Brookings Transportation System Plan
Methodology Memorandum

Prepared for

City of Brookings
898 Elk Drive
Brookings, OR 97415

Prepared by

Parametrix
411 108th Avenue NE, Suite 1800
Bellevue, WA 98004
T: 425.458.6200 F: 425.458.6363
www.parametrix.com

CITATION

This project is partially funded by a grant from the Transportation and Growth Management (TGM) Program, a joint program of the Oregon Department of Transportation and the Oregon Department of Land Conservation and Development. This TGM grant is financed, in part, by federal Moving Ahead for Progress in the 21st Century (MAP – 21), local government, and the State of Oregon funds.

The contents of this document do not necessarily reflect views or policies of the State of Oregon.

Brookings Transportation System Plan.
Methodology Memorandum.
Prepared by Parametrix, May 2014

INTRODUCTION

This technical memorandum outlines the approach proposed for traffic analysis and evaluation for the City of Brookings Transportation System Plan Update (Plan Update). The intent of this memorandum is to document the methodologies and key assumptions that will be used including: analysis years, traffic volume forecasting and methodologies, operational parameters, and safety analysis methods.

ANALYSIS YEARS AND TIME PERIODS

The traffic analysis will be conducted for the following years:

- Existing year (2012), and
- Future horizon year (2034).

The traffic analysis will be conducted for the 30th highest hour. Daily (24-hour) tube counts will be used to identify daily distribution patterns and identify the PM peak period. PM peak period turning movement counts will be collected for intersections identified for analysis to characterize the busiest commute times.

STUDY AREA AND DATA COLLECTION

Brookings is located on the southern coast of Oregon approximately five miles north of the Oregon-California border, on the north side of the Chetco River. Brookings is the largest city in Curry County, with almost 30 percent of the county's population or approximately 6,300 inhabitants.

The study area includes the City of Brookings and the unincorporated area of Curry County that is within the Urban Growth Boundary (UGB). Highway 101 is the major corridor for the movement of people, goods, and services to and from Brookings, and also serves as the City's "Main Street".

Exhibit 1 graphically shows the study intersections and data collection locations. **Exhibit 2** lists the key intersections that will be evaluated in this study and their jurisdictional ownership. **Exhibit 3** lists tube count locations.

