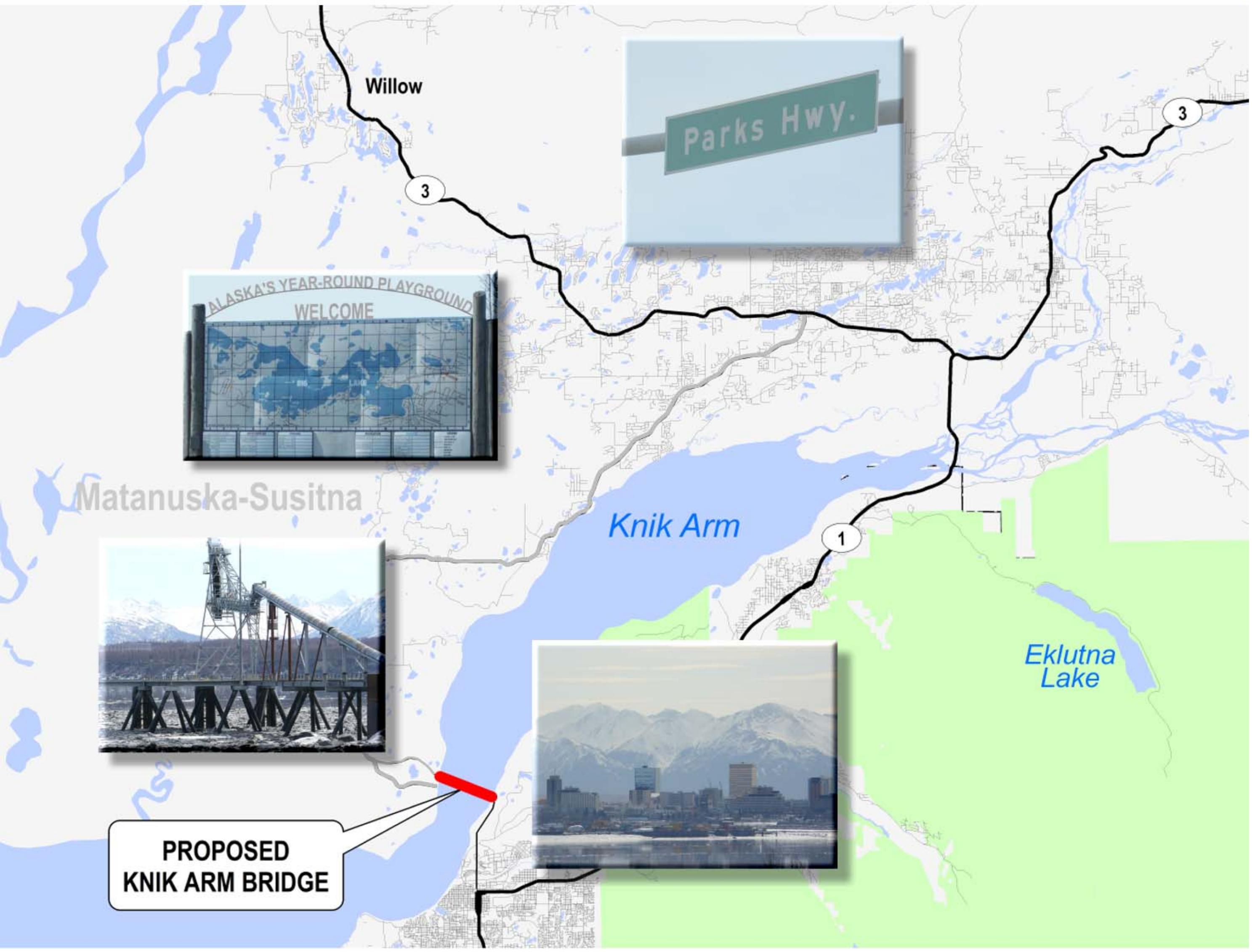
Proposed Knik Arm Bridge

Final Traffic and Toll Revenue Forecast



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KNIK ARM BRIDGE & TOLL AUTHORITY
Knik Arm Bridge and Toll Authority

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INTRODUCTION

Socioeconomic attributes are the principle source from which trip production and attraction activity is derived, forming the foundation for establishing travel patterns and estimating future travel demand. Socioeconomic variables reviewed for this study include household and population trends as well as employment and personal income statistics. For purposes of this study the services of Insight Research Corporation (IRC), an applied economics research firm specializing in transportation economics, were retained. IRC performed a thorough review of historic socioeconomic trends and characteristics as well as a comprehensive regional economic forecast. These forecasts were then incorporated into the traffic and gross toll revenue modeling process. The remainder of this chapter will provide a socioeconomic profile of Anchorage and Mat-Su boroughs as well as an overview of the findings and methodology employed by IRC.

HISTORICAL REGIONAL GROWTH

Alaska, though the largest State in the United States in terms of land area, is the least densely populated state. At an average of approximately 1.1 persons per square mile, Alaska ranks 47th in the nation in terms of total population. Sparsely developed and with little arable land, the vast majority of the population is concentrated in the South Central region, the Matanuska Valley near Anchorage, and the Tanana Valley around Fairbanks. According to Alaska land distribution statistics published by the United States Bureau of Land Management in 2005, approximately 64.0 percent of Alaska was owned and managed by the U.S. federal government as defense and federal land, national forests, national parks, and national wildlife refuges. The next largest land owner is the State of Alaska itself, owning approximately 25.0 percent of the state's land area. Several regional Native corporations account for an additional 10.2 percent, and the remaining land is owned by private interests, though this accounts for only 0.7 percent.

The following is a summary of historical socioeconomic trends for the study area. Regional statistics on population, employment, and household income trends help establish a basis on which forecast can be built and further our understanding of the region's socioeconomic landscape. This data has been prepared by IRC and is presented in greater detail in the IRC report entitled, "Knik Arm Toll Bridge Anchorage Alaska MSA Traffic and Toll Revenue Investment Grade Study – Independent Economic Overview and Development Forecast."

HISTORICAL REGIONAL HOUSEHOLD AND POPULATION GROWTH

The total number of households in Anchorage increased by 18.7 percent between 1990 and 2000. This represents an average annual rate of 1.7 percent and is only slightly higher than the average annual growth rate of the state and the nation as a whole (1.6 and 1.4 percent, respectively). During the same time period, Mat-Su Borough grew at a substantially faster pace experiencing an increase of 54.7 percent in total households. This represents an average annual growth rate of 4.5 percent growth per year. This is comparable to annual growth seen in the fastest growing metropolitan area in the nation, Las Vegas, Nevada. Between 1990 and 2000, Las Vegas grew in population by 6.2 percent per year over the decade. The regional household and population growth from 1990 to 2000 is presented in Tables 1 and 2 and is based on data from the United States Census Bureau and IRC.

Table 1
Historical Household Trends by Borough - 1990 to 2000

	Number of Households			
Borough	**1990 [1]**	**2000 [2]**		**Average Annual Percent Change**
Anchorage Municipality	83,043	98,592		1.7
Matanuska-Susitna Borough	13,501	20,888		4.5
Total	96,544	119,480		2.2
Alaska	189,700	221,804	[1]	1.6
United States	91,993,582	105,539,122	[1]	1.4

Source:
[1] US Census Bureau, 1990 and 2000
[2] Insight Research Corporation, 2007

Table 2
Historical Population Trends by Borough - 1990 to 2000

Borough	Population 1990 [1]	2000 [2]		Average Annual Percent Change
Anchorage Municipality	226,338	260,283		1.4
Matanuska-Susitna Borough	39,683	59,322		4.1
Total	266,021	319,605		1.9
Alaska	550,043	626,932	[1]	1.3
United States	248,709,873	281,421,906	[1]	1.2

Source:
[1] US Census Bureau, 1990 and 2000
[2] Insight Research Corporation, 2007

With respect to population growth, similar trends can be observed from Table 2. The Anchorage-Mat-Su region added approximately 53,600 people to the total population, accounting for 70.0 percent of statewide population growth. In 2000, the Municipality of Anchorage and Mat-Su Borough accounted for over 50.9 percent of the total population of the State of Alaska.

Historical Regional Employment Growth

Between 1990 and 2000, the employment in the Municipality of Anchorage increased at an average annual rate of 1.9 percent, close to the average annual growth rate of the state and the nation as a whole (1.9 and 1.7 percent, respectively). During the same 10-year time period, Mat-Su Borough experienced a 72.2 percent increase in employment; an average annual growth rate of 5.6 percent a year. Historical regional employment growth from 1990 to 2000 is presented in Table 3.

The Anchorage-Mat-Su region added nearly 28,200 jobs between 1990 and 2000. This accounted for roughly 50.2 percent of all new jobs in the State of Alaska during this time period. By 2000, the Anchorage and Mat-Su Boroughs together accounted for over 44.9 percent of total statewide employment.

Table 3
Historical Employment Trends by Borough - 1990 to 2000

	Employment				
Borough	**1990**		**2000**		**Average Annual Percent Change**
Anchorage Municipality	111,400	(1)	134,400	(2)	1.9
Matanuska-Susitna Borough	7,200	(1)	12,400	(2)	5.6
Total	118,600		146,800		2.2
Alaska	270,370	(3)	326,596	(3)	1.9
United States	117,390,130	(3)	138,820,935	(3)	1.7

Source:
(1) Alaska Department of Labor, Industry Employment Estimates
(2) Insight Research Corporation, 2007
(3) US Census Bureau, 1990 and 2000

HISTORICAL REGIONAL HOUSEHOLD INCOME GROWTH

Alaska's statewide median household income was nearly 22.8 percent higher than the rest of the nation in 2000. Between 1990 and 2000, the median household income in Anchorage increased at an average annual rate of 2.4 percent, slightly higher than the average annual growth rate of the state which was 2.2 percent. Median household income in the Mat-Su Borough increased at an average annual rate of 2.3 percent a year. Locally, Anchorage has historically had a higher median household income than Mat-Su. In 1990, the median household income in Anchorage was 7.9 percent greater than that of Mat-Su. By 2000, this gap had increased to about 8.4 percent. This may be attributed in part to the increasing cost of living and housing prices in Anchorage during this period. Historical median household income from 1990 to 2000 is presented in Table 4.

Table 4
Historical Median Household Income Trends by Borough - 1990 to 2000

	Median Household Income		
Borough	**1990**	**2000**	**Average Annual Percent Change**
Anchorage Municipality	43,946	55,546	2.4
Matanuska-Susitna Borough	40,745	51,221	2.3
Total	84,691	106,767	2.3
Alaska	41,408	51,571	2.2
United States	30,056	41,994	3.4

Source:US Census Bureau, 1990 and 2000

STUDY AREA GROWTH FORECAST

As previously indicated, the independent transportation economics firm IRC was contracted to perform a comprehensive review of socioeconomic assumptions. Their initial effort concentrated on updating the historical information used in the 2005 study. For the 2005 study, WSA used socioeconomic data prepared by Institute of Social and Economic Research (ISER) at the University of Alaska. ISER prepared both a “build” scenario which presumed the construction of the proposed Knik Arm Bridge and “no build” scenario. At the time of the study, ISER data was current to 2002 past which all socioeconomic data was forecast. After reviewing the historical data prepared by ISER, IRC developed and incorporated an additional 4 years of historical data to bring the model socioeconomics current to 2006.

Following the revisions to the base model assumptions, IRC developed an independent socioeconomic forecast for the Municipality of Anchorage and Mat-Su Borough for future model years 2012, 2015, 2020, 2025, and 2030. The remainder of this section will provide a brief overview of their methodology and findings. A more detailed explanation of the methodology applied in the development of the IRC forecast can be found in the IRC report entitled, “Knik Arm Toll Bridge Anchorage Alaska MSA Traffic and Toll Revenue Investment Grade Study – Independent Economic Overview and Development Forecast.”

Independent Economic Overview and Development Forecast Methodology

The IRC socioeconomic forecast was based on the previously-discussed ISER forecast. IRC's goal was, first and foremost, to validate the data and assumptions used to develop the previous socioeconomic forecasts. This was done at a regional level as well as at a more refined traffic analysis zone (TAZ) level. The former provided broad checks on previous forecasts, while the latter was eventually incorporated into the travel demand modeling process and, ultimately, the gross toll revenue forecast.

The analysis consisted of reviewing project announcements, land use plans, planned industrial activity, plans for potential improvement in infrastructure such as sea and airport expansion, retail expansion, and news sources. In addition, data was gathered regarding available and developable land to provide an indicator of the likely sites and upward limitations of retail, commercial, and residential expansion. This information was supplemented with interviews conducted by IRC with key local contacts such as city planners, economic development professionals, tax assessors, real estate developers, and other local professionals. This data was then used to cross-check and update the ISER forecast. A complete list of contacts and data sources reviewed can be found in the IRC report.

Lastly, IRC reviewed regional aspects affecting employment volatility. Volatility is introduced primarily through the mining and natural resources sector of the local economy. Fluctuations in global commodities markets, quantity of active extraction operations, and regulations affecting exploration and extraction of natural resources can have a considerable affect on this employment sector. Fluctuation in the natural resources exploration and extraction sectors may, in turn, impact the various associated support and professional services consumed. IRC examined historical cycles of national economic volatility and how these fluctuations affected the Alaska economy. Within the limitations of the required five-year reporting intervals, the probable trend was calculated to incorporate potential cyclical fluctuations in the regional economy which might influence population and employment forecasts.

Impacts with respect to population and employment were developed for two distinct scenarios. The first scenario is the "no build" scenario under which the Knik Arm Bridge is not constructed. The second scenario is a "build" scenario which assumes a 2012 opening year for the Knik Arm Bridge. These two scenarios produce significantly different development patterns and socioeconomic outcomes due to the provision or lack of access to the developable lands north of Anchorage. Both scenarios are necessary in order to be able to gauge the impact of the bridge itself.

Forecasts were then prepared for the 2012, 2015, 2020, 2025, and 2030 future model years. For each year, three potential forecasts were created representing a low-growth scenario, a moderate "probable" scenario, and a high growth scenario. The remainder of this section will primarily discuss the build scenario under the "probable" growth assumptions as this is the set of assumptions ultimately used to produce the traffic and gross toll revenue forecast.

IRC REGIONAL FORECAST

As previously indicated, IRC conducted their analysis at a regional level for purposes of validation and at a TAZ level for use in the modeling process. Note that unlike the other 49 States, Alaska is not segmented by counties and townships, but by boroughs. The following is a summary of the findings of the regional analysis and provides data at the borough level.

In 2012, the assumed opening year of the Knik Arm Bridge, the population projected by IRC for the Municipality of Anchorage is the same as that forecast by ISER, while the employment is lower than the ISER forecast by 0.3 percent. By 2030, the IRC population (and households) forecast for Anchorage is higher than the ISER forecast by about 4.7 percent while the IRC employment forecast is higher than the ISER forecast by about 8.5 percent. Table 5 provides a comparison between the ISER population and household forecast and the corresponding IRC forecast for the Municipality of Anchorage from 2000 to 2030. Table 7 compares the ISER employment projections to the IRC projections for Anchorage for the same time period.

Similarly, Tables 6 and 8 compare the ISER and IRC projections for the Mat-Su Borough. In 2012, the IRC population forecast was higher than the ISER forecast by 7.1 percent. By 2030, the IRC population forecast becomes higher than the ISER forecast by nearly 22.7 percent. The IRC employment forecast for Mat-Su was only slightly higher than the ISER forecast, varying from 3.7 percent higher in 2012 to 0.7 percent higher in 2030.

IRC HOUSEHOLD AND EMPLOYMENT FORECASTS BY TRAFFIC ANALYSIS ZONE

In addition to the borough-level projections, IRC provided forecasts of population and employment at TAZ level. This finer level of analysis provides the detail needed to develop future travel patterns and traffic volumes in a much more specific manner.

Table 5
Municipality of Anchorage
Population with Bridge
2000 - 2030

	ISER Projection [1]			Insight Projection [2]		
Year	**Population**	**Percent Change**	**Households**	**Population**	**Percent Change**	**Households**
2000	260,300		98,598	260,283		98,592
2001	264,100	1.5	100,038	264,903	1.8	100,342
2002	268,700	1.7	101,780	267,824	1.1	101,448
2003	273,600	1.8	103,636	273,024	1.9	103,418
2004	277,900	1.6	105,265	277,627	1.7	105,162
2005	285,700	2.8	108,220	277,980	0.1	105,295
2006	288,700	1.1	109,356	282,813	1.7	107,126
2007	291,700	1.0	110,492	285,900	1.1	108,295
2008	294,600	1.0	111,591	289,400	1.2	109,621
2009	295,400	0.3	111,894	293,400	1.4	111,136
2010	297,300	0.6	112,614	297,300	1.3	112,614
2011	301,400	1.4	114,167	301,400	1.4	114,167
2012	309,100	2.6	117,083	309,100	2.6	117,083
2013	317,500	2.7	120,265	317,500	2.7	120,265
2014	321,500	1.3	121,780	321,500	1.3	121,780
2015	321,100	(0.1)	121,629	321,750	0.1	121,875
2016	319,200	(0.6)	120,909	322,600	0.3	122,197
2017	318,900	(0.1)	120,795	325,450	0.9	123,277
2018	319,600	0.2	121,061	328,300	0.9	124,356
2019	321,000	0.4	121,591	331,150	0.9	125,436
2020	322,800	0.6	122,273	334,000	0.9	126,515
2021	324,600	0.6	122,955	336,850	0.9	127,595
2022	326,700	0.7	123,750	339,700	0.9	128,674
2023	329,400	0.8	124,773	342,550	0.8	129,754
2024	332,200	0.9	125,833	345,400	0.8	130,833
2025	334,900	0.8	126,856	348,250	0.8	131,913
2026	337,100	0.7	127,689	351,100	0.8	132,992
2027	339,100	0.6	128,447	353,950	0.8	134,072
2028	341,300	0.7	129,280	356,800	0.8	135,152
2029	343,700	0.7	130,189	359,650	0.8	136,231
2030	346,100	0.7	131,098	362,500	0.8	137,311

Source:
[1] University of Alaska Anchorage Estimates to 2002
[2] Alaska Department of Labor July 1, 2006 estimates for years 2000 to 2006

Table 6
Mat-Su Borough
Population with Bridge
2000 - 2030

	ISER Projection [1]			Insight Projection [2]		
Year	**Population**	**Percent Change**	**Households**	**Population**	**Percent Change**	**Households**
2000	59,300		20,880	59,322		20,888
2001	61,800	4.2	21,761	61,765	4.1	21,748
2002	64,300	4.1	22,641	64,351	4.2	22,659
2003	67,500	5.0	23,768	67,532	4.9	23,779
2004	70,300	4.2	24,754	70,401	4.3	24,789
2005	72,700	3.4	25,599	74,011	5.1	26,060
2006	75,100	3.3	26,444	77,174	4.3	27,174
2007	78,500	4.5	27,641	80,674	4.5	28,406
2008	83,000	5.7	29,225	84,174	4.3	29,639
2009	89,700	8.1	31,585	87,674	4.2	30,871
2010	96,000	7.0	33,803	96,174	9.7	33,864
2011	102,000	6.3	35,915	105,174	9.4	37,033
2012	107,000	4.9	37,676	114,674	9.0	40,378
2013	114,000	6.5	40,141	124,174	8.3	43,723
2014	120,000	5.3	42,254	133,174	7.3	46,892
2015	124,600	3.8	43,873	142,174	6.8	50,061
2016	128,300	3.0	45,176	150,674	6.0	53,054
2017	131,900	2.8	46,444	159,174	5.6	56,047
2018	135,200	2.5	47,606	167,674	5.3	59,040
2019	139,700	3.3	49,190	176,174	5.1	62,033
2020	144,800	3.7	50,986	184,674	4.8	65,026
2021	150,000	3.6	52,817	193,174	4.6	68,019
2022	155,600	3.7	54,789	199,568	3.3	70,270
2023	161,500	3.8	56,866	205,954	3.2	72,519
2024	167,800	3.9	59,085	212,339	3.1	74,767
2025	174,000	3.7	61,268	218,730	3.0	77,018
2026	179,800	3.3	63,310	225,117	2.9	79,267
2027	185,500	3.2	65,317	231,510	2.8	81,518
2028	191,500	3.2	67,430	237,900	2.8	83,768
2029	197,900	3.3	69,683	244,300	2.7	86,021
2030	204,400	3.3	71,972	250,700	2.6	88,275

Source:
[1] University of Alaska Anchorage Estimates to 2002
[2] Alaska Department of Labor July 1, 2006 estimates for years 2000 to 2006

Table 7
Municipality of Anchorage
Employment with Bridge
2000 - 2030

	ISER Projection [1]		Insight Projection [2]	
Year	**Employment**	**Percent Change**	**Employment**	**Percent Change**
2000	130,900		134,400	
2001	134,900	3.1	138,200	2.8
2002	137,900	2.2	140,800	1.9
2003	140,700	2.0	142,300	1.1
2004	145,000	3.1	144,100	1.3
2005	148,400	2.3	146,600	1.7
2006	151,500	2.1	148,800	1.5
2007	152,900	0.9	150,800	1.3
2008	153,200	0.2	152,483	1.1
2009	154,000	0.5	154,166	1.1
2010	154,400	0.3	155,849	1.1
2011	156,700	1.5	157,532	1.1
2012	159,700	1.9	159,215	1.1
2013	162,100	1.5	160,898	1.1
2014	163,000	0.6	162,581	1.1
2015	161,200	(1.1)	164,264	1.0
2016	160,300	(0.6)	165,947	1.0
2017	159,800	(0.3)	167,630	1.0
2018	159,700	(0.1)	169,313	1.0
2019	160,800	0.7	170,996	1.0
2020	161,500	0.4	172,679	1.0
2021	162,300	0.5	174,362	1.0
2022	163,500	0.7	176,045	1.0
2023	165,100	1.0	177,728	1.0
2024	166,500	0.9	179,411	1.0
2025	167,900	0.8	181,094	0.9
2026	169,100	0.7	182,777	0.9
2027	170,200	0.7	184,460	0.9
2028	171,700	0.9	186,143	0.9
2029	173,200	0.9	187,826	0.9
2030	174,700	0.9	189,500	0.9

Source:
[1] University of Alaska Anchorage Estimates to 2002
[2] Alaska Department of Labor July 1, 2006 estimates for years 2000 to 2006

Table 8
Mat-Su Borough
Employment with Bridge
2000 - 2030

	ISER Projection [1]		Insight Projection [2]	
Year	**Employment**	**Percent Change**	**Employment**	**Percent Change**
2000	12,400		12,400	
2001	12,900	4.0	12,900	4.0
2002	13,900	7.8	13,900	7.8
2003	15,000	7.9	15,000	7.9
2004	15,800	5.3	16,100	7.3
2005	16,500	4.4	17,200	6.8
2006	17,100	3.6	18,300	6.4
2007	18,000	5.3	18,800	2.7
2008	19,300	7.2	19,300	2.7
2009	21,500	11.4	21,500	11.4
2010	23,800	10.7	23,800	10.7
2011	25,800	8.4	26,800	12.6
2012	27,200	5.4	28,200	5.2
2013	28,600	5.2	29,600	5.0
2014	30,300	5.9	31,300	5.7
2015	31,400	3.6	32,800	4.8
2016	32,700	4.1	33,100	0.9
2017	33,700	3.1	34,100	3.0
2018	34,700	3.0	35,100	2.9
2019	36,100	4.0	36,500	4.0
2020	37,600	4.2	38,000	4.1
2021	39,100	4.0	39,500	4.0
2022	40,800	4.4	41,200	4.3
2023	42,700	4.7	43,100	4.6
2024	44,700	4.7	45,100	4.6
2025	46,700	4.5	47,100	4.4
2026	48,400	3.6	48,800	3.6
2027	50,200	3.7	50,600	3.7
2028	52,200	4.0	52,600	4.0
2029	54,200	3.8	54,600	3.8
2030	56,400	4.1	56,800	4.0

Source:
(1) University of Alaska Anchorage Estimates to 2002
(2) Alaska Department of Labor July 1, 2006 estimates for years 2000 to 2006

Figures 1 through 4 show the IRC household forecast by TAZ for the forecast years 2012, 2015, 2020 and 2025, respectively. The largest gains in terms of total households are the Port MacKenzie and Big Lake areas in Mat-Su Borough. Figures 5 through 8 depict the IRC employment forecast over the same period. The largest increases in employment take place in two TAZs within the Port MacKenzie development zone.

