



**COLORADO**

Colorado Water  
Conservation Board

Department of Natural Resources

**Colorado Water Conservation Board**

**Water Supply Reserve Fund**

**Water Project Summary**

Name of Applicant	St. Vrain and Left Hand Water Conservancy District	
Name of Water Project		
Basin Account Request Subtotal		\$380,000.00
Applicant Cash Match		\$380,000.00
Applicant In-Kind Match		\$0.00
Basin Requests		
Sources of Funding		

**Applicant & Grantee Information**

Name of Grantee: St. Vrain and Left Hand Water Conservancy District  
Mailing Address: 1715 Iron Horse Drive, Suite 250 Longmont CO 80501  
FEIN: 846,113,250

Organization Contact: Scott Griebling  
Position/Title: Email: [scott.griebling@svlhwcd.org](mailto:scott.griebling@svlhwcd.org)  
Phone: (303) 772-4060

Organization Contact - Alternate: Sean Cronin  
Position/Title: Executive Director Email: [sean.cronin@svlhwcd.org](mailto:sean.cronin@svlhwcd.org)  
Phone: 3037724060

Grant Management Contact: Scott Griebling  
Position/Title: Email: [scott.griebling@svlhwcd.org](mailto:scott.griebling@svlhwcd.org)  
Phone: (303) 772-4060

Grant Management Contact - Alternate: Sean Cronin  
Position/Title: Executive Director Email: [sean.cronin@svlhwcd.org](mailto:sean.cronin@svlhwcd.org)  
Phone: 3037724060

**Agency Information**

Agency Type District  
Current Assessment  
Number of Shareholders or Customers  
Number of Shares  
Number of Taps  
Average Monthly Water Bill  
Annual Water Delivery (acre-feet)

**Description of Grantee/Applicant**

No description provided

### Location of Water Project

Latitude 0.000000  
Longitude 0.000000  
Lat Long Flag  
Water Source  
Basins  
Counties  
Districts

### Water Project Overview

Major Water Use Type  
Type of Water Project  
Scheduled Start Date - Design 10/23/2022  
Scheduled Start Date - Construction 10/23/2022  
Description

### Measurable Results

0 New Storage Created (acre-feet)  
0 New Annual Water Supplies Developed or Conserved (acre-feet), Consumptive or Nonconsumptive  
0 Existing Storage Preserved or Enhanced (acre-feet)  
0 New Storage Created (acre-feet)  
0 Length of Stream Restored or Protected (linear feet)  
\$0 Efficiency Savings (dollars/year)  
0 Efficiency Savings (acre-feet/year)  
0 Area of Restored or Preserved Habitat (acres)  
0 Quantity of Water Shared through Alternative Transfer Mechanisms or water sharing agreement (acre-feet)  
0 Number of Coloradans Impacted by Incorporating Water-Saving Actions into Land Use Planning  
0 Number of Coloradans Impacted by Engagement Activity  
Other  
No additional measurable results provided

