KITTELSON & ASSOCIATES

Methodology Memo

Bicycle and Pedestrian Comfort Assessment and Modal Priority Methodology Memorandum

MULTIMODAL COMMUNITY PLANNING STUDY

NEXT STOP FORT LAUDERDALE

Advancing the Vision

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MEMORANDUM

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Project: Fort Lauderdale TOD Program

Subject: Bicycle and Pedestrian Comfort Assessment and Modal Priority Methodology Memorandum

INTRODUCTION

The purpose of the Next Stop Fort Lauderdale planning study is to advance the City's vision. The Fast Forward Fort Lauderdale Vision Plan 2035 states that neighbors want a multimodal community where people have choice to get around by car, transit, bicycle or walking. Creating a safe and walkable city was identified as a top ranked priority in the plan. This project is exploring mechanisms that the City can use to foster a walkable, connected and livable environment to enhance the quality of life in our community.

The Kittelson team is working with City of Fort Lauderdale staff to apply a methodology that will evaluate the existing bicycle and pedestrian conditions in the system, and provide recommendations to create a connected, multimodal network by identifying the modal priority for streets within the planning area. To meet this goal, a summary of the following assessments are proposed below. The methodology for each of these assessments are outlined in detail in later sections of this memo.

- **Bicycle Level of Traffic Stress (LTS) Assessment.** The Bicycle Level of Traffic Stress (LTS) assessment evaluates segments based on roadway characteristics to determine how bicyclist will experience the street. The LTS is a methodology developed in 2012 based on research

completed by Peter Furth et.al. Since then, it has become a widely-accepted methodology for bicycle network assessment and planning in the transportation industry. Evaluating the Bicycle LTS for all roadway segments between intersections in the planning area. The methodology provides an understanding of the Level of stress a bicyclist experiences when using a roadway or a bicycle facility. The LTS scores range from an LTS 1, which is comfortable for most of the general population, to an LTS 4, which is uncomfortable for even experienced bicyclists. Parameters that typically impact this evaluation include traffic speeds, volumes, the presence of parking, the presence of a bicycle facility and the context of the road, such as whether there is commercial activity or if the facility is in a residential neighborhood.

- **Bicycle Intersection Level of Comfort.** Intersections are where the greatest number of potential conflict points exist, which can impact a bicyclist comfort in crossing or turning at an intersection. The Bicycle Level of Comfort is a qualitative measure developed to understand how characteristics of an intersection impact a bicyclist comfort. This assessment was developed with the LTS methodology principals in mind and leverages the LTS scores on the intersection approaches, as well as conditions such as right turn lanes and the presence of bicycle facilities. The team will evaluate the bicycle level of comfort at up to 20 key intersections in the planning area.
- **Pedestrian Use Assessment.** The approach to this assessment is built off of the understanding that every street in the planning area requires a pedestrian facility (sidewalk) but the design of that facility for the pedestrian use of the street may change based on the context of the street. For instance, a street with mixed-use commercial uses and sidewalk dining will need wider sidewalks and amenities for things like street furniture and trees while a residential street with single-family detached homes may only require a sidewalk. For this, the assessment will define specific pedestrian uses that are needed in the planning area and assign a use to every street. These uses are further defined later in the memo.
- Develop a multi-modal decision-making framework to assign a modal priority to every street in the network based on the bicycle LTS scores and pedestrian functions.
- Develop a modal prioritization map, where every street is assigned a primary mode priority and a secondary mode priority.

This memo outlines the details and approach to each of the analysis listed above.

DATA COLLECTION

The methodology will involve compiling GIS data from various sources. Kittelson worked with the City to identify and obtain all pertinent data. At the current time, all data requested for the analysis is readily available and no field verifications will be required.

The table below summarizes the GIS data collected and its source.

Data	Data Layer Name	Source	Date Collected
Street Typology	Roadways2019.shp	City of Fort Lauderdale	2/19/2019
Bike Facilities (on and off street)	ExistingBicycleFacility.shp	City of Fort Lauderdale	2/19/2019 2/24/2015
Land Use	Zoning2019.shp	City of Fort Lauderdale	2/19/2019
Bus Routes	BCT_Routes.shp TMA_Routes.shp ExpressBus.shp	Broward County Transit	4/9/2018
Bus Stops	BCT_Stops.shp	Broward County Transit	4/9/2018
AADT	aadt.shp	Florida Department of Transportation	3/7/2019
On-Street Parking	Roadways_studyarea0329.shp	Digitalize from the City of Fort Lauderdale's 2018 Citywide Parking Study	10/9/2018

The Kittelson team collected and compiled the aforementioned data from the City, Broward County Transit and FDOT. While most data to be used in the analysis was obtained, Kittelson worked with City staff to supplement available data with the following assumptions:

- The posted speed is assumed to be 25mph for local roads, 35mph for State and County roads, and 30mph for all other roads in the planning area. A speed limit map will be provided to the City based on these assumptions. The City will provide comments on any changes to be made on the map based on these assumptions.
- AADT data for collectors and arterials will be used from FDOT's AADT online data mapping. It will be assumed that all local roads carry less than 2,500 vehicles AADT.