Exhibit 1. Study Intersections and Count Locations

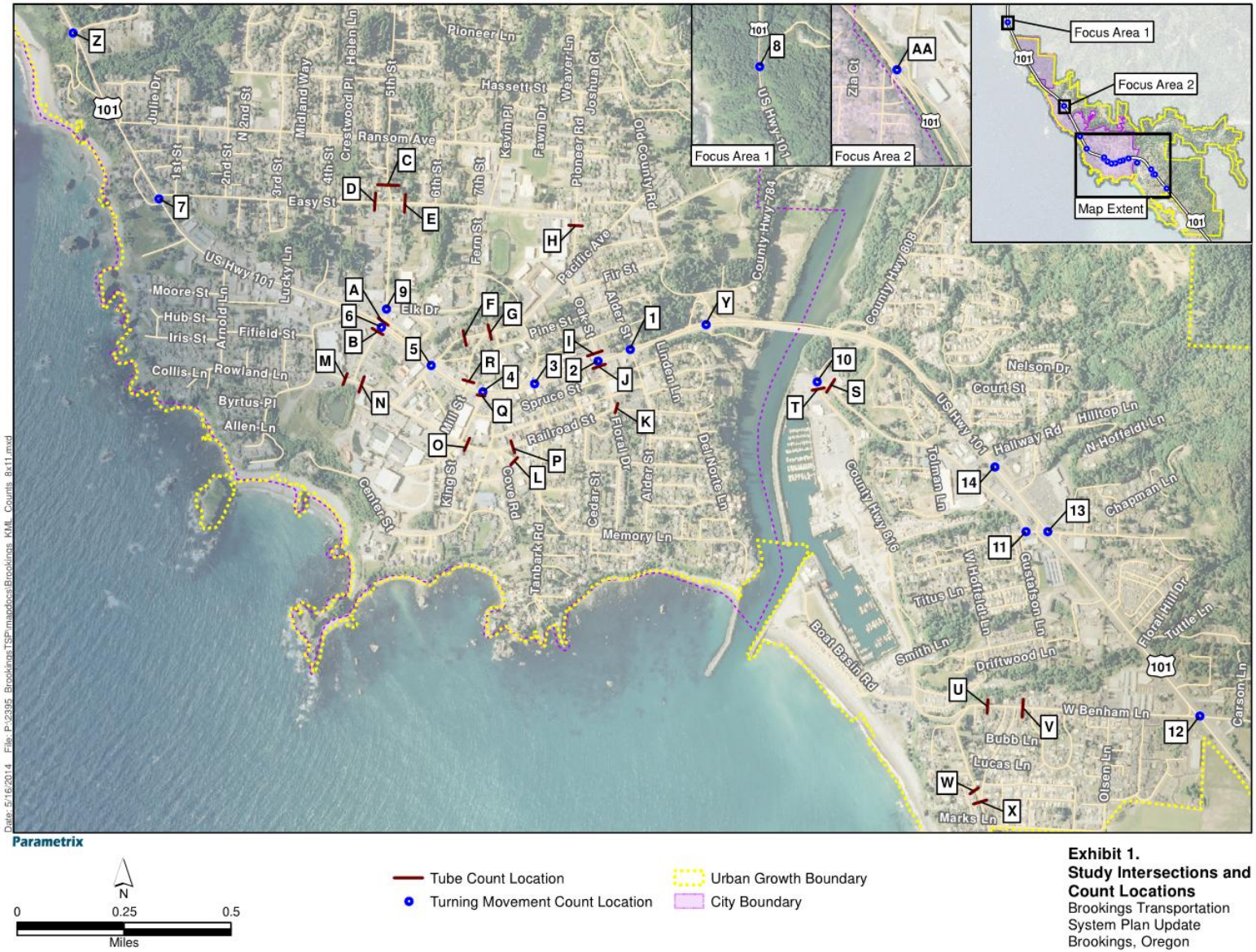


Exhibit 1.
Study Intersections and Count Locations
Brookings Transportation System Plan Update
Brookings, Oregon

Exhibit 2. Study Area Data Collection – Turning Movement Counts

ID #	Intersection Turning Movement Counts	Jurisdiction
1	US 101 / Alder Street	ODOT
2	US 101 / Oak Street	ODOT
3	US 101 / Fern Avenue	ODOT
4	US 101 / Center Street	ODOT
5	US 101 / Pacific Avenue	ODOT
6	US 101 / 5th Street	ODOT
7	US 101 / Easy Street / Crissey Circle (south)	ODOT
8	US 101 / Lone Ranch Parkway	ODOT
9	5th Street / Elk Drive	City
10	Shopping Center Avenue / Lower Harbor Road	County
11	Shopping Center Avenue / W. Hoffeldt Lane	County
12	US 101 / East Benham Lane / West Benham Lane	ODOT
13	US 101 / Hoffeldt Lane	ODOT
14	US 101 / Zimmerman Lane	ODOT

Exhibit 3. Study Area Data Collection – Tube Counts and Vehicle Classification Counts

