

## Tech Memo 5. Colorado's Agricultural Sector and Airports

Agriculture is a significant driver of Colorado's economy, generating \$7.5 billion in revenue, not including sales generated by food processing, biotechnology, and other industries in the state that use agricultural products.<sup>1</sup> A multibillion-dollar industry, crops produced in Colorado are sold across the United States and internationally. These sales expand the Colorado economy by bringing dollars from these markets into the state. In turn, earnings from the export of crops support jobs, wages, and profits in the agriculture sector and are used to purchase business supplies from other Colorado businesses and in the re-spending of wages and profits in local economies. Across Colorado, more than 70,000 people are classified as "producers" and almost 38,000 additional Coloradans are listed as hired farm labor. Of these, almost 27,000 producers' primary occupation is farming, and more than 16,000 hired laborers worked 150 days or more.<sup>2</sup>

Aerial application businesses are an important component of Colorado's agricultural sector as they also make a significant contribution to the state economy. Specifically, aerial application contributes to the economy in the following ways:

1. Preserving cropland value by preventing surface disruption associated with tractors.
2. Supporting Colorado industries by employing pilots and enabling crop production.
3. Increasing crop production yields efficiently and cost-effectively.

While not Colorado-specific, the importance of aerial application to crop protection was demonstrated after the September 11, 2001. In the aftermath, all aircraft were grounded initially, however, agricultural aircraft were the first general aviation operators to be allowed in the air. Subsequently these aircraft were prohibited from operating on three separate occasions as the nation worked through national security concerns. During this time, it is estimated that in California alone where there was a pest infestation threat, nearly \$3 billion in crops were at risk due to the inability to provide aerial application and crop protection.<sup>3</sup>

The following sections examine aerial application's statewide economic contribution in detail. This analysis demonstrates how aviation is important to Colorado's agricultural sector and a variety of other industries throughout the state. In total, Colorado's aerial application industry supports over 5,000 jobs and generates approximately \$864 million in annual business revenues, \$342 million of which is a contribution to Colorado's gross state product.

### 5.1 Preserving Crop Value

According to the National Agricultural Aviation Association (NAAA), there are approximately 1,560 aerial application businesses located in 42 states.<sup>4</sup> Forty aerial application businesses with 102 employees are currently active in Colorado.<sup>5</sup> The U.S. Department of Agriculture (USDA) collects data about crop protection and Colorado is included in their survey. Among the state's major crops that

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<sup>1</sup> United States Department of Agriculture, 2017 Census of Agriculture, Table 2.

<sup>2</sup> Ibid, Tables 7 and 45.

<sup>3</sup> <https://www.agairupdate.com/ag-pilots-demonstrated-need-to-be-proactive-during-911/>

<sup>4</sup> National Agricultural Aviation Association, "Industry Facts," <https://www.agaviation.org/industryfacts>, accessed April 12, 2019.

<sup>5</sup> Email from Jessica Freeman, Executive Director, Colorado Agricultural Aviation Association, Inc., July 2, 2019.



receive various crop protection products (e.g., fertilizer, pesticides, herbicides), approximately 82 percent of harvested acres are treated.

Aircraft are increasingly applying liquid and dry fertilizer formulations (other application methods include tractors and chemigation through irrigation water).<sup>6</sup> Aerial seeding of cover crops is also a growing segment for aerial applicators. Cover crops are an environmental solution to improve soil health and reduce tillage and provide a secondary crop or forage on a single plot of land.

Aerial applicators preserve cropland value by preventing surface disruption by tractors. To estimate the value of crops preserved in Colorado, an understanding of the extent of aerial application is needed. NAAA estimates that 28 percent of all cropland is treated by aerial applicators. By applying this national average to acres harvested in Colorado, it is estimated that 725,200 acres of corn, 547,120 acres of wheat, 204,400 acres of alfalfa, 15,400 acres of potatoes, and 1,960 acres of oats received aerial application at least once in 2018 (see Table 5.1).<sup>7</sup>

