



**DATE:** September 27<sup>th</sup>, 2018

**TO:** Transportation Authority of Marin Board of Commissioners

**FROM:** Dianne Steinhauser, Executive Director  
Derek McGill, Planning Manager

**SUBJECT:** 1) Accept the MEF Review of Origin and Destination Employment Data and 2) Approve the TAM Origin & Destination Study Final Report (Action), Agenda Item No. 6d

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## **RECOMMENDATION**

Staff recommends the TAM Board of Commissioners accept the Marin Economic Forum (MEF) review of Origin and destination Employment Data and Approve the TAM Origin & Destination Study Final Report, with MEF data included as an appendix to the report. By approving the TAM Origin and Destination Study, TAM and partner agencies will use data presented in this study as a source of information for transportation planning purposes, and not employment or economic purposes.

## **BACKGROUND**

In March of 2017, TAM presented a draft Origin and Destination study to the TAM board to understand existing travel behaviors for transportation planning purposes including traffic studies, climate action plans, general plans and support for near-term and long-term improvements. The study uses of extremely large data sources, referred to as “Big Data” collected from mobile phones, GPS devices and automobiles to provide a cost-effective approach to once burdensome system of mail surveys, traffic counting and license plate reader technology. This ‘Big Data’ approach allows for 75 million origin and destination points to be included in the analysis of Marin County’s travel behavior. Note that the data is aggregated and anonymized rather than captured as personalized data due to privacy requirements.

The final report was presented to the TAM Programming and Projects Executive Committee in July 2018 and was heard at the July 2018 Board Meeting. The TAM Board requested TAM to review and provide further insight into the relationship of various sets of employment data and traffic information presented in the TAM Origin and Destination Study.

TAM retained Marin Economic Forum (MEF) to develop a review of employment data to expand local understanding of the relationship between jobs and employment data and traffic data presented in the TAM Origin and Destination Study. This review is included as **Attachment A**.

Note the TAM Origin and Destination Study report represents an ongoing effort as requested by our local member jurisdictions to develop improved travel behavior and traffic data for local studies and projects.

## **DISCUSSION/ANALYSIS**

Working with MEF, TAM staff requested MEF to review four sources of employment or job data including:

- the US Census American Community Survey (ACS)
- the US Census Longitudinal Employment-Household Dynamics (LEHD) database (2015) also referred to as “On-The-Map”
- US Bureau of Economic Analysis (2016), and
- State employment data from the California Employment Development Department (EDD)

TAM provided Caltrans Traffic Counts prepared for the TAM Origin and Destination Study, which provides an estimate of 42,000 in-commute vehicles in the AM commute peak and 43,000 out-commute vehicles during the PM commute period for the year 2015. This data set is included in TAM’s study, which focused on vehicle trips, not workers or jobs.

Due to variances in survey design and reporting methods in the two sources (the ACS and the LEHD) provided by the US Census Bureau, the definition of what a “job” is varies, the total number of jobs vary, and thus the total home location and work locations of the job also varies.

The ACS (2016) reports out that 38% or 44,800 of Marin workers (self-reported) commute in from other counties, and the LEHD (2015) suggests 62.5% or 73,500 of “payroll workers” commute in from other areas; a 24.5% difference in commute numbers. The LEHD does not report residential employment levels, which then reduces the outbound commute numbers.

MEF then used US Bureau of Economic Analysis (BEA) data (the only known source of payroll workers and self-employed or “proprietors’ employment” data) and state EDD to correct for the lack of residential employment numbers in the LEHD. Based on this augmentation of US BEA data to LEHD data sources, the in-commute percentage changes from 62.5% to approximately 33.7-36.2%, in line with the US census ACS commute data and observed traffic counts.

Ultimately, the US Census Bureau data is suspect in two ways:

- The ACS misrepresents the total workers, while providing a good estimate of the total *commuting* workers (suggesting caution for the ACS as source of data for employers or economic development information);
- The LEHD dramatically overcounts in-commute %, without adjusting for self-employed. (suggesting caution for the LEHD as a source of data for traffic studies)

Based on these findings, TAM’s use of ACS data is appropriate for a traffic study and confirms observed travel information from traffic counts and the use of cellphone and GPS data. TAM staff recommend the TAM board accept the MEF study and adopt the TAM Origin and Destination Study.

## **FISCAL CONSIDERATION**

There are no fiscal impacts to this action.

## **NEXT STEPS**

TAM will post the final study online and begin validation of the TAMDM Model development to reflect the travel behaviors documented in the report.

## **ATTACHMENTS**

Attachment A: Marin Economic Forum Review of Origin and Destination Employment data

Attachment B: TAM Origin Destination Report Key Findings. A full copy of the report is available at:  
[TAM Origin and Destination Study Final Draft](#)

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**Origin-Destination Employment Levels and Data Sources  
A Primer**

**August 2018**




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## Origin-Destination Employment Levels and Data Sources A Primer

### 1. Introduction

This study examines current data (as of August 1, 2018) on commuter origins and destinations data in Marin County, California. This study was commissioned by the Transportation Authority of Marin (TAM) to provide an overview of data sources on workforce and commuting. The deliverables of this report include:

- An overview of differences in methodology and survey design among major data sources;
- An overview of the differing sources of data;
- A high-level reconciliation of available data sources used to determine an estimated number of in-commuters; and
- Provide recommendations on appropriate data sources for employment population and commute traffic data.

Generally, there are four sources of employment and worker information for Marin County and other counties throughout the United States. These include:

- the US Census American Community Survey (2013 and 2016, see <http://factfinder.census.gov>);
- the Longitudinal Employment-Household Dynamics or LEHD database (2015) also of the Census Bureau (see <http://lehd.ces.census.gov>);
- US Bureau of Economic Analysis (2016) (see <http://www.bea.gov>);
- and state employment data from the Bureau of Labor Statistics (BLS) reported by the California Employment Development Department (EDD, see [https://www.labormarketinfo.edd.ca.gov/data/Quarterly\\_Census\\_of\\_Employment\\_and\\_Wages.html](https://www.labormarketinfo.edd.ca.gov/data/Quarterly_Census_of_Employment_and_Wages.html)).

In addition to these employment data sources, MEF reviews the TAM Origin and Destination Study Draft report along with Caltrans traffic count information provided by TAM. Plan Bay Area, prepared by the Metropolitan Transportation Commission of California (MTC), provides long-term forecasts of employment, households and population in an attempt to accommodate projected traffic flows and development for new housing units to 2040.

This study has three sections from here. Section 2 provides a brief overview of the data sources, background information on how those sources gather data, and what each source is trying to measure. No source is solely measuring the flow of people to work and back home, but the LEHD and ACS have specific components that do so. Section 3 looks at recent data to compare and contrast each database and attempt to reconcile similarities and differences. Section 4 provides conclusions.



**2. Employment Data Sources and Overview**

It is important to note the distinction between jobs and workers reported in different sources of employment data. A single worker may have multiple jobs; for example, a business owner who also manages a national chain’s retail store, may be counted as two jobs. Additionally, if that same store has multiple business owners, this may be reported as multiple jobs, even without those owners performing any work duties. The dichotomy between “payroll” employment (workers who are eligible for unemployment insurance and have taxes paid to finance that insurance fund) and those working for a self-employed business is a key difference and may unlock reasons why differences exist in reported commute pattern data.

We see below that the major databases are concerned more with reporting the number of workers, and using payroll employment surveys and employee counts as the data’s bases. Self-employed is more difficult to measure, but is estimated by both the Census Bureau’s American Community Survey (ACS) and also the Bureau of Economic Analysis (BEA) as shown below. We start with the Quarterly Census of Employment and Wages (QCEW), as reported by California Employment Development Department (EDD).

*QCEW and EDD Labor Market Data*

Employment data for Marin County come from multiple sources, and we will focus on three sources. California EDD and the Bureau of Labor Statistics (BLS) work in concert to provide data on employment and occupations. Data on employer hiring levels come in two forms, where one source informs the other:

1. Monthly Estimates of Employment and “labor market information”, reported as excel spreadsheets for every county in California; and
2. The Quarterly Census of Employment and Wages or QCEW.

The QCEW program and its data (as reported by California EDD) tracks employment and wage information for workers covered by state unemployment insurance (UI) laws and also federal workers covered under the federal unemployment program. The QCEW is produce for all 50 states, and all 3,142 counties or townships in the Unites States. The Bureau of Labor Statistics (BLS) is the federal government’s repository for these data. Payroll survey data, mainly compiled from quarterly payroll tax submissions by employers to determine UI eligibility, generate QCEW source data.

Notice the QCEW has the word “census” in it on purpose: the data come from survey or census-like data gathering. An employer fills out the payroll data and submits the data. When published and released to the public, the QCEW is the federal government’s official statement (unless there is a future re-benchmarking exercise to revise old data) on the number of people working. Figure 1 shows four major categories of employers (private businesses and three levels of government employers) from 2002 to 2017 for Marin County. Figure 1 is the number of people working for an employer in Marin County, regardless of where the employee lives.

Figure 1: QCEW Labor Market Data, **Working in Marin County**, 2002-2017

Year	Total	Fed	State	Local	Private
2002	111,854	977	1,783	11,231	97,863




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2003	109,696	958	1,798	10,782	96,159
2004	109,601	928	1,849	10,723	96,101
2005	108,903	895	1,842	10,721	95,444
2006	108,984	905	1,874	10,678	95,527
2007	108,655	683	1,929	10,963	95,081
2008	109,340	909	2,117	11,127	95,187
2009	102,632	896	2,136	11,010	88,590
2010	102,062	910	2,129	11,447	87,576
2011	102,656	819	2,128	12,066	87,644
2012	106,021	789	2,002	12,107	91,123
2013	108,850	750	1,883	12,177	94,039
2014	110,424	747	1,815	12,103	95,758
2015	112,056	744	1,954	12,383	96,975
2016	114,063	738	2,004	12,491	98,830
2017	115,421	747	1,978	12,702	99,995

Source: QCEW ([www.bls.gov/cew](http://www.bls.gov/cew))

These QCEW data then inform multiple organizations, such as the Bureau of Economic Analysis (BEA) quarterly GDP and employment estimates. The BEA uses QCEW surveys and estimates as a benchmark for estimates of gross domestic product (GDP) and personal income data. The BEA also publishes labor-market data across many industries and for all counties, though these data are not the same as reported by QCEW. Part of the BEA data, as we see later, includes an estimate on the number of workers not working in jobs for self-employed (non-payroll and not eligible for state unemployment insurance programs), called “Proprietor Employment” in the BEA data, which means working for a self-employed business in Figure 2. These data on self-employed business hiring may be a missing link between datasets on commuting as shown below.

