



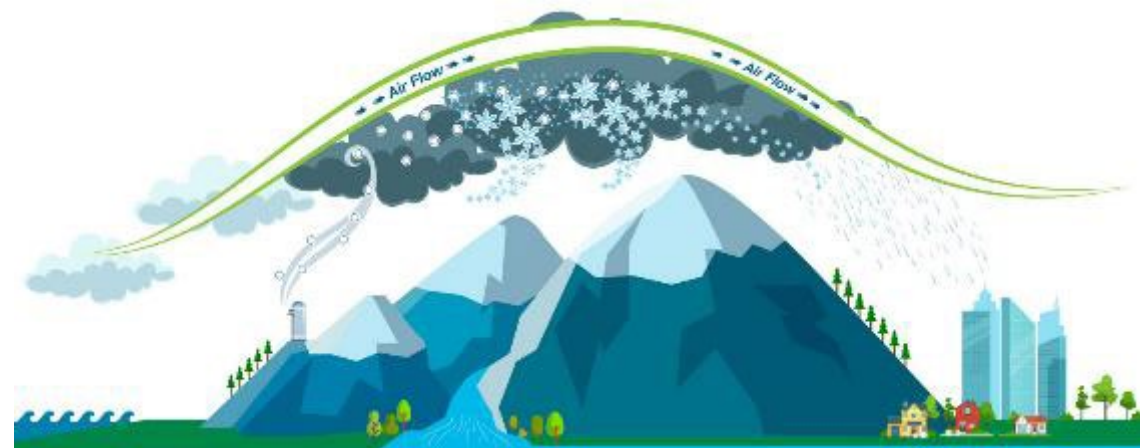
Santa Ana River Weather Modification Pilot Program Status Update

Jeff Mosher, General Manager
Santa Ana Watershed Project Authority

San Geronimo Pass Water Agency
Board of Directors Meeting
Item 6.B
March 4, 2024

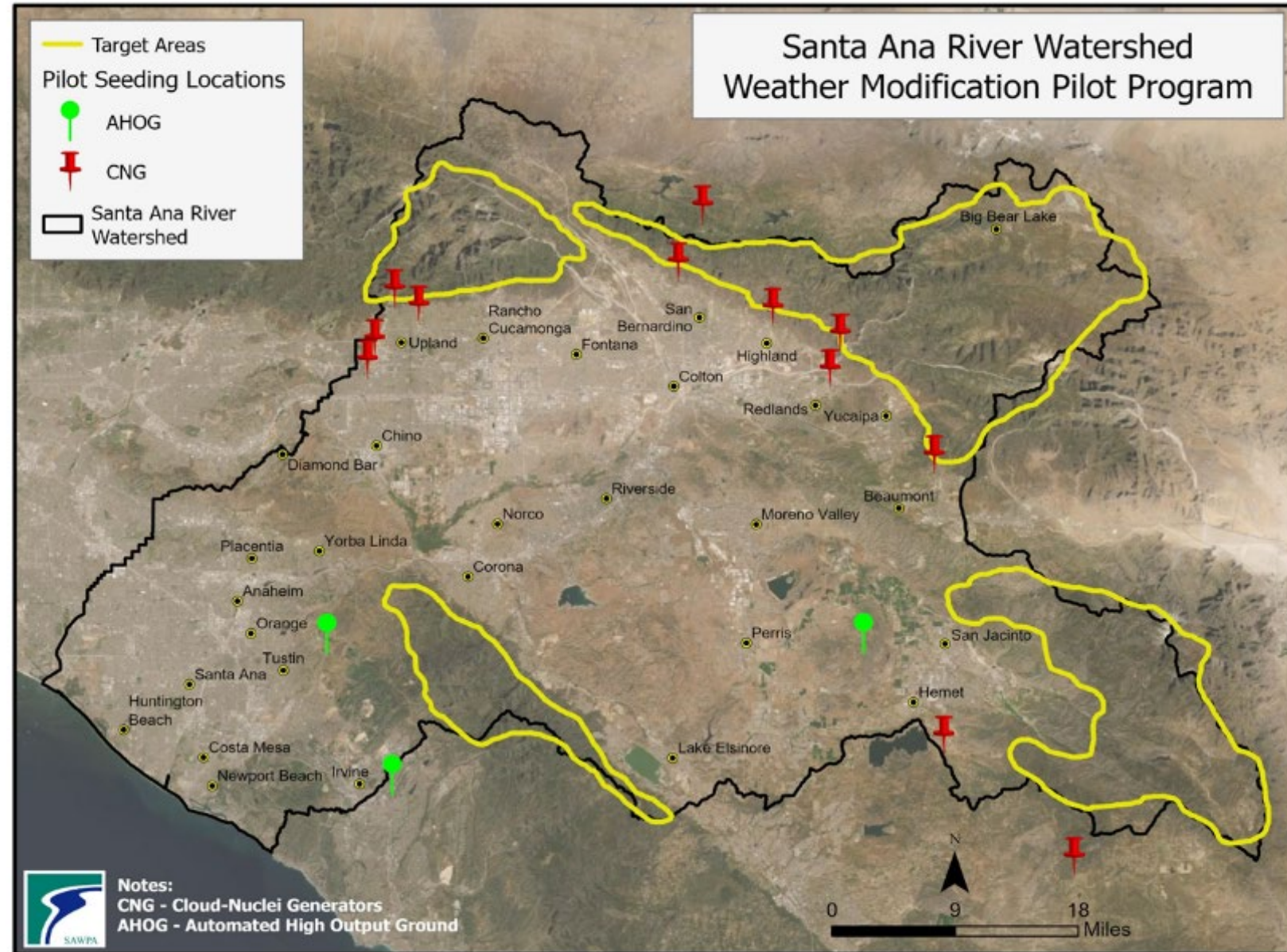
Presentation Overview

- Background Information
 - Pilot Program Overview
- Operations
 - Summary of Cloud Seeding Operations
 - Notifications
- Communications
- Responses to:
 - SPGWA Questions
 - Public Comment Questions



Pilot Project

- Cloud Seeding Pilot
 - 4-year study (Nov 15-April 15)
 - 4 Target Areas (NW, NE, SW, SE)
 - Use of ground-seeding units (15)
 - Use of **Validation Study** to assess increases in precipitation
- Pilot Program Operator
 - North American Weather Consultants (NAWC)



P:\projects\Mark_Norton\WeatherMod_21\WeatherMod2.aprx LoPilotProgram SW-3105

Funding



SAN GORGONIO PASS
WATER AGENCY
Established 1961



SAWPA Member
Agencies

Big Bear City
Community
Services District

Big Bear Lake
Department of
Water & Power



CHINO BASIN
Water
Conservation
District



Chino Basin Water
Conservation
District

City of Corona
Utilities
Department

City of Santa Ana
Municipal Utility
Services



SINCE 1933



Powered by water. Driven by service.



A REGIONAL WATER AGENCY
SINCE 1954

Lake Elsinore and
San Jacinto
Watersheds
Authority

San Antonio Water
Company

San Geronio Pass
Water Agency



Pilot Funding

Source	Amount
Prop 1 Round 2 Grant (DWR)	\$861,400
SAWPA (IEUA, WMWD, EMWD, SBVMWD, OCWD)	\$691,000
Local Funding Partners: <ul style="list-style-type: none">• Big Bear City Community Services District• Big Bear Lake Department of Water & Power• Chino Basin Water Conservation District• City of Corona Utilities Department• City of Santa Ana Municipal Utility Services• Lake Elsinore and San Jacinto Watersheds Authority• San Antonio Water Company• San Geronimo Pass Water Agency	\$94,000
Total (4 years)	\$1,646,400



Operations

Cloud Seeding Ground-Based Unit Locations



Cloud Nuclei Generators (CNGs)



