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Broward Metropolitan Planning Organization
Commitment 2045
Metropolitan Transportation Plan

Technical Report #7

Travel Demand & Transit Market Segmentation

June 2018

MPO MISSION STATEMENT

To collaboratively plan, prioritize, and fund the delivery of diverse transportation options.

MPO VISION STATEMENT

Our work will have measurable positive impact by ensuring transportation projects are well selected, funded, and delivered.

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Core Products of the Broward MPO

Introduction

This transit element of the 2045 MTP will answer several important questions, including the following: What should the role of transit be in the region? Should transit focus on serving transit-dependent populations or choice riders, or both? What opportunities exist for new transit investments and technologies?

The purpose of this report is to use data on travel flows and land use and information on current and potential transit markets in the Broward region to identify areas with the potential to support existing and new transit technologies.

Travel flows will help determine likely commute sheds for the region that are best-suited for transit. The analysis includes an examination of commuting and land use patterns that may generate ridership markets to support transit. In addition to intracounty and intercounty travel, high activity corridors and areas were identified through a parcel-level land use market analysis.

A transit market segmentation analysis was performed to identify and understand the strongest potential transit markets in the Broward region that would benefit from a variety of transit mode technologies and services, such as local and community bus, limited-stop bus, express bus, BRT, and varoius rail options (streetcar, light rail, commuter rail, and heavy rail). In addition, other technologies are considered in this evaluaiton, including autonomous vehicles/connected vehicles (AV/CV), shared ride services (Uber, Lyft, etc.), people mover, and waterborne taxi. The analysis matches transit mode technologies to current and potential transit markets based on academic research, data analysis, and a review of transit surveys to identify underserved transit markets and transit technology gaps.

Travel Demand

Understanding overall travel flows and patterns is critical to transit market segmentation. Of particular importance are commuting flows within Broward County and connecting to adjacent counties, as well as locating areas with high activity. A travel flow analysis also was conducted as part of the transit needs assessment to identify the extent of daily travel between the key travel origins and destinations in the Broward region. A combination of StreetLight and Census Transportation Planning Products (CTPP) data were used. The latest CTPP data is a set of special tabulation from 2006–2010 5-Year American Community Survey (ACS) Data. The CTPP data are designed to help transportation analysts and planners understand where people are commuting to and from and how they get there. It provides information about where people live and work, their journey-to-work commuting patterns, and their socioeconomic and travel characteristics. The analysis provides an understanding of the magnitude of daily person trips between key locations/areas that can be helpful in planning/distributing future transit service delivery.

Internal County Travel Flows

Locations or workers by Traffic Analysis Zone (TAZ) helps to identify areas to which a large concentration of workers are traveling within the Broward region. Figure 1 illustrates the number of workers in the Broward region by workplace TAZ. A high number of workers can be observed in the commercial parks of northwest Fort Lauderdale east of Florida's Turnpike and Commercial Boulevard, the Fort Lauderdale Uptown District, the Plantation Midtown District, Downtown Fort Lauderdale, the Miramar Park of Commerce, Memorial Hospital West/Pembroke Lakes Mall, business parks in Sunrise such as Sawgrass International Corporate Park, and intermittently along Sample Road.

It is important to note that the high number of workerss in larger zones does not necessarily correltate to a strong transit market. For example, Weston is a higher income area showing a high number of workers relative to other smaller zones. This information is used to understand travel flows whereas transit markts are considered more throuhgout in subsequent sections of this report.

Internal travel flows of the Broward region were analyzed to determine major origins and destinations. Although this information does not provide the exact paths taken, as most of the boundaries are delineated by the corridors themselves, it provides a good indication of the general direction in which people travel. Figures 2 and 3 show the top 15 percent of internal personal trips in the Broward region using StreetLight data by AM and PM peak periods. StreetLight uses cell phone tracking data to capture all types of trips such as work, medical, school, etc. Travel flows are divided into 40 districts in Broward County. Many of the heaviest trip flows link to the top TAZ locations by number of workers illustrated in Figure 1. A high volume of trips can be seen traveling in the north-south direction east of I-95 within Fort Lauderdale during both AM and PM peak periods. Similarly, a heavy north-south flow can be observed from west Pembroke Pines to Davie and then to south Sunrise and Plantation.

Figure 1: Internal Workers by Workplace TAZ

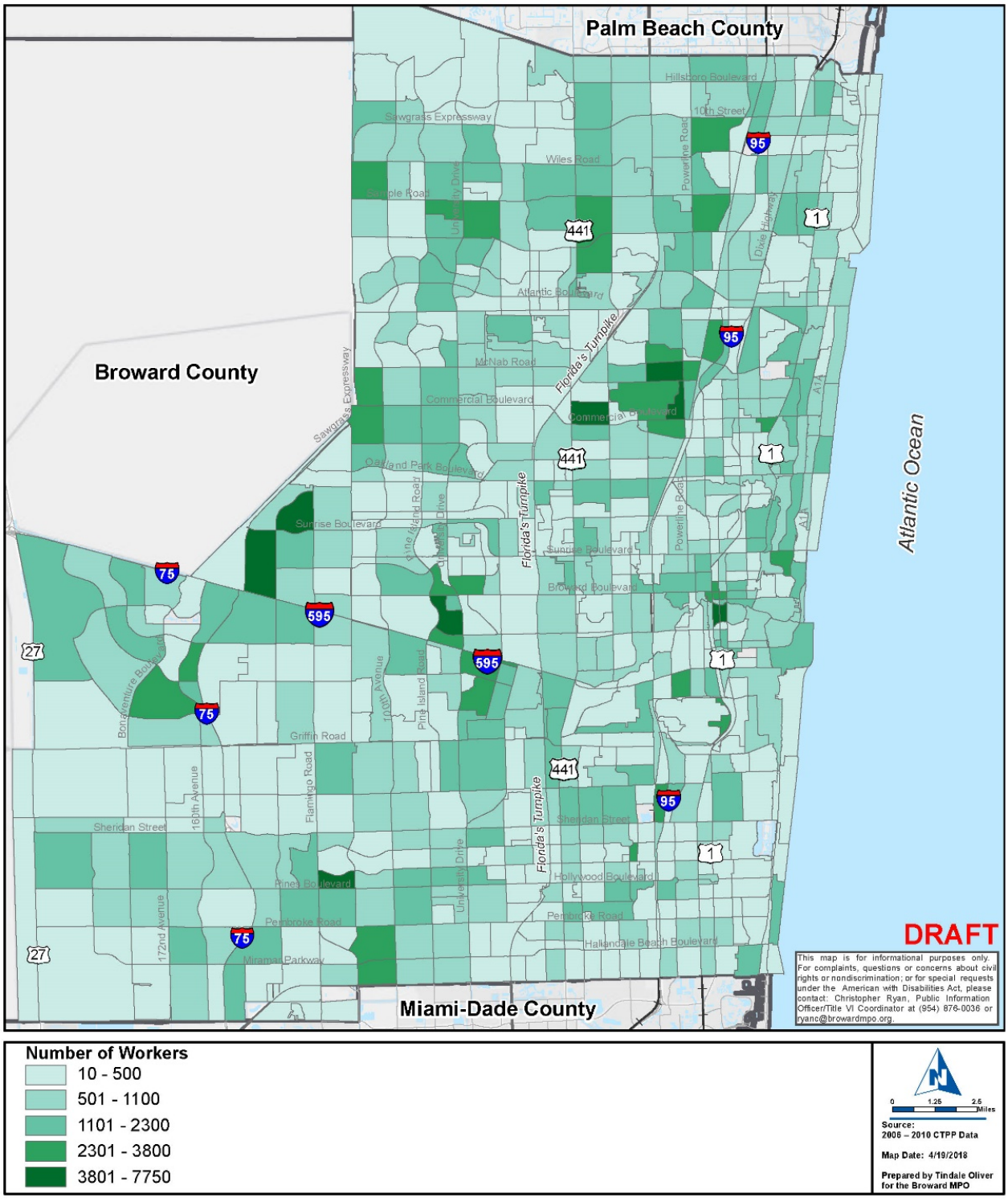


Figure 2: Top 15% of Internal Trip Flows using Streetlight Data (AM Peak)

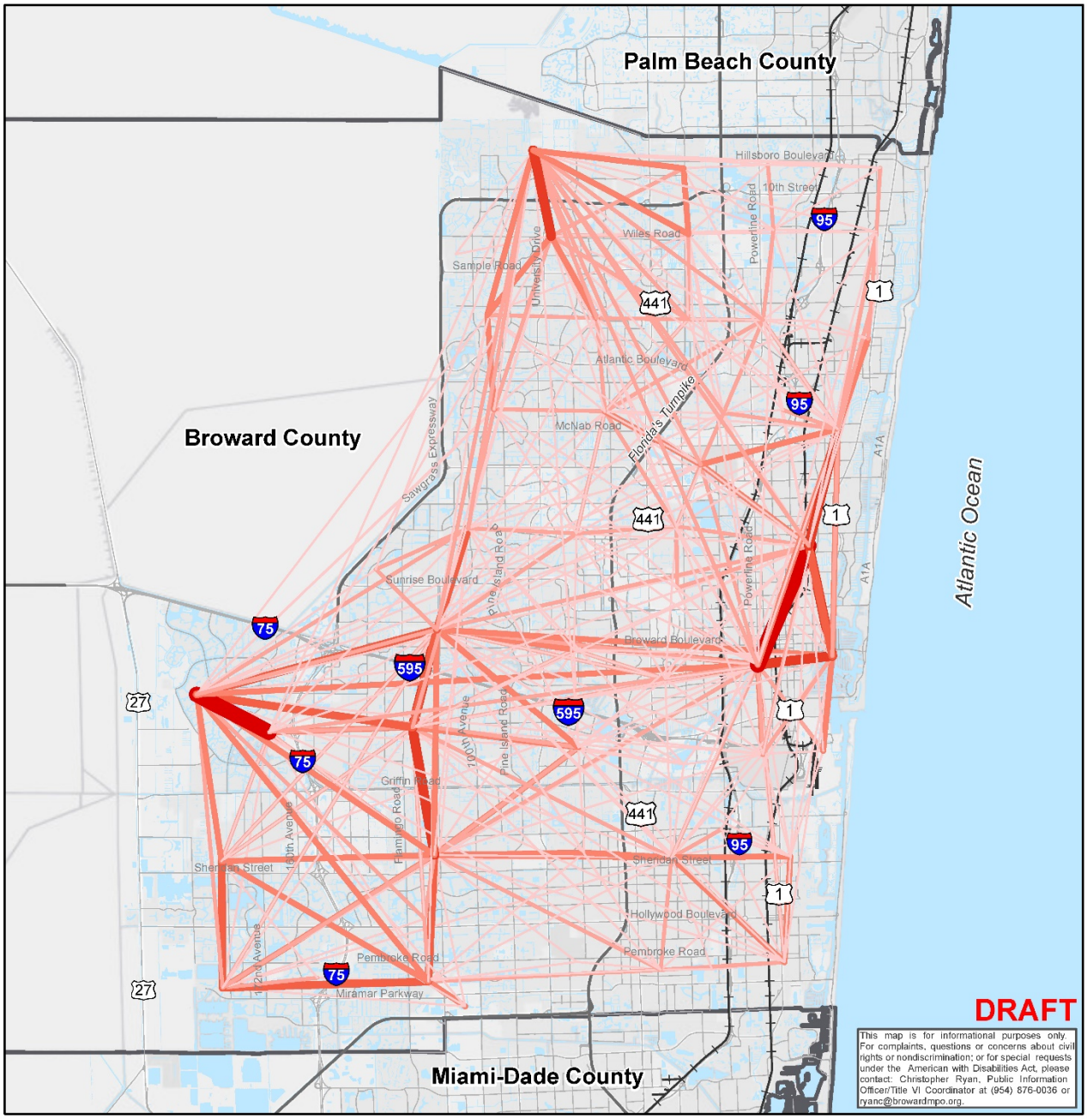
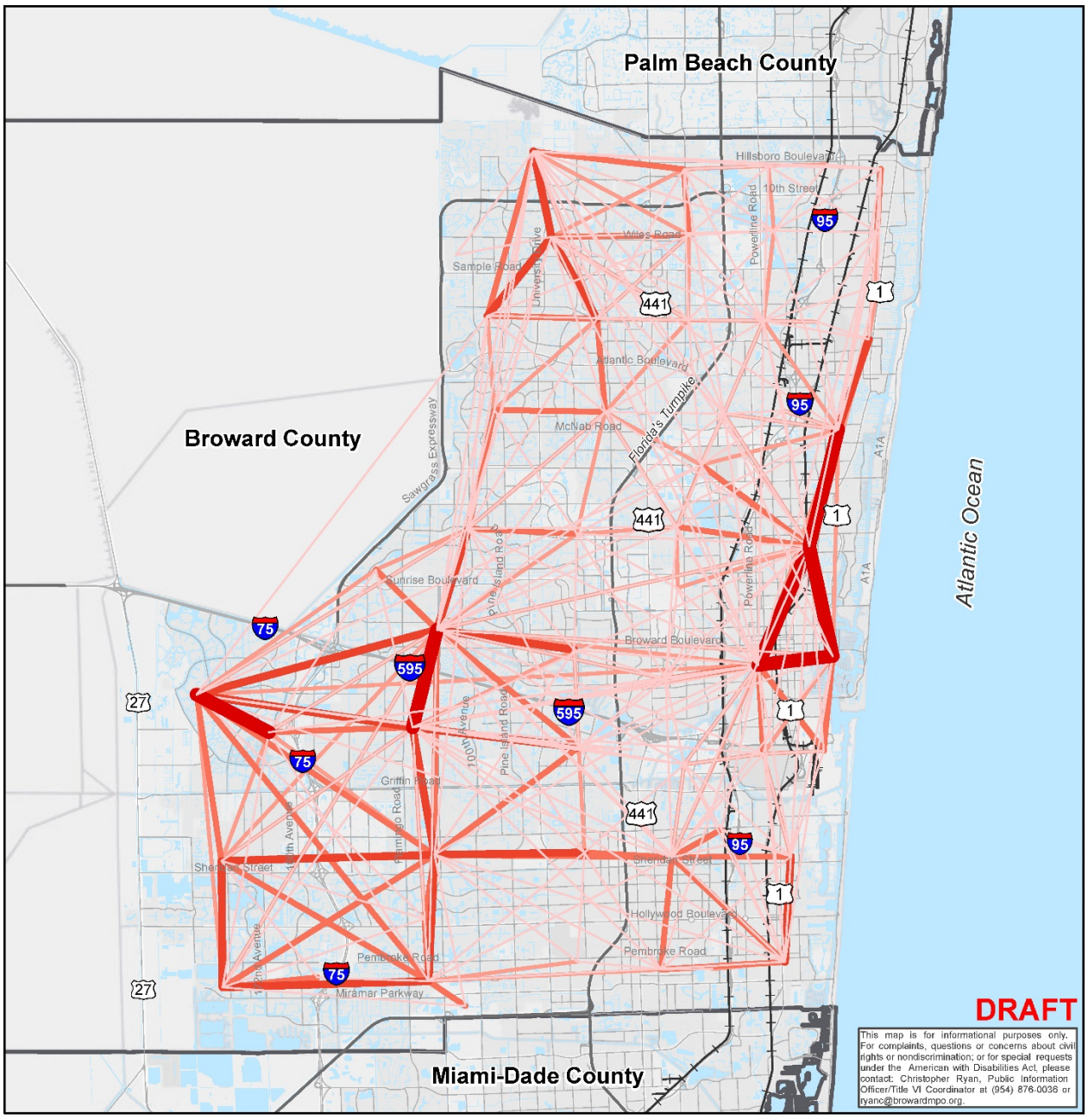


Figure 3: Top 15% of Internal Trip Flows using StreetLight Data (PM Peak)



External County Travel Flows

External travel flows going into and out of the Broward County help identify regional travel patterns, which are significant in the Broward region. According to Longitudinal Employer-Household Dynamics (LEHD) Origin-Destination Employment Statistics (LODES) 2015 data, 35.5 percent (283,740) of workers employed in Broward live outside of the county, and 36.7 percent (298,163) of workers living in Broward work outside of the county. Figure 5 illustrates the top 10 percent of external work flows from Broward to Miami-Dade and Palm Beach counties using CTPP data. The following steps were taken to visualize the top journey-to-work flows to/from Broward County from/to Miami-Dade and Palm Beach counties:

1) Journey-to-work flow tables were downloaded at TAZ level from http://ctpp.transportation.org.

2) Flows to/from 3,285 TAZs within the tri-county region were aggregated to 184 ZIP codes to obtain a better picture of the journey-to-work flows in the region.

3) The top 10 percent flows were selected to be displayed on the map.

