

# Geographic Information Systems (GIS)

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*Inland Empire/Desert Region (Riverside and San Bernardino counties combined)*

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*This workforce demand report uses state and federal job projection data developed before the economic impact of COVID-19. The COE is monitoring the situation and will provide more information as it becomes available. Please consult with local employers to understand their current employment needs.*

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## Introduction

This report profiles occupations related to Geographic Information Systems (GIS) training programs in the Inland Empire/Desert Region. Each GIS occupation is categorized into primary and secondary occupational groups. One occupation requires workers to use GIS as a primary function of their daily work, geographic information systems technologists and technicians. The secondary GIS occupational group consists of occupations that need GIS skills but may only apply those skills less frequently on the job. Occupational definitions are in the Appendix, along with five-year projections.

The California Community College geographic information systems (TOP 2206.10) programs prepare students for GIS employment through instruction related to the computer-based tools used for acquiring, editing, storing, analyzing, and visualizing geographically referenced information, with applications in research, education, management, and planning. These programs include Global Positioning Systems (GPS) (Taxonomy of Programs, 2012).

## Demand for the Primary GIS Occupation

Geographic information systems technologists and technicians (SOC 15-1299.02) use GIS resources as a primary work activity. As an emerging occupation, employment demand cannot be quantified using traditional labor market data. A real-time job advertisement search was conducted to gauge the demand for these workers.

## Job Advertisements

A search of online job advertisements (ads) for Geographic information systems technologists and technicians in the Inland Empire/Desert Region revealed 37 ads over the previous 12 months (November 2020 through October 2021). This search was expanded to the state level to ensure generalizable results; 572 job ads were identified. On average, employers fill online job ads for geographic information systems technologists and technicians within 41 days; a similar time to fill compared to the nation overall. Exhibit 1 displays the number of job online advertisements posted during the last 12 months, along with the

statewide average time to fill. The job titles most frequently associated with primary GIS positions included GIS Analyst, GIS Specialist, GIS Developer, and GIS Technician.

*Exhibit 1: Job ads and time to fill*

Occupation	Job Ads	California Average Time to Fill (Days)
Geographic Information Systems Technologists and Technicians	572	41

Source: Burning Glass – Labor Insights

### Earnings

Community colleges should ensure their training programs lead to employment opportunities that provide self-sustainable income. The University of Washington estimates that a self-sufficient hourly rate for a single adult with one school-age child is \$24.36 per hour or \$51,452 annually in Riverside County; \$23.73 per hour or \$50,119 annually in San Bernardino County (Pearce, 2021). For this study, the higher hourly earnings requirement in Riverside County is adopted as the self-sufficiency standard for the two-county region.

Exhibit 2 displays advertised salary data from geographic information systems technologist and technician online job ads over the last 12 months. Job advertisements indicate that employers are willing to pay geographic information systems technologists and technicians \$77,000 annually, above the \$51,452 self-sufficiency standard in the region. Consider the salary information with caution since only 41% (232 out of 572) of online job ads for this occupation provided salary information. The salary figure is prorated to reflect full-time, annual wage status.

*Exhibit 2: Advertised salary information*

Job Title	Real-Time Salary Information					Average Annual Salary
	Number of job ads	Less than \$35,000	\$35,000 to \$49,999	\$50,000 to \$74,999	More than \$75,000	
Geographic Information Systems Technologists and Technicians	232	3%	7%	43%	47%	\$77,000

Source: Burning Glass – Labor Insights

### Employers, Skills, Education, and Work Experience

Exhibit 3 displays the statewide employers posting the most online job advertisements for geographic information systems technologists and technicians during the last 12 months. Displaying employer names provides some insight into where students may find employment after completing a program. Riverside County Assessor-County Clerk-Recorder (ACR) posted the most job advertisements for primary GIS workers

over the last 12 months in the region.

*Exhibit 3: Employers posting the most job ads*

Occupation	Employers	
Geographic Information Systems Technologists and Technicians (n=572)	<ul style="list-style-type: none"> <li>Rincon Consultants Inc.</li> <li>Nevada County</li> <li>Stantec, Inc.</li> <li>Southern California Gas Company</li> </ul>	<ul style="list-style-type: none"> <li>G2 Integrated Solution, LLC</li> <li>Deloitte</li> <li>Foresters Co-Op</li> <li>Sonoma County</li> <li>Riverside County</li> </ul>

Source: Burning Glass – Labor Insights

Exhibit 4 displays a sample of specialized, employability, and software and programming skills employers seek when looking for workers to fill geographic information systems technologist and technician positions. Specialized skills are occupation-specific skills that employers are requesting for industry or job competency. Employability skills are foundational skills that transcend industries and occupations; this category is often referred to as "soft skills." The skills requested in job ads may be utilized as a helpful guide for curriculum development. ArcGIS, GIS software developed by Esri, was mentioned in 75% (431 ads) of job ads for this occupation, indicating that employers find this software skill valuable for primary GIS positions.

