment
CS-16 Travel Demand Management	CS-16.1	Does the study identify TDM strategies for each alignment that are consistent with the region's Congestion Management Process?	0	2.1 - congestion increases from M2035 discussed, but not strategies; Vol. 2 - lists projects and type, not strategies	0	Every NEPA document has to address the Congestion Management Process (CMP). The 2011 study did not address strategies. Feasibility studies could include boiler plate language for recommending strategies to reduce trips during peak period. Studies also could demonstrate whether any strategy could reduce demand enough to mean the alignment isn't required. We did not have our current CMP when the 2011 study was done.
	CS-16.2	Does the study analyze a TSM&O/TDM-Only Alternative using the steps described in NCTCOG's Congestion Management Process - 2013 Update?	0	2013 CMP Update not available, but M2035 CMP section discussed; 2.1 - CMP note mentioned	0	The 2013 Update was not available in 2011. The 2011 study did not do anything similar. Feasibility studies could list strategies for parallel facilities in lieu of building a new facility. The 2011 study did not look at effects of signal timing, etc. This is much easier to address at the NEPA process than feasibility process, but it could be included if a context-sensitive reason existed.

Exhibit 2-17. CS-17

INVEST Scorecard for Corridor Studies								
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 1	Comments from Reviewer 1 (optional)	Score from Reviewer 2	Comments from Reviewer 2 (optional)	Score from Reviewer 3	Comments from Reviewer 3 (optional)
CS-17 Air Quality & Emissions	CS-17.1	Does the study encourage implementing agencies to compare the emissions generated during construction of alternative alignments by using tools such as the Construction and Maintenance Emissions Calculator?	0		0		0	
	CS-17.2	Does the study include partner agencies relevant to air quality and emissions during the study?	1		1		1	
	CS-17.3	Does the study use tools such as MoSVR to compare alignments that incorporate multimodal strategies and proximity to transit as part of a transportation plan to reduce emissions?	0	I saw transit on the list of RTC initiatives and I know transit agencies are included, but I did not read anywhere that transit was a required part of this project.	0		0	
	CS-17.4	Are opportunities for vehicle technologies identified in the study?	0		0		0	
	CS-17.5	Are opportunities for infrastructure that supports fuel technologies, natural gas refueling, or battery charging stations identified in the study?	0		0		0	

INVEST Scorecard for Corridor Studies				
Criteria Description – Corridor Studies	Criteria Number - Corridor Studies	Criteria	INVEST Team Workshop	
			Workshop Score	Workshop Comment
CS-17 Air Quality & Emissions	CS-17.1	Does the study encourage implementing agencies to compare the emissions generated during construction of alternative alignments by using tools such as the Construction and Maintenance Emissions Calculator?	0	This tool should not be used at the feasibility study level because the data needed is not available at this phase. Studies could identify alignments where more generally we recommend they pay close attention to emissions during construction. Alignments should look at emissions in general, not just during construction. Construction emissions are just temporary; more permanent impacts are more important.
	CS-17.2	Does the study include partner agencies relevant to air quality and emissions during the study?	1	Relevant stakeholders (Texas Commission on Environmental Quality, Environmental Protection Agency) should be included in stakeholder meetings.
	CS-17.3	Does the study use tools such as MoSVR to compare alignments that incorporate multimodal strategies and proximity to transit as part of a transportation plan to reduce emissions?	0	No analysis was run on air quality reductions in the 2011 study. Work shoppers don't think this analysis is feasible because it is time intensive when addressing multiple alignments. Projects undergoing feasibility studies are already included in metropolitan transportation plan and are part of a conformity-approved network. Generally, we say that if congestion is reduced, air quality is improved; this isn't addressed more specifically in a feasibility study.
	CS-17.4	Are opportunities for vehicle technologies identified in the study?	0	This was not addressed in the 2011 study. Even in NEPA, this is only addressed by looking at Mobile Source Air Toxics and trends over 30 years. Emissions are expected to decline over time because vehicle technology is expected to improve over time. But the feasibility study can't influence people to drive electric vehicles.
	CS-17.5	Are opportunities for infrastructure that supports fuel technologies, natural gas refueling, or battery charging stations identified in the study?	0	This study predates this criteria's topic to some extent. But future studies should look at this in Energy Corridors and facilities that connect within 5 miles of Energy Corridors. The air quality team may have a GIS layer for refueling or charging stations. The study could look at density of charging stations. A future task could be modeling where people will start running out of charge (based on where existing stations are) to identify areas that need stations.

Exhibit 2-18. CS-18

INVEST Scorecard for Corridor Studies							
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 1		Comments from Reviewer 1 (optional)	INVEST Team Workshop	
						Workshop Score	Workshop Comment
CS-18 Optimizing Assets	CS-18.1	Does the study address the goals and objectives for linking asset management and planning as identified in the long-range transportation plan?		0		0	The study was conducted 2007-2011 and the long-range transportation plan did not have any directives to link asset management and planning at that time. Efforts to utilize existing facilities were an approach to optimize existing assets. This also was done to be more cost effective.
	CS-18.2	Does the agency cooperate with partner agencies to integrate their asset management data and economic analysis to prioritize investments?		0		0	This was not done in the 2011 study. Jurisdictions may not have asset management plans. City of Dallas may be the only one in the region with such a plan. Prioritization in the 2011 study was done based on most suitable locations; then travel model simulations and other performance data were used to identify the most feasible investments. The vast majority of the corridor was not feasible. City and county thoroughfare plans could establish connectivity by other means. When the 2011 study was being done, jurisdictions wouldn't tend to have (or didn't share) any economic analysis. They probably have this information now. The definition of "economic analysis" was not clear to all work shoppers, but some interpreted this as a cost-benefit analysis. Such an analysis was not done for the 2011 study. If such an analysis is done in the future, it should also include a life-cycle cost analysis. But these analyses tend to occur when there is already money on table for a specific project; this fuels efforts to prioritize projects. But at the feasibility study phase, when money is not yet on the table, this wouldn't typically be done. Some federal grants require cost-benefit analysis, so it would be done for those projects. The Seattle MPO does an economic development plan that is used to prioritize projects. However, in Texas there may not be support for MPOs taking on this responsibility.
	CS-18.3P	Does the study evaluate alignments based on their ability to optimize existing assets?	Yes - Proceed to score related criteria		3.4 - some discussion of air quality assets and CMP projects	Yes	
	CS-18.3a	Did the study analyze how the alignments utilized current roadway/transit infrastructure assets?		1	Figures III-49 - III-56 identify concurrent/existing and new alignments	1	Concurrent/existing and new alignments were identified.

INVEST Scorecard for Corridor Studies							
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 1		Comments from Reviewer 1 (optional)	INVEST Team Workshop	
						Workshop Score	Workshop Comment
	CS-18.3b	Did the study analyze how the alignments utilized current stormwater assets?		0	3.4 - focus on natural resources; some discussion of coordination w/ MS4 municipal water systems	0	Coordination with municipal water systems was discussed but was not looked at in a way to compare different alignments. But in a separate study in Collin County, the study team discussed - at a high level - existing systems' stormwater and drainage accommodations and how potential alignments could tap into those. The study looked at how drainage occurred. On one alignment in the Collin County project, staff have discussed flooding concerns with the US Army Corps of Engineers.
	CS-18.3c	Did the study analyze how the alignments utilized existing major features (bridges, tunnels, retaining walls, or other items not listed in the preceding options)?		0		1	The study did look at existing facilities. The FM 428 corridor is an existing crossing of a park/bridge. While individual assets may not have been looked at specifically, from a segment level the study looked at this. But retaining walls are too micro for a feasibility study. TxDOT has a policy that stating existing facilities should be utilized to the greatest extent practicable. However, this theme duplicates a prior criteria.
	CS-18.4	Does the study evaluate alignments based on BCA?		0		0	Even after the list of alignments is narrowed down, feasibility studies have too many alignments to do a BCA. This should be done after a preferred alternative is identified. In Collin County, an analysis was done based on travel time savings. Staff also have a formula developed for the 10-year plan. A problem with using BCA is there are no universal guidelines. Costs attributed to value of time vary from grant to grant. Discount rate changes all the time.
	CS-18.5	Does the study address performance-based planning and programming components of asset management to analyze and evaluate trade-offs of alignments?		0		0	This was not done for the 2011 study. The MTP addresses this before recommendations are made, prior to the feasibility study. This should be expanded upon in NEPA.

Exhibit 2-19. CS-19

INVEST Scorecard for Corridor Studies						
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 1	Comments from Reviewer 1 (optional)	INVEST Team Workshop	
					Workshop Score	Workshop Comment
CS-19 Operational Efficiency	CS-19.1a	Does the study integrate strategies to improve the efficiency of the transportation system?	0		0	This was not done specifically but improving the efficiency of the transportation system would be the impetus for doing the feasibility study. Any alternative in a congested network could improve efficiency. A feasibility study can look at congestion, but reliability of the results would be subjective. In a Collin County study, two alternatives had about same number of vehicles a day, but one pulled more volume from an existing facility. A new facility can make congestion on the arterial network worse, because people are using the arterials to get to the new facility. It is feasible to look at localized impacts on efficiency by different alignments.
	CS-19.1b	Are these strategies consistent with or do they surpass relevant local, state and/or metropolitan strategies for improving transportation system efficiency?	0		0	These strategies do exist, and we have a Congestion Management Process that calls for every project that increases capacity to the system to have measures to increase efficiency via other modes or alternatives to SOV. Any project submitted to the Transportation Improvement Program has to identify non-SOV strategies before it can be included in TIP. When TxDOT develops a project, they have to take credit for CMP, or for neighboring CMP that will complement if not be part of the actual project. It is also required in NEPA.
	CS-19.2a	Are TSM&O strategies included in the study, as appropriate?	0		0	The 2011 study assumed for all alternatives that ultimately TSMO would be included, but the study didn't specify what or where. The Major Investment Study process (no longer used by NCTCOG) required TDM/TSMO, but since we've moved to a different process this has been lost. The former process would identify the benefit of signal improvements and would look at major employers and identify telecommuting, and other strategies, and the benefit should those strategies be implemented. TSMO is more viable to include in a feasibility study. In contrast, TDM is human behavior and can't really be forecast. These strategies are not something you can model but could be post-process calculations that you add to the no-build, and then to the alternatives to compare. We should include the strategies identified in the asset optimization section of the long-range transportation plan. When developing purpose and need, studies should be flexible to include more elements/issues to solve with the final alternative. You want to do more than just relieve congestion. You can look at / measure the benefit of TSMO strategies between different alignments. In air quality conformity, we acknowledge that these benefits can't be modeled, but they are assigned set benefit values that can offset congestion, etc. But these benefits can't be modeled in TransCad.
	CS-19.2b	Does the study include a discussion of the impacts of including TSM&O strategies?	0		0	Not included in the 2011 study. In a feasibility study, impacts of specific strategies aren't really appropriate, but the study could include general discussion.

INVEST Scorecard for Corridor Studies						
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 1	Comments from Reviewer 1 (optional)	INVEST Team Workshop	
					Workshop Score	Workshop Comment
	CS-19.2c	Are the TSM&O strategies considered and prioritized in the study?	0		0	This is too micro-level of an analysis for a feasibility study.
	CS-19.3	Does the study feed into a process to encourage the implementation of TSM&O strategies identified in the study?	0		0	This is too micro-level of an analysis for a feasibility study.
	CS-19.4	Did the study identify access to fiber networks or other sufficient infrastructure for ITS applications?	1		1	The 2011 study inventoried where fiber was available. Feasibility studies should be looking at this in the age of connected automated vehicles to prioritize one alignment over another. The study should identify other infrastructure needed for connected automated vehicles.

Exhibit 2-20. CS20

INVEST Scorecard for Corridor Studies						
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 1	Comments from Reviewer 1 (optional)	INVEST Team Workshop	
					Workshop Score	Workshop Comment
CS-20 Infrastructure Resiliency	CS-20.1a	Does the study incorporate consideration of climate change or extreme weather impacts, such as drainage; the urban heat island effect; the width of the roadway; the shrink-swell potential for soils, which could be affected by precipitation levels; and flooding potential that may be greater than that documented in FEMA flood maps because of increased impervious surfaces over time?	0	4.2 - outlines existing conditions/projections but does not address impacts	0	While this wasn't done in 2011, feasibility studies could look at low water crossings; road flooding risk could give one alignment a preference over another. For example, some county thoroughfare plans were conducted during drought so they didn't consider low-water crossings; but one done later was done during high rainfall, and they did consider this issue. This was an eye-opening experience. Soil could be considered. One study NCTCOG conducted looked at evacuation routes from a nuclear power plant.
	CS-20.1b	Does the study integrate infrastructure vulnerability and risk assessments?	0		0	Feasibility studies really should integrate these. The greenbelt is an example. What if the USACE has to release large amounts of water from the dam? Should bridges be built to accommodate any potential release? This could be combined with the above criteria. NEPA could compare alternatives -- a risk assessment could include information on amounts of lime to lay down to prevent soil movement. How thick does pavement need to be because of soil movement? Concrete vs asphalt should be considered in the design stage because of its effect on the urban heat island.
	CS-20.2	Did the study address potential GHG emissions through reducing congestion?	0		0	The 2011 study looked at reducing congestion, but it only looked at ozone elements. FHWA had a methodology for accounting for GHG emissions, but it was revoked. No method exists to calculate these emissions. For this reason, this criteria is not being considered. GHG emissions are also more of a regional issue than an alignment issue.
	CS-20.3a	Were partner agencies engaged during the study to reduce barriers and further the prospects for implementation of strategies to address infrastructure resiliency?	0		0	This was not included in 2011 but has already been conducted for the greenbelt study. The study team has talked to USACE lake managers, and this could be done in future studies. USACE, TWDB, TCEQ, EPA, local officials, and counties have hazard mitigation plans. The study can determine how a project is compatible with these plans or enhances their goals and objectives.