The above data will be supplemented by any available, accurate data obtained from Open Streets data online.

Deliverables: Kittelson will provide a map of the parking data, ADT data and speed data as dictated by the data compiled and the assumptions above. The City will review and return the maps marked up with

any changes based on local knowledge. The final deliverable will be revised maps and shapefiles based on the City's revisions.

BICYCLE LEVEL OF TRAFFIC STRESS (BETWEEN INTERSECTIONS)

Research has identified that there are 4 types of bicyclist, Strong and fearless, Enthused and confident, Interested but Concerned and No way, No how[1]. Bicyclists categorized as Strong and Fearless are comfortable riding on busy roads with little physical separation from motorist through travel lanes. Enthused and Confident cyclists are generally recreational and utilitarian riders who will ride on busy streets if there are facilities provided, but may also deviate from the most direct route to ride on low-traffic or shared use paths. The No way no how group will not choose to bicycle for transportation or recreation, regardless of provided infrastructure.

However, the majority of the population falls in the Interested but Concerned category. This group includes a wide range of people of all ages who enjoy cycling, but may only ride on shared use paths, low traffic local streets, or protected on-street facilities. These bicyclists need to be connected via bike facilities/streets that are low stress for the entirety of their trip. This makes it crucial to create connected networks AND to select and build a well-designed facility that meets the needs of these riders. In general terms, this user group prefers:

- Physically separated facilities such as bike lanes with vertical seperation and trails
- Wide, preferably-buffered bike lanes on medium to low speed and low volume streets, adjacent to the curb (not a parking lane)
- Bike boulevard treatments on low-stress neighborhood streets

The Bicycle LTS methodology uses roadway characteristics to evaluate the perceived comfort of people riding a bicycle on a particular street or facility. Fundamentally, most people will travel around Fort Lauderdale in a way that gets them where they need to go and feels safe to them. The way the transportation industry traditionally plan bike facilities, however, often fails to meet one or both of these basic travel needs. Inevitably, a person on a bicycle encounters one of the two following situations:

[1] Dill, Jenifer and McNeil, Nathan, *Four Types of Cyclists?: Testing a Typology to better Understand Bicycling Behavior and Potential.* Portland State University, 2012.

1. A lack of bicycle facilities, or gaps between bicycle facilities that requires people on bikes to ride in mixed traffic on streets where they feel at risk.

2. The bicycle facilities that do exist are designed in such a way that people on bikes don't feel safe, either because they're too close to fast-moving traffic, they're frequently obstructed, or because they are too close to parked cars which may open their doors into them.

LTS is generally evaluated using the following comfort level thresholds:

- LTS 1: This is the most comfortable level of traffic stress for the general population and is suitable for an 8-year old child. Except in low speed(<30MPH)/low volume (<3,00 AADT) traffic situations, a separated bike facility that has physical separation from traffic is usually present.
- LTS 2: This level is defined as a level of stress that most adults can tolerate, particularly those sometimes classified as "interested but concerned." Except in low speed / low volume traffic situations, cyclists have their own place to ride that keeps them from having to interact with traffic except at formal crossings. Where there is a bike lane, there are low levels of parking turn-over and driveway activity, such as in residential neighborhoods.
- LTS 3: Involves interaction with moderate speed (30 MPH) or multilane traffic, or close proximity to higher speed traffic (>35 MPH). Streets with moderate speeds (30 MPH) and lower traffic volumes (<3,000 AADT) can be an LTS 3, if there is a higher level of parking turnover. These streets tend to be comfortable for "enthused and confident" riders.
- LTS 4: This is the most challenging or difficult level of traffic stress and usually involves interaction with higher speed traffic. These streets are typically greater than 35 MPH, are multi-lane roads and have AADT's that exceed 8,000 AADT. Uncomfortable for most bicycle riders, acceptable only to "strong and fearless" riders.

The proposed methodology will evaluate existing street network based on a "Weakest Link" threshold approach. In this methodology every street section that continuous characteristics is assigned an LTS score. This methodology uses the follow data to assign the LTS score:

(1) Posted traffic speeds. This is the posted speed limit on a given street. The speed of traffic is one of the greatest factors in causing stress for bicyclist using the street. In the absence of observed speed data, the posted speed limit is a good first indicator of what the LTS score could be. This is the first level of information that will be assessed for every street section.

(2) Average annual Daily Traffic Volumes (AADT). AADT volumes are an indicator of how often conflicts between bicyclist and cars have the potential to occur. Once the traffic speeds are accessed, AADT is used to further determine the LTS score.

(3) Level of separation from traffic. The is relevant to when a bicycle facility is present either adjacent to or in the street. Bike lanes that have vertical separation between the bike lane and the travel lane tend to be a score of LTS 1, no matter what the speed and volume of the road is. Whereas bike lanes

that do not have vertical separation are only comfortable for the general population at certain levels of speed and volume (this is further defined below in the methodology.