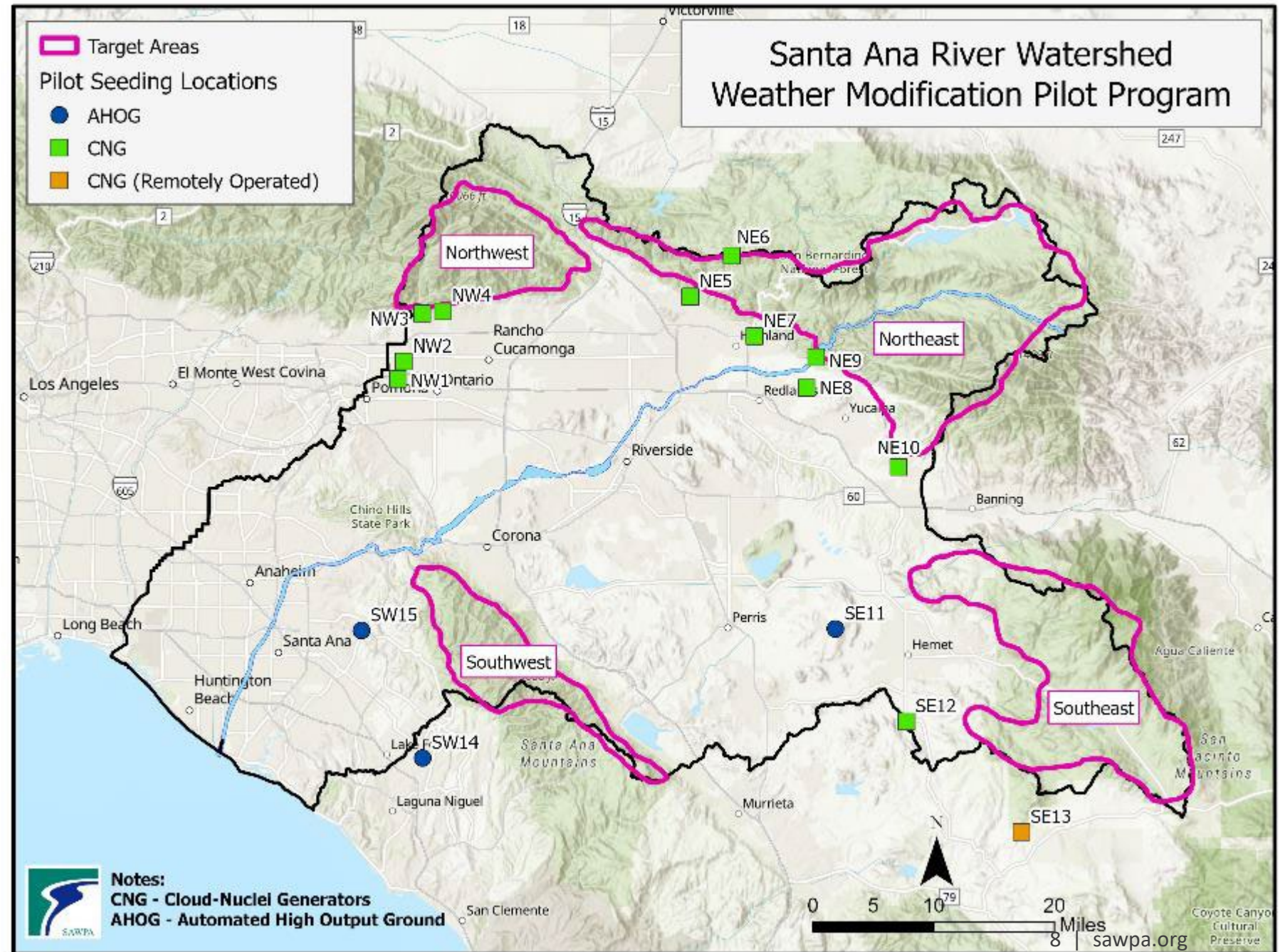
Automated High Output Generating Stations (AHOGS)

Site (15)	Sponsors (11)
Northwest	
NW1	Chino Basin Water Conservation District
NW2	
NW3	San Antonio Water Company
NW4	
Northeast	
NE5	City of San Bernardino MWD
NE6	Private Landowner
NE7	San Bernardino Valley MWD
NE8	San Bernardino Valley Water Conservation District
NE9	
NE10	San Gorgonio Pass Water Agency
Southeast	
SE11*	Eastern Municipal Water District
SE12	
SE13	Private Landowner
Southwest	
SW14*	El Toro Water District
SW15*	East Orange County Water District

* AHOGS

Cloud Seeding Ground-Based Unit Locations

- Not all units are run during every storm
- Units are run based on seeding target areas based on:
 - Wind direction
 - Type of storm



Example Sites



SW14: ETWD (AHOGS)



NE10: SGPWA (CNG)
38987 Orchard street, Cherry Valley, CA



NW2: CBWCD (CNG)

Summary of Incident Reports

Site	Agency	Contact	Date of Incidence	Time of Incidence	Summary and Action
NE5	City of San Bernardino Municipal Water Department	Jose Machuca	December 21, 2023	1830	SBMWD staff (Jason Rodriguez) was performing a site inspection when he encountered the fire department at the entrance of the facility. The Fire Department was called by a resident who thought there was a fire at SBMWD facility. SBMWD staff informed the Fire Department about the Pilot Program. SAWPA spoke with the Captain and notified Fire Department of Pilot Program on January 5, 2024.
NE10	San Gorgonio Pass Water Agency	Matt Howard	December 22, 2023	1715	Resident → Fire Department → Matt Howard → NAWC → SAWPA. SAWPA notified Fire Department of Pilot Program on December 20, 2023.
NW1	Chino Basin Water Conservation District	Dave Schroeder	December 29, 2023	1710	Resident → Fire Department → Dave Schroeder → NAWC → SAWPA. Dave Schroeder explained the Pilot Program to fire department. SAWPA notified Fire Department of Pilot Program on January 4, 2024.

Summary of Cloud Seeding Operations

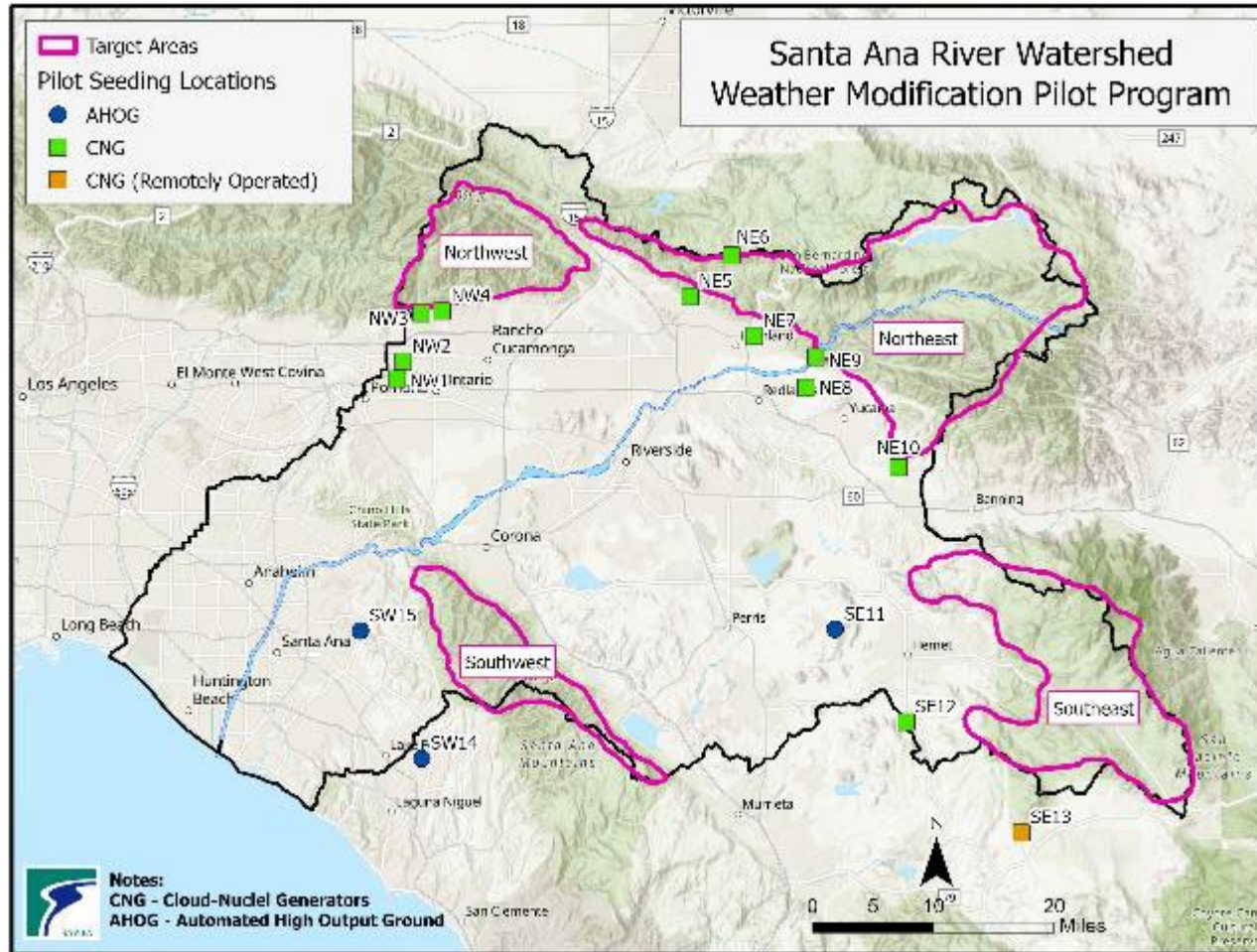
CNG Units	Sponsor	Nov 17-18, 2023	Dec 21-22, 2023	Dec 29-30, 2023	Jan 3, 2024	Jan 20-21, 2024	Jan 21-22, 2024	Feb 1, 2024	Feb 20-21, 2024
NW1	CBWCD			23.00	6.50			10.00	16.75
NW2	CBWCD			23.00	7.00			9.00	16.25
NW3	SAWCO	11.25	22.00	21.00	5.75			23.50	19.50
NW4	SAWCO	13.25	20.75	22.00				23.00	19.75
NE5	City of SB Municipal WD		26.50	21.25	8.75	17.25	24.50		
NE6	Private		21.50	9.00	12.25	17.00	14.25	11.75	18.25
NE7	SBVMWD		22.75	21.00	9.00	17.00			23.00
NE8	SBVWCD		22.25	18.75	9.75	18.50	23.25	7.75	
NE9	SBVWCD		23.00	18.75	9.50	18.25	23.25	8.00	20.50
NE10	SGPWA		24.25	21.25	9.25	17.75	24.75	11.50	24.25
SE12 (Remote)	EMWD		8.75	5.50	9.75			14.00	
SE13	Private		19.00	6.50	8.00	15.25	24.50	12.25	
Total Running Hours		24.5	210.75	211	95.5	121	134.5	130.75	158.25

