	(08/21), and radar indicated it may have produced pea size hail as it tracked across the southeast project area. No project cities were affected, and no other convection capable of hail was detected. Scattered rain showers continued throughout the night, morphing into a large mass of cold rain between Calgary and Red Deer early Friday morning. Max cell top: 7.6km, 60.7 max dBz, 25.4 max VIL Tmax YC = 20.2C and 1.8mm of rain. Tmax QF = 20.1C and 0.2mm of rain. Tmax Radar = 18.3C and 4.3mm of rain.	
August 21, Friday	A sharp upper level trough was expected to move across the project area. Significant mid and upper level PVA was anticipated through the evening, followed by NVA overnight. At the surface, the pressure gradient between a low in southern SK and high pressure building over the mountains was modeled to tighten, increasing northwesterly flow across the project area. Instability was forecast to be negligible while wind shear was excessive, acting against deep convection through the period. No hail was predicted; however the opportunity for frozen precipitation was forecast for higher elevation locations. A broad mass of rain and embedded convection affected the project area from before dawn well into the afternoon. Thunder was observed on the southern flank of this activity Friday morning. Strong cold air advection accompanied the system, and rain turned to snow in higher elevation areas of the project area, including parts of Calgary. The large mass of precipitation departed to the east around 3Z (08/22), however isolated showers and virga continued until 7Z (08/22). No echoes were observed the remainder of the night. Max cell top: 52.9 max dBz, 5.7 max VIL Tmax YC = 11.8C and 36.9mm of rain. Tmax QF = 12.0C and 50.0mm of rain. Tmax Radar = 11.3C and 37.3mm of rain.	No aircraft operations.
August 22, Saturday	Upper level winds were expected to weaken as a shortwave ridge built over the project area. Vorticity advection was predicted to be weak and predominantly negative through the period. A surface high was forecast to pass south of the region, turning winds from northwest to southeast by dusk. The thermodynamic profile was modeled to be absolutely stable through the period. Clear and tranquil conditions were experienced across the project area. Northwest winds slackened and turned southeasterly Saturday afternoon. No other noteworthy meteorological events occurred. No TITAN cells or meteorological echoes. Tmax YC = 16.5C and no rain. Tmax QF = 16.5C and no rain. Tmax Radar = 16.4C and no rain.	No aircraft operations.

August 23, Sunday	The upper level jet was expected to stay north of the area throughout the forecast period. Model output data indicated that 500mb heights would rise through around the time of peak heating. A weak shortwave trough then looked to move eastward across the area starting at around the time of sunset. Only very weak PVA was expected over the region from this small disturbance. Low level winds looked to be westerly to southwesterly, whereas winds at the surface appeared to be southerly to southeasterly. The veering winds with height indicated that warm air advection would likely occur during the period. Area modified model soundings showed a stable air mass in place across the region throughout the day and night. Cumulus, altocumulus, cirrostratus, and cirrus clouds were observed over the region during the day. Overnight, slightly thicker clouds began to overspread the region and very weak echoes were observed on radar. Radar data indicated that virga may have occurred near the Strathmore area during the late overnight hours. Virga was also observed over Calgary at 10Z (08/24). 31.4 max dBz Tmax YC = 23.6C and no rain. Tmax QF = 23.2C and no rain. Tmax Radar = 23.0C and no rain.	HS1 flew a currency flight. They were airborne at 1535Z and landed at 1655Z. Flight Summary HS1: 1522Z-1700Z; no seeding; currency flight.
August 24, Monday	Jet energy looked to stay north of the area throughout the forecast period. A shortwave trough was expected to move northeastward across the region during the evening and early nighttime hours. Moderately strong PVA was expected to be associated with this small-scale trough. The low levels looked to see southwesterly wind flow which would potentially aid in creating down slope conditions. A 700mb thermal ridge appeared to be in place over AB which would keep the lower troposphere capped throughout the daytime. Surface winds looked to be mainly southeasterly. The 03Z (08/25) modified model sounding for CYQF indicated that enough instability would be present for weak convection. Bulk speed shear values would be around 20kts. Chinook arch, altocumulus, and cirrus clouds were observed over the region during the morning and afternoon. Radar data indicated that virga likely occurred over the Calgary area during the morning hours. Smoke began to move into the region during the early morning hours. This smoke was thick at times over the region. The smoky conditions persisted throughout the period. 33.3 max dBz Tmax YC = 23.4C and no rain. Tmax QF = 22.6C and no rain. Tmax Radar = 22.3C and no rain.	Radar tour #10 was conducted at the Olds-Didsbury airport and 23 people were in attendance. HS1 flew a currency flight. They were airborne at 1515Z and landed at 1635Z. HS5 flew a PR flight. The aircraft was airborne out of YBW at 1722Z and landed in EA3 at 1737Z. HS5 then flew a return PR flight. The flight became airborne out of EA3 at 2323Z and landed in YBW at 2340Z. Flight Summary HS1: 1500Z-1639Z; no seeding; currency flight. HS5: 1718Z-1738Z; no seeding; PR flight; takeoff YBW, land EA3. HS5: 2319Z-2342Z; no seeding; PR flight; takeoff EA3, land YBW.
August 25, Tuesday	The main core of the upper level jet was expected to stay north of the region throughout the day and night. At the mid-levels the region would continue to see southwesterly flow. A wave of weak PVA was expected to move	HS4 flew a maintenance flight. The aircraft became airborne at 2320Z and landed at 2333Z.

	northeastward across the northern part of the project area during the early nighttime. The low levels and surface looked to continue seeing westerly to southwesterly winds for most of the day and night. This data suggested that down slope chinook-like conditions would be possible. The wind flow also suggested that smoke would continue to drift over the region. At the surface, a weak front was expected to slide southward into the northern part of the region during the early nighttime hours. A moderately strong cap looked to stay in place over the region. A large chinook cloud formed over the region during the morning hours. This cloud stayed over the region through the afternoon hours. Thick smoke continued to flow over the region throughout the period. Light convective rain showers then fell near the town of Vulcan during the overnight hours. 44.0 max dBz, 3.4 max VIL Tmax YC = 26.1C and no rain. Tmax QF = 22.1C and no rain. Tmax Radar = 23.6C and no rain.	Flight Summary HS4: 2313Z-2338Z; no seeding; maintenance flight.
August 26, Wednesday	Upper level charts showed that the right entrance region of a 90kt upper level jet streak would be positioned over the region. The area looked to experience southwest mid-level wind flow for most of the period. PVA appeared to be negligible during the time of peak heating. A 700mb thermal ridge was expected to build over AB during the daytime which would likely inhibit rising motions in the atmosphere. At 850mb, warm moist air was expected to be in place over the area throughout the nighttime hours. The main trigger mechanism for thunderstorms looked to be surface heating along the foothills. The 00Z (08/27) modified model sounding for CYQF indicated that the region would experience a loaded gun situation. In other words, if convection was able to push through the low level cap, this convection was expected to potentially develop into long-lived hail producing thunderstorms. Smoke continued to flow into the region from fires in southern BC and also from several fires in the state of Washington. The low levels of the atmosphere remained capped throughout the day and nighttime hours. During the period cumulus, altocumulus, and stratocumulus clouds formed over the northern part of the project area. Radar data indicated that these clouds occasionally became thick enough to produce virga. 32.2 max dBz Tmax YC = 21.0C and no rain. Tmax QF = 21.8C and no rain. Tmax Radar = 20.8C and no rain.	HS2 flew a maintenance flight. The flight was airborne at 1732Z and landed at 1813Z. Flight Summary HS2: 1721Z-1815Z; no seeding; maintenance flight.
August 27, Thursday	Model output data indicated that a relatively weak part of the upper level jet stream would be centered over the region during the day and night. The mid-level wind flow was expected to be westerly. PVA looked to be very weak during the daytime and then slightly stronger during the early nighttime hours. At the low levels, warm moist air	No aircraft operations.

	looked to be in place over the region through the evening. The main trigger mechanisms for thunderstorms were expected to be elevated surface heating along the foothills and jet PVA. The 21Z and 00Z (08/28) modified model soundings for Calgary showed that a moderately unstable air mass would be in place over the southern region with bulk speed shear values of roughly 30kts. Chinook arch clouds were observed over the region during the morning hours. In the afternoon and evening mountain wave clouds then formed over foothills and the western half of the project area. Smoky weather conditions persisted throughout the period. 23.6 max dBz Tmax YC = 23.9C and no rain. Tmax QF = 24.3C and no rain. Tmax Radar = 23.4C and no rain.	
August 28, Friday	The area looked to stay in SW flow at the mid-levels throughout the day and night. Several lobes of weak to moderately strong PVA were expected to push northeastward across the region. Model output data suggested that 500mb temperatures would gradually warm throughout the period. Low level and surface winds appeared to be southwesterly and looked to favor down slope conditions through the early nighttime hours. The 00Z (08/29) modified model soundings for the area indicated that the atmosphere will be only slightly unstable. CAPE values appeared to be less than 100J/kg across the entire area and foothills. Furthermore, the low levels looked to contain a modest cap. A very large chinook arch cloud formed during the early morning hours and extended from the elbow region of AB down into Montana. Radar data indicated that the chinook arch cloud became thick enough in places to produce virga. Mountain wave clouds also formed in the lee of the Rocky Mountains during the morning hours. Both the chinook arch and mountain wave clouds persisted into the evening hours. Overnight, no significant weather occurred. Widespread smoke was observed over the area throughout the period. 32.2 max dBz Tmax YC = 25.9C and no rain. Tmax QF = 23.3C and no rain. Tmax Radar = 25.3C and no rain.	No aircraft operations.
August 29, Saturday	The upper level jet looked to be positioned over central AB throughout the day and nighttime hours. A potent shortwave trough was expected to quickly move northeastward through AB in the late afternoon and early evening. PVA appeared to be strongest over the NW part of the project area. At the low levels the cap was expected to erode enough for convection to initiate along the foothills during the afternoon. At the surface, a cold front looked to quickly move northeastward across the region starting around 00Z (08/30). The 00Z (08/30) modified model soundings for the region showed that the	No aircraft operations.

	atmosphere would contain a modest amount of instability. Bulk speed shear values looked to be around 45kts which would potentially be too strong for long-lived convection. Smoky and breezy conditions were observed at the surface through the afternoon. In the evening weak convection pushed into the northwestern part of the project area. Radar data suggested that this convection likely produced virga as it quickly moved northeastward across the protected area. 37.2 max dBz Tmax YC = 26.0C and no rain. Tmax QF = 26.0C and no rain. Tmax Radar = 24.3C and no rain.	
August 30, Sunday	Upper level jet cores were positioned to the west and east of Alberta, and no jet PVA was occurring. The main axis of an upper trough would be pushing through the region during the late afternoon and evening. Several lobes of vorticity were expected to push through the project area. Low levels were relatively dry with dew points expected to linger around 5C. WSW surface winds would aid in keeping dew points low. Weak CAPE of around 500 J/Kg was anticipated over the northern project area during the late afternoon, while the Calgary area would be almost stable. 30kts of bulk shear was apparent on the sounding, but no directional shear. Late afternoon thunderstorms were forecast near Red Deer with a potential for small hail. Rapid stabilization and clearing were expected by 3Z. A single line of weak thunderstorms developed in the northern project area in the late afternoon which impacted Red Deer, and Penhold. There was no significant hail threat according to radar echoes. The activity cleared out by around 2Z, and clear conditions were observed overnight. 6mm size hail was reported near Red Deer. Max cell top: 8.4km, 60.1max dBz, 29.3max VIL Tmax YC = 22C and no rain. Tmax QF = 23C and 1.2mm of rain. Tmax Radar = 22.7C and no rain.	No aircraft operations.
August 31, Monday	An upper level jet streak was moving into AB, but the project area was under the right exit region. Several weak lobes of midlevel vorticity were expected to pass through, but low levels were dry with dew points near 5C. The atmosphere would be virtually stable, and no convection was anticipated. Surface winds would be from the SW. The only radar echoes were from Chinook arch clouds. No precipitation was observed. Some upper and midlevel cloud cover was present throughout the period. 31.2 max dBz Tmax YC = 21C and no rain.	No aircraft operations.

	Tmax QF = 22C and no rain. Tmax Radar = 22C and no rain.	
September 1, Tuesday	The upper jet was positioned over the region, but no jet PVA was occurring. Midlevel vorticity would be pushing through overnight creating some clouds, but no significant precipitation was expected. Low levels were quite dry, and there was only negligible CAPE around 54J/Kg near QF. The southern project area looked to be stable throughout the period. Fair weather cumulus was expected in the afternoon. No rain or hail threats were forecast. A few weak convective echoes were observed during the afternoon near Rocky MH. There were no hail threats. 48.3 max dBz, 5.9 max VIL Tmax YC = 22C and no rain. Tmax QF = 21C and no rain. Tmax Radar = 22C and no rain.	No aircraft operations.
September 2, Wednesday	A jet streak was directly over the project region creating some PVA and extreme vertical wind shear. Midlevel wind speeds were greater than 100 knots. Multiple bands of vorticity were expected to spin off from a large low over BC and move through the project area. Marginal instability was expected over the northern project area during the early and midafternoon while the southern project area would be dry and nearly stable. A minor hail threat was forecast over the northern target area. Weak thunderstorms developed over the northern project area in the early afternoon hours. There were no hail storms, and only a few lightning strikes. A few convective showers were observed in the late evening, and then conditions were stable overnight. Max cell top: 7.6 km, 58 max dBz, 16.6 max VIL Tmax YC = 21C and no rain. Tmax QF = 19C and a trace of rain. Tmax Radar = 20.2C and a trace of rain.	No aircraft operations.
September 3, Thursday	A jet streak remained over the region creating strong vertical wind shear. A small amount of moisture would be moving into the region during the afternoon destabilizing the far southern project area. A small amount of CAPE was expected to create low topped convection. The atmosphere was expected to stabilize by 00z, and then stratus rain was forecast for the overnight hours. Shallow convective showers occurred all day and into the evening. Widespread stratus rain occurred overnight. There were no hail threats. Lightning was observed. Max cell top: 5.4km, 55.3 max dBz, 8.5 max VIL Tmax YC = 14C and 2.2mm of rain. Tmax QF = 15C and 4.0mm of rain. Tmax Radar = 14.1C and 1.0mm of rain.	No aircraft operations.

September 4, Friday	A large low pressure system was shifting from BC into Washington, expected to lift northeastward into AB. Multiple lobes of vorticity were forecast to spin off from the low and move through the project region. Low level moisture was minimal with dew points around 5C, but with cold air in place, relative humidity was high. Thick low overcast was expected over the region along with periods of stratiform rain. The atmosphere would be stable throughout the period, so no convective activating was anticipated. Stratiform rain and low thick cloud cover blanketed the region throughout the period. There were no convective clouds as the atmosphere remained stable and cool. Max cell top: 48.9 max dBz Tmax YC = 6C and 4.6 mm of rain. Tmax QF = 7C and 2.8 mm of rain. Tmax Radar = 5.5C and 2.3 mm of rain.	No aircraft operations.
September 5, Saturday	A deep low pressure system to the southwest was expected to push northeastward into southern AB. Cold, stable conditions were likely with low ceilings and widespread stratus rain. No convection was forecast. Widespread continuous stratus rain occurred all day and all night. Low thick cloud cover blanked the region throughout the period. There were no convective clouds. Light snow was observed overnight in Springbank. 46.7 max dBz Tmax YC = 6.4C and 30.0mm of rain. Tmax QF = 9.3C and 12.4mm of rain. Tmax Radar = 7.3C and 18.3mm of rain.	No aircraft operations.
September 6, Sunday	The closed cold-core, mid and upper level low was centered over southern AB. Model output data suggested that this low pressure system would slowly move northeastward and was expected to be centered over SK late in the forecast period. PVA would continue to be plentiful throughout the period due to the presence of the low pressure system. Both the low levels and surface would continue to see northwesterly cold air advection through the evening hours. The 00Z (09/07) modified model soundings for the region indicated that a slightly unstable air mass would be in place during the afternoon and evening. Stratiform rain showers continued to fall over the region from the previous day through around 18Z. Scattered convective rain showers then occurred off and on throughout the rest of the period. 46.6 max dBz Tmax YC = 9.2C and 3.8mm of rain. Tmax QF = 6.8C and 10.2mm of rain. Tmax Radar = 6.8C and 3.3mm of rain.	No aircraft operations.

September 7, Monday	The closed mid and upper level low was now centered over central SK and was expected to move eastward into MB late in the day. Relatively weak PVA was expected through the early evening hours. Model charts indicated that a shortwave ridge would then briefly cause subsidence over the region in the evening and overnight. Low level and surface winds were expected to be northwesterly, becoming more westerly in the late afternoon and early evening. Afternoon modified model soundings showed a slightly unstable troposphere with around 20kts of bulk speed shear. Scattered convective rain showers fell through the early afternoon hours. Isolated weak thunderstorm then formed over the region in the midafternoon. These short-lived and pulse thunderstorms continued to form over the protected area through the early evening. The convective activity then diminished in the late evening, and the skies gradually cleared over the area overnight. Max cell top: 6.1km, 56.9 max dBz, 16.3 max VIL Tmax YC = 14.1C and 1.8mm of rain. Tmax QF = 14.7C and 1.0mm of rain. Tmax Radar = 13.7C and 5.1mm of rain.	No aircraft operations.
September 8, Tuesday	The right entrance region of a 100kt upper level jet streak was expected to be over the far northern part of the project area. Moderate to strong PVA looked to be likely over the region during the afternoon through evening as a shortwave trough gradually pushed southeastward across central AB. The axis of this trough appeared to move through during the evening, so PVA looked to be strongest during this period of time. Low level and surface winds were expected to be westerly. The 00Z (09/09) modified model sounding for CYQF indicated that the troposphere would be slightly unstable with CAPE values around 100 to 200J/kg. The Southern half of the region appeared to stay capped throughout the forecast period. Scattered convective rain showers fell over the northern part of the region from the late afternoon through the early nighttime hours. The thunderstorm activity stayed just to the north and west of the region. No lightning strikes were observed inside the project area. 50.2 max dBz, 4.9 max VIL Tmax YC = 17.9C and no rain. Tmax QF = 17.6C and 1.4mm of rain. Tmax Radar = 17.8C and a trace of rain.	No aircraft operations.
September 9, Wednesday	Northwesterly upper level jet energy was expected throughout the period. At the mid-levels, a moderately strong shortwave trough was expected to slowly slide southeastward across the region during the afternoon and evening. Although PVA was possible the evening, relatively stronger PVA looked to occur during the late afternoon. The CYYC modified model soundings for 21Z and 00Z (09/10) showed that the atmosphere would contain anywhere from 200 to 300J/kg of CAPE. The 0 to 6km AGL bulk speed shear values appeared to be around	HS3 flew a maintenance flight. The flight became airborne at 1754Z and landed at 1818Z. Flight Summary HS3: 1733Z-1823Z; no seeding; maintenance flight.

	15kts which suggested that thunderstorms would likely be short-lived and unorganized. Moderately thick clouds formed over the western half of the project area. These clouds produced virga during the morning hours. Weak TITAN cells developed in the afternoon along the western project area boundary creating some rain and perhaps ice pellets. Thundershowers pushed through the northeastern project area during the evening. There were no hail threats. Max cell top: 5.4km, 56.9 max dBz, 11.8 max VIL Tmax YC = 19C and no rain. Tmax QF = 17C and 4.8mm of rain. Tmax Radar = 17.4C and no rain.	
September 10, Thursday	The upper jet was shifting to the east as a large ridge was moving into the region. The upper levels were warming and becoming dry. There was some shallow low level CAPE at briefing time along with some isolated convective showers without lightning. The atmosphere would stabilize throughout the day. No hail threats were forecast. Shallow convective showers were present in the morning and early afternoon, and then radar was clear for the remainder of the period. There were no hail threats. No TITAN cells, 41 max dBz Tmax YC = 20.3C and no rain. Tmax QF = 20.5C and 3.2 mm of rain. Tmax Radar = 20.3C and no rain.	No aircraft operations.
September 11, Friday	A large upper level ridge was well-established over the area. High pressure and sinking air were expected throughout the period. The atmosphere was completely stable with no chance of convection. No TITAN cells or meteorological echoes. Clear skies. Tmax YC = 26.1C and no rain. Tmax QF = 26.4C and no rain. Tmax Radar = 26.6C and no rain.	No aircraft operations.
September 12, Saturday	The polar jet stream was initially over northern AB but was expected to sag southward into the region late in the period. The wind flow at the mid-levels looked to be westerly and was expected to increase late in the day due to the upper level jet. PVA appeared to be likely in the late evening through overnight hours. A strong cold front was expected to begin pushing southward into the far northern part of the region in the evening. Area modified model soundings indicated that the area would stay capped through the early evening. Enough instability appeared to be present for weak convection over the northern protected area during the evening and overnight hours. Mostly clear skies were observed over the entire area through the early evening. Cumulus clouds then started to	No aircraft operations.

	develop at around the time of sunset. A line of stratiform rain showers with areas of weak embedded convection then slowly began to move into the region from the northwest at around 06Z (09/13). This line produced moderate rain showers as it slowly moved southeastward across the region during the overnight hours. 52.3 max dBz, 4.6 max VIL Tmax YC = 28.6C and no rain. Tmax QF = 27.8C and no rain. Tmax Radar = 27.3C and no rain.	
September 13, Sunday	The upper level jet stream looked to stay centered over the region throughout the day and night. A large scale trough was expected to deepen along the west coast of North America. PVA was expected to be possible throughout the forecast period. Significant cold air advection (~5C) looked to occur aloft which would aid in keeping the troposphere unstable. The 00Z (09/14) modified model sounding for CYQF showed that the troposphere would be slightly unstable with around 200 to 300J/kg of CAPE. 0 to 6km AGL bulk speed shear values were expected to be very strong (~50kts). Due to the strong speed shear long-lived updrafts would be unlikely, so short-lived thunderstorms were expected. A line of stratiform rain showers pushed southeastward across the region during the morning hours. Scattered convective rain showers then occurred during the afternoon and evening. A few isolated thunderstorms formed over the protected area from roughly the time of peaking heating through the evening hours. A cold air funnel cloud was reported east of Olds. Scattered stratiform rain showers then fell over most of the region during the nighttime hours. Max cell top: 5.4km, 59.0 max dBz, 16.1 max VIL Tmax YC = 12.8C and 3.4mm of rain. Tmax QF = 16.2C and 3.6mm of rain. Tmax Radar = 13.6C and 7.9mm of rain.	No aircraft operations.
September 14, Monday	The main core of a relatively strong upper level jet looked to remain centered over the region throughout the forecast period. Several lobes of moderate to strong vorticity were expected to push northeastward across the area during the day and night. Temperatures were expected to warm by roughly 1 to 2C aloft which would likely hinder deep convection from occurring. Low level and surface winds looked to be northeasterly to easterly which would favor upslope conditions for most of the day. Area modified model soundings indicated that CAPE values would likely be less than 100J/kg during the day. Soundings showed a layer of warm and stable air above 16kft MSL, so no deep convection was expected. Stratiform rain showers fell over the region off and on throughout the period. During the daytime hours embedded convective rain showers also occurred over the area.	No aircraft operations.

	46.9 max dBz Tmax YC = 7.5C and 12.2mm of rain. Tmax QF = 9C and 2.4mm of rain. Tmax Radar = 6.4C and 3.8mm of rain.	
September 15, Tuesday	Weak jet energy was expected over the region throughout the day and night. A large scale mid and upper level trough of low pressure looked to stay in place along the west coast of North America. Weak PVA was expected during the time of peaking heating. A lee cyclone formed over the protected area during the morning hours. This low looked to trigger off convection before diminishing during the evening hours. Due to the low, upslope conditions were expected to be probable during the daytime hours. The modified model soundings for 18Z, 21Z, and 00Z indicated that the area would only see slightly unstable conditions. Dense fog was observed over parts of the region during the early morning hours. This fog quickly evaporated during the mid-morning hours. Isolated, light convective rain showers then fell during the afternoon and evening. 37.3 max dBz Tmax YC = 11C and no rain. Tmax QF = 10C and no rain. Tmax Radar = 9C and no rain.	No aircraft operations.

APPENDIX C – AIRCRAFT OPERATIONS SUMMARY TABLE

	Air Time				
	HS1	HS2	HS3	HS4	HS5
JUNE	9:01	15:16	13:58	15:55	5:12
JULY	28:46	36:22	16:22	27:28	25:55
AUGUST	5:42	9:57	8:26	5:48	9:04
SEPTEMBER	0:00	0:00	0:00	0:00	0:00

	HS1 - Beech King Air			HS2 - Cessna 340A				HS3 - Beech King Air			HS4 - Cessna 340A				HS5 - Beech King Air			DAILY TOTALS	
STORM DAY	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																			
4-Jun	3:06	49	6					1:13	18	3	1:31		1	124				5	3091
10-Jun				2:08		3	158	1:27		4	2:25			176	0:47	29	2	2	2607
11-Jun				0:57			10	1:15	183	9	1:13		7	84				2	6251
16-Jun											0:36								0
19-Jun	1:28	41	6	4:55		18	309	3:58	419	25	5:06		24	327	1:44		12	4	23240
22-Jun								1:28	81	5								2	2370
23-Jun	1:34	65	10	3:10		2	120	0:49			3:25		6	158				5	4564
30-Jun	2:53	171	25	4:06		22	346	3:48	130	5	1:39		7	134	2:41	299	18	5	24523
JULY																			
3-Jul				3:41		14	188	1:52	193	8	2:11		10	204	3:27	78	11	5	12665
4-Jul	3:35	267	15	2:11		17	210				4:15		18	272				3	13817
11-Jul	1:25	75	8	1:49		9	194								3:54	242	27	2	13333
12-Jul	2:23	181	24	2:02		2	212											2	7950
13-Jul	0:37														0:50	42	6	1	1740
14-Jul	5:48	404	34	4:09		23	368	3:13	291	15	2:35		5	154				4	26509
15-Jul				2:37		14	200	1:53	189	13	2:52		16	308	2:00	81	4	3	13480
20-Jul	1:50	86	9	3:23		5	212	2:31	110	15	2:27		7	172	1:25			2	10099
21-Jul	3:21	273	24	5:26		40	415	3:17	400	31	3:32		23	314	6:11	565	35	8	49188
22-Jul	6:17	525	23	2:48		22	284	1:14			4:05		21	157	3:01	289	17	4	29624
23-Jul				2:21		11	216	0:52	100	5	0:53		2	56	2:56	194	17	2	11682
25-Jul	1:03	72	8	1:07		7	82				2:22		11	142				2	5794
26-Jul				2:15		8	192				0:14				2:11	157	12	1	6529
29-Jul	2:27	108	7	2:33		5	180	1:34	280	13	2:02		12	194				2	14068
AUGUST																			
3-Aug				1:54											2:05	4	2	1	380
4-Aug				2:39		22	224	2:30	156	21	2:30		5	80	2:49	302	24	2	20577
5-Aug	5:42	481	31	4:18		28	444	3:44	278	30	3:18		24	266	4:10	202	42	8	43910
9-Aug								1:20	17	2								1	640
14-Aug				1:06				0:52		4								1	600
SEPTEMBER																			
none																			

Tables are seed and patrol only.

All flight times are AIR time, not engine time.

APPENDIX D - Flight Summary Table

ALBERTA HAIL SUPPRESSION PROJECT 2015 - Universal Time Coordinates

MONTHLY FLIGHT TIME TOTAL:	JUNE	JULY	AUGUST	SEPTEMBER	*Season Total*
HS1	11:34	34:15	9:19	0:00	**55:08**
HS2	18:26	43:44	13:28	0:00	**75:38**
HS3	16:57	19:37	10:06	0:50	**47:30**
HS4	20:27	32:25	7:52	0:00	**60:44**
HS5	7:07	29:03	10:10	0:00	**46:20**
					285:20

HailStop #1 - N904DK
HailStop #2- N457DM
HailStop #3- N522JP
HailStop #4- N37356
HailStop #5- N518TS

	TOTAL TIME	AIR TIME
Seeding hours:	237:54	220:24
Patrol hours:	15:30	12:52
Reposition hours:	7:50	5:22
PR hours:	7:18	4:39
Mx hours:	11:24	7:06
Ferry hours:	0:00	0:00
Cur hours:	5:24	4:16
	285:20	254:39

MONTHLY FLARE USAGE:		JUNE	JULY	AUGUST	SEPTEMBER	*Season Total*
HS1	BIP	47	152	31	0	**230**
	EJECT	326	1991	481	0	**2798**
HS2	BIP	45	177	50	0	**272**
	EJECT	0	0	0	0	**0**
	BURNERS	943	2953	668	0	**4564**
HS3	BIP	51	100	57	0	**208**
	EJECT	831	1563	451	0	**2845**
HS4	BIP	45	125	29	0	**199**
	EJECT	0	0	0	0	**0**
	BURNERS	1003	1973	346	0	**3322**
HS5	BIP	32	129	68	0	**229**
	EJECT	328	1648	508	0	**2484**

PILOT/OBSERVER	Initials	PILOT/OBSERVER	Initials
Adam Brainard	ARB	Jody Fischer	JF
Andrew Brice	AB	Joel Zimmer	JZ
Brad Waller	BLW	Lee Goodyear	LG
Brian Kindrad	BK	Matthew Thomson	MWRT
Bruce Boe	BAB	Mike Torris	MT
Dan Gilbert	DBG	Steve Dimitrov	SD
Jacob Eeuwes	JE	Terry Krauss	TWK
Jake Mitchem	JM	Jenny Thorpe	JT
Jenelle Newman	JN	Andreas Bertoni	AMB

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

TOTALS	# Flights: 167			285:20			254:39	8127	1138	7886		Storm-Day Sub-Totals: Total Time for the Day	Total EJ	Total BIP	Total Burner	** Only flares spent for seeding.		79			
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	253:24	8127	1138	7886	Seed Amount (Per Day) (Grams)	Season Seed Accumulation (Grams)**	# Storms	Captain	Co-Pilot	Observer
01-Jun-15	HS1	17:57	18:30	0:33	18:00	18:27	0:27	0	0	0	MX					0	0	0	LG	JE	
01-Jun-15	HS4	23:21	0:22	1:01	23:31	0:18	0:47	0	0	0	CUR	0:00	0	0	0	0	0	0	JN	SD	
03-Jun-15	HS5	13:40	14:17	0:37	13:47	14:15	0:28	0	0	0	MX					0	0	0	JM	AB	
03-Jun-15	HS4	17:41	18:47	1:06	17:54	18:43	0:49	0	0	0	CUR					0	0	0	JF	SD	
03-Jun-15	HS5	22:01	22:43	0:42	22:13	22:40	0:27	0	0	0	MX	0:00	0	0	0	0	0	0	JM	AB	
04-Jun-15	HS1	20:24	23:46	3:22	20:34	23:40	3:06	49	6	0	SEED					0	0	3	LG	JE	JF
04-Jun-15	HS4	22:30	0:14	1:44	22:40	0:11	1:31	0	1	124	SEED					0	0	2	JN	SD	
04-Jun-15	HS3	22:48	0:15	1:27	22:59	0:12	1:13	18	3	0	SEED	6:33	67	10	124	3091	3091	0	MT	JZ	
09-Jun-15	HS2	18:14	19:19	1:05	18:27	19:17	0:50	0	0	0	MX	0:00	0	0	0	0	3091	0	BK	MWRT	
10-Jun-15	HS2	20:50	23:08	2:18	20:59	23:07	2:08	0	3	158	SEED					0	3091	1	BK	MWRT	
10-Jun-15	HS5	22:28	23:23	0:55	22:35	23:22	0:47	29	2	0	SEED					0	3091	0	JM	AB	
10-Jun-15	HS3	23:51	1:31	1:40	0:01	1:28	1:27	0	4	0	SEED					0	3091	1	MT	JZ	
11-Jun-15	HS4	0:16	3:03	2:47	0:35	3:00	2:25	0	0	176	SEED	7:40	29	9	334	2607	5699	0	JN	SD	
11-Jun-15	HS3	22:55	0:24	1:29	23:04	0:19	1:15	183	9	0	SEED					0	5699	1	MT	JZ	
11-Jun-15	HS4	23:00	0:21	1:21	23:05	0:18	1:13	0	7	84	SEED					0	5699	0	JN	SD	
11-Jun-15	HS2	23:25	0:30	1:05	23:31	0:28	0:57	0	0	10	SEED	3:55	183	16	94	6251	11949	1	BK	MWRT	
16-Jun-15	HS4	21:15	22:00	0:45	21:20	21:56	0:36	0	0	0	PATROL	0:45	0	0	0	0	11949	0	JN	SD	
18-Jun-15	HS1	15:59	16:30	0:31	16:09	16:27	0:18	0	0	0	PR					0	11949	0	LG	JE	
19-Jun-15	HS1	0:21	0:50	0:29	0:26	0:48	0:22	0	0	0	PR	0:00	0	0	0	0	11949	0	LG	JE	
19-Jun-15	HS1	17:31	19:18	1:47	17:42	19:10	1:28	41	6	0	SEED					0	11949	1	LG	JE	JF
19-Jun-15	HS2	17:32	19:04	1:32	17:39	19:01	1:22	0	3	110	SEED					0	11949	0	BK	MWRT	
19-Jun-15	HS4	17:50	18:19	0:29	18:00	18:08	0:08	0	0	0	MX					0	11949	0	JN	SD	
19-Jun-15	HS5	18:17	20:06	1:49	18:20	20:04	1:44	0	12	0	SEED					0	11949	0	JM	AB	
19-Jun-15	HS3	18:22	20:31	2:09	18:36	20:26	1:50	248	15	0	SEED					0	11949	1	MT	JZ	
19-Jun-15	HS4	18:50	20:23	1:33	18:55	20:20	1:25	0	6	53	SEED					0	11949	0	JN	SD	
19-Jun-15	HS2	20:31	22:03	1:32	20:38	22:02	1:24	0	1	25	SEED					0	11949	1	BK	MT	
19-Jun-15	HS4	21:45	22:24	0:39	21:50	22:20	0:30	0	0	0	PATROL					0	11949	0	JN	SD	
19-Jun-15	HS4	22:45	2:05	3:20	22:51	2:02	3:11	0	18	274	SEED					0	11949	1	JN	SD	
19-Jun-15	HS3	23:28	1:52	2:24	23:38	1:46	2:08	171	10	0	SEED					0	11949	0	MT	JZ	
19-Jun-15	HS2	23:34	1:47	2:13	23:36	1:45	2:09	0	14	174	SEED	18:58	460	85	636	23240	35189	0	BK	MWRT	

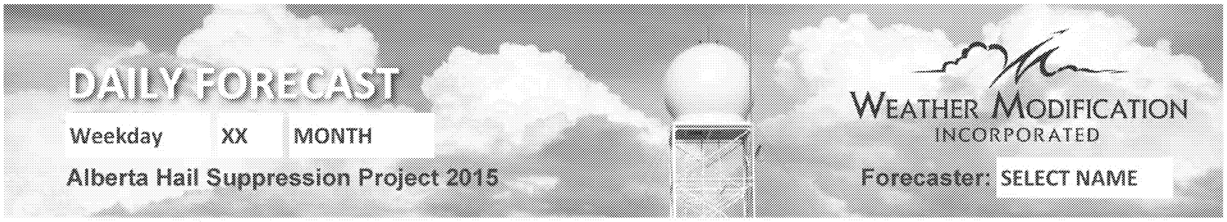
23-Jun-15	HS3	5:00	6:42	1:42	5:10	6:38	1:28	81	5	0	SEED	1:42	81	5	0	2370	37559	2	MT	JZ	
23-Jun-15	HS4	19:35	23:07	3:32	19:40	23:05	3:25	0	6	158	SEED					0	37559	1	JN	SD	
23-Jun-15	HS1	20:10	21:58	1:48	20:20	21:54	1:34	65	10	0	SEED					0	37559	1	LG	JE	JF
23-Jun-15	HS2	20:44	0:06	3:22	20:53	0:03	3:10	0	2	120	SEED					0	37559	3	BK	MWRT	
23-Jun-15	HS3	22:50	23:52	1:02	22:58	23:47	0:49	0	0	0	PATROL	9:44	65	18	278	4564	42123	0	MT	JZ	
24-Jun-15	HS2	17:25	17:56	0:31	17:36	17:55	0:19	0	0	0	PR					0	42123	0	BK	MWRT	
24-Jun-15	HS2	22:55	23:21	0:26	23:02	23:19	0:17	0	0	0	PR	0:00	0	0	0	0	42123	0	BK	MWRT	
30-Jun-15	HS3	17:30	18:03	0:33	17:38	17:59	0:21	0	0	0	PR					0	42123	0	MT	JZ	
30-Jun-15	HS1	21:26	0:30	3:04	21:35	0:28	2:53	171	25	0	SEED					0	42123	2	LG	JE	
30-Jun-15	HS4	22:45	23:06	0:21	22:54	23:04	0:10	0	0	0	MX					0	42123	0	JN	SD	
30-Jun-15	HS3	23:04	1:03	1:59	23:12	0:56	1:44	101	4	0	SEED					0	42123	1	MT	JZ	
30-Jun-15	HS4	23:06	0:55	1:49	23:14	0:53	1:39	0	7	134	SEED					0	42123	0	BK	MWRT	
30-Jun-15	HS2	23:11	0:46	1:35	23:19	0:44	1:25	0	5	98	SEED					0	42123	0	BK	MWRT	
01-Jul-15	HS5	2:53	5:42	2:49	2:58	5:39	2:41	299	18	0	SEED					0	42123	1	JM	AB	
01-Jul-15	HS2	3:01	5:48	2:47	3:05	5:46	2:41	0	17	248	SEED					0	42123	0	BK	MWRT	
01-Jul-15	HS3	4:31	5:39	1:08	4:41	5:34	0:53	0	0	0	PATROL					0	42123	0	MT	JZ	
01-Jul-15	HS5	8:19	8:34	0:15	8:24	8:31	0:07	0	0	0	MX					0	42123	0	JM	AB	
01-Jul-15	HS3	8:30	9:54	1:24	8:38	9:49	1:11	29	1	0	SEED	16:35	600	77	480	24523	66646	1	LG	JE	
01-Jul-15	HS1	17:35	18:01	0:26	17:48	17:57	0:09	0	0	0	MX	0:00	0	0	0	0	66646	0	JF	LG	
02-Jul-15	HS1	14:34	15:22	0:48	14:49	15:18	0:29	0	0	0	MX					0	66646	0	LG	JE	
02-Jul-15	HS1	17:26	18:04	0:38	17:35	18:01	0:26	0	0	0	MX	0:00	0	0	0	0	66646	0	LG	JE	
03-Jul-15	HS2	18:44	19:30	0:46	18:53	19:28	0:35	0	0	0	REPO					0	66646	0	BK	MWRT	
03-Jul-15	HS2	21:34	22:14	0:40	21:39	22:12	0:33	0	0	0	REPO					0	66646	0	BK	MWRT	
04-Jul-15	HS4	1:40	4:02	2:22	1:49	4:00	2:11	0	10	204	SEED					0	66646	2	JN	SD	
04-Jul-15	HS2	1:57	5:51	3:54	2:06	5:47	3:41	0	14	188	SEED					0	66646	2	BK	MWRT	
04-Jul-15	HS3	2:03	4:07	2:04	2:11	4:03	1:52	193	8	0	SEED					0	66646	0	MT	JZ	
04-Jul-15	HS5	2:07	5:42	3:35	2:13	5:40	3:27	78	11	0	SEED	11:55	271	43	392	12665	79311	1	JM	AB	
04-Jul-15	HS4	19:20	23:46	4:26	19:28	23:43	4:15	0	18	272	SEED					0	79311	3	JN	SD	
04-Jul-15	HS1	19:47	23:32	3:45	19:55	23:30	3:35	267	15	0	SEED					0	79311	0	LG	JE	
04-Jul-15	HS2	21:19	23:40	2:21	21:25	23:36	2:11	0	17	210	SEED	10:32	267	50	482	13817	93129	0	BK	MWRT	
11-Jul-15	HS4	17:40	18:13	0:33	17:46	18:10	0:24	0	0	0	MX					0	93129	0	JN	SD	
11-Jul-15	HS2	18:13	18:32	0:19	18:20	18:28	0:08	0	0	0	MX					0	93129	0	BK	MWRT	
11-Jul-15	HS5	22:51	2:54	4:03	22:57	2:51	3:54	242	27	0	SEED					0	93129	1	JM	AB	
11-Jul-15	HS2	23:55	1:56	2:01	0:05	1:54	1:49	0	9	194	SEED					0	93129	0	BK	MWRT	
12-Jul-15	HS1	4:26	6:05	1:39	4:36	6:01	1:25	75	8	0	SEED	7:43	317	44	194	13333	106462	1	LG	JE	
12-Jul-15	HS1	12:45	15:18	2:33	12:50	15:13	2:23	181	24	0	SEED					0	106462	2	LG	JE	
12-Jul-15	HS2	12:54	15:08	2:14	13:03	15:05	2:02	0	2	212	SEED	4:47	181	26	212	7950	114412	0	BK	MWRT	
13-Jul-15	HS5	19:14	20:13	0:59	19:20	20:10	0:50	42	6	0	SEED					0	114412	1	JM	AB	
14-Jul-15	HS1	2:35	3:26	0:51	2:45	3:22	0:37	0	0	0	PATROL	1:50	42	6	0	1740	116152	0	LG	JE	
14-Jul-15	HS4	17:26	17:59	0:33	17:35	17:55	0:20	0	0	0	PR					0	116152	0	JN	SD	
14-Jul-15	HS1	19:16	22:31	3:15	19:22	22:27	3:05	299	28	0	SEED					0	116152	1	MT	JZ	
14-Jul-15	HS2	19:18	22:16	2:58	19:24	22:13	2:49	0	22	290	SEED					0	116152	1	BK	AB	
14-Jul-15	HS3	20:55	0:20	3:25	21:03	0:16	3:13	291	15	0	SEED					0	116152	1	MT	JZ	
14-Jul-15	HS4	23:10	1:55	2:45	23:15	1:50	2:35	0	5	154	SEED					0	116152	1	JN	SD	
14-Jul-15	HS1	23:30	2:24	2:54	23:38	2:21	2:43	105	6	0	SEED					0	116152	0	LG	JE	
15-Jul-15	HS2	0:49	2:17	1:28	0:55	2:15	1:20	0	1	78	SEED	16:45	695	77	522	26509	142661	0	BK	AB	
15-Jul-15	HS4	19:25	20:00	0:35	19:32	19:57	0:25	0	0	0	REPO					0	142661	0	JN	SD	
15-Jul-15	HS4	23:15	2:12	2:57	23:17	2:09	2:52	0	16	308	SEED					0	142661	2	JN	SD	
15-Jul-15	HS2	23:33	2:20	2:47	23:41	2:18	2:37	0	14	200	SEED					0	142661	0	BK	MWRT	
15-Jul-15	HS3	23:53	2:00	2:07	0:02	1:55	1:53	189	13	0	SEED					0	142661	0	MT	JZ	
16-Jul-15	HS5	0:14	2:21	2:07	0:19	2:19	2:00	81	4	0	SEED	9:58	270	47	508	13480	156141	1	JM	AB	
17-Jul-15	HS1	17:22	17:59	0:37	17:27	17:56	0:29	0	0	0	REPO					0	156141	0	LG	JE	
17-Jul-15	HS5	17:43	18:14	0:31	17:52	18:13	0:21	0	0	0	REPO					0	156141	0	JM	AB	
17-Jul-15	HS2	17:55	18:35	0:40	18:06	18:33	0:27	0	0	0	REPO	0:00	0	0	0	0	156141	0	BK	MWRT	
20-Jul-15	HS2	0:25	1:08	0:43	0:41	1:04	0:23	0	0	0	REPO					0	156141	0	BK		
20-Jul-15	HS5	0:26	0:48	0:22	0:32	0:47	0:15	0	0	0	REPO					0	156141	0	JM	AB	
20-Jul-15	HS1	0:35	1:05	0:30	0:45	1:01	0:16	0	0	0	REPO	0:00	0	0	0	0	156141	0	JF	JE	
20-Jul-15	HS2	12:51	13:33	0:42	13:02	13:30	0:28	0	0	0	MX					0	156141	0	BK	MWRT	
20-Jul-15	HS5	15:30	17:03	1:33	15:36	17:01	1:25	0	0	0	PATROL					0	156141	0	JM	AB	
20-Jul-15	HS2	17:54	18:35	0:41	18:02	18:31	0:29	0	0	0	MX					0	156141	0	BK	MWRT	
20-Jul-15	HS1	20:30	22:36	2:06	20:42	22:32	1:50	86	9	0	SEED					0	156141	1	LG	JE	
20-Jul-15	HS2	21:11	22:27	1:16	21:20	22:25	1:05	0	0	76	SEED					0	156141	0	BK	MWRT	
20-Jul-15	HS4	21:20	22:00	0:40	21:27	21:57	0:30	0	0	0	PATROL					0	156141	0	JN	SD	