Figure 2: BEA Employment Data, QCEW benchmark, Marin County, 2002 to 2016

Year	Wage/Salary	Self- Employ	Totals
2002	121,452	55,646	177,098
2003	119,113	56,863	175,976
2004	116,942	59,132	176,074
2005	115,738	60,049	175,787
2006	116,395	60,810	177,205
2007	117,265	64,070	181,335
2008	117,396	64,981	182,377
2009	110,440	66,510	176,950
2010	109,769	66,992	176,761
2011	110,433	68,471	178,904
2012	114,559	68,431	182,990
2013	118,174	70,267	188,441
2014	120,382	71,582	191,964
2015	121,978	72,508	194,486
2016	123,557	74,364	197,921

Source: BEA ([www.bea.gov](http://www.bea.gov))

The U.S. Census Bureau produces two complementary data products, the American Community Survey (ACS) commuting and workplace data and the Longitudinal Employer-Household Dynamics (LEHD) and its Origin-Destination Employment Statistics (LODES). Both datasets can be used to answer questions



relating to workplaces and the flow of people from where they live to work and back again. The products are complementary in the sense that they measure similar activities. They are also compared at length by public policy advocates on opposing sides of traffic and commute and infrastructure funding debates because the implications from each dataset have been different.

The LEHD Origin-Destination Employment Statistics (LODES) are the basis commute data measured inside the LEHD. Studies on the LODES data and methodology describe this proves as combining different source documents of count data rather than extrapolate from survey data that are one to five percent of the population then extrapolated as in the ACS.<sup>1</sup> A recent Census report (2017) suggests that the LODES data understates the in-county commute versus the ACS in-county commute by almost 18 percentage points. However, on an employer match model (ibid), the ACS and the LEHD through LODES would predict about 54.9 percent within county commute rates on average; this 2017 study attempts to reconcile the differences in these databases.

Design differences seem to be the key place where ACS and LEHD differ becoming differences in the data; part of the LODES/LEHD design is to not count self-employed workers, where the ACS does. The LEHD/LODES data are worker-specific data that link worker records to where they live. This is connected to the QCEW and ultimately the Census Bureau's quarterly workforce indicators (QWI, see <https://qwiexplorer.ces.census.gov/static/explore.html>) that utilize more complete aspects of employer surveys from the QCEW. In theory, these LEHD data cover 96 percent of the workforce that are eligible to collect unemployment insurance (are not self-employed or work on contracts such that they must pay self-employment tax).

One of the key concerns with the LEHD is multiple employer locations. In the LEHD model, if there are two locations, as an example, the default address for the employee is the closer location. This location may not be where the worker works, nor in the correct county where the worker works. In the case of multiple locations, the FTE is allocated to each location in a proportional way, though the worker (FTE) has one employment address. Such a model can also help explain longer commute times in the LODES data by providing probability weights to employer locations that have little meaning to a worker.

Figure 3 show the LEHD data that are comparable to the QCEW data on who works in Marin, regardless of where the workers live (shown in Figure 1), as well as the data on who lives in Marin County and is part of the labor force (the measurement of local residents that are working in jobs that are part of payroll surveys that determine the unemployment insurance eligibility in California).

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<sup>1</sup> Please see the "References" section of this paper for studies that provide strong descriptions and understanding from comparing these datasets.



**Figure 3: LEHD and QCEW Labor Market Comparison, 2002-2017**

**Workers in Marin County who live anywhere and those that Live in Marin County and Work Anywhere**

Year	LEHD Works in Marin	QCEW/EDD	Inbound LEHD %	Outbound LEHD %	LEHD Lives in Marin	EDD Civilian Employment
2002	105,571	107,300	55.0%	52.0%	98,822	128,000
2003	101,803	106,700	55.7%	52.6%	95,202	124,300
2004	100,780	105,800	56.6%	53.1%	93,248	123,500
2005	103,716	105,000	57.2%	52.6%	93,569	124,100
2006	103,269	106,000	57.1%	53.2%	94,516	126,000
2007	103,381	107,100	59.2%	56.2%	96,357	127,100
2008	105,208	107,900	59.5%	57.2%	99,656	126,000
2009	102,818	101,300	59.9%	57.2%	96,319	122,100
2010	101,475	100,800	60.1%	58.4%	97,407	122,600
2011	103,790	102,700	60.7%	59.4%	100,428	124,800
2012	104,964	105,800	61.4%	59.8%	101,007	128,300
2013	108,172	109,700	61.9%	60.2%	103,532	131,200
2014	109,639	110,900	62.0%	60.5%	105,625	133,200
2015	112,471	112,300	62.5%	60.1%	105,779	134,600
2016		114,500				135,700
2017		116,000				137,300

Sources: LEHD (<http://onthemap.ces.census.gov>) and QCEW ([www.bls.gov/ces](http://www.bls.gov/ces))

Commuting statistics (or Journey-to-Work) are tabulated from the ACS. Questions about transportation pertain only to work travel. ACS estimates related to commuting are derived from a sample of workers 16 years and over who worked during the ACS reference week, the calendar week preceding the date respondents completed their questionnaire. The ACS questions related to travel focus solely on commuting and do not ask about non-work travel. Respondents answer questions about where they work, what time they leave home for work, the means of transportation used to get there, the number of workers riding in the car, truck, or van, and how long it takes to travel to work.

The ACS attempts to provide annual updates to the 10-year census using a 1- to 5-percent sample. A pooled dataset over five years provides something closer to the sample size of the decennial census, which aims for one in six households. It is from the five-year pooled sample that commute data are estimated. Unlike the LEHD/LODES data, the ACS is not able to provide sub-county estimates of commute patterns or flows.<sup>2</sup> A difference between the ACS and the LEHD is the self-employed are not counted in the LEHD and are estimated in the ACS as part of the broader survey of the working population.

Figure 4 shows the ACS data for those that live in Marin, which include the self-employed; the second panel of Figure 4 are those that work in Marin and the those that work for self-employed businesses, regardless of where the worker lives (based on “workforce geography” versus “resident geography”). These data are, based on the geocoding of where people claimed they work on the survey versus where workers say

<sup>2</sup> Through the ACS, “Journey to Work” data provides county to county flows. These data are also available at the California EDD for 2006 to 2010 (see <https://www.labormarketinfo.edd.ca.gov/data/county-to-county-commute-patterns.html> for more), but there are some journey to work data available for Marin County from the ACS directly through 2016.



they live, determine the commute patterns reported by the ACS and Public Use Microdata System or PUMS data. Figure 5 provides the percent commuting, for those that report in the ACS that as workers they working inside Marin County, versus outside.

Figure 4: ACS Labor Market Data, 2007 to 2016 (Three and Five-Year Averages)

Year	Lives in Marin	Self Employed	Works in Marin	Self Employed
2007	121,198	22,267	125,498	21,029
2008	124,678	22,965	128,925	20,802
2009	121,210	22,241	124,599	20,653
2010	121,354	22,075	124,267	20,398
2011	121,068	21,797	124,749	20,084
2012	122,388	21,554	126,017	19,961
2013	121,269	20,444	124,550	19,277
2014	122,993	20,013	125,849	18,780
2015	125,612	19,816	128,242	18,919
2016	127,178	19,775	127,518	18,507

Source: ACS (<http://factfinder.census.gov>)

Figure 5: Commute Data, Marin County, Percentage of Workers (%), 2007 to 2016 (Three and Five-Year Averages), ACS

Year	Marin Resident		Data Comparisons	
	Works Inside Marin County	Works Outside Marin County	Implied Inbound Workers	LEHD With BEA Self-Employed
2007	66.5	33.5	33.5	33.7
2008	66.1	33.7	33.9	34.3
2009	65.7	34.3	34.3	34.8
2010	65.1	34.0	34.9	34.5
2011	65.3	33.6	34.7	35.2
2012	65.8	33.7	34.2	35.2
2013	65.7	34.5	34.3	35.5
2014	64.9	34.4	35.1	35.4
2015	65.1	35.4	34.9	36.2
2016	64.0	33.5	36.0	36.2

Sources: ACS (<http://factfinder.census.gov>) and LEHD (<http://onthemap.ces.census.gov>)

#### *Forecasts of Workers and Population: Plan Bay Area*

Plan Bay Area's forecast goes out in 5-year increments, we show through 2025 here). The forecast sources use the above, official statements about employment as a benchmark and then forecast from there. None of these discuss inbound commuting. Plan Bay Area (see <http://www.planbayarea.org> for more, though the report that we use here came from TAM staff) reports the level of payroll employment as 131,000, with a 2010 benchmark of 115,855 workers.



Figure 6: Plan Bay Area Employment and Population Forecast, 2010 Benchmark, 2010-2040

Year	Employment	Growth Rate from 2010	Pop	Growth Rate from 2010
2010	110,420		253,975	
2015	129,890	17.6%	262,375	3.3%
2020	130,635	18.3%	265,845	4.7%
2025	131,180	18.8%	269,215	6.0%
2030	132,355	19.9%	274,500	8.1%
2035	132,100	19.6%	278,180	9.5%
2040	131,540	19.1%	282,640	11.3%

Source: Plan Bay Area (data file provided by TAM staff), [www.planbayarea.org](http://www.planbayarea.org)

These data suggest relatively slow rates of population growth through 2040, suggesting as Marin County's population grows more slowly than its employment levels, there will be more inbound commuting growth versus outbound commuting, which looks to switch in the 2030s. The labor force participation rate is another factor to watch in terms of how new residents become new workers available for work or working or not (e.g. retired residents). There are other, private databases and firms (such as EMSI at [www.economicmodeling.com](http://www.economicmodeling.com)) that attempt to estimate commute flows, but all use these government sources as a benchmark and do so through 2028.