(4) level of incursion (based on context). High on-street parking activity and driveway access to/from commercial land uses tend to contribute to higher levels of traffic stress for cyclists along mixed traffic segments, increasing the potential for bike/vehicle conflicts. Commercial land uses will be used to qualify this measure using Fort Lauderdale's existing land use data.

These metrics, in this order, tend to be the street characteristics that have the greatest impact on the LTS score. For example, streets without bicycle facilities that have a posted speed limit of greater than 35 mph is expected to be a score of LTS 4, no matter what the other characteristics of the street are (traffic volumes or presence of parking).

Street segments within the network will be evaluated based on the thresholds developed and explained in the methodology below. Two separate assessments were developed, one for Mixed traffic assessments where a dedicated bike facility is not present (Assessment A) and one for when a dedicated bike facility is present. As indicated in the flow charts in Figure 1, if the street segment meets the threshold, it will be assigned an LTS score. If it does not, it will be evaluated based on the next set of thresholds and assigned a score once the segment meets a threshold.

Mixed-Traffic Assessment: Streets without Dedicated Bike Facilities (Assessment A)

All facilities classified as sharrows or signed route will be assessed using the mixed traffic approach. The evaluation methodology, shown in **Figure 1**, will assign an LTS score to each mixed traffic segment. This results in only one score per segment and uses "Weakest Link" methodology to represent the highest level of stress encountered along that segment. Three main corridor characteristics influence LTS on Mixed Traffic segments – auto speed, number of lanes, and level of incursion / commercial activity.

- ***Automobile Speed***

  Higher automobile speeds along a mixed traffic segment contribute to high levels of traffic stress for cyclists. In the absence of extensive spot speed data throughout the City, this characteristic will be reasonably quantified using assumed speed limits that will be vetted based on City staff knowledge.
  As indicated in Figure 1, Streets with speeds of 35 mph or greater automatically receive an LTS 4 score. For streets with speeds of 30 mph the AADT and amount of anticipated commercial activity will be evaluated to assign an LTS of 1 through4.

- ***Average Annual Daily Traffic Volume (AADT)***

  Higher traffic volumes along a mixed traffic segment contribute to high levels of traffic stress for cyclists due to the increased exposure to interacting with a car in mixed traffic. AADT data

for collectors and arterials will be used from FDOT's AADT online data mapping. It will be assumed that all local roads carry less than 2,500 vehicles AADT. An AADT map will be provided to the City based on these assumptions. City staff will verify the data based on local knowledge or any additional traffic volume sources available.

As indicated in Figure 1, streets that are 30 MPH and have <3,000 AADT, a score of LTS 1 will be assigned to residential areas and LTS 2 will be assigned to commercial areas. At 30 MPH where the traffic volumes exceed 3,000 AADT or at 25 MPH where traffic volumes exceed 6,000 AADT, LTS 4 will be assigned.

- ***Level of Incursion / Commercial Activity***

  High on-street parking activity and driveway access to/from commercial land uses tend to contribute to higher levels of traffic stress for cyclists along mixed traffic segments, increasing the potential for bike/vehicle conflicts. Commercial land uses will be used to qualify this measure using Fort Lauderdale's existing land use data.

  As indicated in Figure 1, for streets under 35 mph with up to three lanes of traffic, land use will be used to make final LTS determination. In these contexts, the street segment will receive a higher LTS score if most of the segment is located in a commercial area where potential for on-street parking activity and driveway access is high.

The evaluation methodology is summarized in Figure 1. This chart is used by starting with the top box with the question "What is the posted speed limit?" Then, follow the flow chart arrows down the chart based on the answer to the next question. The analysis continues down the chart until an LTS score is assigned.