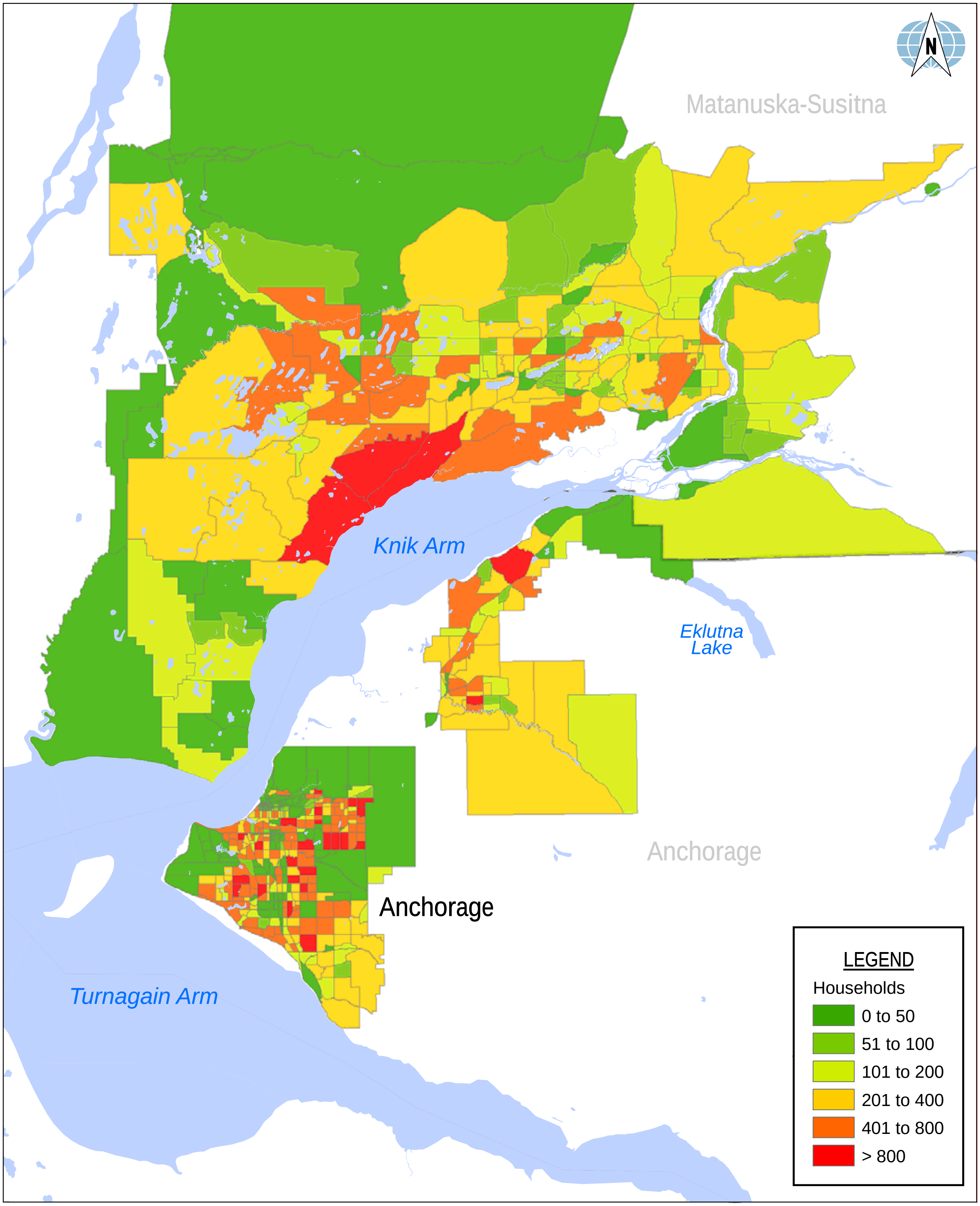
OBSERVATIONS

Historical socioeconomic data and recent trends clearly indicate that the Municipality of Anchorage and Mat-Su Borough have been experiencing higher-than-average growth in the number of households, total population, and employment. The population and employment in Mat-Su Borough in particular increased by approximately 50.9 and 72.2 percent, respectively between 1990 and 2000. Based on historical census data, socioeconomic data from the HDR traffic model, and the independent economic review performed by IRC, it is probable that the Anchorage-Mat-Su region in the vicinity of the Knik Arm Bridge will continue to experience significant growth.

CONVERSION OF SOCIOECONOMIC DATA INTO MODEL INPUT

Though model background and methodology are discussed at greater length in the Methodology section of this report, it is important to understand the progression of how the WSA model was developed and, with specific application to this section, how the socioeconomic data evolved and was incorporated into this modeling process.

The model used by WSA to estimate traffic and gross toll revenue for the preliminary-level study was based on a travel demand model developed by HDR Alaska, Inc. (HDR) in conjunction with Northern Economics, Inc. (NEI). The travel demand model including all the underlying socioeconomic inputs was the result of merging the existing Mat-Su travel demand planning model with the Anchorage Metropolitan Area Transportation Solutions (AMATS) model. This model also incorporates the assumptions from the ISER model used to forecast total population and employment in the Anchorage and Mat-Su region. ISER, Northern Economics, and other members of the Economic Working Group (EWG) developed these assumptions jointly. A second set of assumptions were also developed by HDR/NEI to addresses and analyze the impacts of a Knik Arm crossing on population and employment distributed across the greater Anchorage Mat-Su region under a "No Build" and "Build"



NUMBER OF HOUSEHOLDS BY TRAFFIC ANALYSIS ZONE - WITH BRIDGE - 2012

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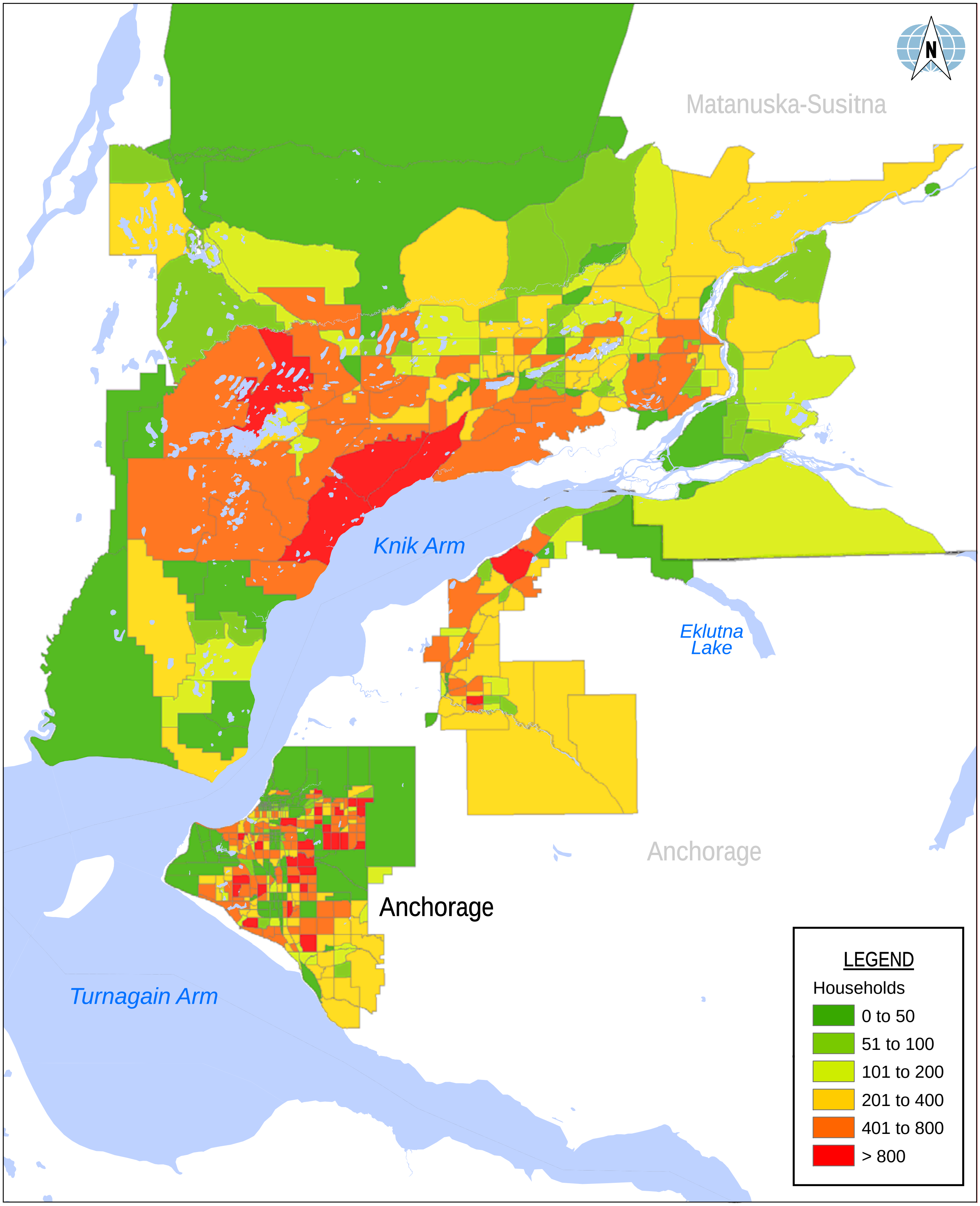

NUMBER OF HOUSEHOLDS BY TRAFFIC ANALYSIS ZONE - WITH BRIDGE - 2015

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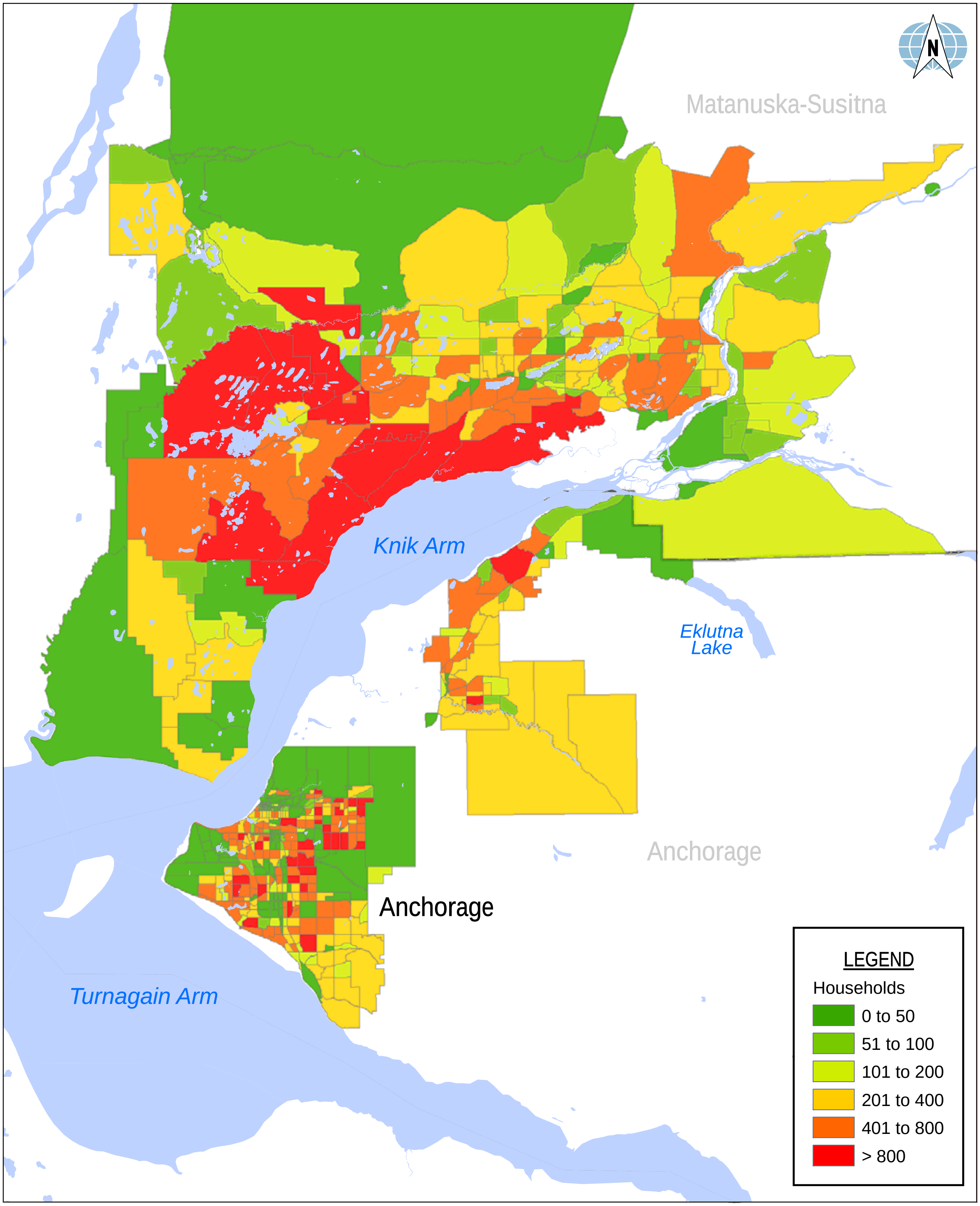
FIGURE 2



NUMBER OF HOUSEHOLDS BY TRAFFIC ANALYSIS ZONE - WITH BRIDGE - 2020

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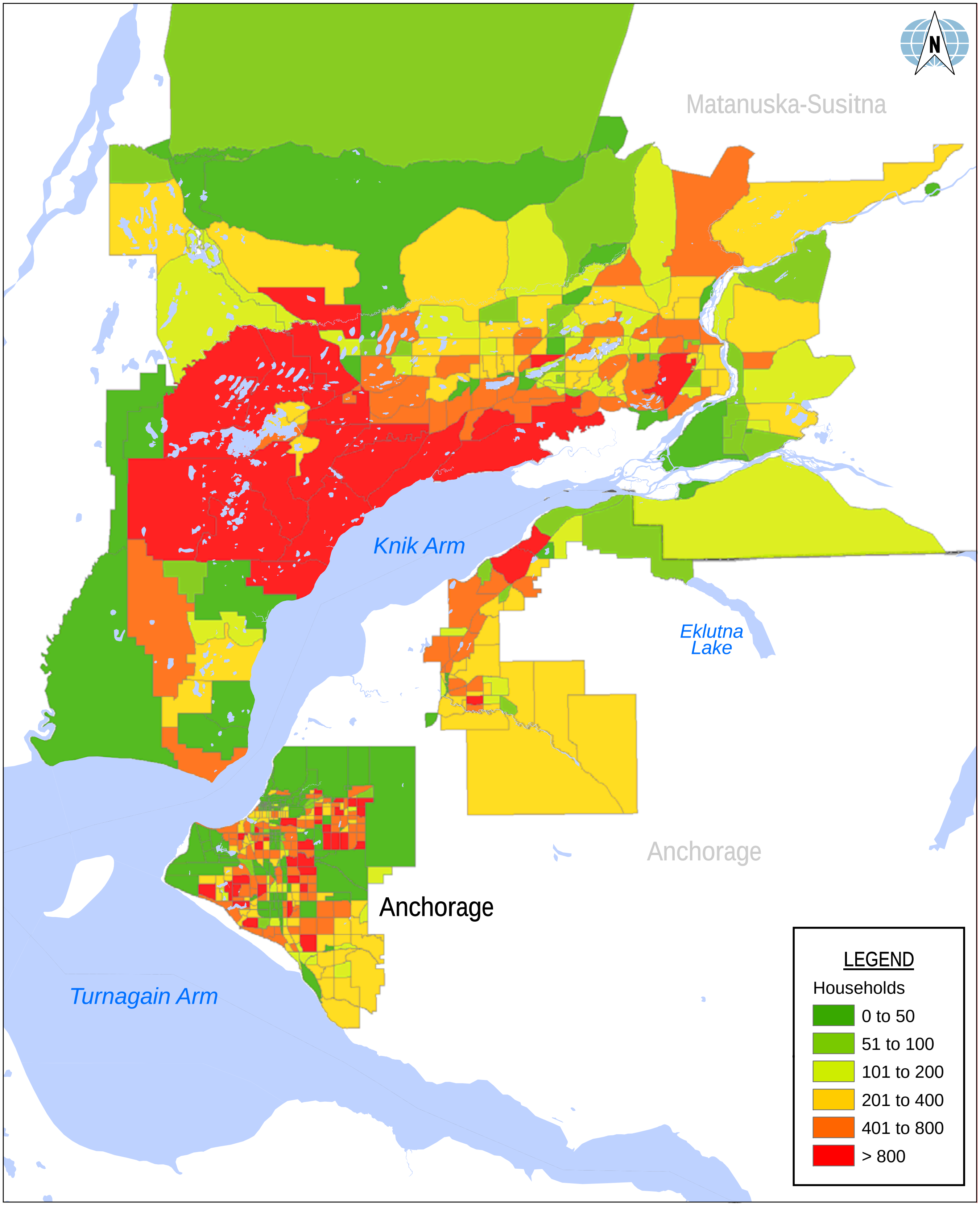
FIGURE 3



NUMBER OF HOUSEHOLDS BY TRAFFIC ANALYSIS ZONE - WITH BRIDGE - 2025

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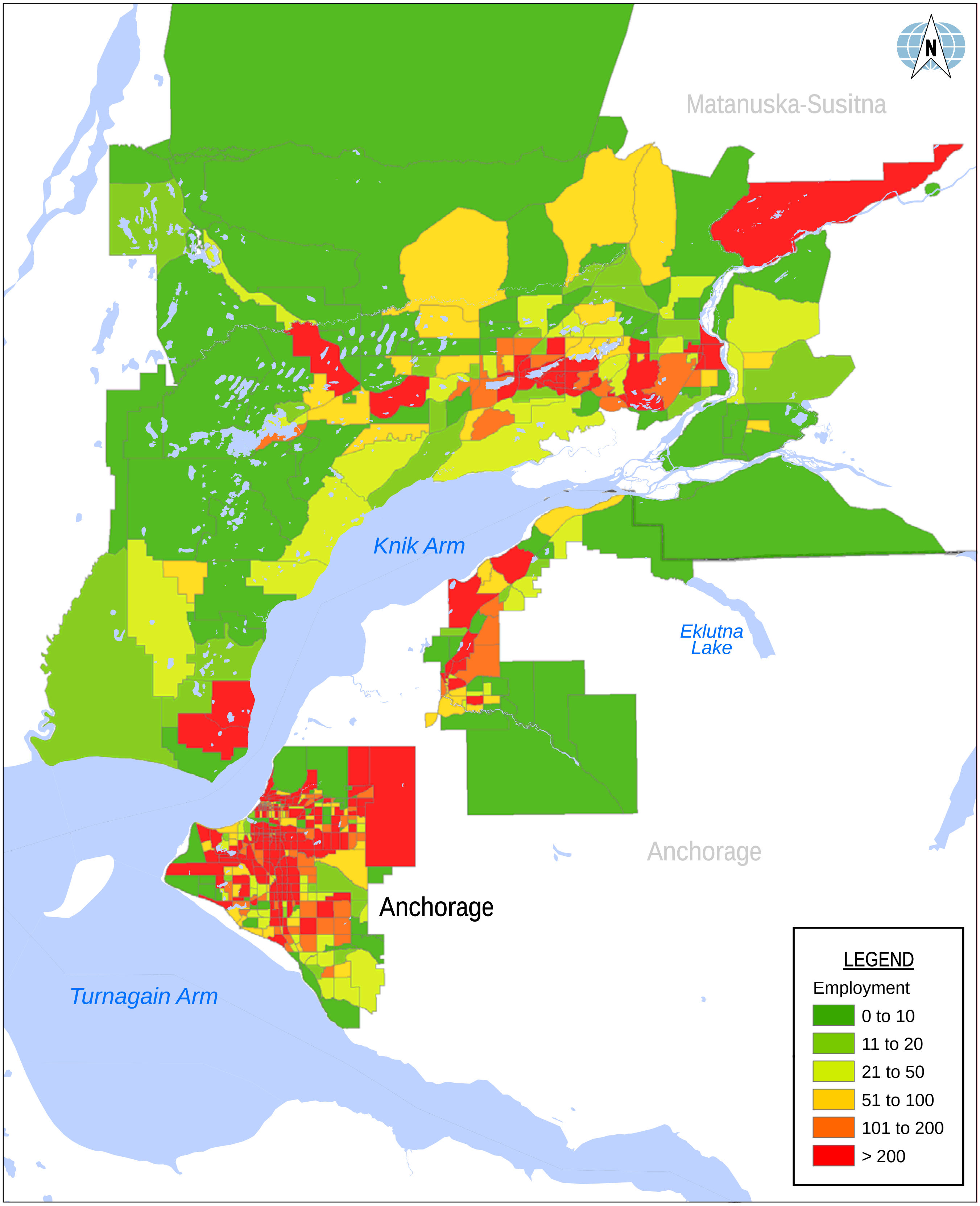
FIGURE 4



EMPLOYMENT BY TRAFFIC ANALYSIS ZONE - WITH BRIDGE - 2012

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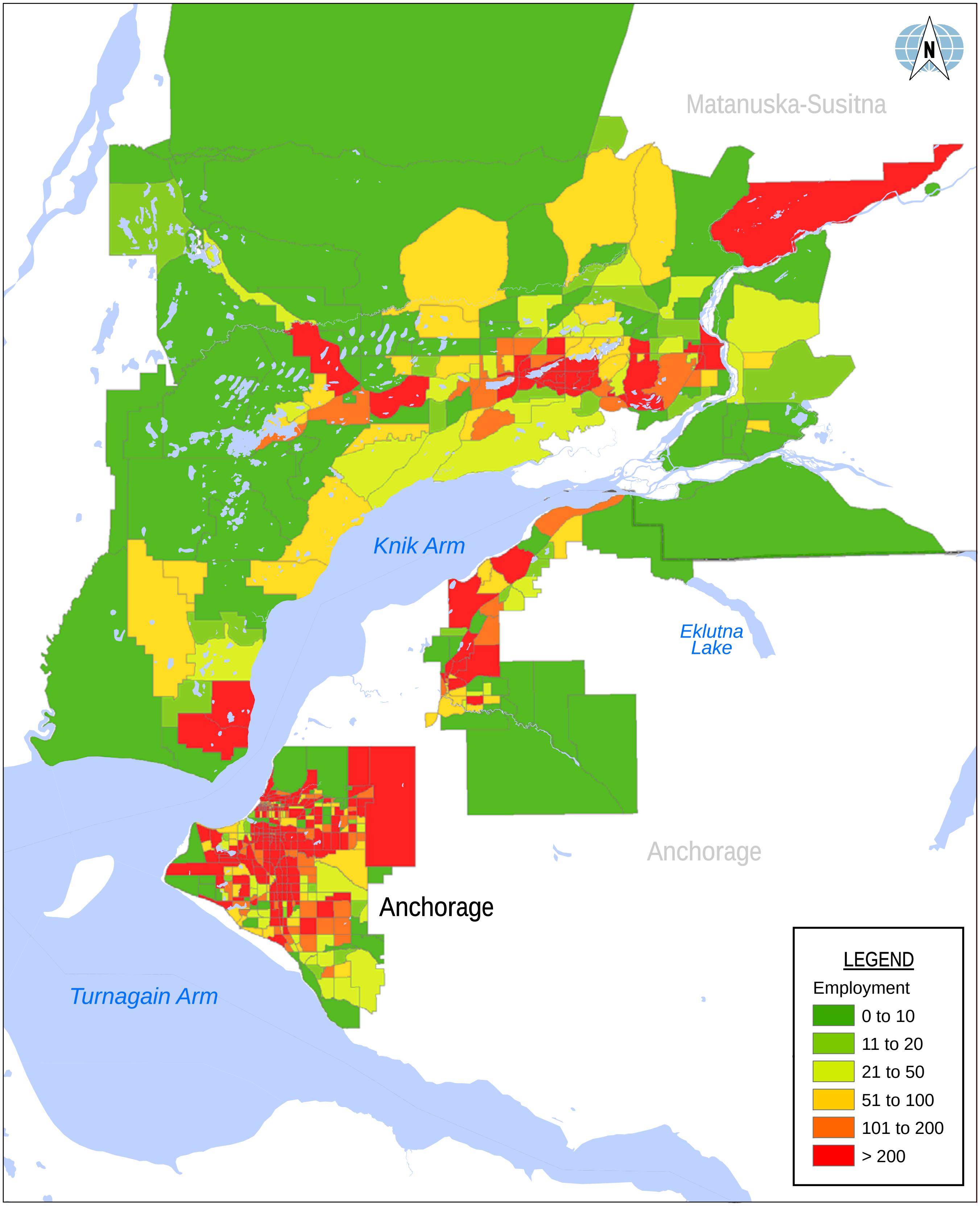
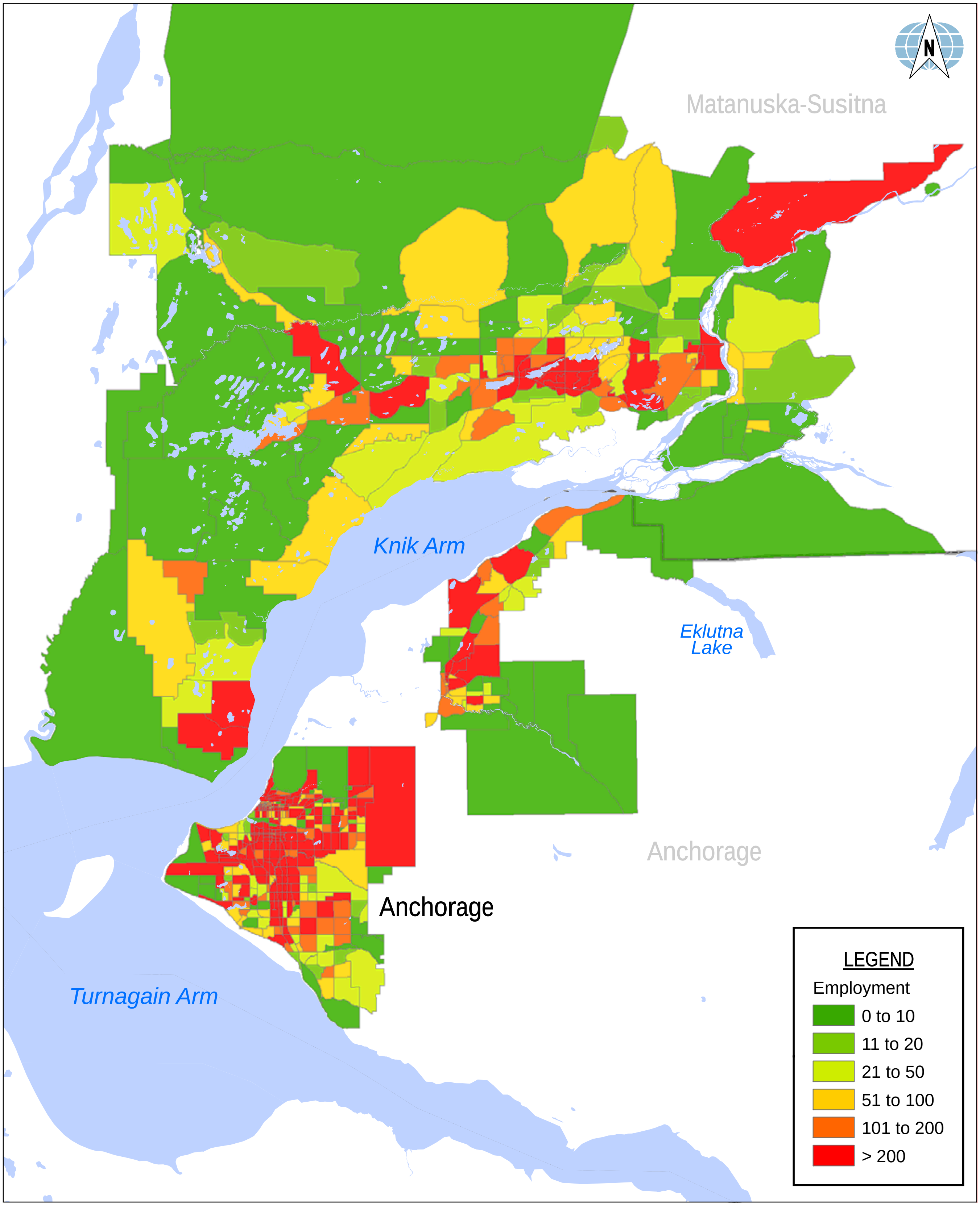
FIGURE 5



