IRVING
TEXAS

Irving Bike Plan

Appendices

Appendix A: Irving Bike Plan Opinion Survey Results

The City of Irving conducted an online survey in 2022 to gauge public opinions on bicycling safety and infrastructure in Irving. The survey launched on May 4, 2022, and closed on August 5, 2022. Four hundred fifty-seven people responded to the survey, with 327 fully completing all questions on the entire survey.

Key findings from the survey included:

FREQUENCY OF BICYCLING

- Nearly 90 percent of respondents had bicycled at least once in the past 12 months, and nearly 76 percent bicycled at least a few times or more every month.
- More than 65 percent of respondents bicycled at least a few times a week.

BICYCLING FOR TRANSPORTATION OR RECREATION

- Over 52 percent of respondents bike to get to a destination such as work, school, or shopping every month.
- Nearly 94 percent of respondents biked for fun or exercise at least once or twice a week in the past month.
- 95 percent of respondents reported they strongly agree or somewhat agree that they would like to travel by bike more than they do now.

PERCEIVED BARRIERS TO BICYCLING

- 43 percent of respondents expressed they feel unsafe while biking in their community.
- Over 35 percent of respondents expressed feeling unsafe was a reason they did not bike as much as they would like to.

BICYCLE ACCESS

- 23 percent of respondents perceive a quarter mile is a reasonable maximum distance for a person to reach a bicycle facility.
- 60 percent of respondents do not bike as much as they would like because bike lanes, trails, and paths do not exist near them.
- Almost 78 percent of respondents do not bike as much as they would like because bike lanes, trails, and paths are disconnected.

PRIORITIES FOR THE IRVING BIKE PLAN

The top priorities identified by respondents for the Irving Bike Plan included (respondents were permitted to select up to three topics from the list):

- Separated bike lanes (64 percent)
- Connections to existing trails (59 percent)
- On-street bike lanes (36 percent)

The following tables summarize the results for each question on the survey. The summary for each question identifies the number of respondents providing and the percentage of respondents giving a response and the total who skipped the question.

1.
Did you ever ride a bicycle, even once, in the past 12 months?

	Responses	Percent
Yes:	408	89.28%
No:	49	10.72%
Total Responded to this question:	457	100%
Total who skipped this question:	0	0%
Total:	457	100%

2. Thinking about the past year, which of the following BEST describes your bicycle-riding behavior:

	Responses	Percent
You ride daily:	42	12.32%
A few times a week:	181	53.08%
A few times a month:	78	22.87%
A few times a year:	28	8.21%
You seldom ride:	12	3.52%
You are not currently a bike rider:	0	0%
Total Responded to this question:	341	74.62%
Total who skipped this question:	116	25.38%
Total:	457	100%

3. In the last 30 days, about how often, if at all, did you bicycle for work, school, shopping, or to get to another destination?

	Responses	Percent
None:	161	47.35%
Once or twice:	70	20.59%
3 or 4 times:	42	12.35%
about once or twice a week:	32	9.41%
3 or 4 times a week:	19	5.59%
5 or more times a week:	16	4.71%
Total Responded to this question:	340	74.4%
Total who skipped this question:	117	25.6%
Total:	457	100%

4. In the last 30 days, about how often, if at all, did you bicycle for fun or exercise?

	Responses	Percent
None:	22	6.47%
Once or twice:	56	16.47%
3 or 4 times:	73	21.47%
about once or twice a week:	67	19.71%
3 or 4 times a week:	81	23.82%
5 or more times a week:	41	12.06%
Total Responded to this question:	340	74.4%
Total who skipped this question:	117	25.6%
Total:	457	100%

5. Over the past year, on average, how many days did you ride your bicycle during each of these seasons?

	Never ride in this season	Ride about 1-2 days during this season	Ride about 1-4 days a month during this season	Ride about once or twice a week during this season	Ride 5+ days a week during this season	I don't know	Total
In the Spring (March, April, May):	0(0%)	31(9.17%)	52(15.38%)	153(45.27%)	101(29.88%)	1(0.3%)	338
In the Summer (June, July, August):	19(5.64%)	41(12.17%)	69(20.47%)	130(38.58%)	76(22.55%)	2(0.59%)	337
In the Fall (September, October, November):	1(0.29%)	30(8.85%)	62(18.29%)	131(38.64%)	114(33.63%)	1(0.29%)	339
In the Winter (December, January, February):	40(11.9%)	59(17.56%)	83(24.7%)	103(30.65%)	46(13.69%)	5(1.49%)	336

Total Responded to this question:	339	74.18%
Total who skipped this question:	118	25.82%
Total:	457	100%

6. How many miles is your AVERAGE bicycle ride?

	Value
Highest:	1200.00
Lowest:	0.00
Average:	22.19
Median:	10.00

Total Responded to this question:	331	72.43%
Total who skipped this question:	126	27.57%
Total:	457	100%

Note: 10 miles, the median number, is the most representative response for question 6.

7. On the days you ride a bicycle, about how many miles on average do you ride?

	Value
Highest:	65.00
Lowest:	0.00
Average:	13.66
Median:	10.00

Total Responded to this question:	333	72.87%
Total who skipped this question:	124	27.13%
Total:	457	100%

Note: 10 miles, the median number, is the most representative response for question 7.

8. How safe or unsafe do you feel when you ride a bicycle in your community?

	Responses	Percent
Very safe:	42	12.43%
Somewhat safe:	148	43.79%
Somewhat unsafe:	94	27.81%
Very unsafe:	52	15.38%
I don't know:	2	0.59%
Total Responded to this question:	338	73.96%
Total who skipped this question:	119	26.04%
Total:	457	100%

9. I would like to travel by bike more than I do now.

	Responses	Percent
Strongly agree:	268	79.06%
Somewhat agree:	56	16.52%
Somewhat disagree:	6	1.77%
Strongly disagree:	3	0.88%
I don't know:	6	1.77%
Total Responded to this question:	339	74.18%
Total who skipped this question:	118	25.82%
Total:	457	100%

10. Do any of the following prevent you from riding a bike more frequently than you currently do? (choose all the apply)

	Responses	Percent
I am not physically able:	7	2.16%
I don't own a bike:	17	5.25%
My bike is not in good working condition:	12	3.7%
I do not feel safe:	116	35.8%
Biking lanes, trails, and paths are not available:	196	60.49%
Biking lanes, trails, and paths are not connected:	252	77.78%
It takes too long:	15	4.63%
Destinations are too far:	45	13.89%
Existing bikeways are in poor condition:	70	21.6%
No showers or place to freshen up at my destination:	54	16.67%
Lack of secure bike parking:	135	41.67%
Weather is too HOT:	113	34.88%
Weather is too COLD:	34	10.49%
It doesn't fit my lifestyle:	10	3.09%
Total Responded to this question:	324	70.9%
Total who skipped this question:	133	29.1%
Total:	457	100%

11.

