

ALBERTA HAIL SUPPRESSION PROJECT FINAL OPERATIONS REPORT 2017

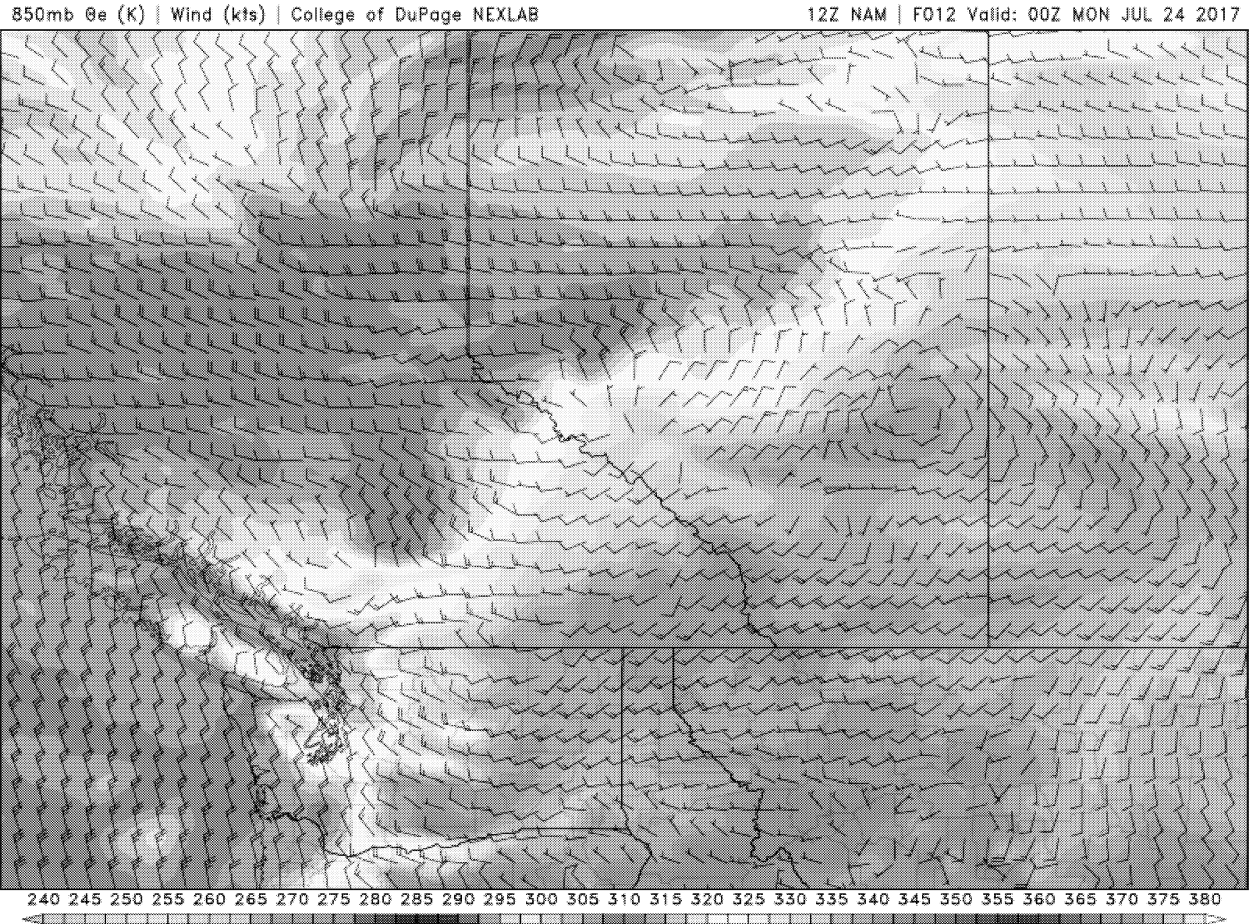


Fig. 43. Low level (850 mb) equivalent potential temperature (Theta E) chart for 6 pm MDT on 23 July 2017 indicated warm moist air was flowing into the region from the south and the northeast due to the low over southeastern Alberta. Converging winds are evident over the central and western project region. A lee trough was also forecast along the foothills.

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

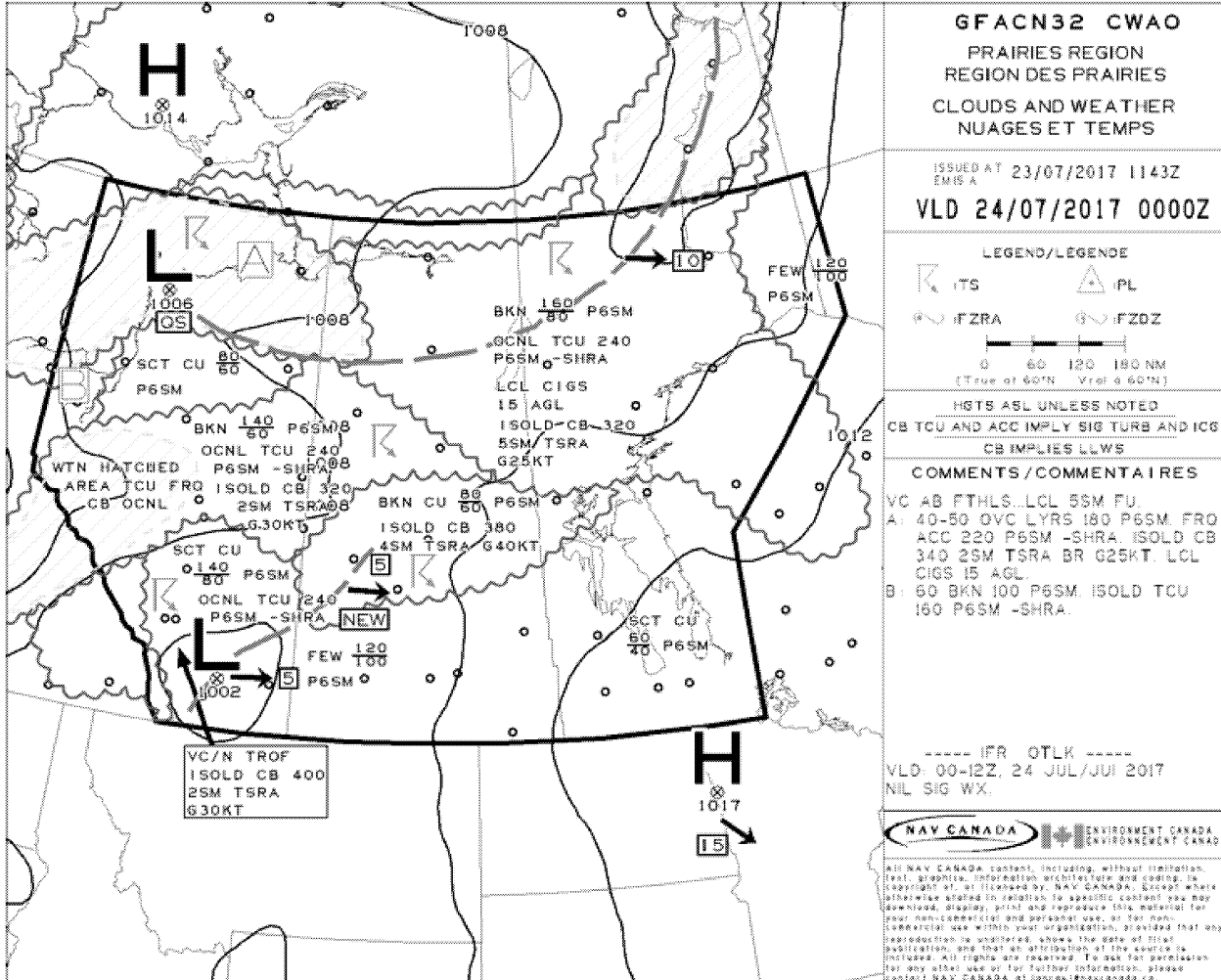


Fig. 44. The surface forecast valid at 6 pm MDT on 23 July 2017 showed low pressure over Southern Alberta. A cold front (not depicted here) would be pushing through around midnight, stabilizing the atmosphere overnight.

Figures 45 through 54 present TITAN radar images of the storm system as it evolved. Details of the significant events that occurred at each time shown are provided in the figure captions.

ALBERTA HAIL SUPPRESSION PROJECT FINAL OPERATIONS REPORT 2017

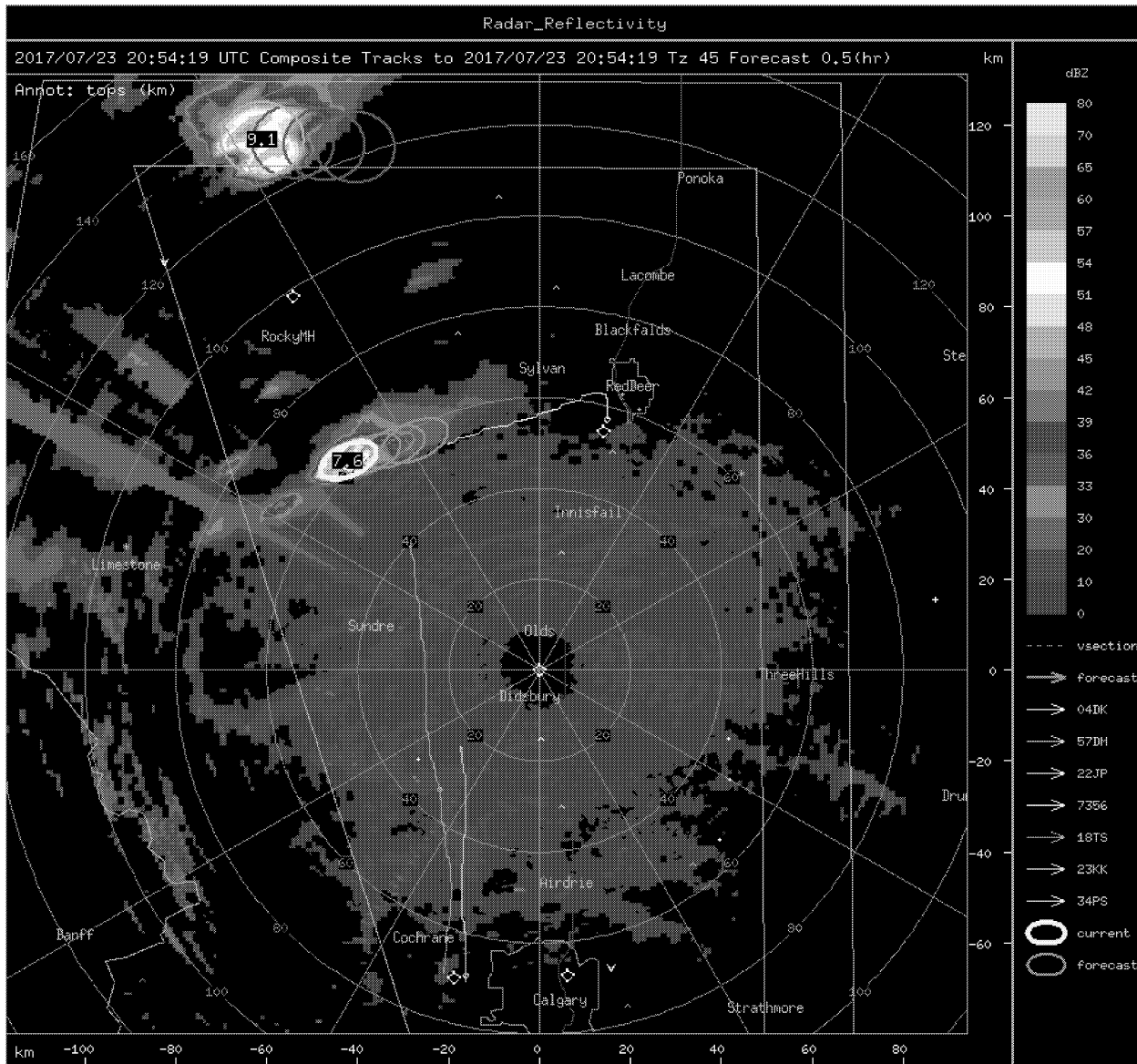


Fig. 45. The Olds-Didsbury radar display at 20:54Z (14:54 MDT) showing the developing stage of the most threatening cell of the day forming near Caroline with 7.6 km TITAN cell tops. This cell would ultimately make a direct impact on Red Deer. The cell was seeded continuously with two base seeders and one top seeder until it moved beyond Red Deer several hours later. Three aircraft can be seen converging on the cell to begin seeding upwind of Red Deer. A second intense supercell storm had also developed at this time north of Rocky Mountain House just outside the project boundary.

ALBERTA HAIL SUPPRESSION PROJECT FINAL OPERATIONS REPORT 2017

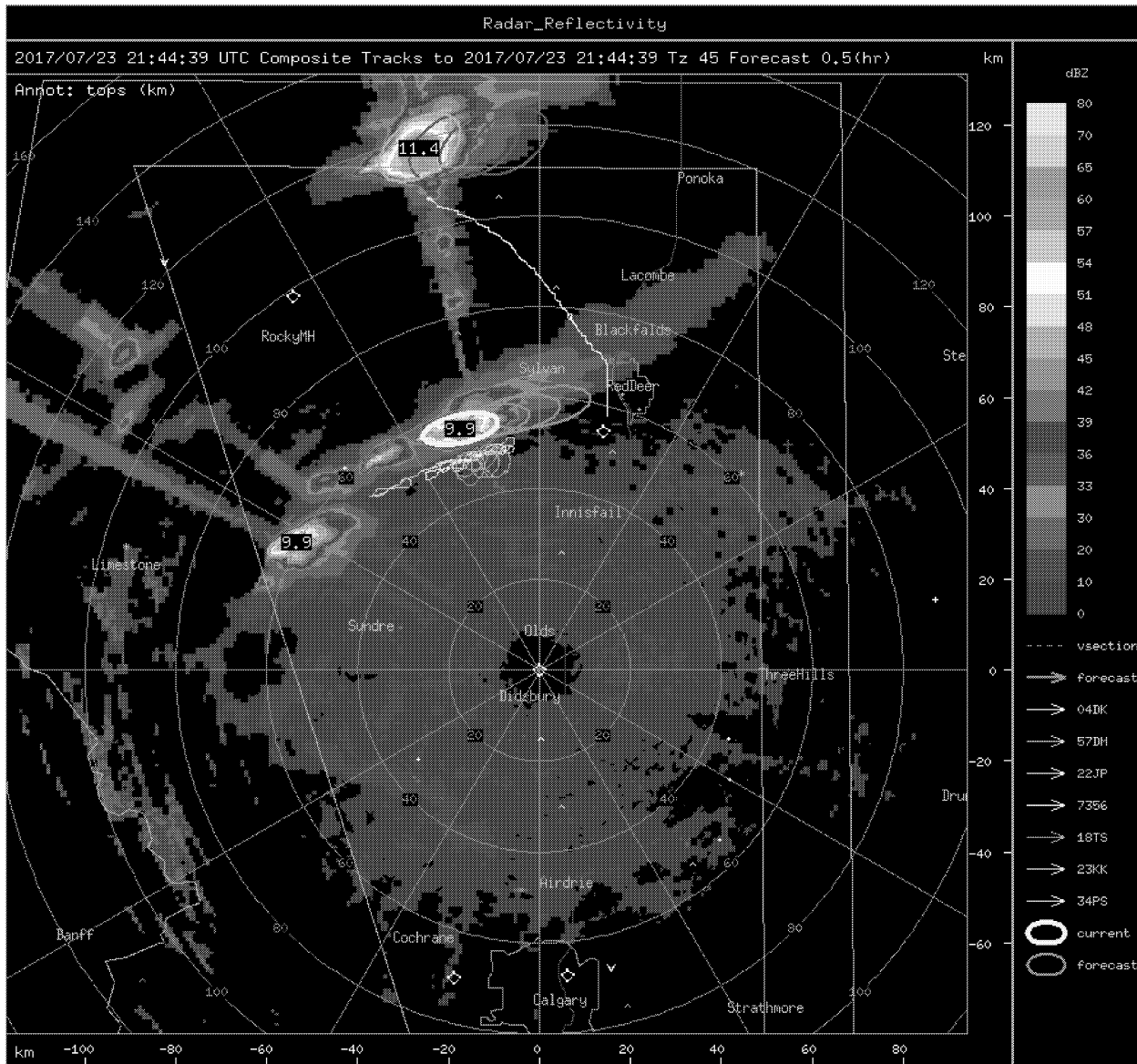


Fig. 46. The Olds-Didsbury radar display at 21:44Z (15:44 MDT) showing the most damaging cell of the day southwest of Sylvan with three aircraft seeding as it approaches Red Deer. Another top seeder (Hailstop 3) can also be seen heading for the northern project boundary to intercept a supercell near Rimbey headed for Ponoka. Four aircraft are airborne at this point, with one plane remaining on the ground as backup. A third cell is now developing northwest of Sundre as well.

ALBERTA HAIL SUPPRESSION PROJECT FINAL OPERATIONS REPORT 2017

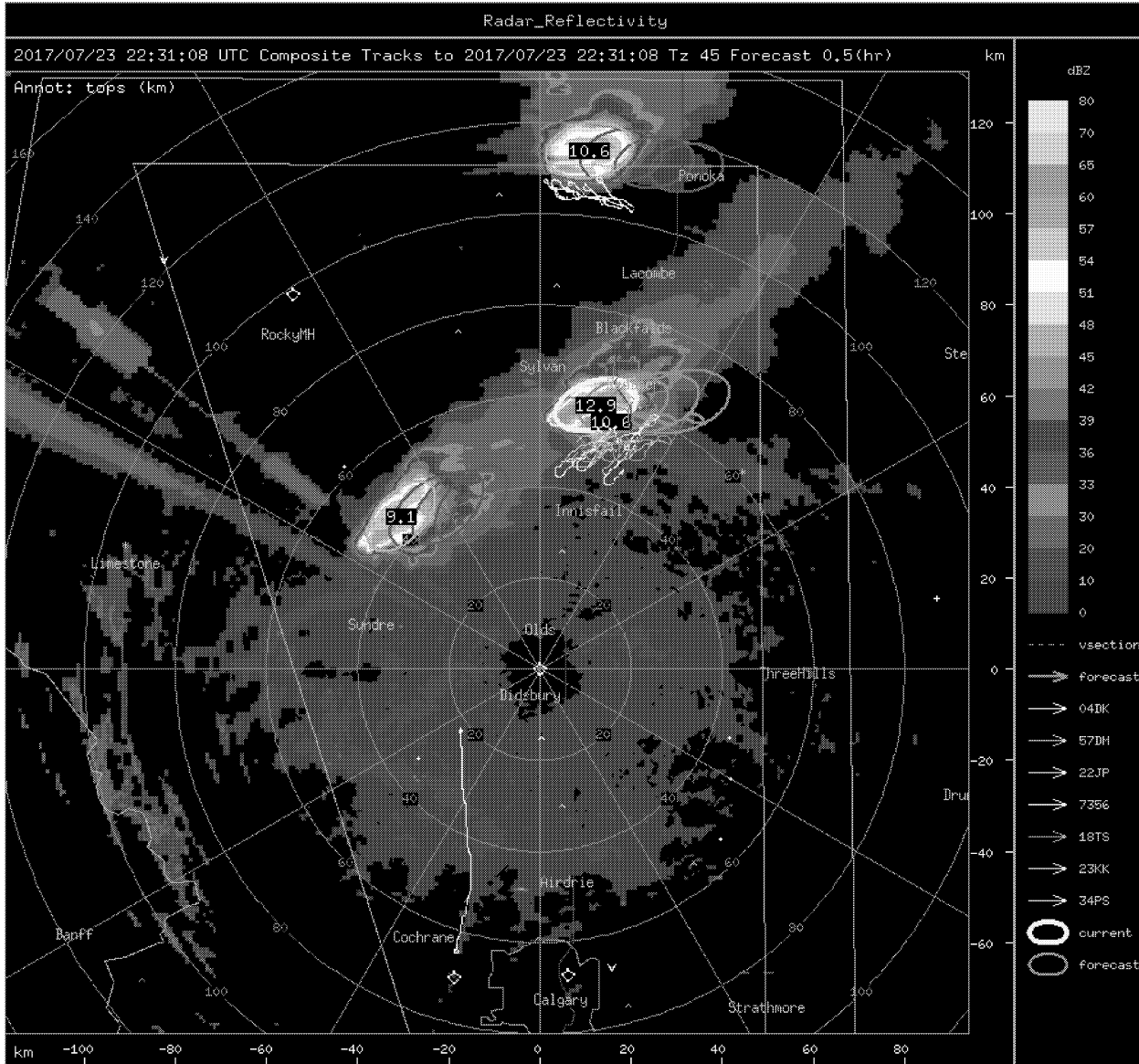


Fig. 47. The Olds-Didsbury radar display at 22:31Z (16:31 MDT) showing a 12.9 km TITAN cell entering Red Deer with three seeding aircraft on it. Top seeding is underway for the northern supercell approaching Ponoka. The fifth aircraft has been dispatched at this time from Springbank to intercept the third cell west of Innisfail.

ALBERTA HAIL SUPPRESSION PROJECT FINAL OPERATIONS REPORT 2017

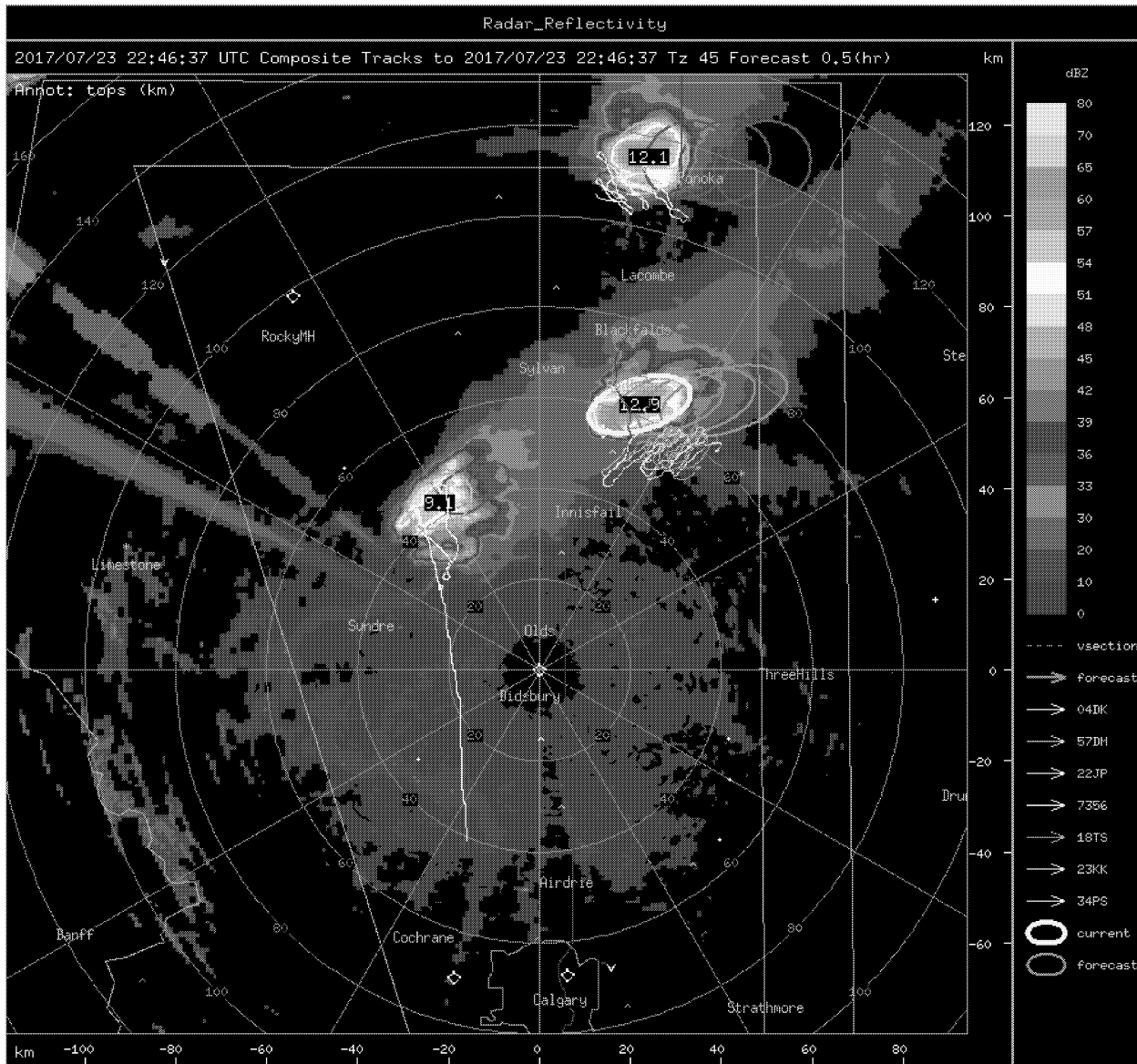


Fig. 48. The Olds-Didsbury radar display at 22:46Z (16:46 MDT) showing a large 12.9 km cell over southern Red Deer being seeded with three aircraft while the northern 12.1 km cell near Ponoka seeded by Hailstop 3 and top seeding begins on the developing 9.1 km cell west of Innisfail by Hailstop 5.

ALBERTA HAIL SUPPRESSION PROJECT FINAL OPERATIONS REPORT 2017

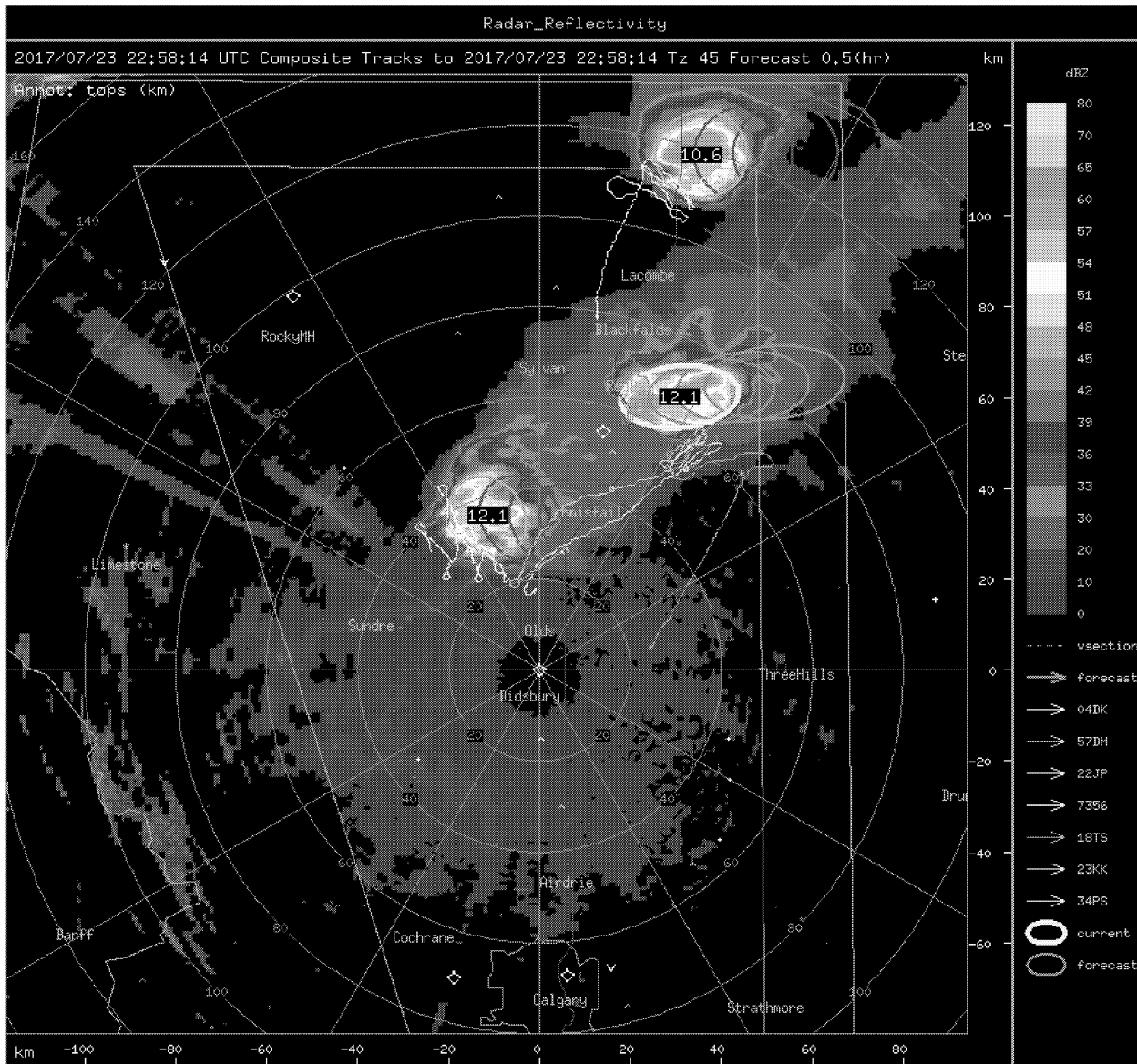


Fig. 49. The Olds-Didsbury radar display at 22:58Z (16:58 MDT) showing a large 12.1 km cell exiting Red Deer. Base seeding aircraft can be seen transitioning from the Red Deer cell to the Innisfail cell. HS5 (pink track) has now been directed to return to Springbank as they were out of ejectable flares. Hailstop 3 has also been directed to return to base in Red Deer for more flares and fuel after the northern cell pushed through Ponoka.

ALBERTA HAIL SUPPRESSION PROJECT FINAL OPERATIONS REPORT 2017

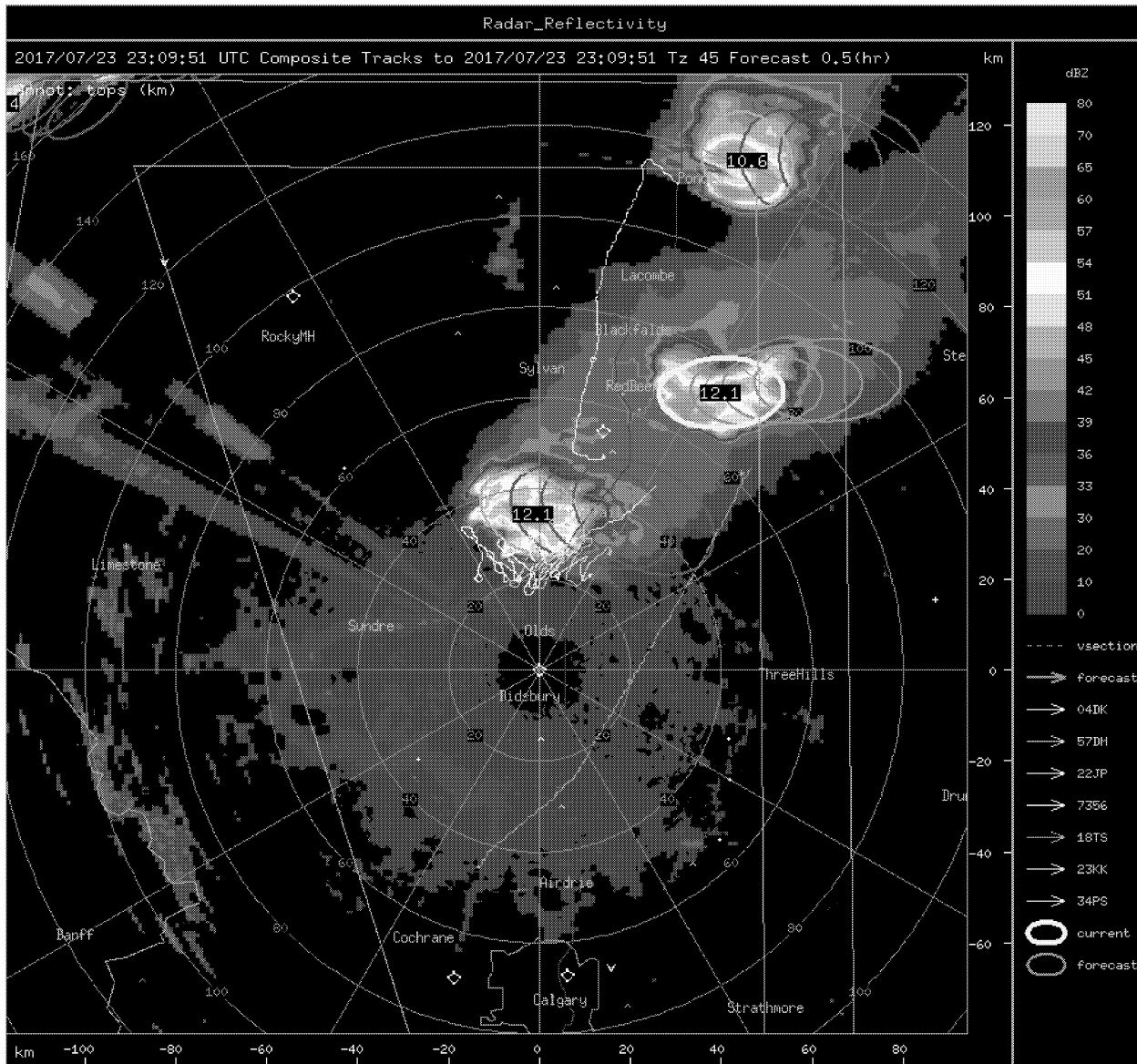


Fig. 50. The Olds-Didsbury radar display at 23:09Z (17:03 MDT) showing the northern two supercells exiting the area to the east while three aircraft seed an intensifying 12.1 km supercell entering innisfail. Another wave of convection is now just beginning to enter the radar coverage area to the far northwest. Crews were directed to fuel and flare quickly in anticipation of additional flights as the next wave approached.

ALBERTA HAIL SUPPRESSION PROJECT FINAL OPERATIONS REPORT 2017

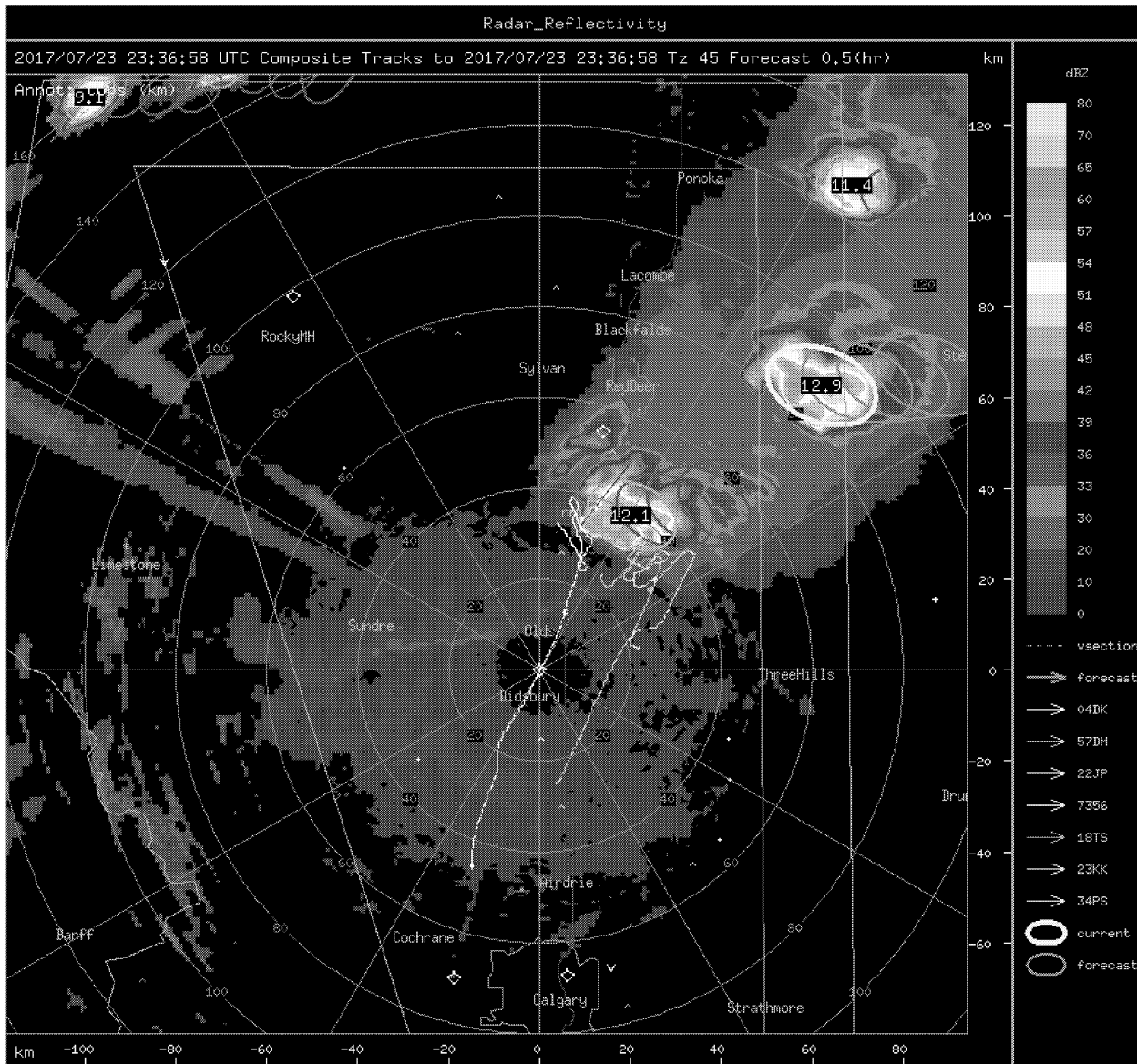


Fig. 51. The Olds-Didsbury radar display at 23:36Z (17:36 MDT) showing all seeding aircraft now heading back to base to fuel and reload seeding agents. The next wave of convection continues to approach from the far northwest.

ALBERTA HAIL SUPPRESSION PROJECT FINAL OPERATIONS REPORT 2017

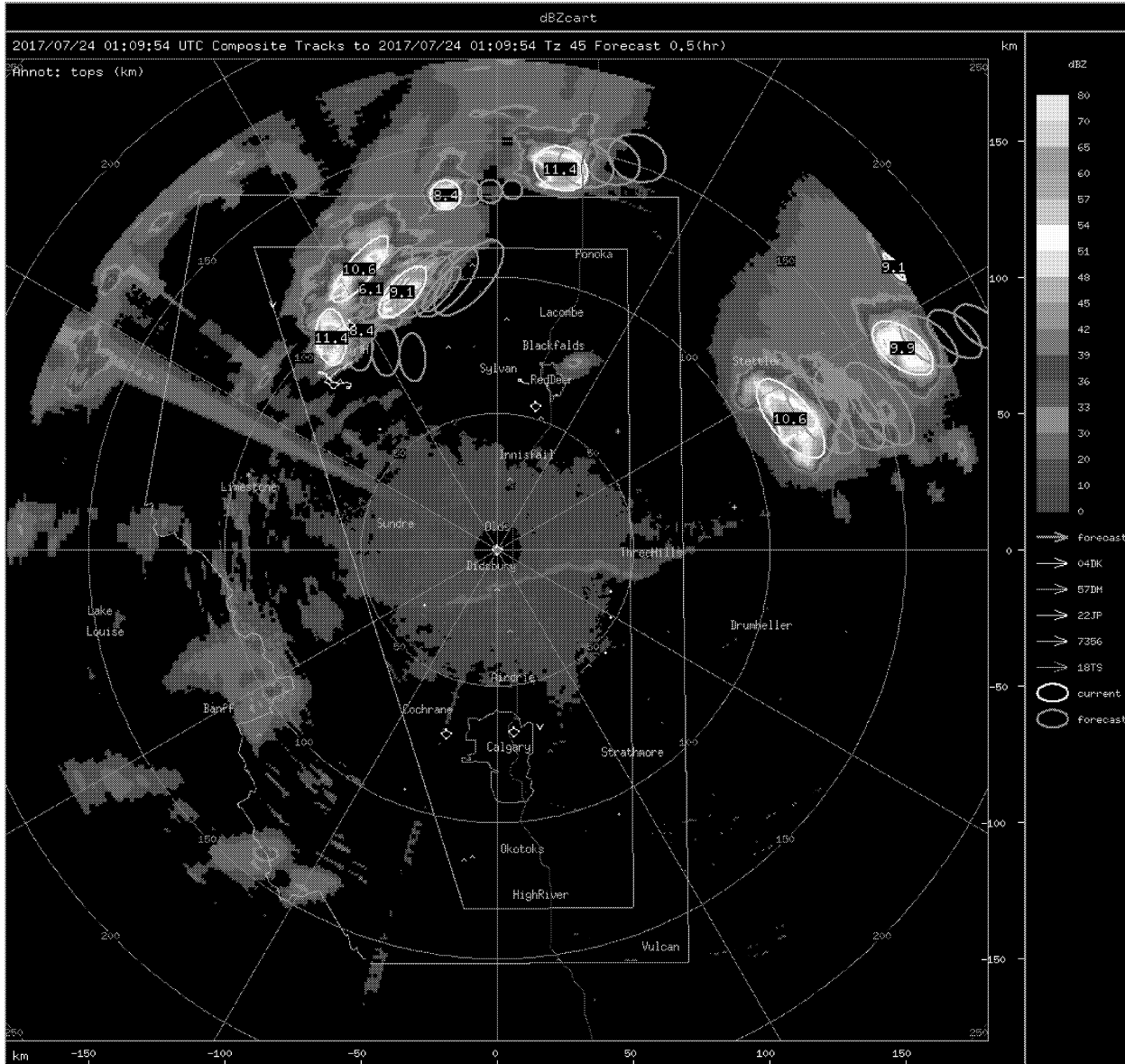


Fig. 52. The Olds-Didsbury radar display at 01:09Z (19:09 MDT) showing the next wave of convection entering the northwestern project region. This second wave was less organized as the storm mode shifted from supercells to multicell clusters which are slightly less threatening. Hailstop 3 can be seen top seeding near Rocky Mountain House while Hailstop 4 has just been launched from Red Deer.

ALBERTA HAIL SUPPRESSION PROJECT FINAL OPERATIONS REPORT 2017

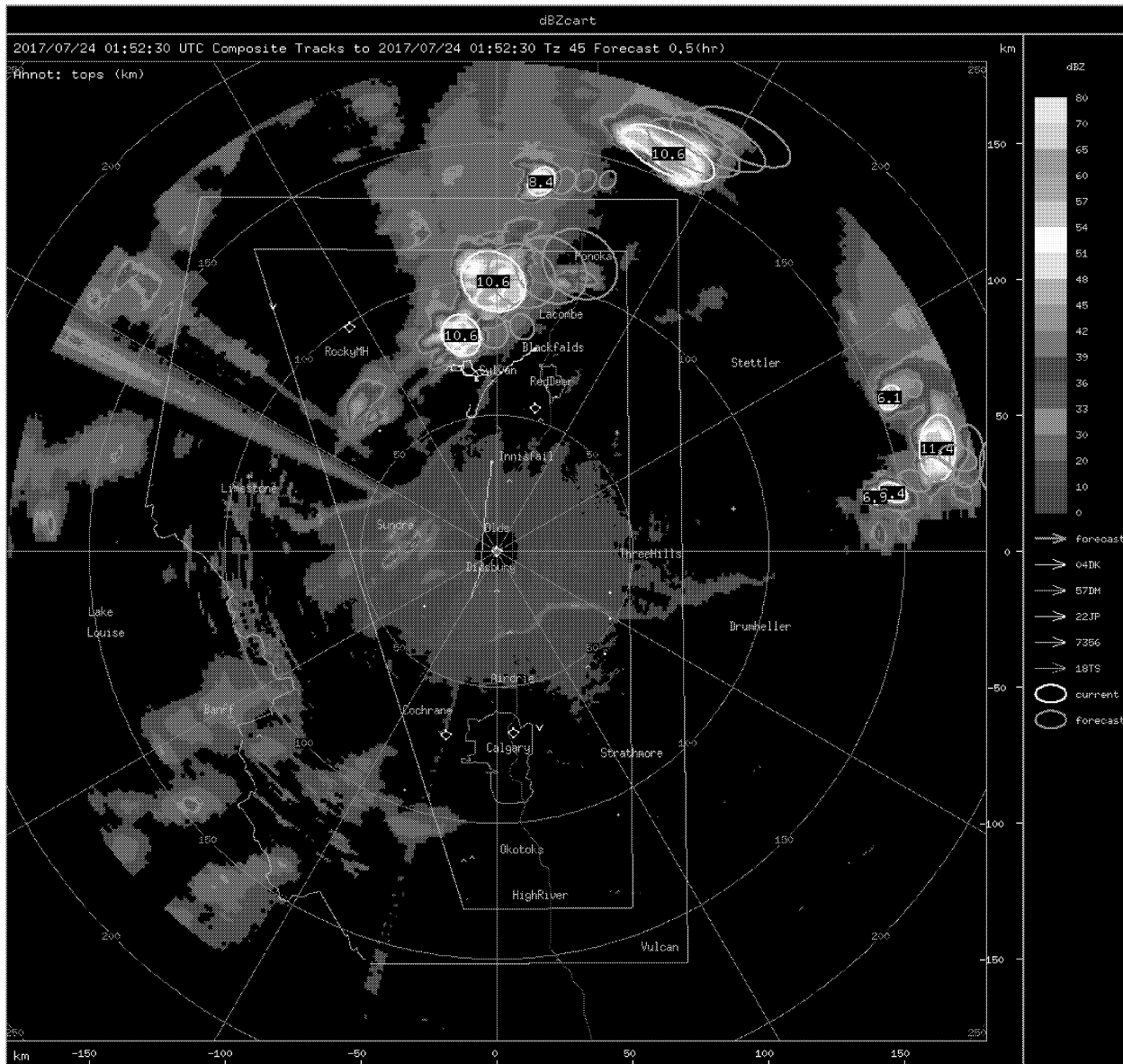


Fig. 53. The Olds-Didsbury radar display at 01:52Z (19:52 MDT) showing a cluster of cells approaching Blackfalds, Lacombe, and Ponoka. Hailstop 4 is base seeding the east side of the cluster while Hailstop 3 top seeds the southern end. Hailstop 2 is approaching the area as an additional base seeder.