The majority of trips originating in Broward County going to Palm Beach County are from the northernmost municipalities, such as Coral Springs, Coconut Creek, Margate, and Deerfield Beach, going to Boca Raton. Much of the flow going to Miami-Dade County originates from the southern municipalities of Broward County, such as Miramar, Pembroke Pines, Hollywood and Hallandale Beach; many of these commutes are to areas in Downtown Miami, West Miami, and Aventura. Figure 6 illustrates the top 10 percent external work flows from Miami-Dade and Palm Beach counties to Broward County by ZIP code using CTPP data. The travel flows are more dispersed compared to Figure 5. Most of the trips originating in Miami-Dade County are from the northernmost municipalities from areas such as Miami Lakes, Miami Gardens, and North Miami and disperse to various employment areas throughout Broward County. Palm Beach County origins are more dispersed throughout the county, with notable concentrations originating from the Boca Raton and Boyton Beach areas going to ZIP codes that contain areas such as the Uptown Urban Village and the corporate parks along Commercial Boulevard in Fort Lauderdale and Downtown Fort Lauderdale. Most of the destinations of these flows that originate in West Palm Beach correspond to the northern TAZs with the highest number of workers illustrated in Figure 1.

Figure 5: Top 10% External Work Flows from
Broward County to Miami-Dade County and Palm Beach County

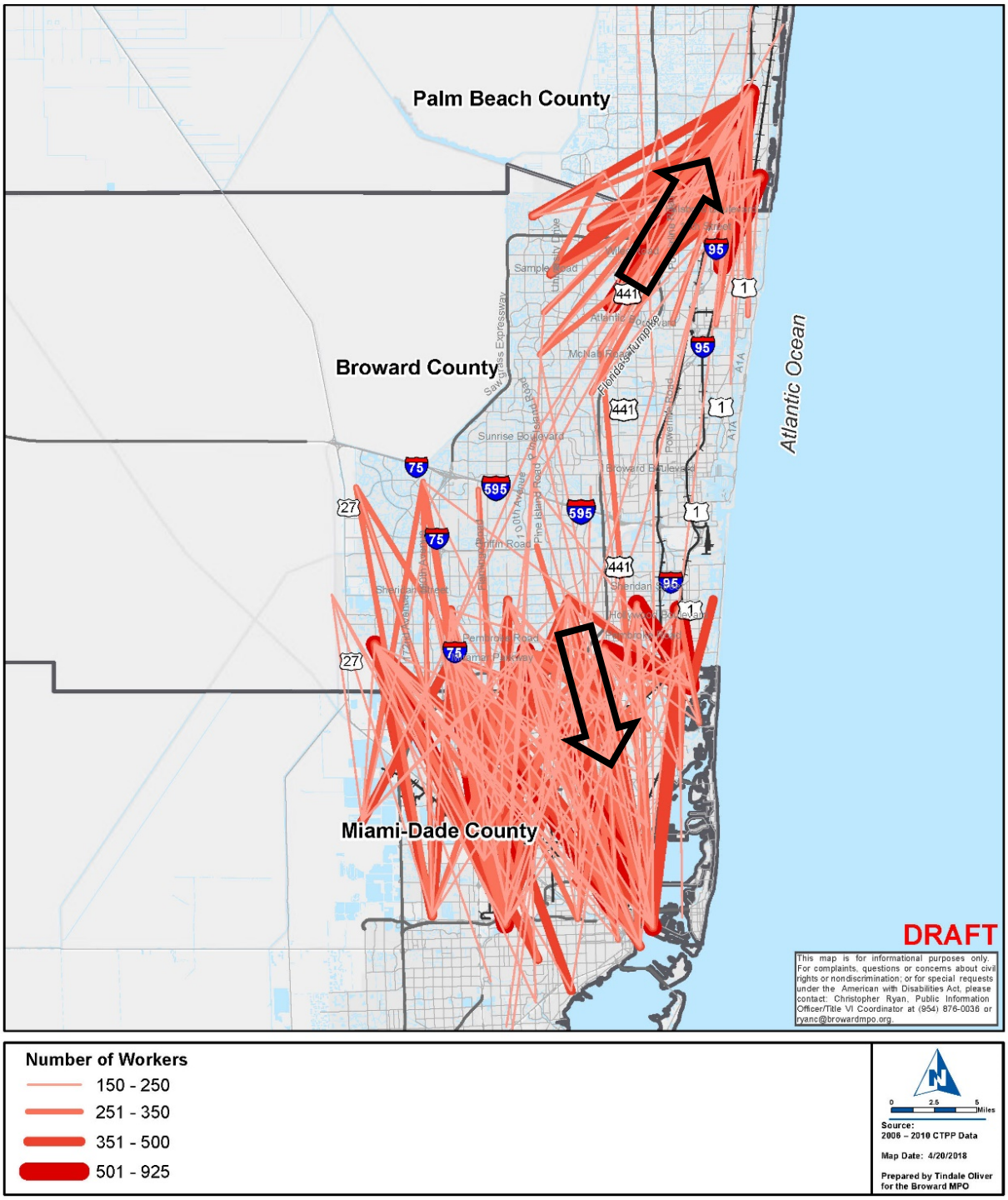
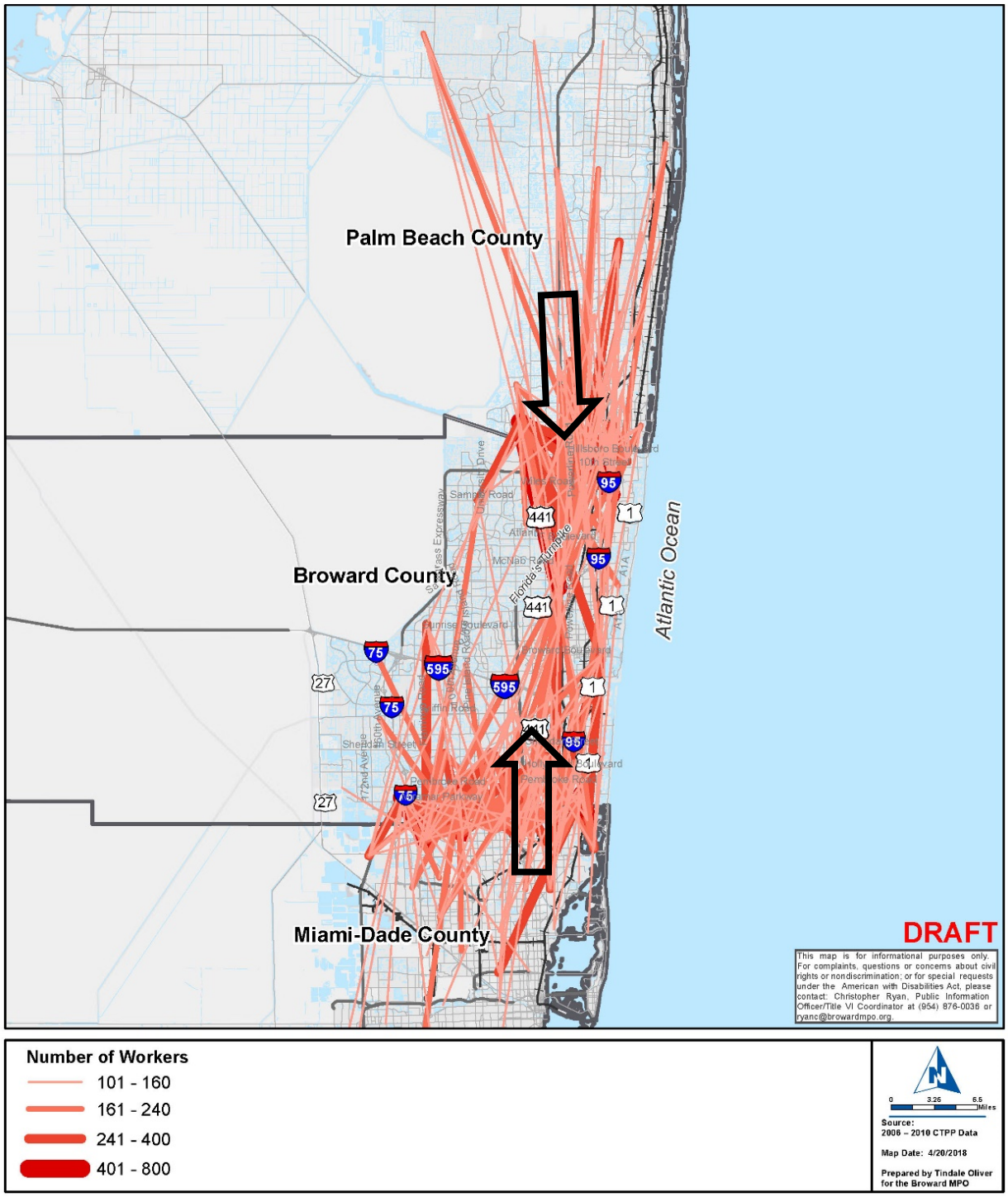


Figure 6: Top 10% External Work Flows to Broward County from Miami-Dade County and Palm Beach County by ZIP Code



Activity

Land Use Activity Analysis by Person Trips Generated

A land use-based activity analysis was performed to identify corridors and areas with high activity, as measured by person trips generated by land use category using commercial, institutional, and government/public facility land uses. This information can aid in the determination of high-demand corridors and areas where transit is needed to meet commuting, education, medical, government, shopping, and recreation needs.

The person trip rates by land use for the service area were based on a methodology that uses the following variables:

- Parcel data (dwelling units and living square footage) and their corresponding land use categories developed from the 2015 Florida Department of Revenue (DOR) land-use classifications.
- Vehicle trip ends by land use code from the *ITE Trip Generation Manual* 10th Edition and other derived sources.
- Percent of land use activity associated with each trip purpose (for purposes of determining temporal distribution of parcel trips)
- National Highway Traffic Safety Administration (NHTSA) vehicle occupancy rates to convert vehicle trips to person trips

Because Florida DOR parcel data are for 2015, this land use activity analysis reflects 2015 land use conditions calculated for a specific time period using land use trip generation rates (i.e., weekday, AM peak, PM peak, Saturday, Sunday). Weekday and PM peak periods were used for this analysis. A combination of work and non-work land uses was used to identify where trips are made, with groups including retail, medical, education, office, restaurant, recreation, hospital, institutional, and government/public facilities. Residential, agriculture, and industrial land uses were excluded from the analysis. Table 1 summarizes the weekday person trips by land use type in the Broward region. The majority of activity in the Broward region is generated by retail and supermarkets (30.7%), followed by office and financial institutions (16.7%), education (13.8%), restaurants and bars (10.9%), and government (10.0%). The remaining land use types total 17.9 percent.

Table 1: Weekday Person Trips by Land Use Type

Land Use Type	Person Trips Generated	Percent
Retail and Supermarkets	4,811,212	30.7%
Office and Financial Institutions	2,626,478	16.7%
Education	2,161,021	13.8%
Restaurants and Bars	1,703,132	10.9%
Government/Public Facilities	1,576,325	10.0%
Vehicle Sales and Repair	981,562	6.3%
Institutional	644,468	4.1%
Hospitals	347,061	2.2%
Mixed Use	331,830	2.1%
Hotels	209,913	1.3%
Commercial Entertainment	140,906	0.9%
Airports or Marinas	103,218	0.7%
Outdoor Recreation	48,562	0.3%
Total	15,685,688	100.0%

Identification of areas with high person-trip activity assists in dertermining which areas have more potential to support transit services due to the higher presence of activity. Figure 7 illustrates the locations of weekday person trips by land use and total weekday person trips. Areas with high activity are noted by larger circles, indicating there is a greater number of person trips generated by the individual parcels as well as by areas with a high density of circles. In general, activity is concentrated along major corridors such as University Drive, US-441, US-1, Pines Boulevard, etc. Person trips for office uses are concentrated in Sunrise, the area surrounding The Fountains in Plantation near University Drive, and the US-1 corridor near Downtown Fort Lauderadale.

Figure 7: Land Use Activity Analysis
(Person Trips Generated on Typical Weekday)

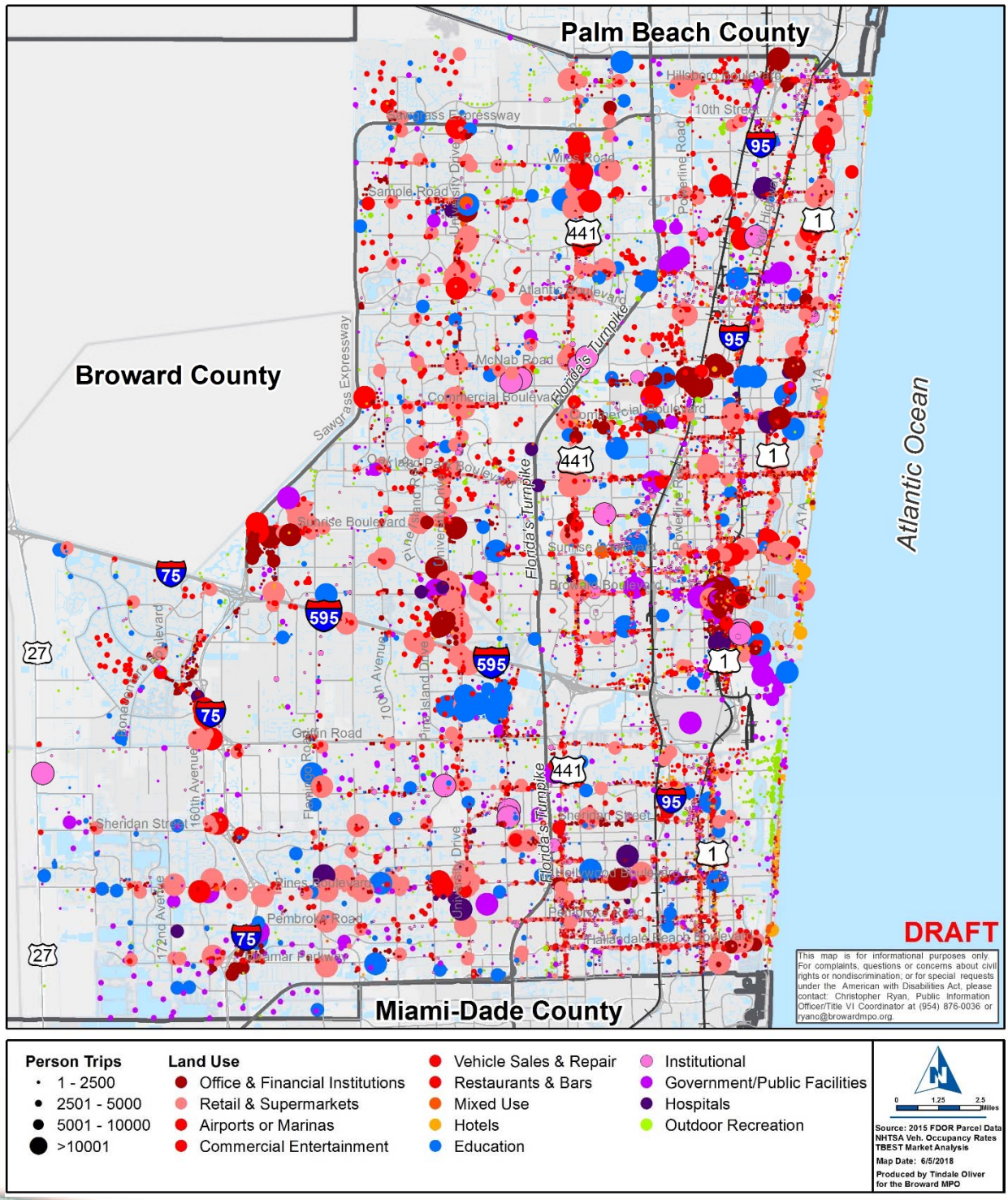


Figure 8 illustrates person trips during the PM peak period (3:00–6:00 PM). Overall, the majority of person trips are generated along major arterials such as University Drive, US-1, US-441, Dixie Highway, and several major arterials in the east-west direction that are generally east of US-441. Large-scale trip generators can be seen for education uses (near the Nova Southeastern University area), government/public facilities (Fort Lauderdale-Hollywood International Airport area), major hospitals, and hotels on the barrier islands. Trips for office uses and financial institutions are concentrated in the areas surrounding Miramar Parkway and I-75, Weston Road, US-1 from Broward Boulvevard to SW 24th Street, Sunrise Boulevard east of the Sawgrass Expressway, The Fountains in Plantation, and the Uptown Business District in Fort Lauderdale.

Identifying major trip locations of residential uses can help identify trips originating from the Broward region.With respect to residential uses, single-family-based person trips account for 63.5 percent of all residential trips, followed by multi-family (15.6%) and condomium uses (15.3%). Mixed-use trips were included in this analysis because they contain residential use.

Figure 9 illustrates the average weekday person trips generated by residential uses only. Residential-generated person trips are dispersed throughout the Broward region. Person trips generated from multi-family and mixed use parcels produce the highest magnitude of person trips and can be observed near several major corridors such as US-1 and Dixie Highway and in various clusters within Miramar, Plantation, Fort Lauderdale, Lauderdale Lakes, and Lauderhill. A higher presence of condomium-based trips can be seen in the Lauderdale Lakes area and near major corridors, especially east of I-95.

In addition to determining areas and corridors with a higher transit potential, identification of high-activty areas and corridors will assist in the determination and segmentation of high-opportunity corridors throughout the Broward region.