For each facility mentioned, check if there are too many, about the right amount, or too few:

	Too Many	About the Right Amount	Too Few	I Don't Know	Total
The number or amount of off-street bicycle paths and trails:	4(1.2%)	55(16.57%)	255(76.81%)	18(5.42%)	332
The number or amount of on-street dedicated bicycle lanes:	6(1.81%)	15(4.53%)	291(87.92%)	19(5.74%)	331
The number or amount of bike-friendly streets:	4(1.2%)	23(6.93%)	287(86.45%)	18(5.42%)	332
The number of places to park bicycles, like bike racks and storage lockers:	2(0.6%)	29(8.76%)	256(77.34%)	44(13.29%)	331

Total Responded to this question:	332	72.65%
Total who skipped this question:	125	27.35%
Total:	457	100%

12.

How would you rate your neighborhood based on the following statements:

	Strongly Agree	Somewhat Agree	Somewhat Disagree	Strongly Disagree	I Don't Know	Total
There are off-street bike trails or paved paths in or near my neighborhood that are easy to get to.:	72(21.62%)	104(31.23%)	44(13.21%)	103(30.93%)	10(3%)	333
There are quiet streets, without bike lanes, that are easy to get to on a bike.:	36(10.84%)	138(41.57%)	76(22.89%)	72(21.69%)	10(3.01%)	332
There is so much traffic along the street I live on that it would make it difficult or unpleasant to bike.:	75(22.59%)	101(30.42%)	89(26.81%)	63(18.98%)	4(1.2%)	332
There is so much traffic along nearby streets that it would make it difficult or unpleasant to bike.:	116(34.94%)	138(41.57%)	47(14.16%)	26(7.83%)	5(1.51%)	332
The speed of traffic on most nearby streets is usually slow.:	9(2.72%)	58(17.52%)	120(36.25%)	137(41.39%)	7(2.11%)	331
Most drivers exceed the posted speed limits in my neighborhood.:	143(43.07%)	121(36.45%)	39(11.75%)	13(3.92%)	16(4.82%)	332
Streets in my neighborhood are poorly maintained.:	35(10.51%)	98(29.43%)	130(39.04%)	65(19.52%)	5(1.5%)	333

Total Responded to this question:	333	72.87%
Total who skipped this question:	124	27.13%
Total:	457	100%

13.

How comfortable would you be riding to a destination on the following facilities?

	Very Comfortable	Somewhat Comfortable	Somewhat Uncomfortable	Very Uncomfortable	I Don't Know	Total
A path or trail that is separate from a street.:	281(84.64%)	33(9.94%)	7(2.11%)	8(2.41%)	3(0.9%)	332

Total Responded to this question:	332	72.65%
Total who skipped this question:	125	27.35%
Total:	457	100%

14.

How comfortable would you be riding to a destination on the following facilities?

	Very Comfortable	Somewhat Comfortable	Somewhat Uncomfortable	Very Uncomfortable	I Don't Know	Total
A residential street with one traffic lane in each direction, with traffic speeds of 25-30 MPH, some on-street parking, and no bike lane.:	34(10.21%)	91(27.33%)	107(32.13%)	99(29.73%)	2(0.6%)	333
				Total Responded to this question:	333	72.87%
				Total who skipped this question:	124	27.13%
				Total:	457	100%

15.

How comfortable would you be riding to a destination on the following facilities?

	Very Comfortable	Somewhat Comfortable	Somewhat Uncomfortable	Very Uncomfortable	I Don't Know	Total
A residential street with one traffic lane in each direction, with traffic speeds of 25-30 MPH, some on-street parking, and no bike lane, with bicycle route markings, speed humps, and other things that slow down car traffic.:	57(17.17%)	139(41.87%)	90(27.11%)	40(12.05%)	6(1.81%)	332
				Total Responded to this question:	332	72.65%
				Total who skipped this question:	125	27.35%
				Total:	457	100%

16.

How comfortable would you be riding to a destination on the following facilities?

	Very Comfortable	Somewhat Comfortable	Somewhat Uncomfortable	Very Uncomfortable	I Don't Know	Total
A neighborhood commercial shopping street with one traffic lane in each direction, with traffic speeds of 25-30 MPH, with on-street parking and no bike lane.:	9(2.71%)	64(19.28%)	112(33.73%)	141(42.47%)	6(1.81%)	332
				Total Responded to this question:	332	72.65%
				Total who skipped this question:	125	27.35%
				Total:	457	100%

17.

How comfortable would you be riding to a destination on the following facilities?

	Very Comfortable	Somewhat Comfortable	Somewhat Uncomfortable	Very Uncomfortable	I Don't Know	Total
A neighborhood commercial shopping street with one traffic lane in each direction, with traffic speeds of 25-30 MPH, with on-street parking and with a striped bicycle lane.:	97(29.22%)	143(43.07%)	55(16.57%)	33(9.94%)	4(1.2%)	332
				Total Responded to this question:	332	72.65%
				Total who skipped this question:	125	27.35%
				Total:	457	100%

18.

How comfortable would you be riding to a destination on the following facilities?

	Very Comfortable	Somewhat Comfortable	Somewhat Uncomfortable	Very Uncomfortable	I Don't Know	Total
A major urban street with two traffic lanes in each direction, speeds of 30-35 MPH, and no bike lane.:	12(3.61%)	35(10.54%)	74(22.29%)	207(62.35%)	4(1.2%)	332
				Total Responded to this question:	332	72.65%
				Total who skipped this question:	125	27.35%
				Total:	457	100%

19.

How comfortable would you be riding to a destination on the following facilities?

	Very Comfortable	Somewhat Comfortable	Somewhat Uncomfortable	Very Uncomfortable	I Don't Know	Total
A major urban street with two traffic lanes in each direction, speeds of 30-35 MPH with a striped bike lane.:	49(14.85%)	153(46.36%)	84(25.45%)	39(11.82%)	5(1.52%)	330
				Total Responded to this question:	330	72.21%
				Total who skipped this question:	127	27.79%
				Total:	457	100%

20.

How comfortable would you be riding to a destination on the following facilities?

	Very Comfortable	Somewhat Comfortable	Somewhat Uncomfortable	Very Uncomfortable	I Don't Know	Total
A major urban street with two traffic lanes in each direction, speeds of 30-35 MPH with a wide bicycle lane separated from traffic by a raised curb.:	231(70%)	65(19.7%)	15(4.55%)	15(4.55%)	4(1.21%)	330
				Total Responded to this question:	330	72.21%
				Total who skipped this question:	127	27.79%
				Total:	457	100%

21.

How comfortable would you be riding to a destination on the following facilities?

	Very Comfortable	Somewhat Comfortable	Somewhat Uncomfortable	Very Uncomfortable	I Don't Know	Total
A major street with two or three traffic lanes in each direction, with traffic speeds of 35-40 MPH, and no bike lane.:	12(3.65%)	29(8.81%)	56(17.02%)	227(69%)	5(1.52%)	329
				Total Responded to this question:	329	71.99%
				Total who skipped this question:	128	28.01%
				Total:	457	100%

22.