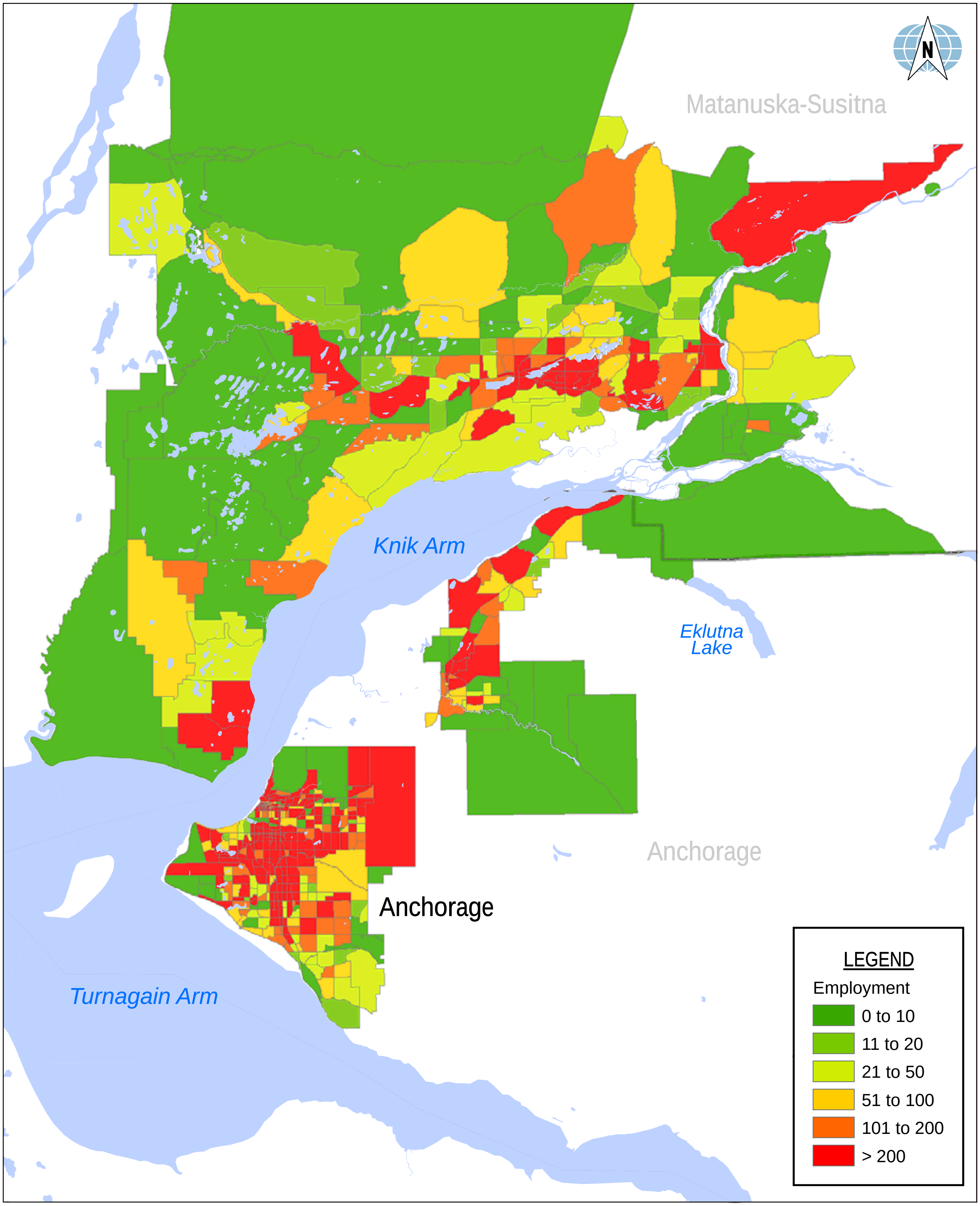
EMPLOYMENT BY TRAFFIC ANALYSIS ZONE - WITH BRIDGE - 2015

AK 100295/9-12-07/Employment - Adjusted IRC Medium SE Forecast - 2020 - With Bridge.mxd



EMPLOYMENT BY TRAFFIC ANALYSIS ZONE - WITH BRIDGE - 2020

FIGURE 7



EMPLOYMENT BY TRAFFIC ANALYSIS ZONE - WITH BRIDGE - 2025

FIGURE 8

alternative. The foundation of both sets of assumptions used ISER's model.

The HDR traffic model employs a trip generation procedure for the Mat-Su TAZs. The trip generation required households and employment by TAZ as input. The TAZ-level household and employment forecasts from IRC were directly used for model trip generation. For the Anchorage TAZs, the HDR model does not have a trip generation step for the Anchorage area. Instead, it uses productions and attractions from the AMATS model. For the Anchorage side, the trip productions and attractions were adjusted proportional to the IRC changes in households and employment, respectively. The modeling process itself is described in more detail in subsequent chapters.

PROJECT METHODOLOGY

KABATA/HDR MODEL

The model used for the proposed Knik Arm Bridge project was originally prepared by HDR Alaska, Inc. (HDR) for KABATA as a regional travel demand model. Because of the regional nature of this project, the separate Anchorage Metropolitan Area Transportation Solutions (AMATS) and Mat-Su travel demand models that were developed for planning purposes in their respective geographic areas are not well suited to this regional travel demand forecasting task. The principle difficulty lay in the treatment of land areas at the furthest extent of their respective models as external traffic analysis zones (TAZs). Generally speaking, external TAZs offer little detail with respect to roadway network or travel patterns. While this is a necessary practice as each model must have physical limits, the regional nature of the proposed bridge project required that previously external TAZs be brought into sharper focus where the geographic boundaries of the two models met. To meet the specific needs of this project, HDR developed a regional model by merging the AMATS and Mat-Su models. In doing so, travel patterns between the Anchorage metropolitan area and Mat-Su Borough could be modeled to represent existing conditions at 2000 levels with greater accuracy. This also ensured logical, consistent travel patterns between the two distinct geographic areas. The HDR model was updated in 2005 and most recently in May 2007.

The HDR model employs a traditional four-step modeling process and was developed using AMATS and Mat-Su base models for years 2000 and 2002. While the two predecessor models were developed using different base years, HDR felt that there was not sufficient cause to rework or recreate the existing two models from scratch. Both had recently undergone substantial updates in preparation for use in their respective Long Range Transportation Plans (LRTPs). The Mat-Su model required minimal updates to socioeconomic and network characteristics to be brought in line with the AMATS base year at which time the two sets of networks and the socioeconomic data sets were merged. The models were then standardized to a TransCAD platform and scripted using GISDK scripting language. The resulting model network is comprised of a total of 600 TAZs and 2,478 links as illustrated in Figure 9. HDR also developed future-year networks and trip tables for 2025 and 2030. The complete model was later provided to WSA.

WSA MODELING PROCESS

The WSA modeling process was conducted in two distinct stages: a preliminary analysis phase intended to provide KABATA with initial traffic impacts and feasibility data and a final analysis intended to be used in support of high-level planning and financial feasibility assessments. The following addresses the methodology employed in these two phases.

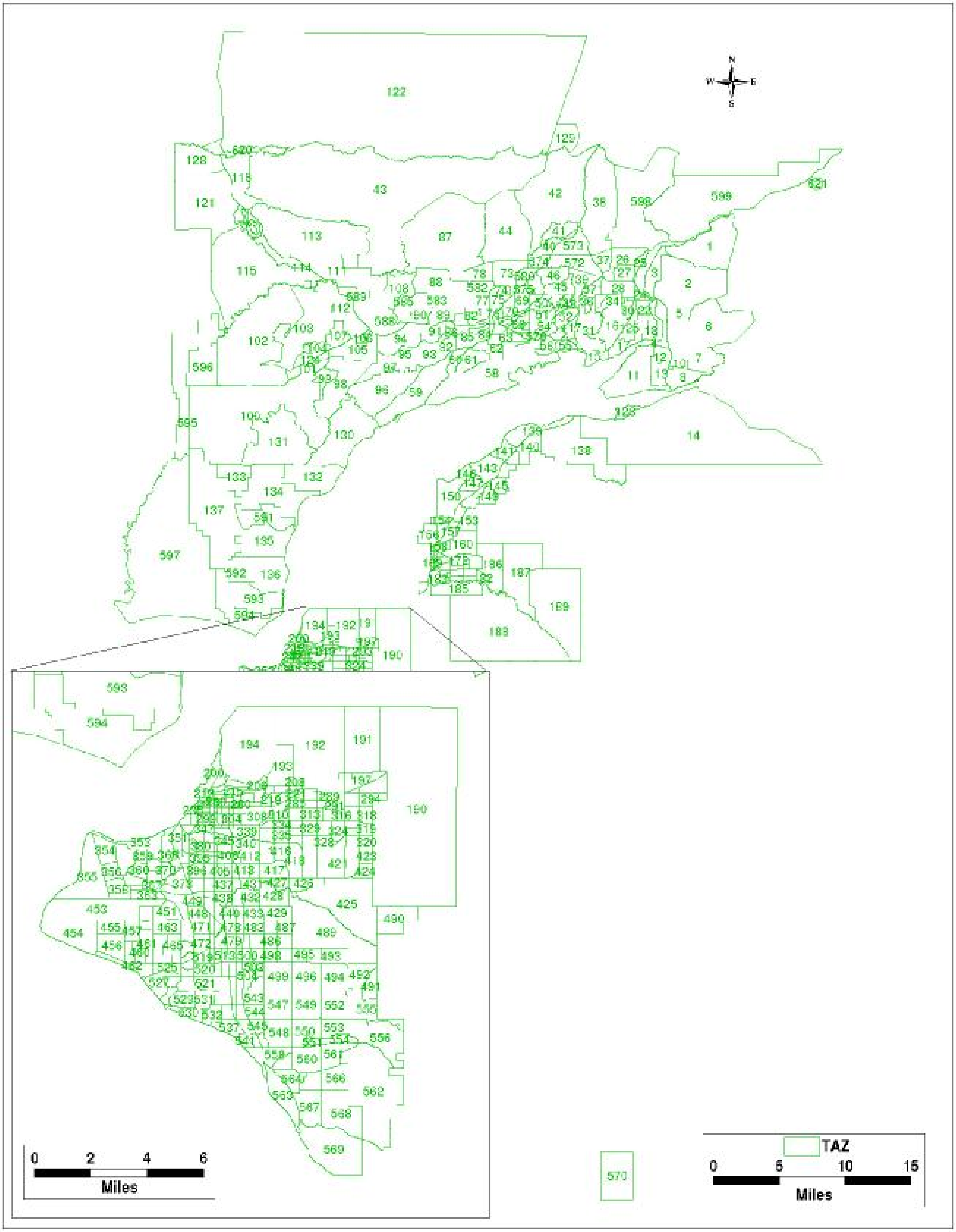
PRELIMINARY ANALYSIS

WSA received the HDR model in May 2007 along with the accompanying technical documentation for the purposes of a preliminary analysis. Upon receipt of the model, WSA reviewed the HDR year 2000 (base-year) network, updating link attributes to accurately reflect the current condition of the network as it existed in 2005 within the specific travel corridor of the proposed bridge. This also served as the base model year used by WSA for calibration purposes.

In addition to the network updates, the underlying socioeconomic data was reviewed and revised by independent economic analysts IRC. The revised 2005 network and trip tables were then subjected to an iterative calibration process whereby model output was compared to existing 2005 trip counts. Network and travel demand attributes were then reviewed and adjusted until model results accurately reflected observed travel patterns and volumes. The calibrated model was then used to produce an impact analysis for the proposed Knik Arm Bridge for 2005 and 2010. Future-year impacts were developed for 2015 and 2030 based on an unaltered HDR 2025 network augmented by updated socioeconomic data provided by IRC. These primary results were used in the early stages of planning and for impact analyses.

FINAL ANALYSIS

In August 2007 WSA conducted a more rigorous final traffic and toll revenue study. The final study, while similar to the preliminary study, involved a greater depth of analysis, confirmation of assumptions including origin – destination surveys and stated preference surveys, and a calibration update for year 2005. Much of this effort was expended on the



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MODEL COVERAGE AREA ZONE SYSTEM

FIGURE 9

revision and enhancement of the HDR provided 2000 and 2025 networks previously refined by WSA.

Network Revisions

Each network underwent extensive review and rigorous quality control procedures to ensure that each was an accurate representation of the transportation network including all projects listed in the official transportation planning documents on which they were based. To that end, a list of completed and proposed network improvement projects spanning 1998 to 2030 were collected and compiled from the following sources:

- Anchorage Metropolitan Area Transportation Solutions (AMATS) Transportation Improvement Plan (TIP) 1998-2000;
- Municipality of Anchorage TIP 2005-2009;
- Municipality of Anchorage Long Range Transportation Plan (LRTP) 2010-2025;
- Mat-Su Long Range Transportation Plan 2025; and
- Confirmation of projects from the Alaska Department of Transportation (DOT).

In addition, WSA conducted a thorough route reconnaissance and speed and delay study. Travel times and distances were measured using Global Positioning Systems (GPS) in conjunction with Geographic Information Systems (GIS) and dash-mounted full-motions video capture devices. Several runs were made along the Glenn and Parks Highways and selected roads in Anchorage. Primary routes were traveled and measured in both directions of travel during the AM and PM peak periods. Secondary speed and delay runs were made during off-peak periods. This data was then coupled with a comprehensive operating profile derived from past and current traffic trends to produce an accurate representation of travel conditions. For an in-depth review of these procedures, please see the WSA document entitled, “Technical Memorandum - Existing Traffic Conditions.”

Ultimately, the renewed refinement effort resulted in the production of the following four networks:

Year 2005

The HDR year 2000 network was used as the basis on which the refined WSA 2005 network was developed. The AMATS Transportation Improvement Program 1998-2000 includes projects that were scheduled to be completed by 2003 in the Anchorage area. All applicable projects listed in the TIP were added to the 2005 network after checking with Alaska DOT for further confirmation of project status. However, in the Mat-Su area, there is no available information of road improvements for the same time period. This is to be expected given the generally rural nature of the Mat-Su area and the lack of formalized plans for any major network improvements.

It should be noted that the 2005 network is the only network to directly reflect the observations made through the speed and delay process described above. Speed and delay and route reconnaissance data were compared to the base-year network to ensure that speeds, number of lanes, and other link attributes were properly coded. These changes were then applied through all future networks.

Table 9 presents a summary of all programmed network improvements derived from the various sources mentioned above. The year beside each entry indicates the model year in which the improvement is assumed to be completed and incorporated into the roadway network. Network improvements are illustrated in Figures 10 through 15 for the noted model year. Each improvement shown in the illustration is accompanied with a project identification number that corresponds to the Map Index number in Table 9.

Year 2012

The newly developed and calibrated 2005 network was used as the basis for developing the 2012 network. As 2012 was assumed to be the first year of operation for the completed Knik Arm Bridge, the proposed bridge was coded using the same configuration as was used in the 2030 HDR network

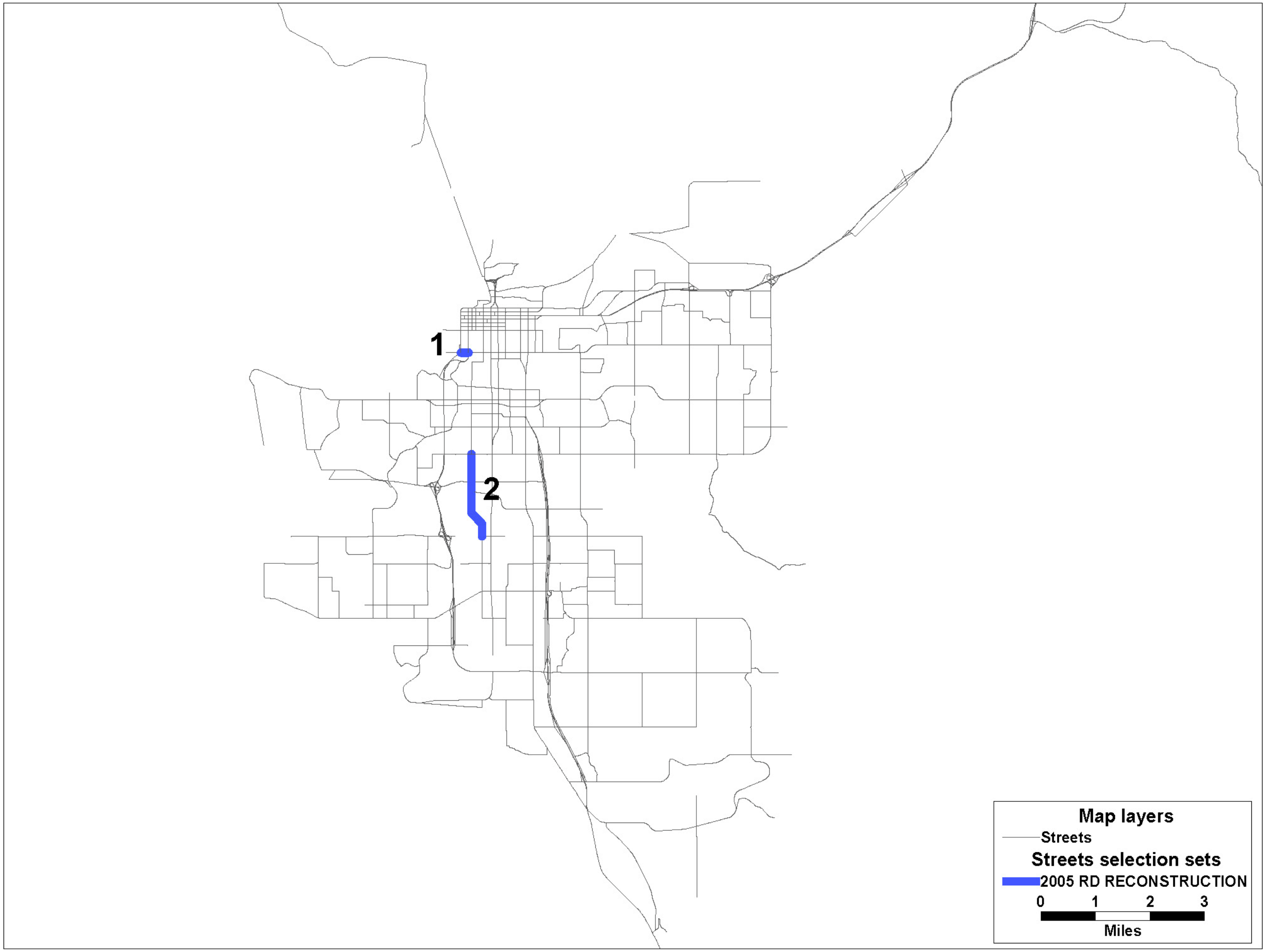
Projects listed for construction in the Municipality of Anchorage TIP 2005-2009 were added to the 2012 network. Two highway projects scheduled for completion by 2010 in the Mat-Su Borough's Long Range Transportation Plan were added as well. See Table 9 for a list of the added improvement programs in the 2012 network. Figures 11 and 12 are maps of Anchorage and Mat-Su, respectively. Network improvement projects are highlighted and are labeled to correspond to the Map Index value in Table 9.

Year 2015

The 2015 network was developed based upon the 2012 network previously described. Those projects listed in the Municipality of Anchorage's Long

Table 9
Included Highway Network Improvements

Year	Reference	Map Index	Project Number	Project Name
2005	AMATS TIP for year 1998-2000	1	R3	15th Ave reconstruction
2005	Municipality of Anchorage TIP	2	414	Artic Rd expansion
2012	Municipality of Anchorage TIP	1	202	C St. extension
2012	Municipality of Anchorage TIP	2	210	New interchange at Minnesota/C St.
2012	Municipality of Anchorage TIP	3	213	Abbott Loop extension
2012	Municipality of Anchorage TIP	4	214	Northern Lights Blvd upgrade
2012	Municipality of Anchorage TIP	5	215	3rd Ave. rehabilitation
2012	Municipality of Anchorage TIP	6	216	Hartzell Rd. extension
2012	Municipality of Anchorage TIP	7	217	Independence Dr. extension
2012	Municipality of Anchorage TIP	8	221	Raspberry Rd. extension
2012	Municipality of Anchorage TIP	9	309	New interchange at Bragaw Rd. /Glenn Hwy
2012	Municipality of Anchorage LRTP	10	502	Knik Arm Bridge and local street reconstruction
2012	Mat-Su Borough LTRP	1		Trunk Rd reconstruction
2012	Mat-Su Borough LTRP	2		Crusey St expansion
2015	Municipality of Anchorage LRTP	1	301	International Airport Rd. extension
2015	Municipality of Anchorage LRTP	2	304	68th Ave. extension
2015	Municipality of Anchorage LRTP	3	305	76th Ave. extension
2015	Municipality of Anchorage LRTP	4	308	Dowling Rd. extension
2015	Municipality of Anchorage LRTP	5	401	O'Malley Rd reconstruction
2015	Municipality of Anchorage LRTP	6	404	Old Seward Hwy reconstruction
2015	Municipality of Anchorage LRTP	7	406	Spenard Rd. reconstruction
2015	Municipality of Anchorage LRTP	8	407	Huffman Rd expansion
2015	Municipality of Anchorage LRTP	9	409	Abbott Rd expansion
2015	Municipality of Anchorage LRTP	10	416	Dowling Rd extension
2015	Municipality of Anchorage LRTP	11	418	100th Ave extension
2015	Municipality of Anchorage LRTP	12	507	Jewel Lake Rd. reconstruction
2015	Municipality of Anchorage LRTP	13	604	Boniface Pkwy extension
2015	Municipality of Anchorage LRTP	14	618	40th Ave. extension
2015	Municipality of Anchorage LRTP	15	628	92nd Ave extension (Brvaton Dr. to Abbott Rd)
2015	Municipality of Anchorage LRTP	16	801	92nd Ave extension (King St. and new Seward Hwy)
2015	Municipality of Anchorage LRTP	17	707	Glenn Hwy at Eagle River expansion
2015	Municipality of Anchorage LRTP	18	303	Seward Hwy Reconstruction
2030	Municipality of Anchorage LRTP	1	302	New interchanges at Seward Hwy/O'Malley Rd and Old Seward Hwy/O'Malley Rd
2030	Municipality of Anchorage LRTP	2	510	Minnesota Dr expansion
2030	Municipality of Anchorage LRTP	3	514	Re-stripe A/C St
2030	Municipality of Anchorage LRTP	4	621	New Minnesota Dr. Frontage road
2030	Municipality of Anchorage LRTP	5	627	Minnesota Dr expansion
2030	Municipality of Anchorage LRTP	6	638	New interchange at Tudor Rd/Minnesota Dr.
2030	Municipality of Anchorage LRTP	7	632	Lake Otis Pkwy extension
2030	Municipality of Anchorage LRTP	8	702	Elmore Rd extension
2030	Municipality of Anchorage LRTP	9	708	Rabbit Creek Rd upgrade
2030	Municipality of Anchorage LRTP	10	603	Glenn Hwy/Seward Hwy Connection
2030	Mat-Su Borough LTRP	1		Trunk Rd reconstruction
2030	Mat-Su Borough LTRP	2		Crusey St expansion
2030	Mat-Su Borough LTRP	3		Rainier St reconstruction