Figure 8: Land Use Activity Analysis
(Person Trips Generated on Typical PM Peak)

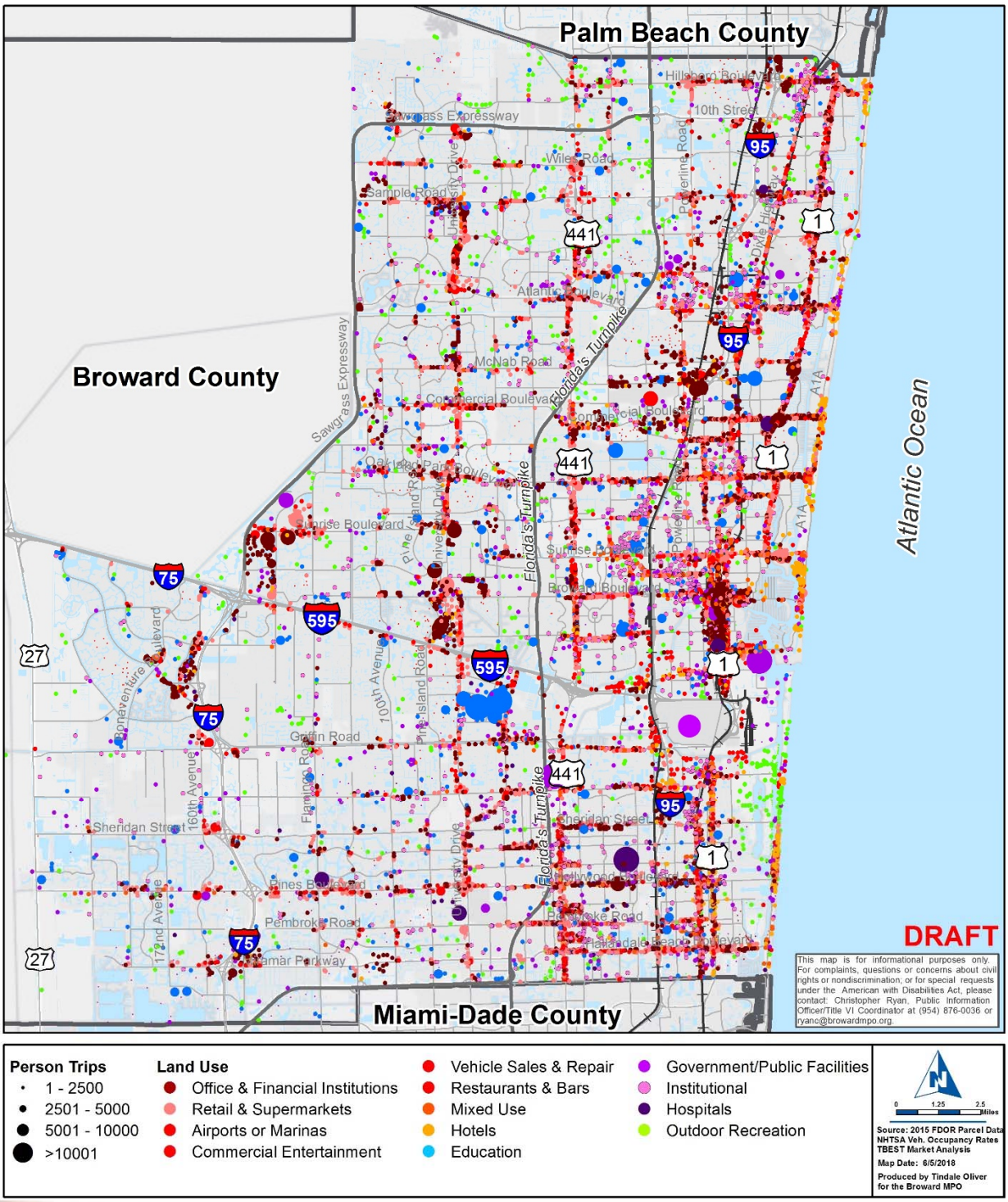
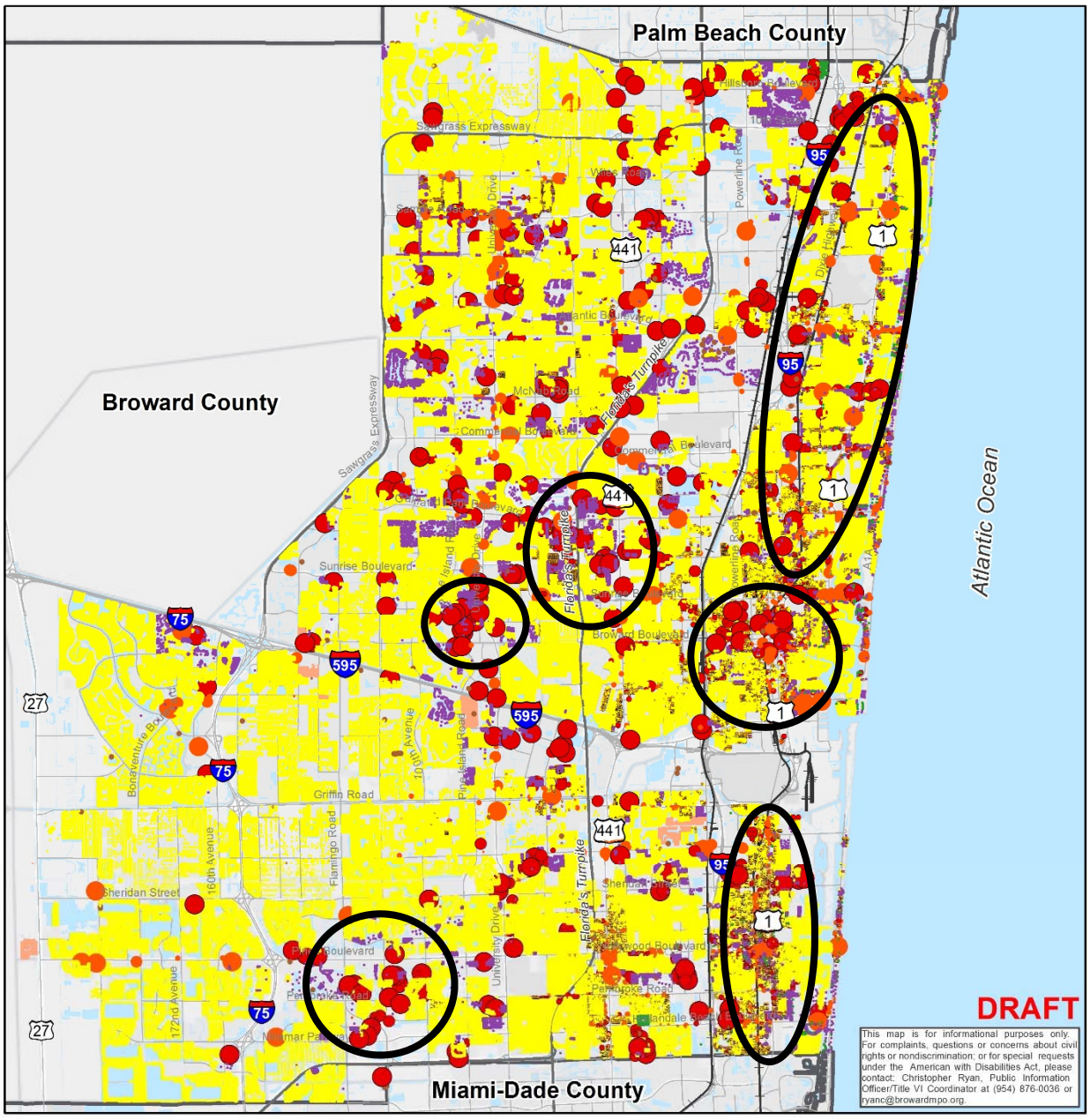


Figure 9: Residential Land Use Activity Analysis
(Person Trips Generated on Typical Weekday)



Transit Market Segmentation

Overview

Transit Cooperative Research Program (TCRP) Report 36, "A Handbook: Using Market Segmentation to Increase Transit Ridership," provides a high-level framework for defining market segmentation and applying transit market segmentation to the Broward MPO's 2045 MTP. The handbook offers the following definitions:

- *Market segments* – essentially, groups of people that are similar in terms of how they respond to a specific good or service, in this case, some type of transit service.
- *Market segmentation* – the identification of groups of customers—or market segments—that have similarities in characteristics or needs and are likely to exhibit similar purchase behavior or demand for services in response to changes in the types of transit services offered.

In most cases, market segmentation involves selecting certain groups from a population based on known characteristics and declaring them "segments." The characteristics are then selected by the analyst based on past research typically measured through surveys of both users and non-users of transit and how they have actually responded to services or how they perceive they would respond in response to a description of services (often referred to as stated preference).

In transit, some of the most common characteristics used to distinguish market segments include the following:

- Riders vs. non-riders
- Frequent riders vs. infrequent riders vs. occasional riders
- Former riders vs. current riders
- Loyal riders vs. vulnerable or non-loyal riders
- Transit dependent riders vs. choice riders
- Commuters vs. non-commuters
- Residents of high-density areas vs. suburban residents
- Commuters-to-downtown-CBDs vs. suburb-to-suburb commuters
- Student commuters vs. work commuters
- "High" vs. "mid" vs. "low" income groups

- Geographic location as defined by ZIP code, census tract, or TAZ

Rosenbloom (1998) identified key transit market groups that were more likely to use transit within various metropolitan environments, even when accounting for income—Blacks, Asians, Hispanics, and those more highly-educated. Other indicators such as income level, employment status, age, and country of origin also were identified as markets with potential to respond to various transit services. Table 2 lists transit markets that have been identified by various studies and transit plans as having a higher propensity or potential to use transit.

Table 2: Traditional and Potential Transit Markets in Broward Region

Transit Markets	% of Broward	Broward Total	% of Florida	Florida Total
Household and Population Characteristics				
Racial minority (non-white)	38.1%	710,214	24.1%	4,803,703
Ethnic minority (Hispanic or Latino)	27.6%	513,748	24.1%	4,806,854
Households with 2+ vehicles[1]	37.3%	251,354	38.0%	2,809,607
Limited English Proficiency (LEP) Households	9.2%	61,610	6.8%	505,136
Women	51.1%	980,255	51.4%	10,541,579
Population with a disability	11.2%	207,082	13.3%	2,615,568
People with less than HS education (age 18+)	12.3%	179,296	13.2%	2,091,112
Young adults enrolled in post-secondary education	7.7%	142,737	6.9%	1,383,794
Discretionary riders (based on DTA)[2]	N/A	N/A	N/A	N/A
Visitors	Data not available			

Transit Markets	% of Broward	Broward Total	% of Florida	Florida Total	Transit Markets
Traditional Transit Dependent Riders					
Low-income households (<$34,999k)[3]		33.0%	222,086	36.0%	2,661,574
Households below poverty level		13.5%	672,988	14.8%	7,393,262
Immigrants		32.7%	609,749	19.9%	3,967,671
Zero-vehicle households		*7.5%*	*505,475*	*6.9%*	511,316
Workers					
Low-income workers (under $24,999)[3]		21.6%	215,027	24.4%	2,368,080
Workers with middle incomes ($25,000–$64,999)		52.9%	526,616	53.4%	5,182,600
Workers with no household vehicles (age 16+)		3.0%	26,741	3.0%	257,916
Young Workers (age 17–29)		N/A	N/A	N/A	N/A
Workers with some high school education (age 25+)		5.7%	74,403	5.5%	768,504
Workers with college and graduate school education (age 25+)		21.9%	590,031	38.1%	5,364,187
Workers with mobility limitations (age 16+)		21.3%	41,612	18.3%	450,661
Workers age 60 and over		6.5%	120,918	6.0%	1,204,506
Age					
Millennials (age 20–34)[3]		19.6%	365,301	19.2%	3,827,415
Independent youth (age 10–17)[3]		9.9%	184,514	9.3%	1,853,904
Older adults (age 65+)		15.4%	287,022	19.1%	3,807,480

Italicized markets are markets chosen for transit segmenation market analysis.

[1]Potential transit market based express bus users from BCT On-Board Survey (2013).

[2]Discretionary riders are identified by areas with a high to very high dwelling unit and employment density threshold, not a population.

[3]Range based on categories available in the American Community Survey (ACS).

Source: 2016 ACS 5-Year Estimates

From this list of transit markets, a selection was chosen for the transit market segmentation analysis based on data availability from various sources including the American Community Survey (ACS), the Transportation Planning Equity Analysis, the Regional Transportation Plan, and prior transit surveys. In some cases, several transit markets could be captured by one analysis. For example, the Broward MPO's Transportation Planning Equity Measure/Tool captures racial minority, ethnic minority, youth, older adult, population below the poverty level, etc. Discretionary riders are discussed and analyzed in more detail later in this report.

Transit Market Segmentation Analysis

The identification and analysis of transit markets includes an evaluation from five different perspectives:

- Traditional transit market demographics
- Workers (commuter origin index)
- Discretionary market (dwelling unit and employment density)
- Student populations
- Prior transit rider survey responses

The identification of these markets can be used to determine if existing transit routes are serving areas of the county considered to be transit-supportive for the corresponding transit market. The transit markets and their corresponding market assessment tools are described below.

Traditional Transit Market Demographics

A traditional transit market refers to population segments that historically have had a higher propensity to use transit and are dependent on public transit for their transportation needs. For some individuals, their ability to drive is greatly diminished with age, so they must rely on others for their transportation needs. Likewise, younger persons not yet of driving age but who need to travel for school, employment, or leisure may rely more on public transportation until they reach driving age. For lower-income households, transportation costs are particularly burdensome, as a greater proportion of income is used for transportation-related expenses than it is for higher-income households. Households with restricted income, particularly those with no private vehicle, are more likely to rely on public transportation for travel. Traditional transit users

also can include minority groups, populations with a limited English proficiency, and persons with a disability.

Two unique markets were identified to locate geographic areas with a higher traditional transit rider demand:

- Populations scoring “high” and “very high” using the Broward MPO’s Transportation Planning Equity Measure/Tool
- Households with limited vehicle access

Transportation Planning Equity Measure/Tool

The Broward MPO developed a Transportation Planning Equity Measure/Tool to support equity analysis in transportation planning and resource allocation. This tool also is effective in identifying demographics consistent with the traditional transit market.

The core set of indicators used to determine areas with a high composite Equity score are listed in Table 5 and include:

- Racial minority (non-White population)
- Ethnic minority (Hispanic population)
- Youth
- Older adults
- Population below poverty level
- Limited English proficiency population
- Population with a disability

Data for each indicator were obtained from the 2016 ACS 5-Year Estimates. A countywide average threshold by indicator was determined for each block group. Four levels of categories were assigned to rank block groups based on the standard deviation of the indicator’s dataset: Low, Medium, High, and Very High. A discrete numerical score was then assigned to each of the four indicator categories assigned to the dataset. These scores serve two purposes: to provide a uniform ranking for all block groups and to numerically differentiate among the four categories for each indicator. The scores for each indicator were summed to calculate a composite equity score for each block group.

Table 5: Core Indicators

Core Indicators	Core Indicator Protected Class	Broward Region Average Threshold**
Racial minority	Race and Minority	31.0%
Ethnic minority	Minority and National Origin	25.7%
Independent youth* (age 10–17)	Age	9.0%
Older adults (age 65 and older)	Age	17.0%
Population below poverty level	Low-Income	14.8%
Limited English Proficiency (LEP) population	Minority and National Origin	15.0%
Population with a disability	Disability	8.9%

*Span of years above based on age categories available in ACS

**Thresholds calculated by averaging block group estimates. Averages may differ from estimates calculated at county level in Table 2.