*Exhibit 4: Sample of in-demand skills from employer online job ads*

Occupation	Specialized Skills	Employability Skills	Software and Programming Skills
Geographic Information Systems Technologists and Technicians (n=561)	<ul style="list-style-type: none"> <li>Information Systems</li> <li>Global Positioning System (GPS)</li> <li>Data Collection</li> <li>Quality Assurance and Control</li> </ul>	<ul style="list-style-type: none"> <li>Communication Skills</li> <li>Planning</li> <li>Research</li> <li>Problem</li> </ul>	<ul style="list-style-type: none"> <li>ArcGIS</li> <li>Python</li> <li>SQL</li> <li>Microsoft Office</li> </ul>

Source: Burning Glass – Labor Insights

Traditional labor market information, which includes typical entry-level education and educational attainment, is not available for geographic information systems technologists and technicians. Exhibit 5 displays the real-time minimum advertised education requirements from employer job ads for geographic information systems technologists and technicians. Nearly 80% (79%) of employers seeking geographic information systems technologists and technicians workers indicated that a candidate should have a bachelor's degree as a minimum education requirement.

Exhibit 5: Minimum advertised education requirements

Occupation	Number of Job Ads	Real-Time Minimum Advertised Education Requirement		
		High school diploma or vocational training	Associate degree	Bachelor's degree or higher
Geographic Information Systems Technologists and Technicians	435	6%	15%	79%

Source: Burning Glass – Labor Insights

Exhibit 6 displays the real-time work experience requirements from employer job ads for geographic information systems technologists and technicians. The majority of job advertisements sought candidates with three or more years of previous work experience, indicating that employers may value previous work experience.

Exhibit 6: Real-time work experience requirements

Occupation	Number of Job Ads	Real-Time Work Experience		
		0 – 2 years	3 – 5 years	6+ years
Geographic Information Systems Technologists and Technicians	443	39%	49%	12%

Source: Burning Glass – Labor Insights

## Demand for Secondary GIS Occupations

Secondary GIS occupations require GIS skills but do not necessarily utilize these skills daily on-the-job. The following occupations are included in the secondary GIS occupational group:

- Cartographers and Photogrammetrists (SOC 17-1021)
- Surveying and Mapping Technicians (17-3031)
- Remote Sensing Scientists and Technologists (19-2099.01)\*

\*Remote sensing scientists and technologists is an emerging occupation for which traditional LMI is not available.

## Job Opportunities

In 2020, there were 696 jobs in the secondary GIS occupational group in the region. The secondary GIS occupational group is projected to have 86 annual job openings to fill new jobs and backfill jobs that workers are permanently vacating (includes occupational transfers and retirements). This occupational group is expected to increase employment by 8% through 2025. Exhibit 7 displays the job counts, five-year projected job growth, job openings, and the share of incumbent workers age 55 years and greater in the region.

Exhibit 7: Five-year job projections, 2020-2025

Occupation	2020 Jobs	2025 Jobs	5-Yr % Change (New Jobs)	5-Yr Openings (New + Replacement Jobs)	Annual Openings (New + Replacement Jobs)	% of workers age 55+
Surveying and Mapping Technicians	550	597	9%	361	72	27%
Cartographers and Photogrammetrists	146	157	8%	67	13	~18%
<b>Total</b>	<b>696</b>	<b>754</b>	<b>8%</b>	<b>428</b>	<b>86</b>	<b>26%</b>

Source: Emsi 2021.3

### Job Advertisements

Exhibit 8 displays the number of online job ads posted during the last 12 months, along with the statewide average time to fill for the secondary GIS occupational group. This job advertisement search was limited to ads that requested GIS skills and expanded to include all advertisements in the state. Approximately 12% (19 ads) of statewide advertisements for the secondary GIS occupational group were posted in the region. On average, employers in California fill online job advertisements for the secondary GIS occupational group in 33 days.