AHOGS Units	Sponsor	Nov 17-18, 2023	Dec 21-22, 2023	Dec 29-30, 2023	Jan 3, 2024	Jan 20-21, 2024	Jan 21-22, 2024	Feb 1, 2024	Feb 20-21, 2024
SE11	EMWD	-	5 flares		2 flares		4 flares	1 flare	
SW14	ETWD	-	1 flare	3 flares		1 flare	3 flares		
SW15	EOCWD	-							

Rainfall for February 2-9 Storms (Not Seeded)

NW Target (rainfall-inch)	
	Feb 2-9 Total
Middle Fk Lytle Ck	15.48
Lytle Crk RAWS	14.64
Deer Creek Dam	12.40
San Sevaine	9.45
Wrightwood FS	7.39
Wrightwood	5.66
Mormon Rock RAWS	6.75
Upper Day Cyn	5.31
Mt Baldy	2.96
Average:	8.89

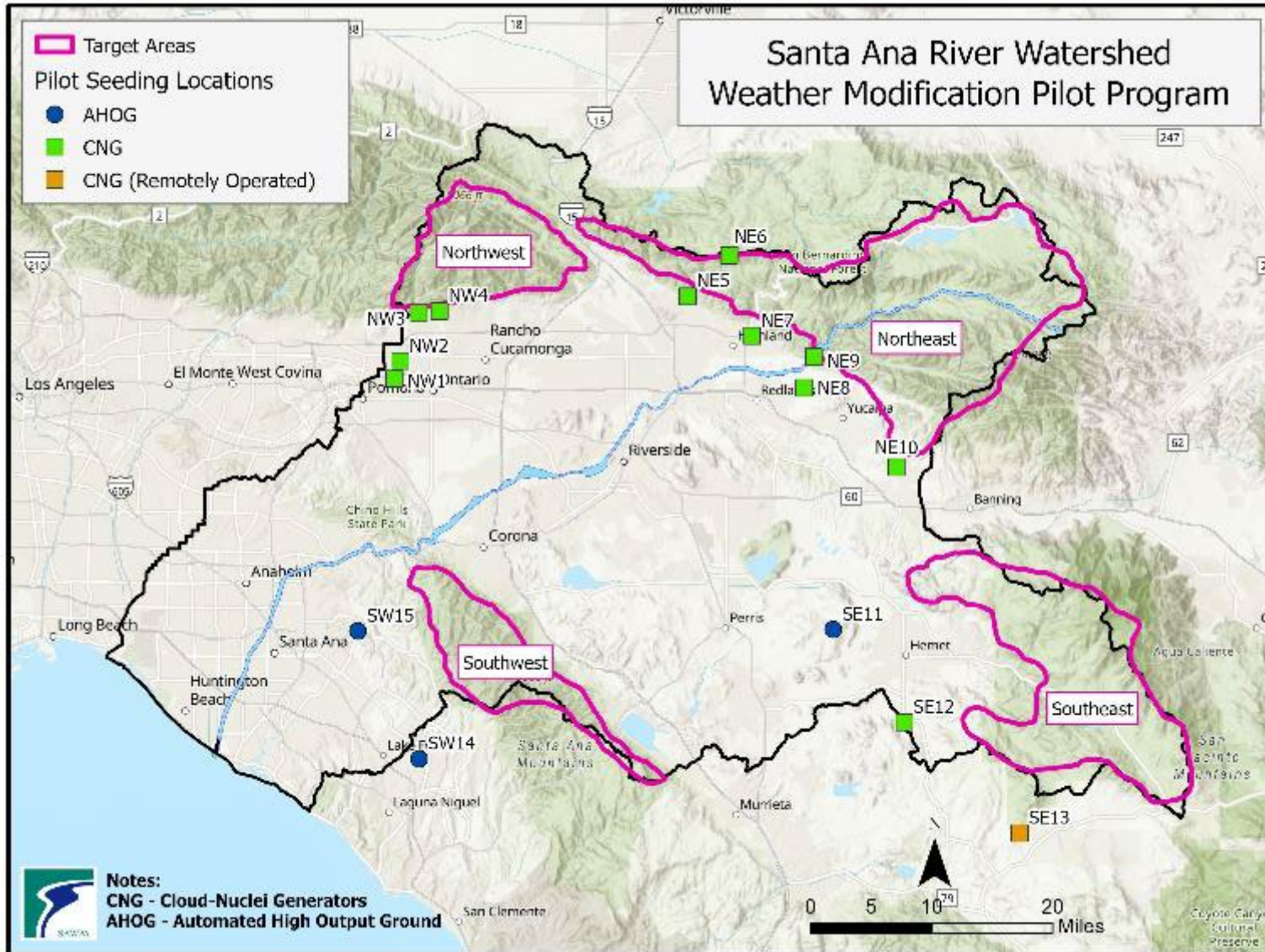
SW Target (rainfall-inch)	
	Feb 2-9 Total
Santiago Pk 5638	11.81
Horsethief/Rice Cyn	10.79
Leach/Dickey Cyn	10.11
Upper Harding Cyn	8.86
Holy Jim Cyn	8.03
McVicker Cyn	8.03
Indian Cyn	7.88
Coldwater Cyn	7.52
El Cariso	6.97
El Cariso RAWS	6.63
Santa Rosa Plateau	6.17
Modjeska Cyn	5.94
Santiago Creek	5.67
Fremont Cyn RAWS	5.38
Silverado Motorway	3.85
Santiago Pk 5660	3.55
Upper Silverado Cyn	2.17
	7.02



NE Target (rainfall-inch)	
	Feb 2-9 Total
Beaumont 4NNE	4.58
Oak Creek Cyn	7.79
Oak Glen WS	7.28
Cable Cyn	6.18
Bernina Drive	12
Panorama Pt	11.88
Manzanita Flats	8.93
Cedar Glen	8.11
Crest Park	7.68
Deep Creek	7.56
Running Springs FS	6.67
Heaps Peak RAWS	5.98
Wildwood Cyn	5.59
Fawnskin	4.45
Big Bear Lake	4.06
Fawnskin RAWS	3.97
Heart Bar	3.22
Converse RAWS	2.47
	6.58

SE Target (rainfall-inch)	
	Feb 2-9 Total
Upper Tahquitz Crk	3.5
Thomas Mtn	4.07
Vista Grande RAWS	5.02
Poppet Flat RAWS	5
Allandale	3.5
Pine Cove Dutch Flat	3.31
Vista Grande	4.37
Keenwild RAWS	4.29
Anza RAWS	1.51
Pine Cove Rocky Pt	1.66
Snow Crk 7N Idyll	5.15
	3.76

Snowfall for February 2-9 Storms (Not Seeded)



NW Target: Feb 2-9 (snow inches)	
Mt Baldy Notch	56
Mountain High	52
Mt Baldy Parking Lot	35
Wrightwood	20
Average	41

NE Target: Feb 2-9 (snow inches)	
Snow Valley	97
Bear Mtn Summit	74
Green Valley Lake	64
Barton Flats	46
Arrowbear Lake	37
Running Springs	37
Forest Falls	36
Lake Arrowhead	34
Big Bear City Yard	30
Big Bear Moonridge	24
Angelus Oaks	20
Oak Glen	18
Average	43