**Table 5.1. Colorado Field Crop Production and Protection in 2018**

Colorado Field Crop Production and Protection in 2018			
Crop	Acres Harvested	Aerial Application	
		Acres Treated (percent)	Estimated Acres Treated
Corn	2,590,000	28%	725,200
Wheat	1,954,000		547,120
Alfalfa	730,000		204,400
Potatoes	55,000		15,400
Oats	7,000		1,960
<b>Total major treated crops</b>	<b>4,606,000</b>	<b>28%</b>	<b>1,289,680</b>

Sources: USDA 2018 Colorado State Agricultural Overview; NAAA

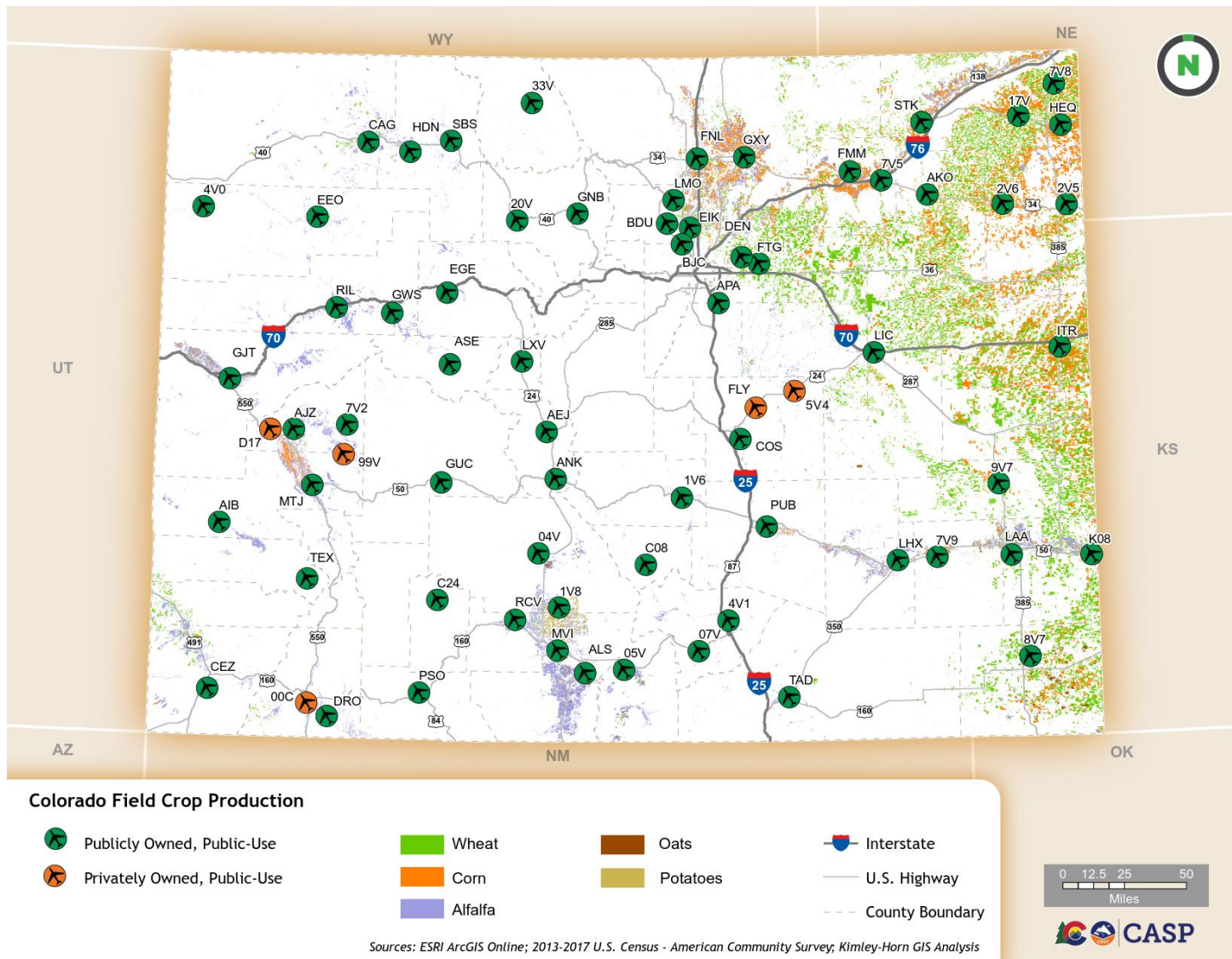
In addition to these major Colorado crops, there are specialty crops such as melons, sweet corn, chilies, and pumpkins also treated through aerial application. More recently, hemp is a new crop that may receive aerial application once the Colorado Department of Agriculture provides final policy on approved treatments.