How comfortable would you be riding to a destination on the following facilities?

	Very Comfortable	Somewhat Comfortable	Somewhat Uncomfortable	Very Uncomfortable	I Don't Know	Total
A major street with two or three traffic lanes in each direction, with traffic speeds of 35-40 MPH, with a striped bike lane.:	31(9.39%)	126(38.18%)	96(29.09%)	72(21.82%)	5(1.52%)	330
				Total Responded to this question:	330	72.21%
				Total who skipped this question:	127	27.79%
				Total:	457	100%

23.

How comfortable would you be riding to a destination on the following facilities?

	Very Comfortable	Somewhat Comfortable	Somewhat Uncomfortable	Very Uncomfortable	I Don't Know	Total
A major street with two or three traffic lanes in each direction, with traffic speeds of 35-40 MPH, with a wide bicycle lane separated from traffic by a raised curb.:	204(62.2%)	85(25.91%)	16(4.88%)	18(5.49%)	5(1.52%)	328
				Total Responded to this question:	328	71.77%
				Total who skipped this question:	129	28.23%
				Total:	457	100%

24.

How important is it for Irving to do each of the following:

	Essential	Very Important	Somewhat Important	Not At All Important	I Don't Know	Total
Provide bike trails separated from roadways.:	150(45.45%)	128(38.79%)	38(11.52%)	11(3.33%)	3(0.91%)	330
Provide bike lanes separated from vehicles so bikes and cars do not have to share the same lane.:	169(51.37%)	111(33.74%)	35(10.64%)	11(3.34%)	3(0.91%)	329
Lower traffic speeds on community roadways to improve the safety of pedestrians and bicyclists sharing the road.:	79(23.94%)	74(22.42%)	108(32.73%)	59(17.88%)	10(3.03%)	330
Provide traffic signals or crossing beacons at intersections and crossings to warn drivers of bike and trail users crossing the road.:	151(45.76%)	118(35.76%)	43(13.03%)	13(3.94%)	5(1.52%)	330
				Total Responded to this question:	330	72.21%
				Total who skipped this question:	127	27.79%
				Total:	457	100%

25.
What types of destinations would you like to ride your bike to if you were able? (check all that apply)

	Responses	Percent
Work:	158	48.02%
School:	92	27.96%
Transit:	136	41.34%
Shopping:	209	63.53%
Restaurant/Bar:	194	58.97%
Parks and recreation:	301	91.49%
Library/Community Center:	209	63.53%
Worship:	58	17.63%
I do not want to bike:	9	2.74%
If other, please specify:	23	6%
Total Responded to this question:	329	71.99%
Total who skipped this question:	128	28.01%
Total:	457	100%

26. From the list below, select the top three things Irving should prioritize in the Irving Bike Plan. (Select up to three)

	Responses	Percent
On-street bike lanes (separated by a painted line):	119	36.28%
Separated bike lanes (separated from motor vehicle traffic by a physical barrier such as a bollard or curb):	210	64.02%
Neighborhood routes (low-stress bicycle boulevards):	96	29.27%
Safe intersection crossings:	88	26.83%
Connections to bicycling facilities in surrounding cities:	112	34.15%
Connections to schools or transit stops/stations:	43	13.11%
Connections to existing trails:	194	59.15%
Slower traffic speeds:	24	7.32%
Better wayfinding or routing information:	10	3.05%
Programs focused on bicycling encouragement and education:	28	8.54%
If other, please specify:	27	8%
Total Responded to this question:	328	71.77%
Total who skipped this question:	129	28.23%
Total:	457	100%

27. What is a reasonable maximum distance for someone to travel to reach a bikeway?

	Responses	Percent
A quarter-mile:	76	23.1%
A half-mile:	109	33.13%
A mile:	119	36.17%
I don't know:	25	7.6%
Total Responded to this question:	329	71.99%
Total who skipped this question:	128	28.01%
Total:	457	100%

28.
What is your relationship to Irving? (Select all that apply)

	Responses	Percent
I live in Irving:	301	92.62%
I work in Irving:	104	32%
I attend school in Irving:	15	4.62%
I visit Irving:	31	9.54%
Total Responded to this question:	325	71.12%
Total who skipped this question:	132	28.88%
Total:	457	100%

29.
In which zip code do you live?

	Responses	Percent
75038:	13	3.99%
75039:	53	16.26%
75060:	50	15.34%
75061:	50	15.34%
75062:	56	17.18%
75063:	79	24.23%
I do not live in Irving:	25	7.67%
Total Responded to this question:	326	71.33%
Total who skipped this question:	131	28.67%
Total:	457	100%

30.
What gender do you identify with?

	Responses	Percent
Female:	116	35.47%
Male:	195	59.63%
Non-Binary:	3	0.92%
Other:	1	0.31%
I prefer not to answer:	12	3.67%
Total Responded to this question:	327	71.55%
Total who skipped this question:	130	28.45%
Total:	457	100%

31.
Which category best describes your age?

	Responses	Percent
18-24 years:	17	5.23%
25-34 years:	58	17.85%
35-44 years:	78	24%
45-54 years:	63	19.38%
55-64 years:	64	19.69%
65+ years:	36	11.08%
I prefer not to answer:	9	2.77%
Total Responded to this question:	325	71.12%
Total who skipped this question:	132	28.88%
Total:	457	100%

32.
Which of the following best describes your racial or ethnic background?

	Responses	Percent
American Indian or Alaska Native:	3	0.92%
Asian:	57	17.48%
Black or African:	10	3.07%
Hispanic, Latino or Spanish:	32	9.82%
Middle Eastern or North African:	1	0.31%
Native Hawaiian or Other Pacific Islander:	1	0.31%
White:	175	53.68%
Some other race, ethnicity or origin:	4	1.23%
I prefer not to answer:	43	13.19%
Total Responded to this question:	326	71.33%
Total who skipped this question:	131	28.67%
Total:	457	100%

33.
Which of the following best describes your total annual household income?

	Responses	Percent
Under $25,000:	6	1.86%
$25,000-$49,999:	14	4.33%
$50,000-$74,999:	52	16.1%
$75,000-$99,999:	46	14.24%
$100,000 or more:	152	47.06%
I prefer not to answer:	53	16.41%
Total Responded to this question:	323	70.68%
Total who skipped this question:	134	29.32%
Total:	457	100%

Appendix B: Demand Zones for Walking and Bicycling Travel

The desire and need for bikeway facilities can vary across a community, where several factors affect an individual's choice to travel from one destination to another. To determine the demand for bicycling travel within Irving, a latent demand analysis was performed to identify existing developed areas most conducive to bicycling for transportation based on existing demographics and travel patterns. This analysis considered criteria including:

- Density of population and employment
- Density of average daily short distance trips
- Density of low-income populations
- Density of zero-car households
- Areas with high vehicle congestion

The analysis identifies areas expected to have the highest demand for bicycling travel. Subsequently, the areas with the highest demand were a focus for developing the recommended bicycle network.

