

Parks Canada
**Air Safety Risk Assessment
Decommissioning the Banff and Jasper Airstrips
Final Report**

July 11th, 2003



Kootenay International Associates



Parks Canada

Air Safety Risk Assessment

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Executive Summary

Parks Canada commissioned Kootenay International Associates to conduct a risk assessment to determine what impact the proposed Banff & Jasper National Parks airstrip decommissioning project will have on aviation safety. This is the final stage of a Comprehensive Study which was initiated in 2000 pursuant to the Canadian Environmental Assessment Act. Issues and historical records relevant to the risk assessment process were analyzed and summarized. A modified stakeholder risk assessment process based on the Canadian Q850 standard was initiated in January and completed during a two-day workshop in March, 2003. Based on participant input and our own analysis, Kootenay International Associates concludes that a serious accident may occur within a generation of aviation users (extremely improbable)¹ if these airstrips are no longer available for diversionary use. This determination assumes the following:

1. No other mitigation or control measure are implemented to compensate for the loss of the existing diversionary landing sites;
2. The existing route capability levels are maintained.²
3. The judgement of stakeholders and experts should be conservative and err on the side of safety given the lack of statistically relevant accident data and information regarding causal relationships between the availability of VFR diversionary airports and safety.

¹ The workshop participants determined that the probability level for both primary risks (off-airport landing and CFIT accident) was “improbable” (definition: unlikely to occur to each aviator but may occur several times within one generation) (Sec 4.3.2). The Kootenay International Associates probability evaluation suggests the risk level is lower by one level, or “extremely improbable” (definition: unlikely to occur during one generation of aviators using the route) (Sec 4.3.2) However, the residual risk is still unacceptable and mitigation and control measures are required.

² The aviation users clearly indicated during the workshop that the imposition of further restrictions on their ability to safely use the Banff and Jasper VFR routes would be unacceptable. While they understand that they would have to make more conservative flight planning decisions if the airstrips were unavailable, they are unwilling to accept this outcome as reasonable or justifiable.



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1.0 Introduction

1.1 General

Parks Canada commissioned Kootenay International Associates to conduct a risk assessment to determine what impact the proposed Banff & Jasper National Parks decommissioning project will have on aviation safety. Stakeholders were invited to participate in an initial introductory and planning meeting on January 22nd, and a two-day risk assessment workshop on March 17th and 18th, 2003. Kootenay International Associates was contracted to advise Parks Canada on aviation risk issues and to facilitate the risk assessment process.

This risk assessment process is based on a modified version of the Canadian Q850 standard. This is a participative, consensus-based process that involves key stakeholders in assessing risk and negotiating mitigation and control measures. The process is subjective and qualitative. Relevant data and evidence is used to inform the process and guide decision-making, but does not usually determine the outcome by itself.

The stakeholder participants assessed the impact to flight safety resulting from the decommissioning of the Banff and Jasper Park airstrips. In order to make this assessment, the primary hazards to flight along the Banff and Jasper low-level VFR air routes were identified along with existing or required risk mitigation and control measures. The suitability and value of the Banff and Jasper airstrips in their roles as risk mitigation and control measures were assessed relative to these hazards and other appropriate measures. Risk mitigation and control measures were identified and recommended.

1.2 Limitation of Scope and Reporting

The purpose of the Air Safety Risk Assessment workshop, according to the study terms of reference provided by Parks Canada, was to examine aviation risk issues only. The impacts of airstrip decommissioning on the natural environment were not to be considered by the participants, nor were they to make an attempt to balance aviation risks against environmental impacts or vice versa.

The Air Safety Risk Assessment workshop report and appendices will be included in the Banff and Jasper Airstrip Decommissioning Comprehensive Study report which has been prepared by Highwood Environmental Management. Their report does consider environmental impacts and issues. The incorporated Study documents will be submitted to key decision-makers for their consideration.

The Air Safety Risk Assessment report and appendices describe participant inputs and the workshop process and outcomes. It is not intended to be a consensus document, however. It has been prepared by Kootenay International Associates and, unless otherwise noted, represents the expert opinion and observations of the author.



1.3 Participation

The Air Safety Risk Assessment for the proposal to decommission the Banff and Jasper airstrips was undertaken with the participation of a number of stakeholders. Parks Canada invited both key and observer stakeholders to the risk assessment workshop. The organizations which were asked to attend as key stakeholders were those which:

- Represent mountain aviators who fly the Banff and Jasper VFR navigation routes and have the experience and knowledge required to help assess the risks to aviation associated with the proposed airstrip decommissionings; or
- Have a direct responsibility for flight safety along the routes in question (e.g. Transport Canada).

Several other organizations were invited to attend as observer stakeholders. Observer stakeholders were:

- Non-aviation organizations which have an interest in, or may be affected by, the outcome of the Banff and Jasper Airstrip Decommissioning Comprehensive study, but which are not qualified to assess aviation risks (e.g. Canadian Parks and Wilderness Society); or
- Representatives of other organizations who were asked to provide relevant information or advice to the key stakeholders (e.g. Alberta Transportation, Nav Canada).

1.3.1 Key Stakeholders

Alberta Aviation Council	Terry Jackson
Banff Flying Club	Bill Clark
Canadian Owners & Pilots Association	Sherry Cooper Bob Kirkby Kevin Psutka
Jasper Flying Club	Bryn Thomas Tom Bell
Parks Canada Agency	Bill Fisher Ron Tessolini Bruce Leeson Janet Mercer
Transport Canada	Tom Umscheid



1.3.2 Observer Stakeholders

AMPPE.....	Julie Canning
Alberta Transportation	Sara Wong
Canadian Environmental Protection Agency	Allison Stoddart
Canadian Parks & Wilderness Society.....	Dave Poulton
Environment Canada.....	Scott McCormick
Nav Canada	Lorne McCrea
Parks Canada	Neil Gilson

1.4 Workshop Resources

The following documents were referenced during the process:

- Banff & Jasper Meteorological Study 2001 Darr, Maqbool & Associates*
- COPA A Response from Mountain Aviators to the TC/PC Joint Study*
- COPA Mountain Aviation Accidents and the Utilization of the Banff and Jasper Airstrips*
- Flight Safety Foundation Reports*
- Kootenay International Associates Issues Summary*
- Parks Landing Incident Record*
- Q850 Risk Analysis Guide*
- Transport Canada/Parks Canada Joint Study of the Need to Retain the Banff and Jasper Airstrips for Emergency/ Diversionary Use*
- Transportation Safety Board Statistics*

1.5 Airstrip Description

The Banff (CYBA) and Jasper (CYJA) aerodromes are National Parks owned and operated turf airstrips that have been used by light aircraft for the purpose of recreation, Parks Canada management operations, search and rescue exercises and searches, medical emergencies, business travel, tourist travel and, on a number of occasions, for enroute diversionary and emergency landings since the 1930's.

The airstrips were closed and restricted to emergency and diversionary use in 1997. Some pilots continue to use the airstrips recreationally in defiance of the National Parks Aircraft Access Regulations.



1.5.1 **Banff**

The Banff airstrip is 3000 feet long and is nestled between the Trans Canada highway and the southern flank of Cascade Mountain approximately 3 km north east of the Banff town site. The Bow Valley is relatively wide at this point and the weather predominantly fair (Darr et al). However, the valley is bounded on the north (Cascade Mtn - 9836' ASL) and south (Mt Rundle - 9836' ASL) by high mountains and further constricted by smaller hills like Tunnel Mountain just to the east of the Town site. Winds in the vicinity of the airstrip are frequently strong, turbulent, and highly variable. The airstrip is on the leeward, down slope side, of both Mt. Norquay and Cascade Mtn. when prevailing westerly and north-westerly winds are blowing. Wind patterns at the airstrip are further disturbed when strong westerly flows divide at low level to exit the outer ranges via Lake Minnewanka or the Canmore and Exshaw gaps.



Photo Courtesy of Bob Kirkby

The Banff airstrip can be a treacherous place to land a small aircraft. The Canada Flight Supplement, which provides pilots with important aerodrome information, cautions pilots that "Moderate to severe subsidence, turbulence and wind shear may be encountered. Take-off rwy 36 not recommended, tall trees and rapidly rising terrain N of airport." The Canadian Transportation Safety Board (CTSB) database records 10 aircraft accidents at the Banff airport for the years 1976 to 2003. Adverse wind conditions and/or high density altitude (field elevation is 4583' ASL) were



contributing factors in many of these accidents, according to the CTSB reporting officer.

Despite these environmental challenges, the Banff airstrip has been regularly used by pilots for emergency and diversionary purposes. Warden logs indicate that 16 diversionary and emergency landings have been completed since 1995. Most of these (10) have been weather related. The COPA Aviation Accident study suggests that it has been used more frequently for this purpose than the Warden logs indicate.

The Banff airstrip receives limited maintenance. The grass is cut and snow removed when either reaches a depth of 6 inches. Gophers are no longer trapped and holes are not filled. The airstrip remains operational with windsocks, runway markings, fences, and club hangars.

1.5.2 Jasper

The 3990' long Jasper turf airstrip is located in the broad Athabasca Valley 15 km north of the Jasper Town site. In comparison to the Banff airstrip, it has good approaches, is lower (3350' ASL), and is less prone to wind turbulence, shear, variability, and subsidence. The weather in the area is also generally fair (Darr et al) for flying. The CTSB only reports one accident for the Jasper airstrip for the same period (1976 to 2003) as mentioned above for Banff.

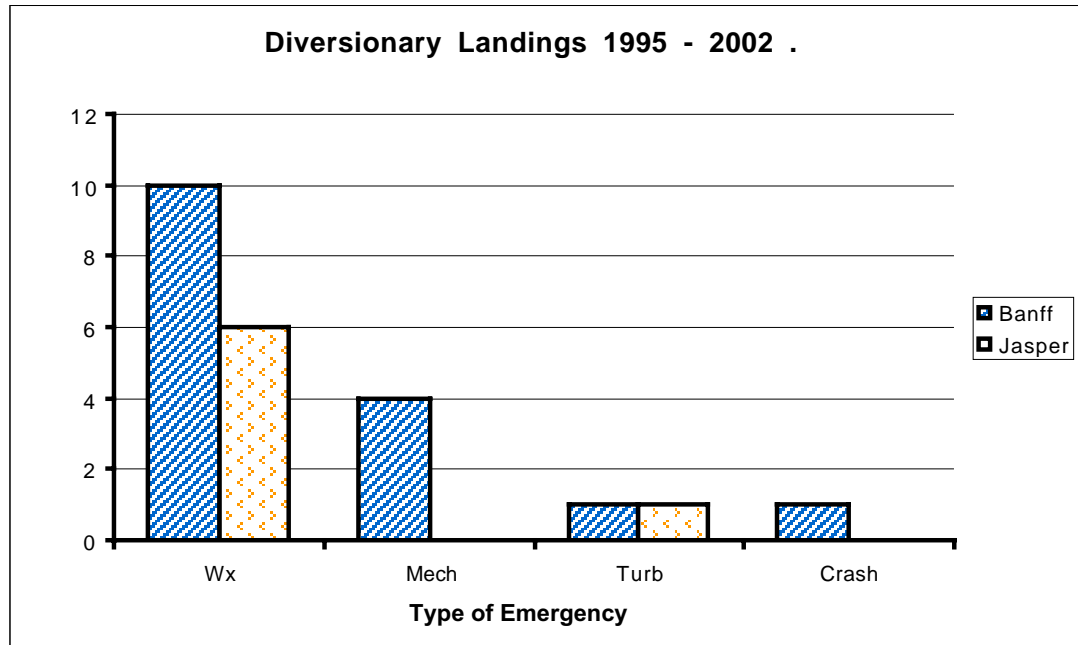


Photo Courtesy of Bob Kirkby

Warden logs indicate that 7 diversionary and emergency landings have been completed at the Jasper airstrip since 1995. The runway is marked and a windsock is displayed, but only limited maintenance is performed. The Jasper airstrip has also been closed to discretionary use since 1997.