Exhibit 8: Job ads and time to fill

Occupation	Job Ads	California Average Time to Fill (Days)
Surveying and Mapping Technicians	157	32
Cartographers and Photogrammetrists	4	43
Remote Sensing Scientists and Technologists	2	49
<b>Total</b>	<b>163</b>	<b>33</b>

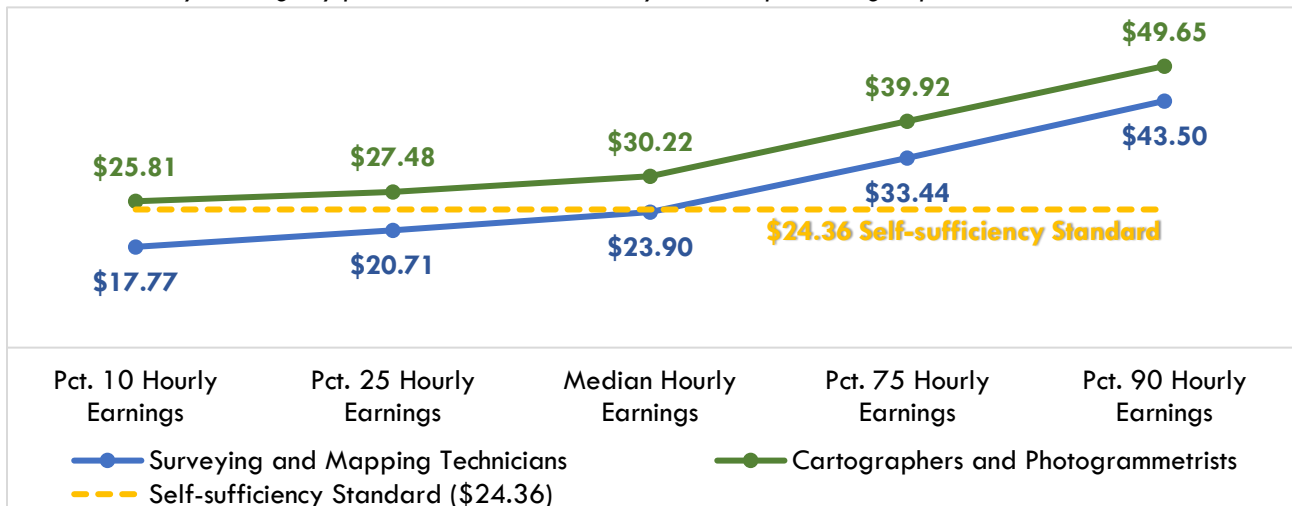
Source: Burning Glass – Labor Insights

### Earnings and Benefits

Community colleges should ensure their training programs lead to employment opportunities that provide self-sustainable income. The University of Washington estimates that a self-sufficient hourly rate for a single adult with one school-age child is \$24.36 per hour or \$51,452 annually in Riverside County; \$23.73 per hour or \$50,119 annually in San Bernardino County (Pearce, 2021). For this study, the higher hourly earnings requirement in Riverside County is adopted as the self-sufficiency standard for the two-county region.

Exhibit 9 displays the hourly earnings for the secondary GIS occupational group. The 10<sup>th</sup> percentile hourly earnings for cartographers and photogrammetrists is above the regional self-sufficiency standard, indicating that at least 90% of workers earn a self-sustainable wage. The hourly earnings for surveying and mapping technicians do not surpass this threshold until the 75<sup>th</sup> percentile. Earnings information is not available for remote sensing scientists and technologists.

Exhibit 9: Hourly earnings by percentile for the secondary GIS occupational group



Source: Emsi 2021.3

Benefits information, typically provided by the California Labor Market Information Division's occupational guides, is not available for the secondary GIS occupational group (Detailed Occupational Guides, 2021).

### Advertised Salary

Exhibit 10 displays advertised salary data from online job ads for the secondary GIS occupational group over the last 12 months. Job advertisements indicate that employers are willing to pay surveying and mapping technicians with GIS skills \$83,000 annually, well above the \$51,452 self-sufficiency standard in the region. Consider the salary information with caution since only 41% (67 out of 163) online job ads for these occupations provided salary information. The salary figures are prorated to reflect full-time, annual wage status. There were insufficient postings for remote sensing scientists and technologists and cartographers and photogrammetrists to obtain reliable salary information.