INVEST Scorecard for Corridor Studies						
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 1	Comments from Reviewer 1 (optional)	INVEST Team Workshop	
					Workshop Score	Workshop Comment
	CS-20.3b	Were partner agencies engaged during the study to develop appropriate strategies to address transportation events related to hazard events?	0		0	This should be done.

Exhibit 2-21. CS-21

INVEST Scorecard for Corridor Studies												
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 1	Comments from Reviewer 1 (optional)	Score from Reviewer 2	Comments from Reviewer 2 (optional)	Score from Reviewer 3	Comments from Reviewer 3 (optional)	Score from Reviewer 4	Comments from Reviewer 4 (optional)	INVEST Team Workshop	
											Workshop Score	Workshop Comment
CS-21 Earthwork Balance	CS-21.1	Were the profile (preliminary engineering schematic) and terrain of alternatives identified to incorporate grade into feasibility considerations?	0		0		0		0		0	This can be incorporated into future studies.

Exhibit 2-22. CS-22

INVEST Scorecard for Corridor Studies								
Criteria Description - Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 1	Comments from Reviewer 1 (optional)	Score from Reviewer 2	Comments from Reviewer 2 (optional)	Score from Reviewer 3	Comments from Reviewer 3 (optional)
CS-22 Linking Planning and NEPA	CS-22.1	Does the study address goals and objectives for linking system and corridor planning with NEPA documentation and implementing PEL best practices as identified in the long-range transportation plan?	1		1		1	
	CS-22.2	Does the agency have documented procedures that link corridor studies with project-level NEPA analysis?	1		1		0	Although not a well-documented procedure, Phase 2 of the evaluation specifically included criteria which incorporates the intent of NEPA. NCTCOG also participated in FHWA Workshop and Peer exchange, both whose goals included aligning corridor studies with NEPA.
	CS-22.3	Does the study incorporate Planning and Environment Linkages concepts found in Table CS-23.3 (see next tab)?	0				0	This study does not consider cumulative impacts or context sensitive design. It does mention the need to consider several PEL concepts in further/future studies of the corridor
	CS-22.4	Were NEPA practitioners consulted during the study?	1		1		0	
	CS-22.5a	Does the study feature components that use NEPA principles and methods?	1		1		1	Phase 2 of the evaluation specifically included criteria which incorporates the intent of NEPA
	CS-22.5b	Does the study incorporate information from the system-level planning process?	1		1		1	

INVEST Scorecard for Corridor Studies						
Criteria Description – Corridor Studies	Criteria Number - Corridor Studies	Criteria	Score from Reviewer 4	Comments from Reviewer 4 (optional)	INVEST Team Workshop	
					Workshop Score	Workshop Comment
CS-22 Linking Planning and NEPA	CS-22.1	Does the study address goals and objectives for linking system and corridor planning with NEPA documentation and implementing PEL best practices as identified in the long-range transportation plan?	1	The Executive Summary's Introduction discuss the MPO's ability to conduct corridor and subarea studies as part of the NEPA project development process. References to TRACES demonstrate efforts to improve environmental consultation.	1	This criteria really just asks us to use PEL in the feasibility document, which was done in 2011. We should ensure the study integrates well into NEPA. NEPA shouldn't be a start from scratch process - we should be linking these two processes. We do that by making sure the feasibility study investigates in a NEPA-esque style, not haphazardly. A recommendations chapter in a feasibility study could be an opportunity to summarize NEPA-related content, as could the introduction. The structure of the document should follow good standard practices.
	CS-22.2	Does the agency have documented procedures that link corridor studies with project-level NEPA analysis?	0		0	NCTCOG does not have a documented procedure for this. Current guidelines are very loose, not recorded. It would be helpful to create this procedure - depending on how many feasibility studies NCTCOG plans to do. However, we need to clarify what we mean by "link." It's understood that the result of a corridor study should tie in to NEPA, but it's not clear how. The procedures should clarify this. The intent of the Collin County study is to have projects move forward into NEPA. If the document is not done correctly, NEPA can't use it. Public meetings must be documented in a specific way, etc.
	CS-22.3	Does the study incorporate Planning and Environment Linkages concepts found in Table CS-23.3 (see next tab)?	1	Purpose and need; alternatives identification; baselining of environmental conditions; evaluation or elimination of alternatives all occur in this study. CSS is mentioned but largely with boiler plate language.	1	Some of these were covered in the 2011 study. All of them should be covered and are relevant to feasibility studies. Some topics such as CSS may have been excluded because of the scale of the outer loop project.
	CS-22.4	Were NEPA practitioners consulted during the study?	1	Including staff from NCTCOG and R&R agencies.	1	It's good to include NEPA practitioners. It helps to bridge gap between feasibility study and NEPA if we have this experience. NEPA practitioner should review study.

Appendix 3 – REF Analysis

The North Central Texas Council of Governments (NCTCOG) supplemented the INVEST analysis by using an existing method to incorporate the agency's Regional Ecosystem Framework (REF) into analysis of feasibility study alternatives. The method was piloted in the Loop 9 Conservation Vision and Opportunities report completed in 2015. That report was funded by a grant from the Federal Highway Administration.

The REF is a tool that identifies areas of relative ecological importance in the Dallas-Fort Worth region. Transportation partners and local governments that are developing infrastructure projects can use the REF as a preliminary screening tool to identify the potential environmental impacts of their projects.

The REF uses a watershed approach to define areas of ecological importance in the region. The 10 mapped layers of ecological importance include:

- Agricultural lands
- Diversity
- Ecosystem sustainability
- Flood zones
- Impaired water segments
- Natural lands
- Rarity
- Surface water quantity
- Wetlands
- Wildlife habitat

While the 10 layers map these factors at the subwatershed (hydrologic unit code 12) scale, the underlying data exists at the scale of 1 km^2 grid cells. Grid cells received scores of 1 through 5 based on the presence of the ecological or environmental factor related to the REF layer.

The REF scores are based on the quantity of ecological or environmental factor, not the quality. Grid cells with less than 20 percent presence of the ecological or environmental factor received a score of 1; grid cells with a 20 to 29 percent presence received a score of 2; grid cells with a 30 to 39 percent presence received a score of 3; grid cells with a 40 to 49 percent presence received a score of 4; and grid cells with a presence of 50 percent or higher received a score of 5.

Data sources for the REF layers used in the feasibility study analysis include:

Agricultural lands: Quantity of agricultural lands classified as 2011 National Land Cover Database (NLCD) Pasture/Hay and Cultivated Crops.

Diversity: Aggregate data from the Regional Ecological Assessment Protocol (REAP) tool developed by Environmental Protection Agency Region 6. The four sub-layers used to calculate the Diversity layer include: Appropriateness of Land Cover, Contiguous Size of Undeveloped Area, Shannon Land Cover Diversity, and Ecologically Significant Stream Segments.

Ecosystem sustainability: Aggregate data from REAP. The Sustainability layer consists of 11 measures that can be loosely grouped into fragmentors and stressors of ecosystems. Fragmentors include contiguous land cover type, regularity of ecosystem boundary, appropriateness of land cover, waterway obstruction, and road density. Stressors include airport noise, Superfund National Priority List and State Superfund Sites, water quality, air quality, RCRA, Treatment-Storage-Disposal Sites, Corrective Action and State Voluntary Cleanup Program Sites, and urban/agricultural disturbance.

Flood zones: Data from 2012 Federal Emergency Management Agency Digital Flood Insurance Rate Maps. The REF Flood Zones score is based on the percentage of a subwatershed that falls inside a 100-year or 500-year floodplain.

Impaired water segments: Data from Texas Commission on Environmental Quality Index of Water Quality Impairments.

Rarity: Aggregate data from the Environmental Protection Agency Region 6 REAP database. The four sub-layers used to calculate the REAP Rarity layer include: Vegetation Rarity, Natural Heritage Rank, Taxonomic Richness, and Rare Species Richness.

Surface water quantity: Data from 1999 National Hydrography Dataset. The REF Surface Water Quantity score is based on the quantity of surface waters present in a subwatershed.

Wetlands: The REF layer measures quantity of wetlands classified as 2011 NLCD Woody Wetlands and Emergent Herbaceous Wetlands.[1]

Wildlife habitat: Quantity of lands classified by the 2011 NLCD as Forestlands, Shrublands, Grasslands, Wetlands, and Open Water.

[1] The REF wetland layer uses NLCD data. This layer was updated for the INVEST analysis to include areas identified as wetlands by the National Wetlands Inventory and the Ecological Mapping Systems of Texas. Areas identified at wetlands by the National Wetlands Inventory, but identified as developed by the more recent NLCD, were not represented as wetlands in the new layer.

Method for REF and Corridor Feasibility Study Comparison

The REF's underlying grid cell data for 9 of the 10 REF layers was used to compare the potential impacts of the alignments in the Denton County Outer Loop/Greenbelt Parkway Feasibility Study.

The REF scores (ranging from 1 to 5) were weighted by the number of grid cells within the proposed right-of-way for the alternatives. Any grid cell that was partially within the proposed right-of-way was treated as if the entire grid cell was within the proposed right-of-way. The result was an average REF category score for both of the alternatives evaluated in the corridor feasibility study.

Results for REF and Corridor Feasibility Study Comparison

The results yielded minimal differences between the two alignments. The alignments run together across part of the length of the project, and even where they diverge, the greatest distance between alignments is about three miles.

The weighted average of REF scores for each alignment ranges from a high of 3.80 (wildlife habitat layer, alignment 2) to a low of 1.00 (ecosystem sustainability layer, both alignments, attributable to the presence of agricultural lands). Two REF layers produced weighted average scores higher than 3 for both alignments: wildlife habitat and agricultural land. The rarity REF layer produced weighted average scores higher than 2 for both alignments. The remaining six layers produced weighted average scores less than 2 for both alignments. The weighted average results are shown in Exhibit 3-1. The frequency of grid cells by REF score per alignment are shown in Exhibit 3-2. This grid cell results within a 1,000-foot buffer of the alignments are shown in Exhibit 3-3.

Exhibit 3-1. REF Layer Analysis

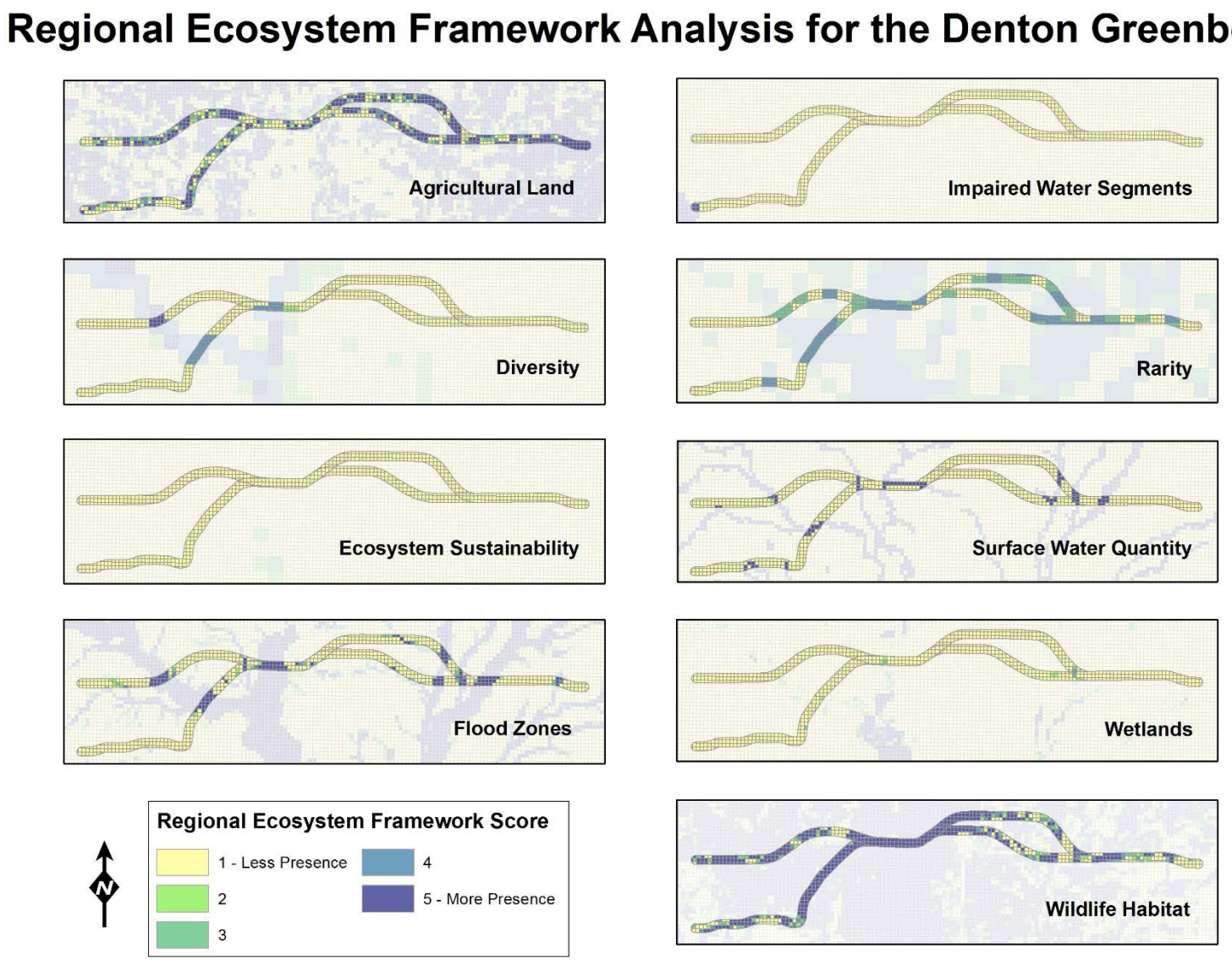
Alignment	REF Layer								
	Surface Waters	Flood Zones	Diversity	Rarity	Wildlife Habitat	Wetland Score	Impaired Water Segments	Ecosystem Sustainability	Agricultural Land
1	1.51	1.89	1.37	2.31	3.76	1.04	1.06	1.00	3.17
2	1.47	1.98	1.31	2.31	3.80	1.04	1.00	1.00	3.39