21-Jul-15	HS4	2:50	4:58	2:08	2:58	4:55	1:57	0	7	172	SEED					0	156141	1	JN	SD	
21-Jul-15	HS3	2:51	5:37	2:46	3:02	5:33	2:31	110	15	0	SEED					0	156141	0	MT	JZ	
21-Jul-15	HS2	3:20	5:49	2:29	3:29	5:47	2:18	0	5	136	SEED	12:58	196	36	384	10099	166240	0	BK	MWRT	
21-Jul-15	HS2	20:16	23:21	3:05	20:26	23:19	2:53	0	18	155	SEED					0	166240	2	BK	MWRT	
21-Jul-15	HS5	20:55	0:14	3:19	20:59	0:11	3:12	304	20	0	SEED					0	166240	0	JM	AB	
21-Jul-15	HS4	22:35	2:18	3:43	22:43	2:15	3:32	0	23	314	SEED					0	166240	2	JN	SD	
21-Jul-15	HS1	23:24	2:58	3:34	23:35	2:56	3:21	273	24	0	SEED					0	166240	2	JG	JE	
21-Jul-15	HS3	23:56	1:49	1:53	0:07	1:46	1:39	276	15	0	SEED					0	166240	0	MT	JZ	
22-Jul-15	HS2	0:41	3:23	2:42	0:47	3:20	2:33	0	22	260	SEED					0	166240	0	BK	MWRT	
22-Jul-15	HS5	1:01	2:40	1:39	1:05	2:37	1:32	201	8	0	SEED					0	166240	0	JM	AB	
22-Jul-15	HS3	2:35	4:22	1:47	2:40	4:18	1:38	124	16	0	SEED					0	166240	1	MT	JZ	
22-Jul-15	HS5	3:52	5:25	1:33	3:57	5:24	1:27	60	7	0	SEED					0	166240	1	JM	AB	
22-Jul-15	HS3	5:26	6:14	0:48	5:34	6:10	0:36	0	0	0	REPO	23:15	1238	153	729	49188	215428	0	MT	JZ	
22-Jul-15	HS1	14:14	16:30	2:16	14:25	16:28	2:03	0	0	0	PATROL					0	215428	0	LG	JE	
22-Jul-15	HS1	16:47	19:54	3:07	16:54	19:51	2:57	299	16	0	SEED					0	215428	2	LG	JE	
22-Jul-15	HS2	16:53	19:55	3:02	17:04	19:52	2:48	0	22	284	SEED					0	215428	0	BK	MWRT	
22-Jul-15	HS5	17:23	20:23	3:00	17:29	20:20	2:51	289	17	0	SEED					0	215428	0	JM	AB	
22-Jul-15	HS4	17:25	20:17	2:52	17:32	20:12	2:40	0	17	77	SEED					0	215428	1	JN	SD	
22-Jul-15	HS3	19:35	21:01	1:26	19:43	20:57	1:14	0	0	0	PATROL					0	215428	0	MT	JZ	
22-Jul-15	HS1	21:54	23:17	1:23	21:57	23:14	1:17	226	7	0	SEED					0	215428	1	LG	JE	
22-Jul-15	HS4	21:55	23:26	1:31	22:00	23:25	1:25	0	4	80	SEED					0	215428	0	JN	SD	
22-Jul-15	HS5	22:54	23:13	0:19	22:59	23:09	0:10	0	0	0	PATROL	18:56	814	83	441	29624	245053	0	JM	AB	
23-Jul-15	HS2	19:42	22:12	2:30	19:49	22:10	2:21	0	11	216	SEED					0	245053	0	BK	MWRT	
23-Jul-15	HS5	19:43	22:45	3:02	19:48	22:44	2:56	194	17	0	SEED					0	245053	1	MT	AB	
23-Jul-15	HS4	23:15	0:16	1:01	23:20	0:13	0:53	0	2	56	SEED					0	245053	1	JN	SD	
23-Jul-15	HS3	23:15	0:18	1:03	23:22	0:14	0:52	100	5	0	SEED	7:36	294	35	272	11682	256734	0	MT	JF	
25-Jul-15	HS4	20:20	22:55	2:35	20:30	22:52	2:22	0	11	142	SEED					0	256734	2	JN	SD	
25-Jul-15	HS1	20:32	21:45	1:13	20:40	21:43	1:03	72	8	0	SEED					0	256734	0	LG	JE	
25-Jul-15	HS2	20:32	21:51	1:19	20:42	21:49	1:07	0	7	82	SEED	5:07	72	26	224	5794	262529	0	BK	MWRT	
26-Jul-15	HS5	20:12	22:27	2:15	20:14	22:25	2:11	157	12	0	SEED					0	262529	1	JM	AB	
26-Jul-15	HS2	20:13	22:38	2:25	20:21	22:36	2:15	0	8	192	SEED					0	262529	0	BK	MWRT	
26-Jul-15	HS4	22:10	22:36	0:26	22:18	22:32	0:14	0	0	0	PATROL	5:06	157	20	192	6529	269058	0	JN	SD	
28-Jul-15	HS5	17:30	17:52	0:22	17:37	17:51	0:14	0	0	0	PR					0	269058	0	JM	AB	
28-Jul-15	HS5	22:55	23:19	0:24	23:02	23:18	0:16	0	0	0	PR	0:00	0	0	0	0	269058	0	JM	AB	
29-Jul-15	HS4	18:32	19:10	0:38	18:45	19:08	0:23	0	0	0	REPO					0	269058	0	JN	SD	
29-Jul-15	HS1	20:42	23:22	2:40	20:51	23:18	2:27	108	7	0	SEED					0	269058	1	LG	JE	
29-Jul-15	HS2	20:47	23:29	2:42	20:55	23:28	2:33	0	5	180	SEED					0	269058	0	AB	MWRT	
29-Jul-15	HS4	20:55	23:10	2:15	21:03	23:05	2:02	0	12	194	SEED					0	269058	1	JN	SD	
29-Jul-15	HS3	21:13	22:56	1:43	21:20	22:54	1:34	280	13	0	SEED					0	269058	0	MT	JZ	
29-Jul-15	HS4	23:40	0:05	0:25	23:45	0:00	0:15	0	0	0	REPO					0	269058	0	JN	SD	
29-Jul-15	HS3	23:51	0:26	0:35	23:58	0:22	0:24	0	0	0	REPO	9:20	388	37	374	14068	283126	0	MT	JZ	
04-Aug-15	HS2	1:05	1:54	0:49	1:13	1:52	0:39	0	0	0	PATROL					0	283126	0	AB	MWRT	
04-Aug-15	HS5	1:03	2:00	0:57	1:07	1:58	0:51	0	0	0	PATROL					0	283126	0	JM	BK	
04-Aug-15	HS2	2:49	4:13	1:24	2:54	4:09	1:15	0	0	0	PATROL					0	283126	0	AB	MWRT	
04-Aug-15	HS5	2:50	4:11	1:21	2:55	4:09	1:14	4	2	0	SEED	4:31	4	2	0	380	283506	1	JM	BK	
04-Aug-15	HS5	21:21	0:15	2:54	21:24	0:13	2:49	302	24	0	SEED					0	283506	2	JM	BK	
04-Aug-15	HS2	21:57	0:46	2:49	22:05	0:44	2:39	0	22	224	SEED					0	283506	0	AB	MWRT	
04-Aug-15	HS3	22:44	1:26	2:42	22:53	1:23	2:30	156	21	0	SEED					0	283506	0	MT	JZ	
04-Aug-15	HS4	23:00	1:38	2:38	23:05	1:35	2:30	0	5	80	SEED	11:03	458	72	304	20577	304083	0	JN	SD	
05-Aug-15	HS2	18:29	21:43	3:14	18:36	21:40	3:04	0	24	338	SEED					0	304083	1	AB	JE	
05-Aug-15	HS1	18:33	21:03	2:30	18:43	21:01	2:18	294	15	0	SEED					0	304083	0	JF	MWRT	
05-Aug-15	HS5	19:13	23:28	4:15	19:15	23:25	4:10	202	42	0	SEED					0	304083	2	JM	BK	
05-Aug-15	HS4	19:20	22:50	3:30	19:28	22:46	3:18	0	24	266	SEED					0	304083	0	JN	SD	
05-Aug-15	HS3	19:55	23:53	3:58	20:04	23:48	3:44	278	30	0	SEED					0	304083	1	MT	JZ	
05-Aug-15	HS1	21:33	1:05	3:32	21:40	1:04	3:24	187	16	0	SEED					0	304083	3	JF	MWRT	
05-Aug-15	HS2	22:39	23:59	1:20	22:43	23:57	1:14	0	4	106	SEED	22:19	961	155	710	43910	347993	1	AB	JE	
06-Aug-15	HS2	17:32	18:10	0:38	17:43	18:07	0:24	0	0	0	PR					0	347993	0	AB	MWRT	
06-Aug-15	HS2	21:55	22:21	0:26	21:59	22:18	0:19	0	0	0	PR	0:00	0	0	0	0	347993	0	AB	MWRT	
10-Aug-15	HS3	2:19	3:52	1:33	2:28	3:48	1:20	17	2	0	SEED	1:33	17	2	0	640	348633	1	MT	JZ	
12-Aug-15	HS4	17:20	17:47	0:27	17:33	17:44	0:11	0	0	0	MX					0	348633	0	JN	SD	
12-Aug-15	HS3	17:45	18:11	0:26	17:54	18:09	0:15	0	0	0	PR					0	348633	0	MT	JZ	
12-Aug-15	HS3	22:42	23:06	0:24	22:49	23:01	0:12	0	0	0	PR	0:00	0	0	0	0	348633	0	MT	JZ	
13-Aug-15	HS2	17:24	18:03	0:39	17:33	18:00	0:27	0	0	0	MX	0:00	0	0	0	0	348633	0	BK	MWRT	
15-Aug-15	HS2	4:03	5:18	1:15	4:09	5:15	1:06	0	0	0	PATROL					0	348633	0	BK	MWRT	
15-Aug-15	HS3	4:08	5:11	1:03	4:14	5:06	0:52	0	4	0	SEED	2:18	0	4	0	600	349233	1	MT	SD	

18-Aug-15	HS4	17:15	17:43	0:28	17:24	17:40	0:16	0	0	0	PR					0	349233	0	JN	SD	
18-Aug-15	HS4	22:18	22:42	0:24	22:24	22:38	0:14	0	0	0	PR	0:00	0	0	0	0	349233	0	JN	SD	
23-Aug-15	HS1	15:22	17:00	1:38	15:35	16:55	1:20	0	0	0	CUR	0:00	0	0	0	0	349233	0	JT	JF	
24-Aug-15	HS1	15:00	16:39	1:39	15:15	16:35	1:20	0	0	0	CUR					0	349233	0	JT	JM	
24-Aug-15	HS5	17:18	17:38	0:20	17:22	17:37	0:15	0	0	0	PR					0	349233	0	JM	JE	
24-Aug-15	HS5	23:19	23:42	0:23	23:23	23:40	0:17	0	0	0	PR	0:00	0	0	0	0	349233	0	JM	JE	
25-Aug-15	HS4	23:13	23:38	0:25	23:20	23:33	0:13	0	0	0	MX	0:00	0	0	0	0	349233	0	JN	SD	
26-Aug-15	HS2	17:21	18:15	0:54	17:32	18:13	0:41	0	0	0	MX	0:00	0	0	0	0	349233	0	BK	AMB	
09-Sep-15	HS3	17:33	18:23	0:50	17:54	18:18	0:24	0	0	0	MX	0:00	0	0	0	0	349233	0	MT		

APPENDIX E – FORMS

Weather Forecast Worksheet



Today's CDC

X

Synopsis:

Forecast:

Day 2 Outlook CDC: X

Model Sounding XXX XXZ

Freezing Level:	kft
- 5˚C Level:	kft
-10˚C Level:	kft
Equilibrium Level:	kft
Tropopause:	kft
Cloud Base Height:	kft
Cloud Base Temp:	˚C
Cell Motion: @	kts
Storm Motion: @	kts
Temp Max:	˚C
Dew Point:	˚C
Convective Temp:	˚C
CAPE:	J/Kg
CIN:	J/Kg
Lifted Index:	
Showalter Index:	
Total Totals:	
Precipitable Water:	inches
WINDEX:	mph

Hailcast Model Output

CALGARY:

RED DEER:

- ☐ Jet PVA
- ☐ Short Wave Trof
- ☐ Lee Cyclogenesis
- ☐ Directional Wind Shear
- ☐ Speed Shear
- ☐ PM Radiative Cooling
- ☐ AM ACC or Cloud Streets
- ☐ NE/SE Moisture Advection
- ☐ Cooling at 500mb
- ☐ Warming at 500mb
- ☐ Dry Line or Dry Slot
- ☐ Smoke/Haze
- ☐ Morning Fog
- ☐ Gusty SFC Winds
- ☐ Loaded Gun
- ☐ Theta E Ridge
- ☐ Chinook
- ☐ Cloud Cover
- ☐ Insolation (sfc heating)
- ☐ Latent Instability
- ☐ Frontal Lift
- ☐ Upslope Flow
- ☐ Low Ceilings
- ☐ Flood Potential

Verification

Observed CDC:	
Max TITAN cell top:	km
Max reflectivity:	dBz
Max VIL:	kg/m^2
YYC:	
YQF:	
Radar:	
Hail Reports:	

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).

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250mb Jet Level Winds	500mb Heights & Vorticity
CLICK HERE TO UPLOAD IMAGE	CLICK HERE TO UPLOAD IMAGE
850mb Theta E / Winds	**Surface Analysis**
CLICK HERE TO UPLOAD IMAGE	CLICK HERE TO UPLOAD IMAGE

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WRF Model Sounding
CLICK HERE TO UPLOAD IMAGE

3

WMI Radar Observer Log

WMI Radar Log
2015 AHSP
Olds-Didsbury Radar Operations Centre

Date (UTC): ______________________

Operator(s): ______________________

Page: ______ of ______

TIME hh:mm (UTC)	Radar Summary PPINE, stratus, TITAN cell etc	Remarks, Action, Decision	Carvel Radar*	Strathmore Radar*

*provide Environment Canada radar summary when Olds-Didsbury radar shows no echoes.

WMI Seeding Aircraft Flight Log

WMI CLOUD SEEDING FLIGHT LOG				Hobbs Off		Engines Off		Landing		ZULU DEPARTURE DATE	
PROJECT	PROJECT NAME	Mission Type:	TYPE	Hobbs On		Engines On		Takeoff			
REV. 06-03-2015		Departure Airport		Total Hobbs	0.00	Total Engine		Flight Time		Page #	1
Pilot:		Copilot:		N-Number:	#	HS #:	NA				

Time (UTC)	Event No.	Lat. (deg & min)	Long. (deg & min)	Alt. (kft)	Generators On	Generators Off	Flares Ejectable	Flares BIP	Track	Remarks and Observations

RH GEN			Page Total:	0	0	Flight Summary:
LH GEN			Total Seeding Attempted:			
TOTAL			Less Misfires:			
			Total Flares Used:	0	0	

Mission Type Categories :						
	Seeding	SEED	Reposition	REPO	Maintenance	MX
	Recon	RECON	Publicity	PR	Ferry	FER
	Patrol	PAT	Currency	CUR		

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 four HAILSTOP aircraft presently used on the project, two 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

WEATHER MODIFICATION
INCORPORATED

Alberta Hail Suppression Project (AHSP)

2015 Ground School – Thursday May 28th 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 of Meteorology
09:00	Introduction from the Insurance Industry Todd Klapak, Alberta Severe Weather Management Society Board Director
09:15	History of the Alberta Hail Suppression Program Terry Krauss
10:00	Break
10:15	Hail Program Overview and Status of Hail Suppression Concepts Bruce Boe
10:45	Overview of 1996-2014 Alberta Operations Brad Waller, WMI Project Meteorologist
11:30	Severe Weather Forecasting & Daily Forecast Sheet Dan Gilbert, WMI Chief Meteorologist
12:00	Lunch (On-Site – AHSP Provided)
12:45	ATC Controlling Procedures YYC TCU Edmonton Control Center (TBA) YBW Springbank Tower (TBA)

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

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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	Alberta Project Radar - Overview, TITAN, Interpretation of web images, VIL, CDC	
		Dan Gilbert
15:45	Daily Routines & Procedures	
		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.

WEATHER MODIFICATION
INCORPORATED

Alberta Hail Suppression Project (AHSP)

2015 Ground School – Friday May 29th Calgary, Alberta

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

09:30	Field Personnel Pictures
09:50	Presentation of 2014 Photography Contest Awards
10:00	WMI Representation and Professionalism WMI Job Responsibilities/ Duties Jody Fischer, WMI Chief Pilot & Canada Project Manager Bruce Boe, WMI Director of 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.

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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: AgI0.85AgCl0.15NaCl

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_4I	144.94	93.9	0.21	n/a
Paradichloro-benzene	$C_6H_4Cl_2$	147.00	19.0	0.042	n/a
Sodium Perchlorate, 99%	$NaClO_4$	140.48	181.8	0.40	n/a
Water	H_2O	17.99	607.7 or less	1.34	0.202
Acetone	$(CH_3)_2CO$	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

June 2015

2015 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	0.75	11.5	13.6	16.7	10.3	3.6	35.2	23	7.5	19.5	494	54.1	-2	-1.9	295	11	295	5	119	7	280	17	237	63	0
2-Jun	0	0.86	9.7	12.9	15.8	7.5	5.8	18.4	19	8.5	16	160	49.7	0	0.6	140	16	180	10	162	25	91	10	199	32	-1
3-Jun	1	0.76	9.7	12.7	15.5	7.7	5.1	31.0	15	8.5	16.5	285	53	-1	-1	196	11	206	7	203	13	176	10	106	30	1
4-Jun	2	0.72	9.8	12	14.7	7.7	6.5	32.3	20	10	18.9	1135	57.8	-4	-3.7	168	14	197	11	172	14	174	18	165	18	2
5-Jun	0	0.69	11.3	13.7	16.4	9.8	4.3	27.4	22	8	21	381	53.9	-2	-1.8	304	16	341	10	306	11	304	17	350	55	0
6-Jun	-1	0.75	12.3	14.7	17.4	11.2	3.1	35.5	25	7.5	24	297	53.2	-2	-1.6	322	23	354	16	306	12	326	31	332	77	-1
7-Jun	-2	0.94	13.0	16.7	19.6	12.2	2.2	15.7	27	7	27	21	47.1	1	1.4	305	30	335	20	289	18	313	38	316	48	-3
8-Jun	-1	0.96	12.3	15.1	18.8	10.5	5	31.2	27	10	27	267	50.1	-1	-0.5	277	45	315	28	281	23	282	62	288	69	-1
9-Jun	-1	0.86	12.1	14.4	17.2	10.8	3.3	27.0	24	7	24	254	52.6	-1	-1.3	270	26	303	19	258	7	279	45	270	83	0
10-Jun	3	0.75	12.1	14.2	16.7	10.2	5.4	35.7	24.5	9	24.5	1039	57.9	-5	-4.4	296	19	324	9	256	7	304	20	315	39	3
11-Jun	2	0.86	11.7	13.9	16.5	10.2	4.0	32.8	25	9	25	608	53.3	-3.0	-1.3	249	29	280	21	232	15	255	42	262	74	4
12-Jun	1	0.52	8.5	10.3	12.7	8.1	1.3	26.6	14	4	14	492	58.5	-3	-2.5	293	19	315	11	328	17	266	21	264	39	1
13-Jun	0	0.60	8.8	10.9	13.5	8.1	2	29.9	15	5	15	513	56.4	-2	-1.6	311	16	345	11	318	11	312	18	284	20	0
14-Jun	0	0.57	8.8	10.6	13.2	8.5	1.1	23.9	15	4	13.7	265	55.4	-1	-0.9	331	15	354	10	360	13	320	19	292	20	0
15-Jun	1	0.56	9.9	11.9	14.2	9.1	2.2	28.6	18	5.5	16	460	56.2	-3	-2	290	14	316	10	276	6	294	23	279	57	0
16-Jun	2	0.56	10.4	12.2	14.3	9.3	2.6	32.7	22	6	21.4	640	57.2	-3	-2.7	289	24	318	14	290	15	292	27	280	39	2
17-Jun	1	0.79	9.5	12.4	15.0	5.5	8.5	26.7	13.5	10	11.8	332	51.9	-1	-0.4	288	10	293	8	270	8	266	17	250	43	-1
18-Jun	2	0.81	11	13.5	16.2	8.5	6.1	32.7	20	9	18.9	657	55	-3	-2.6	280	23	298	13	265	15	276	24	272	56	2
19-Jun	3	0.76	10.2	12.6	15.4	6.1	9.1	34.8	17	13	18.2	947	52.5	-3.0	-0.9	285	19	299	11	293	18	260	20	211	27	2
20-Jun	2	0.59	10.2	12.1	14.3	9.9	1	28.1	19	5	18.5	390	56.7	-3	-2.3	256	26	290	17	223	10	265	35	270	49	2
21-Jun	0	0.60	9.1	10.7	13.2	8.1	2.8	28.6	19	6.5	16.5	594	58.3	-3.0	-3.1	329	16	1	9	297	10	308	17	296	41	2
22-Jun	1	0.65	11.1	12.9	15.1	11	0.2	31.8	24	6	23	595	54.8	-2.0	-1.7	297	22	327	12	273	10	304	23	289	47	2
23-Jun	2	0.79	10.8	12.9	15.3	9.3	4.3	34.9	23	9	22.7	1034	56.8	-3	-3.1	231	6	265	5	259	12	249	16	253	18	2
24-Jun	1	0.69	12.6	14.3	16.7	11.6	3.0	35.7	25	7	22.4	633	57.8	-4	-4	283	11	299	8	248	7	273	12	279	37	1
25-Jun	-1	0.77	13.3	15.5	18.0	11.9	4.1	34.5	27	8.5	25.3	644	56.1	-3	-3.5	295	25	328	16	278	15	306	30	307	84	-1
26-Jun	-1	0.78	15.2	17.5	19.6	11.9	5.6	38.2	29	10.5	30.3	551	52.3	-2	-1.8	299	26	323	15	269	19	300	27	300	65	-1
27-Jun	-3	0.95	15.7	17.8	19.8	12.3	7.4	40.2	30.5	13	33.3	1270	54.0	-4.0	-2.9	295	19	310	11	292	14	279	26	268	40	-3
28-Jun	3	1.04	15.0	17	19.1	11.3	9.3	40.9	31	13	31.6	1538	60.4	-7	-6.6	284	22	327	14	289	7	292	32	297	64	-3
29-Jun	2	1.35	14.7	17.9	21.2	9.6	10.5	41.0	27	14	28.4	382	49	-2	-1	240	40	268	22	214	23	256	43	245	35	2
30-Jun	2	1.05	13.8	17.1	19.7	8.5	10.4	36.8	24	12.5	24.4	737	49.8	-2	-1.5	294	24	321	15	295	17	291	25	268	53	4

July 2015

2015 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-Jul	1	0.96	12.1	15	17.8	8.1	8.8	30.4	21.5	12	21.6	524	51.5	-3	-1.3	332	14	4	12	325	19	338	14	320	60	-1
2-Jul	0	0.97	13.5	16.3	19.5	9.2	9.4	38.2	26	13	26.6	607	49.7	-2	-0.9	298	13	332	6	283	8	325	12	348	13	0
3-Jul	4	0.94	13.5	16	18.9	9.5	9.6	40.3	28	13	29.3	1362	53.6	-4	-2.9	290	17	317	12	291	11	273	27	274	41	4
4-Jul	3	0.83	11.1	13.7	16.2	9.3	5.1	25.1	22	8.5	20.7	373	54.1	-3.0	-1.9	274	24	317	21	344	9	285	46	279	79	2
5-Jul	-1	0.61	9.8	12.0	15.3	8.7	3.5	27.9	18.5	6.5	17.6	355	53.5	-1	-0.8	330	17	18	11	348	17	343	15	318	27	-1
6-Jul	2	0.84	11.6	14.0	16.5	9.2	5.8	31.4	24	11	23.9	562	55.7	-3	-3	306	28	331	15	293	9	297	26	293	55	1
7-Jul	-2	0.68	11.4	13.8	16.5	9.1	5.2	33.8	21.5	9	22.1	607	52.8	-2	-1	331	33	359	16	327	15	330	31	313	45	-2
8-Jul	-3	0.83	13.7	16.4	19.1	12.3	3.1	33.7	29	8	29.3	189	51.3	-1	-0.9	305	19	338	8	256	10	329	16	16	28	-3
9-Jul	-2	0.91	15	17.7	19.9	13.2	3.4	40.0	31	9	31.9	465	50.7	-1	-0.6	255	10	283	7	233	6	281	20	260	26	1
10-Jul	3	1.21	14	16.5	19.0	9.7	10.6	41.8	29.5	15	30.2	2249	55.7	-6	-4.1	177	18	197	11	159	13	184	20	251	21	0
11-Jul	2	1.17	13.7	16.4	19.5	8.9	12	41.7	29	16	29.1	2253	54.6	-6	-4.0	151	8	169	2	134	5	194	2	230	25	4
12-Jul	4	1.24	13.4	16.4	19.4	7.3	12.3	40.1	24	15.5	24.1	1201	49.7	-3	-1.5	291	10	318	8	302	13	278	13	155	28	3
13-Jul	2	0.96	12.2	15	17.8	8.7	7.9	35.3	22.5	11	22.5	665	53.1	-3	-2.3	260	13	271	8	254	9	238	15	175	37	2
14-Jul	3	0.91	11.5	14.1	16.8	8.5	7.3	35.2	22	10.5	22.3	842	54.3	-3	-2.6	285	11	293	6	300	9	256	14	233	31	3
15-Jul	3	0.88	11.6	14.1	16.7	9	6.8	35.8	24.5	13	24.3	1036	54.4	-4	-2.3	260	22	284	13	215	9	260	27	248	42	2
16-Jul	1	0.54	9.3	11.2	13.3	9.4	-0.4	27.2	17	3	16.8	422	57	-2	-2	309	23	338	15	315	18	309	24	283	22	2
17-Jul	0	1.02	10.5	13.6	16.9	5.7	10.1	34.7	18	12.5	16.7	378	49.4	-1	0	10	38	37	29	16	40	13	41	347	14	1
18-Jul	-1	1.18	13	16.9	20.1	9.6	6.7	16.3	26	10	26.3	48	45.2	2	1.6	319	31	341	24	313	31	307	39	327	46	-1
19-Jul	0	1.00	13	16.2	19.0	9.1	7.3	26.1	23.5	10.5	22.6	116	48.4	-1	0.2	309	26	334	16	273	18	308	32	298	34	1
20-Jul	3	1.10	12.8	15.5	18.3	9.4	8.8	37.3	26	13	24.2	1642	54.1	-5.0	-2.8	240	12	277	11	235	12	261	20	260	32	2
21-Jul	4	1.03	12.2	15.2	17.7	7.8	10.9	39.2	25	14	24.5	2089	56	-6	-4.4	246	30	260	17	217	14	231	38	216	56	5
22-Jul	4	0.70	10.8	13	15.1	7.6	8.8	32.3	20	10.5	18.4	1916	64.3	-8.0	-8.2	226	25	252	20	236	16	223	39	225	62	5
23-Jul	2	0.84	11.4	13.4	15.9	9.7	5.0	33.2	23	9	22.9	1145	57.1	-5	-3.6	246	18	286	12	229	7	266	27	250	39	4
24-Jul	1	0.87	11.9	14.6	17.3	10.3	4.1	33.9	25.5	9	25.8	441	52.7	-2	-1.3	252	23	275	15	210	17	266	27	237	49	-1
25-Jul	2	0.80	11.2	13.8	16.3	9.7	3.8	30.4	22	8	22.6	456	52.9	-2	-1.1	252	33	264	20	222	18	220	32	255	78	2
26-Jul	3	0.76	9.6	12.3	15.1	7.2	7.1	29.2	18	10	16.7	687	55.5	-4	-2.3	230	16	259	12	227	10	230	25	235	55	3
27-Jul	1	0.75	9.4	12.2	14.9	7.7	4.9	24.0	17	8	17.3	304	53.2	-2	-0.6	358	7	331	4	17	13	270	4	201	83	0
28-Jul	0	0.82	11	13.6	16.1	9.8	3.5	28.2	22	8	20.9	259	52.5	-2.0	-0.6	319	22	344	13	295	12	317	25	285	18	1
29-Jul	3	0.87	10.2	12.8	15.6	7.4	8.0	34.8	21	12	18.3	1076	55.7	-4.0	-3	291	29	314	18	284	24	280	31	274	43	3
30-Jul	-2	0.87	12.1	14.5	17.2	13.1	-2.1	17.9	24	8.5	26.3	19	48.5	0	1.2	287	35	320	20	272	21	293	41	285	61	-2
31-Jul	-1	0.74	13.4	15.5	18.0	13.2	0.3	34.4	29.5	7	30.2	299	51.5	-2	-0.5	276	26	310	16	262	16	291	36	287	42	-1

August 2015

2015 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-Aug	2	1.08	12.7	15.2	18.0	8	9.3	36.1	24	13	23.7	761	52.1	-3	-2	282	34	321	19	289	20	291	39	290	59	1
2-Aug	-1	0.97	13.4	15.9	18.5	9.8	7.7	38.7	26.5	12.5	28.3	788	52.7	-3	-2.2	282	26	307	13	276	9	289	30	285	51	-1
3-Aug	2	1.06	14.2	16.7	19.2	12.4	4.5	40.5	30.5	11	30.4	896	53.8	-3	-2.3	245	20	274	13	193	11	260	33	250	52	1
4-Aug	2	1.02	12.3	15.1	17.9	8.8	8.6	39.9	24	11.5	22.1	929	54.6	-3	-3.5	246	18	271	12	261	9	235	26	211	46	3
5-Aug	4	0.73	11	13.3	15.7	7.0	8.7	32.0	19	11	19.2	938	55.9	-4.0	-3.3	238	24	266	16	239	13	235	31	228	55	4
6-Aug	1	0.74	9.1	12	14.7	5.7	7.2	28.9	17	7	13.2	283	52.7	-1	-0.5	328	7	14	5	319	11	2	6	147	8	1
7-Aug	-2	0.86	11.6	14.4	17.0	8.2	6.8	31.8	22	10.5	22.2	385	51.5	-2.0	-0.9	305	20	337	13	308	18	308	21	301	42	-1
8-Aug	-1	0.80	12.7	15.1	17.6	9.9	5.4	36.0	25.5	10.5	26.6	415	51.4	-2	-0.7	265	15	268	7	210	8	259	14	263	25	-1
9-Aug	1	0.81	13.6	15.3	17.6	13.0	1.6	37.7	29	7	26.2	1013	56.7	-4	-3.3	255	20	275	14	243	14	243	25	233	32	2
10-Aug	2	0.91	13.4	15.7	18.2	12.1	3.8	38.3	29	9	28.3	1034	54.5	-3	-2.4	246	24	262	13	189	13	258	28	222	33	1
11-Aug	1	0.91	14	16.2	18.8	12.1	4.6	37.3	29	10	29.7	957	54.3	-3	-2.6	261	26	293	14	254	13	267	32	255	53	-1
12-Aug	-2	0.67	14.3	16.4	18.5	14.5	-0.3	33.3	31	6	31.8	511	53.7	-3.0	-1.6	266	24	300	16	269	11	273	31	254	46	-2
13-Aug	2	0.88	14.1	16.2	18.2	13.5	1.9	36.0	31	10	32.8	672	55.6	-4	-2.7	236	26	278	21	237	21	252	39	261	75	-1
14-Aug	1	1.11	14.1	16.4	18.6	13.5	1.4	35.4	23	10	29.1	478	47.7	-3	0.7	221	33	246	19	202	19	225	47	223	74	1
15-Aug	0	0.85	8.5	13.3	16.2	3.9	9.8	10.6	13	8	11	99	43.5	3	4.9	280	11	320	7	286	10	274	11	241	29	0
16-Aug	-1	0.73	9.3	12.4	14.8	6.5	6.5	29.3	15	8.5	14.6	311	52.9	-1.0	-0.4	318	8	348	8	347	9	317	14	305	32	0
17-Aug	2	0.74	10	12.3	14.7	8.5	4.4	31.0	20.5	9	20.4	510	55.6	-3.0	-2	309	24	329	13	296	9	290	25	336	69	1
18-Aug	-3	0.58	10.2	13.1	16.6	8.9	3.7	16.1	19.5	7	19.2	92	44.7	3	3.4	343	16	24	20	339	16	358	37	350	87	-2
19-Aug	-1	0.73	11.8	14.3	17.7	10.7	3.3	25.7	26	8.5	26.1	156	48.2	-1	1.3	296	28	313	20	273	14	284	42	287	57	0
20-Aug	0	1.01	11.9	14.5	17.5	8.8	6.5	27.0	22	10	21.7	268	50.7	-1.0	-0.7	271	32	305	20	245	14	287	46	282	72	1
21-Aug	0	0.69	6.4	10.6	13.9	4.1	5.2	8.7	8	7	8.3	73	41.1	5.0	7.8	36	8	32	3	26	21	195	16	229	48	0
22-Aug	-3	0.39	10.3	13	16.1	11.1	-1.5	14.4	17	3	21.1	0	41.1	5	6.2	310	26	339	17	298	19	315	32	310	65	-3
23-Aug	-3	0.55	12	14.9	17.6	10.6	3	25.9	23	9	26.2	0	47.2	1	2	273	21	292	15	265	14	270	32	273	59	-2
24-Aug	-1	0.81	12.5	14.9	17.2	11.6	2	34.4	25	12	26.9	388	52.8	-3	-1.3	259	19	269	13	229	14	245	30	256	53	-2
25-Aug	0	0.84	12.5	14.3	16.7	12	1.1	31.0	24	11.5	28.1	479	54.7	-3	-2.4	247	16	269	12	226	17	252	26	257	62	-1
26-Aug	1	0.92	13.0	15.1	17.4	10.7	5.5	36.9	24	12	27.1	1003	56.6	-5	-4.4	276	25	300	15	275	13	275	33	270	77	-2
27-Aug	1	0.86	12.8	14.9	17.0	11.7	2.7	35.2	26	8	28.4	565	55.6	-3	-2.8	273	26	299	16	266	13	271	33	259	49	-3
28-Aug	-2	1.01	11.8	14.9	17.8	10.7	2.5	15.4	24	7.5	25.1	6	47.8	1	1.4	243	32	270	21	219	23	250	34	242	59	-2
29-Aug	0	0.87	13.0	15.3	18.1	11.9	2.5	22.9	26	8.5	27.1	133	50.6	-1	-0.3	229	49	254	36	216	35	230	65	216	68	-2
30-Aug	2	0.71	9.7	12.1	14.8	8.9	2.3	29.0	21	6.1	21	474	52.4	-2	-0.1	223	23	256	18	232	10	223	35	215	61	1
31-Aug	-3	0.68	10.1	12.9	15.9	9.8	0.4	12.9	20	4.3	20.5	3	48.4	1	2.0	263	28	285	21	243	13	260	42	254	78	-3

September 2015

2015 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-Sep	-2	0.67	9.9	12.1	15.0	9.9	0.0	15.7	20.5	4	20.6	54	48.6	1	1.9	248	32	267	24	210	14	242	51	252	79	-1
2-Sep	1	0.77	9.2	11.5	14.2	7.3	5	25.8	19	8	18.8	526	54.6	-3.0	-1.3	226	34	253	23	208	9	221	46	224	100	0
3-Sep	-1	0.62	7.8	10.4	13.1	6.3	4	22.6	13.7	5.3	13.7	295	54.4	-2	-0.1	190	15	233	15	149	11	222	27	214	114	0
4-Sep	-2	0.54	7.4	10.3	13.0	4.8	4.9	8.8	7.5	5.5	7.8	1	50.4	2	2.5	189	14	228	14	106	4	198	30	206	90	-2
5-Sep	-2	0.70	6.3	10.0	13.8	3.8	5.3	8.5	7.7	6.2	7.9	36	40.7	7.0	8.1	89	17	139	11	79	15	126	20	177	47	-2
6-Sep	-1	0.59	7.2	10	12.6	5.6	3.7	18.0	9.5	5.5	10.2	116	52.5	0.0	1.4	312	32	340	22	318	26	304	40	324	15	-1
7-Sep	-1	0.56	8.5	10.2	12.7	8.5	0.0	19.2	14.5	3	14.8	181	54	-1.0	0.1	319	26	350	15	298	21	321	27	343	24	0
8-Sep	0	0.74	9.1	11.7	14.3	7.8	2.7	21.5	16	6.5	16.7	114	53.8	-1.0	-0.5	292	26	321	20	288	18	290	33	292	89	-1
9-Sep	1	0.78	10.2	12.9	15.5	7.8	5.5	24.3	18	8	17.5	279	53.7	-2	-1.3	303	23	325	14	293	18	303	24	315	73	0
10-Sep	-1	0.75	9.9	14.6	17.9	6.4	6.5	13.0	17.5	10	17.5	70	39.8	4	6.1	320	22	355	18	329	24	324	30	335	69	-1
11-Sep	-3	0.56	15.2	17.4	19.9	14	2.5	40.6	23.9	8.2	34.2	0	44.8	2	2.5	306	18	329	12	302	17	311	22	261	30	-3
12-Sep	-1	0.98	12	14.9	17.7	10.9	2.7	22.6	27	9.5	28	78	49.6	0.0	-0.2	272	31	310	22	269	16	277	49	279	96	-1
13-Sep	0	0.58	7.9	10.5	13.0	6.7	3.3	21.9	14	5.5	13.9	215	54.7	-1	-0.4	284	21	303	17	290	11	264	34	262	95	0
14-Sep	-1	0.62	6.6	9.5	12.8	5.3	3.8	11.5	9	5	7.5	78	44.6	5	5.2	250	13	270	18	225	5	237	36	241	103	-1
15-Sep	-1	0.42	7.6	9.8	11.9	7.9	-0.8	16.3	13.2	2.4	13.2	151	44.8	4.0	5.1	260	16	286	16	299	19	246	28	234	65	-1
Average	0.5	0.8	11.4	13.9	16.6	9.3	4.8	29.5	21.9	8.9	22.0	551.6	52.5	-1.8	-1.0	267.2	21.7	276.9	14.4	252.7	14.3	265.1	28.0	261.6	51.2	0.3
StdDev	1.9	0.2	2.1	2.1	2.1	2.3	3.1	8.5	5.5	2.9	6.1	481.1	4.3	2.5	2.6	55.5	8.3	79.9	5.7	65.7	6.1	55.9	11.6	51.1	22.6	2.0
Maximum	4.0	1.4	15.7	17.9	21.2	14.5	12.3	41.8	31.0	16.0	34.2	2253	64.3	7.0	8.1	358	49	359	36	360	40	358	65	350	114	5
Minimum	-3	0.4	6.3	9.5	11.9	3.8	-2.1	8.5	7.5	2.4	7.5	0	39.8	-8.0	-8.2	10	6	1	2	16	4	2	2	16	8	-3

APPENDIX J – PROJECT PERSONNEL AND TELEPHONE LIST

ALBERTA HAIL SUPPRESSION PROJECT 2015			
			Last Revised 9 June, 2015
ALBERTA SEVERE WEATHER MANAGEMENT SOCIETY (ASWMS) - CALGARY, ALBERTA			
TODD KLAPAK	ASWMS Board President #1300-321 6th Ave. SW Calgary, AB T2P 0P6	Office: 403-231-1357 Fax: 403-233-2815	todd.klapak@intact.net
CATHERINE JANSSEN	ASWMS Secretary-Treasurer		janssenc@telus.net
TERRY KRAUSS	ASWMS Program Director President, Krauss Weather Services, Inc. 79 Irving Crescent, Red Deer, AB T4R 3S3	Cell: 403-318-0400	twkrauss@gmail.com
WEATHER MODIFICATION, INC. (WMI) - FARGO, NORTH DAKOTA		**PHONE: 701-235-5500 FAX: 701-235-9717**	
BRUCE BOE	Vice President - Meteorology 3802 20th Street North, Fargo, ND 58102	Office: 701-673-3354	bboe@weathermodification.com
HANS AHLNESS	Vice President - Operations Weather Modification, Inc.	Direct Office: 701-373-8834	hahlness@weathermodification.com
ERIN FISCHER	Admin Support Weather Modification, Inc.	Direct Office: 701-373-8829	efischer@weathermodification.com
DENNIS AFSETH	Director of Electronics Weather Modification, Inc.	Office: 701-235-5500 ext 190/193	dafseth@weathermodification.com
TODD SCHULZ	Electronics Technician Weather Modification, Inc.	Office: 701-235-5500 ext.191	tm_schulz@yahoo.com
MIKE CLANCY	Director of Maintenance Weather Modification Inc.	Direct Office: 701-373-8841	mclancy@fargojet.com
RANDY JENSON	CFO Weather Modification, Inc.	Office: 701-235-5500 ext. 103	rjenson@weathermodification.com
PATRICK SWEENEY	President/CEO Weather Modification, Inc.	Office: 701-235-5500 ext.107	pat@weathermodification.com
JAMES SWEENEY	Vice President Weather Modification, Inc.	Office: 701-235-5500 ext.102	jim@weathermodification.com
RADAR OPERATIONS CENTER - OLDS-DIDSBURY AIRPORT, ALBERTA			
RADAR FAX: 403-335-8359 RADAR PHONE: 403-335-8359 ADDRESS: 1436, 320 Bergen Rd., Hangar 4, Didsbury, Alberta T0M 0W0 SHIPPING VIA FedEx/UPS: Weather Modification Inc. Olds-Didsbury Airport, Hangar 4, 1436 Twp Rd 320, Didsbury, AB T0M 0W0 EMAIL: olds@weathermodification.com			
DAN GILBERT	Lead Meteorologist Weather Modification, Inc.		dgilbert@weathermodification.com
BRAD WALLER	Field Meteorologist Weather Modification, Inc.		bwaller@weathermodification.com
ADAM BRAINARD	Field Meteorologist Weather Modification, Inc.		brainard92@tamu.edu
PILOT OFFICE - SPRINGBANK, ALBERTA			
PILOT OFFICE: 403-247-0001 ADDRESS: Springbank Aero Services, Inc. 208A Avro Lane, Calgary, Alberta T3Z 3S5 EMAIL: calgary@weathermodification.com			
JODY FISCHER	Project Operations Manager		jfischer@weathermodification.com
LEE GOODYEAR	Captain Weather Modification, Inc. HS1 - N904DK		leegoodyear.yeg@icloud.com
JACOB EEUWES	Co-Pilot Weather Modification, Inc. HS1 - N904DK		jeeuwes@hotmail.com
BRIAN KINDRAT	Captain Weather Modification, Inc. HS2 - N457DM		briankindrat@gmail.com
MATTHEW THOMSON	Co-Pilot Weather Modification, Inc. HS2 - N457DM		mwrt@live.com
JACOB MITCHEM	Captain Weather Modification, Inc. HS5 - N518TS		jrmitchem2k3@gmail.com
ANDREW BRICE	Co-Pilot C90, Cap. C340 Weather Modification, Inc. HS5 - N518TS, HS2 - N457DM		andrewbrice89@gmail.com

PILOT OFFICE - RED DEER, ALBERTA			
PILOT OFFICE: 403-886-7857 ADDRESS: Hangar #2 Red Deer Ind Airport, Penhold, Alberta, T0M 1R0 EMAIL: reddeer@weathermodification.com			
MIKE TORRIS	Captain Weather Modification, Inc. HS3 - N522JP		metorris@gmail.com
JOEL ZIMMER	Co-Pilot Weather Modification, Inc. HS3 - N522JP		pro_pilotage@hotmail.com
JENELLE NEWMAN	Captain Weather Modification, Inc HS4 - N37356		jenelle401@hotmail.com
STEVE DIMITROV	Co-Pilot Weather Modification, Inc HS4 - N37356		steved496@gmail.com
ADDITIONAL SUPPORT SERVICES			
SPRINGBANK FUEL TRUCK afterhours		Phone: 403-466-8834	
AIR SPRAY - PERRY DANCAUSE	Director of Flight Ops and Administration	Phone: 403-886-4088 Ext.102 Fax: 403-886-2650	
ATC EDMONTON OSS	Notification to Launch Aircraft	Phone: 888-882-2254	
ATC SHIFT MANAGER EDMONTON		Phone: 780-890-8397 Fax: 780-890-4710	
ATC CALGARY TERMINAL SUPERVISOR		Phone: 780-890-4711	
ATC CALGARY TOWER		Phone: 403-216-7121 Fax: 403-216-7122	
YYC INTERNATIONAL AIRPORT	Duty Manager Desk	Phone: 403-735-1200	
STORMWATCH HOTLINE	Severe Weather Desk: 800.239.0484	Phone: 800-66-STORM (800-667-8676)	
RED DEER AIRPORT FLIGHT SERVICE		Phone: 403-886-4547	
SKY WINGS (DENNIS COOPER)	Red Deer Fuel (JET-A)	Phone: 403-886-5191	
HILLMAN AIR LTD (GARY HILLMAN)	Red Deer Fuel (100LL)	Phone: 403-886-4187 Cell: 403-597-4187	
BARRY ROBINSON	Radar Technician	Cell: 403-877-5853, #2: 403-886-2137	
NOT FOR PUBLIC RELEASE			

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 18, 2016
Proposed starting date: June 1st, 2016
Expected duration: September 15th, 2016

Province and area to be affected: Central Alberta, covering the Red Deer to Calgary regions (see attached map showing project area which has remained 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 Inc. (WMI)
http://www.weathermodification.com/
Parent Organization: Weather Modification Inc. (WMI)
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, Inc. 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., 13 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, 42 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, Inc.

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 locations(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
Old-Didsbury Airport, Highway 2A
Olds, AB T4H 1A1

tel. & fax. 403-335-8359,
e-mail: dgilbert@weathermodifcation.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

Memberships and Honors

- Meteorologist Distinguished Service Award, 2013, Weather Modification Association
- Member, Weather Modification Association (certified operator #78)
- Member, American Meteorological Society
- Iowa Central Community College Honor Society, inducted April 27, 2000
- Wilbur E Brewer Professionalism Award, 2007 North Dakota Cloud Modification Project

Field Address:	Olds-Didsbury Airport, Highway 2A, Olds, AB
Field Telephone no.	403-335-8359
Field personnel:	full time = 3
	part time = 14

Daily records of activities: Custodian = Ms. Erin Fischer
WMI Project Operations Centre
Olds-Didsbury Airport, Highway 2A, AB T4H 1A1

All records are maintained June 1st -Sept. 15th annually.

- daily weather synopsis and forecast report
- radar echo storm data report and maps
- daily operations summary report
- chemical inventory report
- equipment status report
- aircraft flight track maps
- flight log report
- project aircraft maintenance report

PART 6. GENERAL INFORMATION CONCERNING PROPOSED ACTIVITY

Reasons for organization seeking modified weather: The hailstorm on Sept. 7, 1991 caused >$400 million damage in the City of Calgary alone. Hailstorms in the City of Calgary caused >$500 Million in 2010 and again in 2012. In addition, hailstorms have caused >$100 Million damage to crops annually since 2007 and the damage to crops was >$400 Million in 2012. Hailstorms have now become a billion dollar problem to the economy of Alberta. The 20 largest insurance companies and their affiliates have banded together to conduct hail suppression operations in the "hail alley" of central Alberta to combat urban hail damage in the Calgary to Red Deer area. The current program has conducted cloud-seeding operations in central Alberta each summer since 1996.

Specific modification sought: Diminish hail damage to property in central Alberta with special priority given to the urban areas of Calgary and Red Deer.

Quantitative estimate of modification expected: Even very small positive results (+1%) will be economically beneficial, however, it is hoped that reductions in damage on the order of 25% or greater will be realized. The insurance industry has been encouraged by the results, estimating a savings of several hundred-million dollars to the industry, paying out approximately 50% of what they expected.

Secondary effects anticipated: Reductions in crop damage due to hail should also be realized. Seeding may also provide an increase in precipitation according to recent analyses of radar data. The crop hail insurance data for the first 10 years of the project indicated a reduction in the loss-to-risk values compared with the historical 58 year average for the province as a whole. However, a recent analysis shows increased variability and an increasing trend in hail damage over the last 5 years both inside and outside the project area which is likely due to climate change. The effect of the seeding on crop damage is inconclusive at this time.

Geographic area affected (see attached map): The main project area is from Calgary to Red Deer, 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 (AgI) 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.

A cloud seeding pass is repeated immediately if there are visual signs of new cloud growth or radar reflectivity gradients remain tight (indicative of persistent updrafts). A 5 to 10 min waiting period may be used, to allow for the seeding material to take effect and the storm to dissipate, if visual signs of glaciation appear or radar reflectivity values decrease and gradients weaken. This waiting period precludes the waste of seeding material and ensures its optimum usage.

For cloud base seeding, a typical seeding rate of 1 burn-in-place flare (150 g each) is used. Cloud seeding runs are repeated until no further inflow is found. Wing-tip seeding solution burners will also be used to provide continuous silver iodide seeding if extensive regions of weak updraft are observed at cloud base and the shelf cloud region. Base seeding is not conducted if only downdrafts are encountered at cloud base, since this would waste seeding material.

The cloud seeding flares are silver-iodide pyrotechnics with an ice nuclei effectiveness of approximately 10^{14} nuclei per gram of pyrotechnic, active at -10°C, as determined by independent cloud chamber tests at Colorado State University.

Sufficient dispersion of the particles is required for AgI plume overlap from consecutive flares by the time the cloud particles reach hail size for effective hail suppression. The work by Grandia et al. (1979) based on turbulence measurements within Alberta feeder clouds indicated that the time for the diameter of the diffusing line of AgI to reach the integral length scale (200 m) in the inertial subrange size scales of mixing, was 140 seconds. This is insufficient time for ice particles to grow to hail size. Therefore, dropping flares at 5 sec intervals should effectively deplete the supercooled liquid water and prevent the growth of hail particles. The use of the 20 gram flares and a frequent drop rate provides better seeding coverage than using larger flares with greater time/distance spacing between flare drops. In fact, the above calculations are conservative when one considers that the center of the ice crystal plume center will have a higher concentration of crystals.

B. EQUIPMENT

Type:

- one Advanced Radar Corporation C-band Doppler weather radar, 250 kw peak power, with 1.65 deg. beam width, located at the Olds-Didsbury airport, 50ft tower mounted including radome.
- Three Beechcraft C90 King-Air prop-jet aircraft (two in Springbank and one in Red Deer).
- Two Cessna 340 aircraft (one in Springbank and one in Red Deer).

C. MATERIALS TO BE EMITTED:

- Cloud top (ejectable) pyrotechnic flares are 20g AgI formulation manufactured by Ice Crystal Engineering (ICE) of Kindred, North Dakota, USA (www.iceflares.com)
- Cloud base (burn-in-place) flares are 150g AgI formulation manufactured by Ice Crystal Engineering (ICE) of Kindred, North Dakota, USA (www.iceflares.com)
- A solution of acetone, silver iodide, sodium perchlorate, paradichlorobenzene, and ammonium iodide will also be burned for continuous seeding at cloud base. The products of combustion yield silver iodide (AgI) ice nuclei, carbon dioxide (CO_2), and water (H_2O).

Activation tests performed at Colorado State University indicate greater than10^{14} ice crystals per gram of seeding agent burned, active at -10°C.

Total flight hours and quantities to be dispersed: We estimate the project may use 5000 twenty-gram flares and 500 one hundred-fifty gram flares, plus approximately 150 gallons of the seeding solution (2% AgI by volume) will be burned. The number of operational days, flights, and amount of seeding material dispensed over the past fifteen years is summarized in the attached table. No harmful effects from these materials is expected. This is based on years of studies (both in the USA and Canada) to detect silver in precipitation (above background levels) following cloud seeding. The amount of silver distributed by the cloud seeding is small compared to the output from industry. Silver amounts from cloud seeding are far, far less than the USA EPA guidelines.

PART 8. GENERAL INFORMATION CONCERNING USE OF AIRCRAFT.

- Three C90 King Air prop-jet aircraft, two in Springbank (N904DK and N518TS) and one based in Red Deer (N522JP).
- Two Cessna 340 aircraft, one in Springbank (N457DM) and one in Red Deer (N37356).

PART 9. GENERAL INFORMATION CONCERNING USE OF GROUND VEHICLES.

No special project ground vehicles will be deployed for the project. (Only private vehicles for personal transportation will be used.)

PART 10. GENERAL INFORMATION CONCERNING ANY MEASUREMENTS OR OBSERVATION INSTRUMENTATION.