The U.S. Census block group was used as the common geographic unit for analysis. The criteria used for analysis are identified in **Table B-1** and were weighted based on the level of influence on the demand for bicycling in Irving.

Table B-1: Latent Demand Analysis Criteria

CRITERIA	WEIGHT
Density of population and employment	35%
Density of average daily short distance trips	20%
Density of Low-income populations	15%
Density of zero-car households	15%
Areas of high vehicle congestion	15%

OVERVIEW OF THE LATENT DEMAND ANALYSIS CRITERIA DATA:

1. **Density of Population** is expressed though the concentration of people per square mile. The data source is the 2019 American Community Survey (ACS) 5-year estimates and is reported by 2010 Census block group geography.
2. **Density of Employment** consists of full and part-time employees. The 2019 employment density estimates source is the North Central Texas Council of Governments (NCTCOG) Data Modeling Team and is reported by 2010 Census block group geography.
3. **Density of Average Daily Short Distance Trips** reflects areas with a high proportion of home-based trips by all modes of travel that are 2.5 miles or less. The data reflects density of short distance trips (origin to destination) from the 2019 LOCUS location-based service (LBS) data collected from personal cell phone GPS data and is reported by where trips ended based on 2010 Census block group geography. **Figure B-1** identifies the density of average daily short distance trips within Irving.
4. **Density of Low-Income Population** is the percentage of persons whose household income is below the Department of Health and Human Services defined poverty level. The data source is the 2019 ACS 5-year estimates and is reported by 2010 Census block group geography. **Figure B-2** identifies areas designated as environmental justice communities.
5. **Density of Zero Car Households** reflects households reporting no access to a motorized vehicle and would therefore benefit from multimodal travel options. The data source is the 2019 ACS 5-year estimates and is reported by 2010 Census block group geography.
6. **Areas of High Vehicle Congestion** reflects roadways (excluding freeways) where vehicles travel slower than the posted speed limit. The congestion model uses a Speed Ratio model or Level of Service (LOS) model that serves as the final congestion data output. The Speed Ratio/LOS is calculated by NCTCOG by dividing the recorded average speed by the posted speed limit. The lower the ratio, the higher the congestion. The data was generalized by 2010 Census block group geography.

ADDITIONAL INFORMATION:

LOCUS: Location-based Services Data and Big Data Analytics, LOCUS, 2023

Figure B-1

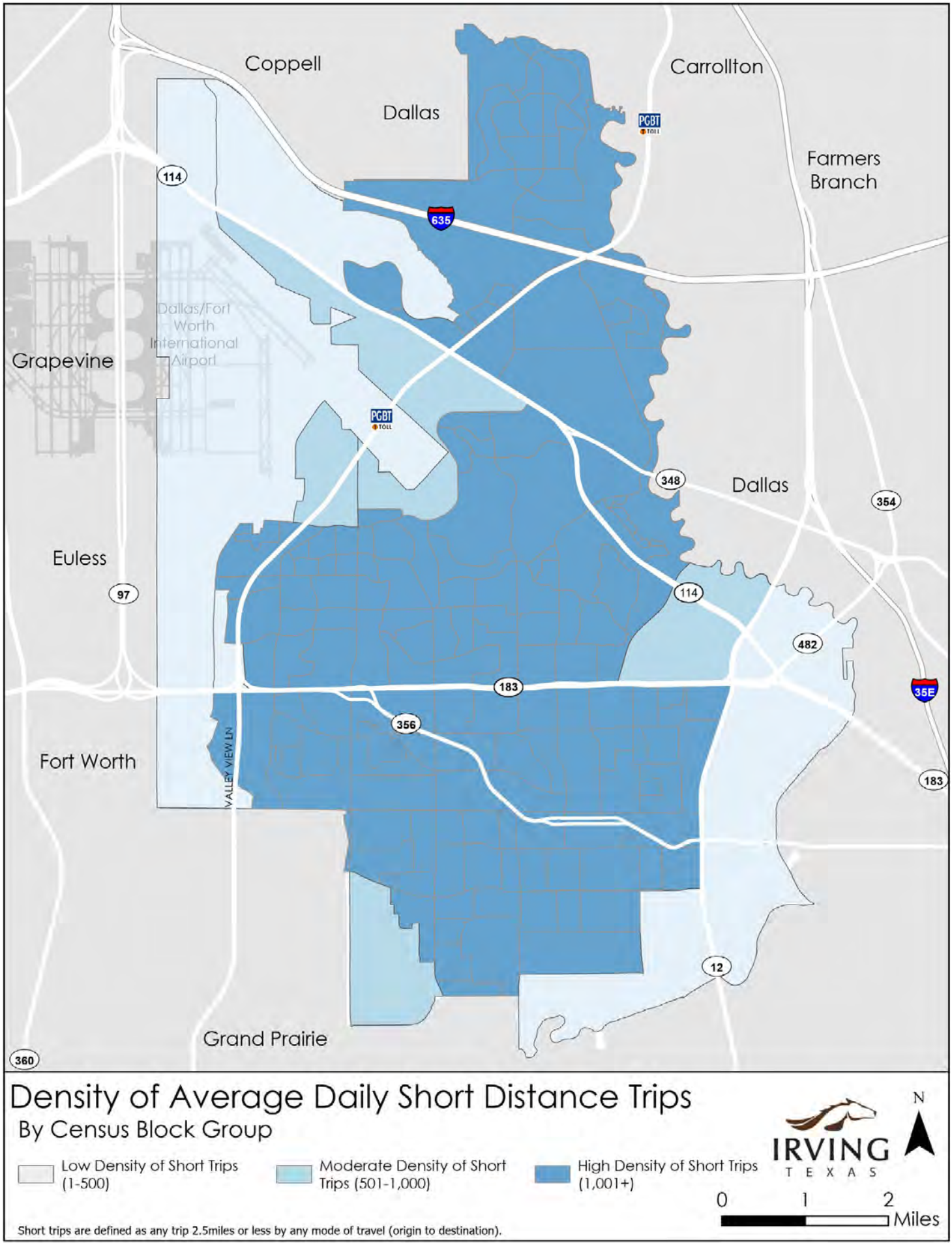
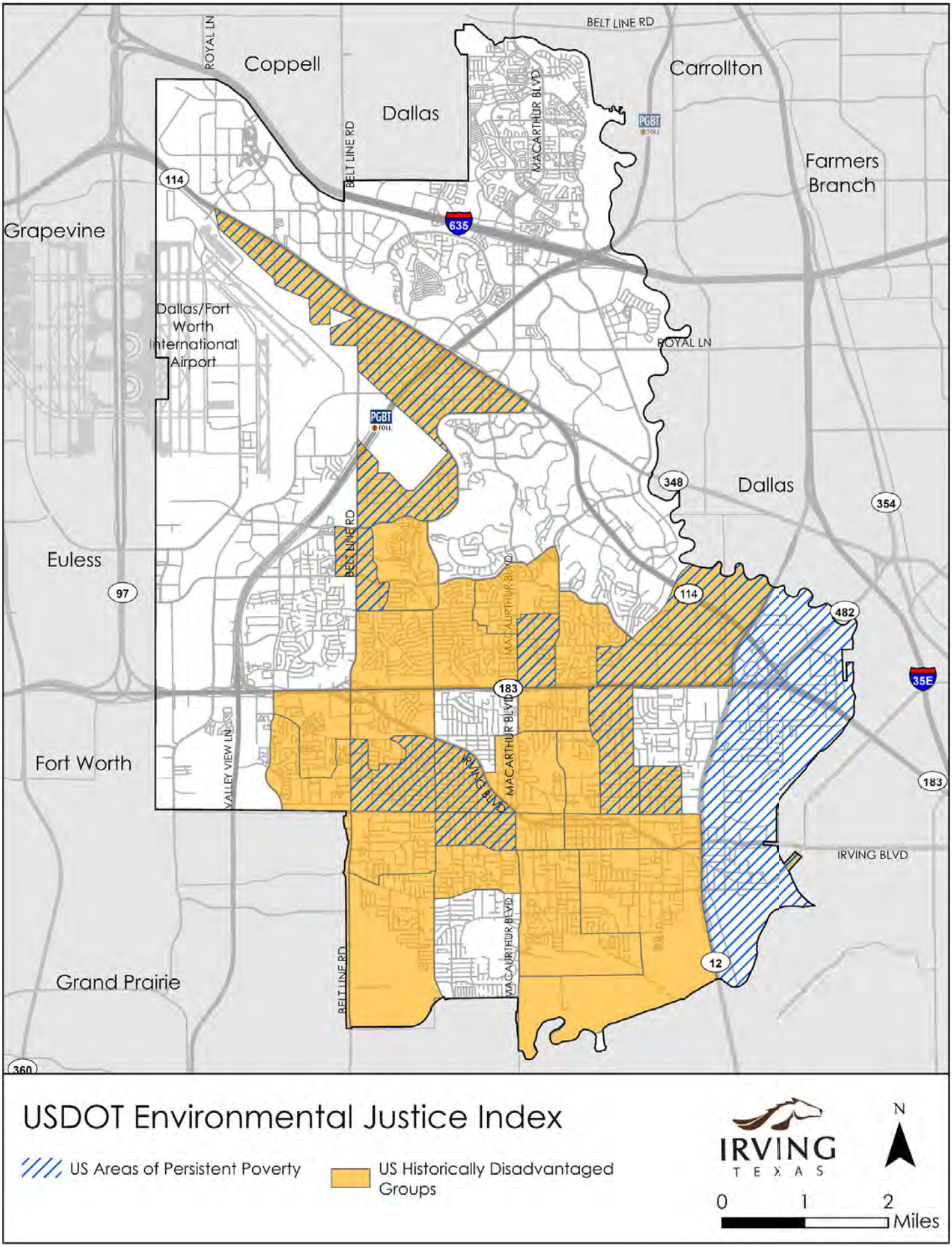