KEY: Higher Score | Equal Scores | Lower Score

Exhibit 3-2. Corridor Feasibility Study Analysis

REF Layer	Score	Alignment		REF Layer	Score	Alignment		REF Layer	Score	Alignment	
		1	2			1	2			1	2
Surface Waters	1	494	474	Rarity	1	287	256	Impaired Water Segments	1	558	538
	2	0	1		2	0	0		2	0	0
	3	0	0		3	94	141		3	0	0
	4	0	1		4	185	141		4	0	0
	5	72	62		5	0	0		5	8	0
Flood Zones	1	419	382	Wildlife Habitat	1	129	113	Ecosystem Sustainability	1	566	538
	2	14	16		2	28	33		2	0	0
	3	14	19		3	36	33		3	0	0
	4	12	12		4	32	31		4	0	0
	5	107	109		5	341	328		5	0	0
Diversity	1	491	482	Wetland Score	1	550	527	Agriculture	1	202	152
	2	8	9		2	9	4		2	36	43
	3	0	0		3	6	4		3	36	42
	4	67	31		4	1	3		4	49	45
	5	0	16		5	0	0		5	243	256

Exhibit 3-3. REF Layers in Alignment Areas



Appendix 4 – Environmental Stewardship in the Denton Greenbelt Corridor

Introduction

Greenbelts are vegetated areas, typically located along waterways, that serve as protective buffers for aquatic resources. They provide a myriad of ecological benefits: they protect water quality, reduce flooding impacts, preserve wildlife and aquatic habitats, act as wildlife corridors, and more. Greenbelts can also offer abundant recreational opportunities and enhance the quality of life of the people who live near and use them. Greenbelts are used all over the world to encourage natural resource policy and to promote opportunities for sustainable resource management.[1]

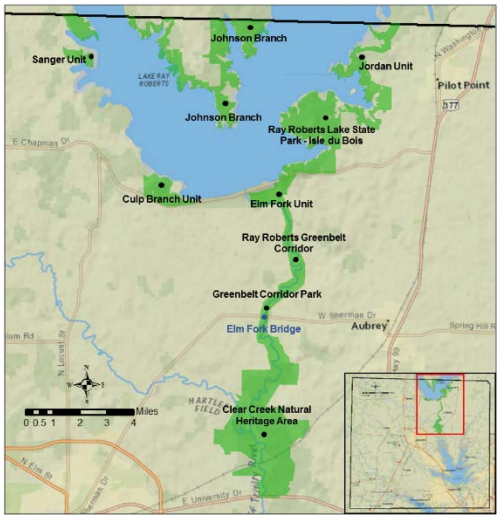
The Ray Roberts Greenbelt Corridor, located in Denton County, Texas, opened on National Trails Day, June 5, 1999.[2] The Greenbelt is a 1,500 acre wilderness corridor that follows the Elm Fork of the Trinity River. It features approximately 20 miles of multi-use trails and has become a premier North Texas destination for outdoor enthusiasts from around the country.

This document covers the history and current conditions of the Ray Roberts Greenbelt Corridor to describe the cultural, ecologic, economic, and social importance it contributes to surrounding communities and the region.

[1] Bengston, D.N. and Youn, *Y-C. Urban Containment Policies and the Protection of Natural Areas: The Case of Seoul's Greenbelt*. p. 2. Ecology and Society. Available at: https://www.nrs.fs.fed.us/pubs/jrnl/2006/nc_2006_bengston_001.pdf.

[2] A Natural History of North Central Texas (NHNCT.org). *North Texas Greenbelt Opens National Trails Day June 5*. May 10, 1999. Available at: http://nhnct.org/nature/ntexas_greenbelt.html.

Exhibit 4-1. Ray Roberts Greenbelt Corridor



History of Denton County and the Greenbelt

Prehistoric: In December of 1988, an archeologist working with the US Army Corps of Engineers (USACE) accidentally stumbled upon an extremely important finding during the construction of Lake Ray Roberts and the dam adjacent to the Elm Fork of the Trinity River.[3] The now world-famous site, called the Aubrey Clovis site, was the camping and hunting ground of some of the first humans in North America and was estimated to be 11,550 years old.[4] Archeologists have found clues to the age of the site by the type of spear and arrow points found there, which are the earliest known type of American projectiles.

Early Settlement: In the 1500s, early hunter-gatherers began frequenting the area in search for food. These hunter-gatherers included the Comanches, Kiowas, and Tonkawas. Settlers began arriving in the 1840s and often clashed with Native Americans. After the Civil War, settlers drove the Native Americans away with the aid of army units from Fort Richardson and Fort Sill. Most

[3] HistoryofLucas.com. *The Early People: The Clovis Complex*. Available at: http://historyoflucas.com/Early_people_clovis_complex.htm.
[4] Texas Parks and Wildlife Department. *Ray Roberts Lake State Park*. Available at: https://tpwd.texas.gov/state-parks/ray-roberts-lake/park_history.

settlers in this area came from states such as Missouri, Kentucky, and Tennessee. Settlers planted vegetable gardens, raised hogs and chickens, and kept cows. Like earlier peoples, they also hunted wild game and gathered seasonal fruits and vegetables.[5]

The Elm Fork branch of the Trinity River was settled by the Sullivan family in 1847. John Ramsey Sullivan (1836-1912) built a cattle ranch, the Smokey Ridge Ranch, in 1856. The property is mostly covered by Lake Ray Roberts today. The 2,000 square foot home built by the Sullivan family around 1872 (the oldest known house in Denton County) was saved and moved to neighboring Cooke County in the 1980s.[6]

The Ray Roberts Greenbelt Corridor Project: The Ray Roberts Greenbelt Corridor project began in 1983 when the city of Dallas and the city of Denton requested USACE to conduct a feasibility study for a greenbelt corridor between Lake Ray Roberts and Lewisville Lake. USACE and the cities of Dallas and Denton provided funding for the creation of the Ray Roberts Greenbelt Corridor. The project cost around $3 million dollars and took 16 years to complete.[7] Texas Parks and Wildlife Department (TPWD) later acquired control of the Greenbelt property through a lease agreement made with USACE and a sublease from the city of Denton. The Greenbelt Corridor is still operated and maintained by TPWD.

Historical Landmarks

The Elm Fork Bridge: The Elm Fork Bridge, built on one of the original wagon trails leading out of the city of Denton (now a road called FM 428), is one of only two remaining iron/steel bridges in Denton County. Shown in Figure 5-2, the Elm Fork Bridge represents an important part of Denton County's transportation history, particularly due to the rise of automobile-oriented transportation systems in the 1920s. At the time construction began on the bridge, Denton County had a population of around 35,000 and had 2,683 automobiles registered in the county. Within five years, the number of cars increased to 5,749.[8]

[5] Texas Parks and Wildlife Department. *Ray Roberts Lake State Park*. Available at: https://tpwd.texas.gov/state-parks/ray-roberts-lake/park_history.
[6] Denton County. *Elm Fork Bridge*. p. 2. Available at: http://apps.dentoncounty.com/website/historicalmarkers/PDFs/Elm-Fork-Bridge-Denton-County-THC-RTHL-Historical-Narrative.pdf.
[7] A Natural History of North Central Texas (NHNCT.org). *North Texas Greenbelt Opens National Trails Day June 5*. May 10, 1999. Available at: http://nhnct.org/nature/ntexas_greenbelt.html.
[8] Denton County. *Elm Fork Bridge*. p. 6. Available at: http://apps.dentoncounty.com/website/historicalmarkers/PDFs/Elm-Fork-Bridge-Denton-County-THC-RTHL-Historical-Narrative.pdf.

Exhibit 4-2. Elm Fork Bridge

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The bridge was opened to traffic on Saturday, July 22, 1922, as the largest bridge in Denton County at the time. The bridge allowed for two-way traffic and improved automobile access to the US Courthouse, located in Sherman, Texas. The bridge remained the only manner of crossing the Elm Fork of the Trinity River until 1990, when FM 428 was widened and the bridge was bypassed. However, the bridge was kept in its original location and later become a pedestrian bridge and part of the Ray Roberts Greenbelt Corridor.[9]

In 2014, the Texas Historical Commission recognized the bridge as a significant structure in Texas history and designated it as a Recorded Texas Historic Landmark – the highest honor bestowed by the state to a historic structure for architectural integrity and historical association.[10]

[9] Denton County. *Elm Fork Bridge*. p. 3. Available at: http://apps.dentoncounty.com/website/historicalmarkers/PDFs/Elm-Fork-Bridge-Denton-County-THC-RTHL-Historical-Narrative.pdf.
[10] Texas Historical Commission. *Texas Historical Site Atlas: Elm Fork Bridge*. Available at: https://atlas.thc.state.tx.us/.

Environmental Features

Priority Watersheds: In a study conducted in 2017, five watersheds in Denton County were identified as "high priority" for greenbelt preservation (Appendix A): 1) Pecan Creek-Lewisville Lake Watershed, 2) Middle Hickory Creek Watershed, 3) Panther Creek-Lewisville Lake Watershed, 4) Culp Branch-Elm Fork Trinity River Watershed, and 5) Denton Creek-Grapevine Lake Watershed.[11] These watersheds were selected as the top priority watersheds based on the number of streams identified as a "high priority" for greenbelt preservation. The watersheds are also located directly adjacent to one of the county's reservoirs and face the greatest immediate pressure from development activities.[12]

Exhibit 4-3. Greenbelt Corridor Park

NCTCOG

[11] Upper Trinity Conservation Trust. *Denton Greenbelt Plan*. pp. 78, 82-86. Available at: http://utct.org/greenbelt_plan.html.
[12] Upper Trinity Conservation Trust. *Denton Greenbelt Plan*. p. 15. Available at: http://utct.org/greenbelt_plan.html.

Results from the study suggested that ordinances be developed to deter or prevent development within these watersheds or near high priority streams. The city of Denton, for example, has watershed protection programs in place, created through city ordinances, that preserve greenspace areas, provide floodplain provisions, and designate environmentally sensitive areas.[13]

Flooding: The floodplains of the Elm Fork of the Trinity River are made of very fine, clay soils that do not drain efficiently. This natural feature, combined with the rapid development that has occurred in the drainage basin around Denton County, makes the area prone to flooding. The expansion of Lewisville Lake in the 1940s and the construction of Lake Ray Roberts in the late 1980s greatly improved flood control in Denton County. The county adopted a floodplain management ordinance in 2011 that limited development in or near the floodplains.