Before we summarize the labor market data and the implications of the databases that report commute statistics, let's review a recent study by Transportation Authority of Marin (TAM) on traffic counts and commuting.

#### *TAM Origin and Destination Study 2018*

Most studies of traffic flows involve a physical count at a point in time, normally at a major connection between highways or at a county line. Such studies are then supplemented by surveys and other third-party data to round out the data sourcing. Like some of the other studies shown here, survey work is a sample and then used as a basis for extrapolation; like the LEHD, TAM generally tries to match data from counts with specific data (license plates provide DMV records on resident origin addresses to match destinations) to complete the count.

The 2018 TAM origin and destination study used a purchase of GPS data using cell phones to locate people and determine locations and where trips begin and end, included home to work based trips for Marin County residents. Saving time on data collection and being able to track person by person using geocoding and "big data" techniques was a major component of this 2018 study by TAM. Intra-county trips are considered easier to gather, as the origin and destination are the same county and there is no need to consider the initial destination further. Linking this to worker flows was not the intent, short of indirectly estimating movement of Marin County residents going to work. Mobile device data of three types were used: countywide data on trips; specific origin-destination data between pre-designated zones; and home-work locations for outbound, Marin County residents that commute and presumed (due to the time of the day) to be going to work when their cell phone is moving on the map.



The TAM Origin and Destination study estimates that the 57 percent of Marin County residents (who are workers) work in Marin. TAM consultants used the ACS estimate of 121,269 workers in Marin County to extrapolate home to work trips for residents. This data suggests that 69,123 workers live in Marin county, and the remainder of the workers, 52,146 (or 43 percent) commute in, larger than the vehicle counts that were conducted.

There are many reasons why trips may be fewer than the number of worker that commute in: carpools; use of mass transit; etc. Because the focus what on residents of Marin County, the outbound location was also a goal of TAM's work. The link to the data above is generally here, as the use of ACS data on "Journey to Work" fills this gap. The study shows that GPS cell-phone data during peak commute times closely matches the number of implied commuters and the numbers are close.

The data used in this report was over 75 million trips. The focus on trips showed that most trips were intra-county, an estimate of 72 percent. TAM concludes that Marin County imports more workers than it exports, with approximately 22,300 trips into Marin County from outside and 15,870 trips from Marin County to other counties during peak commute times. San Francisco is the dominant, outbound location with 52 percent of trips. Most intra-county trips originate in San Rafael and end in San Rafael.

There are 30 "origin" zones in Marin County and 10 destination zones outside the county to help identify flow. Also, some of the cell-phone data were of select "links" to look at trips between specific areas of interest. Examples include: US 101 at the Marin-Sonoma counties line; both north and south of San Rafael; and east and west of US 101 at Sir Francis Drake Blvd.

Some of the basic data conclusions in the TAM study concerning the flow of workers include the following:

- Census data indicates there are approximately 120,000 workers who live in Marin County with approximately 34 percent travelling outside of Marin County for work (28 percent of residents work in San Francisco County).
- Factoring of the census data based on the home and work zone data indicates that approximately 70,000 Marin County residents work in Marin County while approximately 34,000 work in San Francisco County.
- The city with the highest percentage of residents working in San Francisco is Sausalito (57 percent) and the city with the lowest percentage of residents working in San Francisco is Terra Linda/Northern San Rafael (16 percent).
- Census data indicates there are approximately 125,000 workers who work in Marin County with approximately 35 percent living outside of Marin County.

The TAM study uses a clever, modern approach to trip counts and has data on flows of worker that links closely to findings from major governmental sources and also to the reconciliation shown above. The self-employed worker, the resident of Marin County that also works at home or close to it, may generate many of the intra-county trips shown in these GPS data once school commute times are completed. However, the TAM study and conclusions do not address the self-employed versus payroll employment; while we assume for purposes of origin-destination counts that those working for a self-employed business have a work destination and a



home origin that are generally the same for trips purposes, some error in worker movement counts come from this measurement problem. The next section summarizes our findings.

### 3. Data Summary for Latest Available Data

To help close the loop on the above database differences, this section provides the latest data (as of August 1, 2018) on employment levels, self-employment levels, commuting volumes (inbound and outbound commuting), and the commuter destinations and origins.

1. As of June 2018, there are approximately 117,600 people working at jobs covered by unemployment insurance (part of the payroll surveys and tax structure done by California EDD monthly and quarterly) for employers inside Marin County. This number is called “Total Employment” in the dataset from California EDD.
  - a. The number of Marin County residents that are working at jobs covered by unemployment insurance is 136,300 people, what is sometimes called “Civilian Employment” in the data but is really “Residential Employment for Jobs Covered by Unemployment Insurance” or from here “Residential Employment”.
  - b. See <http://www.labormarketinfo.edd.ca.gov/data/employment-by-industry.html> for the datasets.
  - c. This does not include the self-employed.

In a crude but logical way, the difference between these two numbers provides some sense of **net** commute flows. For example, if Residential Employment is greater than Total Employment, it suggests net **outbound** commuting; if the opposite inequality, it suggests net **inbound** commuting. The logic is simple: if there are more working residents than jobs available, those working residents must be working some other place besides Marin County in net. Because these data do not show the self-employed, we must look elsewhere for the self-employed figures, where the ACS and the BEA data provide more details and the other databases do not.

2. As discussed, the Census Bureau’s Longitudinal Employer-Household Dynamics or LEHD database (see <http://lehd.ces.census.gov>) uses the payroll surveys that help determine the EDD estimates (which use the QCEW data and the monthly tally from those QCEW surveys as the basis of what is reported in the employer section of the EDD data). Because the LEHD uses multiple data sources, the reported data tends to lag two or more years (similar to the ACS data but a longer lag). Similar to the EDD data, there are no self-employment figures reported in LEHD.
  - a. December 2018 is the release data for the 2016 LEHD data;
  - b. In 2015 (the latest data), a total employment level of 112,470 workers who may live in anywhere.
    - i. The analogous number from EDD, which is an annual average of sorts and reported different than the monthly data is 112,300 workers, which is close;
    - ii. These numbers should be close as they come from the same database in theory (QCEW);
  - c. Further detail in the LEHD suggests 62.5% or 70,310 of these 112,470 people work in Marin County at payroll jobs commute in from elsewhere;



- d. The percent in-bound commuting to Marin County for payroll fluctuated between 59.2% and 62.5% between 2007 and 2015 according to LEHD; and
  - e. Holding that percentage at 62.5%, for May 2018 that implied approximately 73,500 payroll workers are inbound commuters.
3. Looking at the number of working residents, there is a large discrepancy between the datasets.
    - a. LEHD in 2015 reports 105,780 people living in Marin County and employed;
    - b. EDD reports 134,600 in Civilian Employment;
    - c. The implied difference is not made up by reducing the number of local residents who are “non-civilian” in Marin County; and
    - d. This is a major issue with the LEHD data, as it understates the residential employment level, which can then understate the outbound commuting level.
    - e. By further implication combining the recent EDD data and the 2015 LEHD percentage, 37.5% or 44,100 payroll workers live and work in Marin County.
  4. The American Community Survey (ACS) (<http://factfinder.census.gov>) on commute patterns. The latest data comes from the “Public Use Microdata System” or PUMS as of 2016:
    - a. 44,800 workers (38 percent) in Marin County are inbound commuters (live elsewhere but work in Marin County), which implies that there 117,915 workers.
      - i. 73,115 workers by implication of the LEHD numbers above both live and work in Marin County.
      - ii. ACS is not clear about these workers employed by payroll employers or self-proprietors (see below for more on this dichotomy).
  5. The Bureau of Economic Analysis (<http://www.bea.gov/regional>) estimates payroll (what it calls “wage and salary”) employment as well as self-employed (what it calls “proprietors employment”) jobs for all counties in the United States. The latest data are from 2016.
    - a. For Marin County, the estimate for payroll employment is 123,557 workers in 2016, and self-employed is 74,364 workers (these workers are employed by self-proprietor businesses and those eligible for unemployment insurance).
      - i. There is not an analogous residential employment number in the BEA data;
      - ii. The California EDD figure for 2016 residential employment is 135,700, which implies that there may be as many as 210,000 “workers” living in Marin County when self-employed workers are included; and
      - iii. This does not discern between workers with self-employment and payroll income.
    - b. These two points imply 197,921 workers in Marin County on payroll or working for a self-proprietor, or about 13,000 people net **outbound** commuting in 2016;
    - c. LEHD reports a net **inbound** commuting of 6,600 people; but
    - d. Some of these workers are double-counted because they may earn both payroll and self-employment income.



#### 4. Conclusions

While these estimates have different dates and different assumptions, traffic counts and recent data from TAM point to a rising number of vehicle trips per day likely coming from workers that work in Marin County and live elsewhere. The snapshot data above all come from time series data, and we can track back to 2010 on all these data (ACS oldest data on commute patterns is 2009). To reconcile the datasets means some wild algebra and assumptions about how the data may match up. The LEHD data on payroll comes from payroll data, tax return data, and a point estimate of all the data available, not a survey estimate from a sample (like ACS data are). In considering the number of workers in transit, this study showed several databases on employment and commute patterns. Combining some of these data and recognizing where data are missing or not accounted for can help. Here is how one may surmise and summarize the data above.