No special surface observations are planned for this project. The primary instrumentation is the weather radar and special aircraft instrumentation. Daily weather charts will be recorded for documentation and reporting purposes.

AIRCRAFT TRACKING GLOBAL POSITIONING SYSTEM (GPS): The WMI weather radar control and communications center will be equipped to receive and record data from the GPS aircraft tracking system. The GPS system displays the exact position of aircraft superimposed on the radar display to enable the controller to accurately direct the seeding aircraft to optimum seeding locations within the storm system. The color-coded aircraft position on the PPI will be marked with a small symbol. Electronic coding will enable radar controllers to discriminate between all project aircraft.

TEMPERATURE INSTRUMENTATION: Each of the cloud seeding aircraft will have a temperature sensor to ensure that the cloud penetration seeding runs are conducted at the proper temperature levels.

WEATHER RADAR: The C-band radar will be equipped with a computerized radar recording and display system. The radar recording system will be capable of providing numerous cell statistics and colour products including plots of radar PPI displays and maximum reflectivity maps. The sophisticated radar tracking software called TITAN (Thunderstorm Identification, Tracking, Analysis, and Nowcasting) has been used since 1997 and has proved to be very useful. TITAN is licensed from the U.S. National Center for Atmospheric Research (NCAR).

PART 11. CERTIFICATION BY ORGANIZATION FOR WHOM ACTIVITY IS TO BE CONDUCTED:

State type of working agreement entered into with the weather modifier: Contract.

I HEREBY CERTIFY THAT ALL STATEMENTS MADE IN THIS NOTIFICATION OF INTENT TO ENGAGE IN WEATHER MODIFICATION ACTIVITIES ARE TRUE AND COMPLETE TO THE BEST OF MY KNOWLEDGE, AND REPRESENT IN SUBSTANCE AN ACCURATE DESCRIPTION OF A PROPOSAL TO UNDERTAKE WEATHER MODIFICATION ACTIVITIES ON BEHALF OF THE ORGANIZATION NAMED HEREIN.

Name of organization: Alberta Severe Weather Management Society

Full name of certifying officer and title:
~~Todd Klapak~~ KEN DE DECKER, BOARD MEMBER.
~~President~~, Alberta Severe Weather Management Society
~~(403) 231-1357, Todd.Klapak@intact.net~~
403-231-1300 KEN.DEDECKER@INTACT.NET.

Signature: Date: May 18, 2016

PART 12. CERTIFICATION BY PERSON PROPOSING TO CONDUCT ACTIVITY.

I HEREBY CERTIFY THAT INFORMATION PROVIDED IN THIS NOTIFICATION OF INTENT TO ENGAGE IN WEATHER MODIFICATION ACTIVITIES IS A TRUE AND COMPLETE DESCRIPTION OF MY PROPOSED PLANS TO ENGAGE IN THE SPECIFIC WEATHER MODIFICATION ACTIVITIES HEREIN DESCRIBED.

Name of organization: Weather Modification, Inc.

Full name of certifying officer:
Bruce A. Boe
Vice President of Meteorology
(701) 235-5500

Bruce A. Boe

Signature: Date: May 18, 2016

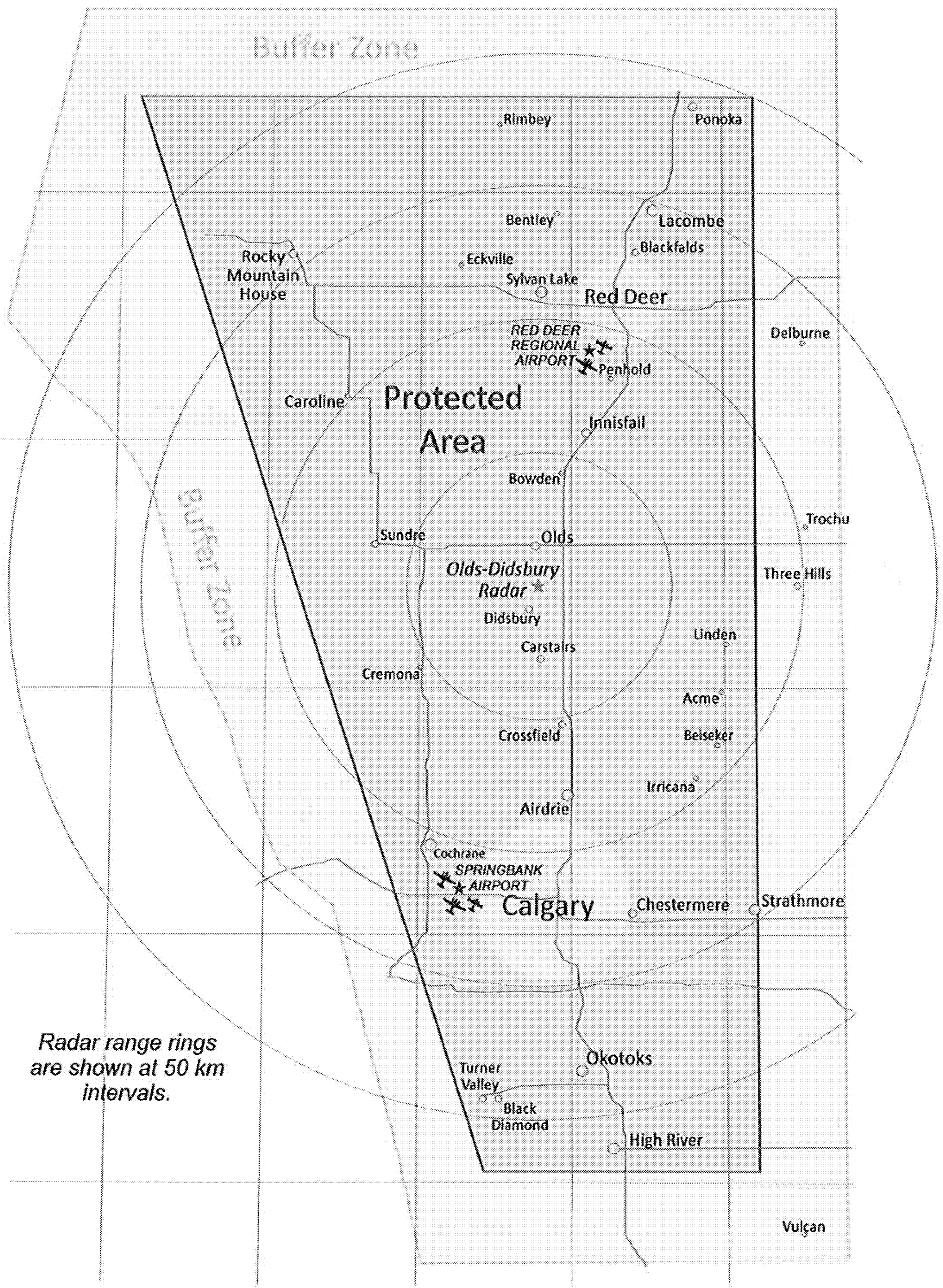

Figure 1: Map of south-central Alberta showing the project area, outlined in green, covered by the Hail Suppression activities.

Table 1: Operational Statistics for 1996 to 2015.

Seeding Activity by Season												
Season	Storm Days With Seeding	Aircraft Missions (Seeding & Patrol)	Total Flight Time (hours)	Number of Storms Seeded	Total Seeding Agent (kg)	Seeding Agent Per Day (kg)	Seeding Agent Per Hour (kg)	Seeding Agent Per Storm (kg)	Ejectable Flares	Burn-in-place Flares	Seeding Solutions (gallons)	Season Activity Rank
2015	25	117	233.3	79	349.2	14.6	1.37	4.42	8127	1138	262.9	6
Mean	30.9	103.4	212.8	91.8	214.6	6.9	1.02	2.4	5179.6	666.2	162.6	
2014	32	128	259.5	101	382.5	12.0	1.47	3.79	10782	1020	228.6	3
2013	26	103	229.6	70	233.3	9.0	1.02	3.33	6311	636	131.7	10
2012	37	143	300.1	116	314.6	8.5	1.16	2.70	7717	914	260.3	2
2011	48	158	383.0	134	400.1	8.3	1.13	3.00	10779	1020	350.2	1
2010	42	115	271.8	118	263.8	6.3	1.10	2.20	5837	851	227.5	7
2009	20	38	109.3	30	48.4	2.4	0.84	1.60	451	237	56.5	20
2008	26	112	194.7	56	122.9	4.7	1.00	2.20	1648	548	113.5	15
2007	19	76	115.3	41	99.7	5.2	0.90	2.40	1622	413	77	19
2006	28	92	190.2	65	214	7.6	1.10	3.30	4929	703	145.4	12
2005	27	80	157.9	70	159.1	5.9	1.00	2.30	3770	515	94.2	16
2004	29	105	227.5	90	270.9	9.3	1.20	3.00	6513	877	132.7	8
2003	26	92	163.6	79	173.4	6.7	1.10	2.20	4465	518	92.6	14
2002	27	92	157.4	54	124.2	4.6	0.80	2.30	3108	377	80.3	18
2001	36	109	208.3	98	195	5.4	0.90	2.00	5225	533	140.8	9
2000	33	130	265.2	136	343.8	10.4	1.30	2.50	9653	940	141.3	4
1999	39	118	251.3	162	212.7	5.5	0.80	1.30	4439	690	297.5	5
1998	31	96	189.9	153	111.1	3.6	0.60	0.70	2023	496	193.8	11
1997*	38	92	188.1	108	110.8	2.9	0.60	1.00	2376	356	144.3	13
1996*	29	71	159.1	75	163.3	5.6	1.00	2.20	3817	542	80.5	17
*The 1996 and 1997 seasons began on June 15, not June 1, which has been the norm ever since.												

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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 9, 2018
Proposed starting date: June 1st, 2018
Expected duration: September 15th, 2018

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[P[1]]
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., 15 years' experience[P[2]]
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, 44 years' experience[P[3]]
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[P[4]] 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, 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[P[5]-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[P[6]-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[P[7]

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[P[8]
Ms. Sherre Newell, Secretary-Treasurer
sherre.newell@aviva.com[P[9]

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 locations(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
Old-Didsbury Airport, Highway 2A
Olds, AB T4H 1A1

tel. & fax. 403-335-8359[P[10],
e-mail: dgilbert@weathermodifcation.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 International (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

Memberships and Honors

- Meteorologist Distinguished Service Award, 2013, Weather Modification Association
- Member, Weather[P[11]] Modification Association (certified operator #78)
- Member, American Meteorological Society
- Iowa Central Community College Honor Society, inducted April 27, 2000
- Wilbur E Brewer Professionalism Award, 2007 North Dakota Cloud Modification Project

Field Address: Olds-Didsbury Airport, Highway 2A, Olds, AB
Field Telephone no. 403-335-8359
Field personnel: full time = 3
part time = 14

Daily records of activities: Custodian = Ms. Erin Fischer
WMI Project Operations Centre
Olds-Didsbury Airport, Highway 2A, AB T4H 1A1

All records are maintained June 1st -Sept. 15th annually.

- daily weather synopsis and forecast report
- radar echo storm data report and maps
- daily operations summary report
- chemical inventory report
- equipment status report
- aircraft flight track maps
- flight log report
- project aircraft maintenance report

PART 6. GENERAL INFORMATION CONCERNING PROPOSED ACTIVITY

Reasons for organization seeking modified weather: The hailstorm on Sept. 7, 1991 caused >$400 million damage in the City of Calgary alone. Hailstorms in the City of Calgary caused >$500 Million in 2010 and again in 2012. In addition, hailstorms have caused >$100 Million damage to crops annually since 2007 and the damage to crops was >$400 Million in 2012. Hailstorms have now become a billion dollar problem to the economy of Alberta. The 20 largest insurance companies and their affiliates have banded together to conduct hail suppression operations in the "hail alley" of central Alberta to combat urban hail damage in the Calgary to Red Deer area. The current program has conducted cloud-seeding operations in central Alberta each summer since 1996.

Specific modification sought: Diminish hail damage to property in central Alberta with special priority given to the urban areas of Calgary and Red Deer.

Quantitative estimate of modification expected: Even very small positive results (+1%) will be economically beneficial, however, it is hoped that reductions in damage on the order of 25% or greater will be realized. The insurance industry has been encouraged by the results, estimating a savings of several hundred-million dollars to the industry, paying out approximately 50% of what they expected.

Secondary effects anticipated: Reductions in crop damage due to hail should also be realized. Seeding may also provide an increase in precipitation according to recent analyses of radar data. The crop hail insurance data for the first 10 years of the project indicated a reduction in the loss-to-risk values compared with the historical 58 year average for the province as a whole. However, a recent analysis shows increased variability and an increasing trend in hail damage over the last 10 years both inside and outside the project area which is likely due to climate change. The effect of the seeding on crop damage is inconclusive at this time.

Geographic area affected (see attached map): The main project area is from Calgary to Red Deer, 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[P[12]] 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 (AgI) 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.

A cloud seeding pass is repeated immediately if there are visual signs of new cloud growth or radar reflectivity gradients remain tight (indicative of persistent updrafts). A 5 to 10 min waiting period may be used, to allow for the seeding material to take effect and the storm to dissipate, if visual signs of glaciation appear or radar reflectivity values decrease and gradients weaken. This waiting period precludes the waste of seeding material and ensures its optimum usage.

For cloud base seeding, a typical seeding rate of 1 burn-in-place flare (150 g each) is used. Cloud seeding runs are repeated until no further inflow is found. Wing-tip seeding solution burners will also be used to provide continuous silver iodide seeding if extensive regions of weak updraft are observed at cloud base and the shelf cloud region. Base seeding is not conducted if only downdrafts are encountered at cloud base, since this would waste seeding material.

The cloud seeding flares are silver-iodide pyrotechnics with an ice nuclei effectiveness of approximately 10^{14} nuclei per gram of pyrotechnic, active at -10°C, as determined by independent cloud chamber tests at Colorado State University.

Sufficient dispersion of the particles is required for AgI plume overlap from consecutive flares by the time the cloud particles reach hail size for effective hail suppression. The work by Grandia et al. (1979) based on turbulence measurements within Alberta feeder clouds indicated that the time for the diameter of the diffusing line of AgI to reach the integral length scale (200 m) in the inertial subrange size scales of mixing, was 140 seconds. This is insufficient time for ice particles to grow to hail size. Therefore, dropping flares at 5 sec intervals should effectively deplete the supercooled liquid water and prevent the growth of hail particles. The use of the 20 gram flares and a frequent drop rate provides better seeding coverage than using larger flares with greater time/distance spacing between flare drops. In fact, the above calculations are conservative when one considers that the center of the ice crystal plume center will have a higher concentration of crystals.

B. EQUIPMENT

Type:

- one Advanced Radar Corporation C-band Doppler weather radar, 250 kw peak power, with 1.65 deg. beam width, located at the Olds-Didsbury airport, 50ft tower-mounted, including radome.
- Three Beechcraft C90 King-Air prop-jet aircraft (two in Springbank and one in Red Deer).
- Two Cessna 340 aircraft (one in Springbank and one in Red Deer).

C. MATERIALS TO BE EMITTED:

- Cloud top (ejectable) pyrotechnic flares are 20g AgI formulation manufactured by Ice Crystal Engineering (ICE) of Kindred, North Dakota, USA (www.iceflares.com)
- Cloud base (burn-in-place) flares are 150g AgI formulation manufactured by Ice Crystal Engineering (ICE) of Kindred, North Dakota, USA (www.iceflares.com)
- A solution of acetone, silver iodide, sodium perchlorate, paradichlorobenzene, and ammonium iodide will also be burned for continuous seeding at cloud base. The products of combustion yield silver iodide (AgI) ice nuclei, carbon dioxide (CO_2), and water (H_2O).

Activation tests performed at Colorado State University indicate greater than10^{14} ice crystals per gram of seeding agent burned, active at -10°C.

Total flight hours and quantities to be dispersed: We estimate the project may use 8,500 twenty-gram flares and 1,000 one hundred-fifty gram flares, plus approximately 250 gallons of the seeding solution (2% AgI by volume) will be burned. The number of operational days, flights, and amount of seeding material dispensed over the past fifteen years is summarized in the attached table. No harmful effects from these materials is expected. This is based on years of studies (both in the USA and Canada) to detect silver in precipitation (above background levels) following cloud seeding. The amount of silver distributed by the cloud seeding is small compared to the output from industry. Silver amounts from cloud seeding are far, far less than the USA EPA guidelines.

PART 8. GENERAL INFORMATION CONCERNING USE OF AIRCRAFT.

- Three C90 King Air prop-jet aircraft, two in Springbank (N904DK and N518TS) and one based in Red Deer (N522JP).
- Two Cessna 340 aircraft, one in Springbank (N234PS) and one in Red Deer (N37356).

PART 9. GENERAL INFORMATION CONCERNING USE OF GROUND VEHICLES.

No special project ground vehicles will be deployed for the project. (Only private vehicles for personal transportation will be used.)

PART 10. GENERAL INFORMATION CONCERNING ANY MEASUREMENTS OR OBSERVATION INSTRUMENTATION.

No special surface observations are planned for this project. The primary instrumentation is the weather radar and special aircraft instrumentation. Daily weather charts will be recorded for documentation and reporting purposes.

AIRCRAFT TRACKING GLOBAL POSITIONING SYSTEM (GPS): The WMI weather radar control and communications center will be equipped to receive and record data from the GPS aircraft tracking system. The GPS system displays the exact position of aircraft superimposed on the radar display to enable the controller to accurately direct the seeding aircraft to optimum seeding locations within the storm system. The color-coded aircraft position on the PPI will be marked with a small symbol. Electronic coding will enable radar controllers to discriminate between all project aircraft.

TEMPERATURE INSTRUMENTATION: Each of the cloud seeding aircraft will have a temperature sensor to ensure that the cloud penetration seeding runs are conducted at the proper temperature levels.

WEATHER RADAR: The C-band Doppler radar will be equipped with a computerized radar recording and display system. The radar recording system will be capable of providing numerous cell statistics and colour products including plots of radar PPI displays and maximum reflectivity maps. The sophisticated radar tracking software called TITAN (Thunderstorm Identification, Tracking, Analysis, and Nowcasting) has been used since 1997 and has proved to be very useful. TITAN is licensed from the U.S. National Center for Atmospheric Research (NCAR).

PART 11. CERTIFICATION BY ORGANIZATION FOR WHOM ACTIVITY IS TO BE CONDUCTED:

State type of working agreement entered into with the weather modifier: Contract.

I HEREBY CERTIFY THAT ALL STATEMENTS MADE IN THIS NOTIFICATION OF INTENT TO ENGAGE IN WEATHER MODIFICATION ACTIVITIES ARE TRUE AND COMPLETE TO THE BEST OF MY KNOWLEDGE, AND REPRESENT IN SUBSTANCE AN ACCURATE DESCRIPTION OF A PROPOSAL TO UNDERTAKE WEATHER MODIFICATION ACTIVITIES ON BEHALF OF THE ORGANIZATION NAMED HEREIN.

Name of organization: Alberta Severe Weather Management Society

Full name of certifying officer and title:

Todd Klapak
President, Alberta Severe Weather Management Society
(403) 231[P[13]-1357, Todd.Klapak@intact.net

Signature: Date: May 09, 2018

PART 12. CERTIFICATION BY PERSON PROPOSING TO CONDUCT ACTIVITY.

I HEREBY CERTIFY THAT INFORMATION PROVIDED IN THIS NOTIFICATION OF INTENT TO ENGAGE IN WEATHER MODIFICATION ACTIVITIES IS A TRUE AND COMPLETE DESCRIPTION OF MY PROPOSED PLANS TO ENGAGE IN THE SPECIFIC WEATHER MODIFICATION ACTIVITIES HEREIN DESCRIBED.

Name of organization: Weather Modification International

Full name of certifying officer:
Bruce A. Boe
Vice President of Meteorology
(701) 235-5500[P[14]]

Bruce A. Boe

Signature: Date: May 09, 2018

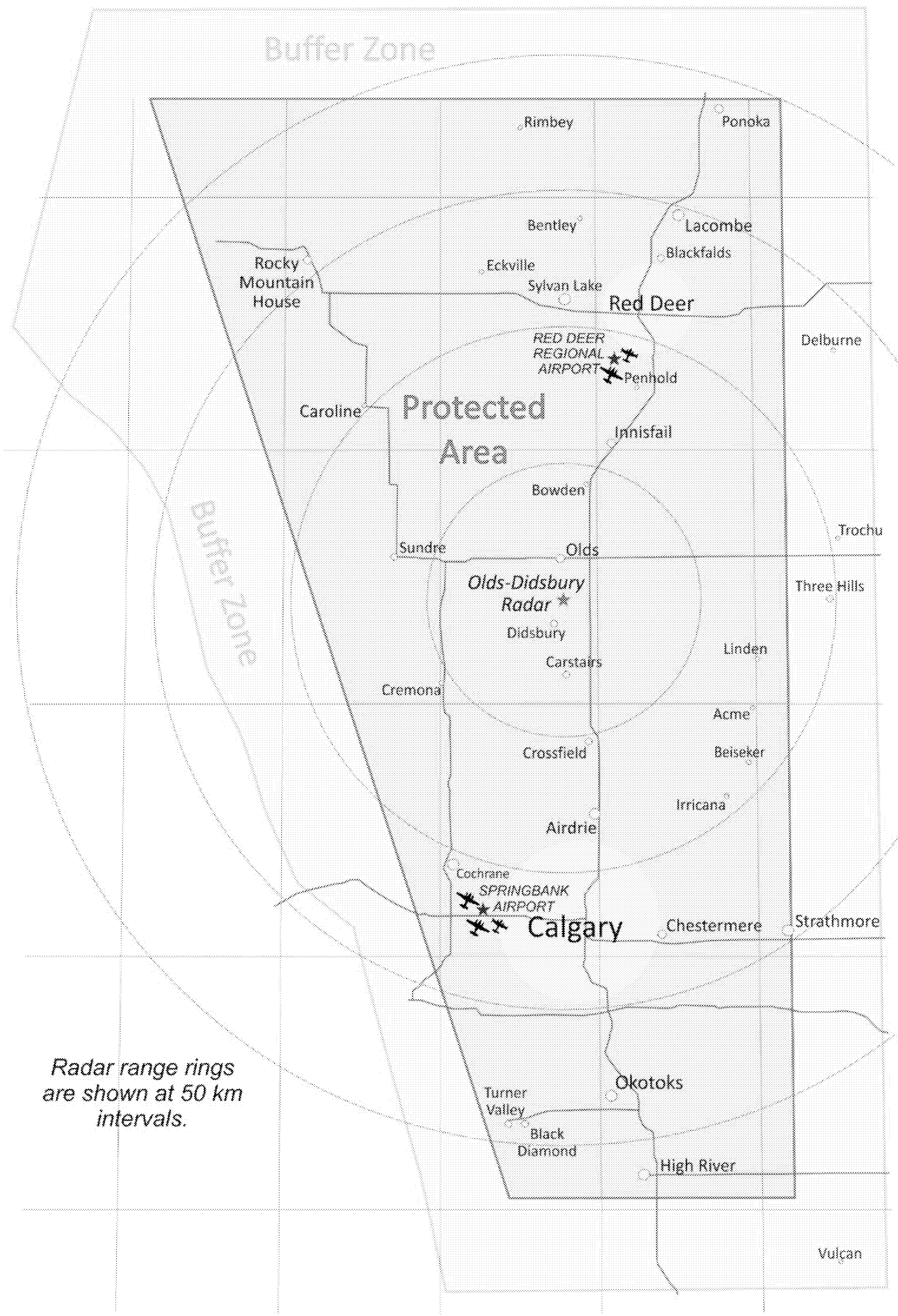

Figure 1: Map of south-central Alberta showing the project area, outlined in green, covered by the Hail Suppression activities.

Table 1. Seeding activity through 2017.

Season	Storm Days With Seeding	Aircraft Missions (Seeding & Patrol)	Total Flight Time (hours)	Number of Storms Seeded	Total Seeding Agent (kg)	Seeding Agent Per Day (kg)	Seeding Agent Per Hour (kg)	Seeding Agent Per Storm (kg)	Ejectable Flares	Burn-in-place Flares	Seeding Solutions (gallons)	Season Activity Rank
2017	25	107	224.5	64	255.4	10.2	1.14	3.99	5939	842	170.2	10
Mean	**31**	**105**	**216.2**	**91**	**220.1**	**7.1**	**1.03**	**2.52**	**5274**	**689**	**166.8**	
2016	35	139	277.1	96	294.9	8.4	1.06	3.07	6496	1000	246.9	6
2015	26	115	233.3	79	349.2	14.6	1.37	4.42	8127	1138	262.9	8
2014	32	128	259.5	101	382.5	12.0	1.47	3.79	10782	1020	228.6	3
2013	26	103	229.6	70	233.3	9.0	1.02	3.33	6311	636	131.7	13
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2011	48	158	383.0	134	400.1	8.3	1.13	3.00	10779	1020	350.2	1
2010	42	115	271.8	118	263.8	6.3	1.10	2.20	5837	851	227.5	7
2009	20	38	109.3	30	48.4	2.4	0.84	1.60	451	237	56.5	22
2008	26	112	194.7	56	122.9	4.7	1.00	2.20	1648	548	113.5	17
2007	19	76	115.3	41	99.7	5.2	0.90	2.40	1622	413	77	21
2006	28	92	190.2	65	214	7.6	1.10	3.30	4929	703	145.4	14
2005	27	80	157.9	70	159.1	5.9	1.00	2.30	3770	515	94.2	19
2004	29	105	227.5	90	270.9	9.3	1.20	3.00	6513	877	132.7	9
2003	26	92	163.6	79	173.4	6.7	1.10	2.20	4465	518	92.6	16
2002	27	92	157.4	54	124.2	4.6	0.80	2.30	3108	377	80.3	20
2001	36	109	208.3	98	195	5.4	0.90	2.00	5225	533	140.8	11
2000	33	130	265.2	136	343.8	10.4	1.30	2.50	9653	940	141.3	4
1999	39	118	251.3	162	212.7	5.5	0.80	1.30	4439	690	297.5	5
1998	31	96	189.9	153	111.1	3.6	0.60	0.70	2023	496	193.8	12
1997*	38	92	188.1	108	110.8	2.9	0.60	1.00	2376	356	144.3	15
1996*	29	71	159.1	75	163.3	5.6	1.00	2.20	3817	542	80.5	18

**The 1996 and 1997 seasons began on June 15, not June 1, which has been the norm ever since.*

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 12, 2011
Proposed starting date:	June 1st, 2011
Expected duration:	September 15th, 20110

Province and area to be affected: Central Alberta, covering the Red Deer to Calgary regions (see attached map showing project area which has remained 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 Inc. (WMI) http://www.weathermodification.com/	
Parent Organization:	Weather Modification Inc. (WMI) 3802 20th Street North Fargo, ND USA 58102	
Chief Officer:	Mr. Patrick H. Sweeney, President pat@weathermod.com	Tel: (701) 235-5500
Local Organization:	Weather Modification, Inc. Olds-Didsbury Airport, Highway 2A Olds, AB T4H 1A1	Tel. (403) 335-8359

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

Chief Officer:	Mr. Daniel Gilbert B.S., 8 years' experience WMA Certified Weather Modification Operator #78 Office Tel: (403) 335-8359 (see Part 5 for details of qualifications and experience)
Director of Meteorology	Mr. Bruce Boe Project Manager/Meteorology, 37 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, Inc.

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 35 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, California, Greece, Texas, California, Idaho, Mexico, UAE, India, Indonesia, Mali, Nevada, North Dakota, Oklahoma, Saudi Arabia, and Wyoming within the last 10 years.

4. References:

1. Dr. Terry Krauss
   Krauss Weather Services
   13 Roche Street
   Red Deer, AB T4P 3K8 Tel. 403-342-5685
2. Mr. Darin Langerud, Director
   State of North Dakota Atmospheric Resource Board
   900 E. Boulevard Ave.
   Bismarck, ND 58505 Tel. 701-328-2788
3. Mr. George W. Bomar, Director
   Texas Department of Licensing and Regulation
   Austin, TX 78711 Tel. 512-936-4313
4. Dr. Paul L. Smith, Director
   Institute of Atmospheric Sciences
   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@ingcanada.com
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 locations(s) of project secondary field base(s):

- Calgary international airport tel. 403-250-8070
- Red Deer industrial airport tel. 403-886-4187

PART 5. GENERAL INFORMATION CONCERNING OPERATING FIELD PERSONNEL

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

tel. & fax. 403-335-8359,
e-mail: dgilbert@weathermodifcation.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
Field 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

Memberships and Honors
- Member, Weather Modification Association (certified operator #78)
- Member, American Meteorological Society
- Iowa Central Community College Honor Society, inducted April 27, 2000
- Wilbur E Brewer Professionalism Award, 2007 North Dakota Cloud Modification Project

Field Address: Olds-Didsbury Airport, Highway 2A, Olds, AB
Field Telephone no. 403-335-8359
Field personnel: full time = 3
part time = 10

Daily records of activities: Custodian = Ms. Erin Fischer
WMI Project Operations Centre
Olds-Didsbury Airport, Highway 2A, AB T4H 1A1

All records are maintained June 1st -Sept. 15th annually.

- daily weather synopsis and forecast report
- radar echo storm data report and maps
- daily operations summary report
- chemical inventory report
- equipment status report
- aircraft flight track maps
- flight log report
- project aircraft maintenance report
- radar calibration report

PART 6. GENERAL INFORMATION CONCERNING PROPOSED ACTIVITY

Reasons for organization seeking modified weather: Hailstorms cause an average of approximately $100 million damage to private and public property annually in Alberta. The hailstorm on Sept. 7, 1991 caused >$400 million damage in the City of Calgary alone. Over 40 major Alberta insurers, as well as reinsurers and brokers, have donated > $15 million to conduct a hail suppression project since 1996.

Specific modification sought: Diminish hail damage to property in central Alberta with special priority given to the urban areas of Calgary and Red Deer.

Quantitative estimate of modification expected: Even very small positive results (+/- 1%) will be economically beneficial, however, it is hoped that reductions in damage on the order of 25% or greater will be realized. After 10 years, the insurance industry is very encouraged by the results, estimating a savings of several hundred-million dollars to the industry, paying out approximately 50% of what they expected.

Secondary effects anticipated: Reductions in crop damage due to hail should also be realized. Seeding may also provide an increase in precipitation according to recent analyses of radar data. The crop hail insurance data for the last 10 years indicates a reduction in the loss-to-risk values compared with the historical 58 year average for the province as a whole. However, a recent analysis shows increased variability and an increasing trend in hail damage over the last 5 years both inside and outside the project area which is likely due to climate change. There are no significant changes in the crop damage within the target area for the last 10 years, compared with the previous 15 years. The effect of the seeding on crop damage is inconclusive at this time.

Geographic area affected (see attached map): The main project area is from Calgary to Red Deer, 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. $2 million per year.

Funds to be expended in Canada: est. $500,000 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- Acetone 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 (AgI) 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 s 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.

A cloud seeding pass is repeated immediately if there are visual signs of new cloud growth or radar reflectivity gradients remain tight (indicative of persistent updrafts). A 5 to 10 min waiting period may be used, to allow for the seeding material to take effect and the storm to dissipate, if visual signs of glaciation appear or radar reflectivity values decrease and gradients weaken. This waiting period precludes the waste of seeding material and ensures its optimum usage.

For cloud base seeding, a typical seeding rate of 1 burn-in-place flare (150 g each) is used. Cloud seeding runs are repeated until no further inflow is found. Acetone burners will also be used to provide continuous silver iodide seeding if extensive regions of weak updraft are observed at cloud base and the shelf cloud region. Base seeding is not conducted if only downdrafts are encountered at cloud base, since this would waste seeding material.

The cloud seeding flares are silver-iodide pyrotechnics with an ice nuclei effectiveness of approximately 10^{14} nuclei per gm of pyrotechnic, active at -10 C, as determined by independent cloud chamber tests at Colorado State University.

Sufficient dispersion of the particles is required for AgI plume overlap from consecutive flares by the time the cloud particles reach hail size for effective hail suppression. The work by Grandia et al. (1979) based on turbulence measurements within Alberta feeder clouds indicated that the time for the diameter of the diffusing line of AgI to reach the integral length scale (200 m) in the inertial subrange size scales of mixing, was 140 seconds. This is insufficient time for ice particles to grow to hail size. Therefore, dropping flares at 5 sec intervals should effectively deplete the supercooled liquid water and prevent the growth of hail particles. The use of the 20 gm flares and a frequent drop rate provides better seeding coverage than using larger flares with greater time/distance spacing between flare drops. In fact, the above calculations are conservative when one considers that the center of the ice crystal plume center will have a higher concentration of crystals.

B. EQUIPMENT

Type:

- one WMI-C band weather radar, 250 kw peak power, with 1.65 deg. beam width, located at the Olds-Didsbury airport, 50ft tower mounted including radome.
- Two Beechcraft C90 King-Air prop-jet aircraft (one in Calgary and one in Red Deer).
- Two Cessna 340 aircraft (one in Calgary and one in Red Deer).

C. MATERIALS TO BE EMITTED:

- Cloud top (ejectable) pyrotechnic flares are 20g AgI formulation manufactured by Ice Crystal Engineering (ICE) of Kindred, North Dakota, USA (www.iceflares.com)
- Cloud base (burn-in-place) flares are 150g AgI formulation manufactured by Ice Crystal Engineering (ICE) of Kindred, North Dakota, USA (www.iceflares.com)
- A mixture of Acetone, Silver iodide, Sodium Perchlorate, Paradichlorobenzene, and Ammonium Iodide will also be dispensed by aircraft mounted burners for continuous seeding at cloud base.

Activation tests performed at Colorado State University indicate greater than10^{14} ice crystals per gram of seeding agent burned, active at -10^{o}C.

Total flight hours and quantities to be dispersed: We estimate the project may use 5000 twenty-gram flares and 500 one hundred-fifty gram flares, plus approximately 150 gallons of acetone (2% AgI solution) will be burned. The number of operational days, flights, and amount of seeding material dispensed over the past fifteen years is summarized in the attached table. No harmful effects from these materials is expected. This is based on years of studies (both in the USA and Canada) to detect silver in precipitation (above background levels) following cloud seeding. The amount of silver distributed by the cloud seeding is small compared to the output from industry. Silver amounts from cloud seeding are far, far less than the USA EPA guidelines.

PART 8. GENERAL INFORMATION CONCERNING USE OF AIRCRAFT.

- Two C90 King Air prop-jet aircraft, one in Calgary (N522JP) and one based in Red Deer (N422PM).
- Two Cessna 340 aircraft, one in Calgary (N123KK) and one in Red Deer (N37356).

PART 9. GENERAL INFORMATION CONCERNING USE OF GROUND VEHICLES.

No special project ground vehicles will be used on the project. (Only private vehicles for personal transportation will be used.)

PART 10. GENERAL INFORMATION CONCERNING ANY MEASUREMENTS OR OBSERVATION INSTRUMENTATION.

No special surface observations are planned for this project. The primary instrumentation is the weather radar and special aircraft instrumentation. Daily weather charts will be recorded for documentation and reporting purposes.

AIRCRAFT TRACKING GLOBAL POSITIONING SYSTEM (GPS): The WMI weather radar control and communications center will be equipped to receive and record data from the GPS aircraft tracking system. The GPS system displays the exact position of aircraft superimposed on the radar display to enable the controller to accurately direct the seeding aircraft to optimum seeding locations within the storm system. The color-coded aircraft position on the PPI will be marked with a small symbol. Electronic coding will enable radar controllers to discriminate between all project aircraft.

SPECIAL CLOUD PHYSICS INSTRUMENTATION: Each of the cloud seeding aircraft will have a temperature sensor to ensure that the cloud penetration seeding runs are conducted at the proper temperature levels. The Cheyenne aircraft will be equipped with a limited cloud physics data acquisition system to measure liquid water cloud droplets using a hot-wire instrument. A special telemetry system is used to transmit the special aircraft data to the radar communications and control center where it will be displayed in real time and recorded at 1 s intervals. The data system does not require a separate operator. These critical meteorological and microphysical measurements will allow for improved documentation and strategic decision making during the cloud seeding missions regarding the growth and or decaying stages of the storm that is being seeded. These microphysical measurements will also help document in-situ cloud seeding "signatures" to confirm that the ice-nucleating agents are participating in the precipitation formation (and hail suppression) processes. These measurements, combined with the recorded radar data, will ensure that the project is conducted on a sound scientific basis.

WEATHER RADAR: The C-band radar will be equipped with a computerized radar recording and display system. The radar recording system will be capable of providing numerous cell statistics and colour products including plots of radar PPI displays and maximum reflectivity maps. The sophisticated radar tracking software called TITAN (Thunderstorm Identification, Tracking, Analysis, and Nowcasting) has been used since 1997 and has proved to be very useful. TITAN is licensed from NCAR.

PART 11. CERTIFICATION BY ORGANIZATION FOR WHOM ACTIVITY IS TO BE CONDUCTED:

State type of working agreement entered into with the weather modifier: Contract.

I HEREBY CERTIFY THAT ALL STATEMENTS MADE IN THIS NOTIFICATION OF INTENT TO ENGAGE IN WEATHER MODIFICATION ACTIVITIES ARE TRUE AND COMPLETE TO THE BEST OF MY KNOWLEDGE, AND REPRESENT IN SUBSTANCE AN ACCURATE DESCRIPTION OF A PROPOSAL TO UNDERTAKE WEATHER MODIFICATION ACTIVITIES ON BEHALF OF THE ORGANIZATION NAMED HEREIN.

Name of organization: Alberta Severe Weather Management Society

Full name of certifying officer and title:

Todd Klapak
President, Alberta Severe Weather Management Society
(403) 231-1357, Todd.Klapak@intact.net

Signature: Date: May 16, 2011

PART 12. CERTIFICATION BY PERSON PROPOSING TO CONDUCT ACTIVITY.

I HEREBY CERTIFY THAT INFORMATION PROVIDED IN THIS NOTIFICATION OF INTENT TO ENGAGE IN WEATHER MODIFICATION ACTIVITIES IS A TRUE AND COMPLETE DESCRIPTION OF MY PROPOSED PLANS TO ENGAGE IN THE SPECIFIC WEATHER MODIFICATION ACTIVITIES HEREIN DESCRIBED.

Name of organization: Weather Modification, Inc.

Full name of certifying officer:
Bruce A. Boe
Director of Meteorology
(701) 235-5500

Bruce A. Boe

Signature: Date: May 16, 2011

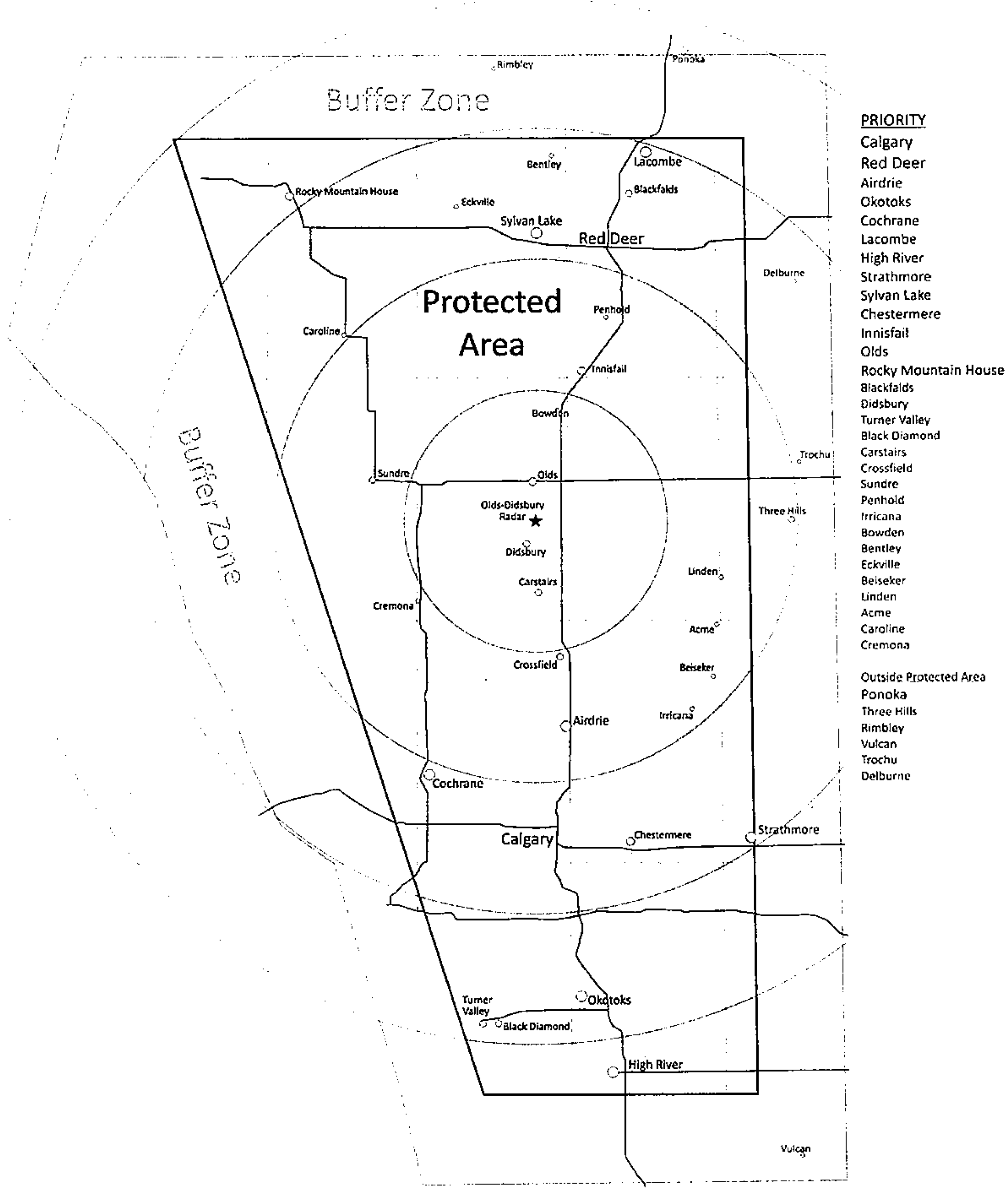

Figure 1: Map of southern Alberta showing the project area, outlined in green, covered by the Hail Suppression activities.

Table 1: Operational Statistics for 1996 to 2010.

	Mean	1996*	1997*	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Days with Seeding	30.0	29	38	31	39	33	36	27	26	29	27	28	19	26	20	42
Aircraft Missions	92.9	71	92	96	118	130	109	92	92	105	80	92	76	112	37	91
Flight Time (hours)	190.0	159.1	188.1	189.9	251.3	265.2	208.3	157.4	163.6	227.5	157.9	190.2	115.3	194.7	109.3	271.8
Seeded Storms	89.0	75	108	153	162	136	98	54	79	90	70	65	41	56	30	118
Seeding Agent (kg)	174.2	163.3	110.8	111.1	212.7	343.8	195.0	124.2	173.4	270.9	159.1	214.0	99.7	122.9	48.4	263.8
Seeding per Day (kg)	5.7	5.6	2.9	3.6	5.5	10.4	5.4	4.6	6.7	9.3	5.9	7.6	5.2	4.7	2.4	6.3
Seeding per Hour (kg)	0.95	1.00	0.60	0.60	0.80	1.30	0.90	0.80	1.10	1.20	1.00	1.10	0.90	1.00	0.84	1.10
Seeding per Storm (kg)	2.1	2.2	1.0	0.7	1.3	2.5	2.0	2.3	2.2	3.0	2.3	3.3	2.4	2.2	1.6	2.2
Ejectable Flares	3991.7	3817	2376	2023	4439	9653	5225	3108	4465	6513	3770	4929	1622	1648	451	5837
Burn-In-Place Flares	573.1	542	356	496	690	940	533	377	518	877	515	703	413	548	237	851
Seeding Solution (gal)	134.5	80.5	144.3	193.8	297.5	141.3	140.8	80.3	92.6	132.7	94.2	145.4	77.0	113.5	56.5	227.5
15-season Activity Rank		8th, 9th	12th	11th	5th	1st	6th	13th	7th	2nd, 3rd	10th	4th	14th	8th, 9th	15th	2nd, 3rd

*The 1996 and 1997 seasons were conducted from 15 June through 15 September only.

ALBERTA HAIL SUPPRESSION PROJECT 2011
DAILY SUMMARY REPORTS
WEEK No.1

Date	Weather	Activities Summary
June 01, Wednesday	A deep upper level trough was positioned over the Pacific Northwest. Southwesterly upper level jet energy was concentrated over southern AB. Several potent shortwave troughs passed through the project area, and the atmosphere was moderately unstable. The region saw low freezing levels along with excellent speed shear. Weak echoes began to form over Banff and Canmore during the early morning hours. Then, during the afternoon hours, stronger cells developed W of Sundre and moved from W to E across the project area. In the evening, another band of moderate convection moved over Rocky MH. Max titan cell= 11.0 km top, 62 max dBz, 64.0 max VIL Tmax YC = 16.6C and 3.4mm of rain. Tmax QF = 17.0C and no data. Tmax Radar = 16.3C and 31.5mm of rain.	No aircraft operations, awaiting clearance to fly from Transport Canada. Work continued on the radar. Adjustments were made to the radar display and TITAN programming.
June 02, Thursday	The trough over the Pacific Northwest moved E which helped push a few shortwaves through central AB. The atmosphere was moderately unstable with weak shear. Positive vorticity advection was the main trigger mechanism. Cumulus clouds started forming over the mountains in the morning. Slightly better convection began to form in the early afternoon but remained outside of the project area. Then around 00z, a few cells began to make their way off the foothills and into the project area. A cluster of convection formed over the Calgary metropolitan area during the early evening hours. The strongest storms of the day formed NW of Sundre and north of Rocky MH. Moderately strong convection was observed through the late evening hours. Max titan cell= 9.1 km top, 60 max dBz, 41.4 max VIL Tmax YC = 17.0C and no rain. Tmax QF = 19.0C and no rain. Tmax Radar = 17.6C and a trace of rain.	The radar software parameters and settings were adjusted and updated. HS3 and HS4 preformed a ferry flight from YYC to YQF and each aircraft tested the seeding equipment. All equipment functioned properly. HS1 patrolled north of Calgary. They fired 1BIP and 2 EJ to test the seeding equipment which functioned properly. HS2 flew a patrol flight northwest of Calgary. Pilots encountered data logger problems, and landed at the Olds-Didsbury airport to troubleshoot. The aircraft then performed a ferry flight from the Olds-Didsbury airport to YYC. HS1 was launched to a growing cell over northern YYC at 0042Z (06/03). The flight was airborne at 0107Z and began patrolling over northern YYC. At 0129Z HS1 report embedded conditions with no liquid water while patrolling N of Cochrane. HS1 eventually found liquid water NW of Sundre and started seeding at 0144Z. The flight only seeded for a short period of time before returning to patrol. HS1 then RTB at 0211Z. HS2 performed a patrol flight over northern YYC. The aircraft was launched at 0047Z (06/03). Pilots reported only minimal inflow and growth over YYC, so the aircraft just patrolled the area. The flight RTB at 0147Z. <u>Flight Summary</u>

		HS3: 2000-2037Z; 1 BIP, 3 EJ, ferry flight. HS4: 2001-2047Z; 1 BIP, 1 EJ, ferry flight. HS1: 2112-2230Z; 1 BIP, 2 EJ, patrol Airdrie. HS2: 2142-2230Z; no seeding, patrol Cochrane. HS2: 0005 (06/03)-0044Z (06/03); 1 BIP, 2 EJ, ferry flight. HS1: 0050 (06/03)-0230Z (06/03); 2 EJ; patrolled N of Cochrane and NW of Sundre, Storm #1 NW of Sundre. HS2: 0053 (06/03)-0200 (06/03); no seeding; patrolled near Airdrie.
June 03, Friday	A cold front moved south through the area, slowing down and stalling as the day went on. The atmosphere was slightly unstable with low freezing levels. The sounding was marginal for hail. Weak thunderstorms began after 19z, forming off the foothills and moving into the project area. The storms had high reflectivity and VIL during their maturing stage, but quickly weakened and became embedded. Another round of strong thunderstorms began around 0030Z (06/04) as frontal passage occurred over the region. These storms also pulsed down after a short period of time. As cool temperatures set in, stratiform rain developed overnight. Max titan cell= 9.9 km top, 58 max dBz, 41.1 max VIL Tmax YC = 17.8C and 1.0 mm of rain. Tmax QF = 14.2C and 1.4 mm of rain. Tmax Radar = 14.6C and 0.7 mm or rain.	HS2 was launched at 1846Z to patrol cells near YYC, and also to test Airlink. At 1907Z, HS2 was airborne, and reported bases around 8.0kft, rain, and poorly defined bases. At 1934Z, HS2 began seeding over southern YYC after encountering marginal inflow. At 1955Z, HS2 began seeding the northern end of the storm. As the storm began to weaken, HS2 was directed to a cluster of storms to the NW at 2008Z. Bases were 7.0kft and more defined on this storm. HS2 continued to seed the storm until 2045Z, when they had to move further NW as directed by ATC. HS2 then attempted to find inflow along the line headed for Calgary, but the line dissipated so at 2124Z HS2 RTB. At 2247Z, HS1 launched for Olds for Airlink testing. They were airborne at 2308Z, and RTB to YYC after Airlink continued to encounter problems. At 0012Z, HS1 and HS2 were launched SW of Calgary. HS1 was directed to top at 15kft, HS2 to 7.5kft. HS1 was airborne at 0031Z (06/04) and W for the cell NW of Okotoks. Bases were observed at 5.5kft. HS2 was airborne at 0032Z for the same cell. Due to the low bases and proximity to the foothills, HS2 RTB at 0049Z. The cells quickly dissipated well below hail criteria, and HS1 RTB at 0111Z. <u>Flight Summary</u> HS2: 1855-2145Z; 116 min acetone generator time; #1 over YYC and #2 NW of YYC. HS1: 2253-2339Z; no seeding, Airlink testing. HS2: 0016 (06/04)-0105Z (06/04); no seeding; patrol NW of Okotoks. HS1: 0018 (06/04)-0126Z (06/04); no seeding; patrol NW of Okotoks.
June 04, Saturday	A cold front was positioned over southern Alberta. The area was experiencing weak cold advection aloft. The atmosphere was slightly unstable for most of the day. Southern Alberta saw clearing early in the day. No upper level triggers were present but a quasistationary warm front was draped over the northeastern part of the region overnight. Mist and light rain showers fell in the morning. The stratiform cloud cover thinned out during the afternoon.	No aircraft operations.