Coppell
Carrollton
Dallas
Farmers Branch
PGBT TOLL
114
635
Dallas/Fort Worth International Airport
Grapevine
PGBT TOLL
348
Dallas
354
Euless
97
114
482
183
35E
356
Fort Worth
VALLEY VIEW LN
183
12
Grand Prairie
360
Density of Average Daily Short Distance Trips
By Census Block Group
Low Density of Short Trips (1-500)
Moderate Density of Short Trips (501-1,000)
High Density of Short Trips (1,001+)
IRVING TEXAS
N
0 1 2 Miles
Short trips are defined as any trip 2.5miles or less by any mode of travel (origin to destination).

Figure B-2


BELT LINE RD
ROYAL LN
Coppell
Carrollton
Dallas
MACARTHUR BLVD
PGBT
TOLL
Farmers Branch
114
635
Grapevine
Dallas/Fort Worth International Airport
ROYAL LN
PGBT
TOLL
348
Dallas
354
Euless
BELT LINE RD
MACARTHUR BLVD
97
114
482
35E
183
Fort Worth
VALLEY VIEW LN
IRVING BLVD
MACARTHUR BLVD
183
IRVING BLVD
BELT LINE RD
MACARTHUR BLVD
12
Grand Prairie
360
USDOT Environmental Justice Index
US Areas of Persistent Poverty
US Historically Disadvantaged Groups
IRVING
TEXAS
N
0
1
2
Miles

Appendix C: Bicycle Level of Comfort

BACKGROUND

In May 2012, the Mineta Transportation Institute published Report 11-19, ***Low-Stress Bicycling and Network Connectivity***, outlining a rating system to evaluate the Level of Comfort (LOC), or stress, of bicyclists riding on roadways. The objective of the study was to develop measures of low-stress connectivity that can be used to evaluate and guide bicycle network planning. The research project used criteria in which road segments and intersections were classified into four Levels of Traffic Stress (LTS) ranging from LTS 1 as suitable for children; LTS 2 representing the traffic stress that most adults will tolerate; and LTS 3 and 4 representing greater levels of stress.

The researchers used San Jose, California as a case study to apply the methodology. Results from the stress map identified small "connectivity clusters" or islands within the city containing a small geographic area of continuous low-stress connectivity. Clusters were separated by high-stress road corridors or intersections limiting the ability to make trips by bicycle to other bicycle-friendly areas of the city.[1] For purposes of the ***Irving Bike Plan***, roadways were evaluated for their Bicycle Level of Comfort (BLOC), which is based on the same methodology as the level of traffic stress.

In general, transportation planners can use BLOC to determine needed improvements on existing roadways or intersections. For example, BLOC is utilized for the ***Irving Bike Plan*** to produce a city-level map identifying roadways by the associated LOC scores. The assessment identified locations where bicycle infrastructure improvements are necessary to result in low-stress connectivity across the city.

The BLOC rating system corresponds with the level of traffic stress methodology, whereby LOC 1 is considered high comfort (low stress), and LOC 4 is considered low comfort (high stress). Each LOC level is associated with a type of bicyclist defined by their level of comfort riding with traffic. For example, LOC 1 is suitable for bicyclists of all ages and abilities that have limited interactions with motor vehicle traffic, LOC 2 represents a comfort level appropriate for people interested in bicycling but concerned about riding in traffic, LOC 3 represents bicyclists that are somewhat comfortable sharing the roadway with vehicle traffic, but prefer to have bike-specific facilities (referred to as enthused and confident), and LOC 4 is suitable for experienced bicyclists that will ride regardless of roadway conditions (referred to as strong and fearless). As such,

1 Report 11-19, Low-Stress Bicycling and Network Connectivity, Mineta Transportation Institute

planning to accommodate a LOC 1 classification on roadways will achieve optimal comfort and safety for all types of bicyclists. **Table C-1** outlines the conditions that impact the comfort level of all types of bicyclists.