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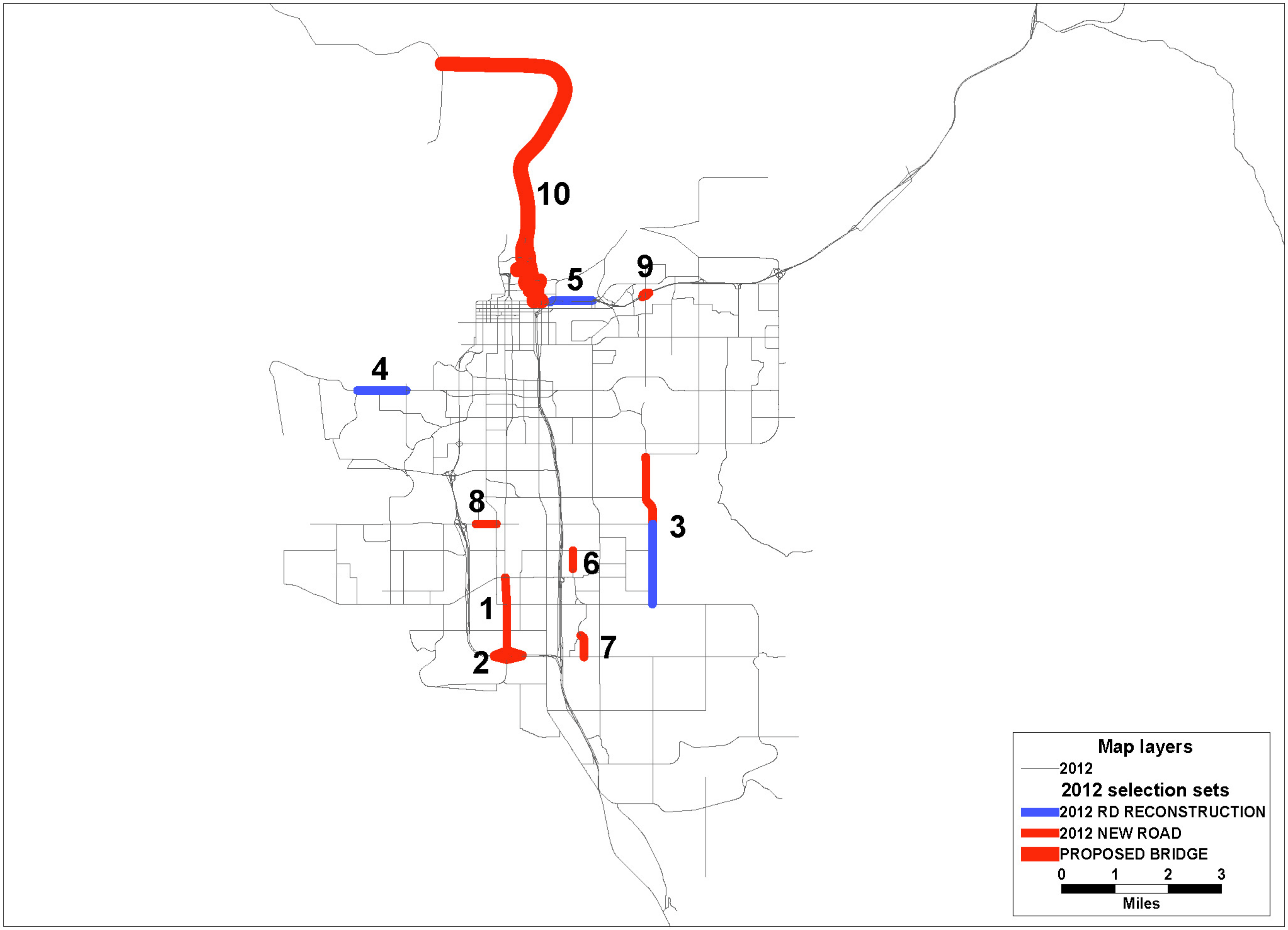
2005 NETWORK FOR ANCHORAGE

FIGURE 10



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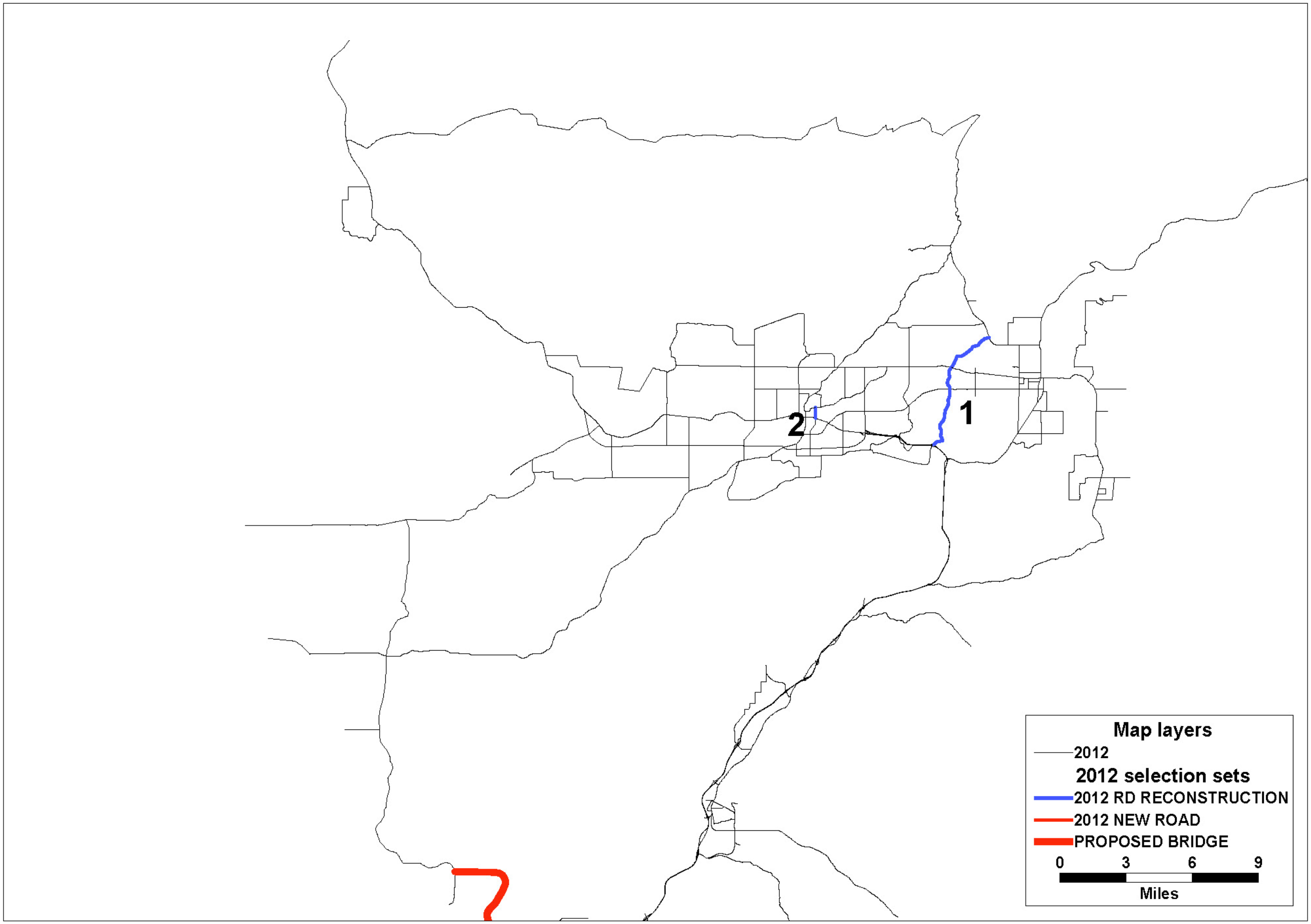
2012 NETWORK FOR ANCHORAGE

FIGURE 11



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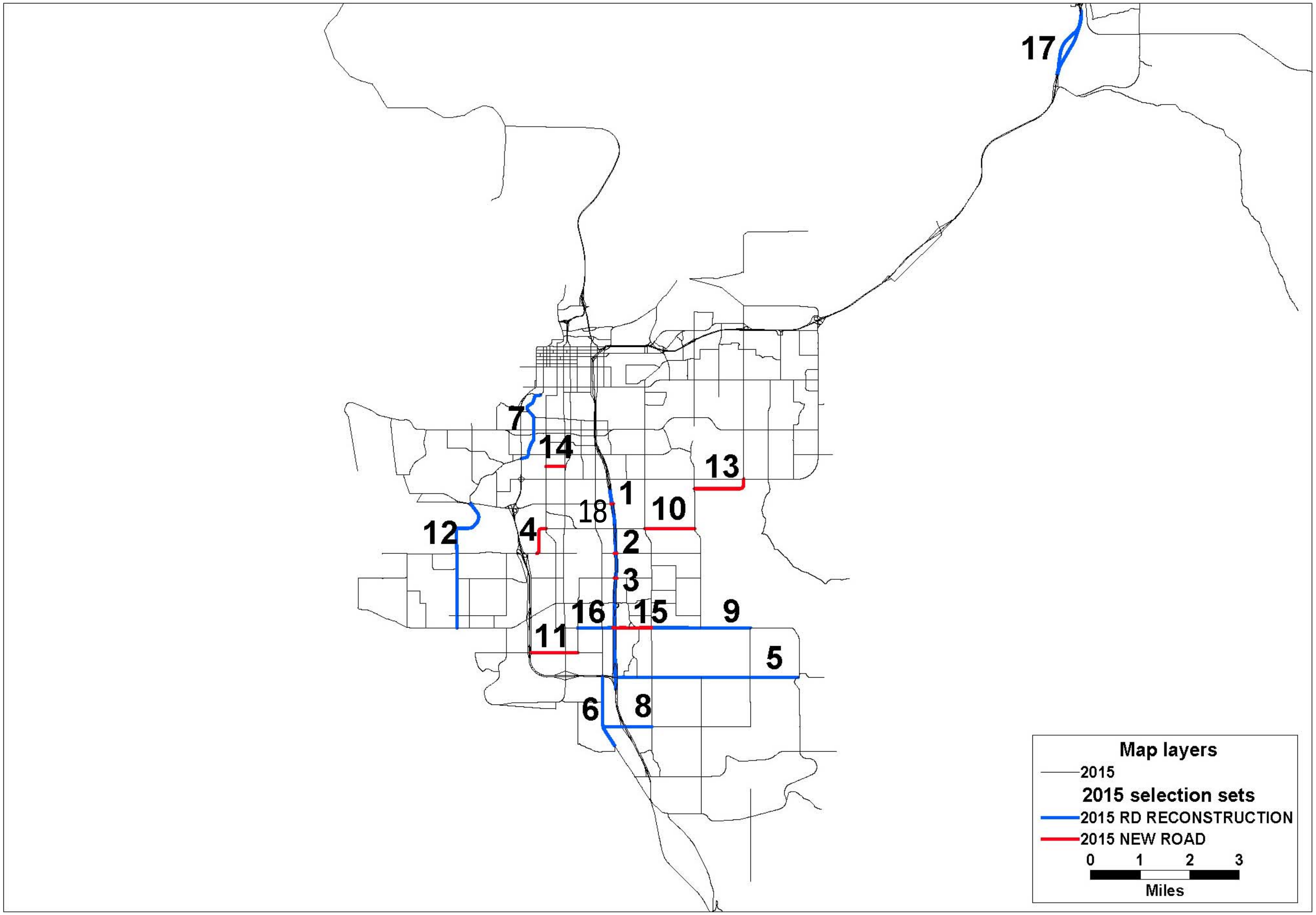
2012 NETWORK FOR MAT-SU

FIGURE 12



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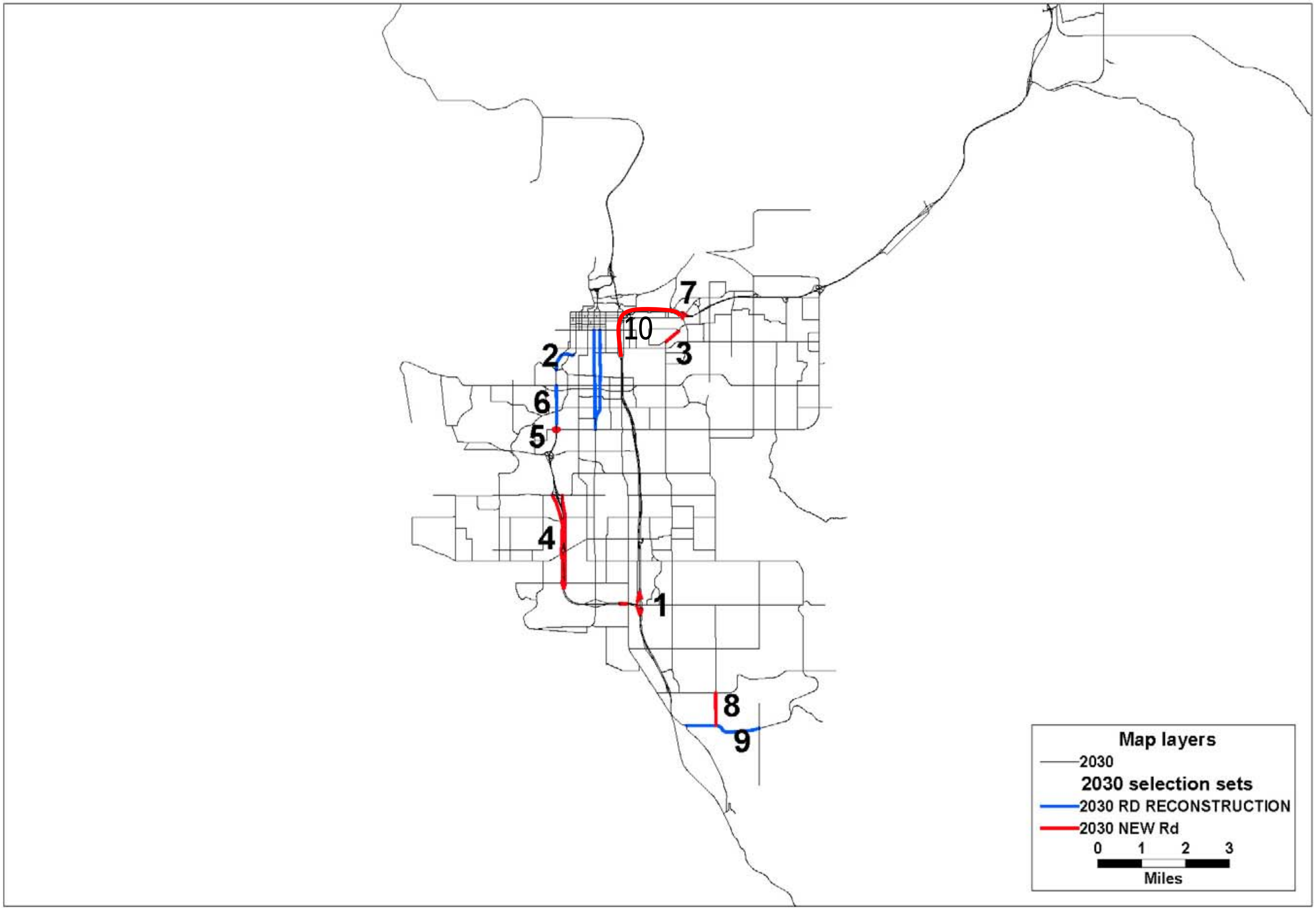
2015 NETWORK FOR ANCHORAGE

FIGURE 13



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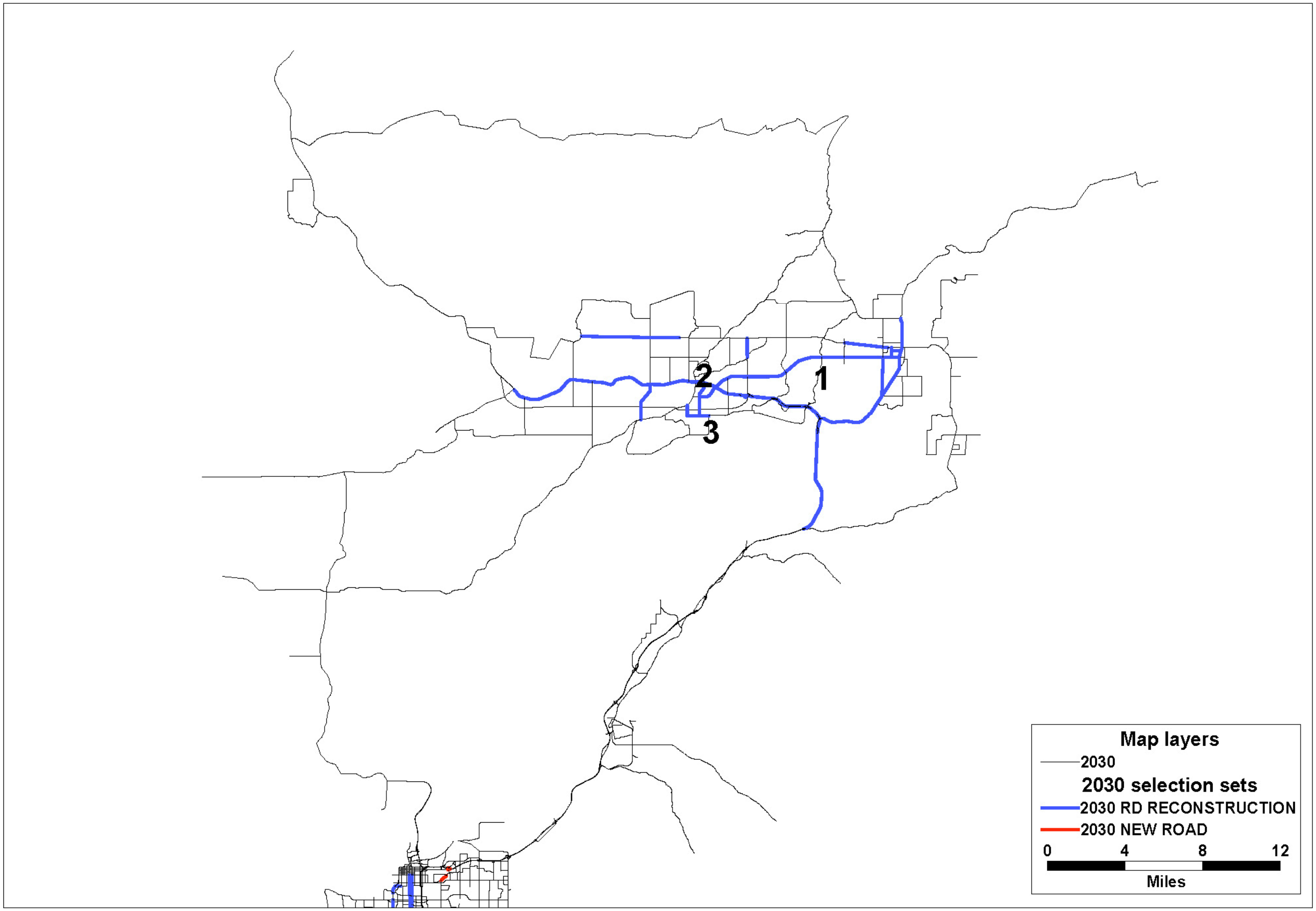
2030 NETWORK FOR ANCHORAGE

FIGURE 14



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2030 NETWORK FOR MAT-SU

FIGURE 15

Range Transportation Plan expected to reach completion prior to 2015 was added to the network. Once again, there is no additional information available regarding Mat-Su improvement programs for this time period.

See Table 9 for a list of the improvement programs added to the 2015 network. Figure 13 is a map with the highway improvement projects highlighted. No figure is included for Mat-Su as the network remains unchanged from the 2012 configuration in this area.

Year 2030

The 2030 network was based on the 2030 network provided by HDR and was augmented by the network improvement programs added to the previous years' highway networks. Additional network revisions include those improvements listed in the Municipality of Anchorage's Long Range Transportation Program and three highway projects listed in the Mat-Su Borough's Long Range Transportation Plan. See Table 9 for a list of the improvement programs added to the 2030 network. Figures 14 and 15 illustrate network revisions made to the Anchorage Metropolitan and Mat-Su area networks.

Trip Generation and Distribution Updates

In addition to the comprehensive review and enhancement of calibration and future-year networks, several other significant improvements were made. The first such improvement was the incorporation of the revised socioeconomic data, followed by incorporating the results from the Origin and Destination (OD) study conducted by WSA.

Socioeconomic Update

As discussed at length in the previous section, IRC made broad enhancements to the regional socioeconomic forecast and reflected the four additional years of actual performance since the original ISER forecast. The socioeconomic updates made by IRC improved the geographic accuracy and specificity of the data and reconciled disparity between the IRC forecast and alternate regional forecasts. By properly allocating population and employment, WSA was able to ensure that trips were not only being produced in the proper quantity, but in the correct location.

Origin and Destination Survey

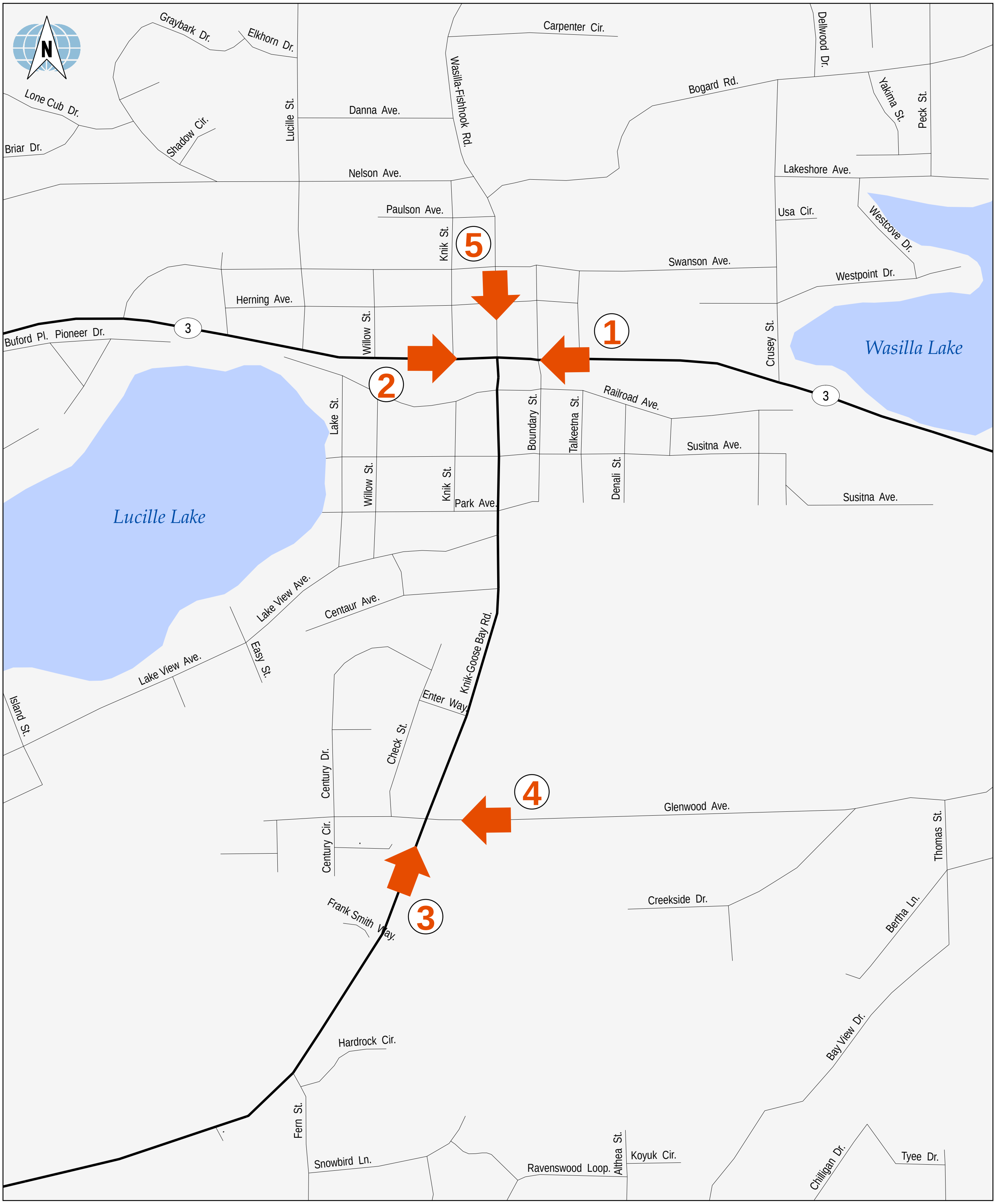
The purpose of the OD survey, an on-site roadside survey of area drivers' trip origins and destinations, is to identify actual or "real world" travel patterns within the study area to substantiate or augment the model's representation of traffic movements as represented in the trip tables. Since the trip table plays such a substantial part in determining travel volumes between two distinct points, it is critical that these patterns are accurately reproduced in the modeling process.

Prior to incorporating the OD data, all survey responses are filtered for validity. The first such filter simply assures that all questions were answered in full. Any questionnaires providing only partial data are removed from the pool. Next, responses are filtered for logical movements. A logical movement is one that can logically have passed through a survey station. A movement that begins and ends in Anchorage could not have logically been distributed at a Wasilla survey station. Survey station locations are illustrated in Figure 16. Questionnaires providing illogical movements are removed as well. Of the 12,923 surveys distributed, a total of 1,675 valid surveys were returned or 13 percent of the total.

Obviously surveys cannot be distributed to 100 percent of all passing vehicles. The total number of valid responses provides a statistically significant sample of vehicles passing through the survey point, but in order to be incorporated into the model the representative data must be expressed in terms of total daily traffic. This is achieved through a process known as "factoring." In the factoring process sample responses are applied to traffic counts taken in synchronicity with the distribution of the questionnaires. By knowing how many total vehicles passed through a given point it is possible to determine how many vehicles each response represents. If 12 percent of all surveys correspond to a particular movement, it can be inferred that 12 percent of the total number of vehicles passing through the survey station are coming from the same origin and are bound for the same destination.

The results of the OD survey are then compared to the original model trip tables. In brief, the OD study serves as a "reality check" and corrective mechanism by which the model's travel pattern assignments may be verified.