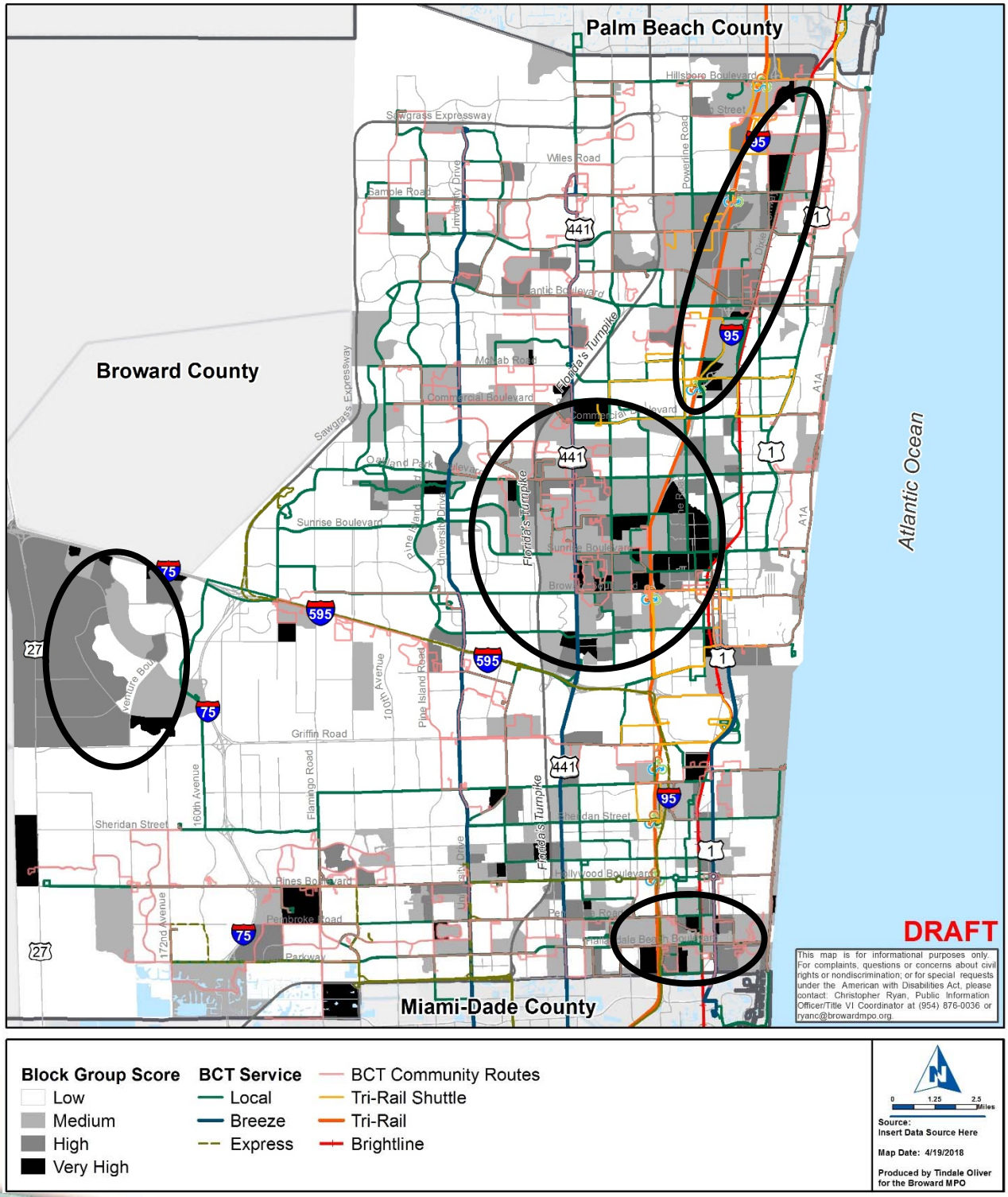
Source: 2016 ACS 5-Year Estimates

Figure 10 illustrates the areas with medium, high, and very high composite scores, reflecting areas throughout the county with varying traditional market potential. Based on the analysis, the following areas had a large concentration of high to very high block group scores:

- Oakland Park – high percent of minority and low-income populations
- Hallandale Beach – high percent of older adult, LEP, and low-income populations
- Pompano Beach near I-95 corridor – high percent of low-income, LEP, and minority populations
- Weston (western half) – high percent of youth and LEP populations

As transit market segments are evaluated, it will be important to distinguish outliers that suggest the existence of transit supportive markets that in reality may not have the absolute population and density to support premium transit investments. For example, while Weston has a high percent of youth and LEP populations, the higher incomes in the area are not likely to result in a strong transit supportive market in the near term. Alternatively, the markets in areas like this will undoubtedly grow in their support of transit during the planning horizon of the MTP. There will be other examples like this as the transit markets are evaluated in cooperation with MPO and its transit agency partners.

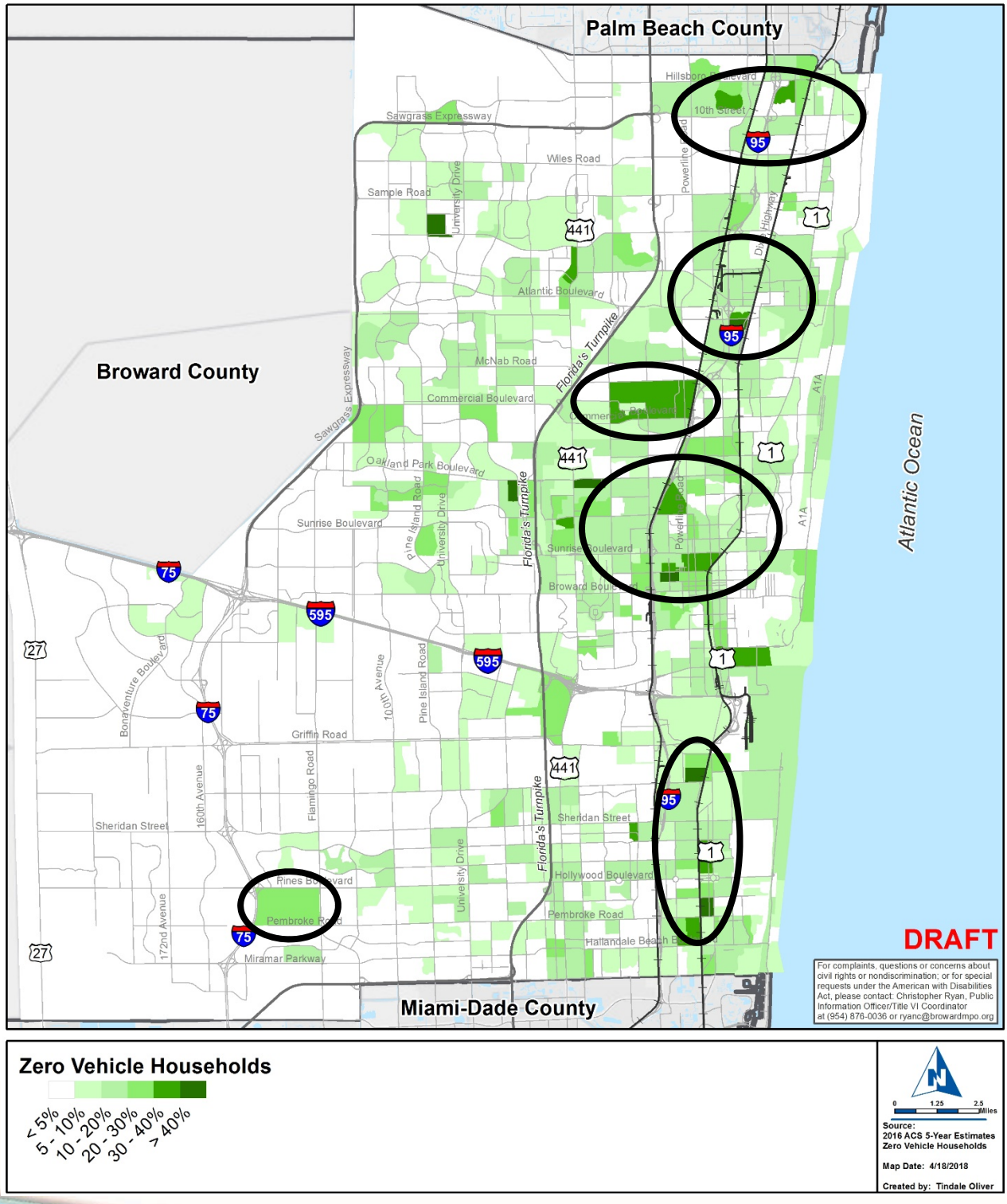
Figure 10: Transportation Planning Equity Areas in Broward Region (2016)



Vehicle Access

Households with limited vehicle access are defined as zero-vehicle households. Zero-vehicle households were not included as a core indicator in the composite score of the Transportation Planning Equity Analysis, but are a key demographic in the traditional transit market. Figure 11 illustrates the percent of zero-vehicle households by block group using 2016 ACS 5-Year Estimates. The block groups with the highest concentration of zero-vehicle households are generally on the eastern side of the Broward region near the I-95 corridor, with the exception of the area in Pembroke Pines east of I-75 where a large retirement community exists.

Figure 11: Zero Vehicle Households in Broward Region (2016)



Discretionary Transit Riders

The discretionary market refers to potential riders living in higher-density areas of the county that may choose to use transit as a commuting or transportation alternative. The Discretionary Threshold Assessment (DTA) uses industry standard relationships to identify the areas within the Broward region that experience transit-supportive residential and employee density levels today as well as in the future. Broward County 2010–2045 Population/Dwelling Unit and the 2015 Base Year Employment data were developed as part of the 2045 MTP.

Three density thresholds were developed to indicate if an area contains sufficient density to sustain some level of fixed-route transit operations:

- **Minimum Investment** – reflects minimum dwelling unit or employment densities to consider basic fixed-route transit services (i.e., local fixed-route bus service).
- **High Investment** – reflects increased dwelling unit or employment densities that may be able to support higher levels of transit investment (i.e., increased frequencies, express bus) than areas meeting only the minimum density threshold.
- **Very High Investment** – reflects very high dwelling unit or employment densities that may be able to support higher levels of transit investment (i.e., premium transit services, etc.) than areas meeting the minimum or high density thresholds.

A limit to using density is that it does not completely account for urban form such as roadway connectivity, but it does provide context for the critical mass needed to potentially support transit investments.

Table 6 presents the dwelling unit and employment density thresholds (in terms of TAZ) associated with each threshold of transit investment.

Table 6: Transit Service Density Thresholds

Level of Transit Investment	Dwelling Unit Density Threshold[1]	Employment Density Threshold[2]
Minimum Investment	4.5–5 dwelling units/acre	4 employees/acre
High Investment	6–7 dwelling units/acre	5–6 employees/acre
Very High Investment	≥8 dwelling units/acre	≥7 employees/acre

[1] TRB, National Research Council, TCRP Report 16, Volume 1 (1996), "Transit and Land Use Form," November 2002, MTC Resolution 3434 TOD Policy for Regional Transit Expansion Projects.
[2] Based on review of research on relationship between transit technology and employment densities.

Tables 7 and 8 list the minimum density thresholds needed to enhance service by transit mode type. These thresholds will be used to assess appropriate transit modes for high opportunity corridors in Technical Report #8: High Opportunity Corridors.

Table 7: Minimum Dwelling Unit Density Thresholds to Enhance Service

Mode	Dwelling Unit Density Thresholds[1] (dwelling units/acre)
Bus	3–5
Commuter Rail[2]	5–7
Bus Rapid Transit	6–7
Light Rail	8–10
Heavy Rail	11+

[1] TRB, National Research Council, TCRP Report 16, Volume 1 (1996), "Transit and Land Use Form," November 2002; MTC Resolution 3434, TOD Policy for Regional Transit Expansion Projects.
[2] Additionally, commuter rail service must connect with one or more large employment centers.

Table 8: Minimum Employment Density Thresholds to Enhance Service

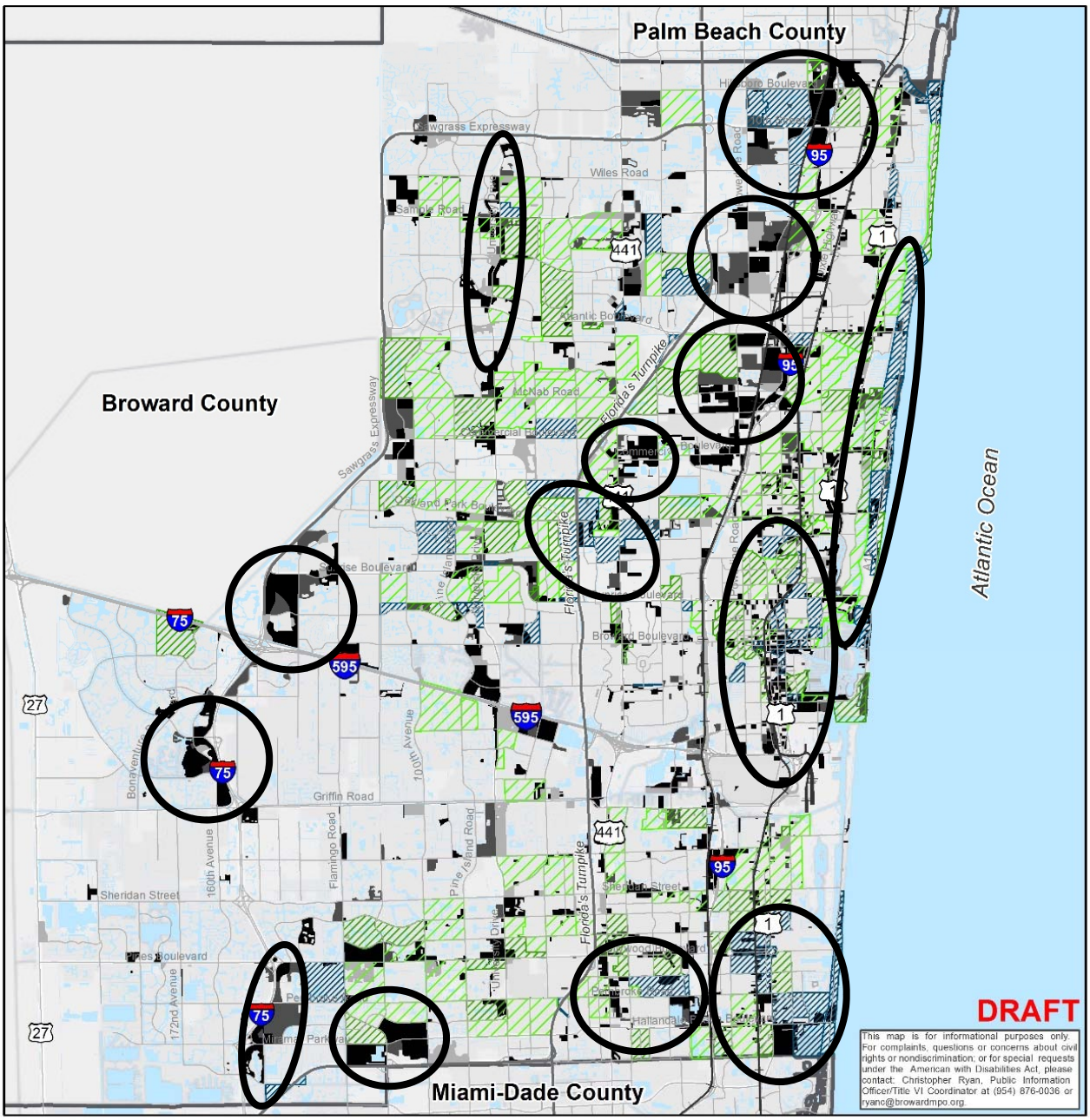
Mode	Employment Density Thresholds[1] (employees/acre)
Bus (Minimum to Enhance Service)	4
Commuter Rail[2]	4–5
Bus Rapid Transit	5–6
Light Rail	7–9
Heavy Rail	10+

[1] Thresholds were established for the Broward region based on review of recent research on the relationship between transit technology and employment densities.
[2] Commuter rail service must connect with one or more large employment centers.

Figure 12 illustrates the results of the 2015 DTA analyses conducted for the Broward region, identifying areas that support different levels of transit investment based on existing and projected dwelling unit and employment densities. The analysis indicates that the employment-based discretionary transit market is dispersed throughout the Broward region. Corridors such as US-441, US-1, Pines Boulevard/Hollywood Boulevard, University Drive, and Dixie Highway consistently have high to very high employment transit investment areas throughout their corridors. The more-dispersed clusters of high and very high transit investment areas can be observed near major highways and corridors such as I-75 in Weston, Sawgrass Expressway in Sunrise, I-595 near University Drive, Powerline Road, and US-1 in Fort Lauderdale.

Dwelling unit-based discretionary areas with high to very high transit investment opportunities are generally dispersed on the eastern and northern halves of the region, especially along the beaches, Lauderhill, Lauderdale Lakes, Deerfield Beach east of I-95, the areas surrounding Downtown Fort Lauderdale, and Hallandale Beach and Hollywood near US-1.