1.5.3 Warden's Log Diversionsary & Emergency Landings 1995 – 2002



1.6 Route Description

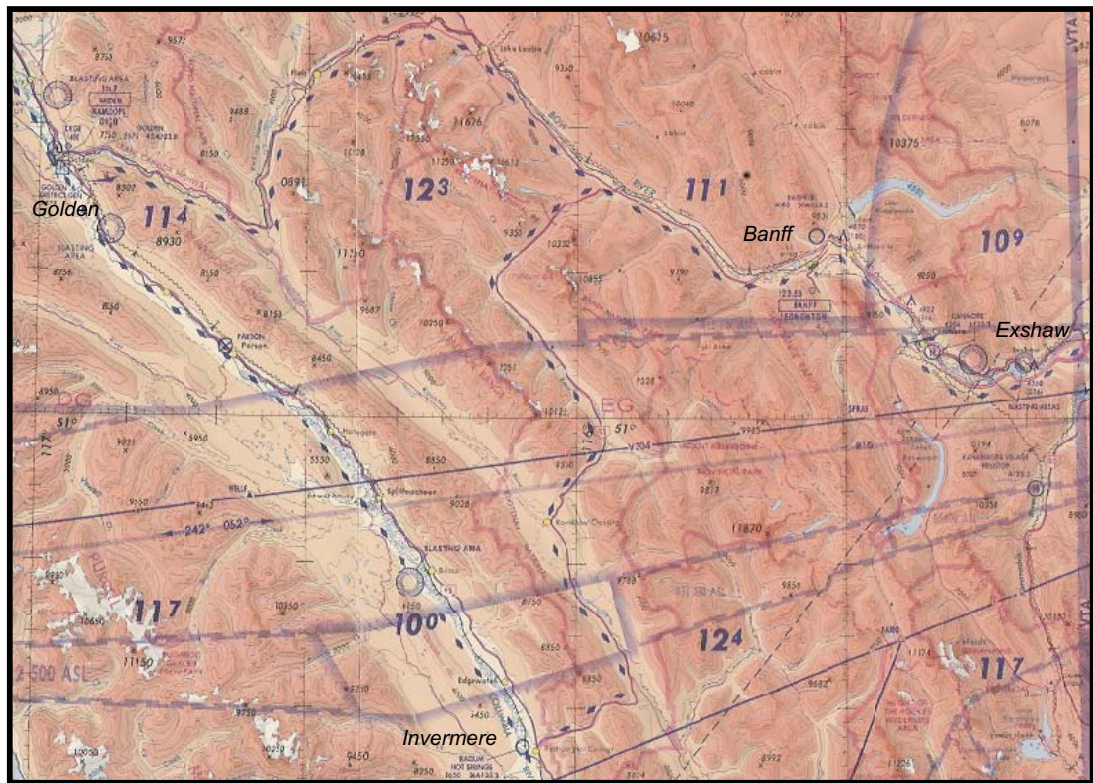
The Banff and Jasper Parks airstrips underlie designated Visual Flight Rules (VFR) routes. VFR routes like these have been established throughout Canada at strategic locations to help guide pilots of light aircraft. They normally follow valleys, rivers, roads or other geographical features that allow pilots to safely navigate through areas of higher terrain or where other hazards exist. The Banff and Jasper routes are especially well used since they are the best of only a few east-west routes which can be used by light aircraft to transverse the Rocky Mountains. They are relatively wide with flat valley floors along much of their length, pass elevations are low compared to other routes, and they are well delineated by roads, railways and towns. It has been estimated that there are approximately 2000 over-flights annually along the Banff VFR route, and 1200 along the Jasper route.

According to Bob Kirkby of COPA, most of the reported diversions at both the Banff and Jasper airports have occurred during east-bound flights. Constrictions in the route exits through the outer ranges and the weather volatility in the area of the eastern slopes create hazards for aircraft attempting to depart the mountains in an eastbound direction. West-bound flights more commonly are blocked from entering the mountains due to these same conditions and normally return to their point of departure to await more favourable conditions.



Weather reporting is limited along both routes. Satellite imagery and aviation graphic area forecasts (GFAs) may be used by pilots and weather briefers to help predict enroute weather conditions, but these tools are of limited usefulness when the weather becomes marginal or when local conditions vary from wider area trends. The lack of weather reporting stations in the mountain passes makes it more difficult for Environment Canada (EC) to accurately forecast weather for these VFR routes, according to Scott McCormick of E.C..

1.6.1 Banff VFR Route



Golden / Invermere to Exshaw

The VFR route segment overlying the Banff airstrip extends approximately 123 NM between the Golden and Springbank airports (all measurements are taken along the route, not direct), or 126 NM between the Invermere and Springbank airports. Weather barriers occur at the following locations where the valleys narrow and/or rise to higher elevations, from east to west:

1. Exshaw gap;
2. Castle Junction;
3. Vermillion Pass;
4. Radium gap;
5. Kicking Horse Pass.



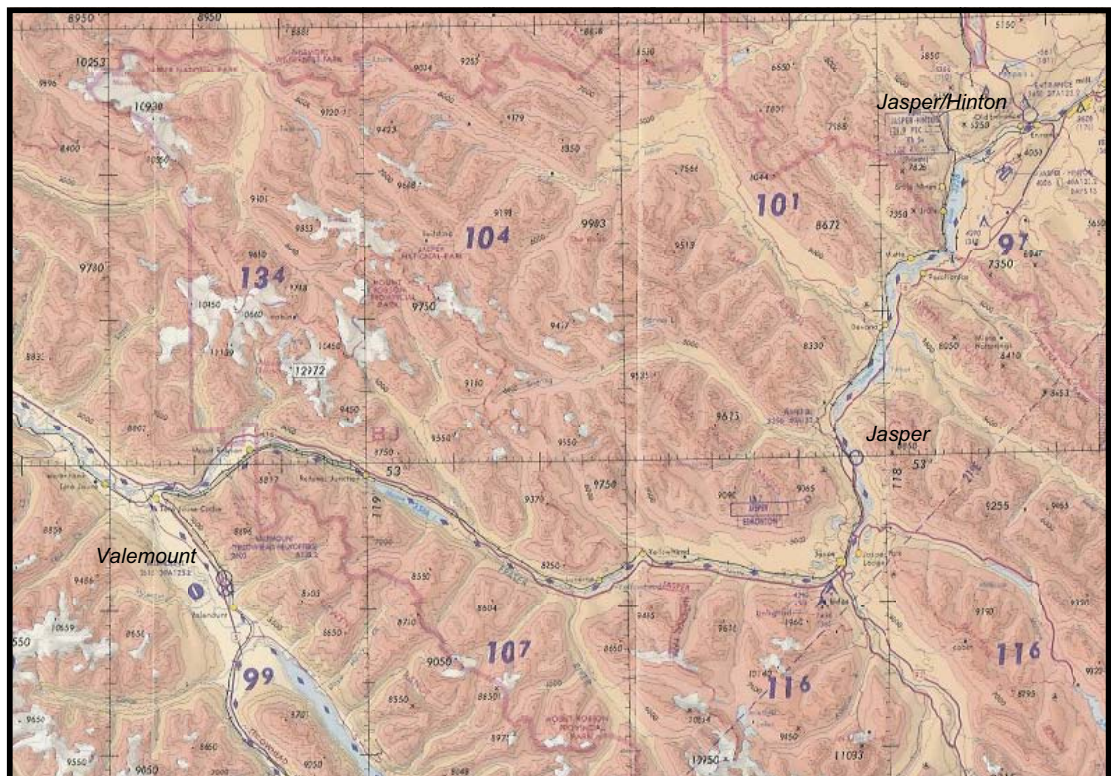
1.6.1.1 Flight Information

Aviation weather reports (METARS) are issued for Springbank and Golden. Aviation weather is not available for the airports at Banff or Invermere, or for any other locations along this route. A Nav Canada remote radio outlet (RCO) is located at Banff. Pilots can receive general area weather updates and METARS by contacting the Flight Information Service (FIS) over this radio. Aviation users have expressed their concern over the recent closure of the Springbank Flight Service Station and the possible loss of local knowledge now that weather and route information briefings are provided remotely by the Edmonton FIS.

1.6.2 Jasper VFR Route

The VFR route overlying the Jasper Park airstrip extends 93 NM between the Valemount and Jasper/Hinton airports. Weather barriers occur at the following locations where the valleys narrow or rise to higher elevations, from east to west:

1. Roche Miette
2. South of Mount Robson



Valemount to Jasper/Hinton



1.6.2.1 Flight Information

METARS are issued for Edson and Blue River, which is located 51 NM south of Valemount. Blue River weather will not necessarily be representative of the weather at Valemount or the area south of Mount Robson.

An RCO was located at Jasper until May 15, 2003, when it was relocated outside the mountains, approximately 3 nautical miles north of the Jasper/Hinton aerodrome. Subsequent operational tests conducted by the Jasper Flying Club have demonstrated that the new RCO is out of range for aircraft flying west of Jasper Park's eastern boundary below 10,000 feet. Pilots flying the Jasper VFR route below 10,000 feet within the mountains are now unable to contact Flight Services.

1.6.3 Sample Flight – Banff to Exshaw





The photographs above were taken by the author during a flight on March 22nd, 2003 from Banff to Calgary. The pictures are shown in numbered sequence and were taken over a 5 minute period:

1. *Banff Townsite looking NE toward Lake Minniwanka:* Flight conditions were good VFR in the Banff area and to the west. Winds on the surface were strong from the west at approximately 25 knots. Note the Banff airstrip marked by the "X."
2. *Passing Tunnel Mountain:* The weather began to deteriorate as soon as we entered the Canmore valley. This weather was not forecast and had moved in rapidly after we had passed through this same area on our way westbound only 30 minutes before.
3. *Flank of Mt. Rundle:* The ceiling was obscured at approximately 2000' AGL in snow and cloud.
4. *Spray Lakes Saddle:* This frequently used VFR route to Spray Lakes and the Kannanskis near Canmore is obscured. This is an example of a narrow and higher route that may not be useable when the broader Bow Valley is still open.