**INITIAL STATEMENT OF WORK**  
**AIRBORNE SNOW OBSERVATORIES, INC.**  
**WATER YEAR 2023**

## 1 BACKGROUND

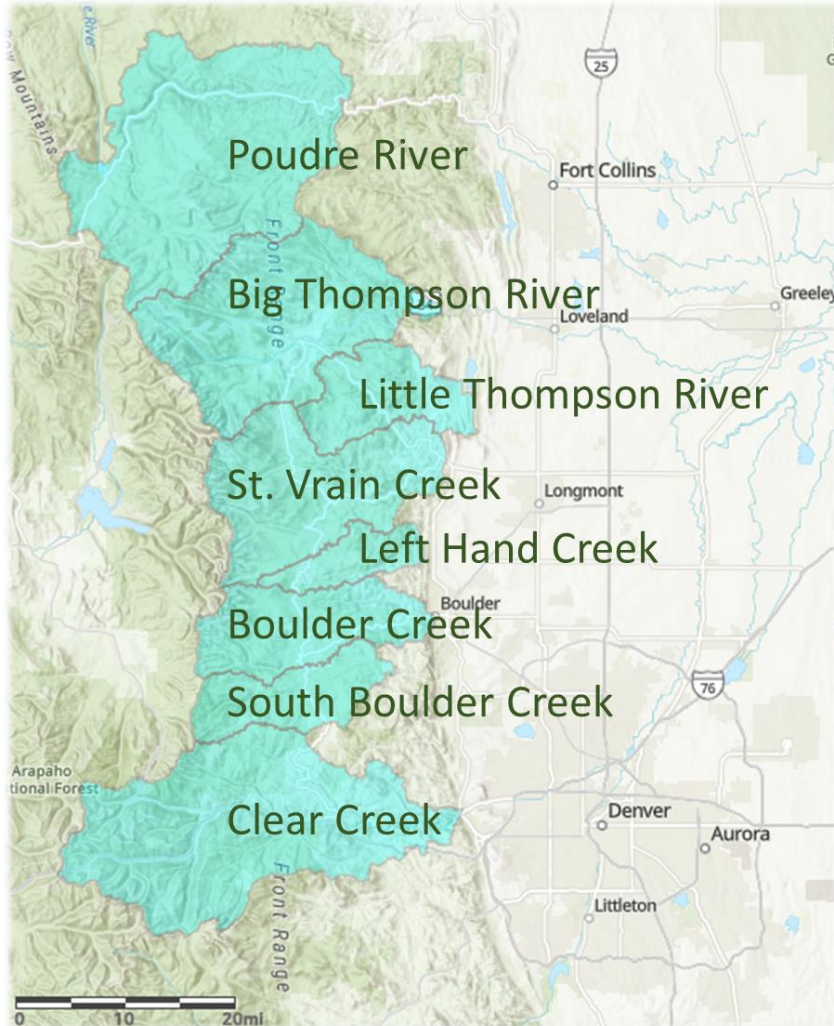
As the ASO program became increasingly operations-critical to water managers, NASA was compelled to transfer the technology out of the JPL research setting. The passion for the program and the intention to assure the highest quality implementation motivated the founding team to leave prestigious NASA science and engineering positions to create ASO, Inc. In the ramp up, we have established a strategic partnership with the global GIS leader, Esri, whose products are used extensively in water management.

ASO generates spatially complete maps of snow water equivalent (the depth of water if the snow were to melt instantaneously) and snow albedo (reflectivity, which controls snowmelt rates) through remote sensing data and snowmelt runoff modeling frameworks to provide the best possible water resources data. The uniqueness of ASO comes from the experience of the team and its exclusive software products developed, applied, advanced, and adopted by our customers over the last seven years. Dr. Painter and his team are the founders of the program, creators of the airborne snow survey market, and now ASO is the sole licensee to commercialize snow surveys with this software suite.

## 2 PROJECT SCOPE & SCHEDULE for Water Year 2023

In collaboration and coordination with adjacent state and local agencies, ASO will carry out the following task for the St. Vrain & Left Hand Water Conservancy District and the funding partners of the Northern Front Range watersheds:

- Production of high resolution, distributed snow depth, snow water equivalent (SWE), and snow albedo data for the Northern Front Range watersheds, including Clear Creek, South Boulder Creek, Boulder Creek, Left Hand Creek, St. Vrain Creek, Little Thompson River, Big Thompson River, and Cache La Poudre River watersheds (collectively the “Northern Front Range Basins”; Figure 1 below) consisting of 2 snowpack measurement surveys per basin. Flights will be planned to provide local stakeholder agencies with measurements timed to be available before key water resources decisions.
- Data analysis and interpretation.
- Delivery of snow depth, snow water equivalent, and snow classification data products.
- Coordination of iSnobal modeling of the snowpack



**Figure 1.** Northern Front Range watersheds

This scope leverages existing, separately-funded ASO, Inc. survey activities, including the Northern Front Range snow-free flights and data preparations from the summer and fall of 2022.

ASO Inc. will be responsible for acquisition of survey data either using its own assets or through a survey subcontractor. ASO, using its proprietary software exclusively licensed from Caltech, will perform the data analysis, interpretation, prepare and deliver a report, and be available for interaction with SVLHWCD and funding partner staff. ASO will interact regularly with SVLHWCD and funding partners to adapt timing of acquisitions, formatting of data products, and timeliness of product delivery. ASO will also work with SVLHWCD and funding partners on public outreach efforts to provide its members with the full knowledge of their investment in water resource technology.

## 3 APPROACH

### **Flight Surveys**

ASO will conduct airborne surveys using aircraft equipped with lidar, spectrometer, and RGB camera over the defined project watersheds. Flight activity will commence on or about April 1, with final timing decisions to be made in consultation participating agency staff.

Flight(s) will occur on relatively clear sky days (< 20% cloud cover) to assess snow depth and snow albedo at 3 m grid resolution and SWE at 50 m grid resolution. The ASO aircraft will operate from a base proximal to the survey areas. Operational decisions (such as flight timing) will be made through a collaboration with the participating agency staff and the ASO Inc. team through meetings coordinated by CWCB staff, with consideration for snowpack state, flight weather, and complementary project needs.