Figure 5.1 below illustrates major crop field production in Colorado.

<sup>6</sup> Comments from Jessica Freeman, Executive Director, Colorado Agriculture Aviation Association, Inc., 2019.

<sup>7</sup> No Colorado-specific data were provided regarding aerial application rates by crop; therefore, the NAAA's national average of 28 percent was applied to all Colorado acreage. It is assumed that similar crop protection practices are adopted across most states (i.e., farmers that grow certain crops know that aerial application provides certain benefits).

Figure 5.1. Colorado Crop Field Production





## 5.1.1 Value of Aerial-Treated Crops

Using the crop production information contained in Error! Reference source not found. combined with average per acre crop yields; average dollar value by crop; and dollar loss due to crop surface disruption, an estimate can be made of the agricultural value of aerial treatment in Colorado. Average corn yields in Colorado are 130 bushels per acre, meaning that the 725,200 aerial-treated acres from Error! Reference source not found. translate to an estimated 94.3 million bushels treated by aerial applicators. Priced at \$3.75 per bushel in Colorado, the estimated value of the state’s aerial-treated corn crop in 2018 was \$353.6 million. Using the same methodology, the aerial-treated wheat crop is valued at \$92.1 million, alfalfa at \$152.2 million, potatoes at \$59.1 million, and oats at approximately \$358,000. The total value of Colorado’s major aerial-treated crops in 2018 was an estimated \$657.4 million as shown in Table 5.2.

**Table 5.2. Colorado Field Crop Yields and Dollar Value (2018\$)**

Colorado Field Crop Yields and Dollar Value (2018\$)				
Crop	Per Acre Yield	Aerial-Treated Cropland Yield (thousand units)	Price per Unit	Value of Aerial-Treated Cropland (millions \$)
Corn	130 bushels	94,300	\$3.75	\$353.6
Wheat	36.1 bushels	19,800	\$4.65	\$92.1
Alfalfa	3.4 tons	695	\$219.00	\$152.2
Potatoes*	395 Cwt	6,100	\$9.69	\$59.1
Oats	50 bushels	98	\$3.65	\$0.358
<b>Total major treated crops</b>		<b>N/A</b>	<b>N/A</b>	<b>\$657.4</b>

\*Potatoes are measured in hundredweight (Cwt). One Cwt equals 100 pounds.  
Source: USDA 2018 State Agriculture Overview for Colorado

## 5.1.2 Effect of Surface Disruption

Zero surface disruption is one of the primary advantages of aerial application. Surface disruption occurs when tractors equipped with sprayers decrease crop yields through soil compaction. Three percent of total crop yield is typically lost to surface disruption when tractors apply crop protection products.<sup>8</sup> Using this figure, it is estimated that approximately 2.8 million bushels of corn, 594,000 bushels of wheat, 20,900 tons of alfalfa, 183,000 hundredweight (18.3 million pounds) of potatoes, and 2,900 bushels of oats would have been lost if not for aerial application in Colorado. This equates to over \$10.6 million worth of corn protected by aerial application in 2018. In addition, aerial application is estimated to have protected \$2.8 million worth of wheat, \$4.6 million worth of alfalfa, \$1.8 million worth of potatoes, and approximately \$10,700 worth of oats. As shown in Table 5.3, the annual value protected by aerial applicators for Colorado’s major treated crops is estimated at \$19.7 million.

