

Geographic Information Systems (GIS)

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

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.

Introduction

This report profiles occupations related to Geographic Information Systems (GIS) training programs in the Inland Empire/Desert Region (IEDR). 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 jobs 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 technologist and technician (15-1299.02) use GIS as a primary function of their daily work. As an emerging occupation, demand for this occupation cannot be quantified using traditional labor market information (LMI). A real-time job advertisement search was conducted to gauge the need for these workers.

Job Advertisements

To ensure generalizable results, all online job advertisements (ads) in California over the last 12 months related to *geographic information systems technologists and technicians* are included in this analysis. Only 4% (33 ads) of the statewide job ads were listed in the local Inland Empire/Desert Region. On average, employers fill online job postings for *geographic information systems technologists and technicians* within 52 days. Exhibit 1 displays the number of job online advertisements posted during the last 12 months, along with the statewide average time to fill.

Exhibit 1: Job ads and time to fill

Occupation	Job Ads	California Average Time to Fill (Days)
Geographic Information Systems Technologists and Technicians	815	52

Source: Burning Glass – Labor Insights

Earnings and Benefits

Community colleges should ensure their training programs lead to employment opportunities that provide a self-sustainable level of income. The Family Needs Calculator estimates that a self-sustainable wage for a single adult with one school-age child is \$21.78 per hour or \$45,992 annually in Riverside County, \$21.24 per hour or \$44,867 annually in San Bernardino County (Pearce, 2020). For this study, the higher hourly wage requirement in Riverside County is adopted as the self-sufficiently standard for the two-county region.

Exhibit 2 displays advertised salary data from *geographic information systems technologists and technicians* online job ads over the last 12 months. Consider the salary information with caution since only 28% (227 out of 815) online job postings 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	Number of job postings	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	
Geographic Information Systems Technologists and Technicians	227	11%	7%	39%	44%	\$73,000

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. The employer posting the most advertisements in the IEDR was Esri, with seven advertisements listed during the previous 12 months.

Exhibit 3: Employers posting the most job ads

Occupation	Employers
Geographic Information Systems Technologists and Technicians (n=675)	<ul style="list-style-type: none"> • TJG Civil Engineers and Land Planners • Nevada County • ASCII Group LLC • Stillwater Sciences • SysMind LLC • Rincon Consultants Incorporated

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 postings may be utilized as a helpful guide for curriculum development. ArcGIS was mentioned in 75% (615 ads) of job ads for this occupation, indicating that employers find this 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=815)	<ul style="list-style-type: none"> • Geographic Information System (GIS) Data • Quality Assurance and Control • Data Collection 	<ul style="list-style-type: none"> • Communication Skills • Research • Editing • Troubleshooting 	<ul style="list-style-type: none"> • ArcGIS • Python • Esri Software • SQL • JavaScript • Microsoft Office

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 requirement from employer job ads for *geographic information systems technologists and technicians*.

Exhibit 5: Minimum advertised education requirements

Occupation	Real-Time Minimum Advertised Education Requirement			
	Number of Job Ads	High school diploma or vocational training	Associate degree	Bachelor's degree or higher
Geographic Information Systems Technologists and Technicians	436	4%	12%	84%

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*.

Exhibit 6: Real-time work experience requirements

Occupation	Real-Time Work Experience			
	Number of Job Ads	0 – 2 years	3 – 5 years	6+ years
Geographic Information Systems Technologists and Technicians	634	28%	55%	17%

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 (TOP 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 2019, there were 520 jobs in the secondary GIS occupational group in the Inland Empire/Desert Region. The secondary GIS occupational group is projected to have 69 annual job openings to fill new jobs and backfill jobs that workers are permanently vacating (includes occupational transfers and retirements).

