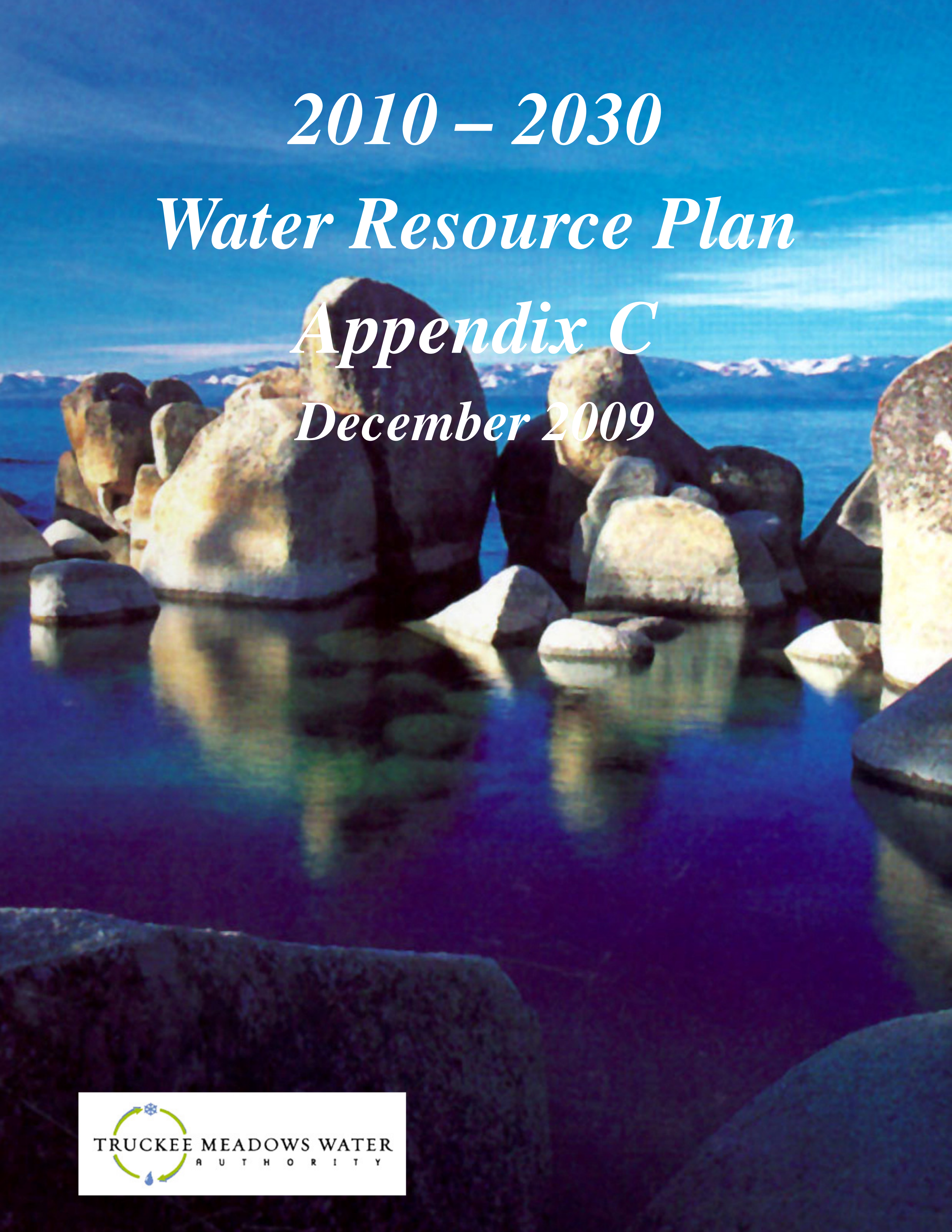
2010 – 2030

Water Resource Plan

Appendix C

December 2009



TRUCKEE MEADOWS WATER AUTHORITY

Appendix C:

Desert Research Institute Proposal to Northern Nevada Water Planning Commission

Northern Nevada Water Planning Commission

STAFF REPORT

DATE: November 25, 2009

TO: Chairman and Members, Northern Nevada Water Planning Commission

FROM: Jim Smitherman, Water Resources Program Manager

SUBJECT: Technical presentation and discussion concerning the Desert Research Institute, ("DRI") cloud seeding program including program history, results, current and future status, funding, beneficiaries of the program in the Truckee River and Tahoe basins and the possible development of a Truckee-Tahoe cloud seeding coalition.