<sup>8</sup> Russ Gasper, “Agriculture, Aerial Applicators and Airports,” 2015, *Agricultural Aviation*, [http://www.agaviationmagazine.org/agriculturalaviation/september\\_october\\_2015?pg=54#pg54](http://www.agaviationmagazine.org/agriculturalaviation/september_october_2015?pg=54#pg54).

**Table 5.3. Effect of Surface Disruption on Colorado Crop Yields and Dollar Value (2018\$)**

Effect of Surface Disruption on Colorado Crop Yields and Dollar Value (2018\$)					
Crop	Aerial-Treated Cropland Yield (thousand units)	Average Yield Loss Due to Surface Disruption	Estimated Loss Due to Surface Disruption (thousand units)	Price per Unit	Value of Loss Due to Surface Disruption
Corn	94,300	3%	2,829	\$3.75	\$10,608,800
Wheat	19,800		594	\$4.65	\$2,762,100
Alfalfa	695		20.9	\$219.00	\$4,577,100
Potatoes	6,100		183	\$9.69	\$1,773,300
Oats	98		2.9	\$3.65	\$10,700
<b>Total major treated crops</b>			<b>N/A</b>	<b>N/A</b>	<b>\$19,732,000</b>

Source: USDA 2018 State Agriculture Overview for Colorado

## 5.2 Supporting Colorado Industries

USDA and U.S. Department of Commerce data assembled by IMPLAN indicate that the industry providing support activities for Colorado’s agriculture and forestry sectors employs approximately 11,200 workers and generates \$376.5 million in payroll (including the value of benefits), \$384.5 million in value added, and \$427.5 million in business revenues (based on 2017 data). Payroll is a component of value added and value added is a component of business revenues (Figure 5.2).<sup>9</sup>

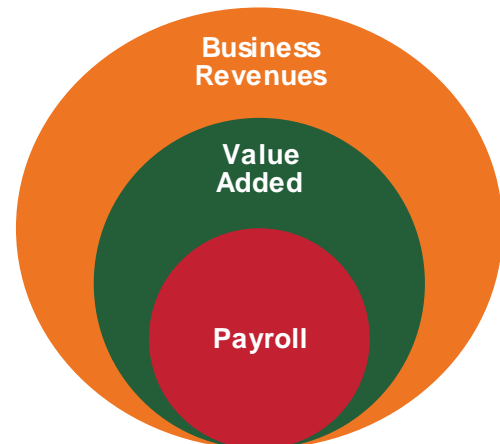
As noted previously, Colorado’s 40 active aerial application businesses support 102 jobs. Using average state- and industry-specific business revenues-per-worker values, these jobs are associated with an estimated

- \$2.86 million in payroll
- \$2.92 million in value added
- \$3.24 million in annual business revenues

### 5.2.1 Grain & Vegetable Farming

Crop production provides an important contribution to Colorado’s economy. The state’s grain farming industry, which includes wheat, alfalfa, and oat harvesting, provides nearly 3,200 jobs and generates \$57.5 million in payroll, \$47.8 million in value added, and \$1.1 billion in business revenues annually as shown in Table 5.4. The industry’s \$57.5 million in payroll includes \$26 million in employee

**Figure 5.2. Economic Impact Measures**



<sup>9</sup> Payroll is based on the U.S. Bureau of Economic Analysis concept of Personal Income (called Labor Income in IMPLAN), which includes compensation and the value of employer-provided benefits.



compensation (wages and benefits) and \$31 million in owner income, an amount that likely reflects high rates of self-ownership in the agriculture sector.

The vegetable farming industry, which includes corn and potato harvesting, provides over 2,600 jobs and generates \$129.3 million in payroll, \$229.5 million in value added, and \$407.2 million in business revenues annually. The industry’s \$129.3 million in payroll includes \$97.5 million in employee compensation and \$31.8 million is owner income. Value added-per-worker is significantly higher in Colorado’s vegetable farming industry than in grain farming, primarily because the former pays higher wages.

Because aerial application covers only a portion of all cropland in Colorado, the direct economic contributions of grain farming and vegetable farming are adjusted using the 28 percent figure previously discussed. This percentage is applied to the total contribution of each industry to arrive at the value of farms receiving aerial application only. These farms generate an estimated \$431.5 million in annual business revenues that supports 1,630 jobs and \$52.3 million in payroll, as well as \$77.6 million in value added (see Table 5.4).