SE Target: Feb 2-9 (snow inches)	
Mt San Jacinto LV	24
Pine Cove	19
Average	22

Suspension Criteria (Operations)

Flood

- Warm storm rain on snow
- Freezing level is >8,000 feet
- Quantitative precipitation forecast is > 3 inches in 24 hours

Burn Scars

- Threat of debris flow
- Coordinate with flood control districts

Severe Weather

- Winter storm warnings
- Flash flood warnings
- Severe thunderstorm warnings
- Sustained winds more than 30 mph at the sites

Real-Time Considerations:

1. Size of storm
2. Consecutive Storms
3. Input from Flood Control Districts on potential for flooding and/or mud slides or debris flows.
4. Input from WWTPs

Summary of Pilot Program Tasks

Task	Description
Pilot Operations	<ul style="list-style-type: none">• 4 years (2023-2027)• April 15 to November 15
Validation – Snow Chemistry	<ul style="list-style-type: none">• Measure silver in snow with and without seeding in four target areas• Purpose: Confirm operations
Validation – Target and Control	<ul style="list-style-type: none">• Use of two control areas and four target areas• Purpose: Assess additional precipitation
Stream Flow Analysis	<ul style="list-style-type: none">• Use of surface water modeling• Purpose: Assess where additional water goes in watershed

Summary of Communications

Goal: raise awareness. Activities:

- Communications Plan
- Pilot Program signs
- SAWPA’s Pilot Program webpage
 - <https://sawpa.gov/santa-ana-river-watershed-weather-modification/>
 - Brochures, FAQs, CEQA documents
 - Cloud seeding event chart
- Staff distributed a press release (January 2024)
- Door hangers
- Email for public inquiries (weathermodification@sawpa.gov)
- Respond to media inquiries

Month/Year	Start	End	Target Area(s)
December 2023	12/21/2023	12/22/2023	NW, NE, SW, and SE
	12/29/2023	12/30/2023	NW, NE, SW, and SE
January 2024	1/3/2024	1/3/2024	NW, NE, SE
	1/20/2024	1/21/2024	NE, SE, SW
	1/21/2024	1/22/2024	NE, SE, SW
February 2024	2/1/2024	2/1/2024	NW, NE, SE
	2/20/2024	2/21/2024	NW and NE

*Last updated: February 22, 2024

Cloud Seeding Event Chart

Pilot Program Site Signage



Custom Door Hangers

WEATHER MODIFICATION PILOT PROGRAM IN YOUR NEIGHBORHOOD

Cloud seeding taking place 11/2023 to 11/2027

What is the Weather Modification Pilot Program?
In 2020, the Santa Ana River Watershed Project Authority (SAWPA) conducted a study on the economic and technical feasibility of implementing a weather modification program, also known as cloud seeding, to increase water supply in the region. Based on the results of the study, SAWPA will now conduct a 4-year Weather Modification Pilot Program to gather data to validate the program and determine the long-term feasibility for implementation in the Santa Ana River Watershed.

Why Cloud Seeding
Cloud seeding is a type of weather modification used to increase the amount of the precipitation, including snow or rain, during the storm season. This process works through releasing particles of silver iodide into clouds when storms occur, which increases the chances of droplet condensation by 5-15 percent.

What to Expect
If you just received this door hanger you should expect to see temporary smoke and hear occasional humming noise throughout the duration of the Pilot Program - but only during storm events. While smoke can be expected to be visible coming from the ground-based seeding units, this does not pose as a fire hazard. **Cloud seeding is safe and has been studied for decades.**



SANTA ANA WATERSHED PROJECT AUTHORITY

How Cloud Seeding Works

Storms come into the watershed region bringing in moist air over the mountains, which cool and forms clouds composed of supercooled water droplets. Silver iodide particles mixed with acetone are vaporized and released into the atmosphere using ground based seeding systems. Silver iodide particles rise into cold, high-altitude air; moisture in the air condenses to form ice crystals on the particles. As the ice crystals form and grow in the clouds, they become large enough to fall to the ground as ice, snow, or rain.



On-Site Work
Work is being performed by SAWPA's contractor. An operations work truck may be occasionally present in your neighborhood throughout the duration of the Pilot Program.

Learn More
Scan the QR code below or visit sawpa.org for additional information.
If you have any questions about the Weather Modification Pilot Program, please call (951) 840-0230 or email weathermodification@sawpa.org

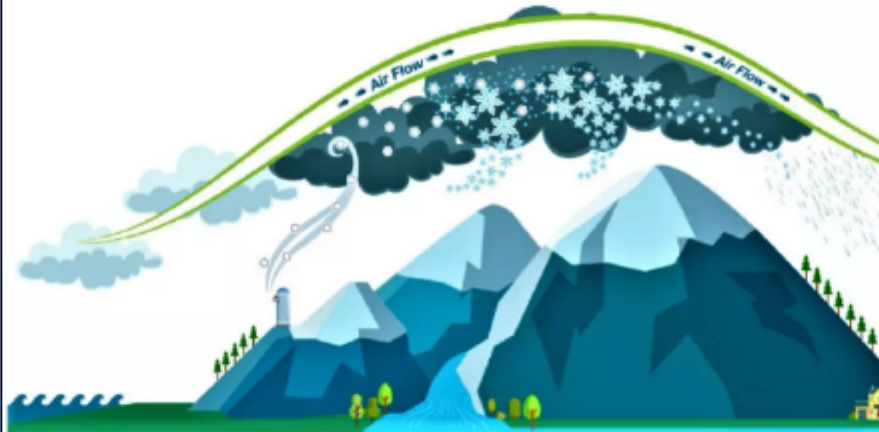


SANTA ANA WATERSHED PROJECT AUTHORITY

☰ **Daily Pilot**

NEWS

New 4-year cloud-seeding pilot program hopes to make it rain in Santa Ana River watershed



An illustration shows how releasing silver iodide particles into storm clouds maximizes precipitation (Courtesy of SAWPA)

BY SARA CARDINE | STAFF WRITER
 JAN. 13, 2024 4:43 PM PT

Using meteorology and chemistry to help prod Mother Nature, water of begun seeding storm clouds throughout the Santa Ana Watershed to bo

Daily Pilot – Jan 13

LA Times – Feb 24



Two ABC 7 Segments

CALIFORNIA

The latest unfounded conspiracy theory: Cloud seeding is to blame for California's storms and flooding

Travis Longcore and others evacuated after an atmospheric river unleashed heavy rain in their Beverly Crest neighborhood. Conspiracy theorists blame cloud seeding for the intensity of recent storms. (Allen J. Schaben / Los Angeles Times)

BY SALVADOR HERNANDEZ | STAFF WRITER
 FEB. 24, 2024 5 AM PT

When a water agency for most of California's Inland Empire and parts of Orange County started a pilot program to seed clouds in the region in November to see if it could

Pilot Program Schedule

Task	2023				2024					
	Mar	Apr-Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Project Operations & Demobilization										
Project Validation										
Review NAWC Operations										
Snow Chemistry										
Baseline Snow Samples										
Seeded Snow Samples										
Lab Analysis and Report										
Snow Water Equivalent										
Target-Control Evaluation										
Stream Flow Analysis										
Surface Water Modeling Contract Award										