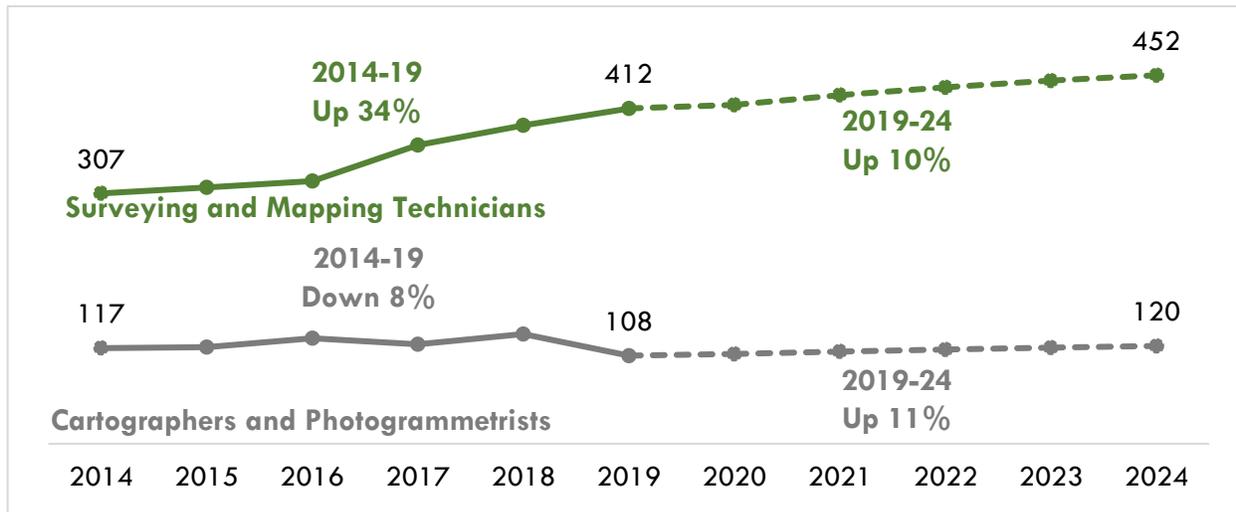
This occupational group is expected to increase employment by 10% through 2024. Exhibit 7 displays five-year projected job growth, and Exhibit 8 displays historical (2014 to 2019) and projected (2019-2024) jobs for the secondary GIS occupational group.

Exhibit 7: Five-year job projections, 2019-2024

Occupation	2019 Jobs	2024 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	412	452	10%	350	58	26%
Cartographers and Photogrammetrists	108	120	11%	64	11	~17%
Remote Sensing Scientists and Technologists	N/A	N/A	N/A	N/A	N/A	N/A
Total	520	572	10%	414	69	25%

Source: Emsi 2020.4

Exhibit 8: Historical and projected jobs for surveying and mapping technicians (green) and cartographers and photogrammetrists (grey), 2014 – 2024



Source: Emsi 2020.4

Job Advertisements

Exhibit 9 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 expanded to include all advertisements in the state. Approximately 10% (42 ads) of statewide advertisements for the secondary GIS occupational group were posted in the IEDR. Time to fill information is not available for *remote sensing scientists and technologists* and *cartographers and photogrammetrists*.

Exhibit 9: Job ads and time to fill

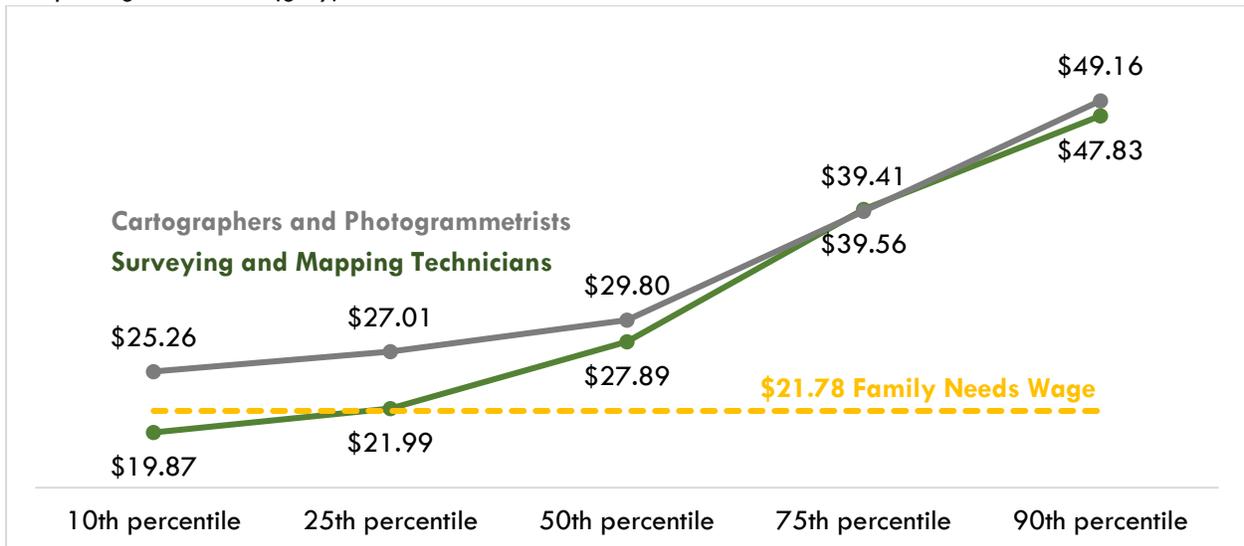
Occupation	Job Ads	California Average Time to Fill (Days)
Surveying and Mapping Technicians	375	89
Remote Sensing Scientists and Technologists	15	-
Cartographers and Photogrammetrists	12	-
Total	402	89

Source: Burning Glass – Labor Insights

Earnings and Benefits

Exhibit 10 displays the hourly earnings for the IEDR. The 25th percentile hourly wages for the secondary GIS occupational group are higher than the Family Needs Calculator self-sustainability rate, \$21.78, indicating that approximately the top 75% of workers in the field earn self-sufficient hourly wages.