Greenbelts can ameliorate floods by dissipating flood energy along their entire length, helping to reduce downstream flooding in the flood plains.[14] The Greenbelt Corridor and the adjacent trails are prone to flooding – a design strategy meant to reduce the flooding in the surrounding urbanized areas. However, widespread flooding caused by extreme rainfall events in 2007 and 2015 reiterated the need for the county to pursue the preservation of existing greenbelts and creation of additional greenbelts.[15] In 2017, the county also adopted the North Central Texas Council of Governments Sixteen County Watershed Management Initiative, which outlines recommended standards in watershed management intended to reduce or prevent flooding.[16]

Creeks, Streams, and Lakes: Denton County encompasses over 950 square miles of land and has hundreds of miles of streams and creeks – all tributaries to the Elm Fork of the Trinity River. There are approximately 73 named streams and creeks within Denton County. Twenty-six of these streams were identified by the 2017 study as high priority, totaling approximately 1,225 miles.[17] The high priority status is given to streams and creeks that are significant contributors of water to the local water supply reservoirs, help maintain existing greenbelts, and have the potential of restoring connections to existing greenbelt corridors. There are also currently 137 miles of stream segments with some form of protection granted through ordinances, setbacks, dedications, protected lands, and conservation easements.[18] A map of the prioritized streams is seen in figure 5-3. A 2017 study, the Denton

[13] Upper Trinity Conservation Trust. *Denton Greenbelt Plan*. p. 95. Available at: http://utct.org/greenbelt_plan.html.
[14] Upper Trinity Conservation Trust. *Denton Greenbelt Plan*. p. 77. Available at: http://utct.org/greenbelt_plan.html.
[15] Gray-Hatfield, M. Denton Record-Chronicle. *History in the Making*. May 20, 2015. Available at: http://www.dentonrc.com/news/news/2015/05/20/history-in-the-making.
[16] The 380 News. County Supports North Central Texas Council of Government's Watershed Management Initiative. Available at: http://www.380news.com/2017/09/05/4082/from-the-desk-of-hugh-coleman-denton-county-commissioner-pct-1-september-2017/.
[17] Upper Trinity Conservation Trust. *Denton Greenbelt Plan*. pp. 11, 15. Available at: http://utct.org/greenbelt_plan.html.
[18] Upper Trinity Conservation Trust. *Denton Greenbelt Plan: For the Future*. Available at: http://utct.org/greenbelt_plan.html.

County Greenbelt Plan, categorized streams by priority and identified five "high" priority watersheds for greenbelt preservation measures.

Exhibit 4-4. Prioritized Streams in the Denton County Greenbelt Plan

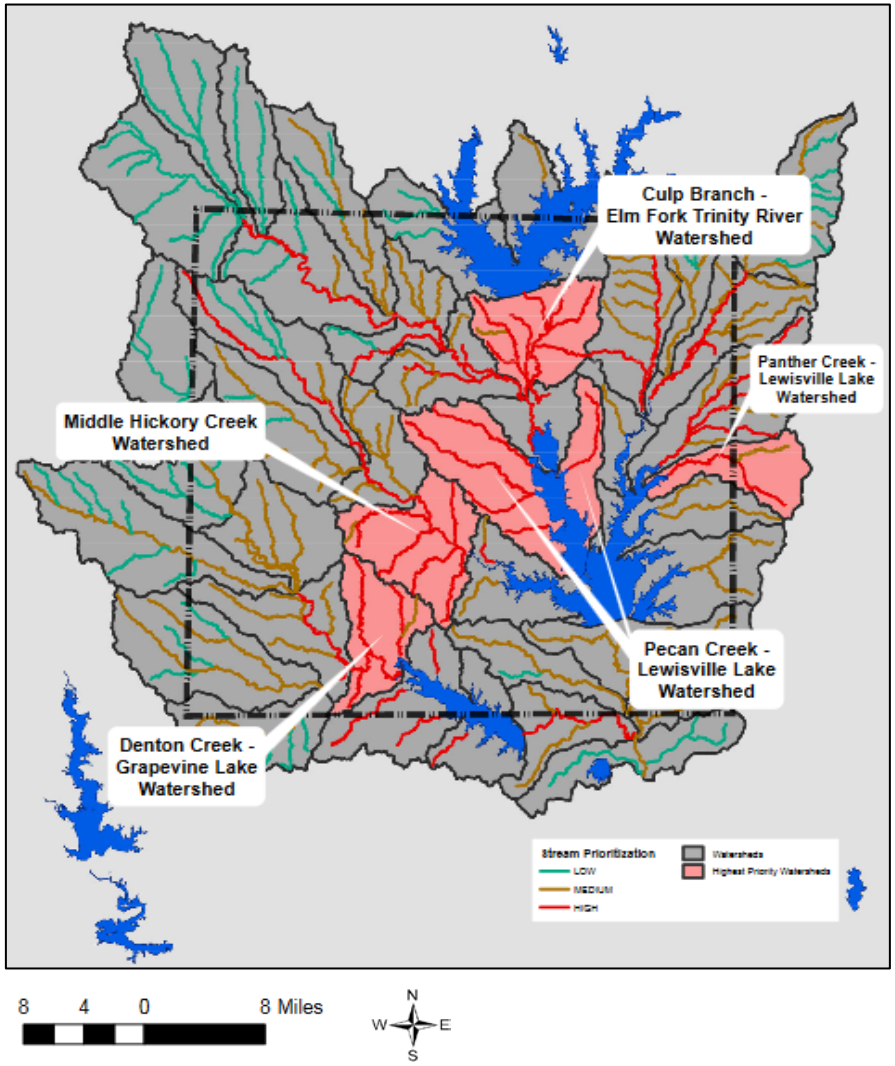

Exhibit 4-5. Elm Fork of the Trinity River at the Elm Fork Park

NCTCOG

Denton County has three water supply reservoirs: Lewisville Lake, Lake Ray Roberts, and Grapevine Lake. Lewisville Lake and Lake Ray Roberts both span around 29,000 acres, and Grapevine Lake is about 8,000 acres. [19] Lewisville Lake was the principle source of municipal water for the city of Dallas for 31 years.[20] The three reservoirs are operated and managed by USACE, and provide drinking water to the cities of Denton and Dallas, and the surrounding communities.

State Park and Recreation Areas: The Ray Roberts Lake State Park is owned by USACE and operated by TPWD. The main park unit is adjacent to Lake Ray Roberts and offers many amenities, including: hiking and biking trails, equestrian trails, picnic pavilions, rest room facilities, regular and equestrian parking, camping, pier and shore-side fishing, fish cleaning stations, and swimming.

[19] Upper Trinity Conservation Trust. *Denton Greenbelt Plan*. pp. 41, 53. Available at: http://utct.org/greenbelt_plan.html; Lake Grapevine. *About Lake Grapevine*. Available at: http://www.lake-grapevine.com/.
[20] Texas Water Development Board. *Lewisville Lake (Trinity River Basin)*. Available at: http://www.twdb.texas.gov/surfacewater/rivers/reservoirs/lewisville/index.asp.

Exhibit 4-6. Greenbelt Corridor Park

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The park also has nine units that offer a large variety of amenities. Three of those units, the Isle du Bois (1,397 acres), Johnson Branch (1,514 acres), and the Ray Roberts Greenbelt, are developed and offer paved trails, water, and restrooms. Six satellite units, Jordan (477 acres), Elm Fork (290 acres), Sanger (20 acres), Pond Creek (20 acres), Pecan Creek (48 acres), and Buck Creek (11 acres), also have boat ramps and courtesy boat docks available for visitors. Lake Ray Roberts Marina, a full service marina that includes boat rentals, fueling, boat slips, and a store, is located in the Sanger unit. The Jordan unit is also home to the Lone Star Lodge and Marina, which offers Jet Ski and kayak rentals, and offers a wedding venue.[21]

The Park and its satellite units have around 800,000 visitors per year, making it the second-most visited state park in Texas. [22] Reservations are needed to camp and stay at the lodges – which are fully booked 10 months out of the year.

[21] Texas Parks and Wildlife Department. *Ray Roberts Lake State Park*. Available at: https://tpwd.texas.gov/state-parks/ray-roberts-lake.
[22] True, Chris. Personal Communication. June 06, 2017.

Trail System: The Ray Roberts Greenbelt Corridor is a 20-mile, multi-use trail system, beginning at the Lake Ray Roberts Dam in the north, and ending at the headwaters of Lewisville Lake to the south. The trail follows the heavily wooded riparian corridor along the banks of the Elm Fork of the Trinity River. There are 10 miles of equestrian trails, and 10 miles are reserved specifically for hike and bike use. The Greenbelt trails also connect the trails in the main portion of the state park on the northern point of the Greenbelt. Altogether, the state park and the Greenbelt Corridor provide a total of 65 miles of trails.[23]

Exhibit 4-7. Clear Creek Natural Heritage Area

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Protected Areas: The Ray Roberts Wildlife Management Area (WMA) was established after the completion of Lake Ray Roberts in 1987. The WMA property is 41,303 acres and encompasses Lake Ray Roberts and the Greenbelt Corridor. The WMA sits where three unique ecoregions meet: Eastern Cross Timbers, Blackland Prairie, and Grand Prairie.[24] More than 300 species of plants

[23] Texas Parks and Wildlife Department. *Ray Roberts Lake State Park*. Available at: https://tpwd.texas.gov/state-parks/ray-roberts-lake.
[24] Texas Parks and Wildlife Department. *Ray Roberts Lake State Park*. Available at: https://tpwd.texas.gov/state-parks/ray-roberts-lake.

grow here, and many animals find food and shelter in the oak woodlands and prairie grasslands of the park.[25] Within the WMA, 229 bird species have been recorded, including a nesting pair of bald eagles on the lower portion of the Greenbelt Corridor.[26] Wildlife also includes white-tailed deer, coyotes, bobcats, wild turkey, and the occasional black bear or mountain lion.

The Clear Creek Natural Heritage Center is a nature education and outreach center that offers free classes and guided hikes by Master Naturalists. The center is located near the southern portion of the Greenbelt Corridor and acts as a gateway to 2,900 acres of protected forests, wetlands, prairies, and aquatic habitats.[27]

Open Space and Connectivity: The city of Denton is seeking to link open spaces, incorporate land conservation and management, and retain the rural and natural character of Denton, with the purpose of promoting the formation of a cohesive, broad, green infrastructure framework. [28] Through the Denton 2030 Plan, the city of Denton has acquired property for parks and open space with goals for urban design, mobility, infrastructure, and environmental conservation. The Denton Greenbelt Plan (discussed later) also encourages the acquisition of land for open space preservation and the construction of a system of connected parks and trails for outdoor recreation, while keeping agriculture conservation easements for equestrian and farming use.[29]

Horse Ranching and Equestrian Groups: Horse ranching remains a major industry in Denton County. The county has one of the largest concentrations of horse farms in the country. Over 300 horse ranches exist along an area of well-drained, gently sloping, loamy soil.[30] Large breeding farms, training facilities, and equine specialists are abundant, making the area a mecca for professional equestrians and horse enthusiasts.[31]

The Lake Ray Roberts Equestrian Trails Association (LRRETA) was formed in 2012 as part of the Greenbelt Alliance of Denton County, a network of community based, volunteer associations, supporting the preservation of the Greenbelt Corridor.[32] As part of

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[25] Texas Parks and Wildlife Department. Ray Roberts Lake State Park. Available at: https://tpwd.texas.gov/state-parks/ray-roberts-lake.
[26] OutAboutTexas.com. *Ray Roberts Lake Wildlife Management Area*. Available at: http://www.outabouttexas.com/LocSrv?locId=5935093973516288.
[27] City of Denton. *Clear Creek*. Available at: https://www.cityofdenton.com/residents/parks-recreation/parks-trails/clear-creek; North Central Texas Council of Governments. *National Ecological Framework: Denton County Wetlands*. Available at: http://nctcoggis.maps.arcgis.com/apps/webappviewer/index.html?id=629ea7bf1f5e4d93a38f857ebb1f2f1f.
[28] City of Denton. *Denton Plan 2030*. Available at: https://www.cityofdenton.com/CoD/media/City-of-Denton/Government/Denton_Plan_2030.pdf.
[29] Upper Trinity Conservation Trust. *Denton County Greenbelt Plan*. Available at: http://utct.org/greenbelt_plan.html.
[30] Denton County. *Elm Fork Bridge*. p. 2. Available at:http://apps.dentoncounty.com/website/historicalmarkers/PDFs/Elm-Fork-Bridge-Denton-County-THC-RTHL-Historical-Narrative.pdf.
[31] DiscoverDenton.com. *Horse Country Tours*. Available at: https://www.discoverdenton.com/what-to-do/horse-country/.
[32] Burgess, D. *Bridge on Greenbelt Equestrian Trail to Open Sept. 25*. Denton Record-Chronicle. Available at: http://www.dentonrc.com/news/news/2016/09/13/bridge-on-greenbelt-equestrian-trail-to-open-sept.-25.

their fundraising and education/outreach efforts, LRRETA and the Greenbelt Alliance hosted an annual festival called GreenFest on the Greenbelt Corridor. The festival, which raises money for trail improvements and amenities, was discontinued in 2016, then reinstated for 2018.[33] In 2017, LRRETA also began hosting an annual equestrian obstacle competition with the goal of raising funds to maintain the Greenbelt Corridor. In addition to fundraising, members of LRRETA have written grants to secure funding for construction projects that would restore the trail from previous floods and help it withstand any future floodwaters.[34]

Conservation Easements: Aside from owning the Ray Roberts Lake State Park, the Ray Roberts Greenbelt Corridor, and the Ray Roberts Wildlife Management Area, USACE also holds several conservation easements on some lands adjacent to the Greenbelt Corridor. These conservation easements were purchased by USACE to prevent the development of the land and preserve the area in its current condition. Property owners are still allowed to use the land for agricultural and grazing purposes, but generally, no other uses are allowed and structural development is limited.[35]

The Upper Trinity Conservation Trust (UTCT) provides an additional mechanism for watershed protection. [36] As a nonprofit 501(c)(3) land trust, UTCT is able to acquire land through conservation easements from landowners, developers, and municipalities, that wish to preserve and protect greenbelts. Easement donors enjoy a valuable partnership with UTCT, which can help them attain their personal goals for the land while still conserving and preserving greenbelts.[37]

[33] The Greenbelt Alliance of Denton County. *The Greenbelt Alliance History & Formation*. Available at: http://www.friendsofthegreenbelt.org/who-we-are; GreenFest on the Greenbelt. *About GreenFest*. Available at: http://www.greenfestdenton.com/about-greenfest.
[34] Lake Ray Robert's Equestrian Trails Association. *About LRRETA and Lake Ray Roberts*. Available at: https://www.lrreta.com/.
[35] US Army Corps of Engineers. *Ray Roberts Lake Guidelines for Adjacent Property Land Owners and Residents*. Available at: http://www.swf-wc.usace.army.mil/rayroberts/Realestate/Adjacent%20Landowners%20brochure%20Ray%20Roberts.doc.
[36] Alldredge, B. and J. Pierce. *Protecting Watersheds: A Coordinated Approach – County-wide Plan Preserves Greenbelts, Protects Water Quality*. p. 30.Texas Water Conservation Association. Available at: http://utct.org/pdfFiles/Confluence%20Q2_2017_Digital.pdf.
[37] Upper Trinity Conservation Trust. *Your Land Matters*. Available at: http://utct.org/#.