Exhibit 10: Advertised salary information

Job Title	Number of job ads	Real-Time Salary Information				Average Annual Salary
		Less than \$35,000	\$35,000 to \$49,999	\$50,000 to \$74,999	More than \$75,000	
Surveying and Mapping Technicians	63	3%	10%	25%	62%	\$83,000
Cartographers and Photogrammetrists	4	N/A	N/A	N/A	N/A	N/A
Remote Sensing Scientists and Technologists	0	N/A	N/A	N/A	N/A	N/A

Source: Burning Glass – Labor Insights

### Employers, Skills, Education, and Work Experience

Exhibit 11 displays the employers that posted the most online job advertisements for the secondary GIS occupational group over the last 12 months. Displaying employer names provides some insight into where students may find employment after completing a program. There were insufficient job advertisements for cartographers and photogrammetrists and remote sensing scientists and technologists to provide reliable employer information.

Exhibit 11: Employers posting the most job ads

Occupation	Employers
Surveying and Mapping Technicians (n=157)	<ul style="list-style-type: none"> <li>Pacific Gas Electric Company</li> <li>Esri</li> <li>Sacramento Suburban Water District</li> <li>Deloitte</li> <li>Orange County</li> </ul>
Cartographers and Photogrammetrists (n=4)	<ul style="list-style-type: none"> <li>N/A</li> </ul>
Remote Sensing Scientists and Technologists (n=2)	<ul style="list-style-type: none"> <li>N/A</li> </ul>

Source: Burning Glass – Labor Insights

Exhibit 12 displays a sample of specialized, employability, and software and programming skills employers seek when looking for workers to fill secondary GIS positions. Specialized skills are occupation-specific skills that employers are requesting for industry or job competency. Employability skills are foundational skills that transcend industries and occupations; this category is often referred to as "soft skills." The skills requested in job ads may be utilized as a helpful guide for curriculum development. There were insufficient job advertisements for cartographers and photogrammetrists and remote sensing scientists and technologists to provide reliable skills information.

Exhibit 12: Sample of in-demand skills from employer online job ads

Occupation	Specialized Skills	Employability Skills	Software and Programming Skills
Surveying and Mapping Technicians (n=157)	<ul style="list-style-type: none"> <li>Information Systems</li> <li>Project Management</li> <li>Budgeting</li> <li>Scheduling</li> </ul>	<ul style="list-style-type: none"> <li>Research</li> <li>Planning</li> <li>Writing</li> <li>Communication Skills</li> </ul>	<ul style="list-style-type: none"> <li>ArcGIS</li> <li>Microsoft Office</li> <li>Python</li> </ul>
Cartographers and Photogrammetrists (n=4)	<ul style="list-style-type: none"> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>
Remote Sensing Scientists and Technologists (n=2)	<ul style="list-style-type: none"> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>

Source: Burning Glass – Labor Insights

Exhibit 13 displays the entry-level education typically required to gain employment in the GIS occupational group according to the Bureau of Labor Statistics (BLS), educational attainment for incumbent workers with "some college, no degree" and an "associate degree" according to the U.S. Census (2016-17) and the real-time minimum advertised education requirement from employer job ads. N/A indicates that either traditional LMI is not available for detailed-emerging occupations or too few job advertisements to yield minimum advertised education requirements. Traditional labor market information, which includes typical entry-level education and educational attainment, is not available for remote sensing scientists and technologists.

Exhibit 13: Typical entry-level education, educational attainment, and minimum advertised education requirements

Occupation	Typical Entry-Level Education Requirement	CC-Level Educational Attainment*	Real-Time Minimum Advertised Education Requirement			
			Number of Job Ads	High school diploma or vocational training	Associate degree	Bachelor's degree or higher
Surveying and Mapping Technicians	High school diploma or equivalent	56%	145	25%	4%	71%
Cartographers and Photogrammetrists	Bachelor's degree	23%	0	N/A	N/A	N/A
Remote Sensing Scientists and Technologists	N/A	N/A	2	N/A	N/A	N/A

Source: Emsi 2021.3, Burning Glass – Labor Insights

\*Percentage of incumbent workers with a Community College Award or Some Postsecondary Coursework



Exhibit 14 displays the work experience typically required for the secondary GIS occupational group and the real-time work experience requirements from employer job ads. There were insufficient advertisements for cartographers and photogrammetrists and remote sensing scientists and technologists to obtain reliable advertised work experience information.

*Exhibit 14: Work experience required and real-time work experience requirements*

Occupation	Work Experience Typically Required	Real-Time Work Experience			
		Number of Job Ads	0 – 2 years	3 – 5 years	6+ years
Surveying and Mapping Technicians	None	123	33%	33%	33%
Cartographers and Photogrammetrists	None	4	N/A	N/A	N/A
Remote Sensing Scientists and Technologists	N/A	0	N/A	N/A	N/A

Source: Emsi 2021.3, Burning Glass – Labor Insights

## Student Completions and Program Outcomes

Exhibit 15 displays the annual average awards from regional geographic information systems (TOP 2206.10) programs over the last three academic years. These programs have awarded an annual average of three (3) awards over the last three academic years. The student completion and program outcome methodology is available in the Appendix.