5. *Canmore and Trans Canada Highway:* The visibility dropped to just over 3 miles. Combined with the high winds and turbulence we encountered, these conditions would be considered marginal for light airplanes attempting to exit the mountains along the Bow Valley corridor.
6. *Exshaw and Scott Lake Hill:* We emerged into the open with an unobstructed view of the foothills and prairie beyond as we turned the corner at Exshaw.

This flight is typical of many the author has made through the outer ranges in the Banff area. Weather can change rapidly over short distances and periods of time.

2.0 Initiation

2.1 Stakeholder Identification

An initial meeting was held on January 22nd, 2003 between representatives from Parks Canada, key stakeholders, and the author to introduce the risk assessment process and to discuss concerns and issues. A brief record of this meeting can be found in Appendix A. This meeting concluded that the following stakeholders should participate in a risk assessment workshop:

- Canadian Owners and Pilots Association (COPA)
- Banff Flying Club
- AMPEE
- Jasper Flying Club
- Alberta Aviation Council
- Civil Air Search and Rescue Association of Alberta (CASARA)
- Transport Canada
- Environment Canada
- Canadian Environmental Assessment Agency
- Parks Canada
- Canadian Parks and Wilderness Society (CPAWS)
- Nav Canada
- Alberta Transportation
- BC Transportation
- Air Transport Association of Canada (ATAC)

All of these agencies or associations were invited to the March 17th and 18th risk assessment workshop. Unfortunately, a few invitations were sent late and the affected organizations, like ATAC, may have been unable to attend for this reason.



2.1.1 Stakeholder Role

Workshop participants questioned their role and that of the risk assessment process. Bruce Leeson of Parks Canada confirmed that any decisions the stakeholders made with regard to the decommissioning proposal and air safety would be of an advisory nature. The following steps must be completed before a final decision regarding decommissioning can be made:

1. *Risk Assessment Workshop* – Stakeholder recommendations and opinions will be determined and recorded;
2. *Consultant Report* – Kootenay International Associates (KIA) will prepare and submit a draft report describing the risk assessment process and offering expert opinion;
3. *PC Review of Consultant’s Report* – The KIA Report will be reviewed by Parks Canada;
4. *Stakeholder Review of Consultant’s Report* – After Parks Canada has completed an initial review of the report, it will be distributed to workshop participants and stakeholders for review and comment.³
5. *Collation of Comprehensive Study* – The KIA risk assessment report will be revised as required and attached to the Highwood Environmental Comprehensive Study.
6. *Initial Public Consultation* – The collated Comprehensive Study will be made available to the public for comment.
7. *PC Review of Public Comment* – Parks Canada will review any input received from the public and attach their final analysis and recommendations to the Comprehensive Study.
8. *Submission to the Minister of Heritage*- The Comprehensive Study and Parks Canada report will be submitted to the Minister of Heritage for review.
9. *Submission to the Minister of the Environment* – The Minister of Heritage will then submit the reports to the Minister of the Environment.
10. *Submission to the Environmental Assessment Agency* – The report will next be submitted to the Environmental Assessment Agency. The Agency will:
 - a. Review the report and assess it for compliance with the mandated process;

³ Transport Canada will receive a copy of the report as a workshop participant. It will first be submitted to the regional System Safety Office in Edmonton. The System Safety representative will then submit it to the Transport Canada Regional Director General for consideration. Transport Canada has maintained that they are an “observer” to the process, and not a stakeholder or a decision-maker.



- b. Initiate a 30 day public consultation process;
 - c. Re-submit the report to the Minister of the Environment with their findings and recommendations.
11. *Assessment by the Minister of the Environment* – The reports and findings will be evaluated by the Minister of the Environment. If it is determined that the project undertakings will result in significant negative effects further study or remedial action may be required.
 12. *Return of Reports and Findings to the Minister of Heritage* – The reports and findings will be returned to the Minister of Heritage and Parks Canada for appropriate action.

2.2 Problem Definition

Two main problem “proposition statements” were identified by workshop participants as requiring resolution. They may be paraphrased as follows:

1. *Parks Canada* – “Parks Canada will be unable to enforce the National Parks Aircraft Access Regulation at the Banff and Jasper airstrips until such time as they are clearly marked as being closed⁴ in compliance with the Canadian Aviation Regulations (CARs).⁵ Aircraft operations must be restricted within the Banff and Jasper National Parks in order to achieve management plan and environmental objectives.”
2. *Aviation Users* – “The proposed closure and reclamation of the Banff and Jasper airstrips will negatively impact aviation users.”

These problems are related and, apparently, in conflict. The objective of this risk workshop was to determine whether the Aviation users problem statement is valid and, if so, to suggest alternatives which will provide acceptable solutions to both of the principle stakeholders.

⁴ The CARs do not distinguish between a “closed” and a “decommissioned” aerodrome. These airstrips have been deemed to be closed to discretionary use by Parks Canada even though they do not display closure markings specified in the CARs. For the purposes of this document, “decommissioning” will mean the closure of the airstrips in compliance with the CARs and reclamation in compliance with the Highwood Comprehensive Study recommendations.

⁵ Parks Canada legal counsel is of the opinion that Justice Norhiem found in favour of the defendants who had been charged with landing in contravention of the National Parks Access Regulation because the airstrips were “undead.” In other words, pilots were misled into believing they were still open because they did not display any of the visible closure markings required by the CARs.



2.3 Risk Identification

The aviation stakeholders identified the following risks that may be associated with the loss of the Banff and Jasper airstrips as diversionary landing sites. They are listed in descending order of significance as ranked by the participants:

1. Controlled Flight into Terrain (CFIT) or disorientation accident with high probability of fatalities;
2. Forced landing at unprepared site with probability of traumatic injury;
3. Loss of, or significant damage to aircraft;
4. Third party losses;
5. Search and Rescue costs;
6. Flight delay resulting in:
 - a. Loss of income;
 - b. Inconvenience;
 - c. Increased aircraft rental charges;
 - d. Alternate transportation and accommodation costs.

2.4 Scope of Decisions

The workshop findings are advisory only. The decisions under consideration relative to the proposed airstrip decommissioning include:

1. What are the impacts to aviation users?
2. What is the potential severity and probability of any risks to aviation safety?
3. How can these risks be mitigated or controlled?
4. Who is responsible for implementing these strategies?
5. How can the enforceability of the National Parks Aircraft Access Regulation be maintained?

2.5 Assumptions, Positions & Constraints

All of the risk workshop participants, including the author and facilitator⁶, were considered to be interested parties with pre-existing assumptions or positions. The terms of reference specified by Parks Canada as the proponent of the Comprehensive Study also imposed constraints on the process. Following are a few of the

⁶ I acted in dual roles; as aviation expert to Parks Canada and as the risk assessment process facilitator. Participants believed these roles were potentially in conflict and the workshop process would most likely be negatively impacted as a result. I asked them to reserve judgement until they had a chance to review the final report.



assumptions, positions and constraints which were mentioned or alluded to during the workshop. This list was compiled by the author after the completion of the workshop and has not been ratified by the participants:

Parks Canada

- Closure of the airfields was undertaken to meet Park Management Plan objectives for the Banff and Jasper National Parks;
- The airstrips must be decommissioned in order to enable enforcement of the National Parks Aircraft Access Regulation;
- The policy decision to close the airstrips and the supporting environmental justifications are not subjects for review by the risk workshop. The environmental need for closure has been established and is documented in the Highwood Environmental study.

Aviation Users

- Mountain weather is volatile and inadequately reported and forecast (Darr et al);
- The Banff and Jasper VFR routes are part of a vital “Trans-Canada” coast-to-coast flight corridor;
- The Banff and Jasper airstrips are strategically located in areas of good weather adjacent to known weather “gaps” that often become barriers to safe flight;
- Pilots have relied on, and have used these airstrips for decades as “safe harbours” when transiting the eastern Rocky Mountains;
- Roads and other emergency landing areas are not acceptable for diversionary planning and use unless they can be secured and made safe for landing⁷;
- The removal of these airstrips will force pilots to land at unsafe sites or to “push” adverse weather in search of a safe landing area;
- The Government of Canada has a duty to support the safe and effective use of the Banff and Jasper VFR routes.
- An independent and impartial agency should conduct the Comprehensive Environmental Assessment and the Air Safety Risk Assessment.

⁷ The Canadian Safety Board database records 155 (17 in Alberta and 36 in BC) occurrences of airplanes landing on roads or highways in Canada from 1976 to the present. The majority of these landings resulted in at least some aircraft damage and were classified as accidents.



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- Inadequate accident and incident data and analysis⁸ for the areas under study make it difficult, if not impossible, to establish a cause and effect relationship between the availability of diversionary landing sites and CFIT and disorientation accidents.⁹
- Pilots are responsible for managing risk by assessing available resources and conditions¹⁰ along the flight route and making appropriate pre and in-flight decisions.¹¹
- Minimum flight safety service or facility levels are not prescribed for VFR flight routes. The Government of Canada does not have a regulatory, legal, or policy-based obligation to maintain a diversionary airstrip at Banff or Jasper.
- Operational experience and judgement can be used to qualitatively evaluate the impact of airstrip decommissioning and to make mitigation and control recommendations. This risk assessment process is conditional and the results affected by participant assumptions, positions, biases, and experience.

⁸ At best, the accident history in the mountainous areas of Canada can only be used to support general safety trends and findings. Cumulative flight hours for any local area are too low to allow for the calculation of meaningful local accident rates or to establish statistically relevant relationships between local conditions and safety. For example, COPA suggests that the fact that there were no fatal CFIT or disorientation accidents along the Banff VFR route over a 12 year period is “compelling” evidence that the Banff airstrip has been instrumental in preventing these types of accidents. Unfortunately, only 20,000 to 24,000 flight hours may have been accumulated over the route during that period. If the fatal accident rate for general aviation in Canada is 2.1/100,000 hours, then a “statistical” fatal accident along the Banff route would only be expected once every 50 years, or so. Not enough data has been collected, nor may it ever be sufficient, to determine whether local accident rates are above or below industry averages or what local factors are influencing these rates.

⁹ This issue was discussed with an inspector with the Canadian Transportation Safety Board regional office in Edmonton. A search of the CTB database from 1976 to the present did not find any reports or research that attempted to establish a relationship between the availability of VFR diversionary airports and safety. My own review of Flight Safety Foundation accident analysis reports from 1990 to 2002 indicates that, in the opinion of the investigators, the leading cause of CFIT and disorientation accidents is pilot error or poor decision-making. This does not mean that the lack of a safe diversionary landing site was not a factor in any of these accidents; it does mean it was not identified or addressed as an issue.