Exhibit 4-8. Land Use Near the Greenbelt Corridor Park

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Priorities in Surrounding Communities

The communities surrounding the Greenbelt Corridor have established various priorities related to the protection of environmental features and the pursuance of sustainability efforts. These established priorities can be found as formalized strategic plans and through the efforts of their respective community volunteer or nonprofit organizations. The goals that have been adopted and encouraged by the communities surrounding the Denton Outer Loop Greenbelt Parkway region demonstrate the level of dedication and responsibility the communities and residents have toward environmental stewardship.

The following outlines the communities' environmental and sustainability priorities, as well as the efforts of local environmental groups:

City of Aubrey

Active local environmental group: Keep Aubrey Beautiful.[38]

City of Celina

Active local environmental group: Keep Celina Beautiful.[39]

Environmental Stewardship Priorities:

- Protect stream corridors and other physical assets as amenities.
- Plan for the expansion of Celina's park system to meet future needs through the development of the Parks Master Plan.[40]
- Coordinate with other public entities to identify opportunities for shared public facilities that include parks. This includes all jurisdictions sharing boundaries with the city of Celina.[41]

City of Denton

Active local environmental groups include: Keep Denton Beautiful,[42] Denton County Citizen's Climate Lobby Chapter,[43] and University of North Texas Student Sustainability.[44]

Environmental Stewardship Priorities:

- Promote land use and code/zoning patterns that positively affect energy use and the environment.
- Preserve open space, natural areas, and the tree canopy.[45]
- Coordinate acquisition of parks and open space with goals for urban design, mobility, infrastructure, and environmental conservation objectives.

[38] City of Aubrey. *Keep Aubrey Beautiful*. Available at: https://www.aubreytx.gov/community/page/keep-aubrey-beautiful.
[39] Keep Celina Beautiful. *Keep Celina Beautiful Facebook Account*. Available at: https://www.facebook.com/Keep-Celina-Beautiful-840514586024869/.
[40] City of Celina. *Comprehensive Plan: Guiding Principles for Future Land Use Pattern and Development Character*. p. 39. Available at: https://www.celina-tx.gov/DocumentCenter/View/110.
[41] City of Celina. *Comprehensive Plan: Goals, Policies and Strategies*. p. 75. Available at: https://www.celina-tx.gov/DocumentCenter/View/110.
[42] Keep Denton Beautiful. *About Keep Denton Beautiful*. Available at: http://kdb.org/.
[43] Citizens' Climate Lobby. *Denton County Lobby Chapter*. Available at: http://citizensclimatelobby.org/chapters/TX_Denton_County.
[44] University of North Texas. *Student Sustainability / We Mean Green Fund*. Available at: http://studentaffairs.unt.edu/sustainable.
[45] City of Denton. *Simply Sustainable Plan*. p. 35. Available at: https://www.cityofdenton.com/CoD/media/City-of-Denton/Simply_Sustainable_Plan_2012.pdf.

- Promote the formation of a cohesive, broad green infrastructure framework for the city that links open space and natural resources, incorporates goals for land conservation and management, and retains the rural and natural character of Denton.46

Town of Little Elm

Active local environmental group: Keep Little Elm Beautiful.[47]

Environmental Stewardship Priorities:

- Environment -- Continue to promote and protect the natural environment of Little Elm, including the lake, wildlife, scenery, and vegetation.
- Take the initiative to establish a collaborative relationship with the Army Corps of Engineers, the Upper Trinity River Water District, and the North Texas Municipal Water Districts regarding protecting the natural environment.
- Preserve natural areas for public use, such as areas with extensive tree coverage, wildlife habitat, and views of the lake.
- Ensure the environment and the natural areas of the lake are connected.[48]

City of Pilot Point

Active local environmental group: Keep Pilot Point Beautiful.[49]

Environmental Stewardship Priorities:

- Preserve agriculture and open space to ensure continuous rural feel and way of life.
- Develop policies and preservation districts to restrict development on identified sensitive natural areas and support the preservation of natural and agricultural land.
- Work with the Corps of Engineers and county and city adjacencies to preserve wildlife corridors.
- Identify environmentally sensitive areas such as wetlands, steep slopes, flood plains, etc. and define them as primary conservation areas.
- Maintain diversity in natural areas to preserve the current balance of the natural and built environment.[50]

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[46] City of Denton. *Denton Plan 2030*. p. 111. Available at: https://www.cityofdenton.com/CoD/media/City-of-Denton/Government/Denton_Plan_2030.pdf.
[47] Town of Little Elm. *Keep Little Elm Beautiful*. Available at: http://www.littleelm.org/489/Keep-Little-Elm-Beautiful.
[48] Town of Little Elm. *Comprehensive Plan*: *Transportation Strategies*. p. 41. Available at: http://www.littleelmtx.us/DocumentCenter/Home/View/655.
[49] City of Pilot Point. *Keep Pilot Point Beautiful*. Available at: https://www.cityofpilotpoint.org/originals/objects/Comp_Plan.pdf.
[50] City of Pilot Point. *Comprehensive Plan*. p. 13. Available at: https://www.cityofpilotpoint.org/originals/objects/Comp_Plan.pdf.

- Make provisions for open space preservation and agriculture conservation easements.[51]

Town of Prosper

Environmental Stewardship Priorities:

- Preserve open spaces that create a quiet, open feel.
- Build a system of connected parks and trails for outdoor recreation.[52]

Town of Shady Shores

Active local environmental group: Keep Shady Shores Beautiful.[53]

Community Groups

In addition to the strategies and efforts supported by local communities, there are several community groups who work towards enhancing or benefit from the environmental stewardship of the region. These groups are Cross Timbers Sierra Club,[54] Elm Fork Master Naturalists,[55] Cross Timbers Equestrian Trail Association,[56] Dallas Off-Road Bicycle Association,[57] and the Upper Trinity Conservation Trust.[58]

Denton County Greenbelt Plan

Denton County, one of the 12 counties that make up the North Central Texas metropolitan planning area, is rapidly urbanizing. The US Census Bureau estimated the 2014 population of Denton County at 753,363, which is expected to double by 2040.[59] Developed land is also projected to nearly double, transforming the county from a largely agricultural setting to an urban and suburban

[51] City of Pilot Point. *Comprehensive Plan*. p. 23. Available at: http://www.cityofpilotpoint.org/keepppbeautiful.html.
[52] Town of Prosper. *Comprehensive Plan*: *Community Livability Guidelines*. p. 50. Available at: https://www.prospertx.gov/wp-content/uploads/Prosper_Comprehensive_Plan_Combined.pdf.
[53] Town of Shady Shores. *Keep Shady Shores Beautiful*. Available at: https://www.shady-shores.com/index.aspx?nid=940.
[54] Cross Timbers Sierra Club. *About: Cross Timbers Sierra Club*. Available at: https://crosstimberssierraclub.org/.
[55] Texas A&M AgriLife Extension. *Elm Fork Chapter Master Naturalists*. Available at: https://txmn.org/elmfork/.
[56] Cross Timbers Equestrian Trails. *Cross Timbers Equestrian Trails Association*. Available at: http://www.cteta.org/.
[57] Dallas Off-Road Bicycle Association. *DORBA*. Available at: http://www.dorba.org/.
[58] Upper Trinity Conservation Trust. *Your Land Matters*. Available at: http://www.utct.org/.
[59] Upper Trinity Conservation Trust. *Denton County Greenbelt Plan: For the Future*. Available at: http://utct.org/greenbelt_plan.html.

setting. [60] The majority of this growth is attributed to low-density suburban development, stemming mainly from the center of the Dallas-Fort Worth area. If not planned correctly, this land development could significantly affect the county's natural resources.

To address these foreseeable development pressures, and with the Ray Roberts Greenbelt as a focus, UTCT, Denton County, and the Upper Trinity Regional Water District, commissioned the creation of the Denton County Greenbelt Plan. The UTCT recognized the need for public participation and the input of regional expertise to ensure the adoption and ultimate success of the Greenbelt Plan. The North Central Texas Council of Governments, along with stakeholders including nonprofits, local governments, businesses, land owners, natural resource agencies, and universities, came together to support the Greenbelt preservation effort and create the plan.

Exhibit 4-9. Denton County Greenbelt Plan

[60] Alldredge, B. and J. Pierce. *Protecting Watersheds: A Coordinated Approach – County-wide Plan Preserves Greenbelts, Protects Water Quality*. p. 28. Texas Water Conservation Association. Available at: http://utct.org/pdfFiles/Confluence%20Q2_2017_Digital.pdf.

The purpose of the Greenbelt Plan was two-fold: first, to identify and prioritize highly valued greenbelt areas in Denton County that should be preserved, connected, or established for maximum benefit; and second, to serve as a guide in protecting the existing greenbelts associated with the streams that flow into the local water supply reservoirs, including the Lake Ray Roberts Greenbelt Corridor.[61] The plan also advocates for a common vision, providing a toolbox of strategies that the county, municipalities, nonprofit organizations, agencies, or developers can use to preserve the greenbelts "right where we live."[62]

Closing Remarks

Greenbelts go beyond preserving natural landscapes and protecting natural resources – greenbelts also provide the community with a sense of place that is socially and culturally rewarding. The creation of the Greenbelt Corridor relied heavily upon grassroots community efforts. Input from the communities surrounding the Greenbelt Corridor helped to define the future goals and priorities for the natural resources in the area. The values of the local constituency and the direction of local policy has made it clear that efforts will continue to preserve and conserve the Ray Roberts Greenbelt Corridor and other greenbelts. With careful planning, the region will continue to benefit from the ecological, social, and cultural benefits provided by the Ray Roberts Greenbelt Corridor and enjoy the enhanced quality of life that it offers.

This report was funded by the North Central Texas Council of Governments Environmental Stewardship Program.

[61] Alldredge, B. and J. Pierce. *Protecting Watersheds: A Coordinated Approach – County-wide Plan Preserves Greenbelts, Protects Water Quality*. p. 30. Texas Water Conservation Association. Available at: http://utct.org/pdfFiles/Confluence%20Q2_2017_Digital.pdf.

[62] Upper Trinity Conservation Trust. *Denton County Greenbelt Plan*. p. 4. Available at http://utct.org/greenbelt_plan.html.

References

A Natural History of North Central Texas (NHNCT.org). North Texas Greenbelt Opens National Trails Day June 5. May 10, 1999. Available at: http://nhnct.org/nature/ntexas_greenbelt.html.

Alldredge, B. and J. Pierce. Protecting Watersheds: A Coordinated Approach – County-wide Plan Preserves Greenbelts, Protects Water Quality. Texas Water Conservation Association. pp. 1-136. Available at: http://utct.org/pdfFiles/Confluence%20Q2_2017_Digital.pdf.

Bengston, D.N. and Youn, Y-C. 2006. Urban Containment Policies and the Protection of Natural Areas: The Case of Seoul's Greenbelt. *Ecology and Society*. Available at: https://www.nrs.fs.fed.us/pubs/jrnl/2006/nc_2006_bengston_001.pdf.

Burgess, D. Bridge on Greenbelt Equestrian Trail to Open Sept. 25. Denton Record-Chronicle. Available at: http://www.dentonrc.com/news/news/2016/09/13/bridge-on-greenbelt-equestrian-trail-to-open-sept.-25.

City of Aubrey. Keep Aubrey Beautiful. Available at: https://www.aubreytx.gov/community/page/keep-aubrey-beautiful.

City of Celina. Comprehensive Plan. pp. 1-91. Available at: https://www.celina-tx.gov/DocumentCenter/View/110.

City of Denton. Clear Creek. Available at: https://www.cityofdenton.com/residents/parks-recreation/parks-trails/clear-creek.

City of Denton. Denton Plan 2030. pp. 1-415. Available at: https://www.cityofdenton.com/CoD/media/City-of-Denton/Government/Denton_Plan_2030.pdf.

City of Denton. Simply Sustainable Plan. Available at: https://www.cityofdenton.com/CoD/media/City-of-Denton/Simply_Sustainable_Plan_2012.pdf.