Table C-1: Bicycle Level of Comfort Descriptions

COMFORT LEVEL	TARGET USER TYPE	DESCRIPTION
1	All Ages and Abilities	The type of bicyclists at LOC 1 includes most children and elderly between the ages of 8 and 80 who are comfortable riding on very quiet streets and have limited interactions with traffic such as bicycle boulevards. Bicyclists are also comfortable riding in bicycle facilities with the highest level of comfort, such as separated bicycle facilities and shared-use paths (trails).
2	Interested but Concerned	The type of bicyclists at LOC 2 includes most adults and some children who may require adult supervision. Bicyclists are comfortable riding in separated bicycle facilities on multilane roadways.
3	Enthused and Confident	The type of bicyclists at LOC 3 are typically adults who are somewhat comfortable in traffic but prefer some form of separation from vehicle traffic. Bicyclists are comfortable riding in conventional bike lanes alongside moderate traffic traveling at moderate speeds.
4	Strong and Fearless	The type of bicyclists at LOC 4 are typically highly experienced and are willing to ride a bicycle regardless of the traffic conditions. Bicyclists are comfortable sharing lanes with vehicles on busy streets with no separation from traffic.

CORRIDOR METHODOLOGY

Five factors were considered to determine a corridor's LOC: the number of travel lanes on a roadway; traffic speed; traffic volumes; the presence of on-street parking; and the presence of bicycle facilities. The level of comfort decreases as the dedicated space and/or separation for bicyclists from motor vehicles decreases and as the number of travel lanes, speed, and volumes increases.

Tables C-2 through C-5 outline the level of comfort criteria for various roadway configurations, including the type of bicycle facility (if any) and/or the presence of on-street parking. All tables consider the number of travel lanes and vehicle travel speed. **Table C-2** considers

the additional impact of traffic volumes. The levels of comfort are color coded, wherein LOC 1 is green, LOC 2 is blue, LOC 3 is yellow, and LOC 4 is red. For purposes of this Plan, off-street shared-use paths (trails), are classified as LOC 1 along all types of roadways regardless of traffic volumes and speeds.

Table C-2: Level of Comfort Criteria for Mixed Traffic, including Bicycle Boulevards

Total Number of Travel Lanes	Daily Traffic Counts (AADT)	Posted Speed Limit (mph)					
		≤ 25	30	35	40	45	50+
2	0 through 750	1	2	2	3	3	3
	751 through 1,500	1	2	3	3	4	4
	1,501 through 3,000	2	3	3	4	4	4
	3,001+	3	3	3	4	4	4
3 through 5	0 through 8,000	3	3	3	4	4	4
	8,001+	3	4	4	4	4	4
6+	0+	3	4	4	4	4	4

Note: LOC 1 is considered high comfort (low stress) and LOC 4 is considered low comfort (high stress).

Table C-3: Level of Comfort Criteria for Conventional Bike Lanes and Buffered Bike Lanes (No On-Street Parking)

Total Number of Travel Lanes	Buffered Bike Lanes	Posted Speed Limit (mph)					
		≤ 25	30	35	40	45	50+
2	No	1	2	2	3	3	4
	Yes	1	1	2	3	3	4
3 through 5	No	2	2	2	3	4	4
	Yes	2	2	2	3	4	4

Note: LOC 1 is considered high comfort (low stress) and LOC 4 is considered low comfort (high stress).

The additional complexity and conflicts resulting from vehicles turning in and out of on-street parking spaces and drivers opening their car door increases the level of stress for bicyclists. A minimal number of streets in Irving currently provide designated on-street parking. For these select corridors, **Table C-4** was used to designate the level of comfort.

Table C-4: Level of Comfort Criteria for Conventional Bike Lanes and Buffered Bike Lanes Adjacent to On-Street Parking

Total Number of Travel Lanes	Buffered Bike Lanes	Posted Speed Limit (mph)					
		≤ 25	30	35	40	45	50+
2	No	2	2	3	3	4	4
	Yes	1	2	3	3	4	4
3 through 5	No	2	3	3	3	4	4
	Yes	2	3	3	3	4	4

Note: LOC 1 is considered high comfort (low stress) and LOC 4 is considered low comfort (high stress).

Providing a vertical barrier between motor vehicle traffic and bicyclists has a significant impact on bicyclists perceived level of comfort. Table C-5 identifies the level of comfort on roadways with separated bike lanes or two-way cycle tracks with vertical separation from traffic. This analysis does not differentiate the level of comfort that may result by providing various forms of vertical separation.

Table C-5: Level of Comfort Criteria for Separated Bike Lanes and Two-Way Cycle Tracks

Total Number of Travel Lanes	Posted Speed Limit (mph)			
	≤ 25	30	35	40
2 through 3	1	1	1	2
4 through 5	1	1	1	3

Note: LOC 1 is considered high comfort (low stress) and LOC 4 is considered low comfort (high stress).

DATA SOURCE

The Bicycle Level of Comfort analysis uses the Roadway Inventory Geographic Information System (GIS) dataset maintained by the Texas Department of Transportation (TxDOT) and includes attributes related to traffic speeds, volumes, number of lanes, and presence of on-street parking.[2] The TxDOT dataset was downloaded in the spring of 2022 and reviewed by City of Irving and North Central Texas Council of Governments (NCTCOG) staff and adjusted as necessary to reflect existing conditions.

ASSUMPTIONS AND LIMITATIONS

The speed of traffic has a significant impact on the perceived level of comfort for bicyclists. Ideally, a level of comfort determination would consider actual operating traffic speeds. However, the posted speed limit was utilized due to a lack of available data related to actual traffic operating speeds. The BLOC analysis assumes motorists are operating at the posted speed limit.

Roadway intersections are a critical consideration for bicyclist level of comfort in addition to the roadway corridors. Factors impacting the comfort of bicyclists traveling through an intersection include the type of intersection control, the number of lanes being crossed, and vehicle travel speed. Intersection crossings were excluded from the systemic analysis due to a lack of a statewide database with intersection attributes. This limitation may lead to the false assumption that if a corridor is rated a high level of comfort, then all crossings along that corridor will be similarly high in comfort. However, the 2012 Mineta Transportation Institute Report 11-19 research subscribed to the "weakest link" principle, whereby a single roadway segment or intersection with a lower level of comfort renders an entire trip unacceptable to a bicyclist. Any route with a single stressful section of roadway or intersection is thereby considered too stressful. Thus, for purposes of this analysis, it is assumed the City of Irving will utilize best practices to improve intersections over time to maintain a level of comfort consistent with the connecting roadway segments. Best practices and design guidance to improve the comfort of intersections for bicyclists in included in the ***Don't Give Up at the Intersection*** publication by the National Association of City Transportation Officials.

