# Rainmaker Pendleton Operations Briefing

**Submitted to the Oregon Department of Agriculture**

**Winter 2024–2025**

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## Purpose of Operations

Rainmaker initiated its first licensed precipitation enhancement activities in Umatilla County during winter 2024–2025 under the oversight of the Oregon Department of Agriculture. The primary goal of this effort was not to maximize seeding effect but rather to **design, build, and qualify the first version of our autonomous drone-based cloud seeding system**.

This pilot season served as a **proof-of-concept deployment**—a controlled environment for testing hardware, validating flight operations, and exercising suspension and safety criteria. While enhancing precipitation remains Rainmaker's long-term mission, the Pendleton operations focused on:

- **Aircraft qualification**: Demonstrating stable flight profiles, autonomous navigation, and payload dispersal functions in winter cloud environments.
- **Operational safety**: Executing missions under strict suspension criteria aligned with National Weather Service warnings, flood risk forecasts, and high-wind thresholds.
- **System validation**: Coordinating with the Pendleton UAS Range to ensure compliance with FAA regulations while integrating advanced forecasting and QPE monitoring tools.

This initial effort established the foundation for scaling UAS-based precipitation enhancement in Oregon and beyond.

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## Operational Framework

Rainmaker operated under a **public FAA Certificate of Authorization (COA)** facilitated by the Pendleton UAS Range, with landowner permissions secured at a test site near Pilot Rock, OR.

Operations were scheduled between **November 2024 and April 2025**, with up to 30 potential mission days depending on suitable weather conditions. Target conditions were carefully

constrained to clouds containing **supercooled liquid water between –5°C and –15°C**, ensuring that flights occurred only when scientifically appropriate and environmentally safe.

Suspension safeguards included automatic halts for storm/flood warnings, warm winter storms, excessive runoff potential, or high-wind events. Additional monitoring of McKay Reservoir inflows ensured operations posed no risk of contributing to historic flood sensitivities in the basin.

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# Results from the Pendleton QPE Analysis

Rainmaker employed **Quantitative Precipitation Estimation (QPE)** techniques using KPDT (Pendleton) NEXRAD radar merged into hybrid scans, enhanced by hydrometeor classification and ensemble modeling .

Key observations:

- **December 12, 2024**: ~1.05 acre-feet of precipitation analyzed; weak reflectivity signatures observed.
- **March 3, 2025**: ~1.29 acre-feet; weak but regularly spaced reflectivity features were detected downwind of the seeding site, consistent with potential seeded cloud microphysics.
- **March 4, 2025**: ~65.97 acre-feet; a significant downstream precipitation signature was recorded, spatially aligned with the seeding site's upwind position and consistent with orographic enhancement.

While causality cannot be strictly proven from this small dataset, the QPE analysis demonstrated that **our operational workflow, dispersion system, and monitoring protocols were effective in producing scientifically relevant observations**.

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# Context & Next Steps

## Lessons Learned

- The Pendleton pilot season successfully validated Rainmaker's **Elijah UAS platform**, its autonomous dispersal system, and coordination with local and federal safety authorities.

- Safety and suspension criteria were exercised effectively, reinforcing community confidence and environmental responsibility.

- Radar-based precipitation monitoring provided valuable insight into operational signatures, laying groundwork for future validation partnerships.

### Future Directions

Rainmaker intends to **continue operations in the Pilot Rock test area,** servicing Umatilla County, including farms, soil and water conservation districts, and municipal water stakeholders. These efforts will increasingly emphasize precipitation yield while maintaining the same commitment to safety and environmental stewardship.

By integrating drone-based seeding with advanced radar and forecast analytics, Rainmaker aims to contribute meaningfully to Oregon's water resilience goals—enhancing snowpack in the Blue Mountains, improving irrigation reliability, and supporting aquifer recharge for long-term sustainability.

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# Conclusion

The Winter 2024–2025 Pendleton operations achieved their primary objective: **proving that a drone-based, locally operated cloud seeding system can be flown safely, effectively, and responsibly in Oregon airspace**.

While seeding effects were secondary in this pilot season, QPE indications suggest promising potential for measurable precipitation enhancement. Building on this foundation, Rainmaker is positioned to scale operations in support of Oregon's agricultural, hydrological, and climate resilience priorities.