City of Pilot Point. Comprehensive Plan. pp. 1-91. Available at: https://www.cityofpilotpoint.org/originals/objects/Comp_Plan.pdf.

City of Pilot Point. Keep Pilot Point Beautiful. Available at: https://www.cityofpilotpoint.org/originals/objects/Comp_Plan.pdf.

Citizens' Climate Lobby. Denton County Lobby Chapter. Available at: http://citizensclimatelobby.org/chapters/TX_Denton_County.

Cross Timbers Equestrian Trails. Cross Timbers Equestrian Trails Association. Available at: http://www.cteta.org/.

Cross Timbers Sierra Club. About Cross Timbers Sierra Club. Available at: https://crosstimberssierraclub.org/.

Dallas Off-Road Bicycle Association. DORBA. Available at: http://www.dorba.org/.

Denton County. Elm Fork Bridge. pp. 1-9. Available at: http://apps.dentoncounty.com/website/historicalmarkers/PDFs/Elm-Fork-Bridge-Denton-County-THC-RTHL-Historical-Narrative.pdf.

DiscoverDenton.com. Horse Country Tours. Available at: https://www.discoverdenton.com/what-to-do/horse-country/.

Gray-Hatfield, M. History in the Making. Denton Record-Chronicle. May 20, 2015. Available at: http://www.dentonrc.com/news/news/2015/05/20/history-in-the-making.

GreenFest on the Greenbelt. About GreenFest. Available at: http://www.greenfestdenton.com/about-greenfest.

HistoryofLucas.com. The Early People: The Clovis Complex. Available at: http://historyoflucas.com/Early_people_clovis_complex.htm.

Keep Celina Beautiful. Keep Celina Beautiful Facebook Account. Available at: https://www.facebook.com/Keep-Celina-Beautiful-840514586024869/.

Keep Denton Beautiful. About Keep Denton Beautiful. Available at: http://kdb.org/.

Lake Grapevine. About Lake Grapevine. Available at: http://www.lake-grapevine.com/.

Lake Ray Robert's Equestrian Trails Association. About LRRETA and Lake Ray Roberts. Available at: https://www.lrreta.com/.

North Central Texas Council of Governments. National Ecological Framework: Denton County Wetlands. Available at: http://nctcoggis.maps.arcgis.com/apps/webappviewer/index.html?id=629ea7bf1f5e4d93a38f857ebb1f2f1f.

OutAboutTexas.com. Ray Roberts Lake Wildlife Management Area. Available at: http://www.outabouttexas.com/LocSrv?locId=5935093973516288.

Texas A&M AgriLife Extension. Elm Fork Chapter Master Naturalists. Available at: https://txmn.org/elmfork/.

Texas Historical Commission. Texas Historical Sites Atlas: Elm Fork Bridge. Available at: https://atlas.thc.state.tx.us/.

Texas Parks and Wildlife Division. Ray Roberts Lake: Public Access Facilities. Available at: https://tpwd.texas.gov/fishboat/fish/recreational/lakes/ray_roberts/access.phtml.

Texas Parks and Wildlife Division. Ray Roberts Lake State Park. Available at: https://tpwd.texas.gov/state-parks/ray-roberts-lake.

Texas Water Development Board. Lewisville Lake (Trinity River Basin). Available at: http://www.twdb.texas.gov/surfacewater/rivers/reservoirs/lewisville/index.asp.

The 380 News. County Supports North Central Texas Council of Government's Watershed Management Initiative. Available at: http://www.380news.com/2017/09/05/4082/from-the-desk-of-hugh-coleman-denton-county-commissioner-pct-1-september-2017/.

The Greenbelt Alliance of Denton County. The Greenbelt Alliance History & Formation. Available at: http://www.friendsofthegreenbelt.org/who-we-are.

Town of Little Elm. Comprehensive Plan 2008. pp. 1-49. Available at: http://www.littleelmtx.us/DocumentCenter/Home/View/655.

Town of Little Elm. Keep Little Elm Beautiful. Available at: http://www.littleelm.org/489/Keep-Little-Elm-Beautiful.

Town of Prosper. Prosper Comprehensive Plan. pp. 1-125. Available at: https://www.prospertx.gov/wp-content/uploads/Prosper_Comprehensive_Plan_Combined.pdf.

Town of Shady Shores. Keep Shady Shores Beautiful. Available at: https://www.shady-shores.com/index.aspx?nid=940.

True, Chris. Personal Communication. June 06, 2017.

University of North Texas. Student Sustainability/We Mean Green Fund. Available at: http://studentaffairs.unt.edu/sustainable.

Upper Trinity Conservation Trust. Your Land Matters. Available at: http://utct.org/#.

Upper Trinity Conservation Trust. Denton County Greenbelt Plan. pp. 1-195. Available at: http://utct.org/greenbelt_plan.html.

Upper Trinity Conservation Trust. Denton Greenbelt Plan: Plan for the Future. Available at: http://utct.org/greenbelt_plan.html.

US Army Corps of Engineers. Ray Roberts Lake Guidelines for Adjacent Property Land Owners and Residents. Available at: http://www.swf-wc.usace.army.mil/rayroberts/Realestate/Adjacent%20Landowners%20brochure%20Ray%20Roberts.doc.

Appendix 5 – Case Studies

Introduction

The proposed Denton County Outer Loop/Greenbelt Parkway provides environmental challenges because the corridor passes perpendicular to a protected greenbelt within a highly visited Texas state park, the Ray Roberts Lake State Park. The greenbelt is linear and situated between Ray Roberts Lake and Lewisville Lake. To meet the transportation need, it will be impossible to avoid the park and greenbelt.

Within the United States, there are several other instances of parks or natural areas being segmented because of the transportation needs of the region. Five case studies of segmented parks or natural areas by a major transportation facility will be explored in this report. For each segmented park/natural area, the report will provide a summary of the purpose and need for the road, a description of the park, the major environmental impacts, and the mitigation completed or planned. A summary of these case studies can be found in Exhibit 5-1.

Exhibit 5-1. Summary of Environmental Impacts of Segmented Parks/Natural Areas

Road	Park/Natural Area	Location	Summary of Major Impacts
SR 73, San Joaquin Toll Road	Laguna Greenbelt	Orange County, California	Wildlife corridor Habitat Streambed modifications Wetlands Noise Light
US 93, The People's Way	Flathead Reservation Lolo National Forest Flathead National Forests	Missoula and Lake counties, Montana	Tribal land Large species wildlife mortality Habitat Wetlands
SR 84/I-75, Alligator Alley	Fakahatchee Strand State Preserve Florida Panther National Wildlife Refuge Big Cypress National Park Everglades National Park	Broward and Collier counties, Florida	Alligators and panthers Wetlands Tribal usage Hydrology impacts Habitat
I-270/US 15 Multimodal Corridor	Seneca Creek State Park Monocacy National Battlefield Park	Frederick and Montgomery counties, Maryland	Historical landmark Wetlands Surface water Wildlife habitat Threatened fish species

Road	Park/Natural Area	Location	Summary of Major Impacts
SH 100	Laguna Atascosa National Wildlife Refuge	Cameron County, Texas	Wetlands Wildlife mortality

Segmented Parks

SR 73

Purpose and Need

SR 73, or San Joaquin Toll Road, is located in Orange County in southern California. The roadway expansion had been planned since 1976 as a part of the Orange County Master Plan of Arterial Highways. The road was planned to reduce current and predicted congestion in the area (USDOT et al., 1992). The vehicles on the major roadways in the area, including I-5, I-405, and SR 1, were forecasted to double and expanding SR 73 would help to reduce the congestion. The road would also increase access to the University of California at Irvine and several recreation areas in the region. Population, jobs, and corresponding development was also expected to increase in the next 20 years (USDOT et al., 1992). The road was expanded to eight lanes, with three general purpose lanes and one high-occupancy vehicle (HOV) lane in each direction (USDOT et al., 1992).

Impact

The SR 73 tollway impacts an area collectively known as the Laguna Greenbelt. The Laguna Greenbelt contains approximately 22,000 acres made up of six wilderness parks, including Crystal Cove State Park, Brommer-Shady Canyon Open Space, Laguna Coast Wilderness Park, Jim Dilley Preserve, Alta Laguna Park, and Aliso and Wood Canyons Park (Laguna Greenbelt Inc., 2015). The toll road is in close proximity to all of these open spaces and parks, but five miles of the toll road directly bisects the Laguna Coast Wilderness Park (USDOT et al., 1992). As a result of the toll road's proximity to a large natural area, there were environmental concerns. The greenbelt is home to a variety of wildlife, including larger animals such as deer, bobcats, and coyotes (Laguna Canyon Foundation, 2014). The area is home to one endangered species, the Least Bell's Vireo, and 23 candidate bird, reptile, amphibian, mammal, and plant species (USDOT et al., 1992). It is also an important wildlife corridor. Other impacts include those to wetlands, streambed modifications, increase in water pollutants, and floodplain encroachment (USDOT et al., 1992). Light and noise pollution were also concerns for both wildlife and humans. In addition, there was a potential for archeological and fossil specimens being unearthed during the construction of the road (USDOT et al., 1992).

Mitigation

Mitigation for the environmental impacts were discussed in the Environmental Impact Statement (EIS) (USDOT et al., 1992). Some impacts were regulatory, such as those to floodplains, under Executive Order 11988 (FEMA, 2017) and wetlands, under the Clean Water Act Section 404 (EPA, 2017). These were mitigated according the standards of the law. As complete habitat mitigation was not possible due to the large area impacted, several mitigation options were used, including avoiding removal of the vegetation or relocating or replacing native vegetation where possible. Wildlife mitigation included protective fencing, construction outside of nesting season, and the construction of a wildlife undercrossing (USDOT et al., 1990). Noise, light, and visual impacts were mitigated through barriers and the use of different grades. Finally, all construction activities were monitored by an archeologist and paleontologist (USDOT et al., 1990).

Current Status/Result

This roadway had, and still has, support from very active nonprofit groups with a long history of activism in the area. These included Laguna Greenbelt, Inc., The Laguna Canyon Conservancy, Stop Polluting our Newport, and Save Our San Juan (USDOT et al. v. Laguna, 1994). Activities of the nonprofits included purchasing and dedicating land, participating in protests, and supporting environmental legislation. Several of the nonprofits are actively engaged in education, preservation, and restoration of the greenbelt area (Laguna Greenbelt, Inc., 2015 and Laguna Canyon Conservancy, 2014). In 1994, the nonprofits filed a lawsuit against the United States Department of Transportation, the Federal Highway Administration, and the San Joaquin Hills Transportation Corridor Agency. The lawsuit alleged that the National Environmental Policy Act and section 4(f) of the Transportation Act were violated (USDOT et al. v. Laguna, 1994). The nonprofits claimed that the EIS should not have been approved due to inadequate information about need for the toll road, alignment alternatives, environmental impacts, and mitigation for the toll road (USDOT et al. v. Laguna, 1994). In addition, the lawsuit alleges the EIS failed to provide a supplemental EIS necessary because of recent fires in the area. In terms of 4(f), the defendants allege that an inadequate analysis of the park properties was completed. Disputing the allegations made, the court ruled in favor of the transportation agencies, and the portion of the tollway that was delayed as a result of the lawsuit proceeded (USDOT et al. v. Laguna, 1994).

US 93

Purpose and Need

The portion of US 93 discussed here is 53.6 miles long between Evaro and Polson in Missoula and Lake counties of Montana and is also known as the People's Way (USDOT et al., 2008). It serves as a principal arterial and provides a vital north-south connection to other major highways and regional access to resource industries and tourism. The need for this roadway is to accommodate future demand for truck traffic, recreation, and tourism. Substantial population growth is also expected within this area (USDOT et al., 1996). A concern for the original roadway was safety as the area had a high presence of large wildlife and had several design features that were not up to current standards (USDOT et al., 1996). The current roadway has differing lane numbers depending on the location and ranges, from two-lane with interspersed turning lane to four-lane divided (USDOT et al., 2008). The suggested improvements and expansion also vary depending on the location.

Impact

Although this portion of US 93 does not directly segment any parks or open spaces, it is in close proximity to a reservation and two national parks. A large proportion of the project is contained within the Flathead Reservation, which is the land of the Confederated Salish and Kootenai Tribes (city of Polson et al., 2011). The project is also situated between Flathead National Forest and Lolo National Forest. Within the vicinity of the project there are also other public lands with significant cultural and historic resources (USDOT et al., 1996). The Salish and Kootenai Tribes have a strong spiritual, cultural, and physical relationship with the land including, in some cases, a subsistence way of life. Their concerns for the land were reflected in the EIS, including hydrologic pollution and wildlife mortality, as well as impacts to wetlands, visual aesthetics, and habitat (USDOT et al., 1996). Habitat and wildlife mortality were of specific concern in the area that includes several threated plant and animal species, including the water howellia, Spalding's campion, grizzly bear, Canada lynx, and bull trout (city of Polson et al., 2011).