Figure 12: Density Threshold Assessment (2015)



Commuter Index

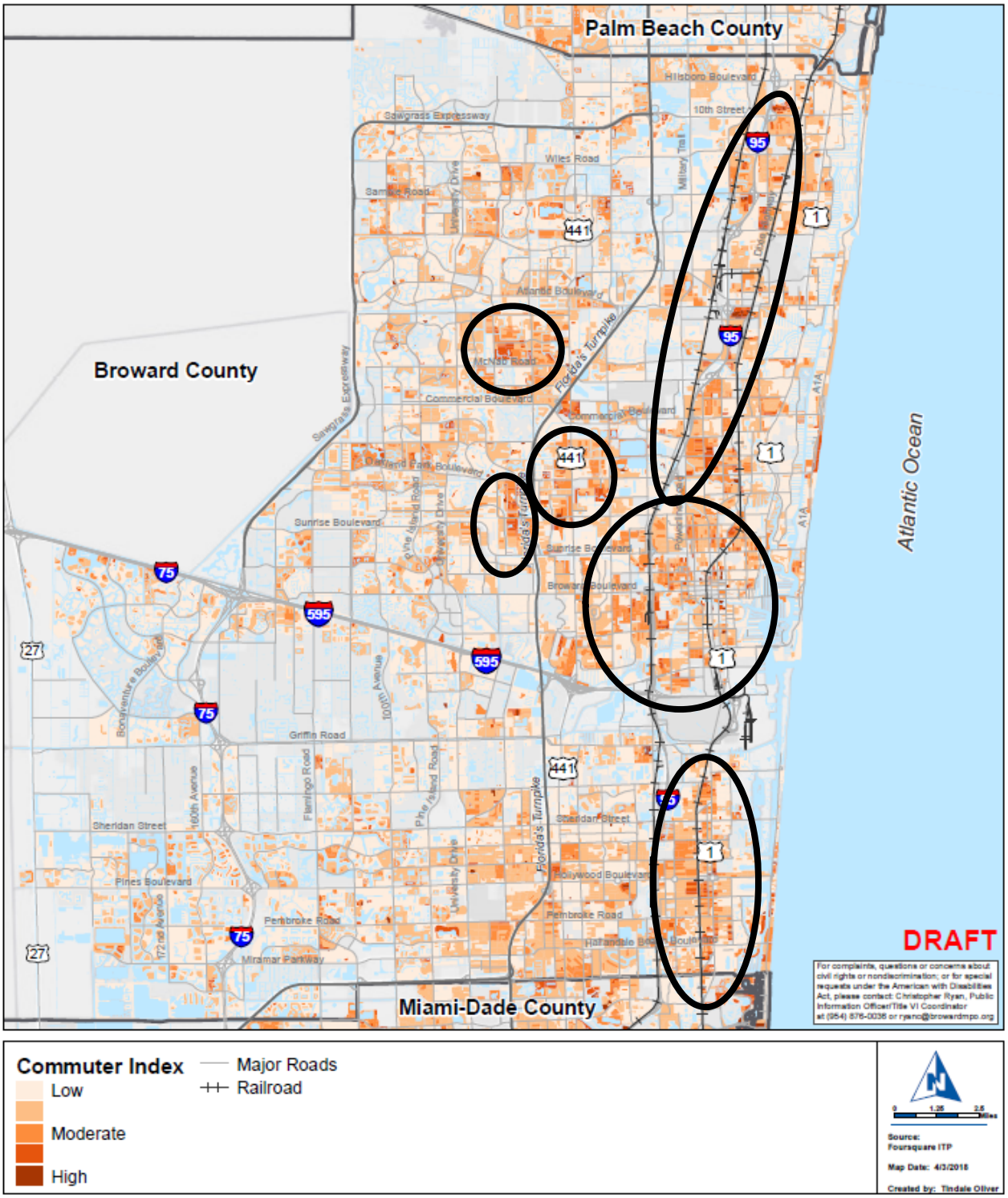
The Commuter Index is intended to capture all types of workers. Developed by Foursquare ITP for the 2045 Regional Transportation Plan, it is used to identify where persons with jobs reside, with an emphasis on non-single-occupancy vehicle (SOV) commuters. High concentrations of workers can warrant the consideration of specialized transit services. Table 8 lists the measures combined to create the Commuter Index developed for the 2045 Regional Transportation Plan. The index considered the Labor Force and Commute modes. The Labor Force category identifies where persons eligible for work or those who are currently employed live; the Commute category incorporates where commuters reside and isolates the number of non-SOV transit specific commuters using 2016 ACS Five-Year Estimates. Table 8 lists the measures used to develop the labor force and commute mode categories.

Table 8: Commuter Index Measures

Mode Category	Measurement
Labor Force	Labor force size
	Labor force density
	Employed persons
	Employed persons density
	Percent employed
Commute	Total commuters
	Commuter density
	Total non-SOV commuters
	Percent non-SOV commuters
	Non-SOV commuter density

Figure 13 illustrates the locations with a low to high commuter origin index. Low-density census block groups were screened out. The high index areas can be observed mostly in the eastern half of the Broward region, especially between the US-1 and I-95 corridors. Notable clusters can be observed in North Lauderdale, central Lauderhill, and Lauderdale Lakes.

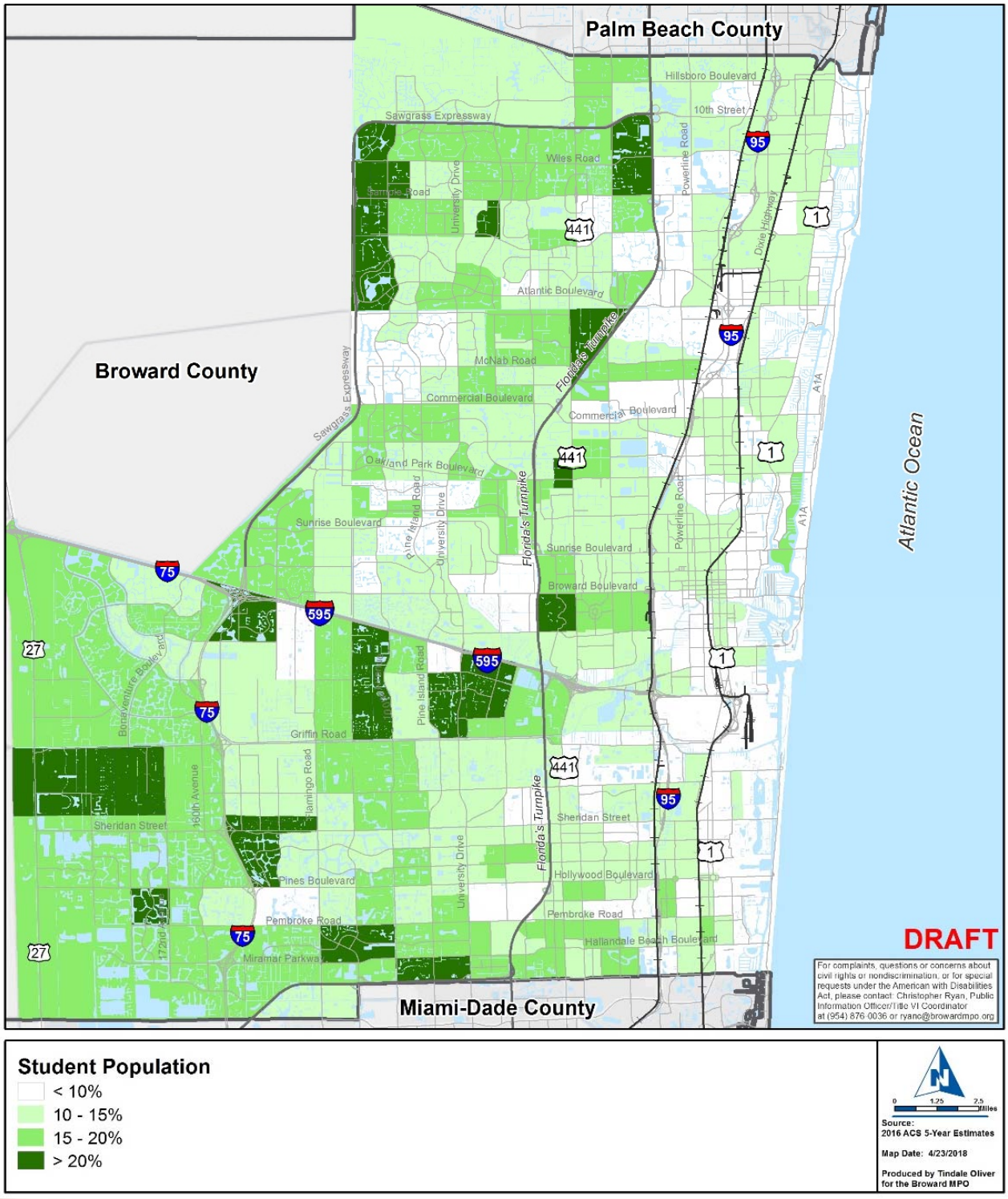
Figure 13: Commuter Index



Student Population

High school, college, and graduate students are transit markets identified by Rosenbloom (1998) as current market groups. Figure 14 illustrates the percent of population enrolled in high school, college, or graduate school using 2016 ACS 5-Year Estimates at the census tract level. Higher student populations are generally found west of Florida's Turnpike. The majority of students living in census tracts with the highest concentration of students (greater than 20%) are enrolled in undergraduate school. The undergraduate population is especially prominent in Coral Springs, Coconut Creek, North Lauderdale, Southwest Ranches, the area just east of I-75 in Pembroke Pines, central Miramar, and the Nova Southeastern University area. Areas with 15–20 percent of the total population enrolled in a school are in enrolled mostly in high school.

Figure 14: Student Population

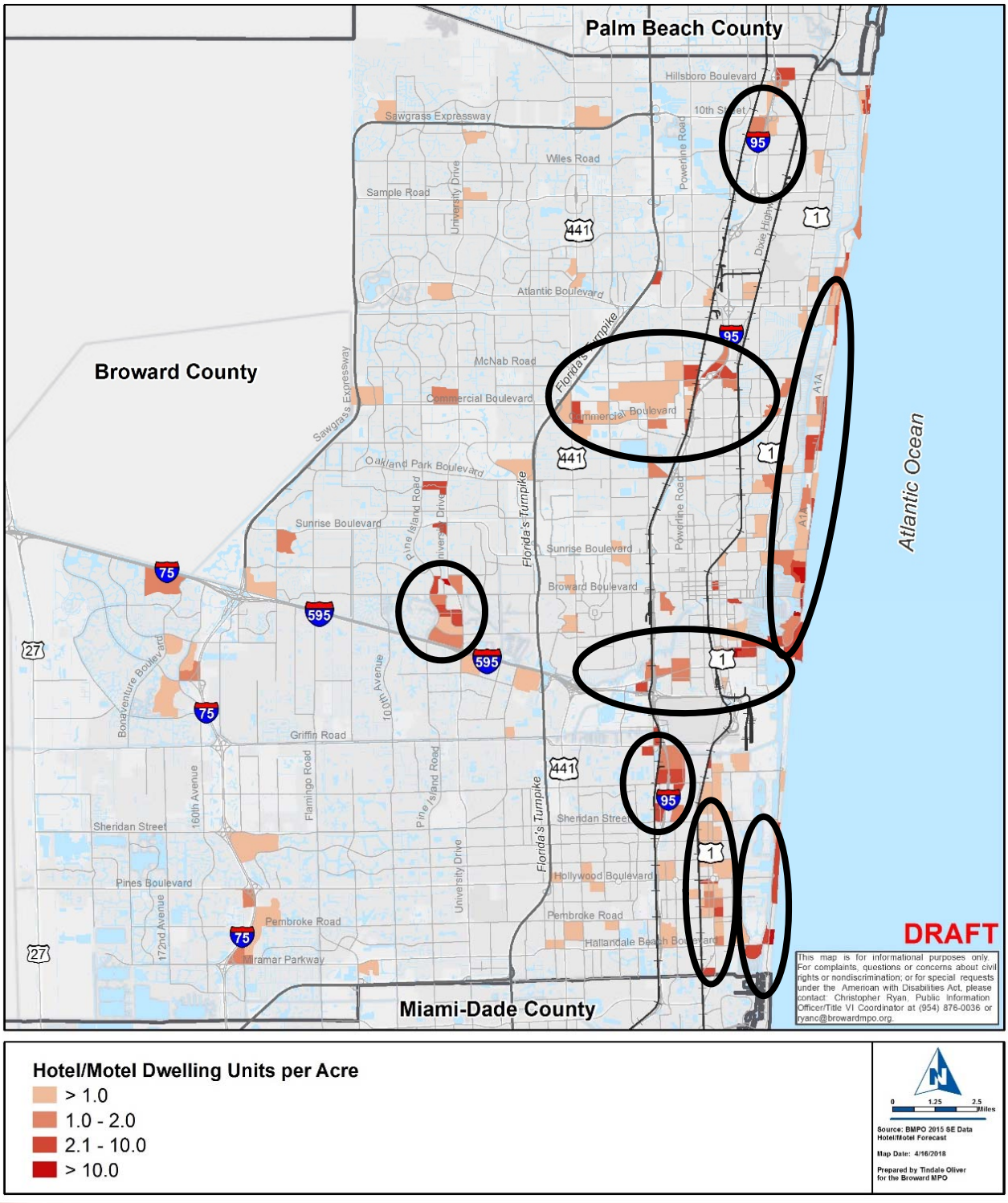


Tourists and Visitors

The Broward region has a high presence of both long- and short-term visitors. Many tourists and visitors may choose to stay in traditional accommodations such as hotels and motels, although non-traditional accommodations such as those booked through services like AirBnB are growing in popularity. Although no comprehensive dataset exists for non-traditional accommodations, they are somewhat captured in the general residential dwelling unit inventory. The extent of this, however, is not known.

Figure 15 illustrates the micro-analysis zones (MAZ) with a high density of hotel and motel dwelling units using 2015 socioeconomic data developed for the MPO's 2045 MTP. The highest concentration of hotel/motel dwelling units can be observed along A1A and intermittently along major corridors such as I-75, I-595, I-95, US-1, northwest Fort Lauderdale, south Plantation between Pine Island Road and University Drive, and Downtown Hollywood.

Figure 15: Hotels and Motel Dwelling Units



Prior Rider Surveys

The purpose of the transit rider survey review is to support the transit market segmentation analysis by understanding how different transit markets in the Broward region use different modes of transit. These surveys include:

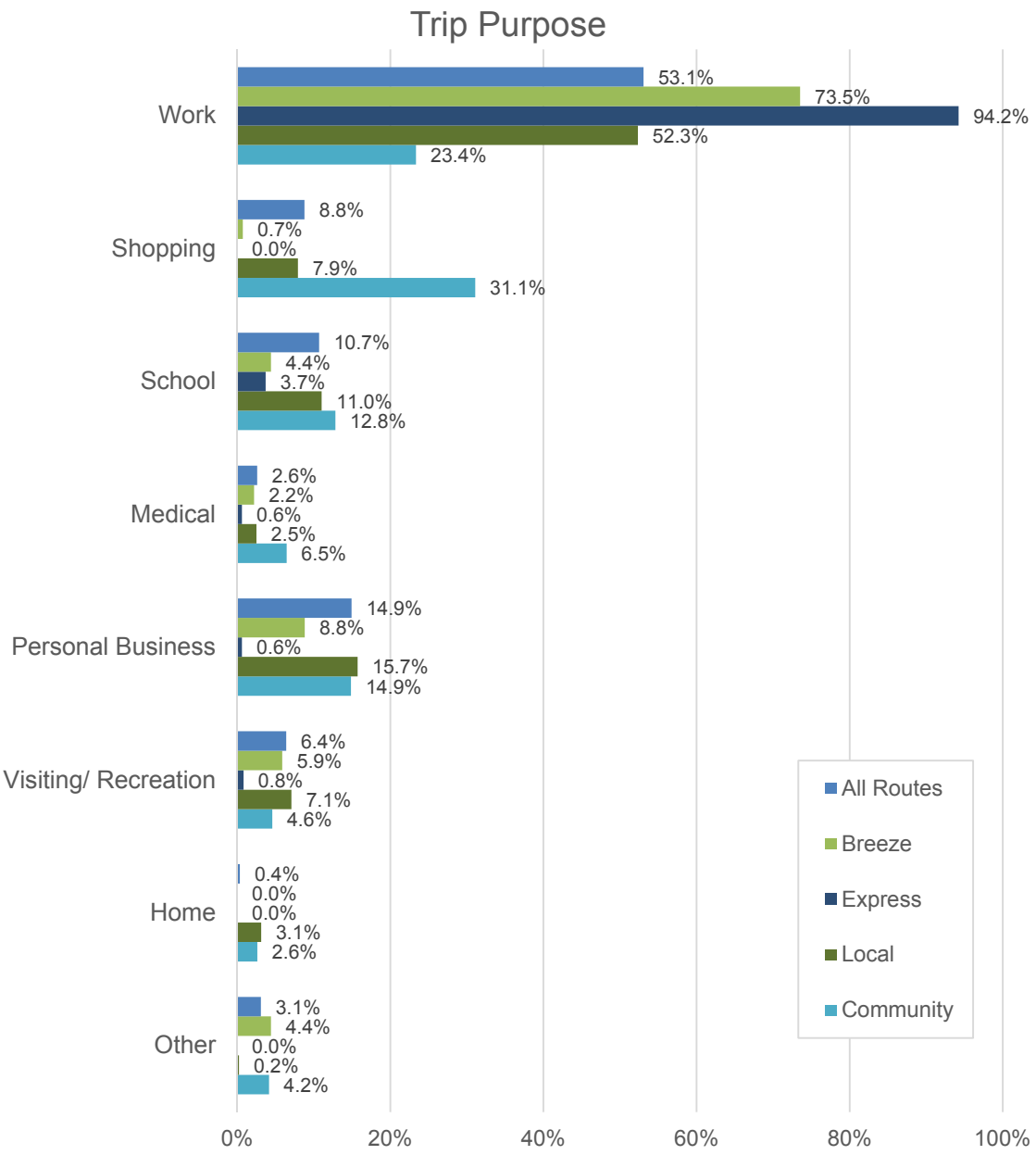
- Broward County On-Board Survey (2013) – updated on-board survey will be available in Summer 2018
- Tri-Rail On-Board Survey (2013) – updated platform survey will be available in Summer 2018

Broward County Transit (BCT) On-Board Survey (2013)

The BCT Connected on-board survey was conducted between February 26 and March 10, 2013. During this timeframe, a survey plan was designed to gather a 10 percent sample. Following completion of this effort, it was determined that additional surveying would be conducted on the Community Bus system. This additional surveying took place between May 2 and 18, 2013. For the two surveying timeframes, a total of 8,913 completed surveys were completed.