**Table 5.4. Direct Economic Contribution of Industries Producing Colorado’s Major Crops by Total & Aerial-Treated Crop Production (2018\$)**

Direct Economic Contribution of Industries Producing Colorado’s Major Crops by Total & Aerial-Treated Crop Production (2018\$)				
Industry	Jobs	Payroll (millions \$)	Value Added (millions \$)	Business Revenues
<b>All Crop Production</b>				
Grain farming	3,190	\$57.5	\$47.8	\$1,134.0
Vegetable farming	2,640	\$129.3	\$229.5	\$407.2
<b>Total, all crop production</b>	<b>5,830</b>	<b>\$186.8</b>	<b>\$277.3</b>	<b>\$1,541.2</b>
<b>Aerial-treated Crop Production</b>				
Grain farming	890	\$16.1	\$13.4	\$317.5
Vegetable farming	740	\$36.2	\$64.2	\$114.0
<b>Total, all crop production</b>	<b>1,630</b>	<b>\$52.3</b>	<b>\$77.6</b>	<b>\$431.5</b>

*Source: Calculations by EDR Group using IMPLAN 2017*

## 5.2.2 Total Role of Aerial Spraying in the Colorado Economy

The total contribution of aerial spraying to the Colorado state economy—including jobs associated with aerial-treated crops and jobs in aerial application—amounts to over \$870 million in annual business revenues and 5,140 jobs as depicted in Table 5.5. This includes \$431.5 million in direct business revenues and over 1,600 direct jobs. These direct impacts represent the sales made by aerial applicators and farms plus the workers they employ full-time and part-time.

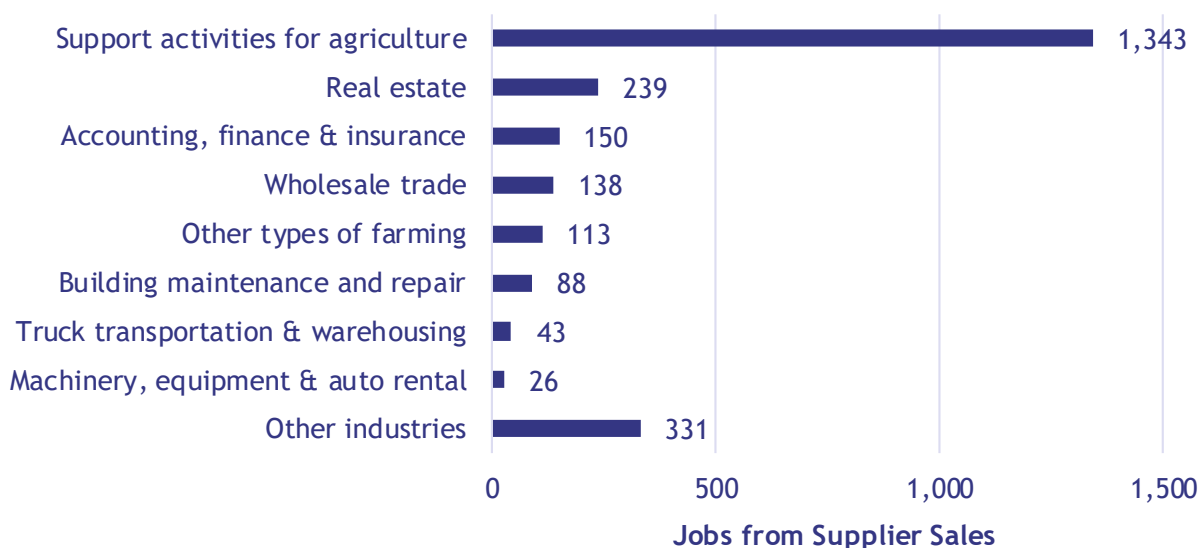
**Table 5.5. Total Contribution of Aerial Application to the Colorado Economy (2018\$)**