1. The QCEW/BLS/EDD employment counts are the official statement of employment in an area by our state and national governments. However, these only count workers eligible for unemployment insurance (payroll workers), not the self-employed.
2. The BEA uses these data as a basis for their estimates of macroeconomic data, as well as employment, and also estimates the number of workers not eligible for unemployment insurance (self-employed or working as a contract worker for another employer).
  - a. The self-employed are considered to not be commuting anywhere to a job location otherwise.
3. The LEHD data measure the flow of payroll workers, and do not include estimates of the self-employed.
  - a. The basis for these estimates includes the QCEW data, which are also the bases of the payroll (wage and salary) employment data for the BEA.
  - b. The LEHD uses other data on where workers live to match up the flow of workers from home to work and back and is a precise estimate for payroll workers.
4. The ACS uses a census-like survey instrument and matches the number of workers that live in a place (resident geography) with where workers identify is the place they work (workplace geography).
  - a. These data in combination allow the ACS to estimate the “county-to-county” flows of people for work, giving a similar number as the LEHD figures.
  - b. The ACS data also attempt to estimate the self-employed, thus giving a percentage of overall workers that move between two counties, or in total toward a specific county.
5. In Marin County, the percent of inbound workers as reported by the ACS (a rolling five-year average since 2009 and a three-year rolling average from 2007 to 2009) ranges between 33.5% and 36.0% of workers are coming into Marin to work for all the workers in Marin County.
6. The LEHD reports a range from 2007 to 2015 that is from 33.7 to 36.2 **if self-employment workers are added to the based LEHD payroll employment for total employment levels in Marin County.**
  - a. This close matching of the ACS data and LEHD data plus BEA suggests tracking self-employed workers is a key to tracking traffic patterns;
  - b. The assumption here is that self-employed workers are not “commuting” thus work where they live; and
  - c. The ACS total workplace geography estimate of workers for Marin County is similar to the QCEW figures for Marin County employers and the number of workers that work in Marin



County, suggesting major miscalculation of the total workers in Marin but a good estimate of the percentage of total workers commuting.

It is recommended that TAM consider using older data (as available) to provide a time series of trips to compare to governmental sources on commuting, as well as repeat the GPS, cell-phone exercise in the future.

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Plan Bay Area data provided by TAM staff from Association of Bay Area Governments (ABAG) and Metropolitan Transportation Commission (MTC)

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# **TAM Origin and Destination Report**

## **Key Findings**

Prepared for:  
Transportation Authority of Marin

September 19, 2018

WC16-3330

FEHR  PEERS



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## STUDY PURPOSE

The purpose of the TAM Origin and Destination study was to collect origin-destination (OD) data specific to Marin County to provide an updated understanding of Marin County travel patterns and to support the development of the TAM Travel Demand Model (TAMDM). A primary purpose of the OD data collection is to understand regional travel patterns on our national highway system and in addition, assess local travel behaviors generated from communities and towns within Marin County.

Traditionally, gaining an understanding of regional travel behavior patterns would involve traffic count collection to quantify the number of vehicles crossing the county line. The data would then be supplemented with origin-destination and demographic information obtained from license plate matching and a subsequent mail survey sent to the registration address of observed inter-county vehicles. Fehr & Peers has conducted a number of these studies and has typically received a small sample of user-response data (response rates have ranged in the one to two percent range) based on a single day of observation at a very high cost per sample.

Recognizing the limitations of the traditional approach, this study uses "Big Data" to obtain OD data passively and anonymously from mobile devices. This allows for the quantification of the flow of devices within, to, and from a specific geographic area for all types of trips that occur, including visitors to and trips passing through the area. This data provides trip making information for a very large sample of trips, including the inferred origin and destination of individual trips, in a format nearly identical to that used by travel demand models for a very small cost per sample. This data collection method has other benefits such as not requiring set up time or human transcribing of observed field data and can be collected for any length of time that has occurred in the past. The use of "Big Data" to quantify and determine the origin and destination of inter-county trips has been compared to data collected using traditional methods, resulting in a high level of confidence in this approach.

An additional purpose of this study is to obtain origin-destination data for trips that occur within Marin County. This data has traditionally been very difficult to obtain due to multiple access routes in and out of communities, and high costs of detailed surveying. Quantifying inter-county travel has traditionally been much easier to obtain as there are usually a limited number of routes in and out of a county and inter-county trips are typically a small percentage of total trips generated by a county.

An additional goal of the data collection plan was to obtain the "work" location of commuters who live in Marin County. This data has traditionally been obtained through Journey-to-Work commuting data provided by the United States Census Bureau. While this data is readily available for areas within Marin County, the data represents estimates that are generally more reliable for large geographic areas with



large populations due to the sample size and estimation techniques applied. For this study the goal was to understand commute patterns for commuters who lived in specific areas of Marin County and to determine how and why they may differ. Therefore, cellular data was used to obtain the “work” location of commuters in specified “home” locations, whether that be within the same “home” zone or a specified “work” zone outside their “home” zone or Marin County.

## STUDY APPROACH AND METHODOLOGY

The first step of the OD Data Collection study was to obtain existing travel behavior data to understand what data was available for Marin County. To supplement and compliment this data, mobile device data was obtained from AirSage, INRIX, and StreetLight Data, which provided a very large sample of real-world observed OD information. This data was obtained for a zone system based on the regional travel demand model zone system that will be used for the development of the TAM Demand Model (TAMDM). The mobile device OD data was then refined using existing traffic count data and checked for reasonableness against existing United States Census Bureau data, reducing the limitations of the data.

In order to obtain OD data for travel patterns associated with the primary and secondary purposes of this study, three types of mobile device data were obtained.

1. Countywide origin-destination data was obtained to provide the number of trips between each zone in the geographic layer (which covered the entire Bay Area) to every other zone in the geographic layer.
2. Select-link origin-destination data was obtained to provide the number of trips between each zone that traveled through a selected roadway segment.
3. Home/work location data was obtained to determine the “work” location of commuters who live in specified “home” zones.

OD data from the three mobile device data sources was then analyzed and summarized to draw a set of conclusions and key findings regarding travel patterns within, to, from, and through Marin County. A robust, comprehensive dataset, specific to Marin County, is included in this report.

This report is divided into five chapters as described below:

- **Study Purpose** discusses the purpose of this report.
- **Study Approach and Methodology** discusses the organization of this report and provides an overview of the study methodology and mobile device data including advantages and limitations of the data.
- **Existing Travel Behavior Data** provides a summary of existing and historic Marin County travel behavior data that was gathered to refine and check the reasonableness of the mobile device-generated OD data. Data sources include 2009-2013 American Community Survey (ACS), 2010 California Household Travel Survey (CHTS), and transit on-board surveys conducted throughout the SF Bay Area between 2004 and 2015.

- **Mobile Device Data** provides a summary of the three types of origin-destination data provided by StreetLight Data.
- **Conclusions** provides a list of key questions answered from the existing travel behavior and mobile device data collected as part of this study.

Below is an alphabetical list of terms and acronyms with accompanying definitions that will be discussed in this report.

- Mobile device data – a subset of “Big Data” that uses anonymous, archival location data from mobile devices (i.e. cellular phones, global positioning systems, on-board or in hand navigation systems) to help planners answer important questions about their communities that were previously difficult, expensive, and time consuming to answer.
- MTC (Metropolitan Transportation Commission) - the transportation planning, financing and coordinating agency for the nine-county San Francisco Bay Area.
- TAZ (Traffic Analysis Zone) - is the unit of geography most commonly used in conventional transportation planning models to account for land use and socio-economic data.
- Travel Model Two – an activity-based travel demand model maintained by the Metropolitan Transportation Commission covering the nine-county San Francisco Bay Area.
- VMT (Vehicle Miles Traveled) - a measurement of miles traveled by vehicles within a specified region for a specified time period.
- Cut-through traffic – traffic that passes through an area or region with stopping on roadways not designated or designed for regional travel.
- Select-link analysis – the analysis of trips that travel through a select roadway segment (such as the Golden Gate Bridge) rather than through a select area such as Marin County or San Rafael.
- Origin-destination data – data associated with where trips start (origin) and end (destination) as opposed to data associated with locations where trips travelled through (traffic count data).

## KEY FINDINGS

The TAM Origin and Destination study collected OD data specific to Marin County to provide an updated understanding of Marin County travel patterns and to support the development of the TAM Travel Demand Model (TAMDM). OD data was obtained passively and anonymously from mobile devices, providing a very large sample of empirical data that included the origins and destination of individual trips as well as the home and work locations associated with individual devices. Analysis of this data

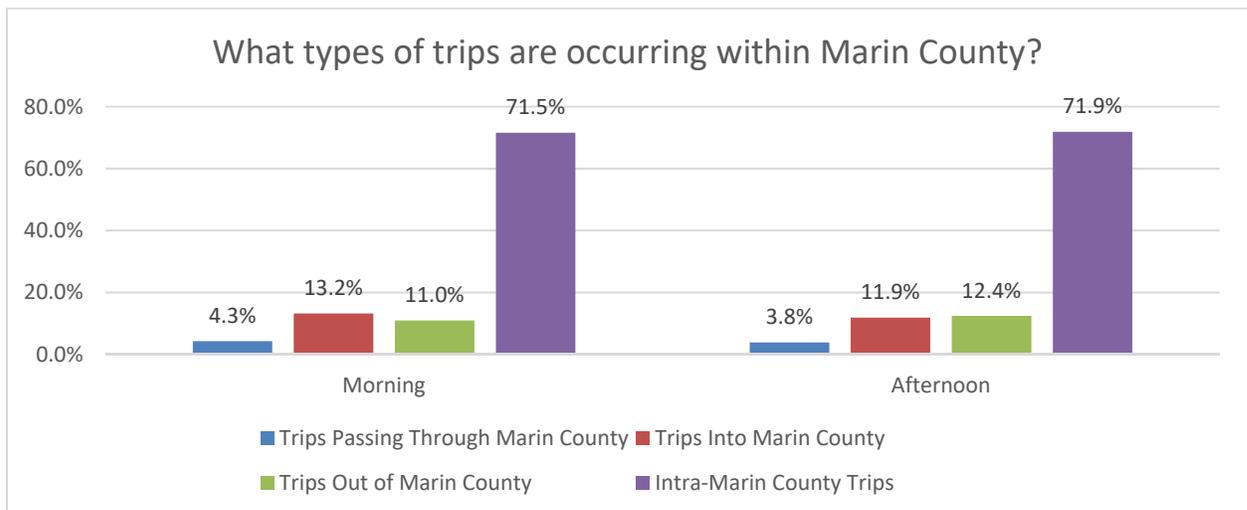
provided an understanding of Marin inter-county travel patterns on our national highway system as well as local travel behaviors generated from communities and towns within Marin County.