SUMMARY

Desert Research Institute ("DRI") funding cuts have affected its cloud seeding operations such that outside financing is necessary to continue the program. In September 2009 the Truckee River Fund awarded $165,151 in partial support of the 2009-2010 program. Last month the Western Regional Water Commission (WRWC) approved an agreement with DRI for $45,000 from the Regional Water Management Fund to make up the remainder of the approximately $210,000 budget, however long term funding remains uncertain. Cooperation among entities that benefit from cloud seeding in the Truckee River and Tahoe basins has been suggested as a long-term program support strategy. DRI staff will provide a presentation about the cloud seeding program and address questions from the Commission.

BACKGROUND

An excerpt of the proposal provided to the WRWC for 2009-2010 funding is attached as background information.

JS:jd

Specific project goals and measureable outcomes

The goal of this project is to enhance snowfall from winter storms and to increase the snowpack of the Tahoe and Truckee Basins through the application of wintertime cloud seeding technology. The benefits of additional snowfall are expected to be an enhancement in the spring snow melt and subsequent enhancement in runoff into the streams and reservoirs of the targeted basins. The current relatively poor water conditions following three below normal water years in northern Nevada warrant this effort to increase water resources for the Truckee River system. Results from carefully conducted experiments in the Sierra Nevada and other mountainous regions in the western U. S. have shown that snowfall can be increased by 5-15% annually in the specific basins targeted by cloud seeding operations. Past environmental assessments have all indicated that no negative impacts to watersheds are produced by cloud seeding operations.

The primary measureable outcome of the project will be an estimate of the enhancement in snow water computed for each seeded storm period, and for the entire winter season, based on the hours of seeding, the amount of seeding material released, the expected increase in precipitation rate, and the average areal coverage of the fallout from each seeding site. Historical research results from ground-based cloud seeding projects have documented the hourly increases in precipitation rate due to seeding to be in the range of a few hundredths up to 2 mm per hour. As a conservative estimate of the effect for the Tahoe-Truckee project a value of 0.25 mm per hour will be used in the enhancement estimates. Prior estimates from the DRI state program yielded snow water increases ranging from 8,000 to 30,000 acre-feet, an annual average of about 18,250 acre-feet over the past 10 seasons.

Project location

This proposal focuses on a cloud seeding effort for the Tahoe Basin and the Truckee River Basin which DRI has conducted for the state of Nevada for more than 25 years. Figure 1 shows the location of the project. The shaded region approximately encloses the cloud seeding target area for the two basins. The DRI ground based seeding sites from prior seasons are shown as yellow squares. Aircraft seeding, an option in this proposal, has been done in prior years using the flight tracks shown in Fig. 1. Other cloud seeding projects that target the western slope of the Sierra Nevada use the sites marked by triangle and flags. DRI used the sites marked by green stars as snow sampling sites in prior research studies. Trace chemical analyses of snow samples from these locations in 2004 and 2005 showed that 34-52% of the samples contained enhanced concentrations of silver, indicative of snow frequently being created by cloud seeding with AgI.

Project description

The project design and method of operation will be nearly identical to the Nevada state-funded project conducted from 1985-2009. Seeding will be conducted from a line of five ground-based generators positioned on, or a few miles upwind of, the main Sierra Nevada crest to the west of Lake Tahoe (Fig. 1). The generators have been positioned to take advantage of typical wind directions in winter storms in the Tahoe area, and are remotely activated by DRI staff when the proper weather and cloud conditions for seeding have been verified.