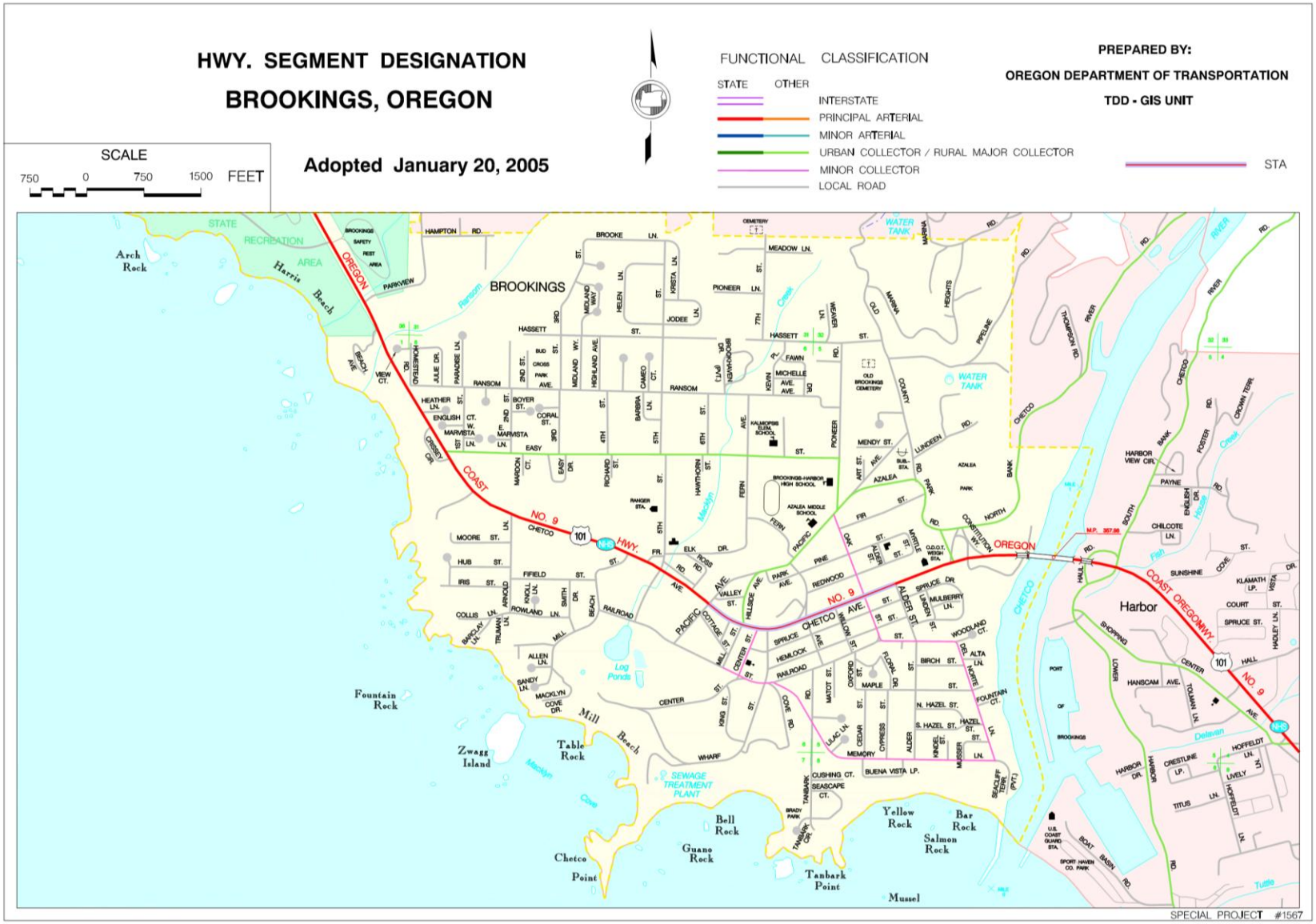
ID #	Roadway Tube Counts	Jurisdiction
A	5th Street north of US 101	City
B	5th Street south of US 101	City
C	5th Street north of Easy Street	City
D	Easy Street west of 5th Street	City
E	Easy Street east of 5th Street	City
F	Pacific Avenue west of Hillside Avenue	City
G	Pacific Avenue east of Hillside Avenue	City
H	Pioneer Road south of Easy Street	City
I	Oak Street north of US 101	City
J	Oak Street south of US 101	City
K	Del Norte Road east of Oak Street	City
L	Memory Lane south of Railroad Street	City
M	Railroad Street west of 5th Street	City
N	Railroad Street east of 5th Street	City
O	Railroad Street east of Center Street	City
P	Railroad Street east of Memory Lane	City
Q	Center Street south of US 101	City
R	Hillside Avenue north of US 101	City
S	Shopping Center Avenue south of Lower Harbor Drive	City
T	Lower Harbor Road south of Shopping Center Avenue	City
U	Benham Lane between Oceanview Drive and Wenbourne Lane	City
V	Benham Lane east of Wenbourne Lane	City
W	Oceanview Drive north of Wenbourne Lane	City
X	Oceanview Drive south of Wenbourne Lane	City
Y	US 101 at Constitution Way (vehicle classification)	ODOT
Z	US 101 at Parkview Drive (vehicle classification)	ODOT
AA	US 101 at Carpenterville Road (vehicle classification)	ODOT

STUDY AREA STREETS

US 101 is the only state highway in the study area, and is classified as a National Highway System Route. The section between Alder Street and Pacific Avenue is classified as a Special Transportation Area. In the Brookings city limits, north of US 101, Easy Street and Hillside Avenue/Pacific Avenue are classified as Urban Collectors. Center Street is classified as a Minor Collector south of US 101, and Oak Street is also classified as a Minor Collector both north and south of US 101.

East of the Chetco River, Shopping Center Avenue and Lower Harbor Road are classified as Urban Collectors. **Exhibit 4** graphically shows information about key roadways in the study area and their functional classifications. Benham Lane (not shown in Exhibit) is also classified as an Urban Collector.