ALBERTA HAIL SUPPRESSION PROJECT FINAL OPERATIONS REPORT 2017

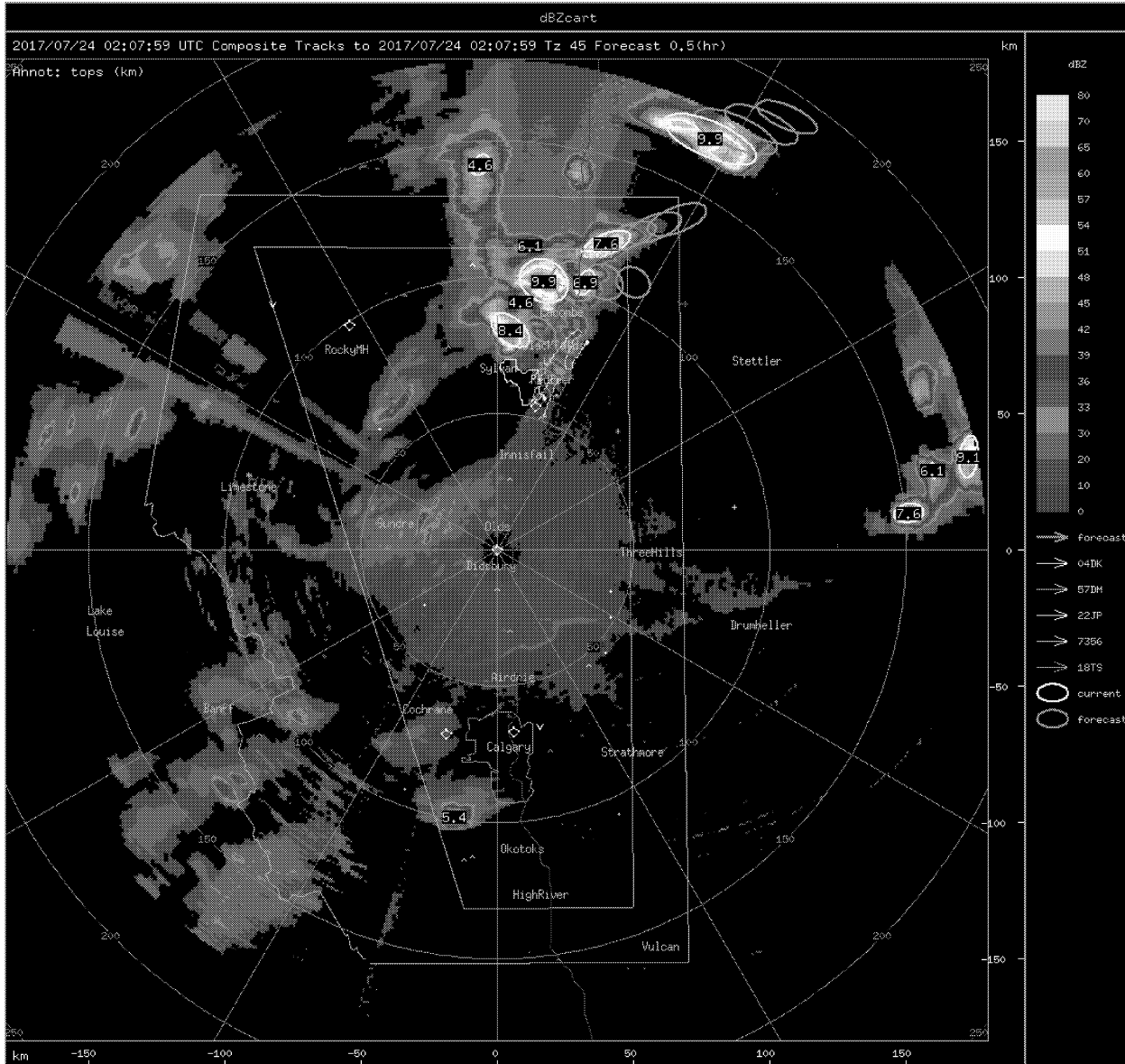


Fig. 54. The Olds-Didsbury radar display at 02:07Z (19:07 MDT) shows three aircraft seeding from Red Deer to Lacombe on the southeast side of a weakening cluster of cells. Cells are becoming embedded at this time and the hail threat is diminishing significantly. A developing weak cell is evident southwest of Calgary with low tops. Aircraft would be scrambled to intercept this cell near Calgary, but the cell ultimately dissipated and posed no hail threat as it moved through southern Calgary.

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

OPERATIONS SUMMARY – 23 JULY 2017

The first convective cells of the day were observed along the foothills near Rocky Mountain House. The initial cells dissipated quickly, but the next cells to form near Caroline would intensify and organize rapidly as they moved toward the east-northeast. The first flight of the day (HS4) was launched at 14:19 MDT, to the Caroline area. HS5 was launched shortly after at 14:28 MDT to the same area for top seeding. HS4 called the radar to report a dead battery in their plane which would delay their take off. HS2 had just completed a maintenance flight and was near their plane on the ground, so they launched immediately to the Caroline area due to the HS4 delay. This HS4 delay did not affect operations in any significant way. Seeding began on cell #1 near Caroline with HS5 top seeding at 15:06 MDT. TITAN tracking indicated the cell would be heading toward Red Deer in the next two hours. HS4 and HS2 began base seeding storm #1 together with HS5 as storm #1 moved east through southern Red Deer. Storm #2 of the day formed in the northern buffer zone north of Rocky Mountain House. As this storm pushed east through the buffer zone, it slowly turned right and threatened Ponoka. HS3 was launched at 15:16 MDT to intercept storm #2 and begin top seeding on arrival. Seeding began on storm #2 with HS3 at 15:55 MDT. Since this northern cell was approaching a relatively low priority city, most of the seeding aircraft were utilized for the storm moving into Red Deer. Storm #3 developed west of Innisfail and the last available aircraft (HS1) was launched to this cell near Sundre at 16:15 MDT. HS1 began top seeding storm #3 alone at 16:45 MDT. At 16:52 MDT, the cell over Red Deer was moving out of the city and HS2 and HS4 were directed to reposition and begin base seeding the cell west of Innisfail, with HS1 above them at cloud top. Seeding of the Red Deer storm ended as the base seeders departed the cell, and HS5 was directed to land in Springbank for flares and fuel at 16:59 MDT. Shortly after, at 17:01 MDT, storm #2 was exiting Ponoka and HS3 was directed to land in Red Deer for flares and fuel. By 17:02 MDT, three aircraft were seeding storm #3 west of Innisfail while the other two were landing. At 17:39 MDT, storm #3 had moved through Innisfail and all aircraft were directed to return to base and prepare for another incoming wave of storms in the far northwest.

Hailstop 3 was launched again at 18:17 MDT to the Rocky Mountain House area as a cluster of less organized convection entered the northwest project region. HS4 was also launched to this cluster of cells at 18:56 MDT. HS3 began top seeding storm #4 near Rocky Mountain House at 19:01 MDT. HS2 was ready to go again and launched to storm #4 at 19:12 MDT. HS4 began base seeding storm #4 at 19:25 MDT. HS2 began seeding the same cluster at 19:56 MDT. As this embedded cluster of storms pushed eastward toward Red Deer and Lacombe, it weakened significantly becoming only a marginal hail threat. At 20:03 MDT, a new weak cell was forming southwest of Calgary moving toward the city. Several aircraft were scrambled to intercept this cell in case it developed into a significant storm over Calgary. HS2 was directed to reposition south to the developing Calgary cell at 20:07 MDT. Seeding of storm #4 north of Red Deer ended at 20:22 MDT as HS3 landed in Red Deer. HS4 was caught ahead of a strong gust front and unable to get back to Red Deer due to severe wind shear at the airport, so they diverted to Drumheller to wait for conditions to improve before returning home. The cell over Calgary was patrolled by HS5 and HS2 for a short time, but the cell ultimately dissipated without becoming a hail threat and no seeding was done over Calgary. All aircraft were directed to return to base by 20:38 MDT, and operations ended for the day.

ALBERTA HAIL SUPPRESSION PROJECT FINAL OPERATIONS REPORT 2017

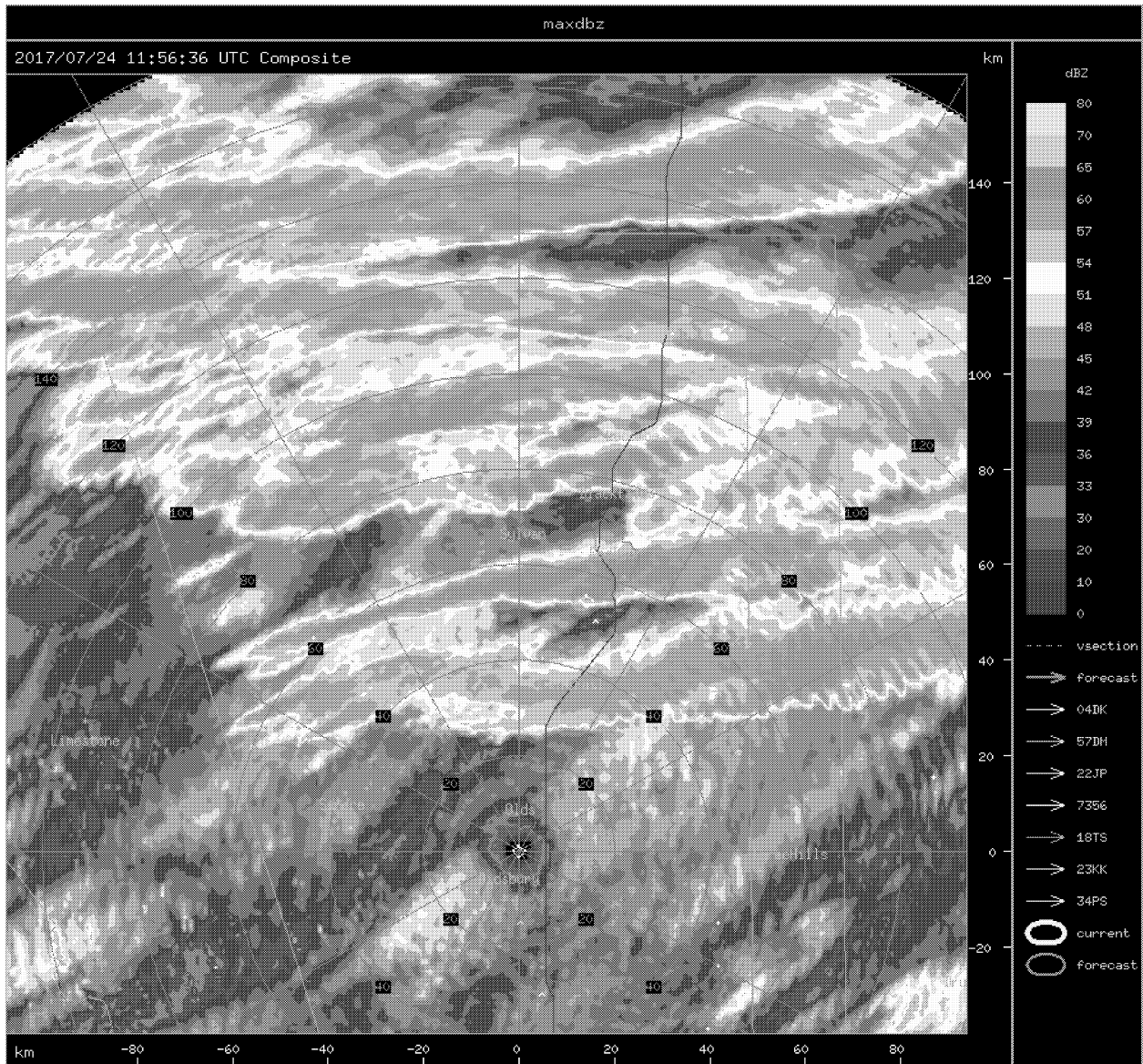


Fig. 55. Composite maximum radar reflectivity plot for the entire storm day of 23 July 2017.

ALBERTA HAIL SUPPRESSION PROJECT FINAL OPERATIONS REPORT 2017

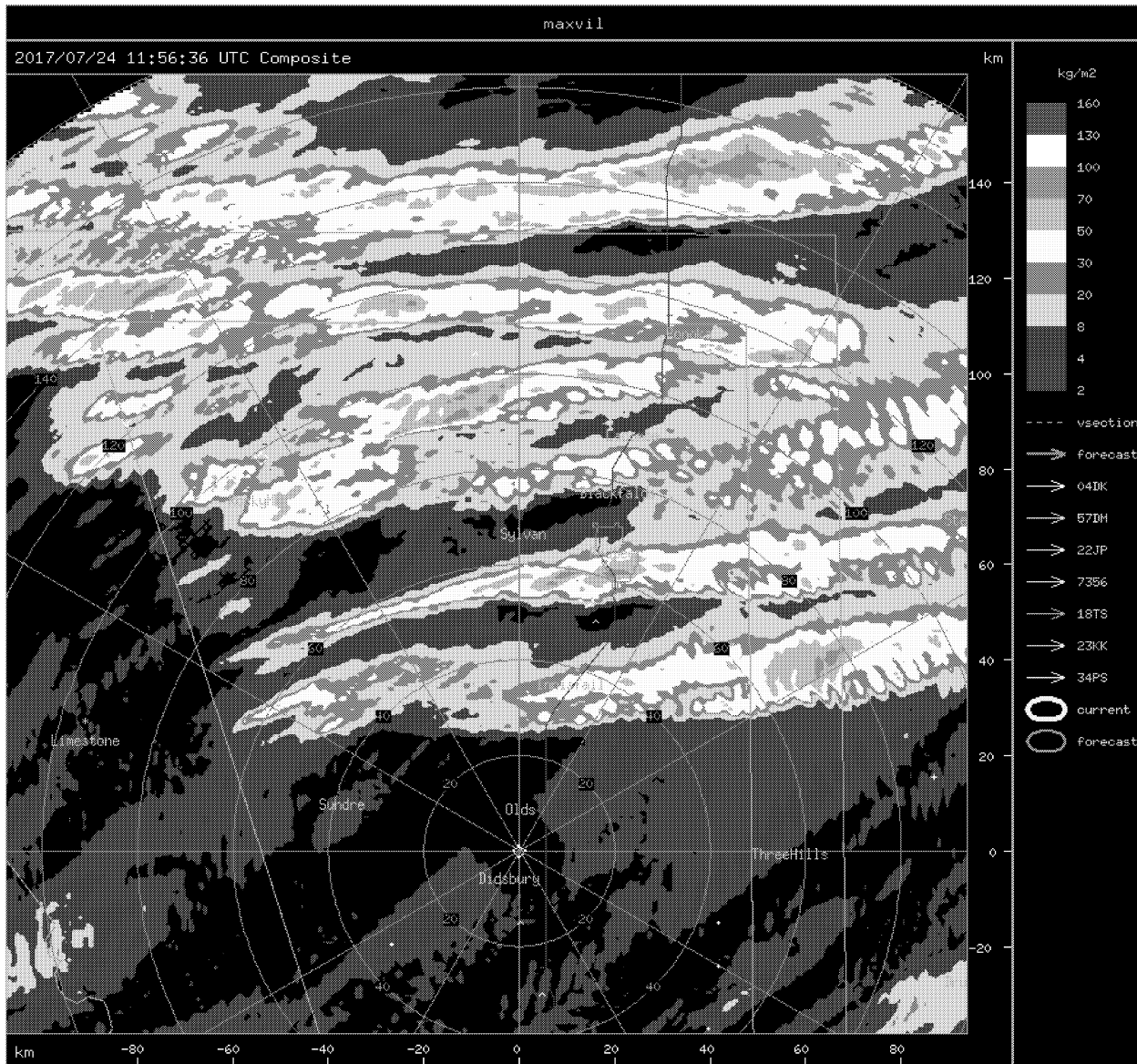


Fig. 56. The maximum vertically-integrated liquid (VIL) measured by the radar is shown. VIL is well-correlated with hail size. The largest hail swaths were associated with the tracks of the northern cell outside the seeded area.

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

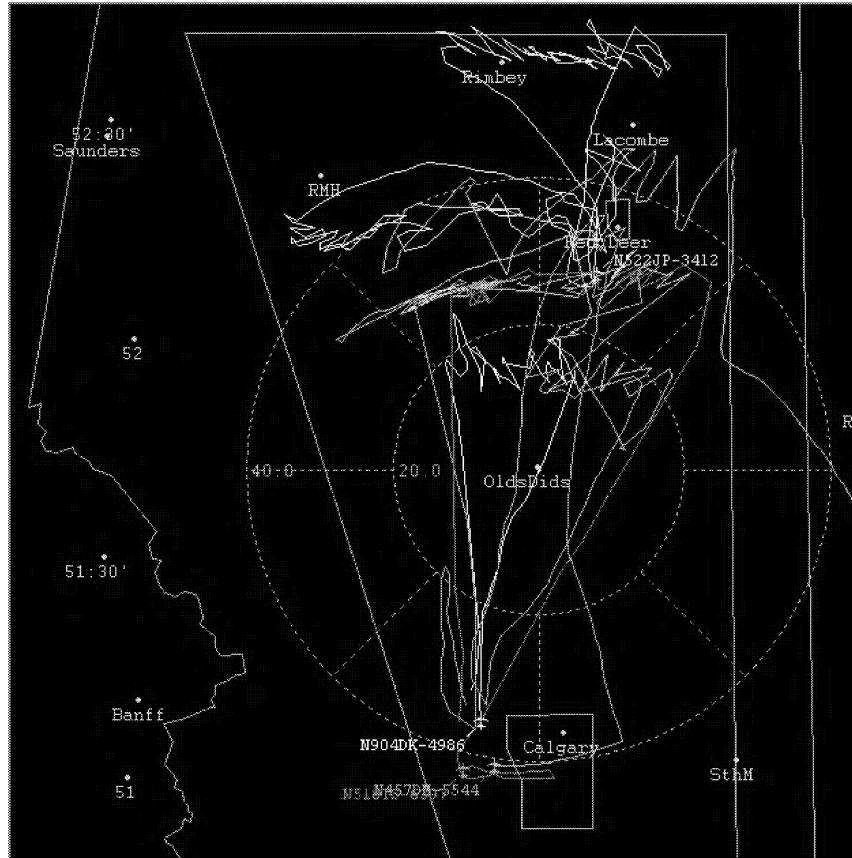


Fig. 57. AirLink GPS aircraft seeding tracks for the entire storm day of 23 July 2017. Track colors are as follows: Hailstop 1, white; Hailstop 2, orange; Hailstop 3, light blue; Hailstop 4 green; and Hailstop 5, pink. The WMI AirLink aircraft tracks show that the storms that moved through Red Deer were well-seeded, by multiple aircraft. Seeding began almost two hours upwind of Red Deer with sufficient time and continuous dosage for positive seeding affects to be realized.

SUMMARY OF 23 JULY 2017 STORM DAY

Fig. 55 shows the maximum reflectivity for the entire storm day, activity was confined to the northern half of the project area. Fig. 56 depicts maximum VIL maps for the entire storm day. VIL is well-correlated with hail size, the most intense pockets of hail occurred near Red Deer, Eckville, and north of Ponoka outside the project area. Large damaging hail was reported over numerous places in the northern project and surrounding area. A report of 6 cm hail in the northeast buffer zone meant the observed Convective Day Category was +5 for larger than golf ball size hailstones. Ping pong ball size hail was reported in isolated parts of Red Deer, and 3.5 cm hail was observed in Ponoka. The most threatening cell of the day, which moved through Red Deer, was seeded by three aircraft (one top seeder and two base seeders). Due to multiple simultaneous hail storms over the region, some storms could only be targeted by one aircraft or could not be targeted until later than what is optimal. Despite these challenges, all five aircraft were utilized to their full potential, and all seeding equipment functioned properly on this, the most heavily seeded day of the 2017 season.

A total of 41.6 kg of silver iodide seeding material was utilized during 8 seeding flights. A total of 942 ejectable 20 gram flares were utilized along with 142 burn-in-place 150 gram flares. Wing tip generators were utilized for a combined total of 722 minutes of single generator time. There were four seeded storms throughout the course of the day including cells over Red Deer, Ponoka, Innisfail, and Rocky Mountain House.

**ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017**

14. CLIMATIC PERSPECTIVES

The daily and accumulated rainfall for from December 2016 through November 2017 are shown in Fig. 58 and Fig. 59, respectively. Calgary was above normal through the entire project period. Though the total number of thunderstorm days was down, a number of widespread stratiform precipitation (nimbostratus) events helped keep the precipitation above normal.

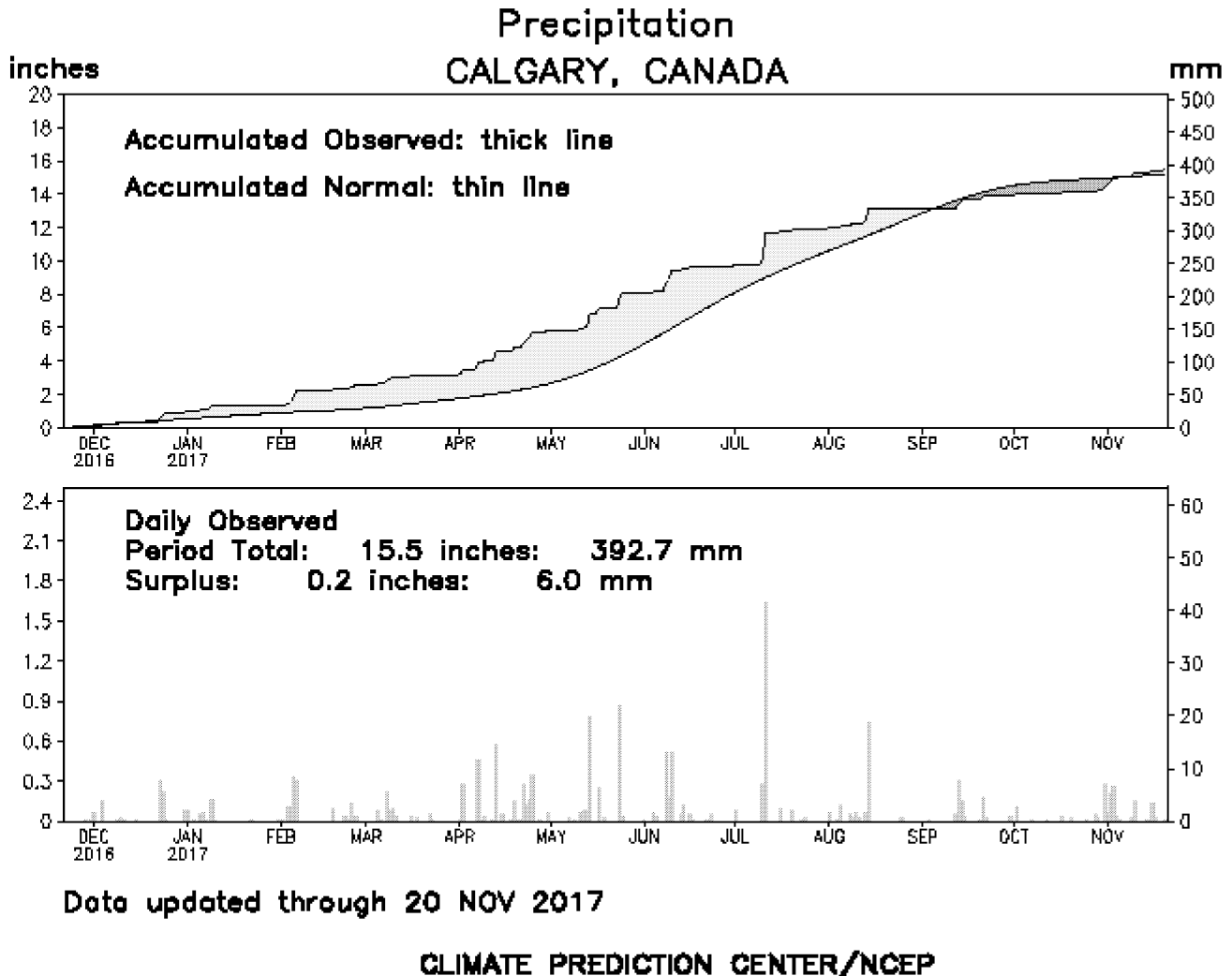


Fig. 58. Calgary precipitation, daily and cumulative, for calendar year 2017. (Data and plot from the National Center for Environmental Prediction, NOAA.)

Conditions were drier than normal in Red Deer in the spring of 2017. However, June was wetter than normal by about 10 mm. July and August were significantly below normal, but September near normal.

**ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017**

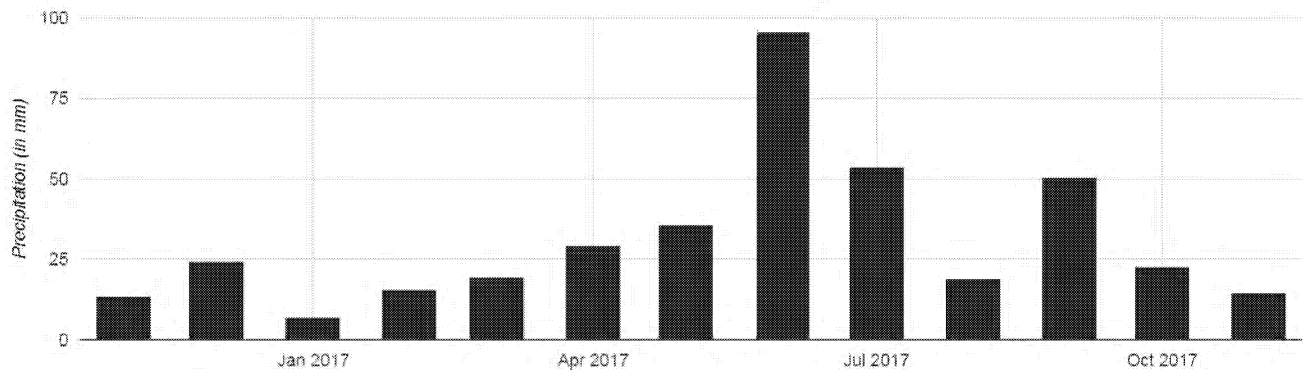


Fig. 59. Red Deer 2017 precipitation, by month, from <https://reddeer.weatherstats.ca/>. An analogous plot for Calgary can be viewed at <https://calgary.weatherstats.ca/>.

14.1 EL NIÑO/SOUTHERN OSCILLATION (ENSO) DISCUSSION

The links between sea surface temperatures in the equatorial Pacific Ocean and the weather and climate of Alberta are not clearly defined. However, there has been a slightly positive correlation between hot, dry summers and El Niño (warm ocean) conditions; and cool, wet, stormy summers with La Niña (cool ocean) conditions.

During May, ENSO-neutral continued, though SSTs were above average in the east-central Pacific Ocean. The weekly Niño index values were near +0.5 °C in most of the Niño regions, except for the easternmost Niño-1+2, which was at +0.2 °C. The upper-ocean heat content anomaly increased during May, reflecting the expansion of above average sub-surface temperatures across the central and eastern Pacific in association with a downwelling oceanic Kelvin wave. While ocean temperatures were elevated, the atmosphere was close to average. Atmospheric convection anomalies were weak over the central tropical Pacific and Maritime Continent, while the lower-level and upper-level winds were near average over most of the tropical Pacific. Both the Southern Oscillation Index (SOI) and Equatorial SOI were also near zero. Overall, the ocean and atmosphere system remained consistent with ENSO-neutral.

During July, ENSO-neutral continued, as equatorial SSTs were near average across most of the Pacific Ocean. The latest weekly Niño SST index values were close to zero in all four Niño regions, having recently decreased from higher levels in the Niño-4 and Niño-3.4 regions. The upper-ocean heat content anomaly was near average during July, reflecting below-average temperatures along the thermocline across the central and eastern Pacific overlain by slightly above-average temperatures. Tropical convection was near average over the eastern half of the Pacific and enhanced over the western Pacific and the Maritime Continent. The lower-level trade winds were slightly enhanced near the International Date Line, and upper-level winds were near average over most of the tropical Pacific. Overall, the ocean and atmosphere system remained consistent with ENSO-neutral.

ALBERTA HAIL SUPPRESSION PROJECT FINAL OPERATIONS REPORT 2017

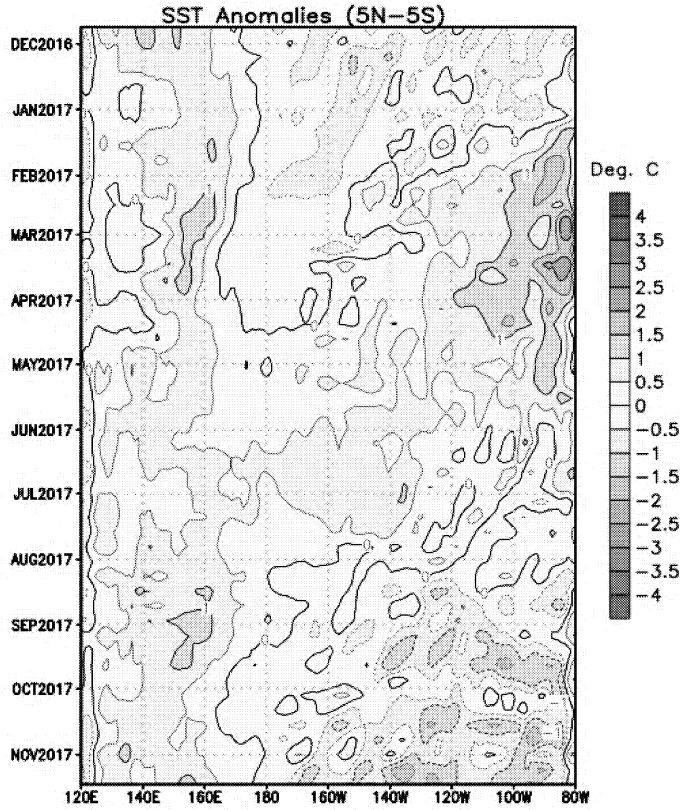


Fig. 60. Sea Surface Temperature (SST) anomalies by date and longitude, for latitudes 5°N through 5°S. (Graphic from NCEP.)

During September, ENSO-neutral conditions were reflected in near-to-below average SSTs across most of the central and eastern Pacific Ocean. The weekly Niño indices were volatile during the month, with negative values increasing to near zero during the past week in the Niño-4, Niño-3.4, and Niño-3 regions. In contrast, sub-surface temperature anomalies were increasingly negative during September, reflecting the shallow depth of the thermocline across the central and eastern Pacific. Also, convection was suppressed near the International Date Line and enhanced near Indonesia. Over the western equatorial Pacific Ocean, low-level trade winds were anomalously easterly and upper-level winds were anomalously westerly. Overall, the ocean and atmosphere system remained consistent with ENSO-neutral, although edging closer to La Niña conditions.

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

15. CONCLUSIONS

The 2017 field program ran smoothly, except the administrative delays within the Canadian government that resulted in operations beginning on June 2nd, rather than the scheduled June 1st date. All storms worthy of treatment according to the current operational guidelines were seeded in a timely way. The most significant storm day of the season was July 23rd when all five aircraft seeded, and some flew multiple missions. Numerous strong storms, many having supercell characteristics, blossomed over the project area during the afternoon and evening, threatening northern cities. A detailed storm summary of this day is included.

Aircraft maintenance was mostly routine; no aircraft was in maintenance for more than a day through the entire season.

The storm frequency was near normal; the season ranked tenth in terms of seeding activity. Having the fifth aircraft available allowed the project Lead Meteorologist to increase aircraft coverage when long-lived storms moved through or near a succession of municipalities, and to seed earlier at sustained, effective rates when severe storms threatened high priority cities and towns. Overall, it was a good year.

Bruce Boe, Vice President - Meteorology
Daniel Gilbert, Chief Meteorologist, Alberta Lead Meteorologist
Bradley Waller, Field Meteorologist
Adam Brainard, Field Meteorologist
Jody Fischer, Director of Flight Operations

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

16. REFERENCES

- Abshaev, M. T., 1999: Evolution of seeded and non-seeded hailstorms. Proceedings, Seventh WMO Scientific Conference on Weather Modification. WMP Report No. 31, World Meteorological Organization, Geneva, 407-410.
- Barge, B.L., and F. Bergwall, 1976: Fine scale structure of convective storms associated with hail production. Proceedings, 2nd WMO Scientific Conference on Weather Modification, Boulder, CO, 341-348.
- Brimelow, J.C, G.W. Reuter, R. Goodson, and T.W. Krauss, 2006: Spatial Forecasts of Maximum Hail Size using Prognostic Model Soundings and HAILCAST, *Weather and Forecasting*, **21**, No. 2, 206-219.
- Browning, K. A., 1977: The structure and mechanisms of hailstorms. Hail: A Review of Hail Science and Hail Suppression. *Meteor. Monogr.*, No. 16, 38, 1-43.
- Chisholm, A.J., 1970: Alberta hailstorms: A radar study and model. Ph.D. dissertation, McGill University, Montreal, QC. 287 pp.
- Chisholm, A.J., and J.H. Renick, 1972: The kinematics of multicell and supercell Alberta hailstorms –1972. Alberta Research Council Report 72-2, Alberta Hail Studies, 24-31.
- Cooper, W. A., and J. Marwitz, 1980: Winter storms over the San Juan Mountains. Part III: Seeding potential. *J. Appl. Meteor.*, **19**, 942-949.
- Dennis, A.S., M.A. Schock, A. Koscielski, 1970: Characteristics of hailstorms of Western South Dakota. *J. Appl. Meteor.*, **9**, 127-135.
- DeMott, P.J., 1999: Report to the Weather Modification, Incorporated on tests of the ice nucleating ability of aerosols produced by new formulation pyrotechnics. Dept. Atmos. Sci., Colorado State University, Fort Collins, CO., 10 pp.
- English, M., 1986: The testing of hail suppression hypotheses by the Alberta Hail Project. Preprints, *10th Conf. on Weather Modification*, Amer. Meteor. Soc., Arlington, VA. 72-76.
- Etkin, D., and S. E. Brun, 1999: A note on Canada's hail climatology: 1977-1993. *Int. J. Climatol.* **19**, 1357–1373.
- Foote, G.B., 1984: The study of hail growth utilizing observed storm conditions. *J. Appl. Meteor. Climatol.*, **23**, 84-101.
- Foote, G.B., 1985: Aspects of cumulonimbus classification relevant to the hail problem. *J. Atmos. Research*, **19**, 61-74.
- Foote, G.B., and J.C. Fankhauser, 1973: Airflow and moisture budget beneath a northeast Colorado hailstorm. *J. Appl. Meteor.*, **12**, 1330-1353.
- Foote, G.B., T.W. Krauss, and V. Makitov, 2005: Hail metrics using conventional radar. Proceedings, *16th Conf. on Planned and Inadvertent Weather Modification*, Amer. Meteor. Soc., Boston, MA.

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

- Foote, G. B., and C. A. Knight, 1979: Results of a randomized hail suppression experiment in northeast Colorado. Part I. Design and conduct of the experiment. *J. of Appl. Meteor.*, **18**, 1526-1537.
- Garvey, D.M., 1975: Testing of cloud seeding materials at the Cloud Simulation and Aerosol Laboratory, 1971-1973. *J. of Appl. Meteor.*, **14**, 883-890.
- Grandia, K.L., D.S. Davison and J.H. Renick, 1979: On the dispersion of silver iodide in Alberta hailstorms. *Proceedings: 7th Conference on Planned and Inadvertent Weather Modification*, Banff, Alberta, Canada. Amer. Meteor. Soc., Boston, MA. 56-57.
- Humphries, R.G., M. English, and J. Renick, 1987: Weather Modification in Alberta. *J. of Weather Modification*, **19**, 13-24.
- IBC, 2017: *Facts of the Property and Casualty Insurance Industry in Canada 2017*. Insurance Bureau of Canada report, 39th edition, 2017 Spring, ISSN 1197 3404. 62 p.
- Krauss, T.W., 1981: Precipitation Processes in the New Growth Zone of Alberta Hailstorms. Ph.D. Dissertation, University of Wyoming, Laramie, WY, 296 pp.
- Krauss, T.W., and J.D. Marwitz, 1984: Precipitation processes within an Alberta supercell hailstorm. *J. Atmos. Sci.*, **41**, 1025-1034.
- Krauss, T.W., and J.R. Santos, 2004: Exploratory analysis of the effect of hail suppression operations on precipitation in Alberta. *Atmos. Research*, **71**, 35-50.
- Makitov, V., 1999: Organization and main results of the hail suppression program in the northern area of the province of Mendoza, Argentina. *J. of Weather Modification*, **31**, 76-86.
- Marshall, J.S., and W. McK. Palmer, 1948: The distribution of raindrops with size. *J. Meteor.*, **5**, 165-166.
- Marwitz, J.D., 1972a: The structure and motion of severe hailstorms, Part I: Supercell storms. *J. Appl. Meteor.*, **11**, 166-179.
- Marwitz, J.D., 1972b: The structure and motion of severe hailstorms, Part II: Multicell storms. *J. Appl. Meteor.*, **11**, 180-188.
- Marwitz, J.D., 1972c: The structure and motion of severe hailstorms, Part III: Severely sheared storms. *J. Appl. Meteor.*, **11**, 189-201.
- Marwitz, J.D., 1972d: Precipitation efficiencies of thunderstorms on the High Plains. *J. Atmos. Research*, **6**, 367-370.
- Rinehart, R.E., 1997: *Radar for Meteorologists, 2nd Ed.* Depart. of Atmos. Sci., University of North Dakota, Grand Forks, 334 pp.
- Rudolph, R.C., C.M. Sackiw, and G.T. Riley, 1994: Statistical evaluation of the 1984-1988 seeding experiment in northern Greece. *J. Weather Modification*, **26**, 53-60.

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

Smith, P.L., L.R. Johnson, D.L. Priegnitz, B.A. Boe, and P.W. Mielke, 1997: An exploratory analysis of crop-hail insurance data for evidence of cloud-seeding effects in North Dakota. *J. of Appl. Meteor.*, **36**, 463-473.

Strong, G.S., 1979: A convective forecast index as an aid in hail suppression evaluation. *Proc., 7th Conference on Planned and Inadvertent Weather Modification*, Banff, AB. Amer. Meteor. Soc., Boston, MA. 2 pp.

Waldvogel, A., B. Federer, and P. Grimm, 1979: Criteria for the detection of hail cells. *J. of Appl. Meteor.*, **25**, 1521-1525.

World Meteorological Organization, 1995: WMO meeting of experts to review the present status of hail suppression. Golden Gate National Park, South Africa, 6-10 November. WMP Report No. 26, WMO Technical Document No. 764, R. List, Editor, 39 pp.

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

APPENDICES

- A. Organization Chart
- B. Daily Weather and Activities Summary Table
- C. Aircraft Operations Summary Table
- D. Flight Summary Table
- E. Forms
 - Weather Forecast Worksheet
 - WMI Radar Observer Log
 - WMI Seeding Aircraft Flight Log
- F. Aircraft Specifications
 - Cessna 340A Aircraft
 - Beechcraft King Air C90
- G. Ground School Agenda
- H. Airborne Seeding Solution
- I. Daily Meteorological Forecast Statistics
- J. Project Personnel and Telephone List

ALBERTA HAIL SUPPRESSION PROJECT FINAL OPERATIONS REPORT 2017

APPENDIX A – ORGANIZATION CHART



ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

APPENDIX B – DAILY WEATHER AND ACTIVITIES SUMMARY TABLE

ALBERTA HAIL SUPPRESSION PROJECT 2017 DAILY SUMMARY REPORTS		
Date	Weather	Activities Summary
June 1, Thursday	<p>The project area lay between a large trough centered south of the Gulf of Alaska and a broad ridge moving east across Saskatchewan. A shortwave trough was expected to eject from the large-scale trough and move north directly over the project area Thursday evening. Instability was projected to be hindered by cloud cover, especially in the south, but higher CAPE values were forecast in the central and northern project area. Showers were expected to continue overnight until the shortwave trough departed Friday morning.</p> <p>Weak convective thundershowers began to develop in the foothills northwest of Rocky Mountain House around noon, gradually spreading south along the foothills and moving east into the project area. All storms were short-lived, though several likely contained ice pellets or pea size hail. The strongest storms of the day formed north and west of Rocky Mountain House around 0Z (06/02), where radar indicated pea size hail fell. Thunderstorms weakened into rain showers overnight, and a large band of rain moved slowly northeast across the project area from dusk Thursday into Friday morning.</p> <p>Max cell top: 9.1km, 57.8 max dBz, 29.7 max VIL</p> <p>Pea size hail reported northwest of Sundre.</p> <p>Tmax YC = 23.6C and 0.4mm of rain. Tmax QF = 23.4C and 9.4mm of rain. Tmax Radar = 22.9C and no rain.</p>	No aircraft operations.
June 2, Friday	<p>A quieter day was forecast with dry downslope air advecting into the project area. The convective temperature was relatively low, however, so a threat of weak diurnal convective showers was anticipated, particularly in the north and east where deeper moisture lingered. Clearing was expected Friday evening, with calm clear skies overnight.</p> <p>Rain showers associated with Thursday night's shortwave trough moved east across the northern project area Friday morning, exiting the area around 17Z. As this activity departed, a new wave of convection began to develop northwest of Rocky Mountain House, forming along a residual boundary from the morning's precipitation. Thunderstorms began to intensify as they developed further southeast along this boundary, becoming small hail threats. Radar indicated several cells were capable of producing grape-size hail, though the largest reported hail was pea-size. At 2220Z, a particularly strong cell formed at the leading edge of a cluster of storms halfway between Innisfail and Three</p>	<p>HS4 was launched at 1918Z for a weak thunderstorm north of RMH. They were airborne at 1940Z. HS4 discovered a problem with the right burner after takeoff, and RTB at 1945Z. They landed at 1948Z.</p> <p>HS3 was launched for convection west and northwest of Red Deer at 1953Z. They were airborne at 2021Z. HS3 started seeding storm #1 Red Deer at 2027Z. HS3 stopped seeding and RTB at 2038Z. They landed at 2046Z.</p> <p>Flight Summary HS4: 1929Z-1959Z; no seeding; maintenance flight. HS3: 2005Z-2052Z; 12 EJ, 2 BIP; storm #1 Red Deer.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>Hills. This cell followed the aforementioned boundary southeast, right of the mean flow, and produced a tornado just north of Three Hills around 23Z. Convective activity then began to dissipate and move out of the project area, with mostly clear skies prevailing across the entire project area after 1Z (06/03).</p> <p>Max cell top: 10.6km, 59.0 max dBz, 40.1 max VIL</p> <p>A tornado was observed north of Three Hills. Pea size hail reported in NE Red Deer.</p> <p>Tmax YC = 21.7C and a trace of rain. Tmax QF = 20.0C and a trace of rain. Tmax Radar = 22.1C and 9.1mm of rain.</p>	
<p>June 3, Saturday</p>	<p>A shortwave ridge was observed across the project area Saturday morning, with a strongly capped atmosphere expected through the afternoon. Instability was forecast to increase Saturday evening, with a series of weak mid-level shortwave disturbances prognosticated to affect the project area from the evening through the overnight hours. These disturbances were predicted to bring scattered showers and thundershowers to the region, but elevated CAPE was modeled to remain too low for an appreciable hail threat.</p> <p>Stable conditions were observed throughout the day with a chinook arch cloud covering much of the project area. Weak showers began to move across the far southern project area and buffer after 8Z (06/04), with a stronger second wave moving in east of High River between 10Z and 12Z (06/04). One embedded convective cell with this activity became a TITAN cell on RADAR and produced lightning. No hail threats were observed.</p> <p>Max cell top: 5.4km, 49.5 max dBz, 7.4 max VIL</p> <p>Tmax YC = 26.4C and no rain. Tmax QF = 25.4C and no rain. Tmax Radar = 25.6C and no rain.</p>	<p>HS2 flew a maintenance flight. They were airborne at 1747Z and landed at 1817Z.</p> <p>HS4 flew a maintenance flight. They were airborne at 1755Z and landed at 1819Z.</p> <p>Flight Summary HS2: 1731Z-1822Z; no seeding; maintenance flight. HS4: 1732Z-1827Z; no seeding; maintenance flight.</p>
<p>June 4, Sunday</p>	<p>A southwesterly upper level jet looked to be present over the area. Strong PVA was expected to be possible roughly around the time of peak heating. The low levels of the atmosphere and surface looked to contain warm moist air through the early evening hours before the wind flow would shift more northwesterly starting around the time of sunset. The 00Z (06/05) CYYC sounding showed a modest amount of CAPE (~500J/kg), but PVA was expected to be strong at the time of peak heating and bulk speed shear values looked to be around 50kts.</p> <p>The project area remained capped throughout the afternoon hours. In the early evening, the convection present over the foothills during the late afternoon began to push into the western part of the region. This convection merged into a line of thunderstorms which pushed northeastward across the project area in the evening. These thunderstorms were a minimal hail threat. Ice pellets were observed at the radar. Light, scattered</p>	<p>No aircraft operations.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>convective rain showers continued over central AB during the night.</p> <p>Max cell top: 7.6km, 60.5 max dBz, 25.6 max VIL</p> <p>Tmax YC = 23.5C and 1.8mm of rain. Tmax QF = 19.5C and 0.6mm of rain. Tmax Radar = 20.3C and 5.1mm of rain.</p>	
June 5, Monday	<p>The upper level jet stream was expected to lift northward. A trough, with weak PVA, appeared to be moving northeastward across southern AB during the afternoon hours. In the evening, a shortwave ridge would build over the southern half of AB. The ridging was then expected to continue throughout the rest of the period. Surface pressure values looked to rise throughout the day. The main trigger mechanism for convection appeared to be elevated surface heating along the foothills. Area soundings showed dry air above 8kft MSL and bulk speed shear values of around 5kts.</p> <p>The stratiform cloud cover over the region shifted to the east of the protected area during the morning. Surface heating then occurred which allowed for weak convection to form along the foothills starting around noon local time. This convection strengthened into a couple weak thunderstorms which produced a few lightning strikes near Turner Valley and Black Diamond in the afternoon. The skies then cleared in the evening.</p> <p>Max cell top: 5.4km, 49.7 max dBz, 8.3 max VIL</p> <p>Tmax YC = 17.8C and 0.8mm of rain. Tmax QF = 19.7C and no rain. Tmax Radar = 18.9C and 0.5mm rain.</p>	No aircraft operations.
June 6, Tuesday	<p>Energy associated with the upper level jet stream looked to remain well north of the region. AB looked to see SW flow at the mid-levels. In the evening, a shortwave trough with moderate PVA was expected to push northeastward across the area. At 700mb (~10kft MSL) a thermal ridge appeared to build into the southern half of AB. This thermal ridge looked to remain in place for the remainder of the period. Area modified model soundings indicated the atmosphere would remain mostly stable.</p> <p>Fair weather cumulus clouds formed over the area during the afternoon. In the late afternoon and evening, altocumulus, cirrocumulus, and cirrus clouds were also seen over the region.</p> <p>No TITAN cells, 25.9 max dBz, 0.2 max VIL</p> <p>Tmax YC = 23.1C and no rain. Tmax QF = 23.7C and no rain. Tmax Radar = 22.7C and no rain.</p>	No aircraft operations.
June 7, Wednesday	<p>The wind flow appeared to remain southwesterly at the mid and upper levels. A shortwave trough looked to push northeastward across AB at around the time of peak heating. A 700mb (~10kft MSL) thermal ridge was</p>	No aircraft operations.