Mitigation

Extensive consultation with tribal leaders and communities occurred as a result of the cultural significance of the land. Cultural mitigation will be implemented, including prominent signs for community entrances and exits, the use of native and English languages, and two visitor centers (city of Polson et al., 2011). Tribal communities were hesitant to allow the expansion of the road without extensive mitigation for the land and its resources. This resulted in an innovative road design sensitive to the land or "Spirit

of Place" (Marshik et al., 2001). The design remains one of the most extensive wildlife-sensitive highways in the United States (Marshik et al., 2001). To mitigate for the concern of wildlife mortality, fragmentation, and habitat, 42 fish and wildlife crossing structures and 15 miles of fencing were implemented (Huijser et al., 2016). Wetlands and riparian areas were mitigated by planting woody vegetation and protective purchase of adjacent land (USDOT et al., 1996). Visual mitigation included the retention of trees and natural vegetation and excavating in a way that would allow for easy reestablishment (USDOT et al., 2008).

Current Status/Result

As a result of the complexity and size of the project, it was approved in phases. The Record of Decision for the 1996 EIS (USDOT et al., 1996) held off on approving all sections and resulted in a Memorandum of Agreement (1996) between the Federal Highway Administration, Montana Department of Transportation, and the Confederated Salish and Kootenai Tribes to continue discussions. In 2001, a Record of Decision was made on the reevaluation, and construction commenced on the approved portion of the roadway in 2002 (USDOT et al., 2008). In 2006, a final EIS was conducted for the remaining portions of the road, and a Record of Decision was made in 2008 (USDOT et al., 2008). The final portion of the road is currently under construction.

SR 84/I-75

Purpose and Need

When SR 84 was built in 1969, it was a controversial two-lane roadway that provided an east-west connection through Alligator Alley in southern Florida. The road was controversial as it divided the community and there were concerns for safety and projected use of the road (Sipes, 2013). The need for the project resulted from a growing population in the western Gold Coast region of Florida (FDOT, 1974). The project would convert a two-lane highway into a four-lane interstate highway that would connect into the existing I-75 system and provide a connection between Naples and Fort Lauderdale and a fast growing west (FDOT, 1974). It would provide solutions to the concern for safety that had plagued the road since its original completion.

Impact

SR 84 travels through four natural areas and a tribal land, segmenting Big Cypress National Park, Everglades National Park, and Miccosukee Reservation, and providing a border between Fakahatchee Strand State Preserve and Florida Panther National Wildlife Refuge. The natural areas cover over two million acres with over 60 miles bordering or segmented by SR 84 (Florida State Parks,

2017, NPS, 2017, and USFW, 2017). The EIS produced in 1975 was one of the first of its kind (Sipes, 2013). A major environmental concern was the wildlife habitat fragmentation and mortality in the area, including those species listed as threatened or endangered, such as the American alligator and the Florida panther (NCHRP, 2002). At the time of construction, there were only 20 to 50 panthers remaining (NCHRP, 2002). There was also concern for the traditional access to the land by the Seminoles and Miccosukee Tribes (FDOT, 1974). This area is ecologically rich, and concerns exist for impacts to hydrology and water quality due to the vast number of wetlands (FDOT, 1974).

Mitigation

As the first EIS lacked mitigation, a reevaluation was done that included extensive mitigation for concerns of habitat fragmentation and wildlife mortality. The completed project included 23 wildlife undercrossing structures, 65 miles of fencing, and 12 bridge extensions. The Florida Department of Transportation also purchased additional land to ensure its protection (NCHRP, 2002). Education was also an important mitigation method and included brochures, information kiosks, and wildlife warning signs. Consultation was completed with the Seminoles and Miccosukee Tribes to ensure their access to the land (NCHRP, 2002).

Current Status/Result

The road was constructed from 1986 to 1992, opening in 1993. Due to the success of the wildlife crossing structures, an additional six structures were planned on SR 29, adjacent to I-75 (NCHRP, 2002).

I 270/US 15

Purpose and Need

The I-270/US 15 corridor is in Frederick and Montgomery counties in Maryland. The corridor provides an essential multimodal connection between central and south Maryland with the DC metropolitan area (MDOT, 2009). Although multiple modes are available, there is a lack of a high-speed alternative to this corridor leaving it highly congested. Due the level of congestion, the area is serviced by slow and unreliable local transit (MDOT, 2009). Congestion is expected to increase in both counties, with Frederick County expected to experience almost double the amount of growth in population and employment than Montgomery County by 2030 (MDOT 2009). Corresponding with this growth, a large number of development projects have been planned,

approved, or are currently under construction (MDOT, 2009). Northbound, the existing I-270 has a combination of HOV and general purpose lanes, while southbound has two to four general purpose lanes (MDOT, 2009). US 15 has two general purpose lanes in each direction (MDOT, 2009). The proposed improvements would include express toll lanes and general purpose lanes, with an added capacity of two to six lanes, depending on the location (MDOT, 2009). The transit component of the project proposed up to 16 new light rail or bus stations (MDOT, 2009).

Impact

There are 28 parks or recreational facilities in the vicinity of the roadway, with 13 that will be directly impacted by proposed improvements (MDOT, 2009). The two biggest parks that will be segmented are Seneca Creek State Park and Monocacy National Battlefield Park, with the corridor taking just over 26 acres (MDOT, 2009). Seneca State Creek Park is made up of 6,290 acres of forested floodplains, upland forest, and a creek, which is crossed by the existing I-270 roadway (MDNR, n.d.). Monocacy National Battlefield Park is relatively free of modern development and preserves a civil war era agricultural environment (NPS 2016). The national park also has hardwood forested areas along the Monocacy River. The impacted area is home to terrestrial and aquatic species, including the state threatened comely shiner and pearl dace (MDOT, 2009). The large tracts of forested land are essential to the area's wildlife. There is also concern for the forested and emergent wetlands and the connections they have to larger wetlands systems (MDOT, 2009). Of special concern to the state is the Germantown Bog located within Seneca Creek as it has some listed species of vegetation (MDOT, 2009). Hydrologically, there are concerns of water quality as the project will impact 77 minor and 13 major bodies of water, including the Moncacy River and Seneca Creek (MDOT, 2009). Other impacts include noise, visual, and historic as Monocacy Park is a national historic landmark (MDOT, 2009).

Mitigation

Mitigation for this project is largely regulatory. The impacts to surface waters and wetlands are unavoidable and will be mitigated through the requirements of the Clean Water Act, including permits and compensatory mitigation (MDOT, 2009). Best management practices for potential stormwater pollution issues will also be applied (MDOT, 2009). Impacts to the forested areas will be mitigated according the Maryland Forest Conservation Act and will include reforestation of other areas (MDOT, 2009). Concerns regarding threatened fish will be addressed by eliminating in-stream work and stream closures and by using specially designed culverts and bridges. The Germantown Bog species were deemed not to be directly impacted by the project (MDOT, 2009).

Current Status/Result

The EIS for this project was completed in 2002. A supplemental assessment was completed in 2010. As of fall 2015, the project was under design (MDOT, 2015).

SH 100

Purpose and Need

This case study does not involve the expansion of a roadway but rather a roadway improvement. SH 100 is located In Cameron County of southern Texas. In 2007, due to concern about safety as a result of several head-on collisions, a concrete traffic barrier was installed on 11 miles of the roadway (TxDOT, 2006).

Impact

SH 100 segments Laguna Atascosa National Wildlife Refuge. The refuge consists of 97,000 acres and is home to a vast number of habitats, including coastal prairies, tidal flats, dunes, thorn forest, and thousands of acres of wetlands (USFWS, 2013). It is home to several threatened or endangered species. Of greatest concern is the ocelot, which has been listed endangered federally since 1972 in the state of Texas (USFWS, 2016).

Mitigation

Consultation between the Texas Department of Transportation (TxDOT) and United States Fish and Wildlife Service (USFWS) occurred in consideration of the endangered ocelot (USFWS, 2015). High culverts were proposed to mitigate drainage issues and were to double as crossings for the cat species. Further incidents of ocelot mortality in 2010, 2013, and 2014 resulted in further consultation between TxDOT and USFWS (USFWS, 2015). A final biological opinion was submitted in 2015 by USFWS evaluating the impact of crossings, fencing, and cattle guards proposed as conservation actions by TxDOT. The opinion concluded that the proposed actions would minimize road impacts and not further endanger ocelots in the area (USFW, 2015).

Current Status/Result

Consultation resulted in the decision to install four underpasses and six-foot fencing along 7.1 miles of SH 100. The improvements were planned for implementation in 2016 (TxDOT, 2017).

Conclusion

Due to transportation need, it is not always feasible for a roadway to avoid a natural area or park. These case studies show that mitigation of environmental impacts as a result of the roadway are necessary and possible. Mitigation strategies have improved with time and with increased consultation with stakeholders.

References

City of Polson, Lake County, Confederated Salish and Kootenai Tribes, and the Montana Department of Transportation. (2011). US 93 Polson Corridor Study. Retrieved from http://www.mdt.mt.gov/pubinvolve/polsoncorridorstudy/docs/final/final_report.pdf

Environmental Protection Agency (EPA). (2017). Overview of Section 404. Retrieved from https://www.epa.gov/cwa-404/overview-section-404

Florida Department of Transportation (FDOT). (1974). Environmental Statement for Administrative Action on State Road 84. Division of Planning and Programming, Florida Department of Transportation.

Federal Emergency Management Agency (FEMA). (2017). Executive Order 11988. Retrieved from https://www.fema.gov/executive-order-11988

Florida State Parks. (2017). Fakahatchee Strand Preserve State Park. Retrieved from https://www.floridastateparks.org/park/Fakahatchee-Strand

Huijser, M.P., Camel-Mean, W., Fairbank., E.R., Purdum, J.P., Allen, T.D.H., Hardy, A.R., Graham, J., Begley, J.S., Basting, P., Becker, D. (2016). US 93 North Post-Construction Wildlife-Vehicle Crossing Monitoring on the Flathead Indian Reservation Between Evaro and Polson, Montana. Montana Department of Transportation Research Programs. Project Summary Report 8208. Retrieved from http://www.mdt.mt.gov/other/webdata/external/research/docs/research_proj/wildlife_crossing/phaseii/PHASE_II_FINAL_REPORT.pdf

Laguna Canyon Foundation. (2014). Laguna Canyon Foundation. Retrieved from https://lagunacanyon.org/

Laguna Greenbelt, Inc. (2015). About. Retrieved from http://lagunagreenbelt.org/history-of-laguna-greenbelt/

Marshik, J., Renz, L., and Sipes, J. (2001). Preserving a spirit of place: US Highway 93 on the Flathead Indian Reservation. *International Conference on Ecology and Transportation.* Retrieved from https://escholarship.org/content/qt51f1h0df/qt51f1h0df.pdf

Maryland Department of Transportation (MDOT). (2009). I-270/US 15 Multi-Modal Corridor Study. Frederick and Montgomery Counties, Maryland. Alternatives Analysis/Environmental Assessment. Retrieved from http://www.cctmaryland.com/en/environmental-studies/20-alternatives-analysisenvironmental-assessment-aaea-document

Maryland Department of Natural Resources. (n.d.). Seneca Creek State Park. Retrieved from (http://dnr.maryland.gov/publiclands/Pages/central/seneca.aspx

Maryland Department of Transportation. (n.d.). Corridor Cities Transitway Schedule. Maryland Transit Administration. Retrieved from http://www.cctmaryland.com/en/about-the-project/schedule

Memorandum of Agreement. (1993). Confederated Kootenai and Salish Tribes, Federal Highway Administration, and Montana Department of Transportation (2001). Memorandum of Agreement US 93 Evaro to Polson. Retrieved from http://www.peopleswaywildlifecrossings.org/images/history/Memorandum-Of-Agreement-US-93-Evarto-to-Polson-December-20-2000.pdf

Montana Department of Transportation (MDOT). (n.d.). Ronan-Urban. Retrieved from http://www.mdt.mt.gov/pubinvolve/ronanurban/

Montana Department of Transportation. (2008). US Highway 93 Ninepipe/Ronan Improvement Project: Final Supplemental Environmental Impact Statement and Section 4(f) Evaluation. Retrieved from https://www.loc.gov/item/2008412624/

National Cooperative Highway Research Program (NCHRP). (2002). Interaction between Roadways and Wildlife Ecology, Synthesis 305. Transportation Research Board of the National Academies. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_305.pdf

National Park Service (NPS). (2017). Big Cypress National Preserve Florida. Retrieved from https://www.nps.gov/bicy/index.htm

National Park Service. (2016). Monocacy National Battlefield Park, Learn About the Park. Retrieved from https://www.nps.gov/mono/learn/index.htm

National Park Service. (2017). Everglades National Park Florida. Retrieved from https://www.nps.gov/ever/index.htm

Sipes, J.L., Sipes, M.L. (2013). Creating Green Roadways: Integrating Cultural, Natural, and Visual Resources into Transportation. Island Press, Washington.