Exhibit 4. Study Area Roadways and Functional Classifications



EXISTING (2012) AND FUTURE (2034) TRAFFIC VOLUMES

Existing 2012 Traffic Volumes

Daily (24-hour) tube counts were collected at 24 locations. These tube counts will be used to identify the system wide PM peak hour. Vehicle classification counts were collected at three locations. **Exhibit 1** shows the 24 tube count locations and three vehicle classification count locations

Traffic volumes for the traffic analysis will be based on turning movement counts collected by the Oregon Department of Transportation (ODOT). **Exhibit 1** shows the 14 turning movement count locations.

The existing 2013 PM peak hour turning movement counts will be adjusted to account for seasonal effects according to ODOT Transportation Planning Analysis Unit (TPAU) Analysis Procedures Manual (APM). The APM describes three methods to account for seasonal adjustments:

- On-Site ATR Method
- ATR Characteristic Table Method
- Seasonal Trend Method

The On-Site ATR Method and the Seasonal Trend Method will be used to calculate a seasonal adjustment factor and the method that results in the most conservative (highest) seasonal factor will be used to develop the 30th highest peak hour traffic volumes.

The counts will then be adjusted to the project base year, 2012, using a historical factor derived from the Future Volumes Table.

The existing conditions analysis will be conducted using the 30th highest hour volumes. The derived 30th highest hour design volumes will not be balanced between study intersections if other intersections or driveways exist between study intersections because imbalances would be expected in these cases.

Future 2034 Traffic Volumes

Section 4.8 of the APM identifies three methods for forecasting future traffic volumes:

- Level 1: Historical Trends
- Level 2: Cumulative Analysis
- Level 3: Urban Travel Demand Models

The Urban Travel Demand Models method will be used to forecast future 2034 PM peak period traffic volumes. Future year traffic volumes will be generated by the Brookings travel demand model and supplied by TPAU. As discussed in the APM, the base model year will be adjusted to the base project year (2012), if necessary, using the Straightline Method.

The future traffic volumes will be derived from the Brookings travel demand model by post-processing according to the guidelines detailed in the NCHRP Report 255. The average of the Growth Method and Difference Method will be applied to each directional link to determine future growth, unless the Growth Method results in an unrealistically high growth rate, in which case only the Difference Method will be applied.

STATE AND LOCAL MOBILITY STANDARDS

Depending on jurisdiction, mobility standards will be used to determine acceptability of facility operations for this study.

State Mobility Standards

Federal highways, such as US 101 (Chetco Avenue), are designated as a State Highway under state jurisdiction. State highway mobility standards were developed for the 1999 Oregon Highway Plan (OHP) as a method to gauge reasonable and consistent standards for traffic flow along state highways. Revised mobility standards were adopted in 2011 as part of the OHP Policy 1F Amendments. These mobility standards consider the classification (e.g., freeway, district) and location (rural, urban) of each state highway. Mobility standards are based on v/c

ratios. The OHP Policy 1F Amendments, were adopted in December 2011. This version of the OHP will be used in this study. The mobility standards for sections on US 101 through the study area are illustrated in **Exhibit 5**.

Exhibit 5. State Mobility Standards

US 101 Segment	ODOT Classification	Jurisdiction	Existing or Future No Build Mobility Standard	Future Build Mobility Standard
North of Ransom Street	Statewide Non-Freight Route, UBA Non-MPO >=45 mph	ODOT	0.80	0.70
Between north of Ransom Street and north of Pacific Avenue	Statewide Non-Freight Route, UBA, Non-MPO <=35 mph	ODOT	0.90	0.75
Between north of Pacific Avenue and south of Alder Street	Statewide Non-Freight Route, UBA, STA	ODOT	0.95	0.90
Between south of Alder Street and south of Flora Hill Drive	Statewide Non-Freight Route, UBA Non-MPO <=35 mph	ODOT	0.90	0.75
South of Flora Hill Drive	Statewide Non-Freight Route, UBA Non-MPO >=45 mph	ODOT	0.80	0.70

Local Mobility Standards

The City of Brookings does not have intersection level of service standards, however, the 2002 Transportation System Plan identities a goal of LOS C.