The majority of respondents riding the Breeze, Express, and local routes reported work as their primary trip purpose. Express routes had the highest number of work trips, with 94.2 percent of riders reporting work as their primary trip purpose, followed by school at 3.7 percent. School trips were observed mostly on local and community buses. Recreation trips were spread between Breeze and local and community buses by proportion of riders on each service type. Community buses served mostly shopping trips, accounting for 31.1 percent of trips. Figure 15 summarizes the results of the trips on each transit service by trip purpose.

Figure 15: Trip Purpose (BCT On-Board)



Source: BCT Connected Transit Development Plan 2013 Major Update

Student populations were identified as an important transit market. Only 5.5 percent of fare payments on all routes were made with a 31-day college pass. The majority of riders who use a college pass (96.7%) used local bus for all routes and local service, indicating that local routes are an important service for college students.

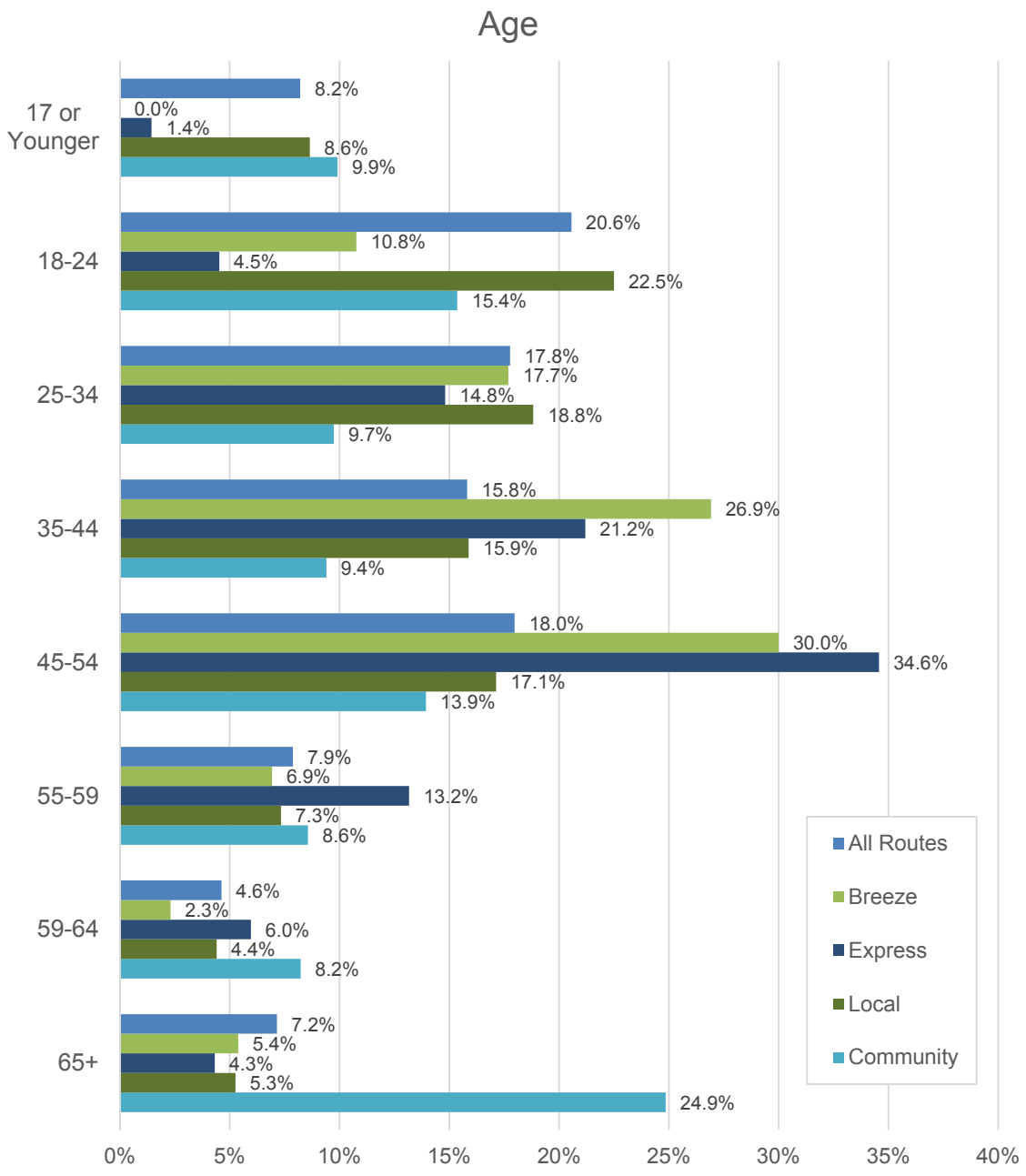
The majority of Community bus riders indicated they are a low-income household, with a household income under $29,000. Approximately 30 percent of all respondents live in households with annual incomes less than $10,000, and 61 percent of Express service riders live in households with annual incomes of $60,000 or greater, indicating that, in general, low-income households are an important transit market in local and community bus service, whereas higher-income riders are the majority of Express riders.

The majority of riders (42%) for all services except Express indicated having no vehicles available in their household, demonstrating that community, local, and Breeze services capture primarily a transit-dependent market.

A total of 75 percent of Express riders would drive if there was no bus service and were more likely to have an automobile available to them, suggesting that they are choice riders who have access to a vehicle. In fact, the majority of Express riders had two or more vehicles available in their household (the reason that population characteristic was used previously as a potential transit market in the Broward region).

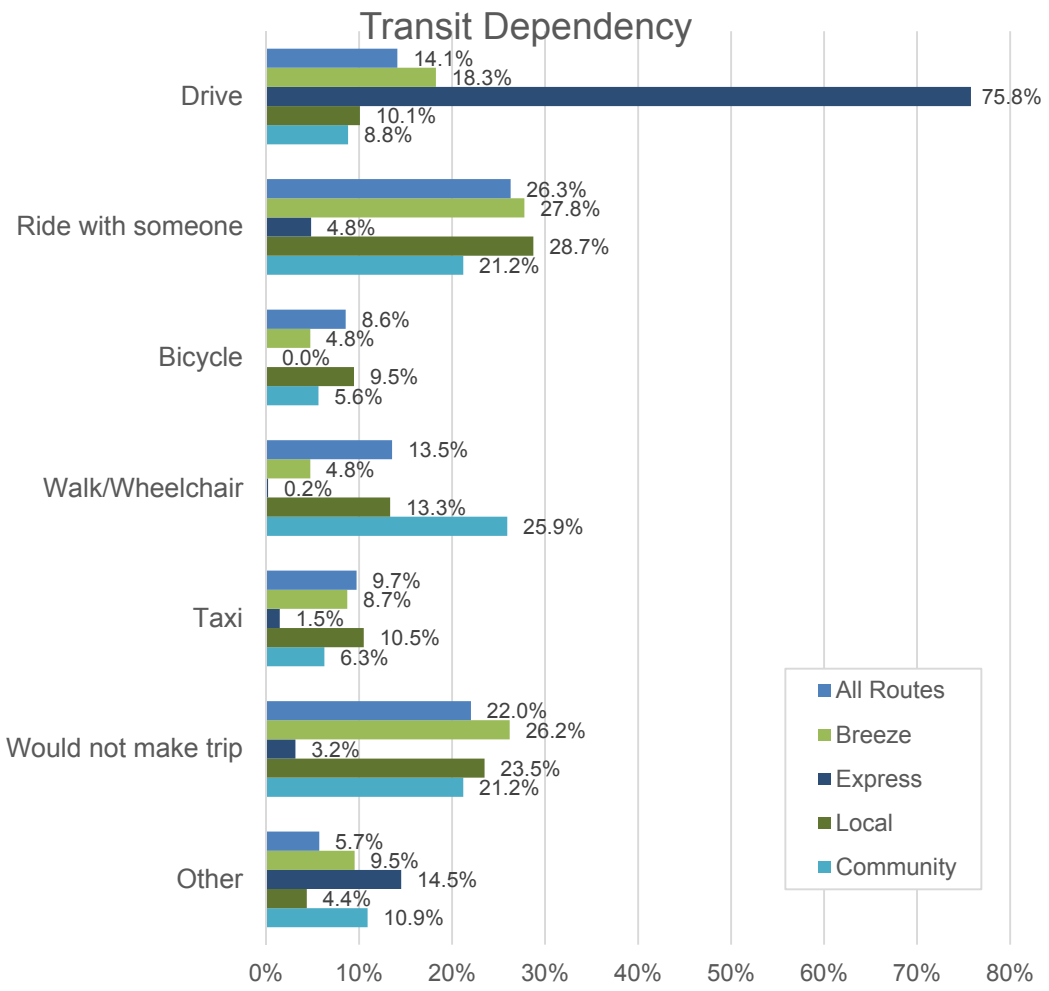
As for the breakdown of passengers by age, Breeze and Express riders were more likely to be age 45–54. Older adults (age 65+) represented the largest age group of community bus riders.

Figure 16: Age Demographics (2013 BCT On-Board)



Source: BCT Connected Transit Development Plan 2013 Major Update

Figure 17: Transit Dependency (2013 BCT On-Board)



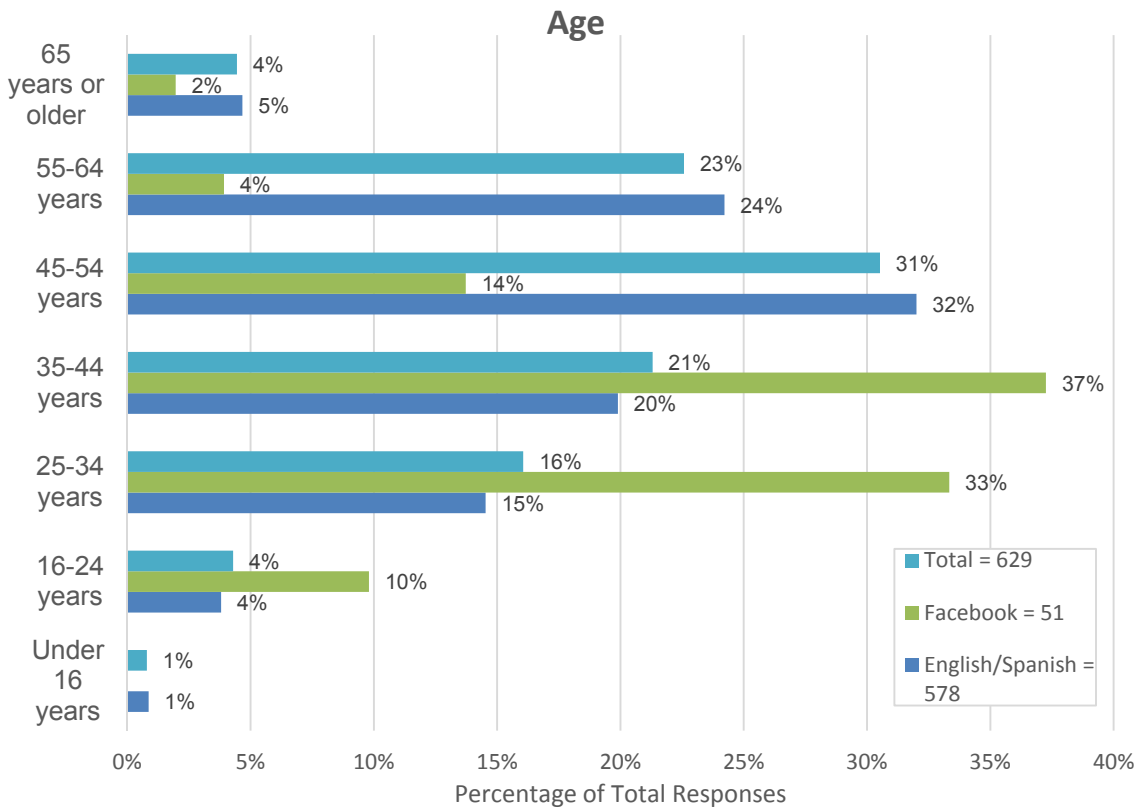
Source: BCT Connected Transit Development Plan 2013 Major Update

Tri-Rail On-Board Survey (2013)

Intercept surveys or platform interviews were conducted in 2013 at six Tri-Rail stations for the South Florida Regional Transportation Authority (SFRTA) FY 2014–2023 Transit Development Plan Major Update over the course of three days—Tuesday and Thursday, March 19 and 21, and Saturday, April 6. These platform interviews were conducted to obtain feedback from Tri-Rail riders to determine their main reasons to ride Tri-Rail and their most desired improvements or initiatives for SFRTA/Tri-Rail in the next 10 years. In total, 898 intercept surveys were completed from interviews with riders at 9 stations over the 3-day survey period.

Due to survey brevity, few questions asked for rider demographics (e.g., age or household income); therefore, limited insight is available on the different transit markets using the service. Also, questions on income or availability of vehicles in the household were not included in the survey. Figure 18 summarizes the age groups of Tri-Rail riders. The majority were age 25–54, indicating that the service is important for adults of prime working age. Only 4 percent of riders were young adults age 16–24, and 1 percent were under age 16. Although youth and older adults represent a minority of Tri-Rail riders, the service still provides an important connection for the persons in those age groups.

Figure 18: Age of All Respondents (2013 SFRTA Intercept Survey)



Source: SFRTA FY 2014-2023 Transit Development Plan Major Update

Potential Transit Service Improvements

This section identifies three categories of transit modes that will be considered and evaluated for the purpose of the MTP—bus, rail, and other. Because various bus and rail services require different levels of investment and provide different levels of service, they are presented as a hiearchy of transit modes. The following discusses the characteristics these transit modes.

Bus

- *Community bus* is typically a smaller shuttle-like vehicle that circulates a small area such as a neighborhood. Service in the Broward region is operated by BCT.
- *Local bus* is the primary service currently operated by BCT. Local bus operates with traditional bus stops, makes very frequent stops, and travels at lower speeds. It operates in regular traffic, but it can have high or low frequencies.
- *Express bus* travels in regular traffic, and trips typically are concentrated during peak commute periods. Stops are concentrated at the ends of the route, with few or none in the middle. Enhanced express bus often operates out of park-and-ride lots and provides passengers with longer-distance rides along the I-95 express lanes. The vehicles may offer amenities such as WiFi, television, or radio. BCT and Miami-Dade Transit (MDT) currently operate several express routes. Both transit agencies provide some limited reverse commute options on the express bus routes rather than operating out of revenue service on some of the return trips.
- *Bus Rapid Transit* (BRT) operates in mixed traffic or an exclusive lane. The vehicles are typically stylized to look more like a rail car than a bus, can be articulated, and are usually branded. BRT usually operates at higher frequencies and can use Traffic Signal Priority to reduce travel time. Optional premium features include level-boarding, off-board fare payment, and larger stations.

Rail

- *Streetcar* is typically a single car operated on rails traveling at lower speeds. It is used for shorter distances of travel than light rail and works well with tourist populations. It is specially branded, has medium frequencies, and is usually semi-segregated from traffic. Stops can have minimal or more substantial infrastructure.

- *Light rail* is not currently available in South Florida. Although streetcar is a form of light rail, they tend to serve different markets. Light rail can be one or two cars in length, operates on rail, and is segregated from traffic. It operates at medium speeds and medium frequencies and makes frequent stops. Light rail is specifically branded and has significant stations. Light rail may operate like a streetcar in some sections of an urban area.
- *Heavy rail* is similar to light rail, but with a higher passenger capacity. Heavy rail operates at higher speeds than light rail and runs in separate a right-of-way from vehicular traffic. MDT operates a heavy rail service known as MetroRail.
- *Commuter rail* provides an option for long-distance travel. Stations are substantial and fairly far apart, and multiple train cars operate on rail and are segregated from traffic at high speed and lower frequency. Tri-Rail is the only available commuter rail service operating in South Florida.
- *High speed rail* is a premium transit service for long distance travel. It is segregated from traffic at high speed and has a low frequency. Brightline, a privately-operated high speed service, currently services downtown West Palm Beach to downtown Fort Lauderdale with connection to Downtown Miami.

Other

- *Autonomous transit* is a technology still under development that could be implemented with on-demand features for ride requests. The service can be implemented in controlled low-speed environments such as university campuses until the technology is developed enough to be implemented in high-speed and high volume roadways.
- *Shared ride* is similar to a paratransit-type service, except ride requests, trip planning, and fare payment are automated through a smartphone application. The service can be operated by a public agency or subsidized via a public-private partnership such as partnerships with established ridesourcing companies such as Uber and Lyft.
- *People mover* is fully automated and powered by electricity that runs through a rail below the vehicle. The tracks are elevated above traffic and has a smaller capacity than light rail. Stops and headways are frequent.
- *Waterborne taxi* is used to shuttle passengers between destinations separated by water bodies such as lakes, canals, rivers, and intra-coastal waterways.