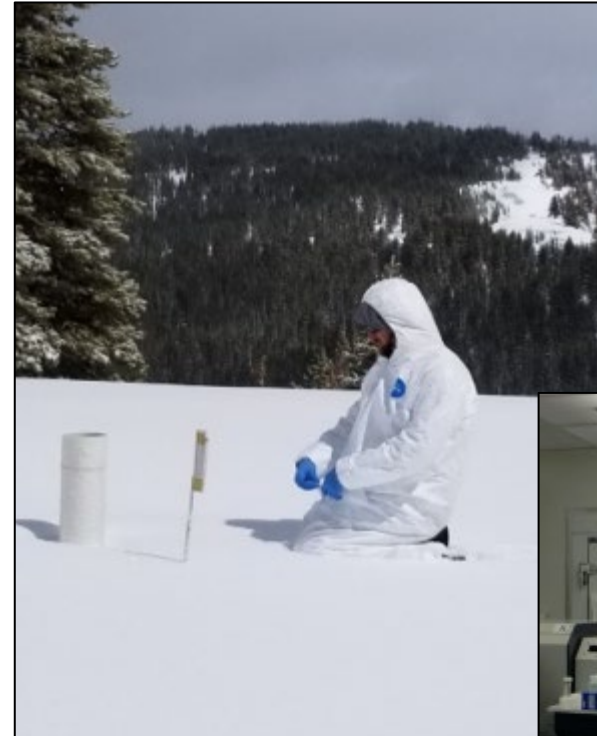


SGPWA Board Questions

1. How do we measure if cloud seeding is successful?

Cloud Seeding Independent Validation

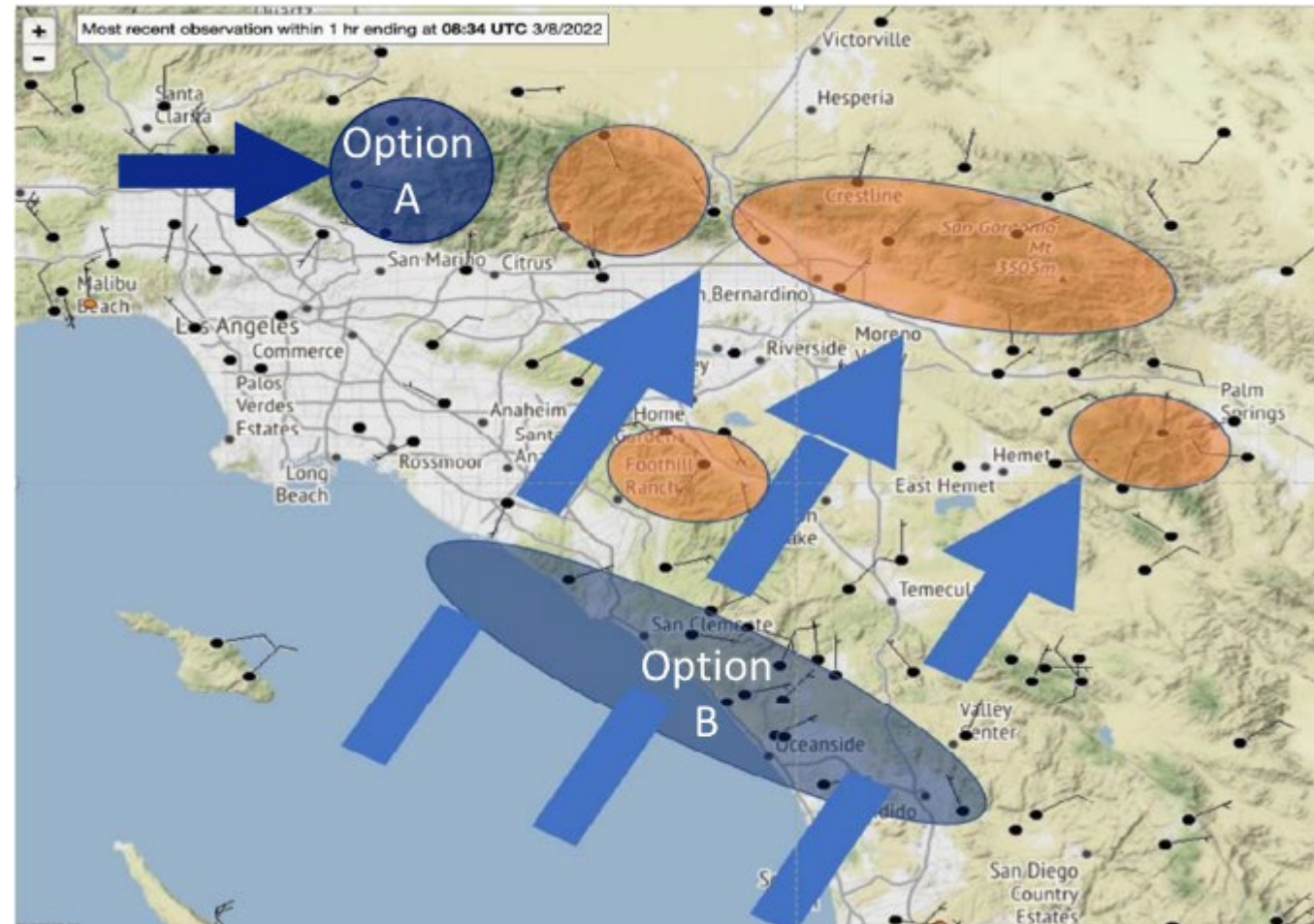
- Validation Consultant
 - Desert Research Institute (Reno, NV)
- Purpose
 - Verify deposition of silver iodide
 - Verify increases in precipitation and stream flows
 - Review of operations
 - Review of suspension criteria



Validation Study Approach (4-Year Study)

- Verify deposition
 - Measure elemental **silver** in snow before and after cloud seeding
- Verify increases in precipitation
 - Use of:
 - Snow gauges
 - Stream gauges
- Compare “Target Areas” to “Control Areas”
 - Two options: A and B
- Based on statistical analysis of 30 years of weather data

Control Area Options:



2. How does the high wind variability affect the local cloud seeding operations and rainfall?

- Local terrain can have an impact on wind speed and direction
 - Units are located to produce the seeding plumes that will move toward the intended target area
- Wind flow patterns dictate which areas see more rainfall and which see less
 - Locations that tend to see a lot of upslope flow will see more
- Strong winds have an impact on seeding operations
 - Winds may reach speeds that will deem seeding operations ineffective as stronger winds could push the seeding plumes well past the intended target area before nucleation can occur

3. Do we have the ability to measure the impacts at some point throughout the project?

Benefits:

- DRI Target and Control Validation, after each year:
 - Preliminary estimates of additional precipitation (volume and percent)
 - Year 1 preliminary results – Summer/Fall 2024
- Water supply benefits
 - Surface water model – where does the additional precipitation end up?

Impacts:

- Suspension Criteria – Avoid Impacts
 - Flooding and debris flow (from burn scars)
 - Reviewed for each storm
- CEQA review
 - Addressed potential human health and environmental impacts

4. Do you know the elevation gain of the released silver iodide particles from the ground-based units? (e.g., ten thousand feet elevation)?

- Yes, the elevation gain can be assessed.
- HYSPLIT Model
 - Hybrid Single-Particle Lagrangian Integrated Trajectory Model
 - Used to simulate atmospheric transport, dispersion, and deposition of particles.
- Use of HYSPLIT modeling
 - Determine how the seeding plumes disperse from the sites
 - Takes both horizontal and vertical movement into account
- Results of modeling
 - Target cloud formations
 - Plumes can reach over 10,000 feet

5. Are you "stealing" downstream/downwind entity's water by having a cloud-seeding generator? What are the water rights implications for our cloud seeding operations?