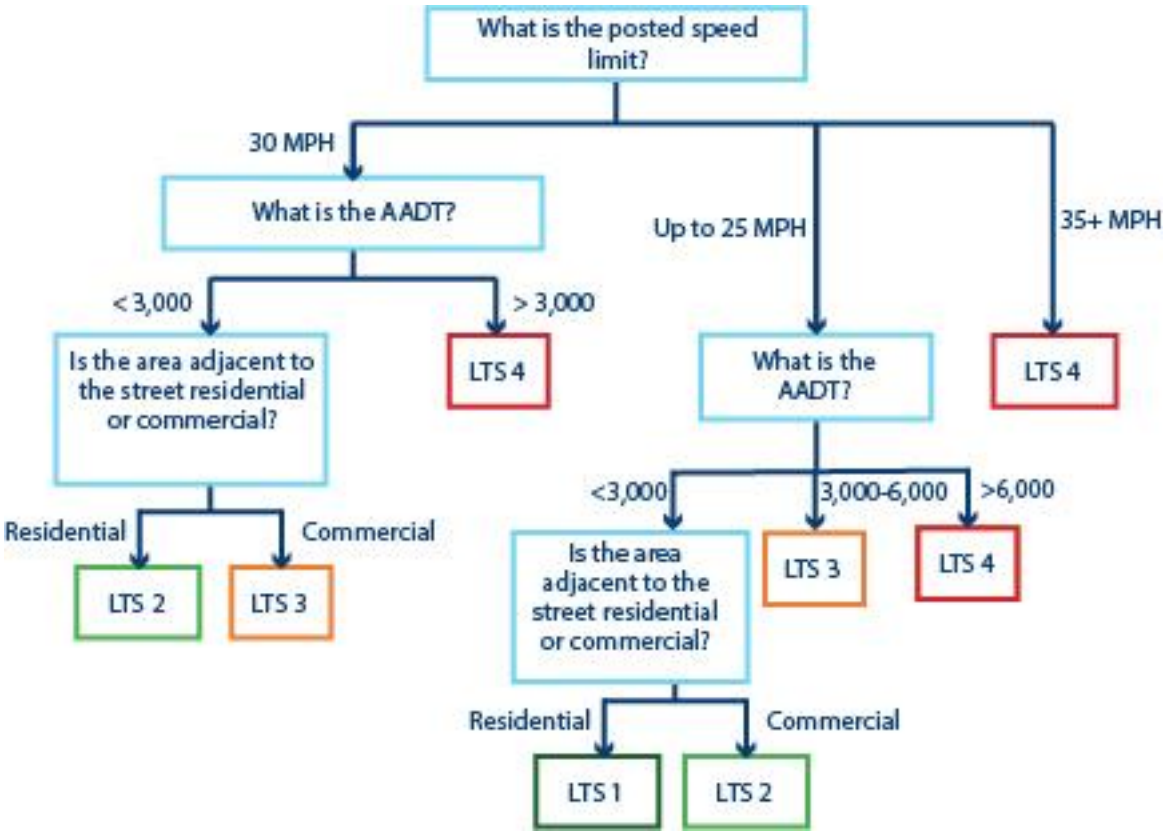

Figure 1 Mixed Traffic Bicycle LTS Methodology (Assessment A)

Streets with Bike Facilities Assessment (Assessment B)

All street segments with bicycle facilities will be evaluated using the Bicycle Facility LTS Methodology. The evaluation methodology, shown in **Figure 2**, will assign a LTS score to each street segment. Only one score is assigned to the street segment, the methodology in Figure 2 is used if there is a bicycle facility on the segment. There is not a separate LTS score for the street and for the bicycle facility. This results in only one score per segment and uses "Weakest Link" methodology to represent the highest level of stress encountered along that segment. Three main elements influence level of traffic stress on bicycle facilities – type of bicycle facility, auto speed, and presence of on-street parking.

Type of Bicycle Facility

As shown in Figure 2, for bike facilities that have vertical separation from traffic (i.e., shared use paths and cycle tracks), as long as there are no known design flaws, an LTS 1 is assigned.

A facility (including shoulders) will be classified as a bike lane if it is four feet or wider. For streets with bicycle facility on only one side, an LTS score will be assigned to each side of the street, and the segment score will be represented by the highest (most stressful) LTS.

Automobile Speed

Although bicycles may not share the same lane with motorists on these segments, high auto speeds along bike lanes contribute to high levels of traffic stress for cyclists. In the absence of observed speed data throughout the City, this characteristic will be assumed to be 25mph for local roads, 35mph for State and County roads and 30mph for all other roads in the planning area, unless otherwise advised by City staff.

Bike lanes with adjacent auto speeds of 40 mph or greater automatically receive an LTS 4 score. Bike lanes with adjacent auto speeds of 35 mph receive an LTS 3 score. For streets with speeds of 30 mph and lower, presence of parking and bike lane width (four feet or wider) will be evaluated to assign an LTS of 1-3.

Buffered bike lanes with adjacent auto speeds of 45 mph or greater automatically receive an LTS 4 score. Buffered bike lanes with adjacent auto speeds of 40 mph or 35 mph receive an LTS 3 score. For streets with speeds of 30 mph and lower, presence of parking and bike lane width (four feet or wider) will be evaluated to assign an LTS of 1-3.

Presence of On-Street Parking

For streets with a bike lane and buffered bike lanes and speeds of 30 mph or lower, it is necessary to take the presence of a parking lane and its width into account. In these cases, Kittelson will use the parking information available on the City's website as a starting point and conduct a desk audit of the presence and width of parking adjacent to the bike lanes. Google Earth measurements are adequate in order to streamline this process. If the bike lane is adjacent to parking, and the width of the bike lane plus parking exceeds 13', an LTS 2 will be assigned. If the width does not exceed 13', an LTS 3 will be assigned. For bike lanes that are not adjacent to parking, LTS 1 through 3 will be assigned depending on the width of the bike lane.