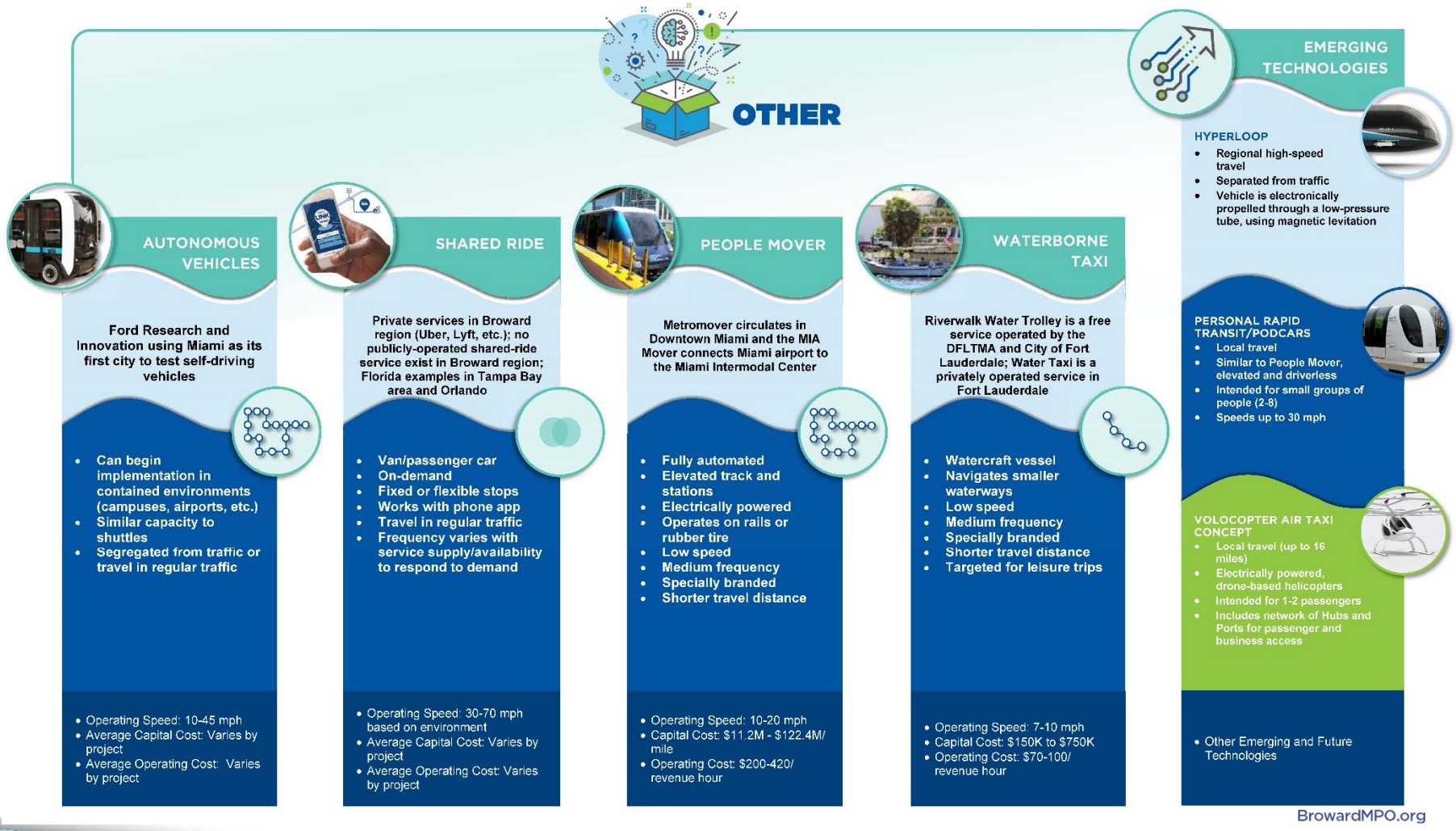
Service typically is at designated stops and is affected by adverse water and weather conditions

The following graphics summarize the transit services and technologies, including existing services in the region, service characteristics, and performance and cost metrics.

Figure 19: Description of Transit Service/Technologies for Buses

Figure 20: Description of Transit Service/Technologies for Rail

Figure 21: Description of Transit Service/Technologies for Other Services



Matching Transit Improvements to Market Segments

To better prioritize the new transit services, it is important to match the various transit modes and services that are sought by captive and potential transit markets. According to "Transit Markets of the Future: The Challenge of Change" (Rosenbloom 1998), different market niches tend to use different types of transit services. For example, women and minority groups are transit markets that use all service environments, and older workers over age 65 tend to use few service environments. Rosenbloom states that, "it is necessary to adopt specific service concepts that meet the needs of current or potential riders." For example, low-income persons and persons with limited vehicle access need services that provide more direct access to their work sites or personal needs to maintain ridership among these groups.

Adults over age 65 have been found to be very receptive to taxi and demand-response type services for non-work trips, but they are drawn to customized transit routes, community buses, and services with deviations (Rosenbloom 1998). Rosenbloom (1996) found that one surprising transit market that is disproportionately dependent on transit are those with a college degree and some graduate school training: "These travelers seem particularly well served by transit concepts which personalize efforts or provide a higher level of service, particularly providing direct service to their employers and offering various deviation and flex services." In addition, such riders may be more sensitive to time and speed, thereby being over-represented in express buses, light rail, and commuter rail. Their need to conduct mid-day shopping, eating, and personal errands can be attributed to their over-representation in downtown circulator and loop system services. Therefore, more convenient services that serve additional destinations through route deviation such as flex routes, autonomous vehicles, and ridesourcing modes have the potential to capture new transit market segments such as students and older adults.

The objective of this analysis is to identify transit services and modes that will best serve existing and potential riders. Based on results from the transit market segmentation analysis, available data from transit surveys, studies, and professional judgment, transit market segments were selected and matched to transit modes that might best capture these markets. Table 9 lists the current and potential transit market segments selected, and Tables 10, 11, and 12 match various transit

services/technologies to segments to which people may respond most positively today and in the future. Autonomous transit was not evaluated because not enough case studies or data are available to consider how different transit market segments respond to autonomous transit.

Table 9: Selected Transit Market Segments

Transit Market	Market Characteristics
Commuters	High Commuter Index
Discretionary Riders	Discretionary Transit Assessment (DTA) areas with a high to very high dwelling unit and/or employment threshold
Students	Enrolled in high school, college, university, or graduate school
Traditional Market	Populations with a high equity composite score
Visitors	Hotel and motel dwelling units
Older Adults	Age 65 and older

Table 10: Matching Bus Service Modes to Market Segments

Target Market Segment	Bus Service Type			
	Community Bus	Local Bus	Express Bus	BRT
Commuters				
Discretionary (High Density)				
Students				
Visitors				
Traditional Market (Equity)				
Older Adults				

Match Level:

Table 11: Matching Rail Modes to Market Segments

Target Market Segment	Rail Service Type				
	Streetcar	Light Rail	Heavy Rail	Commuter Rail	Higher Speed Rail
Commuters					
Discretionary (High Density)					
Students					
Visitors					
Traditional Market (Equity)					
Older Adults					

Match Level:

Table 12: Matching Other Transit Service Modes to Market Segments

Target Market Segment	Other Transit Service Type			
	Autonomous	Shared Ride	People Mover	Waterborne Taxi
Commuters	TBD			
Discretionary (High Density)	TBD			
Students	TBD			
Visitors	TBD			
Traditional Market (Equity)	TBD			
Older Adults	TBD			

Match Level:

Very High | High | Medium | Low

Transit Demand and Technology Gaps

Approach

This section reviews transit demand based on the prior review of transit market segments. Transit markets are evaluated against existing transit service to identify potential gaps in transit services. Appropriate transit modes will then be identified to best match the current and potential transit market in the gap areas. The project team performed the gap assessment by overlaying the existing transit service network on the trnaist market gaps idnetified from the transit market segmentation analysis. A visual inspection of the overlay resulted in the identification of gaps in geogrpahic service coverage.

As a part of the Transit Scenario Development and Analysis for the MTP, a concurrent analysis is being performed that identifies high-opportunity transit corridors. This analysis will match high-opportunity corridors to the transit mode technologies identified in this report based on corridor characteristics such as facility type, surrounding land use, population, employment, traditional riders, hotel and motel dwelling units, commuters, etc.

It is important to note that the focus of this analysis is largely on the definition of a premium transit vision network and not on community and local bus services. Although many existing and potential transit markets in the Broward region would benefit from improvements to community and local bus services, the detailed evaluation of these services will be undertaken by BCT as part of the Major Update of the Transit Development Plan in 2018 and a Comprehensive Operational Analysis (COA) anticipated in 2019. A COA is a comprehensive assessemnt of exisitng transit services and ultimately will result in productivity improvements and enhancements to help address transit accessiblity gaps and the first-mile/last-mile needs of the transit network.

Results

The current and potential transit markets include commuters, discretionary riders, students, traditional market, visitors, and older adults. These markets were spatially analyzed with current transit services to determine areas of transit demand and service

gaps. In this evaluation, the idnetification of service gaps focuses on geogrpahic coverage and not on the freuqency and space of existing services. The following gaps and potential transit service modes were identified:

- *Traditional riders* include minority groups, youth, older adults, persons below poverty, LEP, and persons with a disability. Existing traditional riders, as defined by the Transportation Planning Equity Measure, in the Broward region primarily use local and community bus services. Existing local bus and community bus services overall are adequate for areas with traditional riders, with a few exceptions. Potential gaps in community bus service (greater than 0.25 mile away from current community bus service) for traditional riders are identified in Figure 19. Note that only residential areas were highlighted in green; therefore, census block groups indicating a high to very high composite score may not be highlighted in their entirety.
- *Discretionary riders* in the Broward region currently use many transit modes including Express bus, local bus, and rail and have a high potential to use other modes such as ridesharing and autonomous vehicles. Discretionary riders were defined as areas with a high to very high DTA threshold. In general, there is adequate local bus service coverage in areas with a high concentration of discretionary riders. However, gaps in transit mode technologies for premium service exist, particularly for east-west travel within the region.

  Areas or corridors with a high to very high DTA threshold were compared to areas lacking Express bus service, BRT and rail service for the purpose of this analysis. Small and more-isolated areas meeting a high DTA threshold are identified as areas having potential to support express bus service, and are highlighted in red areas in Figures 23 and 24. Corridors with a consistently high DTA threshold for both dwelling units and employment were identified as corridors with potential to service more premium transit services such as BRT and rail and are highlighted in orange in Figures 23 and 24.

  Although areas meeting a high to very high DTA threshold are currently serviced by premium transit services such as Tri-Rail's commuter rail service and Brightline's passenger rail service in the north-south direction, many are not serviced adequately by premium services in the east-west direction on corridors such as Oakland Park Boulevard and Hollywood/Pines Boulevard. In addition, although Breeze services highlight corridors such as University Drive, US-441,

and US-1, these corridors have the potential to have higher levels of transit investments in BRT or rail.

- *Commuters* represent the majority of trip purposes for riders using local bus, especially limited-stop peak service such as the Breeze, community bus, and premium transit services such as Tri-Rail's commuter rail. Commuters were defined in areas having a moderate to high Commuter Index. The analysis for commuter gaps builds on the prior gaps identified in Figures 23 and 24, and are highlighted in yellow in Figure 25. If an area with a high commuter index was near a corridor or area identified as having the potential to service more premium modes of transit, then it was not highlighted. Gaps for commuters also were considered if there were insufficient east-west connections. Such is the case in areas near premium services such as Tri-Rail that have been highlighted.

  Because the areas identified as having a high commuter index are larger and more dispersed throughout the region, they may not have the ability to support premium transit services such as rail (highlighted in green); rather, these areas may be more suitable for increased local bus service or other modes. Such is the case for areas surrounding the western portion of Sample Road, McNab Road just east of US-441, and several dispersed areas along Oakland Park Boulevard, as illustrated in Figure 25.
- *Students* in the Broward region tend to use all transit services, especially local and community bus. This population has the potential to be attracted to other transit technology modes such as ridesharing, autonomous, and rail. Transit technology gaps and overall service gaps are especially prevalent in Coral Springs west of Coral Ridge Drive, central Coconut Creek, Miramar, and throughout Davie, including the Nova Southeastern University area.
- *Visitors* in the Broward region were identified as areas with a high concentration of hotel and motel dwelling units and coincide with areas that have a high to very high DTA threshold. Therefore, no additional transit service gaps were identified for this transit market

Figure 22: Potential Community Bus Service Gaps for Traditional Markets

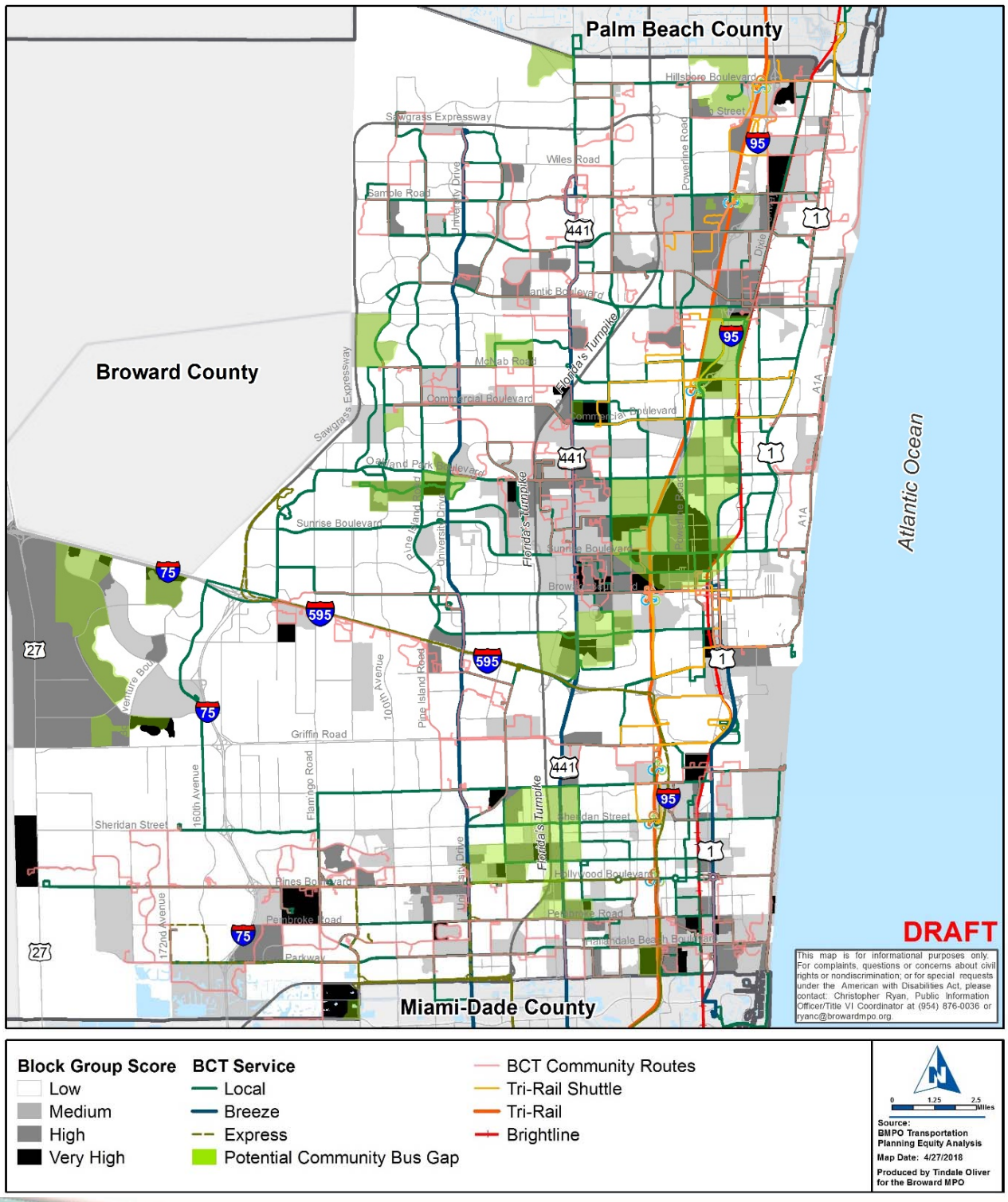


Figure 23: Transit Technology Gaps for Discretionary Market (Employment)