Exhibit 10: Hourly earnings by percentile for surveying and mapping technicians (green) and cartographers and photogrammetrists (grey)



Source: Emsi 2020.4

Benefits information is not available for the secondary GIS occupational group (Detailed Occupational Guides, 2020).

Advertised Salary

Exhibit 11 displays advertised salary data from online job ads for the secondary GIS occupational group over the last 12 months. Consider the salary information with caution since only 35% (142 out of 402) online job postings for these occupations provided salary information. The salary figures are prorated to reflect full-time, annual wage status. There were too few postings for *remote sensing scientists and technologists* and *cartographers and photogrammetrists* to obtain reliable salary information.

Exhibit 11: Advertised salary information

Job Title	Number of job postings	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	136	13%	35%	25%	27%	\$59,000
Remote Sensing Scientists and Technologists	0	N/A	N/A	N/A	N/A	N/A
Cartographers and Photogrammetrists	6	N/A	N/A	N/A	N/A	N/A

Source: Burning Glass – Labor Insights

Employers, Skills, Education, and Work Experience

Exhibit 12 displays the employers posting the most online job advertisements for the secondary GIS occupational group during the last 12 months.

Exhibit 12: Employers posting the most job ads

Occupation	Employers
Surveying and Mapping Technicians (n=375)	<ul style="list-style-type: none"> TJG Civil Engineers and Land Planners Esri Pacific Gas and Electric Company
Remote Sensing Scientists and Technologists (n=15)	<ul style="list-style-type: none"> The Aerospace Corporation Jet Propulsion Laboratory
Cartographers and Photogrammetrists (n=12)	<ul style="list-style-type: none"> Toyota Motors The State of California American Automobile Association (AAA)

Source: Burning Glass – Labor Insights

Exhibit 13 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 postings may be utilized as a helpful guide for curriculum development.

Exhibit 13: Sample of in-demand skills from employer online job ads

Occupation	Specialized Skills	Employability Skills	Software and Programming Skills
Surveying and Mapping Technicians (n=370)	<ul style="list-style-type: none"> Land Surveys Calculation Global Positioning Systems (GPS) 	<ul style="list-style-type: none"> Physical Abilities Communication Skills Research 	<ul style="list-style-type: none"> AutoCAD Microsoft Office Civil 3D ArcGIS
Remote Sensing Scientists and Technologists (n=15)	<ul style="list-style-type: none"> Physics Data Analysis Performance Analysis 	<ul style="list-style-type: none"> Teamwork/ Collaboration Planning Research 	<ul style="list-style-type: none"> Python MATLAB C++
Cartographers and Photogrammetrists (n=12)	<ul style="list-style-type: none"> Mapping Lidar Digital Photography 	<ul style="list-style-type: none"> Teamwork/ Collaboration Research Troubleshooting 	<ul style="list-style-type: none"> Python Git ArcGIS

Source: Burning Glass – Labor Insights

Exhibit 14 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 14: 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	59%	216	66%	3%	31%
Remote Sensing Scientists and Technologists	N/A	N/A	11	-	-	100%
Cartographers and Photogrammetrists	Bachelor's degree	14%	7	-	-	100%

Source: Emsi 2020.4, Burning Glass – Labor Insights

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

Exhibit 15 displays the work experience typically required for the GIS occupational group and the real-time work experience requirements from employer job ads. Traditional labor market information, which includes typical work experience requirements, is not available for *remote sensing scientists and technologists*.

Exhibit 15: 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	259	48%	42%	10%
Remote Sensing Scientists and Technologists	N/A	10	20%	50%	30%
Cartographers and Photogrammetrists	None	1	-	100%	-

Source: Emsi 2020.4, Burning Glass – Labor Insights

Student Completions and Program Outcomes

Exhibit 16 displays the annual average awards for geographic information systems (TOP 2206.10) programs in the IEDR. These programs have awarded an annual average of four (4) annual average awards over the last three academic years; one associate degree and three certificates.