	Cumulus clouds were observed during the late afternoon hours. Weak convection was present over the YQF area during the evening. The strongest cells of the day moved through near Lacombe around 10z. Small hail was reported near Lacombe. Max titan cell= 8.4 km top, 64 max dBz, 43.2 max VIL Tmax YC = 17.0C and 1.0 mm of rain. Tmax QF = 14.9C and 1.0 mm of rain Tmax Radar = 16.5C and 0.5 mm of rain.	

ALBERTA HAIL SUPPRESSION PROJECT 2011

DAILY SUMMARY REPORTS
WEEK No. 2

Date	Weather	Activities Summary
June 05, Sunday	The upper level jet was located in Saskatchewan and no upper or midlevel triggers were present. Soundings indicated that atmospheric instability was moderate with good speed shear. A weak stationary front was located over southern Alberta. Morning fog indicated high amount of low level moisture. Cloud cover was diminishing during the afternoon allowing for increased surface heating. The surface boundary moved from N to S during the afternoon creating marginal hail storms from Sundre to Calgary along the foothills. The most intense cell developed over Cochrane and moved through Airdrie. Convection became weak and embedded after midnight. Light to moderate rain continued through the morning with low echo tops. Max cell top: 7.5km, 62 max dBz, 27.9 max VIL Tmax YC = 20.2C and 0.2mm of rain. Tmax QF = 18.0C and a trace of rain. Tmax Radar = 19.0C and 2.4mm of rain.	HS3 was launched at 1830Z to NW of Panoka. At 1903Z, the aircraft was airborne. HS3 began top seeding storm #1 NW of Panoka at 1916Z. By 1923Z, pilots reported weak growth with no seedable targets; seeding was stopped and the aircraft patrolled the area. At 1931Z, HS3 was repositioned to growth upwind of Red Deer. They began seeding storm #2 NW of Red Deer at 1939Z with pockets of moderate liquid water and embedded cumulus towers. At 2007Z, the aircraft was repositioned northwest of Calgary for new growth which was determined to be low-topped and not seedable. HS3 was directed to RTB at 2043Z and landed at YQF at 2103Z. HS4 was launched at 1858Z for development NW of Red Deer. The aircraft was airborne at 1913Z and headed toward the Sylvan Lake area. HS4 began seeding storm #2 at 1931Z NW of Red Deer for cells approaching Lacombe. HS4 base seeded with acetone generators and BIP flares. Pilots reported abundant inflow at base. At 2009Z, the storm began to weaken; seeding continued with generators only. The storm continued to weaken as it moved east of the cities, and seeding was halted at 2028Z. HS4 patrolled for a brief time and was then directed to RTB at 2043Z. HS4 landed at YQF at 2055Z. HS1 was launched at 0029Z (06/06) for new cells developing NW of Cochrane. The aircraft was airborne at 0059Z (06/06) and began top seeding storm #3 at 0127(06/06). HS1 repositioned to southwest of Calgary at 0135Z (06/06) and patrolled that area reporting only weak vertical development. This growth was not seeded. HS1 then shifted back to the NW and resumed seeding on two connecting cells (storm #3) NW of Cochrane at 0159Z (06/06). They continued to seed this same storm until HS3 moved in to take their place. HS1 stopped seeding and RTB at 0256Z (06/06). The aircraft landed at 0311Z (06/06). HS4 was launched at 0121Z (06/06) for their second flight of the day. They were airborne at 0132Z (06/06) and headed south toward the cells near Cochrane. HS4 began base seeding storm #3 with burners and BIPs at 0202Z (06/06). They ran racetrack seeding patterns at cloud base NW of Calgary along with HS2. HS4 stopped using BIP flares and seeded with generators only at 0235Z (06/06) as the storm

		became more linear and weaker over NW Calgary. At 0318Z (06/06) HS4 repositioned to new growth west of Caroline as the cells near Calgary were no longer a hail threat. HS4 began seeding storm #6 W of Caroline at 0342Z (06/06). Seeding continued until the cells were no longer a hail threat. Seeding ended at 0413Z (06/06) and HS4 was directed to RTB. The plane landed at 0428Z (06/06). HS2 was launched at 0139Z (06/06) for cells near Calgary. They were airborne at 0151Z (06/06) and began searching for inflow on weak echoes developing over SW Calgary. HS2 began base seeding storm #4 west of Calgary at 0205Z (06/06). Not much inflow was reported in this area, and the cells to the SW of YYC were determined to be nonthreatening. HS2 was shifted north to the two connecting cells NW of YYC. Seeding began on storm #3 at 0222Z (06/06). Pilots flew racetracks in the same area with HS4 at cloud base. They continued seeding the cells as they moved through N YYC into Airdrie. The storm then weakened below hail criteria so HS2 stopped seeding and was directed to RTB at 0350Z (06/06). The plane landed at 0357Z (06/06). HS3 was launched at 0137Z (06/06) for a new cell forming near Sundre. They were airborne at 0206Z (06/06). They were instructed by ATC to deviate from the most direct flight path due to skydiving activity near Innisfail. They reached the developing storm near Sundre and began top seeding storm #5 at 0222Z (06/06). The storm then weakened to below hail criteria. At 0235Z (06/06), they stopped seeding and began patrol NW of Olds. At 0241Z (06/06) they were redirected to the activity NW of Calgary and began seeding storm #7 NW of Cochrane. Shortly after that, HS1 RTB and HS3 took their place seeding storm #3 NW of Calgary at 0246Z (06/06). After several hours of seeding, the Calgary storm weakened, and HS3 was directed to stop seeding and RTB at 0451Z (06/06). They landed at 0508Z (06/06). <u>Flight Summary</u> HS3: 1846-2107Z; 90 EJ, #1 NW of Ponoka, #2 NW of Red Deer, patrol W of Didsbury. HS4: 1905-2059Z; 4 BIP, 114 min acetone generator time; #2 NW of Red Deer. HS1: 0050 (06/06)-0314Z (06/06); 198 EJ, 3 BIP; patrol W of Didsbury, storm #3 NW of Cochrane. HS4: 0126 (06/06)-0431Z (06/06); 5 BIP, 262 min acetone generator time; #3 N of Cochrane, #6 W of Caroline. HS2: 0143 (06/06)-0400Z (06/06); 206 min acetone generator time; #4 SW of YYC, #3 N of Cochrane. HS3: 0200 (06/06)-0515Z (06/06); 233 EJ, 15

		BIP; #5 NW of Olds, Patrol NW of Olds, #3 N of Cochrane, #7 NW of Cochrane.
June 06, Monday	A deep low pressure system, previously lingering off the coast of California, was forecast to move quickly to the NE ejecting multiple shortwave troughs through the project area. The model sounding indicated high amounts of upper level moisture, with sufficient speed shear for organized convection. The surface was moist due to overnight rain showers. Afternoon highs were expected to reach the convective temperature. Isolated rain showers occurred during the morning. Intense cells developed over the far NW quadrant of the project area during the afternoon. The cells moved southward parallel to the foothills remaining outside the project boundary. The most intense cell occurred in the buffer zone west of Sundre. Only weak convection and dissipating thunderstorms moved through the project area. There were no hail threats inside the project boundaries. Weak showers moved through during the overnight hours. Max cell top: 7.6km, 56 max dBz, 20.2 max VIL Tmax YC = 14.2C and 12.4mm of rain. Tmax QF = 15.4C and 0.4mm of rain. Tmax Radar = 13.7C and a trace of rain.	HS3 was launched at 2134Z for intense hailstorms approaching the NW corner of the project area. They were airborne at 2154Z. At 2212Z, HS3 began patrolling NW of RMH. The cells then shifted to a more southerly track parallel to the foothills, remaining outside the project area. It was determined that the cells would not enter the project area. HS3 was directed to RTB at 0004Z (06/07). They landed at YQF at 0022Z (06/07). Flight Summary HS3: 2144 (06/06)-0026Z (06/07); no seeding; patrol NW of RMH.
June 07, Tuesday	The upper level jet was located along the back side of a closed upper low over Vancouver. A cold front was moving southward through AB but it was progged to became stationary during the evening hours. Atmospheric instability was moderate with weak speed shear favoring short-lived cells. The vertical wind profile indicated that the wind directions switched from easterly to westerly at around 500mb, which inhibited storm growth above this level. The region had weak moisture convergence at the surface. Low topped pop-up convection occurred during the morning and afternoon. Cells were generally less than 7km tall and not significant hail threats. Cell motion was from SE to NW due to the position of a surface low pressure system that developed to the south. Light stratus rain occurred during the overnight hours. Max cell top: 8.4km, 61 max dBz, 38.8 max VIL Tmax YC = 15.5C and 1.6mm of rain. Tmax QF = 16.0C and 7.2mm of rain. Tmax Radar = 16.9C and 4.6mm of rain.	HS1, HS3, and HS4 all performed brief maintenance flights to test Airlink tracking after modifications to the data logger software. HS4 also tested the wing tip generators. Airlink tracking problems were resolved with all three planes, and aircraft tracks were displayed on the TITAN computer. Flight Summary HS1: 2128-2205; no seeding; maintenance flight to test Airlink system. HS3: 2336 (06/07)-0012 (06/08); no seeding; maintenance flight to test Airlink system. HS4: 2337 (06/07)-0007 (06/08); no seeding; maintenance flight to test Airlink system.
June 08, Wednesday	A closed upper level low continued to slowly shift to the southeast over southern British Columbia. The atmosphere was slightly unstable with poor speed and directional shear. Vorticity advection was minimal, but a surface trough over the area was progged to initiate convection. Light stratiform rain occurred in the morning. Low topped, unorganized pop-up convection occurred during the afternoon and evening hours. There were no significant hail threats in the project area. Widespread light stratus rain and virga moved through during the night.	HS2 performed a maintenance flight in the morning hours to test Airlink tracking after modifications to the GPS and the data logger software. The test was successful, and tracks were displayed on the TITAN computer. Flight Summary HS2: 1645-1723; no seeding; maintenance flight for Airlink testing.

	Max cell top: 6.9km, 61 max dBz, 25.0 max VIL Tmax YC = 15.6C and 2.8mm of rain. Tmax QF = 17.2C and 1.8mm of rain. Tmax Radar = 15.2C and 3.4mm of rain.	
June 09, Thursday	The strongest upper level jet energy was south of AB. A deep closed low was located over Idaho during the morning hours which quickly weakened into an open wave trough as it moved eastward across Montana. Weak, upper level ridging then built over AB during the daytime hours. A surface trough formed along the lee side of the Rockies. The atmosphere was slightly unstable but capped with weak wind shear. The low level cap held strong throughout the forecast period, and surface dew points remained lower than expected. Skies were mostly clear for the entire period. There were no TITAN cells or significant radar echoes. Tmax YC = 18.3C and no rain. Tmax QF = 21.4C and no rain. Tmax Radar = 18.9C and no rain.	No aircraft operations.
June 10, Friday	The upper level jet remained south and west of AB. The upper level ridge moved east over Saskatchewan and a trough pushed into the area during the afternoon and evening. At the surface, a low formed over central AB during the late afternoon and evening hours. The atmosphere was unstable with CAPE values near 1100J/kg, and the wind shear was weak. During the early afternoon, rain showers occurred west of the project area. During the midafternoon, storms developed west of Calgary and Rocky Mountain House, moving down from the foothills. The storms were slowly moving to the northeast, and were marginal hail threats through the evening. The storms weakened significantly around midnight. During the overnight hours, there were widespread convective showers. Max cell top: 10.6km, 62.5 max dBz, 46.4 max VIL Tmax YC = 22.7C and no rain. Tmax QF = 24.2C and no rain. Tmax Radar = 23.1C and 0.5mm of rain.	HS4 performed a maintenance flight to check aircraft tracking with the backup TITAN computer. The test was successful. Aircraft tracks were displayed on the backup TITAN system. HS2 was launched at 2142Z to development SW of Calgary. At 2200Z HS2 was airborne. At 2216Z, HS2 found 500-1000 fpm inflow on storm #1 and began seeding with generators and BIP flares. At 2259Z, HS2 reported weaker inflow and continued seeding with burners only. At 0044Z (06/11) the storm was no longer a hail threat and HS2 RTB. They landed at YYC at 0057Z (06/11). HS1 was launched at 2142Z for development SW of Calgary. At 2221Z, HS1 was airborne. At 2233Z, HS1 began top seeding storm #1 west of Cochrane with EJs and BIPs. At 0014Z (06/11), HS1 was directed to stop seeding and patrol the weakening storm #1. HS1 reported additional growth on the storm at 0053Z (06/11), and resumed seeding for a short period of time. At 0200Z (06/11), the storm weakened and HS1 RTB to YYC. They landed at 0205Z (06/11). HS3 was launched at 2229Z for development SW of RMH. At 2250Z, they were airborne. At 2312Z, HS3 began top seeding with EJs on storm #2 S of RMH. This cell quickly diminished. At 2323Z, they stopped seeding and began to patrol the area. At 2332Z, there were no seedable targets left and HS3 was directed to RTB. They landed at YQF at 2348Z.

		HS4 was launched at 0026Z (06/11) for development SW of Caroline. At 0045Z (06/11) HS4 was airborne. At 0058Z (06/11), HS4 started base seeding storm #3 with acetone generators SW of Caroline. HS4 found good inflow and a shelf cloud for the next few hours as the storm moved through Caroline and into Eckville. At 0329Z (06/11), as the storm left Eckville, they stopped seeding and RTB. They landed at YQF at 0342Z (06/11). After landing at YQF, HS3 was immediately launched again at 0042Z (06/11) on storm #3 S of RMH, moving NNE. At 0100Z (06/11) HS3 was airborne, and at 0110Z began top seeding storm #3 S of Caroline with EJs and BIP flares. HS3 reported a steep radar gradient and intensifying lightning as they continued to seed the storm. As the storm left the project area, HS3 stopped seeding and RTB at 0318Z (06/11). They landed in YQF at 0336Z (06/11). HS1 was launched SW of Cochrane at 0317Z (06/11) after a cell showed up on radar. By the time they were airborne, the cell had diminished and they were instructed to patrol without seeding. At 0400Z (06/11), they RTB after radar and pilot observations showed the storm was not a hail threat. They landed in YYC at 0413 (06/11). <u>Flight Summary</u> HS4: 1654-1725Z; no seeding. Mx flight S of Red Deer to test Airlink tracking. HS2: 2147 (06/10)-0102Z (06/11); 3 BIP, 300 min acetone generator time; storm #1 SW Cochrane. HS1: 2210 (06/10)-0210Z (06/11); 119 EJ, 3 BIP; storm #1 SW Cochrane. HS3: 2240-2353Z; 18 EJ; patrol W of Caroline, storm #2 S of RMH. HS 4: 0035 (06/11)-0345Z (06/11); 1 BIP, 300min acetone generator time; Storm #3 SW of Caroline. HS3: 0052 (06/11)-0339Z (06/11); 295 EJ, 14 BIP; Storm #3 SW Caroline. HS1: 0325 (06/11)-0418Z (06/11); No seeding; patrol W of Cochrane.
June 11, Saturday	An upper level trough remained over British Columbia. Several vorticity lobes slowly passed over the project area during the day. Low pressure remained over the area during the morning and afternoon hours. This surface low was progged to move off to the southeast overnight. Rain showers were visible on radar all day. During the early afternoon, strong storms exploded in the eastern buffer and moved to the northeast away from the project boundaries. Stratus and widespread convective showers lingered over the project area throughout the period. Max cell top: 12.1km, 63.5 max dBz, 87.3 max VIL	No aircraft operations.

	Tmax YC = 12.0C and 7.2mm of rain. Tmax QF = 15.1C and 6.0mm of rain. Tmax Radar = 13.1C and 3.6mm of rain.	

ALBERTA HAIL SUPPRESSION PROJECT 2011

DAILY SUMMARY REPORTS

WEEK No. 3

Date	Weather	Activities Summary
June 12, Sunday	An upper level trough was centered over Alberta for most of the day. The trough axis shifted towards eastern AB overnight. A shortwave trough moved from W to E across the project area during the early afternoon hours. Vorticity advection was minimal along the trough. A surface low pressure system was positioned along the AB and Saskatchewan border. Towering cumulus was observed in the late morning, and radar echoes began popping up around briefing time. Storms lasted all day, initiating mainly along a shortwave trough moving through the area. Storm motion was toward the ENE throughout the day. West of the shortwave, there was minimal activity until the early evening when a storm initiated over the mountains and moved E towards Sundre. As the storm moved into the project area, it became organized and began to move right, spawning additional cells in its outflow boundary. The atmosphere stabilized in the late evening. All convective activity ceased and there was no precipitation overnight. Max titan cell top=9.9km, 67 max dBz, 83.4 max VIL Tmax YC = 18.4C and 0.2mm of rain. Tmax QF = 18.2C and 0.4mm of rain. Tmax Radar = 18.0C and 1.6mm of rain.	HS4 was launched at 1750Z to a cell S of Sundre. They were airborne at 1803Z and began base seeding storm #1 at 1824Z. This storm quickly dissipated. HS4 stopped seeding at 1830Z and was redirected to a cell near Southern Calgary. HS4 began seeding storm #2 with generators at 1854Z. At 1921Z, storm #2 was dissipating so HS4 repositioned to the north and began seeding storm #3 W of Cremona. Storm #3 then diminished on TITAN, and HS4 repositioned to storm #5 W of Airdrie and began seeding at 2011Z. In response to strengthening inflow and radar signature, HS4 began using flares at 2023Z. Storm #5 began to weaken significantly after this, and as it ceased to be a hail threat, HS4 stopped seeding and RTB at 2106Z. They landed at 2136Z. HS3 was launched at 1933Z for a cell W of Didsbury. HS3 was airborne at 1959Z. Storms intensified W of Caroline and Eckville, and HS3 was directed to the area. At 2017Z, HS3 began seeding storm #4 W of Caroline with EJs. They descended to shed ice at 2109Z, and resumed seeding at 2141Z. At 2156Z, HS3 had stop seeding due to conflict with skydiving operations. Seeding resumed at 2205Z. HS3 had to stop seeding for parachute traffic again at 2220Z, and decided to descend to shed ice. At 2245Z, HS3 was able to begin climbing again. They seeded storm #6 with BIPs during the climb. The Red Deer cell quickly weakened below hail criteria, and HS3 RTB at 2258Z. They landed at 2308Z. HS2 launched as a top seeder at 2023Z for storm #5 W of Airdrie. At 2041Z, HS2 was airborne. HS2 ignited burners at 2049Z on storm #5 and used BIPs during the climb to cloud top as well. This cell near Airdrie quickly diminished. At 2113Z, HS2 stopped seeding and began patrolling S of Cochrane. At 2200Z, HS2 descended to cloud base, and repositioned to the E side of the line of thunderstorms W of Innisfail. At 2233Z, HS2 began base seeding storm #6 between Innisfail and Red Deer with generators and BIPs. As the cell moved beyond Innisfail, HS2 stopped seeding storm #6 at 2309Z. They were then directed to patrol NW of Sundre. When radar and pilot observations indicated no seedable activity in the Sundre area, HS2 RTB at 2345Z. They landed at 0003Z (06/13).

		HS1 launched for top seeding at 0003Z (06/13) on the cell NW of Sundre which HS2 had patrolled earlier. At 0021Z (06/13), HS1 was airborne. They began top seeding storm #7 W of Sundre at 0049Z (06/13). Pilots reported a difficult time finding good feeder clouds. HS1 moved further to the west. They found good growth along the south side of the storm and continued seeding. At 0254Z (06/13), HS1 reported fewer feeder clouds, and TITAN also showed the storm diminishing. By 0336Z (06/13), the storm was below hail criteria, and HS1 RTB. They landed at 0350Z (06/13). Up to 22mm hail was reported W of Sundre. HS4 was launched for base seeding at 0045Z (06/13) for the hailstorm NW of Sundre to work with HS1. HS4 was airborne at 0109Z (06/13) and advised by the radar of severe overhang on the eastern and southern areas of this cell. They commenced seeding with acetone generators and BIPs at 0115Z (06/13). HS4 found very good inflow, which continued for the next 2 hours. HS4 RTB at 0336Z (06/13) when TITAN and pilot observations showed the cell diminishing below hail criteria. They landed at 0354Z (06/13). <u>FLIGHT SUMMARY</u> HS4: 1754-2141Z; 304 min acetone generator time, 10 BIP; patrol SW of Calgary, #2 Calgary, #3 Cremona, #5 Airdrie. HS3: 1947-2311Z; 143 EJ, 15 BIP; #4 Caroline to Eckville, #6 Red Deer. HS2: 2034Z (06/12)-0005Z (06/13); 112 min acetone generator time, 4 BIP; #5 Airdrie, patrol SW Calgary, #6 Innisfail, patrol NW of Sundre, patrol W of Caroline. HS1: 0015Z (06/13)-0355Z (6/13); 213 EJ, 8 BIP; #7 Sundre HS4: 0100Z (06/13)-0354Z (6/13); 258 min acetone generators, 5 BIP; #7 Didsbury
June 13, Monday	The upper level jet was well to the southwest. Midlevel charts indicated a shortwave trough approaching from the west with a few small vorticity maxima expected to move through during the day. Upper levels were relatively warm in the morning, but gradually cooling throughout the day. There was abundant low level instability below 7.5km, but only minimal instability above 7.5km. Widespread low topped thundershowers were forecast to occur throughout the afternoon with a few isolated cells expected to reach up to 30kft. Stratus rain was expected overnight. Convective rain showers began in the early afternoon over the entire project area as vorticity advection occurred. The cells inside the project area were mainly pulse type storms with low tops, heavy rain, and no hail. In the early evening, two bowing cells initiated over the mountains and moved into the project area. One of these was visually observed from the Olds radar. The storm had a shelf cloud on the east side for a brief time. These	No aircraft operations.

	cells quickly diminished below hail criteria. Max titan cell top=8.4km, 62.5 max dBz, 37.8 max VIL Tmax YC = 18.6C and 2.6mm of rain. Tmax QF = 21.4C and 6.6mm of rain. Tmax Radar = 20.0C and 0.6mm of rain.	
June 14, Tuesday	The upper level jet remained south of the project area. A developing low pressure system was approaching the west coast, progged to develop into a deep closed low during the forecast period. A weak N/S oriented lobe of midlevel vorticity was progged to push through from the W during the afternoon and evening. At the surface, a low pressure trough was centered over NW Saskatchewan. The atmosphere was slightly unstable below 25kft with weak wind shear. Weak convection was forecast during the afternoon/evening with no hail expected. Thick cloud layers, stratus rain, and low ceilings were forecast for the overnight hours. Beginning in the early afternoon, vorticity advection over the area set off a line of rain showers. Lightning was observed in some of the storms, and some reached hail threat criteria. Storms grew slowly and glaciated rapidly. No long-lived multicellular storms were observed. In the early evening, a shortwave feature visible on radar moved in from the north and triggered storms in the northern part of the project area. These storms would develop dark rain shafts and good shelf clouds, but dissipate after the initial push due to lack of wind shear. Around sunset, all storms diminished becoming light convective rain showers and stratiform rain. Max titan cell top=8.4km, 63 max dBz, 32.3 max VIL Tmax YC = 18.9C and no rain. Tmax QF = 19.6C and a trace of rain. Tmax Radar = 19.0C and 4.4mm of rain.	HS1 was launched on growth W of Didsbury at 2016Z, and was airborne at 2035Z. They patrolled W of Didsbury reporting glaciated clouds and no feeders. They were then directed to patrol cells W of Acme at 2053Z and reported similar conditions. HS1 then RTB to YYC 2109Z. They landed at 2131Z. HS4 was launched at 0143Z (06/15) for a cell W of Innisfail, and became airborne at 0158Z (06/15). As they approached the storm, HS4 reported a shelf cloud and heavy rain on storm #1 and lit acetone generators at 0207Z (06/15). HS4 soon found inflow up to 800fpm and began lighting BIPs as well. HS4 worked a long line from Innisfail to Bowden until the storm was past these two towns. At 0249Z (06/15), HS4 stopped seeding and was redirected to a cell NW of Penhold for patrol. Finding no good bases and poor inflow on the cell, HS4 RTB at 0307Z (06/15). They landed at 0319Z (06/15). <u>Flight Summary</u> HS1: 2025Z-2131Z; patrol W Didsbury, patrol W Acme. HS4: 0148Z (6/15) – 0322Z (06/15); 6 BIP, 104 min acetone generator time; Storm #1 W Innisfail, patrol N Caroline.
June 15, Wednesday	A deep low pressure system was centered over the region. The upper jet core remained to the south of Alberta. Multiple intense pockets of vorticity were progged to wrap around the upper low and push through the project area from the N during the evening and overnight hours. Afternoon and evening instability was weak, and the shear profile was not favorable for long-lived convection. Upper level winds were from the NNE due to the position of the upper level circulation. Surface winds were westerly due to the position of a surface low over Saskatchewan. Weak thundershowers were forecast during the afternoon and evening with tops expected to remain below 25kft. Stable conditions were expected after midnight with widespread stratus rain and low ceilings through morning. Light rain showers occurred over the southern half of the project area during the afternoon. Clouds were predominantly fair weather cumulus, and everything remained below hail criteria. In the early evening, a line of strong cells initiated north of Calgary moving south. These cells quickly diminished in strength, and passed	HS1 was launched at 0056Z (06/16) on cells north of Calgary. They were airborne at 0110Z (06/16) and directed to the north side of the cells. They reported embedded conditions throughout the flight, but they were able to find adequate liquid water and began seeding with BIPs at 0138Z (06/16), making East-West passes. By 0206Z (06/16), both radar and pilot reports indicated the cells were diminishing in intensity. At 0214Z (06/16), HS1 stopped seeding and began patrol. HS1 RTB at 0227Z (06/16) as the cell continued to die out. They landed at 0236Z (06/16). <u>Flight Summary</u> HS1: 0102Z (06/16)-0240Z (06/16); 6 BIP; #1 NE of YYC.

	through Calgary as rain showers. Overnight, some rain showers occurred. Max titan cell top=8.4km, 62.5 max dBz, 34.4 max VIL Tmax YC = 14.9C and 5.8mm of rain. Tmax QF = 16.6C and 3.0mm of rain. Tmax Radar = 16.0C and 12.0mm of rain.	
June 16, Thursday	A deep low pressure system remained in place over the region, centered just east of the project area over far eastern AB. Ample amounts of vorticity advection were expected throughout the day and overnight hours as lobes of vorticity wrapped around the north side of the low and pushed through the project area. A surface low was also centered just to the east of the project area. Forecast soundings indicated weak to moderate instability during the afternoon and evening with a weak wind shear profile. The atmosphere was expected to stabilize overnight. Afternoon and evening thundershowers were expected with small hail possible. Rain showers were also expected to occur throughout the forecast period. Convective rain showers fell over the project area for most of the day. Convective development was strongest during the afternoon hours over the northern part of the project area, near Sylvan Lake and Red Deer. The evening and overnight hours saw continued rain showers, especially over the Sundre region. Max titan cell top=9.1km, 61 max dBz, 38.4 max VIL Tmax YC = 11.5C and 19.6mm of rain. Tmax QF = 13.6C and 24.2mm of rain. Tmax Radar = 11.5C and 12.5mm of rain.	HS3 was launched to the north of YQF at 1907Z. The flight became airborne at 1925Z and quickly found growth near the YQF airport and over the YQF area. HS3 started seeding storm #1, over YQF, at 1934Z. The crew reported minimal growth over YQF at 1940Z, so the flight was redirected towards new and stronger growth south of the Lacombe area. The aircraft started seeding storm #2, northeast of Sylvan Lake, at 2000Z. HS3 continued to seed this storm until it was south of Sylvan Lake. The aircraft then stopped seeding at 2031Z and RTB as the activity diminished. They landed at 2043Z. <u>Flight Summary</u> HS3: 1920-2047Z; 114 EJ, 9 BIP; #1 over YQF, #2 NE of Sylvan Lake.
June 17, Friday	The deep low pressure system over the region was shifting slightly to the east over SK during the period. A small amount of midlevel vorticity was expected to move through the region. A surface trough was draped over the northeastern portion of the project area during the early afternoon. The atmosphere was slightly unstable. The wind shear profile was very weak and cell motion was expected to be from the northeast at less than 5 knots. Weak popup single cells were expected during the afternoon. Cells were expected to develop and dissipate rapidly with tops less than 28kft. Clearing was expected during the evening and overnight hours. A line of nearly stationary popup convection formed over the eastern buffer during the morning hours. This line moved southwestward into the project area. Another line of thunderstorms extending from Ponoka to Stettler moved into the northeastern part of the project area. These storms were the strongest of the day but were short lived due to the weak shear profile. The rest of the day saw weak pop-up convection but not significant hail threats. Max titan cell top=9.1km, 61 max dBz, 34.2 max VIL Tmax YC = 15.6C and 1.4mm of rain. Tmax QF = 16.4C and 2.8mm of rain. Tmax Radar = 15.5C and a trace of rain.	HS3 was launched at 2214Z northeast of YQF for a marginal hail threat developing in the northern buffer zone. The flight was airborne at 2231Z. The crew found good liquid water at 2243Z and began top seeding. Seeding stopped at 2249Z once the pilots determined the new growth was only reaching 20kft. The flight RTB at 2259Z and landed at 2307Z. HS4 flew a night currency flight over the YQF area. <u>Flight Summary</u> HS3: 2224-2310Z; 18 EJ, 1 BIP; #1 NE of YQF. HS4: 0445 (06/18)-0548Z (06/18); no seeding, currency flight over YQF.

June 18, Saturday	The deep low pressure system over the region shifted back toward the west. It was centered over the AB/SK border. At the surface, a trough of low pressure was located east of the project area near the SK border. The atmosphere was stable throughout the forecast period. Heavy stratiform rain was expected throughout the day and overnight hours along with gusty northwesterly surface winds and low ceilings. Stratiform rain showers fell over the region for most of the day. A few short lived convective cells formed in the buffer zone northeast of Red Deer during the early evening. There were no hail threats. Max titan cell top=6.9km, 59 max dBz, 17.7 max VIL Tmax YC = 13.6C and 10mm of rain. Tmax QF = 12.2C and 15mm of rain. Tmax Radar = 12.0C and 11mm of rain.	No aircraft operations.

ALBERTA HAIL SUPPRESSION PROJECT 2011
DAILY SUMMARY REPORTS
WEEK No.4

Date	Weather	Activities Summary
June 19, Sunday	The stacked low remained the main weather feature on the map, located over the Alberta-Saskatchewan border. PVA supplied by the low was forecast to keep cloud cover thick, limiting severe convection as surface temperatures remained low. Some convection was expected in the early evening. The low level cloud cover started to become broken during the early afternoon which allowed surface heating to occur. The southern half of the project area received more insolation which allowed for slightly stronger convection to develop. The most organized cells formed during the late afternoon and early evening hours. These storms mainly occurred along the western project area boundary. The northern half also saw lots of convection, but cell tops rarely grew above 6km. Max cell top: 9.9km, 63 max dBz, 37.5 max VIL. Tmax YC = 18C and 1.4mm of rain. Tmax QF = 17C and 7.4mm of rain. Tmax Radar = 16C and 0.6mm of rain.	HS2 was launched at 2226Z because of cell development NW of Cochrane. At 2243Z, HS2 became airborne. Seeding began on storm #1 over northwestern Calgary at 2254Z. Then at 2310Z the pilot reported that the storm was beginning to weaken. HS2 stopped seeding storm #1 over Calgary at 2335Z. The flight was redirected to NW of Airdrie and patrolled for a short time before being RTB at 2349Z. HS2 was launched for a second base seeding flight at 0016Z (06/20) to an intensifying cell NW of Turner Valley and Black Diamond. The flight became airborne at 0030Z (06/20). The aircraft was forced to maneuver around a weak cluster of cells to the south of Calgary before intercepting the main cell. Once the crew arrived, they quickly found inflow and started seeding storm #2 NW of the towns of Turner Valley and Black Diamond at 0045Z (06/20). HS2 continued seeding the storm until it started to enter the southern buffer zone. HS2 stopped seeding at 0145Z (06/20) and was redirected to new growth near the Calgary airport. The flight ended up patrolling northern Calgary until 0230Z (06/20) when HS2 RTB. <u>Flight Summary</u> HS2: 2239Z (06/19)-0007Z (06/20); 2 BIP, 82 min acetone generator time; #1 NW YYC, patrol NW of Airdrie. HS2: 0025Z (06/20)-0301Z (06/20); 8 BIP, 120 min acetone generator time; #2 NW of Turner Valley and Black Diamond, patrol northern Calgary.
June 20, Monday	The low pressure system moved to the east and weakened. There were no upper level triggers. Clearing in the morning indicated a very warm day was likely. High temperatures were forecast to be well above convective temperature, providing the primary trigger for the day. Although instability was good, shear was poor, so storms were expected to be "pop-up" and short lived. Convection developed over the mountains during the late morning hours and began to move over the foothills around noon. Several moderately strong cells then moved off the foothills during the early afternoon hours. The most intense storms formed near the Cochrane area. One of these storms (#2) moved eastward through northern Calgary and Airdrie. Once this storm moved to northeastern Calgary, another strong cell developed near Cochrane and slowly moved to the south-southeast. The project area to the north of Calgary saw several multicellular storms which produced moderate to heavy	HS1 was launched at 1822Z to growing cells southwest of Calgary. By the time the flight became airborne at 1843Z, the cells were diminishing SW of Calgary, so the aircraft was redirected towards a developing cell NW of Calgary. HS1 started seeding this storm (#1) at 1904Z. Next the crew reported strong multicellular growth over the Springbank area and started seeding this storm (#2) at 1925Z. HS1 continued to find decent growth and followed the storm eastward across the project area. At 2154Z, HS1 stopped seeding and RTB. HS2 was launched to a growing cell NW of Okotoks at 1910Z. The aircraft became airborne at 1924Z. HS2 started seeding storm #3 NW of Okotoks at 1946Z. HS2 continued to seed the storm until it was over Okotoks. The

	rain showers across this region during the later afternoon and evening. Overnight, the area saw weak scattered rain showers. Max cell top: 10.6km, 65.5 max dBz, 69.4 max VIL. Tmax YC = 18C and 2.8mm of rain. Tmax QF = 19C and no rain. Tmax Radar = 19C and 10.5mm of rain.	aircraft was then redirected to growing convection over northwestern Calgary. HS2 started seeding storm #2 over northwestern Calgary at 2010Z. The aircraft then remained along the southern end of the cell as it moved eastward towards northern Strathmore. At 2141Z, HS2 repositioned to new cells W of Calgary. Then at 2202Z the aircraft began seeding storm #4. At 2254Z HS2 stopped seeding and RTB. HS3 was launched at 2104Z to replace HS1 who was getting low on fuel and chemical, but once HS3 became airborne at 2124Z, the aircraft was redirected to new development W of Calgary (Storm #4). HS3 started seeding at 2153Z. The aircraft continued to seed the storm until it ran out of flares. HS3 stopped seeding and RTB at 2330Z. HS4 was launched at 2143Z to the same storm (#4) that HS3 was working W of Calgary. The flight became airborne at 2200Z and headed toward Springbank. At 2230Z, HS4 started seeding Storm #4 W of Calgary. The flight continued to seed the storm as it moved south-southeastward through the towns of Turner Valley, Black Diamond, and High River. HS4 stopped seeding at 0117Z (06/21) and RTB. HS1 was launched for a second flight at 2256Z to take over seeding for HS3 on a cell SW of Calgary. HS1 was airborne at 2312Z. The aircraft climbed to cloud top and headed down south along the SE side of the main cell. The flight started seeding Storm #4 at 2331Z, making east-west passes along the southern end of the storm. Then at 0025Z (06/21), HS1 was not finding any growth on Storm #4 W of Okotoks so the flight was redirected to convection W of Didsbury. The aircraft briefly seeded these cells (Storm #5). HS1 stopped seeding at 0057Z (06/21) and then patrolled NW of Calgary. The aircraft RTB at 0132Z (06/21). <u>Flight Summary</u> HS1: 1836-2214Z; 230 EJ, 6 BIP; #1 NW of YYC, #2 over Springbank. HS2: 1918-2305Z; 21 BIP, 340 min acetone generator time; #3 W of Okotoks, #2 NW YYC, #4 YYC. HS3: 2114Z (06/20)-0002Z (06/21); 298 EJ, 11 BIP; #4 W of YYC. HS4: 2150Z (06/20)-0209Z (06/21); 17 BIP, 320 min acetone generator time; #4 W of YYC. HS1: 2305Z (06/20)-0148Z (06/21); 39 EJ, 6 BIP; #4 W of YYC, #5 W of Didsbury, patrol NW of YYC.
June 21, Tuesday	Mostly clear skies with some morning towering cumulus indicated an active day. There was some mid-level	HS4 was launched at 1846Z to a cluster of cells to the W of Rocky MH. As the flight became

	ridging during the day, and soundings indicated slight capping until early evening. High forecast surface dewpoints and temperatures, as well as excellent speed shear made for an unstable hail-type sounding. Storms were expected to initiate along the mountains due to orographic lift in the late afternoon, and would be concentrated in the northern part of the project area where the ridging was weaker. Convection first started to form over the mountains W of Rocky MH during the late morning hours. This line of cells eventually moved eastward during the afternoon. The further this line moved to the east, the more intense the cells became. One major storm moved southeastward away from the line through Sylvan and part of Red Deer. Around 00z another strong storm developed NW of Rocky MH and made its way southeastward through Rocky MH. Once this very intense storm began to diminish, another series of cells popped up W of Sundre and eventually made its way through Red Deer. Max cell top: 11.4km, 69.5 max dBz, 119.6 max VIL. Tmax YC = 22C and no rain. Tmax QF = 22C and 0.4mm of rain. Tmax Radar = 22C and a trace of rain.	airborne at 1904Z, the convection near Rocky MH diminished, so the flight was redirected towards new growth to the south of Red Deer. The aircraft began seeding at 1918Z and briefly seeded Storm #1. HS4 then patrolled the Red Deer area. At 2040Z, HS4 was redirected to convection S of Lacombe. The flight did not find any active growth near Lacombe, so the flight was then redirected to a new storm (#2) SW of Sylvan. The aircraft started seeding this storm at 2056Z. HS4 continued to seed this storm until a stronger line of convection developed NW of Sylvan. The crew started seeding storm #3 at 2135Z. The flight continued to seed this storm as it passed over Sylvan and part of Red Deer. At 2316Z HS4 stopped seeding and RTB. HS3 was launched at 2102Z to a strengthening line of cells stretching from Rimbey to NW of Sylvan. The flight became airborne at 2121Z. The aircraft started seeding at 2132Z upon arrival along the southern portion of the line of convection. The flight continued to seed this storm as it passed over Sylvan and part of Red Deer. At 2317 HS3 reported that the storm was beginning to come down in intensity. Then at 2320Z the aircraft stopped seeding and patrolled the Red Deer area. HS3 RTB at 2335Z. HS1 was launched at 0028Z (06/22) to a rapidly growing cell NW of Rocky MH. The flight became airborne at 0049Z. By the time the aircraft arrived to seed the storm (#4) at 0120Z (06/22), the intense storm was already over the Rocky MH region. HS1 continued to seed the storm as it moved towards Innisfail. The aircraft stopped seeding the cell at 0208Z (06/22) and was redirected to a new storm (#5) W of Sundre. The flight started seeding this storm at 0301Z (06/22). This storm eventually began to diminish, so HS1 started seeding storm #6 SW of Sylvan at 0423Z (06/22). This convection eventually became fairly embedded, so the aircraft was forced to reposition itself on the southeastern side of the storm. HS1 stopped seeding at 0514Z (06/22) and RTB. HS4 was launched for a second flight at 0135Z (06/22). The flight became airborne at 0145Z (06/22) and started seeding storm #4 at 0156Z (06/22) NW of Innisfail. HS4 stopped seeding at 0214Z (06/22) and was redirected to new cells S of Rocky MH. HS4 found no new growth while patrolling between Caroline and Rocky MH, so the flight RTB at 0223Z (06/22). HS2 performed a patrol flight W of Sundre and over the Cochrane area. The aircraft was launched at 0301Z (06/22) and became airborne at 0320Z (06/22). HS2 found no inflow

		along storm #5, so it was redirected to patrol the Cochrane area for a short time before being RTB at 0416Z (06/22). HS4 was launched for its third flight of the day at 0455Z (06/22) due to embedded convection to the W and S of Red Deer. The flight became airborne at 0511Z (06/22) and started seeding storm #6 W of Red Deer at 0516Z (06/22). Then at 0516Z (06/22) the aircraft found a good pocket of 500fpm inflow. HS4 eventually stopped seeding at 0547Z (06/22). HS4 decided to land at the Olds-Didsbury airport for a short time to wait out the storms passing over the Red Deer airport. Once the convection had passed the airport in Red Deer, HS4 took off at 0656Z (06/22) from the Olds-Didsbury airport and landed at the Red Deer airport at 0715Z (06/22). <u>Flight Summary</u> HS4: 1855-2327Z; 16 BIP, 292 min acetone generator time; #1 S of YQF, #2 SW of Sylvan, and #3 NW of Sylvan. HS3: 2113-2346Z; 229 EJ, 13 BIP; #3 NW of Sylvan. HS1: 0035Z (06/22)-0549Z (06/22); 172 EJ, 18 BIP; #4 NW of Innisfail, #5 W of Sundre, and #6 SW of Sylvan. HS4: 0138Z (06/22)-0248Z (06/22); 36 min acetone generator time; #4 NW of Innisfail. HS2: 0316Z (06/22)-0431Z (06/22); no seeding; patrol W of Sundre and over Cochrane. HS4: 0503Z (06/22)-0605Z (06/22); 1 BIP, 62 min acetone generator time; #6 W of YQF; landed at Olds-Didsbury airport due to storms over the Red Deer airport. HS4: 0650Z (06/22)-0718Z (06/22); no seeding; flew a ferry flight from Olds-Didsbury airport to Red Deer once the storms had moved to the east of the airport.
June 22, Wednesday	A 500mb ridge provided clear skies during the morning, allowing temperatures and dewpoints to increase rapidly. The sounding for the day was impressive, showing an unstable atmosphere with good speed shear. There were numerous triggers during the day but the ridge was expected to delay convection until later in the day. Troughing was progged to begin by the evening hours, coupled with an area of moderate PVA. Winds had a strong easterly component which was thought would aid in storm initiation. The project area was mostly clear throughout the forecast period. A few towering cumulus were observed over the foothills and north of Rocky MH. Some of the towering cumulus developed into virga and very weak radar echoes. There was nothing remotely seedable all day. The atmosphere was indeed moderately unstable, but it remained capped due to upper level ridging. Tmax YC = 23C and no rain. Tmax QF = 24C and 1.6mm of rain.	No aircraft operations.