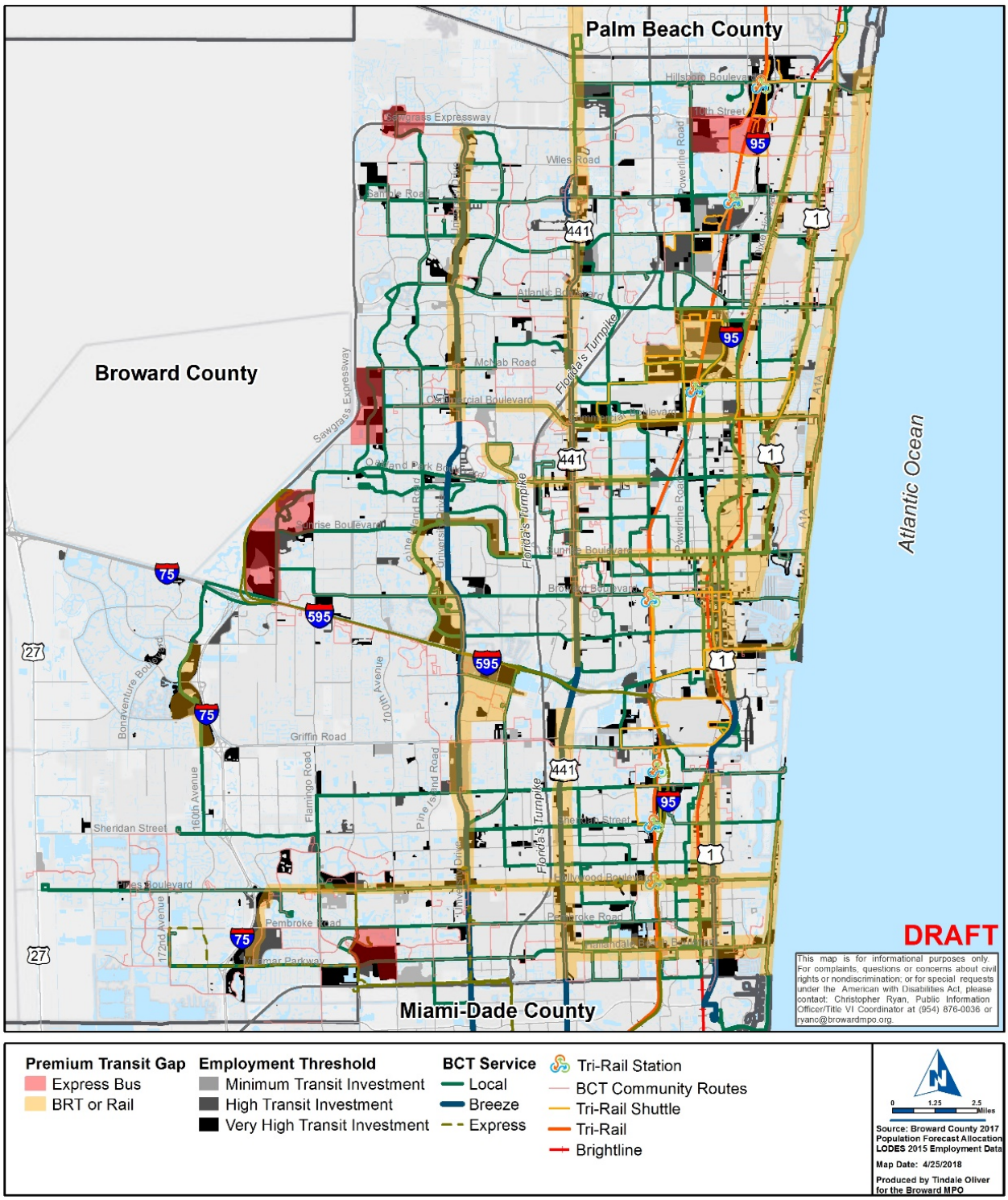


Figure 24: Transit Technology Gaps for Discretionary Market (Dwelling Units)

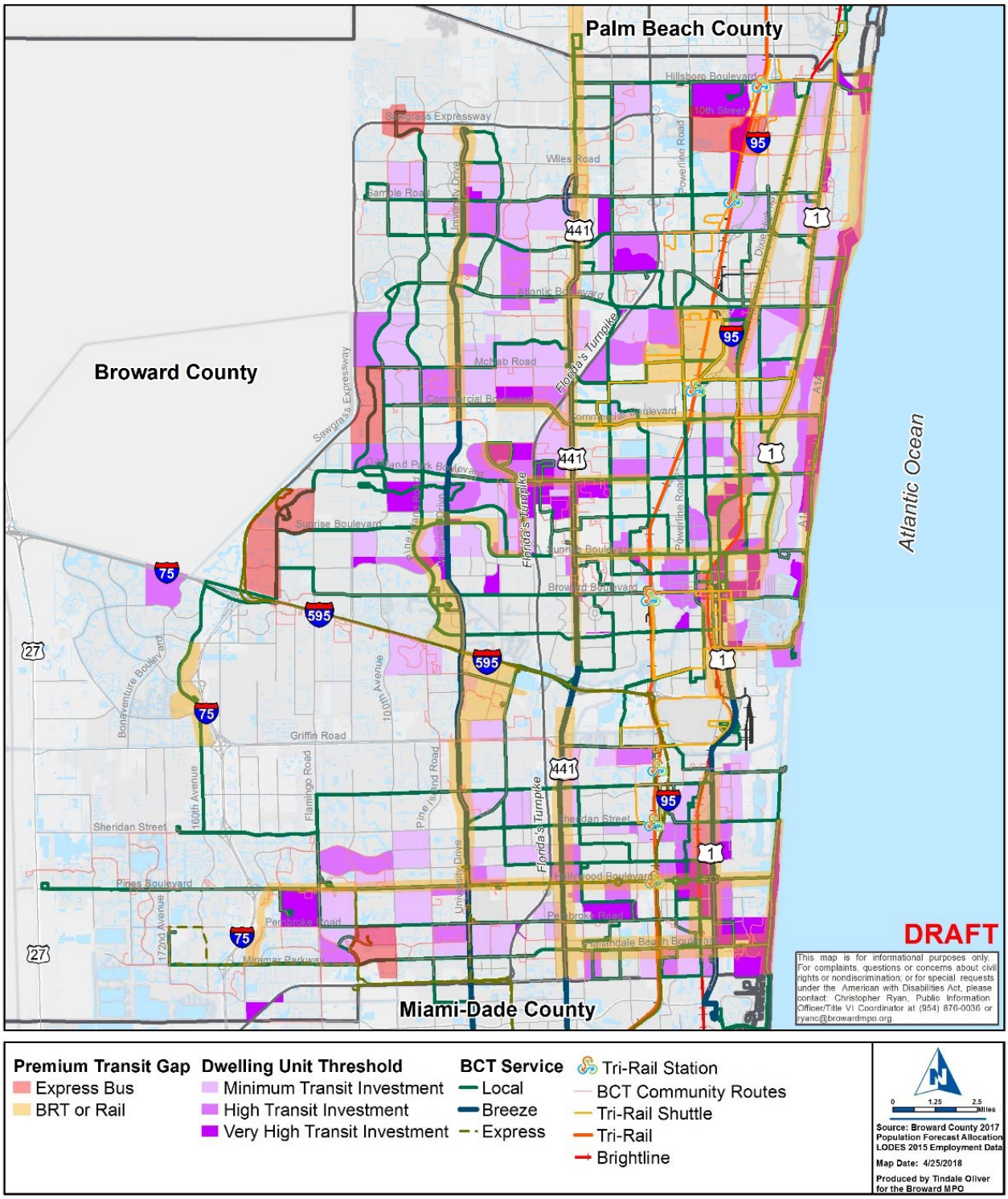
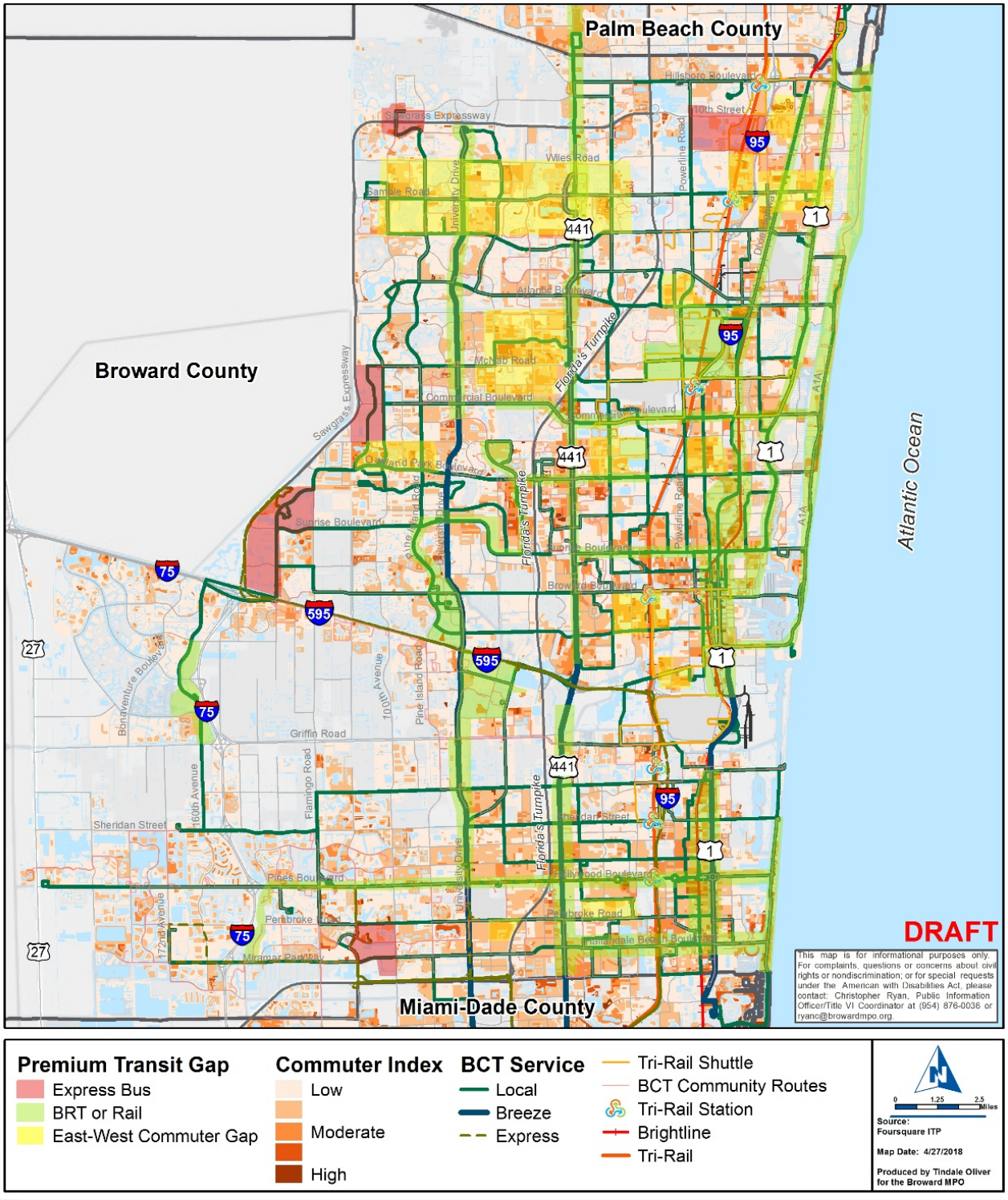


Figure 25: Transit Technology Gaps for Commuter Market



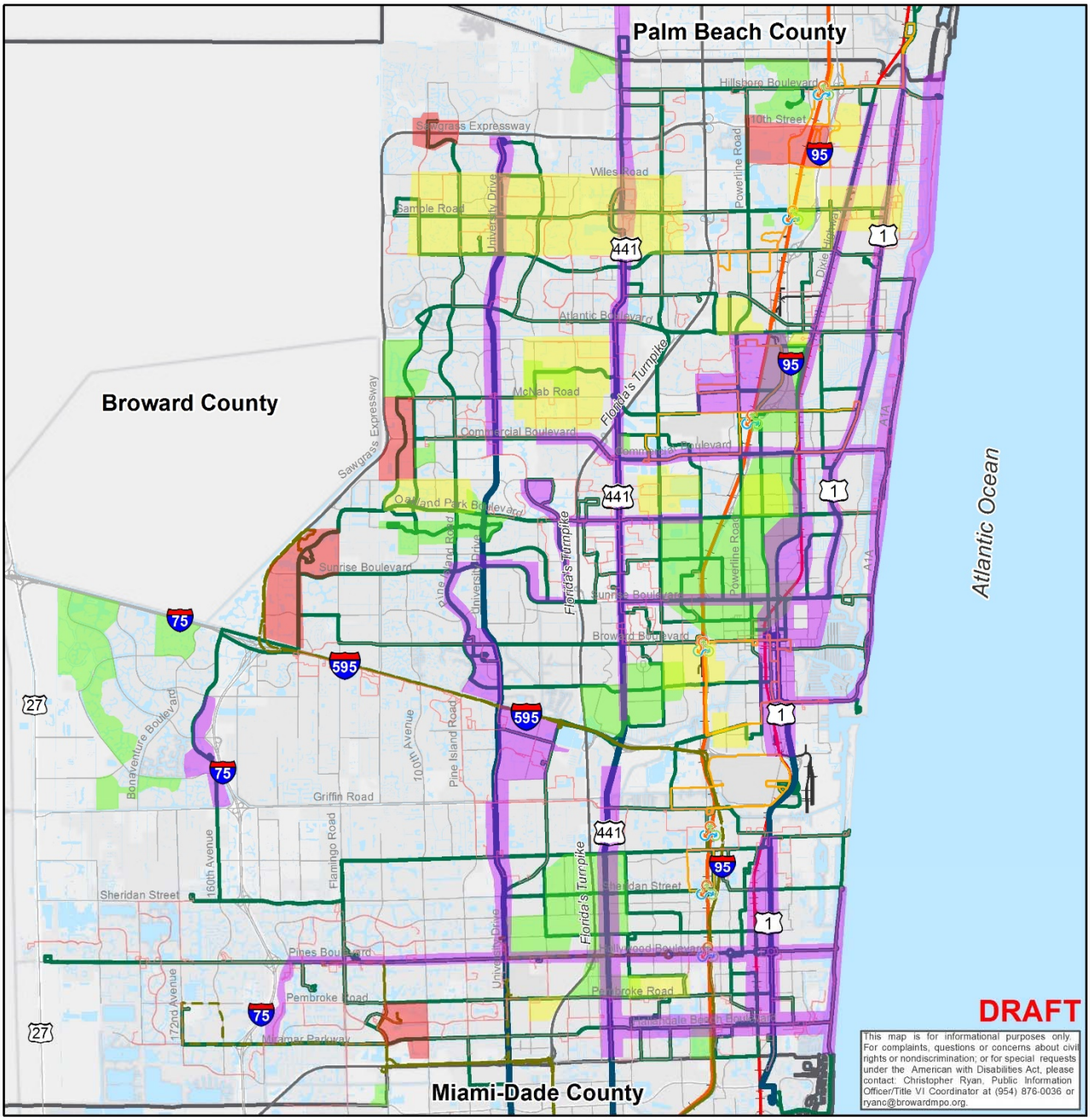
Conclusion

This report identifies existing and future opportunities for new transit investments and technologies based on a review of travel flows and various transit markets within the Broward region. With respect to travel flows, areas with a high number of internal workers were found to coincide with flows originating in Miami-Dade County and traveling to Broward County, indicating high opportunities to provide transit services to large employment centers for both internal and external workers in areas such as the commercial parks of northwest Fort Lauderdale east of Florida's Turnpike and Commercial Boulevard, the Fort Lauderdale Uptown District, the Plantation Midtown District, Downtown Fort Lauderdale, the Miramar Park of Commerce, Memorial Hospital West/Pembroke Lakes Mall, business parks in Sunrise such as Sawgrass International Corporate Park, and intermittently along Sample Road. Significant internal travel flows were observed going north to south in the Fort Lauderdale area as well as in the western portion of Davie to Plantation/Sunrise and within Weston.

A transit market segmentation analysis identified the strongest potential transit markets in the Broward region that would benefit from a variety of transit mode technologies and services, such as community bus, local bus, limited-stop, express bus, BRT, and various rail technologies (streetcar, light rail, commuter rail, heavy rail). The analysis matched transit mode technologies to current and potential transit markets based on academic research, data analysis, and a review of transit surveys to identify underserved transit markets and transit technology gaps in the context of the region. From this review, it was determined that commuters, discretionary riders, students, visitors, the traditional transit market, and older adults represented the most salient transit markets in the Broward region. These markets were analyzed by comparing the results of numerous analyses (Commuter Index, DTA, review of student population, review of hotel dwelling units, and the MPO's Transportation Planning Equity Measure) with that of existing transportation services. Figure 26 illustrates the potential transit service gaps by technology for the transit markets, categorizing them as community bus, express bus, BRT, rail, or Commuter Index gaps.

Although the travel flow and activity analysis combined with the analysis of the transit markets show there are opportunities to invest in and support different transit mode technologies, the success of such investments will rest largely on the level of service of those modes, cost, travel times, and first/last-mile connections. The results of this evaluation are being applied and extended to support a high opporutnity transit corridor assessment for the Broward region (being documented in a separate technical report).

Figure 26: Transit Technology Gaps for All Transit Markets



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