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>expected to stay centered over the southern half of AB throughout the period. Winds at the surface looked to stay southeasterly, favoring moisture convergence along parts of the foothills. Area modified model soundings indicated enough instability would be present for thunderstorms over the foothills during the daytime hours. Model guidance suggested directional wind shear would exist, but speed shear looked to be approximately 15kts.</p> <p>Mostly clear skies were observed through noon local time. In the afternoon, fair weather cumulus formed over parts of the project area. The evening and overnight hours then saw mid and upper level clouds flow over the area from the southwest.</p> <p>No TITAN cells, 24.2 max dBz, 0.1 max VIL</p> <p>Tmax YC = 26.4C and no rain. Tmax QF = 26.2C and no rain. Tmax Radar = 24.7C and no rain.</p>	
<p>June 8, Thursday</p>	<p>A deep low was predicted to move southward along the coast of BC. This low was expected to swing a shortwave trough with strong PVA northeastward across the project area in the evening. This along with ample moisture within the boundary layer appeared to provide the right ingredients for potentially severe thunderstorms in the evening. At the surface, a lee trough looked to be co-located with the shortwave trough. Model sounding data suggested a strong cap would be in place across the region through at least the time of peak heating. Model sounding temperature and dew-point profiles indicated enough instability for medium size hail. Cell motion was expected to be south-southeasterly which would initially keep storms moving along the mountains and foothills.</p> <p>In the late afternoon, thunderstorms developed along the mountains and southern foothills. Then at 0045Z (06/09) these storms began to push northeastward into the southern part of the project area near Turner Valley and Black Diamond. This long line of thunderstorms (storm #1) quickly moved northeastward across the entire project area during the evening hours. Starting around at 0115Z (06/09), thunderstorms started forming near Olds (storm #2) and Caroline (storm #3) ahead of the main line. At roughly the same time, another storm (#4) formed near Vulcan and quickly tracked northward toward Strathmore. In the late evening, the entire line of thunderstorms morphed in a mesoscale convective system (MCS) which produced moderate to heavy rain showers across much of the region into the overnight hours.</p> <p>Nickel size hail reported in Caroline. Pea size hail reported near Bragg Creek and in Olds.</p> <p>Max cell top: 12.9km, 62.8 max dBz, 73.0 max VIL</p> <p>Tmax YC = 26.7C and 13.2mm of rain. Tmax QF = 26.6C and 42.0mm of rain. Tmax Radar = 25.9C and 25.7mm of rain.</p>	<p>HS5 was launched at 0011Z (06/09) to a line of thunderstorms beginning to push into the southern protected area near Turner Valley and Black Diamond. They became airborne at 0027Z (06/09). HS5 started top seeding storm #1 for Cochrane and Calgary at 0041Z (06/09). The flight then stopped seeding at 0206Z (06/09) and repositioned to another storm moving toward Strathmore. Before they arrived at the Strathmore convection, the mission was ended. They diverted to YQF at 0212Z (06/08), and landed at 0235Z (06/09).</p> <p>HS2 was launched at 0015Z (06/09) to patrol the Cochrane area. They were airborne at 0035Z (06/09). HS2 began base seeding the Cochrane and Calgary area starting at 0042Z (06/09). At 0216Z (06/09) HS2 stopped seeding and diverted to YQF. They landed in YQF at 0232Z (06/09).</p> <p>HS1 was launched at 0024Z (06/09) to High River. The aircraft was airborne at 0048Z (06/09) and was redirected to the southwest of High River. HS1 began base seeding storm #1 at 0101Z (06/09) for Okotoks. At 0138Z (06/09) the aircraft stopped seeding and repositioned to the south of Strathmore. HS1 then started base seeding storm #4 for Strathmore at 0147Z (06/09). At 0218Z (06/09) HS1 stopped seeding and diverted to YQF. They landed in YQF at 0242Z (06/09).</p> <p>HS4 was launched to a long line of convective storms moving toward Sundre at 0104Z (06/09). The flight became airborne at 0129Z (06/09) and was repositioned to new convective growth over Caroline heading for Rocky MH. HS4 started base seeding storm #3 for Rocky MH at 0147Z (06/09). At 0212Z (06/09) they stopped</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

		<p>seeding and RTB. The aircraft landed at 0225Z (06/09).</p> <p>HS3 was launched to convection forming just to the northeast of the Olds-Didsbury airport at 0109Z (06/09). The aircraft became airborne at 0127Z (06/09). At 0140Z (06/09) HS3 started top seeding storm #2 for Olds. They then stopped seeding and RTB at 0214Z (06/08). The flight landed at 0222Z (06/08).</p> <p>HS5 flew a reposition flight. They were airborne from YQF at 0535Z (06/09) and landed in YBW at 0625Z (06/09).</p> <p>HS2 flew a reposition flight. They were airborne from YQF at 0543Z (06/09) and landed in Springbank at 0618Z (06/09).</p> <p>HS1 flew a reposition flight. They were airborne from YQF at 0553Z (06/09) and landed in YBW at 0632Z (06/09).</p> <p>Flight Summary HS5: 0018Z-0239Z (06/09); 189 EJ, 17 BIP; #1 Cochrane, Calgary, Airdrie, and Carstairs; takeoff YBW, land YQF. HS2: 0026Z-0235Z (06/09); 190 minutes wing-tip generators, 17 BIP; #1 Cochrane, Calgary, Airdrie, and Carstairs; takeoff YBW, land YQF. HS1: 0034Z-0246Z (06/09); 0 EJ, 15 BIP; #1 Okotoks to Calgary; #4 Strathmore; takeoff YBW, land YQF. HS4: 0117Z-0229Z (06/09); 50 minutes wing-tip generators, 2 BIP; #3 Rocky MH. HS3: 0120Z-0227Z (06/09); 98 EJ, 7 BIP; #2 Olds. HS5: 0524Z-0627Z (06/09); no seeding; reposition flight; takeoff YQF, land YBW. HS2: 0532Z-0622Z (06/09); no seeding; reposition flight; takeoff YQF, land YBW. HS1: 0533Z-0633Z (06/09); no seeding; reposition flight; takeoff YQF, land YBW.</p>
<p>June 9, Friday</p>	<p>The large scale low off the coast of Vancouver Island was expected to slowly begin tracking southeastward. An inverted trough was forecast to be in place over AB for most of the period. Low level and surface wind flow looked to stay out of the W to NW, so no upslope flow was expected. Model data suggested dew-points would steadily fall throughout the period. Area modified model soundings for 21Z and 00Z (06/10) showed a slightly unstable troposphere. Cloud bases were forecasted to be around -1C.</p> <p>Scattered stratiform rain showers fell over the region in the morning. These stratiform rain showers continued into the afternoon hours over the northern part of the protected area. In the afternoon several TITAN cells formed along a dry line. This dry line was a convex curve, extending from Cremona to Crossfield to the west of</p>	<p>No aircraft operations.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>Strathmore and then south to Vulcan. Radar data suggested grape size hail may have fallen inside the eastern buffer zone north of Vulcan. The rain showers then tapered off in the evening before more stratiform rain showers pushed into the region from the north overnight.</p> <p>Max cell top: 10.6km, 61.6 max dBz, 45.2 max VIL</p> <p>Tmax YC = 20.3C and 4.6mm of rain. Tmax QF = 16.6C and 17.0mm of rain. Tmax Radar = 17.3C and 11.9mm of rain.</p>	
June 10, Saturday	<p>The closed low was predicted to stay centered along the coast of Oregon for much of the day. A trough looked to extend from this low up to Hudson Bay. This trough was expected to create broad scale lift across the region. Model data suggested temperatures at 500mb (~10kft MSL) would warm throughout the period which would inhibit deep convection. Windy conditions were expected at the low levels and surface. Upslope conditions looked to be possible over the northern part of the project area in the afternoon. Afternoon and evening soundings for the region showed a slightly unstable troposphere (~100J/kg of CAPE) with a low equilibrium level near 15kft MSL.</p> <p>In the morning and afternoon, a precipitation shield slowly slid southward across the project area. Scattered, light convective rain showers were observed over the northwestern part of the protected area in the afternoon. In the evening, the rain showers ended. The cloud cover then slowly diminished during the night.</p> <p>No TITAN cells, 53.0 max dBz, 5.1 max VIL</p> <p>Tmax YC = 11.0C and 13.0mm of rain. Tmax QF = 13.4C and 7.4mm of rain. Tmax Radar = 10.3C and 15.5mm of rain.</p>	No aircraft operations.
June 11, Sunday	<p>Upper level flow was split across Alberta, with easterly flow in the southern Alberta responding to a deep upper level low in California, and westerly flow further north associated with a jet streak in northeast Alberta. Mid-level temperatures were forecast to rise sharply through the day, hindering instability despite strong insolation. Convective showers were predicted in the north in the early overnight hours, but no thunder or hail was anticipated.</p> <p>Convective rain showers moved southeast from Rimbey to Three Hills Sunday morning, followed by clearing across the project area. Clouds and light rain showers returned to the northern and eastern project area overnight, but no lightning or hail threats were observed.</p> <p>Max cell top: 48.1 max dBz, 3.2 max VIL</p> <p>Tmax YC = 20.7C and no rain. Tmax QF = 16.5C and a trace of rain. Tmax Radar = 17.8C and 0.3mm of rain.</p>	No aircraft operations.
June 12,	Upper level flow was expected to turn southwesterly	HS4 was launched at 2326Z for strong

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

<p>Monday</p>	<p>ahead of a strong upper level trough lifting NE out of Nevada. Mid-level flow was weak, but low-level moisture was modeled to advect into the northern project area from the southeast. Instability was prognosticated to be significant, and upslope convection was expected by mid-afternoon. This activity was largely expected to stay near the foothills, though a few cells were predicted to cross into the western project area and produce a moderate hail threat.</p> <p>Mostly clear skies across the project area yielded to orographic convection over the foothills north of Limestone Mountain around 20Z. Convection generally dissipated as it moved away from the foothills, though one storm produced radar indicated grape size hail in the northwest corner of the project area around 2330Z. A second storm west of Sundre also appeared to threaten the project area, but dissipated before crossing the project boundary. Weaker convection continued in the northwest project area throughout much of the night, but no further hail threats occurred.</p> <p>Max cell top: 11.4 km, 59.3 max dBz, 34.9 max VIL</p> <p>Tmax YC = 23.3C and no rain. Tmax QF = 23.1C and no rain. Tmax Radar = 22.6C and no rain.</p>	<p>convection near the foothills west of Sundre. They were airborne at 2341Z. HS4 began to patrol Sundre at 2359Z. They RTB at 0016Z (06/13), and landed at 0032Z (06/13).</p> <p>Flight Summary HS4: 2331Z (06/12)-0035Z (06/13); no seeding; patrol Sundre.</p>
<p>June 13, Tuesday</p>	<p>A closed upper-level low was observed moving northeast across Montana Tuesday morning. This disturbance was modeled to rejoin the polar jet late Tuesday as a deep trough over Saskatchewan. Moisture associated with this low was predicted to advect into the project area from the east, and combined with significant PVA, instigate rain and thunderstorms inside the project area. Surface conditions were expected to remain predominately cool and cloudy, though pockets of clearing were predicted to drive the strongest thunderstorms of the day. PVA and moisture advection were forecast to continue into the overnight hours, with rain continuing and a localized flooding threat possible.</p> <p>After a brief lull in convective activity early Tuesday morning, rain and thunderstorms redeveloped in the northwest foothills around 1330Z. This activity grew in coverage throughout the morning, but moved slowly north and did not cross the western project boundary until 17Z. Meanwhile, an additional area of convection developed in the southeast buffer at 1530Z, briefly producing radar indicated pea-size hail. By 18Z, widespread clouds and shallow rain showers began to affect the northeast project area. A line of stronger convection began to develop from the southeast project area northeast through Drumheller in the early afternoon, and slowly moved west into the project area. The strongest storms of the day were associated with this line, producing radar-indicated grape size hail in the east buffer north of Strathmore around 22Z. This line began to weaken considerably as moved further west into the project area at 23Z, evolving into a mass of scattered rain showers that persisted through Tuesday night.</p>	<p>No aircraft operations.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>Max cell top: 8.4km, 59.9 max dBz, 35.0 max VIL</p> <p>Tmax YC = 17.1C and 1.2mm of rain. Tmax QF = 18.1C and 11.6mm of rain. Tmax Radar = 17.2C and 0.5mm of rain.</p>	
<p>June 14, Wednesday</p>	<p>An upper-level shortwave trough was predicted to pivot north across the region Wednesday into Wednesday night. Mid-level vorticity advection was modeled to be relatively weak, though stronger PVA was expected overnight. Widespread cloud cover Wednesday morning was predicted to clear early Wednesday afternoon, quickly destabilizing the atmosphere. Orographic convection was then forecast from mid-late afternoon into the evening. A dry line was modeled to develop parallel with the foothills, and was identified as a potential region of stronger storm organization. Considerable elevated CAPE was modeled to linger until the dry line mixed east of the project area around midnight.</p> <p>Widespread clouds with embedded weak showers persisted from Wednesday morning into the early afternoon. At 20Z a line of weak convection developed along the southwestern foothills, and moved east entering the project area at 2130Z. A stronger area of convection developed behind this line southwest of Cochrane around 2230Z, but did not produce any radar-indicated hail as it passed through Calgary around 0Z. A third round of convection developed around 0130Z (06/15) with two discrete cells – one southwest of Calgary and another southwest of Rocky MH – becoming the strongest storms of the day. The former cell near Calgary briefly produced radar-indicated grape size hail southwest of town, and radar-indicated pea size hail in south Calgary. Mostly clear skies were observed Wednesday night.</p> <p>Max cell top: 7.6km, 59.7 max dBz, 30.3 max VIL</p> <p>Tmax YC = 17.3C and 3.0mm of rain. Tmax QF = 16.2C and 0.2mm of rain. Tmax Radar = 16.2C and 1.5mm of rain.</p>	<p>HS1 was launched at 2136Z for a line of convection developing over the foothills. They were airborne at 2202Z. HS1 began to patrol Cochrane at 2212Z. They RTB at 2359Z, and landed at 0014Z (06/15).</p> <p>HS2 was launched at 2136Z for a line of convection developing over the foothills. They were airborne at 2218Z. HS2 began to patrol Cochrane at 2221Z. They RTB at 2345Z, and landed at 0000Z (06/15).</p> <p>HS2 was launched at 0153Z (06/15) for new convection west of RMH. They were airborne at 0213Z (06/15). At 0225Z (06/15), they changed course to patrol convection near Calgary. HS2 began patrolling Cochrane at 0240Z (06/15). HS2 RTB at 0253Z (06/15), and landed at 0302Z (06/15).</p> <p>Flight Summary HS1: 2150Z (06/14)-0018Z (06/15); no seeding; patrol Cochrane. HS2: 2159Z (06/14)-0004Z (06/15); no seeding; patrol Cochrane. HS2: 0207Z-0304Z (06/15); no seeding; patrol Cochrane.</p>
<p>June 15, Thursday</p>	<p>A shortwave ridge was forecast to develop over the project area Thursday. This was expected to bring a strong convective cap around 550mb, with no diurnal convection predicted to breach this layer. Modest PVA was anticipated Thursday night, enhancing mid-level cloudiness and bringing the threat of showers into the project area.</p> <p>Mostly clear skies were observed Thursday throughout the central and eastern project area, while broken mid-upper level clouds blanketed the western project area and foothills. Clouds lowered and became more widespread after midnight, with rain showers observed in parts of the western project area. No discrete convection or lightning was observed.</p> <p>Max cell top: 32.0 max dBz, 0.5 max VIL</p>	<p>No aircraft operations.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>Tmax YC = 19.6C and no rain. Tmax QF = 19.3C and a trace of rain. Tmax Radar = 18.8C and no rain.</p>	
<p>June 16, Friday</p>	<p>A shortwave trough was modeled to move across the project area Friday, with temperatures cooling substantially aloft. This mid-level cooling, combined with surface insolation, was forecast to promote convective development within the project area from early afternoon into the evening. Shear was predicted to be relatively weak, with only minimal storm organization expected. Surface moisture was generally low, though deeper moisture was expected further east. Scattered convection was expected to continue overnight, with skies clearing after midnight.</p> <p>Clouds with embedded virga and light rain continued before clearing late Friday morning. Conditions then rapidly destabilized, with convection developing in the far western project area and foothills by noon. Thunderstorms grew more widespread into Friday afternoon, though all storms were short-lived with minimal or no hail threats. The first seeded storm of the day was a group of stronger thunderstorms that developed in the foothills northwest of Sundre around 2230Z. This storm began to dissipate as it entered the project area, and ultimately did not produce any radar-indicated hail outside of the western buffer. While storm #1 dissipated, an outflow boundary sinking south toward Calgary began to initiate convection north of town. Around 2330Z, a strong thunderstorm developed on the outflow boundary immediately east of Calgary International Airport, and continued to back-build and sink south paralleling the eastern Calgary city limits. This became the second seeded storm of the day, and it was seeded until it moved out of the Calgary-Chestermere area into the southeast corner of the project area. Outside of this storm, deeper convection had generally transitioned into rain showers, though a final stronger thunderstorm developed northwest of Okotoks around 0230Z (06/17), producing the highest dBz and VIL of the day. Radar indicated grape-size hail fell with this storm, which almost entirely dissipated before reaching Okotoks. Rain showers continued across much of the central and southern project area overnight, eventually dissipating and moving out of the project area before dawn.</p> <p>Max cell top: 10.6km, 60.9 max dBz, 38.5 max VIL</p> <p>Tmax YC = 21.2C and 1.4mm of rain. Tmax QF = 19.4C and 3.4mm of rain. Tmax Radar = 18.8C and 1.8mm of rain.</p> <p>Pea size hail reported in Penhold.</p>	<p>HS5 was launched at 2027Z for scattered convection northeast of Calgary. They were airborne at 2046Z. They began to patrol the Cochrane area at 2053Z. HS5 RTB at 2139Z, and landed at 2147Z.</p> <p>HS4 was launched at 2056Z for a strong thunderstorm northeast of Caroline. They were airborne at 2111Z. HS4 began to patrol Sylvan at 2118Z. HS4 RTB at 2210Z. They landed at 2217Z.</p> <p>HS5 was relaunched for stronger convection near Limestone Mountain at 2244Z. They were airborne at 2300Z. HS5 began top seeding storm #1 Sundre at 2319Z. HS5 stopped seeding and repositioned to a developing storm east of Calgary at 2343Z. HS5 was unable to get into seeding position until 0012Z (06/17) per ATC restrictions caused by issues related to a hoax security threat at YYC. The aircraft was stuck in a holding pattern as a storm cell developed over the eastern part of the city. They were finally allowed to begin seeding storm #2 Calgary-Chestermere with BIPs at 0012Z (06/17), and were then approved to seed with EJs at 0019Z (06/17). HS5 stopped seeding and continued patrolling Chestermere at 0057Z (06/17). They RTB at 0109Z (06/17), and landed at 0121Z (06/17).</p> <p>Flight Summary HS5: 2040Z-2153Z; no seeding; patrol Cochrane. HS4: 2105Z-2220Z; patrol Sylvan; no seeding. HS5: 2254Z (06/16)-0123Z (06/17); 274 EJ, 9 BIP; #1 Sundre, #2 Calgary-Chestermere.</p>
<p>June 17, Saturday</p>	<p>The upper level jet was forecast to rise toward the project area as a broad ridge developed over the Pacific Northwest. Mid-level NVA was modeled over the project area Saturday afternoon, bringing a substantial cap to the project area around 500mb. Mesoscale upslope flow was expected to drive orographic convection along the</p>	<p>No aircraft operations.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>foothills, and given the moderate easterly cell motion, bring weak, capped showers and thundershowers into the project area. Mid-level PVA was forecast to bring scattered elevated showers to the project overnight, but no hail threats were anticipated.</p> <p>Scattered clouds and virga moved out of the project area after dawn Saturday morning, leaving mostly clear skies across the project. Weak convective rain showers began to develop along the foothills shortly before noon, but generally dissipated upon entering the project. A stronger convective cell developed south of Sundre around 2130Z, and became the strongest storm of the day when it pulsed into a TITAN cell southwest of Didsbury. This cell expanded into a cluster of showers and thundershowers as it continued east, exiting south of Three Hills around 0130Z (06/18). Lightning was observed with this activity. Areas of cloud cover continued into the overnight hours, but no convective threats occurred.</p> <p>Max cell top: 6.9km, 54.5 max dBz, 11.4 max VIL</p> <p>Tmax YC = 19.6C and 0.4mm of rain. Tmax QF = 19.2C and no rain. Tmax Radar = 18.9C and no rain.</p>	
<p>June 18, Sunday</p>	<p>A northwesterly jet streak was forecast to shift eastward across AB as a ridge of high pressure began to build into the region from the west. 500mb temperatures were expected to warm by roughly 2C during the daytime. 500mb heights also looked to gradually rise throughout the day. Surface winds appeared to mainly stay out of the northwest to west. The winds along the foothills were expected to be mainly westerly which would aid in keeping dew-points relatively low. Area afternoon and evening model soundings showed enough instability for convective rain showers and isolated thunderstorms. The 0 to 6km bulk speed shear looked to be around 30kts.</p> <p>Convective rain showers were observed on radar near the Pine Lake area in the morning. In the early afternoon, isolated convective rain showers began to push into the area near Rocky MH. The wave of isolated convective showers eventually moved eastward across the entire northern half of the project area during the remainder of the afternoon. Mid and upper level cloud cover then flowed over the region throughout the rest of the period.</p> <p>No TITAN cells, 49.9 max dBz, 5.6 max VIL</p> <p>Tmax YC = 21.6C and no rain. Tmax QF = 19.9C and a trace of rain. Tmax Radar = 20.6C and no rain.</p>	<p>No aircraft operations.</p>
<p>June 19, Monday</p>	<p>An upper level ridge was expected to continue building over AB through around the time of peak heating. A couple of shortwave troughs were predicted to push through during the period. The first shortwave looked to slide across southern AB at the time of peak heating. Another shortwave then appeared to move through overnight. Winds at the low levels and surface were</p>	<p>No aircraft operations.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>forecast to be out of the S to SSE as an area of high pressure moved southeastward across central AB. Modified model soundings for the region suggested two caps would be present in the troposphere. The first cap was located roughly at 700mb (~10kft MSL) and the second cap looked to be located at 500mb (~18kft MSL).</p> <p>Cirrostratus and altocumulus clouds flowed across the region through the early afternoon hours. Starting around 21Z convective rain showers began falling over the foothills west of Sundre. These showers began to push into the protected area at around 23Z. The convective rain showers were short-lived and gradually dissipated as they pushed eastward over the towns of Caroline and Sundre. Mid and upper level clouds then flowed over the area in the evening and overnight.</p> <p>No TITAN cells, 47.7 max dBz, 3.7 max VIL</p> <p>Tmax YC = 21.3C and no rain. Tmax QF = 20.1C and no rain. Tmax Radar = 20.3C and no rain.</p>	
<p>June 20, Tuesday</p>	<p>A 140kt jet streak was predicted to nose its way into AB. The left exit region for the jet streak appeared to be over the northern project area at the time of peak heating. Moderately strong PVA was expected as a shortwave trough pushed eastward across the region in the late afternoon and evening. The wind flow was forecast to switch to northwesterly as a cold front quickly moved southeastward across the region in the evening. Area modified model soundings suggested close to 1000J/kg of CAPE would be present over the northern part of the project area in the late afternoon and evening. 0 to 6km bulk speed shear values looked to be around 45 kts and would likely be strong enough for long-lived thunderstorms.</p> <p>Thunderstorms started forming north of Rocky MH at around 21Z. These TITAN cells merged into a tall thunderstorm (storm #1) which tracked toward Ponoka during the late afternoon hours. Radar data suggested grape size hail could have fallen east of Ponoka. In the late afternoon, another storm (#2) developed northwest of Bentley. This storm eventually moved through the Bentley area. Around the same time a line of thunderstorms (storm #3) began developing from near Lacombe down through the Sylvan area. The line of convection turned into a cluster of TITAN cells as it pushed eastward across the northern part of the project area.</p> <p>Max cell top: 11.4km, 62.1 max dBz, 54.8 max VIL</p> <p>Tmax YC = 26.8C and a trace of rain. Tmax QF = 24.9C and no rain. Tmax Radar = 24.7C and no rain.</p>	<p>HS2 flew a reposition flight. The aircraft was airborne out of YBW at 1943Z and landed in Rocky MH at 2020Z.</p> <p>HS2 was launched at 2241Z to growing thunderstorms north of Rimbey. The flight became airborne out of Rocky MH at 2257Z. HS2 began base seeding storm #1 for Ponoka at 2309Z. Then at 0002Z (06/21) the aircraft continued seeding as they repositioned to a new storm northwest of Bentley. HS2 started base seeding storm #2 for Bentley at 0010Z (06/21). At 0022Z (06/21) HS2 was redirected to stronger cells near Gull Lake. The aircraft left their wing-tip generators on while enroute to this new storm. At 0036Z (06/21) they started base seeding storm #3 for Lacombe. HS2 then stopped seeding and RTB at 0100Z (06/21). They landed in YBW at 0132Z (06/21).</p> <p>HS3 was launched to an intensifying TITAN cell moving north of Rimbey at 2243Z. The aircraft was airborne at 2307Z. HS3 started top seeding storm #1 for Ponoka at 2325Z. HS3 then extended their line to near the Sylvan area, and they started top seeding this storm (#3) for Sylvan at 0018Z (06/21). At 0056Z (06/21) they stopped seeding and started patrolling the Sylvan area. HS3 RTB at 0109Z (06/21), and the aircraft landed at 0158Z (06/21).</p> <p>HS4 was launched at 2253Z to a tall thunderstorms north of the Bentley area. They were airborne at 2314Z. The flight started base seeding #1 for Ponoka at 2330Z. The aircraft then continued seeding as they extended their line to the southwest, and they started base seeding storm #3 for Sylvan at 0020Z (06/21).</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

		<p>At 0104Z (06/21) HS4 stopped seeding and RTB. The flight landed at 0215Z (06/21).</p> <p>HS5 was launched to new thunderstorm development northwest of Rocky MH at 2333Z. The flight became airborne at 2347Z. HS5 started patrolling the Rocky MH area at 0014Z (06/21). They RTB at 0112Z (06/21) and landed at 0134Z (06/21). No seeding occurred.</p> <p>Flight Summary HS2: 1925Z-2022Z; no seeding; reposition flight; takeoff YBW, land Rocky MH. HS2: 2251Z (06/20)-0134Z (06/21); 222 minutes wing-tip generators, 12 BIP; #1 Ponoka, #2 Bentley, #3 Lacombe; takeoff Rocky MH, land YBW. HS3: 2256Z (06/20)-0202Z (06/21); 166 EJ, 16 BIP; #1 Ponoka, #3 Sylvan. HS4: 2300Z (06/20)-0218Z (06/21); 188 minutes wing-tip generators, 2 BIP; #1 Ponoka, #3 Sylvan. HS5: 2342Z (06/20)-0136Z (06/21); no seeding; patrol Rocky MH.</p>
<p>June 21, Wednesday</p>	<p>Upper level jet energy looked to be present along the US/Canada border. A shortwave trough was forecast to push eastward across the southern part of AB in the afternoon. During the nighttime hours a trough was predicted to slide southeastward across AB. Westerly winds at the low levels and surface were expected to aid in keeping dew-points low during the daytime. Overnight, moisture looked to be advected into the region from the north. Modified model soundings for the afternoon and evening indicated the troposphere would possess 200 to 400J/kg of CAPE with ample bulk speed shear values near 40kts. The tropopause height was expected to be fairly low, approximately 27kft MSL.</p> <p>Towering cumulus clouds began growing over the region in the late morning. In the early afternoon, scattered thunderstorms developed over the entire area. Storm #1 formed west of Innisfail. This storm moved toward Olds. During the afternoon other thunderstorms formed over the region. Radar data indicated grape size hail may have fallen to the southeast of Linden. In the evening, scattered convective rain showers fell across the area. Overnight, a precipitation shield began to push southward into the northern part of the region.</p> <p>Pea size hail reported in southern Calgary and west of Sylvan.</p> <p>Max cell top: 9.1km, 59.2 max dBz, 33.3 max VIL</p> <p>Tmax YC = 20.3C and 0.2mm of rain. Tmax QF = 18.5C and 3.0mm of rain. Tmax Radar = 17.4C and 0.3mm of rain.</p>	<p>Radar tour #1 was conducted at the Olds-Didsbury airport. 15 mayors and city administrators were in attendance from cities and towns across the project area.</p> <p>HS5 flew a PR flight. They were airborne out of YBW at 1731Z and landed in EA3 at 1744Z.</p> <p>HS5 was launched at 2016Z to a growing thunderstorm west of Innisfail. The flight became airborne out of EA3 at 2022Z. HS5 started base seeding storm #1 for Olds at 2029Z. They then stopped seeding and started patrolling the Olds area at 2053Z. HS5 then RTB at 2056Z. They landed in EA3 at 2102Z.</p> <p>HS5 flew a return PR flight. They were airborne out of EA3 at 2217Z and landed in YBW at 2231Z.</p> <p>Flight Summary HS5: 1723Z-1745Z; no seeding; PR flight; takeoff YBW, land EA3. HS5: 2019Z-2105Z; 0 EJ, 3 BIP; #1 Olds; takeoff EA3, land EA3. HS5: 2214Z-2233Z; no seeding; PR flight; takeoff EA3, land YBW.</p>
<p>June 22, Thursday</p>	<p>The upper level trough was expected to continue sliding southeastward across southern AB during the early</p>	<p>No aircraft operations.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>afternoon. A shortwave trough then looked to follow behind the main trough at the time of peak heating. The majority of the PVA with this disturbance was forecast to stay east of the region. Windy northwesterly winds were predicted to persist at the low levels and surface through the nighttime hours. The afternoon and evening modified model soundings for the region indicated slightly more instability would be present over the southern half of the region. The primary trigger mechanism for convection was expected to be surface heating. Bulk speed shear values appeared to be only on the order of 5 to 15kts.</p> <p>During the morning hours a precipitation shield slid southward across the entire region. Gusty northwesterly winds were observed through the early evening. In the late evening and overnight hours scattered convective rain showers fell from the Calgary area and south.</p> <p>No TITAN cells, 47.1 max dBz, 3.9 max VIL</p> <p>Tmax YC = 16.9C and 0.3mm of rain. Tmax QF = 16.1C and no rain. Tmax Radar = 15.8C and 1.0mm of rain.</p>	
<p>June 23, Friday</p>	<p>Upper level jet energy was expected over the region throughout the period. Due to a ridge centered along the coast of BC, the area was predicted to see northwest flow at the mid-levels. Boundary layer and surface winds looked to favor upslope flow along certain parts of the foothills. The primary thunderstorm triggers were forecast to be jet PVA and elevated surface heating along the foothills. Convective temperatures were expected to be reached. Modified model soundings for Calgary were suggesting 200 to 300J/kg of CAPE would be available during the afternoon and early evening. 0 to 6km bulk speed shear values were expected to reach 20kts.</p> <p>Towering cumulus clouds began to develop over the western half of the region in the late morning. In the afternoon, the convective growth became stronger over the project area north of Calgary. Air mass thunderstorms formed near Rocky MH and east of Red Deer in the mid-afternoon. Radar data indicated pea size hail may have fallen to the east of Lacombe. Scattered convective rain showers continued into the evening and overnight hours.</p> <p>Max cell top: 6.9km, 57.4 max dBz, 23.9 max VIL</p> <p>Tmax YC = 20.2C and 1.2mm of rain. Tmax QF = 19.4C and a trace of rain. Tmax Radar = 18.8C and no rain.</p>	<p>No aircraft operations.</p>
<p>June 24, Saturday</p>	<p>The upper level jet was forecast to slowly shift eastward into SK late in the period. Nonetheless, jet PVA looked to occur over the region in the evening. Jet PVA appeared to be strongest early in the day. Low level and surface winds were expected to switch to northeasterly in the afternoon favoring upslope conditions. The 18Z and 21Z modified model soundings for the region showed a moderate amount of instability with 400 to 700J/kg CAPE. Bulk speed shear values would potentially reach 45kts in</p>	<p>No aircraft operations.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>certain areas, especially over the southeast quadrant of the project area. Convective temperatures were expected to be reached early in the afternoon.</p> <p>Scattered convective rain showers and isolated thunderstorms were observed over the region in the morning and afternoon. In the evening, the skies became clear, and these clear skies persisted through the rest of the period.</p> <p>Max cell top: 4.6km, 54.2 max dBz, 9.5 max VIL</p> <p>Tmax YC = 21.3C and no rain. Tmax QF = 21.0C and no rain. Tmax Radar = 20.6C and no rain.</p>	
<p>June 25, Sunday</p>	<p>A pronounced shortwave ridge was modeled to move across the project area Sunday. Warming temperatures aloft, combined with mid-level negative vorticity advection, were expected to foster a strong cap that would inhibit all convection. Weak PVA overnight was forecast to promote mid and upper level cloudiness overnight, but neither rain nor convection was anticipated.</p> <p>Very quiet conditions were observed through the period. No significant echoes were observed until a band of low clouds was detected from Sundre to Cochrane between 3-8Z (06/26), followed by a pronounced chinook arch cloud across much the entire western project area after 0830Z (06/26).</p> <p>Max cell top: 26.7 max dBz, 0.1 max VIL</p> <p>Tmax YC = 26.4C and no rain. Tmax QF = 24.7C and no rain. Tmax Radar = 24.0C and no rain.</p>	<p>No aircraft operations.</p>
<p>June 26, Monday</p>	<p>A large upper-level trough was forecast to move east across northern B.C. as a ridge exited the project area. A convective cap associated with this ridge was expected to stymie convection through most of the afternoon, but ultimately yield to extreme instability arising from anomalously warm temperatures and high surface moisture. Modest PVA was predicted to help orographic convection move off the foothills through the project area, and considerable shear was prognosticated to allow moderate to severe hail growth with this convection. Strong elevated convection was a predicted concern overnight, ending with a cold front moving southeast across the project area after midnight.</p> <p>Chinook arch clouds were observed Monday morning, slowly breaking up early Monday afternoon. A wave of weak convection moved across the mountains into the project area around 2230Z, eventually evolving into a very high-based thunderstorm west of Three Hills around 0Z (06/27). A second wave of linear weak convection approached the southwest project area, but failed to mature into an appreciable convective threat. A cold front was observed moving south across the project area between 5-10Z (06/27), but did not instigate any</p>	<p>HS1 was launched at 2221Z for developing convection northwest of Cremona. They were airborne at 2245Z. They began to patrol north of Cochrane at 2250Z. HS1 repositioned to patrol near Turner Valley at 2323Z. HS1 RTB to EA3 at 0110Z (06/27), and landed at 0124Z (06/27).</p> <p>HS4 was launched at 0008Z (06/27) for a line of convection moving east toward the southwest project area. They were airborne at 0025Z. HS4 began patrolling Calgary at 0053Z (06/27). They RTB at 0143Z (06/27) and landed at 0216Z (06/27).</p> <p>HS5 was launched at 0057Z (06/27) for developing convection west of Calgary. They were airborne at 0109Z (06/27). HS5 began patrolling Turner Valley at 0119Z (06/27). HS5 RTB at 0204Z (06/27), and landed at 0218Z (06/27).</p> <p>HS2 was launched at 0052Z (06/27) for developing convection in the southwest project</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>convection.</p> <p>Max cell top: 8.4km, 53.8 max dBz, 10.4 max VIL</p> <p>Tmax YC = 32.1C and a trace of rain. Tmax QF = 27.4C and no rain. Tmax Radar = 28.9C and a trace of rain.</p>	<p>area. They were airborne at 0115Z (06/27). They began patrolling Calgary at 0119Z (06/27). HS2 RTB at 0212Z (06/27), and landed at 0223Z (06/27).</p> <p>HS1 flew a reposition flight. They were airborne from EA3 at 0240Z (06/27) and landed in YBW at 0256Z (06/27).</p> <p>Flight Summary HS1: 2232Z (06/26)-0128Z (06/27); no seeding; patrol Cochrane, Turner Valley; takeoff YBW, land EA3. HS4: 0017Z-0219Z (06/27); no seeding; patrol Calgary to Turner Valley. HS5: 0104Z-0220Z (06/27); no seeding; patrol Turner Valley. HS2: 0106Z-0226Z (06/27); no seeding; patrol Calgary to Turner Valley. HS1: 0232Z-0258Z (06/27); no seeding; reposition flight; takeoff EA3, land YBW.</p>
<p>June 27, Tuesday</p>	<p>An upper-level low was predicted to slide southeast into central Alberta Tuesday bringing significant PVA to the northern project area. Surface conditions were drier and cooler than Monday, with instability modeled to remain below 500 J/kg. A low level cap was forecast to inhibit convection through much of the afternoon, though a more conducive window for convective opportunity was identified between 0-3Z (06/28). Given the limited CAPE and unimpressive shear, this threat was not anticipated to produce an appreciable hail risk. Stable conditions were forecast to resume after midnight.</p> <p>Clear, quiet conditions were observed Tuesday morning. During the mid-afternoon, a thunderstorm began to form over the western boundary of the project area near Cremona. This thunderstorm (storm #1) pushed east-southeastward across the protected area during the afternoon, eventually moving through Airdrie and the northern part of the Calgary area. This storm then moved through Strathmore in the early evening. In the late afternoon, cumulonimbus clouds develop from Rocky MH down to Cremona. Several TITAN cells developed over the central part of the project area. A thunderstorm then grew to the south of Sundre. This storm (#2) moved southeastward through Cremona and Crossfield during the late evening hours. No significant weather was observed after midnight.</p> <p>Pea size hail was observed in Airdrie. Loonie size hail was reported north of Calgary. Nickle to quarter size hail reported in the town of Dogpound. Dime size on the QE2 near Crossfield.</p> <p>Max cell top: 9.9km, 60.6 max dBz, 39.4 max VIL</p> <p>Tmax YC = 21.8C and no rain. Tmax QF = 21.1C and 0.6mm of rain. Tmax Radar = 20.2C and 0.3mm of rain.</p>	<p>HS2 was launched at 2223Z for a pulsing convective cell west-northwest of Airdrie. They were airborne at 2243Z. At 2251Z HS2 began seeding storm #1 for Airdrie. HS2 then continued seeding this storm as it moved toward Calgary and Strathmore. The crew reported being restricted by air traffic control at 2340Z and 2351Z. At 0043Z (06/28) they stopped seeding and RTB. The aircraft landed at 0103Z (06/28).</p> <p>HS3 was launched to a long-lived thunderstorm moving toward Airdrie and Strathmore at 2301Z. The flight became airborne at 2322Z. At 2341Z the aircraft started top seeding storm #1 for Calgary. Pilots encountered significant restrictions over northern Calgary while trying to seed near YYC. The aircraft continued seeding this storm as it moved toward Strathmore. HS3 then stopped seeding and was redirected at 0044Z (06/28) to new convective growth to the northwest of Sundre. At 0112Z (06/28) the aircraft began patrolling the Sundre area. HS3 was then low of fuel, so they RTB at 0133Z (06/28). The flight landed at 0144Z (06/28).</p> <p>HS5 was launched at 2356Z to new convective growth to the northwest of Sundre. The aircraft was airborne at 0011Z (06/28). At 0031Z (06/28) HS5 started base seeding storm #1 for Strathmore. At 0040Z (06/28) HS5 stopped seeding and was repositioned to a growing storm northwest of Sundre. HS5 then RTB at 0049Z (06/28). At 0100Z (06/28) the aircraft landed.</p> <p>HS4 was launched to a TITAN cell northwest of Sundre at 0112Z (06/28). The flight became airborne at 0129Z (06/28). HS4 started</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