### **Data Analysis and Interpretation**

ASO Inc. will process and analyze the acquired data from raw acquisition through to generation of snow and snow-free data products. The processing of the imaging spectrometer data includes angular calibration, spectral calibration, radiometric calibration, and orthorectification with the topography (based on the ASO's airborne Global Positioning System/Inertial Navigation System - GPS/INS). The integration with the lidar requires the additional synchronization in space, which relies on a robust synchronization of timing and pointing by the respective GPS/INS of the spectrometer and the lidar. Unique to the ASO processing is the per-acquisition update of the digital elevation model from which sunlight is reflected given the changes in snow slope, aspect, and depth.

The ASO processing chain is designed to deliver high-accuracy snow-on data products within 72 hours of acquisition in order to meet snowmelt runoff forecasting and water management needs.

### **Deliverables**

- Snow depth maps (3 m, geotiff format)
- Snow water equivalent maps (50 m, geotiff format)
- Snow albedo maps (3 m, geotiff format)
- Total basin report (text)
- Elevation stratification report (text)
- Survey report (PDF)
- Delivery of Provider products for iSNOBAL

### *Delivery of ASO Inc. products*

ASO team will provide and maintain the above snow-on products within 72 hours after the flight date on the ASO cloud-enabled database and web portal.

## 4 PRICING

### Costing

ASO Inc costing is based on base costs and variable costs. These are listed as below.

*Base costs cover product region preparation, aircraft mobilization/demobilization, calibration flights and processing, and the first flight+processing.*

*Variable costs are dependent on the flight area, number of flights, and number of months across which flights occur. These costs are specific to monthly deployment and standby, flying, processing, and modeling.*

The pricing components are shown in Table 1. As we have experienced in previous years, as snowmelt continues, the requisite area to be flown decreases. However, the area flown will not necessarily decrease at the rate of snow-covered area because of the “horseshoe” shape of high elevation snow cover in basins.

Hence, the not-to-exceed costs (Table 2) are based on the full area of the Northern Front Range Basins and the number of flights and number of months.

Table 1 ASO Inc costing components for water year 2023.


Flying price per km <sup>2</sup> per acquisition	\$38.46
Processing price per km <sup>2</sup> per acq	\$6.82
Modeling price per km <sup>2</sup> per season	\$27.29
Aircraft period cost per month per basin	\$12,405.10

The ASO Inc. pricing scenario for the Northern Front Range Basins for water year 2023 is set forth in Table 2 below. This pricing scenario assumes surveys with lidar point densities of > 1 surface point/m<sup>2</sup>. The area of the Northern Front Range Basins to be flown is ~4345 km<sup>2</sup>. This region will likely be flown from the Rocky Mountain Metro and Fort Collins Airports, and data will be processed at the ASO Inc. processing center in Mammoth Lakes, CA and in cloud-enabled infrastructure as appropriate.

ASO Inc. scenario presented in Table 2 below consists of:

- 2 surveys in 2 months across 3 contiguous months of April-June, 2022.
- Based on pricing set forth in the Scope of Work, the work to be performed under this Statement of Work will not exceed \$698,128.22 as described in Table 2 below.

Table 2 ASO Inc. pricing for Northern Front Range Basins surveys and processing for 2 acquisitions in 2 months. These numbers are based on an area of 4345 km<sup>2</sup> and represent the not-to-exceed cost.

Airborne Snow Observatories, Inc. Cost Estimate				
Front Range (Clear Creek - Poudre)				
Water Year 2023 Snow-on Surveys				
		<i>Area (km<sup>2</sup>): 4345</i>	<i>Basins: 5</i>	
		<i>Surveys: 2</i>	<i>Months: 2</i>	
				
<b>Baseline + First Survey</b>				<b>Cost</b>
Product + region prep				\$62,025.52
Aircraft mobilization / demobilization				\$37,215.31
Calibration				\$62,025.52
1st month deployment + standby fee				\$12,405.10
1st survey				\$167,090.54
1st survey processing				\$29,645.10
iSnoBal modeling (full season)				\$118,580.39
WRF-Hydro modeling (full season)				\$0.00
<b>Baseline + First Survey Subtotal</b>				<b>\$488,987.48</b>
<hr/>				
<b>Subsequent Surveys</b>	<b>Months or Acquisitions</b>	<b>Area</b>	<b>Unit Price</b>	<b>Cost</b>
Monthly deployment cost + standby fee	1	N/A	\$12,405.10	\$12,405.10
Flying price (survey #2)	1	4345	\$38.46	\$167,090.54
Processing price (survey #2)	1	4345	\$6.82	\$29,645.10
<b>Subsequent Surveys Subtotal</b>				<b>\$209,140.74</b>
<b>Total</b>				<b>\$698,128.22</b>
Quote generated by AKB 8/4/2022				