Total Contribution of Aerial Application to the Colorado Economy (2018\$)				
Impact Type	Jobs	Payroll (millions \$)	Value Added (millions \$)	Business Revenues
Direct impact	1,630	\$52.3	\$77.6	\$431.5
Supplier sales effect	2,470	\$113.8	\$176.2	\$284.6
Income re-spending effect	1,040	\$50.4	\$91.7	\$156.7
<b>Total contribution</b>	<b>5,140</b>	<b>\$216.6</b>	<b>\$345.6</b>	<b>\$872.8</b>

Source: Calculations by EDR Group using IMPLAN 2017

The direct activities of aerial applicators and farms involve the purchase of supplies, equipment, and services from other Colorado businesses. These *supplier sales* support an additional 2,470 jobs. Over half of these additional jobs are in the industry that provides support activities for agriculture. This industry employs farmworkers and other laborers who operate equipment, maintain crops and nurseries, and care for farm animals, among other tasks.<sup>10</sup> The remaining jobs are in a range of industries that support aerial applicators as identified in **Figure 5.3**.

**Figure 5.3. Jobs from Supplier Sales in Select Industries**

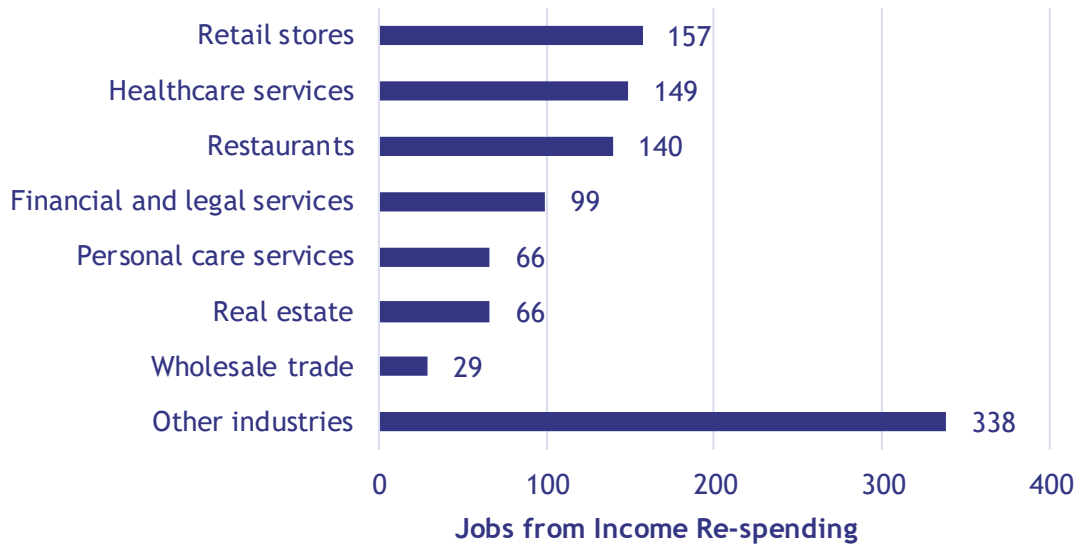


Source: Calculations by EDR Group using IMPLAN 2017

*Income re-spending* leads to an additional 1,040 jobs. These jobs are created when workers at aerial applicators and supplier companies spend their wages at Colorado businesses. As a result, these jobs exist in dozens of industries. The industries with the largest number of income re-spending jobs include retail, healthcare services, restaurants, financial and legal services, personal care services, real estate, and wholesale trade as shown in **Figure 5.4**.

<sup>10</sup> <https://www.bls.gov/iag/tgs/iag115.htm>

Figure 5.4. Jobs from Income Re-spending in Select Industries



Source: Calculations by EDR Group using IMPLAN 2017

### 5.3 Summary

Aerial applicators generate significant economy activity in Colorado. They not only protect crop value by preventing surface disruption, but also support the state’s agricultural sector and a variety of other industries by purchasing supplies and paying wages that are spent at businesses throughout the state. The variety of industries that are supported by supplier sales and income re-spending within Colorado demonstrates the extensive reach of Colorado’s aerial application industry.