		<p>patrolling Cochrane at 0200Z (06/28). At 0301Z (06/28) they repositioned to the Crossfield area. HS4 began patrolling from Cremona to Crossfield at 0313Z (06/28). At 0345Z (06/28) HS4 RTB, and landed at 0410Z (06/28).</p> <p>HS1 was launched at 0230Z (06/28) to a cluster of TITAN cells near the Sundre area. The aircraft was airborne at 0244Z (06/28). At 0259Z (06/28) HS1 started top seeding storm #2 for Cremona. The crew continued seeding this storm as it approached Airdrie. At 0501Z (06/28) they stopped seeding and started patrolling the Cochrane area. The aircraft RTB at 0533Z (06/28) and landed at 0542Z (06/28).</p> <p>HS2 was launched to a long-lived thunderstorm near Cremona at 0315Z (06/28). The flight became airborne at 0338Z (06/28). At 0348Z (06/28) they began patrolling the Crossfield area. At 0358Z (06/28) the crew reported aircraft control was restricting them from flying close to the thunderstorm. Then at 0408Z (06/28) HS2 RTB and landed at 0420Z (06/28).</p> <p>Flight Summary HS2: 2233Z (06/27)-0105Z (06/28); 224 minutes wing-tip generators, 18 BIP; #1 Airdrie, Calgary, and Strathmore. HS3: 2315Z (06/27)-0149Z (06/28); 122 EJ, 14 BIP; #1 Calgary to Strathmore; patrol Sundre. HS5: 0005Z-0101Z (06/28); 0 EJ, 2 BIP; #1 Strathmore. HS4: 0123Z-0415Z (06/28); no seeding; patrol Cochrane, Crossfield, and Cremona. HS1: 0238Z-0545Z (06/28); 178 EJ, 14 BIP; #2 Cremona to Crossfield; patrol Cochrane. HS2: 0329Z-0424Z (06/28); no seeding; patrol Crossfield.</p>
<p>June 28, Wednesday</p>	<p>A large upper-level low in central Alberta was predicted to move south over the project area Wednesday afternoon. Strong PVA associated with this feature was forecast to instigate periods of rain and thundershowers moving south across the region. A moderate hail threat was anticipated despite widespread clouds and modest shear, particularly for convection developing behind scattered pockets of clearing expected Wednesday afternoon. Scattered rain showers were forecast to continue overnight, gradually ending Thursday morning.</p> <p>Widespread clouds with embedded weak rain showers moved south across the project area Wednesday morning. Stronger convective cells began to occur near breaks in the cloud cover around 20Z, with a particularly strong cell developing just southwest of Calgary around 2130Z. This cell, storm #1, was seeded as it clipped far southern Calgary and threatened Okotoks. It dissipated by 2230Z, but produced radar-indicated grape size hail on the far southwest corner of Calgary. Scattered convective rain showers continued into the evening and overnight</p>	<p>Radar tour #2 was conducted at the Olds-Didsbury airport. 22 individuals were in attendance.</p> <p>HS5 flew a PR flight. They were airborne from YBW at 1729Z, and landed in EA3 at 1744Z.</p> <p>HS5 was launched for strong convection southwest of Calgary at 2136Z. They were airborne from EA3 at 2146Z. HS5 began top seeding storm #1 Okotoks at 2207Z. HS5 stopped seeding and continued patrolling Okotoks at 2226Z. They RTB at 2237Z, and landed in YBW at 2258Z.</p> <p>HS1 was launched at 2145Z for strong convection southwest of Calgary. They were airborne at 2202Z. HS1 started base seeding storm #1 Okotoks at 2210Z. HS1 stopped seeding and RTB at 2226Z. They landed at 2241Z.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>hours, though no other hail threats were observed.</p> <p>Max cell top: 9.9km, 59.6 max dBz, 41.3 max VIL</p> <p>Tmax YC = 20.0C and a trace of rain. Tmax QF = 16.3C and no rain. Tmax Radar = 16.4C and no rain.</p> <p>Pea size hail in far southwest Calgary.</p>	<p>Flight Summary HS5: 1722Z-1747Z; no seeding; PR flight; takeoff YBW, land EA3. HS5: 2142Z-2300Z; 18 EJ, 2 BIP; #1 Okotoks. HS1: 2151Z-2243Z; 0 EJ, 2 BIP; #1 Okotoks.</p>
<p>June 29, Thursday</p>	<p>Northerly upper-level flow was observed across the Alberta as the region lay between a broad ridge in the Pacific Northwest and a deep trough extending across the Canadian Prairies. NVA behind the upper-level trough was forecast to create hostile thermodynamic conditions, with only shallow convection expected. No synoptic sources of lift were prognosticated, and orographic convection was forecast to remain along the foothills. Weak showers were expected Thursday night with a subtle wave of PVA, but no thunderstorms or hail threats were forecast.</p> <p>A cluster of embedded rain showers moved south-southeast inside the project area between 12Z and 18Z, nearly paralleling the western project border. Skies then cleared Thursday afternoon, with no significant weather. Discrete convective showers moved southeast between Sundre and Airdrie between 4Z and 7Z (06/30) Thursday night producing the day's highest radar metrics, but did not produce lightning nor become a TITAN cell.</p> <p>Max cell top: 46.3 max dBz, 3.7 max VIL</p> <p>Tmax YC = 22.7C and no rain. Tmax QF = 22.1C and no rain. Tmax Radar = 21.5C and no rain.</p>	<p>No aircraft operations.</p>
<p>June 30, Friday</p>	<p>A shortwave ridge was projected to move east toward the project area Friday, with no synoptic convective triggers anticipated. Mesoscale upslope flow was forecast to lead to convection along the foothills, with mid-level flow sufficient to bring this activity into the western project area. A cap near 400mb was expected to keep deep convection from occurring. No significant weather was predicted overnight.</p> <p>Weak embedded rain showers moved southeast across the northeast project area Friday morning, followed by mostly clear skies much of Friday afternoon. Isolated weak convective showers moved off of the foothills into the far western project area between 23Z and 0130Z (07/01), but never posed any convective threat in the project area. Quiet conditions were then observed until 6Z (07/01), when a broken line of elevated convection intensified as it moved southeast near Red Deer. This convection produced lightning in and southeast of Red Deer, though it never became a radar-indicated hail threat. All activity weakened and departed the project area by 10Z (07/01).</p> <p>Max cell top: 6.9km, 56.8 max dBz, 12.7 max VIL</p>	<p>No aircraft operations.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>Tmax YC = 27.5C and no rain. Tmax QF = 25.8C and 0.4mm of rain. Tmax Radar = 25.3C and no rain.</p>	
<p>July 1, Saturday</p>	<p>An upper-level ridge axis was modeled to slide east of the region Saturday as a longwave trough moved onshore in B.C. Southeasterly low-level flow was projected to provide warm moist air advection through the period, as well as provide low-level directional shear with westerly winds aloft. Instability was forecast to be very high, with CAPE values exceeding 1,000 J/kg across the project area. Speed shear was not particularly strong; however it was predicted to be sufficient for multicellular storm growth. Convection was forecast to fire along the foothills early Saturday afternoon and spread east across the project area through Saturday evening. A moderate to large hail threat was anticipated, along with severe convective downdrafts.</p> <p>Convection developed quickly Saturday, with thunderstorms spreading southeast along the foothills from 17Z to 19Z. Convection west of Cochrane prompted the first hailstop missions around 19Z, though this activity initially floundered away from the foothills. Further north, convection was able to survive in the western project area, with one storm (storm #1) moving east toward Sundre between 1930-20Z. This cell eventually weakened and merged with other convection into a broad line of thunderstorms that stretched from the foothills west of Cremona north beyond the northern project boundary. Storm #3 was identified as a segment of this line in the northern project area, and was seeded as it moved east threatening Sylvan and eventually Red Deer. Storm #2 developed on the southern flank of this line of storms around 20Z, and was seeded until a higher priority cell developed northwest of Cochrane. Storm #4 was a discrete thunderstorm that began to move off the foothills west of Turner Valley around 2130Z. The cell produced the highest radar-indicated hail of the day, and was seeded until it dissipated north of Black Diamond at 22Z. Storm #5 was a quickly developing storm west of Cochrane at 22Z. It was seeded briefly until it dissipated west of town. Storm #6 was a regeneration of storm #2 near the southern flank of the line of convection. It was seeded as it threatened Airdrie and later Irricana as it moved east with the line. Storm #7 was a cluster of quickly developing storms between Cochrane and Calgary. They were seeded until they dissipated and moved through Calgary. Storm #8 was another area of convection south of storm #7 (southwest of Calgary). It was seeded as it moved across the project boundary toward Calgary, but it dissipated before arriving in town. Finally, storm #9 was an elevated cluster of strong storms moving ENE into the southwest corner of the project area around 4Z (07/02). The northeast leading cell in this cluster, storm #9, was seeded as it approached Okotoks, but it weakened as it moved toward the QE2. Dissipating thundershowers continued to track across the project area until 9Z, with dense fog developing through the overnight hours.</p>	<p>HS5 was launched at 1907Z for convection developing west of Bragg Creek. They were airborne at 1925Z, and were redirected to stronger convection west of Sundre. HS5 started top seeding storm #1 Sundre at 1951Z. HS5 had an in-flight emergency with smoke in the cabin, and RTB to EA3 at 2007Z. They landed safely at EA3 at 2014Z, and determined the aircraft was safe to continue flying.</p> <p>HS2 was launched at 1907Z for convection developing west of Bragg Creek. They were airborne at 1929Z, and were redirected to stronger convection west of Sundre. HS2 began base seeding storm #1 Sundre at 1950Z. HS2 stopped seeding and RTB at 2036Z. They landed at 2053Z.</p> <p>HS4 was launched at 2014Z for a line of storms heading east across the northern project area. They were airborne at 2036Z, but landed back in YQF briefly to fix a wing-tip generator issue. They began base seeding storm #3 Sylvan at 2100Z. At 2157Z HS4 repositioned along a line of convection to southwest of Didsbury, seeding in transit. HS4 continued seeding with storm #7 Calgary at 2226Z. HS4 stopped seeding and RTB at 2316Z. They landed at 2353Z.</p> <p>HS5 was relaunched at 2025Z for a strong thunderstorm west of Caroline. They were airborne from EA3 at 2028Z. HS5 began top seeding storm #2 Cremona at 2042Z. At 2056Z they descended to 12kft and continued to seed storm #2 with BIPs. HS5 stopped seeding and repositioned to new development northwest of Cochrane at 2200Z. They began base seeding storm #5 Cochrane at 2206Z. HS5 stopped seeding and RTB at 2216Z. They landed at YBW at 2221Z.</p> <p>HS3 was launched at 2100Z ahead of a line of convection overspreading Red Deer. They were airborne at 2120Z. HS3 began top seeding storm #2 Carstairs at 2147Z. HS3 stopped seeding and repositioned east to shed ice and patrol Acme at 2209Z. HS3 repositioned toward Springbank at 2218Z. They started seeding storm #6 Airdrie at 2224Z. HS3 stopped seeding and descended to shed ice and patrol Strathmore at 2240Z. They RTB at 0020Z (07/02), and landed at 0048Z (07/02).</p> <p>HS2 was launched at 2117Z for a strong thunderstorm northwest of Turner Valley. They were airborne at 2137Z. HS2 began base</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>Max cell top: 12.9km, 62.9 max dBz, 68.8 max VIL</p> <p>Tmax YC = 25.3C and 2.0mm of rain. Tmax QF = 25.7C and 4.0mm of rain. Tmax Radar = 23.8C and 0.3mm of rain.</p>	<p>seeding storm #4 TVBD at 2150Z. They stopped seeding but continued to patrol convection near Okotoks at 2213Z. HS2 repositioned toward Cochrane at 2226Z. HS2 started seeding storm #7 Cochrane at 2238Z. HS2 repositioned toward storm #6 east of Airdrie at 2305Z, seeding in-transit. They began seeding storm #6 Irricana at 2321Z. At 0001Z (07/02) HS2 stopped seeding and RTB. They landed at 0038Z (07/02).</p> <p>HS1 was launched at 2117Z for a strong thunderstorm northwest of Turner Valley. They were airborne at 2139Z. HS1 began top seeding storm #4 TVBD at 2150Z. HS1 stopped seeding at 2218Z and descended to shed ice east of Okotoks. HS1 repositioned toward Calgary and climbed back to top seeding altitude at 2235Z. HS1 started seeding storm #8 Calgary at 2246Z. HS1 repositioned north to storm #7 Calgary at 2308Z, seeding in-transit. HS1 stopped seeding and RTB at 2338Z. They landed at 2349Z.</p> <p>HS1 was launched at 0402Z (07/02) for strong elevated convection west of High River. They were airborne at 0421Z (07/02). HS1 began top seeding storm #9 Okotoks at 0431Z (07/02). They stopped seeding and RTB at 0441Z (07/02), and landed at 0453Z (07/02).</p> <p>Flight Summary HS5: 1918Z-2015Z; 18 EJ, 3 BIP; #1 Sundre; takeoff YBW, land EA3. HS2: 1916Z-2056Z; 92 min wing-tip generators, 7 BIP; #1 Sundre. HS4: 2025Z-2357Z; 280 min wing-tip generators; 16 BIP; #3 Sylvan to Red Deer, #7 Calgary. HS5: 2026Z-2223Z; 6 EJ, 16 BIP; #2 Cremona to Carstairs, #5 Cochrane. HS3: 2109Z (07/01)-0053Z (07/02); 190 EJ, 8 BIP; #2 Carstairs, #6 Airdrie, patrol Acme, patrol Strathmore. HS2: 2131Z (07/01)-0040Z (07/02); 212 min wing-tip generators, 8 BIP; #4 Turner Valley, #7 Cochrane, #6 Irricana, patrol Okotoks. HS1: 2131Z-2352Z; 150 EJ, 13 BIP; #4 Turner Valley, #8 Calgary, #7 Calgary, patrol Okotoks. HS1: 0412Z-0456Z (07/02); 0 EJ, 2 BIP; #9 Okotoks.</p>
<p>July 2, Sunday</p>	<p>Southwesterly flow was predicted to be present at the mid and upper levels of the troposphere. A few small and weak lobes of PVA looked to push northeastward across the region in the afternoon and evening. Low level and surface winds were expected to switch to southeasterly starting in the mid-afternoon. The main thunderstorm trigger mechanism looked to be elevated surface heating along the foothills during the afternoon hours. Modified model soundings for the region showed anywhere from</p>	<p>No aircraft operations.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>500 to 800J/kg of CAPE for the afternoon and evening. Dew-points appeared to be higher over the northern part of the region.</p> <p>Mostly clear skies were observed through the mid-afternoon. In the late afternoon a line of towering cumulus clouds formed near Three Hills. Towering cumulus clouds were also seen along the foothills at the time of peak heating. Overnight, a cool front pushed southward across the northern part of the area producing stratiform cloud cover and breezy conditions across the region.</p> <p>No TITAN cells, 14.2 max dBz, 0.1 max VIL</p> <p>Tmax YC = 28.7C and no rain. Tmax QF = 27.1C and no rain. Tmax Radar = 25.9C and no rain.</p>	
<p>July 3, Monday</p>	<p>Jet energy looked to be centered just to the north of the area as a mid and upper closed low tracked eastward along the NWT/AB border. A shortwave trough was forecasted to be associated with the low and was expected to slide across the region in the late afternoon and early evening. Weak PVA was predicted with the shortwave trough. Dew-points at the surface and within the boundary layer looked to be in the lower teens which would be sufficient for thunderstorms with hail. Area soundings for the late afternoon and evening suggested a moderate amount of instability would be present. The close proximity of the jet stream was expected to allow bulk speed shear values to reach 35kts in places. Deep layer shear looked to be even stronger.</p> <p>A thunderstorm began to form northwest of Rocky MH at roughly 2030Z. This storm (#1) pushed eastward along the far northern part of the project area in the mid-afternoon. During this same time, thunderstorms also formed west of Sundre and Rocky MH. Another storm (#2) then grew to the west of the original storm and tracked eastward through Bentley, Lacombe, and Blackfalds. Radar data indicated walnut size hail may have fallen north of Eckville from this storm. At 2230Z convection quickly intensified into a storm (#3) northwest of Rocky MH. Storm #3 moved through Eckville, Sylvan, and then lastly through Red Deer. At this same time convection formed west of Calgary, and moved through the southern part of the city. The fourth storm of the day grew near the town of Caroline and then moved through the Innisfail and Bowden area. Another TITAN cell (storm #5) then formed southwest of Caroline at approximately 0100Z (07/04) and tracked through Sundre, Olds, and Didsbury. During the late evening, this line of thunderstorms slowly moved southeastward through the Linden, Acme, Beiseker, and Irricana area. The thunderstorm activity shifted to the east of the protected area during the nighttime hours.</p> <p>Pea size hail reported at Gull Lake. Terry Krauss reported pea size hail at his house in Red Deer.</p>	<p>HS4 was launched to a long-lived TITAN cell west of Rimbey at 2155Z. The flight became airborne at 2217Z. They began patrolling Rimbey at 2244Z. At 2245Z they were redirected to another TITAN cell to the west of Rimbey. HS4 then began base seeding storm #2 at 2249Z for Bentley. At 2300Z they continued seeding as they repositioned to the northwest of Rocky MH. HS4 began base seeding storm #3 for Rocky MH at 2305Z. They then repositioned back over to storm #2 at 2318Z. At 2324Z the aircraft started base seeding #2 for Lacombe/Blackfalds. HS4 then continued seeding as they repositioned back over storm #3 at 2346Z. The aircraft began base seeding storm #3 for Sylvan at 2351Z. At 0057Z (07/04) HS4 stopped seeding and RTB. They landed at 0110Z (07/04).</p> <p>HS3 was launched at 2158Z to a growing supercell west of Rimbey. The aircraft was airborne out of YQF at 2225Z. The flight started top seeding storm #1 for Lacombe at 2244Z. At 2303Z they stopped seeding and were redirected to a stronger storm (#2) to the west. HS3 then started top seeding storm #2 for Lacombe/Blackfalds at 2310Z. The aircraft was then running low on seeding material, so they stopped seeding and RTB at 0014Z (07/04). The flight landed in EA3 at 0026Z (07/04).</p> <p>HS5 was launched to convection west of Sundre at 2213Z. The flight was airborne at 2225Z. At 2240Z HS5 began patrolling the Cremona area. They then repositioned to the northwest of Rocky MH at 2251Z. At 2306Z the aircraft was repositioned to new convection developing west of Calgary. HS5 was then redirected to the north of Eckville at 2313Z. At 2327Z they began base seeding storm #2 for Lacombe/Blackfalds. HS5 stopped seeding and was redirected over to storm #3 at 2352Z. They started base seeding storm #3 for Sylvan at</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>Max cell top: 10.6km, 66.0 max dBz, 83.0 max VIL</p> <p>Tmax YC = 24.5C and no rain. Tmax QF = 23.2C and 1.8mm of rain. Tmax Radar = 22.5C and 5.1mm of rain.</p>	<p>2359Z. At 0057Z (07/04) they stopped seeding and RTB. The aircraft landed at 0132Z (07/04).</p> <p>HS1 was launched at 2318Z to a growing storm west of Calgary. The flight became airborne at 2336Z and was redirected to a stronger storm west of Sylvan. At 0000Z (07/04) HS1 started top seeding storm #3 for Sylvan/Red Deer. At 0048Z (07/04) they were out of ejectable flares and iced up, so they RTB. They landed at 0109Z (07/04).</p> <p>HS2 was launched to intensifying convection west of Calgary at 2318Z. The aircraft was airborne at 2339Z and started patrolling Calgary. HS2 was then redirected to the Olds area at 0000Z (07/04). At 0027Z (07/04) the aircraft began patrolling Olds. At 0028Z (07/04) they repositioned to a TITAN cell near Caroline. HS2 started base seeding storm #4 for Innisfail at 0036Z (07/04). At 0135Z (07/04) the aircraft continued seeding as they repositioned to a storm north of Sundre. Then at 0143Z (07/04) HS2 started base seeding storm #5 for Olds. At 0202Z (07/04) the flight stopped seeding and began patrolling the Didsbury area. The flight RTB at 0206Z (07/04) and landed at 0223Z (07/04).</p> <p>HS3 was launched at 0040Z (07/04) to a new TITAN cell northwest of Sundre. The aircraft was airborne out of EA3 at 0116Z (07/04). At 0126Z (07/04) they started top seeding storm #5 for Sundre. HS3 stopped seeding and started patrolling for Olds at 0146Z (07/04). They were then redirected to Cochrane area at 0215Z (07/04). The aircraft began patrolling the Cochrane area at 0230Z (07/04). At 0324Z (07/04) they RTB and landed in YQF at 0335Z (07/04).</p> <p>HS4 flew a maintenance flight. The aircraft was airborne at 0239Z (07/04) and landed at 0245Z (07/04).</p> <p>Flight Summary HS4: 2211Z (07/03)-0114Z (07/04); 256 minutes wing-tip generators, 19 BIP; patrol Rimbey, #2 Bentley and Lacombe/Blackfalds, #3 Rocky MH to Sylvan to Red Deer. HS3: 2217Z (07/03)-0028Z (07/04); 289 EJ, 20 BIP; #1 Lacombe, #2 Lacombe/Blackfalds; takeoff YQF, land EA3. HS5: 2218Z (07/03)-0135Z (07/04); 0 EJ, 24 BIP; patrol Cremona, #2 Lacombe/Blackfalds, #3 Sylvan. HS1: 2326Z (07/03)-0111Z (07/04); 305 EJ, 12 BIP; #3 Sylvan/Red Deer. HS2: 2328Z (07/03)-0226Z (07/04); 172 minutes wing-tip generators, 9 BIP; patrol Calgary, #4 Innisfail, #5 Olds, patrol Didsbury.</p>
--	--	--

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

		<p>HS3: 0112Z-0338Z (07/04); 43 EJ, 0 BIP; #5 Sundre, patrol Olds, patrol Cochrane; takeoff EA3, land YQF. HS4: 0232Z-0250Z (07/04); no seeding; maintenance flight.</p>
<p>July 4, Tuesday</p>	<p>Upper level jet energy was expected to be centered near the Edmonton area. The area was forecast to see southwest flow at the mid-levels with little to no PVA. At the low levels and surface, lee cyclogenesis looked to occur near the Rocky MH area starting around the time of peak heating. This low was then expected to track eastward from the evening into the overnight hours. Upslope conditions were predicted to the north of the low and downslope conditions appeared to occur to the south. A dry line looked to be present near the foothills. Modified model soundings for CYQF showed a curved hodograph from the surface up to 15kft with ample bulk speed shear and instability for severe thunderstorms with hail.</p> <p>A chinook arch cloud was observed over most of the project area from the morning into the early afternoon hours. The widespread chinook arch cloud coverage allowed less surface heating to occur than was predicted. Scattered cirrus and cumulus clouds were seen over the region in the late afternoon and evening. At 0430Z (07/05) convection began to grow over the northeastern quadrant of the project area. This convection grew into scattered thunderstorms which intensified to the east of Ponoka and Lacombe. The storms then tracked eastward out of the protected area during the early nighttime hours.</p> <p>Grape size hail reported in the town of Mirror which is east of Lacombe.</p> <p>Max cell top: 8.4km, 57.9 max dBz, 30.8 max VIL</p> <p>Tmax YC = 27.7C and no rain. Tmax QF = 23.8C and no rain. Tmax Radar = 23.9C and no rain.</p>	<p>HS4 flew a maintenance flight. The aircraft was airborne at 1752Z and landed at 1801Z.</p> <p>Flight Summary HS4: 1732Z-1805Z; no seeding; maintenance flight.</p>
<p>July 5, Wednesday</p>	<p>A mid and upper level ridge of high pressure was forecasted to build along the BC/AB border. A wave of PVA was expected to move through the flow of the ridge overnight. This PVA looked to potentially trigger off convection over the northern part of the project area overnight. The afternoon and evening model thermodynamic soundings for the region showed a strong cap would be in place throughout the daytime. The CYQF overnight soundings indicated enough instability for elevated thunderstorms during the overnight hours. PVA looked to be relatively weak overnight.</p> <p>Cirrus clouds were observed flowing over the region through the early nighttime hours. Starting around 0830Z (07/06), scattered convective rain showers fell in the northern buffer zone to the northeast of Ponoka. These showers lasted for a little over an hour before shifting east of the area.</p> <p>No TITAN cells, 38.9 max dBz, 1.4 max VIL</p>	<p>No aircraft operations.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>Tmax YC = 26.6C and no rain. Tmax QF = 24.6C and no rain. Tmax Radar = 23.4C and no rain.</p>	
July 6, Thursday	<p>A moderately strong ridge of high pressure was expected to continue building over the BC/AB border. No major disturbances were predicted to move through the flow of the ridge. 500mb temperatures were forecasted to warm by around 1C during the day. The low levels and surface appeared to see wind flow favoring upslope conditions along the foothills. Southeast moisture advection was expected. Temperatures and dew-points were forecasted to be very high across the region. The 00Z (07/08) modified model sounding for CYQF indicated a loaded gun situation. Area soundings showed anywhere from 800 to 1500J/kg of CAPE across the region at the time of peak heating. Bulk speed shear values looked to be around 20kts.</p> <p>The project area remained capped throughout the period. Weak convection formed along the foothills from the late afternoon through the time of sunset. This convection did not move into the protected area.</p> <p>No TITAN cells, 15.7 max dBz, 0.1 max VIL</p> <p>Tmax YC = 30.0C and no rain. Tmax QF = 28.0C and no rain. Tmax Radar = 27.8C and no rain.</p>	<p>HS2 flew a maintenance flight. They became airborne at 0052Z (07/07) and landed at 0056Z (07/07).</p> <p>Flight Summary HS2: 0043Z-0058Z (07/07); no seeding; maintenance flight.</p>
July 7, Friday	<p>An upper level jet streak was expected to begin nosing its way into AB from the southwest in the evening. A shortwave trough with moderately strong PVA looked to begin pushing northeastward across the area starting in the evening. Lee cyclogenesis was forecast to occur in the evening. Surface winds looked to be from the east to southeast favoring upslope flow. Modified model soundings for the area showed a loaded gun air mass in place. The cap appeared to be strong enough to hold back thunderstorm development until the mid-evening. The 0 to 6km bulk speed shear values looked to range from 20 to 30kts across the region. Elevated instability was expected to linger across the area through morning hours the next day.</p> <p>Isolated tall thunderstorms began forming along the foothills during the mid-afternoon. These storms were back building and initially stayed along the foothills. The thunderstorms started to move into protected area in the mid-evening. Storm #1 formed west of Rocky MH around 0230Z (07/08) and briefly appeared to be a hail threat for the town. It ultimately passed well north of town around 0345Z (07/08). Radar data indicated grape size hail may have fallen northwest of Rocky MH. Elevated thunderstorms with rain showers continued to form over the northern half of the region well into the overnight hours. The convective activity eventually shifted to the northeast of the area starting around 0800Z (07/08).</p> <p>Max cell top: 12.1km, 64.5 max dBz, 65.8 max VIL</p>	<p>HS5 was launched at 0147Z (07/08) to convection threatening the Rocky MH area. The flight became airborne at 0209Z (07/08). HS5 began to patrol Eckville at 0233Z (07/08). They repositioned west toward strong convection west of Rocky MH at 0248Z (07/08). HS5 began patrolling Rocky MH at 0253Z (07/08). HS5 began top seeding storm #1 Rocky MH at 0259Z (07/08). They stopped seeding but continued patrolling Rocky MH at 0304Z (07/08). HS5 repositioned back to weak convection west of Red Deer at 0309Z (07/08). They began patrolling Sylvan at 0321Z (07/08). HS5 RTB at 0329Z (07/08), and landed at 0353Z (07/08).</p> <p>HS4 flew a maintenance flight. The aircraft was airborne at 0241Z (07/08) and landed at 0250Z (07/08).</p> <p>Flight Summary HS5: 0156Z-0355Z (07/08); 12 EJ, 0 BIP; #1 Eckville, patrol Rocky MH, patrol Sylvan. HS4: 0233Z-0256Z (07/08); no seeding; maintenance flight.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>Tmax YC = 33.0C and no rain. Tmax QF = 29.4C and 0.2mm of rain. Tmax Radar = 28.9C and no rain.</p>	
July 8, Saturday	<p>The mid and upper level ridge centered over AB was forecast to flatten during the period. A weak shortwave trough appeared to move northeastward across southern AB in the late afternoon into early evening. A hot and moist air mass was expected to remain in place throughout the day and night with upslope conditions likely near and along the foothills. Area soundings showed a loaded gun situation with a very unstable air mass in place across the entire region. 700mb and 600mb wind speeds looked to be sufficient enough to push thunderstorms off the foothills. The cap was expected to slowly erode during the afternoon hours. 0 to 6km bulk speed shear values were predicted to be around 20kts.</p> <p>Isolated thunderstorms started forming along the northern foothills starting at approximately 1900Z. Some of these thunderstorms grew tall but then dissipated as they moved toward the western boundary of the project area. At roughly 0115Z (07/09) a tall thunderstorm (storm #1) formed to the northwest of Cochrane. This storm became tall and moved toward Cochrane and CYBW. The TITAN cell gradually diminished as it moved into the project area west of Calgary in the late evening. Radar data showed that grape size hail may have fallen to the southwest of Cochrane. No significant weather occurred during the nighttime hours.</p> <p>Max cell top: 12.1km, 61.2 max dBz, 57.2 max VIL</p> <p>Tmax YC = 28.5C and no rain. Tmax QF = 26.9C and no rain. Tmax Radar = 26.4C and no rain.</p>	<p>HS4 flew a reposition flight. The flight became airborne out of YQF at 2032Z and landed in Rocky MH at 2054Z.</p> <p>HS4 flew a reposition flight. The aircraft was airborne out of Rocky MH at 2258Z and landed in YQF at 2317Z.</p> <p>HS5 was launched at 0145Z (07/09) to a strengthening thunderstorm northwest of Cochrane. They became airborne at 0157Z (07/09) and began patrolling Cochrane. At 0209Z (07/09) HS5 started top seeding storm #1 for Cochrane. They then stopped seeding and started patrolling the Calgary area at 0323Z (07/09). The aircraft RTB at 0326Z (07/09) and landed at 0332Z (07/09).</p> <p>HS2 was launched to a long-lived thunderstorm threatening Cochrane at 0212Z (07/09). The aircraft was airborne at 0230Z (07/09). At 0237Z (07/09) the flight started base seeding storm #1 for Cochrane. They then stopped seeding and started patrol Calgary at 0315Z (07/09). HS2 RTB at 0326Z (07/09) and landed at 0330Z (07/09).</p> <p>HS1 was launched at 0233Z (07/09) to a tall and intensifying storm tracking toward Cochrane and Calgary. The aircraft was airborne at 0253Z (07/09) and began patrolling Calgary. At 0332Z (07/09) HS1 RTB and landed at 0343Z (07/09).</p> <p>Flight Summary HS4: 2021Z-2057Z; no seeding; reposition flight; takeoff YQF, land Rocky MH. HS4: 2246Z-2323Z; no seeding; reposition flight; takeoff Rocky MH, land YQF. HS5: 0153Z-0335Z (07/09); 256 EJ, 10 BIP; #1 Cochrane; patrol Calgary. HS2: 0222Z-0335Z (07/09); 76 minutes wing-tip generators, 5 BIP; #1 Cochrane; patrol Calgary. HS1: 0246Z-0347Z (07/09); no seeding; patrol Calgary.</p>
July 9, Sunday	<p>A broad upper level ridge was expected to move east through the day as a shortwave trough advances across the project area. Modest PVA was modeled to occur with this feature, along with slowly cooling mid-level temperatures. A strong cap was observed across the project area, but was forecast to break down from the foothills east through the afternoon. Extreme CAPE and low-level moisture were forecast to build in the early afternoon. Shear was only modest, but was anticipated to be sufficient for multicell and isolated supercell</p>	<p>HS1 was launched at 1819Z for developing convection west of Calgary. They were airborne at 1840Z and immediately began patrolling Calgary. HS1 began seeding storm #1 Calgary at 1945Z. HS1 stopped seeding and RTB at 2003Z. They landed at 2014Z.</p> <p>HS2 was launched at 1819Z for developing convection west of Calgary. They were airborne at 1845Z and immediately began patrolling</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>development. A cold front was modeled to drop southeast across the project overnight, ending the convective threat for the period.</p> <p>Quiet, hazy morning skies gave way to elevated clouds approaching the southwest project area around noon. Surface based convection began developing with this activity along the foothills west of Calgary, gradually intensifying into a hail threat in the project area around 1930Z. One of these cells, storm #1, was seeded as it moved off the foothills and moved directly toward Calgary. It dissipated quickly away from the foothills, and only produced a weak rain shower in the city. Attention then turned to the northwest project area, where stronger convection began forming at 21Z. Storm #2 formed northeast of Limestone Mountain around 2230Z. This cell was strong but disorganized, pulsing wildly as new feeders grew around the initial core. It moved east over Caroline and toward Red Deer between 0Z and 1Z (07/10), though it weakened considerably when new stronger convection formed upwind. Storm #2 was seeded as it approached Caroline, and again before it hit Red Deer, but it became clear it would not pose a hail threat to the latter city around 1Z (07/10). Storm #3 was a long track supercell that grew explosively in the northwest buffer before moving southeast into the project area. It was seeded for Rocky MH when it passed extremely close to the airport, and again as it approached the QE2 near Lacombe. As it moved past Rocky MH it encountered considerable anvil from less organized cells its south, and weakened losing supercellular characteristics southeast of Rimbey. Storm #4 developed around 0Z immediately behind storm #2 west of Caroline. This storm, on the southern flank of all convection affecting the northern project area, evolved into an extremely powerful supercell that tracked southeast from near Caroline, crossed the QE2 between Bowden and Olds, and exited the project north of Three Hills. It was seeded as it approached Caroline and as it approached the QE2, after which it was let go. This cell produced the highest reported hail of the day, with greater than golf ball size hail measured north and northwest of Olds. Finally, storm #5 developed in the mid-evening as a discrete cell well south of the other evening convection. It briefly appeared to be a small hail threat for the Crossfield area around 0245Z (07/10), but grew into a cluster of non-threatening convection as it approached the QE2. All remaining convection moved out of the project area around 5Z, with quiet conditions observed until a new wave of activity spread northeast into the southern project area around 9Z. Embedded, elevated convection began to intensify within this region around dawn, though no hail threats were observed through 12Z (07/10).</p> <p>Max cell top: 15.9km, 66.5 max dBz, 142.6 max VIL</p> <p>Tmax YC = 31.1C and no rain. Tmax QF = 27.9C and 4.2mm of rain. Tmax Radar = 26.8C and a trace of rain.</p> <p>Greater than golf ball size hail reported north and</p>	<p>Calgary. HS2 began seeding storm #1 Calgary at 1944Z. HS2 stopped seeding but continued patrolling Calgary at 1959Z. HS2 RTB at 2016Z, and landed at 2022Z.</p> <p>HS4 was launched at 1945Z for a strong thunderstorm west of Calgary. They were airborne at 2008Z. HS4 began patrolling Didsbury at 2027Z. They repositioned west to new convective growth near Sundre at 2035Z, and began patrolling Sundre at 2038Z. HS4 repositioned north to a new cell near Caroline at 2106Z. HS4 RTB at 2113Z, and landed at 2126Z.</p> <p>HS5 was launched at 1948Z for a strong thunderstorm west of Calgary. They were airborne at 2002Z and immediately began patrolling Calgary. HS5 RTB at 2119Z, and landed at 2126Z.</p> <p>HS1 was relaunched at 2145Z for strong new convection in the northwest project area. They were airborne at 2204Z. HS1 began patrolling Caroline at 2226Z. HS1 began top seeding storm #2 Caroline at 2252Z. HS1 stopped seeding and repositioned to a severe thunderstorm north of Rocky MH at 2347Z. HS1 began seeding storm #3 Rocky MH at 2356Z. HS1 continued seeding while descending to base seeding altitude at 0038Z (07/10). HS1 stopped seeding and RTB at 0141Z (07/10). They landed at 0207Z (07/10).</p> <p>HS2 was launched to reposition to Red Deer at 2242Z. They were airborne from YBW at 2303Z, and landed in YQF at 2332Z.</p> <p>HS2 was launched for strong thunderstorms around Caroline at 0023Z (07/10). They were airborne at 0045Z (07/10). HS2 started base seeding storm #4 Bowden at 0101Z (07/10). HS2 repositioned to a new cell west of Crossfield at 0232Z (07/10). They began seeding storm #5 Crossfield at 0241Z (07/10). HS2 stopped seeding but continued to patrol Crossfield 0255Z (07/10). HS2 RTB at 0302Z (07/10). They landed at 0312Z (07/10).</p> <p>HS3 was launched for strong thunderstorms around Caroline at 0023Z (07/10). They were airborne at 0045Z (07/10). HS3 started top seeding storm #2 Red Deer at 0105Z (07/10). HS3 repositioned to storm #4 north of Sundre at 0116Z (07/10), seeding in-transit. They started seeding storm #4 Bowden at 0128Z (07/10). HS3 repositioned to a new cell west of Crossfield at 0232Z (07/10). They began seeding storm #5 Crossfield at 0241Z (07/10). HS3 stopped seeding and RTB at 0254Z (07/10). They landed at 0312Z (07/10).</p>
--	--	--

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>northwest of Olds.</p>	<p>HS4 was launched at 0055Z (07/10) for a cluster of strong convection west of Red Deer. They were airborne at 0106Z. HS4 began base seeding storm #3 Blackfalds at 0117Z (07/10). HS4's left wing-tip generator became inoperable at 0132Z (07/10), but they continued seeding with the right wing-tip generator and BIPs. They repositioned southwest to strong convection near Sundre at 0135Z (07/10). HS4 began seeding storm #4 Bowden at 0050Z (07/10). HS4 stopped seeding and continued patrolling east of Olds at 0240Z (07/10). HS4 RTB at 0248Z (07/10), and landed at 0311Z (07/10).</p> <p>Flight Summary HS1: 1831Z-2016Z; 28 EJ, 2 BIP; #1 Calgary. HS2: 1833Z-2027Z; 30 min wing-tip generators, 0 BIP; #1 Calgary. HS4: 1955Z-2130Z; no seeding; patrol Didsbury, patrol Sundre. HS5: 1957Z-2128Z; no seeding; patrol Calgary. HS1: 2155Z (07/09)-0209Z (07/10); 215 EJ, 19 BIP; #2 Caroline, #3 Rocky MH to Lacombe. HS2: 2256Z-2335Z; reposition flight; no seeding; takeoff YBW, land YQF. HS2: 0035Z-0314Z (07/10); 228 min wing-tip generators, 15 BIP; #4 Bowden, #5 Crossfield; takeoff YQF, land YBW. HS3: 0036Z-0315Z (07/10); 268 EJ, 22 BIP; #2 Red Deer, #4 Bowden, #5 Crossfield. HS4: 0100Z-0317Z (07/10); 100 min wing-tip generators, 11 BIP; #3 Blackfalds, #4 Bowden.</p>
<p>July 10, Monday</p>	<p>A shortwave trough was forecast to remain nearly stationary over the project area Monday, with the jet stream remaining well south of the region. Light westerly mid-level flow was anticipated, with only weak and disorganized vorticity advection. Morning clouds and convection were predicted to give way to clearing Monday afternoon, with rapidly destabilizing conditions. Shear was modeled to remain unimpressive through the period, though multicellular convective development was anticipated. A moderate hail threat was expected with afternoon and evening convection. Scattered thunderstorms were forecast to continue overnight, with a small hail threat continuing.</p> <p>Intense morning convection south and southwest of Calgary prompted crews to be ready for launch early Monday morning, but no storms were seeded as convection remained elevated and embedded, and all cells weakened before moving into protected project cities. This activity devolved into a broad mass of rain showers by 15Z, lifting northeast across the southern project area through the morning. New convection began to develop along the foothills between 19-21Z. A strong left moving cell developed west of Cochrane around 22Z, becoming the first seeded storm of the day (storm #1). It was seeded in the event it turned east toward protected</p>	<p>HS4 flew a maintenance flight. They were airborne at 2139Z and landed at 2204Z.</p> <p>HS5 was launched at 2201Z for developing convection west of Cochrane. They were airborne at 2220Z. HS5 began top seeding storm #1 Cochrane at 2237Z. HS5 stopped seeding and repositioned toward Cremona at 2257Z. They began patrolling Cremona at 2305Z. HS5 repositioned to clear air southwest of Springbank at 2330Z. They began patrolling Cochrane at 2340Z, and RTB at 2345Z. HS5 landed at 2359Z.</p> <p>HS2 was launched at 2201Z for developing convection west of Cochrane. They were airborne at 2220Z. HS2 started seeding storm #1 Cochrane at 2234Z. They stopped seeding and repositioned northeast into to patrol Cremona at 2257Z. HS2 began patrolling Cremona at 2305Z. HS2 repositioned to clear air southwest of Springbank at 2330Z. HS2 began patrolling Cochrane at 2340Z and RTB at 2345Z. They landed at 2350Z.</p> <p>HS3 was launched to a thunderstorm moving</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>cities, but it ultimately dissipated as it moved north off the foothills northwest of Cochrane. Widespread rain with embedded thundershowers then moved east into the central project area, though no substantial hail threats were observed through 1Z (07/11). Another wave of convection began developing in the southwest project area between 2-4Z (07/11), with relatively short-lived convection developing spontaneously and affecting cities such as Calgary and Airdrie. One such cell developed directly over west Calgary at 0230Z (07/11), and tracked southeast across town until dissipating around 0330Z (07/11). Radar indicated up to grape size hail may have fallen with this storm in central Calgary, however only pea size hail was reported. Localized urban flooding was also observed with this activity. At roughly 0400Z (07/11) convection began to develop to the northeast of Ponoka. Over the next few hours this convection produced several TITAN cells as it pushed southwest across the northern project area. Storm #2 grew just to the east of Ponoka and tracked south-southwestward. This thunderstorm eventually moved through the east part of Red Deer. Radar data suggested walnut size hail may have fallen southeast of Lacombe. Additional convective development occurred across the northern and eastern project area through the rest of the night, evolving into a widespread, slow-moving mass of rain and thunderstorms that nearly enveloped the entire project area by early Tuesday morning. Radar indicated small (pea to grape) size hail accompanied the strongest cells within this broad area of activity, but given the highly embedded and stochastic nature of the nocturnal convection, no action was taken.</p> <p>Pea size hail reported in Calgary. A non-mesocyclone tornado was confirmed by Environment Canada 13km northwest of the Calgary International Airport at approximately 0220Z (07/11).</p> <p>Max cell top: 12.1km, 63.4 max dBz, 75.4 max VIL</p> <p>Tmax YC = 21.6C and 7.2 rain. Tmax QF = 20.9C and 25.0mm of rain. Tmax Radar = 20.1C and 0.8mm of rain.</p>	<p>southwestward toward Red Deer at 0701Z (07/11). They became airborne at 0723Z (07/11) and started patrolling the Red Deer area. At 0744Z (07/11) the crew started top seeding storm #2 for Red Deer. HS3 then stopped seeding and started patrolling Red Deer at 0754Z (07/11). At 0807Z (07/11) the aircraft RTB and landed at 0819Z (07/11).</p> <p>Flight Summary HS4: 2132Z-2208Z; no seeding; maintenance flight. HS5: 2211Z (07/10)-0001Z (07/11); 2 EJ, 4 BIP; #1 Cochrane, patrol Cremona-Didsbury. HS2: 2213Z-2353Z; 46 min wing-tip generators, 0 BIP; #1 Cochrane, patrol Cremona-Didsbury. HS3: 0713Z-0823Z (07/11); 60 EJ, 0 BIP; #2 Red Deer.</p>
<p>July 11, Tuesday</p>	<p>Convergence between southwesterly flow around a large trough in northwest B.C. and northeasterly flow around a low in Saskatchewan was expected to weaken through the day. An upper level shortwave trough was modeled to shift east of the area overnight, with a shortwave ridge moving overhead. Clouds and showers observed Tuesday morning were predicted to linger, gradually clearing to the southeast by late afternoon. Surface insolation was then forecast to trigger upslope convection on the foothills, but this activity was not expected to bring a hail threat to the project area.</p> <p>Widespread rain with embedded thundershowers slowly weakened and moved southeast of the project area from Tuesday morning into the early afternoon. Scattered orographic convection developed from late afternoon into the evening, but remained relatively weak and largely</p>	<p>HS4 flew a maintenance flight. They were airborne at 0153Z (07/12) and landed at 0211Z (07/12).</p> <p>Flight Summary HS4: 0145Z-0215Z (07/12); maintenance flight; no seeding.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>west of the project area. No hail threats were observed.</p> <p>Max cell top: 5.4km, 54.6 max dBz, 11.4 max VIL</p> <p>Tmax YC = 18.1C and 41.7mm of rain. Tmax QF = 18.4C and 1.2mm of rain. Tmax Radar = 16.8C and 19.3mm of rain.</p>	
<p>July 12, Wednesday</p>	<p>The leading edge of a jet streak was modeled to approach western Alberta Wednesday while a broad upper level ridge built over western Saskatchewan. Southeast low-level flow was forecast to provide warm moist air across the project area, and combined with afternoon insolation, promote very unstable conditions. Stronger mid and upper level flow was anticipated relative to previous days, with shear suitable for supercellular development expected. No substantial synoptic forcing mechanisms were prognosticated, and a stronger cap in the eastern project area was predicted to cause all orographic initiated convection moving into the area to weaken in the eastern project area. Conditions were expected to stabilize after dusk, with a strengthening cap building into Wednesday.</p> <p>Dense fog Wednesday morning was slow to mix out across the central project area. Isolated orographic convection began developing early Wednesday afternoon, but was initially slow to progress off the foothills. The first seeded storm of the day (#1) developed around 1930Z, but remained along the foothills until it grew rapidly into a hail threat around 2030Z west of Turner Valley. It then moved east away from the foothills, and was seeded as it moved east-southeast near Black Diamond and toward Okotoks. It dissipated quickly near the QE2 south of Okotoks around 2245Z. Additional convection continued forming along the foothills near the northwest project area. At 22Z a convective cell northwest of Sundre intensified (storm #2), and was seeded in the event it made a right-turn for the town. It ultimately dissipated as it was overtaken by a more powerful supercell to its northwest. This supercell went on to produce the highest VIL and cell top of the day northwest of Sundre around 2330Z, before weakening into a line of thunderstorms that moved east toward the QE2 between Innisfail and Carstairs. The final seeded storm of the day (#3) seemed to form along an outflow boundary south of storm #2 around 2340Z. It quickly exploded in intensity and became supercellular, and was seeded as it moved southeast across Cremona and threatened cities as far south as Airdrie. It weakened slightly as it moved past Cremona, and began moving on a more easterly vector closer the mean flow, though it retained supercellular characteristics until it approached Crossfield. It weakened more substantially upon reaching Crossfield, and was not seeded east of the QE2. Weak convective thundershowers continued in the remnants of storm #3, which moved east-northeast out of the project near Three Hills shortly after 6Z (07/13).</p> <p>Max cell top: 13.6km, 63.9 max dBz, 92.0 max VIL</p> <p>Tmax YC = 25.1C and no rain.</p>	<p>HS4 performed a maintenance flight. They were airborne at 2006Z and landed at 2019Z.</p> <p>HS1 was launched at 2031Z for strong convection developing along the foothills west of Turner Valley. They were airborne at 2044Z. HS1 began top seeding storm #1 Turner Valley at 2103Z. HS1 stopped seeding and RTB at 2236Z. They landed at 2249Z.</p> <p>HS2 was launched at 2031Z for strong convection developing along the foothills west of Turner Valley. They were airborne at 2051Z. HS2 began base seeding storm #1 Turner Valley at 2100Z. HS2 stopped seeding but continued to patrol Okotoks at 2240Z. They RTB at 2244Z, and landed at 2300Z.</p> <p>HS4 was launched at 2053Z for developing convection near Sundre. They were airborne at 2111Z. HS4 began patrolling Caroline at 2125Z. HS4 began base seeding storm #2 Sundre at 2158Z. They stopped seeding and RTB at 2222Z, and landed at 2244Z.</p> <p>HS5 was launched at 2225Z for slow moving convection near Okotoks. They were airborne at 2240Z and began patrolling Calgary. At 2243Z it became clear storm #1 would no longer threaten the project area, and they RTB. HS5 landed at 2247Z.</p> <p>HS5 was relaunched for new convection near Sundre at 2304Z. They were airborne at 2312Z. HS5 started top seeding storm #3 Cremona at 2326Z. They stopped seeding and RTB at 0120Z (07/13). HS5 landed at 0127Z (07/13).</p> <p>HS4 was launched at 2342Z for strong convection surrounding Sundre. They were airborne at 2354Z (07/13). HS4 started base seeding storm #3 Crossfield at 0006Z (07/13). HS4 stopped seeding and RTB at 0206Z (07/13). They landed at 0237Z (07/13).</p> <p>HS3 was launched at 2354Z for strong convection near Sundre. They were airborne at 0010Z (07/13). At 0019Z (07/13) they were directed to Springbank for patrol. HS3 started patrolling Cochrane at 0041Z (07/13). At 0116Z (07/13) they repositioned to replace HS5 seeding storm #3, and began top seeding it for Crossfield at 0120Z (07/13). HS3 stopped</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>Tmax QF = 22.9C and 4.0mm of rain. Tmax Radar = 22.9C and 1.8mm of rain.</p> <p>2.5cm size hail measured west of the James River Bridge store (approx.15km north-northwest of Sundre). Nickel to Loonie size hail northwest of Cremona.</p>	<p>seeding and RTB at 0206Z (07/13). They landed at 0232Z (07/13).</p> <p>HS2 was launched at 2342Z for strong convection near Sundre. They were airborne at 0007Z (07/13). HS2 began base seeding storm #3 Crossfield at 0021Z (07/13). HS2 stopped seeding and RTB at 0145Z (07/13). They landed at 0155Z (07/13).</p> <p>HS1 was relaunched at 2355Z for strong convection near Sundre. They were airborne at 0008Z (07/13). HS1 began base seeding storm #3 Crossfield at 0020Z (07/13). HS1 stopped seeding and RTB at 0158Z (07/13). They landed at 0210Z (07/13).</p> <p>Flight Summary HS4: 1953Z-2023Z; maintenance flight; no seeding. HS1: 2035Z-2251Z; 184 EJ, 14 BIP; #1 Turner Valley to Okotoks. HS2: 2042Z-2302Z; 210 min wing-tip generators, 5 BIP; #1 Turner Valley to Okotoks. HS4: 2103Z-2247Z; 48 min wing-tip generators, 0 BIP; #2 Sundre, patrol Caroline. HS5: 2234Z-2250Z; no seeding; patrol Calgary. HS5: 2308Z (07/12)-0128Z (07/13); 305 EJ, 21 BIP; #3 Cremona to Crossfield. HS4: 2347Z (07/12)-0241Z (07/13); 244 min wing-tip generators, 21 BIP; #3 Crossfield. HS3: 2359Z (07/12)-0239Z (07/13); 177 EJ, 12 BIP; #3 Crossfield, patrol Cochrane. HS2: 0001Z-0157Z (07/13); 168 min wing-tip generators, 9 BIP; #3 Crossfield. HS1: 0003Z-0212Z (07/13); 0 EJ, 20 BIP; #3 Crossfield.</p>
<p>July 13, Thursday</p>	<p>The nose of an elongated jet streak was forecast to be centered across the northwest project area while a 500mb speed max entered southwest Alberta. PVA associated with a shortwave trough was projected to move across the project area around peak heating. A lee cyclone and trough were expected to develop Thursday afternoon, with the latter predicted to serve as a divisive dry line. Most of the project area was modeled to be west of the dry line by late afternoon, but the far north and northeast project area were projected to remain within the deeper moisture and more significant instability. Very strong supercellular thunderstorms were forecast for central Alberta, but it was unclear if that activity would evolve far enough south to pose a threat to the northern project area. All convective opportunities were expected to cease overnight behind a cold front slipping southeast across the region.</p> <p>Clear, capped conditions were observed across the project area from Thursday morning throughout the afternoon. A strong supercell was observed approximately 30 miles north of the project area, producing up to tennis ball size hail between Breton and Drayton Valley, and</p>	<p>HS4 was launched at 0035Z (07/14) for developing convection in the northern buffer. They were airborne at 0054Z (07/14). HS4 began patrolling Rimbey at 0114Z (07/14). They RTB at 0133Z (07/14), and landed at 0142Z (07/14).</p> <p>HS3 was launched at 0035Z (07/14) for developing convection in the northern buffer. They were airborne at 0057Z (07/14). HS3 began patrolling Rimbey at 0117Z (07/14). HS3 RTB at 0138Z (07/14), and landed at 0147Z (07/14).</p> <p>HS2 was launched at 0035Z (07/14) for developing convection in the northern buffer. They were airborne at 0058Z (07/14). HS2 began patrolling near Rimbey at 0133Z (07/14). They RTB at 0138Z (07/14), and landed at 0221Z (07/14).</p> <p>Flight Summary HS4: 0044Z-0146Z (07/14); no seeding; patrol</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>also produced an EF-1 tornado. Just after 0Z (07/14), a storm rapidly developed in the northern buffer south of Buck Lake, and was patrolled in the event it also became supercellular and threatened Ponoka. It did not follow this course, however, weakening considerably after 1Z (07/14), and ultimately remaining in the northern buffer. Radar indicated grape size hail fell with this storm in the northern buffer northwest of Rimbey. No other convection was observed through the period.</p> <p>Max cell top: 11.4km, 62.0 max dBz, 57.9 max VIL</p> <p>Tmax YC = 30.4C and no rain. Tmax QF = 27.6C and no rain. Tmax Radar = 27.6C and no rain.</p> <p>A tornado and up to tennis ball size hail was observed 30 miles north of the project area -- from around Breton to Drayton Valley, AB.</p>	<p>Rimbey. HS3: 0044Z-0153Z (07/14); no seeding; patrol Rimbey. HS2: 0050Z-0223Z (07/14); no seeding; patrol Rimbey.</p>
<p>July 14, Friday</p>	<p>A strong upper-level ridge was modeled to build across eastern Alberta through the forecast period. Mid-level NVA was forecast Friday afternoon, with very dry capped air above the boundary layer. Mesoscale upslope flow was anticipated, but any orographic convection was expected to dissipate immediately away from the foothills. No synoptic trigger mechanisms were foreseen until Saturday afternoon.</p> <p>Mostly clear conditions were observed throughout the forecast period. High clouds were seen in the northern project area around dusk, but no discernable meteorological echoes were detected. Patchy valley fog developed before dawn Saturday.</p> <p>No meteorological echoes.</p> <p>Tmax YC = 27.5C and no rain. Tmax QF = 25.0C and no rain. Tmax Radar = 23.9C and no rain.</p>	<p>No aircraft operations.</p>
<p>July 15, Saturday</p>	<p>The jet stream was forecast to move over the project area Saturday as a deep trough moved east across B.C. A shortwave trough observed in far southeast B.C. was projected to move northeast across the project area early Saturday afternoon. Very warm mid-level temperatures associated with a robust ridge in western S.K. were forecast to keep a strong cap that would inhibit surface-based convection through the forecast period. However, substantial elevated instability was prognosticated to yield a small hail threat with isolated discrete convection late Saturday afternoon into the overnight hours.</p> <p>Widespread clouds and light showers moved across the southeast project area from late Saturday morning through mid-afternoon. Clearing then overspread the project area, with warm temperatures exceeding 30C observed in the southern project area. Waves of elevated convection began approaching the western project area Saturday evening, but dissipated upon exiting the foothills. Modest convective activity developed into the</p>	<p>No aircraft operations.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>northwest project area after midnight, with a few cells producing isolated lightning strikes in the project. No radar-indicated hail threats were observed.</p> <p>Max cell top: 8.4km, 52.5 max dBz, 12.1 max VIL</p> <p>Tmax YC = 31.3C and no rain. Tmax QF = 28.3C and no rain. Tmax Radar = 27.7C and no rain.</p>	
<p>July 16, Sunday</p>	<p>An upper level jet streak was forecast to push northeastward across the region in the afternoon. A broad trough looked to move eastward across AB during the period. Several lobes of moderately strong vorticity were expected to be associated with the trough. PVA looked to be strongest during the afternoon hours. 500mb temperatures appeared to cool by at least 6C during the daytime. At the surface, a cold front was predicted to quickly slide southeastward through the area during the afternoon. Additionally, a dry line was expected to setup west of Calgary and looked to shift northeastward across the region in the afternoon. Area modified model soundings showed anywhere from 500 to 700J/kg of CAPE along with extremely robust speed shear values of approximately 80kts.</p> <p>In the morning a line of thunderstorms formed over Sylvan and Bentley. This convection was elevated and posed a minimal hail threat as it pushed northeastward through Ponoka and Lacombe during the late morning hours. At 1930Z a thunderstorm started pushing into the far northwestern part of the region. This long-lived storm (#1) was fast moving as it pushed eastward through Rocky MH, Sylvan, and Red Deer. At roughly 2140Z another storm (#2) started forming west of Airdrie. This thunderstorm was relatively short-lived and dissipated as it tracked eastward through Airdrie. At 2200Z towering cumulus clouds were observed over Calgary. These clouds quickly grew into a thunderstorm (storm #3) over Calgary which tracked eastward across the city in the late afternoon. During the early evening hours the cold front continued to trigger off thunderstorms as it pushed southeastward across the southern part of the project area. Smoke was observed across the entire area for most of the period. Pilots reported the smoke layer extended from the surface up to 12,000ft MSL.</p> <p>Mostly pea to grape size hail was observed in Red Deer, Nolan Hill in northwestern Calgary, Airdrie, Sylvan, Penhold, and Benalto (west of Sylvan), although a few walnut size hail stones were reported in these areas. Pea size hail was observed in Sundre and at the Olds-Didsbury airport.</p> <p>Max cell top: 9.9km, 62.1 max dBz, 57.0 max VIL</p> <p>Tmax YC = 22.1C and 1.6mm of rain. Tmax QF = 19.9C and 2.2mm of rain. Tmax Radar = 18.9C and 0.5mm of rain.</p>	<p>HS3 was launched at 1925Z to thunderstorm northwest of Rocky MH. They became airborne at 1940Z. At 1958Z HS3 began top seeding storm #1 for Rocky MH. The aircraft continued seeding the storm as it swiftly moved toward Red Deer. They then stopped seeding and started patrolling for Red Deer at 2144Z. At 2204Z HS3 was redirected to a new thunderstorm west of Airdrie. At 2226Z HS3 RTB when the cell dissipated near Airdrie. The flight landed at 2256Z.</p> <p>HS1 was launched to towering cumulus developing west of Airdrie at 2150Z. The flight became airborne at 2204Z. They started top seeding storm #2 for Airdrie at 2220Z. HS1 stopped seeding and started patrolling the Calgary area at 2226Z. The aircraft was redirected at 2233Z to a new TITAN cell forming directly over Calgary. HS1 started top seeding storm #3 for Calgary at 2238Z. At 2318Z the crew stopped seeding and started patrolling the Okotoks area. HS1 then RTB at 2333Z and landed at 2345Z.</p> <p>Flight Summary HS3: 1933Z-2259Z; 163 EJ, 22 BIP; #1 Rocky MH to Red Deer. HS1: 2155Z-2346Z; 195 EJ, 15 BIP; #2 Airdrie, #3 Calgary, patrol Okotoks.</p>
<p>July 17,</p>	<p>A shortwave trough with weak PVA was expected to slide</p>	<p>No aircraft operations.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