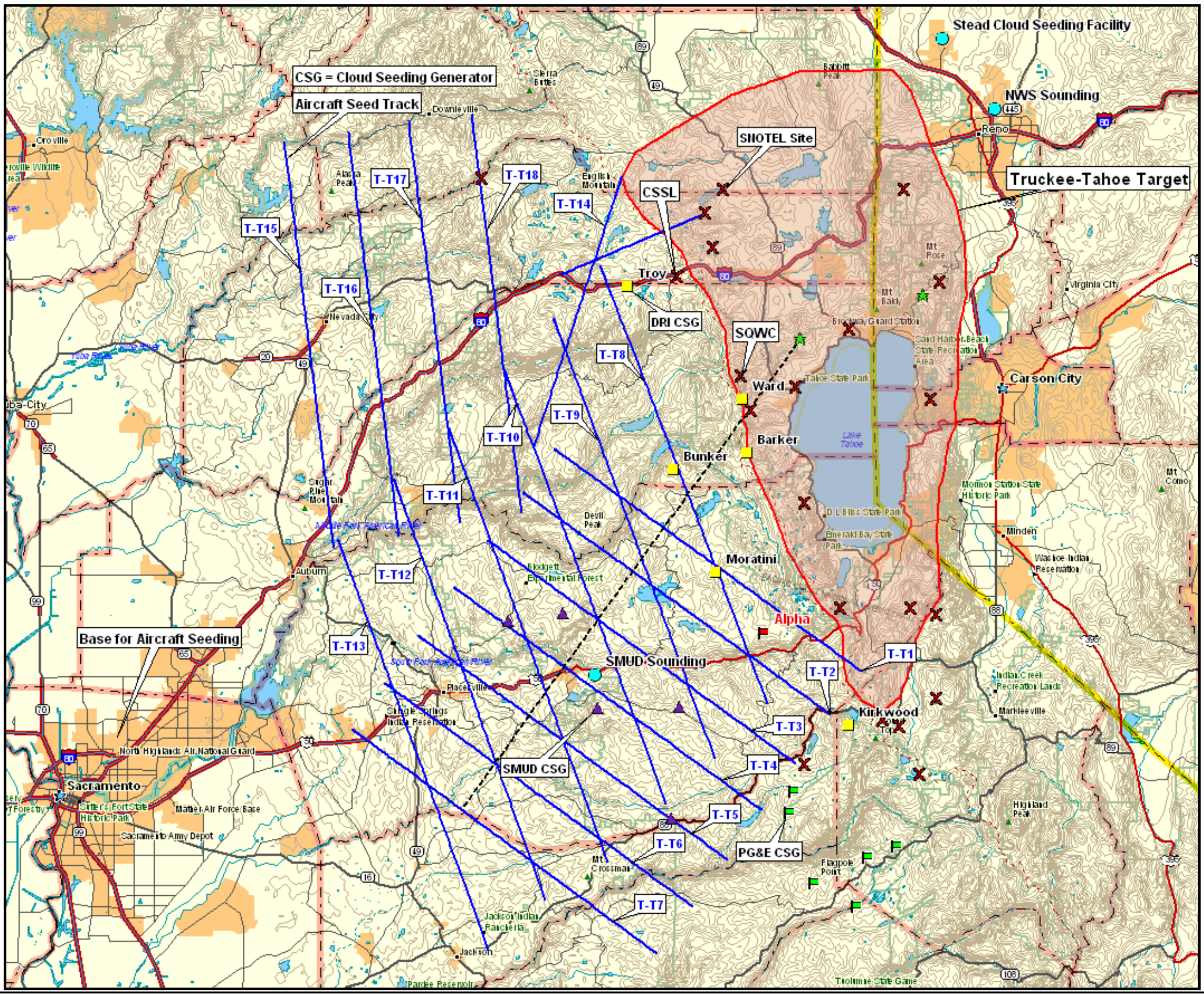


Figure 1. Map showing the Tahoe and Truckee Basins (pink shading) and instrument sites used by and for the DRI cloud seeding project. Yellow squares show DRI cloud seeding generator sites used to seed the Tahoe-Truckee area. Purple triangles and green flags are seeding sites used by other projects. Blue lines are cloud seeding flight tracks designed to target Tahoe-Truckee. Red Xs are SNOTEL sites and blue circles show the locations of upper air sounding sites. The two green stars north of Lake Tahoe are locations used by DRI for snow sampling to verify the presence of silver (from AgI).