¹⁰ Including factors such as: the availability of enroute diversionary airports; reasonably anticipated weather volatility; impending darkness; fuel shortage and unreliability of weather reporting and forecasting, to name a few.

¹¹ If a resource like an enroute diversionary airport is lost, the pilot can maintain an acceptable level of risk by making more conservative planning and in-flight decisions. These may include: maintaining the departure airport as the diversionary option by carrying extra fuel, having adequate daylight, and monitoring and ensuring return weather conditions; and making more conservative pre-flight planning decisions that allow for mountain weather volatility and unpredictability.



- Where data is uncertain or indeterminate, the aviation risk-decision making process must err on the side of safety.

3.0 Analysis

3.1 Research & Reports

Workshop participants presented or discussed several reports and research projects which they believed were relevant to the risk assessment process. Other resources listed in section (1.3) above influenced the decision-making process but were not formally presented. These documents are available from Parks Canada or COPA on request. The revised Kootenay International Associates (KIA) Issues Summary document is attached in Appendix B.

3.1.1 COPA Accident Study

Bob Kirkby, COPA Director for Alberta and NWT, presented his research project entitled “Mountain Aviation Accidents and the Utilization of the Banff and Jasper Airstrips.” The Overview page of this document is inserted below:

Overview

The purpose of this document is to bring together and analyze data pertinent to VFR flight in the mountains of Alberta and BC as it may relate to the Banff and Jasper airstrips. The focus is on weather related mountain aviation accident statistics and weather related diversionary landings at Banff and Jasper.

Mountain accident statistics are derived from a Transportation Safety Board report issued in 1990 plus a recent study of Transportation Safety Board accident reports, conducted by the author, covering 1990 to 2002.

The diversionary landing data is derived from a Joint Study by Transport Canada and Parks Canada from 1991 to 1994 plus a recent survey of pilots who have executed diversionary landings at Banff and Jasper, conducted by the author. The actual pilot reports and interviews are contained herein.

Although a lot of data is presented here, there are some primary numbers which are particularly relevant to the value of the Banff and Jasper airstrips in mitigating potentially fatal aviation accidents along the Bow Valley and Yellowhead transportation corridors through the Rockies.

1. From the TSB study there appear to be approximately 7 accidents per year in the Alberta and BC mountains resulting from VFR flight into IMC weather, all phases of flight.



2. From the author's accident study there appear to be an average of 2.3 accidents per year in the mountains of Alberta and interior BC resulting from VFR flight into non-forecast IMC weather, en route.
3. The Joint study reported 11 adverse weather related diversionary landings per year at Banff.
4. From his survey the author estimates there are 5 to 7 adverse weather diversionary landings per year at both Banff and Jasper. The pilot reports indicated the adverse weather frequently blocked the valley exits.
5. The number of known VFR-into-IMC accidents along the Bow Valley and Yellowhead transportation corridors is zero.

These numbers very strongly suggest that the Banff and Jasper airstrips do play a valuable roll in preventing VFR-into-IMC aviation accidents, and perhaps other types as well. From the author's survey it appears, on average, the two airstrips are used almost equally to avoid adverse weather. (Kirby:3)

As part of his study, Mr. Kirkby also collected 45 pilot reports of emergency or diversionary landings at the Banff and Jasper airstrips. The appendixes to the document include a brief description of each incident, and, in most cases, a first-person account of the conditions which lead to the need for the landing. Most of the diversions were weather related. Mr. Kirkby concluded:

...that the unpredictability of the weather in the mountains surrounding the Bow Valley and Yellowhead transportation corridors has continued to create serious problems for pilots flying these routes for many year. According to the pilots who have had these experiences the Banff and Jasper airstrips have played an important role in preventing accidents - their accidents. (Kirby:15)

3.1.2 KIA Issues Summary

The Risk Assessment Issues Summary document prepared by Kootenay International Associates (Appendix B) was circulated to stakeholders prior to the workshop. The purpose of this document was to provide Parks Canada and the participants with an analysis of key issues which may affect the risk assessment process and outcomes. It also provides participants with a better understanding of the positions and philosophies of Kootenay International Associates as they relate to decommissioning issues.

COPA was given an opportunity during the workshop to present their comments and objections. Most were accepted and have been incorporated into the revised document. A few issues became topics for further debate during the workshop, including:

1. *Duty of Care* – Participants discussed whether Parks Canada or the Government of Canada owed the aviation users a “duty of care” under civil law as a result of their decades-long provision of airport facilities at Banff and Jasper. This debate was inconclusive and in the final analysis can only



be resolved by the courts. The sections in the Issues Summary document that discuss civil law issues have not been revised.

2. *Root Causes and Opportunity vs. Safety* – A lengthy and, at times, contentious debate took place between some participants and me regarding the relationship between pilot decision making, preplanning, Cockpit Resource Management (CRM), information and enroute resources, and safety. I argued that:
 - a. The leading root cause in the majority of CFIT and disorientation accidents is poor pilot decision making;
 - b. A lack of resources (e.g. weather reporting, enroute diversionary aerodromes, etc.) are secondary causes which are inputs to the pilot decision-making process;
 - c. Mission capability (opportunity) and risk are often linked. If resources are lacking or removed, a pilot can decide to reduce mission capability (i.e. delay the flight, carry more fuel, not fly at all, etc.) in order to maintain a comparable level of risk.

3.1.3 COPA Aviators Response

Bryn Thomas of the Jasper Flying Club distributed copies of the COPA “A Response from Mountain Aviators to the TC/PC Joint Study “ which was originally published in 1994. Bryn stated that the “professional judgement” of the aviators who provided testimonials and opinions in favour of maintaining the Banff and Jasper airstrips are still valid and should be considered by workshop participants. Most participants were already familiar with the contents of this report.

3.2 Risk Scenario

A risk scenario case study was selected from the COPA accident analysis report. After discussing the particulars of the pilot’s report, a composite risk scenario was created. This scenario was developed for the Banff route but participants felt it was equally valid for Jasper. The risk scenario described below was intended by the participants to be representative of the flight capability and risk levels that can reasonably be expected to exist or be accommodated along the Banff and Jasper VFR routes:

1. *Pilot Experience and Qualifications:*
 - a. Private Pilot License
 - b. Relatively low time (200 to 400 hours);
 - c. Mountain Course.



2. *Aircraft Specifications:*
 - a. Light single engine airplane;
 - b. VFR;
 - c. No high altitude capability (no oxygen or turbocharger);
 - d. Wheeled landing gear;
 - e. 3 hours range;
 - f. 100 knots cruising speed.
3. *Route:*
 - a. Golden airport to Springbank airport.
4. *Weather:*
 - a. Reported VFR – good flying conditions with clear skies and light winds reported at Golden and Springbank.
 - b. Forecast VFR – existing favourable conditions forecast to extend along flight route throughout the duration of the flight. No fog forecast;
 - c. Actual Weather – upslope fog unexpectedly encountered at the Exshaw gap. Flight is unable to continue.
5. *Available Landing Sites:*
 - a. Golden;
 - b. Springbank;
 - c. Emergency sites (highway, fields, swamps, etc) – the Banff Park airstrip is assumed to be fully decommissioned for the purposes of this scenario.
6. *Time of Day:*
 - a. Late afternoon with more than enough daylight available to complete the flight to Springbank but not enough to return to Golden from Exshaw.

4.0 Risk Evaluation

4.1 Hazard Identification & Priorization

For the risk scenario described above, the workshop participants identified the following hazards, listed in descending order of significance:



1. *Unreliable flight safety information;*
2. *Poor communications;*
3. *Low visibility;*
4. *Darkness;*
5. *Mountainous terrain;*
6. *Lack of diversionary options.*

4.2 Risk Identification & Priorization

The risks identified for this scenario and the associated hazards, listed in order of descending significance, are:

1. *Forced, off-airport landing;*
2. *Controlled Flight into Terrain (CFIT)/Disorientation accident;*
3. *Physical or physiological trauma;*
4. *Property and/or third party damage;*
5. *Search and Rescue costs.*

4.3 Severity & Probability Estimation

The following matrix was used to estimate severity and probability:

	Minor	Major	Hazardous	Catastrophic
Probable	4	5	6	7
Improbable	3	4	5	6
Extremely Improbable	2	3	4	5
Extremely Remote	1	2	3	4



4.3.1 **Matrix Definitions**

Probability:

- *Extremely Remote* – not anticipated to occur but may a few times over the entire history of aviation use of the route
- *Extremely Improbable* – unlikely to occur during one generation of aviators using the route
- *Improbable* – unlikely to occur to each aviator but may occur several times within one generation
- *Probable* – likely to occur one or more times to each aviator using the route

Severity:

- *Minor* – no significant reduction in Safety
- *Major* – significant decrease in safety with possibility of injuries
- *Hazardous* – large reduction in safety with possibility of serious injury or fatality
- *Catastrophic* – loss of airplane and multiple fatalities

4.3.2 **Risk Scenario Estimation**

Participants assigned severity and probability values to the top two risks for the workshop scenario:

1. *Forced off-airport landing:*
HAZARDOUS - IMPROBABLE (Yellow)
2. *CFIT or Disorientation Accident:*
CATASTROPHIC - IMPROBABLE (Red)



5.0 Decision

5.1 Risk Acceptability

Workshop participants rated the risk severity and frequency levels as unacceptable. Mitigation and control measures are required. Flight operations which are similar to this scenario should not be conducted until risk levels are reduced.¹²

5.2 Mitigation & Control

The following mitigation and control measures were identified, listed in descending order of priority:

1. *Improve the reliability and availability of Flight Safety Information Services weather for the Banff and Jasper VFR route:*
 - a. Weather reports for critical route locations;
 - b. More detailed and reliable forecasting for the critical passes and gaps;
 - c. Additional remote radio communication outlets (RCOs) to allow pilots to receive enroute weather updates.
2. *Maintain safe landing sites at, or in the vicinity, of the existing Banff and Jasper airstrips that can be relied on by pilots for pre-flight and enroute planning and use.*

5.3 Implementation

5.3.1 Flight Safety Information Services

The provisions of flight safety information services in Canada is the responsibility of Nav Canada. Lorne McCrea of Nav Canada joined the workshop as an observer. He informed us that:

- Most of Nav Canada's revenue comes from the major airlines. The recommended service upgrades would not be of value to them;
- Nav Canada is presently losing money. The organization could not provide additional services in the Banff and Jasper areas unless services are downgraded elsewhere in the system;
- The Government of Canada would only pay for the increased service levels if Transport Canada "ruled" that they are required.

¹² This scenario assumed that the Banff airstrip was unavailable. Participants agreed that risk levels for flights similar to the scenario are acceptable provided the airstrip remains available for diversionary use.



- Nav Canada would consider providing additional services if users are able find a way to fund them.