During the model calibration process, Anchorage trips were increased by 12 percent to bring vehicular activity in this model location closer to observed counts. Trips on the Glenn Highway south of Mat-Su were reduced slightly to achieve a closer fit to this important facility. These trip table adjustments not only affect the 2005 base calibration year, but are carried through to future-year trip tables as well. For additional information on the origin and destination survey, please see the WSA



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SURVEY LOCATIONS

FIGURE 16

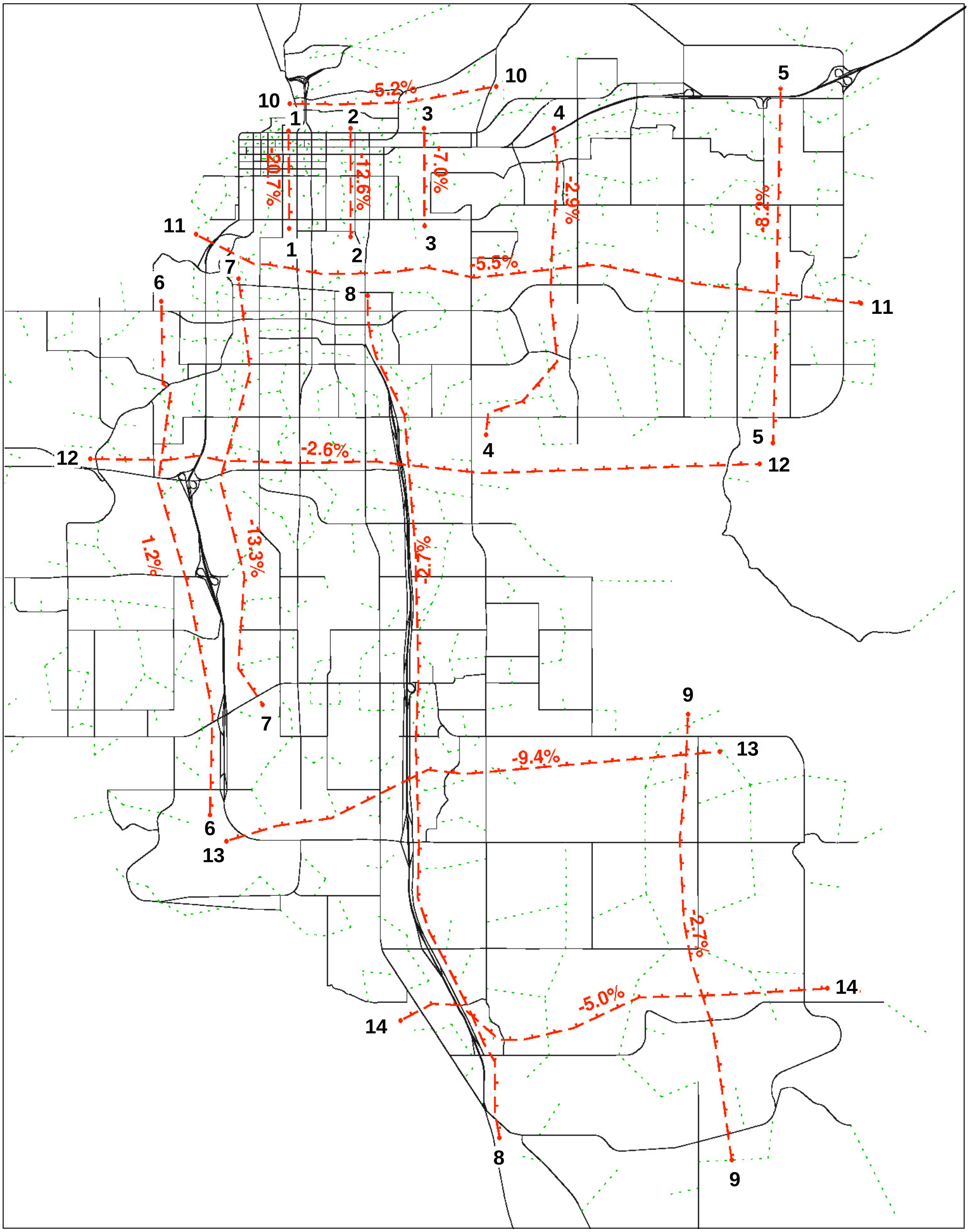
document entitled "Technical Memorandum: Proposed Knik Arm Bridge Origin and Destination Study."

BASE YEAR CALIBRATION

Once the aforementioned components had been refined and incorporated into the model, the base year model was calibrated to observed 2005 traffic volumes provided by the Alaska DOT. In total, the calibration process underwent seven iterations, each time making minor network corrections, alterations to travel patterns, and reconciling capacity. Specific attention was paid to the revision of traffic assignments on the Glenn Highway. At this point, the OD survey and the resulting travel pattern adjustment are calculated as a difference matrix; a TAZ-to-TAZ matrix indicating where travel patterns have increased or decreased. This matrix is added to the base and all the future-year models to reflect the calibrated travel pattern. The results of the final calibration screenline analyses are illustrated in Figures 17 and 18 with detail provided in Table 10.

Table 10
Screenline Analysis

Screen Line	2005 Traffic Count	Calibrated Assignment	Absolute Difference	Percent Difference
1	84,059	66,699	(17,360)	20.7
2	86,392	75,516	(10,876)	(12.6)
3	96,223	89,506	(6,717)	(7.0)
4	168,801	163,844	(4,957)	(2.9)
5	119,450	109,705	(9,745)	(8.2)
6	155,820	157,698	1,878	1.2
7	155,709	134,933	(20,776)	(13.3)
8	217,666	211,836	(5,830)	(2.7)
9	23,314	22,684	(630)	(2.7)
10	34,506	32,710	(1,796)	(5.2)
11	253,591	239,689	(13,902)	(5.5)
12	250,467	243,841	(6,626)	(2.6)
13	116,334	105,424	(10,910)	(9.4)
14	37,276	35,398	(1,878)	(5.0)
15	29,434	30,590	1,156	3.9
16	23,949	20,916	(3,033)	(12.7)
17	27,993	24,566	(3,427)	(12.2)
18	29,925	32,465	2,540	8.5
19	44,871	50,455	5,584	12.4
20	50,679	39,835	(10,844)	(21.4)
21	20,070	21,115	1,045	5.2
Total	2,026,529	1,909,425	(117,104)	(0.1)



2005 MODEL CALIBRATION SCREEN LINE STATUS
ANCHORAGE PERCENT TRAFFIC ASSIGNMENT / TRAFFIC COUNT

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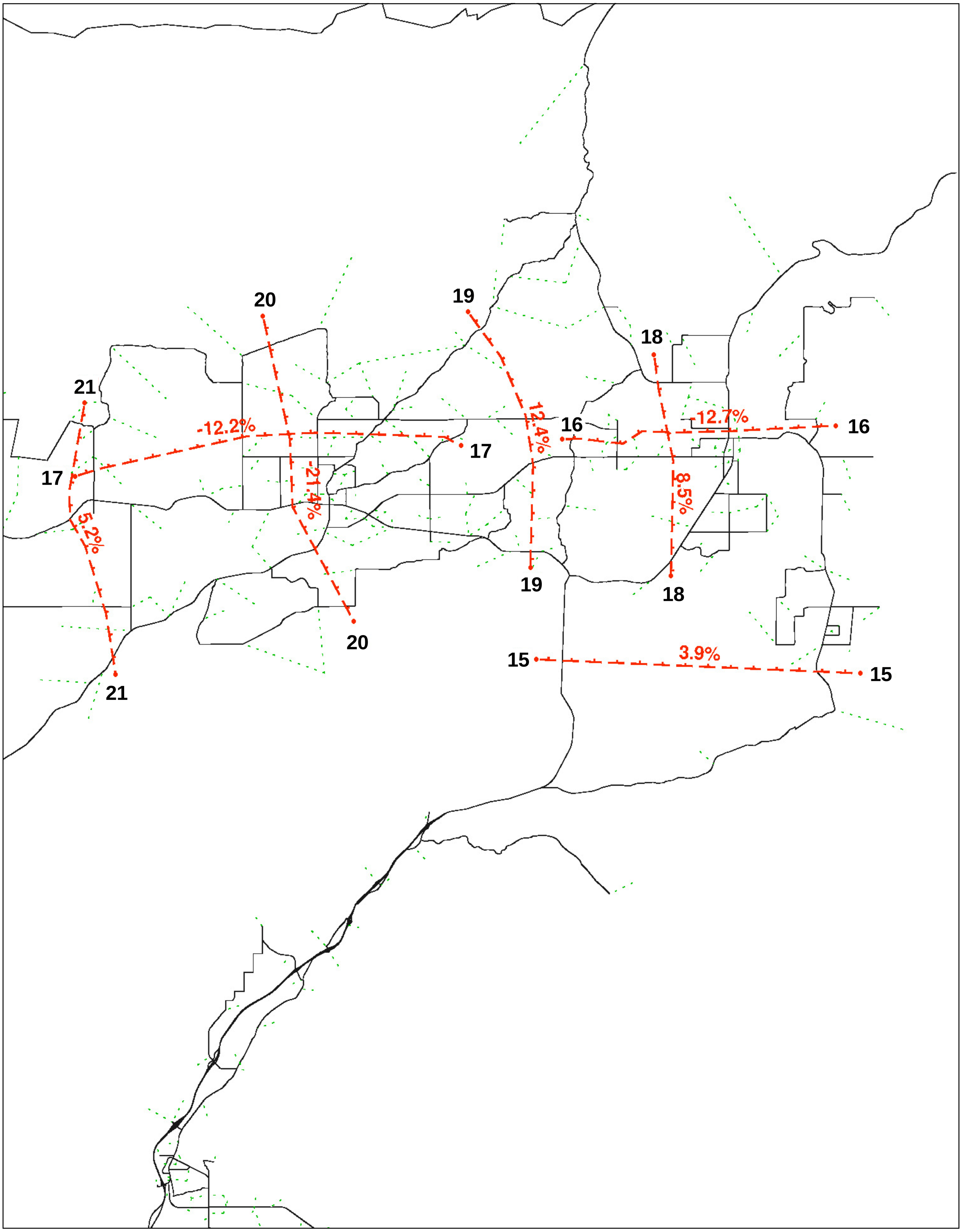
FIGURE 17



2005 MODEL CALIBRATION SCREEN LINE STATUS
MAT-SU PERCENT TRAFFIC ASSIGNMENT / TRAFFIC COUNT

Lastly, while screenlines are important for showing that the model correctly reflects trip movements in the system, an overall measure of how well the assigned volumes on all links replicate actual volumes is needed. This is most important for links with high volumes. The statistical measure used is called Root Mean Squared Error (RMSE) of estimates. To calculate RMSE, the count for each link is deducted from the assigned volume for that link. The difference is then squared. If the assigned volume and actual count are close, the difference between them is low and the RMSE value will be minimized. If there is a large difference between the count and the assigned volume, the measure grows at an increasing rate.

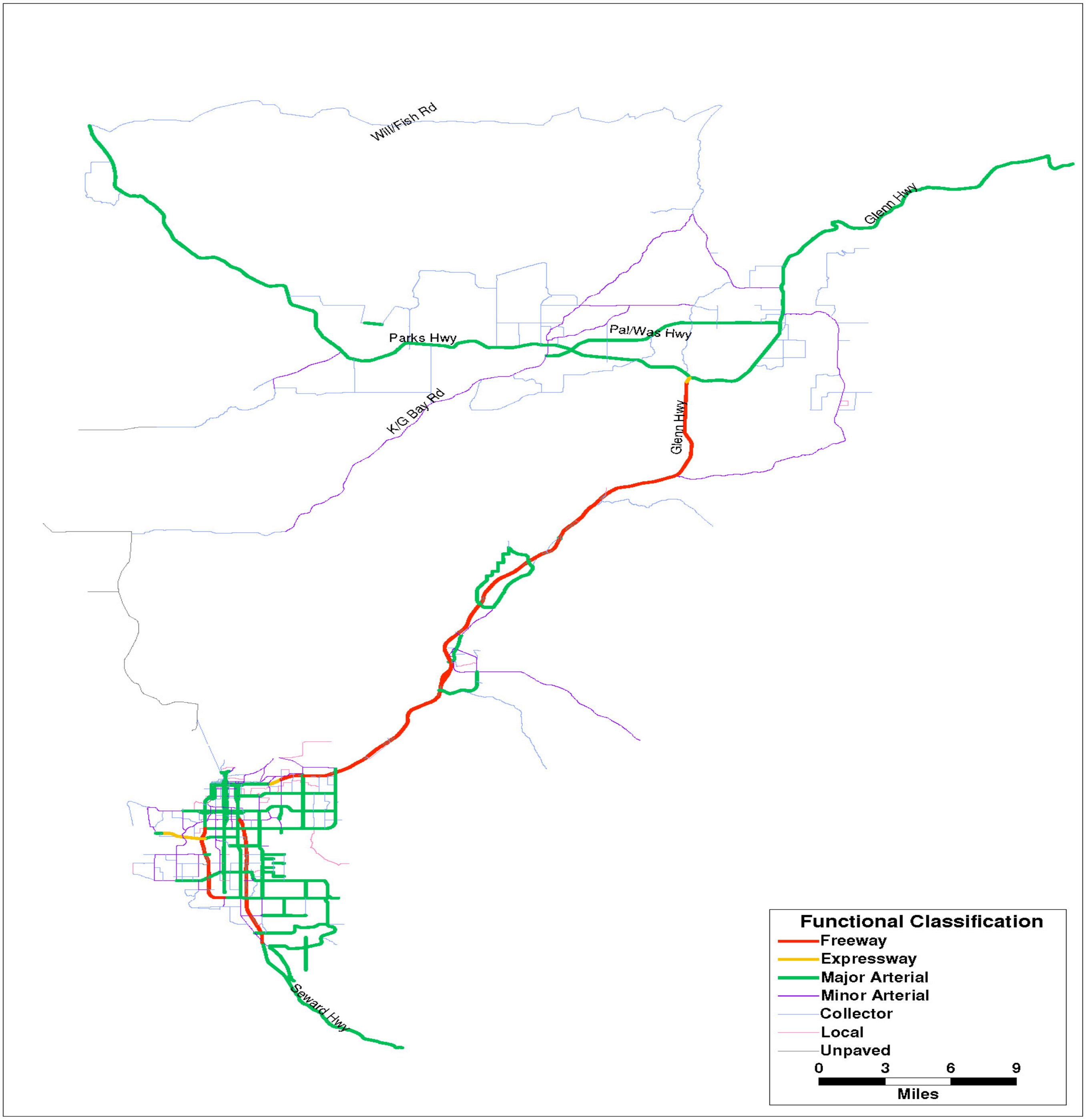
The formula for RMSE is:

$$\%RMSE = \frac{\left(\sum_i (Volume_i - Count_i)^2 / (Number\_of\_Counts - 1)\right)^{0.5}}{\left(\sum_i Count_i / Number\_of\_Counts\right)}$$

This value was calculated for each individual function class and for all roads. Generally, a RMSE of less than 40.0 percent is necessary to indicate a sufficiently calibrated model at the regional level. The final calibration update assignment performed by WSA produced an overall RMSE of 29.1 percent indicating a performance much better than the threshold of acceptable results. Percent RMSE value for each function class are shown below in Table 11 and is followed by a function class and capacity illustration in Figure 19.

Table 11
Validation Statistics for Year 2005 by Facility Type

Facility Type	Number of Links	Percent RMSE	Percent Error
Freeway	27	12.13	5.33
Major Arterial	186	24.27	-9.86
Minor Arterial	126	30.75	-7.25
Collector	121	56.97	-24.41
Total	**460**	**29.06**	**-8.51**



Capacity (vehicles/hour)

Function Class	Central Business Dist. No Median	Central Business Dist. Median	Commercial/Industrial No Median	Commercial/Industrial Median	Fringe No Median	Fringe Median	Rural No Median	Rural Median	Limited Access	No Direct Access
Freeway	--	--	--	--	--	--	--	--	--	195,000
Expressway	--	--	--	--	--	--	--	--	15,000	--
Major Arterial	8,300	9,200	8,300	9,200	8,300	9,200	7,400	9,200	--	--
Minor Arterial	7,500	8,300	7,500	8,300	7,500	8,300	6,200	8,300	--	--
Collection	6,500	--	6,500	--	6,500	--	5,000	--	--	--
Local	5,500	--	5,500	--	5,500	--	5,500	--	--	--
Unpaved	--	--	--	--	--	--	--	500	--	--

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YEAR 2005 ROAD NETWORK FUNCTIONAL CLASSIFICATION

FIGURE 19

MODEL PLATFORM CONVERSION IN FORECAST PROCESS

As previously mentioned, the original HDR model was created using a TransCAD platform. To this point, all calibration efforts and future-year model revisions and enhancements performed by WSA had been applied to WSA's enhanced TransCAD model. Once the model was determined to be replicating actual traffic counts and performing within acceptable parameters with respect to the 2005 calibration year, WSA began converting the model for use in the alternate modeling platform, Citilabs Cube Voyager. The change in modeling platform was necessary in order to apply WSA's proprietary toll diversion algorithms which are written for use in Voyager. These algorithms are essential for performing toll sensitivity and diversion analyses which form the basis of the traffic projection and the resulting revenue forecast.

To ensure the integrity of the conversion process, the newly converted Voyager model was run in conjunction with the TransCAD model for the 2005 calibration year. The resulting traffic assignments from both models were then closely scrutinized for any deviation or anomaly. Once it had been determined that the conversion process performed within acceptable parameters, the TransCAD-generated networks and trip tables were all subject to the conversion process.

TRIP PURPOSE CONVERSION

The five trip purposes in the TransCAD model were combined into three trip purposes: work, non-work, and truck. This was done to correspond to the trip-type classifications used by (RSG in the conduct of the stated preference survey. Table 12 shows the equivalency in the model and stated preference survey.

Table 12
Trip Purpose Equivalency

Purpose	Equation
WRK	HBW + NHB * 0.5
NWK	HBO + NHB * 0.5
TRK	SINGLE + COMBI

WRK = Work-related
NWK = Non-work
TRK = Truck
HBW = Home-based work
NHB = Non-home based
SINGLE = Single-unit commercial vehicle
COMBI = Multi-unit commercial vehicle

NETWORK CONVERSION

The binary formatted TransCAD networks were exported to text data files, which were used to build Voyager networks. All the important link attributes such as distance, speed, capacity, and facility type were preserved. As Voyager is used for future-year traffic and revenue sensitivity test, there was no need to convert calibration year 2005 data sets. Therefore, TransCAD 2012, 2015, and 2030 networks were converted and checked to ensure correct conversion.

TRIP TABLE CONVERSION

TransCAD trip matrices were exported to text data files, which were then used to generate identical Voyager trip tables. Three trip purposes are defined within the trip tables; work trips, non-work trips, and truck trips. Because the conversion process retains trip values to the decimal point, the trip conversion process is precise.

TRAVEL DEMAND FORECASTING PROCESS

Upon completion of the calibration and conversion process, model runs were required for all future model years; 2012 (opening year), 2015, 2020, 2025, and 2030. While it would have been possible at this point to simply introduce the toll bridge at various rates in future years and gauge the impact, doing so would have ignored a very important component of how traffic is generated and distributed.

The calibrated trip tables as described earlier in this section are based on a trip distribution that assumes no direct means of crossing the Knik Arm Bridge. As such, the places where people choose to live and work are different than they would be if crossing the bridge were possible. In other words, a resident of Anchorage would be unlikely to choose to work or shop in the Point MacKenzie area under the current (no build) network configuration. Therefore, when the trip tables are generated very few trips will be assigned to such an origin and destination pair. However, once the bridge is added to the network, the entire dynamic of traffic distribution changes. The likelihood of someone living in Anchorage and shopping or working on the other side of the bridge becomes far more likely. Moreover, trip movements between origin and destination zones are affected by the cost of the trip. For example, if tolls are very high commuters may be hesitant to take a job that requires a large financial outlay for daily travel. As such, separate trip tables were developed for each future model year under the following scenarios:

- The Knik Arm Bridge is in place, under a no toll scenario. The resulting trip distribution would be more favorable to establishing travel patterns which require a bridge crossing.

- The Knik Arm Bridge is in place with a low toll rate. The resulting trip distributions would still generate more trips crossing the bridge, but the number of trips doing so would be slightly dampened by the toll.

- The Knik Arm Bridge is in place with a high toll rate. Again, more trips will be generated with origins and destination on either side of the bridge than would be without the bridge, but the high toll suppresses the numbers ever further.

However, it is not sufficient to simply generate these three trip tables since the trip distribution process relies not just on where activity takes place (e.g., jobs, housing, retail, and commercial activity) but also the volume in which these activities occur. To account for several possibilities, IRC developed three socioeconomic forecasts under low, moderate, and high growth scenarios. Coupled with the previous three scenarios dealing with the bridge conditions, a total of nine trip tables were developed for each model year.

With these trip tables in place, WSA began to run toll sensitivity tests to determine bridge traffic under a range of toll rates. Recall that the trip distribution process explained above only described the process whereby origin and destination pairs are generated. The actual route used by motorists is not determined until the trip assignment phase. At this point, motorists have the choice of a multitude of routes between their origins (e.g., Anchorage) and their destinations (e.g., Port MacKenzie); some which utilize the bridge and other which do not. The decision to use the bridge is based in part on the value of time and distance saved by using the toll facility. As models employing a range of toll rates are run, a curve referred to as the "toll sensitivity curve" begins to emerge. This curve indicates how many trips will be diverted away from the bridge as the toll rate increases from a baseline value of $0.00. Sensitivity analyses were run for a range beginning with the toll free scenario and testing tolls up to and including $6.00 for a one-way trip.

In total, over 300 scenarios were developed and tested utilizing the WSA refined traffic forecasting model. The model results provide a broad range of trip distributions, corresponding time and distance savings, and traffic estimates on the proposed Knik Arm Bridge. The section that follows presents only a small sample of those results felt to be representative of the process.

TRAFFIC DISTRIBUTION AND TRAVEL PATTERNS

To help understand the effect of the toll bridge on route choice and traffic patterns, Tables 13 and 14 list the top traffic analysis zones from which bridge traffic originates. Illustrations (Figures 20 through 25) follow their respective tables. Note that because of the large number of possible scenarios, only a small subset has been chosen to illustrate these impacts. The scenarios below all use the trip tables generated using the moderate socioeconomic growth assumptions, "low toll" distributions, and travel patterns at a $5.00 toll rate. It should be noted that these scenarios are for illustrative purposes only and do not represent the final conclusions or recommendations of WSA. For report conclusions, please see the "Traffic and Gross Toll Revenue Forecast" section of this report.

The following observations are based on the data presented above:

1. In 2012 the 10 most active Anchorage traffic analysis zones (TAZs) accounted for 13.2 percent of all northbound bridge traffic.

2. By 2030 the same 10 Anchorage zones account for 13.7 percent of all northbound bridge traffic.

3. All 10 Anchorage TAZs contribute equally to bridge traffic. There was no single dominant generator of trips.

4. In 2012 the 10 most active Mat-Su TAZs accounted for 86.0 percent of all southbound bridge traffic.

5. By 2030 the same 10 Mat-Su TAZs represent 87.2 percent of all southbound bridge traffic.

6. In 2012, Mat-Su bridge traffic is concentrated in zones 136 and 593. These TAZs represent the proposed Port MacKenzie development zones and port facility and account for 64.7 percent of the southbound bridge traffic, while 8 other zones contribute the remaining 35.3 percent.

7. By 2030 traffic generated in zones 136 and 593 represents 69.6 percent of southbound bridge traffic.

Table 13
Top Ten Contributing Zones for Northbound Bridge Traffic
Based on Probable Socioeconomic Forecast
Passenger Car Toll Rate ($5.00)

		2012					2020				
TAZ	Rank	No. of Trips	Percent Total Bridge Traffic	Total Trips in TAZ	TAZ	Rank	No. of Trips	Percent Total Bridge Traffic	Total Trips in TAZ	Bridge Trip Growth AAPC	Total TAZ Trip Growth AAPC
192	1	182	2.3	12,258	192	2	376	2.6	13,350	9.5	1.1
194	2	169	2.2	6,648	194	3	318	2.2	7,306	8.2	1.2
358	3	166	2.1	24,649	358	1	472	3.3	30,976	14.0	2.9
417	4	103	1.3	10,510	417	4	217	1.5	12,600	9.7	2.3
437	5	78	1.0	9,728	437	5	155	1.1	11,059	8.9	1.6
191	6	78	1.0	5,690	191	8	133	0.9	6,006	7.0	0.7
418	7	64	0.8	6,839	418	6	158	1.1	8,788	12.0	3.2
200	8	62	0.8	2,846	200	9	120	0.8	3,296	8.5	1.9
339	9	61	0.8	3,784	399	7	139	1.0	8,472	10.8	10.6
419	10	59	0.8	6,224	259	10	105	0.7	7,688	7.5	2.7
TOTAL		**1,022**	**13.2**		**TOTAL**		**2,192**	**28.2**			
TOTAL (Bridge Traffic)		**7,766**			**TOTAL (Bridge Traffic)**		**7,766**				