Below is an abbreviated list of key questions answered by the TAM Origin and Destination study – see the “Conclusions” section below for more information.

**What types of trips are occurring within Marin County?**

- Approximately 72 percent of total trips are intra-Marin County trips, four percent of total trips are passing through Marin County, and 24 percent of total trips are inter-county trips in the morning and afternoon peak periods.

**Countywide Trips by Trip Type**



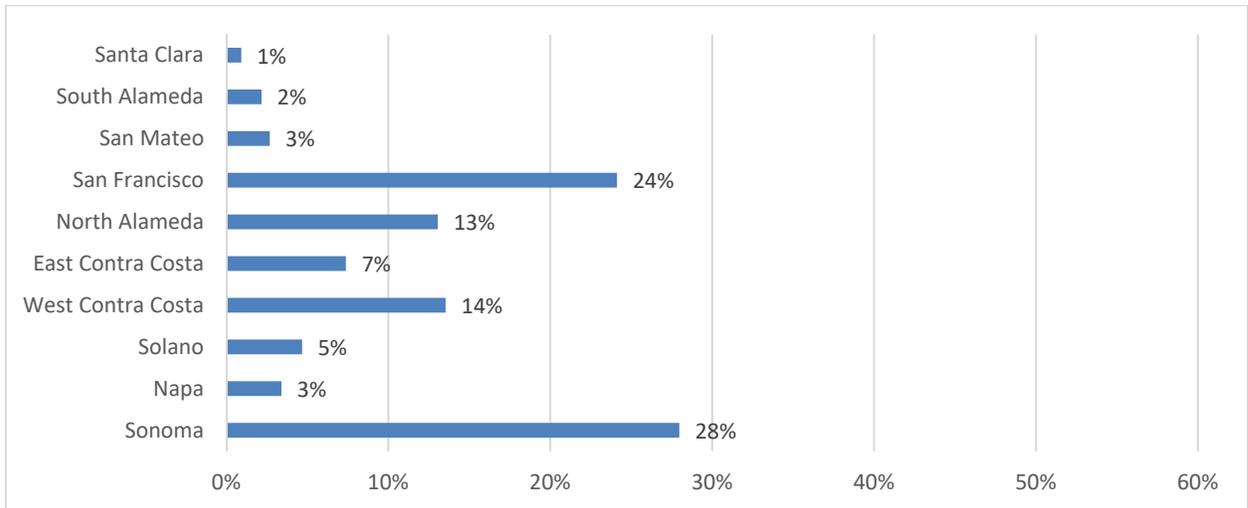
**Does Marin County import or export workers?**

- Traffic count data indicates that Marin County imports workers, with 9,000 more vehicles or 27 percent more traffic coming into Marin County in the morning peak period and 3,000 more vehicles or eight percent more traffic leaving Marin County in the afternoon peak period.
- Through a comparison of “trips into Marin County” and “trips out of Marin County,” mobile device data indicates that in the morning peak period Marin County imports 10,647 trips (and exports 4,990 trips) from Sonoma and other North Bay counties on US 101 and SR 37, exports 15,865 trips (and imports 7,894 trips) to San Francisco County on US 101, and imports 11,750 trips (and exports 4,235 trips) from the East Bay on I-580.

### Where are morning peak period trips into Marin County coming from?

- Approximately 52 percent of morning peak period trips into Marin County are coming from Sonoma (24 percent) or San Francisco (28 percent) counties, while 14 percent are coming from West Contra Costa County and 13 percent are coming from North Alameda County.

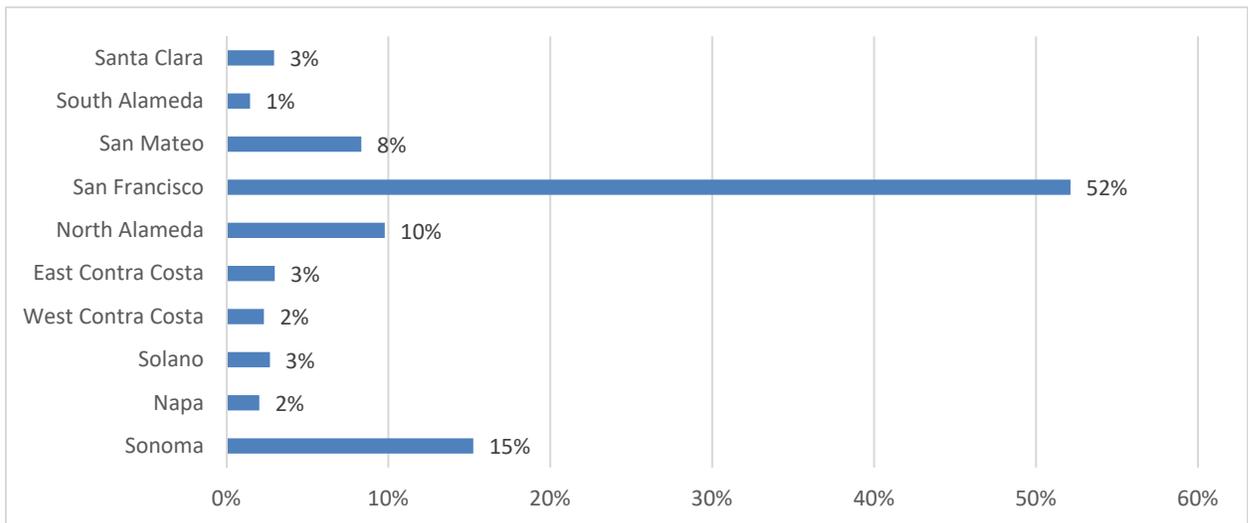
**AM Peak Period Trips into Marin County**



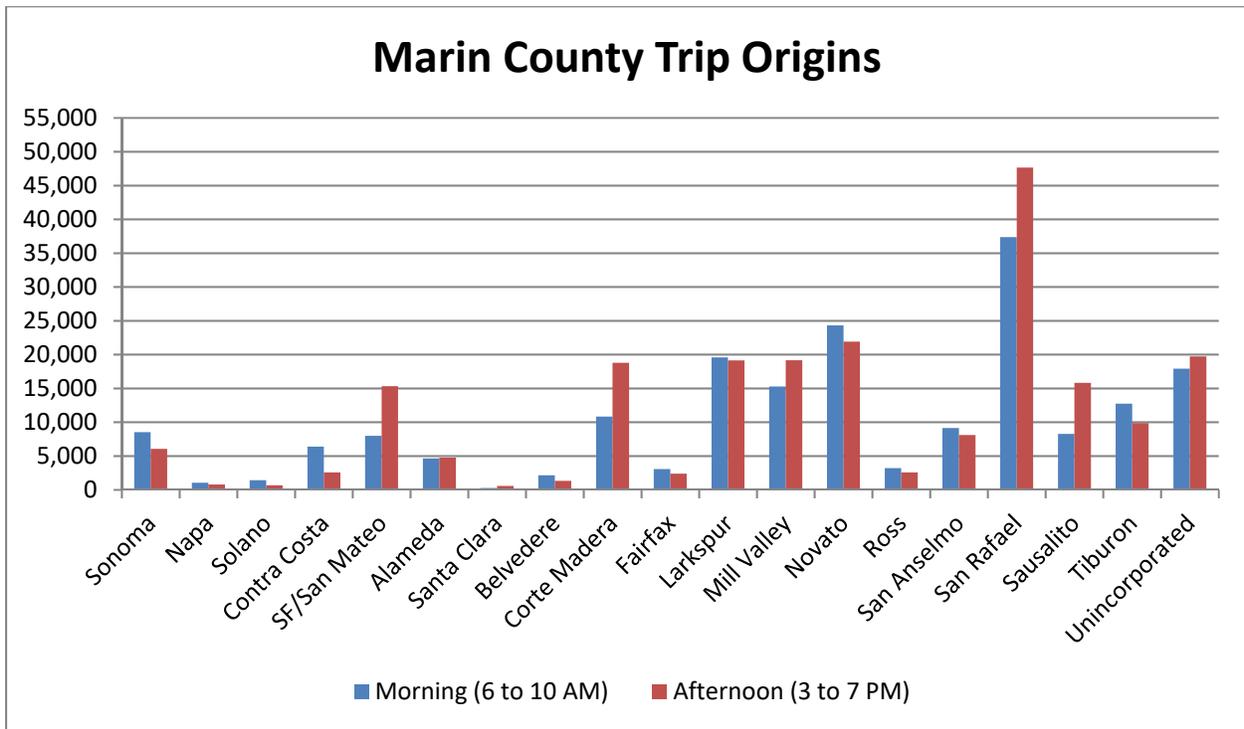
### Where are morning peak period trips out of Marin County going to?

- Approximately 67 percent of all morning peak period trips out of Marin County are going to Sonoma (15 percent) or San Francisco (52 percent) counties, while ten percent are going to North Alameda County and eight percent are going to San Mateo County.