ADDITIONAL INFORMATION:

Low-Stress Bicycling and Network Connectivity, Mineta Transportation Institute, 2012

Don't Give Up at the Intersection, National Association of City Transportation Officials, 2019

2 TxDOT Roadway Inventory Data: *https://gis-txdot.opendata.arcgis.com/datasets/TXDOT::txdot-roadway-inventory/about.*

Appendix D: Bicycle Boulevards Overview

Bicycle boulevards are streets intended for shared bicycle and motor vehicle travel. The primary characteristics of these designated corridors include low motorized traffic volumes and low travel speeds to maintain safety and comfort for bicyclists. From a bicycle network planning perspective, bicycle boulevards support the dedicated bikeway corridors identified in the ***Irving Bike Plan***. These shared roadway facilities are typically located on residential streets and provide critical connections between dedicated bikeways and access to neighborhood destinations such as schools and community facilities.

Bicycle boulevards differ from other dedicated bikeway facility types outlined in the ***Irving Bike Plan***, in that there is not a universal design approach. Multiple strategies may be used on bicycle boulevards based on the context of the neighborhood to encourage lower motor vehicle traffic speeds. Design strategies may be based on the street width, adjacent land uses, existing traffic patterns, and the location and frequency of driveways and major street intersections. High comfort (low stress) bicycle boulevards often require the use of multiple design strategies.

According to the Institute of Transportation Engineers (ITE) there are four types of traffic calming measures:

- Vertical deflections, horizontal shifts, and roadway narrowing intended to reduce speed and enhance the street environment for non-motorists.
- Closures (diagonal diverters, half closures, full closures, and median barriers) intended to reduce cut-through traffic by obstructing traffic movements in one or more directions.

Design Considerations

Bicycle Boulevards in Irving may consider variations of the following strategies:

Speed Reduction Strategies slow traffic and enhance safety for bicyclists. The preferred operating travel speed for motor vehicles on a bicycle boulevard is 25 mph or less. The low vehicle speed contributes to a high level of comfort for bicyclists of all ages and abilities. During the design process for bicycle boulevards, City staff will perform an engineering study to evaluate the feasibility of reducing the speed limit below the City of Irving's standard 30 mph for residential streets.

Delaware DOT

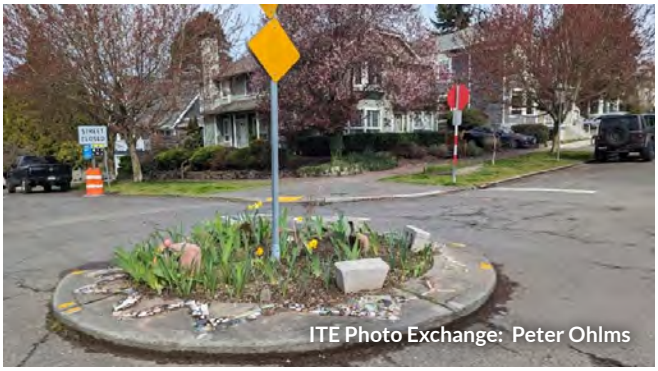
Chicanes serve as a traffic speed calming measure through a series of alternating curves or lane shifts that force a motorist to steer back and forth instead of traveling a straight alignment at higher speed.

ITE Photo Exchange: Dongho Chang

Temporary or permanent curb extensions narrow the roadway requiring motorists to navigate slowly around the curbs or bulb-outs.

ITE Photo Exchange: Dongho Chang

Speed cushions with gaps between raised areas slow the speed of motor vehicles; gaps are spaced to allow emergency vehicles and bicyclists to maintain a constant speed of travel.



ITE Photo Exchange: Peter Ohlms

Traffic circles placed at an intersection require drivers to slow their speed to comfortably maneuver around them.

Vehicular Travel Management is the reduction in volume of motor vehicles on a roadway serving as a bicycle boulevard. Volume management discourages motor vehicles from entering a designated bicycle boulevard and gives priority to bicyclist travel. Vehicle volumes on bicycle boulevards are recommended to be less than 1,500 vehicles per day.

A median island refuge at an intersection serving as a diverter allows bicyclists to comfortably travel across three or more lanes while also reducing through traffic.

Signage, Wayfinding, and Pavement Markings communicate to motorists that a roadway designated as a bicycle boulevard is shared with bicyclists, and that they must practice caution and travel at slower speeds. Signage and wayfinding also help bicyclists identify designated bicycle boulevard corridors as part of the overall bicycle network.

Wayfinding or street signs branded with a bicycle boulevard symbol or logo distinguish these designated bicycle friendly streets from other roadways.

Wayfinding signage identifying the distance and direction of nearby landmarks and major destinations assists bicyclists to navigate the designated boulevard route to dedicated bikeway facility corridors throughout the city.

Pavement markings, such as shared-lane markings, indicate the travel lane is shared between bicyclists and motorists.

Pavement markings designate areas for bicyclists to cross an intersection or make a turning movement.

Minor Street Crossing strategies at the intersection of two local or residential streets aim to encourage continuous bicycle travel with fewer stops. Stop signs installed on perpendicular minor street crossings can prioritize the movement of bicyclists along the bicycle boulevard. Yield signs allow bicyclists to maintain their momentum through intersections. Giving travelers on bicycle boulevards the right of way and reducing the number of stop signs for bicyclists maintains the flow of bicycle travel. In addition, design characteristics at street crossings may include "crossbike" markings adjacent to crosswalk markings, raised crossings to improve bicyclist visibility and reduce speed at which vehicles turn, compact corners with small radii to force turning drivers to slow down, and centerline hardening to reduce the speed of motor vehicles on turns that interfere with bicyclists.

Bike boxes and "crossbike" markings adjacent to pedestrian crosswalk markings designate turning and crossing locations.

Green lane pavement markings define lanes for bicyclists through an intersection.

Raised crossings may slow traffic speeds and improve the safety of bicyclists and pedestrians.

Islands and compact corners with small radii slow the speed of turning vehicles.

Dedicated Bicycle Signals and Bicycle Signal Phases at Major Intersection Crossings can be enhanced for bicyclists navigating a major street, typically four or more lanes.

A dedicated bicycle signal actuated by a push button at the intersection.

Pedestrian Hybrid Beacon (HAWK) signals may be used for bicycle intersection crossings where a full traffic signal is not warranted.

Example of a bicycle detection with a bicycle signal phase installed at a bicycle boulevard intersection of a major roadway.

Bicycle detection installed at an intersection may be used in addition to activating a push button.

Offset Intersections are asymmetrical and require special considerations to facilitate safe bicycle crossings. When appropriate design strategies are implemented, offset intersections allow bicyclists to travel seamlessly across junctions.

A median island can provide safe refuge for bicyclists travelling across an intersection.

Green pavement markings are used to identify where bike facilities transition through an offset intersection.

Green Infrastructure can be integrated into the above design considerations and serve to enhance the aesthetics of the roadway for residents. Green infrastructure consists of landscape elements within the roadway right of way to improve stormwater management, air quality, and shade.

Green infrastructure may include rain gardens or bioswales, which absorb stormwater runoff and can be placed within curb extensions or islands.

Green infrastructure adds a buffer or protection for bicyclists from vehicles. Street trees provide shade and cooling for bicyclists, as well as landscape beatification for the roadway.