Exhibit 16: 2016-19, Annual average community college awards for the geographic information systems programs in the IEDR

2206.10 – Geographic Information Systems	Associate degree	Certificate requiring 30 to <60 semester units	Certificate requiring 18 to <30 semester units	Certificate requiring 6 to <18 semester units	Total CC Annual Average Awards, Academic Years 2016-19
Mt. San Jacinto	1	0	-	-	1
San Bernardino	-	-	2	three1	3
Total	1	0	2	1	4

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 codes and region is provided in Exhibit 17. The outcome methodology is available in the appendix section of this report. Dashes indicate there were too few students from which to obtain program outcome information.

Exhibit 17: 2206.10 – Geographic information systems strong workforce program outcomes

Strong Workforce Program Metrics: 2206.10 – Geographic Information Systems Academic Year 2017-18, unless noted otherwise	Inland Empire/Desert Region	California
Unduplicated count of enrolled students (2018-19)	139	2,303
Completed 9+ career education units in one year (2018-19)	19%	26%
Perkins Economically disadvantaged students (2018-19)	85%	70%
Students who earned a degree, certificate, or attained apprenticeship (2018-19)	-	96
Transferred to a four-year institution (transfers)	-	166
Job closely related to the field of study (2016-17)	-	67%
Median annual earnings (all exiters)	\$32,052	\$46,404
Median change in earnings (all exiters)	27%	29%
Attained a living wage (completers and skills-builders)	74%	69%

Sources: LaunchBoard Community College Pipeline and Strong Workforce Program Metrics

Recommendation

This report profiles occupations related to geographic information systems (GIS) training programs and is categorized into primary and secondary occupational groups. The primary GIS occupation, geographic information systems technologist and technicians, use GIS skills as a primary function of their job. In the absence of traditional labor market data for emerging occupations, online job advertisements were

accessed to gauge demand across the state. The geographic information systems technologist and technician had 815 job postings over the last 12 months, from December 2019 to November 2020. Only 4% of these job ads (33 job ads) were located in the local region. The average annual salary was \$73,000. The Family Needs Calculator estimates that a self-sustainable wage for a single adult with one school-age child is \$21.78 per hour or \$45,992 annually in the region. Please note, only 28% of online job ads reveal salary information. About 84% of online job ads requested a bachelor's degree or higher as a minimum advertised education requirement; 12% requested an associate degree.

Secondary GIS occupations, which may use GIS skills on a less frequent basis, are expected to have approximately 69 combined annual job openings. Survey and mapping technicians will have the most annual job openings in this group, 58 annual job openings. The Family Needs Calculator estimates that a self-sustainable wage for a single adult with one school-age child is \$21.78 per hour in the region. The survey and mapping technician occupation exceeds the self-sustainable rate at the 25th percentile; the cartographers and photogrammetrists occupations exceeds this rate at the 10th percentile. Online employer job ads indicate that 66% of survey and mapping technicians require a high school or vocational training; 100% of the cartographers and photogrammetrists online job ads requested a bachelor's degree.

Two regional community colleges offer GIS programs and reported four annual average awards over the last three years; one associate degree and three certificates. Outcome metrics reported median annual earnings of \$32,052 after exit, and 74% of students attained a living wage.

The COE recommends caution for developing new GIS programs due to the low annual job openings for related occupations in the region. Existing GIS programs that lead to the *survey and mapping technician* occupation are the best opportunities for exiting students to achieve employment after exiting a community college program. This occupation is expected to have 58 annual job openings and offers a self-sufficient hourly wage at the 25th percentile. Colleges considering this program should partner with applicable employers to document the requirements needed to gain employment in this field.

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

Occupation Definitions (SOC) code), Education and Training Requirement, Community College Educational Attainment

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

Incumbent workers with a Community College Award or Some Postsecondary Coursework: 14%

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: One to twelve months of on-the-job training

Incumbent workers with a Community College Award or Some Postsecondary Coursework: 59%

Appendix: Program Completion and Outcome Methodology

Exhibit 16 displays the average annual California Community College (CCC) awards conferred during the three academic years between 2016 and 2019, 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, 2021a).

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: 2019 to 2024 job growth, wages, education, training, and work experience required, IEDR

Occupation (SOC)	2019 Jobs	5-Yr Change	5-Yr % Change	Annual Openings (New + Replacement Jobs)	Entry-Experienced Hourly Wage Range (10 th to 90 th percentile)	Median Hourly Wage (50 th percentile)	Average Annual Earnings	Typical Entry-Level Education & On-The-Job Training Required	Work Experience Required
Surveying and Mapping Technicians (17-3031)	412	41	10%	58	\$19.87 to \$47.83	\$27.89	\$64,500	High school diploma or equivalent & 1-12 months	None
Cartographers and Photogrammetrists (17-1021)	108	12	11%	11	\$25.26 to \$49.16	\$29.80	\$69,700	Bachelor's degree & none	None
Total	520	53	10%	69	-	-	-	-	-

Source: Emsi 2020.4