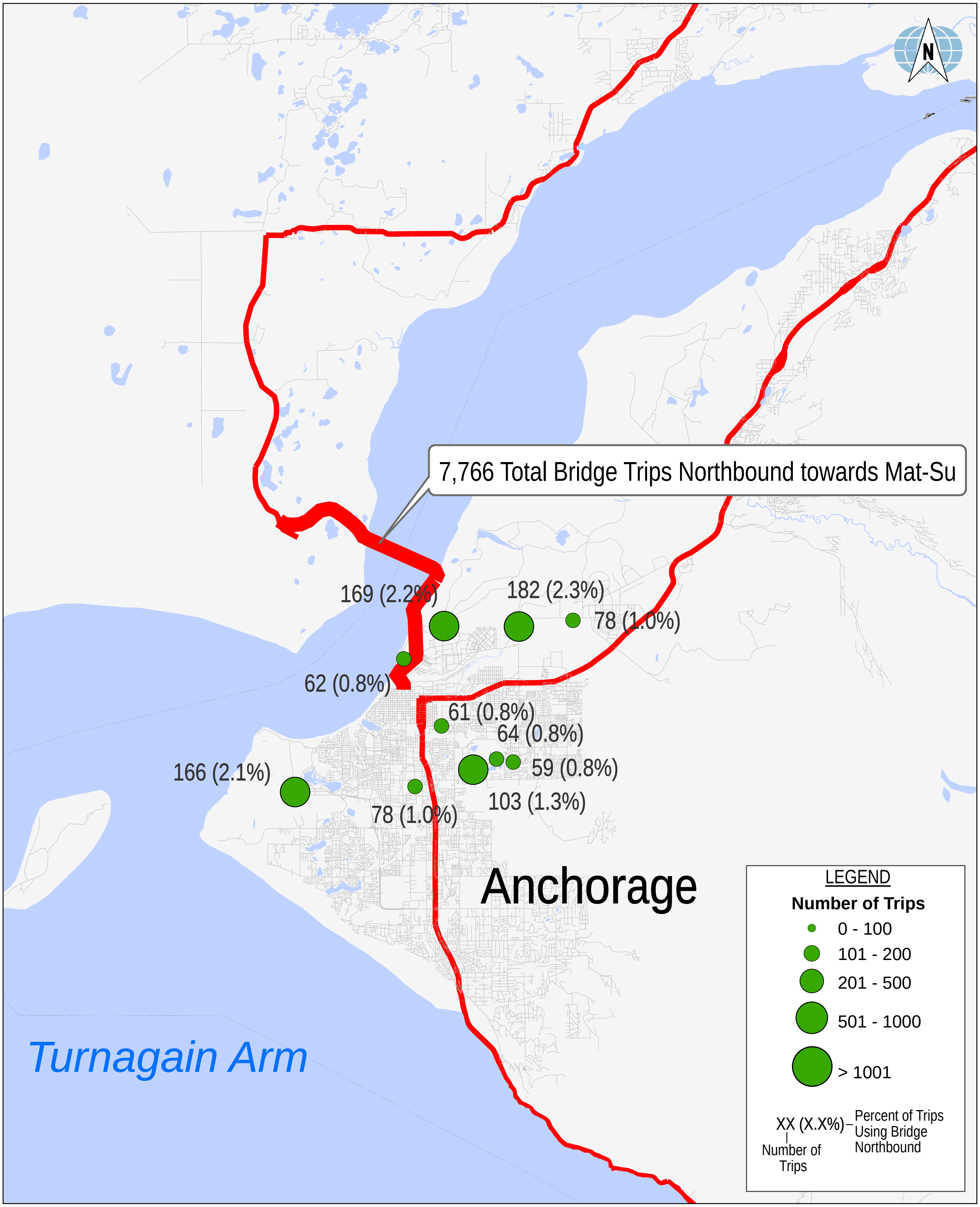
		2020					2030				
TAZ		TRIPS	% OF BRIDGE	TOTAL TAZ TRIPS	TAZ		TRIPS	% OF BRIDGE	TOTAL TAZ TRIPS	Bridge Trip Growth AAPC	Total TAZ Trip Growth AAPC
358	1	472	3.3	30,976	358	1	690	3.1	39,355	3.9	2.4
192	2	376	2.6	13,350	192	2	494	2.2	13,652	2.8	0.2
194	3	318	2.2	7,306	194	3	417	1.9	7,486	2.7	0.2
417	4	217	1.5	12,600	417	4	316	1.4	13,970	3.8	1.0
437	5	155	1.1	11,059	437	5	225	1.0	11,989	3.8	0.8
418	6	158	1.1	8,788	418	6	213	0.9	9,924	3.0	1.2
399	7	139	1.0	8,472	399	7	203	0.9	9,928	3.9	1.6
191	8	133	0.9	6,006	191	8	191	0.8	5,934	3.7	-0.1
200	9	120	0.8	3,296	200	9	176	0.8	3,752	3.9	1.3
259	10	105	0.7	7,688	--		--	--	--	--	--
--		--	--	--	419	10	158	0.7	6,640	--	--
TOTAL		**2,192**	**15.2**		**TOTAL**		**3,082**	**13.7**			
TOTAL (Bridge Traffic)		**14,390**			**TOTAL (Bridge Traffic)**		**22,500**				

Table 14
Top Ten Contributing Zones for Southbound Bridge Traffic
Based on Probable Socioeconomic Forecast
Passenger Car Toll Rate ($5.00)

2012					2020						
TAZ	Rank	No. of Trips	Percent Total Bridge Traffic	Total Trips in TAZ	TAZ	Rank	No. of Trips	Percent Total Bridge Traffic	Total Trips in TAZ	Bridge Trip Growth AAPC	Total TAZ Trip Growth AAPC
136	1	3,491	46.0	7,358	136	1	6,717	47.6	28,236	8.5	18.3
593	2	1,417	18.7	2,966	593	2	1,718	12.2	5,763	2.4	8.7
59	3	356	4.7	7,399	59	3	660	4.7	18,522	8.0	12.2
130	4	255	3.4	3,096	130	4	507	3.6	7,710	9.0	12.1
96	5	248	3.3	4,323	96	5	416	2.9	10,657	6.7	11.9
594	6	198	2.6	581	594	9	268	1.9	1,091	3.9	8.2
592	7	156	2.1	578	--		--	--	--	--	--
137	8	153	2.0	800	137	10	220	1.6	1,667	4.6	9.6
131	9	130	1.7	1,081	131	6	330	2.3	3,198	12.3	14.5
135	10	122	1.6	521	--		--	--	--	--	--
--		--		--	102	7	291	2.1	3,077	--	--
--		--		--	132	8	279	2.0	3,954	--	--
TOTAL		**6,527**	**86.0**		**TOTAL**		**11,405**	**80.8**			
TOTAL (Bridge Traffic)		**7,586**			**TOTAL (Bridge Traffic)**		**14,112**				

2020					2030						
TAZ	Rank	No. of Trips	Percent Total Bridge Traffic	Total Trips in TAZ	TAZ	Rank	No. of Trips	Percent Total Bridge Traffic	Total Trips in TAZ	Bridge Trip Growth AAPC	Total TAZ Trip Growth AAPC
136	1	6,717	47.6	28,236	136	1	12,496	56.7	54,142	6.4	6.7
593	2	1,718	12.2	5,763	593	2	2,847	12.9	9,992	5.2	5.7
59	3	660	4.7	18,522	59	3	881	4.0	26,173	2.9	3.5
130	4	507	3.6	7,710	130	4	619	2.8	10,914	2.0	3.5
96	5	416	2.9	10,657	96	5	549	2.5	15,011	2.8	3.5
131	6	330	2.3	3,198	131	6	419	1.9	4,796	2.4	4.1
102	7	291	2.1	3,077	102	9	342	1.6	4,219	1.6	3.2
132	8	279	2.0	3,954	132	8	368	1.7	6,098	2.8	4.4
594	9	268	1.9	1,091	594	7	386	1.8	1,724	3.7	4.7
137	10	220	1.6	1,667	137	10	296	1.3	2,644	3.0	4.7
TOTAL		**11,405**	**80.8**		**TOTAL**		**19,202**	**87.2**			
TOTAL (Bridge Traffic)		**14,112**			**TOTAL (Bridge Traffic)**		**22,020**				

AK 100295/9-12-07/Top Ten Origins - Northbound - 2012.mxd



TOP TEN ZONES FOR TRIPS CROSSING
KNIK ARM BRIDGE NORTHBOUND - YEAR 2012

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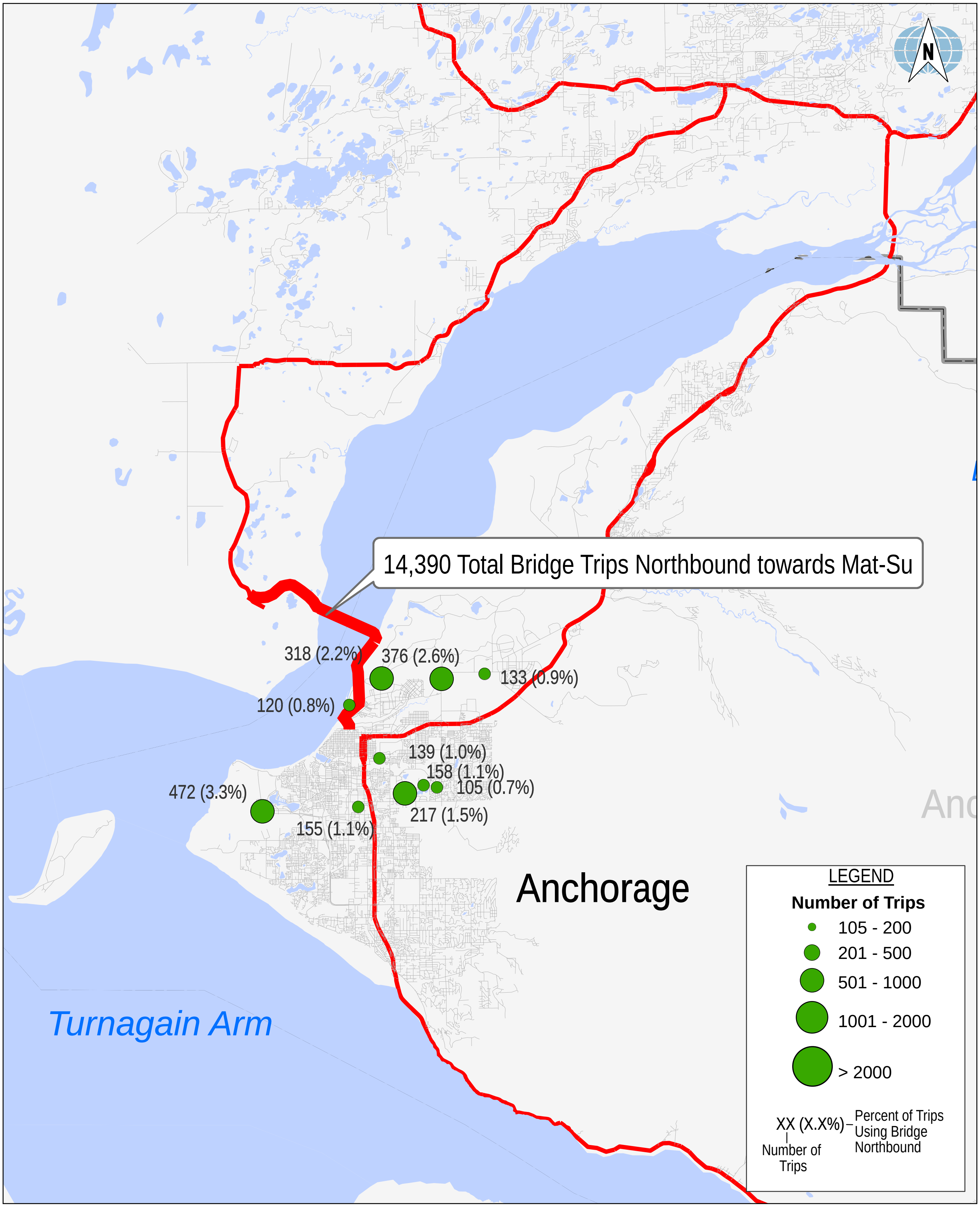
FIGURE 20

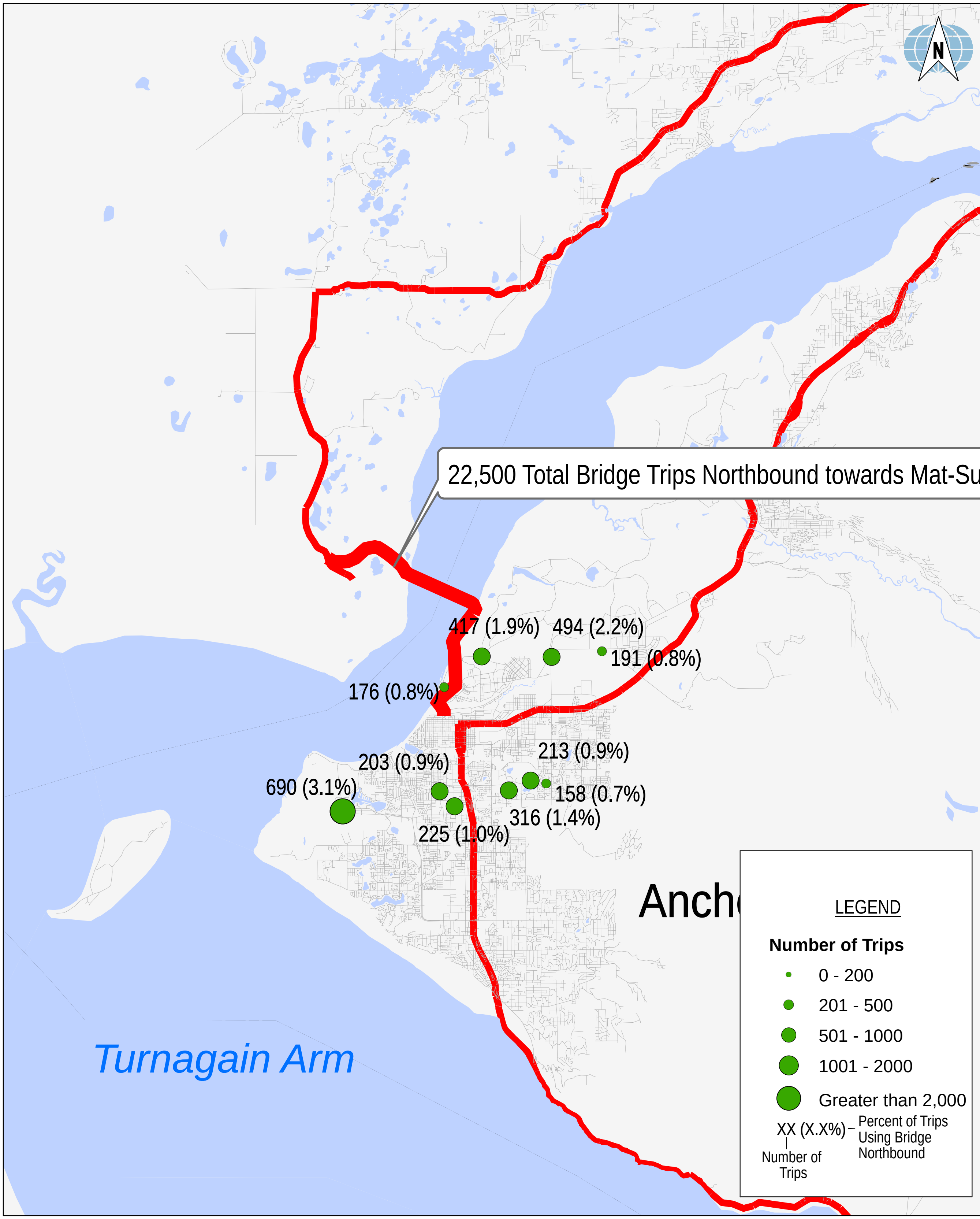
AK 100295/9-12-07/Top Ten Origins - Northbound - 2012.mxd



TOP TEN ZONES FOR TRIPS CROSSING
KNIK ARM BRIDGE NORTHBOUND - YEAR 2020

WilburSmith ASSOCIATES

FIGURE 21



TOP TEN ZONES FOR TRIPS CROSSING
KNIK ARM BRIDGE NORTHBOUND - YEAR 2030

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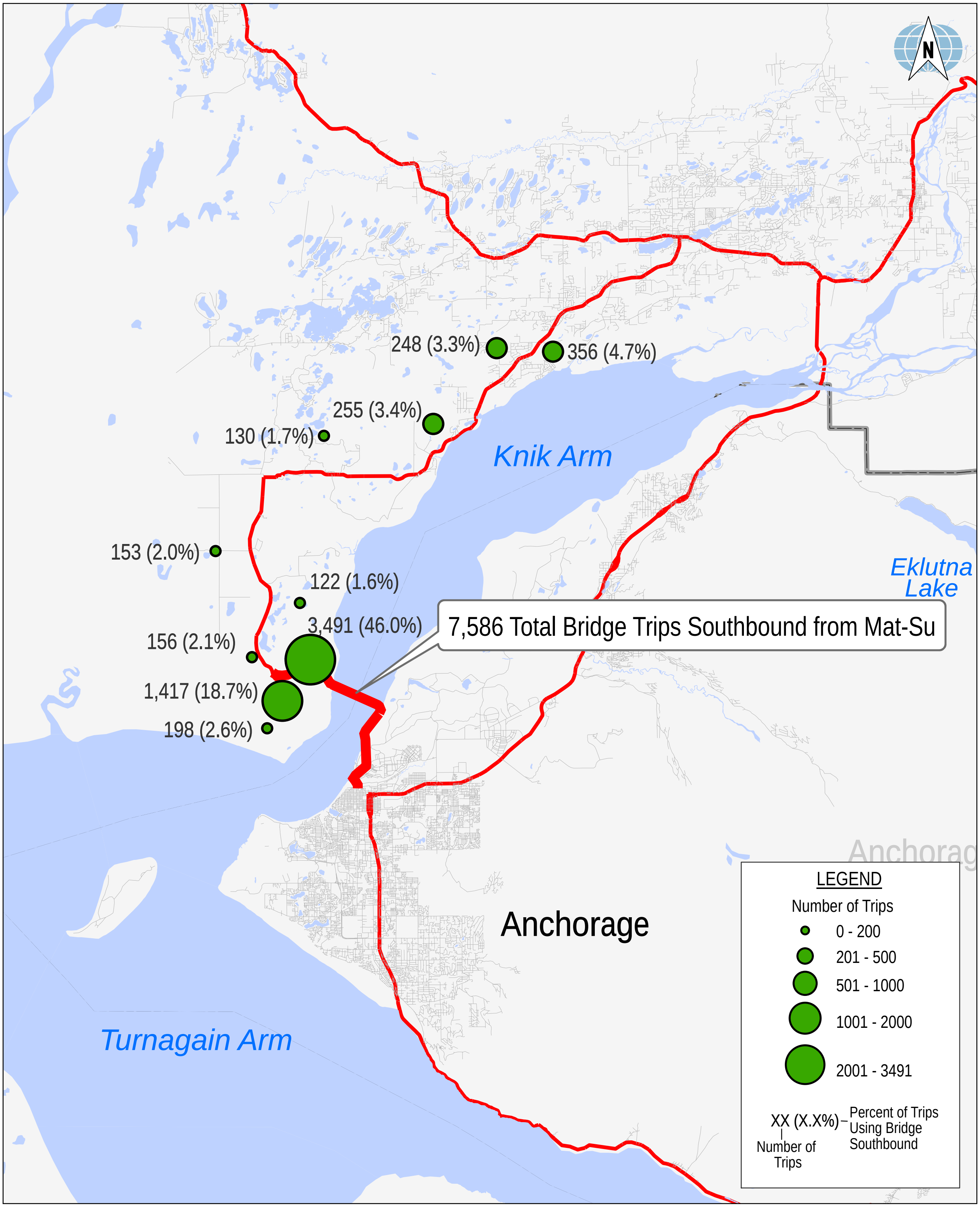
FIGURE 22



TOP TEN ZONES FOR TRIPS CROSSING KNIK ARM BRIDGE SOUTHBOUND - YEAR 2012

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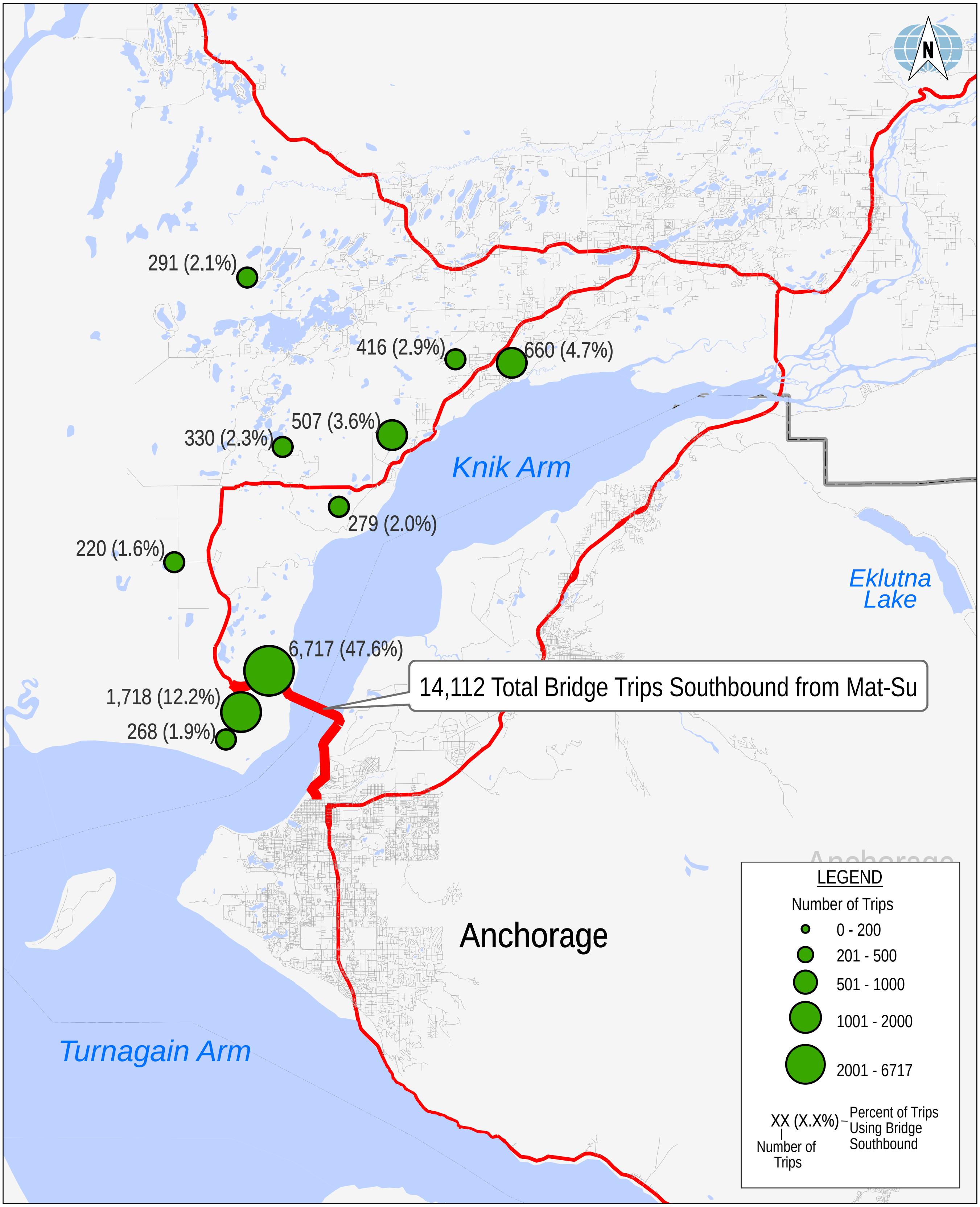
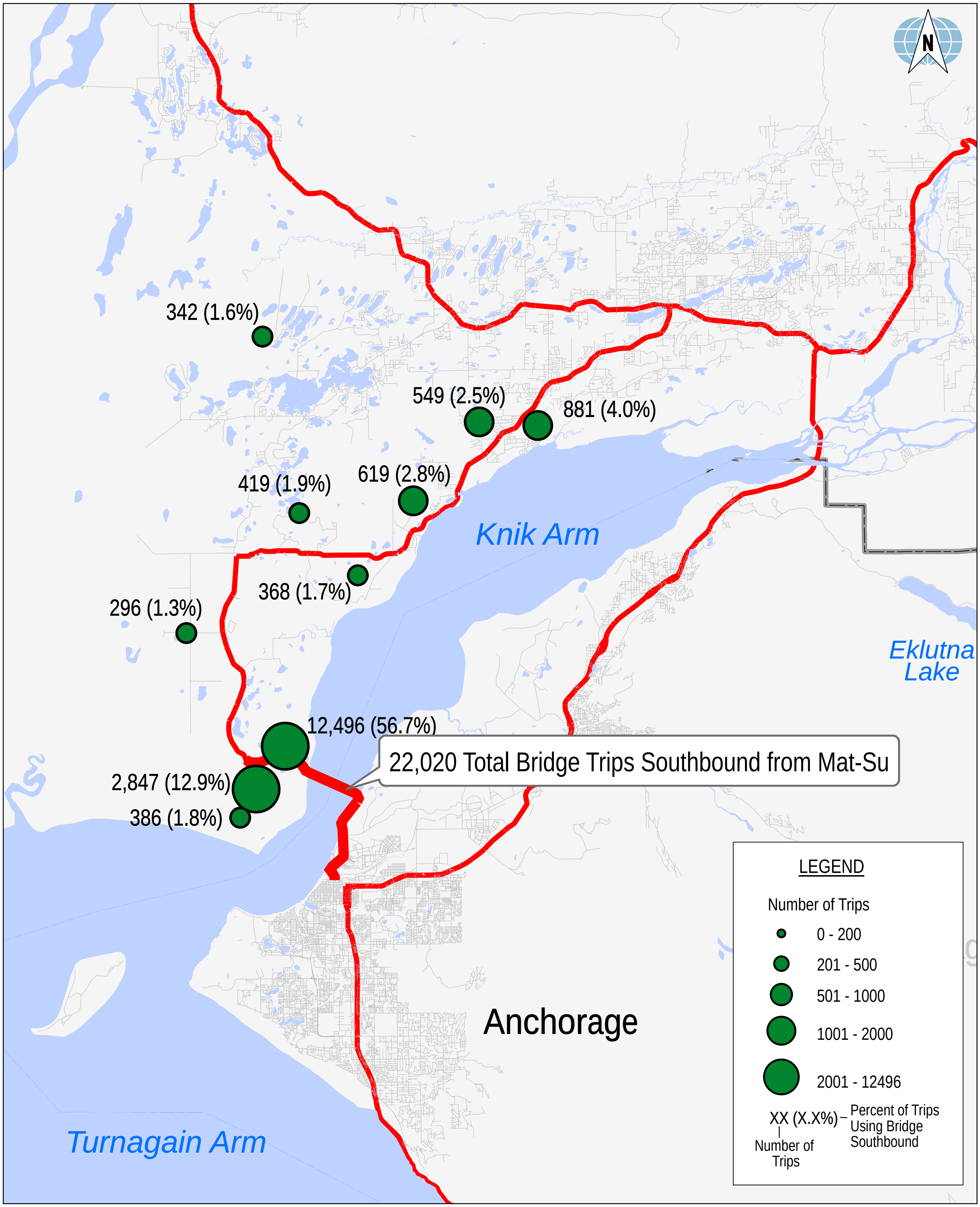
FIGURE 23



TOP TEN ZONES FOR TRIPS CROSSING KNIK ARM BRIDGE SOUTHBOUND - YEAR 2020

AK 100295/9-12-07/Top Ten Origins and Destinations - 2012.mxd



TOP TEN ZONES FOR TRIPS CROSSING
KNIK ARM BRIDGE SOUTHBOUND - YEAR 2030

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FIGURE 25

8. Zones 136 and 539 represent 64.7 percent of southbound bridge traffic in 2012 and 69.6 percent by 2030. Conversely, bridge traffic generated in Anchorage TAZs is dispersed across the metropolitan area. Based on these results and the knowledge of the economic development and land use plans for the Port MacKenzie area, it can be assumed that a significant portion of bridge traffic is driven by motorists living in the Anchorage area and working in the Mat-Su/Port MacKenzie development area.