	Tmax Radar = 23C and no rain.	
June 23, Thursday	A low pressure system was developing east of the Rockies, with a cold front expected to make its way through the area, followed by the trough axis. High temperatures and dewpoints made for an unstable atmosphere, while speed and directional shear were conducive to severe storms. The first wave of convection was forecast to occur before 3pm as the cold front moved through the project area, with another event beginning after 6 pm as the trough axis moved through. The overnight forecast was for clear skies as temperatures dropped, stabilizing the atmosphere. Rapidly growing embedded thunderstorms formed just south of Springbank within an hour after the noon briefing. A long line of intense hail storms developed along a cold front from YYC to Rocky MH with cells moving northward along the front. There were multiple significant hail threats along this line with the most significant cells over Airdrie, Eckville, and Rimbey. All aircraft were utilized for seeding this line of storms. By late afternoon, the cold front had moved to the NE of the project area, but the upper level trough axis was approaching west of Banff. Another line of intense convection was observed on radar approaching far to the west. As the first wave moved out, all aircraft were directed to RTB and prepare for another round of seeding to begin shortly. The second wave of hailstorms then developed from Rocky MH toward YYC and moved toward the northeast along a mesoscale frontal boundary that was visible on radar. This second wave of hailstorms was somewhat weaker than the first with lower echo tops and less intense radar reflectivity. Three aircraft were utilized for this second wave. All cells dissipated before sunset. The project area was cold, clear and stable overnight. Max cell top: 12.9km, 65.5 max dBz, 60.7 max VIL. Tmax YC = 25C and .2mm of rain. Tmax QF = 25C and a trace of rain. Tmax Radar = 23C and .22mm of rain.	HS2 was launched at 1834Z for new cells developing southwest of YYC. They were airborne at 1853Z and began base seeding storm #1 SW of YYC at 1905Z. They continued to work a developing hailstorm over YYC as it moved northward toward Airdrie. The best inflow and new growth was on the N to NE side of the cells. At 2025Z, HS2 was redirected to another area of growth approaching Innisfail. They began seeding storm #2 SW of Innisfail at 2032Z. They continued to work this line of cells toward the north along with HS3 at cloud base. At 2127Z, the Innisfail cells diminished and HS2 started working the northern end of the line near Sylvan as HS3 pulled off in order to ascend to cloud top. HS2 was eventually replaced by HS4 N of Sylvan. HS2 stopped seeding at 2146Z and RTB to YYC to prepare for another wave of activity. They landed in YYC at 2228Z. HS1 was launched at 1847Z for top seeding over SW YYC. They were airborne at 1910Z and began seeding storm #1 at 1915Z dragging BIPs through their climb to cloud top. Pilots reported excellent liquid water and updrafts over the YYC and Airdrie area. At 2020Z, HS1 had descended to shed airframe icing. At 2022Z, HS1 began seeding storm #2 near Innisfail. They continued to work the same storm as it moved northward toward Eckville. At 2140Z, HS1 was out of flares and was replaced at cloud top by HS3 near Bentley. HS1 RTB at that time and landed in YYC at 2210Z to prepare for another wave of activity approaching from the west. HS3 was launched at 1925Z toward a line of development southeast of Rocky MH. They were airborne at 1947Z and reported excellent seedable bases extending from Rocky MH toward Airdrie. HS3 was directed to turn south and begin base seeding with BIPs. They began seeding storm #2 at 2009Z working from just NW of Olds to just S of Didsbury. HS3 continued base seeding the line as it pushed toward the north near Sylvan. At 2132Z, HS3 was directed to stop base seeding, ascend for top seeding and replace HS1 near Eckville. They began top seeding storm #2 at 2140Z. At 2217Z, the storm began to weaken and HS3 RTB to YQF to prepare for another wave of activity coming from the west. They landed at 2228Z. HS4 was launched at 2124Z for base seeding near Sylvan. They were airborne at 2141Z and began base seeding storm #2 at 2143Z. They worked the north end of the line from Eckville to Rimbey until the storm moved out of the project

		area to the north. At 2239Z, HS4 stopped seeding storm #2 and repositioned to the south intending to patrol near Cochrane as another wave moved in. They reached the Cochrane area at 2321Z and were then directed to land in YYC to top off their fuel and generators. They landed in YYC at 2332Z. HS3 was launched again at 0000Z (06/24) for development near Caroline moving toward Rocky MH. They were airborne at 0022Z (06/24) and began patrol S of Rocky MH at 0035Z (06/24). They then began top seeding storm #4 S of Caroline at 0126Z (06/24). At 0148Z (06/24), HS3 stopped seeding storm #4 and repositioned to the east near Carstairs. They began top seeding storm #3 at 0200Z (06/24). They descended to shed ice at 0208Z. After climbing back to cloud top, the storm was dissipating and seeding was halted. HS3 was directed to RTB at 0250Z (06/24). As HS3 was arriving near YQF, they reported new growth directly over the airport. They were instructed to cancel their RTB and began top seeding storm #5 over YQF at 0258Z (06/24). The cell quickly pulsed up and down and dissipated between Sylvan and Red Deer. HS3 RTB to YQF at 0325 (06/24) and landed at 0331Z (06/24). At 0011Z (06/24) HS4 was directed to relaunch out of YYC as soon as they were finished refueling and filling the generators. At 0103Z (06/24) the aircraft was ready and airborne with full fuel and chemical. They headed northeast of Cochrane and began base seeding storm #3 near Carstairs at 0121Z (06/24). At 0132Z (06/24), HS4 reported excellent inflow and a large shelf cloud connecting two cells. HS4 was then pushed out to the east of the storm by a mesoscale frontal boundary while the storm dissipated over the radar. At 0244Z (06/24), there were no hail threats and HS4 was directed to stop seeding and RTB. As they were heading home at 0303Z (06/24) they briefly patrolled a dissipating cell over the YQF airport. No inflow was found. They landed in YQF at 0325Z (06/24). HS2 was launched again at 0141Z (06/24) for hailstorms from Carstairs to Olds. HS2 was airborne out of YYC at 0158Z (06/24) and began patrolling at cloud base near Carstairs in the same area with HS4. The storm was already dissipating by the time they reached the area, and no inflow was found. HS2 was directed to RTB at 0236Z (06/24). No seeding occurred on this flight. They landed in YYC at 0255Z (06/24). <u>Flight Summary</u> HS2: 1844-2230Z; 11 BIP, 320 min acetone

		generator time; #1 SW of YYC, #2 SW of Innisfail. HS1: 1858-2216Z; 275 EJ, 20 BIP; #1 Calgary, #2 Innisfail to Sylvan. HS3: 1938-2232Z; 70 EJ, 21 BIP; #2 Didsbury to Sylvan. HS4: 2130-2336Z; 108 min acetone generator time; #2 SW Lacombe, patrol Cochrane. HS3: 0016Z (06/24)-0336Z (06/24); 188 EJ, 12 BIP; #4 S of Caroline, #3 Carstairs, #5 over YQF. HS4: 0050Z (06/24)-0332Z (06/24); 8 BIP, 166 min acetone generator time; #3 Carstairs, patrol YQF. HS2: 0149Z (06/24)-0300Z (06/24); no seeding, patrol Carstairs.
June 24, Friday	An upper level low was situated over the area with multiple pockets of vorticity rotating around it. The low provided good speed shear in the sounding, and moisture from the previous day's rain over the northern half of the project area provided good instability. Dewpoints were quite low in Calgary, limiting the chance of convective activity. The main trigger was a shortwave progged to move through the project area during the afternoon. Widespread weak thundershowers developed from west to east across the project area beginning just before the noon briefing. Cells were mostly embedded, low-topped, and nonthreatening. A few afternoon cells developed into significant hail threats between Bowden and Caroline, but they were not seeded as they did not pose a threat to any project cities. These hailstorms were nearly stationary. Pea size (5-10mm) hail was reported over far southeast YQF associated with a short-lived cell that developed directly over the city. By late evening, convection ended and widespread stratus rain developed over most of the region along with gusty surface winds. The western part of the project area cleared out overnight while light stratus rain lingered over the far northeast portion of the project area until morning. No convection occurred overnight. Max titan cell top=9.9km, 65 max dBz, 73.9 max VIL Tmax YC = 17C and a trace of rain. Tmax QF = 20C and 7.8mm of rain. Tmax Radar = 22C and 1.8mm of rain.	HS1 was launched at 1832Z for new weak development southwest of YYC. They were airborne at 1847Z and began patrolling from Cochrane to Okotoks. Pilots reported nothing seedable with only shallow convection. There were no hail threats, and HS1 was directed to RTB at 1915Z. They landed back in YYC at 1929Z. No seeding occurred. HS4 was launched at 0155Z (06/25) for possible development southwest of YQF. They were airborne at 0208Z (06/25), but had to land immediately due to problems with the acetone generators. They landed at 0215Z (06/25). HS4 fixed the generator problem quickly and took off again immediately. They were airborne again at 0221Z (06/25). They patrolled west of Sylvan for a brief time, but nothing seedable was found. All activity was diminishing and HS4 RTB at 0243Z (06/25). No seeding occurred. HS4 landed in YQF at 0250Z (06/25). <u>Flight Summary</u> HS1: 1840-1934Z; no seeding; patrol Calgary. HS4: 0202Z (06/25)-0218Z (06/25); no seeding; maintenance flight due to acetone generator failure. HS4: 0218Z (06/25)-0254Z (06/25); no seeding; patrol Sylvan.
June 25, Saturday	The upper level jet was located along the southern AB/SK border. Additionally, an upper level closed low was over the central AB/SK border. A shortwave trough swung counter-clockwise around the low. Weak vorticity advection occurred along the shortwave. The atmosphere was moderately unstable with weak speed shear. Weak thundershowers moved through the region during the afternoon and early evening. In the late afternoon, one isolated cell developed a 7.6km top east of Bowden. Another small area of threatening cells developed upwind of Red Deer in the late afternoon which seemed to be growing larger and taller, but the cells diminished before reaching any cities. There were no significant hail storms. The project area was stable overnight.	HS4 was launched at 2329Z for weak cells developing in the buffer zone northwest of YQF. They were airborne at 2350Z and patrolled for a short time near Sylvan Lake. The cells in the area were completely dissipating at that time and nothing seedable was observed. HS4 RTB at 0002Z (06/26). They landed in YQF at 0009Z (06/26). <u>Flight Summary</u> HS4: 2343Z (06/25)-0012Z (06/26); no seeding; patrol Sylvan.

	Max titan cell top=7.6km, 58 max dBz, 17.8 max VIL Tmax YC = 18.8C and no rain. Tmax QF = 17.6C and 2.8mm of rain. Tmax Radar = 16.0C and 10.0mm of rain.	

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Date	Weather	Activities Summary
June 26, Sunday	The previous day's closed upper level low weakened into a trough as it moved eastward across SK. Weak ridging began to replace the trough during the early evening hours. Vorticity advection was minimal over the area. At the surface, a cold front pushed southward over northern AB and became stationary over the Edmonton area. The only trigger mechanism was surface heating, and the sounding showed weak speed shear. Rapidly developing cells occurred over the northern half of the project area from early afternoon through early evening. Cells grew to threatening heights with 9 to 10 km tops. These hailstorms were short lived. They generally dissipated within 45 minutes of formation. Cells moved quickly from N to S. All activity cleared out well before dusk, and the project area was clear overnight. Max cell top: 10.6km, 64.5 max dBz, 79.5 max VIL Tmax YC = 18.9C and 5.2mm of rain. Tmax QF = 19.9C and 1.8mm of rain. Tmax Radar = 18.4C and 3.2mm of rain.	HS3 was launched at 1950Z for rapidly developing, short lived hail storms in the NE quadrant of the project area. The aircraft was airborne at 2014Z and began top seeding storm #1 N of YQF at 2027Z. At 2117Z, HS3 repositioned to N of Sylvan and began seeding storm #2 at 2126Z. At 2146Z, HS3 repositioned to near Rocky MH and began seeding storm #3 at 2158Z. At 2210Z, HS3 repositioned to N of Olds and began seeding storm #4 at 2221Z. At 2301Z, HS3 reported they were out of flares. They were replaced by HS1 at cloud top and RTB at that time. The aircraft landed in YQF at 2312Z. HS1 was launched at 2245Z for top seeding as the replacement for HS3. They were airborne at 2304Z and headed toward the eastern project boundary. They began seeding storm #5 N of Strathmore at 2319Z. At 2347Z, they stopped seeding storm #5 and repositioned to N of Olds for patrol. They then repositioned N of Three Hills and began seeding storm #6 at 0020Z (06/27). By 0025Z (06/27), convective activity began to diminish and HS1 was directed to RTB. On the way home, they reported some new development over YYC and patrolled for a brief time. Nothing significant developed in that area, and they landed in YYC at 0117Z (06/27). HS4 was launched at 2343Z for cells near Innisfail. They were airborne at 2359Z and began patrolling 0009Z (06/27) N of Olds with only weak inflow at cloud base. At 0022Z (06/27) HS4 repositioned to near Rocky MH. Nothing seedable was observed near Rocky MH, and all convective activity started to diminish. HS4 was directed to RTB at 0106Z (06/27) without doing any seeding. They landed in YQF at 0129Z (06/27). <u>Flight Summary</u> HS3: 2000Z-2315Z; 294 EJ, 18 BIP; #1 N of YQF, #2 Sylvan, #3 N of Rocky MH, #4 Olds. HS1: 2255Z (06/26)-0120Z (06/27); 39 EJ; #5 Strathmore, #6 Three Hills, patrol YYC. HS4: 2350Z (06/26)-0134Z (06/27); no seeding; patrol Olds, patrol Rocky MH.
June 27, Monday	Jet energy was located west and south of AB. At the mid-levels, a deep low formed off the coast of BC and began creeping towards California. A weak shortwave trough passed through the project area during the late afternoon and early evening hours, and weak vorticity was	HS4 flew a PR Flight from YQF to Olds for a radar tour. They departed YQF at 1722Z and landed in Olds at 1738Z. After the tour, they returned to YQF. They departed Olds at 2135Z and landed in YQF at 2153Z.

	associated with the shortwave. The atmosphere was capped with weak speed shear. Although the atmosphere was unstable, a strong midlevel cap developed at 10kft inhibiting any deep convection. There were a few shallow towering cumulus clouds in the afternoon, but no rain. A few weak radar echoes passed close to the N border overnight, but there were no TITAN cells detected on radar. Tmax YC = 22.5C and no rain. Tmax QF = 23.5C and no rain. Tmax Radar = 22.9C and no rain.	<u>Flight Summary</u> HS4: 1712Z-1741Z; no seeding; PR flight to Olds. HS4: 2129Z-2158Z; no seeding; PR return flight from Olds to YQF.
June 28, Tuesday	An upper level trough was positioned over BC which aided in sending several lobes of vorticity over central AB. The atmosphere was potentially very unstable but was capped for most of the day. Thunderstorms were expected to be longer lived due to the decent speed and directional shear. High clouds persisted throughout the day with a few modest cumulus clouds over the foothills producing rain showers and virga. In the early evening, a cell moved through the southern half of the project area. The cell eventually grew large enough to produce lightning after leaving the project area. No aircraft operations were conducted. Max cell top: 7.6km, 51.5 max dBz, 7.0 max VIL Tmax YC = 25.8C and no rain. Tmax QF = 23.8C and no rain. Tmax Radar = 25.2C and no rain.	No aircraft operations.
June 29, Wednesday	A small upper level jet streak was positioned over the Jasper National Park area. An upper level trough remained over BC for most of the day before moving northeastward through AB overnight. A shortwave trough moved across the area during the late afternoon and early evening hours. At the surface, a low formed just north of Red Deer with a trough extending southward along the lee side of the Rockies. The main triggers were surface heating and the shortwave trough. CAPE values were near 1200J/kg. During the afternoon, strong thunderstorms were observed to the north of the project area, but no significant radar echoes occurred inside the buffer zone borders. As evening set in, a line of weak echoes formed W of Red Deer. These did not grow to thunderstorm strength, and dissipated as night fell. Overnight, there were weak rain showers over the project area as a front moved through. Max cell top: 7.6km, 55.5 max dBz, 12.7 max VIL Tmax YC = 25.9C and no rain. Tmax QF = 26.7C and no rain. Tmax Radar = 24C and no rain.	HS4 was launched at 0104Z (6/30) for weak echoes W of Red Deer. Ground observations showed slowly growing clouds with crisp tops and wide bases. HS4 was airborne at 0122Z (06/30), and they were directed to patrol the southern edge of the line. They found marginal inflow and poor bases, and as radar failed to detect any intensification, HS4 RTB at 0142Z (06/30). They landed in Red Deer at 0148Z (06/30). <u>Flight Summary</u> HS4: 0112Z (06/30)-0153Z (6/30); no seeding; Patrol W of Red Deer.
June 30, Thursday	The upper level jet was over the Vancouver area during the afternoon hours and began to nudge its way into west central AB overnight. A shortwave trough moved over the	HS2 was launched at 1849Z for a cell over Calgary. They were airborne at 1904Z and reported a dissipating cell with poor bases and

	project area overnight. A surface trough was positioned over southern AB for most of the day. The atmosphere was slightly unstable with weak convective inhibition over the northeast part of the project area. Weak echoes from cumulus clouds were apparent on radar in the late morning. Shortly after briefing, a line over Calgary began to intensify, with more cells farther to the northwest threatening the southern and central section of the project area. Cells were a marginal hail threat to a few towns, and were patrolled and seeded for some time. During the early evening, a few significant cells formed quickly over the foothills moving to the central part of the project area before dissipating into rain showers for the overnight period. Max cell top: 9.9km, 63.5 max dBz, 51.2 max VIL Tmax YC = 20C and no rain. Tmax QF = 19C and 5mm of rain. Tmax Radar = 18C and 2.4mm of rain.	marginal inflow. They were then directed to patrol a weak echo W of Okotoks, which they observed to be a cumulus cloud with very little growth and no precipitation. As conditions near Calgary and Okotoks continued to weaken, HS2 was directed to a growing cell W of Carstairs at 2007Z. They reported a heavy rain shaft, lightning, and small pockets of 500fpm inflow on the SE side of the cell. They began seeding with acetone burners at 2025Z in response to more constant 500fpm inflow. At 2101Z, HS2 began using BIPs when radar showed intensification and pilots reported inflow increasing. At 2115Z, HS2 reported the cell was weakening and stopped using BIPs. As the cell continued to weaken and moved to the E of Carstairs, HS2 RTB YYC and landed at 2220Z. At 0255Z (07/01), HS4 launched for a significant cell W of Didsbury. This storm had intense lightning and was exhibiting right-turning tendencies. HS4 was airborne at 0311Z (07/01) and reported disorganized, low bases with light rain. Radar confirmed that the cell had dissipated significantly. The cell was patrolled until HS4 RTB at 0350Z (07/01). HS4 landed at 0409Z (07/01). <u>Flight Summary</u> HS2: 1900Z-2225Z; 3 BIP, 190 min acetone generator time; patrol E of Calgary, patrol W of Okotoks, patrol W of Carstairs, storm #1 W of Carstairs. HS4: 0302Z (07/01)-0414Z (07/01); no seeding; patrol W of Didsbury.
July 1, Friday	The upper level jet was pushing into southern Alberta while a ridge was beginning to develop over the area. Strong warm air advection was occurring at midlevels. Low levels were relatively dry. There were no significant surface features or forcing mechanisms and the atmosphere was stable above 16kft. Only a very shallow layer of instability was present from 10kft to around 16kft. A few isolated convective echoes were expected with mainly just virga and/or sprinkles of rain. Widespread fair weather cumulus was expected in the afternoon. Stable conditions were expected overnight. Small convective rain showers and virga were observed on radar during the late morning through afternoon, and a layer of fair weather cumulus was present throughout the day. Clouds cleared during the evening and overnight. There were no TITAN cells. Tmax YC = 19.6C and no rain. Tmax QF = 18.2C and no rain. Tmax Radar = 17.5C and no rain.	No aircraft operations.
July 2, Saturday	The upper level jet was positioned just north of the project area over northern AB. An upper level ridge remained in place with warming and subsidence aloft. Surface dew	No aircraft operations.

	points were rising to around 8 to 10C during the day, but the thermodynamic profile was mainly stable due to the warm temperatures aloft. A Chinook arch cloud was present along the range during the morning which indicated stable conditions. A very thin layer of unstable air was present just below 16kft, but only enough to provide some afternoon fair weather cumulus. No convective precipitation was forecast. Stable, clear conditions were expected overnight. Cirrus and chinook clouds were visible during the late morning. A few isolated fair weather cumulus clouds were observed during the afternoon, but skies remained mostly clear throughout the day and overnight. There were no radar echoes through the period. Tmax YC = 23.7C and no rain. Tmax QF = 24C and no rain. Tmax Radar = 24C and no rain.	

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Date	Weather	Activities Summary
July 3, Sunday	A southwesterly upper jet was positioned over southern Alberta. A cold front and a shortwave trough were progged to push through the project area during the early afternoon hours. Low level moisture was present with surface dew points near 12C. Midlevels were cooling gradually. The atmosphere was unstable with nearly 1000 J/Kg CAPE and a Lifted Index of -5. The project area was under the left exit quadrant of the upper jet. There was decent speed shear, but poor directional shear. Severe hailstorms were expected to begin shortly after the noon briefing, lasting through the evening hours. Stable conditions were forecast for the overnight hours. In the early afternoon, convection began to initiate along the cold front as it crested the Rockies. The storms along the front were weak at first, but became more severe as the front moved through the project area. Seeding conditions were very embedded and difficult to work during this wave of convection. After frontal passage, the project area was void of storms except for the northern area, where storms began to initiate along a trough during the evening. These storms displayed strong right moving characteristics and tracked through some densely populated areas, including Red Deer. The overnight period was uneventful. Hail up to 25mm was reported in NW Red Deer. Max cell top: 12.1km, 66.5 max dBz, 88.6 max VIL Tmax YC = 26.4C and no rain. Tmax QF = 24.4C and 3mm of rain. Tmax Radar = 24.0C and no rain.	HS2 flew from Calgary to Spring Bank for refueling due to problems with the Calgary fuel truck. They were airborne at 1709Z and landed at 1718Z. They refueled successfully and were ready for operations shortly after landing. HS2 was launched from Springbank to patrol some developing storms SW of Sundre at 1740Z. They were airborne at 1758Z and reported a weak code 2 rain shaft, while radar showed some shallow embedded convection during the same period. HS2 patrolled the cells until 1849Z when they RTB YYC after no intensification of the cells was noted. They landed at 1858Z. HS1 was launched for top seeding at 1913Z in response to quickly developing cells over N Calgary and Airdrie. They were airborne at 1935Z and began using BIPs at 1947Z as they climbed to top seeding altitude and were redirected to a cell developing directly over Calgary. When they reached altitude, they found embedded conditions and began using EJs. They continued to experience low visibility and embedded conditions, and radar indicated the storm beginning to dissipate as it moved W of Calgary. At 2036Z, HS1 was redirected to Cochrane as the Calgary cell continued to dissipate. It was immediately obvious that this cell was a low topped cumulus of no threat, so HS1 RTB at 2045Z. They landed at 2100Z. HS2 was launched again to base at 1918Z to the cells over Airdrie and N Calgary. They were airborne at 1936Z and were redirected to the cells growing directly over Calgary. HS2 lit burners at 1950Z, with BIPs following shortly at 1955Z. They initially found good inflow, but by 1959 were finding only outflow, so they were directed to the E end of the cell to protect Strathmore using only acetone generators. They continued to find only outflow with visibility becoming poor. As the storm continued to weaken, they were directed to patrol SW of Calgary at 2026Z. As the cells appeared to pose no threat, HS2 RTB to Spring Bank for fuel at 2121Z. They landed in Spring Bank at 2135Z. HS3 was launched for top seeding at 1921Z on development W of Red Deer. They were airborne at 1941Z and reported a good convective base with embedded conditions at top. They had difficulty finding many feeders, but feeders had good liquid water and they

		seeded with BIPs and EJs. At 2025, HS3 stopped seeding as the main cell had passed Red Deer, and the convection to the W proved to be weak rain showers. Pilot and radar observations continued to show no threat of severe convection for Red Deer, so at 2049Z HS3 RTB Red Deer. They landed at 2055Z. HS4 was launched to cloud base for convection W of Red Deer at 1923Z. They were airborne at 1936Z. They were told to ignite burners at 1942Z, and to use BIPs beginning at 1955Z. It soon became apparent that the cells W of Red Deer posed little threat. HS4 was redirected over Sylvan Lake and told to stop using BIPs at 2003Z. They were unable to find any seedable bases, and reported poor visibility. They were directed to patrol further W over the RMH VOR on some weak cells identified on radar. They reported light rain and glaciated tops, so HS4 RTB to Red Deer at 2102Z. They landed at 2127Z. HS2 was launched again at 2210Z to patrol severe cells N of RMH. They were airborne at 2224Z, and were directed to climb to cloud top at 2307Z due to difficulty with radio communication. They began to seed lightly with EJs at 2336Z as the storm was intense and would eventually enter some target cities. They reported a lack of performance from their aircraft due to ice buildup. At 0042Z (07/04), HS3 arrived to replace HS2 at cloud top, and HS2 descended to base where they began seeding with BIPs and acetone generators at 0054Z (07/04). They continued to find excellent inflow for the duration of the storm. After the storm moved E of Red Deer, HS2 RTB to YQF at 0140Z (07/04). They landed at 0148Z (07/04). HS3 was launched again at 0012Z (07/04) to the storm N of RMH. They were airborne at 0029Z (07/04) and directed to top where they would replace HS2. They arrived and began seeding with BIPs and EJs at 0042Z (07/04), reporting excellent liquid water and very strong updrafts. They descended to shed ice at 0118Z (07/04), ascending again at 0126Z (07/04), lighting BIPs during the climb. As the storm moved E of Red Deer, they repositioned for a cell W of Innisfail which had formed along the storms outflow boundary. They seeded using only EJs beginning at 0148Z (07/04). At 0221Z (07/04), as the storm moved E of Innisfail, they were directed to stop seeding and patrol W of Olds on a towering cumulus spotted from the radar. They found the cell to be no threat. They RTB to Calgary at 0227Z (07/04). They landed at 0244Z (07/04). HS4 was launched at 0015Z (07/04) to a storm

		NW of Lacombe. They were airborne at 0036Z (07/04) and began seeding with acetone generators at 0048Z (07/04). As this storm posed little threat to Lacombe, and the storm W of Red Deer was very severe, they were directed to move to the Red Deer storm at 0101Z (07/04) leaving their acetone generators on and lighting BIPs when they arrived at the storm. They found excellent inflow and a good base, sharing the space with HS2 until the storm was E of Red Deer. At 0139Z (07/04), they repositioned to W of Innisfail, continuing to seed with generators and BIPs beginning at 0150Z (07/04). They reported intensifying and then diminishing conditions. They stopped seeding at 0224Z (07/04) as the inflow became marginal. They then RTB to YQF at 0227Z (07/04), landing at 0251Z (07/04). HS1 was launched at 0133Z (07/04) to patrol a towering cumulus W of Olds which was spotted by meteorologists and appeared to indicate storm initiation along a gust front. They reported mechanical problems and remained on the ground in Calgary. HS3 flew a reposition flight from Calgary to Red Deer after the threat of storms had passed. They were airborne at 0436Z (07/04) and landed at 0500Z (07/04). <u>Flight Summary</u> HS2: 1702Z-1720Z; no seeding; YYC to Spring Bank for fuel. HS2: 1752Z-1901Z; patrol SW Sundre, patrol SW Didsbury; no seeding; launched from Spring Bank, landed at YYC. HS3: 1935Z-2100Z; 68 EJ, 2 BIP; storm #2 Red Deer. HS1: 1925Z-2105Z; 72 EJ, 3 BIP; storm #1 Calgary to Strathmore. HS4: 1928Z-2131Z; 2 BIP, 84 min generator time; #2 Red Deer, patrol Sylvan, patrol RMH. HS2: 1928Z-2137Z; 1 BIP, 70 min acetone generator time; storm #1 Calgary to Strathmore, patrol SW of Calgary. Takeoff from Calgary, land in Spring Bank. HS3: 0024Z (07/04)-0248Z (07/04); 271 EJ, 2 BIP; storm #3 Red Deer, storm #5 W Innisfail, patrol W Olds; Landed at YYC. HS4: 0028Z (07/04)-0255Z (07/04); 12 BIP, 190 min generator time. Storm #4 Lacombe, storm #3 W Red Deer, patrol NW Innisfail. HS2: 2218Z (07/03)-0150Z (07/04); 72 EJ, 9

		BIP, 110 min generator time; patrol NW Red Deer, top seed #3 NW Red Deer, base seed #3 NW Red Deer. Takeoff Spring Bank, land Red Deer. HS3: 0426Z (07/04)-0505Z (07/04): Reposition from YYC to YQF.
July 4, Monday	A weak upper jet was positioned over central Alberta. The upper level flow was nearly zonal with no significant vorticity pushing through the region. The atmosphere was warming aloft. Southeasterly surface winds were channeling moisture into the region. Morning dew points were low and forecast to reach modest levels during the day. Weak thunderstorms were forecast during the afternoon with low tops below 25kft. The atmosphere was expected to stabilize after 8z. Afternoon dew points rose higher than expected which allowed for deep convection. Towering cumulus clouds began to slowly form over the foothills during the late afternoon hours. Most of these growing cumulus clouds were short-lived and did not become large enough to show up on radar. Around 00z, stronger growth was observed north of Sundre. This convection eventually turned into a strong TITAN cell that marched southeastward across the project area. Another strong cell formed W of this large storm and tracked southeastward through Carstairs. Overnight, the atmosphere was stable. Max cell top: 9.1km, 63 max dBz, 43.9 max VIL Tmax YC = 21.8C and no rain. Tmax QF = 20.0C and no rain. Tmax Radar = 21.0C and 8mm of rain.	HS2 flew a reposition flight from Red Deer to Calgary. The flight became airborne at 1855Z and landed at 1925Z. HS3 was launched at 0107Z (07/05) to a rapidly growing cell W of Olds. The flight became airborne at 0128Z (07/05) and found growth along the southern edge of the storm. At 0142Z (07/05) HS3 started seeding storm #1 NW of Didsbury. Then at 0147Z (07/05) the aircraft reported excellent growth. HS3 continued to seed the storm as it moved over the town of Didsbury. At 0248Z (07/05), the aircraft stopped seeding storm #1 and was repositioned toward new growth S of Sundre. HS3 started seeding storm #2 W of Didsbury at 0253Z (07/05). The aircraft fired its last EJ at 0317Z (07/05), so the aircraft dropped to base and started seeding the same storm with BIPs. At 0408Z HS3 (07/05) stopped seeding and RTB to Calgary. The aircraft landed in YYC at 0420Z (07/05). HS4 was launched to storm #1 NW of Didsbury at 0122Z (07/05). The flight became airborne at 0147Z (07/05). At 0207Z (07/05) the pilots quickly found 500fpm inflow and started seeding storm #1 NW of Didsbury. HS4 continued to seed this convection until it began to leave the project area near the town of Acme. The aircraft was then redirected to another storm (#2) NW of Carstairs. They started seeding this storm at 0402Z (07/05) and stopped seeding the storm, at 0443Z (07/05) once it was past Carstairs. The aircraft RTB at the same time, landing in YQF at 0457Z (07/05). HS2 was launched to top seed storm #2 NW of Carstairs at 0324Z (07/05). The aircraft became airborne at 0335Z (07/05). HS2 eventually found growing turrets along the southern edge of the storm and started seeding storm #2 at 0402Z (07/05). The aircraft stopped seeding the storm after it had passed over the town of Carstairs at 0445Z and RTB. The aircraft landed in Calgary at 0455Z (07/05). HS3 flew a reposition flight from Calgary to Red Deer. The flight became airborne at 0614Z (07/05) and landed at 0640Z (07/05). <u>Flight Summary</u> HS2: 1850Z-1928Z; no seeding; reposition

		flight from YQF to YYC. HS3: 0119Z (07/05)-0429Z (07/05); 300 EJ, 18 BIP; #1 NW of Didsbury, patrol NW of Olds, and #2 W of Didsbury. HS4: 0137Z (07/05)-0502Z (07/05); 308 min generator time, 17 BIP; #1 W of Didsbury and #2 Carstairs. HS2: 0330Z (07/05)-0500Z (07/05); 63 EJ; #2 Carstairs. HS3: 0606Z (07/05)-0642Z (07/05); no seeding; reposition flight from YYC to YQF.
July 5, Tuesday	The upper level jet core stretched across northern Alberta. A broad ridge was building over the region, and midlevels were warming. A significant temperature inversion was expected to develop around 15kft as the day progressed. Some weak instability was present in a shallow layer below the stable layer. The midlevel cap was expected to inhibit any low level cumulus from developing into thunderstorms. Only fair weather cumulus was expected to develop during the afternoon. Stable conditions were expected overnight. Fair weather cumulus clouds formed along the western and eastern borders of the project area during the afternoon hours. Otherwise, skies remained mostly clear and there were no radar echoes. Tmax YC = 24.3C and no rain. Tmax QF = 24.5C and no rain. Tmax Radar = 23.0C and no rain.	HS2 flew a PR Flight from YYC to Olds for a radar tour. They departed YYC at 1708Z and landed in Olds at 1723Z. After the tour, they returned to YYC. They departed Olds at 2118Z and landed in YYC at 2138Z. <u>Flight Summary</u> HS2: 1700Z-1725Z; no seeding; PR flight to Olds. HS2: 2115Z-2140Z; no seeding; PR return flight from Olds to YYC.
July 6, Wednesday	A broad ridge was positioned over Alberta. Low levels were very moist with dew points up above 12C. A warm front was draped across N Alberta and a cold front stretched from Jasper to Seattle. The atmosphere was unstable with CAPE values near 1300 J/Kg and lifted index of -4. The wind shear was weak and not sufficient for organized updrafts. There was a low level cap, but afternoon high temperatures were expected to reach convective temperature, and there was weak upslope flow. Otherwise, there were no other triggers for afternoon convection. Afternoon and evening hailstorms were forecast with a possibility for activity continuing into the overnight hours. A weak cold front was expected to approach the area late in the forecast period. Towering cumulus clouds were observed along the western project area border during the late afternoon hours. All thunderstorm activity was concentrated just north of the project area. There were no TITAN cells inside the project area. Tmax YC = 26C and no rain. Tmax QF = 26C and no rain. Tmax Radar = 25C and no rain.	No aircraft operations.
July 7, Thursday	Early morning fog and then clear skies later in the morning evidenced a very unstable and eventful day. An approaching 500mb trough was expected to initiate lee cyclogenesis during the afternoon with a series of fronts expected to be the main triggers throughout the day. Strong upslope flow was also expected to contribute to	HS3 was launched at 1933Z to a developing storm SW of Sundre. The flight became airborne at 2002Z. HS3 started low dose seeding storm #1 at 2020Z. Then at 2102Z the aircraft was redirected to storm #2 SW of Rocky MH. The flight seeded this convection

	storm initiation. The atmosphere was very unstable with good speed shear and was capped during the early afternoon, displaying a classic loaded gun type situation with a curved hodograph. Very severe convection was forecast to start in the midafternoon with supercells possible. Towering cumulus began to form over the foothills during the early afternoon hours. The southern cumulus clouds had trouble busting through the cap. On the other hand, the northern convection quickly broke through the cap and explosive cellular growth soon followed. This storm (#1) was originally back-building over the foothills and near stationary SW of Sundre, but the storm eventually became a supercell and began to move east towards Innisfail and Red Deer. The supercell dropped tennis ball sized hail near Sundre and eventually moved through Bowden, Penhold, Innisfail, and Red Deer before dissipating near the town of Lacombe. Golf ball sized hail was reported in western Red Deer while eastern Red Deer received only heavy rain. Additionally, 2.5 to 5 cm hail was reported in Penhold. This strong storm system also produced several tornadoes between Sundre and Innisfail. One tornado destroyed some rural property near Innisfail. Other storms formed over the project area during this same time period but were minimal in comparison to the supercell. Overnight, a cold front moved from W to E across central AB which triggered several weak convective TITAN cells over the region. These cells produced rain showers. Max cell top: 15.1km, 67.5 max dBz, 117.4 max VIL Tmax YC = 27C and no rain. Tmax QF = 23C and 14.2mm rain. Tmax Radar = 25C and a trace of rain.	for a short time, seeding began at 2142Z. At 2152Z, HS3 was redirected to an intensifying supercell near Sundre. The flight started seeding storm #1 again at 2216Z. Then at 2258Z the aircraft dropped to base and continued to seed storm #1. HS3 base seeded along with HS4. At 2349Z the aircraft RTB and landed at 0009Z (07/08). HS1 was launched at 1942Z to patrol the area W and SW of Calgary. The flight became airborne at 1959Z and RTB at 2214Z. The aircraft landed at 2230Z. HS4 was launched at 2211Z to an intense storm (#1) over Sundre. The aircraft became airborne at 2223Z. Then at 2238Z HS4 started base seeding storm #1 W of Didsbury. HS4 base seeded along with HS3. Once HS3 RTB, the aircraft then base seeded with HS2. The crew reported they were finding 900fpm inflow along the S side of the cell at 0051Z (07/08). At 0133Z (07/08), HS4 stopped seeding and RTB to YYC. The aircraft landed at 0156Z (07/08). HS2 was launched at 2231Z to top seed Storm #1 W of Olds. The aircraft became airborne at 2259Z. The flight's airborne time was delayed due to royalty flying into the Calgary airport. At 2330Z HS2 began top seeding Storm #1 with ejectables flares only. The aircraft began to pick up a lot of airframe ice by 2344Z. Then at 2350Z, the crew reported that they could not maintain altitude with their aircraft due to ice buildup, so HS2 was dropped to base. The aircraft then started seeding with BIPs and generators. Next, the crew reported at 0122Z (07/08) that the inflow was increasing. HS2 then continued to seed as the supercell moved northeastward across the project area. At 0308Z (07/08) the crew reported that the left generator was empty. The aircraft RTB at 0314Z (07/08) after running out of chemical and landed at 0345Z (07/08). HS1 was launched at 2347Z to a supercell W of Olds; this was HS1's second flight of the day. The flight became airborne at 0002Z (07/08) and started seeding Storm #1 at 0019Z (07/08). At 0034Z (07/08), HS1 got out of position and was redirected to the S. Unfortunately, the aircraft started to become boxed in with growing turrets, so the crew was forced to continue to the NW side of the Supercell. The aircraft then had to fly around another cell to the W before they were able to come back around to the S side of the supercell again. At 0248Z (07/08), HS1 descended to base and started seeding. The flight then stopped seeding storm #1 at 0314Z (07/08) and RTB. HS1 landed at 0425Z (07/08).

		HS3 was launched for a second flight at 0114Z (07/08); the crew returned to the same supercell (Storm #1) which was now SW of Innisfail. The aircraft became airborne at 0130Z (07/08) and flew around the eastern side of the storm in order to start base seeding. The flight started seeding at 0145Z (07/08). Then at 0157Z (07/08) the crew reported a tornado. The aircraft stopped base seeding and began to climb up to top in order to replace HS1, at 0235Z (07/08). The supercell (storm #1) diminished around 0359Z (07/08), so the aircraft was redirected to new growth SW of Rocky MH. HS3 started seeding Storm #3, SW of Rocky MH, at 0421Z (07/08). The flight stopped seeding the storm at 0438Z (07/08) and started patrolling the same area. They RTB at 0454Z (07/08) and landed at 0514Z (07/08). HS4 flew an overnight reposition flight from Calgary to Red Deer. The aircraft was airborne at 0856Z and landed at 0926Z (07/08). <u>Flight Summary</u> HS3: 1952Z (07/07)-0013Z (07/08); 298 EJ, 16 BIP; #1 SW of Sundre, #2 SW of RMH. HS1: 1952Z-2237Z; no seeding; patrol W and SW of Calgary. HS4: 2214Z (07/07)-0202Z (07/08); 335 min generator time, 24 BIP; #1 W of Didsbury to YQF. HS2: 2241Z (07/07)-0349Z (07/08); 381 min generator time, 20 BIP, 35 EJ; #1 W of Olds to YQF. HS1: 2354Z (07/07)-0429Z (07/08); 269 EJ, 16 BIP; #1 W of Olds to YQF. HS3: 0125Z (07/08)-0516Z (07/08); 125 EJ, 13 BIP; #1 Innisfail to YQF and #3 SW of Rocky MH. HS4: 0845Z (07/08)-0931Z (07/08); no seeding; reposition flight from YYC to YQF.
July 8, Friday	Low pressure was located over central Alberta, and a 500mb trough axis was just breaching the Rockies. A dry continental air mass was encroaching into the area with dewpoints and temperatures expected to drop throughout the day. Showers were possible in the early afternoon, but the atmosphere was stabilizing throughout the day. No severe convection was expected. Rain showers began to push into the region during the afternoon. Weak, short-lived convection sprung up along the leading edge of these stratiform rain showers. By the evening hours, most of the project area was experiencing light to moderate rain showers. The stratiform rain showers lasted through the rest of the forecast period. Max cell top: 6.1km, 53 max dBz, 16.4 max VIL Tmax YC = 20C and 0.2mm rain. Tmax QF = 20C and 6.4mm rain. Tmax Radar = 21C and a trace of rain.	No aircraft operations.

July 9, Saturday	A closed low was located over central Alberta with wrap around clouds and vorticity obvious on satellite imagery. The wrap around moisture gave a chance of showers and possibly a weak thunderstorm in the northern buffer zone. The southern half of the project area was expected to remain free of precipitation. The atmosphere was marginally unstable with poor shear indicating the threat for severe convection was nil. Deep convection remained far to the northeast of the project area during the day. Bands of light stratus rain pushed through the area during the afternoon and evening. A few convective clouds were embedded in the stratus rain during the afternoon, but no lightning was detected. Isolated light showers moved through the project area during the overnight hours. Max cell top: 5.4km, 51 max dBz, 5.1 max VIL Tmax YC = 20C and 0.2mm of rain. Tmax QF = 20C and 6.4mm of rain. Tmax Radar = 21C and a trace of rain.	No aircraft operations.

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WEEK No. 7

Date	Weather	Activities Summary
July 10, Sunday	One trough was located to the north over Edmonton and another over central British Columbia. Combined with upslope flow, these were expected to be the main triggers for the day. Wind shear was poor with very little instability in the forecast sounding as well. Rain showers were expected for the later afternoon with no threat of severe convection. The focus was on the northern half of the project area where rain the previous few days provided the boundary layer with more moisture than in the southern sections of the project area. A line of weak convection moved off the hills along the western project boundary at 00Z and pushed east through the entire project area throughout the evening. A few cells developed into marginal hail threats over the Calgary area, and some seeding took place during the early evening between Calgary and High River. Convection became weak during the late evening and eventually transitioned to widespread stratiform rain which lingered over the area through morning. Max cell top: 9.9km, 63.5max dBz, 53.8max VIL Tmax YC = 21C and 7mm of rain. Tmax QF = 19C and a trace of rain. Tmax Radar = 19C and 7.4mm of rain.	HS2 was launched at 0140Z (07/11) for a line of convection developing along the foothills west of Cochrane. They were airborne at 0152Z (07/11). HS2 began base seeding storm #1 over Calgary at 0204Z (07/11) with acetone generators. At 0221Z (07/11) HS2 repositioned to another cell nearing southern Calgary. They began seeding #2 near Okotoks at 0232Z (07/11). At 0239Z (07/11) they moved back to cell #1 and continued seeding. At 0313Z (07/11) they shifted back to cell #2 near Okotoks again and continued seeding with only marginal inflow. At 0332Z (07/11) HS2 repositioned to near High River for patrol. They then reported a burner problem and briefly landed in High River to fix the burner. They were airborne and seeding again with both generators on storm #3 High River at 0350Z (07/11). At 0424Z (07/11) they stopped seeding and RTB to YYC. They landed at 0445Z (07/11). HS1 was launched at 0310Z (07/11) for top seeding near High River. They were airborne at 0326Z (07/11) and began seeding storm #3 near High River at 0343Z (07/11). All activity then began to diminish below hail criteria as it cleared the High River area. HS1 stopped seeding and RTB to YYC at 0434Z (07/11). They landed at 0448Z (07/11). <u>Flight Summary</u> HS2: 0148Z (07/11)-0449Z (07/11); 8 BIP, 176min acetone generator time; #1 YYC, #2 Okotoks, #3 High River. HS1: 0319Z (07/11)-0453Z (07/11); 72 EJ; #3 High River.
July 11, Monday	The day began with cool temperatures and thick cloud cover over the project area. Surface moisture was high, but cloud cover was expected to keep temperatures somewhat low. There was good shear in the sounding and modest instability in the southern half of the project area. While there were a few factors inhibiting convection for the day, such as mid-level warming and the presence of high pressure, these were not anticipated to completely prevent convection. Convection was anticipated to arise mainly over the foothills beginning in the mid-afternoon as a surface trough approached and convective temperatures were breached. Good upslope flow during the day was to aid in convective initiation. Stratiform rain was present during the morning hours. Thunderstorms began developing south of Calgary in the late morning and intensified to above hail criteria during the noon briefing. Widespread thunderstorms moved	HS3 flew a PR flight from Red Deer to Olds for a radar tour. They took off at 1727Z and landed in Olds at 1740Z. HS1 was launched at 1807Z for hailstorms south of Calgary moving toward the north. They were airborne at 1824Z and began top seeding storm #1 south of Calgary at 1839Z with good feeders and liquid water. They seeded the cell until it moved well clear of Calgary. They stopped seeding and RTB at 1952Z. HS1 landed in YYC at 2004Z. HS2 was launched at 1755Z for developing hailstorms south of Calgary. They were airborne at 1820Z and began base seeding storm #1 south of Calgary at 1826Z with one acetone burner and BIPs. They had trouble

	through the entire project area throughout the afternoon and all evening. Most cells remained just below hail criteria, but there were also multiple hail storms that were seeded. Thunderstorms finally transitioned to rain showers around 08Z. Stratus rain lingered through the rest of the night. Max cell top: 12.9km, 69.5max dBz, 132.4max VIL Tmax YC = 19C and 10.4mm of rain. Tmax QF = 20C and 0.6mm of rain. Tmax Radar = 20C and 0.6mm of rain.	with the right burner and could not get it ignited. At 1933Z inflow began to diminish. At 1950Z, HS2 reported no inflow left and RTB to YYC. They landed at 2005Z. HS3 was launched at 1937Z from Olds-Didsbury airport (at radar for tour) toward cells near Carstairs. They were airborne at 1947Z and began patrol near Carstairs finding nothing worth seeding. They then continued south to a storm over Okotoks headed toward Strathmore. They began top seeding storm #2 at 2030Z. At 2038Z, they stopped seeding #2 and patrolled near Cochrane. At 2104Z, they moved back toward the cell approaching Strathmore and resumed seeding at 2124Z. At 2127Z, they stopped seeding #2 and patrolled the cell as it was starting to track south of Strathmore. They then repositioned to near Red Deer. At 2214Z HS3 began seeding #4 over YQF. This cell remained weak, and they stopped seeding at 2223Z to patrol Rocky MH. At 2306Z, they moved southward and then began seeding #6 near Cremona at 2319Z. At 2347Z, HS3 was low on fuel and RTB. They landed in Olds-Didsbury at 2357Z to drop off a field meteorologist who was on board observing the flight. HS3 then took off from Olds-Didsbury immediately to return to YQF. They were airborne at 0001Z (07/12) and landed in YQF at 0012Z (07/12). HS4 was launched at 2027Z to the Lacombe area. They were airborne at 2045Z and began base seeding storm #3 near Lacombe at 2051Z with burners and BIPs in good inflow. At 2146Z, the cell cleared the Lacombe area. HS4 stopped seeding #3 and RTB. They landed in YQF at 2151Z. HS1 was launched again at 2121Z for new development west of Calgary. They were airborne at 2133Z and began top seeding storm #5 near Cochrane at 2214Z. They continued to seed at a very low rate in developing cumulus towers near Cochrane until 0006Z (07/12) when they were directed to stop seeding and just patrol west of Calgary. At 0130Z (07/12) they began top seeding #7 west of Okotoks. At 0222Z (07/12) HS1 was getting low on fuel and RTB. They landed in YYC at 0237Z (07/12). HS2 was launched again at 2236Z to southwest of Springbank. They were airborne at 2258Z. Due to low cloud bases, HS2 was forced to stay east of the foothills and patrol, awaiting any significant activity moving off the hills. At 2329Z, HS2 began base seeding storm #5 southwest of Calgary with burners only. At 0006Z (07/12) they lost all inflow and were directed to stop seeding and patrol the area. At 0019Z (07/12) activity was diminishing

		and HS2 RTB to YYC. They landed at 0029Z (07/12). HS2 was launched for a third flight at 0121Z (07/12). They were airborne at 0146Z (07/12) and headed for a cell approaching Okotoks. They began base seeding storm #7 near Okotoks at 0202Z (07/12) with burners and BIPs along the east side of a large shelf cloud. At 0337Z (07/12), HS2 stopped seeding when the cell became weaker and inflow dropped off. They continued to patrol the area near Okotoks. At 0359Z (07/12), the cell dissipated and HS2 RTB to YYC. They landed at 0414Z (07/12). HS3 was launched again at 0224Z (07/12) for an intense cell near Okotoks. They were airborne at 0243Z (07/12). At 0317Z (07/12), they began top seeding storm #7 near Okotoks finding lots of liquid water and graupel for a short time. At 0337Z (07/12), they stopped seeding and reported very minimal growth. They continued to patrol the area for a short time as the cell continued to weaken. At 0349Z (07/12) they started heading back north. At 0406Z (07/12) they started seeding storm #8 near Sundre, but only made a couple passes on the storm before repositioning to near Eckville at 0412Z (07/12). They began seeding storm #9 near Eckville at 0422Z (07/12). At 0427Z (07/12), HS3 pulled off that cell and repositioned to near Rocky MH. At 0435Z (07/12) they began seeding #10 near Rocky MH. They RTB at 0442Z (07/12) as all activity across the area was diminishing. They landed in YQF at 0454Z (07/12). HS4 was launched at 0348Z (07/12). They were airborne at 0359Z (07/12) and headed toward cells near Eckville. They began base seeding storm #9 near Eckville at 0406Z (07/12) with burners and BIPs. The storm moved out of the project area and HS4 RTB at 0524Z (07/12). They landed in YQF at 0533Z (07/12). <u>Flight Summary</u> HS3: 1716Z-1741Z; no seeding; PR flight from YQF to Olds-Didsbury. HS2: 1815Z-2010Z; 11 BIP, 92 min acetone generators; #1 Calgary. HS1: 1811Z-2009Z; 9 BIP, 232 EJ; #1 Calgary. HS3: 1942Z-2359Z; 1 BIP, 197 EJ; #1 Calgary, patrol S Didsbury, #2 Okotoks, patrol Cochrane, #2 SW Strathmore, #4 Red Deer, patrol RMH, #6 SW Cremona; Landed at Olds-Didsbury. HS4: 2035Z-2154Z; 2 BIP, 106 min generator time; #3 Lacombe. HS1: 2125Z (07/11)-0241Z (07/12); 177 EJ; patrol W Calgary, #5 Cochrane to Calgary, #7

		Okotoks. HS2: 2250Z (07/11)-0033Z (07/12); 80 min acetone generators; #5 Cochrane to Calgary. HS3: 0000Z (07/12)-0015Z (07/12); no seeding; reposition flight from Olds to Red Deer. HS2: 0135Z (07/12)-0416Z (07/12); 13 BIP, 188 min acetone generators. #7 Okotoks. HS3: 0236Z (07/12)-0501(07/12); 152 EJ; #7 Okotoks, #8 Sundre, #9 Eckville, #10 RMH. HS4: 0353Z (07/12)-0537Z (07/12); 5 BIP, 164 min acetone generators; #9 Eckville.
July 12, Tuesday	A trough was expected to move into the area, finally becoming a factor after having lingered over BC for several days. There were multiple triggers, with upslope flow and troughing the main aids to convection. Beginning in the early evening, the area would also be under warm air advection from the surface through the low levels. Convection was expected to begin as early as the early afternoon, continuing throughout the day. The model sounding was best in the early evening, displaying good wind shear and ample instability. Elevated instability lingered overnight, but strong triggers were lacking, indicating a quiet night after significant capping had occurred. Stratiform rain was moving through during the early morning hours. All rain cleared out after dawn, and the project area saw some partial clearing. Weak convection developed along the foothills during the afternoon, but it dissipated before it could reach any project cities. After 04Z in the evening, hailstorms southwest of Calgary moved far enough to the east to be a threat, and aircraft seeded several cells that moved through Calgary. Around 07Z, all convection moved east of Calgary and weakened into rain showers. The project area was clear for a few hours overnight, but another wave of rain was moving into the foothills at the end of the forecast period. Max cell top: 12.1km, 68.5 max dBz, 83.6 max VIL Marble size hail was reported over southeast Calgary. Tmax YC = 20.7C and 2.4mm of rain. Tmax QF = 18.0C and 2.4mm of rain. Tmax Radar = 18.6C and 1.5mm of rain.	HS1 was launched at 0329Z (07/13) for cells west and south of Calgary. They were airborne at 0352Z (07/13) and began top seeding storm #1 southwest of Calgary at 0404Z (07/13). HS1 worked in embedded seeding conditions, and picked up very heavy airframe icing throughout the flight. At 0447Z (07/13) they descended to shed ice. They resumed seeding at 0455Z (07/13) as they dragged BIPs through the climb back to altitude where they resumed seeding with ejectables. At 0500Z (07/13) HS1 reported explosive growth over Calgary with over 2,500 fpm updrafts and very frequent lightning. They descended to shed ice again at 0520Z (07/13). At 0539Z (07/13) HS1 stopped seeding storm #1. They repositioned to southwest of Calgary and began seeding storm #2 at 0552Z (07/13). As the cell approached Calgary, they were replaced by HS3 and RTB at 0640Z (07/13). They landed at 0649Z (07/13). HS2 was launched at 0433Z (07/13) for hailstorms to the southwest of Calgary. They were airborne at 0450Z (07/13) and began seeding storm #1 at 0453Z (07/13) with burners and BIPs. They seeded the storm over Calgary as long as possible, but lowering cloud bases became a safety concern and they were forced to RTB at 0528Z (07/13). They landed at 0545Z (07/13). HS3 was launched at 0555Z (07/13) toward the storms over Calgary as backup for HS1. They were airborne at 0620Z (07/13). They began seeding storm #2 over Calgary at 0650Z (07/13). They only seeded for a brief time before the storm was determined to be raining out. They stopped seeding at 0656Z (07/13). At 0705Z (07/13) HS3 reported nothing seedable in the area and RTB to YQF. They landed at 0737Z (07/13). Flight Summary HS1: 0340Z (07/13)-0655Z (07/13); 204 EJ, 16 BIP; #1 Calgary, #2 SW Calgary. HS2: 0440Z (07/13)-0551Z (07/13); 3 BIP, 60min acetone generator time; #1 Calgary. HS3: 0606Z (07/13)-0740Z (07/13); 15 EJ; #2 Calgary.
July 13,	At the surface, a low moved through central AB which	HS1 was launched at 2352Z for a rapidly

Wednesday	contained a warm front as well as a cold front. The warm and cold front influenced project area weather during the morning and early afternoon hours. A closed mid-level low was located over southern BC. Jet energy was mainly over southeastern BC. During the evening, a shortwave trough moved across the project area. The sounding showed a moderately unstable profile with wind shear favoring organized storms. A frontal band of rain moved through during the morning and early afternoon with some weak embedded convection that was not a hail threat. More significant convection moved in from the south around 00Z. Cells moved quickly from the south. As these cells moved in, more convection began to form over the project area with some tall cells that moved through Calgary. Once all the activity was through the Calgary area, the aircraft focused on a larger but weaker line of convection that moved from W to E through the northern half of the project area. The line dissipated over Red Deer. The project radar was mainly clear overnight. Max cell top: 13.6km, 67 max dBz, 81.2 max VIL Tmax YC = 22.5C and 10.0mm of rain. Tmax QF = 21.4C and 11.2mm of rain. Tmax Radar = 20.7C and 3.2mm of rain.	moving cell moving northward toward High River. They were airborne at 0020Z (07/14) and observed hard growth SW of Calgary. They continued down to the cell near Okotoks and began seeding storm #1 at 0042Z (07/14). At 0058Z (07/14), HS1 repositioned to SW of Calgary and began seeding storm #2. They seeded heavily as the cell was a significant hail threat for downtown Calgary. They were replaced at cloud top by HS3 and RTB at 0218Z (07/14). They landed in YYC at 0241Z (07/14). HS2 was launched at 0030Z (07/14) for developing hailstorms over southwest Calgary. They were airborne at 0046Z (07/14) and began base seeding storm #2 over Calgary at 0057Z (07/14) with burners and BIPs. At 0146Z (07/14) HS2 reported a funnel cloud over SW Calgary near Signal Hill. The funnel was immediately reported to Environment Canada. At 0245Z, HS2 stopped seeding storm #2 and climbed to cloud top near Didsbury. They began top seeding storm #4 at 0311Z (07/14) southwest of Red Deer. They continued to top seed until they were replaced at top by HS3 and RTB at 0342Z (07/14). They landed at 0407Z (07/14). HS3 was launched at 0053Z (07/14) for cells approaching Rocky MH. They were airborne at 0108Z (07/14). HS3 began seeding storm #3 near Rocky MH at 0126Z (07/14). At 0144Z (07/14) they descended to shed ice and stopped seeding #3. They climbed back to cloud top and began seeding storm #2 over Calgary at 0218Z (07/14) with ample seedable targets reported. At 0245Z (07/14), they repositioned toward Sylvan Lake. HS3 began seeding a long line of convection #4 west of Sylvan at 0301Z (07/14), mainly dragging BIP flares in embedded conditions. At 0340Z (07/14) HS3 moved down to the south end of the line and replaced HS2. At 0424Z (07/14) HS3 descended to shed ice. They then patrolled the area near YQF for a brief time and then RTB to YQF at 0440Z (07/14). They landed at 0453Z (07/14) once the storm was past the airport. HS4 was launched at 0238Z (07/14) to the area northwest of Olds. They were airborne at 0248Z (07/14) and began base seeding storm #4 at 0306Z (07/14) with burners and BIPs in good inflow along a shelf cloud. At 0342Z (07/14) they reported trouble with the right burner blowing a circuit breaker. At 0432Z (07/14) the storm began to rain out and there were no good areas for base seeding. They stopped seeding and RTB at that time. HS4 landed at Olds-Didsbury to wait for the storm to clear the YQF airport before returning home.