5.3.2 Weather Reporting and Forecasting

Weather services are supplied to Nav Canada by Environment Canada. Scott McCormick from the Calgary office briefed us as follows:

- Additional automated weather reporting stations along the Banff and Jasper routes would be required to provide the reporting and forecasting service levels requested by the participants:
 - a. Automatic Weather Observation System (AWOS) at Banff and Jasper;
 - b. Limited Weather Information System (LWIS) at the critical weather gaps and passes. Two or three for each route might be required.
- Forecasting accuracy for the mountain routes is directly affected by the quality of the reported data. The recently announced Environment Canada re-organization and office closure should not affect forecasting reliability according to Scott. Additional weather reporting sites along the mountain flight routes would allow Environment Canada to generate more specific route and local area forecasts.
- The costs involved in upgrading weather services can be expected to be relatively high. New or upgraded reporting stations would have to be paid for by Nav Canada, by the users, or some other agency. Estimated costs are:
 - a. AWOS - \$200,000 to \$300,000 each plus \$35,000 annually for maintenance;
 - b. LWIS - \$35,000 each plus annual maintenance.

5.3.3 Diversionary Landing Site

5.3.3.1 Criteria

The participants identified several diversionary landing site options using the following criteria:

1. *Enforce-ability of the National Parks Aircraft Access Regulation* – Parks Canada requires that any risk mitigation or control solutions that may be implemented will ensure that aircraft landings within the Parks can be controlled and pilots violating the Act can be prosecuted successfully; and
2. *Suitability* – The aviation users agreed that pilots must be aware of the diversionary option and perceive it to be a safe alternative to continued flight in marginal weather. Emergency or forced landing sites that would



most likely result in aircraft damage, personal injury, or extended loss of use of the airplane would not be acceptable.

5.3.3.2 Landing Site Options and Priorization

The following landing site options were identified by participants and listed in descending order of acceptability:

1. *Re-open and Restrict* - Return the status of the Banff and Jasper airstrips to open and restrict landings through NOTAMS and CFS Prior Permission Required (PPR) and cautionary notices.¹³
2. *Voluntary Compliance* - Maintain the airstrips in their present state and negotiate a voluntary compliance agreement with the users in which they agree to limit flight operations to emergency and diversionary use only;
3. *New Diversionary Aerodrome Standard* - Request that Transport Canada develop a new standard for VFR diversionary aerodromes so that the Banff and Jasper airstrips can be brought into compliance with the CARs without having to display closure markings that would, in the opinion of the participants, discourage diversionary use. The status of the airstrips would remain unchanged until the new standard was implemented. This standard should include:
 - a. Criteria for marking the aerodromes in such a manner that they are clearly distinguishable as safe landing sites for diversionary and emergency use only;
 - b. Design and maintenance safety standards;
 - c. Provisions for publication in the CFS and GPS database.
4. *Move the Airstrips* - Develop a new diversionary airstrip in some other less environmentally sensitive location that is in the same strategic weather area as the existing airstrips and would provide equivalent or better levels of operational safety.
5. *Lease the Airstrips* – Lease the existing airstrips to a private operator with a contractual obligation to restrict operations to emergency and diversionary use only. The operator could then charge violators under trespass.

¹³ Kevin Psutka of COPA stated that one interpretation of Judge Norheim’s decision in the Pendrak case is that he ruled in favour of the pilots who had landed in contravention of the National Parks Aircraft Access Regulation (NPAAR) because of the conflicting information that was available to them; the advisories and notices indicated the airstrips were closed yet they did not display the required closure markings. Kevin believes that if this conflict was removed the normal remedies would be available to Parks Canada to prevent undesired flight operations (including enforcement of the NPAAR). Legal counsel for Parks Canada seems to be of the opinion that it is the lack of closure markings alone that prevented Parks from enforcing, not the conflict in status as suggested by Kevin.



6. *Maintain & Close* – Maintain the existing airstrips but display closure markings and remove windsocks and other features of an operating airstrip in compliance with the CARs. The area would still be considered to be a safe diversionary option and published in the CFS and GPS database.
7. *Create a Designated Road Landing Site* – Select a strategically placed section of straight road that is maintained and can safely accommodate landing and take-off operations. This landing site would require the following:
 - a. Signage;
 - b. ARCAL operated vehicle barriers;
 - c. Warning lights;
 - d. Publication in the CFS and GPS databases;
 - e. Aircraft parking turnout.
8. *Open Field* – Create a new diversionary landing site in a less environmentally sensitive area. This site should be maintained so that the risk of potential aircraft damage is minimized. It would also be published in the CFS with cautions, although there is currently no mechanism to accommodate this in the CFS or on the aeronautical charts.

5.3.3.3 Acceptability of Landing Site Options

The aviation users clearly stated that only landing site options (1) to (5) above are acceptable without further consultation and discussion. At least one participant reserved judgement on any of the options. All of the aviation users continued to express their displeasure with being “forced” to give up normal recreational use of the Banff and Jasper airstrips.

5.3.3.4 Landing Site Maintenance

All of the landing site options listed above require ongoing maintenance. Participants suggested that the minimum maintenance required for a grass airstrip should include:

1. *Grass cut at least once annually;*
2. *Snow compacted as required;*
3. *Weekly inspection* – An inspection checklist and standards should be created for use by Parks Wardens or other assigned agency. COPA and/or the local flying clubs could assist in the preparation of an airstrip operations manual.



5.4 Residual Risk

The participants were asked to assess whether the residual risk remaining after the implementation of the recommended mitigation and control measures would be acceptable. For the purpose of this evaluation it was assumed that only one measure would be implemented:

Upgrade Flight ServicesAcceptable¹⁴
Provide Safe Diversion Landing SiteAcceptable

6.0 Consultant Conclusion

6.1 Decommissioning Impact on Aviation Safety

Kootenay International Associates has determined, as a result of participant input and our own analysis, that the proposed Banff and Jasper airstrip decommissioning and reclamation project will have an impact on aviation safety. In our opinion, it is reasonable to assume that a serious accident may occur within a generation of aviation users (extremely improbable)¹⁵ if these airstrips are no longer available for diversionary use. This determination assumes the following:

1. No other mitigation or control measure are implemented to compensate for the loss of the existing diversionary landing sites;
2. The existing route capability levels are maintained.¹⁶
3. The judgement of stakeholders and experts should be conservative and err on the side of safety given the lack of statistically relevant accident data and information regarding causal relationships between the availability of VFR diversionary airports and safety.

6.2 Recommendations

Kootenay International Associates recommends that the following actions be undertaken as a result of this study:

¹⁴ If a decision is made to upgrade Flight Information Services in compliance with these recommendations, the existing airstrips should remain available until the service upgrade is fully implemented.

¹⁵ The workshop participants determined that the probability level for both primary risks (off-airport landing and CFIT accident) was “improbable” (Sec 4.3.2). While the Kootenay International Associates probability evaluation suggests the risk level is lower by one level, the residual risk is still unacceptable and mitigation and control measures are required.

¹⁶ The aviation users clearly indicated during the workshop that the imposition of further restrictions on their ability to safely use the Banff and Jasper VFR routes would be unacceptable. While they understand that they would have to make more conservative flight planning decisions if the airstrips were unavailable, they are unwilling to accept this outcome as reasonable or justifiable.



1. Legal council to Parks Canada should re-evaluate the Norheim decision to determine whether the implementation of landing site mitigation option (1) would allow for the successful prosecution of pilots who are charged under the National Parks Aircraft Access Regulation;
2. The appropriate agency(s) should implement one or more of the recommended mitigation and control measures described in Section “5.0 Decision” of this report. Note that the participants asked for further consultation if landing site options (6) to (8) are selected.
3. If a diversionary landing site is maintained in the Banff area, long term consideration should be given to selecting an alternative site that is less affected by lee and down slope wind conditions.
4. Transport Canada should conduct a full aeronautical study of VFR flight safety along designated mountainous routes in Canada.



7.0 Appendices



7.1 Appendix A – January 27th Initial Meeting Summary



**Air Safety Risk Assessment
Banff & Jasper Park Airstrip Decommissioning
Preliminary Stakeholder Meeting**

Date: January 22, 2003

Time: 0900 - 1230

Present:	Bill Clark	Banff Flying Club
	Terry Jackson	Alberta Aviation Council
	Bob Kirby	COPA
	Bryn Thomas	Jasper Flying Club
	Kevin Psutka	COPA
	Janet Mercer	Parks Canada
	Tom Umscheid	Transport Canada
	Jack Koosel	Transport Canada
	Dave Poulton	CPAWS
	Ron Tessolini	Parks Canada
	Bruce Leeson	Parks Canada
	Bob Toews	Kootenay International - Facilitator

Location: Parks Canada Regional Office, Calgary

Meeting Summary:

This was a preliminary meeting to discuss the process to be used to complete the Air Safety Risk Assessment as the final stage of the Banff and Jasper Park Airstrip Decommissioning Comprehensive Study. Following are short summaries of the main discussion topics:

Introduction

Bruce Leeson of Parks Canada began the session by providing a brief description of the airstrip decommissioning issue and the status of the comprehensive study report. Bob Toews of Kootenay International Associates was introduced as the aviation expert who would facilitate a Q850 risk assessment process.



Q850 Process and Air Safety Background

Bob Toews introduced the participants to the Q850 stakeholder risk assessment process and provided a short presentation on aviation accident trends and risk factors. His main points were:

- The Q850 process is participative and consensus based. It relies on the good judgement and operational experience of stakeholders to create risk scenario and make qualitative risk evaluations. Mitigation and control measures are negotiated;
- Research and statistics are used to inform, but not “drive” the process;
- The most important initial step is to define the problem and the decisions that must be made;
- General aviation accident statistics and reports indicate that the leading event in the majority of fatal airplane and helicopter accidents is flight into terrain or disorientation resulting from poor pilot decision making while flying in marginal weather. An analysis of representative Flight Safety Foundation accident reports does not suggest that these accidents occurred due to a lack of a suitable diversionary landing area;
- The next stakeholder risk assessment session is intended to explore this issue and determine what the role of the Banff and Jasper airstrips play with respect to flight safety. Risks and hazards to flight for the air routes in question must be identified and evaluated in order to address this issue.