<p>Monday</p>	<p>southeastward across the area during the afternoon hours. 500mb temperatures looked to warm by at least 1C during the daytime hours. Low level and surface winds generally appeared to stay out of the northwest to north, although upslope conditions were expected to occur near Rocky MH for a few hours during the late afternoon. Dew-points were forecast to be higher over the northern part of the region. CAPE values for the area looked to range from 100 to 400J/kg from the mid-afternoon through early evening. Bulk speed shear values were predicted to be weak which suggested convection would likely be short-lived.</p> <p>Isolated, embedded weak convection was observed over the northern part of the region during the afternoon hours. Smoke continued to flow over AB from the fires in British Columbia and Banff National Park. No convection was observed during the evening and overnight hours.</p> <p>No TITAN cells, 35.5 max dBz, 0.3 max VIL</p> <p>Tmax YC = 20.3C and no rain. Tmax QF = 18.0C and no rain. Tmax Radar = 17.9C and no rain.</p>	
<p>July 18, Tuesday</p>	<p>A shortwave trough was predicted to move through the west-northwest mid-level flow. The PVA associated with the trough looked to stay just barely to the northeast of the area. None the less, the PVA was expected to be close enough to the region that this disturbance could potentially move through the far northeast part of the project area. Low level and surface winds looked to favor weak upslope conditions near the Rocky MH area. This upslope didn't appear to be strong enough for convection to initiate. Both the CYYC and CYQF soundings for 00Z (07/19) were indicating a moderately strong cap would be present over the area. CAPE values appeared to range from 100 to 300J/kg with a dry layer present from roughly 8,000ft to 25,000ft MSL. Speed shear values were expected to reach 30kts.</p> <p>Mostly clear skies were seen across the region throughout the period. Smoke continued to flow into the area from several fires in British Columbia and western AB.</p> <p>No meteorological echoes.</p> <p>Tmax YC = 23.4C and no rain. Tmax QF = 21.2C and no rain. Tmax Radar = 20.3C and no rain.</p>	<p>No aircraft operations.</p>
<p>July 19, Wednesday</p>	<p>A shortwave ridge was forecast to build along the BC/AB border during the daytime. A few weak lobes of vorticity were expected to slide eastward across the protected area in the afternoon and evening. The low levels and surface looked to see weak lee cyclogenesis. This lee cyclogenesis appeared to occur between Sundre and Calgary. Due to the lee cyclogenesis upslope conditions were predicted to be possible from roughly the Sundre area and to the north. Area modified model soundings for</p>	<p>No aircraft operations.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>21Z and 00Z (07/20) showed anywhere from 200 to 400J/kg of CAPE along with 20 to 30kts of bulk speed shear.</p> <p>Cumulonimbus clouds were seen developing west of Caroline starting at 1920Z. Then at 2000Z convection began to grow along the foothills. This convection extended from the Cremona area and to the north. This convection drifted into the northwest quadrant of the project area producing scattered convective rain showers across this area. In the early evening a weak storm formed just to the south of Sundre and pushed eastward through the town of Olds. A few lightning strikes were observed near Olds. Overnight, isolated light convective rain showers occurred over the northern half of the area. Most of the region saw thick smoke during the day and night which reduced visibility.</p> <p>Max cell top: 6.9km, 54.2 max dBz, 8.3 max VIL</p> <p>Tmax YC = 26.2C and no rain. Tmax QF = 24.7C and no rain. Tmax Radar = 24.2C and no rain.</p>	
<p>July 20, Thursday</p>	<p>A mid and upper level low pressure system was centered over southern BC. Due to the low, a plentiful amount of PVA was expected for most of the period. Lee cyclogenesis looked to occur near Sundre during the afternoon hours which would favor upslope flow near the Rocky MH area. This surface low was expected to track northeastward in the afternoon and evening. Surface insolation was expected to be highest over the northern project area, and dew-points looked to be higher in the north. Modified model soundings indicated a very unstable air mass would be in place over the project area through the early nighttime hours. 0 to 6km bulk speed shear values were expected to be around 30kts.</p> <p>Embedded thunderstorms formed east of High River during the late morning hours. Thunderstorms started forming along the northern foothills at roughly 1800Z. These storms continued to grow and eventually began to move toward Rocky MH and Caroline in the mid-afternoon. Radar data indicated grape size hail may have fallen to the southwest of Rocky MH. Storm #1 formed over Limestone Mountain at approximately 1900Z and pushed eastward toward Caroline and Sundre. This storm was slow moving but long-lived, and it eventually moved through Sylvan and Red Deer area in the late afternoon. At roughly 2200Z a cluster of TITAN cells (storm #2) began to form west of Sundre. This thunderstorm pushed northeastward toward Sylvan and Red Deer during the early evening hours. A multicellular mass of thunderstorms continued to develop over the northern project area during the evening hours. These thunderstorms shifted to the northeast in the late evening.</p> <p>The smoke concentrations over the area became lower during the daytime hours.</p> <p>Max cell top: 11.4km, 62.1 max dBz, 59.7 max VIL</p>	<p>HS1 was launched at 1933Z to thunderstorm threatening to move through Rocky MH. The flight became airborne at 1955Z. They began patrolling the Caroline area at 2021Z. At 2032Z HS1 started top seeding storm #1 for Caroline. The aircraft then stopped seeding and started patrolling for Sundre at 2101Z. At 2132Z resumed top seeding the same storm (#1) for Sundre. HS1 stopped seeding and started patrolling for Innisfail at 2202Z. They resumed top seeding storm #1 for Innisfail at 2212Z. At 2321Z the aircraft stopped seeding and RTB. The flight landed at 2344Z.</p> <p>HS4 was launched to a long-lived storm moving toward Red Deer at 2143Z. The aircraft was airborne at 2202Z. They started patrolling the Innisfail area at 2210Z. At 2218Z HS4 was repositioned to Sundre. The aircraft started patrolling the Sundre area at 2224Z. HS4 then started patrolling the Sylvan area at 2244Z. At 2352Z HS4 started base seeding storm #2 for Red Deer. The aircraft then stopped seeding at 0012Z (07/21) and RTB. They landed at 0023Z (07/21).</p> <p>Flight Summary HS1: 1943Z-2346Z; 200 EJ, 4 BIP; patrol Innisfail, #1 Caroline to Sylvan. HS4: 2150Z (07/20)-0028Z (07/21); 40 minutes wing-tip generators, 0 BIP; patrol Innisfail, patrol Sundre, patrol Sylvan, #2 Red Deer.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>Tmax YC = 28.3C and 2.0mm of rain. Tmax QF = 24.3C and 4.6mm of rain. Tmax Radar = 27.8C and 0.5mm of rain.</p>	
July 21, Friday	<p>The mid and upper low was forecast to shift eastward into SK during the afternoon. Several lobes of vorticity were expected to continue rotating counter-clockwise around the low. The convective activity was expected to taper off in the early evening as the energy associated with the low shifted to the east. Surface dew-points looked to be higher in the north. Modified model soundings for the region showed more instability present in the north with CAPE values approaching 400J/kg through the time of peak heating. Speed shear values appeared to be around 25kts. A mid-level cap was predicted to be present over the southern part of the region which would inhibit deep convection.</p> <p>A precipitation shield moved southeastward across the northern part of the region in the morning and early afternoon. Isolated convective rain showers then fell over the northeast quadrant of the project area during the mid-afternoon and late afternoon. The skies cleared in the evening and remained clear the rest of the period.</p> <p>No TITAN cells, 51.2 max dBz, 5.2 max VIL</p> <p>Tmax YC = 21.9C and no rain. Tmax QF = 19.9C and 3.4mm of rain. Tmax Radar = 20.2C and 0.8mm of rain.</p>	No aircraft operations.
July 22, Saturday	<p>The upper level jet was expected to shift north of the region as a shortwave ridge of high pressure briefly built over the area. A few lobes of weak vorticity appeared to pass over the project area. The first lobe looked to move eastward across the area in the afternoon, and the second wave of vorticity was expected to move through during the early nighttime hours. At the surface, a weak lee trough appeared to develop over the region at the time of peak heating. The modified model soundings for the project area showed surface dew-points higher over the northern part of the area, although this moisture looked to be very shallow.</p> <p>Cumulus, altocumulus, and cirrus clouds flowed over the project area throughout the period. No deep convection was observed during the day and overnight.</p> <p>Max cell top: No TITAN cells, 35.7 max dBz, 0.9 max VIL</p> <p>Tmax YC = 28.8C and no rain. Tmax QF = 25.4C and no rain. Tmax Radar = 26.1C and no rain.</p>	No aircraft operations.
July 23, Sunday	<p>The upper-level jet was modeled to move over the region Sunday evening as a pronounced negatively tilted shortwave trough entered the project area. Extremely strong PVA was forecast with this feature, particularly from the late evening into the overnight hours. At the surface, a lee trough was predicted to develop near the</p>	<p>HS2 flew a maintenance flight. They were airborne at 1737Z, and landed at 1800Z.</p> <p>HS5 was launched at 2028Z for new convective development near Caroline. They were airborne at 2045Z. HS5 began top seeding storm #1</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>foothills, with strong convergence expected along this boundary. Significant shear was anticipated, with supercellular convection predicted. A strong cold front was modeled to drop south across the project in the late evening, ending the severe convective threat by midnight.</p> <p>Weak convective showers began to develop along the foothills late Sunday morning, dissipating in the western project area. Stronger and taller convection gradually developed in the early afternoon, with a supercell forming in the northwest buffer around 1930Z. This storm would become the second seeded storm of the day as it moved east across far northern project area and buffer, threatening Rimbey and later Ponoka Sunday afternoon. This cell also produced the largest hail reported Sunday, with 6cm hail photographed northwest of Bashaw in the far northeast project buffer. The first seeded storm of the day formed just after 20Z west-southwest of Caroline. It was seeded for Caroline and later Red Deer as it became a supercell and moved east across the project area. Hail up to the size of ping-pong balls was reported in Red Deer from this storm. Storm #3 formed northwest of Sundre at 2130Z. It was initially slow to organize, but ultimately turned supercellular and tracked toward Innisfail. This storm was seeded until it crossed the QE2 around 2330Z. Radar indicated grape-size hail may have fallen in Innisfail with this storm. While this initial round of activity (storms 1-3) departed, a new cluster of strong convection approached the northwest project area. By 0030Z (07/24) it was clear this activity would threaten Rocky MH, and the storm was seeded (storm #4) for Rocky MH, Eckville, and Blackfalds to Red Deer as it moved southeast across the northern project area. This convection crossed the QE2 around 0215Z (07/24), around the time a new convective cell quickly developed southwest of Calgary. This convection prompted aircraft patrol, but remained high based and relatively weak as it moved across Calgary. No hail was reported. A cold front was observed moving quickly south from the cluster of storms in the north (storm #4) around 0130Z (07/24). This feature raced south, bringing low ceilings and strong winds gusting to near 40kts, and pushed through Calgary around 3Z (07/24). HS4 landed in Drumheller to remain ahead of this powerful front. Strong elevated convection continued behind the front, with widespread rain and thunderstorms moving quickly northeast across the project area between 3-7Z (07/24). No appreciable hail threats were observed with this activity.</p> <p>Max cell top: 12.9km, 66.1 max dBz, 96.8 max VIL</p> <p>Tmax YC = 30.5C and 0.4mm of rain. Tmax QF = 26.7C and 2.2mm of rain. Tmax Radar = 27.5C and 3.0mm of rain.</p> <p>6.0cm hail reported northwest of Bashaw. Up to ping pong ball size hail reported in Red Deer. 3.5cm hail reported just north of Ponoka.</p>	<p>Caroline at 2106Z. HS5 RTB at 2259Z, and landed at 2325Z.</p> <p>HS4 was launched at 2019Z for developing convection near Caroline. They were airborne at 2053Z. HS4 began base seeding storm #1 Caroline at 2109Z. HS4 repositioned to storm #3 west of Innisfail at 2256Z. They began seeding storm #3 Innisfail at 2302Z. HS4 stopped seeding and RTB at 2239Z, and landed at 0003Z (07/24).</p> <p>HS2 was launched at 2032Z for convection developing near Caroline. They were airborne at 2051Z. HS2 began base seeding storm #1 Caroline at 2116Z. HS2 repositioned to storm #3 west of Innisfail at 2252Z, seeding in-transit. HS2 began seeding storm #3 Innisfail at 2301Z. HS2 stopped seeding and RTB at 2334Z. They landed at 2359Z.</p> <p>HS3 was launched at 2116Z for a mature supercell west-northwest of Rimbey. They were airborne at 2134Z. HS3 began top seeding storm #2 Rimbey at 2155Z. They stopped seeding and RTB at 2301Z. HS3 landed at 2317Z.</p> <p>HS1 was launched at 2215Z for strong convection north of Sundre. They were airborne at 2230Z. HS1 started top seeding storm #3 Innisfail at 2245Z. They stopped seeding and RTB at 2334Z. HS1 landed at 2352Z.</p> <p>HS3 was relaunched at 0018Z (07/24) for a new wave of convection northwest of Rocky MH. They were airborne at 0040Z (07/24). HS3 began top seeding storm #4 Rocky MH at 0101Z (07/24). HS3 stopped seeding and RTB at 0222Z (07/24). They landed at 0232Z (07/24).</p> <p>HS4 was relaunched at 0056Z (07/24) for developing convection near Rocky MH. They were airborne at 0107Z (07/24). HS4 started base seeding storm #4 Eckville at 0125Z (07/24). They stopped seeding and repositioned south toward Didsbury at 0222Z (07/24). HS4 RTB Drumheller at 0231Z (07/24). They landed in Drumheller at 0252Z (07/24).</p> <p>HS2 was relaunched at 0112Z (07/24) for convection near Rocky MH. They were airborne at 0128Z (07/24). HS2 started base seeding storm #4 Blackfalds at 0156Z (07/24). HS2 continued seeding south along the shelf to Innisfail 0207Z (07/24), and stopped seeding to reposition to Turner Valley at 0212Z (07/24). HS2 RTB at 0232Z (07/24), and landed at 0245Z (07/24).</p>
--	---	---

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

		<p>HS5 was launched at 0203Z (07/24) for new convection developing southwest of Calgary. They were airborne at 0227Z (07/24). HS5 began patrolling 0236Z (07/24), and RTB at 0238Z (07/24). They landed at 0245Z (07/24).</p> <p>Flight Summary HS2: 1729Z-1803Z; no seeding; maintenance flight. HS5: 2038Z-2327Z; 282 EJ, 25 BIP; #1 Caroline to Red Deer. HS4: 2044Z (07/23)-0006Z (07/24); 300 min wing-tip generators, 24 BIP; #1 Caroline to Red Deer, #3 Innisfail. HS2: 2044Z (07/23)-0001Z (07/24); 276 min wing-tip generators, 23 BIP; #1 Caroline to Red Deer, #3 Innisfail. HS3: 2125Z-2321Z; 203 EJ, 21 BIP; #2 Rimbey to Ponoka. HS1: 2223Z-2354Z; 185 EJ, 12 BIP; #3 Innisfail. HS3: 0031Z-0234Z (07/24); 272 EJ, 24 BIP; #4 Rocky MH to Red Deer. HS4: 0101Z-0254Z (07/24); 114 min wing-tip generators, 10 BIP; #4 Eckville to Blackfalds; takeoff YQF, land Drumheller. HS2: 0122Z-0247Z (07/24); 32 min wing-tip generators, 3 BIP; #4 Blackfalds to Red Deer. HS5: 0217Z-0246Z (07/24); no seeding; patrol Calgary.</p>
<p>July 24, Monday</p>	<p>A strong upper level low was forecast to progress east into Saskatchewan Monday. A shortwave trough moving south on the backside of the low was modeled to bring moderate PVA to the project area mid-afternoon. Surface conditions were expected to destabilize with diurnal heating, despite breezy cold air advection from the northwest. However, weak mid-level lapse rates and drier air above 600mb was predicted to inhibit deep convection.</p> <p>Clear skies Monday morning gave way to cumulus clouds midday. Convective rain showers were observed Monday afternoon across the northern project area, however all activity remained relatively shallow, and no TITAN cells were detected. Convective activity faded after 0Z (07/25), with no significant weather overnight. No lightning was observed with this activity.</p> <p>Max cell top: 45.7 max dBz, 2.2 max VIL</p> <p>Tmax YC = 22.3C and 0.6mm of rain. Tmax QF = 18.6C and no rain. Tmax Radar = 19.0C and 0.8mm of rain.</p>	<p>HS4 flew a reposition flight. They were airborne from Drumheller at 1546Z and landed in YQF at 1620Z.</p> <p>Flight Summary HS4: 1538Z-1624Z; no seeding; reposition flight; takeoff Drumheller, land YQF.</p>
<p>July 25, Tuesday</p>	<p>A small upper level cyclone was observed west of Rocky MH Tuesday morning, and was expected to move east across the project through Tuesday afternoon. Mid-level flow was relatively weak, particularly in the northern project area, and only meager PVA was anticipated. Light and variable surface winds were forecast to turn upslope Tuesday afternoon, with weak orographic convection</p>	<p>No aircraft operations.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>likely. There was a predicted risk that this activity may move into the western project area late Tuesday afternoon and evening. Skies were predicted to clear overnight as a ridge built across the region.</p> <p>Mostly clear skies Tuesday morning gave way to isolated orographic convection mid-afternoon. Convective activity largely dissipated upon exiting the foothills, but a couple cells showed weak growth in the far western project area between Cremona and Cochrane. No lightning was observed with this convection. All activity subsided after 0Z, and no significant weather occurred overnight.</p> <p>Max cell top: 48.2 max dBz, 5.5 max VIL</p> <p>Tmax YC = 24.3C and no rain. Tmax QF = 23.2C and no rain. Tmax Radar = 22.6C and no rain.</p>	
<p>July 26, Wednesday</p>	<p>A strong shortwave ridge was modeled to move across the project area Wednesday. Negative vorticity advection was predicted to accompany this ridge through peak heating. Strong insolation was forecast to create anomalously warm surface conditions across the project area, but sinking air associated with the ridge was predicted to stymie any convective opportunity. No synoptic forcing mechanisms were expected overnight.</p> <p>No significant weather occurred through the daytime hours. Skies remained clear, aside from wildfire smoke drifting into the southern project area. Quiet conditions continued overnight, with patchy upper level cloudiness drifting into the western project area between 0830Z (07/27) and dawn.</p> <p>Max cell top: 11.3 max dBz</p> <p>Tmax YC = 29.8C and no rain. Tmax QF = 27.3C and no rain. Tmax Radar = 27.6C and no rain.</p>	<p>HS2 flew a maintenance flight. They were airborne from YBW at 1428Z and landed in YQF at 1458Z.</p> <p>HS2 flew a return maintenance flight. They were airborne from YQF at 2119Z and landed in YBW at 2147Z.</p> <p>Flight Summary HS2: 1421Z-1505Z; no seeding; maintenance flight; takeoff YBW, land YQF. HS2: 2110Z-2150Z; no seeding; maintenance flight; takeoff YQF, land YBW.</p>
<p>July 27, Thursday</p>	<p>A subtle shortwave trough was modeled to pass across central Alberta Thursday afternoon. Southwesterly mid-level flow was anticipated, with considerable speed and directional shear. At the surface, a lee cyclone was forecast to develop between Sundre and Calgary, with a dry line extending south of the feature, and enhanced upslope to the north. Convective initiation was predicted in the northern foothills north of the lee cyclone in the mid-late afternoon, with storms tracking northeast into the project. Supercell organization was expected with the strongest cells, though bases were forecast to be high with very warm surface temperatures. A cold front was anticipated to drop south in the late evening and overnight hours, providing a chance for elevated convection in the late evening through around midnight.</p> <p>Quiet conditions were observed across the project area from Thursday morning through mid-afternoon. Convection began to develop in the northwest project area and foothills around 22Z, though activity was initially</p>	<p>HS2 flew a reposition flight. They were airborne from YBW at 2030Z and landed in YQF at 2100Z.</p> <p>HS2 was launched at 2258Z for developing convection in the northwest project area. They were airborne at 2315Z. HS2 began patrolling near Rocky MH at 2338Z. HS2 RTB back to YQF at 0023Z (07/28), and landed at 0038Z (07/28).</p> <p>HS4 was launched at 0130Z (07/28) for strong new convection southwest of Caroline. They were airborne at 0146Z (07/28). HS4 started base seeding storm #1 Caroline at 0205Z (07/28). The aircraft then continued seeding as they extended their line to a new TITAN cell forming west of Innisfail at 0350Z (07/28). HS4 stopped seeding and RTB at 0408Z (07/28). At 0417Z (07/28) the flight landed.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>short-lived and disorganized. At 23Z a larger thunderstorm moved northeast off the foothills west of Rocky MH, showing some supercellular characteristics, and becoming the strongest radar-indicated storm of the day west of Rimbey. It never hit a protected project city, and exited the project buffer northwest of Ponoka at 2Z (07/28). A second supercell directly east of this storm produced 3cm hail in the far northern buffer. A broken line of strong convection developed in the northwest project area around 0130Z, and spread east across the northern half of the project area. Cells within this broken line were seeded (storm #1) for Caroline, Sylvan, and Blackfalds between 2-4Z (07/28). A discrete cell, storm #2, developed over Cremona shortly before 4Z, and was seeded briefly as it moved toward the QE2. This storm joined the existing broken line of convection northeast of Didsbury, and the line exited the project area around 0630Z (07/28). Scattered weak showers were observed in the northeast and southwest project area the rest of the night, but no convective threats developed.</p> <p>3cm hail at the intersection of the QE2 and Hwy 611. Nickel size hail north of Sylvan Lake. Pea size hail in Sylvan Lake at 0320Z (07/28).</p> <p>Max cell top: 14.4km, 63.5 max dBz, 96.1 max VIL</p> <p>Tmax YC = 32.7C and no rain. Tmax QF = 30.9C and 1.0mm of rain. Tmax Radar = 30.6C and 0.8mm of rain.</p>	<p>HS2 was launched at 0225Z (07/28) for a line of convection near Rocky MH. They were airborne at 0242Z (07/28). HS2 began patrolling the Sylvan area at 0248Z (07/28). At 0255Z (07/28) they started base seeding storm #1 for Sylvan. At 0355 HS2 was redirected to Cremona. The aircraft continued seeding while enroute to Cremona. At 0413Z (07/28) started base seeding storm #2 for Cremona. HS2 then stopped seeding and RTB at 0419Z (07/28). They landed in YQF at 0433Z (07/28).</p> <p>HS1 flew a reposition flight. The aircraft was airborne out of YBW at 0450Z (07/28) and landed in YQF at 0520Z (07/28).</p> <p>HS5 flew a reposition flight. The aircraft was airborne out of YBW at 0456Z (07/28) and landed in YQF at 0523Z (07/28).</p> <p>Flight Summary HS2: 2020Z-2103Z; no seeding; reposition flight; takeoff YBW, land YQF. HS2: 2310Z (07/27)-0041Z (07/28); no seeding; patrol Rocky MH. HS4: 0136Z-0421Z (07/28); 248 min wing-tip generators, 0 BIP; #1 Caroline to Red Deer. HS2: 0236Z-0439Z (07/28); 168 min wing-tip generators, 0 BIP; #1 Sylvan to Red Deer; #2 Cremona. HS1: 0440Z-0525Z (07/28); no seeding; reposition flight; takeoff YBW, land YQF. HS5: 0448Z-0528Z (07/28); no seeding; reposition flight; takeoff YBW, land YQF.</p>
<p>July 28, Friday</p>	<p>A small upper-level shortwave trough was modeled to move across central Alberta Friday afternoon. The southern project area was projected to be in the right entrance region of a jet streak through peak heating. A lee cyclone was expected to form in the far southern project area, enhancing moist upslope flow in the central and southern project area. Orographic convection was forecast to form by mid to late afternoon, with the possibility of supercell development in the strongest cells. Considerable elevated instability was anticipated overnight, slowly waning after midnight.</p> <p>Weak upslope convection began to develop shortly after noon near Limestone mountain. Convection gradually intensified, with TITAN cells entering the project by 21Z. The first seeded storm of the day grew into a supercell south of Sundre around 22Z, and moved east toward the Olds-Didsbury airport. It was seeded for nearly the entire width of the project area until it passed into the east buffer near Linden. The second seeded storm of the day formed west of Sundre shortly before 0Z (07/29). It also became a supercell, despite being surrounded by weaker convection to the northeast and southwest, and produced the largest hail reports of the day. It moved east from Sundre through Olds, where 4cm hail was reported. It was</p>	<p>HS1 was launched at 2103Z for convection developing southwest of Sundre. They were airborne at 2119Z. HS1 began patrolling Sundre at 2139Z. They began seeding storm #1 Didsbury at 2215Z. HS1 stopped seeding and RTB back to YQF at 2327Z. Before they arrived, at 2336Z, their RTB directive was rescinded they repositioned to developing convection west of Innisfail. They were repositioned again at 2355Z to the southwest end of this new convection near Sundre. HS1 began base seeding storm #2 Sundre at 0012Z (07/29). HS1 stopped seeding and RTB YQF at 0111Z (07/29). They landed at 0127Z (07/29).</p> <p>HS5 was launched at 2121Z for convective development west of Calgary. They were airborne at 2144Z. HS5 began patrolling Cochrane 2209Z. HS5 repositioned west of Didsbury and descended to base seeding altitude at 2231Z. HS5 began base seeding storm #1 Didsbury at 2238Z. They stopped seeding and repositioned toward Springbank at 2330Z. HS5 began patrolling Calgary at 2339Z. At 0001Z (07/29) HS5 repositioned to new</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>no longer seeded after passing east of the QE2, and it ultimately exited the project area near Three Hills around 0230Z (07/29). The third seeded storm was a cluster of weaker cells that formed northwest of Calgary at 0130Z (07/29). These storms remained disorganized as they moved northeast between Calgary and Airdrie, but intensified rapidly east of Airdrie in the late evening, producing radar-indicated grape size hail south of Irricana. Additional elevated convection continued in the north and northeast buffer overnight, but did not become a hail threat for any protected city.</p> <p>Max cell top: 12.1km, 63.2 max dBz, 58.7 max VIL</p> <p>Dime size hail at EA3. Around 4cm size hail measured in Olds.</p> <p>Tmax YC = 28.2C and no rain. Tmax QF = 24.9C and a trace of rain. Tmax Radar = 24.3C and 19.6mm of rain.</p>	<p>convective growth near Sundre. HS5 began top seeding storm #2 Sundre at 0012Z (07/29). HS5 stopped seeding and RTB YQF at 0111Z (07/29). They landed at 0128Z (07/29).</p> <p>HS2 was launched at 2214Z for a supercell west of EA3. They were airborne at 2232Z. HS2 began base seeding storm #1 Didsbury at 2245Z. They stopped seeding and RTB YQF at 0040Z (07/29). HS2 landed at 0103Z (07/29).</p> <p>HS4 was launched at 0009Z (07/29) for convection near Sundre. They were airborne at 0024Z (07/29). HS4 began patrolling Calgary at 0101Z (07/29). HS4 started base seeding storm #3 Calgary at 0126Z (07/29). HS4 stopped seeding and continued to patrol Cochrane at 0234Z (07/29). HS4 RTB at 0246Z (07/29), and landed at 0308Z (07/29).</p> <p>HS3 was launched at 0009Z (07/29) for convection near Sundre. They were airborne at 0028Z (07/29). HS3 began patrolling Calgary 0101Z (07/29). They started top seeding storm #3 Calgary at 0122Z (07/29). HS3 stopped seeding but continued to patrol Calgary at 0228Z (07/29). The aircraft then RTB at 0315Z (07/29). They landed at 0328Z (07/29).</p> <p>Flight Summary HS1: 2110Z (07/28)-0130Z (07/29); 299 EJ, 30 BIP; #1 Didsbury, #2 Sundre to Olds, patrol Sundre. HS5: 2133Z (07/28)-0132Z (07/29); 94 EJ, 23 BIP; #1 Didsbury, #2 Sundre to Olds, patrol Cochrane, patrol Calgary. HS2: 2225Z (07/28)-0106Z (07/29); 230 min wing-tip generators, 18 BIP; #1 Didsbury to Linden. HS4: 0018Z-0313Z (07/29); 136 min wing-tip generators, 0 BIP; #3 Calgary, patrol Cochrane. HS3: 0020Z-0332Z (07/29); 94 EJ, 9 BIP; #3 Calgary.</p>
<p>July 29, Saturday</p>	<p>A broad but weakly amplified ridge was predicted to overspread Alberta Saturday afternoon. NVA and a considerable cap were forecast to inhibit deep convection through the period. Synoptic upslope flow was anticipated in the low-levels, however orographic convection was expected to stay weak and not threaten the project area. No significant weather was anticipated overnight.</p> <p>No significant weather occurred in the project area. Skies were mostly clear, with scattered haze and smoke aloft. Second trip echoes from powerful storms northwest of Edmonton were depicted in the northern project area, but no meteorological echoes were observed.</p> <p>No meteorological echoes.</p> <p>Tmax YC = 28.7C and no rain.</p>	<p>No aircraft operations.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>Tmax QF = 26.3C and no rain. Tmax Radar = 26.1C and no rain.</p>	
<p>July 30, Sunday</p>	<p>A shortwave trough was forecast to slide eastward through the west-southwest mid and upper level flow starting in the early evening. Only a modest amount of PVA was expected with this disturbance. Starting mid-afternoon, upslope conditions appeared to be likely over the northern part of the region. A well-defined dry line looked to extend from Sundre down through Calgary during the afternoon. The YQF 0000Z (07/31) modified model sounding showed a loaded gun situation across the northern part of the project area in the afternoon with CAPE values approaching 1200J/kg and bulk speed shear values around 25kts. The low level cap appeared to erode enough for thunderstorms to start initiating at around peak heating.</p> <p>Two thunderstorms started forming along the northern foothills in the midafternoon. One thunderstorm initiated north of Limestone Mountain but quickly diminished as it attempted to move toward Caroline at 0030Z (07/31). The strongest storm (#1) of the day formed along the far northern foothills at approximately 2200Z. This TITAN cell gradually pushed southeastward across the northern project area and dissipated as it approached the Bentley and Lacombe area. Radar data indicated grape size hail may have fallen north of Rocky MH. Smoke was present from the surface all the way to 16,500ft MSL which reduced visibility across most of the region.</p> <p>Pea size hail was observed west of Rimbey at 0110Z (07/31).</p> <p>Max cell top: 10.6km, 63.3 max dBz, 65.0 max VIL</p> <p>Tmax YC = 26.3C and no rain. Tmax QF = 24.8C and no rain. Tmax Radar = 23.2C and no rain.</p>	<p>HS5 was launched at 0001Z (07/31) to thunderstorms moving off the foothills near Rocky MH and Caroline. The flight became airborne out of YQF at 0014Z (07/31). At 0028Z (07/31) they started patrolling Rocky MH. HS5 started top seeding storm #1 for Bentley at 0133Z (07/31). The aircraft then stopped seeding at 0140Z (07/31) and began patrolling the Bentley area. They RTB at 0143Z (07/31), and the aircraft landed in YBW at 0209Z (07/31).</p> <p>HS1 flew a reposition flight. The aircraft was airborne out of YQF at 0211Z (07/31) and landed in YBW at 0237Z (07/31).</p> <p>HS2 flew a reposition flight. The flight was airborne out of YQF at 0226Z (07/31) and landed in YBW at 0254Z (07/31).</p> <p>Flight Summary HS5: 0008Z-0212Z (07/31); 16 EJ, 0 BIP; patrol Rocky MH; #1 Bentley; takeoff YQF, land YBW. HS1: 0203Z-0240Z (07/31); no seeding; reposition flight; takeoff YQF, land YBW. HS2: 0220Z-0256Z (07/31); no seeding; reposition flight; takeoff YQF, land YBW.</p>
<p>July 31, Monday</p>	<p>The region looked to see mainly zonal flow during the daytime as a weak shortwave trough pushed eastward across AB during the time of peak heating. Low level and surface upslope flow appeared to be possible over the entire area throughout the period. A low level jet was expected to be present during the overnight hours which would advect warm moist air into the region from the southeast. Within the boundary layer, dew-points were expected to be higher over the southern part of the project area. The thermodynamic model soundings for the region showed enough instability would be present during peak heating for moderately strong thunderstorms. Bulk speed shear values looked to be around 25kts.</p> <p>A convective cell formed along the foothills southwest of Bragg Creek at 1840Z. This weak convection was short-lived and diminished as it tried to push into the protected area. At approximately 2300Z a storm (#1) grew over the foothills to the west of Turner Valley. This thunderstorm quickly grew into a tall storm. As the storm pushed into the project area it rapidly dissipated. Starting around</p>	<p>HS1 was launched to a quickly intensifying thunderstorm west of Turner Valley at 2317Z. The aircraft was airborne at 2333Z. They began top seeding storm #1 for Turner Valley at 2347Z. At 2354Z HS1 stopped seeding and started patrolling Turner Valley. They extended their patrol area northward toward Cochrane at 0022Z (08/01). At 0122Z (08/01) HS1 started top seeding storm #2 for Calgary. They then stopped seeding and started patrolling the Calgary area at 0213Z (08/01). At 0243Z (08/01) they resumed top seeding storm #2 for Calgary. HS1 stopped seeding and RTB at 0319Z (08/01). They landed at 0332Z (08/01).</p> <p>HS2 was launched at 0126Z (08/01) to a TITAN cell pushing eastward toward Calgary. The flight became airborne at 0145Z (08/01). HS2 started base seeding storm #2 for Calgary at 0148Z (08/01). At 0213Z (08/01) the aircraft stopped seeding and began patrolling the</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>0020Z (08/01) convection rapidly intensified northwest of Bragg Creek. The convection became organized and grew into a long-lived storm (#2) which tracked eastward through southern Calgary during the evening hours. Radar data indicated grape size hail may have fallen west of Calgary. Scattered, elevated thunderstorms then formed over the entire area starting around the time of sunset. This thunderstorm activity persisted well into the overnight hours. Smoke continued to flow into the region from fires in BC and western AB.</p> <p>Pea size hail reported in southern Calgary. 1 inch size hail observed in Bragg Creek which is just west of the western project area boundary.</p> <p>Max cell top: 10.6km, 61.8 max dBz, 71.7 max VIL</p> <p>Tmax YC = 25.7C and a trace of rain. Tmax QF = 21.8C and a trace of rain. Tmax Radar = 21.5C and 2.0mm of rain.</p>	<p>Calgary area. HS2 RTB at 0223Z (08/01) and landed at 0231Z (08/01).</p> <p>Flight Summary HS1: 2323Z (07/31)-0334Z (08/01); 132 EJ, 14 BIP; #1 Turner Valley, patrol Cochrane, #2 Calgary. HS2: 0138Z-0235Z (08/01); 50 min wing-tip generators, 1 BIP; #2 Calgary.</p>
<p>August 1, Tuesday</p>	<p>Jet PVA was expected to increase over the region during the afternoon hours as a trough dropped southeastward across AB. The area was forecast to continue experiencing PVA from the trough through the early nighttime hours. The low level and surface wind flow looked to favor upslope conditions across the area. The 1800Z, 2100Z, and 0000Z (08/02) modified model soundings for the region showed a strong cap would exist at roughly 13kft MSL. The cap was predicted to inhibit any deep convection from occurring throughout the forecast period. 0 to 6km bulk speed shear values looked to be around 35kts which would likely shear any growing convection apart.</p> <p>Scattered convective rain showers fell over the region from the morning through the time of sunset. A few isolated, weak and short-lived thunderstorms were observed in the evening near Strathmore and High River. During the overnight hours the precipitation shifted to the southeast of the area and fog began to form over parts of the project area.</p> <p>Max cell top: 4.6km, 53.8 max dBz, 9.9 max VIL</p> <p>Tmax YC = 21.0C and 1.8mm of rain. Tmax QF = 15.0C and 1.0mm of rain. Tmax Radar = 14.7C and 5.3mm of rain.</p>	<p>No aircraft operations.</p>
<p>August 2, Wednesday</p>	<p>A broad scale ridge was expected to be centered along the coast of BC which would result in northwest mid-level flow across the area. 500mb heights and temperatures were forecast to rise slightly during the daytime as a shortwave ridge moved through the northwest flow. No significant PVA looked to occur throughout the period. The area was expected to see upslope flow, but this upslope flow did not look to be strong enough to overcome the strong cap. The modified model soundings for the afternoon and evening indicated a mostly stable air mass would be in place across the area during the period. A strong cap appeared to be present at around 12kft MSL</p>	<p>No aircraft operations.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>(~650mb) which would inhibit deep convection.</p> <p>Thick fog was observed over parts of the project area during the morning. Cumulus, stratocumulus, altocumulus, and cirrus clouds were observed over the area in the afternoon and evening. The skies then became mostly clear overnight.</p> <p>No meteorological echoes.</p> <p>Tmax YC = 21.4C and no rain. Tmax QF = 22.2C and no rain. Tmax Radar = 20.4C and no rain.</p>	
<p>August 3, Thursday</p>	<p>An 80kt jet streak was forecast to shift southward over the region in the evening as a mid-level trough slid southeastward across AB. PVA was expected to begin increasing in the evening but looked to be strongest during the nighttime hours. Upslope wind flow looked to aid in pooling moisture over the northern part of the region. Lee cyclogenesis was expected north of Rocky MH during the evening. Model soundings for the area showed a strong cap in place during the daytime. The modified model soundings for 0300Z (08/04) indicated a moderate amount of instability across the northern part of the region. 0 to 6km bulk speed shear values of 30kts suggested a possibility of long-lived storms.</p> <p>Cirrus and cirrostratus clouds flowed over the protected area through the early evening hours. In the late evening thunderstorms began to form along the northern foothills to the northwest of Rocky MH. This convection slowly pushed into the northwestern part of the protected area shortly after sunset. In general, the elevated convection and isolated thunderstorms were fairly weak, although radar data suggested pea size hail may have fallen to the west-southwest of Rocky MH.</p> <p>Max cell top: 6.9km, 59.0 max dBz, 29.2 max VIL</p> <p>Tmax YC = 29.0C and no rain. Tmax QF = 25.9C and 1.8mm of rain. Tmax Radar = 23.8C and no rain.</p>	<p>No aircraft operations.</p>
<p>August 4, Friday</p>	<p>A northwesterly upper level jet looked to be place over southern AB. The low was expected to be centered along AB/SK border by late afternoon. Due to the low, PVA from the north and northeast was probable throughout the forecast period. The low level and surface low was expected to be co-located with the mid and upper level low. As a result, widespread upslope flow appeared to be likely across the entire region throughout the day and night. The 2100Z and 0000Z (08/05) modified model soundings for YYC and YQF showed anywhere from 300 to 600J/kg of CAPE. None the less, bulk speed shear values were expected to be only around 5kts which suggested that the thunderstorms would most likely be short-lived.</p> <p>A cold front pushed southeastward across the region during the early morning hours producing convective rain</p>	<p>HS5 flew a maintenance flight. The aircraft was airborne out of YBW at 1457Z and landed in YQF at 1528Z.</p> <p>HS5 then flew a return maintenance flight. The flight was airborne out of YQF at 1942Z and landed in YBW at 2020Z.</p> <p>Flight Summary HS5: 1450Z-1534Z; no seeding; maintenance flight; takeoff YBW, land YQF. HS5: 1936Z-2023Z; no seeding; maintenance flight; takeoff YQF, land YBW.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>showers. Scattered convective rain showers then continued into the evening hours in the post frontal air mass. Scattered thunderstorms formed over the northern part of the area at roughly the time of peak heating. These thunderstorms were short-lived and did not threaten any populous areas. Radar data indicated grape size hail may have fallen to the east of Lacombe.</p> <p>Max cell top: 7.6km, 60.6 max dBz, 38.6 max VIL</p> <p>Tmax YC = 19.7C and 0.2mm of rain. Tmax QF = 19.1C and 0.6mm of rain. Tmax Radar = 17.4C and 4.3mm of rain.</p>	
<p>August 5, Saturday</p>	<p>A northwesterly jet was predicted to shift over the area starting around the time of peak heating. This jet appeared to provide a modest amount of PVA. A mid and upper level trough was expected to remain over southern AB through around the time of sunset. PVA looked to occur through the early evening hours. 500mb temperatures were expected to cool by around 1C. Upslope wind flow was forecast over the entire region. The YQF and YYC model soundings for 2100Z and 0000Z (08/06) showed that the troposphere would contain anywhere from 500 to 1000J/kg of CAPE with bulk speed shear values of 20 to 25kts. The model soundings indicated drier air would begin to move into the area aloft starting in the early evening.</p> <p>Scattered convection began forming over the area starting around 1800Z. In the afternoon the convection became strong enough for scattered thunderstorms to form over the region. In the late afternoon a wave of longer-lived thunderstorms pushed southward across the northern part of the project area. Radar data indicated grape size hail may have fallen to the southeast of Red Deer.</p> <p>Pea size hail at Dickson Dam.</p> <p>Max cell top: 10.6km, 63.1 max dBz, 65.5 max VIL</p> <p>Tmax YC = 20.1C and 3.2mm of rain. Tmax QF = 22.2C and no rain. Tmax Radar = 18.9C and 0.8mm of rain.</p>	<p>No aircraft operations.</p>
<p>August 6, Sunday</p>	<p>A shortwave ridge was modeled to move across southern Alberta Sunday. Subsidence beneath the ridge was forecast to create dry inhospitable convective conditions across the project area. Upslope flow was projected to foster scattered orographic convection, but this activity as projected to dissipate away from the foothills. No synoptic triggers were anticipated, and no significant weather was forecast overnight.</p> <p>No meteorological echoes were observed through the daytime hours. A line of weak thunderstorms developed near Rocky MH around 5Z (08/07) and moved southeast across the northern project area, but did not become a hail threat. Lightning was observed with this convection. This line dissipated northwest of Innisfail around 0730Z (08/07). A second wave of rain showers developed in the</p>	<p>No aircraft operations.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>northern buffer around 10Z (08/07), but remained in the buffer and weak.</p> <p>Max cell top: 6.9km, 54.4 max dBz, 14.7 max VIL</p> <p>Tmax YC = 25.4C and no rain. Tmax QF = 24.9C and no rain. Tmax Radar = 23.9C and no rain.</p>	
<p>August 7, Monday</p>	<p>A pronounced shortwave trough was modeled to move southeast out of central Alberta Monday. PVA along the leading edge of this disturbance was expected to drop south across the project area through peak heating. Moist north to northeast flow was forecast in the low-levels, though instability was projected to be countered by a weak area of subsidence around 700mb. Upslope flow along the foothills was predicted to trigger moderate to strong thunderstorms in the west and southwest buffer, with a hail threat extending in the far south and southwest project area as this activity progressed southeast. A second axis of PVA was projected to clip the north and northeast project area overnight, bringing a chance for elevated showers to that region.</p> <p>Weak convective showers moved east-southeast along the northern buffer Monday morning, exiting east of Ponoka around 16Z. Clear skies were then observed into the afternoon, when strong convection began developing along the foothills west of Cochrane. These cells deteriorated quickly as they moved off the foothills. Remnant convective showers entered the project area west of Springbank around 23Z. New convection began to develop along the leading edge of dying convection in southwest Calgary just before 0Z (08/08). This activity was briefly seeded until it dissipated into rain showers. No radar-indicated hail fell with this convection. Convective rain showers and short-lived thunderstorms continued through the evening across the southern project area, with additional scattered convection forming south and east of Olds at dusk. New areas of moderate elevated convection formed south of Strathmore and west of Cremona at 5Z. The activity south of Strathmore briefly became a small hail threat in the southeast project area, but did not affect any project cities. The activity near Cremona expanded and pushed southeast, bringing thundershowers to Cochrane, Calgary, and Airdrie between 6-7Z (08/08). All activity pushed southeast out of the project area by 9Z (08/08), with clearing skies and scattered fog the remainder of the night.</p> <p>Max cell top: 9.1 km, 58.0 max dBz, 27.7 max VIL</p> <p>Tmax YC = 25.8C and no rain. Tmax QF = 21.9C and no rain. Tmax Radar = 21.3C and no rain.</p>	<p>HS2 was launched at 2247Z for convection developing northwest of Cochrane. They were airborne at 2303Z. HS2 began to patrol Cochrane at 2315Z. HS2 began seeding storm #1 Calgary at 0003Z (08/08). They stopped seeding and began to patrol Okotoks at 0024Z (08/08). HS2 RTB at 0041Z (08/08), and landed at 0057Z (08/08).</p> <p>HS1 was launched at 2247Z for convection developing northwest of Cochrane. They were airborne at 2312Z. HS1 began to patrol Cochrane at 2321Z. They stopped patrolling and RTB at 0024Z (08/08). HS1 landed at 0036Z (08/08).</p> <p>Flight Summary HS2: 2256Z (08/07)-0059Z (08/08); 42 min wing-tip generators, 0 BIP; #1 Calgary, patrol Cochrane, Okotoks. HS1: 2302Z (08/07)-0038Z (08/08); no seeding; patrol Cochrane to Calgary.</p>
<p>August 8, Tuesday</p>	<p>A shortwave ridge was predicted to develop across the project area Tuesday afternoon. Subsidence under this ridge was modeled to form a formidable cap, eliminating any threat for deep convection. No synoptic forcing mechanisms were forecast through the entire period, and</p>	<p>No aircraft operations.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>no significant weather was anticipated.</p> <p>Fog and low clouds slowly mixed out through the morning and early afternoon hours. Clear skies were then observed across the project area throughout the forecast period.</p> <p>No meteorological echoes.</p> <p>Tmax YC = 21.9C and no rain. Tmax QF = 23.0C and no rain. Tmax Radar = 21.4C and no rain.</p>	
<p>August 9, Wednesday</p>	<p>Northwest flow aloft was predicted to continue Wednesday as a high amplitude ridge slowly moved east into B.C. Weak PVA was modeled to move south through the project in the late afternoon, but this was not forecast to be sufficient for convective development. Instability was expected to remain low, with a substantial CAP and convective inhibition in the low levels. Afternoon orographic convection was anticipated with synoptic upslope winds, but given the cap and predicted cell motion, was not expected to pose a hail threat to the project area.</p> <p>Orographic convection began to develop over the mountains and foothills early Wednesday afternoon. Activity tracked more easterly than predicted, and was slow to dissipate as it moved across the western project boundary. Radar indicated pea size hail may have fallen with one cell as it crossed the western project area northwest of Sundre. This storm gradually weakened as it continued east-southeast, and dissipated into a rain shower before passing north of Sundre. A second cell formed in the project area at the leading edge of a dissipating storm near Cremona, but the radar did not indicate hail with this storm. Rain showers continued to move southeast across the southern project area through the evening and overnight hours, finally exiting the southern buffer at 0830Z (08/10).</p> <p>Max cell top: 8.4km, 58.4 max dBz, 28.6 max VIL</p> <p>Tmax YC = 26.3C and 0.6mm of rain. Tmax QF = 25.8C and no rain. Tmax Radar = 25.3C and no rain.</p>	<p>No aircraft operations.</p>
<p>August 10, Thursday</p>	<p>A subtle shortwave trough was forecast to move south across Alberta as a high amplitude ridge stalls over British Columbia. Two waves of PVA were modeled, with a leading lobe of vorticity Thursday afternoon and a second wave moving south overnight. A weak upper level jet was prognosticated to stretch from north to south across central Alberta Thursday, with the southern project in the left-exit region. A significant cap was anticipated through the day, though considerable elevated instability was predicted above the cap. Synoptic upslope flow was forecast Thursday afternoon, with orographic convection potentially approaching the western project boundary. Additional showers and thundershowers were expected overnight, though no significant hail threats were forecast.</p>	<p>A PR tour was conducted at the Olds-Didsbury airport with 20 people in attendance.</p> <p>HS3 flew a PR flight. They were airborne from YQF at 1731Z and landed at EA3 at 1745Z</p> <p>HS3 flew a PR flight. They were airborne from EA3 at 2207Z and landed in YQF at 2220Z.</p> <p>HS1 was launched at 0518Z (08/11) to a line of TITAN cells developing directly over the Calgary area. The flight became airborne at 0538Z (08/11). At 0550Z (08/11) they started patrolling Calgary. HS1 then RTB at 0606Z</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>Strong convection developed in the foothills west of Turner Valley from 19Z into the evening hours. All activity tracked southeastward paralleling the foothills, and did not pose a threat to the project area. A second discrete storm formed over the foothills west of Cochrane around 2Z (08/11), but again followed the foothills west of the project boundary. Convection began to develop near the Airdrie area at around 0410Z (08/11). This convection quickly intensified into a cluster of strong TITAN cells which tracked south-southeastward into the Calgary area. Up to Loonie size hail was reported with this convection as it tracked through Calgary. Another weaker wave of convection formed north of Airdrie around 6Z (08/11), but did not become a hail threat for any project city. A final wave of moderately strong thunderstorms developed southeast of Okotoks just after 10Z (08/11). Radar indicated pea size hail may have fallen with these cells as they moved southeast out of the project area early Friday morning.</p> <p>Up to Loonie size hail reported in Calgary.</p> <p>Max cell top: 12.1km, 62.4 max dBz, 43.9 max VIL</p> <p>Tmax YC = 27.0C and 1.8mm of rain. Tmax QF = 25.6C and no rain. Tmax Radar = 24.4C and no rain.</p>	<p>(08/11). They landed at 0625Z (08/11).</p> <p>Flight Summary HS3: 1723Z-1748Z; no seeding; PR flight; takeoff YQF, land EA3. HS3: 2202Z-2224Z; no seeding; PR flight; takeoff EA3, land YQF. HS1: 0530-0630Z (08/11); no seeding; patrol Calgary.</p>
<p>August 11, Friday</p>	<p>A large upper level ridge was modeled to spread east into Alberta Friday. Subsidence associated with negative vorticity advection was predicted to create very dry and capped mid-level air across the project area. Strong insolation was forecast to yield considerable instability above the cap, however there were no synoptic trigger mechanisms anticipated. No significant weather was forecast throughout the period with the exception of exiting convective showers in the southern buffer that occurred at 12Z.</p> <p>Morning convective showers leftover from Thursday night's thunderstorms quickly departed the southern buffer after dawn. Skies were then mostly clear across the project area for the rest of the forecast period. No other meteorological echoes were observed.</p> <p>Max cell top: 8.4km, 46.0 max dBz, 8.2 max VIL</p> <p>Tmax YC = 25.5C and 0.6mm of rain. Tmax QF = 25.0C and no rain. Tmax Radar = 23.4C and no rain.</p>	<p>No aircraft operations.</p>
<p>August 12, Saturday</p>	<p>A broad upper level ridge was projected to weaken as it moved east across Alberta. No synoptic convective trigger mechanisms were foreseen. Upslope flow was expected to penetrate a strong cap that existed across the region, though storms were forecast to be short-lived and slow given poor wind shear. There was a threat orographic convection could travel far enough east to bring dissipating convective showers into the far west and southwest project area. No convective activity was</p>	<p>HS4 flew a maintenance flight. The aircraft became airborne at 0208Z and landed at 0216Z.</p> <p>Flight Summary HS4: 0157Z-0219Z (08/13); no seeding; maintenance flight.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>anticipated overnight.</p> <p>Sunny, capped conditions prevailed across the project area and nearby foothills. No meteorological echoes were observed.</p> <p>No meteorological echoes.</p> <p>Tmax YC = 28.6C and no rain. Tmax QF = 28.3C and no rain. Tmax Radar = 26.3C and no rain.</p>	
<p>August 13, Sunday</p>	<p>The right entrance region of a southeasterly upper level jet was forecast to be positioned over the region. A shortwave trough with strong PVA was expected to slide northeastward across the region in the afternoon. At the low levels and surface, lee cyclogenesis looked to occur in the afternoon. The moderately strong cap in place over the project area was expected to quickly erode during the early afternoon hours which would allow thunderstorms to easily develop along the foothills and push into the project area. The modified model soundings for the region showed anywhere from 600 to 1300J/kg in the afternoon. Speed shear values looked to be anywhere from 15 to 20kts.</p> <p>At 1915Z a TITAN cell formed just east of the town of Banff. This storm marked the leading edge of a shortwave trough and cold front beginning to push northeastward into the area. Over the next couple of hours convection started forming along the entire length of the foothills. At 2020Z a thunderstorm initiated just west of Sundre and pushed northward toward Caroline. While near the Caroline area, the thunderstorm (#1) intensified along the intersection zone of the northeastward moving cold front and a southeastward propagating mesoscale boundary. After becoming more organized, the storm tracked northeastward through Eckville, Bentley, and Rimbey. During this same time period the rest of the project area saw convective rain showers. In the evening, the convective activity waned across the area.</p> <p>1 inch size hail reported at Gull Lake. Dime size hail reported west of Ponoka.</p> <p>Max cell top: 14.4km, 64.0 max dBz, 97.5 max VIL</p> <p>Tmax YC = 30.5C and 1.6mm of rain. Tmax QF = 29.9C and 3.8mm of rain. Tmax Radar = 28.6C and 1.5mm of rain.</p>	<p>HS3 was launched at 2111Z to a thunderstorm growing near the Sundre area. The flight was airborne at 2139Z. At 2152Z they started top seeding storm #1 for Eckville. HS3 stopped seeding and RTB at 2248Z. The aircraft landed at 2255Z.</p> <p>HS5 was launched to convection growing near the Turner Valley and Black Diamond area at 2125Z. The aircraft became airborne at 2144Z. They started patrolling Calgary at 2158Z. At 2243Z HS5 RTB and landed at 2256Z.</p> <p>HS4 was launched at 2148Z to a tall storm moving toward Sylvan. The flight became airborne at 2202Z. HS4 began base seeding storm #1 for Sylvan at 2218Z. At 2332Z HS4 stopped seeding and RTB. They landed at 0002Z (08/14).</p> <p>HS1 was launched to an intensifying storm moving toward the Sylvan area at 2152Z. The aircraft was airborne at 2208Z. They started base seeding storm #1 for Sylvan at 2234Z. At 2335Z HS1 stopped seeding and RTB. The flight landed at 0021Z (08/14).</p> <p>Flight Summary HS3: 2120Z-2259Z; 197 EJ, 15 BIP; #1 Eckville to Sylvan. HS5: 2133Z-2258Z; no seeding; patrol Calgary. HS4: 2153Z (08/13)-0005Z (08/14); 148 min wing-tip generators, 11 BIP; #1 Sylvan to Ponoka. HS1: 2202Z (08/13)-0024Z (08/14); 0 EJ, 13 BIP; #1 Sylvan to Ponoka.</p>
<p>August 14, Monday</p>	<p>A mid and upper level low pressure system was expected to be centered over AB. PVA looked to be possible throughout the period, although PVA was forecast to be somewhat stronger during the late afternoon and evening. The wind flow at the surface and low levels appeared to be mainly out of the northwest to north for much of the day. Weak upslope conditions were expected over the southern part of the region near the foothills. The atmosphere looked to contain anywhere from 200 to 500J/kg of CAPE through the early evening hours. Bulk</p>	<p>HS5 was launched for patrol west of Cochrane at 1940Z. The flight was airborne at 1957Z. At 2008Z the aircraft began top seeding storm #1 for Cochrane. At 2047Z HS5 extended their seeding track further south to the southwest of Calgary. They stopped seeding and started patrolling the Calgary area at 2058Z. At 2129Z HS5 RTB and landed at 2144Z.</p> <p>HS2 was launched at 1952Z to the west of</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>speed shear values were predicted to approach 40kts in parts of the region. This amount of speed shear was expected to be sufficient enough for long-lived thunderstorms.</p> <p>A cluster of TITAN cells started forming along the foothills to the west of Cochrane at roughly 1930Z as a cold front began to slide into the region. These convective cells merged into a long line of thunderstorms which extended from Sundre down through Turner Valley during the mid-afternoon. Radar data indicated grape size hail may have fallen over a small area to the northwest of Cochrane. Overall, the line of thunderstorms presented a marginal hail threat as it slowly moved across the area during the afternoon hours. Behind the cold front, thick smoke moved into the area from fires in BC and western AB. Weaker convective activity then continued into the early nighttime hours as a surface low deepened over the eastern half of the project area.</p> <p>Max cell top: 8.4km, 59.1 max dBz, 31.3 max VIL</p> <p>Tmax YC = 19.3C and 19.0mm of rain. Tmax QF = 19.2C and 7.8mm of rain. Tmax Radar = 17.6C and 9.4mm of rain.</p>	<p>Cochrane. The aircraft became airborne at 2008Z. HS2 started base seeding storm #1 for Cochrane at 2013Z. At 2042Z HS2 extended their seeding track to the south along the line of convection closer to Turner Valley. The aircraft then continued seeding as they repositioned back to convection forming along the north end of the line of thunderstorms at 2056Z. At 2118Z the aircraft stopped seeding and started patrolling Airdrie. HS2 RTB at 2137Z. The aircraft landed at 2150Z.</p> <p>Flight Summary HS5: 1949Z-2156Z; 42 EJ, 10 BIP; #1 Cochrane to Calgary. HS2: 2001Z-2153Z; 132 min wing-tip generators, 2 BIP; #1 Cochrane, Calgary, and Airdrie.</p>
<p>August 15, Tuesday</p>	<p>The upper level low was predicted to continue moving eastward into central SK. Alberta was forecast to transition into northwest flow at the mid-levels. Two shortwave troughs with weak PVA were expected to move through the northwest flow. The first trough appeared to move through at the time of peak heating. The second wave of PVA was expected to move through at roughly midnight local time. The diurnal plains-mountain circulation (i.e. upslope flow) appeared to set up over the northern area for a few hours beginning around the time of peak heating. The 0000Z (08/16) modified model sounding for YQF indicated only a sliver of CAPE would be present. The atmosphere looked to largely stay capped throughout the forecast period.</p> <p>Altostratus, cirrus, cirrocumulus, and cirrostratus clouds formed over the region during the period. Smoke continued to flow into the project area. Smoke concentrations were higher over the southern half of the project area due to fires over BC and western AB.</p> <p>No meteorological echoes.</p> <p>Tmax YC = 21.1C and a trace of rain. Tmax QF = 20.9C and no rain. Tmax Radar = 20.2C and no rain.</p>	<p>No aircraft operations.</p>
<p>August 16, Wednesday</p>	<p>A shortwave trough was forecast to slowly slide eastward through the zonal mid-level flow during the evening hours. PVA appeared to be adequate enough for convective initiation. Lee cyclogenesis looked to occur in the evening, and a cold front was expected to push southeastward into the northern part of the area. The lee cyclone was expected to provide upslope conditions to the region north of Sundre and Olds. The modified model sounding for</p>	<p>Radar tour #4 was conducted at the Olds-Didsbury airport. 27 people were in attendance from the insurance industry.</p> <p>HS1 flew a PR flight. The aircraft was airborne out of YBW at 1724Z and landed in EA3 at 1740Z.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>YQF at 0000Z (08/17) suggested enough instability would be present for small hail. The sounding showed 225J/kg of CAPE, although more unstable conditions were expected to the west and north of Red Deer. Bulk speed shear values looked to approach 35kts.</p> <p>Smoke continued to flow over the region from fires in BC and western AB. Light convective rain showers were observed near Sundre, Didsbury, and Olds in the afternoon. In the evening and overnight, scattered convective rain showers were observed from the Airdrie area and to the north. At approximately 0600Z (08/17) a short-lived thunderstorm formed south of Rocky MH and tracked toward Sylvan before dissipating.</p> <p>No TITAN cells, 52.8 max dBz, 7.6 max VIL</p> <p>Tmax YC = 26.4C and no rain. Tmax QF = 24.9C and 1.4mm of rain. Tmax Radar = 24.0C and a trace of rain.</p>	<p>HS1 then flew a return PR flight. The aircraft was airborne out of EA3 at 2330Z and landed in YBW at 2345Z.</p> <p>Flight Summary HS1: 1716Z-1741Z; no seeding; PR flight; takeoff YBW, land EA3. HS1: 2324Z-2348Z; no seeding; PR flight; takeoff EA3, land YBW.</p>
<p>August 17, Thursday</p>	<p>A mid and upper level ridge was predicted to build over AB during the day and night. 500mb temperatures looked to warm by around 3C during the daytime. No PVA was expected throughout the period. Modified model soundings for the afternoon and evening showed CAPE values ranging anywhere from 0 to 50J/kg. A strong cap looked to be present at 15kft MSL (~600mb) which would likely inhibit deep convection from occurring during peak heating.</p> <p>Smoke was present over much of the project area throughout the period. The project area experienced minimal cloud cover during the day and nighttime hours.</p> <p>No meteorological echoes.</p> <p>Tmax YC = 25.3C and no rain. Tmax QF = 22.5C and no rain. Tmax Radar = 21.9C and no rain.</p>	<p>No aircraft operations.</p>
<p>August 18, Friday</p>	<p>The left-exit region of an 80kt jet streak looked to provide jet PVA during the evening. A mid and upper level trough with strong PVA was forecast to slide east across central AB in the evening and overnight. Most of the project area looked to experience downslope conditions until a strong cold front began to push southward into the far northern part of the region in the evening. Area modified model soundings showed a tight gradient of instability over the northern part of the project area. The atmosphere looked to be mostly stable in the south, but in the far northern area the air mass was expected to contain upwards of 800J/kg of CAPE. Speed shear values of roughly 40kts appeared to be strong enough for long-lived thunderstorms.</p> <p>A chinook arch cloud formed over the region in the morning. This large scale cloud remained over the region reducing insolation through the early afternoon hours. In the late afternoon into the evening hours towering cumulus clouds were observed as a cold front pushed</p>	<p>No aircraft operations.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>southward across the project area. During the nighttime a line of embedded convective rain showers slowly slid southeastward across the project area.</p> <p>No TITAN cells, 49.6 max dBz, 5.6 max VIL</p> <p>Tmax YC = 28.8C and no rain. Tmax QF = 28.2C and 1.6mm of rain. Tmax Radar = 27.8C and no rain.</p>	
August 19, Saturday	<p>AB was forecast to transition into northwest flow in the afternoon as a trough made its way into SK. Weak PVA looked to continue into the afternoon hours. At the low levels and surface downslope wind flow was expected to persist throughout the period. Surface dew-points appeared to steadily fall during the afternoon and looked to be at or below 0C by early evening. The YYC 21Z sounding was suggesting the atmosphere would be slightly unstable in the afternoon. Since very dry air existed above 14kft MSL (~600mb), deep convection looked unlikely.</p> <p>In the morning a narrow line of embedded convection pushed southeastward across the southern part of the project area. During the early half of the afternoon, discrete convective rain showers formed near Caroline, Olds, and Didsbury. The cloud cover then slowly diminished during the remainder of the daytime. No significant weather occurred overnight.</p> <p>No TITAN cells, 48.6 max dBz, 7.4 max VIL</p> <p>Tmax YC = 19.1C and no rain. Tmax QF = 20.5C and no rain. Tmax Radar = 19.6C and 0.3mm of rain.</p>	No aircraft operations.
August 20, Sunday	<p>A strong jet streak was modeled to move southeast into central Alberta Sunday while a broad upper level ridge moved across the Pacific Northwest. No significant PVA was anticipated through the period. Very dry air was observed at the surface Sunday morning, with only slight improvement expected due to low level downslope winds. Instability was very low, with CAPE modeled to remain less than 100 J/kg through the period. Periods of mid and upper level clouds and isolated weak rain showers were forecast, but discrete convection was not anticipated.</p> <p>A broad band of mid-level cloudiness moved east into the project area Sunday afternoon. Virga and very light rain showers were observed with this activity in Calgary. No significant weather occurred overnight.</p> <p>No TITAN cells, 31.0 max dBz, 0.3 max VIL</p> <p>Tmax YC = 20.4C and a trace of rain. Tmax QF = 19.4C and no rain. Tmax Radar = 19.3C and no rain.</p>	No aircraft operations.
August 21, Monday	<p>Negative vorticity advection was predicted to be the dominant weather influence as a broad ridge spread east into Alberta. Surface flow was forecast to turn southerly</p>	No aircraft operations.