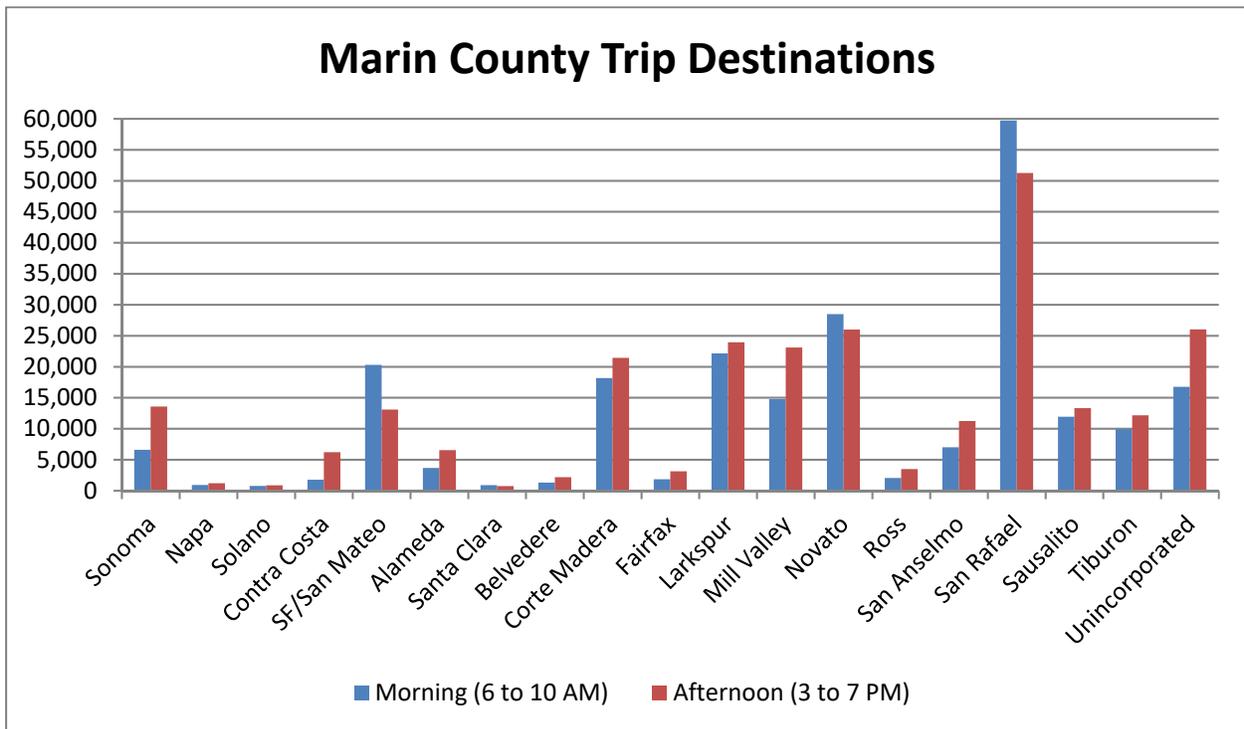
**AM Peak Period Trips Out of Marin County**



**Where are Marin County trips originating?**



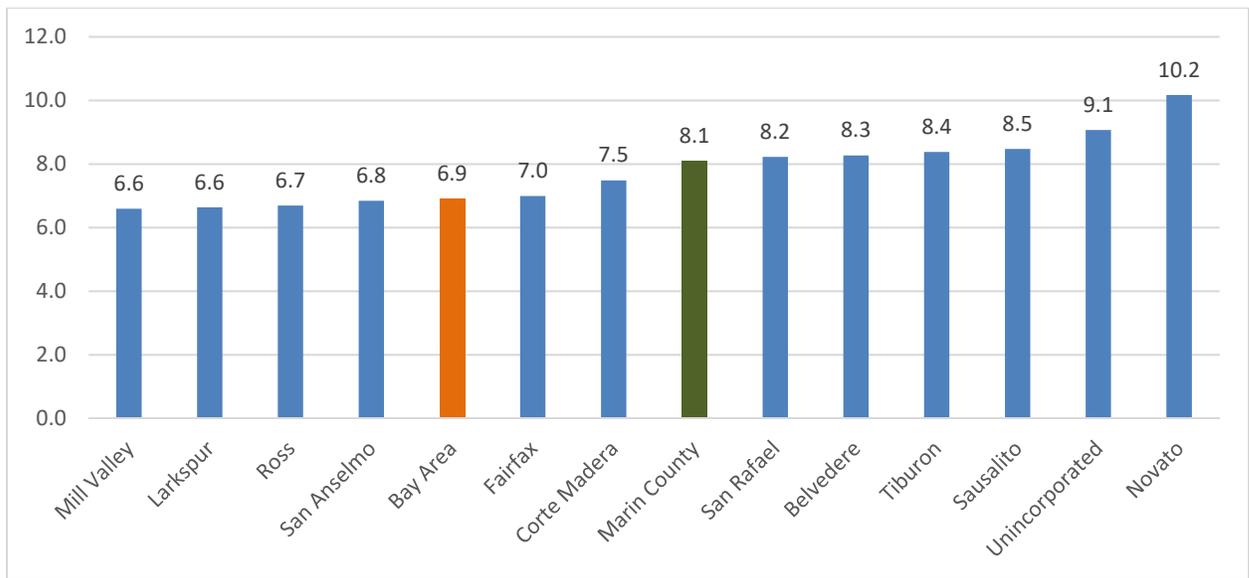
**Where are the destinations of Marin County trips?**



**What is the average daily trip length of Marin County trips? How does it vary by city? How does it compare to the Bay Area average?**

- The average daily trip length for Marin County trips is 8.1 miles, 17 percent longer than the average daily trip length for Bay Area trips.
- Novato has the longest average daily trip length at 10.2 miles and Mill Valley has the shortest average daily trip length at 6.6 miles.

**Average Daily Trip Lengths (Miles)**



**What types of trips are occurring on the Richmond-San Rafael Bridge?**

- Approximately 16 percent of trips are passing through Marin County, 62 percent of trips are travelling into Marin County, and 22 percent of trips are travelling out of Marin County in the morning peak period.

**What types of trips are occurring on the Golden Gate Bridge?**

- Approximately 21 percent of trips are passing through Marin County, 26 percent of trips are travelling into Marin County, and 53 percent of trips are travelling out of Marin County in the morning peak period.

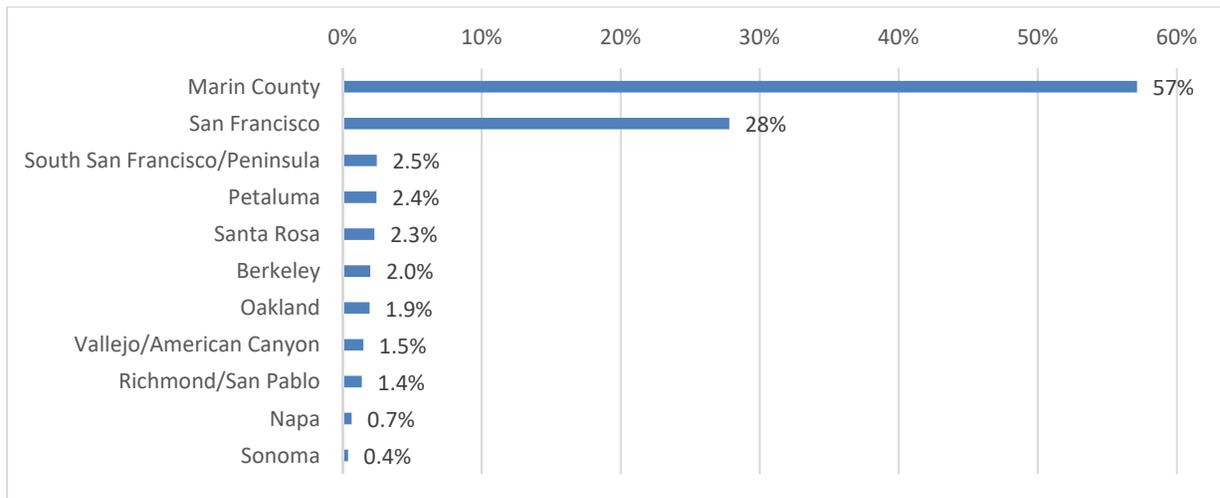
**What types of trips are occurring at the Marin/Sonoma County Line (US 101 and SR 37)?**

- Approximately 40 percent of trips are passing through Marin County, 41 percent of trips are travelling into Marin County, and 19 percent of trips are travelling out of Marin County in the morning peak period.

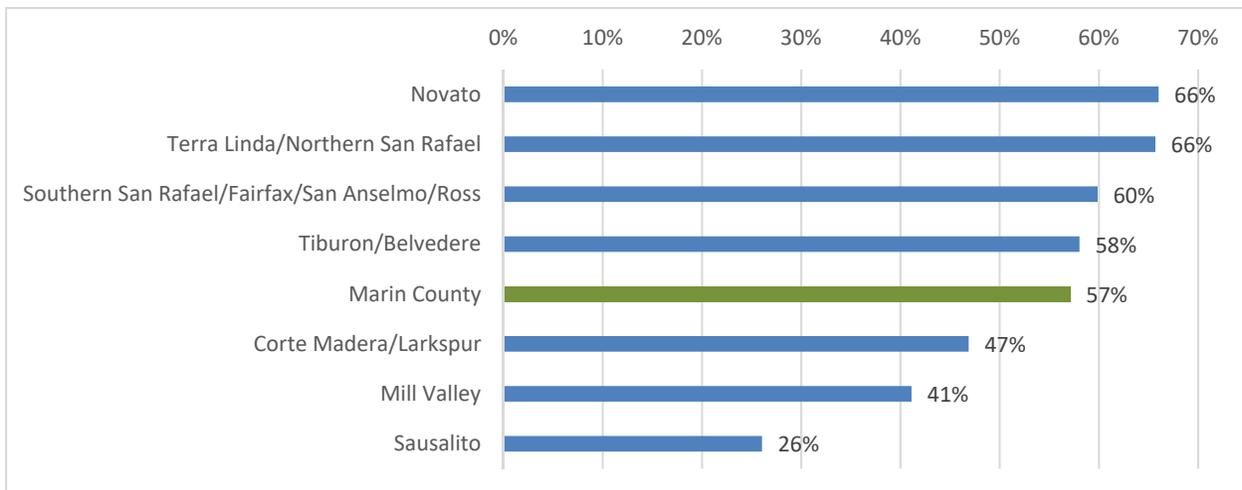
**Where do Marin County residents work? How does it vary by city?**