*Exhibit 15: 2017-20, Annual average community college awards for the geographic information systems programs*

2206.10 – Geographic Information Systems	Certificate requiring 30 to < 60-semester units	Certificate requiring 18 to < 30-semester units	Certificate requiring 16 to < 30-semester units	Certificate requiring 6 to < 18-semester units	Total CC Annual Average Awards, Academic Years 2016-19
Mt. San Jacinto	0	-	-	-	0
San Bernardino	-	2	0	1	3
<b>Total</b>	<b>0</b>	<b>2</b>	<b>-</b>	<b>1</b>	<b>3</b>

Source: MIS Data Mart

California program outcome data may provide a useful insight into the likelihood of success for the proposed program. Community college student outcome information based on the selected TOP code and region is provided in Exhibit 16. Geographic information systems outcome metrics reported median annual earnings of \$33,540 after exit, and 67% of students attained a living wage in the region. The outcome methodology is available in the appendix section of this report.

*Exhibit 16: 2206.10 – Geographic information systems strong workforce program outcomes*

<b>Strong Workforce Program Metrics: 2206.10 – Geographic Information Systems Academic Year 2018-19, unless noted otherwise</b>	<b>Inland Empire/Desert Region</b>	<b>California</b>
Unduplicated count of enrolled students (2019-20)	145	2,340
Completed 9+ career education units in one year (2019-20)	22%	24%
Perkins Economically disadvantaged students (2019-20)	78%	68%
Students who earned a degree, certificate, or attained apprenticeship (2019-20)	-	89
Transferred to a four-year institution (transfers)	20	234
Job closely related to the field of study (2017-18)	-	73%
Median annual earnings (all exiters)	\$33,540	\$48,190
Median change in earnings (all exiters)	20%	19%
Attained a living wage (completers and skills-builders)	67%	65%

Sources: LaunchBoard Community College Pipeline and Strong Workforce Program Metrics

Exhibit 17 displays awards reported by other postsecondary education providers in geographic information science and cartography (CIP 45.0702) programs. Completion data is compiled from the Integrated Postsecondary Education Data System (IPEDS) for the most recent three years available. On average, two other postsecondary education institutions in the region have issued 18 master's degrees annually over the last three academic years.

*Exhibit 17: Other educational provider geographic information science and cartography training programs, three-year annual average credentials in the region*

<b>45.0702 – Geographic Information Science and Cartography</b>	<b>Bachelor's Degree</b>	<b>Master's Degree</b>	<b>Other Educational Providers Annual Average Credentials, Academic Years 2016-19</b>
Loma Linda University	0	0	0
University of Redlands	-	18	18
<b>Total</b>	<b>0</b>	<b>18</b>	<b>18</b>

Source: IPEDS

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## Appendix: Occupation definitions, sample job titles, five-year projections, and earnings for GIS occupations

### **Geographic Information Systems Technologists and Technicians (15-1299.02)\***

Assist scientists or related professionals in building, maintaining, modifying, or using geographic information systems (GIS) databases. May also perform some custom application development or provide user support.

**Sample of reported job titles:** Geographic Information System Analyst (GIS Analyst), Geographic Information Systems Administrator (GIS Administrator), Geographic Information Systems Analyst (GIS Analyst), Geographic Information Systems Coordinator (GIS Coordinator), Geographic Information Systems Technician (GIS Technician), GIS Specialist (Geographic Information Systems Specialist), Resource Analyst

### **Remote Sensing Scientists and Technologists (19-2099.01)\***

Apply remote sensing principles and methods to analyze data and solve problems in areas such as natural resource management, urban planning, or homeland security. May develop new sensor systems, analytical techniques, or new applications for existing systems.

**Sample of reported job titles:** Data Analytics Chief Scientist, Geospatial Intelligence Analyst, Remote Sensing Analyst, Remote Sensing Scientist, Research Scientist, Scientist, Sensor Specialist

**\*Traditional labor market data is not available for these emerging occupations at this time.**

### **Cartographers and Photogrammetrists (17-1021)**

Research, study, and prepare maps and other spatial data in digital or graphic form for one or more purposes, such as legal, social, political, educational, and design purposes. May work with Geographic Information Systems (GIS). May design and evaluate algorithms, data structures, and user interfaces for GIS and mapping systems. May collect, analyze, and interpret geographic information provided by geodetic surveys, aerial photographs, and satellite data.