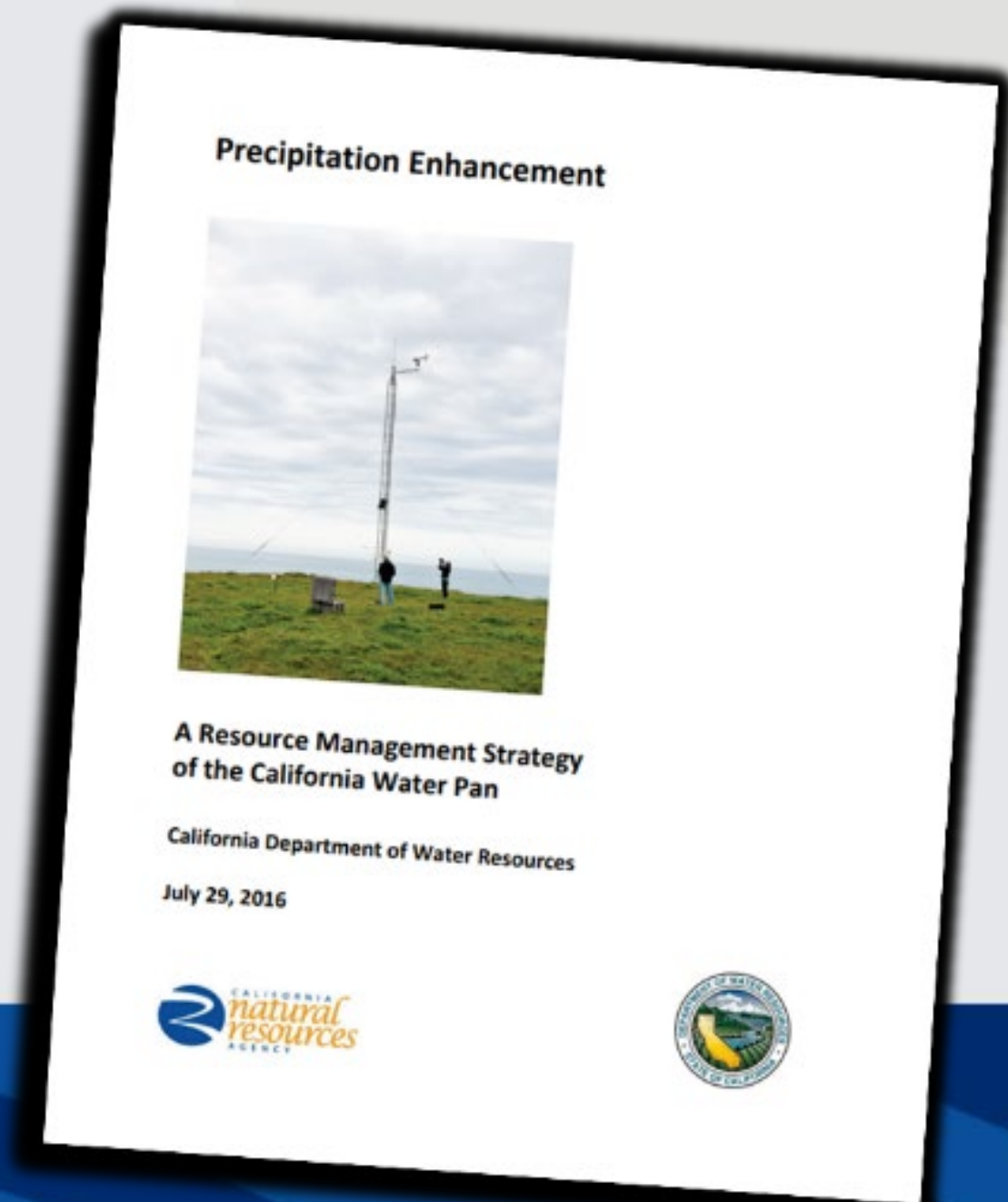
Water Rights

- DWR “Precipitation Enhancement Report” (2016):

“State law says that water gained from cloud seeding is treated the same as natural supply in regard to water rights.”

Source:

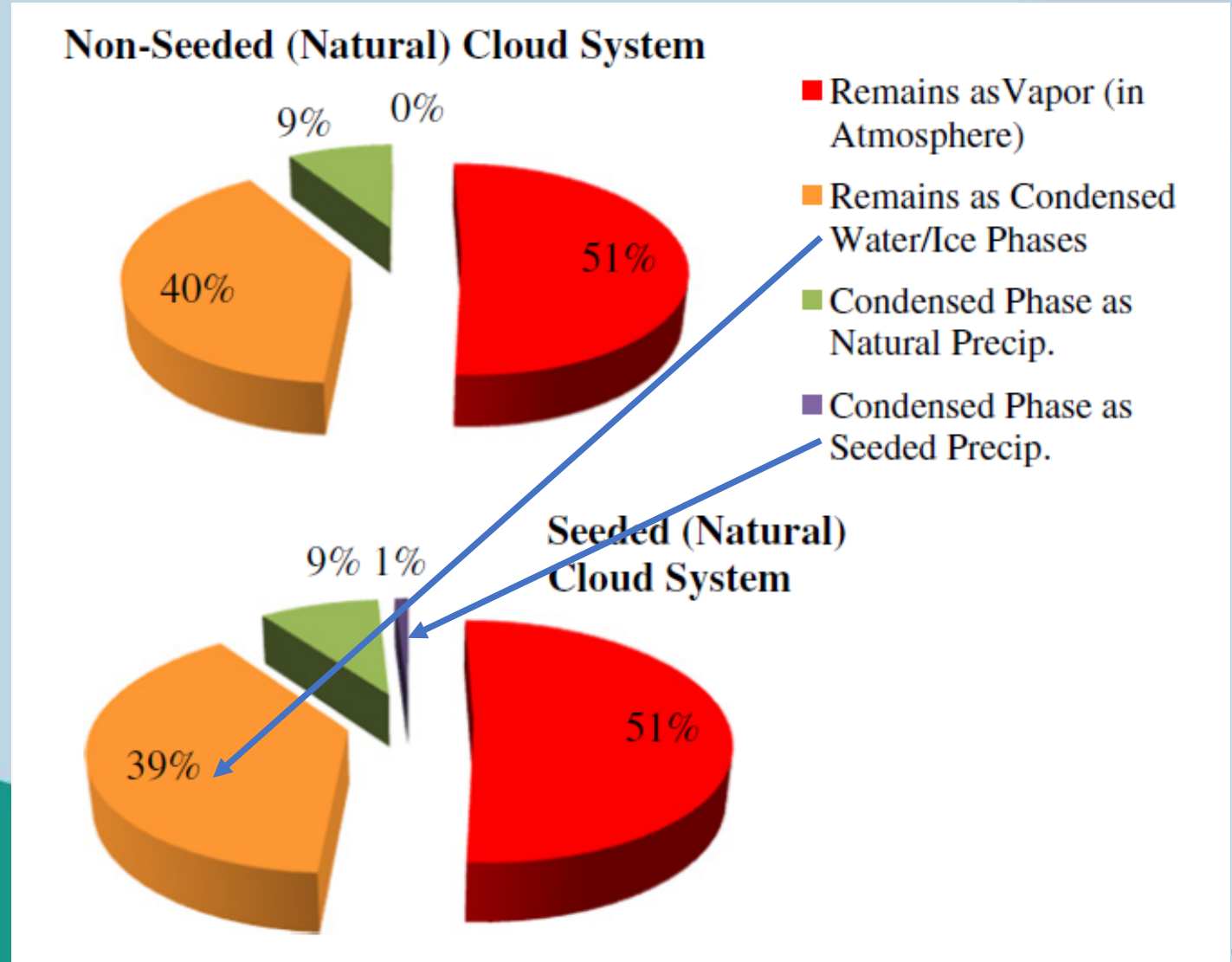
<https://cawaterlibrary.net/document/precipitation-enhancement-resource-management-strategy/>



Cloud Seeding – “Extra Area” Effects

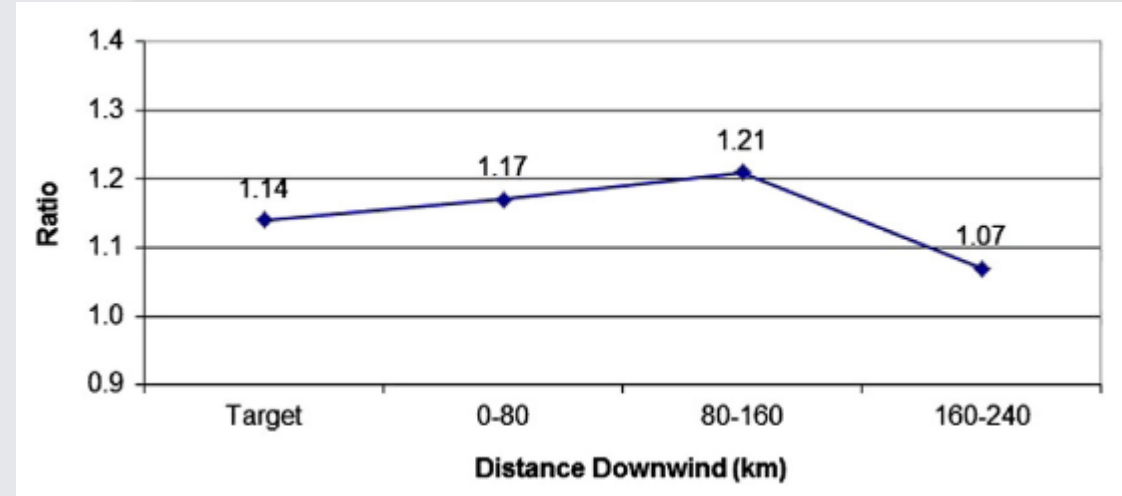
(T.P. DeFelice et al., Atmospheric Research 135-136 [2014] pp 193-203)

- Sometimes referred to as:
 - “Downwind” effects
 - AKA “Robbing Peter to pay Paul”
- Studies have shown:
 - Cloud seeding activates precipitation otherwise unavailable (**see figure**)
 - Long-term research shows **no decreases**
 - Extra Area seeding effects appear to be positive at 5%-15% (**see next slide**)
 - **Positive effects** are due to physical (static) and dynamical (dynamic) effects of seeding