STATED PREFERENCE SURVEY AND ESTIMATED VALUE OF TIME

The objective of the stated preference survey was to collect data, perform analyses, and develop reliable estimates of the toll sensitivity, or “values of time,” of resident auto travelers who are potential bridge users. Detailed data were required to allow analyses of travelers’ responses to different toll structures and an analysis of toll sensitivities by trip type sufficient to support route diversion modeling and revenue forecasting.

Respondents provided details of their most recent trip within the study area. Origin and destination location and other trip information were used to customize eight stated preference scenarios in which respondents chose among using their current route and two faster tolled alternatives. By presenting hypothetical future toll options, all qualified respondents were presented with believable travel times and costs, thus allowing appropriate value-of-time ranges to be tested. The questionnaire collected sufficient demographic details to allow the sample values of time to be applied to the full population of users and for the results to be segmented into market groups of similar characteristics.

Data collection took place between April and June 2007. A total of 718 completed responses were collected by intercepting respondents at activity sites and through online completion by employees of local businesses and recipients of targeted postcard invitations.

Statistical analysis and discrete choice model estimation were carried out using survey data segmented by trip purpose (work related and non-work related travel). The estimated values of time range from $7 to $19 per hour, depending on trip purpose, trip frequency, household income, and trip distance. Values of time at median levels of income and distance were approximately $14.50 per hour for work related travelers and $11 per hour for non-work related travelers.

Analysis of the stated preference survey found a median household income of approximately $62,500. This compares favorably to the median area income as stated by the U.S. Census of $65,600. Such a close fit is an indication that the sample taken by the SP survey is representative of the area at-large and accurately captures the distribution of projected patterns by income group. The value of time by trip purpose as derived from the 2007 stated preference survey is shown in Table 15.

Table 15
Current VOT Values (Year 2007)

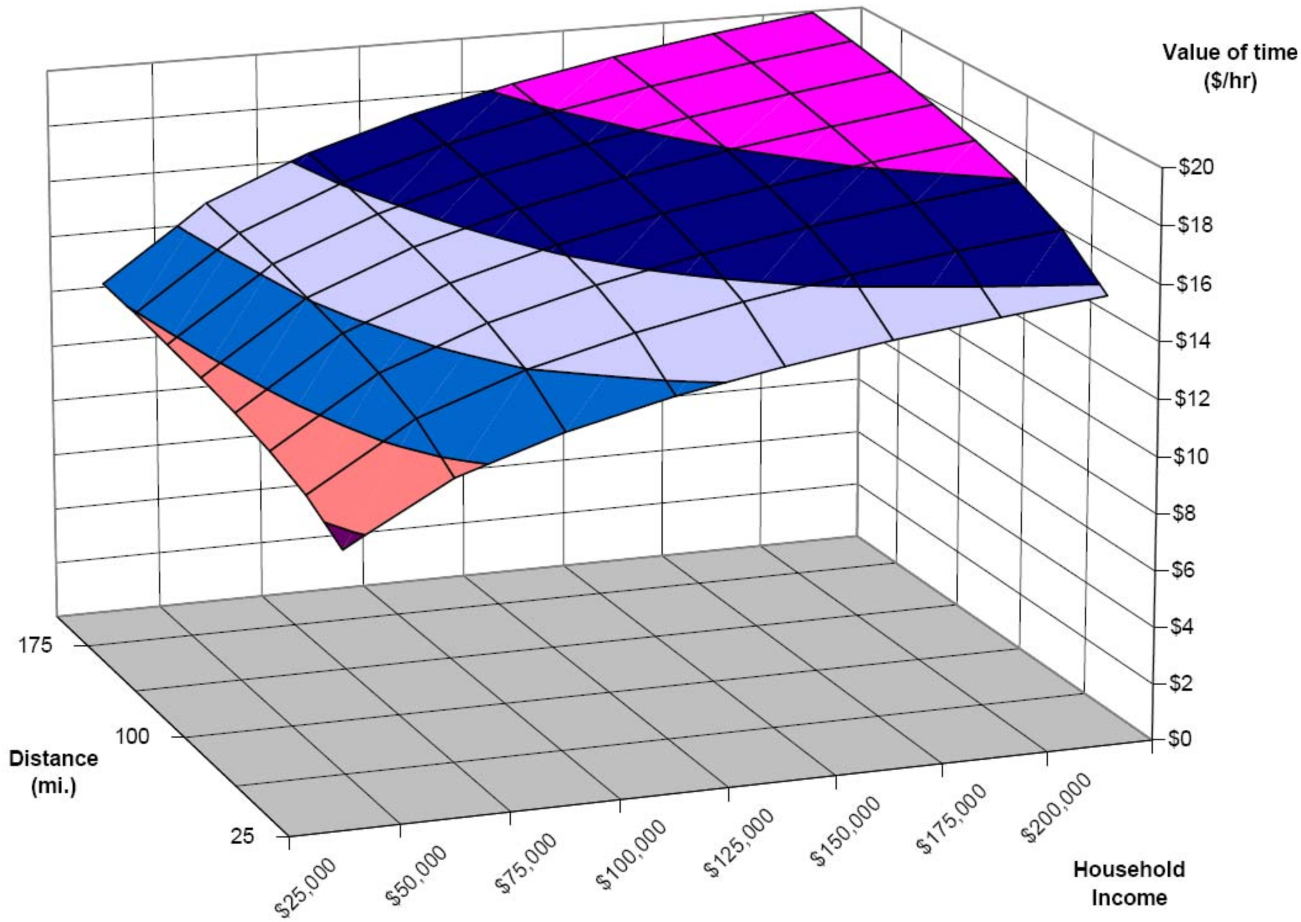
Trip Purpose	$/hour
Work related trips	$14.49
Non-work trips	11.16
Commercial vehicle	21.74
Hourly Average	12.99
VOT/minute	$0.22

Table 16 presents the value of time per minute saved by trip purpose for all future model years. Future years were derived by inflating the 2007 value by 2.5 percent compounding annually. These values of time are implemented in the WSA Voyager-based model to estimate bridge traffic under different tolling conditions.

Table 16
Value of Time (Dollars per minute)

Analysis Year	Work Related	Non-Work Related	Truck	Weighted Average
2007	$0.24	$0.19	$0.36	$0.22
2010	0.26	0.20	0.39	0.23
2012	0.27	0.21	0.41	0.25
2015	0.29	0.23	0.44	0.26
2020	0.33	0.26	0.50	0.30
2025	0.38	0.29	0.56	0.34
2030	0.43	0.33	0.64	0.38
2035	0.48	0.37	0.72	0.43

Lastly, the distribution of value of time for frequent work related trips by household income and current route distance is shown in Figure 26.



	Distance of Current Route (miles)							
Income	**25**	**50**	**75**	**100**	**125**	**150**	**175**	**200**
$25,000	$9.58	$11.64	$12.84	$13.70	$14.36	$14.91	$15.36	$15.76
50,000	10.42	12.67	13.98	14.91	15.64	16.23	16.72	17.16
75,000	10.92	13.27	14.65	15.62	16.38	17.00	17.52	17.97
100,000	11.27	13.70	15.12	16.13	16.91	17.55	18.09	18.55
125,000	11.54	14.03	15.49	16.52	17.32	17.97	18.52	19.00
150,000	11.77	14.30	15.78	16.84	17.65	18.32	18.88	19.37
175,000	11.96	14.53	16.04	17.11	17.93	18.61	19.18	19.68
200,000	12.12	14.73	16.26	17.34	18.18	18.87	19.45	19.95

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VALUE OF TIME BY HOUSEHOLD INCOME AND TRIP DISTANCE

FIGURE 26

TIME AND DISTANCE SAVINGS ANALYSIS

A time and distance saving analysis was undertaken for the opening year of 2012 and the forecast year of 2030. This analysis helps illustrate the benefit offered to potential patrons by the proposed Knik Arm Bridge over alternate routes. Tables 17 and 18 indicate the time and distance savings available to motorists traveling between major Mat-Su development areas and the high density Anchorage area. Figure 27 shows the representative areas chosen for this analysis.

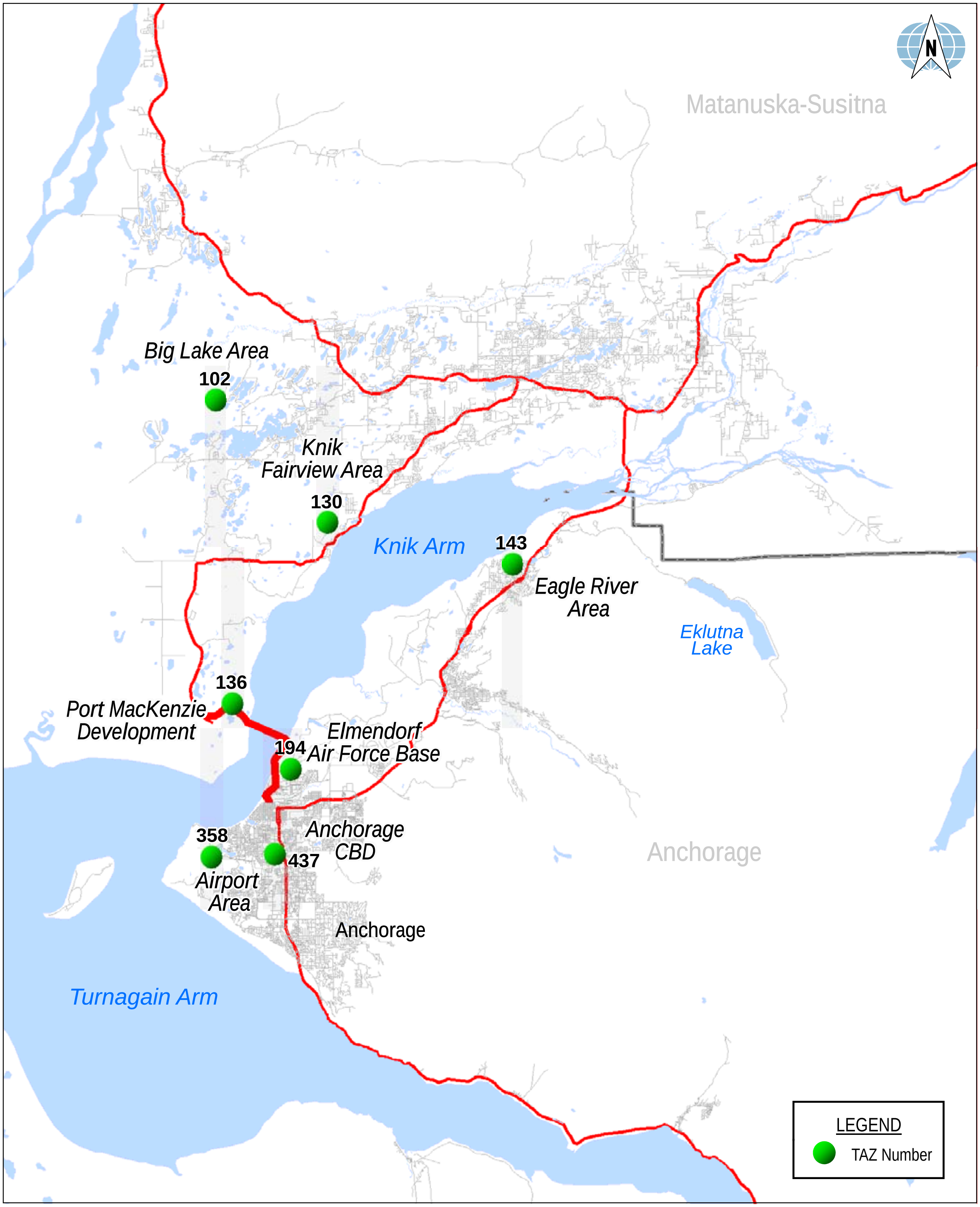
Generally speaking, the proposed Knik Arm Bridge will potentially save travelers between 10 and 76 miles in terms of driving distance depending on the origin and destination of the trip. In terms of time savings, potential patrons can expect to save between 7 minutes and just under 2 hours of travel time, again, depending on the origin and destination in question. It should be noted that the two time and distance savings tables may in some instances show a slightly different total distance between the same origin and destination pair across two periods of time. This may be due to planned improvements or to slight discrepancies in model coding between the model year networks. Moreover, where negative time and distance saving values are indicated, they are presented for comparative purposes only. It is highly unlikely that a motorist would choose to use a toll facility if doing so meant incurring a greater distance and travel time. Motorists making such trips will likely continue to use their established route.

Table 17
Time and Distance Savings
2012

From	To	From	To	With Bridge Time	With Bridge Distance	No Bridge Time	No Bridge Distance	Savings Time	Savings Distance
Port McKenzie Development	Eagle River Area	136	143	45.6	31.8	107.7	61.4	62.1	29.6
	Air Force Base	136	194	20.0	10.5	140.7	86.4	120.8	76.0
	Airport area	136	358	29.3	16.2	146.0	89.7	116.7	73.5
	Anchorage CBD	136	437	22.2	12.4	138.8	85.9	116.7	73.5
Knik Fairview Area	Eagle River Area	130	143	73.4	52.6	76.5	39.6	3.1	(13.0)
	Air Force Base	130	194	47.8	31.2	109.5	64.6	61.7	33.4
	Airport area	130	358	57.2	36.9	114.8	67.9	57.6	30.9
	Anchorage CBD	130	437	50.0	33.1	107.6	64.1	57.6	30.9
Big Lake Area	Eagle River Area	102	143	132.9	76.5	85.5	43.8	(47.4)	(32.7)
	Air Force Base	102	194	107.3	55.1	118.5	68.8	11.3	13.7
	Airport area	102	358	116.6	60.9	123.7	72.1	7.1	11.2
	Anchorage CBD	102	437	109.5	57.1	116.6	68.3	7.1	11.2

Table 18
Time and Distance Savings
2030

				With Bridge		No Bridge		Savings	
From	**To**	**From**	**To**	**Time**	**Distance**	**Time**	**Distance**	**Time**	**Distance**
Port McKenzie Development	Eagle River Area	136	143	44.8	32.7	84.9	58.4	40.2	25.7
	Air Force Base	136	194	19.7	11.2	117.2	83.3	97.5	72.1
	Airport area	136	358	30.3	16.7	122.5	86.4	92.3	69.7
	Anchorage CBD	136	437	21.4	13.1	113.7	82.8	92.3	69.7
Knik Fairview Area	Eagle River Area	130	143	72.9	53.2	53.8	36.8	(19.1)	(16.4)
	Air Force Base	130	194	47.8	31.6	86.1	61.7	38.3	30.1
	Airport area	130	358	58.4	37.2	91.4	64.9	33.0	27.7
	Anchorage CBD	130	437	49.5	33.6	82.6	61.2	33.0	27.7
Big Lake Area	Eagle River Area	102	143	80.7	50.9	66.3	43.4	(14.4)	(7.6)
	Air Force Base	102	194	55.7	29.4	98.6	68.3	43.0	38.9
	Airport area	102	358	66.3	34.9	104.0	71.4	37.7	36.5
	Anchorage CBD	102	437	57.4	31.3	95.1	67.8	37.7	36.5



TIME DISTANCE SAVINGS

FIGURE 27

TRAFFIC AND GROSS TOLL REVENUE FORECAST

The two previous sections of this report detail the analysis undertaken in the development of the toll transactions and gross toll revenue forecasts for the proposed Knik Arm Bridge. As described earlier, historical trends and forecasts for the socioeconomic parameters of population, households, and employment for the State of Alaska as a whole as well as the large metropolitan areas of Anchorage and Mat-Su Borough were reviewed by IRC for this forecasting analysis. In addition, Alaska's economic indicators such as the gross state product, the regional gross product, and other economic parameters were incorporated into the creation of the forecast.

After understanding the macro-scale trends of the various economic indicators for the region, historic growth as well as the possibilities of future growth were incorporated into the travel demand model via underlying socioeconomic data. The remainder of this report will discuss the findings of this analysis in greater detail.

ESTIMATED ANNUAL GROSS TOLL REVENUE

The review of the economic factors of the region, state and local areas provided a historic and future vision of growth for the potential motorists served by the proposed Knik Arm Bridge. The origin and destination survey provided the basis for refinement of the model trip distribution within the study corridor. The stated preference survey provided the area-specific data to permit refinement of the calculated value of time used in the forecasting model.

WSA prepared the traffic and gross toll revenue estimates for the proposed Knik Arm Bridge reflecting the many assumption changes previously discussed and referenced in the earlier sections. This final traffic and gross toll revenue forecast assumed an opening year passenger car toll rate of $5.00 in 2012, with commercial vehicle rates proportionately higher (based on the n-1 formula). Subsequent to 2012, toll rates were assumed to increase at an average of 2.5 percent per year to account for inflation.

The assumed passenger car and average commercial vehicle toll rates are shown in Table 19.

Table 19
Maximum Assumed Tolls
for Passenger Car and Average
Commercial Vehicle Rates

Year	Passenger Car	Commercial Vehicle
2012	$5.00	$18.00
2013	5.13	18.45
2014	5.25	18.91
2015	5.38	19.38
2016	5.52	19.87
2017	5.66	20.37
2018	5.80	20.87
2019	5.94	21.40
2020	6.09	21.93
2021	6.24	22.48
2022	6.40	23.04
2023	6.56	23.62
2024	6.72	24.21
2025	6.89	24.81
2026	7.06	25.43
2027	7.24	26.07
2028	7.42	26.72
2029	7.61	27.39
2030	7.80	28.07
2031	7.99	28.78
2032	8.19	29.50
2033	8.40	30.23
2034	8.61	30.99
2035	8.82	31.76
2036	9.04	32.56
2037	9.27	33.37
2038	9.50	34.21
2039	9.74	35.06

The forecasting effort utilized the latest travel demand model previously described and made use of additional information from the travel pattern and stated preference surveys, as well as refinements to the socioeconomic estimates developed by IRC and several other modeling refinements. The refinements to the model reflect improved travel patterns assumed within the trip tables that reflect actual travel patterns or origin/destination trip movements described by the respondents of the travel pattern survey. The original value of time was calculated based on data from the Alaska

Department of Labor & Workforce Development. The assumed value of time used in this forecast reflects the benefits of the data collected through the recent stated preference surveys. In addition, the attached updated traffic and gross toll revenue forecasts reflect a considerable amount of effort on the part of IRC as they refined their estimates at the TAZ level.

INDUCED TRIPS VS. DIVERTED TRIPS

Vehicles making use of the proposed facility can be divided into two categories: induced trips and diverted trips. Induced trips refer to those trips generated due to socioeconomic growth brought about as a result of building the facility. These are new trips that would not have come about without the construction of the facility. Diverted trips are trips that previously traveled on the competing roads, but are attracted to the facility due to cost and time savings or changes in destination.

Induced trips indicate that more trips are generated because of more household and employment. Diverted trips indicate drivers' route choice behavior to minimize the travel cost and their choice of different destinations due to the new bridge construction.

Diverted trips are further categorized as those previously using the Glenn Highway and rerouted trips due to the fact that people are more likely to travel to different places via the new bridge.

The model used in the development of this traffic and gross toll revenue forecast explicitly forecasted the household and employment growth in the future years for scenarios both with and without the bridge. It is also assumed that the primary competing road in this study area is the Glenn Highway. Therefore, the traffic changes on Glenn Highway using the without-bridge scenario of household and employment data forecast are used to calculate the diverted trips. Induced trips due to socioeconomic growth are calculated as the difference of bridge traffic between the "with" and "without-bridge" socioeconomic data. Diverted trip due to the traveler's change in destination is calculated as the remainder of traffic using the bridge.

As show in Tables 20 and 21, a total of 48.0 percent of the bridge traffic is comprised of diverted trips in 2012. This share drops to 37.9 percent in 2030. Induced trip shares for years 2012 and 2030 are 52.0 and 62.1 percent, respectively. In both years, the induced traffic makes up the majority of the bridge uses. As presented, it can be observed that the expected socioeconomic growth has a significant impact on the bridge traffic in future years.

Table 20
Induced Traffic on the Knik Arm Bridge and Glenn Highway

Year	Bridge in Network	Socioeconomic Forecast	Toll	Bridge Total	Glenn Total	Total Traffic
2012	No	No Build	--	--	44,317	44,317
2012	Yes	No Build	$5.00	7,425	41,331	48,756
2012	Yes	Build	5.00	15,477	39,743	55,220
2030	No	No Build	--	--	72,793	72,793
2030	Yes	No Build	5.00	16,309	65,574	81,883
2030	Yes	Build	5.00	42,990	52,332	95,322

Table 21
Induced Trips versus Diverted Trips
On the Knik Arm Bridge and Glenn Highway

			Diverted			Induced	
Year	Toll		Diverted from Glenn Highway	Diverted from All Other Zones	Total Diverted	Socioeconomic Growth	Bridge Total
2012	$5.00	Traffic	4,574	2,851	7,425	8,052	15,477
		Percentage	29.6	18.4	48.0	52.0	100.0
2030	5.00	Traffic	7,219	9,090	16,309	26,681	42,990
		Percentage	16.8	21.1	37.9	62.1	100.0

KNIK ARM BRIDGE ELASTICITY ANALYSIS

An increase in the tolls will generally lead to a decrease in the number of vehicles that use the toll facility as drivers look for a less expensive route or find an alternative to driving. Thus, in an effort to determine the increase in total toll revenue due to a toll rate increase, the decrease in traffic volume must first be determined. In other words, the elasticity of demand for trips on the proposed toll facility with respect to the toll level must be determined. This can be done by looking at the impact of toll increases on traffic volume on other similar facilities across the country. It is important to understand how travel demand reacts to price variations as well as its progression over time as personal income rises. However, many other factors affect traffic volumes; for example, regional changes in population or economic activity, the price of gasoline, congestion on the facilities or routes leading to and from the facilities, the price and congestion on alternative roads, bridges and tunnels. In order to isolate the effect of the increase in toll, these other factors must be accounted for.

Such research on the toll-price elasticity of demand for traffic here in the U.S., as well as Europe has indicated elasticities ranging from -0.03 to -0.61. [1]

Elasticity of demand is the proportional change in the quantity of goods or services consumed with respect to an incremental change in the price of goods or services. As applied to transportation economics, in this case a toll facility, elasticity is the change in traffic volume on a particular facility with respect to the change in the toll rate. As tolls increase, the demand for use of a facility such as the proposed Knik Arm Bridge will decline due to the rising cost of use. If tolls are too low, demand will not be constrained and the bridge may become congested. If the toll is too high, few will use the facility. As such, elasticity is an extremely useful measure of how a facility and the corresponding demand will behave in a market environment.

Using the Mat-Su / Anchorage updated travel demand model, levels of traffic on the bridge were forecasted under toll levels from $1.00 to $6.00 per trip in each direction. As shown in Table 22, price elasticity ranges from -0.10 to -0.73. Typically, a toll facility competing with a parallel toll-free route has a toll elasticity of around -0.20 to -0.30. This indicates that in doubling the toll rate, the traffic will decline on the facility by 20 to 30 percent. In the case of the proposed Knik Arm Bridge, the imposition of higher tolls results in redistribution of traffic within each sub-market of Mat-Su and Anchorage, respectively. This is due to the unique location of the bridge with respect to the shortest competing route, the Glenn Highway, which adds approximately 80 miles to the trip from Anchorage to Port MacKenzie. As a result the demand for the bridge crossing is more elastic (higher than -0.30) than a typical facility at toll rates of $2.00 and higher. A toll increase causes the demand for use of the bridge to drop more quickly. Zonal demand is met within each respective sub-market rather than between the sub-markets of Mat-Su and Anchorage using the Knik Arm bridge crossing.

[1] N.H. Weustefeld, and E.J. Regan (1981) Wilbur Smith Associates "Impact of rate Increases on Toll facilities" Traffic Quarterly, 35, 639-655.

Table 22
Estimated Toll Elasticity

Toll Rate	Year 2012	2015	2020	2025	2030
$1.00	--	--	--	--	--
2.00	-0.10	-0.10	-0.15	-0.15	-0.14
3.00	-0.16	-0.17	-0.26	-0.25	-0.24
4.00	-0.28	-0.28	-0.45	-0.42	-0.40
5.00	-0.39	-0.38	-0.61	-0.58	-0.54
6.00	-0.47	-0.40	-0.73	-0.66	-0.60
Average	-0.28	-0.27	-0.44	-0.41	-0.38

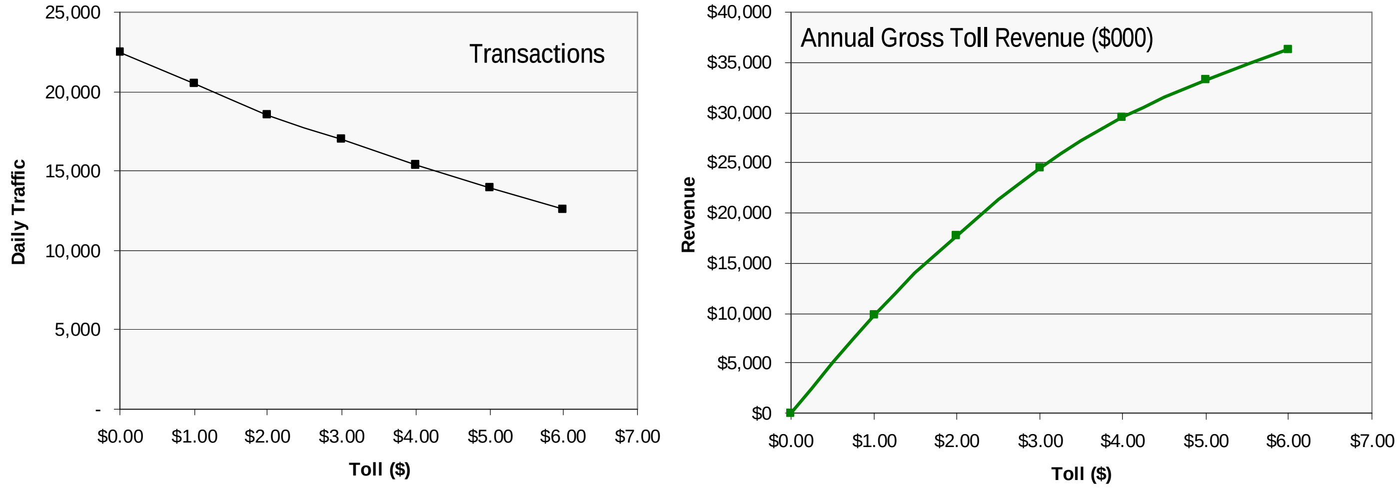
As illustrated in Figures 28 and 29, the shape of the elasticity curves is smooth indicating the possibility of matching trip demand within each sub-market. As the toll rate increases, a portion of total non-work related trips can be satisfied within Mat-Su or Anchorage without incurring the cost of a bridge crossing. The source of the decrease in demand as a response to an increase in toll rates is most likely home-based non-work trips for shopping and services.