- Census data indicates there are approximately 120,000 workers who live in Marin County with approximately 34 percent travelling outside of Marin County for work (28 percent of residents work in San Francisco County).
- Factoring of the census data based on the home and work zone data indicates that approximately 70,000 Marin County residents work in Marin County while approximately 34,000 work in San Francisco County.
- The city with the highest percentage of residents working in San Francisco is Sausalito (57 percent) and the city with the lowest percentage of residents working in San Francisco is Terra Linda/Northern San Rafael (16 percent)

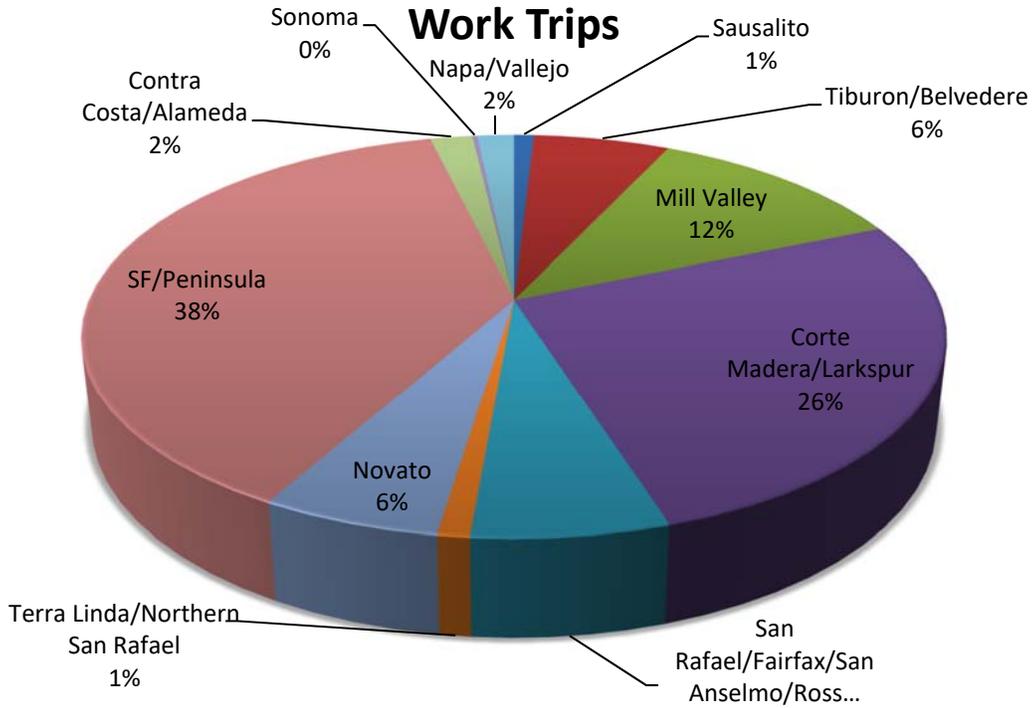
**Where do Marin County Residents Work?**



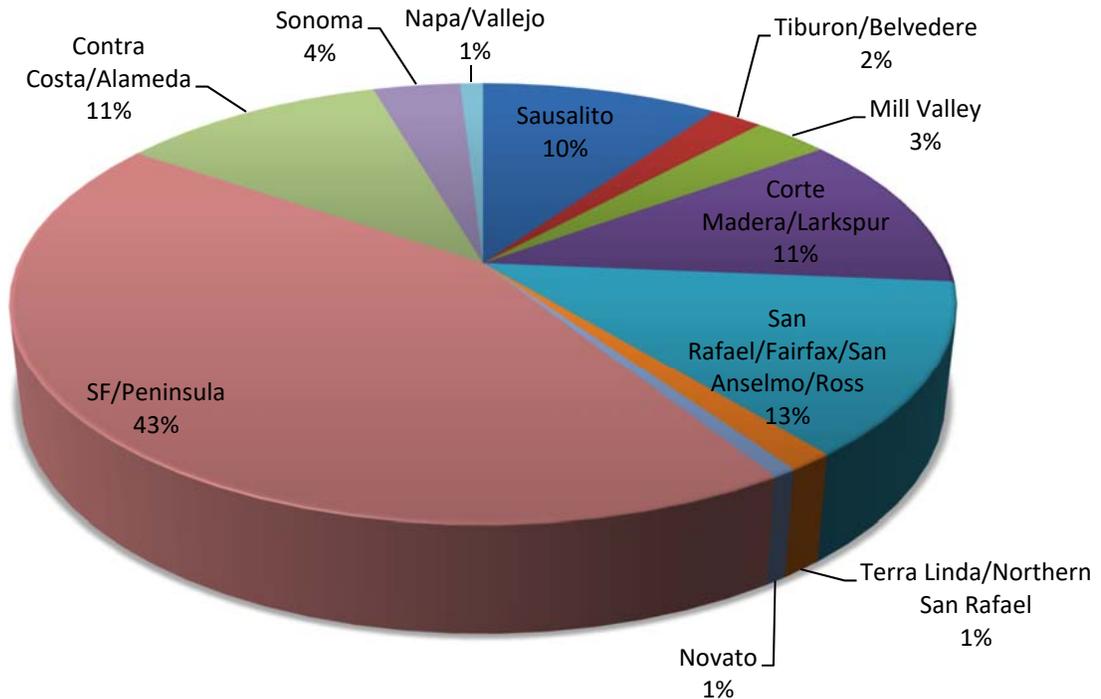
**What percentage of Marin County residents work in Marin County?**