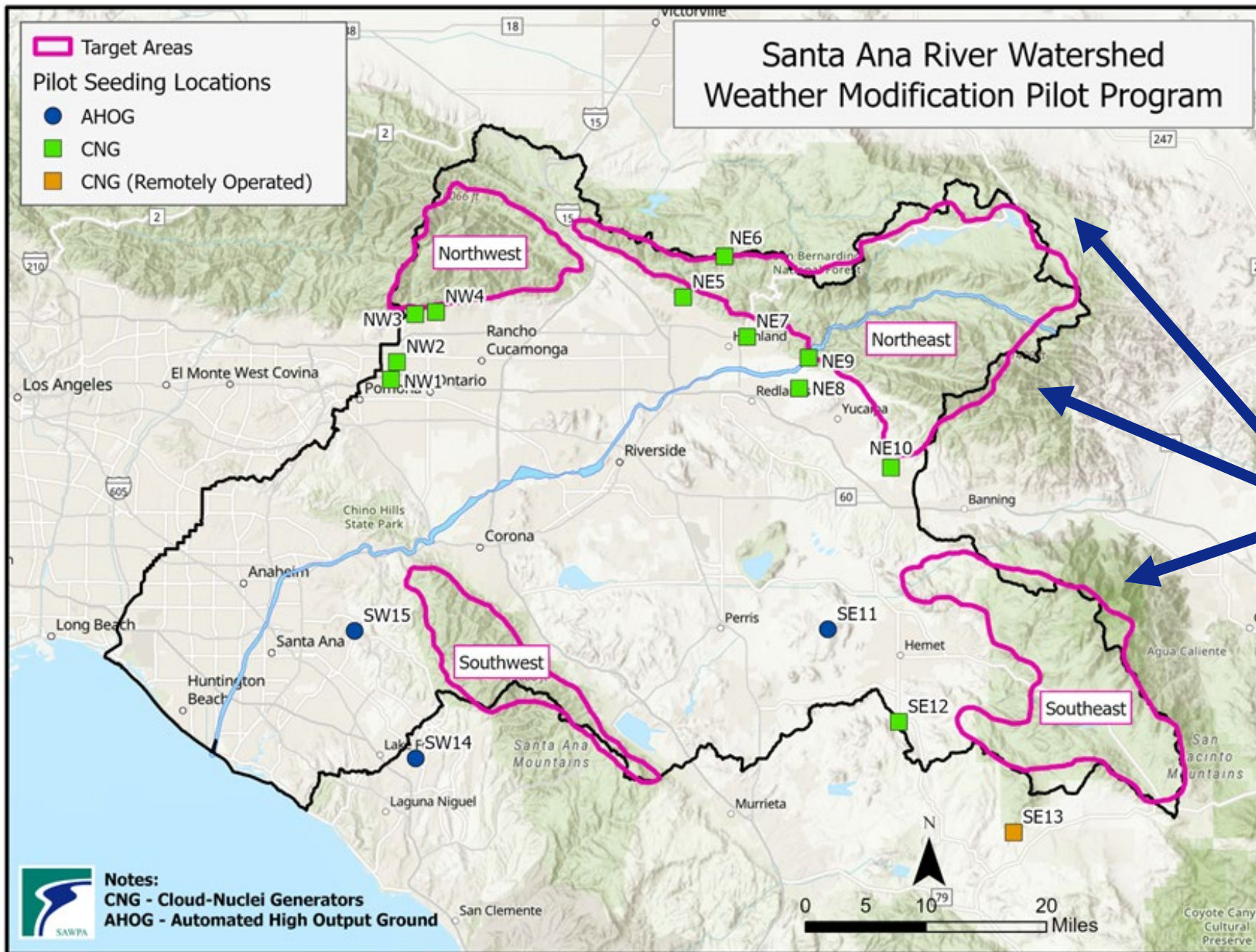
“Extra Area” Effects

(T.P. DeFelice et al., Atmospheric Research 135-136 [2014] pp 193-203)



- Central/Southern Utah
- Target Area: 9,000-12,000 feet in elevation
- 70-75 ground-based seeding sites

- Average Additional Precipitation (34 winters):
 - Target = 14%
 - 0-80 km = 17%
 - 80-160 km = 21%
 - 160-240 km = 7%
- However, it will be site specific
- Seeded-enhanced precipitation processes persist (as much as 8 hours based on studies)

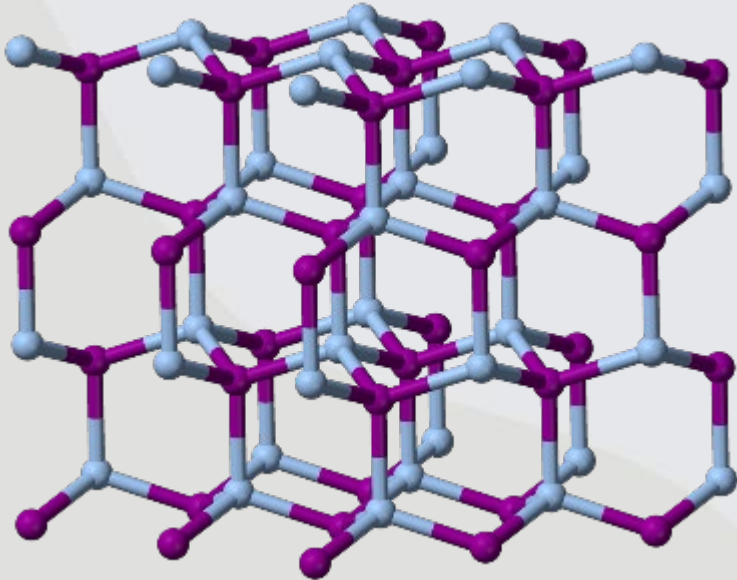


Extra-Area Effects

- Validation will look at snow and stream gauges on mountains east of target Areas
- Evaluate impacts on areas outside of SAR watershed

6. What are the long-term health effects of silver Iodide in cloud seeding operations, both breathing and drinking water?

Potential Environmental Effects



- Silver iodide:
 - Chemically inert and not soluble in water or biologically available
 - Low toxicity and does not accumulate in soils at levels above natural background
- “Silver” Concentrations
 - Numerous studies have shown that cloud seeding does not result in concentrations of **silver** in the environment that would be toxic to humans or wildlife.

CEQA Section 4.4.2 Environmental Impacts

- Environmental Impact – CEQA Finding: Less than Significant with Mitigation.
- The program would disperse small quantities of silver iodide particles over four large areas.
- Silver iodide has a very low solubility and would not result in the presence of silver ions in the environment at sufficient quantities to harm sensitive ecological receptors.
- Numerous studies have shown that cloud seeding does not result in concentrations of silver in the environment that would be toxic to humans or wildlife.
- In its annual reviews of Snowy Hydro cloud seeding program in Australia since 2004, no significant difference was found in silver concentrations in aquatic, soil, sediments, and aquatic species in the area cloud seeding target areas compared with non-target areas (NSW EPA 2020).
- In California, measurements taken in the Salt Spring Reservoir, within the target area of PG&E's Mokelumne water cloud seeding project showed that silver concentrations were less than 0.0005 ppb, a level within natural background concentrations (Stone 2006).

CEQA Section 4.4.2 Environmental Impacts

- Silver bioavailability in freshwater is significantly diminished by the presence of dissolved minerals (e.g., chlorine, carbonate, sulfide ions) and dissolved carbon and particulates.
- The insolubility of silver iodide limits its bioavailability and effects on the environment.
- Based on the chemical properties of silver iodide, the proposed project would have less than significant impacts on special-status species.
- The project may have a beneficial effect on special-status plants and wildlife by providing additional precipitation to facilitate growth and prevent or decrease the occurrence of drought-related fire.



SGPWA Public Comments

1. Is there a fear of local flooding caused by cloud seeding operations in our local area?

- SAWPA Weather Modification Feasibility Study (2020)
 - Flood Control Districts were consulted
- Operations Plan: Suspension Criteria
 - Flooding
 - Flooding Situations (from extreme rainfall events)
 - Flooding from rainfall on existing snowpack
 - Burn scars
 - Review of new wildfires
 - Two-year timeline for burn areas
 - Other issues from Flood Control Districts
 - Severe Weather
 - Flash Flood Warnings (National Weather Service)
 - Severe Thunderstorm Warnings (National Weather Service)
- “Unanticipated” rain incident (rare event)
 - Shut down any ongoing seeding

2. Is there a potential for local lawsuits for flooding directly related to cloud seeding operations? Have there been any in the recent past throughout Southern California?

- SAWPA is not aware of any lawsuits that been filed in southern California relating to cloud seeding in recent years.
- LA County operated a seeding program on and off for 14 years in the 1960s and 1970s (Source: LA Times, February 10, 1991)
 - It was canceled in 1978 after heavy rains caused flooding in Big Tujunga Canyon.
 - Cloud-seeding had taken place a day before the storm.
 - The flooding caused \$43 million in damage and dozens of lawsuits were filed against the county.
 - All of the suits were eventually rejected by the courts.
- Both SAWPA and SAWPA's consultant carry insurance for damage caused by cloud seeding operations.

3. A heavy hailstorm occurred in Calimesa on/around January 6th-7th. Was this a result of the cloud seeding operations at our location or throughout the watershed?