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>Monday afternoon, with mesoscale upslope flow anticipated. A subtle mid-level disturbance ahead of the ridge was the only convective concern, but given the poor thermodynamic profile, only weak embedded showers were anticipated.</p> <p>Several rounds of mid-level clouds and virga occurred through the forecast period. The first wave moved southeast from Sundre to Crossfield Monday morning, the second developed and exited the project near Three Hills around 0Z (08/22), and the third spread southeast from Rocky MH to Three Hills between 1Z and 6Z (08/22). No precipitation was observed with this activity.</p> <p>No TITAN cells, 26.5 max dBz, 0.1 max VIL</p> <p>Tmax YC = 22.1C and no rain. Tmax QF = 22.1C and no rain. Tmax Radar = C and no rain.</p>	
<p>August 22, Tuesday</p>	<p>A broad upper level ridge was modeled to continue moving east across Alberta Tuesday. NVA was anticipated through the afternoon hours, forming a convective cap across the project area. Light to moderate southerly flow was forecast to turn upslope in the afternoon, with weak orographic convection likely. This activity was predicted to dissipate immediately away from the foothills, however, with no significant weather in the project area.</p> <p>Mid-level clouds and virga were observed early Tuesday morning in the northern project buffer, followed by clear skies across the project area into the afternoon. Weak convection began developing along the mountains and foothills around 2230Z, but all activity dissipated rapidly and posed no convective threat to the project area. No significant weather occurred within the project area overnight.</p> <p>Max cell top: 26.9 max dBz, 0.4 max VIL</p> <p>Tmax YC = 27.6C and no rain. Tmax QF = 26.9C and no rain. Tmax Radar = 26.2C and no rain.</p>	<p>A PR tour was conducted at the Olds-Didsbury airport with 26 individuals in attendance.</p> <p>HS2 flew a PR flight. They were airborne from YBW at 1727Z and landed at EA3 at 1743Z.</p> <p>HS2 flew a return PR flight. They were airborne from EA3 at 2305Z and landed at YBW at 2324Z.</p> <p>Flight Summary HS2: 1718Z-1745Z; no seeding; PR flight; takeoff YBW, land EA3. HS2: 2300Z-2327Z; no seeding; PR flight; takeoff EA3, land YBW.</p>
<p>August 23, Wednesday</p>	<p>An upper level ridge was modeled to move east away from the project area Wednesday. Synoptic convective triggers were modeled to be negligible through the day, though a lee cyclone was projected to develop in the project area by Wednesday evening. This feature was expected to create a dry slot across the southern project area, but enhance moisture and upslope flow to the north and northwest. Convective development was therefore forecast to develop near the northwestern project area by late afternoon, bringing a risk of small to moderate hail. A wave of PVA was predicted to move toward the southern project area from the southwest late Wednesday night into Thursday morning, providing a second chance for rain and thunderstorms before dawn.</p> <p>Weak orographic convection began drifting northeast into</p>	<p>HS4 was launched at 0248Z (08/24) for a strong thunderstorm southwest of Rocky MH. They were airborne at 0306Z (08/24). HS4 started patrolling the Rocky MH area at 0330Z (08/24). They then RTB at 0400Z (08/24) and landed at 0417Z (08/24).</p> <p>Flight Summary HS4: 0257Z-0422Z (08/24); no seeding; patrol Rocky MH.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>the project area mid-afternoon. Convection began to intensify in the far northwest project area around 0Z (08/24), continuing into the evening and early overnight hours. One stronger cell moved northeast in the vicinity of Rocky MH at 0330Z (08/24), but ultimately remained west and north of town. Radar indicated grape size hail fell with this cell north of Rocky MH. Additional convective showers and thundershowers developed near Sylvan around midnight, but no additional hail threats occurred.</p> <p>Max cell top: 9.9km, 61.1 max dBz, 41.7 max VIL</p> <p>Tmax YC = 31.1C and no rain. Tmax QF = 30.5C and no rain. Tmax Radar = 29.2C and no rain.</p>	
<p>August 24, Thursday</p>	<p>A strong and fast moving trough was projected to move east into Alberta Thursday. An upper level jet associated with this trough was modeled to move overhead in the overnight hours. PVA and upper level divergence were expected, but favored areas north of the project area. At the surface, dew points were expected to fall as downslope flow intensified through the day. Better moisture and instability was therefore expected to retreat to the far north and northeast regions of the project area. Speed shear near 40kts was also anticipated. A strong cold front was modeled to move south across the entire project area Thursday evening, ending the hail threat for the period.</p> <p>Pervasive chinook cloudiness present across much of the project area Thursday morning slowly dissipated and moved east Thursday afternoon. Orographic convection quickly followed, intensifying rapidly west of Rocky MH around 20Z. The first seeded storm of the day (storm #1) developed at the southern end of a cluster of cells west of Rocky MH. It became a small to moderate hail threat for Rocky MH, and was seeded for the town and eventually for Rimbey as it progressed northeast. Seeding stopped after the storm passed Rimbey, as the cell showed signs of weakening and was moving into the northern project buffer, but the storm suddenly reorganized around 2315Z. It began turning right of the mean flow, and unexpectedly passed through parts of Ponoka with radar indicated grape size hail. After passing east of Ponoka, it experienced another rapid intensification cycle, briefly producing radar indicated golf ball size hail in the northeast project buffer. Elsewhere, another area of weak convection moved northeast from Sundre to Sylvan from 2130-2230Z. This disorganized convection also experienced a rapid intensification cycle near Sylvan, and produced radar indicated grape size hail in Blackfalds as it tracked northeast. The southeast cell in the cluster (storm #2) was seeded as it approached the QE2 near Blackfalds and Lacombe, and additional convection on the southwest flank (storm #3) was seeded for Bentley. After this cluster of storms exited the northeast buffer around 1Z (08/25), elevated post-frontal showers were observed across much of the project area. This activity eventually dissipated and moved east of the area around 8Z (08/25).</p>	<p>HS4 was launched at 2021Z for developing convection west of Rocky MH. They were airborne at 2041Z. HS4 began to patrol Eckville at 2050Z. HS4 began base seeding storm #1 Rocky MH at 2111Z. They stopped seeding at 2201Z as the storm began to dissipate, but resumed seeding as it intensified near Rimbey. HS4 stopped seeding and RTB at 2239Z, and landed at 2249Z.</p> <p>HS3 was launched at 2215Z. They were airborne at 2235Z. HS3 began to patrol Ponoka at 2249Z. They repositioned to new development near Sylvan at 2253Z, and began to patrol Sylvan at 2256Z. HS3 repositioned to the south side of this convection at 2302Z, and began to patrol Innisfail at 2322Z. They repositioned to the east side of the storm and dropped to base seeding altitude at 2345Z, and began base seeding storm #2 Blackfalds at 2349Z. At 2355Z HS3 shifted their track westward, and began seeding storm #3 Bentley at 0002Z (08/25). HS3 stopped seeding and RTB at 0021Z (08/25). They landed at 0026Z (08/25).</p> <p>Flight Summary HS4: 2030Z-2252Z; 154 min wing-tip generators, 1 BIP; #1 Rocky MH to Rimbey, patrol Eckville. HS3: 2223Z-0030Z (08/25); 0 EJ, 11 BIP; #2 Blackfalds, #3 Bentley, patrol Ponoka, patrol Sylvan, patrol Innisfail.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>Max cell top: 13.6km, 64.8 max dBz, 108.0 max VIL</p> <p>Tmax YC = 28.5C and a trace of rain. Tmax QF = 29.0C and 1.0mm of rain. Tmax Radar = 27.4C and 1.0mm of rain.</p> <p>1.7cm size hail was reported south of Rimbey.</p>	
August 25, Friday	<p>A subtle shortwave trough was modeled to move across the project area Friday afternoon before a broad ridge spread across the region late in the period. Modest PVA associated with the trough was forecast to bring mid-level clouds and virga to the area around peak heating. Extremely dry surface conditions were anticipated due to persistent downslope flow, with no instability anticipated throughout the forecast period.</p> <p>Clear skies gave way to scattered areas of mid and upper level clouds from mid-afternoon into the evening. RADAR detected virga falling from this activity near Three Hills and near High River, but no convection or precipitation was observed. No significant weather occurred overnight.</p> <p>No TITAN cells, 29.1 max dBz, 0.2 max VIL</p> <p>Tmax YC = 23.2C and 1.0mm of rain. Tmax QF = 20.0C and no rain. Tmax Radar = 20.9C and no rain.</p>	No aircraft operations.
August 26, Saturday	<p>A broad upper level ridge was forecast to build north across the region Saturday. No synoptic scale convective triggers were predicted. Strong mid-level warming was projected to foster a robust convective cap, and relatively dry air was expected to persist at the surface. CAPE was modeled to remain at or near zero throughout the period, and clear skies were expected to prevail.</p> <p>No significant weather was observed. No meteorological echoes were detected, and clear skies were observed throughout the period.</p> <p>No meteorological echoes.</p> <p>Tmax YC = 25.8C and no rain. Tmax QF = 24.9C and no rain. Tmax Radar = 24.0C and no rain.</p>	No aircraft operations.
August 27, Sunday	<p>The upper level ridge of high pressure was forecast to flatten in the evening as a shortwave trough slid eastward across the far northern part of the project area. PVA with this disturbance was expected to be weak. At the low levels and surface, a lee trough appeared to form starting around the time of peak heating. The YQF modified model sounding for 00Z (08/28) indicated the atmosphere would stay mostly stable and a strong cap would be in place at the low levels. None the less, model soundings suggested elevated instability would be present to the west and north of Red Deer during the evening hours. Bulk speed shear values appeared to be around 30kts from the late afternoon into the overnight hours.</p>	No aircraft operations.

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>No significant weather occurred throughout the period. Altostratus, altostratus, cirrus, and cirrostratus clouds were observed over the region in the afternoon and evening.</p> <p>No TITAN cells, 22.8 max dBz, 0.1 max VIL</p> <p>Tmax YC = 31.1C and no rain. Tmax QF = 30.1C and no rain. Tmax Radar = 29.1C and no rain.</p>	
August 28, Monday	<p>A shortwave trough was located over the state of Washington. This shortwave was expected to push into AB in the evening. PVA looked to generally be weak with this disturbance. The diurnal upslope flow (i.e. mountain-plains circulation) appeared to be strongest over the northwest part of the project area. The CYQF modified model soundings for the evening through the early nighttime hours showed elevated instability would be present over the northern part of the project area.</p> <p>Due to a strong cap remaining in place across the entire region, mostly clear skies were observed over the project area through the time of sunset. Overnight, convective rain showers fell near the Pine Lake area.</p> <p>Max cell top: 7.6km, 56.8 max dBz, 17.2 max VIL</p> <p>Tmax YC = 28.0C and no rain. Tmax QF = 25.5C and no rain. Tmax Radar = 25.4C and no rain.</p>	<p>Radar tour #6 was conducted at the Olds-Didsbury airport. 19 people were in attendance from the insurance industry.</p> <p>HS4 flew a PR flight. The aircraft became airborne out of YQF at 1712Z and landed in EA3 at 1731Z.</p> <p>HS4 then flew a return PR flight. The flight was airborne out of EA3 at 2357Z and landed in YQF at 0015Z (08/29).</p> <p>Flight Summary HS4: 1706Z-1733Z; no seeding; PR flight; takeoff YQF, land EA3. HS4: 2346Z (08/28)-0017Z (08/29); no seeding; PR flight; takeoff EA3, land YQF.</p>
August 29, Tuesday	<p>A ridge of high pressure was expected to continue building over AB through around the time of sunset. A shortwave trough with weak PVA looked to then slide northeastward through the flow of the ridge during the late overnight hours. Broad scale upslope flow was forecast over the region. This upslope flow didn't look to be strong enough to initiate convection. Modified model soundings showed a loaded gun situation with elevated instability lingering into the overnight hours.</p> <p>Smoke flowed into AB from several fires in British Columbia. Other than the smoke, mostly clear skies occurred during the day and nighttime hours. No convection was observed during the period.</p> <p>No TITAN cells, 20.6 max dBz, 0.1 max VIL</p> <p>Tmax YC = 25.6C and no rain. Tmax QF = 27.4C and no rain. Tmax Radar = 25.1C and no rain.</p>	No aircraft operations.
August 30, Wednesday	<p>The region was forecast to see southwest flow at the mid and upper levels as the ridge shifted eastward over SK. A couple waves of PVA were expected. The first wave looked to move northeastward across the area during the mid-afternoon. The second wave of PVA appeared to move through in the early evening. At the low levels, a lee cyclone was expected to form near the Rocky MH area.</p>	No aircraft operations.

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>Moisture pooling was predicted over the northern part of the project area. A north-south orientated dry line also appeared to act as a trigger for convective development. Regional model soundings showed anywhere from 700 to 1000J/kg of CAPE would exist during the afternoon hours over the eastern half of the project area.</p> <p>Thick smoke was observed over the area throughout the period. In the morning, a couple of thunderstorms formed south of Three Hills. Radar data suggested pea size hail may have fallen over a small area to the east of Acme. The rest of the daytime hours saw no significant weather. Overnight, scattered convective rain showers fell over the eastern half of the project area.</p> <p>Max cell top: 9.9km, 59.0 max dBz, 20.9 max VIL</p> <p>Tmax YC = 33.0C and no rain. Tmax QF = 31.0C and no rain. Tmax Radar = 32.7C and no rain.</p>	
<p>August 31, Thursday</p>	<p>A mid and upper level trough was expected to slowly slide eastward over AB during the afternoon. PVA looked to be weak throughout the day and nighttime hours. The low level and surface wind flow was forecast to initially be northwesterly but then looked to veer to northeasterly by late afternoon. Upslope flow was expected starting in the late afternoon. The modified model soundings for 00Z and 03Z (09/01) over the northern part of the region indicated the troposphere would see anywhere from 50 to 300J/kg of CAPE. Bulk speed shear values appeared to range from 25 to 35kts across the northern part of the area.</p> <p>For most of the daytime hours the atmosphere remained capped. Altocumulus and cirrus clouds were seen over the region during the morning and afternoon. At roughly the time of sunset thunderstorms developed over the northern part of the project area. Radar data showed pea size hail may have fallen to the west-northwest of Rocky MH. From the Crossfield area and to the south, the project area did not see any convective rain showers. Thick smoke continued to drift into AB from numerous fires in BC.</p> <p>Max cell top: 7.6km, 57.1 max dBz, 20.7 max VIL</p> <p>Tmax YC = 26.5C and no rain. Tmax QF = 24.0C and a trace of rain. Tmax Radar = 23.4C and 2.8mm of rain.</p>	<p>No aircraft operations.</p>
<p>September 1, Friday</p>	<p>The west-northwesterly upper level jet stream was expected to shift northward as a mid and upper level ridge began to build over BC and AB. Several waves of moderately strong PVA were forecast to slide eastward across the area. Downslope wind flow was expected throughout the period. Area soundings showed a slightly unstable troposphere with dry air existing at the mid-levels.</p> <p>In the morning, isolated light convective rain showers fell to the east of Lacombe. Cumulus, altocumulus, cirrus,</p>	<p>No aircraft operations.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>cirrocumulus, and cirrostratus clouds then flowed over the area during the rest of the period. Smoke concentrations were lower across the region than the previous day.</p> <p>No TITAN cells, 36.9 max dBz, 0.9 max VIL</p> <p>Tmax YC = 27.0C and no rain. Tmax QF = 25.2C and no rain. Tmax Radar = 24.7C and no rain.</p>	
<p>September 2, Saturday</p>	<p>The mid and upper level ridge of high pressure looked to stay centered over AB through the afternoon hours. Starting around the time of sunset a cold front was expected to begin pushing southeastward into the far northern part of the project area. A shortwave trough looked to be co-located with the cold front. The cold front was expected to quickly push southeastward across the entire project area during the overnight hours. The modified model soundings showed a strong cap in place at 550mb (~17kft MSL). Small pockets of weak instability appeared to exist over the northern part of the project area during the overnight hours.</p> <p>Mostly clear skies were seen through the evening. In the evening and early nighttime a cold front swiftly pushed southward across the entire region. Most of the project area experienced strong wind speeds and cooler temperatures with the frontal passage. YQF reported wind gusts up to 47kts. Stratiform rain showers with embedded convection occurred over the far northern part of the area during the overnight hours.</p> <p>No TITAN cells, 36.0 max dBz, 1.0 max VIL</p> <p>Tmax YC = 32.0C and no rain. Tmax QF = 32.8C and 0.8mm of rain. Tmax Radar = 31.3C and no rain.</p>	<p>No aircraft operations.</p>
<p>September 3, Sunday</p>	<p>A shortwave trough was modeled to move southeast across the project area Sunday. Moderate to strong PVA was anticipated from mid-afternoon into the evening. Instability was projected to be very poor despite cooling temperatures aloft, with insolation mitigated by cloud cover in the central and northern project area. Showers were therefore expected with the strong PVA forcing, but no hail threats were forecast. NVA and clearing skies were predicted overnight.</p> <p>Weak rain showers moved east-southeast across the northern project area Sunday morning, leaving residual overcast skies midday. Rain showers associated with the shortwave trough began dropping southeast in the northern project near Rocky MH around 21Z, spreading across the project as far south as northern Calgary by 0Z (09/04). A few stronger embedded cells developed within the mass of rain showers near Olds, but no hail threats were observed. Lightning was present with this activity. All rain and thundershowers exited to the east near Strathmore around 2Z (09/04), with mostly clear skies and fog developing overnight.</p>	<p>No aircraft operations.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>Max cell top: 7.6km, 57.7 max dBz, 8.7 max VIL</p> <p>Tmax YC = 20.9C and 0.2mm of rain. Tmax QF = 15.8C and 3.9mm of rain. Tmax Radar = 16.5C and 3.3mm of rain.</p>	
September 4, Monday	<p>A broad upper level ridge was projected to build across B.C. and Alberta Monday, and remain over the region for several days. Considerable mid-level warming was anticipated, forming a very strong cap and near zero instability through the period. Low level flow was forecast to turn southeast Monday afternoon, with drier air slowly spreading into the region. Clear skies were anticipated throughout the forecast period.</p> <p>No significant weather occurred. Scattered dense fog Monday morning gave way to clear skies the remainder of the day.</p> <p>No meteorological echoes.</p> <p>Tmax YC = 20.9C and no rain. Tmax QF = 20.2C and no rain. Tmax Radar = 19.4C and no rain.</p>	No aircraft operations.
September 5, Tuesday	<p>An immense longwave ridge was modeled to remain nearly stationary over Western Canada. A strong convective cap was forecast to persist across the project area through the forecast period. A weak area of vorticity was prognosticated to move east under the ridge in the southern project area overnight, but neither precipitation nor convective development was anticipated.</p> <p>Clear skies with light to moderate southerly flow were observed throughout the forecast period. Mid-level smoke from upstream forest fires intensified, especially in the southern project area.</p> <p>No meteorological echoes.</p> <p>Tmax YC = 26.7C and no rain. Tmax QF = 26.9C and no rain. Tmax Radar = 25.9C and no rain.</p>	No aircraft operations.
September 6, Wednesday	<p>A strongly amplified ridge was projected to remain across Western Canada Wednesday. No synoptic scale convective triggers were anticipated. Upslope easterly flow was forecast, but little to no convective development was expected. Clear skies were predicted throughout the forecast period.</p> <p>Anomalously warm but dry conditions were observed. Smoke continued the blanket the mid-levels of the atmosphere, though surface visibility was generally unaffected.</p> <p>No meteorological echoes.</p> <p>Tmax YC = 29.9C and no rain. Tmax QF = 29.1C and no rain. Tmax Radar = 28.6C and no rain.</p>	No aircraft operations.