ADDITIONAL INFORMATION:

- National Association of City Transportation Officials Bicycle Boulevard Guidance
- City of Tucson Bicycle Boulevards
- City of Portland Neighborhood Greenways

Appendix E: Access to the Recommended Bicycle Network

CONNECTIONS TO SCHOOLS

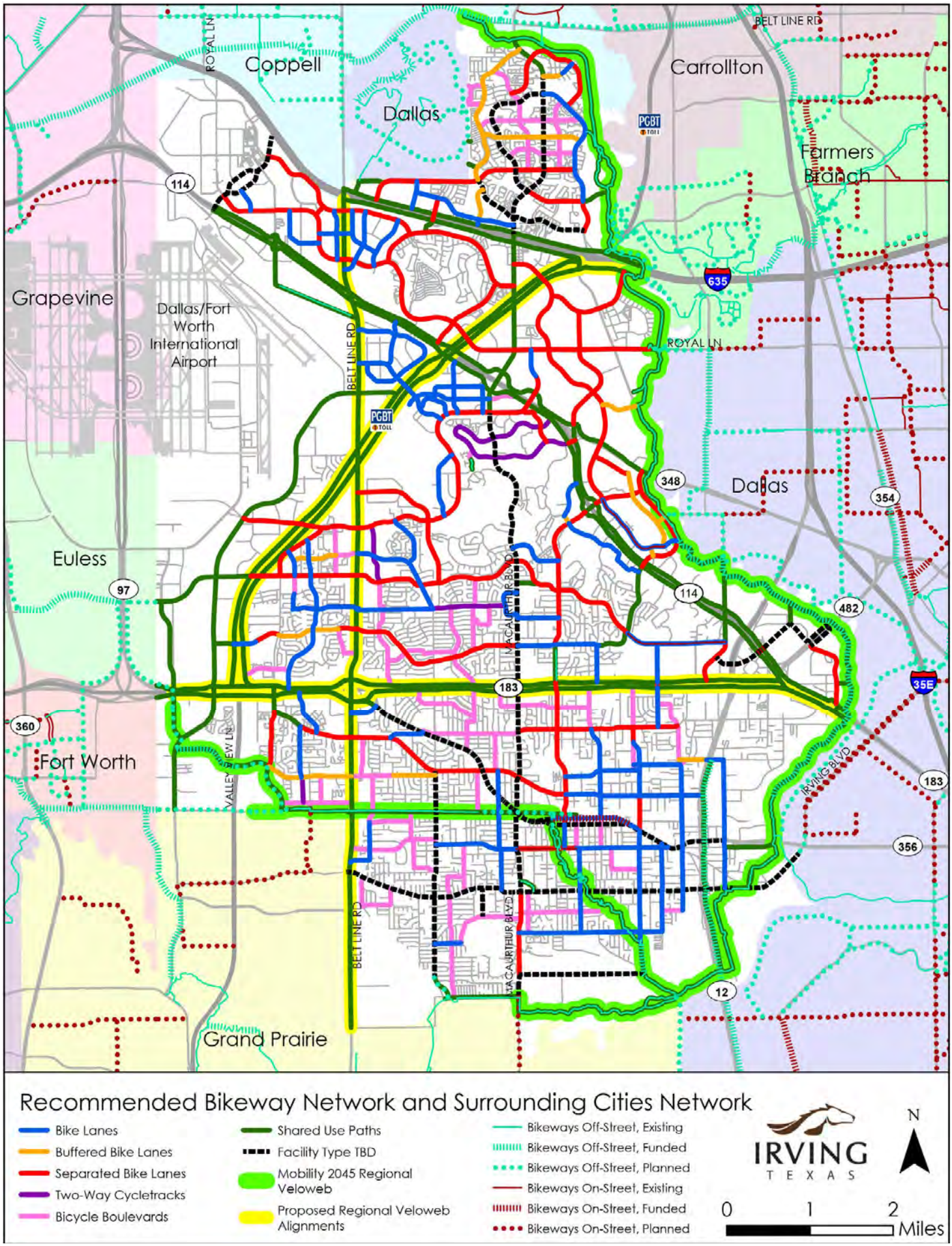
Safe Routes to School (SRTS) programs are focused on encouraging and enabling more children to safely walk and bicycle to school, thereby improving student health, traffic congestion, safety, and air quality around schools. The following schools are located along roadway corridors proposed to be improved with bicycle facilities and may serve as candidates for future individual SRTS Plans.

1. Austin Middle School
2. Barbara Bush Middle School
3. Barton Elementary School
4. Bernice Chatman Freeman Elementary School
5. Bowie Middle School
6. Brandenburg Elementary School
7. Canyon Ranch Elementary School
8. Crockett Middle School
9. Elliott Elementary School
10. Gilbert Elementary School
11. Hanes Elementary School
12. Irving Secondary Reassignment Center
13. Ivy Montessori Academy
14. Jackie Mae Townsell Elementary
15. James A. Ratteree Career Development Center
16. J.O. Davis Elementary School
17. John Haley Elementary School
18. John R. Good Elementary School
19. John W. & Margie Stipes Elementary School
20. Johnston Elementary School
21. Keyes Elementary School
22. Lamar Middle School
23. Lee Britain Elementary School
24. Lee Elementary School
25. Lively Elementary School
26. Lorenzo De Zavala Middle School
27. MacArthur High School
28. Nimitz High School
29. Otis Brown Elementary School
30. Radiant STEM Academy
31. Sam Houston Middle School
32. Schulze Elementary School
33. Thomas Haley Elementary School
34. Tom Landry Elementary School
35. Townley Elementary School
36. Travis Middle School
37. Universal Academy
38. Uplift Infinity Preparatory
39. Valley Ranch Elementary School

CONNECTIONS TO SURROUNDING COMMUNITIES

Figure E-1 identifies where the recommended bicycle network in Irving will connect with existing and planned bicycle networks in surrounding cities.

Figure E-1


Coppell
Dallas
Carrollton
Farmers Branch
Grapevine
Dallas/Fort Worth International Airport
Euless
Dallas
Fort Worth
Grand Prairie
ROYAL LN
BELT LINE RD
BELT LINE RD
BELT LINE RD
MACARTHUR BLVD
MACARTHUR BLVD
IRVING BLVD
VALLEY VIEW LN
PGBT TOLL
PGBT TOLL
114
635
348
354
97
114
482
183
35E
360
183
356
12
Recommended Bikeway Network and Surrounding Cities Network
Bike Lanes
Buffered Bike Lanes
Separated Bike Lanes
Two-Way Cycletracks
Bicycle Boulevards
Shared Use Paths
Facility Type TBD
Mobility 2045 Regional Veloweb
Proposed Regional Veloweb Alignments
Bikeways Off-Street, Existing
Bikeways Off-Street, Funded
Bikeways Off-Street, Planned
Bikeways On-Street, Existing
Bikeways On-Street, Funded
Bikeways On-Street, Planned
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