Tewes, Michael. (2001). Ocelot Management and Conservation along Transportation Corridors in Southern Texas. *International Conference of Ecology and Transportation, A Time for Action*. Retrieved from https://escholarship.org/uc/item/6mc7x9mx

Texas Department of Transportation (TxDOT). (2006). Detail Letting Schedule for Cameron County (FY 2006). Retrieved from https://www.dot.state.tx.us/insdtdot/orgchart/cmd/cserve/let/2006/cameron.htm#033101038

Texas Department of Transportation. (2017). Project Tracker. Retrieved from http://apps.dot.state.tx.us/apps-cq/project_tracker/

United States Department of Transportation (USDOT), Federal Highway Administration, and Montana Department of transportation. (1996). Final Environmental Impact Statement and Final 4(f) Evaluation. Retrieved from http://www.mdt.mt.gov/pubinvolve/polsoncorridorstudy/ docs/feis_volume1.pdf

US Department of Transportation, Federal Highway Administration, San Joaquin Transportation Authority. (1992). Draft Environmental Impact Statement and Section 4(f) Evaluation for Propose US 73 Extension. Retrieved from https://cdxnodengn.epa.gov/cdx-enepa-II/public/action/eis/details?eisId=82235

United States Department of Transportation, Federal Highway Administration, San Joaquin Transportation Authority v. Laguna. (1994). 42 F.3d 517. Retrieved from https://openjurist.org/42/f3d/517/laguna-greenbelt-inc-v-united-states-department-of-transportation)

United States Fish and Wildlife Service (USFWS). (2013). Laguna Atascosa National Wildlife Refuge, Texas. Retrieved From https://www.fws.gov/refuge/laguna_atascosa/wildlife_and_habitat/ habitat.html

United States Fish & Wildlife Service. (2015). Letter of Biological Opinion, Consultation Number 02ETCC00-2015-F-0022. Retrieved from https://www.fws.gov/southwest/es/Documents/R2ES/ BO_TxDOT_SH100_CameronCnty_2015.pdf

United States Fish and Wildlife Service. (2016). Southwest Region USFW. Recovery Plan for the Ocelot (*Leopardus pardalis)* First Edition. Albuquerque, New Mexico. Retrieved from https://www.fws.gov/southwest/es/Documents/R2ES/Ocelot_FinalRecoveryPlan_July2016.pdf

United States Fish and Wildlife Service. (2017). Florida Panther National Wildlife Preserve. Retrieved from https://www.fws.gov/refuge/florida_panther/

Appendix 7 – Media Coverage

Efforts to engage stakeholders in the INVEST project drew attention from print and social media. An article in the Ray Roberts Lake Visitors Guide highlighted the participation of the Lake Ray Roberts Equestrian Trails Association in the first stakeholder meeting conducted by the North Central Texas Council of Governments. The article was published June 30, 2017 (Exhibit 7-1). A Facebook post from the city of Aubrey, Texas, promoted the agency's attendance at the Aubrey Peanut Festival. Staff attended the festival to seek input on the Denton County Outer Loop/Greenbelt Parkway project. The Facebook item was posted on September 19, 2017 (Exhibit 7-2).

Exhibit 7-1. Article in Ray Roberts Lake Visitors Guide

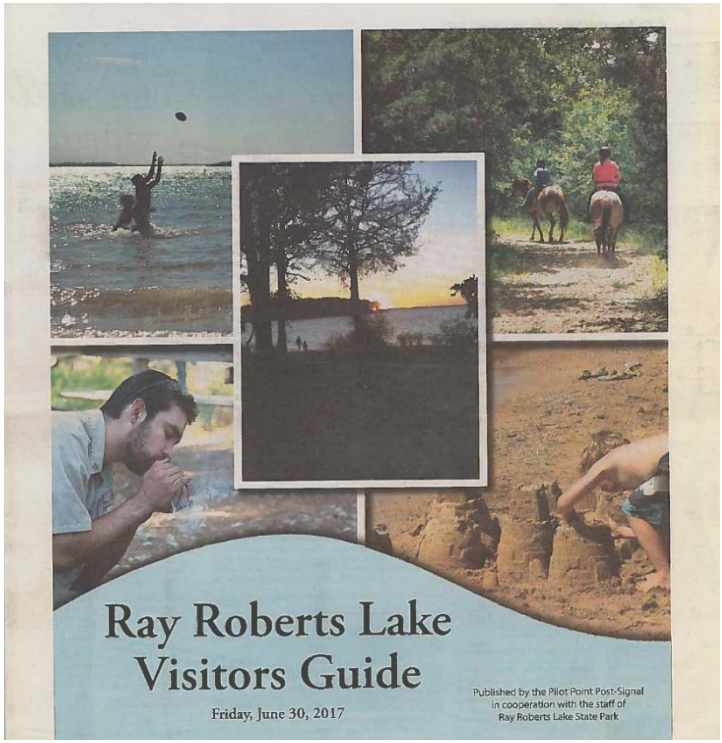


Exhibit 7-1. (continued)

Damon Brown works on a horse shed with his daughter, Shanika Allen, at the Bluestem Grove area of Ray Roberts Lake State Park. The sheds are being built by members of the Lake Ray Roberts Equine Trail Association.

Group creating haven for riders

By Don Munsch
Assistant Editor

The Lake Ray Roberts Equestrian Trails Association does not just focus on trail-riding.

The group also works to ensure riders have a smooth trail for their horses and amenities to use at Ray Roberts Lake State Park.

New sheds in the Bluestem Grove area of Ray Roberts Lake State Park will keep horses cooler in the summer, thanks to a Stewards for Trails, Education and Partnerships grant.

Seven roofed sheds will be built and can hold two horses apiece, said Linda Moore, board president of the LRRETA.

The round pen was paid for by the STEP grant as well. The pen functions as a safety measure. The STEP grant from American Quarter Horse Association and Tractor Supply.

LRRETA also was a force in making the Greenbelt Equestrian Bridge a reality.

"That was as much as anything a safety aspect because when you bring horses out here, it's a good idea to warm them up and see how they're acting and we have a confined area to do that," Moore said about the pen. "They had the sandy area all along, but they had actual round pen, so now people can come and bring their horse and work a horse for a while and then go down the trail."

New signage on the trail will be installed from Texas Parks & Wildlife grant money in 2014. The stickers on trail signs will give riders, bicyclists and walkers information on pets, motorized vehicles and trail info.

"That's a pretty big project because it takes two tractors and a crew of about five people," she said. "They're marked with a GPS by a park ranger. Then we come through and put in steel posts. Then we'll have all new stickers."

The Texas Parks & Wildlife Department approved money for repairs and upgrades to the horse trails at Ray Roberts Lake State Park.

The Greenbelt Alliance of Denton County in Denton County received $106,408.26 toward the Ray Roberts Equestrian Trail and Trailhead Improvements Project. The money will go toward the renovation of 9.5 miles of existing trail, horse corrals, hitching rails, two utility task vehicles, a UTV trailer, two chainsaws, two pole saws and training. The grant covers the equestrian trail section from FM 428 to U.S. 380.

The funds are part of The Texas Parks and Wildlife Commission's announcement on May 25 of the approved $8.46 million in grants to help enhance 22 motorized and non-motorized recreational trail-related projects across the state.

The total grant is worth $133,010.32. GBA and Lake Ray Roberts Equestrian Trails Association will be responsible for a 20 percent match of $26,602.

LRRETA, which has 61 members and is a part of the 501(c)(3) Greenbelt Alliance of Denton County, had just two trail sections to finish in early June, from U.S. 380 to FM 428 and from 428 up to the Greenbelt Equestrian Trail bridge.

"We feel fortunate," Moore said. "I think we've got a good public-private partnership going on with Texas Parks and Wildlife, and they're just traditionally underfunded. ... These are additional funds that we're bringing into the park."

The grants require a 20 percent match, Moore said, and the match money is met through donations, memberships and sweat equity. Local area merchants have been generous in donating materials for necessities, such as lumber for ramps or concrete for posts. Other businesses will donate prizes for the trail challenge.

"Those are all kinds of things that help us be able to do what we can do," Moore said, adding she appreciates the support from area businesses and individuals. She said LRRETA will soon start a business membership of $100 and individual (patron) membership for $25.

LRRETA has conducted geocaching on horseback workshops, and LRRETA members have gotten "leave no trace" training in which people learn how to leave less of a footprint in the park.

Sometimes the footprints they find are not human. Feral hogs are present on the trails.

"The main (concern) for the equestrians is they spook the horses," Moore said. "We have quite a bit of evidence of them most recently."

LRRETA participated in a meeting with Denton Greenbelt stakeholders group in early June when future road construction – such as the widening of FM 428 – was a topic. The Greenbelt crosses 428.

"This was the very first meeting, and of course, they're wanting to know what our needs and what we really want," Moore said. "Of course, one of the things we really want is to make sure that all of the trails are still open and we still maintain the trailheads at least at the size that we have. Of course, we talked about the concerns about having a big highway there, being able to turn in there with big trailers and just the noise and the impact on wildlife trying to across the highway."

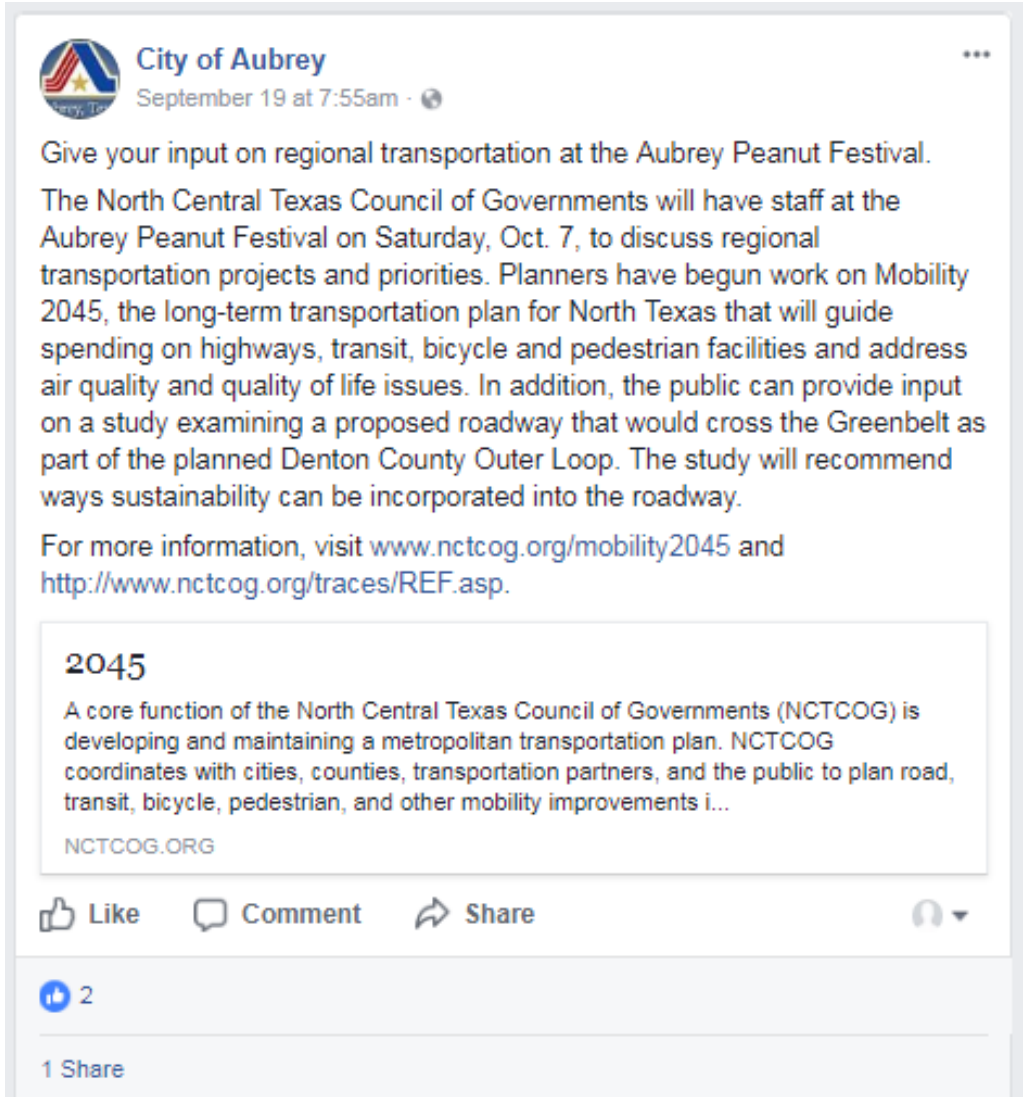
Officials are still in the planning stages with the road, and that stakeholder group will meet quarterly. Both LRRETA and the Cross Timbers Equestrian Trails Association are invited to attend the meetings and express their opinions.

LRRETA's board meets the second Tuesday of every month at 6:30 p.m. at Ernesto's in Pilot Point. The public is welcome to attend.

Group creating haven for riders

Linda Moore, board president of the Lake Ray Roberts Equestrian Trails Association, walks with her granddaughter, Averie Moore, at the Bluestem Grove area of Ray Roberts Lake State Park.

Exhibit 7-2. City of Aubrey Facebook Post



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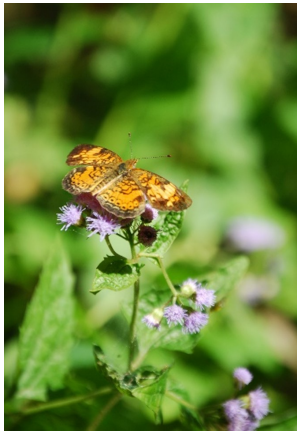

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