Stakeholder Response

- The representatives of the aviation user community present re-affirmed their opposition to the decommissioning effort. COPA, the flying clubs, and the Alberta Aviation Council representatives all believe that airstrip closure and decommissioning will adversely affect flight safety along the Banff and Jasper VFR routes.
 - The aviation representatives also expressed concern with the expansion of the scope of the air safety investigation as proposed by Mr. Toews. They would prefer to focus the study on airstrip closure issues.
 - Diversionary landing incidents are significant and should be considered when evaluating the need for these airstrips. COPA will provide additional data and information regarding these incidents at the next meeting. Transport Canada will provide accident data for the Banff and Jasper routes.
 - Dave Poulton reminded the participants that the environmental issues associated with these airstrips are not trivial and must be considered.
-



7.2 Appendix B – Air Safety Risk Assessment Issue Summary

Parks Canada
Air Safety Risk Assessment
Decommissioning the Banff and Jasper Airstrips
Issues Summary

January 27th, 2003



Kootenay International Associates



Parks Canada

Air Safety Risk Assessment

Decommissioning the Banff and Jasper Airstrips

Issues Summary

January 27th, 2003

Executive Summary

The decision by Parks Canada to close and then decommission the Banff and Jasper airstrips has been the subject of numerous studies and reports. It has a long history and remains controversial with stakeholders. This paper attempts to understand some of the key issues that have caused disagreement in the past and presents some new information, which may be used to inform the risk assessment process. While this discussion was not intended to answer a particular question or provide recommendations, it suggests the following:

- The legal and regulatory context for this decision and its resolutions are complex and confused. Past decisions by the courts and existing regulations can be used to support arguments on either side of the debate for and against full decommissioning.
 - Previous studies have suffered for a lack of meaningful data on the topic of air safety.
 - Nation-wide and provincial safety data, supported by relevant US statistics, indicate that pilot error or poor decision-making is the leading cause in the majority of weather related controlled flight into terrain and disorientation accidents.
 - A risk assessment process that is based on stakeholder participation and negotiation is the most likely to result in an acceptable outcome for the stakeholders involved in this decision.
-



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1. *Introduction and Disclaimer*

This paper summarizes some of the key issues, processes, and information that may be considered during the Air Safety Risk Assessment of the Decommissioning of the Banff and Jasper airstrips. The items are not presented in any particular order and are not necessarily directly related. They have been selected because they either have been items of controversy in the past, or because of their potential bearing on the risk assessment process and action plan. They are offered as expert opinion but should not be relied on exclusively for decision-making by the parties involved. The author is a well-qualified aviator and has studied regulatory law and its application to aviation risk issues. He is not a lawyer, however. Legal opinions and analysis offered in this document should be reviewed by licensed legal counsel prior to taking any action based on them.

2. *Regulatory and Legal Context*

2.1 National Park Aircraft Access Regulation

2.1.1 Prohibited Operations

The National Parks Access Regulations were implemented in the mid-1990s with the intent of restricting aircraft operations within all Canadian National Parks (*Bowen v Canada*). The 1994 Parks Canada Guiding Principles and Operational Policies established that access by private aircraft to National Parks "will not be permitted except in remote areas" (Highwood 2001:3-2). These Access Regulations prohibit takeoffs and landings by aircraft anywhere within the Parks unless authorized by Parks Canada.

At the time the regulations were implemented, a Notice to Airmen (NOTAMs) was issued advising pilots that the airstrips were only available for emergency and diversionary use, and a restrictive note was added to the Canada Flight Supplement (CFS). They were not officially closed or decommissioned in compliance with the Canadian Aviation Regulations (CARs), but it was clearly the intent of Parks Canada to stop aircraft from using these airstrips.

Aircraft operations within the Banff and Jasper National Parks are still permitted, but only if authorized. As an example, helicopters working on contract to Parks or other authorized agencies are regularly used for maintenance, servicing, construction, and emergency purposes.

2.1.2 Permitted Facilities

The National Parks Access Regulations do not prohibit the construction and maintenance of facilities which may be used by aircraft, like airports and heliports. The Regulations do allow Parks Canada to control the manner in which such facilities are used, however.



2.1.3 Intent to Enforce

Parks Canada intends to enforce the Access Regulations in order to meet policy and planning objectives. The decision to close and mark the airstrips in compliance with the CARs made subsequent to an Alberta Provincial Court ruling which determined that the pilots who landed at the airstrips could not be successfully prosecuted under the Access Regulation because the facilities in question had not been properly closed and decommissioned.

2.2 Bowen v Canada

2.2.1 Jurisdiction

In 1997 the Federal Court of Justice Campbell heard the case of *Bowen v Canada* in which the aviation user community contested Parks Canada's jurisdiction and authority to close and decommission the Banff and Jasper airstrips. With respect to jurisdiction, Campbell J. found there was no conflict between Transport Canada and Parks Canada concerning jurisdiction over the airstrips, as the aviation users argued. He determined that Parks Canada has full jurisdiction over who is allowed to land and take-off within the Parks (*Bowen v Canada* 1997). Following from this, he found that the decision by the Federal Cabinet to close the airstrips was a discretionary planning decision which was not subject to review.

2.2.2 Environmental Assessment

Campbell J. further determined, however, that Parks Canada is required to complete a Comprehensive Assessment under the Canadian Environmental Assessment Act (CEAA) prior to acting on its decision to effect the closure of the airstrips in compliance with the CARs. This requirement was triggered because the proponent was a Federal agency, physical works were involved, and full "decommissioning" and reclamation as proposed by Parks appeared to be in conflict with the Parks Management Plan in effect at the time the decision was made. This plan stated the airstrips would be maintained for emergency and diversionary purposes "unless this is demonstrated to be unnecessary" (*Bowen v Canada* 1997). Having established that a Comprehensive Study was required, Campbell J. suggested its scope should be expanded to include relevant aviation safety issues, as argued by the user community.

2.3 Canadian Environmental Assessment Act

2.3.1 Scope of Assessment

In addition to an assessment of the impact of a project's activities, the CEAA requires a consideration of, among other things: the purpose of the project; and alternative means for carrying it out (CEAA). The Act does not explicitly require that "alternatives to" the project be considered.

2.3.2 Environmental Effects

The CEAA requires that a Comprehensive Study for a project consider the effects to human health and socio-economic conditions resulting from any impact to the



environment. It is not clear that where the effect on the environment, as defined by the Act, is considered to be positive that any further consideration of the "related effects" on human health or socio-economic considerations is required.

2.4 Pendrak v Canada

2.4.1 Inability to Enforce the Aircraft Access Regulation

In the case of *Pendrak v Canada* (2000) Justice Norheim appears to have disregarded Campbell J's early finding with respect to the validity of the "two decision" argument. Unlike Campbell J, Norheim J did not distinguish between the planning decision to "close" the airstrips, and the decision to complete the physical works of decommissioning. He argued that Parks had ignored due process and acted in bad faith by attempting to prohibit landing and take-offs (in effect to "close" the airstrips) prior to completing the Comprehensive Study even though the Federal Court had determined that this requirement only applied to the physical works of decommissioning. Persuaded by this argument, Norheim J. found that "...the accused made a reasonable mistake in determining that the airstrip was operational since Parks had intentionally given the impression the airstrip was operational..." (*Pendrak v Canada*).

Whether intended or not, this ruling has undermined the ability of any agency or person to prohibit aircraft operations at an airport or heliport, regardless of official Notices to Airmen (NOTAMs) or other public prohibitions. It may be up to future courts to decide whether Norheim J. found in favour of the applicants (the aviation users) primarily because the airstrips in question were not visibly closed, or because Parks, according to the judge, acted in bad faith and ignored due process.

2.5 Canada National Transportation Policy

2.5.1 Mandate to Protect Safety and Mobility

The National Transportation Policy is contained in the introduction to the Canada Transportation Act, 1996. Transport Canada's mandate under this policy, along with other key transportation agencies and boards, is to help maintain a:

...network of viable and effective transportation services...that makes the best use of all available modes of transportation at the lowest cost...under conditions ensuring that...the national transportation system meets the highest practicable safety standards, (and that)...each carrier or mode of transportation, as far as is practicable, carries traffic to or from any point in Canada under fares, rates and conditions that do not constitute...an undue obstacle to the mobility of persons, including persons with disabilities...(and that) each mode of transportation is economically viable. (*Canada Transportation Act, 1996*)

Members of the aviation user community who are affected by the decision to decommission the Banff and Jasper airstrips continue to argue that the Government of Canada, if not Parks Canada in particular, has an obligation to ensure the vitality of



the low-level VFR flight corridors that link key regions and cities within the country (COPA:1994). They have argued, with some justification, that these corridors are neglected and, if anything, are becoming less useable and safe as a result of service withdrawals or reductions by Transport Canada, Nav Canada, and Environment Canada. The threatened final decommissioning of the grass airstrips in Banff and Jasper Parks is a painful “last straw” for a vibrant segment of the aviation industry.

2.6 Canadian Aviation Regulations (CARs)

2.6.1 Level of Safety

The new Canadian Aviation Regulations and standards were implemented in October 1996. These regulations are more comprehensive than the ones they replaced but still have little to say with respect to the flight safety and control issues that are raised by this proposal to decommission the Banff and Jasper airstrips. The regulations attempt to set a minimum standard that balances the need to protect public safety with the mandate to promote an efficient and effective national transportation system (National Transportation Act:1996). General operational flight rules and regulations which apply to all aviators are prescribed in Part 6 of the CARs. Part 7 imposes additional restrictions and requirements on commercial operations that progressively raise safety standards as one moves from smaller to larger aircraft and from unscheduled to scheduled operations. Private pilots and their aircraft receive the lowest level of supervision and oversight by Transport Canada, followed by commercial operators of small aircraft used for unscheduled, for-hire operations (air-taxi). Underlying this regulatory approach are two key assumptions:

1. A higher level of safety and protection is required for fare paying passengers on commuter and airline category aircraft. These passengers should not be expected to evaluate the risks associated with a flight nor do they exert any control or influence over operational decisions.
2. It is not in the public interest to impose prohibitive costs on operators of small private and commercial aircraft.

2.6.2 Landing Prohibitions

CAR 602.13 prohibits aircraft from landing within the built-up areas of towns and cities except at certified aerodromes, unless the operation is conducted for law enforcement or life-saving purposes. CAR 601.04 prohibits aircraft from entering and operating in Class F, restricted airspace, unless they are authorized to do so. The boundaries of Class F airspace are specific to each location where it has been applied and are described in the “Designated Airspace Handbook.” The airspace in the vicinity of the Banff and Jasper airports is Class G, uncontrolled airspace. Class F restrictions do not apply in these areas.

This author is not aware of any other provisions within the CARs which attempt to control where aircraft may or may not land and take-off. Land owners and custodians (like Parks Canada) who wish to take action against a pilot for landing without



permission must rely on civil action under trespass or nuisance, regulations like the National Parks Aircraft Access Regulation (see the section 2.1 above) or local bylaws and ordinances. No recourse is normally available under the CARs.

“Prior Permission Required” (PPR) is a term commonly used in aeronautical publications like the Canada Flight Supplement (CFS) to notify pilots that prior permission should be obtained from a facility operator (like an aerodrome or navigation aid) before it is used. Advisories and restrictions may also be posted in a Notice to Airmen (NOTAM). These notices are advisory, however, and are not, in and of themselves, prohibitive. For example, a PPR notice contained in the CFS or a NOTAM is not ordinarily enforceable because the CARs have not defined PPR or specified the conditions under which it applies.

In a similar manner, the CARs provide detailed instructions on how to close an aerodrome (CAR 601.04) and a prohibition against displaying “...a marker, marking, light or signal that is likely to cause a person to believe that the place is an aerodrome...” at a place that is not an aerodrome (CAR 601.08). However, there is no CARs prohibition against a pilot landing at, or continuing to use an aerodrome that is closed provided it is safe to do so.