TRAFFIC ANALYSIS SOFTWARE AND INPUT ASSUMPTIONS

Synchro software (Version 8, Build 805) will be used for the intersection analysis. The reported results will be the v/c ratios from the 2000 HCM report. Key input assumptions are listed in **Exhibit 6**.

Exhibit 6. Synchro Operations Parameters and Assumptions

Intersection Parameters	Conditions	
	Existing (2012)	**No Build and Build Alternatives**
Peak Hour Factor	From traffic count	-0.85 for minor street inflows and outflows -0.90 for minor arterials -0.95 for major streets If traffic count has higher PHFs than default PHFs, then continue using the existing PHFs
Conflicting Hourly Bikes and Pedestrians	From traffic count	Same as Existing
Area Type	Default	Same as Existing
Ideal Saturation Flow Rate per Lane (for all movements)	1750 vph	Same as Existing
Lane Width	12'	Same as Existing
Percent Heavy Vehicles	From traffic count, otherwise 2%	Same as Existing
Percent Grade	Assumed to be 0%	Same as Existing
Parking Maneuvers per Hour	If on-street parking allowed, assume some maneuvers (approx. 1 maneuver per stall)	Same as Existing
Bus Blockages	Assume 0	Same as Existing
Intersection signal phasing and coordination	Optimize phase and cycle length, phase sequence and offset (if coordinated)	Optimize phase and cycle length, phase sequence and offset (if coordinated)
Intersection signal timing and optimization limits	60 to 120 seconds depending on the number of phases [1]	60 to 120 seconds depending on the number of phases [1]
Minimum Green Time	Meet pedestrian minimums	Meet pedestrian minimums
Yellow and All-Red Time	Exhibit 7-15 [1]	Exhibit 7-15 [1]
Right Turn on Red	Assume "allow"	Assume "allow"
Vehicle Queues	95th percentile, calculated based on an average of 25 feet per vehicle and the 2 minute rule for unsignalized intersections	95th percentile, calculated based on an average of 25 feet per vehicle and: -For isolated intersections use the 95th percentile results from Synchro for signalized intersections -Use the 2 Minute Rule for unsignalized intersections

[1] Parameters identified in the “Analysis Procedures Manual” Section 7.3.9, ODOT, TPAU, April 2006 will be used for the traffic operations analysis.

QUALITATIVE MULTIMODAL ASSESSMENT

Pedestrian Network Analysis: Pedestrian Level of Service (PLOS)

The recommended PLOS analysis is rooted in the concept that a doubling of travel speed results in a four-fold increase in stopping time and resulting crash severity. According to one study, speed has the following impact on pedestrian fatalities:[1]

- At 20 mph the odds of pedestrian fatality are 5%
- At 30 mph the odds of pedestrian fatality are 45%
- At 40 mph the odds of pedestrian fatality are 85%

While other studies have found some variation, these approximate numbers are reported consistently across the literature.

It is imperative that dedicated travel facilities are provided to create safe travel conditions for pedestrians. This model is based primarily on safety and does not consider factors of the built environment known to make walking an attractive and preferred form of transportation. While this is true, lower posted speeds and more dedicated pedestrian space will typically correlate with places people want to walk based on the surrounding land uses and urban form.

Method

The team will conduct a GIS-based PLOS analysis of streets in Brookings to determine existing level of service and identify streets with low PLOS scores in areas of high demand. PLOS evaluation grades and scores are shown in **Exhibit 7**. The intent of the analysis is to identify a pedestrian network that provides a level of comfort and safety for users. The analysis will be used to inform, create and confirm recommendations for pedestrian facilities in the Plan Update.

Exhibit 7. PLOS Evaluation

PLOS Grade	PLOS Score	Description	Conditions - Speed	Conditions - Space
A	5	Best pedestrian environment	Less than 30 mph	Complete sidewalk or at least one shoulder wider than 4 feet
B	4	Good pedestrian environment	Less than 30 mph	No dedicated space
C	3	Fair pedestrian environment	30 - 35 mph	Complete sidewalk or at least one shoulder wider than 4 feet
D	2	Moderate pedestrian environment	30 - 35 mph	No dedicated space
			40-50 mph	Complete sidewalk or at least one shoulder wider than 4 feet
E/F	1	Deficient/unsafe environment	40+ mph	No dedicated space

[1] 2 Killing Speed and Saving Lives, UK Dept. of Transportation, London, England. See also Limpert, Rudolph. Motor Vehicle Accident Reconstruction and Cause Analysis. Fourth Edition. Charlottesville, VA. The Michie Company, 1994, p. 663.