### Destination of Tiburon & Belvedere Home to Work Trips

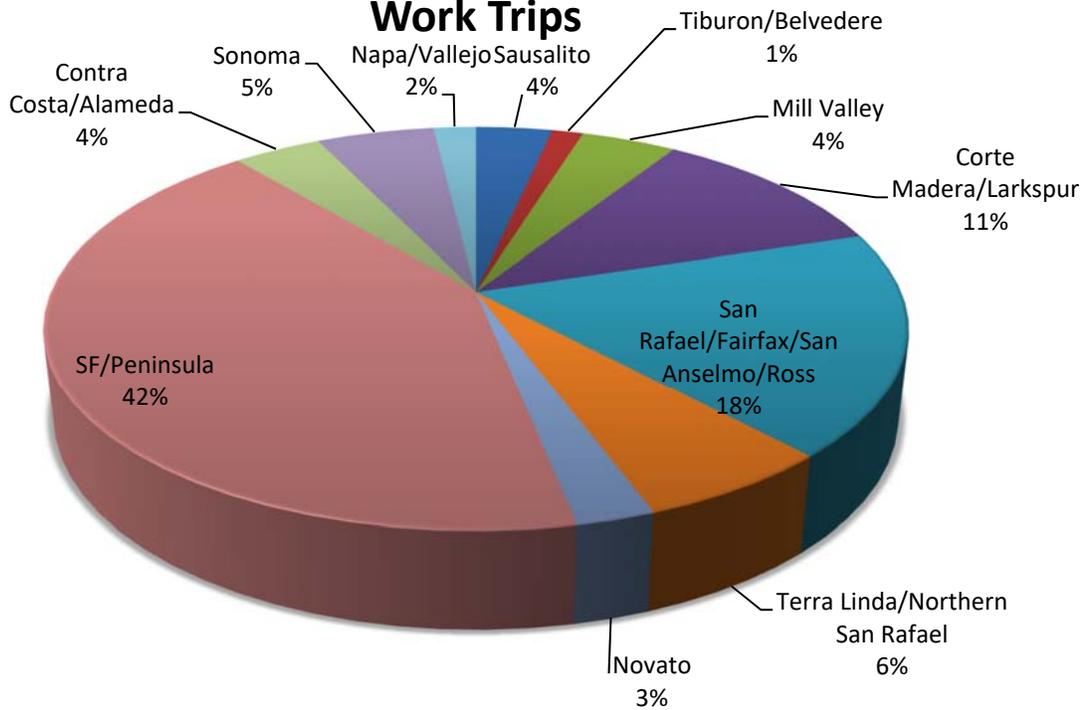


### Destination of Mill Valley Home to Work Trips

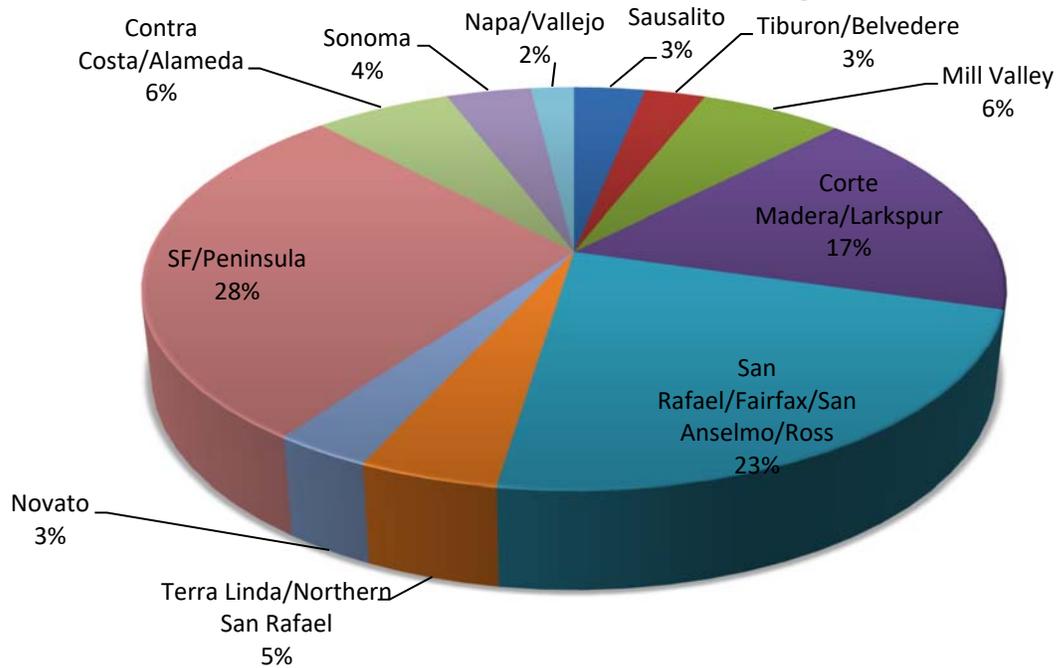


### Destination of Corte Madera & Larkspur Home to

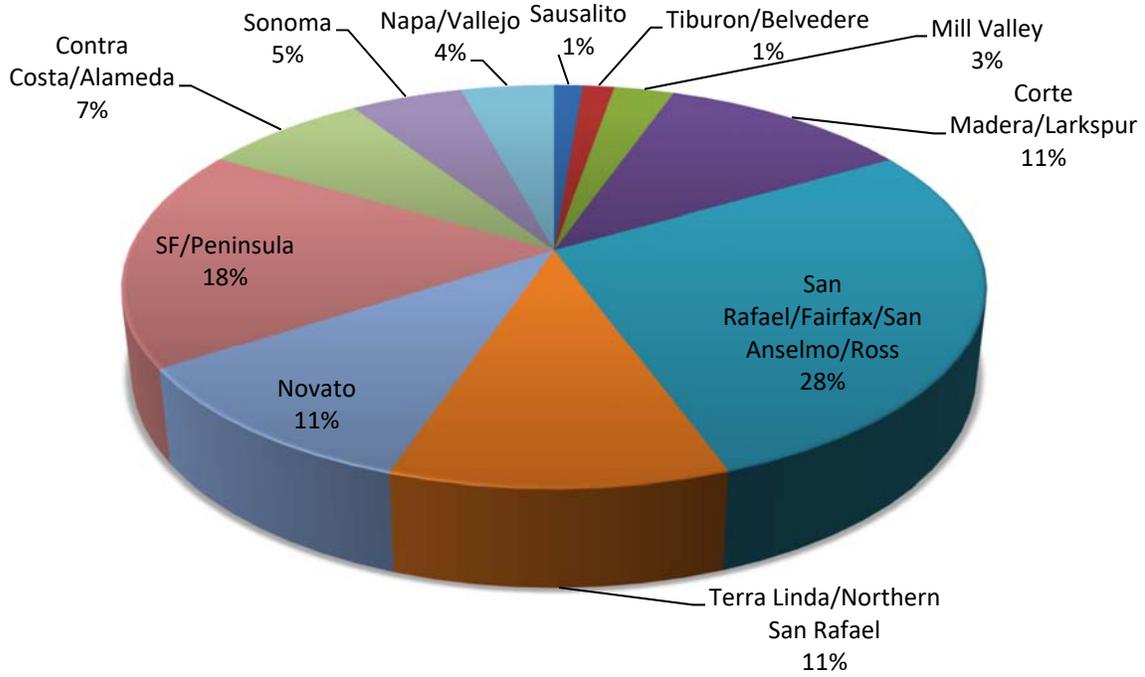
#### Work Trips



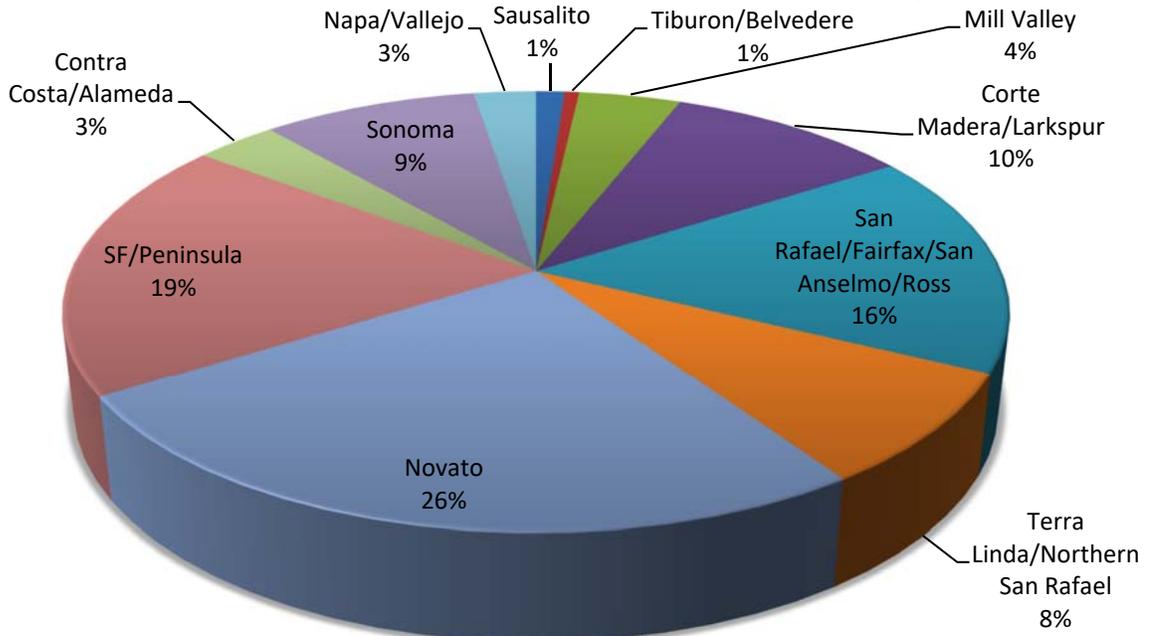
### Destination of San Rafael, San Anselmo, Ross & Fairfax Home to Work Trips

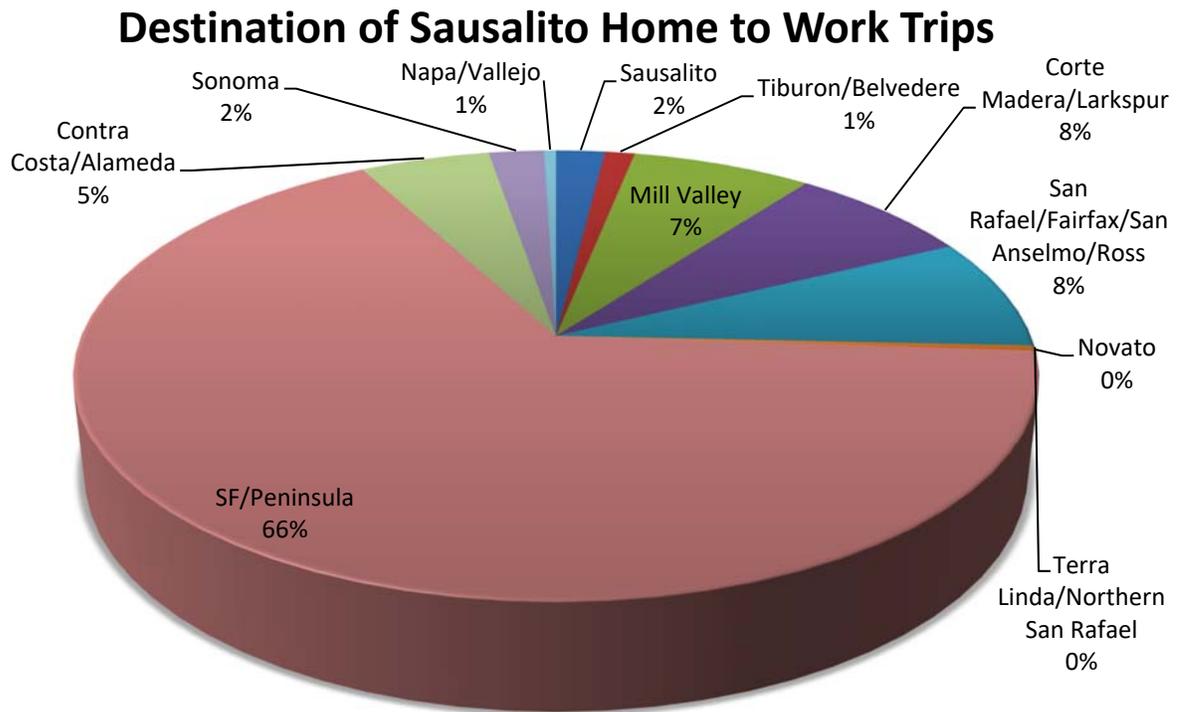


### Destination of Northern San Rafael & Terra Linda Home to Work Trips



### Destination of Novato Home to Work Trips





#### Where do Marin County workers live?

- Census data indicates there are approximately 125,000 workers who work in Marin County with approximately 35 percent living outside of Marin County.

## MOBILE DEVICE DATA SUMMARY

Mobile devices such as cell phones and GPS units (in cars, on phones, and handheld units) frequently communicate with the mobile network, both during use (on a call or sending/receiving text or data) and in idle mode. INRIX, AirSage and StreetLight Data are firms that specialize in mobile device data and are able to collect and analyze this information while the device is in use to record the anonymous location (ensuring user privacy) and movement of mobile devices (and thus the population of mobile users) on the roadway network, both in real-time and over almost any designated time period, based on this mobile signaling data.

In order to infer the travel patterns and trip making characteristics of the mobile devices, such as the origin and destination of individual trips, StreetLight Data purchases from INRIX and AirSage movement

and usage patterns in the form of activity data points. StreetLight Data then uses algorithms to create trip distribution tables by first identifying mobile devices which were seen in a single location multiple times over a specified time interval and subsequently seen in a different location multiple times over a specified time interval. All of the sightings for the mobile device in a single location over this specified time interval are then combined to create an "Origin-Destination Point." The "Origin-Destination Points" of each mobile device are then paired to create a table of trips with origin and destination coordinate points as well as the observed time period. StreetLight Data then tags the "origin-destination points" to a pre-determined zone system based on the origin and destination coordinate points.

Fehr & Peers provided StreetLight Data with a zone system that the "origin-destination points" were tagged to. StreetLight Data then provided Fehr & Peers with three types of OD data in a tabular format nearly identical to that used by travel demand models. The three types of OD data were countywide OD data, select-link OD data, and home/work location data.