- Due to strong winds that day, seeding operations did not occur in the area or in the watershed.
- Regarding the Jan 6-7 event:
 - The hail that day was pea-sized (1/4 inch).
- January 3rd event:
 - There was heavy **graupel** (looks almost like styrofoam pellets, opaque white pellets) on January 3, which occurred while seeding operations were coming to an end.
 - Graupel is a useful to observe during and after seeding operations as it confirms the presence of **supercooled water**, which is what is targeted during seeding operations.

4. Do the chemicals used in cloud seeding operations end up in our groundwater? The Public informed us of a recent LA Times article where they suspended cloud seeding operations because of fears of flooding and the chemicals ending up in the groundwater.

- County of Los Angeles Weather Modification Project (approved ~2015)
 - County of Los Angeles, Dept of Public Works
 - Suspended due to debris flow concerns from the burn scar of the Bobcat Fire (2020)
- SAWPA is not aware of any programs that had to be suspended because of “fears of chemicals ending up in the groundwater”
- SAWPA’s CEQA Review did not identify any significant risk of impacts to groundwater from silver iodide.

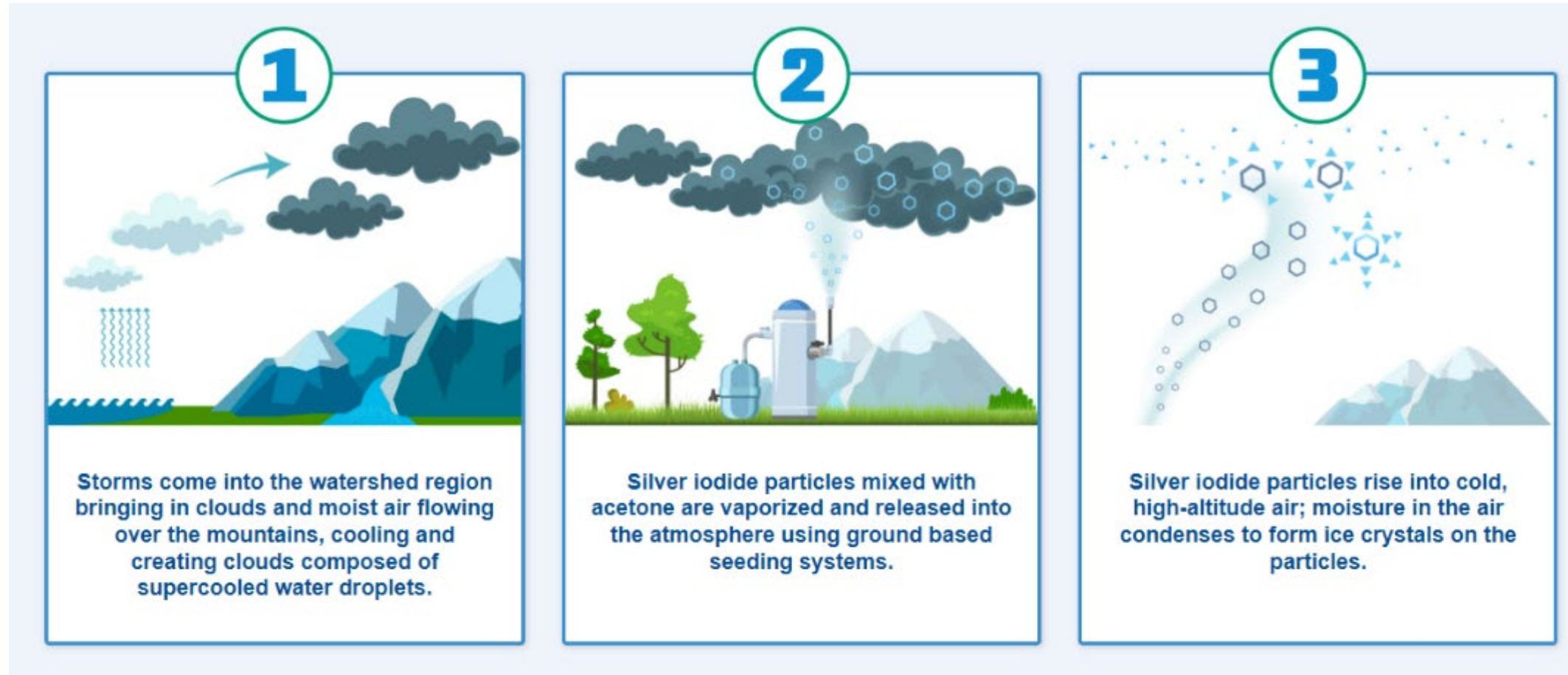


Questions



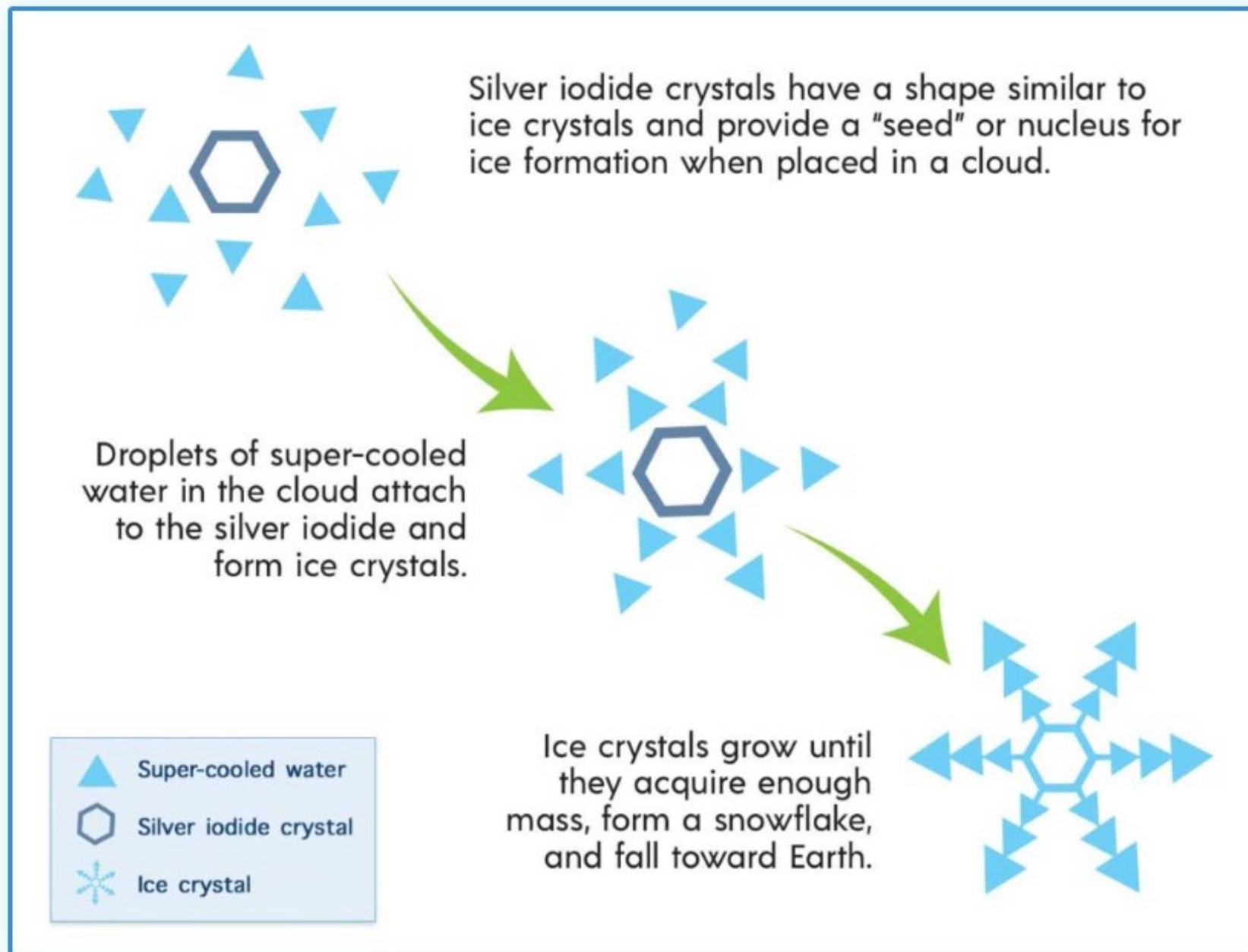
Background Slides

Cloud Seeding Process – Steps 1-4



See next slide for Step 4 →

4



Silver Iodide Seed Plume Modeling

Ground Based Seeding
Dispersion Model

4 seeding areas:

- NW
- NE
- SW
- SE

Includes several ground
sites in each area

Target additional snow in
high elevation

Source: SAWPA Feasibility Study
(2020)