2.6.3 Diversionsary and Emergency Landing Provisions

Part 6 of the CARs is silent with respect to diversionsary landing requirements and provisions. The term is not defined nor do the regulations and standards specify under what conditions diversionsary landings should be planned for or accommodated during VFR flights by light aircraft¹⁷, either in mountainous regions or elsewhere (Transport Canada/Parks Canada:1994). The regulations would appear to assume that pilots of light VFR aircraft will plan, and take all necessary precautions, to safely fly from their departure point to destination without relying on the need to divert to an enroute alternate aerodrome during the flight.

The regulations and standards do recognize that aircraft, regardless of size or type, may be forced to conduct an emergency landing at any point during flight. Emergencies, by definition, are unpredictable, and are more likely to result in a forced landing in smaller aircraft with fewer redundant and safety backup systems. CARs Part 6 does not prohibit aircraft from flying over hazardous surfaces such as mountainous terrain or open water. CARs 602.61-63 specify the type of survival equipment that must be carried but the CARs do not assume, nor do they require, that

¹⁷ CAR 425.13 do require that pilot training programs include “...the procedures [to be followed] in the event of an unscheduled or forced landing...” The regulations do not assume that a safe diversionsary aerodrome will be available to accommodate this landing, however.



an emergency landing will be conducted without damage to the aircraft or serious or mortal injury to the occupants.

2.7 Civil Law

2.7.1 Liability

The brief discussion above of the regulatory context for the proposed decommissioning of the Banff and Jasper airstrips suggests that neither Parks Canada, Transport Canada or the Government of Canada as a whole are required to provide and maintain a diversionary or emergency landing area for the use of VFR aircraft at these, or any other, location. This does not mean, however, that a duty to do so may not be established under the civil law.

2.7.2 Duty of Care

In any case where liability under tort is in question, the courts must first concern themselves with establishing whether the defendant owed the plaintiff a duty of care, and if so, what it might be. Reasonableness, proximity, neighbourliness, and foreseeability are all principles that the courts have used over the years to test for the existence of such a duty. For offences involving the negligent and harmful actions of private individuals, the courts may reach as far back as the last century for instructive precedents and examples (Toews, 1998:23).

The aviation user community in this case have suggested or implied that the Government of Canada does, in fact, owe a duty of care to the VFR pilots who fly through the Banff and Jasper corridors. These airstrips have been used for decades and have been considered a “safe harbour” by pilots who may have been trapped between passes by bad weather or other unforeseen circumstances. They would no doubt argue that the relationship that has existed between Parks Canada as an aerodrome operator and the users meets all the tests of reasonableness, proximity, neighbourliness, and foreseeability. With respect to the latter, they have argued for years that the consequences of fully closing the airstrips are obvious and incontestable; someone, sooner or later, will crash and die if these airstrips are closed (COPA:1994).

Should Parks Canada, in the end, agree to continue to make these airstrips available in whatever limited capacity for emergency and/or diversionary use, careful consideration ought to be given to the manner in which this is done. Because the standards and requirements for such a facility or service are not prescribed in the regulations, the courts will be free to determine what continuing duty of care is required of Parks. The regulations and past precedent under tort may not be helpful in determining what level of safety must be maintained at the airstrips for Parks Canada to avoid becoming liable for damages in the event a serious accident occurs while an aircraft is attempting to use them for their intended purpose. It could even be argued in the case of the Banff airstrip that it already offers too many hazards to an



unprepared or unfamiliar pilot and should be fully decommissioned regardless of the justification for its continued emergency or diversionary use.

2.7.3 Public Agencies

The courts have expanded the scope of civil liability for public authorities since the late 1970s by distinguishing between policy, or discretionary decisions, and those that are operational in nature. (Reynolds, 1992:2) Operational decisions made by public agencies are now subject to court review.

Parks Canada and its legal council should carefully consider this distinction when reviewing the outcome of the Comprehensive Study and deciding on recommendations for action. Despite the dicta of Campbell J., future courts may determine that the impact of decommissioning on the aviation users is, in fact, a product of the policy decision to close the airstrips and not an “effect of the environmental impacts of the project” as understood by the CEAA. A policy decision to continue to maintain these airstrips will almost certainly expose Parks Canada to an ongoing duty of care under civil law since this action will fall on the “operational” side of the dichotomy.

3. *Aviation Safety Analysis*

3.1 General

3.1.1 Safety Context

The overall safety context for an activity should be understood before any attempt is made to identify specific risks and mitigation measures. Countrywide aviation accident statistics are collected and analyzed in an effort to identify safety trends and deficiencies for the entire industry and its segments. Major accidents are also analyzed in detail by the Canadian Transportation Safety Board (TSB) to better understand why aircraft crash and how those lessons can be applied to prevent accident recurrences. The US National Transportation Safety Board (NTSB) provides an even more detailed breakdown of causes and events for accidents that occur in that country. These findings can then be used to help identify local or operation-specific hazards and risks. In many cases, sufficient data does not exist at the local level to establish statistical certainty or significance. Local data can be used to confirm overall trends, however.

Following are some extracts for the TSB and NTSB safety reports for the last year in which a full analysis has been provided. The data provided here is focused on privately operated (non-commercial) airplane operations which are also referred to as “General” aviation. This is the industry segment to which CARs Part 6 rules apply. Comparative statistics for other segments of the aviation industry are also provided. Private and commercial “Air Taxi” airplanes can be assumed to be the primary users of the Banff and Jasper VFR corridors.



3.1.2 Root Causes

The goal of an aviation safety program is to identify the leading causes of accidents for an operation and introduce appropriate mitigation and control measures. The most effective interventions are those that are generally applicable in most, if not all circumstances. Interventions which have more limited application to a particular situation or hazard may be required but should be considered only after the overall safety issues have been analyzed. The assessment should move from the general to the specific.

The Banff and Jasper airstrip decommissioning air safety risk assessment provides a good opportunity to apply this methodology. The aviation users have argued, as noted above, that “someone will be killed” if these airstrips are closed. This may very well be true, but not necessarily for the reasons suggested. The statistics indicate that the next fatal accident that occurs in the Banff or Jasper VFR routes will most likely be a result of a weather-related collision with terrain caused by pilot error. In other words, poor pilot decision-making will be the cause of the accident, not necessarily the lack of a suitable diversionary landing area. The most effective intervention based on an overview of aviation safety trends is to improve pilot decision-making and information gathering skills so that pilots do not place themselves in a position where only an unplanned landing will save their lives. Providing more diversionary airports or making the requirement for one mandatory for VFR flight may save some lives, but would not address the dominant root causes of enroute fatal accidents.

This does not necessarily mean that a diversionary landing airport may not be an appropriate safety intervention in a specific situation. The availability of a diversionary landing airport gives a pilot an opportunity to make a good decision and break an “error chain” or to escape from a hazardous situation that could not have reasonably been foreseen. The movement from the general to the specific in the case of the Banff and Jasper VFR routes is to ask whether there is something unique about the flight environment which makes pilots unusually susceptible to poor decision making or to be caught in weather conditions they could not reasonably have anticipated and cannot safely escape. All of the mitigation and control measures that may be used to improve pilot decision-making for flights along these VFR routes should be considered first and the residual risk evaluated. If the residual risk of an accident is still higher than normal when compared to flight operations in general and mountain flying in particular, then the provision of a diversionary airstrip at a strategic location may be an appropriate intervention.

3.1.3 Opportunity vs. Safety

Improvements to operational procedures, equipment, or facilities often increase opportunity or mission capability at the same time they attempt to mitigate and control risk. Intended positive impacts to safety may be nullified or the situation even worsened if the increased opportunities are exploited. For example, increasing driver



sight lines on roadways during the middle of the last century had the unanticipated consequence of increasing the severity of accidents as drivers predictably took advantage of the opportunity to speed (Toews, 1998:54).

The provision of a diversionary airport along the Banff and Jasper VFR routes may result in the same outcome for flight safety. If the existence of the opportunity to divert short of their destination causes pilots to fly in weather that is worse or more unpredictable than they would otherwise, the safety impact of the intervention may be neutral or even negative. The justification for providing the airports would then be to improve the usability of the routes, not to improve safety.

3.2 Transport Canada/Parks Canada Joint Study 1994

The 1994 “Transport Canada/Parks Canada Joint Study of the Need to Retain the Banff and Jasper Airstrips for Emergency/Diversionary Use” concluded that:

1. Use of the aerodromes for practical diversions and/or emergencies has not been accurately ascertained. Notwithstanding this, the information gathered from the accident reports and other sources indicates that the aerodromes do not play a significant role in ensuring aviation safety in their vicinities.”
2. The weather conditions at these locations are typical for mountain valleys on the lee side of mountain ranges. Both sites have relatively good weather for VFR flying.”
3. Transport Canada does not have a policy or legislation for VFR emergency/diversionary airstrips.
4. Transport Canada has not identified a significant role played by either of these airstrips for emergency/diversionary use (TC/PC Joint Study, 1994:7).

These findings were used to justify the decision to fully decommission the airstrips. They have subsequently been challenged by the aviation users and their validity, as a result, needs to be re-examined.

My own analysis of the Study and the supporting annual Air Traffic Monitoring Reports suggests that only the last two findings (3 & 4 above) are valid: Transport Canada still does not have a policy or regulation pertaining to VFR diversionary airports; and the Study failed to identify the role these airstrips play with respect to flight safety and emergency/diversionary use. To claim, as the first finding does, that these aerodromes “do not play a significant role in ensuring aviation safety” may be true, but this conclusion is neither supported or disproved by the information and arguments contained in the Study. The following additional extracts and comments help illustrate this shortcoming:

- The authors of the report admit that the emergency/diversionary landing data is not reliable and that such events are either under or over reported. The Study also does not describe what efforts were made to evaluate the chain of events or the pilot decision-making process that necessitated the diversionary landing. For



example, weather was a frequently cited cause for the diversions, but no other information is provided for each occurrence (e.g. what was the actual reported weather in the region, what information did the pilot obtain before commencing the flight, was returning to the departure point an option, how much fuel was carried, etc?).