		They landed at 0435Z (07/14). HS4 then flew a reposition flight from Olds-Didsbury to YQF. They were airborne at 0619Z (07/14) and landed in YQF at 0635Z (07/14). <u>Flight Summary</u> HS1: 0005Z (07/14)-0245Z (07/14); 305 EJ, 13 BIP; #1 Okotoks, #2 Calgary. HS2: 0043Z (07/14)-0412Z (07/14); 62 EJ, 20 BIP, 240min acetone generators; #2 Calgary, #4 SW of Red Deer. HS3: 0100Z (07/14)-0500Z (07/14); 227 EJ, 6 BIP; #3 SW of Rocky MH, #2 Calgary, #4 W of Sylvan. HS4: 0246Z (07/14)-0437Z (07/14); 7 BIP, 112min acetone generator time; #4 SW of YQF; landed at Olds-Didsbury. HS4: 0615Z (07/14)-0640Z (07/14); no seeding; reposition flight from Olds-Didsbury to YQF.
July 14, Thursday	The left exit region of a southerly jet was over the region during the afternoon and evening hours. A closed low over BC weakened into an upper level trough as it entered AB during the evening hours. Vorticity advection was expected to be strongest during the evening. The previous day's surface low was now along the AB/SK border. Dew points were higher along the northern part of the project area, so atmospheric instability was highest over this region. Weak cells developed over Calgary in the afternoon, but they did not develop into hailstorms. A patrol flight was launched over Calgary as the cells were propagating upwind toward town. The northern half of the project area saw more significant afternoon convection from Sunde to Red Deer. Several hailstorms pushed through the northern project area through the early evening, but they diminished to convective rain showers and dissipated as they reached the Red Deer area. A few weak showers lingered through midnight. The project area was mainly clear overnight except for a small rain shower over the northern buffer zone. Max cell top: 12.1km, 65.5 max dBz, 67.4 max VIL Tmax YC = 21.0C and 0.8mm of rain. Tmax QF = 21.9C and 4.2mm of rain. Tmax Radar = 21.2C and no rain.	HS2 was launched at 2151Z for back building weak convection over Calgary. They were airborne at 2213Z and began patrol over Calgary. Nothing seedable was observed over the area. At 2249Z, they repositioned to near Sundre and began base seeding storm #1 with burners only. At 2257Z, they found excellent inflow and began using BIP flares for a brief time before the cell diminished and all inflow was lost. They stopped seeding #1 at 2304Z and headed back toward the Cochrane and Airdrie area for more patrolling. At 2352Z, they headed north toward Olds and began seeding #2 SW of Innisfail at 2359Z with burners and BIPs. At 0039Z (07/15) HS2 stopped using BIPs as the cell was less of a hail threat. Shortly after that, all inflow dropped off and HS2 RTB at 0041Z (07/15). They landed in YYC at 0103Z (07/15). HS4 was launched for top seeding at 2255Z and began top seeding storm #2 W of Olds at 2342Z. They worked the area at cloud top until HS3 relieved them. At 0029Z (07/15) they descended and began base seeding with burners at 0031Z (07/15) in the same area with HS2. The storm began to diminish by 0043Z (07/15) and HS4 stopped seeding and just patrolled, searching for new pockets of inflow. No additional growth was found and HS4 RTB to YQF at 0109Z (07/15). They landed in YQF at 0133Z (07/15). HS3 was launched at 2344Z for a cell north of Olds that was headed toward Red Deer. They were airborne at 0009Z (07/15). HS3 replaced HS4 on the south end of the cell at cloud top. They began top seeding storm #2 at 0036Z (07/15) and continued working that same storm until it weakened below hail criteria. They stopped seeding at 0109Z (07/15) and patrolled briefly. At 0119Z (07/15) they RTB. They

		landed at 0138Z (07/15). Flight Summary HS2: 2202Z (07/14)-0106Z (07/15); 8 BIP, 110min acetone generators; #1 Sundre, #2 SW of Innisfail. HS4: 2308Z (07/14)-0138Z (07/15); 106 EJ, 24min acetone generators; #2 SW of Innisfail, patrol Red Deer. HS3: 2357Z (07/14)-0142Z (07/15); 130 EJ, 2 BIP; #2 SW of Innisfail.
July 15, Friday	Jet energy was nonexistent over AB. A mid-level, open wave low was located along the northern AB/SK border which aided in sending a lobe of vorticity through the project area during the early afternoon hours. Warm air advection was present at the mid-levels which helped to inhibit tall convection from occurring. At the surface, a lee trough developed over the region. Dewpoints were again much higher over the northern project area than the southern portion. The project area was partly cloudy throughout the day with stable mountain wave clouds in the afternoon. There were several very weak convective echoes near Caroline and in the northern buffer during the late afternoon, but they were just virga/light sprinkles. No lightning strikes were detected, and there were no TITAN cells. The area remained clear overnight. Tmax YC = 22.2C and no rain. Tmax QF = 22.7C and no rain. Tmax Radar = 23.1C and no rain.	No aircraft operations.
July 16, Saturday	The jet stream was positioned over southern SK and MB. Weak mid-level ridging occurred over AB for most of the day, but weak lobes of vorticity still passed over the region during the evening and overnight. Surface low pressure was centered over central BC, and a stationary front was draped across northern AB. Low level moisture advection was expected out of the SE overnight. The atmosphere was capped for most of the daytime hours. The daytime hours were mainly clear, with only a few cirrus clouds and some cumulus over the mountains and more extensive cloud coverage over Calgary. During the evening, a surface trough moved through the PA from the southwest to the northeast triggering a few storms near High River and over Calgary. These storms formed quickly, but were very short lived. During the overnight period, stabilization occurred such that the trough developed only light rain showers/virga. Max cell top: 9.9km, 59.5 max dBz, 31.7 max VIL Tmax YC = 23.5C and 0.2mm of rain. Tmax QF = 23.8C and no rain. Tmax Radar = 22.6C and no rain.	HS1 was launched on development near Calgary at 0527Z (07/17). They were airborne at 0548Z (07/17) and began climbing to top seed. The cell quickly grew into a 9.9km topped storm, but then began to steadily diminish in intensity from radar scan to scan. As HS1 reached top seeding altitude, the cell had diminished into a light rain showers on radar, and pilots reported no weather over Calgary. Due to the cessation of any threat whatsoever, and the lack of any weather behind the trough, HS1 RTB YYC at 0604Z (07/17). They landed at 0623Z (07/17). Flight Summary HS1: 0540Z (07/17)-0626Z (07/17); no seeding; patrol Calgary.

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Date	Weather	Activities Summary
July 17, Sunday	The upper level ridge that was over AB the previous day began to move eastward. A closed low was centered off Vancouver Island and was expected to slowly dig southward. In the evening, a shortwave trough slid through central AB providing weak vorticity advection. A surface low was expected to form over the Red Deer area during the afternoon hours. The atmosphere was moderately unstable with good speed and directional shear. Atmospheric instability was also expected during the overnight hours as low level moisture poured into the region from the southeast. Skies were clear all day, with no echoes detected on radar. A few weak rain showers then appeared on radar during the evening. Overnight, cells moving into the project area from the South exploded into severe convection over the project area. Storms continued to initiate quickly over the entire area through the early morning hours, until they cleared shortly after sunrise. Rare late night/early morning seeding occurred. Max cell top: 15.9km, 69.5 max dBz, 157.5 max VIL Tmax YC = 27.0C and 0.2mm of rain. Tmax QF = 26.6C and no rain. Tmax Radar = 26.7C and no rain.	HS1 was launched at 0903Z (07/18) for cells SW of Strathmore. They were airborne at 0921Z (07/18) and began top seeding storm #1 at 0945Z (07/18). They stopped seeding and began patrol near Sundre at 1003Z (07/18). As development was observed W of Red Deer, they were repositioned to the area and began seeding storm #2 for Lacombe at 1053Z (07/18). They stayed on this storm as it tracked through Blackfalds and Lacombe, then began seeding storm #3 S of Red Deer at 1123Z (07/18). They reported weak development and seeded at a low rate until 1143Z (07/18), when they stopped seeding and began patrolling. As no new development was occurring, they RTB YYC at 1151Z (07/18), landing at 1220Z (07/18). HS2 was launched at 0903Z (07/18) for development SW of Strathmore. They were airborne at 0919Z (07/18), and began seeding storm #1 with burners at 0940Z once they reached the storm. They found a shelf cloud on the N end of their pass, and worked this area until 1003Z (07/18) when they were instructed to stop seeding. They then reposition to the W and began patrolling. No new targets were observed. HS1 RTB at 1022Z (07/18) and landed at 1028Z (07/18). HS4 was launched at 1107Z (07/18) for the development S of Red Deer, and became airborne at 1129Z (07/18). They were unable to find seedable bases near Red Deer, so at 1135Z (07/18) they were directed towards Eckville. They continued to find only dissipating cells and no seedable bases. At 1211Z (07/18) they RTB to Red Deer. They landed at 1223Z (07/18). <u>Flight Summary</u> HS1: 0910Z (07/18)-1226Z (07/18); 108 EJ, 2 BIP; #1 Strathmore, #2 Lacombe, #3 S. Red Deer. HS2: 0911Z (07/18)-1031Z (07/18); 46 minutes generator time; #1 Strathmore. HS4: 1118Z (07/18)-1227Z (07/18); no seeding; patrol S. Red Deer, patrol W Ponoka.
July 18, Monday	The left exit region of a jet streak was over the area during the afternoon and evening hours. A closed, mid-level low was now over northern California and aided in sending vorticity lobes towards AB. In the evening, a	HS2 was launched at 2102Z for weak echoes SW of Calgary. With the very unstable conditions that day, cells were expected to grow rapidly. HS2 was airborne at 2122Z and

		began seeding at 0055Z, working above HS4. They reported explosive growth on this cell. HS3 RTB to YQF at 0157Z (07/19). They landed at 0205Z (07/19). HS2 was launched at 0029Z (07/19) for development W of Airdrie. They were airborne at 0048Z (07/19) and reported a shelf on storm #6, lighting burners at 0052Z (07/19). At 0103Z (07/19), they found abundant inflow and began using BIPs. They continued to find very good inflow as it moved through Airdrie. They ceased BIPs at 0147Z (07/19) when the cell moved into an unpopulated area. At 0230Z (07/19), with the cell E of any targets, HS2 turned off burners at 0214Z (07/19) and RTB YYC at 0230Z (07/19). They landed at 0250Z (07/19). <u>Flight Summary</u> HS2: 2118Z-2324Z; 26 minutes generator time; patrol SW Calgary, #2 Sundre. HS3: 2156Z-2332Z; 97 EJ; #1 SW RMH, #3 S RMH. HS4: 2348Z- 0209Z (07/19); 93 minutes generator time, 9 BIP; #4 SW Sylvan. HS1: 0020Z (07/19)-0229Z (07/19); 126 EJ, 5 BIP; #6 Airdrie. HS3: 0021Z (07/19)-0209Z (07/19); 228 EJ; #5 Olds, #4 SW Sylvan HS2: 0041Z (07/19)-0254Z (07/19); 12 BIP, 190 minutes generator time; #6 Airdrie.
July 19, Tuesday	The upper level jet core was directly over the project area. It was progged to exit the region toward the east during the evening and overnight hours while an upper level trough moved southeastward into AB from northern BC. The southern half of the project area was under a favorable jet quadrant providing shear vorticity. Midlevel vorticity was progged to move through the area during the afternoon, mostly impacting the southern project areas. The atmosphere was highly unstable throughout the afternoon, and expected to stabilize after 03Z. Southeasterly surface winds were progged to shift to westerly by early evening as well. Severe hail storms were forecast to occur through the early evening and then stable conditions were expected in the evening and overnight hours. Convection began in the early afternoon with a few weak rain showers. Over the course of a few hours, more cells began to initiate over the entire project area, most of them severe. Convection ended in the early evening and the project area was quiet overnight. Very heavy rain occurred in Red Deer with urban flash flooding. Very heavy rain also occurred in Calgary, but no significant flooding occurred. One inch hail was reported SSW of Strathmore near Carseland. Max cell top: 15.1km, 70.5max dBz, 210.8max VIL Tmax YC = 24.0C and 39.6mm of rain. Tmax QF = 21.7C and 31.8mm of rain.	HS3 was launched at 1800Z for development SW of RMH. They were airborne at 1828Z. They were directed to patrol a weak echo near Sundre at 1855Z. They patrolled areas of growth from Sundre to Cochrane. HS3 then moved down to SW of Calgary for a significant system tracking directly toward the metropolitan area. They started seeding storm #1 at 2043Z. They repositioned to High River at 2124Z, seeding until 2201Z, when they stopped seeding and RTB YYC as the cells moved away from major population centers. They landed in YYC at 2217Z. HS1 was launched at 2025Z for development near Calgary. They were airborne at 2047Z. HS1 began seeding storm #1 at 2131Z. After the cell moved through Cochrane, HS1 moved N to seed storm #3. They worked that line until 2254Z when they RTB to YYC as the cell moved NE of Red Deer. They landed at 2321Z. HS4 was launched at 2029Z for development S of RMH. They were airborne at 2043Z, and reported embedded conditions. They began seeding storm #2 with burners at 2114Z with good inflow. At 2124Z, the cell appeared to be merging with a line to the SE. HS4 moved to the E side of the cell heading towards Red

	Vorticity advection was expected to deal a glancing blow to the northern parts of the project area where surface moisture was higher. The northern part of the project area was the most unstable while drier downslope winds made for less instability in YYC. The atmosphere was slightly unstable below 26kft. Weak convection with small hail was forecast to occur in the afternoon with the bulk of convection to the north of the area. Stable conditions were expected overnight. In the early afternoon, a line of thunderstorms moved through the N half of the project area. Most of the cells were weak, producing light to moderate rain with a few a bits of pea sized hail. There were reports of quarter sized hail in a cell west of Red Deer. After this first line of convection, the project area had a few convective rain showers, but there were no severe echoes. Radar echoes diminished into the evening and the area was clear overnight. Max cell top: 10.6km, 63.5max dBz, 67.9max VIL Tmax YC = 21.0C and 1.8mm of rain. Tmax QF = 19.3C and 0.2mm of rain. Tmax Radar = 18.7C and 0.5mm of rain.	benign appearance of these storms, there had been reports of quarter sized hail from them. They were airborne at 2017Z and immediately began seeding storm #1 with BIPs. They reported good lightning, a green tint, and moderate inflow. After the storm had passed through Red Deer, HS3 RTB YQF 2044Z. They landed at 2053Z. <u>Flight Summary</u> HS3: 2012Z-2057Z; 7 BIP; #1 Red Deer.
July 21, Thursday	A deep low pressure system was approaching the project area. The atmosphere was only slightly unstable. Surface dew points were somewhat high, but the moisture was confined to a very shallow surface layer. Overall, the low levels were not particularly moist. A surface low was located over the project area with an occlusion progged to pass through during the day. Behind the occlusion, low levels were expected to dry out. The upper level circulation and associated vorticity advection were progged to affect the area in the evening and overnight hours, but the atmosphere was expected to stabilize overnight. Weak afternoon convection was forecast with stratus and low ceilings overnight. The day began with a few fair weather cumulus and no echoes on the radar. A few larger clouds were seen throughout the afternoon, but no significant echoes were observed beyond a few rain showers. During the early evening, a more significant line of convection occurred in the N half of the project area, but as this diminished, the overnight period proved clear. Max cell top: 9.1km, 62.5 max dBz, 40.9 max VIL Tmax YC = 22.5C and no rain. Tmax QF = 22.9C and a trace of rain. Tmax Radar = 22C and a trace of rain.	HS1 flew a public relations flight to the Olds-Didsbury operations center. They took off at 1721Z and landed in Olds at 1738Z. After the tour, they returned to Calgary. They took off from Olds at 2120Z and landed back in YYC at 2140Z. HS4 was launched at 0316Z (07/22) on weak development W of Red Deer. They were airborne at 0332Z (07/22) and began seeding storm #1 with acetone generators at 0346Z (07/22). By 0407Z (07/22), the cell had weakened on radar, and HS4 was reporting a poor base and weak inflow. As the cell was not a hail threat, HS4 RTB YQF at 0421Z (07/22), landing at 0427Z (07/22). <u>Flight Summary</u> HS1: 1703Z-1740Z; no seeding; PR flight from YYC to Olds. HS1: 2115Z-2144Z; no seeding; PR flight from Olds to YYC. HS4: 0325Z (07/22) - 0432Z (07/22); 42 min generator time; #1 Red Deer.
July 22, Friday	A deep low pressure system was slowly moving through central AB during the period. Ample vorticity was expected over the project area. All surface features had moved east of the project area by forecast time, and only upper level triggers were present for the rest of the day. The 500mb vorticity center was progged to reach the project area around 00Z. Low levels were relatively dry with some weak downslope winds. Surface temperatures	No aircraft operations.

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Date	Weather	Activities Summary
July 24, Sunday	The upper level jet was south of the project area, stretched along the US/Canada border. A broad ridge was well established over the region. Low levels were relatively dry, and midlevels were warm. The atmosphere was stable. No significant weather was forecast. Mostly clear skies were forecast to persist throughout the period. Cumulus, altocumulus, and cirrus clouds were observed. The region was also stable overnight. No radar echoes. Tmax YC = 23C and no rain. Tmax QF = 23C and no rain. Tmax Radar = 23C and no rain.	No aircraft operations.
July 25, Monday	The forecast period began with high pressure over the project area. A strong midlevel trough was located over British Columbia, expected to move through the project area and be the main trigger for later in the day. Excellent instability and shear made the day look very active. Storms were expected in the evening and overnight periods. The first convection of the day formed W of Rocky MH. Late in the afternoon, this convection eventually made its way off the foothills. The strongest of these cells developed SW of Rocky MH and slowly tracked towards the town. Then around 00z, a long line of thunderstorms formed along the mountains and moved eastward across the region. The strongest cell along the line was near the Sundre area. The convection dissipated as it reached the center of the project area. Max cell top: 12.1km, 65.0 max dBz, 72.9 max VIL Tmax YC = 25C and no rain. Tmax QF = 26C and no rain. Tmax Radar = 25C and 1.6mm of rain.	HS3 was launched at 2108Z to a rapidly intensifying cell SW of Rocky MH. The flight became airborne at 2139Z and flew toward the cell. While flying to the cell, the crew reported that the storm had a dark flat base. At 2159Z HS3 started seeding storm #1 SW of Rocky MH. Then at 2215Z, the pilots reported decent overhang along the southern edge of the cell. The aircraft continued to seed the storm until it dissipated to the E of Rocky MH at 2327Z. The crew then patrolled the Rocky MH area until they RTB at 0040Z (07/26). The flight landed in Red Deer at 0056Z (07/26). HS2 was launched at 0103Z (07/26) to top seed a cluster of cells SW of Calgary. The flight became airborne at 0126Z (07/26). The aircraft found a small amount of new growth along the SW side of the cluster of convection. Once the flight found the weak growth, they started top seeding storm #2 near Okotoks at 0143Z (07/26). Then at 0205Z (07/26) the aircraft was finding no new growth, so they stopped seeding and started patrolling the same area. HS2 was eventually redirected to new convection near the Cochrane area at 0245Z (07/26). The aircraft then patrolled an area N of Cochrane until 0316Z (07/26), when the flight RTB. They landed in Calgary at 0332Z (07/26). HS4 was launched at 0133Z (07/26) to a line of convection extending from Rocky MH to Cremona. They were airborne at 0151Z (07/26) and flew toward the most intense cell just W of Sundre. HS4 started seeding the Sundre storm (#3) at 0209Z (07/26). They continued to seed the storm as it moved across the project area. By 0311Z (07/26), the storm had almost completely dissipated, so HS4 stopped seeding storm #3 and RTB. The

		aircraft landed in Red Deer at 0335Z (07/26). Flight Summary HS3: 2122Z (07/25)-0100Z (07/26); 155 EJ; #1 Rocky MH, patrol Rocky MH. HS2: 0117Z (07/26)-0336Z (07/26); 12 EJ; #2 Okotoks and patrol Cochrane. HS4: 0141Z (07/26)-0339Z (07/26); 124 min generator time; #3 Sundre and patrol W of Sylvan.
July 26, Tuesday	A low pressure system was located just east of the project area. A surface trough was located over British Columbia, progged to move through in the early evening. There was good wind shear, but weak instability indicated that severe storms were not likely. The area saw widespread weak thunderstorms during the morning hours. In the mid-afternoon, a stronger line of convection developed along the mountains and foothills. The first cells along this line originally formed south of Sundre and moved eastward towards Carstairs before dissipating. As the line moved eastward, stronger cells continued to develop along the southern end of the line. The tallest and most intense of these cells formed W of Cochrane and moved southeastward towards Okotoks. During this same time, another line of convection formed north of Rocky MH and moved southeastward across the northern half of the project area. Scattered, convective rain showers then persisted through the overnight hours. Max cell top: 12.1km, 64.0 max dBz, 73.6 max VIL Tmax YC = 17C and 13.0mm of rain. Tmax QF = 19C and 27.2mm of rain. Tmax Radar = 18C and 12.6mm of rain.	HS1 was launched at 2157Z to patrol actively growing convection W of Carstairs and Crossfield. The aircraft became airborne at 2216Z. The crew eventually found growth along the northeast side of storm #1 and started seeding at 2242Z. HS1 next reported that the storm was dissipating. At 2253Z, they stopped seeding and repositioned toward new actively growing cells W of Calgary. They found moderate growth W of Cochrane and started seeding storm #2 at 2301Z. The aircraft continued to seed the storm until it was passed the Okotoks area. At 0019Z (07/27), HS1 stopped seeding storm #2 and started patrolling High River. Then at 0113Z (07/27) the flight was redirected to growing convection NW of Olds. Once the aircraft arrived at the storm they patrolled an elongated line of convection until it began to dissipate. HS1 RTB at 0205Z (07/27) and landed in Calgary at 0225Z (07/27). Flight Summary HS1: 2210Z (07/26)-0230Z (07/27); 104 EJ, 8 BIP; #1 W of Carstairs, #2 W of Calgary, patrol High River, and patrol Olds.
July 27, Wednesday	Some weak vorticity, observed on the 500mb map, along with mid-level divergence was expected to be the main focus for thunderstorms. While temperatures were cool, parameters indicated moderate instability. Storms were expected to initiate in the mid to late afternoon across the entire project area with skies clearing overnight as temperatures cooled. The morning hours mainly saw widespread rain showers but a few convective cells did begin to form over the foothills during the late morning. Throughout the early afternoon, the convection began to push off the foothills near the Calgary area. One of these storms (#1) became severe W of Cochrane but ended up tracking south-southeastward along the project area border before dissipating near Turner Valley. Loonie sized hail was reported SW of Calgary from storm #1. Then around 21Z, a moderately strong cell (#2) formed directly over southern Calgary and tracked southeastward. The northern half of the region mainly saw convective rain showers that were heavy at times. At around 2230Z another cell formed W of Calgary and tracked southeastward towards the town of Okotoks. Once this particular storm (#3) started to approach Okotoks, it was apparent that more cells were being triggered to the W of this storm. This line of convection eventually tracked	HS2 was launched at 1918Z to patrol a developing storm W of Cochrane. The flight became airborne at 1931Z. They found inflow and started seeding storm #1 W of Calgary. At 2050Z, HS2 reported the cell was beginning to become less intense. They stopped seeding storm #1 at 2102Z and repositioned to a cell directly over southern Calgary. HS2 started seeding this storm (#2) at 2108Z. The aircraft seeded this storm until it moved southeast of Calgary. HS2 stopped seeding at 2133Z and was directed to patrol the Olds area. The crew patrolled Olds for a short period of time before being redirected to strong development NW of Calgary. The aircraft starting seeding storm #3 NW of Cochrane at 2222Z. HS2 stopped seeding at 0007Z (07/28) and RTB. The aircraft landed at 0017Z (07/28). HS1 was launched to storm #3 W of Calgary at 2305Z. The aircraft became airborne at 2319Z and was found good growth along the south side the cell. The crew began seeding W of Calgary at 2334Z. Then at 0008Z (07/28), HS1 reported only weak to moderate updrafts. At 0019Z (07/28), no feeders were being found, so

	southward forming the strongest cell of the day over the southern buffer zone. Max cell top: 13.6km, 67.0 max dBz, 132.7 max VIL Tmax YC = 17C and 8.8mm of rain. Tmax QF = 19C and 4.4mm of rain. Tmax Radar = 19C and a trace of rain.	HS1 stopped seeding and started patrolling. The aircraft continued to patrol the line of convection until it was no longer a threat to the towns of Okotoks, Turner Valley, and Black Diamond. At 0108Z (07/28), HS1 stopped patrolling and RTB. The aircraft landed at 0124Z (07/28). <u>Flight Summary</u> HS2: 1925Z (07/27)-0020Z (07/28); 13 BIP, 473 min generator time; #1 NW of Turner Valley, #2 southern Calgary, patrol Olds, and #3 NW of Cochrane. HS1: 2310Z (07/27)-0127Z (07/28); 75 EJ; #3 W of Calgary, patrol Okotoks.
July 28, Thursday	West winds and a weak ridge over the area assured the day started out clear, allowing temperatures to rebound quickly. Surface dew points were expected to be high. The ridge was progged to persist throughout the day, but a weak surface trough was expected to be enough to fire off a few weak thunderstorms after peak heating. Thunderstorms were expected in the early evening. A few very weak convective showers developed in the northern half of the project area during the late afternoon. There was one strike of lightning. More widespread convective rain showers occurred overnight. There were no hail threats and no seed flights. Max cell top: 5.4km, 46.0 max dBz, 3.8 max VIL Tmax YC = 22C and no rain. Tmax QF = 22C and no rain. Tmax Radar = 21C and no rain.	HS3 performed a maintenance flight. They were airborne at 1929Z and landed back in YQF at 1945Z. <u>Flight Summary</u> HS3: 1922Z-1950Z; no seeding; maintenance flight.
July 29, Friday	A strong vort max moving through central Alberta was the main focus for convection, expected to initiate storms in the early evening. Speed shear was excellent, and instability parameters were conducive to moderate sized hail. After the vort max moved through, ridging was expected to occur, and clear skies were expected overnight. Severe hailstorms developed in the early afternoon. The storms were long lived and moved through the entire project area. The most severe cells moved through Rocky MH to Red Deer and Airdrie to Strathmore. The atmosphere stabilized by early evening, and the project area was stable overnight. 32mm hail and high wind was reported in Red Deer with lots of shredded trees and vegetation. Loonie to golf ball size hail was reported in Airdrie. Max cell top: 12.9km, 69.0 max dBz, 172.4 max VIL Tmax YC = 21C and no rain. Tmax QF = 20C and a trace of rain. Tmax Radar = 20C and no rain.	HS3 was launched at 1924Z for developing hailstorms near Rocky MH. They were airborne at 1940Z and began top seeding storm #1 west of Rocky MH at 2003Z. At 2028Z, the storm moved through Rocky MH, and HS3 stopped seeding. They descended to shed ice and then climbed back to top. They began seeding storm #2 NW of Sylvan at 2042Z. They continued seeding the storm until it cleared the Red Deer area. They stopped seeding #2 at 2145Z and descended again to shed ice. At 2151Z, they began seeding storm #5 near Innisfail. They stopped seeding #5 at 2217Z and RTB to YQF as the cell passed Innisfail and they were getting low on fuel. They landed at 2226Z. HS1 was launched at 2033Z for intensifying clusters of cells approaching Airdrie. They were airborne at 2048Z and began top seeding storm #3 Airdrie at 2055Z. At 2139Z, they stopped seeding #3 as the cell moved east of Airdrie. They then moved a few kilometers to the west and began seeding #4 west of Airdrie at 2143Z. They continued working the cell as it passed through the northern Calgary/Airdrie area all the way through Strathmore. They stopped seeding #4 at 2306Z and RTB to YYC.

		They landed at 2318Z. HS4 was launched at 2038Z for an organized hailstorm near Rocky MH heading toward Sylvan and Red Deer. They were airborne at 2054Z and began base seeding storm #2 near Sylvan at 2103Z with excellent inflow. They continued working the storm until it cleared the Red Deer area. They stopped seeding storm #2 at 2145Z and repositioned to a cell approaching Innisfail. They began seeding storm #5 Innisfail at 2151Z. They stopped seeding #5 at 2215Z and repositioned to near Sundre for patrol. At 2308Z, HS4 reported increasing inflow and began seeding storm #6 west of Innisfail. They stopped seeding #6 at 2316Z and patrolled for a few minutes before RTB at 2320Z. They landed in YQF at 2334Z. HS2 was launched at 2116Z for cells near Airdrie. They were airborne at 2139Z and began base seeding storm #4 Airdrie at 2146Z with burners and BIPs. They stayed with the storm as it moved all the way through Strathmore. They stopped seeding #4 at 2306Z and RTB to YYC. They landed at 2322Z. <u>Flight Summary</u> HS3: 1935Z-2231Z; 13 BIP, 146 EJ; #1 Rocky MH, #2 Sylvan, #5 Innisfail. HS1: 2042Z-2325Z; 11 BIP, 265 EJ; #3 Airdrie, #4 Airdrie to Strathmore. HS4: 2048Z-2339Z; 12 BIP, 160min acetone generator time; #2 Sylvan, #5 Innisfail, #6 Innisfail, patrol Sundre. HS2: 2130Z-2325Z; 18 BIP, 160min acetone generator time; #4 Airdrie to Strathmore.
July 30, Saturday	A strong 500mb ridge was located over Alberta and British Columbia, with clear skies over the project area. The ridge was expected to slowly move off during the overnight period, providing no threat of convection during the forecast period. Skies were completely clear all day and all night. There were no radar echoes. Tmax YC = 25.5C and no rain. Tmax QF = 24.4C and no rain. Tmax Radar = 24.7C and no rain.	No aircraft operations.

ALBERTA HAIL SUPPRESSION PROJECT 2011
DAILY SUMMARY REPORTS
WEEK No.10

Date	Weather	Activities Summary
July 31, Sunday	Two upper level jet streaks were positioned over AB. The right rear quadrant of the northern jet streak passed over the project area during the evening hours. At the mid-levels, a trough was in place over BC and northwestern AB. A weak shortwave trough was expected to move through the region during the evening hours. At the surface, a low was forming near Red Deer and moving eastward. The atmosphere was moderately unstable with decent speed shear. The project area remained partly cloudy through most of the morning and afternoon. Towering cumulus began to develop in the late afternoon, but they were sheared apart over the project area for the most part. More intense organized cells developed near Rocky MH in the early evening which developed into significant hail threats over the far northern part of the project area. The cells moved from Rocky MH through the Lacombe and Panoka area dropping toonie size hail west of Panoka. Activity diminished around dusk. Weak convective showers lingered over the area through the night. Max cell top: 12.1km, 71.5 max dBz, 159.6 max VIL Tmax YC = 29.4C and no rain. Tmax QF = 23.2C and 0.6mm of rain. Tmax Radar = 26.0C and no rain.	HS4 was launched at 0207Z (08/01) for a severe cell developing near Rocky MH. They were airborne at 0220Z (08/01). They began base seeding at 0240Z (08/01) on storm #1 near Rocky MH. They continued working that cell until it was through town. They stopped seeding #1 at 0309Z (08/01) and repositioned to the northeast for a storm heading toward Lacombe and Panoka. They began seeding that storm as it was north of Sylvan Lake at 0319Z (08/01). The storm moved clear of Panoka and they RTB at 0415Z (08/01). They landed in YQF at 0426Z (08/01). HS3 was launched at 0225Z (08/01) to the same area as HS4 near Rocky MH. They were airborne at 0244Z (08/01). They began seeding storm #1 west of Rocky MH at 0302Z (08/01). As the storm cleared Rocky, they stopped seeding #1 at 0317Z (08/01) to reposition to the northeast. They began seeding #2 west of Lacombe at 0322Z (08/01). They top seeded until they were forced to descend to shed ice. The cell was nearly through Panoka at that time so they stopped seeding and RTB at 0404Z (08/01). They landed in YQF at 0410Z (08/01). Flight Summary HS4: 0212Z (08/01)-0430Z (08/01); 9 BIP, 196min acetone generator time; #1 Rocky MH, #2 Panoka. HS3: 0236Z (08/01)-0415Z (08/01); 86 EJ, 10 BIP; #1 Rocky MH, #2 Panoka.
August 1, Monday	The upper level jet was south and east of AB. Weak mid-level ridging was expected to begin influencing the area during the evening hours. Vorticity advection was expected during the afternoon but the atmosphere was capped. At the surface, high pressure was over northern AB, and a cold front was over southern AB. The cold front was progged to shift southeastward throughout the day. The atmosphere was expected to be stable in the evening and overnight. A few weak thundershowers were still lingering over the project area in the very early morning hours. By dawn, all showers had ended. The project area had a few towering cumulus and widespread fair weather cumulus throughout the afternoon. Skies cleared out in the late afternoon and remained clear overnight. There were no hail threats. Max cell top: 6.1km, 47.5 max dBz, 7.5 max VIL Tmax YC = 21.5C and no rain. Tmax QF = 22.0C and 0.6mm of rain. Tmax Radar = 23.3C and no rain.	No aircraft operations.

August 2, Tuesday	The upper level jet continued to be south and east of the province. At the mid-levels, the ridge began to flatten over AB during the morning and early afternoon. The late evening saw a shortwave trough with strong vorticity move across the region. Low level moisture was also expected to increase in the evening. The region was slightly unstable with moderate speed shear, but the atmosphere experienced convective inhibition for most of the daytime hours. The day began mostly clear with a few clouds over the foothills. During the afternoon, a few towering cumulus formed on the foothills, while east of the range clear skies prevailed. Marginal hail storms developed just before midnight over the far northern project area. They moved through Lacombe. All activity ended around 8Z in the morning. Max cell top: 11.4km, 67 max dBz, 69.7 max VIL Tmax YC = 23.6C and no rain. Tmax QF = 22.6C and no rain. Tmax Radar = 22.9C and no rain.	HS4 was launched at 0543Z (08/03) for marginal hail storms west of Sylvan. They were airborne at 0600Z (08/03). They began seeding storm #1 southwest of Lacombe with acetone generators at 0606Z (08/03). At 0635Z (08/03) they stopped seeding storm #1 and began patrol near Red Deer. They RTB at 0708Z (08/03) and landed in YQF at 0717Z (08/03). HS3 was launched at 0549Z (08/03) for cells west of Sylvan. They were airborne at 0608Z (08/03) and began dragging BIPs for storm #1 west of Lacombe at 0617Z (08/03). They stopped seeding at 0636Z (08/03) and started patrol SW of Sylvan. No more seedable clouds were found. They RTB at 0709Z (08/03) and landed in YQF at 0720Z (08/03). <u>Flight Summary</u> HS4: 0552Z (08/03)-0721Z (08/03); 60min acetone generator time; #1 Lacombe. HS3: 0601Z (08/03)-0725Z (08/03); 5 BIP; #1 Sylvan.
August 3, Wednesday	An upper level ridge was over northern BC. A shortwave trough was expected to slide down the backside of the ridge through central AB during the afternoon and evening hours. At the surface, a lee trough was progged to form over the area during the afternoon and evening hours. Another low was also centered near the Vancouver area which aided in sending weak vorticity towards the Calgary area. The atmosphere was slightly unstable with weak convective inhibition. During the afternoon, a few rain showers initiated along the foothills, moving into the project area with little threat. As the afternoon progressed, a few of these storms became more severe, some tracking through the Calgary metropolitan area. By midnight, storms had died down as the atmosphere became sufficiently capped. Quarter sized hail reported just SW of Calgary. Max cell top: 11.4km, 67 max dBz, 88.3 max VIL Tmax YC = 22.0C and 17.2mm of rain. Tmax QF = 21.8C and 3.2mm of rain. Tmax Radar = 20.2C and 0.6mm of rain.	HS4 was launched at 2234Z for a cell near Sundre, tracking for Olds and Didsbury. They were airborne at 2246Z. At 2307Z, HS4 began seeding storm #1 with burners. They continued until the storm moved E of Didsbury at 2346Z. They were then directed to patrol a cell near Sundre, and then repositioned W of Airdrie. They began seeding storm #2 at 0058Z (08/04). At 0151Z (08/04), as it became clear this storm would head through Calgary, HS4 was directed to burn BIPs end to end. They continued until the storm moved past Calgary, stopping BIPs at 0240Z (08/04). At 0315Z (08/04) they reported that the generators were running empty, and HS4 RTB at 0319Z (08/04). They landed at 0353Z (08/04). HS1 was launched at 0114Z (08/04) for a storm NW of Calgary. They were airborne at 0127Z (08/04) and began top seeding storm #2 at 0142Z (08/04). They continued until 0232Z (08/04), when they began reporting glaciated conditions. They were then repositioned to storm #3, also tracking through Calgary. At 0317Z (08/04), as the storm left Calgary and there was no other troubling convection in the area, HS1 RTB. They landed at 0331Z (08/04). HS2 was launched at 0155Z (08/04) for storm #2. They were unable to takeoff immediately due to the proximity of the storm to the airport. They became airborne at 0227Z (08/04) and began base seeding storm #3 at 0232Z (08/04) with both acetone generators and BIPs. They experienced good inflow, but by 0251Z (08/04) reported the bases deteriorating slightly. They were told to stop using BIPs at 0300Z (08/04) as the storm became weaker both on radar and

		from pilot reports. As the storm moved out of Calgary, HS2 RTB YYC at 0328Z (08/04), landing at 0340Z (08/04). HS3 was launched at 0217Z (08/04) for storm #2. They were airborne at 0240Z (08/04) and were directed along the east side of the storm to avoid conflicts with ATC. They began seeding with BIPs at 0306Z (08/04), reporting only isolated seedable clouds. It became apparent the storm would not pose a threat to any target cities, and HS3 RTB at 0328Z (08/04), landing at 0411Z (08/04). <u>Flight Summary</u> HS4: 2240Z-0357Z (08/04); 18 BIP, 351 minutes acetone generators; #1 Didsbury, patrol NW Sundre, patrol Airdrie, #2 NW Calgary. HS1: 0122Z (08/04)-0334Z (08/04); 284 EJ, 15 BIP; #2 Calgary. HS2: 0200Z (08/04)-0345Z (08/04); 8 BIP, 112 minutes acetone generator time; #3 NW Calgary, #2 Strathmore. HS3: 0232Z (08/04)-0415Z (08/04); 3 BIP; #2 Strathmore.
August 4, Thursday	The jet was located over SK and MB. Northern BC and AB experienced ridging while southern BC and AB had zonal flow. A shortwave trough was expected to slide through central AB during the early evening hours. The area saw SE moisture advection and 850mb theta-e ridging for most of the day. The Calgary sounding showed directional shear with the wind veering with height. Additionally, the sounding showed a moderately unstable atmosphere with decent speed shear. Fair weather cumulus and a few towering cumulus occurred throughout the day. The area saw clearing during the late afternoon. During the evening, a few hail storms occurred in the northern part of the project area. They moved ESE through the northern buffer zone through Blackfalds and clipped the north end of Red Deer. Max cell top: 12.9km, 68 max dBz, 98.3 max VIL Tmax YC = 23.1C and a trace of rain. Tmax QF = 23.3C and 0.2mm of rain. Tmax Radar = 22.6C and no rain.	HS4 flew a PR flight from Red Deer to Olds-Didsbury airport. They took off at 1708Z and landed at 1725Z. For their return flight to Red Deer, they took off at 2126Z and landed at 2144Z. HS3 was launched to cloud top at 0455Z (08/05) for development W of Lacombe. They were airborne at 0506Z (08/05) and reported large mammatus clouds and frequent cloud to ground lightning. At 0522Z (08/05), they reported their right engine ice deflector door was malfunctioning. They were unable to rectify the problem. They performed a few top seeding runs before they had to descend to warmer temperatures. They began top seeding storm #1 at 0527Z (08/05), reporting moderate updrafts and good liquid water. They descended at 0542Z (08/05) and began base seeding with BIPs at 0549Z (08/05). They continued seeding until the storm moved past Red Deer. They RTB to YQF at 0731Z (08/05), landing at 0743Z (08/05). HS4 was launched to base at 0519Z (08/05) for development W of Lacombe. They were airborne at 0543Z (08/05) and reported a right burner malfunction. They began seeding storm #1 with their working burner at 0555Z (08/05), beginning BIPs at 0653Z (08/05) in response to increased inflow and intensification on radar. They continued seeding until the storm moved past Red Deer. They RTB YQF at 0731Z (08/05), landing at 0739Z (08/05). <u>Flight Summary</u>

		HS4: 1658Z-1729Z; no seeding; PR flight YQF to Olds. HS4: 2120Z-2148Z; no seeding; PR flight Olds to YQF. HS3: 0500Z (08/05)-0747Z (08/05); 20 BIP, 81 EJ; #1 Lacombe. HS4: 0534Z (08/05)-0744Z (08/05); 6 BIP, 97 minutes acetone generators; #1 Red Deer.
August 5, Friday	The main synoptic feature was a closed, upper level low over northern BC. Several lobes of weak to moderate vorticity were expected to pass over the project area from the SW to NE during the day. At the surface, a cold front was over central BC which was progged to begin pushing through AB during the late-night hours. The surface wind was expected to remain southeasterly for most of the day. 850mb theta-e ridging continued over the region, and the sounding data showed a moderately unstable atmosphere. The wind shear profile hinted at the possibility for long lived thunderstorms. During the late morning, skies were generally clear except for some strong storms in the southern buffer zone. Storms formed in the foothills during the early afternoon, and some of them moved into the project area. One severe storm moved down off the foothills and directly impacted Calgary. All aircraft were involved with seeding this Calgary storm. Overnight, there were a few rain showers and weak thunderstorms across the project area as the cold front passed through. There was one report of golf ball sized hail in northwest Calgary, and several reports of rivers of pea sized hail flowing in the streets. Nickel to quarter size hail was reported to the north of downtown. Flash flooding in the city was reported by the news media. An elderly man died in Calgary when he was washed under his vehicle in flood waters. Several people were stranded on the roofs of vehicles on flooded streets. Max cell top: 15.1km, 67 max dBz, 142.2 max VIL Tmax YC = 24.8C and 15.4mm of rain. Tmax QF = 24.5C and 0.4mm of rain. Tmax Radar = 24.0C and no rain.	HS2 flew to the Red Deer airport for scheduled maintenance. They were airborne at 1615Z and landed at 1653Z. HS1 was launched for development W of Okotoks at 1727Z, becoming airborne at 1745Z. They began patrol near Okotoks. HS1 found good growth on the NE side of the cell, but the storm began to change shape such that no cities were being threatened. It also began to weaken significantly as it moved off the foothills. HS1 RTB YYC at 1812Z, landing at 1833Z. HS2 was launched for development NW of Cochrane at 1957Z, becoming airborne at 2013Z. They reported a poorly defined base. They were told to patrol. At 2143Z, as the storm appeared to be holding its intensity and began moving towards Carstairs and Crossfield, HS2 began seeding storm #1 with burners. At 2234Z, as the storm strengthened and began to track more for Airdrie and northern Calgary, HS2 began using BIPs. A cell to the south of storm #1 showed explosive growth, and HS2 moved to storm #2 at 2312Z. This storm began to move south directly through Calgary, and was seeded heavily by HS2 until 0008Z (08/06), when they had to RTB for fuel. Because the storm was over the Calgary airport, they RTB YQF, landing at 0038Z (08/06). HS1 was launched to top at 2207Z for storm #1 W of Airdrie. They were airborne at 2225Z, and began seeding the south end of the storm at 2241Z. As storm #2 formed south of storm #1, they repositioned to it at 2318Z. At 0014Z (08/06), HS1 exhausted their EJs, and descended to 14kft to use BIPs at the -5C level. They continued until 0037Z (08/06) when they ran out of BIPs, at which point they RTB YYC. They landed at 0051Z (08/06). HS4 was launched at 2322Z to replace HS2 on storm #2. They were airborne at 2339Z and began seeding with generators and BIPs at 0011Z (08/06). They were initially restricted to E of the storm due to conflicts with ATC, but soon began a favorable track and reported moderate inflow. Throughout the flight, HS4 reported the storm weakening, with radar imagery confirming this. At 0058Z (08/06), due to reports of holes in the base and poor inflow,

		they stopped using BIPs and moved their track farther to the west in search of better inflow. No more inflow was found, only downdraft so they stopped seeding and began patrol at 0115Z (08/06). The storm continued to weaken on radar, and HS4 RTB YQF at 0123Z (08/06). They landed at 0155Z (08/06). HS3 was launched at 2346Z to replace HS1 on storm #2. They were airborne at 2357Z and began seeding storm #2 at 0025Z (08/06). They found good water and strong updrafts initially, but found more and more glaciated as the cell moved through Calgary. By 0101Z (08/06), they were finding nearly no liquid water, and stopped seeding at 0106Z (08/06). They RTB YQF 0113Z (08/06) as the storm ceased to be a hail threat. HS3 landed at 0145Z (08/06). HS2 flew a reposition flight from YQF to YYC. They became airborne at 0147Z (08/06) and landed at 0229Z (08/06). <u>Flight Summary</u> HS2: 1610Z-1657Z; no seeding; maintenance flight. HS1: 1739Z-1837Z; no seeding; patrol W Okotoks. HS2: 2003Z (08/05)-0040Z (08/06); 22 BIP, 286 minutes acetone generator time; #1 Airdrie, #2 Calgary; takeoff YQF, land YQF. HS1: 2215Z (08/05)-0057Z (08/06); 293 EJ, 23 BIP; #2 Calgary. HS4: 2330Z (08/05)-0158Z (08/06); 5 BIP, 126 minutes acetone generator time; #2 Calgary. HS3: 2351Z (08/05)-0148Z (08/06); 147 EJ; #2 Calgary. HS2: 0143Z (08/06)-0232Z (08/06); no seeding; reposition from YQF to YYC.
August 6, Saturday	There were no significant upper jet streaks over the area, but a closed upper low was moving through the northern project area in the afternoon and evening hours. The atmosphere was only moderately unstable. Wind shear was weak. A cold front had pushed through to the east by forecast time and would not be a factor for the day. Small hail was expected during the afternoon and early evening as the upper low moved through the area. Stratiform showers were expected overnight after the atmosphere stabilized in the evening. Clear skies prevailed during the morning, becoming cloudy during the early afternoon. A few showers occurred over the foothills. In the late afternoon, the upper low moving through the northern project area set off severe thunderstorms in the northern half of the PA. The most intense cells were east of Rocky MH. A moderately strong cell went through Penhold. Overnight, cold air set in, the atmosphere stabilized, and a few rain showers occurred. Barry Robinson reported lots of pea to marble sized hail	HS4 was launched for development near RMH at 0017Z (08/07). They were airborne at 0035Z (08/07), and started seeding storm #1 at 0052Z (08/07) with both burners. As the cell intensified on radar, they began using BIPs at 0101Z (08/07). They were directed to shift their track to the NE at 0129Z (08/07) as this was threatening Sylvan Lake. HS4 continued seeding the storm, moving d own to the S end of the cell at 0241Z (08/07). When the storm was past Red Deer at 0250Z (08/07), they discontinued seeding and repositioned to storm #3 by Sundre. They began seeding again at 0303Z (08/07) using only their left burner, as their right burner would not restart. The storm dissipated, and they RTB YYC. They landed at 0341Z (08/07). HS3 was launched at 0102Z for development W of RMH. They were airborne at 0111 (08/07), and began seeding storm #1 at 0125Z (08/07) with both EJs and BIPs. After one

	in Penhold. Nickel size hail occurred 2 km south of Didsbury. Max cell top: 11.4km, 69.5 max dBz, 156.6 max VIL Tmax YC = 21.8C and no rain. Tmax QF = 20.7C and 29mm of rain. Tmax Radar = 20.0C and 2mm of rain.	pass, they were directed to storm #2 W of Didsbury, which they began seeding at 0140Z (08/07). As this tracked south of Didsbury, HS3 moved back to storm #1, which was now threatening Sylvan Lake. They began seeding again at 0200Z (08/07). They found exceptional liquid water in this cell, and at 0214Z (08/07) descended to melt ice. They began climbing again at 0224Z (08/07), using BIPs through the climb. By this time, they were having trouble finding feeders on the SW side of the storm, so were directed to the E side where they were more successful. HS3 continued seeding this cell until it had moved past Red Deer, and were told to RTB YQF at 0255Z (08/07). Due to rain at the airport, they had to hold before landing, and finally touched down at 0314Z (08/07). HS2 was launched to storm #1 at 0129Z (08/07). They were airborne at 0145Z (08/07), and began seeding with burners at 0204Z (08/07). They began BIPs at 0208Z (08/07). They continued until 0241Z (08/07), when HS4 replaced them and they moved down to storm #2 W of Linden. They resumed seeding at 0250Z (08/07) with generators, stopping when the storm moved past Linden. They then repositioned to the Olds area at 0321Z (08/07). When a gust front pushed them far out from the storm, they RTB YYC at 0328Z (08/07). They landed at 0349Z (08/07). HS1 was launched at 0308Z (08/07) for the storm W of Olds. They were airborne at 0321Z (08/07). They were unable to find any updraft or suitable seeding area due to the dissipating nature of the storm. As this cell did not appear to be a hail threat, HS1 RTB YYC at 0352Z (08/07), landing at 0406Z (08/07). HS4 repositioned from YYC back to YQF after all activity diminished in the late night hours. They took off at 0713Z (08/07) and landed at 0751Z (08/07). <u>Flight Summary</u> HS4: 0028Z (08/07)-0345Z (08/07); 15 BIP, 256 minutes acetone generators; #1 RMH, #3 Sundre. HS3: 0103Z (08/07)-0320Z (08/07); 189 EJ, 17 BIP; #1 RMH, #2 Didsbury, #1 Red Deer. HS2: 0136Z (08/07)-0352Z (08/07); 5 BIP, 138 minutes acetone generators; #1 Sylvan Lake, #2 Linden, patrol Olds. HS1: 0314Z (08/07)-0410Z (08/07); no seeding; patrol W Olds. HS4: 0704Z (08/07)-0756Z (08/07); no seeding; reposition YYC to YQF.