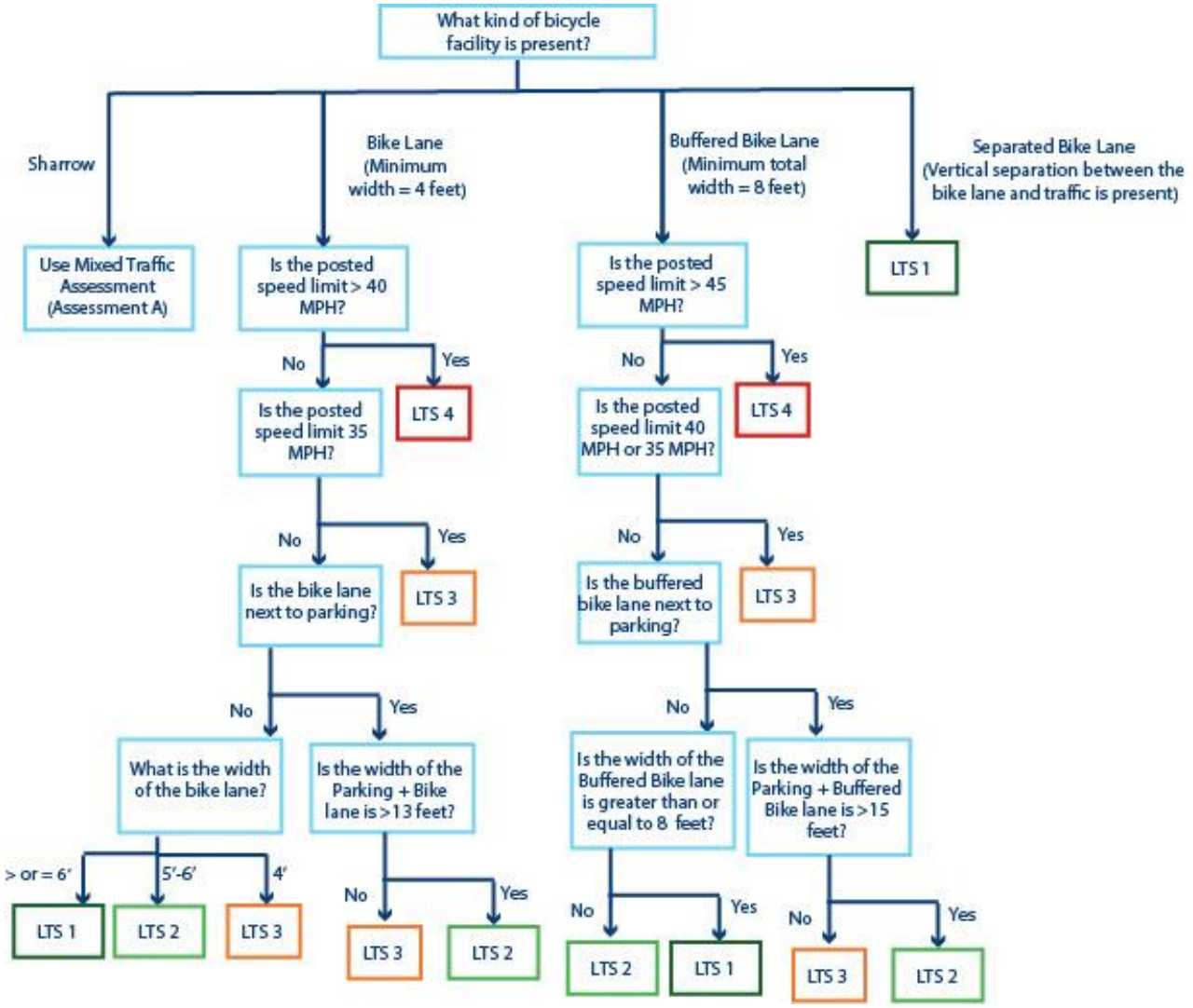

Figure 2 Bicycle Facility LTS Methodology (Assessment B)

Kittelson will develop a Bicycle LTS map based on the above analysis. The results of the analysis will be "ground-truthed" with City staff local knowledge and refined based on their on-the-ground experience and understanding of the street network. A refined bicycle LTS map will be created.

Based on the Bicycle LTS map, Kittelson will identify the critical bicycle corridors that will maximize the use of the existing low-stress network and highlight the streets that are critical to create a connected network. These recommendations will be reviewed with City staff.

Deliverables: A bicycle LTS map and a map of recommended critical bicycle corridors in the network.

BICYCLE INTERSECTION COMFORT EVALUATION

Roadway intersections are where the greatest interaction between cars and bicycles occur and where the highest likelihood for conflict exists. This means that intersections can represent critical barriers to a continuous low-stress trip.