WSA has compared the above estimated elasticities with observed elasticities for reasonableness. Analysis of observed elasticities on facilities throughout the world indicates that elasticity will depend on the level of congestion on the facility itself as well as traffic congestion on competing facilities. Also elasticity will vary by trip purpose, frequency of trip and condition of the economy including the price of gas and income level of the patrons. However, the main factor is the existence of competition; i.e. is there a free bridge/free road available as an alternative for use or not?

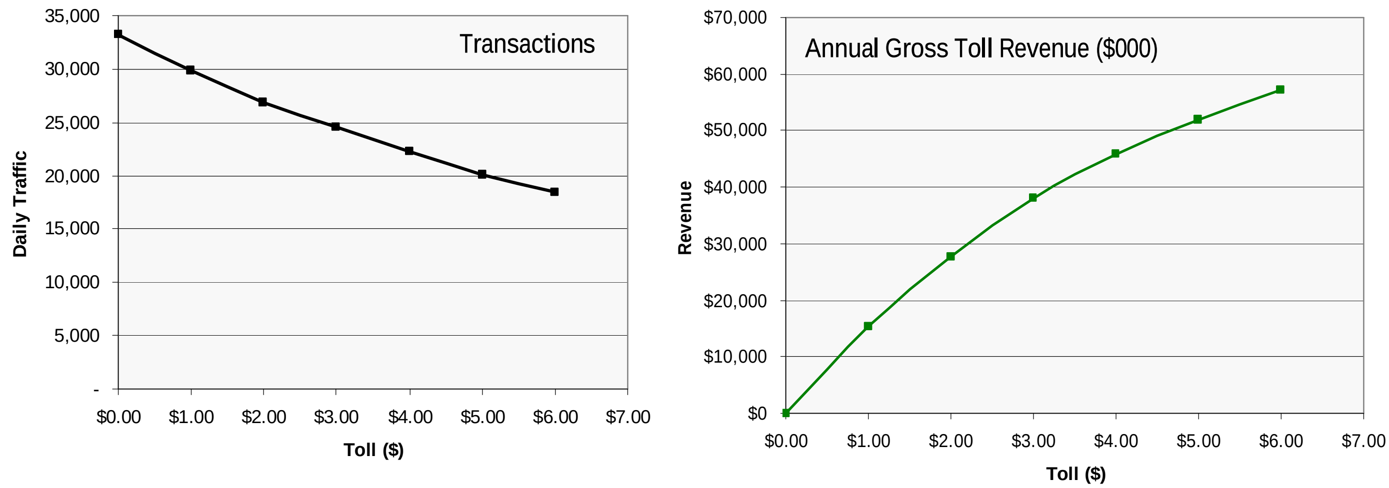
Observed elasticity on nine major facilities (seven bridges and two tunnels) in New York City has shown ranges from 0.00 to -0.61 (see McKnight. [(2)] The variation of elasticity depends on the location of the bridge and its nearest competing toll free alternative in the region. For example, the Whitestone and the Throgs Neck bridges exhibited low elasticity of 0.00 and -0.18, respectively. There are no close toll free alternatives for these two bridges. The Henry Hudson Bridge has exhibited elasticity of -0.40 and -0.61 for an average elasticity of -0.50.

[(2)] Optimal Toll Strategies for the Tri-borough Bridge and Tunnel Authority, Final Report, McKnight Claire E., John R. Pucher, Joseph Berechman, Robert E. Paaswell, Jorge A. Hernandez and Jack Gamill, December 1992.

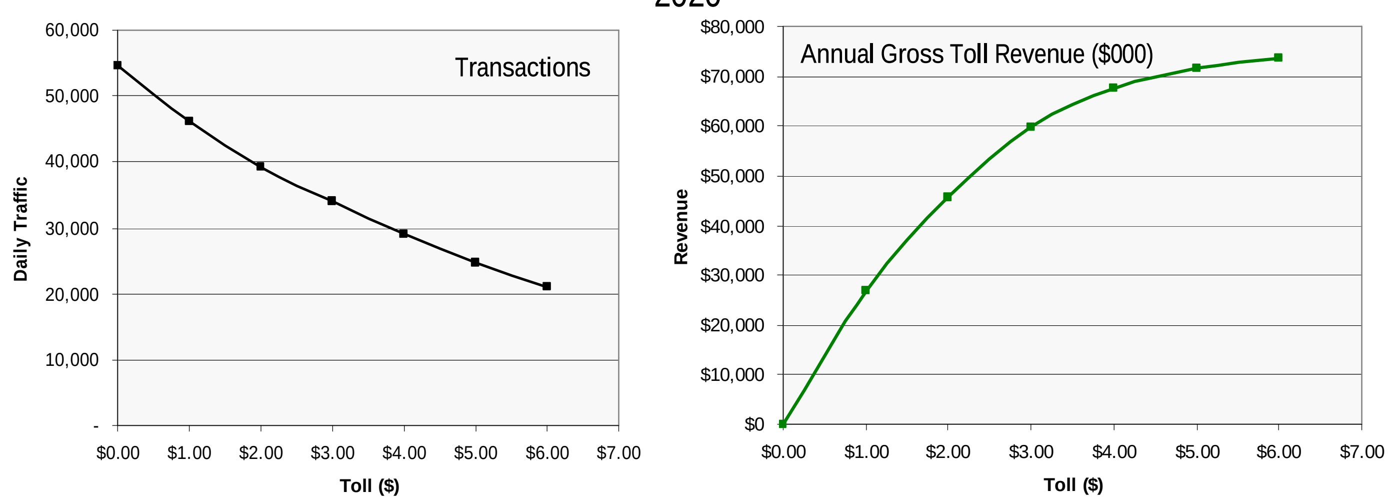
2012



2015

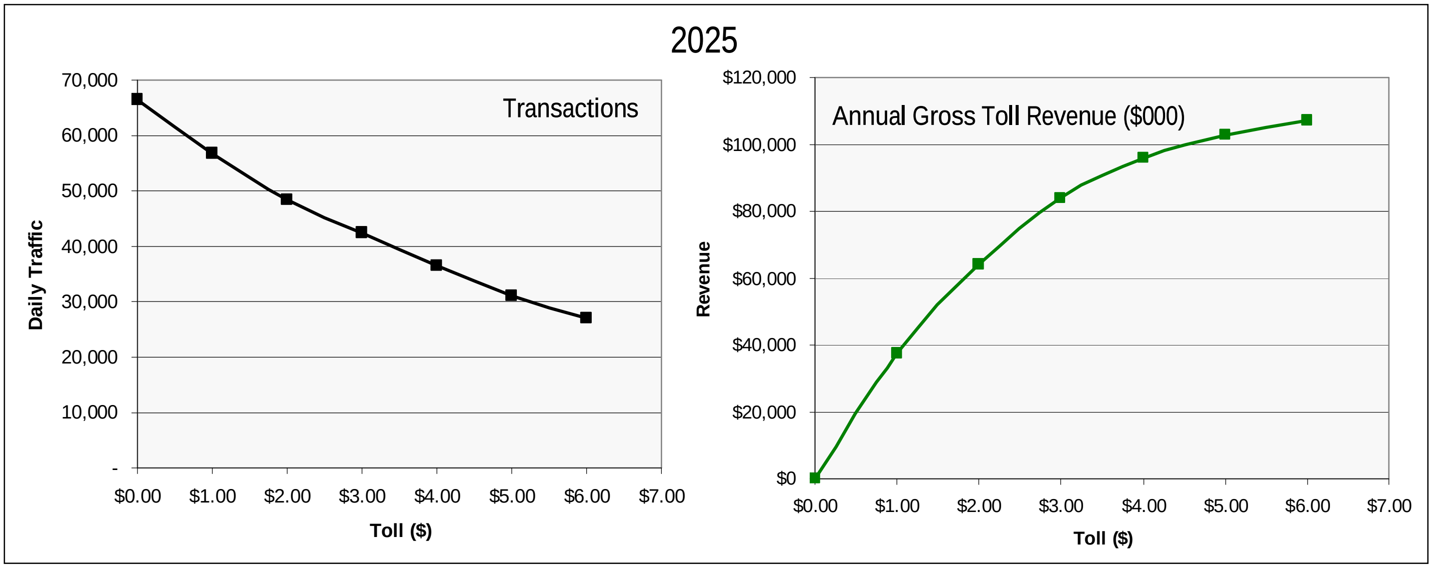


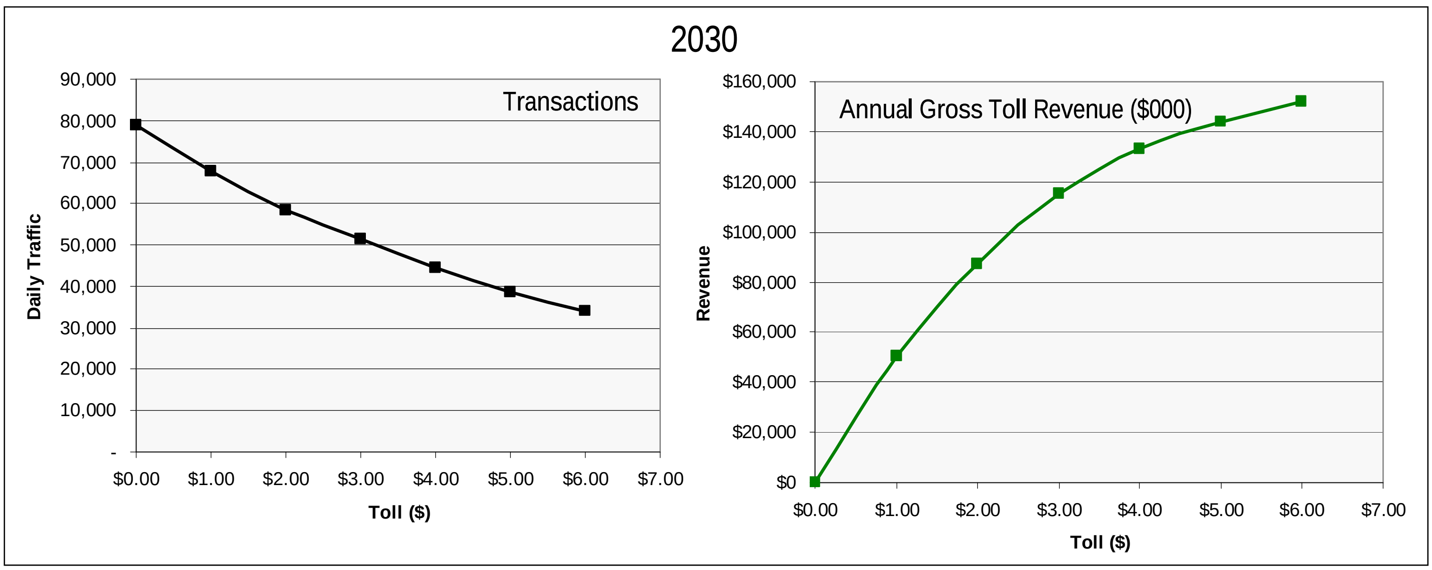
2020



Toll Sensitivity

FIGURE 28





Toll Sensitivity

FIGURE 29

This is a bridge leading to west side of Manhattan, where several free roads are available to serve similar trip movements. The same study (McKnight, et. al.) indicates that for most bridges in the study, the mean elasticity is less than -0.20.

One has to remember that all of the facilities mentioned here are owned and operated by Tri-borough Bridge and Tunnel Authority. It is most likely that timing and level of toll increase for these facilities are coordinated in such a way that patrons of these facilities would find it difficult to find a lower priced bridge as an alternative for their existing route choice. In another words, toll increase for many of these facilities will be simultaneous to minimize trip diversion to lower toll bridges. In essence the low elasticity bridges (Whitestone and Throgs Neck) have their own captive market.

A more recent study by Anna Matas, using empirical cited literature finds that the most frequent values of elasticity fall around -0.20 and -0.30[(3)] These values correspond to average demand facility. The same source indicates a value of -0.20 for New Jersey Turnpike and -0.22 to -0.35 for French motorways for trips longer than 100 kilometers.

As cited by Lake, Luk (1999) used the traffic volumes in Singapore before and after a change in the price of the toll to enter the Singapore CBD. [(4)] Elasticities derived were between -0.19 and -0.58. In the case of Singapore, the diverted trips from auto to bus has resulted in an increase in bus ridership of 17 percent for introduction of auto tolls and 80 percent for subsequent toll increases (see Lake, 2002).

In summary, the KnikArm elasticity curves indicate an elastic demand due to existence of the two sub-markets; Mat-Su and Anchorage. Non-essential and discretionary trip demand in each sub-market can be met within each market, obviating the need to cross the bridge. Work trips are less elastic where the locations of employment require inter-market travel. In the case of commercial trips, the cost of tolls can easily be passed to the consumer and are, therefore, also less sensitive to toll rate increases.

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(3) The Demand Elasticity on Tolled Motorways, Anna Matas, TRB papers.

(4) Demand for Toll Roads: A summary of Elasticities, Travel Time Values and Modeling Approaches, Dr. Maree Lake and Prof Luis Ferreira, Transport Research Consortium, Queensland University of Technology, January 2002.

TRAFFIC AND GROSS TOLL REVENUE

The traffic and gross toll revenue estimates for the base forecast based on IRC's Probable socioeconomic datasets are shown in attached Table 23. Table 24 and Table 25 present traffic and gross toll revenue estimates based on IRC's Low and High socioeconomic datasets, respectively. Table 26 reflects a sensitivity test requested by TIFIA that reduces the assumed value-of-time by 25.0 percent (reduction factor of 0.75) while continuing to use the IRC's Probable socioeconomic datasets assumed in the base forecast presented in Table 23.

DISCLAIMER

Current professional practices and procedures were used while developing these findings. However, there is considerable uncertainty inherent in future traffic and revenue forecasts for any toll facility. There may sometimes be differences between forecast and actual results caused by events and circumstances beyond the control of the forecasters. These differences could be material. It should be recognized that traffic and revenue forecasts in this document are intended to reflect the overall estimated long-term trend, and actual experience in any given year may vary due to economic conditions and other factors.

Our project director, Raymond P. Richard, assisted by Senior Modeler and Project Manager Kazem Oryani, gratefully acknowledges the assistance provided by staff of Knik Arm Bridge and Toll Authority and Alaskan Department of Transportation. We sincerely appreciate the opportunity to have been of service.

Table 23
Estimated Average Daily Transactions and Gross Toll Revenue
Base Forecast using Probable Economic Assumptions

	Estimated Annual Average Daily Transactions			Estimated Annual	
Year	**Passenger Car**	**Commercial Vehicle**	**Total**	**Transactions**	**Gross Toll Revenue**
2012 (1)	7,400	1,000	8,400	3,066,000	$ 20,075,000
2013	11,000	1,500	12,500	4,562,500	30,678,000
2014	14,300	2,000	16,300	5,949,500	41,224,000
2015 (2)	17,000	2,300	19,300	7,044,500	49,683,000
2016	17,900	2,400	20,300	7,409,500	53,464,000
2017	18,800	2,600	21,400	7,811,000	58,145,000
2018	19,800	2,700	22,500	8,212,500	62,477,000
2019	20,900	2,800	23,700	8,650,500	67,207,000
2020	22,000	3,000	25,000	9,125,000	72,934,000
2021	23,100	3,100	26,200	9,563,000	78,085,000
2022	24,100	3,300	27,400	10,001,000	84,055,000
2023	25,300	3,400	28,700	10,475,500	89,892,000
2024	26,400	3,600	30,000	10,950,000	96,606,000
2025	27,600	3,800	31,400	11,461,000	103,852,000
2026	28,900	3,900	32,800	11,972,000	110,728,000
2027	30,100	4,100	34,200	12,483,000	118,571,000
2028	31,400	4,300	35,700	13,030,500	127,008,000
2029	32,800	4,500	37,300	13,614,500	136,071,000
2030	34,200	4,700	38,900	14,198,500	145,507,000
2031	35,200	4,800	40,000	14,600,000	153,112,000
2032	36,100	4,900	41,000	14,965,000	160,708,000
2033	36,800	5,000	41,800	15,257,000	167,975,000
2034	37,500	5,100	42,600	15,549,000	175,505,000
2035	38,200	5,200	43,400	15,841,000	183,306,000
2036	38,900	5,300	44,200	16,133,000	191,388,000
2037	39,700	5,400	45,100	16,461,500	200,097,000
2038	40,300	5,500	45,800	16,717,000	208,429,000
2039	40,800	5,600	46,400	16,936,000	216,697,000

Ramp up Schedule:
2012 assumes a ramp-up factor of 61.0 percent.
2013 assumes a ramp-up factor of 81.3 percent.
2014 assumes a ramp-up factor of 94.5 percent.
No ramp-up is assumed in 2015 or beyound.

(1) Bridge assumed opened to traffic on January 1, 2012 with a Passenger Car Toll of $5.00; tolls proportionately higher for Commercial Vehicles.

(2) Assumes a Toll Schedule increased by 2.5 percent annually beginning January 1, 2013;. tolls proportionately higher for Commercial Vehicles.

Table 24
Estimated Average Daily Transactions and Gross Toll Revenue
Base Forecast using Low Economic Assumptions

	Estimated Annual Average Daily Transactions			**Estimated Annual**	
Year	**Passenger Car**	**Commercial Vehicle**	**Total**	**Transactions**	**Gross Toll Revenue**
2012 [(1)]	6,600	900	7,500	2,737,500	$ 17,958,000
2013	9,900	1,300	11,200	4,088,000	27,274,000
2014	12,800	1,700	14,500	5,292,500	36,277,000
2015 [(2)]	15,100	2,100	17,200	6,278,000	44,534,000
2016	15,900	2,200	18,100	6,606,500	47,984,000
2017	16,800	2,300	19,100	6,971,500	51,786,000
2018	17,600	2,400	20,000	7,300,000	55,535,000
2019	18,600	2,500	21,100	7,701,500	59,874,000
2020	19,600	2,700	22,300	8,139,500	65,196,000
2021	20,500	2,800	23,300	8,504,500	69,697,000
2022	21,500	2,900	24,400	8,906,000	74,617,000
2023	22,500	3,100	25,600	9,344,000	80,601,000
2024	23,500	3,200	26,700	9,745,500	85,954,000
2025	24,600	3,400	28,000	10,220,000	92,681,000
2026	25,700	3,500	29,200	10,658,000	98,763,000
2027	26,800	3,700	30,500	11,132,500	106,043,000
2028	28,000	3,800	31,800	11,607,000	112,920,000
2029	29,200	4,000	33,200	12,118,000	121,075,000
2030	30,400	4,200	34,600	12,629,000	129,567,000
2031	31,300	4,300	35,600	12,994,000	136,482,000
2032	32,100	4,400	36,500	13,322,500	143,363,000
2033	32,700	4,500	37,200	13,578,000	149,890,000
2034	33,400	4,500	37,900	13,833,500	155,837,000
2035	34,100	4,600	38,700	14,125,500	163,146,000
2036	34,700	4,700	39,400	14,381,000	170,394,000
2037	35,400	4,800	40,200	14,673,000	178,240,000
2038	35,900	4,900	40,800	14,892,000	185,679,000
2039	36,300	5,000	41,300	15,074,500	193,022,000

Ramp up Schedule:
2012 assumes a ramp-up factor of 61.0 percent.
2013 assumes a ramp-up factor of 81.3 percent.
2014 assumes a ramp-up factor of 94.5 percent.
No ramp-up is assumed in 2015 or beyound.

(1) Bridge assumed opened to traffic on January 1, 2012 with a Passenger Car Toll of $5.00; tolls proportionately higher for Commercial Vehicles.
(2) Assumes a Toll Schedule increased by 2.5 percent annually beginning January 1, 2013;. tolls proportionately higher for Commercial Vehicles.

Table 25
Estimated Average Daily Transactions and Gross Toll Revenue
Base Forecast using High Economic Assumptions

	Estimated Annual Average Daily Transactions			Estimated Annual	
Year	Passenger Car	Commercial Vehicle	Total	Transactions	Gross Toll Revenue
2012 [1]	8,300	1,100	9,400	3,431,000	$ 22,375,000
2013	12,300	1,700	14,000	5,110,000	34,457,000
2014	15,900	2,200	18,100	6,606,500	45,672,000
2015 [2]	18,900	2,600	21,500	7,847,500	55,540,000
2016	19,900	2,700	22,600	8,249,000	59,668,000
2017	21,000	2,900	23,900	8,723,500	64,918,000
2018	22,100	3,000	25,100	9,161,500	69,631,000
2019	23,200	3,200	26,400	9,636,000	75,320,000
2020	24,600	3,300	27,900	10,183,500	81,116,000
2021	25,700	3,500	29,200	10,658,000	87,292,000
2022	26,800	3,700	30,500	11,132,500	93,727,000
2023	28,200	3,800	32,000	11,680,000	100,284,000
2024	29,400	4,000	33,400	12,191,000	107,504,000
2025	30,800	4,200	35,000	12,775,000	115,525,000
2026	32,200	4,400	36,600	13,359,000	123,880,000
2027	33,500	4,600	38,100	13,906,500	132,316,000
2028	35,000	4,800	39,800	14,527,000	141,638,000
2029	36,600	5,000	41,600	15,184,000	151,622,000
2030	38,200	5,200	43,400	15,841,000	162,016,000
2031	39,200	5,400	44,600	16,279,000	171,084,000
2032	40,200	5,500	45,700	16,680,500	179,429,000
2033	41,000	5,600	46,600	17,009,000	187,470,000
2034	41,800	5,700	47,500	17,337,500	195,801,000
2035	42,600	5,800	48,400	17,666,000	204,432,000
2036	43,400	5,900	49,300	17,994,500	213,372,000
2037	44,300	6,000	50,300	18,359,500	222,969,000
2038	44,900	6,100	51,000	18,615,000	231,873,000
2039	45,500	6,200	51,700	18,870,500	241,082,000

Ramp up Schedule:
2012 assumes a ramp-up factor of 61.0 percent.
2013 assumes a ramp-up factor of 81.3 percent.
2014 assumes a ramp-up factor of 94.5 percent.
No ramp-up is assumed in 2015 or beyound.

(1) Bridge assumed opened to traffic on January 1, 2012 with a Passenger Car Toll of $5.00; tolls proportionately higher for Commercial Vehicles.
(2) Assumes a Toll Schedule increased by 2.5 percent annually beginning January 1, 2013;. tolls proportionately higher for Commercial Vehicles.

Table 26
Estimated Average Daily Transactions and Gross Toll Revenue
Base Forecast using Probable Economic Assumptions
Reduced Value of Time

	Estimated Annual Average Daily Transactions			Estimated Annual	
Year	**Passenger Car**	**Commercial Vehicle**	**Total**	**Transactions**	**Gross Toll Revenue**
2012 (1)	6,500	900	7,400	2,701,000	$ 17,776,000
2013	9,700	1,300	11,000	4,015,000	26,900,000
2014	12,500	1,700	14,200	5,183,000	35,702,000
2015 (2)	14,700	2,000	16,700	6,095,500	43,041,000
2016	15,300	2,100	17,400	6,351,000	46,051,000
2017	16,000	2,200	18,200	6,643,000	49,390,000
2018	16,700	2,300	19,000	6,935,000	52,869,000
2019	17,500	2,400	19,900	7,263,500	56,707,000
2020	18,300	2,500	20,800	7,592,000	60,704,000
2021	19,100	2,600	21,700	7,920,500	64,865,000
2022	20,000	2,700	22,700	8,285,500	69,431,000
2023	20,900	2,800	23,700	8,650,500	74,183,000
2024	21,800	3,000	24,800	9,052,000	80,014,000
2025	22,900	3,100	26,000	9,490,000	85,688,000
2026	23,900	3,300	27,200	9,928,000	92,265,000
2027	25,000	3,400	28,400	10,366,000	98,431,000
2028	26,100	3,600	29,700	10,840,500	105,822,000
2029	27,400	3,700	31,100	11,351,500	113,078,000
2030	28,600	3,900	32,500	11,862,500	121,370,000
2031	29,400	4,000	33,400	12,191,000	127,788,000
2032	30,200	4,100	34,300	12,519,500	134,452,000
2033	30,800	4,200	35,000	12,775,000	140,756,000
2034	31,400	4,300	35,700	13,030,500	147,291,000
2035	32,000	4,400	36,400	13,286,000	154,065,000
2036	32,600	4,500	37,100	13,541,500	161,085,000
2037	33,300	4,500	37,800	13,797,000	167,481,000
2038	33,800	4,600	38,400	14,016,000	174,650,000
2039	34,200	4,700	38,900	14,198,500	181,718,000

Ramp up Schedule:
2012 assumes a ramp-up factor of 61.0 percent.
2013 assumes a ramp-up factor of 81.3 percent.
2014 assumes a ramp-up factor of 94.5 percent.
No ramp-up is assumed in 2015 or beyound.

(1) Bridge assumed opened to traffic on January 1, 2012 with a Passenger Car Toll of $5.00; tolls proportionately higher for Commercial Vehicles.

(2) Assumes a Toll Schedule increased by 2.5 percent annually beginning January 1, 2013;. tolls proportionately higher for Commercial Vehicles.