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Date	Weather	Activities Summary
August 7, Sunday	An upper low was located over the Alberta-Saskatchewan border. The low was moving off to the east, and a ridge was building over the project area. Low levels were drying, midlevels were warming, and the sounding was nearly stable. A very shallow unstable layer was evident below 15kft. Weak convective showers were forecast to occur over the northern project area and foothills. Gusty winds were expected in the afternoon. Skies were expected to clear in the late afternoon, and stable conditions were forecast overnight. The day started out clear with fair weather cumulus over the area during the afternoon. As night fell, clearing occurred. A weak rain shower producing mainly virga passed through the northern part of the project area overnight. Max cell top: 5.4 km, 49.5 max dBz, 5.0 max VIL Tmax YC = 20.0C and no rain. Tmax QF = 19.0C and 3.4mm of rain. Tmax Radar = 18.0C and no rain.	No aircraft operations.
August 8, Monday	There was no significant upper jet over the region. A weak ridge was established over the project area. High pressure was in place, while surface dew points were high. The atmosphere was moderately unstable. A lee trough was expected to develop during the afternoon, and upslope winds were forecast to initiate thunderstorms along the foothills. The wind shear was unfavorable for sustained updrafts and long lived convection. The ridge was expected to inhibit thunderstorms over the plains, and convection was forecast to be confined to the foothills. Stable conditions were expected overnight. Uneventful weather occurred during the morning and afternoon as only some fair weather cumulus was present. In the late afternoon, some cells initiated over the foothills and moved to the south, dissipating as they moved into the project area. Overnight, skies were mostly clear. Max cell top: 6.1 km, 47.5 max dBz, 5.6 max VIL Tmax YC = 21.9C and no rain. Tmax QF = 22.6C and no rain. Tmax Radar = 2300C and no rain.	No aircraft operations.
August 9, Tuesday	No upper jet features were evident over the region. The upper ridge was flattening, and the upper level flow was weak from the northwest. Moderate instability was present, especially over the northern project area. Upslope flow was expected to trigger pulse-type thunderstorms during the day. Storms were expected to move off the mountains in the late afternoon. The wind	HS4 was launched at 2020Z to growing convection NW of Rocky MH. The aircraft became airborne at 2039Z. At 2058Z, the crew reported that they were only finding weak sporadic inflow, so they patrolled the Rocky MH area. Then at 2144Z the flight was redirected to new convection NW of Airdrie. The aircraft

	shear profile was weak, and long lived severe storms were not expected. Small hail was forecast to occur during the afternoon and evening. Weak instability was expected overnight with elevated weak thundershowers continuing through morning. Convection began forming along the mountains and foothills during the late morning hours. This convection grew in the afternoon and began pushing off the foothills in the mid-afternoon. The strongest storm (#2) of the day formed NW of Cochrane and initially tracked south-southeastward along the foothills. Once the storm neared the Cochrane area, it began to move off the foothills and passed through northern Calgary before dissipating. The late evening and overnight hours saw strong embedded storms across the northern part of the project area. Most of these storms were of the pulse variety and mainly consisted of heavy rain. Max cell top: 11.4 km, 64 max dBz, 102.3 max VIL Tmax YC = 24.3C and 4.2mm of rain. Tmax QF = 25.2C and no rain. Tmax Radar = 24.9C and 1mm of rain.	patrolled this area for a short time before being redirected to stronger convection NW of Sylvan at 2250Z. HS4 started seeding the Sylvan storm (#1) at 2317Z with one generator due to failure of the right generator. HS4 briefly seeded storm #1 until the flight was redirected at 2327Z to a much stronger storm NW of Calgary. The aircraft began seeding the Calgary storm (#2) at 2352Z. The aircraft seeded with BIPs only as the left burner would not reignite. HS4 continued to seed Storm #2 until HS2 replaced them. HS4 stopped seeding and RTB at 0021Z (08/10). The aircraft landed in YQF at 0049Z (08/10). HS1 was launched at 2313Z to strong development NW of Cochrane. The flight became airborne at 2335Z. HS1 started seeding storm #2 from Cochrane to Calgary at 2350Z. At 0059Z (08/10), the aircraft stopped seeding and started patrolling after the crew said they were finding minimal feeder clouds. HS1 stopped patrolling and RTB at 0153Z (08/10). The flight landed in YYC at 0210Z (08/10). HS2 was launched at 2345Z to replace HS4 at cloud base for storm #2 near Cochrane. The flight became airborne at 0016Z (08/10). The aircraft quickly found inflow and started seeding the Calgary storm (#2) at 0027Z (08/10). At 0044Z (08/10), the crew reported that the storm's base was breaking up and inflow diminishing. HS2 stopped seeding and started patrolling at 0105Z (08/10). HS2 then patrolled the southern Calgary area until 0222Z (08/10) when they RTB. The aircraft landed in YYC at 0233Z (08/10). HS4 was launched for a brief patrol flight to the SW of Red Deer at 0630Z (08/10). The flight became airborne at 0646Z (08/10). Nothing seedable was found and they RTB at 0714Z (08/10). They landed back in YQF at 0723Z (08/10). <u>Flight Summary</u> HS4: 2028Z (08/09)-0052Z (08/10); 9 min acetone generator time, 6 BIP; patrol Rocky MH, patrol Airdrie, #1 Sylvan, and #2 Calgary. HS1: 2320Z (08/09)-0215Z (08/10); 174 EJ, 3 BIP; #2 Calgary and patrol Calgary. HS2: 0010Z (08/10)-0237Z (08/10); 74 minutes acetone generator time, 3 BIP; #2 Calgary and patrol Calgary. HS4: 0637Z (08/10)-0727Z (08/10); no seeding; patrol Red Deer.
August 10, Wednesday	There was no significant upper level jet over the area. An upper level trough was progged to begin moving into the area during evening hours. Midlevels of the atmosphere were cooling while low level moisture was increasing.	HS2 flew a maintenance flight from Calgary to Red Deer. The aircraft was airborne at 1513Z and landed at 1541Z.

	Moderate instability was expected throughout the forecast period. Wind shear was weak and unfavorable for severe storm development. Afternoon and evening pulse-type hail storms were forecast. Weak nocturnal convection was also expected through morning. Convection began to form along the foothills around noon. The afternoon saw a line of TITAN cells developing along the foothills. As the line began to move off the foothills onto the project area, many of these cells diminished and became embedded rain. One storm W of Airdrie was able to make its way into the project area. This storm (#1) eventually strengthened and moved through Airdrie and northern Calgary during the late afternoon hours dropping nickel and quarter size hail. The rest of the project area saw weak to moderate thunderstorm activity. Max cell top: 12.4 km, 68 max dBz, 118.8 max VIL Tmax YC = 22.6C and 4.2mm of rain. Tmax QF = 25.5C and 10.2mm of rain. Tmax Radar = 22.0C and no rain.	HS2 then flew a public relations flight from Red Deer to the Olds-Didsbury airport. The aircraft was airborne at 1715Z and landed at 1729Z. HS2 was launched from the Olds-Didsbury airport at 2116Z in order to patrol an area N of Cochrane. The flight became airborne at 2125Z. HS2 started seeding storm #1 W of Airdrie at 2205Z. The aircraft followed the storm as it moved through Airdrie and northern Calgary. At 2303Z, HS2 was restricted by air traffic control to the south-southwest side of the storm. HS2 stopped seeding at 2354Z and briefly patrolled the area before being RTB at 2357Z. The aircraft landed in Calgary at 0006Z (08/11). HS1 was launched at 2219Z to storm #1 W of Airdrie. The aircraft became airborne at 2239Z. The crew quickly found seedable conditions over northern Calgary and started seeding storm #1 at 2248Z. At 2306Z the crew reported they were finding 1000fpm updrafts. Once the storm diminished, HS1 stopped seeding at 2354Z and started patrolling eastern Calgary. At 0009Z (08/11) the flight RTB to Calgary. The aircraft landed at 0015Z (08/11). HS4 was launched for a patrol flight near the Lacombe area at 0024Z (08/11). The flight became airborne at 0036Z (08/11). No hailstorms developed over the area. HS4 RTB at 0119Z (08/11) and landed in YQF at 0129Z (08/11). <u>Flight Summary</u> HS2: 1506-1545Z; no seeding; maintenance flight Calgary to Red Deer. HS2: 1709-1731Z; no seeding; PR flight Red Deer to Olds-Didsbury airport. HS2: 2122Z (08/10)-0011Z (08/11); 200 min acetone generator time, 11 BIP; #1 Airdrie/Calgary and patrol Calgary. HS1: 2227Z (08/10)-0020Z (08/11); 168 EJ, 10 BIP; #1 Airdrie/Calgary and patrol Calgary. HS4: 0030Z (08/11)-0132Z (08/11); no seeding; patrol Lacombe.
August 11, Thursday	The upper level jet remained well south of the project area. An upper low was located along the Montana border southeast of the project area. A low level circulation was present to the east of Calgary moving out of the area in the morning. Weak ridging was expected to begin in the afternoon. A thick cirrus cloud layer was expected to persist throughout the day which would inhibit insolation. A lee trough was expected to develop in the afternoon, and upslope flow was progged to initiate storms along the foothills. The atmosphere was moderately unstable with a weak wind shear profile. Early morning weak thunderstorms had already occurred by forecast time. Thundershowers were expected during the afternoon and evening. Stable, clear conditions were	HS1 was launched to new growth near the Cochrane area at 2233Z. The flight became airborne at 2259Z and was initially vectored by air traffic control to the SW of Calgary. Then at 2325Z the aircraft started seeding storm #1 over southern Calgary. HS1 then stopped seeding at 2339Z and RTB at 2341Z. The flight landed in Calgary at 2357Z. <u>Flight Summary</u> HS1: 2252Z (08/11)-0002Z (08/12); 40 EJ; #1 southern Calgary to Okotoks.

	forecast to begin around midnight. A line of embedded convection formed over the foothills during the afternoon hours. This line extended from Sundre down to High River and eventually moved into the project area during the late afternoon. The strongest storm (#1) formed just south of Cochrane and moved southeastward through Calgary and Okotoks dropping pea size hail. The rest of the project area saw weaker thunderstorms. The region then experienced clearing during the late evening and overnight. Max cell top: 11.4 km, 65.0 max dBz, 67.1 max VIL Tmax YC = 19.0C and 2.0mm of rain. Tmax QF = 20.0C and 2.4mm of rain. Tmax Radar = 20.0C and no rain.	
August 12, Friday	An upper level ridge had developed with its axis over central Alberta. The atmosphere was moderately unstable. Due to the significant ridging and lack of strong triggers, no severe convection was expected. A weak easterly wind and good instability made rain showers a possibility for later in the afternoon. The region saw mainly clear skies with occasional fair weather cumulus. Thunderstorms formed over the foothills south of Calgary but dissipated before reaching the project area boundary. Stronger thunderstorms were seen west of Edmonton and south of High River. Tmax YC = 22C and no rain. Tmax QF = 23C and no rain. Tmax Radar = 23C and no rain.	No aircraft operations.
August 13, Saturday	An upper level ridge axis was located over the Alberta-Saskatchewan border, and a weak trough was located over central Alberta. The upper jet had protruded into the project area, but there were no jet streaks. Due to the ridge, no severe convection was expected, despite the moderate instability and good shear on the sounding. Rain showers in the eastern buffer were forecast due to the proximity of the trough. Towering cumulus clouds were seen along the northern foothills during the afternoon hours. These clouds dissipated as they approached the project area. The northern buffer zone saw convective rain showers during the late afternoon and early evening. Clear skies then occurred in the late evening and overnight hours. Max cell top: 5.4km, 53.5 max dBz, 11.2 max VIL Tmax YC = 26C and no rain. Tmax QF = 26C and no rain. Tmax Radar = 26C and no rain.	No aircraft operations.

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Date	Weather	Activities Summary
August 14, Sunday	The upper level trough was moving in during the forecast period, and small midlevel shortwaves were present. Moisture was in very good supply, and combined with speed shear and mid-level cooling made for an impressive sounding. A dry cold front extending SE through the center of the project area was obvious on the surface observations. Severe thunderstorms were expected beginning in the mid-afternoon focused on the northern half of the project area. Convection developed in the afternoon along the foothills between Sundre and Rocky MH. Around 00Z, some of these cells became strong enough to move into the project area. Storm #1 moved through Rocky MH at roughly 01Z before dissipating. The foothills near Rocky MH continued to see strong convection during the rest of the evening. Weaker convective storms moved through the project area overnight. Max cell top: 10.6km, 59.0 max dBz, 30.6 max VIL Tmax YC = 27C and no rain. Tmax QF = 22C and no rain. Tmax Radar = 23C and 1.2mm rain.	HS4 was launched at 2319Z to a cluster of convective cells W and SW of Rocky MH. The flight became airborne at 2334Z. The aircraft began patrolling the still developing storm (#1) SW of Rocky MH at 2356Z. HS4 started seeding storm (#1) at 0025Z (08/15) once it was apparent on radar that the storm was moving off the foothills towards Rocky MH. At 0134Z (08/15) HS4 stopped seeding and started patrolling the Rocky MH area. The aircraft stopped patrolling and RTB at 0150Z (08/15). HS4 landed in YQF at 0206Z (08/15). <u>Flight Summary</u> HS4: 2326Z (08/14)-0210Z (08/15); 140 min acetone generator time, 3 BIP; #1 Rocky MH and patrol Rocky MH.
August 15, Monday	The upper level trough axis was located W of the BC/AB border, with an associated jet streak producing stratus rain and a thick cloud shield over the Rockies. This band of showers was expected to be the main feature for the day, with some weak thunderstorms possible in NE areas of the project area, where temperatures could possibly increase enough to support convection. Due to exceptionally cool temperatures, no convection was expected in the evening or overnight. It was rainy and cloudy during the early afternoon with clearing occurring by late afternoon. During the early evening, some storms occurred over the foothills moving off into the central and southern project area. Marginal hail storms moved from Sundre through the Airdrie/Calgary area. Some weaker cells moved over the radar and Didsbury area. Weak showers lingered over the northern project area through the late evening, and then the area was clear overnight. In Sundre, pea sized hail to a depth of 1 inch was reported. Ice pellets smaller than 4mm were observed at the radar. Max cell top: 9.9km, 67.5 max dBz, 78.2 max VIL Tmax YC = 14C and no rain. Tmax QF = 14C and 9.8mm rain. Tmax Radar = 15C and 9.3mm rain.	HS3 was launched at 0020Z (08/16) for cells near Sundre. They were airborne at 0040Z (08/16). HS3 began seeding storm #1 near Sundre at 0050Z (08/16) dragging BIPs through their climb to cloud top. They seeded the cell very briefly making only one seeding pass before being redirected to new growth on the west side of Calgary. They stopped seeding #1 at 0055Z (08/16) as they headed toward Calgary. They began top seeding storm #2 over Calgary at 0110Z (08/16) with BIPs and EJs. At 0144Z (08/16) HS3 stopped seeding over Calgary and moved back to storm #1 and began seeding it again at 0158Z (08/16) as it was approaching Airdrie. At 0210Z (08/16) there were no hail threats left to seed so HS3 stopped seeding and RTB to YQF. They landed at 0229Z (08/16). HS1 was launched at 0105Z (08/16) for base seeding over the Calgary area to work the same area with HS3. HS1 was airborne at 0127Z (08/16) and began base seeding storm #1 near Airdrie with BIPs at 0154Z (08/16). They only seeded for a brief time before the storm moved east and was no longer a hail threat. They stopped seeding at 0211Z (08/16) and patrolled for a few minutes before RTB at 0225Z (08/16). They landed back in YYC at 0232Z (08/16).

		<u>Flight Summary</u> HS3: 0031Z (08/16)-0234Z (08/16); 157 EJ, 6 BIP; #1 Sundre and Airdrie, #2 Calgary. HS1: 0117Z (08/16)-0235Z (08/16); 5 BIP; #1 Airdrie.
August 16, Tuesday	With the trough axis west of the project area, the mid and high levels were in zonal flow. With no mid or low level triggers, cool temperatures, and low dewpoints, no convection or precipitation was expected throughout the period. The project area was mostly clear throughout the period. Chinook arch clouds formed late in the day. There were no TITAN cells or precipitation observed. Tmax YC = 21C and no rain. Tmax QF = 21C and no rain. Tmax Radar = 22C and no rain.	No aircraft operations.
August 17, Wednesday	An upper level trough was progged to move through the project area during the afternoon and evening, with associated vorticity in the N half of the PA during the early evening hours. The sounding showed some instability during this period with good speed shear. A few weak thunderstorms were thus anticipated in the evening, becoming embedded as night fell. After the passage of this feature, northwest flow was expected to dominate, and no convection was expected overnight or tomorrow. Mountain wave and Chinook arch clouds overspread the project area in the morning and afternoon hours. During the late afternoon, an isolated convective cell developed near Rocky MH which moved ESE through the Red Deer area dropping pea sized hail. The cell was seeded from Sylvan to Red Deer. A large band of rain showers then moved through from northwest to southeast during the evening and overnight hours. There were some weak low-topped embedded convective cells overnight, but no hail threats. HS3, Jody Fischer, Terry Krauss, and all meteorology staff were present for an afternoon radar tour presented to insurance industry representatives. Max cell top: 8.4km, 64.5 max dBz, 35.2 max VIL Tmax YC = 22.9C and no rain. Tmax QF = 22.3C and 1.6mm of rain. Tmax Radar = 22.1C and 5.8mm of rain.	HS4 was launched at 2350Z for a weak cell near Sylvan approaching the Red Deer area. They were airborne at 0004Z (08/18) and began seeding storm #1 near Sylvan at 0011Z (08/18) with burners only. They then reported some pockets of strong inflow 0027Z (08/18) and burned two BIP flares. As the cell moved east of Red Deer, HS4 stopped seeding and RTB at 0049Z (08/18). They landed at 0054Z (08/18). <u>Flight Summary</u> HS3: 1709Z-1735Z; no seeding; PR flight YQF to radar. HS3: 2120Z-2143Z; no seeding; PR flight from radar back to YQF. HS4: 2356Z (08/17)-0057Z (08/18); 2 BIP, 72min acetone generator time; #1 Sylvan to Red Deer.
August 18, Thursday	The upper level jet flow was mainly over southern AB, but jet PVA was possible over Calgary. Mid-level flow was northwesterly with one shortwave trough moving through the southern part of the project area during the late afternoon and early evening hours. Moderate vorticity advection was expected with the shortwave late in the day. The sounding showed a slightly unstable atmosphere with moderate speed shear. Weak convection occurred throughout the early and midafternoon without lightning. By late afternoon, activity intensified. Cells near Calgary developed into hail threats and moved directly through Calgary from northwest to southeast. Two storms were seeded as they moved	HS1 was launched at 0029Z (08/19) for marginal hail storms approaching northwestern Calgary. They were airborne at 0048Z (08/19) and began top seeding storm #1 with EJs and BIPs over northern Calgary at 0056Z (08/19). They continued seeding that cell until it was beginning to move out of the southeast Calgary area and repositioned to another cell near Cochrane at 0141Z (08/19). They began seeding storm #2 over northwestern Calgary at 0144Z (08/19). Once the second cell moved out of Calgary, HS1 RTB to YYC at 0242Z (08/19). They landed at 0254Z (08/19).

	through the Calgary area dropping hail up to 27mm. All activity diminished by around 04Z and the atmosphere was stable overnight with just a few isolated weak showers through morning. 27mm hail was reported 1km east of Cochrane. Marble size hail was observed at YYC. Max cell top: 9.9km, 64 max dBz, 54.5 max VIL Tmax YC = 15.9C and 6.0mm of rain. Tmax QF = 17.4C and 3.2mm of rain. Tmax Radar = 15.2C and 0.6mm of rain.	HS2 was launched toward a cell near Cochrane at 0047Z (08/19). They were airborne at 0117Z (08/19) and began seeding storm #2 over northwestern Calgary at 0123Z (08/19). They continued base seeding the cell with burners and BIPs until it moved out of the Calgary area to the southeast. They RTB at 0244Z (08/19) and landed in YYC at 0256Z (08/19). <u>Flight Summary</u> HS1: 0038Z (08/19)-0258Z (08/19); 275 EJ, 14 BIP; #1 Calgary, #2 Calgary. HS2: 0102Z (08/19)-0259Z (08/19); 15 BIP, 162min acetone generator time; #2 Calgary.
August 19, Friday	Jet energy was mainly to the NE of the region. A shortwave trough moved through the project area during the late morning and early afternoon hours. Mid-level ridging then occurred through the rest of the forecast period, but a weak lobe of vorticity passed over the region in the evening. The atmosphere was warming near 500mb which inhibited convective growth above 20kft. Weak thundershowers occurred in the morning and early afternoon over the far northeast and eastern project area. There were no hail threats. All activity moved well east of the area by late afternoon and the region remained mostly clear through the night with some cirrus moving in from the northwest. Max cell top: 6.9km, 60 max dBz, 21.0 max VIL Tmax YC = 18.0C and no rain. Tmax QF = 18.6C and no rain. Tmax Radar = 17.4C and no rain.	No aircraft operations.
August 20, Saturday	A broad upper level ridge was in place over the region. No vorticity advection was expected, and a surface trough developed in the lee of the Rockies. The atmosphere was capped with strong convective inhibition in the low levels and subsidence aloft. An isolated very small echo was observed over the far southeastern buffer zone near Vulcan around dawn. Other than that, the project area remained echo free and clear for the entire day and overnight. There were no TITAN cells. 29.5 max dBz Tmax YC = 23.1C and no rain. Tmax QF = 24.1C and no rain. Tmax Radar = 24.3C and no rain.	No aircraft operations.

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ALBERTA HAIL SUPPRESSION PROJECT 2011
DAILY SUMMARY REPORTS
WEEK No.16

Date	Weather	Activities Summary
September 11, Sunday	The upper level jet continued to sag to the south for most of the day. A mid-level shortwave trough moved through central AB during the day. This shortwave was expected to stay just north of the project area. A surface low formed south of Edmonton and tracked southeastward towards southern SK. There was a cold front associated with the low which pushed through the project area during the morning and early afternoon hours. The atmosphere was slightly unstable with decent speed shear. Cloud cover was increasing throughout the morning. By late afternoon, waves of stratiform rain and a few weak convective cells moved across the northern part of the project area. There were no hail threats, no lightning strikes, and no TITAN cells. The precipitation ended by 6Z. 39.0 max dBz Tmax YC = 23.6C and no rain. Tmax QF = 21.3C and no rain. Tmax Radar = 20.0C and no rain.	No aircraft operations.
September 12, Monday	Upper level jet energy was mainly to the north of the area. Vorticity advection was also north of the region. A surface cold front was expected to slide from north to south through the project area during the late evening hours. The modified sounding showed a layer of weak instability between 8 and 11kft. The project area was cold and cloudy throughout the period. In the early evening, a small line of weak convection developed over the southeastern part of the project area. There were no lightning strikes and no hail threats. No TITAN cells. 36.5 max dBz Tmax YC = 12.3C and no rain. Tmax QF = 14.2C and no rain. Tmax Radar = 13.1C and no rain.	No aircraft operations.
September 13, Tuesday	The mid-levels saw ridging over BC and AB. A lobe of weak vorticity was expected to slide through the project area from NW to SE during the afternoon hours. A cold front pushed through the region during the morning hours which triggered weak convection. The main surface feature was a broad high pressure system over AB and SK. A layer of instability existed between 6 and 9kft. The project area was cloudy and cold throughout the daytime and evening hours. Waves of stratus rain moved through all day and overnight. Late in the period, a few weak convective showers developed with a few strikes of lightning observed. Max cell top: 6.1km, 49.5 max dBz, 5.6 max VIL	No aircraft operations.

	Tmax YC = 11.4C and no rain. Tmax QF = 11.0C and no rain. Tmax Radar = 12.0C and no rain.	
September 14, Wednesday	A mid-level trough passed over the region during the morning hours, and moderately strong vorticity advection was associated with the trough. The rest of the day saw upper level ridging. At the surface, a low formed over the Rockies as a large, dominant high pressure system, over the prairies, moved southeastward into the U.S. The Calgary sounding showed a mostly stable atmosphere during peak heating hours. Weak thundershowers were observed near Sundre and west of Calgary very early in the period. During the daytime hours, the project area was mostly clear while a few hailstorms lingered over the foothills. None of the storms moved into the project area. Convective activity diminished in the early evening and the project area cleared out overnight. Max cell top: 6.1km, 50.5 max dBz, 8.5 max VIL Tmax YC = 17.1C and a trace of rain. Tmax QF = 18.3C and no rain. Tmax Radar = 17.3C and no rain.	HS4 performed a maintenance flight. They took off from YQF at 1852Z and landed at YQF at 1915Z. <u>Flight Summary</u> HS4: 1830Z-1920Z; no seeding; Mx flight.
September 15, Thursday	An upper level jet streak passed over central AB during the overnight hours. Additionally, a mid-level trough was also expected to slide through during the late evening and overnight hours. The southwest flow caused several lobes of vorticity to move through during the late afternoon, evening, and overnight hours. At the surface, a low pressure system moved over the area. Convective inhibition was present between 5 and 12kft. A wave of virga moved through the northern project area around dawn. The project area had low overcast in the morning and afternoon hours. More virga and light stratus rain was present over the southern project area in the afternoon and evening. A few weak convective cells were observed. Max cell top: 7.6km, 47.5 max dBz, 8.5 max VIL Tmax YC = 22.7C and no rain. Tmax QF = 22.5C and no rain. Tmax Radar = 23.2C and 0.3mm of rain.	No aircraft operations.

ALBERTA HAIL SUPPRESSION PROJECT 2011 - Universal Time Coordinates

Last Updated: 2020-03-10

MONTHLY FLIGHT TIME TOTAL:	JUNE	JULY	AUGUST	SEPTEMBER	*Season Total*
HS1	37:22	43:13	16:24	0:00	**96:59**
HS2	33:22	50:49	18:28	1:59	**104:38**
HS3	33:58	49:36	15:20	0:00	**98:54**
HS4	40:17	35:31	30:25	1:49	**108:02**
					408:33

HailStop #1 - N904DK
HailStop #2- N37356
HailStop #3- N522JP
HailStop #4- N123KK

	TOTAL TIME	AIR TIME
Seeding hours:	355:30	326:22
Patrol hours:	27:28	22:05
Reposition hours:	6:32	4:42
PR hours:	8:09	4:46
Mx hours:	8:10	4:55
Ferry hours:	1:41	1:08
Cur hours:	1:03	0:45
	408:33	364:43

MONTHLY FLARE USAGE:		JUNE	JULY	AUGUST	SEPTEMBER	*Season Total*
HS1	BIP	70	99	70	0	**239**
	EJECT	1287	2262	1234	0	**4783**
HS2	BIP	52	153	64	0	**269**
	EJECT	0	244	0	0	**244**
	BURNERS	1842	2623	972	46	**5483**
HS3	BIP	129	83	61	0	**273**
	EJECT	1990	2996	660	0	**5646**
HS4	BIP	73	102	64	0	**239**
	EJECT	0	106	0	0	**106**
	BURNERS	2326	1903	1307	0	**5536**

(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

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	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
TOTALS	# Flights: 204			[redacted]			**364:43**	10779	1020	11019		382:58	10779	1020	11019		** Only flares spent for seeding.	134			
02-Jun-11	HS3	20:00	20:37	0:37	20:05	20:34	0:29	*3	*1		FERRY					0	0	0	RT		
02-Jun-11	HS4	20:01	20:47	0:46	20:09	20:39	0:30	*1	*1	*10	FERRY					0	0	0	ML	JN	
02-Jun-11	HS1	21:12	22:30	1:18	21:26	22:24	0:58	*2	*1		PATROL					0	0	0	RC	RY	
02-Jun-11	HS2	21:42	22:30	0:48	22:00	22:28	0:28	0	0	0	PATROL	2:06	0	0	0	0	0	0	MF	KB	
03-Jun-11	HS2	0:05	0:44	0:39	0:10	0:40	0:30	*2	*1	*1	MX					0	0	0	MF	KB	
03-Jun-11	HS1	0:50	2:30	1:40	1:07	2:28	1:21	2	0	0	SEED					0	0	1	RC	RY	JF
03-Jun-11	HS2	0:53	2:00	1:07	1:06	1:55	0:49	0	0	0	PATROL					0	0	0	MF	KB	
03-Jun-11	HS2	18:55	21:45	2:50	19:07	21:41	2:34	0	0	152	SEED					0	0	2	MF	KB	
03-Jun-11	HS1	22:53	23:39	0:46	23:08	23:35	0:27	0	0	0	MX	5:37	2	0	152	474	474	0	RC	RY	JF
04-Jun-11	HS2	0:16	1:05	0:49	0:32	1:00	0:28	0	0	0	PATROL					0	474	0	MF	KB	
04-Jun-11	HS1	0:18	1:26	1:08	0:31	1:23	0:52	0	0	0	PATROL	1:57	0	0	0	0	474	0	RC	RY	JF
05-Jun-11	HS3	18:46	21:07	2:21	19:03	21:03	2:00	90	0	0	SEED					0	474	1	RT	JZ	
05-Jun-11	HS4	19:05	20:59	1:54	19:13	20:55	1:42	0	4	114	SEED	4:15	90	4	114	2726	3200	1	ML	JN	
06-Jun-11	HS1	0:50	3:14	2:24	0:59	3:11	2:12	198	3	0	SEED					0	3200	1	JF	RY	
06-Jun-11	HS4	1:26	4:31	3:05	1:32	4:28	2:56	0	5	262	SEED					0	3200	1	ML	JN	
06-Jun-11	HS2	1:43	4:00	2:17	1:51	3:57	2:06	0	0	206	SEED					0	3200	1	MF	KB	
06-Jun-11	HS3	2:00	5:15	3:15	2:06	5:08	3:02	233	15	0	SEED					0	3200	1	RT	JZ	
06-Jun-11	HS3	21:44	0:26	2:42	21:54	0:22	2:28	0	0	0	PATROL	13:43	431	23	468	13408	16608	0	RT	JZ	
07-Jun-11	HS1	21:28	22:05	0:37	21:40	21:59	0:19	0	0	0	MX					0	16608	0	RC	RY	
07-Jun-11	HS3	23:36	0:12	0:36	23:44	0:09	0:25	0	0	0	MX					0	16608	0	RT	JZ	
07-Jun-11	HS4	23:37	0:07	0:30	23:46	0:03	0:17	0	0	0	MX	0:00	0	0	0	0	16608	0	ML	JN	JF
08-Jun-11	HS2	16:45	17:23	0:38	16:50	17:20	0:30	0	0	0	MX	0:00	0	0	0	0	16608	0	MF	KB	
10-Jun-11	HS4	16:54	17:25	0:31	17:10	17:22	0:12	0	0	0	MX					0	16608	0	ML	JN	
10-Jun-11	HS2	21:47	1:02	3:15	22:00	0:57	2:57	0	3	300	SEED					0	16608	1	MF	KB	
10-Jun-11	HS1	22:10	2:10	4:00	22:17	2:05	3:48	119	3	0	SEED					0	16608	0	RC	RY	JF
10-Jun-11	HS3	22:40	23:53	1:13	22:50	23:48	0:58	18	0	0	SEED	8:28	137	6	300	4497	21105	1	RT	JZ	
11-Jun-11	HS4	0:35	3:45	3:10	0:45	3:42	2:57	0	1	300	SEED					0	21105	1	ML	JN	
11-Jun-11	HS3	0:52	3:39	2:47	1:00	3:36	2:36	295	14	0	SEED					0	21105	0	RT	JZ	
11-Jun-11	HS1	3:25	4:18	0:53	3:34	4:13	0:39	0	0	0	PATROL	6:50	295	15	300	9007	30113	0	RC	RY	JF
12-Jun-11	HS4	17:54	21:41	3:47	18:03	21:36	3:33	0	10	304	SEED					0	30113	4	ML	JN	JF
12-Jun-11	HS3	19:47	23:11	3:24	19:59	23:08	3:09	143	15	0	SEED					0	30113	2	RT	JZ	
12-Jun-11	HS2	20:34	0:05	3:31	20:41	0:03	3:22	0	4	112	SEED	10:42	143	29	416	8399	38512	0	MF	KB	

13-Jun-11	HS1	0:15	3:55	3:40	0:21	3:50	3:29	213	8	0	SEED						0	38512	1	RC	RY	
13-Jun-11	HS4	1:00	3:54	2:54	1:09	3:49	2:40	0	5	258	SEED	6:34	213	13	258	6947	45459	0	ML	JN	JF
14-Jun-11	HS1	20:25	21:31	1:06	20:35	21:26	0:51	0	0	0	PATROL	1:06	0	0	0	0	45459	0	RC	RY	
15-Jun-11	HS4	1:48	3:22	1:34	1:58	3:19	1:21	0	6	104	SEED	1:34	0	6	104	1197	46656	1	ML	JN	
16-Jun-11	HS1	1:02	2:40	1:38	1:10	2:36	1:26	0	6	0	SEED					0	46656	1	RC	RY	
16-Jun-11	HS3	19:20	20:47	1:27	19:25	20:43	1:18	114	9	0	SEED	3:05	114	15	0	4530	51186	2	RT	JZ	
17-Jun-11	HS3	22:24	23:10	0:46	22:31	23:07	0:36	18	1	0	SEED	0:46	18	1	0	510	51696	1	RT	JZ	JF
18-Jun-11	HS4	4:45	5:48	1:03	4:56	5:41	0:45	0	0	0	CUR	0:00	0	0	0	0	51696	0	ML	JN	
19-Jun-11	HS2	22:39	0:07	1:28	22:43	0:05	1:22	0	2	82	SEED	1:28	0	2	82	534	52230	1	MF	KB	
20-Jun-11	HS2	0:25	3:01	2:36	0:30	2:58	2:28	0	8	120	SEED					0	52230	1	MF	KB	
20-Jun-11	HS1	18:36	22:14	3:38	18:43	22:10	3:27	230	6	0	SEED					0	52230	2	RC	RY	
20-Jun-11	HS2	19:18	23:05	3:47	19:24	23:02	3:38	0	21	340	SEED					0	52230	2	MF	KB	JF
20-Jun-11	HS3	21:14	0:02	2:48	21:24	23:56	2:32	298	11	0	SEED					0	52230	0	RT	JZ	
20-Jun-11	HS4	21:50	2:09	4:19	22:00	2:03	4:03	0	17	320	SEED					0	52230	0	ML	JN	
20-Jun-11	HS1	23:05	1:48	2:43	23:12	1:44	2:32	39	6	0	SEED	19:51	567	69	780	23919	76150	1	RC	RY	
21-Jun-11	HS4	18:55	23:27	4:32	19:04	23:22	4:18	0	16	292	SEED					0	76150	2	ML	JN	
21-Jun-11	HS3	21:13	23:46	2:33	21:21	23:42	2:21	229	13	0	SEED	7:05	229	29	292	9765	85914	1	RT	JZ	
22-Jun-11	HS1	0:35	5:49	5:14	0:49	5:43	4:54	172	18	0	SEED					0	85914	3	RC	RY	
22-Jun-11	HS4	1:38	2:48	1:10	1:45	2:42	0:57	0	0	36	SEED					0	85914	0	ML	JN	
22-Jun-11	HS2	3:16	4:31	1:15	3:20	4:28	1:08	0	0	0	PATROL					0	85914	0	MF	KB	
22-Jun-11	HS4	5:03	6:05	1:02	5:11	6:03	0:52	0	1	62	SEED					0	85914	0	ML	JN	
22-Jun-11	HS4	6:50	7:18	0:28	6:56	7:15	0:19	0	0	0	REPO	8:41	172	19	98	6570	92484	0	ML	JN	
23-Jun-11	HS2	18:44	22:30	3:46	18:53	22:28	3:35	0	11	340	SEED					0	92484	2	MF	KB	
23-Jun-11	HS1	18:58	22:16	3:18	19:10	22:10	3:00	275	20	0	SEED					0	92484	0	RC	RY	JF
23-Jun-11	HS3	19:38	22:32	2:54	19:47	22:28	2:41	70	21	0	SEED					0	92484	0	RT	JZ	
23-Jun-11	HS4	21:30	23:36	2:06	21:41	23:32	1:51	0	0	108	SEED	12:04	345	52	448	15980	108465	0	ML	JN	
24-Jun-11	HS3	0:16	3:36	3:20	0:22	3:31	3:09	188	12	0	SEED					0	108465	3	RT	JZ	
24-Jun-11	HS4	0:50	3:32	2:42	1:03	3:25	2:22	0	8	166	SEED					0	108465	0	ML	JN	
24-Jun-11	HS2	1:49	3:00	1:11	1:58	2:55	0:57	0	0	0	PATROL					0	108465	0	MF	KB	JF
24-Jun-11	HS1	18:40	19:34	0:54	18:47	19:29	0:42	0	0	0	PATROL	8:07	188	20	166	7234	115699	0	RC	RY	
25-Jun-11	HS4	2:02	2:18	0:16	2:08	2:15	0:07	0	0	0	MX					0	115699	0	ML	JN	
25-Jun-11	HS4	2:18	2:54	0:36	2:21	2:50	0:29	0	0	0	PATROL	0:36	0	0	0	0	115699	0	ML	JN	
25-Jun-11	HS4	23:43	0:12	0:29	23:50	0:09	0:19	0	0	0	PATROL	0:29	0	0	0	0	115699	0	ML	JN	
26-Jun-11	HS3	20:00	23:15	3:15	20:14	23:12	2:58	294	18	0	SEED					0	115699	4	RT	JZ	
26-Jun-11	HS1	22:55	1:20	2:25	23:04	1:17	2:13	39	0	0	SEED					0	115699	2	RC	RY	
26-Jun-11	HS4	23:50	1:34	1:44	23:59	1:29	1:30	0	0	0	PATROL	7:24	333	18	0	9360	125059	0	ML	JN	
27-Jun-11	HS4	17:12	17:41	0:29	17:22	17:38	0:16	0	0	0	PR					0	125059	0	ML	JN	
27-Jun-11	HS4	21:29	21:58	0:29	21:35	21:53	0:18	0	0	0	PR	0:00	0	0		0	125059	0	ML	JN	
30-Jun-11	HS4	1:12	1:53	0:41	1:22	1:48	0:26	0	0	0	PATROL					0	125059	0	ML	JN	
30-Jun-11	HS2	19:00	22:25	3:25	19:04	22:20	3:16	0	3	190	SEED	4:06	0	3	190	993	126052	1	MF	KB	
01-Jul-11	HS4	3:02	4:14	1:12	3:11	4:09	0:58	0	0	0	PATROL	1:12	0	0	0	0	126052	0	ML	JN	
03-Jul-11	HS2	17:02	17:20	0:18	17:09	17:18	0:09	0	0	0	FERRY					0	126052	0	MF	KB	
03-Jul-11	HS2	17:52	19:01	1:09	17:58	18:58	1:00	0	0	0	PATROL					0	126052	0	ML	JN	
03-Jul-11	HS1	19:25	21:05	1:40	19:35	21:00	1:25	72	3	0	SEED					0	126052	1	RC	RY	
03-Jul-11	HS4	19:28	21:31	2:03	19:36	21:27	1:51	0	2	84	SEED					0	126052	0	ML	JN	
03-Jul-11	HS2	19:28	21:37	2:09	19:36	21:35	1:59	0	1	70	SEED					0	126052	0	MF	KB	
03-Jul-11	HS3	19:35	21:00	1:25	19:41	20:55	1:14	68	2	0	SEED	8:26	140	8	154	4440	130492	1	RT	JZ	
04-Jul-11	HS3	0:24	2:48	2:24	0:29	2:44	2:15	271	2	0	SEED					0	130492	2	RT	JZ	
04-Jul-11	HS4	0:28	2:55	2:27	0:36	2:51	2:15	0	12	190	SEED					0	130492	1	ML	JN	
04-Jul-11	HS3	4:26	5:05	0:39	4:36	5:00	0:24	0	0	0	REPO					0	130492	0	RT	JZ	
04-Jul-11	HS2	18:50	19:28	0:38	18:55	19:25	0:30	0	0	0	REPO					0	130492	0	MF	KB	
04-Jul-11	HS2	22:18	1:50	3:32	22:24	1:48	3:24	72	9	110	SEED	8:23	343	23	300	11167	141660	0	MF	KB	
05-Jul-11	HS3	1:19	4:29	3:10	1:28	4:20	2:52	300	18	0	SEED					0	141660	2	RT	JZ	
05-Jul-11	HS4	1:37	5:02	3:25	1:47	4:57	3:10	0	17	308	SEED					0	141660	0	ML	JN	
05-Jul-11	HS2	3:30	5:00	1:30	3:35	4:55	1:20	63	0	0	SEED					0	141660	0	MF	KB	
05-Jul-11	HS3	6:06	6:42	0:36	6:14	6:40	0:26	0	0	0	REPO					0	141660	0	RT	JZ	
05-Jul-11	HS2	17:00	17:25	0:25	17:08	17:23	0:15	0	0	0	PR					0	141660	0	MF	KB	
05-Jul-11	HS2	21:15	21:40	0:25	21:18	21:38	0:20	0	0	0	PR	8:05	363	35	308	13390	155050	0	MF	KB	
07-Jul-11	HS1	19:52	22:37	2:45	19:59	22:30	2:31	0	0	0	PATROL					0	155050	0	RC	RY	