Once the bicycle LTS analysis is completed and critical corridors have been identified, Kittleson will work with City staff to evaluate up to twenty (20) intersections based on their bicycle level of comfort. Each intersection will be given a minimum of two scores, one for the main street and one for the side street. In cases where a bike facility ends at an intersection, the assessment where a bike facility is NOT present will be used. This assessment will use the segment LTS scores and other existing conditions to evaluate each intersection. Additional factors to be included in the assessment include presence of right-turn lanes, existing turn radius, and type of intersection treatments. Scores will be applied and will be ranked using three categories: good, needs improvement, and poor. Similar to the segment LTS analysis, two separate analyses will be provided: 1) for mixed traffic conditions (when a bike lane is not present), and 2) where a bicycle facility goes through the intersection.

Figure 3 outlines the analysis for intersections where a bicycle facility is NOT present. When specific bicycle facilities are not present, the presence of a right-turn lane and the curb radius will be the two primary factors to impact the comfort of the intersection for bicyclists. Otherwise, the LTS score of the segment approaching the intersection is a good indicator of how comfortable an intersection will be for bicycles. For instance, two LTS 1 streets intersecting each other is a good indication that the intersection is comfortable for bikes, while an LTS 4 street crossing an LTS 3 street is likely an uncomfortable intersection for bikes without specific bicycle infrastructure accommodating them.

To complete the analysis for an intersection where a bicycle facility is not present, use the flow chart in Figure 3 to create two scores per intersection.

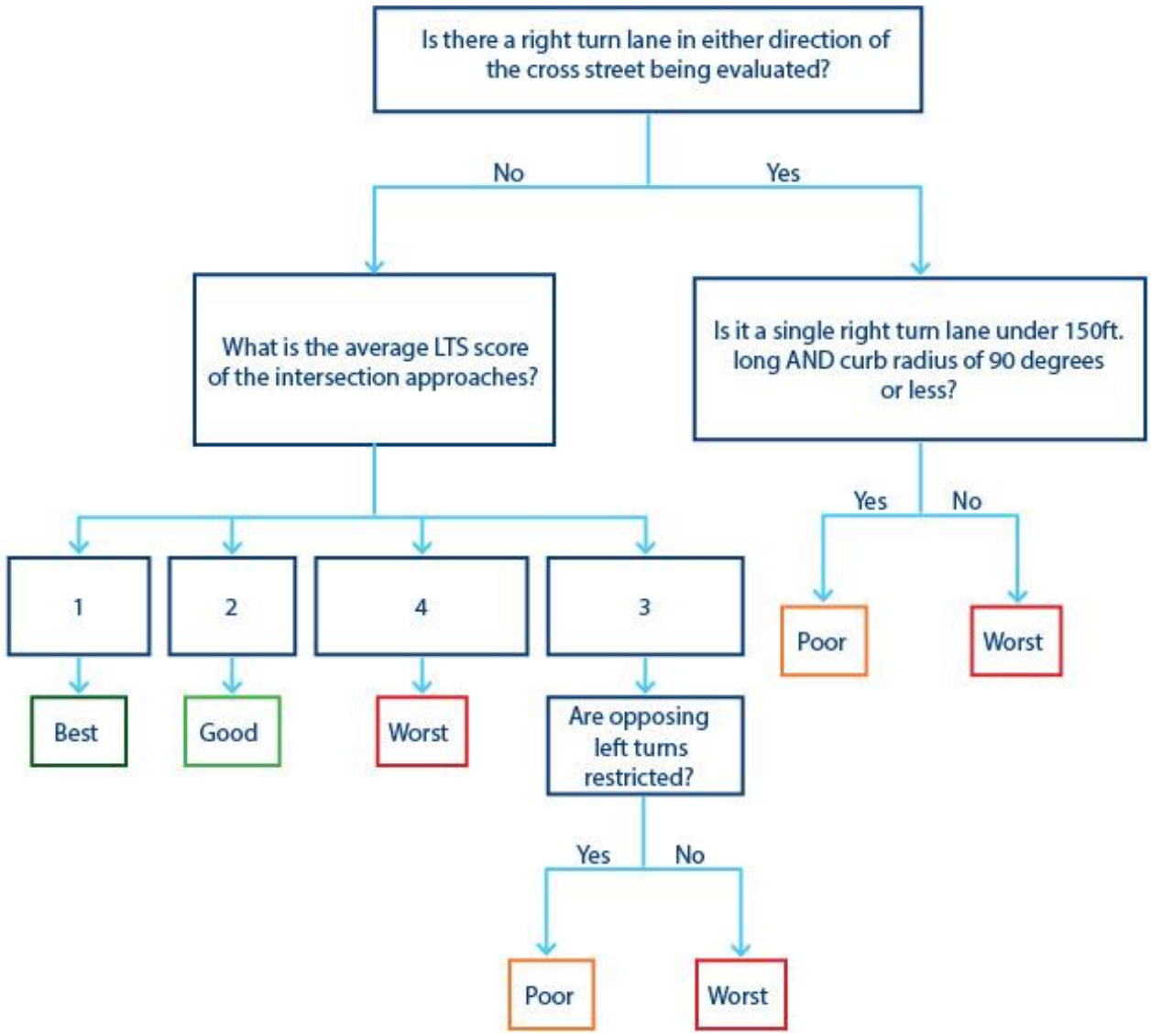

Figure 3. Bicycle Intersection accommodation score when a bike lane is NOT present

Figure 4 outlines the analysis for intersections where a bicycle facility IS present. When bike facilities such as bike signals, protected intersections, bike boxes and two-stage turn boxes are incorporated into the intersection design, there is a perception from bicyclists that the intersection has been designed with them in mind and increases driver awareness of when and where to expect bicyclist. Additionally, managing the right-turn conflict when a right turn lane and bike lane are present is also key. Treatments, such and mixing zones and bicycle signals can be applied to manage when bikes and right turns interact.