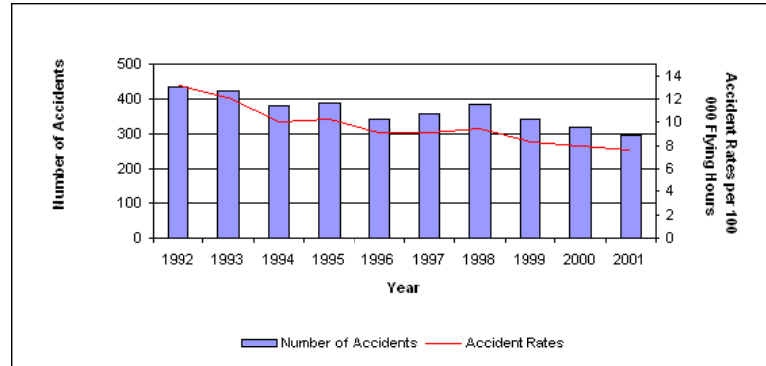
- The report states that “The conditions that normally make VFR flight difficult or impossible are well understood and are normally forecast in the Banff and Jasper areas. There is no indication that the weather conditions near these two aerodromes lead to an extraordinary need for enroute aircraft to land in the vicinity. *It should be noted that we were unable to study the effects of weather in the surrounding passes on the use of the strips.*” (italics added) (3) I would not agree that localized weather in the outer ranges of the Rocky Mountains is either well understood or forecast. Neither the authors of this Study or that of the “Banff and Jasper Meteorological Study” (2001) were able to collect weather observation data for the passes and valley gaps that create weather barriers to aviation. The need to make use of the Banff or Jasper for diversionary purposes would be a result of any instability and unpredictability of weather at critical points along the route, like the Kicking Horse and Vermillion passes and the Exshaw and Radium gaps, to name a few along the Banff route.
- Transport Canada gave up on their own attempts to determine safe flight altitudes through the passes in question: “An attempt was made to determine the minimum altitudes which are required to fly through the passes close to Banff and Jasper safely in a Twin Otter however there was too much turbulence (created by strong winds aloft) to enter the main part of the passes.” (First Interim Report, 1990:18) The Twin Otter is a powerful and very capable aircraft so this failure to complete the test flight is a comment on the severity of the weather that local pilots may encounter. The next year’s monitoring report stated that “The assessment of safe altitudes required to fly through the major passes near the parks has been abandoned. The variable nature of the safe altitude, aircraft type and different manoeuvring speeds, pilot experience, local knowledge and the unpredictable nature of mountain weather all affect the minimum altitude which a pilot would use to fly through these passes. A great deal of local knowledge and experience would be needed before a correlation could be attempted with any degree of confidence.” (Second Report, 1991:7)
- The justification offered in the report for the lack of a regulatory requirement for VFR diversionary airports contains a circular argument; to say there is no regulation in this area because Transport Canada believes the regulations are sufficient (i.e. provide for appropriate minimum safety levels) is self-evident but does not establish that the regulations have in fact met their objective. The study claims that: “The provision of airports for emergency or diversionary use has not been considered for some time. Ready access to weather information and the reliability of modern aircraft have rendered this idea practically obsolete.”





(TC/PC Joint Study, 1994:3) It is this very assumption that the aviation user community is hotly contesting in the case of the Banff and Jasper VFR routes.

3.3 Statistics and Analysis

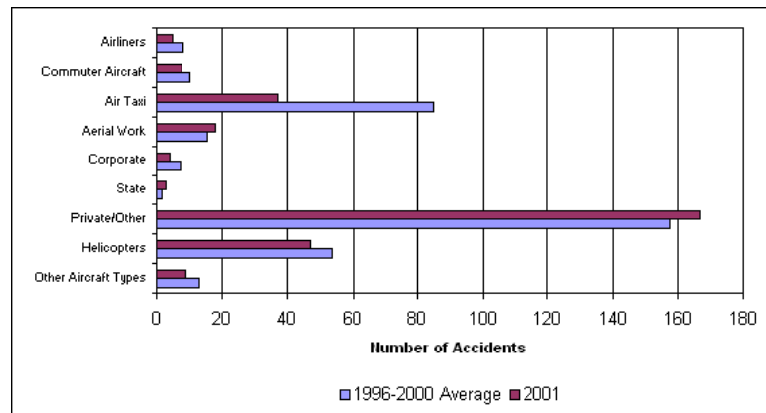
3.4 Canadian Annual Accidents – All Operations



 44% of all accidents in 2001 occurred on recreational flights followed by training (19%)

 295 aircraft accidents from 1992 to 2001 of which 167 were private airplanes

3.5 Canadian Annual Accidents by Operation



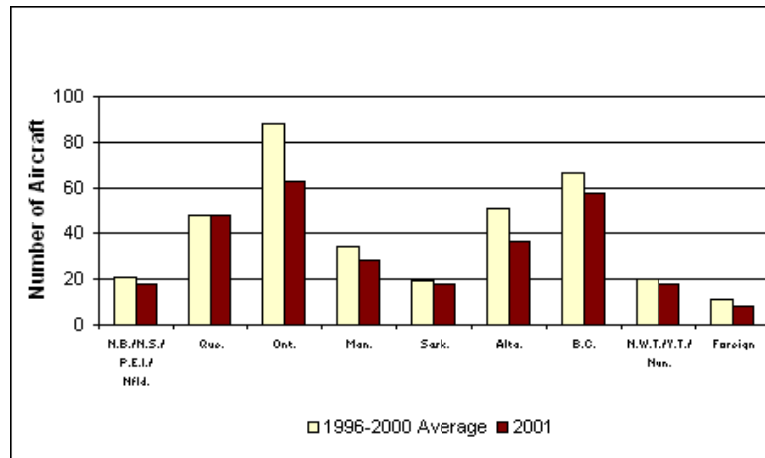
 Average Accident Rates from 1992 – 2001

- Airlines 0.7/100,000 hrs
- Commuter 3.3/100,000 hrs
- Air Taxi 10.6/100,000 hrs



■ Aerial Work	13.0/100,000 hrs
■ Corporate/Private/Other	26.6/100,000 hrs
■ Helicopter	9.3/100,000 hrs

3.6 Canadian Accidents by Province



- ✈ Alberta (46) and BC (63) had the highest number of accidents from 1992 to 2001 next to Ontario (84)
- ✈ 70% more fatal accidents as a percentage of total accidents in BC compared to Alberta & Ontario

3.7 Canadian Fatal Accident Rates

✈ Average Fatal Accident Rates 1992 – 2001

■ Airliners	0.05/100,000 hrs
■ Commuter	0.35/100,000 hrs
■ Air Taxi	1.14/100,000 hrs
■ Aerial Work	0.80/100,000 hrs
■ Corporate/Private/Other	2.79/100,000 hrs
■ Helicopter	1.10/100,000 hrs

3.8 US NTSB Accident Summary 1997

- ✈ 1997 Accident rate for US General Aviation was 7.26 accidents per 100,000 hrs



- Single engine piston powered airplanes accounted for 78% of the fleet
- Accident rate for single engine piston airplanes was:
 - 8.06/100,000 hrs all accidents; and
 - 1.47/100,000 hrs fatal accidents
- Accidents were evenly divided between local and cross country flights



More than 90% of the accidents occurred in visual weather conditions

- Fatal accidents and weather
 - IMC¹⁸ accidents 69% fatal
 - VMC¹⁹ accidents 16% fatal
- Most frequently cited weather factors in fatal accidents
 - Low ceiling 27%
 - Fog 16%
 - Rain and Snow 11%
 - High Density Altitude 7%



Fatal Accident Analysis







- Percentage of accidents occurring in Cruise Flight
 - All accidents 17%
 - Fatal accidents 29%
- Leading first event in fatal accidents
 - Collisions in flight 33%
 - Loss of control 28%
- Leading Accident Cause or Contributing Cause
 - Pilot 78%
 - Environment 38%
 - Aircraft 21%

¹⁸ Instrument Meteorological Condition (IMC)

¹⁹ Visual Meteorological Conditions (VMC)



3.9 Flight Safety Foundation

-  "...weather related accidents involving low visibility or spatial disorientation are the most serious and most easily prevented types of accidents." FAA Study
-  Pilots are reluctant to change their plans once a flight has been initiated
 - landing short of the destination to avoid weather is often perceived to be an unacceptable admission of failure or poor judgement to depart in the first place...
-  A pilot can easily overrun his ability to see and avoid hazards
 - it takes an average of 5 seconds to recognize a hazard, to determine what corrective action is required, and to respond
 - a pilot flying at 120 knots will require 3220 feet to initiate and complete a 30 degree bank course reversal turn - high risk of spatial disorientation in the turn
-  90% of general aviation accidents involving disorientation are fatal
-  Good decision making reduces the risk of a weather related accident - Bad decisions:
 - influence those that follow
 - distort information
 - preclude options such as diversion
-  FSF reports of helicopter accidents involving Controlled Flight into Terrain (CFIT) and disorientation over the past 10 years suggest that:
 - "Pilots either are not being adequately trained, are forgetting their training or are not maintaining their proficiency..." FAA report
 - Weather related accidents continue to occur despite the availability of diversionary landing sites



4. Air Safety Risk Assessment

4.1 General

The following risk assessment process is based on the Canadian Q850 process and adapted to the Banff and Jasper decommissioning issue. It is a participative, consensus-based process that involves key stakeholders in assessing risk and negotiating mitigation and control measures. The process is subjective and qualitative. Relevant data and evidence is used to inform the process and guide decision-making, but does not usually determine the outcome on its own.

4.2 Risk Assessment Process - Initial



Process Initiation

- Define the Problem
- Identify associated risks
- Prioritize risk issues



Define the Scope of the Decisions to be Made

- Key risk decisions
- Possible mitigation strategies
- Assumptions and constraints



Identify the Risk Management Team

- Identify stakeholders
- Define status on team
- Assign responsibilities and authorities



Develop a Risk Communication Strategy

- How will team members stay informed?
- How will progress be communicated to stakeholders?

4.3 Risk Assessment Process – Analysis



Collect relevant data and research




Create a representative risk scenario

- Valemount to Jasper/Hinton
- Golden to Springbank



- Define:
 - Aircraft type
 - Pilot type, training, experience & currency
 - Weather conditions
 - Time of year and day
- Identify Potential Hazards & Losses

4.4 Risk Assessment Process – Estimation

 Estimate Frequency and Consequences

	Minor	Major	Hazardous	Catastrophic
Probable	4	5	6	7
Improbable	3	4	5	6
Extremely Improbable	2	3	4	5
Extremely Remote	1	2	3	4

4.5 Risk Assessment Process – Estimation

 Probability:

- *Extremely Remote* – not anticipated to occur but may a few times over the entire history of aviation use of the route
- *Extremely Improbable* – unlikely to occur during one generation of aviators using the route



- *Improbable* – unlikely to occur to each aviator but may occur several times within one generation
- *Probable* – likely to occur one or more times to each aviator using the route



Severity:

- *Minor* – no significant reduction in Safety
- *Major* – significant decrease in safety with possibility of injuries
- *Hazardous* – large reduction in safety with possibility of serious injury or fatality
- *Catastrophic* – loss of airplane and multiple fatalities

4.6 Risk Assessment Process – Decision



Determine Acceptability of Risks:

- Risk is acceptable at current levels
- Risk is unacceptable at any level
- Risk might be acceptable but control measures should be considered



Identify Risk Control Options:

- Avoid the exposure
- Reduce the probability
- Reduce the severity
- Separate the exposures
- Duplicate assets
- Transfer the risk



Implement the Control Plan

- Develop an implementation plan
- Implement control, financing and communication strategies



Establish a monitoring process.



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