07-Jul-11	HS3	19:52	0:13	4:21	20:02	0:09	4:07	298	16	0	SEED					0	155050	2	RT	JZ	
07-Jul-11	HS4	22:14	2:02	3:48	22:23	1:56	3:33	0	24	335	SEED					0	155050	0	ML	JN	
07-Jul-11	HS2	22:41	3:49	5:08	22:59	3:45	4:46	35	20	381	SEED					0	155050	0	MF	KB	
07-Jul-11	HS1	23:54	4:29	4:35	0:02	4:25	4:23	269	16	0	SEED	20:37	602	76	716	25486	180536	0	RC	RY	JF
08-Jul-11	HS3	1:25	5:16	3:51	1:30	5:14	3:44	125	13	0	SEED					0	180536	1	RT	JZ	
08-Jul-11	HS4	8:45	9:31	0:46	8:56	9:26	0:30	0	0	0	REPO	3:51	125	13	0	4450	184986	0	ML	JN	
11-Jul-11	HS2	1:48	4:49	3:01	1:52	4:45	2:53	0	8	176	SEED					0	184986	3	MF	KB	JF
11-Jul-11	HS1	3:19	4:53	1:34	3:26	4:48	1:22	72	0	0	SEED					0	184986	0	RC	RY	
11-Jul-11	HS3	17:16	17:41	0:25	17:27	17:40	0:13	0	0	0	PR					0	184986	0	RT	JZ	
11-Jul-11	HS2	18:15	20:10	1:55	18:20	20:05	1:45	0	11	92	SEED					0	184986	1	MF	KB	
11-Jul-11	HS1	18:11	20:09	1:58	18:24	20:04	1:40	232	9	0	SEED					0	184986	0	RC	RY	
11-Jul-11	HS3	19:42	23:59	4:17	19:47	23:57	4:10	197	1	0	SEED					0	184986	3	RT	JZ	BW
11-Jul-11	HS4	20:35	21:54	1:19	20:45	21:51	1:06	0	2	106	SEED					0	184986	1	ML	JN	
11-Jul-11	HS1	21:25	2:41	5:16	21:33	2:37	5:04	177	0	0	SEED					0	184986	2	RC	RY	
11-Jul-11	HS2	22:50	0:33	1:43	22:58	0:29	1:31	0	0	80	SEED	21:03	678	31	454	19508	204494	0	MF	KB	
12-Jul-11	HS3	0:00	0:15	0:15	0:01	0:12	0:11	0	0	0	REPO					0	204494	0	RT	JZ	
12-Jul-11	HS2	1:35	4:16	2:41	1:46	4:14	2:28	0	13	188	SEED					0	204494	0	MF	KB	
12-Jul-11	HS3	2:36	5:01	2:25	2:43	4:54	2:11	152	0	0	SEED					0	204494	3	RT	JZ	
12-Jul-11	HS4	3:53	5:37	1:44	3:59	5:33	1:34	0	5	164	SEED	6:50	152	18	352	6746	211240	0	ML	JF	
13-Jul-11	HS1	3:40	6:55	3:15	3:52	6:49	2:57	204	16	0	SEED					0	211240	2	RC	RY	
13-Jul-11	HS2	4:40	5:51	1:11	4:50	5:45	0:55	0	3	60	SEED					0	211240	0	MF	KB	
13-Jul-11	HS3	6:06	7:40	1:34	6:20	7:37	1:17	15	0	0	SEED	6:00	219	19	60	7401	218641	0	RT	JZ	
14-Jul-11	HS1	0:05	2:45	2:40	0:20	2:41	2:21	305	13	0	SEED					0	218641	2	RC	RY	
14-Jul-11	HS2	0:43	4:12	3:29	0:46	4:07	3:21	62	20	240	SEED					0	218641	1	MF	KB	
14-Jul-11	HS3	1:00	5:00	4:00	1:08	4:53	3:45	227	6	0	SEED					0	218641	1	RT	JF	
14-Jul-11	HS4	2:46	4:37	1:51	2:48	4:35	1:47	0	7	112	SEED					0	218641	0	ML	JZ	
14-Jul-11	HS4	6:15	6:40	0:25	6:19	6:35	0:16	0	0	0	REPO					0	218641	0	ML	JZ	
14-Jul-11	HS2	22:02	1:06	3:04	22:13	1:03	2:50	0	8	110	SEED					0	218641	2	MF	KB	
14-Jul-11	HS4	23:08	1:38	2:30	23:16	1:33	2:17	106	0	24	SEED					0	218641	0	ML	JF	
14-Jul-11	HS3	23:57	1:42	1:45	0:09	1:38	1:29	130	2	0	SEED	19:19	830	56	486	26389	245030	0	RT	JZ	
17-Jul-11	HS1	5:40	6:26	0:46	5:48	6:23	0:35	0	0	0	PATROL	0:46	0	0	0	0	245030	0	RC	RY	
18-Jul-11	HS1	9:10	12:26	3:16	9:21	12:20	2:59	108	2	0	SEED					0	245030	3	RC	RY	
18-Jul-11	HS2	9:11	10:31	1:20	9:19	10:28	1:09	0	0	46	SEED					0	245030	0	MF	JF	
18-Jul-11	HS4	11:18	12:27	1:09	11:29	12:23	0:54	0	0	0	PATROL					0	245030	0	ML	JN	
18-Jul-11	HS2	21:18	23:24	2:06	21:22	23:21	1:59	0	0	26	SEED					0	245030	1	MF	KB	
18-Jul-11	HS3	21:56	23:32	1:36	22:09	23:27	1:18	97	0	0	SEED					0	245030	2	RT	JZ	
18-Jul-11	HS4	23:48	2:09	2:21	0:00	2:04	2:04	0	9	93	SEED	11:48	205	11	165	6222	251252	1	ML	JN	
19-Jul-11	HS1	0:20	2:29	2:09	0:30	2:25	1:55	126	5	0	SEED					0	251252	1	RC	RY	
19-Jul-11	HS3	0:21	2:09	1:48	0:29	2:05	1:36	228	0	0	SEED					0	251252	1	RT	JZ	
19-Jul-11	HS2	0:41	2:54	2:13	0:48	2:50	2:02	0	12	190	SEED					0	251252	0	MF	KB	
19-Jul-11	HS3	18:18	22:24	4:06	18:28	22:17	3:49	293	0	0	SEED					0	251252	1	RT	JZ	
19-Jul-11	HS1	20:34	23:27	2:53	20:47	23:21	2:34	253	16	0	SEED					0	251252	1	RC	RY	
19-Jul-11	HS4	20:35	0:06	3:31	20:43	0:02	3:19	0	12	161	SEED					0	251252	1	ML	JN	
19-Jul-11	HS2	21:00	0:43	3:43	21:05	0:40	3:35	0	17	221	SEED					0	251252	1	MF	KB	
19-Jul-11	HS3	23:17	2:29	3:12	23:31	2:21	2:50	294	3	0	SEED	23:35	1194	65	572	35265	286517	2	RT	JZ	
20-Jul-11	HS4	3:08	4:12	1:04	3:21	4:07	0:46	0	0	0	REPO					0	286517	0	ML	JN	
20-Jul-11	HS3	20:12	20:57	0:45	20:17	20:53	0:36	0	7	0	SEED	0:45	0	7	0	1050	287567	1	RT	JZ	
21-Jul-11	HS1	17:03	17:40	0:37	17:21	17:38	0:17	0	0	0	PR					0	287567	0	RC	RY	
21-Jul-11	HS1	21:15	21:44	0:29	21:20	21:40	0:20	0	0	0	PR	0:00	0	0	0	0	287567	0	RC	RY	
22-Jul-11	HS4	3:25	4:32	1:07	3:32	4:27	0:55	0	0	42	SEED	1:07	0	0	42	120	287687	1	ML	JN	
25-Jul-11	HS3	21:22	1:00	3:38	21:39	0:56	3:17	155	0	0	SEED	3:38	155	0	0	3100	290787	1	RT	JN	
26-Jul-11	HS2	1:17	3:36	2:19	1:26	3:32	2:06	12	0	0	SEED					0	290787	1	MF	JF	MH
26-Jul-11	HS4	1:41	3:39	1:58	1:51	3:35	1:44	0	0	124	SEED					0	290787	1	ML	JN	
26-Jul-11	HS1	22:10	2:30	4:20	22:16	2:25	4:09	104	8	0	SEED	8:37	116	8	124	3874	294661	2	RC	RY	
27-Jul-11	HS2	19:25	0:20	4:55	19:31	0:17	4:46	0	13	473	SEED					0	294661	3	MF	MH	
27-Jul-11	HS1	23:10	1:27	2:17	23:19	1:24	2:05	75	0	0	SEED	7:12	75	13	473	4802	299463	0	RC	RY	
28-Jul-11	HS3	19:22	19:50	0:28	19:29	19:45	0:16	0	0	0	MX	0:00	0	0	0	0	299463	0	RT	JZ	
29-Jul-11	HS3	19:35	22:31	2:56	19:40	22:26	2:46	146	13	0	SEED					0	299463	3	RT	JZ	
29-Jul-11	HS1	20:42	23:25	2:43	20:48	23:18	2:30	265	11	0	SEED					0	299463	2	RC	RY	

29-Jul-11	HS4	20:48	23:39	2:51	20:54	23:34	2:40	0	12	160	SEED					0	299463	1	ML	JN	
29-Jul-11	HS2	21:30	23:25	1:55	21:39	23:22	1:43	0	18	160	SEED	10:25	411	54	320	17235	316697	0	MF	BH	
01-Aug-11	HS4	2:12	4:30	2:18	2:20	4:26	2:06	0	9	196	SEED					0	316697	2	ML	JN	
01-Aug-11	HS3	2:36	4:15	1:39	2:44	4:10	1:26	86	10	0	SEED	3:57	86	19	196	5130	321828	0	RT	JZ	
03-Aug-11	HS4	5:52	7:21	1:29	6:00	7:17	1:17	0	0	60	SEED					0	321828	1	ML	JN	
03-Aug-11	HS3	6:01	7:25	1:24	6:08	7:20	1:12	0	5	0	SEED					0	321828	0	RT	JZ	
03-Aug-11	HS4	22:40	3:57	5:17	22:46	3:53	5:07	0	18	351	SEED	8:10	0	23	411	4625	326452	2	ML	JN	
04-Aug-11	HS1	1:22	3:34	2:12	1:27	3:31	2:04	284	15	0	SEED					0	326452	0	RC	RY	
04-Aug-11	HS2	2:00	3:45	1:45	2:27	3:40	1:13	0	8	112	SEED					0	326452	1	MF	MH	
04-Aug-11	HS3	2:32	4:15	1:43	2:40	4:11	1:31	0	3	0	SEED					0	326452	0	RT	JZ	
04-Aug-11	HS4	16:58	17:29	0:31	17:08	17:25	0:17	0	0	0	PR					0	326452	0	ML	JN	
04-Aug-11	HS4	21:20	21:48	0:28	21:26	21:44	0:18	0	0	0	PR	5:40	284	26	112	9900	336352	0	ML	JN	
05-Aug-11	HS3	5:00	7:47	2:47	5:06	7:43	2:37	81	20	0	SEED					0	336352	1	RT	JZ	
05-Aug-11	HS4	5:34	7:44	2:10	5:43	7:39	1:56	0	6	97	SEED					0	336352	0	ML	JN	
05-Aug-11	HS2	16:10	16:57	0:47	16:15	16:53	0:38	0	0	0	MX					0	336352	0	MF	MH	
05-Aug-11	HS1	17:39	18:37	0:58	17:45	18:33	0:48	0	0	0	PATROL					0	336352	0	RC	RY	
05-Aug-11	HS2	20:03	0:40	4:37	20:13	0:38	4:25	0	22	286	SEED					0	336352	2	MF	MH	
05-Aug-11	HS1	22:15	0:57	2:42	22:25	0:51	2:26	293	23	0	SEED					0	336352	0	RC	RY	
05-Aug-11	HS4	23:30	1:58	2:28	23:39	1:55	2:16	0	5	126	SEED					0	336352	0	ML	JN	
05-Aug-11	HS3	23:51	1:48	1:57	23:57	1:45	1:48	147	0	0	SEED	17:39	521	76	509	23275	359627	0	RT	JZ	
06-Aug-11	HS2	1:43	2:32	0:49	1:47	2:29	0:42	0	0	0	REPO	0:00	0	0	0	0	359627	0	MF	MH	
07-Aug-11	HS4	0:28	3:45	3:17	0:35	3:41	3:06	0	15	256	SEED					0	359627	2	ML	JN	
07-Aug-11	HS3	1:03	3:20	2:17	1:11	3:14	2:03	189	17	0	SEED					0	359627	1	RT	JZ	
07-Aug-11	HS2	1:36	3:52	2:16	1:45	3:49	2:04	0	5	138	SEED					0	359627	0	MF	MH	
07-Aug-11	HS1	3:14	4:10	0:56	3:21	4:06	0:45	0	0	0	PATROL					0	359627	0	RC	RY	
07-Aug-11	HS4	7:04	7:56	0:52	7:13	7:51	0:38	0	0	0	REPO	8:46	189	37	394	10456	370083	0	ML	JN	
09-Aug-11	HS4	20:28	0:52	4:24	20:39	0:49	4:10	0	6	9	SEED					0	370083	2	ML	JN	
09-Aug-11	HS1	23:20	2:15	2:55	23:35	2:10	2:35	174	3	0	SEED	7:19	174	9	9	4856	374939	0	RC	RY	
10-Aug-11	HS2	0:10	2:37	2:27	0:16	2:33	2:17	0	3	74	SEED					0	374939	0	MF	MH	
10-Aug-11	HS4	6:37	7:27	0:50	6:46	7:23	0:37	0	0	0	PATROL					0	374939	0	ML	JN	
10-Aug-11	HS2	15:06	15:45	0:39	15:13	15:41	0:28	0	0	0	MX					0	374939	0	JF	MF	MH
10-Aug-11	HS2	17:09	17:31	0:22	17:15	17:29	0:14	0	0	0	PR					0	374939	0	MF	MH	JF
10-Aug-11	HS2	21:22	0:11	2:49	21:25	0:06	2:41	0	11	200	SEED					0	374939	1	MF	MH	JF
10-Aug-11	HS1	22:27	0:20	1:53	22:39	0:15	1:36	168	10	0	SEED	7:59	168	24	274	7743	382682	0	RC	RY	
11-Aug-11	HS4	0:30	1:32	1:02	0:36	1:29	0:53	0	0	0	PATROL					0	382682	0	ML	JN	
11-Aug-11	HS1	22:52	0:02	1:10	22:59	23:57	0:58	40	0	0	SEED	2:12	40	0	0	800	383482	1	RC	RY	
14-Aug-11	HS4	23:26	2:10	2:44	23:34	2:06	2:32	0	3	140	SEED	2:44	0	3	140	850	384332	1	ML	JN	
16-Aug-11	HS3	0:31	2:34	2:03	0:40	2:29	1:49	157	6	0	SEED					0	384332	2	RT	JZ	
16-Aug-11	HS1	1:17	2:35	1:18	1:27	2:32	1:05	0	5	0	SEED	3:21	157	11	0	4790	389122	0	RC	RY	
17-Aug-11	HS3	17:09	17:35	0:26	17:19	17:32	0:13	0	0	0	PR					0	389122	0	RT	JZ	
17-Aug-11	HS3	21:20	21:43	0:23	21:26	21:38	0:12	0	0	0	PR					0	389122	0	RT	JZ	
17-Aug-11	HS4	23:56	0:57	1:01	0:04	0:54	0:50	0	2	72	SEED	1:01	0	2	72	506	389628	1	ML	JN	
19-Aug-11	HS1	0:38	2:58	2:20	0:48	2:54	2:06	275	14	0	SEED					0	389628	1	RC	RY	
19-Aug-11	HS2	1:02	2:59	1:57	1:17	2:56	1:39	0	15	162	SEED	4:17	275	29	162	10313	399941	1	MF	MH	
23-Aug-11	HS4	16:48	17:23	0:35	17:00	17:19	0:19	0	0	0	PR					0	399941	0	ML	JN	
23-Aug-11	HS4	21:35	22:00	0:25	21:41	21:56	0:15	0	0	0	PR	0:00	0	0	0	0	399941	0	ML	JN	
25-Aug-11	HS3	17:29	17:49	0:20	17:36	17:47	0:11	0	0	0	PR					0	399941	0	RT	JZ	
25-Aug-11	HS3	21:34	21:55	0:21	21:37	21:50	0:13	0	0	0	PR	0:00	0	0	0	0	399941	0	RT	JZ	
29-Aug-11	HS4	20:35	21:09	0:34	20:45	21:04	0:19	0	0	0	MX					0	399941	0	ML		
01-Sep-11	HS4	17:01	17:32	0:31	17:13	17:29	0:16	0	0	0	PR					0	399941	0	ML	JN	
01-Sep-11	HS2	18:55	19:14	0:19	19:07	19:11	0:04	0	0	0	MX					0	399941	0	MF	MH	
01-Sep-11	HS4	21:32	22:00	0:28	21:37	21:56	0:19	0	0	0	PR					0	399941	0	ML	JN	
02-Sep-11	HS2	20:00	21:40	1:40	20:07	21:35	1:28	0	0	46	SEED	1:40	0	0	46	131	400072	1	MF	MH	
14-Sep-11	HS4	18:30	19:20	0:50	18:52	19:15	0:23	0	0	0	MX					0	400072	0	ML	JN	
End of Season																0					
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Alberta Hail Suppression Project

Alberta Severe Weather Management Society

Final Operations Report 2012

Tel: 1.701.235.5500 • Fax: 1.701.235.9717 • 3802 20th Street N • Fargo, ND • USA • www.weathermodification.com

ALBERTA HAIL SUPPRESSION PROJECT (AHSP) FINAL OPERATIONS REPORT 2012

A Program Designed for
Seeding Convective Clouds
With Glaciogenic Nuclei to
Mitigate Urban Hail Damage in the
Province of Alberta, Canada

by

Weather Modification, Inc.
3802 - 20th Street North
Fargo, North Dakota
U.S.A. 58102
www.weathermodification.com

for the

Alberta Severe Weather Management Society
Calgary, Alberta
Canada

December 2012

EXECUTIVE SUMMARY

This report summarizes the activities during the 2012 field operations of the Alberta Hail Suppression Project. This was the seventeenth year of operations by Weather Modification, Inc. (WMI) of Fargo, North Dakota under contract with the Alberta Severe Weather Management Society (ASWMS) of Calgary, Alberta. This season was the second year of the current 5-year contract cycle for this on-going program; WMI has been the contractor since operations began in 1996. The program was again directed for the ASWMS by Dr. Terry Krauss. The program continues to be funded entirely by private insurance companies in Alberta with the sole intent to mitigate the damage to urban property caused by hail.

The cloud-seeding contract with WMI was renewed in 2001, 2006, and again in 2011. Calgary, Red Deer and many of the surrounding communities have seen significant growth in population—and area—since 1996. Calgary's population exceeded 1 million in 2006, and property values have more than doubled since the program's inception. In 2008 it was estimated that a hail storm similar to that which caused $400 million damage in Calgary in 1991 would now cause more than $1 billion damage. New record Alberta hailstorms have recently occurred in 2009 and 2010, and the severe storm that struck Calgary on August 12, 2012 caused hundreds of millions of dollars damage, clearly indicating that a billion dollar storm within Calgary is now possible.

The project design has remained the same throughout the period, but a fourth seeding aircraft was added to the project in the summer of 2008 to improve seeding coverage on active storm days. The new project radar (2011) is more sensitive and has Doppler capability which provides additional information about internal storm circulations that would not otherwise be available.

The program was operational from June 1st to September 15th, 2012. Only storms that posed a hail threat to an urban area as identified by the project's weather radar situated at the Olds-Didsbury Airport were seeded. The project target area covers the region from High River in the south to Lacombe in the north, with priority given to the two largest cities of Calgary and Red Deer. The project area is shown in Figure 3.

The summer of 2012 experienced above average severe thunderstorms both inside and outside the project area. Hail was reported within the project area (protected area and buffer area) on 56 days this past summer.

Larger than golf ball size hail was reported on July 28th east southeast of Airdrie and south of Irricana. The 12th of August also saw a report of larger than golf ball size hail in the northwestern part of Calgary.

Golf ball size hail was reported or observed by radar signature on June 13th east of the town of Linden; July 1st southwest of High River, north of Three Hills, and near Linden; the 5th of July in northwestern Calgary; on the 12th of July northwest of Rocky Mountain House, southwest of High River, and southwest of Calgary; then on the 13th of July southwest of Calgary; and the 17th of July northwest of Rocky Mountain House. Hail up to golf ball size was also reported on the 18th of July near Rimbey, southwest of Ponoka, and east of Lacombe; the 23rd of July north of Rocky Mountain House and northwest of Caroline; on the 25th of July southwest of Three Hills; on the 27th of July south and southeast of High River and near Irricana; on the 30th of July north of Sundre; and the 31st of July southwestern Calgary, near the town of Three Hills, and east southeast of Strathmore. The month of August saw up to golf ball size hail on the 4th, north of Lacombe; on the 5th south and southeast of Rocky Mountain House; on the 6th west of Sylvan Lake; the 7th in eastern Calgary and near Irricana; on the 8th west of Rocky Mountain House, west of Sundre, south of Red Deer, and east of the town of Acme; the 10th northwest of Lacombe and northwest of Rocky Mountain House; on the 14th near Turner Valley and west of High River; on the 20th southwest of Cremona; on the 21st north and south of Rocky Mountain House; and on the 23rd northwest of Caroline and east southeast of Red Deer.

Walnut size hail was reported or observed by radar signature on June 2nd near Strathmore; June 6th southeast of Strathmore; on June 9th northeast of Innisfail; on the 17th of June in Rocky Mountain House; June 24th south of Sundre and east southeast of Airdrie; July 3rd north northeast of Sundre and near Three Hills, on the 8th of June west southwest of Cremona, July 10th north of Rocky Mountain House, on the 20th of July south of Strathmore, the 22nd of July west of Strathmore, July 26th east northeast of Airdrie, and west of the town of Caroline on the 10th of September.

The weather pattern was less active in June than 2011, but even so 70.1 hours were flown for seeding and patrol. July was the busiest month; the four project aircraft flew a total of 181.6 hours during seeding and patrol flights. A "patrol" flight is a flight flown to check cloud intensity or in anticipation of clouds becoming intense enough to warrant seeding, but during which no seeding was actually conducted. A total of 74.4 hours were flown in August, and only 4.5 hours in September.

There were thunderstorms reported within the project area on 70 days this summer, compared with 73 days in 2011. However, 22 of the 70 days produced storms having hail or radar vertically-integrated liquid (VIL) values commensurate with the Convective Day Category of +4, indicating an unusual number of very strong storms. The weather became much less active by mid-August, and only two seeding missions were flown after August 14th.

During this season, there were 300.1 hours flown on 43 days with seeding and/or patrol operations. A total of 116 storms were seeded during 115 seeding flights (271.1 flight hours) on the 37 seeding days. There were 28 patrol flights (30 hours), and 24 short "public relations" flights on which one aircraft was flown to the Olds-Didsbury Airport to be available for viewing by insurance company employees attending tours of the operations centre and radar.

The amount of silver-iodide nucleating agent dispensed during the 2012 field season totaled 314.6 kg. This was dispensed in the form of 7,717 ejectable (cloud-top) flares (154.34 kg seeding agent), 914 burn-in-place (cloud-base) flares (137.1 kg seeding agent), and 260.3 gallons of silver iodide seeding solution (23.12 kg seeding agent).

Four specially equipped cloud seeding aircraft were dedicated to the project. One Beech C90A King Air and a Cessna 340A were based in Calgary (Springbank after June 25), and a C90A and another C340A were based in Red Deer. The procedures used in 2012 remained the same as the previous years. The Calgary office and aircraft were initially stationed at the Landmark Aviation hangar at the Calgary International Airport, but because of new arrival scheduling procedures at the airport, operations were for the first time shifted to the Springbank Airport west of Calgary. This change was implemented on June 25th, without interruption of service. A WMI Red Deer office was again set up in the Air Spray hangar at the Red Deer Regional Airport, as had been done in 2010 and 2011.

The aircraft and crews provided a 24-hour service, seven days a week throughout the period. Eight full-time pilots and three meteorologists were assigned to the project this season. In addition, WMI's Chief Pilot, Mr. Jody Fischer, served as overall program manager. The 2012 crew was well experienced. The Red Deer aircraft team was led by Mr. Roger Tilbury, who has been flying cloud research and cloud seeding missions since the 1970s, and Mr. Joel Zimmer who has been with the Alberta Program for ten years. In addition to Mr. Fischer, the Calgary (Springbank) team was anchored by Mr. Brook Mueller and Mr. Mark Friel, both of whom also had considerable experience. The radar crew was led by Mr. Daniel Gilbert, now with three seasons' experience in Alberta, in addition to seven seasons' work in a similar capacity on a hail suppression program in North Dakota.

Overall, the personnel, aircraft, and radar performed exceptionally well and there were no interruptions or missed opportunities. A gear failure in the radar antenna drive placed the radar temporarily out of service at 6:01 pm on June 17th, while operations were being conducted near Rocky Mountain House. Radar guidance for the operations immediately began using imagery from the Environment Canada radar near Strathmore, though real-time aircraft flight tracks were still being received at the WMI radar on AirLink. Once the problem was isolated, a replacement drive gear was found in the on-site spare parts and repairs began. Flight operations were completed without difficulty. The repairs were completed by 4:53 pm the following day. A second, similar failure occurred on August 6th at about 5:00 pm but repairs were quickly made and the radar was back in operation by 8:45 that same evening, without any interruption in operations.

High speed Internet service was once again obtained at the Calgary (Springbank) and Red Deer offices for the pilots so that they could closely monitor the storm evolution and storm motion using the radar images on the web prior to take-off.

All of the project's radar data, meteorological data, and reports have been recorded onto a portable hard drive as a permanent archive for the Alberta Severe Weather Management Society. These data include the daily reports, radar maps, aircraft flight tracks, as well as meteorological charts for each day. The data can be made available for outside research purposes through a special request to the Alberta Severe Weather Management Society. In addition, ASWMS Program Director Dr. Terry Krauss was provided the entire season's TITAN (radar) data, as he has that software running on a computer in his office. This will enable mutual (WMI and ASWMS) examination of the data set in the off season, prior to the 2013 program.

ACKNOWLEDGEMENTS

WMI acknowledges the continuing, kind support of Todd Klapak, Catherine Janssen, Dr. Terry Krauss, and the entire Board of Directors of the Alberta Severe Weather Management Society (ASWMS). Their understanding, support, and cooperation of the ASWMS are greatly appreciated.

A number of organizations and people deserve recognition and thanks. The cooperation of these persons and agencies is very important in making the project successful, in positive working environments.

- Edmonton Area Control Center and Calgary Terminal Air Operations. The excellent cooperation by the ATC once again played a very important role in allowing the project pilots to treat the threatening storms in an efficient and timely manner as required, often directly over the city of Calgary.
- Saroj Aryal and Kathleen Cleveland of Alberta Financial Services Corp. (AFSC) in Lacombe are thanked for providing the crop insurance information.
- For the seventeenth year, special thanks go to Bob Jackson for sharing his office and hangar at the Olds-Didsbury airport, used for the radar and communications control center.
- Lynne Fawcett of Intact Insurance is thanked for organizing the 14 informational seminars that were conducted at the Olds radar this summer as part of the Alberta Insurance Council accreditation program.
- Perry Dancause, Ross Katterhagen and the staff of Air Spray Ltd are sincerely thanked for providing offices, ramp space, and timely reliable aircraft maintenance this season at the Red Deer Airport.
- Tony Hickey, Wade Dornstauder and the staff of Landmark Aviation are thanked for providing office space and other operational support to the project at Calgary International Airport.
- Kevin Gies and the staff of Springbank Aero are thanked for providing office space, ramp space, and other operational support to the project at the Springbank Airport.

WMI wishes to acknowledge the contributions of the staff who served on the project during the summer of 2012: project manager Jody Fischer, meteorologists (Dan Gilbert, Brad Waller, and Joe Pehoski), electronics-radar technicians (Dave Civil, and Todd Schulz), pilots in command (Roger Tilbury, Brook Mueller, Mark Friel, and Jenny Thorpe); the co-pilots (Joel Zimmer, Jenelle Newman, Hing Kwok, and Matthias Morel). The staff performed very well as a team. The support of the WMI corporate head office in Fargo ND is also acknowledged, specifically, the efforts of Erin Fischer, Cindy Dobbs, Patrick Sweeney, James Sweeney, Randy Jenson, Hans Ahlness, Jody Fischer, Bruce Boe, Dennis Afseth, Mike Clancy and Mark Grove are greatly appreciated.

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1.0 Introduction

Hail has long been a problem for both agriculture and municipalities in the Province of Alberta. Figure 1 shows the average number of hail days throughout Canada. It is very interesting to note that there is a bull's eye on the area from Calgary to Red Deer, which also coincides with the greatest population density of the province, which continues to increase. In 1956, under the aegis of the Alberta Research Council, a research program was undertaken that sought to develop and evaluate the effectiveness of cloud seeding from aircraft to mitigate crop-hail damage. Though never "operational", the program continued to research the hail problem and ways to reduce the hail impact on agriculture until 1985, when it was discontinued.

The hail problem did not end with the hail research program, and in 1991 a severe hailstorm caused several hundred million dollars damage in the City of Calgary and adjacent metropolitan areas. This storm, though by no means the first of its kind, was of sufficient magnitude to rekindle interest in hail damage mitigation through cloud seeding.

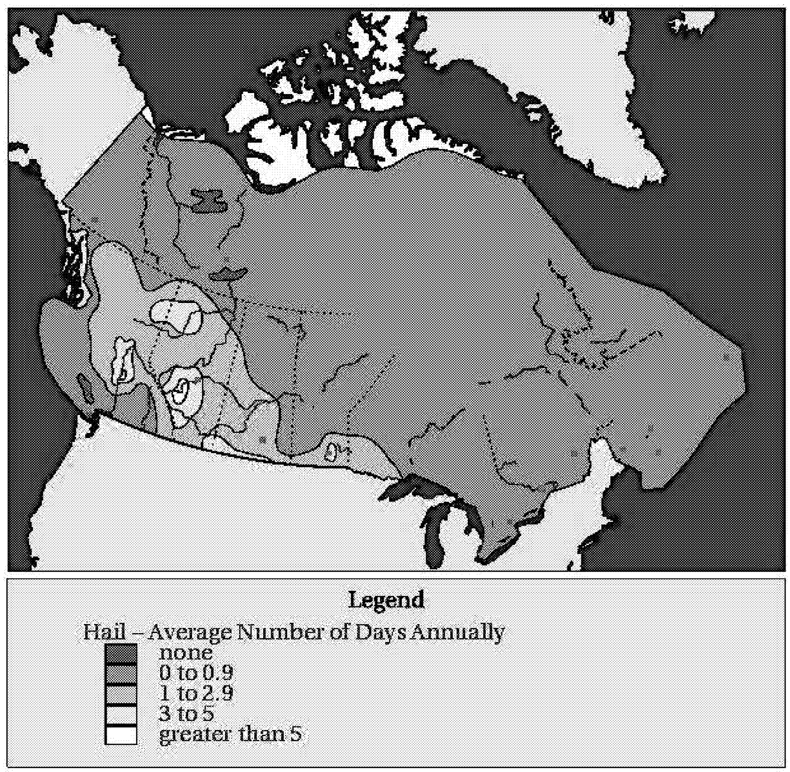

Figure 1 (right). Hail climatology for Canada. The average number of hail days per year, based on the 1951-1980 climate normal of Environment Canada (1987), from Etkin and Brun (1999).

A consortium of underwriters of property and casualty insurance in Alberta was formed in the wake of the 1991 Calgary storm, and named itself the Alberta Severe Weather Management Society (ASWMS). From its formation, the ASWMS was focused on establishing a renewed Alberta Hail Suppression Program through cloud seeding, but this time, the focus was to be on protecting municipalities, not crops. The necessity for such a program was presented to the Insurance Bureau of Canada (IBC), and though the IBC was encouraging it offered no financial support. The Province of Alberta was itself approached for funding of the program. Though the need was acknowledged by the provincial leaders funding was not forthcoming.

In 1995 the ASWMS developed a protocol through which its members would pay into a common project fund, amount proportional with market share, and the current Alberta Hail Suppression Project finally became possible. An international tender was issued, and Weather Modification, Inc. (WMI) was awarded an initial five-year contract to conduct operations from June 15 through September 15 each summer, beginning in 1996.

The goal of the project from the beginning has been the protection from the ravages of hailstorms to property concentrated in urban areas, to the maximum extent technology and safety will allow. The two largest such areas within the project target area are Calgary and Red Deer, but there are dozens of additional cities and towns that also warrant attention. To do this, the project established a weather radar and Operations Centre at the Olds-Didsbury Airport, approximately halfway between the two largest metropolitan areas. Two aircraft were based in Calgary, a third in Red Deer. At the conclusion of the initial five-year period the contract between the ASWMS and WMI was renewed for a second 5-year period (2001-2005), a third (2006-2010), and in 2011, a fourth.

Four significant changes have been made to the project scope during the first sixteen seasons. Early on (season 2) it was recognized that the hail problem begins earlier in the year than June 15, so since 1998, the project has begun each season on June 1.

Beginning in the 2006 season the protected area was expanded somewhat to the east, to include the town of Strathmore and communities east of Calgary.

The third change did not occur until the 13th season, 2008. The unrelenting expansion of the metropolitan areas within the project area meant increasing risk, and a fourth cloud seeding aircraft was added to the project. This aircraft is based in Red Deer. This fourth aircraft has proved its worth, especially in 2011 and 2012, when all four aircraft seeded on the same days on twenty-three different dates. The continuing growth of the Calgary metropolitan area is now causing discussion about adding even a fifth aircraft.

The final change and most recent was the replacement of the aging WR-100 weather radar with a new set built by WMI. This radar possesses significantly increased sensitivity which means that clouds are detected sooner than they were previously (earlier in their development), and Doppler capability means that internal storm motions can also be observed.

Calgary, the focus of southern Alberta population (and thus risk) is located very near the Rocky Mountains, and a favored location for storm genesis is the foothills immediately west. The mountains are a great target when it comes to showing up on radar. Thus, the "clutter" produced by the "rocks" was significant. Shown in Figure 2 is the "ground clutter" displayed with the old and new radars.

This final operations report summarizes in detail all the activities during the 2012 field operations of the Alberta Hail Suppression Project, the seventeenth summer of operations by Weather Modification, Inc. (WMI) of Fargo, North Dakota under contract with the Alberta Severe Weather Management Society (ASWMS) of Calgary, Alberta.

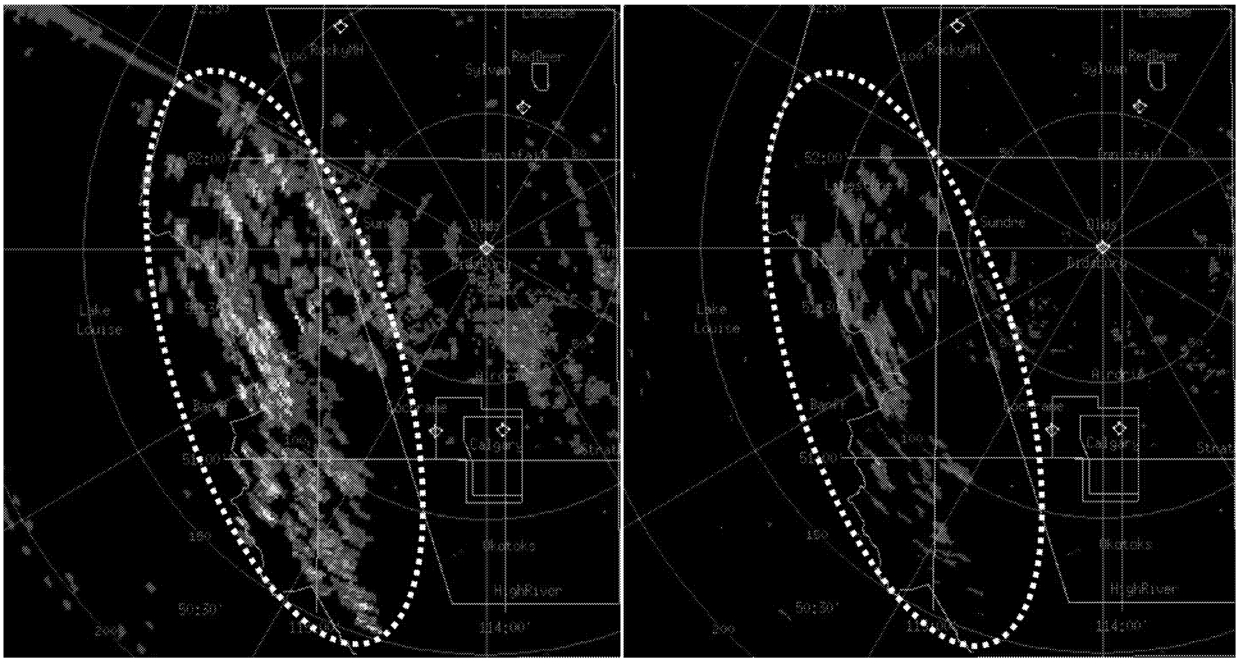

Figure 2. The radar echoes produced by the foothills and mountains. Such ground returns, called "clutter", do not indicate storms but can make it more difficult to see real storms when they develop. The older radar produced the clutter shown on the left, the present radar that to the right. The new Doppler radar is more sensitive, but has a better clutter rejection algorithm. It is not possible to eliminate ground returns completely without risking the non-detection of some clouds as well.

2.0 The 2012 Field Program

The program again conducted operations to mitigate hail storms threatening cities and towns from June 1st through September 15th, 2012. Only those storms posing hail threats to an urban area were treated by the project aircraft. The project target area covers the region from High River in the south to Lacombe in the north, with priority given to the two largest cities of Calgary and Red Deer. The summer of 2012 experienced above average severe thunderstorms both inside and outside the project area. Hail was reported within the project area on 56 days this past summer.

The present program utilizes the latest cloud seeding technology available, incorporating several notable improvements over previous projects in the province. These improvements include:

- Fast-acting, high-yield mixtures for the silver-iodide flares and the liquid seeding solution. The flares are manufactured by Ice Crystal Engineering (ICE) of North Dakota. The new generation ICE pyrotechnics produce >10^{11} ice nuclei per gram of AgI active at a temperature of -4°C, and produce between 10^{13} and 10^{14} ice nuclei per gram of pyrotechnic active between -6°C and -10°C. Colorado State University (CSU) isothermal cloud chamber tests (DeMott 1999) indicate that at a temperature of -6.3°C, 63% of the nuclei are active in <1 min, and 90% active in 1.12 minutes. This high-yield, fast-acting agent is important for hail suppression since the time-window of opportunity for successful intervention of the hail growth process may be less than 10 minutes.
- Use of the latest GPS tracking and advanced TITAN (Thunderstorm Identification Tracking Analysis and Nowcasting) computer software to accurately display the aircraft locations on the radar displays to improve the controlling of aircraft and facilitate the direction of seeding operations to the most critical regions of the storms.
- Injection of the seeding material directly into the developing cloud turrets as the most frequent seeding method.
- Use of experienced meteorologists and pilots to conduct the seeding operations.
- The deployment of sensitive, Doppler weather radar.

The target or "protected" area is shown in Figure 3 and focuses on the area from Lacombe in the north, to High River in the south, with priority given to the cities of Calgary and Red Deer. In 2006, the target area was increased slightly towards the east to include the town of Strathmore and some of the smaller towns east of the QE II highway. Four aircraft specially equipped to dispense silver iodide were used. Two aircraft (one Beech King Air C90 and one Cessna 340, or C340) were based in Calgary and two aircraft (one Beechcraft King Air C90 and one C340) were based in Red Deer. The radar remained located at the Olds-Didsbury airport. The radar coordinates are 51.71 N Latitude, 114.11 W Longitude, with a station elevation of 1024 m above sea level. The WMO station identifier is no. 71359 and the ICAO identifier is CEA3. The project area dimension is approximately 240 km (N-S) by 120 km (E-W) or 28,800 square km.

3.0 Project Objectives

The project has two main objectives:

- To conduct cloud seeding operations to suppress hail and reduce property damage, and
- To develop a data archive that may eventually be used for the scientific assessment of the program's effectiveness.

The first of these is met by using four aircraft and experienced pilots and meteorologists to identify potential threats and react appropriately. The second is being achieved through the operation of a C-band weather radar with full archival, and the collection of other weather information by project meteorologists. These efforts include the comprehensive archival of all project decision records, as well as a wealth of additional weather data from the internet and other sources.

The project operations area is illustrated in Fig. 3. The boundaries of flight operations (actual seeding) are indicated by the broad yellow line, which actually includes the foothills of the Rocky Mountains, west of the protected area. This is very important, for the foothills are an important zone for storm genesis. The broad green line denotes the boundary of the protected area, i.e., storms threatening any of the communities within this area will be seeded, as resources allow.

Figure 3. Map of southern Alberta showing the project target area. The major cities and towns in and near the protected area are shown, along with the location of the Olds-Didsbury Operations Centre identified by a red star.

4.0 Priorities

Cities and towns are protected according to priority and proximity of aircraft, with greatest attention given to Calgary and Red Deer. Priority is determined based on rank in population, as shown in Table 1, below. There have been significant changes since the 2006 census. Just since 2006, Calgary has grown another 11%, Red Deer 9%, Airdrie 47%, Okotoks 43%, and Chestermere 49%! Most storms are not seeded after they cross the QE II highway, except for storms east of Airdrie and Calgary that might threaten Strathmore.

TABLE 1. AHSP Priority List Based on City Population.

Priority	City/Town Name	Population 2011	Population 2006	Percent Change
1	Calgary	1,096,833	988,812	10.9%
2	Red Deer	90,564	83,154	8.9%
3	Airdrie	42,564	28,927	47.1%
4	Okotoks	24,511	17,150	42.9%
5	Cochrane	17,580	13,760	27.8%
6	Chestermere	14,824	9,923	49.4%
7	High River	12,920	10,716	20.6%
8	Sylvan Lake	12,327	10,250	20.3%
9	Strathmore	12,305	10,280	19.7%
10	Lacombe	11,707	10,752	8.9%
11	Olds	8,235	7,253	13.5%
12	Innisfail	7,876	7,331	7.4%
13	Rocky Mountain House	6,933	6,874	0.9%
14	Blackfalds	6,300	4,618	36.4%
15	Didsbury	4,957	4,305	15.1%
16	Turner Valley & Black Diamond	4,540	3,808	19.2%
17	Carstairs	3,442	2,699	27.5%
18	Crossfield	2,853	2,668	6.9%
19	Sundre	2,610	2,523	3.4%
20	Penhold	2,375	1,971	20.5%
21	Bowden	1,241	1,210	2.6%
22	Irricana	1,162	1,243	-6.5%
23	Eckville	1,125	951	18.3%
24	Bentley	1,073	1,083	-0.9%
25	Beiseker	785	804	-2.4%
26	Linden	725	660	9.8%
27	Acme	653	656	-0.5%
28	Caroline	501	515	-2.7%
29	Cremona	457	463	-1.3%

5.0 The Scientific Basis for Hail Suppression

Hail is formed when small ice particles known as hail embryos are held aloft by strong thunderstorm updrafts within regions of unfrozen supercooled cloud water. This supercooled cloud water is collected by the hail embryos and freezes to them, resulting in growth to hail (greater than 5 mm diameter) sizes. Growth continues until (1) the supporting updraft weakens, (2) the in-storm motion of the growing hailstone moves it to the downdraft side from whence it can fall, or (3) the hailstone grows so large that the updraft can no longer support it.

In most situations the subcloud layer is relatively warm (much warmer than 0°C) so hailstones begin to melt during the final portion of their plummet to earth, but in many cases the hailstones are too large for melting to be complete, and hail reaches the ground.

THE FORMATION OF HAIL

Understanding of the development of hail includes knowledge gained from work in Alberta by Chisholm (1970), Chisholm and Renick (1972), Marwitz (1972a, b, and c), Barge and Bergwall (1976), Krauss and Marwitz (1984), and English (1986). Direct observational evidence from the instrumented aircraft penetrations of Colorado and Alberta storms in the 1970s and early 1980s indicates that hail embryos grow within the evolving *main updraft* of single cell storms and within the updrafts of developing *feeder clouds* (the cumulus towers) that flank mature *multi-cell* and *supercell* storms (see e.g. Foote 1984, Krauss and Marwitz 1984). The computation of hail growth trajectories within the context of measured storm wind fields provided a powerful new tool for integrating certain parts of hail growth theories, and illustrated a striking complexity in the hail growth process.

Figure 4. An energetic line of thunderstorms approaches the Operations Centre at the Olds-Didsbury Airport at 4:40 PM on July 31, 2012. (WMI photograph by Bradley Waller)

Some of this complexity is reviewed in the paper of Foote (1985) that classifies a broad spectrum of storm types according to both dynamic and microphysical processes thought to be critical to hail production. Small precipitation embryos that eventually grow into hailstones are called hail embryos. Hail embryo sources identified by Foote (1985) include the following:

- Embryos from first-ice in a time-developing updraft
- Embryos from first-ice in the core of a long-lived updraft
- Embryos from flanking cumulus congestus
- Embryos from a merging mature cell
- Embryos from a mature cell positioned upwind
- Embryos from the edges of the main updraft
- Embryos created by melting and shedding
- Embryos from entrainment of stratiform cloud
- Embryos from embedded small-scale updrafts and downdrafts
- Recirculation of embryos that have made a first pass through the updraft core

Hail embryos grow into hailstones by collecting unfrozen, supercooled liquid water through collisions. This water freezes to the already-frozen embryo, increasing the size, weight, and fall speed, and also the potential for damage at the surface. This growth to large hail is theorized to occur primarily along the edges of the main storm updraft where the merging feeder clouds interact with the main storm updraft (WMO 1995). However, the mature hailstorm most certainly consists of complicated airflow patterns and particle trajectories.

Studies of the internal structure of large hailstones in Alberta and elsewhere have shown that hailstones can have either a graupel (snow pellet) embryo or a frozen drop embryo. The different hail embryos indicate different growth histories and trajectories and illustrate the complexity within a single hailstorm.

HAIL SUPPRESSION CONCEPTS

The hail suppression conceptual model utilized in the Alberta Hail Suppression Project is based on the results of the former research program of the Alberta Research Council and the experiences of WMI in the USA, Canada, Argentina, and Greece. It involves the use of glaciogenic (ice-forming) materials to seed the developing feeder clouds near the -10°C level in the upshear, new growth "propagation" region of hailstorms. The glaciogenic reagents initiate the rapid development of small ice particles through the condensation-freezing nucleation process, and thus produce enhanced concentrations of ice crystals that compete for the available, supercooled liquid water in storms. This helps prevent the growth of large, damaging hail. The seeding also stimulates the precipitation process by speeding the growth of ice-phase hydrometeors, initially into snow pellets (also called graupel) which fall from the cloud earlier, melt, and reach the ground as rain, instead of continuing to grow into large ice particles that reach the ground as damaging hail.

The present seeding methodology modifies the graupel embryo hail development process. Frozen drop hail embryos are thought to originate from secondary sources (shedding from large existing hailstones, or via a recirculation process at the edge of the main updraft). Cloud seeding can only reduce the hail that grows from frozen drop embryos if the available liquid water can be reduced to limit their growth, or if the dynamics of the storm can be affected to eliminate the recirculation processes that formed the drop embryo in the first place. Both are extremely complex, and are not the focus of the Alberta project.

Figure 5 (left). Hailstop 4 was seeding at cloud base on August 9, 2012. The smooth, flat cloud base between the aircraft and the rain shaft is indicative of updraft, that is, growing clouds. (WMI photograph by Bradley Waller)

The governing premise of the Alberta cloud seeding operations is the cloud microphysical concept called *beneficial competition*. The premise of beneficial competition is that the well-documented natural deficiency of ice nuclei (ice-forming particles) in the atmosphere can be corrected by the release of additional ice nuclei (glaciogenic seeding material) into developing storm clouds. This is done by the combustion of small amounts of reagent and/or solutions containing silver iodide (AgI), either as pyrotechnics (flares) or from wing-borne solution-burning ice nucleus generators. With either method, from 10^{13} to 10^{14} (or from 10,000,000,000,000 to 100,000,000,000,000) ice nuclei are produced for each gram of silver iodide burned, e.g., see Figure 10. This potentially increases greatly the number of precipitation embryos in the cloud. These natural and human-made ice crystals, many of which become precipitation, then "compete" for the available supercooled liquid cloud water within the storm. Because the total amount of supercooled liquid remains essentially unchanged, that same mass is divided among the increased number of embryos, meaning the final maximum size of each individual ice particle is significantly decreased. Hence, the hailstones that form within seeded clouds will be smaller and produce less damage if they should survive the fall to the surface. If they are sufficiently small they will melt completely in the warmer subcloud layer and reach the ground as rain.

Cloud seeding alters the microphysics of the treated clouds, assuming that the existing precipitation process is inefficient due to a lack of natural ice nuclei. This deficiency of natural ice has been documented in the new growth zone of Alberta storms (Krauss 1981). Cloud seeding does not alter directly the energy or dynamics of the storm. Any alteration of the storm dynamics that does occur results as a consequence of the increased ice crystal concentrations and the development of additional precipitation-sized ice particles earlier in the cloud's lifetime.