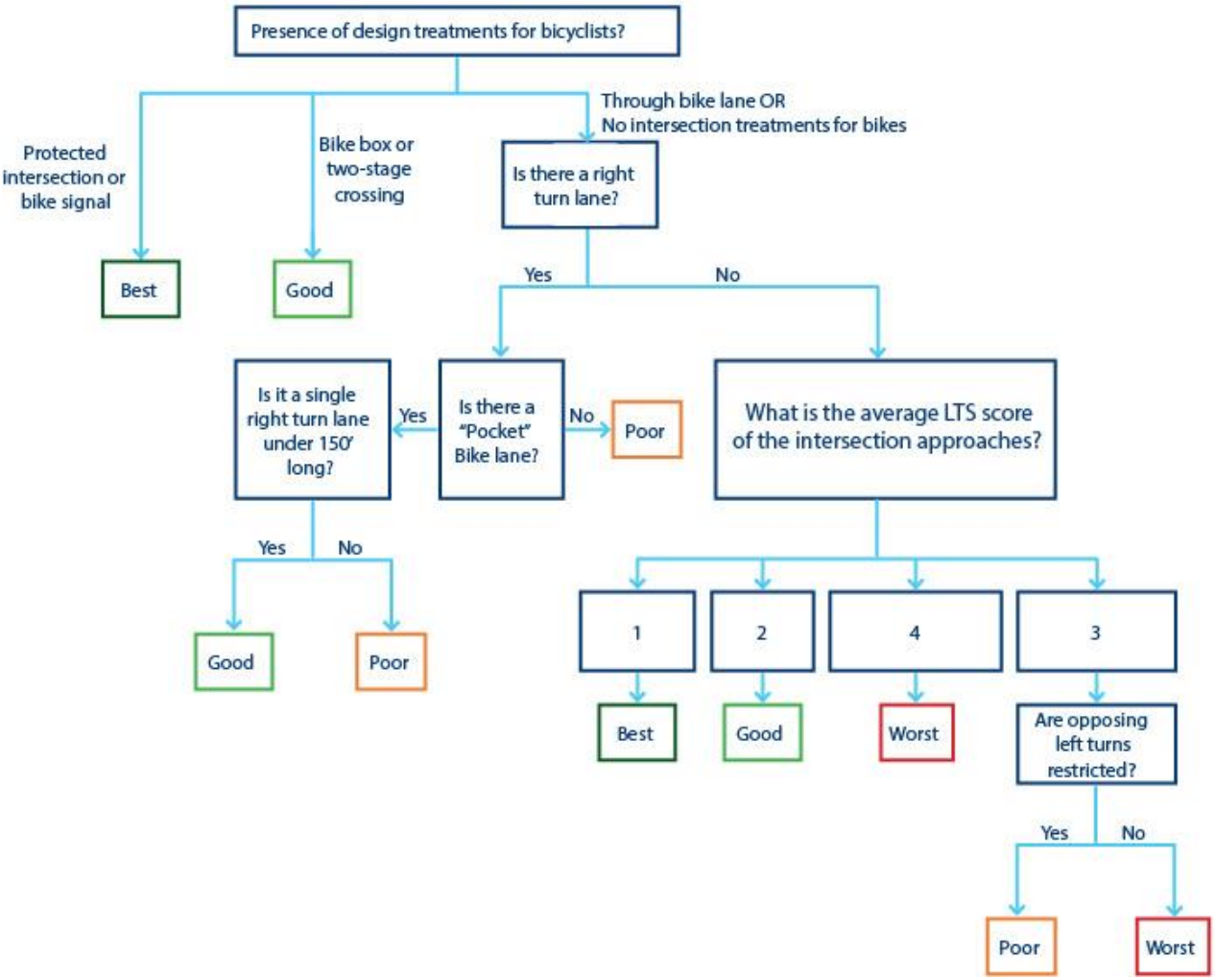

Figure 4. Bicycle Intersection accommodation score <u>when a bike lane IS present</u>

Deliverable: A map of the bicycle intersection comfort for up to 20 intersections in the planning area

PEDESTRIAN USE

Pedestrians are a vulnerable mode, that are extremely sensitive to detour, lack of marked crossings and weather. Creating a robust pedestrian network is the very cornerstone of a walkable downtown. This methodology recognizes that every street in the planning area has pedestrian needs. However, those needs vary based on the adjacent land uses. Commercial areas with night life, shopping and dining may need wider sidewalks to serve the placemaking needs, while a low-volume residential street may only need a functional, ADA compliant sidewalk. Kittelson will work with the City to tailor the preliminary list of street types based on pedestrian use below to address the needs of the planning area. A pedestrian use will be assigned to every block in the planning area through a work session arranged by the consultant team with City staff. Qualitative information such as local knowledge, street context and information from planning studies will be used to assign a pedestrian use to every street.