Ground-based cloud seeding is based on the following sequence of events. The seeding material is silver iodide (AgI). The seeding "generators" burn a solution containing AgI dissolved in acetone. The burning process produces a "smoke" of microscopic AgI particles (about 0.0001 mm is size) that are transported downwind and dispersed into clouds over the mountains. Vertical dispersion up to at least 2000 feet above the surface is produced by the turbulence created by wind moving over the uneven terrain. In the presence of cloud droplets existing at temperatures below -5^{o} C the silver iodide particles act as ice-forming nuclei and enhance the ice particle concentration in the natural clouds. Once initiated by silver iodide the ice particles grow in size and mass as they move downwind and begin falling to the surface when they have sufficient mass to overcome the upward motion in the clouds. In the time frame of 20 to 30 minutes snowfall within the seeding plume can reach the surface in and around the Tahoe Basin. This "chain-of-events" in the cloud seeding process has been verified by numerous detailed experiments conducted in the Sierra Nevada and other mountainous regions of the western U.S. The aircraft seeding scenario is similar, except seeding material is dispensed directly into clouds at the appropriate temperature and upwind distance to account for the transport of seeding material by upper level winds.

Phase 1 of the project will include re-establishment of five seeding generators at the locations shown in Fig. 1. This will require several weeks, and involves moving the generators into position, filling the seeding solution tanks, setting and filling propane tanks, testing all generator components and communications links (including time to re-establish a radio communications link for one site). Generators will be filled with 100 gallons of solution, which allows for about 250 hours of seeding per unit. [If included, a subcontract will be negotiated with an aircraft seeding company for a specified number of flight hours. Historically the aircraft component of the Tahoe project contributed about 30% of the estimated snow water enhancement from cloud seeding.] The meteorological forecasts and observations needed to conduct the project are available either through the DRI Western Regional Climate Center or through public web-based weather data links. The project manager who also serves as project meteorologist has previously set up a weather web page to access all the needed data and weather images (http://cloudseeding.dri.edu/Weather/). In Phase 1 the project manager will also redesign the DRI cloud seeding web page to focus on the Tahoe-Truckee project (http://cloudseeding.dri.edu/Operations/tahoe_truckee.php) where the progress of winter operations will be routinely updated. All operational guidelines, safety restrictions and suspension criteria for the project have previously been developed and can also be found on the DRI cloud seeding web site at: http://cloudseeding.dri.edu/. The guidelines specify the cloud, wind and temperature conditions in which a seeding event can be initiated, and also hazardous conditions (for example potential flooding situations) in which no seeding can be done.

Phase 2 of the project will involve the actual cloud seeding operations, beginning on 15 November. Aircraft seeding, if funded, will focus on a shorter period between December and February. The project manager will begin monitoring the weather and making forecasts for seeding events to be expected within three to five days. The DRI technical staff will make at least weekly checks of each seeding generator by logging into the generator computer, briefly activating the unit and monitoring key operating parameters such as flame temperature and solution flow. As a storm begins affecting the Tahoe region cloud conditions will be monitored more frequently to determine when seeding criteria are satisfied. When the meteorologist determines that conditions are correct he will call the lead research technician with instructions regarding which generators to run and for how long. For aircraft seeding the meteorologist coordinates with the flight crew to schedule a flight on an appropriate flight track (Fig. 1). The Tahoe communication links are internet-based and a generator can be started from any computer with internet access. Seeding commences when all pre-established seeding criteria are met, and continues until conditions in the storm fail to meet the criteria. Based on prior experience in the Tahoe region, 15 to 30+ seeding events can be expected during the period from mid-November through mid-April, the 5-month period proposed for Phase 2 of this project. The end date could occur sooner if generators run out of solution or other expendable supplies. Maintenance of generators will be performed by snowmobile field trips to remote sites as needed in Phase 2.

Phase 3 of the project will begin on 1 May and includes the documentation of weather events to verify that seeding occurred during optimal time periods. Each period will be evaluated and a seedability factor will be applied to quantify the fraction of time when seeding was potentially effective. The estimates of snow water enhancement will be made and adjusted by the seedability factor. A report on project operations, including the measureable outcome, will be completed by 15 June. Phase 3 also includes the removal of seeding units as dictated by some of the Forest Service special use permits. Removal of generators is only possible after snow has melted and the roads to the sites are useable. In some years this can be mid- to late July, so Phase 3 is scheduled to end on 31 August. This also allows time for removed generators to be taken to the cloud seeding facility in Stead, Nevada, checked for problems, and repaired as needed.