Data Collection

Required data includes posted or 85th percentile speed, and presence of sidewalks and shoulders by width. No primary data collection will be conducted for the analysis, as the team will rely on existing data provided by ODOT and the City of Brookings.

Data Analysis

After collating the data, the team will use GIS to map the street network by PLOS score. The results of this mapping exercise will be presented with accompanying narrative documentation about the methodology and the implications of the analysis.

Outcome

Based on the results of the PLOS assessment, the project team will proceed with developing transportation system alternatives in Plan update project Task 4. The intent of the alternatives development process is to identify improvements that will create a pedestrian network that is responsive to the goals of the TSP, such as emphasizing pedestrian safety, serving high volume destinations and supporting business activity.

LEVEL OF TRAFFIC STREES

Bicycle Network Analysis: Level of Traffic Stress (LTS)

A low stress bicycle network is likely to attract a larger portion of the population if its fundamental attribute is low stress connectivity. In other words, a network should provide direct routes between origins and destinations that do not include links that exceed one's tolerance for traffic stress. The foundation for the Street Stress Analysis is based on the Mineta Transportation Institute's Low-Stress Bicycle and Network Connectivity model. Level of Traffic Stress (LTS) analysis is an objective, data-driven model that scores network links on a scale of 1 – 4. The analysis identifies high traffic stress links, bicycle network gaps and gaps between "low stress" links. The premise for this analysis is that points increase as stress-inducing factors, such as traffic speeds and volume, increase.

Level of Traffic Stress modeling results in four possible street type outcomes:

- LTS 1 – Most children are comfortable
- LTS 2 – Most of the adult population are comfortable
- LTS 3 – Confident cyclists are comfortable
- LTS 4 – Only the strongest and most experienced cyclists are capable (but not necessarily comfortable)

Method

The team will conduct a GIS-based Level of Traffic Stress (LTS) analysis of streets in Brookings to determine existing level of service and identify LTS 1 "Family Friendly Routes". The intent of the analysis is to identify a fine-grained bicycle circulation network that serves users of all ages and abilities, connecting places where people live, work, play, and learn. The analysis will be used to inform, create and confirm recommendations for bicycle facilities in the Plan Update.

Data Collection

Previous applications of the LTS model indicates that results are improved with increasing quality and quantity of data. Required data includes posted or 85th percentile speed, traffic volumes, and presence of bikeway by facility type. Other data that can improve the model include:

- Number of lanes
- Existing no parking zones
- Intersection controls
- Lane width for motor vehicle and bicycle facilities
- Existing traffic calming including bicycle turning pockets
- Land use zoning maps or an alternative proxy for the density of driveways
- Topography (optional)
- Freeway crossings

No primary data collection will be conducted for the analysis, as the team will rely on existing data provided by ODOT and the City of Brookings.

Data Analysis

After collating the data, the team will use GIS to map the network by stress level, using a calculated composite index score. Then a shortest path analysis at each stress level to identified destinations (e.g., schools, parks and other key attractors) will reveal connectivity clusters, or groups of streets that people can use to journey between destinations. The results of this mapping exercise will be presented with accompanying narrative documentation about the methodology and the implications of the analysis.

Outcome

Based on the results travel stress mapping, the project team will proceed with developing transportation system alternatives in the Plan update project Task 4. The intent of the alternatives development process is to identify improvements that will create a family-friendly network that serves the entire city. A key feature of LTS analysis is the ability to determine if recommendations provide facilities that are consistent with the design stress levels for each conceived route. For example, providing approach and departure bicycle lanes may connect an LTS 3 route while a separated bicycle facility or alternative route (a “Bicycle Boulevard”, also called a “Neighborhood Greenway”) might be required to connect a LTS 1 “Family Friendly” route.

SAFETY ANALYSIS

The past five years (2008 – 2012) of crash data from ODOT’s Crash Data and Reporting Unit for both state and non-state roadways will be used to perform crash analysis. The Highway Safety Manual (HSM) Part B Network Screening Critical Crash Rate method for intersections will be used to determine safety issue areas.

Intersections that exceed the identified critical crash rate and/or the published 90th percentile rate will have crash patterns, and evaluation of cause and potential countermeasures identified. These locations and the Safety Priority Index System (SPIS) sites will be summarized graphically. Crash Data and Multimodal Level of Service will be used to identify potential countermeasures and safety improvement alternatives.