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

<p>September 7, Thursday</p>	<p>The axis of the upper level ridge was forecast to drift east across the region as a jet streak and shortwave trough developed in B.C. Southeast upslope flow was expected to interact with modestly unstable air over the foothills, with weak to moderate orographic convection predicted. All convective activity was forecast to remain west of the project area due to slow cell motion and poor shear. No convective triggers were prognosticated overnight.</p> <p>No significant weather occurred from Thursday morning well into the afternoon. Orographic convection began to develop around 23Z, but all activity dissipated before entering the project area. A second round of activity occurred late Thursday night. Convective showers developed west of Rocky MH around 1030Z (09/08), and produced rain in the far northwest project area and northern buffer between 11Z and 12Z (09/08).</p> <p>No TITAN cells, 46.4 max dBz, 5.6 max VIL</p> <p>Tmax YC = 30.9C and no rain. Tmax QF = 30.7C and no rain. Tmax Radar = 29.9C and no rain.</p>	<p>There was a PR tour conducted at the Olds-Didsbury Airport with 18 people in attendance.</p> <p>HS4 flew a PR flight. They were airborne from YQF at 1610Z and landed at EA3 at 1627Z.</p> <p>HS4 flew a return PR flight. They were airborne from EA3 at 0433Z (09/08) and landed in YQF at 0500Z (09/08).</p> <p>Flight Summary HS4: 1556Z-1631Z; no seeding; PR flight; takeoff YQF, land EA3. HS4: 0429Z-0507Z (09/08); no seeding; PR flight; takeoff EA3, land YQF.</p>
<p>September 8, Friday</p>	<p>Central Alberta lay between two dominant weather systems: a broad ridge moving east across Saskatchewan, and an upper level trough developing across central British Columbia. A wave of PVA was modeled to move east across the project area near peak heating. Surface upslope flow was anticipated from north to northeast winds. Moisture was much higher than recent days; however a strong low-level cap was projected around 700mb. High elevated instability was indicated above this cap, with MUCAPE as high as 1,000 J/kg near the foothills. Elevated, fast moving thunderstorms were forecast, moving with the PVA across the project area. Weaker more isolated convective showers were expected overnight.</p> <p>Convective rain showers moved northeast across parts of the northern project area between 12-15Z Friday morning. Clear skies under very thick smoke were then observed into the afternoon. A line of weak convective showers moved east off the foothills through the project area between 20Z and 2Z (09/09), but did not become a hail threat. Isolated convective showers moved northeast from the mountains toward the far northwest project area overnight, but dissipated significantly before entering the project and northern buffer. Lightning was not observed through the period.</p> <p>No TITAN cells, 48.3 max dBz, 6.8 max VIL</p> <p>Tmax YC = 25.9C and no rain. Tmax QF = 23.8C and no rain. Tmax Radar = 23.1C and no rain.</p>	<p>No aircraft operations.</p>
<p>September 9, Saturday</p>	<p>An upper level trough was projected to move into central Alberta Saturday. Periods of weak to moderate PVA were expected from midafternoon into the late evening. A cold</p>	<p>No aircraft operations.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>front was modeled to move east across the project area in the late afternoon. Instability was relatively low, and trapped above a modest low-level cap. Showers and thunderstorms were forecast to develop along the front, with the most concerning convective threat in the far north and northeast where the greatest moisture and instability were anticipated. Skies were expected to clear Saturday night, with drier and more stable air advecting in behind the front.</p> <p>Dissipating rain showers moved across the far northwest project area Saturday morning, with thick smoke and mid-level clouds remaining in the project area into the afternoon. A wave of weak convective rain showers moved east from Rocky MH between 20-23Z, before stalling in the Sylvan to Ponoka area. Rain showers continued in this area until 2Z (09/10), when the activity pivoted east out of the project area. Around 5Z (09/10), a new wave of fast-moving convective rain showers moved northeast off the foothills into the northern project area. This activity rapidly intensified at 0545Z (09/10), producing radar indicated pea and grape size hail northeast of Caroline, southwest of Ponoka, and near Rimbey. These thunderstorms weakened before reaching the QE2, and departed the project to the northeast around 9Z (09/10). Clear, stable conditions were observed the remainder of the night.</p> <p>Max cell top: 9.9km, 62.1 max dBz, 46.8 max VIL</p> <p>Tmax YC = 27.8C and no rain. Tmax QF = 22.6C and 1.0mm of rain. Tmax Radar = 27.2C and no rain.</p>	
<p>September 10, Sunday</p>	<p>The upper level jet stream was forecast to lift to the north as a ridge of high pressure built over AB. The ridging looked to last throughout the period. 500mb temperatures were expected to warm by around 2C during the daytime hours. Downslope conditions were predicted to persist through the nighttime hours. Surface dew points appeared to fall during the daytime. Modified model soundings for the region indicated the atmosphere would be stable. No deep convection was expected due to a warm layer extending from 650mb to 550mb (approximately 12kft to 17kft).</p> <p>No significant weather was observed throughout the forecast period. The smoke plumes from fires in southern BC and southwestern AB were mainly confined to the far southern part of the project area.</p> <p>No meteorological echoes.</p> <p>Tmax YC = 23.0C and no rain. Tmax QF = 22.0C and no rain. Tmax Radar = 21.2C and no rain.</p>	<p>No aircraft operations.</p>
<p>September 11, Monday</p>	<p>The upper level jet looked to shift southward into the northern part of the project area late in the period. The mid and upper levels were forecast to transition to southwest flow as a large scale trough began to move</p>	<p>No aircraft operations.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>from southeast Alaska into northern BC. At the low levels and surface, downslope conditions were expected to persist through the early evening. A cold front looked to drop southward across the entire region during the overnight hours. Area modified models soundings showed mostly stable tropospheric conditions during the overnight hours. Bulk speed shear values appeared to be too strong relative to any elevated instability that might exist.</p> <p>A chinook arch cloud covered most of the project area throughout the daytime hours. A cold front then quickly pushed southward across the project area during the early nighttime hours. Light stratiform rain showers fell over the far northern part of the project area late in the period.</p> <p>No TITAN cells, 36.0 max dBz, 1.0 max VIL</p> <p>Tmax YC = 29.1C and no rain. Tmax QF = 29.2C and no rain. Tmax Radar = 29.1C and no rain.</p>	
<p>September 12, Tuesday</p>	<p>An upper level trough was centered over southeast Alaska and was expected to deepen as it began to slide southeastward across BC. In the afternoon and early evening a couple of shortwave troughs with moderately strong PVA looked to move through the southwest flow. 500mb temperatures were expected to cool by at least 7C over the next 48 hours. Synoptic scale upslope flow appeared to be likely. According to the modified model soundings, the atmosphere looked to be mostly stable. None the less, pockets of weak instability were forecast to be present during the day and night. Bulk speed shear values were expected to remain very strong, roughly 55kts.</p> <p>Stratiform rain showers were observed along a stationary front draped west to east across the northern part of the project area. In the evening the stratiform rain showers overspread much of the area. During the overnight hours isolated, weak and short-lived thunderstorms occurred over the southern part of the project area.</p> <p>Max cell top: 4.6km, 53.3 max dBz, 8.8 max VIL</p> <p>Tmax YC = 20.5C and 1.2mm of rain. Tmax QF = 13.0C and 18.8mm of rain. Tmax Radar = 14.0C and 5.6mm of rain.</p>	<p>No aircraft operations.</p>
<p>September 13, Wednesday</p>	<p>Southwesterly jet energy looked to remain centered over southern AB throughout the period. A deepening, positively tilted, large scale mid and upper level trough appeared to remain over AB throughout the day and night. Despite cool surface temperatures, 500mb temperatures were forecast to fall by at least 5C during the daytime which would keep the troposphere unstable. Synoptic scale upslope flow was expected to persist through at least Friday afternoon. The modified model soundings for late afternoon and evening indicated enough instability (i.e. CAPE values of around 100J/kg) would exist for ice pellets. Bulk speed shear values</p>	<p>No aircraft operations.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	<p>looked to potentially reach 30kts during peak heating.</p> <p>Discrete convective cells were observed on radar over the southern part of the project area in the morning. None the less, the region mainly saw stratiform rain showers with embedded convection throughout the day and nighttime hours.</p> <p>No TITAN cells, 46.4 max dBz, 3.4 max VIL</p> <p>Tmax YC = 8.1C and 7.7mm of rain. Tmax QF = 7.4C and 7.4mm of rain. Tmax Radar = 7.2C and 4.1mm of rain.</p>	
<p>September 14, Thursday</p>	<p>The southwesterly upper level jet stream was expected to be centered over far southeastern AB. A mid and upper level trough was forecast to stay in place over AB through the overnight hours. A shortwave trough was expected to slowly move southward through the flow of the large scale trough. With the troughing, moderately strong PVA and upslope flow looked to be possible throughout the period. The modified model soundings for 21Z and 00Z (09/15) showed anywhere from 150 to 250J/kg of CAPE. Bulk speed shear values looked to be around 25kts.</p> <p>Scattered convective rain showers fell over the area during the morning and afternoon. During the mid-afternoon, short-lived thunderstorms formed over the northern part of the region. These thunderstorms were short-lived. Freezing levels were around 6.4kft MSL which allowed any ice pellets and small hail to easily reach the ground.</p> <p>Pea size hail was reported by a WMI pilot in Innisfail. Ice pellets were observed in Olds.</p> <p>Max cell top: 6.1km, 55.1 max dBz, 13.3 max VIL</p> <p>Tmax YC = 9.5C and 4.0mm of rain. Tmax QF = 10.4C and 1.2mm of rain. Tmax Radar = 8.4C and 0.3mm of rain.</p>	<p>No aircraft operations.</p>
<p>September 15, Friday</p>	<p>The mid and upper level trough over AB was expected to gradually morph into a closed low during the overnight hours. Since the trough continued to be in place over the area, PVA was probable throughout the period. Low level and surface winds were expected to veer during the daytime hours but mostly appeared to favor upslope flow. The YQF and YYC soundings for 21Z and 00Z (09/16) indicated CAPE values would range from 200 to 300J/kg in the late afternoon. Bulk speed shear values looked to be roughly 5 to 15kts.</p> <p>Scattered thunderstorms were observed during the afternoon hours over the northeast quadrant of the project area. These thunderstorms were short-lived and slow moving. During the early evening hours the convective activity rapidly diminished, and the skies became mostly clear during the overnight hours.</p> <p>Max cell top: 6.9km, 56.3 max dBz, 13.4 max VIL</p>	<p>No aircraft operations.</p>

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

	Tmax YC = 8.2C and 0.8mm of rain. Tmax QF = 10.2C and 1.8mm of rain. Tmax Radar = 9.6C and 0.3mm of rain.	
--	---	--

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

APPENDIX C – AIRCRAFT OPERATIONS SUMMARY TABLE

	Air Time				
	HS1	HS2	HS3	HS4	HS5
JUNE	10:22	11:13	6:33	10:26	11:07
JULY	29:48	29:59	24:14	27:08	23:10
AUGUST	4:24	3:36	3:07	5:19	2:59
SEPTEMBER	0:00	0:00	0:00	0:00	0:00

STORM DAY	HAILSTOP 1 Beech King Air C90			HAILSTOP 2 Cessna 340A				HAILSTOP 3 Beech King Air C90			HAILSTOP 4 Cessna 340A				HAILSTOP 5 Beech King Air C90			Daily Totals	
	Flight Time	EJ Flares	BIP Flares	Flight Time	EJ Flares	BIP Flares	Gen Time	Flight Time	EJ Flares	BIP Flares	Flight Time	EJ Flares	BIP Flares	Gen Time	Flight Time	EJ Flares	BIP Flares	No. of Storms	Daily Agl (grams)
JUNE																			
2-Jun								0:25	12	2								1	540
8-Jun	1:54		15	1:57		17	190	0:55	98	7	0:56		2	50	2:08	189	17	4	14927
12-Jun											0:51							0	0
14-Jun	2:12			2:31														0	0
16-Jun											1:06				3:22	274	9	2	6830
20-Jun				2:35		12	222	2:51	166	16	3:01		2	188	1:47			3	8651
21-Jun															0:40		3	1	450
26-Jun	2:39			1:08							1:51				1:09			0	0
27-Jun	2:58	178	14	3:02		18	224	2:22	122	14	2:41				0:49		2	2	13654
28-Jun	0:39		2												1:12	18	2	1	960
JULY																			
1-Jul	2:42	150	15	4:25		15	304	3:28	190	8	3:17		16	280	2:42	24	19	9	19414
3-Jul	1:33	305	12	2:44		9	172	4:20	332	20	2:53		19	256	3:07		24	5	26208
7-Jul															1:44	12		1	240
8-Jul	0:50			1:00		5	76								1:35	256	10	1	7524
9-Jul	5:37	243	21	4:04		15	258	2:27	268	22	3:23		11	100	1:24			5	21296
10-Jul				1:30			46	0:56	60						1:39	2	4	2	1933
12-Jul	4:07	184	34	3:57		14	378	2:22	177	12	4:16		21	292	2:22	305	21	3	29979
14-Jul				1:23				0:50			0:48							0	0
16-Jul	1:41	195	15					3:16	163	22								3	12710
20-Jul	3:49	200	4								2:21			40				2	4681
23-Jul	1:22	185	12	4:25		26	308	3:35	475	45	4:55		34	414	2:58	282	25	4	41604
27-Jul				3:14			168				2:31			248				2	844
28-Jul	4:08	299	30	2:31		18	230	3:00	94	9	2:44			136	3:44	94	23	3	22482
30-Jul															1:55	16		2	320
31-Jul	3:59	132	14	0:46		1	50											2	4991
AUGUST																			
7-Aug	1:24			1:54			42											1	85
10-Aug	0:47																	0	0
13-Aug	2:13		13					1:16	197	15	2:00		11	148	1:12			1	10090
14-Aug				1:42		2	132								1:47	42	10	1	2908
23-Aug											1:11							0	0
24-Aug								1:51	0	11	2:08		1	154				3	2112
SEPTEMBER																			

Tables are seed and patrol only.
All flight times are AIR time, not engine time.

ALBERTA HAIL SUPPRESSION PROJECT FINAL OPERATIONS REPORT 2017

APPENDIX D - FLIGHT SUMMARY TABLE

ALBERTA HAIL SUPPRESSION PROJECT 2017 - Universal Time Coordinates

MONTHLY FLIGHT TIME TOTAL	JUNE	JULY	AUGUST	SEPTEMBER	Season Total
HS1	13:01	33:33	5:47	0:00	52:21
HS2	15:19	37:07	4:49	0:00	67:15
HS3	7:34	26:36	4:33	0:00	38:43
HS4	13:08	34:29	7:19	1:13	66:09
HS5	14:22	25:50	5:03	0:00	45:15
					249:43

HailStep #1 - NS04DK
HailStep #2 - NS07DB
HailStep #3 - NS02JP
HailStep #4 - NS0356
HailStep #5 - NS087S

	TOTAL TIME	AIR TIME
Seeding hours:	186:39	170:52
Patrol hours:	37:50	32:33
Reposition hours:	10:15	7:02
PR hours:	5:47	3:36
Mx hours:	9:12	5:04
Ferry hours:	0:00	0:00
Cur hours:	0:00	0:00
	249:43	219:07

MONTHLY FLARE USAGE:	JUNE	JULY	AUGUST	SEPTEMBER	Season Total
HS1	BIP 31	157	13	0	201
	EJECT 178	1893	0	0	2071
	BIP 47	103	2	0	152
	EJECT 0	0	0	0	0
HS2	BURNERS 636	1990	174	0	2800
	BIP 39	138	26	0	203
	EJECT 398	1759	197	0	2354
	BIP 4	101	12	0	117
	EJECT 0	0	0	0	0
HS3	BURNERS 238	1766	302	0	2306
	BIP 33	126	10	0	169
	EJECT 481	991	42	0	1514

PILOT/OBSERVER	Initials	PILOT/OBSERVER	Initials
Adam Brnard	ARB	Jenelle Newman	JN
Andrew Brice	AB	Jody Fischer	JF
Andrew Wilkes	AW	Joel Zimmer	JZ
Brad Walter	BLW	Kole Lunde	KL
Brad Brooks	BB	Louis-David Dayon	LD
Brian Kindrat	BK	Mike Torris	MT
Brook Mueller	BM	Mike Benson	MB
Christian Avram	CA	Andreas Bertoni	AMB
Don Gilbert	DGG		
Hing Kwok	HK		

(Storm-day chemical totals ONLY include flares spent for seeding).
(Storm-day totals ONLY include flight hours for seed and patrol).

Storm-Day Sub-Totals																					
TOTALS	# Flights: 160	249:43		219:07		5939	842	5106	Total Time for the Day	Total EJ	Total BIP	Total Burner	Seed Amount (Per Day) (Grams)	Season Seed Accumulation (Grams)**	# Storms	Captain	Co-Pilot	Observer			
Date (UTC)	Aircraft	Engine On (UTC)	Engine Off (UTC)	Total Time (hh:mm)	Take-Off Time (UTC)	Landing Time (UTC)	Air Time (hh:mm) (all flights)	EJ (#) *used in flight tests	BIP (#) *used in flight tests	Burner Minutes *Test burns	Flight Type										
02-Jun-17	HS4	19:29	19:59	0:30	19:40	19:48	0:08	0	0	0	MX	224:29	5939	842	5106	0	0	JN	KL	BB	
02-Jun-17	HS3	20:05	20:52	0:47	20:21	20:46	0:25	12	2	0	SEED	0:47	12	2	0	540	1	JZ	MT	BB	
03-Jun-17	HS2	17:31	18:22	0:51	17:47	18:17	0:30	0	0	0	MX					540	0	LD	CA	AW	
03-Jun-17	HS4	17:32	18:27	0:55	17:55	18:19	0:24	0	0	0	MX	0:00	0	0	0	540	0	JN	KL		
09-Jun-17	HS5	0:18	2:39	2:21	0:27	2:35	2:08	189	17	0	SEED					540	1	BM	HK		
09-Jun-17	HS2	0:26	2:35	2:09	0:35	2:32	1:57	0	17	190	SEED					540	0	LD	CA	BK	
09-Jun-17	HS1	0:34	2:46	2:12	0:48	2:42	1:54	0	15	0	SEED					540	1	AB	AW		
09-Jun-17	HS4	1:17	2:29	1:12	1:29	2:25	0:56	0	2	50	SEED					540	1	JN	BB		
09-Jun-17	HS3	1:20	2:27	1:07	1:27	2:22	0:55	98	7	0	SEED					540	1	MT	JZ		
09-Jun-17	HS5	5:24	6:27	1:03	5:35	6:25	0:50	0	0	0	REPO					540	0	BM	HK		
09-Jun-17	HS2	5:32	6:22	0:50	5:43	6:18	0:35	0	0	0	REPO					540	0	LD	CA	BK	
09-Jun-17	HS1	5:33	6:33	1:00	5:53	6:32	0:39	0	0	0	REPO	9:01	287	58	240	14927	0	AB	AW		
12-Jun-17	HS4	23:31	0:35	1:04	23:41	0:32	0:51	0	0	0	PATROL	1:04	0	0	0	15467	0	JN	KL		
14-Jun-17	HS1	21:50	0:18	2:28	22:02	0:14	2:12	0	0	0	PATROL					15467	0	AB	CA		
14-Jun-17	HS2	21:59	0:04	2:05	22:18	0:00	1:42	0	0	0	PATROL					15467	0	HK	BK		
15-Jun-17	HS2	2:07	3:04	0:57	2:13	3:02	0:49	0	0	0	PATROL	5:30	0	0	0	15467	0	HK	BK		
16-Jun-17	HS5	20:40	21:53	1:13	20:46	21:47	1:01	0	0	0	PATROL					15467	0	BK	AW		
16-Jun-17	HS4	21:05	22:20	1:15	21:11	22:17	1:06	0	0	0	PATROL					15467	0	JN	KL		
16-Jun-17	HS5	22:54	1:23	2:29	23:00	1:21	2:21	274	9	0	SEED	4:57	274	9	0	6830	22297	2	BK	AW	
20-Jun-17	HS2	19:25	20:22	0:57	19:43	20:20	0:37	0	0	0	REPO					22297	0	HK	BK		
20-Jun-17	HS2	22:51	1:34	2:43	22:57	1:32	2:35	0	12	222	SEED					22297	3	HK	BK		
20-Jun-17	HS3	22:56	2:02	3:06	23:07	1:58	2:51	166	16	0	SEED					22297	0	MT	JZ		
20-Jun-17	HS4	23:00	2:18	3:18	23:14	2:15	3:01	0	2	188	SEED					22297	0	JN	BB		
20-Jun-17	HS5	23:42	1:36	1:54	23:47	1:34	1:47	0	0	0	PATROL	11:01	166	30	410	8651	0	BM	AW		
21-Jun-17	HS5	17:23	17:45	0:22	17:31	17:44	0:13	0	0	0	PR					30948	0	BM	CA		
21-Jun-17	HS5	20:19	21:05	0:46	20:22	21:02	0:40	0	3	0	SEED					30948	1	BM	CA	AB	
21-Jun-17	HS5	22:14	22:33	0:19	22:17	22:31	0:14	0	0	0	PR	0:46	0	3	0	450	31398	0	BM	CA	
26-Jun-17	HS1	22:32	1:28	2:56	22:45	1:24	2:39	0	0	0	PATROL					31398	0	AB	BK	MB	
27-Jun-17	HS4	0:17	2:19	2:02	0:25	2:16	1:51	0	0	0	PATROL					31398	0	JN	KL		
27-Jun-17	HS5	1:04	2:20	1:16	1:09	2:18	1:09	0	0	0	PATROL					31398	0	BM	CA		
27-Jun-17	HS2	1:06	2:26	1:20	1:15	2:23	1:08	0	0	0	PATROL					31398	0	HK	AW		
27-Jun-17	HS1	2:32	2:58	0:26	2:40	2:56	0:16	0	0	0	REPO	7:34	0	0	0	31398	0	AB	BK	MB	

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

27-Jun-17	HS2	22.33	1.05	2.32	22.43	1.03	2.20	0	18	224	SEED							0	31398	1	HK	AW	
27-Jun-17	HS3	23.15	1.49	2.34	23.22	1.44	2.22	122	14	0	SEED							0	31398	0	MT	BB	
28-Jun-17	HS5	0.05	1.01	0.56	0.11	1.00	0.49	0	2	0	SEED							0	31398	0	BM	CA	
28-Jun-17	HS4	1.23	4.15	2.52	1.29	4.10	2.41	0	0	0	PATROL							0	31398	0	JN	KL	
28-Jun-17	HS1	2.38	5.45	3.07	2.44	5.42	2.58	178	14	0	SEED							0	31398	1	AB	BK	MB
28-Jun-17	HS2	3.29	4.24	0.55	3.38	4.20	0.42	0	0	0	PATROL	12.56	300	48	224	13654		45052	0	HK	AW		
28-Jun-17	HS5	17.22	17.47	0.25	17.29	17.44	0.15	0	0	0	PR							45052	0	BK	CA		
28-Jun-17	HS5	21.42	23.00	1.18	21.46	22.58	1.12	18	2	0	SEED							45052	1	BK	CA		
28-Jun-17	HS1	21.51	22.43	0.52	22.02	22.41	0.39	0	2	0	SEED	2.10	18	4	0	960		46012	0	AB	AW		
01-Jul-17	HS5	19.18	20.15	0.57	19.25	20.14	0.49	18	3	0	SEED							46012	1	BM	CA		
01-Jul-17	HS2	19.16	20.56	1.40	19.29	20.53	1.24	0	7	92	SEED							46012	0	HK	AW		
01-Jul-17	HS4	20.25	23.57	3.32	20.36	23.53	3.17	0	16	280	SEED							46012	2	JZ	KL		
01-Jul-17	HS5	20.26	22.23	1.57	20.28	22.21	1.53	6	16	0	SEED							46012	2	BM	CA		
01-Jul-17	HS3	21.09	0.53	3.44	21.20	0.48	3.28	190	8	0	SEED							46012	1	MT	BB		
01-Jul-17	HS2	21.31	0.40	3.09	21.37	0.38	3.01	0	8	212	SEED							46012	1	HK	AW		
01-Jul-17	HS1	21.31	23.52	2.21	21.39	23.49	2.10	150	13	0	SEED							46012	1	BK	MB		
02-Jul-17	HS1	4.12	4.56	0.44	4.21	4.53	0.32	0	2	0	SEED	18.04	364	73	584	19414		65427	1	BK	MB		
03-Jul-17	HS4	22.11	1.14	3.03	22.17	1.10	2.53	0	19	256	SEED							65427	2	JN	KL		
03-Jul-17	HS3	22.17	0.28	2.11	22.25	0.26	2.01	289	20	0	SEED							65427	1	MT	JZ		
03-Jul-17	HS5	22.18	1.35	3.17	22.25	1.32	3.07	0	24	0	SEED							65427	0	BK	CA		
03-Jul-17	HS1	23.26	1.11	1.45	23.36	1.09	1.33	305	12	0	SEED							65427	0	AB	AW		
03-Jul-17	HS2	23.28	2.26	2.58	23.39	2.23	2.44	0	9	172	SEED							65427	2	HK	MT		
04-Jul-17	HS3	1.12	3.38	2.26	1.16	3.35	2.19	43	0	0	SEED							65427	0	MT	JZ		
04-Jul-17	HS4	2.32	2.50	0.18	2.39	2.45	0.06	0	0	0	MX	15.40	637	84	428	26208		91635	0	JN			
04-Jul-17	HS4	17.32	18.05	0.33	17.52	18.01	0.09	0	0	0	MX	0.00	0	0	0	0		91635	0	JN	BB		
07-Jul-17	HS2	0.43	0.58	0.15	0.52	0.56	0.04	0	0	0	MX	0.00	0	0	0	0		91635	0	AB	MB		
08-Jul-17	HS5	1.56	3.55	1.59	2.09	3.53	1.44	12	0	0	SEED							91635	1	BM	CA		
08-Jul-17	HS4	2.33	2.56	0.23	2.41	2.50	0.09	0	0	0	MX	1.59	12	0	0	240		91675	0	JN	KL		
08-Jul-17	HS4	20.21	20.57	0.36	20.32	20.54	0.22	0	0	0	REPO							91675	0	JN	BB		
08-Jul-17	HS4	22.46	23.23	0.37	22.58	23.17	0.19	0	0	0	REPO							91675	0	JN	BB		
09-Jul-17	HS5	1.53	3.35	1.42	1.57	3.32	1.35	296	10	0	SEED							91675	1	BM	AW		
09-Jul-17	HS2	2.22	3.35	1.13	2.30	3.30	1.00	0	5	76	SEED							91675	0	AB	BK		
09-Jul-17	HS1	2.46	3.47	1.01	2.53	3.43	0.50	0	0	0	PATROL	3.56	256	15	76	7524		99399	0	AB	BK		
09-Jul-17	HS1	18.31	20.16	1.45	18.40	20.14	1.34	28	2	0	SEED							99399	1	AB	BK		
09-Jul-17	HS2	18.33	20.27	1.54	18.45	20.22	1.37	0	0	30	SEED							99399	0	HK	MB		
09-Jul-17	HS4	19.55	21.30	1.35	20.08	21.28	1.18	0	0	0	PATROL							99399	0	JN	BB		
09-Jul-17	HS5	19.57	21.28	1.31	20.02	21.28	1.24	0	0	0	PATROL							99399	0	BM	AW		
09-Jul-17	HS1	21.55	2.09	4.14	22.04	2.07	4.03	215	19	0	SEED							99399	2	AB	BK		
09-Jul-17	HS2	22.56	23.35	0.39	23.03	23.32	0.29	0	0	0	REPO							99399	0	HK	MB		
10-Jul-17	HS2	0.35	3.14	2.39	0.45	3.12	2.27	0	15	228	SEED							99399	2	HK	MB		
10-Jul-17	HS3	0.36	3.15	2.39	0.45	3.12	2.27	268	22	0	SEED							99399	0	MT	JZ		
10-Jul-17	HS4	1.00	3.17	2.17	1.06	3.11	2.05	0	11	100	SEED	18.34	511	69	358	21296		120695	0	JN	BB		
10-Jul-17	HS4	21.32	22.08	0.36	21.39	22.04	0.25	0	0	0	MX							120695	0	JN	KL		
10-Jul-17	HS5	22.11	0.01	1.50	22.20	23.59	1.39	2	4	0	SEED							120695	1	BM	CA		
10-Jul-17	HS2	22.13	23.53	1.40	22.20	23.50	1.30	0	0	46	SEED							120695	0	HK	AW		
11-Jul-17	HS3	7.13	8.23	1.10	7.23	8.19	0.56	60	0	0	SEED	4.40	62	4	46	1933		122628	1	MT	JZ		
12-Jul-17	HS4	1.45	2.15	0.30	1.53	2.11	0.18	0	0	0	MX	0.00	0	0	0	0		122628	0	JN	BK		
12-Jul-17	HS4	19.53	20.23	0.30	20.06	20.19	0.13	0	0	0	MX							122628	0	JN	KL		
12-Jul-17	HS1	20.35	22.51	2.16	20.44	22.49	2.05	184	14	0	SEED							122628	1	AB	MB		
12-Jul-17	HS2	20.42	23.02	2.20	20.51	23.00	2.09	0	5	210	SEED							122628	0	HK	AW		
12-Jul-17	HS4	21.03	22.47	1.44	21.11	22.44	1.33	0	0	48	SEED							122628	1	JN	KL		
12-Jul-17	HS5	22.34	22.50	0.16	22.40	22.47	0.07	0	0	0	PATROL							122628	0	BM	CA		
12-Jul-17	HS5	23.08	1.28	2.20	23.12	1.27	2.15	305	21	0	SEED							122628	1	BM	CA		
12-Jul-17	HS4	23.47	2.41	2.54	23.54	2.37	2.43	0	21	244	SEED							122628	0	JN	KL		
12-Jul-17	HS3	23.59	2.39	2.40	0.10	2.32	2.22	177	12	0	SEED							122628	0	MT	BB		
12-Jul-17	HS2	0.01	1.57	1.56	0.07	1.55	1.48	0	9	168	SEED							122628	0	HK	AW		
13-Jul-17	HS1	0.03	2.12	2.09	0.08	2.10	2.02	0	20	0	SEED	18.35	666	102	670	29979		152607	0	AB	MB		
14-Jul-17	HS4	0.44	1.46	1.02	0.54	1.42	0.48	0	0	0	PATROL							152607	0	JN	JZ		
14-Jul-17	HS3	0.44	1.53	1.09	0.57	1.47	0.50	0	0	0	PATROL							152607	0	MT	BB		
14-Jul-17	HS2	0.50	2.23	1.33	0.58	2.21	1.23	0	0	0	PATROL	3.44	0	0	0	0		152607	0	HK	AW		
16-Jul-17	HS3	19.33	22.59	3.26	19.40	22.56	3.16	153	22	0	SEED							152607	1	MT	JZ		
16-Jul-17	HS1	21.55	23.46	1.51	22.04	23.45	1.41	195	15	0	SEED	5.17	358	37	0	12710		165317	2	AB	AW		
20-Jul-17	HS1	19.43	23.46	4.03	19.55	23.44	3.49	200	4	0	SEED							165317	1	AB	BK		
20-Jul-17	HS4	21.50	0.28	2.38	22.02	0.23	2.21	0	0	40	SEED	6.41	200	4	40	4681		169998	1	JN	BB		

Tel: 1-701-235-5500 * Fax: 1-701-235-9717 * 3802 20th Street N * Fargo, ND 58102 * USA
 www.weathermodification.com

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

23-Jul-17	HS2	17.29	18.03	0.34	17.37	18.00	0.23	0	0	0	MX								0	169998	0	HK	MB
23-Jul-17	HS5	20.38	23.27	2.49	20.45	23.25	2.40	282	25	0	SEED								0	169998	1	BM	AW
23-Jul-17	HS4	20.44	0.06	3.22	20.53	0.03	3.10	0	24	300	SEED								0	169998	1	JN	BB
23-Jul-17	HS2	20.44	0.01	3.17	20.51	23.59	3.08	0	23	276	SEED								0	169998	0	HK	MB
23-Jul-17	HS3	21.25	23.21	1.56	21.34	23.17	1.43	203	21	0	SEED								0	169998	1	BK	JZ
23-Jul-17	HS1	22.23	23.54	1.31	22.30	23.52	1.22	185	12	0	SEED								0	169998	0	AB	CA
24-Jul-17	HS3	0.31	2.34	2.03	0.40	2.32	1.52	272	24	0	SEED								0	169998	1	BK	JZ
24-Jul-17	HS4	1.01	2.54	1.53	1.07	2.52	1.45	0	10	114	SEED								0	169998	0	JN	BB
24-Jul-17	HS2	1.22	2.47	1.25	1.28	2.45	1.17	0	3	32	SEED								0	169998	0	HK	MB
24-Jul-17	HS5	2.17	2.46	0.29	2.27	2.45	0.19	0	0	0	PATROL	18.45	942	142	722	41804			0	211602	0	BM	AW
24-Jul-17	HS4	15.38	16.24	0.46	15.46	16.20	0.34	0	0	0	REPO	0.00	0	0	0	0			0	211602	0	JN	
26-Jul-17	HS2	14.21	15.05	0.44	14.28	14.58	0.30	0	0	0	MX								0	211602	0	HK	AW
26-Jul-17	HS2	21.10	21.50	0.40	21.19	21.47	0.28	0	0	0	MX	0.00	0	0	0	0			0	211602	0	HK	AW
27-Jul-17	HS2	20.20	21.03	0.43	20.30	21.00	0.30	0	0	0	REPO								0	211602	0	HK	MB
27-Jul-17	HS2	23.10	0.41	1.31	23.15	0.38	1.23	0	0	0	PATROL								0	211602	0	HK	MB
28-Jul-17	HS4	1.36	4.21	2.45	1.46	4.17	2.31	0	0	248	SEED								0	211602	1	JN	KL
28-Jul-17	HS2	2.36	4.39	2.03	2.42	4.33	1.51	0	0	168	SEED								0	211602	1	HK	MB
28-Jul-17	HS1	4.40	5.25	0.45	4.50	5.20	0.30	0	0	0	REPO								0	211602	0	AB	AW
28-Jul-17	HS5	4.48	5.28	0.40	4.56	5.23	0.27	0	0	0	REPO	6.19	0	0	416	844			0	212446	0	BK	CA
28-Jul-17	HS1	21.10	1.30	4.20	21.19	1.27	4.08	299	30	0	SEED								0	212446	2	AB	AW
28-Jul-17	HS5	21.33	1.32	3.59	21.44	1.28	3.44	94	23	0	SEED								0	212446	0	BM	CA
28-Jul-17	HS2	22.25	1.06	2.41	22.32	1.03	2.31	0	18	230	SEED								0	212446	0	HK	MB
29-Jul-17	HS4	0.18	3.13	2.55	0.24	3.08	2.44	0	0	136	SEED								0	212446	1	JN	KL
29-Jul-17	HS3	0.20	3.32	3.12	0.28	3.28	3.00	94	9	0	SEED	17.07	487	80	366	22482			0	234928	0	MT	BB
31-Jul-17	HS5	0.08	2.12	2.04	0.14	2.09	1.55	16	0	0	SEED								0	234928	2	BM	CA
31-Jul-17	HS1	2.03	2.40	0.37	2.11	2.37	0.26	0	0	0	REPO								0	234928	0	AB	AW
31-Jul-17	HS2	2.20	2.56	0.36	2.26	2.54	0.28	0	0	0	REPO	2.04	16	0	0	320			0	235248	0	HK	MB
31-Jul-17	HS1	23.23	3.34	4.11	23.33	3.32	3.59	132	14	0	SEED								0	235248	2	AB	AW
01-Aug-17	HS2	1.38	2.35	0.57	1.45	2.31	0.46	0	1	50	SEED	5.08	132	15	50	4991			0	240240	0	HK	MB
04-Aug-17	HS5	14.50	15.34	0.44	14.57	15.28	0.31	0	0	0	MX								0	240240	0	BM	AMB
04-Aug-17	HS5	19.36	20.23	0.47	19.42	20.20	0.38	0	0	0	MX	0.00	0	0	0	0			0	240240	0	BM	AMB
07-Aug-17	HS2	22.56	0.59	2.03	23.03	0.57	1.54	0	0	42	SEED								0	240240	1	HK	MB
07-Aug-17	HS1	23.02	0.38	1.36	23.12	0.36	1.24	0	0	0	PATROL	3.39	0	0	42	85			0	240325	0	AB	BK
10-Aug-17	HS3	17.23	17.48	0.25	17.31	17.45	0.14	0	0	0	PR								0	240325	0	MT	BB
10-Aug-17	HS3	22.02	22.24	0.22	22.07	22.20	0.13	0	0	0	PR								0	240325	0	MT	BB
11-Aug-17	HS1	5.30	6.30	1.00	5.38	6.25	0.47	0	0	0	PATROL	1.00	0	0	0	0			0	240325	0	AB	AW
13-Aug-17	HS4	1.57	2.19	0.22	2.08	2.16	0.08	0	0	0	MX	0.00	0	0	0	0			0	240325	0	JN	
13-Aug-17	HS3	21.20	22.59	1.39	21.39	22.55	1.16	197	15	0	SEED								0	240325	1	AB	JZ
13-Aug-17	HS5	21.33	22.58	1.25	21.44	22.56	1.12	0	0	0	PATROL								0	240325	0	BM	AMB
13-Aug-17	HS4	21.53	0.05	2.12	22.02	0.02	2.00	0	11	148	SEED								0	240325	0	JN	BB
13-Aug-17	HS1	22.02	0.24	2.22	22.08	0.21	2.13	0	13	0	SEED	7.38	197	39	148	10090			0	250415	0	BK	AW
14-Aug-17	HS5	19.49	21.56	2.07	19.57	21.44	1.47	42	10	0	SEED								0	250415	1	BM	AMB
14-Aug-17	HS2	20.01	21.53	1.52	20.08	21.50	1.42	0	2	132	SEED	3.59	42	12	132	2908			0	253323	0	BK	AB
16-Aug-17	HS1	17.16	17.41	0.25	17.24	17.40	0.16	0	0	0	PR								0	253323	0	AB	AW
16-Aug-17	HS1	23.24	23.48	0.24	23.30	23.45	0.15	0	0	0	PR	0.00	0	0	0	0			0	253323	0	AB	AW
22-Aug-17	HS2	17.18	17.45	0.27	17.27	17.43	0.16	0	0	0	PR								0	253323	0	HK	MB
22-Aug-17	HS2	23.00	23.27	0.27	23.05	23.24	0.19	0	0	0	PR	0.00	0	0	0	0			0	253323	0	HK	MB
24-Aug-17	HS4	2.57	4.22	1.25	3.06	4.17	1.11	0	0	0	PATROL	1.25	0	0	0	0			0	253323	0	JN	BB
24-Aug-17	HS4	20.30	22.52	2.22	20.41	22.49	2.08	0	1	154	SEED								0	253323	1	JN	BB
24-Aug-17	HS3	22.23	0.30	2.07	22.35	0.26	1.51	0	11	0	SEED	4.29	0	12	154	2112			0	255435	2	MT	JZ
28-Aug-17	HS4	17.06	17.33	0.27	17.12	17.31	0.19	0	0	0	PR								0	255435	0	JN	KL
28-Aug-17	HS4	23.46	0.17	0.31	23.57	0.15	0.18	0	0	0	PR	0.00	0	0	0	0			0	255435	0	JN	KL
07-Sep-17	HS4	15.56	16.31	0.35	16.10	16.27	0.17	0	0	0	PR								0	255435	0	JN	BB
07-Sep-17	HS4	4.29	5.07	0.38	4.33	5.00	0.27	0	0	0	PR	0.00	0	0	0	0			0	255435	0	JN	BB
				0.00			0.00												0	255435			

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

APPENDIX E – FORMS

Weather Forecast Worksheet



<p>Today's CDC</p> <p style="font-size: 2em; font-weight: bold;">X</p>	<p>Synopsis:</p>
---	------------------

Forecast:

Day 2 Outlook CDC: X

<p>Model Sounding XXX XXZ</p> <p>Freezing Level: kft</p> <p>- 5°C Level: kft</p> <p>-10°C Level: kft</p> <p>Equilibrium Level: kft</p> <p>Tropopause: kft</p> <p>Cloud Base Height: kft</p> <p>Cloud Base Temp: °C</p> <p>Cell Motion: @ kts</p> <p>Storm Motion: @ kts</p> <p>Temp Max: °C</p> <p>Dew Point: °C</p> <p>Convective Temp: °C</p> <p>CAPE: J/Kg</p> <p>CIN: J/Kg</p> <p>Lifted Index:</p> <p>Showalter Index:</p> <p>Total Totals:</p> <p>Precipitable Water: inches</p> <p>WINDEX: mph</p>	<p>Hailcast Model Output</p> <p>CALGARY:</p> <p>RED DEER:</p> <table style="width: 100%;"> <tr> <td><input type="checkbox"/> Jet PVA</td> <td><input type="checkbox"/> Morning Fog</td> </tr> <tr> <td><input type="checkbox"/> Short Wave Trof</td> <td><input type="checkbox"/> Gusty SFC Winds</td> </tr> <tr> <td><input type="checkbox"/> Lee Cyclogenesis</td> <td><input type="checkbox"/> Loaded Gun</td> </tr> <tr> <td><input type="checkbox"/> Directional Wind Shear</td> <td><input type="checkbox"/> Theta E Ridge</td> </tr> <tr> <td><input type="checkbox"/> Speed Shear</td> <td><input type="checkbox"/> Chinook</td> </tr> <tr> <td><input type="checkbox"/> PM Radiative Cooling</td> <td><input type="checkbox"/> Cloud Cover</td> </tr> <tr> <td><input type="checkbox"/> AM ACC or Cloud Streets</td> <td><input type="checkbox"/> Insolation (sfc heating)</td> </tr> <tr> <td><input type="checkbox"/> NE/SE Moisture Advection</td> <td><input type="checkbox"/> Latent Instability</td> </tr> <tr> <td><input type="checkbox"/> Cooling at 500mb</td> <td><input type="checkbox"/> Frontal Lift</td> </tr> <tr> <td><input type="checkbox"/> Warming at 500mb</td> <td><input type="checkbox"/> Upslope Flow</td> </tr> <tr> <td><input type="checkbox"/> Dry Line or Dry Slot</td> <td><input type="checkbox"/> Low Ceilings</td> </tr> <tr> <td><input type="checkbox"/> Smoke/Haze</td> <td><input type="checkbox"/> Flood Potential</td> </tr> </table>	<input type="checkbox"/> Jet PVA	<input type="checkbox"/> Morning Fog	<input type="checkbox"/> Short Wave Trof	<input type="checkbox"/> Gusty SFC Winds	<input type="checkbox"/> Lee Cyclogenesis	<input type="checkbox"/> Loaded Gun	<input type="checkbox"/> Directional Wind Shear	<input type="checkbox"/> Theta E Ridge	<input type="checkbox"/> Speed Shear	<input type="checkbox"/> Chinook	<input type="checkbox"/> PM Radiative Cooling	<input type="checkbox"/> Cloud Cover	<input type="checkbox"/> AM ACC or Cloud Streets	<input type="checkbox"/> Insolation (sfc heating)	<input type="checkbox"/> NE/SE Moisture Advection	<input type="checkbox"/> Latent Instability	<input type="checkbox"/> Cooling at 500mb	<input type="checkbox"/> Frontal Lift	<input type="checkbox"/> Warming at 500mb	<input type="checkbox"/> Upslope Flow	<input type="checkbox"/> Dry Line or Dry Slot	<input type="checkbox"/> Low Ceilings	<input type="checkbox"/> Smoke/Haze	<input type="checkbox"/> Flood Potential	<p>Verification</p> <p>Observed CDC:</p> <p>Max TITAN cell top: km</p> <p>Max reflectivity: dBz</p> <p>Max VIL: kg/m²</p> <p>YYC:</p> <p>YQF:</p> <p>EA3:</p> <p>Hail Reports:</p>
<input type="checkbox"/> Jet PVA	<input type="checkbox"/> Morning Fog																									
<input type="checkbox"/> Short Wave Trof	<input type="checkbox"/> Gusty SFC Winds																									
<input type="checkbox"/> Lee Cyclogenesis	<input type="checkbox"/> Loaded Gun																									
<input type="checkbox"/> Directional Wind Shear	<input type="checkbox"/> Theta E Ridge																									
<input type="checkbox"/> Speed Shear	<input type="checkbox"/> Chinook																									
<input type="checkbox"/> PM Radiative Cooling	<input type="checkbox"/> Cloud Cover																									
<input type="checkbox"/> AM ACC or Cloud Streets	<input type="checkbox"/> Insolation (sfc heating)																									
<input type="checkbox"/> NE/SE Moisture Advection	<input type="checkbox"/> Latent Instability																									
<input type="checkbox"/> Cooling at 500mb	<input type="checkbox"/> Frontal Lift																									
<input type="checkbox"/> Warming at 500mb	<input type="checkbox"/> Upslope Flow																									
<input type="checkbox"/> Dry Line or Dry Slot	<input type="checkbox"/> Low Ceilings																									
<input type="checkbox"/> Smoke/Haze	<input type="checkbox"/> Flood Potential																									

Convective Day Category (CDC)		
-3	No Seeding	Clear skies, fair weather cumulus, or stratus without rain, no deep convection
-2	No Seeding	Towering Cumulus, altocumulus, alto-stratus, or nimbostratus producing rain for several hours or weak echoes (e.g. virga)
-1	No Seeding	Scattered convective rain showers but no threat of hail. No reports of lightning.
0	Patrol/Seeding	Thunderstorms (at least one) but no hail. VIL < 20 kg/m2 within the project area or buffer zones
+1	Seeding	Thunderstorms with pea or shot size hail (0.5 to 1.2 cm diameter). 20 kg/m2 < VIL < 30 kg/m2
+2	Seeding	Thunderstorms with grape size hail (1.3 to 2.0 cm diameter). 30 kg/m2 < VIL < 70 kg/m2
+3	Seeding	Thunderstorms with walnut size hail (2.1 to 3.2 cm diameter). 70 kg/m2 < VIL < 100 kg/m2
+4	Seeding	Thunderstorms with golf ball size hail (3.3 to 5.2 cm diameter). VIL > 100 kg/m2
+5	Seeding	Thunderstorms with greater than golf ball size hail (>5.2 cm diameter).

© This forecast has been prepared by Weather Modification LLC expressly for the Alberta Severe Weather Management Society to facilitate Alberta Hail Suppression planning and flight (Hailstop) operations. No other use is implied or intended. Not to be redistributed without ASWMS and WMI permission.

ALBERTA HAIL SUPPRESSION PROJECT FINAL OPERATIONS REPORT 2017

DAILY FORECAST
Weekday MONTH
Alberta Hail Suppression Project 2017

WEATHER MODIFICATION INTERNATIONAL
Forecaster:

300mb Jet Level Winds	500mb Heights & Vorticity
<p>CLICK HERE TO UPLOAD IMAGE</p>	<p>CLICK HERE TO UPLOAD IMAGE</p>
850mb Theta E / Winds	Surface Analysis
<p>CLICK HERE TO UPLOAD IMAGE</p>	<p>CLICK HERE TO UPLOAD IMAGE</p>

© This forecast has been prepared by Weather Modification LLC expressly for the Alberta Severe Weather Management Society to facilitate Alberta Hail Suppression planning and flight (Hailstop) operations. No other use is implied or intended. Not to be redistributed without ASWMS and WMI permission.

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017



WRF Model Sounding

CLICK HERE TO UPLOAD IMAGE

REV. 5, 03-2017

© This forecast has been prepared by Weather Modification LLC expressly for the Alberta Severe Weather Management Society to facilitate Alberta Hail Suppression planning and flight (Hailstop) operations. No other use is implied or intended. Not to be redistributed without ASWMS and WMI permission.

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

APPENDIX F – AIRCRAFT SPECIFICATIONS

Several types of aircraft are presently utilized on the project. Though all are twin-engine, the engine type and other performance characteristics make each significantly different from the others. Of the five HAILSTOP aircraft presently used on the project, three are turboprop (prop-jet) aircraft, and the other two are powered by turbocharged, reciprocating piston engines. While the turboprop aircraft are faster and more powerful, they are also more expensive to operate, so the two piston-engine aircraft are used to operate where less performance is needed—at cloud base.

CESSNA 340A AIRCRAFT

Primary mission: cloud base seeding
Power Type, Turbocharged piston twin engine
6290 lbs gross weight
4184 lbs empty weight
1802 lbs useful load
310 hp per engine
280 mph max speed
263 mph rec. cruise
82 mph stall dirty
183 - 203 gals fuel capacity
29,800 feet all engine service ceiling
15,800 feet single engine service ceiling
1650 feet per minute all engine rate of climb
315 feet per minute single engine rate of climb
2175 feet for takeoff over 50 foot obstruction
1615 feet for takeoff ground roll
1850 feet land over 50 foot obstruction
770 foot land ground roll
34 ft 4 in length
12 ft 7 in height
38 ft 1 in wingspan

BEECHCRAFT KING AIR C90

Primary mission: cloud-top seeding
Power Type, Turboprop twin engine
PT6A-21 engines
Full deicing capabilities
9650 lbs gross weight
6382 lbs empty weight
3268 lbs useful load
550 hp per engine
208 kts max speed
185 kts recommended cruise
74 kts dirty stall
384 gals fuel capacity
30,000 feet all engine service ceiling
14,200 single engine service ceiling
1500 feet per minute all engine rate of climb
350 feet per minute single engine rate of climb
3100 for takeoff over a 50 foot obstruction
2250 feet take off roll
1730 feet for landing over 50 foot obstacle
800 foot landing roll
35 ft 6 in length
14 ft 3 in height
50 ft 3 in wingspan

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

APPENDIX G – GROUND SCHOOL AGENDA



Alberta Hail Suppression Project (AHSP)

2017 Ground School – Monday, May 29th Calgary, Alberta

Intact Zone Training Centre – Red Room
12th Floor- Energy Plaza East Tower
311-6th Avenue SW, Calgary AB

- 08:45 Welcome and Staff Introductions
Jim Sweeney, WMI Executive Vice President
Dr. Terry Krauss, Alberta Severe Weather Management Society (ASWMS) Project Director
Bruce Boe, WMI Vice President - Meteorology
- 09:00 Introduction from the Insurance Industry
Todd Klapak, Alberta Severe Weather Management Society Board Chair
- 09:15 History and Status of the Alberta Hail Suppression Program
Terry Krauss
- 10:00 Break
- 10:15 Overview of 1996-2015 Alberta Operations
Brad Waller, WMI Project Meteorologist
- 10:45 Hail Program Overview and Status of Hail Suppression Concepts
Bruce Boe
- 11:30 Severe Weather Forecasting & Daily Forecast Sheet
Brad Waller, WMI Chief Meteorologist
- 12:00 Lunch (On-Site – AHSP Provided)
- 12:45 ATC Controlling Procedures
Calgary Terminal &/or Edmonton Control (TBD)
YBW Springbank Tower (TBD)

Attendance is mandatory for all Weather Modification, Inc. project personnel.

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017



- 13:30 Aviation Weather & Special Procedures
Cloud Seeding Aircraft & Equipment
Targeting - Seeding Rates
Storm Tracking and Directing
Jody Fischer, WMI Chief Pilot & Canada Project Manager
- 14:45 Job Responsibilities/ Duties
Bruce Boe
Terry Krauss
- 15:00 Break
- 15:15 Project Operations: Routines, Procedures, and Meteorological Information
Dan Gilbert
- 16:00 Safety and Emergency Procedures
Jody Fischer
- 16:15 End of Ground School

Attendance is mandatory for all Weather Modification, Inc. project personnel.

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017



Alberta Hail Suppression Project (AHSP)

2016 Ground School – Tuesday, May 30th, Calgary, Alberta

Holiday Inn Express Banff Trail
2373 Banff Trail North West, Calgary AB

- 09:30 Field Personnel Pictures
- 09:50 Presentation of 2015 Photography Contest Awards
- 10:00 WMI Representation and Professionalism
WMI Job Responsibilities/ Duties
Jody Fischer, WMI Chief Pilot & Canada Project Manager
Bruce Boe, WMI Vice President - Meteorology
- 10:30 Approved Flight Operations
Aircraft Maintenance Procedures & Pilot Discussion
Aircraft Binders, NAFTA
Aircraft Refueling Procedures
Jody Fischer
- 11:00 Sharefile Introduction
Paperwork Procedures
Erin Fischer, WMI Project Assistant
- 11:45 Accounting – Company Expense Reports
- 12:00 Team Lunch (WMI Provided)
- 13:00 Sharefile iPad Session with Field Crew
Erin Fischer
- 14:30 Cloud Seeding Chemical Inventory & Procedures
Jody Fischer
- 14:45 Additional Project Discussion – Q & A
- 15:30 End of Ground School

Attendance is mandatory for all Weather Modification, Inc. project personnel.

**ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017**

APPENDIX H – AIRBORNE SEEDING SOLUTION

- Chemical Formulation: 2% AgI - 0.5 NH₄I - 0.1 C₆H₄Cl₂ - 1.0 NaClO₄
- Recommended Burn Rate: ~2.0 gph
- Nucleation Mechanism: Condensation Freezing
- Total Solution Weight: 33.5 lbs.
- Volume: ~ 5.0 gallons, (20 liters) scale for other amounts
- Seeding Aerosol: AgI_{0.85} AgCl_{0.15} NaCl

CONSTITUENT	CHEMICAL FORMULATION	MOLECULAR WT.(G/MOLE)	MASS (G)	WEIGHT (LB.)	VOLUME (GAL)
Silver Iodide	AgI	234.77	304.2	0.67	n/a
Ammonium Iodide	NH ₄ I	144.94	93.9	0.21	n/a
Paradichloro-benzene	C ₆ H ₄ Cl ₂	147.00	19.0	0.042	n/a
Sodium Perchlorate, 99%	NaClO ₄	140.48	181.8	0.40	n/a
Water	H ₂ O	17.99	607.7 or less	1.34	0.202
Acetone	(CH ₃) ₂ CO	58.08	13985.5	30.84	4.645

Note: Sodium Perchlorate, anhydrous can be utilized in the formula by adjusting the weight or mass to include 0.34 lb or 158.1 g respectively, although proper handling becomes more difficult. Water amounts should be increased to 1.40 lb or 630 g (0.21 gal).

Note: Use 2.4 urinal pucks (85 gram Paradichloro-benzene) for 205 litre barrel of acetone.

Mixing procedures are as follows:

- 1.) Combine AgI and acetone in a 5 gallon container and begin stirring;
- 2.) Combine ammonium iodide, sodium perchlorate and water in another small container and stir until the solution is clear and cool (caution the perchlorate is a strong oxidizer and needs to be done at room temperatures, don't do this in a hot hanger)
- 3.) Add the ammonium iodide, sodium perchlorate and water mixture to the stirring silver iodide/acetone slurry;
- 4.) Continue mixing until the solution is clear;
- 5.) Add the paradichlorobenzene any time after you have added container #2 and the solution is beginning to clear;
- 6.) Continue mixing for another 10 minutes until very clear; and
- 7.) Pump the solution into the aircraft generator immediately after mixing or store in an appropriate labeled sealed container. Storage containers can be either stainless or plastic (polypropylene).

Supplier: Solution Blend Service
2720 7th Avenue N.E., Calgary, AB, T2A 5G6
403-207-9840

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

APPENDIX I - DAILY METEOROLOGICAL STATISTICS

June 2017

2017 Date	Forecast CDC	Precipitable Water (inches)	0°C Level (kft)	-5°C Level (kft)	-10°C Level (kft)	Cloud Base Height (kft)	Cloud Base Temp (°C)	Maximum Cloud Top Height (kft)	Temp. Maximum (°C)	Dew Point (°C)	Conv. Temp (°C)	CAPE (J/kg)	Total Totals	Lifted Index	Showalter Index	Cell Direction (deg)	Cell Speed (knots)	Storm Direction (deg)	Storm Speed (knots)	Low Level Wind Direction (deg)	Low Level Wind Speed (knots)	Mid Level Wind Direction (deg)	Mid Level Wind Speed (knots)	High Level Wind Direction (deg)	High Level Wind Speed (knots)	Observed CDC
1-Jun	2	0.85	11.6	13.9	16.2	7.7	8.1	33.1	22	11	21.1	760	56.7	-5	-3.8	276	11	281	8	309	13	224	11	213	208	1
2-Jun	-1	0.56	9.8	11.5	13.5	9.7	0.1	26.5	20	6	19.7	487	56.1	-3	-1.7	297	29	321	19	286	21	295	28	277	36	2
3-Jun	0	0.74	11.5	13.8	16.5	10.1	3.9	23.3	24	10.5	25.2	202	52	-2	-0.3	250	27	265	19	236	19	238	37	232	62	0
4-Jun	3	0.89	11.5	13.8	16.6	9.7	4.5	31.1	21.5	9.5	22.3	452	52.3	-2	-1.2	214	23	238	19	210	12	210	45	219	85	1
5-Jun	-1	0.43	10	11.5	14.1	9.6	1.2	19.4	19	5	18.7	201	51.6	0	0.4	299	18	344	13	324	21	306	21	252	17	0
6-Jun	-3	0.55	11.9	15.4	17.9	9.6	4	12.4	22	8	22.1	13	47.0	1	2	250	15	240	13	193	13	228	21	227	29	-3
7-Jun	-1	0.89	13.0	15.3	17.7	11.6	3.1	31.4	26	9	26.6	382	54.7	-3	-2.5	261	14	264	9	223	9	252	19	234	33	-3
8-Jun	3	1.11	14	16.4	18.7	12	4.8	40.9	26	13	28.3	1219	53.9	-4	-3.3	173	35	200	22	154	29	191	33	202	33	3
9-Jun	0	0.46	9.6	11.5	13.8	9.9	-0.9	23.2	18	4	17.7	217	53.6	-1	-0.5	250	22	275	11	288	18	223	20	132	15	2
10-Jun	-1	0.53	7.8	11.8	14.9	5.4	6.9	14.6	14	9	11.3	132	48.9	1	2.8	26	19	67	15	28	21	53	22	44	35	-1
11-Jun	-1	0.90	10.0	13.0	16.8	8.8	6.8	15.0	18	10	17.7	109	46.8	1	2	296	28	323	17	279	28	304	30	344	42	-1
12-Jun	2	0.69	11.8	14.3	16.7	9.1	5.9	35.3	24	10	25.7	841	53.8	-3	-1.8	241	13	248	10	199	13	239	17	201	10	2
13-Jun	1	0.87	11.1	13.5	16.0	7.4	8.5	25.8	17	10.5	21.3	356	54.2	-3	-2.8	96	8	143	3	81	13	181	9	174	33	2
14-Jun	2	0.74	9.9	12.5	15.3	7.9	5.2	30.6	18	8.5	18.2	362	50.7	-1	0.3	305	16	299	9	270	20	259	10	202	26	2
15-Jun	-2	0.67	9.6	12.2	15.8	7.8	4.8	16.6	19	8.5	18.2	141	48.5	1	1.6	271	12	274	9	252	17	244	14	246	24	-2
16-Jun	2	0.74	9.4	12.2	14.4	7.4	5.6	31.0	18.5	8.5	16.8	777	57.3	-4	-2.9	292	18	321	12	297	23	281	15	244	19	2
17-Jun	0	0.48	10	11.6	13.3	10.9	-2.8	21.0	19	2	18.4	144	51.3	0	0.8	278	23	314	14	249	10	293	26	301	68	0
18-Jun	0	0.58	8.5	10.6	13.0	8	1.1	18.2	21	6	17.4	163	52.1	0	0.9	267	17	319	18	290	15	285	31	303	121	-1
19-Jun	-2	0.82	11.6	13.5	16.1	11.6	0.0	17.6	22	6.5	23.2	94	45.6	2	2.8	288	22	305	17	264	19	287	34	281	79	-1
20-Jun	2	0.81	11.1	13.4	15.7	9.3	5.3	31.4	24	9.5	23.2	956	56.2	-4	-2.9	267	32	288	21	239	17	277	45	268	123	2
21-Jun	0	0.43	10	11.6	13.3	11.6	-5	25.5	19	0	16.8	385	56.2	-3	-2.6	293	23	316	22	297	19	281	41	288	73	2
22-Jun	-1	0.42	8.9	11.2	13.7	9.1	-0.5	16.2	16	3	15.4	42	50.5	1	1.8	320	29	353	19	328	29	323	27	319	36	-1
23-Jun	1	0.52	9.8	11.5	13.8	9.7	0.3	21.7	18.5	4	18.5	275	55.8	-2	-1.4	327	19	360	15	329	13	323	19	322	94	1
24-Jun	2	0.63	9.8	11.5	13.6	8.7	3.2	21.9	21	7	18.7	400	54.5	-2	-1.2	323	20	360	18	336	12	331	33	322	84	0
25-Jun	-3	0.84	11.8	14.5	16.9	8.9	6.6	33.7	25	11.5	24	645	54.2	-3	-2.4	320	23	337	12	292	10	316	36	310	67	-3
26-Jun	3	1.07	13.2	15.3	17.4	9.9	9	37.9	28.5	14	29.4	2074	61	-8	-6.6	262	34	267	21	245	22	268	47	249	46	0
27-Jun	0	0.64	9.6	11.6	13.9	8.5	3.1	28.5	21	8	19.5	401	51.6	-1	0.7	279	36	319	20	288	25	293	29	276	34	3
28-Jun	2	0.78	8.2	11.9	14.4	5.4	8	29.9	16	10	13.3	539	52	-2	0.0	313	23	339	18	314	26	305	22	316	14	2
29-Jun	-1	0.63	11.2	14.5	16.9	9	5.2	25.9	21.5	9	21.5	215	51.1	-2	-0.1	335	22	1	14	325	24	330	27	4	54	-1
30-Jun	0	1.07	13	15.5	18.2	10	6.8	33.0	26	10.5	24.9	409	53.4	-3	-2.2	309	22	340	14	275	8	317	32	313	41	0

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

July 2017

2017 Date	Forecast CDC	Precipitable Water (inches)	0°C Level (ft)	-5°C Level (ft)	-10°C Level (ft)	Cloud Base Height (ft)	Cloud Base Temp (°C)	Maximum Cloud Top Height (ft)	Temp. Maximum (°C)	Dew Point (°C)	Conv Temp (°C)	CAPE (J/kg)	Total Totals	Lifted Index	Showwater Index	Cell Direction (deg)	Cell Speed (knots)	Storm Direction (deg)	Storm Speed (knots)	Low Level Wind Direction (deg)	Low Level Wind Speed (knots)	Mid Level Wind Direction (deg)	Mid Level Wind Speed (knots)	High Level Wind Direction (deg)	High Level Wind Speed (knots)	Observed CDC
1-Jul	3	1.08	13	15.4	18.0	9.2	8.9	39.0	25	12.5	26.2	1384	55.0	-4	-3.5	239	15	264	10	254	9	246	21	251	35	2
2-Jul	2	0.94	13.2	15.8	18.4	9.8	-2.1	33.0	26	11.5	26.7	624	53.0	-3	-2.5	271	21	284	11	254	12	268	20	271	50	-1
3-Jul	2	0.84	12	14.2	17.4	9.7	6.9	35.5	25	11	24.9	805	54.1	-4	-2.5	259	30	293	19	267	14	261	39	266	50	3
4-Jul	3	0.92	12	15.1	17.6	8.9	7.6	35.8	25	12.5	24.2	978	54.4	-3	-2.9	274	32	288	19	236	21	266	38	266	69	2
5-Jul	1	0.82	14.1	16.5	18.6	11.5	5.6	36.7	27	11.5	28.8	1061	55.0	-4	-3.3	272	24	292	15	253	13	268	33	268	55	-1
6-Jul	0	0.98	13.6	15.9	18.5	9.9	8.8	38.0	26	14	28.8	1463	55.5	-5	-4.7	291	29	333	13	311	15	302	25	303	46	-3
7-Jul	2	1.11	14.1	16.2	18.3	12.5	4.8	38.1	30	17	32.6	1145	58.1	-6	-5	278	16	286	12	253	13	264	24	270	40	2
8-Jul	3	1.03	14.2	16.8	19.6	8.5	12.3	41.8	27	15	26.4	1984	55.4	-5	-5.1	266	23	305	12	265	10	275	26	278	55	2
9-Jul	4	1.27	13.1	15.7	18.7	8.4	13.1	41.4	27.5	17.5	28.9	2721	57.9	-7	-6.5	224	21	277	13	236	9	265	31	234	26	5
10-Jul	3	0.99	12.1	14.6	17.4	7	11.2	36.8	21.5	13.5	22.6	1489	54.7	-5	-3.9	305	13	312	9	299	10	273	16	232	27	3
11-Jul	0	0.94	11.8	14.8	17.5	6.3	8.9	11.8	17	11	17.4	25	47.0	0	1.4	310	11	343	7	327	11	300	12	278	22	0
12-Jul	3	0.83	12.4	15.2	17.8	7.7	11.3	37.7	23.5	14	23.1	2000	56.1	-5	-4.6	252	14	271	11	255	9	251	23	254	41	3
13-Jul	3	0.82	13.3	15.9	18.5	8.2	12.0	39.9	26.5	16	26.6	2076	56.7	-6	-5.7	246	22	266	18	229	15	240	37	243	62	2
14-Jul	-3	0.78	15.3	17.3	19.3	12.1	6.0	37.0	28.5	11	32.2	972	52.7	-3	-2	271	27	282	17	256	16	259	36	256	50	-3
15-Jul	1	0.79	14.5	16.4	18.7	10.4	9.7	11.4	27.5	15	33.6	1099	54.9	-5	-3.14	234	24	259	23	241	21	244	46	239	61	0
16-Jul	2	0.75	10.4	12.5	14.5	6.4	8	24.9	18	11	16.7	534	56.8	-4	-3.2	250	38	276	28	253	24	242	60	231	90	3
17-Jul	0	0.67	9.1	11.3	14.3	8.2	2.7	28.1	18	6.5	16.8	342	54.1	-1	-0.7	305	27	332	19	289	30	307	25	280	38	-2
18-Jul	-3	0.61	11.3	13.6	16.1	9.9	2.7	29.6	23	8	23	284	54.2	-2	-1.6	288	30	319	17	294	23	287	33	280	30	-3
19-Jul	0	0.68	12.7	14.3	16.5	13.3	-1.9	31.5	27	4.5	27.3	281	54.3	-2	-1.7	275	27	301	14	259	8	273	28	267	40	0
20-Jul	3	0.81	12.8	14.8	16.7	10	6.7	36.6	27	13.5	27.2	1803	60.2	-7	-6.1	225	19	262	15	238	16	239	28	248	54	2
21-Jul	0	1.02	10.5	13.9	16.6	5.1	10.8	31.2	19	13	15.5	358	47.3	-1	1.7	332	39	352	27	324	44	327	35	323	37	-1
22-Jul	-2	1.04	12.9	15.5	19.0	10.2	5.4	19.6	25.5	12	26.6	95	48.0	0	0.6	286	25	308	18	279	21	283	37	285	55	-2
23-Jul	4	1.15	12.8	15.5	18.3	7.5	11.4	36.8	24.5	15	21.8	1363	54	-4	-3.9	250	34	275	21	227	26	251	47	245	61	5
24-Jul	-1	0.62	9.1	11.8	15.3	8.2	2.8	14.3	18	7	15.9	73	49.2	1	1.8	301	29	333	21	301	33	299	28	298	22	-1
25-Jul	-2	0.69	12.0	14.1	16.6	11.8	0.6	31.1	25	5.5	23.2	560	55.1	-2	-2.1	293	21	314	10	278	2	278	21	283	42	-1
26-Jul	-3	0.70	13.6	16.1	18.7	11.6	4.4	36.4	29	11	30	547	52.4	-2	-1.5	272	16	298	9	245	9	286	22	262	30	-3
27-Jul	3	1.12	13.5	16	18.3	10.8	7.0	37.0	30	13	29.8	1401	57	-5	-4.3	230	22	252	12	199	5	221	30	228	56	3
28-Jul	3	1.00	13	15.6	18.1	10.8	6.1	36.7	27.5	10	26.7	1176	56.7	-4	-4.1	252	22	271	15	186	13	260	32	251	47	4
29-Jul	-3	0.88	14.2	16.9	19.4	12.2	4.3	36.5	29	9.5	30.3	566	51.6	-2	-1.2	271	24	285	10	225	11	280	21	255	44	-3
30-Jul	2	0.88	12.8	15.1	17.6	9.9	7.3	37.3	25	14	25.7	1125	55.3	-5	-4.2	275	32	305	18	254	25	275	35	308	64	2
31-Jul	2	1.00	13.1	15.4	18.2	8.6	9.1	35.6	24	12	23.3	822	53.8	-3	-3.0	283	22	317	13	286	15	280	27	296	31	3

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

August 2017

2017 Date	Forecast CDC	Precipitable Water (inches)	0°C Level (ft)	-5°C Level (ft)	-10°C Level (ft)	Cloud Base Height (ft)	Cloud Base Temp (°C)	Maximum Cloud Top Height (ft)	Temp. Maximum (°C)	Dew Point (°C)	Conv Temp (°C)	CAPE (J/kg)	Total Totals	Lifted Index	Showalter Index	Cell Direction (deg)	Cell Speed (knots)	Storm Direction (deg)	Storm Speed (knots)	Low Level Wind Direction (deg)	Low Level Wind Speed (knots)	Mid Level Wind Direction (deg)	Mid Level Wind Speed (knots)	High Level Wind Direction (deg)	High Level Wind Speed (knots)	Observed CDC
1-Aug	-1	0.97	11.5	14.2	16.5	4.8	10.6	18.4	16	12.5	13.3	106	44.6	0	3.9	293	20	322	12	304	5	285	31	295	63	0
2-Aug	-3	0.61	12.9	15.7	18.5	9.5	5.3	11.9	23	9	21.8	11	47.7	1	1.1	318	13	350	10	301	10	320	23	326	63	-3
3-Aug	2	1.01	12.9	15.3	17.7	13.6	-1.4	27.7	26	11	28.3	109	50.8	-1	-0.4	281	25	312	13	264	13	288	31	296	74	1
4-Aug	1	1.05	10.6	14	16.8	5	11.2	32.5	17	12	16.2	525	50	-2	-0.5	11	23	36	17	11	22	7	21	312	29	2
5-Aug	2	0.77	11	13.8	16.3	8.1	6.8	32.3	20.5	9.5	20.2	750	54.4	-3	-2.4	333	14	359	10	334	11	322	18	324	38	2
6-Aug	-1	0.76	12.5	15.2	17.8	11.4	2.7	27.2	26	7	25.4	218	52.4	-1	-1.1	326	21	354	9	302	4	320	18	330	27	0
7-Aug	2	0.94	13.0	15.1	17.3	9.5	8.2	36.6	24	11.5	25.6	1433	58.6	-6	-5.4	284	18	335	12	300	13	293	22	285	30	1
8-Aug	-3	0.59	13.0	15.2	17.4	9	6	32.7	22	9	20.1	441	53.4	-2	-1.8	351	16	27	9	349	12	354	18	351	21	-3
9-Aug	-2	0.74	13.1	15.2	17.5	13.2	-0.1	29.9	26.5	5	28.7	147	52.6	-1	-1	310	15	348	8	330	11	314	17	330	46	1
10-Aug	0	0.84	12.9	15.5	18.0	11.4	3.7	35.8	27	8	25.2	1047	54	-2	-2.1	324	28	4	14	340	11	329	24	333	37	3
11-Aug	-1	0.67	13.3	15.8	18.1	10.7	4.9	35.4	26	9	25.6	574	53.3	-2	-1.9	347	16	32	10	333	5	358	22	16	39	-1
12-Aug	-1	0.75	14.1	16.4	18.8	12.7	3.2	36.6	29	8.5	30.6	620	53.1	-2	-1.9	309	16	304	4	302	8	303	8	294	7	-3
13-Aug	3	0.97	12.9	15.5	18.1	7.3	11.3	39.2	27	14	27.5	1279	53.9	-4	-3.8	184	24	228	11	173	17	205	26	205	30	3
14-Aug	2	0.73	9.6	11.9	14.3	8.2	3.7	27.8	17	7	17.6	483	54.9	-2	-1.3	280	15	261	9	283	9	216	21	215	27	2
15-Aug	-2	0.63	10.2	12.6	15.5	10.0	0.3	15.4	21	5	21.6	19	50	1	1.2	301	29	329	18	286	9	284	30	293	61	-3
16-Aug	1	0.82	11.6	13.8	16.0	10.2	2.9	27.3	24	8	25	225	52.6	-1	-0.9	281	35	316	18	267	20	292	33	281	54	0
17-Aug	-3	0.70	11.9	15.6	18.2	9.9	4.7	19.6	25	9.5	24.3	43	49.1	0	0.5	307	27	338	16	290	27	311	29	325	72	-3
18-Aug	2	0.75	12.3	14.7	17.6	11.1	3.5	35.0	27.5	9	27.2	596	52.6	-2	-1.3	268	28	291	20	262	13	258	38	256	59	-1
19-Aug	-1	0.52	10.1	11.8	14.0	10.7	-1.7	16.8	19.5	2	18.7	87	51.4	0	0.6	298	31	324	24	261	12	302	49	289	77	-1
20-Aug	-2	0.74	9.9	12.3	14.9	9.4	1.6	16.6	20.5	6	20.6	95	48.4	1	2	301	36	332	23	269	18	306	48	301	59	-2
21-Aug	-2	0.99	11.6	14.2	18.4	9.5	4.7	16.0	23.5	8.5	24.7	71	45.8	2	2.3	314	30	344	22	305	24	314	44	315	61	-3
22-Aug	-3	0.80	14.1	16.9	19.3	13.4	1.7	23.7	28	7	31.5	10	48.8	0	0.6	289	21	311	10	272	14	294	20	285	40	-3
23-Aug	2	0.86	13.7	16.1	18.8	11.7	4.7	33.4	28	12	31.1	399	50.1	-1	-0.2	258	18	276	10	258	8	252	23	237	34	2
24-Aug	2	0.73	12.6	14.3	16.8	12	1.8	35.4	28.5	7.5	27.8	870	56.8	-5	-3.2	226	21	256	20	233	7	219	37	226	46	4
25-Aug	-3	0.43	11.4	14.3	16.8	15.5	-7.4		23	0	32.3	0	44	3	3.9	273	27	298	16	263	10	264	30	265	49	-3
26-Aug	-3	0.68	12.6	15.1	18.6	13.1	-1		25	6	32	0	42.3	4	4.7	296	27	325	17	297	22	304	36	309	57	-3
27-Aug	-2	0.86	14.2	16.8	19.4	11.8	4.9		28	8	34	0	45.9	2	2.2	285	25	302	15	282	22	274	31	271	47	-3
28-Aug	-2	0.98	13.5	15.8	18.1	15.8	-4.9	28.5	27	11	29.6	94	49.9	-1	-0.7	281	26	314	13	276	11	283	30	284	44	-1
29-Aug	-3	0.70	14.6	16.8	18.9	14.1	1.3	37.3	30	9	32	1007	55.2	-3	-3	283	18	307	9	269	12	287	19	274	30	-3
30-Aug	2	0.80	14.1	16.4	18.5	13.6	1.5	36.2	32	8	34.2	1006	55.5	-3	-2.8	225	21	262	14	226	16	242	26	244	18	1
31-Aug	0	0.78	11.8	14	16.6	11.7	0.3	21.2	24	7	25.6	88	51.3	-1	-0.3	268	28	315	16	297	23	272	28	299	63	1

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017

September 2017

2017 Date	Forecast CDC	Precipitable Water (inches)	0°C Level (ft)	-5°C Level (ft)	-10°C Level (ft)	Cloud Base Height (ft)	Cloud Base Temp (°C)	Maximum Cloud Top Height (ft)	Temp. Maximum (°C)	Dew Point (°C)	Conv Temp (°C)	CAPE (ft/kg)	Total Totals	Lifted Index	Showwater Index	Cell Direction (deg)	Cell Speed (knots)	Storm Direction (deg)	Storm Speed (knots)	Low Level Wind Direction (deg)	Low Level Wind Speed (knots)	Mid Level Wind Direction (deg)	Mid Level Wind Speed (knots)	High Level Wind Direction (deg)	High Level Wind Speed (knots)	Observed CDC
1-Sep	-1	0.68	10.9	13.4	16.7	10.6	0.9	16.2	23.5	5.5	23.4	49	47.3	2	2.1	301	41	332	31	294	23	303	65	308	109	-1
2-Sep	-2	0.77	13.6	17	19.5	12	2.7		30	7	30.5	0	45.3	3	2.5	290	42	313	29	268	24	280	52	278	68	-2
3-Sep	-1	0.90	13.2	16.4	18.7	11.0	3.9		22	8	26.8	0	46.2	2	2	277	29	314	30	277	29	285	70	277	87	0
4-Sep	-3	0.56	13.7	17	20.2	14.4	-0.8		21	5	33.6	0	36.6	7	7.7	340	23	8	14	330	13	338	32	344	40	-3
5-Sep	-3	0.43	15.2	17.7	20.0	19.1	-7.9		26.5	0	39.6	0	37.3	7	7	316	17	331	10	309	11	307	22	302	57	-3
6-Sep	-3	0.55	15.1	17.1	19.0	17.1	-4.9		30	2	36	0	46.5	2	2.1	323	16	351	10	322	12	315	17	319	49	-3
7-Sep	-3	0.61	15.3	17.4	19.5	17.2	-4.4		31	4	39.1	0	44	2	3.3	298	10	297	4	245	8	324	12	291	26	-1
8-Sep	2	1.01	14.9	16.7	18.9	11.9	7.6	33.9	28	12	32.5	1013	56.4	-5	-4.5	210	30	250	17	252	19	209	33	214	54	-1
9-Sep	1	1.00	12.9	15.2	17.8	10	6.0	28.0	25	10	27.4	189	50.7	-2	-0.7	230	35	263	24	238	18	228	45	230	60	2
10-Sep	-3	0.47	9.6	12	17.1	11.2	-3.6		20	1	33.2	0	37.3	7	8.0	287	45	320	31	278	29	294	57	308	113	-3
11-Sep	-2	0.84	12.6	15.6	19.2	9.7	4.9		27	1	34.9	0	41.5	5	4.7	277	49	301	30	276	19	264	59	255	85	-2
12-Sep	-1	0.81	11.6	14.4	17.2	9.7	2.3		20	5	26	0	45.2	3	3.3	254	52	282	27	220	29	260	61	259	83	0
13-Sep	0	0.61	6.3	9.3	12.1	3.5	6.6	13.6	9	8	7.9	102	52.7	0	1.9	55	9	24	2	70	12	289	13	258	70	-1
14-Sep	1	0.48	6.4	8.5	11.0	5.9	1.6	19.1	10	4	9.5	232	56.9	-1	-0.1	314	15	340	12	318	9	310	24	259	53	1
15-Sep	1	0.42	6.9	8.8	11.0	6.9	0	19.3	10	2	8.5	273	57.4	-1	-0.5	303	6	344	4	252	2	333	12	230	30	0
Average	0.1	0.8	11.9	14.4	16.9	10.0	4.1	26.5	23.3	8.8	24.4	549.2	51.9	-1.5	-0.8	272.3	23.7	281.1	15.2	264.3	16.1	274.2	29.6	265.3	51.0	0.0
StdDev	2.1	0.2	1.9	2.0	2.0	2.7	4.4	8.5	4.7	3.8	6.4	573.4	4.7	2.9	2.9	55.9	8.6	81.5	6.2	57.6	7.5	49.1	12.5	57.1	27.8	2.2
Maximum	4.0	1.3	15.3	17.7	20.2	19.1	13.1	41.8	32.0	17.5	39.6	2721	61.0	7	8.0	351	52	360	31	349	44	359	79	351	208	5
Minimum	-3	0.4	6.3	8.5	11.0	3.5	-7.9	11.4	9.6	0.0	7.9	0	36.8	-8	-6.6	11	6	1	2	11	2	7	6	4	7	-3

**ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017**

APPENDIX J - PROJECT PERSONNEL AND TELEPHONE LIST



ALBERTA HAIL SUPPRESSION PROJECT 2017			
			REV. 6, 07-2017
PILOT OFFICE - SPRINGBANK, ALBERTA			
<small>PILOT OFFICE: 403-247-0081 ADDRESS: Springbank Aero Services, Inc. 205A Avro Lane, Calgary, Alberta T3Z 3S5 EMAIL: calgary@weathermodification.com</small>			
SPRINGBANK PILOTS	BRIAN KINDRAT	Project Ops Manager Captain King Air/C340 - HS1-5	
	ANDREW BRICE	Captain King Air - HS1 Captain C340 - HS2	
	BROOK MUELLER	Captain King Air - HS5	
	HING KWOK	Captain C340 - HS2 Co-Pilot King Air	
	CRISTIAN AVRAM	Co-Pilot King Air/C340	
	MICHAEL BENSON	Co-Pilot King Air/C340	
	ANDREW WILKES	Co-Pilot King Air/C340	
	PILOT OFFICE - RED DEER, ALBERTA		
<small>PILOT OFFICE: 403-856-7857 ADDRESS: Hangar #2 Red Deer Int Airport, Penfold, Alberta, T0M 1R0 EMAIL: reddeer@weathermodification.com</small>			
RED DEER PILOTS	MIKE TORRIS	Captain King Air - HS3	
	JOEL ZIMMER	Captain C340 - HS4 Co-Pilot King Air - HS3	
	JENELLE NEWMAN	Captain C340 - HS4	
	BRADY BROOKS	Co-Pilot King Air/C340	
	KOLE LUNDIE	Co-Pilot King Air/C340	
	RADAR OPERATIONS CENTER - OLDS-DIDSBURY AIRPORT, ALBERTA		
<small>RADAR FAX: 403-335-8159 RADAR PHONE: 403-335-8159 ADDRESS: 1436, 320 Sorque Rd., Hangar 6, Olds, Alberta T0M 0W0 SHIPPING VIA FedEx/UPS: Weather Modification LLC Olds Didsbury Airport, Hangar 4, 1436 Sorque Rd #20, Olds, AB T0M 0W0 EMAIL: olds@weathermodification.com</small>			
METEOROLOGISTS	DAN GILBERT	Chief Meteorologist Lead Meteorologist	
	BRAD WALLER	Field Meteorologist	
	ADAM BRAINARD	Field Meteorologist	
ADDITIONAL SUPPORT SERVICES			
SPRINGBANK FUEL TRUCK (AFTERHOURS)			
AIR SPRAY (KIRK CARLETON)	Director of Maintenance		
ATC EDMONTON OSS	Notification to launch Aircraft		
ATC SHIFT MANAGER EDMONTON			
ATC CALGARY TERMINAL SUPERVISOR			
ATC CALGARY TOWER			
YYC INTERNATIONAL AIRPORT	Duty Manager Desk		
STORM WATCH HOTLINE	Severe Weather Desk: 800.239.0884		
RED DEER AIRPORT FLIGHT SERVICE			
SKY WINGS (DENNIS COOPER)	Red Deer Fuel (JET-A)		
HILLMAN AIR LTD (GARY HILLMAN)	Red Deer Fuel (100LL)		
BARRY ROBINSON	Radar Technician		
REDACTED			

ASWMS and WMI Contact Information On Next Page

ALBERTA HAIL SUPPRESSION PROJECT
FINAL OPERATIONS REPORT 2017



ALBERTA HAIL SUPPRESSION PROJECT 2017			
REV. 6-07-2017			
ALBERTA SEVERE WEATHER MANAGEMENT SOCIETY (ASWMS) - CALGARY, ALBERTA			
TODD KLAPAR	ASWMS Board Chairman #1300-321 6th Ave. SW Calgary, AB T2P 3P6		
TERRY KRAUSS	ASWMS Program Director President, Krauss Weather Services, Inc. 79 Irving Crescent, Red Deer, AB T4R 2S2		
WEATHER MODIFICATION LLC - FARGO, NORTH DAKOTA PHONE: 701-239-5500 FAX: 701-239-9717			
JAMES SWEENEY	Executive Vice President		
NEIL BRACKIN	President		
RANDY JENSON	Chief Financial Officer		
BRUCE BOE	Vice President of Meteorology 3802 20th Street North, Fargo, ND 58102		
MIKE CLANCY	Vice President of Technical Services		
DENNIS AFSETH	Director of Electronics		
JOEY FISCHER	Director of Flight Operation		
ERIN FISCHER	Client Services Administrative		
THUY TRAN	Client Services Assistant		
TODD SCHULZ	Electronics Technician		
ADDITIONAL SUPPORT SERVICES			
SPRINGBANK FUEL TRUCK (AFTERHOURS)			
AIR SPRAY (KIRK CARLETON)	Director of Maintenance		
ATC EDMONTON OSS	Notification to Launch Aircraft		
ATC SHIFT MANAGER EDMONTON			
ATC CALGARY TERMINAL SUPERVISOR			
ATC CALGARY TOWER			
YYC INTERNATIONAL AIRPORT	Duty Manager Desk		
STORM WATCH HOTLINE	Severe Weather Desk: 800.239.0484		
RED DEER AIRPORT FLIGHT SERVICE			
SKY WINGS (DENNIS COOPER)	Red Deer Fuel (JET-A)		
HILLMAN AIR LTD (GARY HILLMAN)	Red Deer Fuel (100LL)		
BARRY ROBINSON	Radar Technician		
REDACTED			

**NOTICE OF INTENT TO ENGAGE IN WEATHER MODIFICATION ACTIVITIES
PURSUANT TO THE WEATHER MODIFICATION INFORMATION ACT AND REGULATIONS
SCHEDULE I**

PART 1. GENERAL IDENTIFICATION OF ACTIVITY

Date of notice: May 16, 2017
Proposed starting date: June 1st, 2017
Expected duration: September 15th, 2017

Province and area to be affected: Central Alberta, covering the Red Deer to Calgary regions (see attached map showing project area which has remained essentially the same since 1996).

Weather elements to be modified: Thunderstorms
Modification expected: Hail Suppression
Class of operation: Operational
Operating method: airborne
Class of economy to benefit: insurance industry: private and public property primary, agriculture secondary.

PART 2. GENERAL INFORMATION CONCERNING WEATHER MODIFIER

Organization name: Weather Modification International (WMI)
<http://www.weathermodification.com/>
Parent Organization: Weather Modification LLC
3802 20th Street North
Fargo, ND USA 58102
Chief Officer: Mr. Neil Brackin, President Tel: (701) 235-5500
nbrackin@weathermod.com
Local Organization: Weather Modification International Tel. (403) 335-8359
Olds-Didsbury Airport, Highway 2A
Olds, AB T4H 1A1

Name and relevant qualifications of officer(s) designated in charge of project:

Chief Officer: Mr. Daniel Gilbert, Chief Meteorologist
B.S., 14 years' experience
WMA Certified Weather Modification Operator #78
Office Tel: (403) 335-8359
(see Part 5 for details of qualifications and experience)

Vice President - Meteorology Mr. Bruce Boe
Project Manager/Meteorology, 43 years' experience
Tel: (701) 235-5500

Primary activities of organization (see web page at www.weathermodification.com):

- cloud seeding
- atmospheric research
- air pollution monitoring
- meteorological radar monitoring
- equipment design and fabrication
- aircraft modifications

Amount of public liability insurance carried applicable to activity: CAD\$50 million by the Alberta Severe Weather Management Society and US\$5 million by Weather Modification LLC.

List of similar weather modification activities previously undertaken:

- a. Canada: The Alberta Hail Project has been operating in its present form since 1996. The contractor (operator) for this entire period has been WMI.
- b. Elsewhere:
 - WMI has conducted the hail suppression cloud seeding in North Dakota for more than 50 years. This is an ongoing project.
 - WMI conducted hail suppression in Mendoza, Argentina using 3 to 4 Cheyenne II aircraft and a Lear Jet 1998-2004.
 - WMI conducted operational cloud seeding in Oklahoma for Rain Enhancement and Hail Suppression 1997-2001.
 - WMI has conducted operational cloud seeding in Alberta, Burkina Faso, California, Idaho, Mexico, UAE, India, Indonesia, Mali, Nevada, North Dakota, Saudi Arabia, Senegal, and Wyoming within the last 10 years.

4. References:

1. Dr. Terry Krauss
Krauss Weather Services
79 Irving Crescent
Red Deer, AB T4R 3S3 Tel. 403-318-0400
2. Mr. Darin Langerud, Director
State of North Dakota Atmospheric Resource Board
900 E. Boulevard Ave.
Bismarck, ND 58505 Tel. 701-328-2788
3. Dr. Ronald E. Rinehart
4408 Greystone Drive
St. Joseph, MO 64505 Tel. 816-233-1394
4. Dr. Paul L. Smith
South Dakota School of Mines & Technology
501 E. St. Joseph Street
Rapid City, SD 57701-3995 Tel. 605-394-2291

List of subcontractors: WMI owns and operates its own fleet of aircraft and weather radars. No major sub-contractors are being used on the Alberta Hail project for aircraft or radar services. Solution Blend Services, Calgary, Alberta (403) 207-9840 will be handling and mixing seeding solutions for the project.

PART 3. GENERAL INFORMATION CONCERNING ORGANIZATION FOR WHOM ACTIVITY IS TO BE CONDUCTED.

Name of organization: Alberta Severe Weather Management Society (ASWMS)

Chief officers: Mr. Todd Klapak, President
todd.klapak@intact.net
Ms. Catherine Janssen, Secretary-Treasurer
janssenc@telus.net

Nature of organization: A not-for-profit society of the property and casualty insurers and brokers operating in Alberta. The society was formed for the purpose of collecting funds from its members to operate a hail suppression program to help reduce insurance payout due to hail and stabilize insurance rates throughout the province.

PART 4. GENERAL INFORMATION CONCERNING FIELD BASES OF ACTIVITY

Address and location of project primary field base:

Olds-Didsbury Airport, Alberta. tel. 403-335-8359

Address(es) and location(s) of project secondary field base(s):

- Springbank airport tel. 403-247-0001
- Red Deer industrial airport tel. 403-886-7857

PART 5. GENERAL INFORMATION CONCERNING OPERATING FIELD PERSONNEL

Name and title of field officer in charge: Mr. Daniel Gilbert, Chief Meteorologist
Olds-Didsbury Airport, Highway 2A
Olds, AB T4H 1A1

tel. & fax. 403-335-8359,
e-mail: dgilbert@weathermodification.com
home page: <http://www.weathermodification.com/>

Qualifications of field officer in charge (Gilbert):

Education

Bachelor of Science, Meteorology and Environmental Studies (double major) May 2004, Iowa State University, Ames, IA

Associate of Arts, Liberal Arts, May 2000, Iowa Central Community College, Fort Dodge, IA

Weather Modification Experience

Chief Meteorologist, Weather Modification, Inc. (Wyoming and Alberta) - November 2009 to present
Forecaster, radar operator, rawinsondes, direction of seeding aircraft. Case declarations, wintertime (Wyoming) research program.

Meteorologist, RHS Consulting (Fresno, CA) – November 2008-February 2009

Directed airborne and ground based cloud seeding operations over portions of the central and southern Sierra Nevada Mountains. Set up and performed routine maintenance of ground based ice nucleus generators. Provided daily forecasts for clients and project personnel.

Meteorologist, Independent Contractor, (Boise, ID) – October 2007 to April 2008

Provided meteorological services to support Idaho Power Company's winter cloud seeding project in West Central Idaho, directed airborne and ground seeding operations, directed rawinsonde releases, provided short-term operational forecasts and nowcasts for pilots, communicated with aircraft via two-way radio

Field Meteorologist, North Dakota Cloud Modification Project, (Stanley or Bowman, ND) – Summers, 2003-2009

Operated 5 cm weather radar equipped with TITAN software package, launched and directed seeding aircraft using two-way radio and GPS tracking, performed data recording and documentation of cloud seeding operations, prepared silver iodide seeding solution, assisted with radar calibrations, prepared forecasts and briefed pilots daily, supervised intern meteorologists, presented case studies for ground school, operated cloud condensation nuclei counter for joint research with South Dakota School of Mines

Forecaster, Atmospherics Incorporated, (Fresno, CA) - October 2006 - May 2007

Field Meteorologist, Atmospherics, Inc. (Modesto, CA) - November 2005 - April 2006

Field Meteorologist, Atmospherics, Inc. (Paso Robles, CA) - December 2004 - February 2005

Provided daily forecasts for seeding operations and/or clients, operated 5cm weather radar, directed winter cloud seeding operations over the Sierra Nevada utilizing both glaciogenic and hygroscopic seeding agents, traced radar overlays, performed data recording of operations, wrote monthly and annual reports

Alberta and west to the foothills of the Rocky Mountains.

Estimate of adjoining geographic area possibly affected: Areas downwind (east) of highway no. 2 to highway no. 21 may also benefit from the seeded storms.

Approximate total cost: approx. \$3.1 million per year.

Funds to be expended in Canada: est. \$600,000 per year.

General period of operation: June 1st - Sept. 15th annually.

PART 7. GENERAL INFORMATION CONCERNING OPERATIONS AND TECHNIQUES

A. GENERAL: The following text describes the methods to be used, general principles of techniques, description of specific techniques, and a brief description of typical operations:

OVERVIEW OF METHOD

For hail suppression, aircraft patrolling based upon forecasts and hourly weather reports will be used to initiate seeding as soon as appropriate conditions develop. Storms will be seeded if they have radar reflectivities of approximately 35 dBZ at heights above the -5°C temperature level, and are considered to be a potential hail threat to an urban or populated area. When large hail is forecast, seeding will commence when radar reflectivities reach approximately 20 dBZ in order to start the microphysical suppression process as early as possible within the potential hailstorms. Storms will be seeded by aircraft using either droppable AgI pyrotechnics and/or wing mounted AgI pyrotechnics or AgI-solution burners.

The amount of seeding material used will depend upon the lifetime and size of the cloud or storm and other meteorological conditions. The seeding rates are about double those used during the 1970's and 1980's in Alberta. Seeding will be focused on the feeder clouds of the storm's new growth zone and will be conducted at cloud top and cloud base. Further details of the seeding method are discussed below.

HAIL SUPPRESSION HYPOTHESIS

The cloud seeding hypothesis is based on the cloud microphysics concept of "beneficial competition". Beneficial competition assumes a lack of natural ice nuclei in the environment effective at temperatures warmer than -20°C and that the injection of AgI will result in the production of a significant number of "artificial" ice nuclei. The natural and artificial ice crystals "compete" for the available supercooled liquid cloud water within the storm. Hence, the hailstones that are formed within the seeded cloud volumes will be smaller and produce less damage if they should survive the fall to the surface. If enough nuclei are introduced into the new growth region of the storm, then it is possible that the hailstones will be small enough to melt completely before reaching the ground.

Cloud seeding operations are intended to alter the cloud microphysics of the treated clouds, assuming that the present precipitation process is inefficient due to a lack of natural ice nuclei. The seeding is based on a conceptual model of Alberta hailstorms that evolved from the studies of Chisholm (1970), Chisholm and Renick (1972), Barge and Bergwall (1976), Krauss and Marwitz (1984), English and Krauss (1986) and English (1986).

It is assumed that hail embryos grow within the time evolving "main" updraft of single cell storms and within the updrafts of developing "feeder clouds" or cumulus towers that flank mature "multi-cell" and "super-cell" storms (see e.g. Foote 1984). The growth to large hail is hypothesized to occur along the edges of the main storm updraft where the merging feeder clouds interact with the main storm updraft.

For hail suppression, seeding with a large amount of silver-iodide will dramatically increase the ice crystal concentration in thunderstorm clouds and compete for the available supercooled cloud water to prevent the growth of large, damaging, ice particles. Based on WMI's experience, the cloud seeding will be targeted on the feeder cloud updraft regions associated with the production of hail and will leave

unseeded those regions of the storm associated with the production of rain only. This will make efficient use of the seeding material (Agl) and will reduce the possible risk of overseeding rain clouds.

CLOUD SEEDING METHODOLOGY - SEEDING TECHNIQUES

Convective cells (defined by radar) with maximum reflectivity approximately >35 dBZ within the cloud layer above the -5°C level, located within the project areas or within a 20 min travel time "buffer zone" upwind of the project area, will be seeded if they pose a potential threat of damaging hail for an urban or populated area. Radar observers/controllers will be responsible for making the "seed" decision and directing the cloud seeding missions.

Patrol flights will be launched before clouds within the target area meet the radar reflectivity seeding criteria. These patrol flights are meant to provide immediate response to developing cells. In general, a patrol is launched in the event of visual reports of vigorous towering cumulus clouds near Calgary or Red Deer, or when radar cells exceed 25 kft height over the higher terrain along the western border and begin moving towards the urban areas.

Launches of more than one aircraft are determined by the number of storms in each area, the lead time required for a seeder aircraft to reach the proper location and altitude, and projected overlap of coverage and on-station time for multiple aircraft missions. In general, only one aircraft can work safely at cloud top and one aircraft at cloud base for a single storm. The operation of three aircraft is recommended to provide uninterrupted seeding coverage at either cloud-base or cloud-top and to seed three storms simultaneously if required.

The program is designed to seed convective clouds, before they achieve radar reflectivities associated with hail, and deliver seeding material to regions of updraft and supercooled liquid water i.e. the primary conditions responsible for the growth of hailstones.

Factors that determine cloud top or cloud base seeding are: storm structure, visibility, cloud base height, or time available to reach seeding altitude. Cloud base seeding is conducted by flying at cloud base within the main inflow of single cell storms, or the inflow associated with the new growth zone (shelf cloud) located on the upshear side of multi-cell storms.

Cloud top seeding is conducted between typically between -5°C and -10°C. The pencil flares fall approximately 1.5 km (approximately 10°C) during their 35-40 second burn time. The seeding aircraft will penetrate the edges of single convective cells meeting the seed criteria. For multi-cell storms, or storms with feeder clouds, the seeding aircraft will penetrate the tops of the developing cumulus towers on the upshear sides of convective cells, as they grow up through the aircraft's altitude.

Occasionally, with embedded cells or convective complexes, there are no clearly defined feeder turrets visible to the flight crews or on radar. In these instances, at an altitude between -5°C and -10°C, a seeding aircraft will penetrate the storm edge (region of tight radar reflectivity gradient) on the upshear side and burn a burn-in-place flare and inject droppable pencil flares when updrafts are encountered.

Seeding is effective only within cloud updrafts and in the presence of supercooled cloud water, i.e. the developing, and mature stages in the evolution of the classic thunderstorm conceptual model. The dissipative stages of a storm would be seeded only if the maximum reflectivity is particularly severe and there is evidence (visual cloud growth, or tight reflectivity gradients) indicating the possible presence of embedded updrafts.

SEEDING RATE

A seeding rate of one 20 g flare every 5 s is typically used during cloud penetration. A slightly higher rate is used (e.g. 1 flare every 2 s) if updrafts are very strong (e.g. > 2000 ft/min) and the storm is particularly intense. Calculations show that this seeding rate will produce >1300 ice crystals per litre which is more than sufficient to deplete the liquid water content produced by updrafts of 10 m/s (2000 ft/min), thereby preventing the growth of hailstones within the seeded cloud volumes.