- **Destination Streets –** These streets are classified as current or future 'destinations' within the region and the City. They act at times as a destination or a place. Some of the characteristics and considerations for these streets include:

    - Mixture of land uses with street level entertainment, retail, or eateries
    - High levels of pedestrian use/traffic
    - Pedestrian safety is a high consideration. Consider trade-offs with other intense modes of travel, (i.e. transit, high volumes of vehicles)
    - Focus on Place-making elements, sense of scale, aesthetics, and enhanced character. This can include art, pedestrian scale lighting, and street furniture.
    - Sidewalk widths are typically wider, between 12 feet and 16 feet.

    Example streets include: Las Olas Boulevard and Himmarshee Street

- **Community Link Streets –** A primary function of these streets is to act as 'connections' between community destinations and amenities. The environment of these streets should recognize the 'pedestrian travel-function' that must occur. Certain characteristics of these streets include:

    - Mixture of land uses, there tends to be nodes of commercial activity along the street,
    - Multimodal features complement these streets
    - May or may not include street level activity, such as gather spaces, sidewalk dining, major bus stops.
    - Moderate to high levels of pedestrian travel and activity
    - Sidewalk widths are typically between 8 feet and 10 feet wide.

    Example streets include: NE 3rd Avenue, Andrews Avenue and Avenue of the Arts

- **Utility Streets –** Most typically in Fort Lauderdale, these occur around business and commercial land uses that are more auto-oriented, such as big-box retail stores, car-washes, and drive through restaurants. They must move all modes of traffic, and remain true to the pedestrian principles. These streets need to focus on access management, controlled crossing opportunities and having minimum width sidewalks (6 feet) that are unimpeded by objects to provide a safe condition for pedestrians.

Example Streets include: Broward Boulevard and US-1.

- **Neighborhood Streets –** Neighborhood streets are typically in low-density residential neighborhoods. Here the street has low speeds (25 MPH) and AADT's below 3,000. In many cases the street is comfortable to walk in because traffic volumes are so low, but a sidewalk on at least one side of the street is typically available, and sidewalks on both side is preferred. These are streets where shade is important and many of the trips are shorter

distance trips to and from the community link streets. Example Streets include: NE 4th avenue and NE 4th street.

Deliverables: A map of the pedestrian uses for every street in the planning area and a summary of each of the functions.

MODAL PRIORITY MAP

Complete Streets principles provide for accommodating every transportation mode in every street. While these principles are important, there are cost and right-of-way constraints that make it difficult for every street in the network to be "complete." However, cities have started to move towards planning complete networks and complete districts, where streets are tagged with primary and secondary modal priorities. For example, a downtown street with a high number of shops and restaurants may be prioritized for walking and transit, while a parallel street may be prioritized for biking. This model allows for places to be accessible by all modes and manage the tradeoffs of "fitting" everything on one main thoroughfare, or expecting all streets to have equal roles.

In order to assign modal priorities, a decision-making framework or parameters will be developed and vetted with City staff. The decision-making framework will use the critical bicycle corridors identified through the LTS analysis, the pedestrian use assignments, existing and proposed transit route and stop location data, AADT data, land use, and long-range master plans (Uptown and Tri-Rail Coastal Link). These factors will be used to create the following maps:

- A map of the recommended bicycle corridors and pedestrian uses,
- A map of the pedestrian uses and the transit routes on the same map,
- A map of the recommended bicycle corridors and transit routes,
- A map of the assigned modal priority based on the modal decision-making framework developed with city staff based on the three maps mentioned above.

These maps will be used in a workshop with City staff to refine the assigned modal priorities. In the workshop, the team will develop decision making parameters in which streets will be assigned a modal priority. This will help guide the decision-making process for the workshop in determining the primary and secondary modal priorities for each street.

Kittelson will map the recommended modal priorities identified in the workshop to create a master modal priority map and document the decision-making framework.

Deliverables: One consultant workshop with the City, a map of the modal priorities within the planning area network.

DOCUMENTATION

The key findings from the above outlined analysis and baseline conditions will be documented in the network comfort assessment technical memo. Upon completing the network comfort assessment technical memo, the recommendations and infrastructure needs for the bicycle and pedestrian networks will be identified and summarized in the infrastructure needs assessment technical memo.

Deliverables: One network comfort assessment technical memo and one infrastructure needs assessment technical memo.