**Sample of reported job titles:** Aerial Photogrammetrist, Cartographer, Cartographic Designer, Digital Cartographer, Mapper, Photogrammetric Technician, Photogrammetrist, Stereo Compiler, Stereoplotter Operator

*Entry-Level Education Requirement: Bachelor's degree*

*Training Requirement: None*

*Work Experience Requirement: None*

*Incumbent workers with a Community College Award or Some Postsecondary Coursework: 23%*

### **Surveying and Mapping Technicians (17-3031)**

Perform surveying and mapping duties, usually under the direction of an engineer, surveyor, cartographer, or photogrammetrist, to obtain data used for construction, mapmaking, boundary location, mining, or other purposes. May calculate mapmaking information and create maps from source data, such as surveying notes, aerial photography, satellite data, or other maps to show topographical features, political boundaries, and other features. May verify accuracy and completeness of maps.

**Sample of reported job titles:** Aerotriangulation Specialist, Engineering Technician, Geospatial Analyst, Mapping Editor, Mapping Technician, Photogrammetric Compilation Specialist, Photogrammetric Technician, Stereoplotter Operator, Survey Technician, Tax Map Technician

*Entry-Level Education Requirement: High school diploma or equivalent*

*Training Requirement: Between one and twelve months of on-the-job training*

*Work Experience: None*

*Incumbent workers with a Community College Award or Some Postsecondary Coursework: 56%*

## Appendix: Program Completion and Outcome Methodology

Exhibit 15 displays the average annual California Community College (CCC) awards conferred during the three academic years between 2017 and 2020, from the California Community Colleges Chancellor's Office Management Information Systems (MIS) Data Mart. Awards are the combined total of associate degrees and certificates issued during the timeframe, divided by three in this case to calculate an annual average. This is done to minimize the effect of atypical variation that might be present in a single year.

Community college student outcome information is from LaunchBoard and based on the selected TOP code and region. These metrics are based on records submitted to the California Community Colleges Chancellor's Office Management Information Systems (MIS) by community colleges, which come from self-reported student information from CCC Apply and the National Student Clearinghouse. Employment and earnings metrics are sourced from records provided by California's Employment Development Department's Unemployment Insurance database. When available, outcomes for completers are reported to demonstrate the impact that earning a degree or certificate can have on employment and earnings. For more information on the types of students included for each metric, please see the web link for LaunchBoard's Strong Workforce Program Metrics Data Element Dictionary in the References section (LaunchBoard, 2020a). Finally, employment in a job closely related to the field of study comes from self-reported student responses on the CTE Employment Outcomes Survey (CTEOS), administered by Santa Rosa Junior College (LaunchBoard, 2021 a).

Job postings data is limited to the information provided by employers and the ability of artificial intelligence search engines to identify this information. Additionally, preliminary calculations by Georgetown Center on Education and the Workforce found that "just 30 to 40 percent of openings for candidates with some college or an associate degree, and only 40 to 60 percent of openings for high school diploma holders appear online" (Carnevale et al., 2014). Online job postings often do not reveal the hiring intentions of employers; it is unknown if employers plan to hire one or multiple workers from a single online job posting, or if they are collecting resumes for future hiring needs. A closed job posting may not be the result of a hired worker.

Table 1: 2020 to 2025 job growth, wages, education, training, and work experience required, Inland Empire/Desert Region

Occupation (SOC)	2020 Jobs	5-Yr Change	5-Yr % Change	Annual Openings (New + Replacement Jobs)	Entry-Experienced Hourly Wage Range (10 <sup>th</sup> to 90 <sup>th</sup> percentile)	Median Hourly Wage (50 <sup>th</sup> percentile)	Average Annual Earnings	Typical Entry-Level Education & On-The-Job Training Required	Work Experience Required
Surveying and Mapping Technicians (17-3031)	550	47	9%	72	\$17.77 to \$43.50	\$23.90	\$57,500	High school diploma or equivalent & 1-12 months	None
Cartographers and Photogrammetrists (17-1021)	146	11	8%	13	\$25.81 to \$49.65	\$30.22	\$70,700	Bachelor's degree & none	None
<b>Total</b>	<b>696</b>	<b>58</b>	<b>8%</b>	<b>86</b>	-	-	-	-	-

Source: Emsi 2021.3