ACRP 4-18 –RUNWAY PROTECTION ZONES (RPZ) RISK ASSESSMENT TOOL

FINAL PROJECT REPORT

PREPARED FOR THE AIRPORT COOPERATIVE RESEARCH

TRANSPORTATION RESEARCH BOARD OF THE NATIONAL ACADEMIES

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ABSTRACT

This report documents the effort in developing quantitative models to estimate the risk of airport operation to the people on the ground within the boundaries of runway protection zones (RPZ). Data from historical accidents and incidents that have occurred around the airports are collected and stored in a relational database. To facilitate modeling, historic events are classified as landing overrun, landing undershoot, takeoff overrun and takeoff overshoot, and separate models are developed for each accident types.

The modeling structure includes three parts. First, accident models estimate the likelihood of an aircraft going off the runway. Next, location models estimate the accident aircraft reach certain locations beyond the runway. Finally, consequence models estimate the likelihood of fatality of the people on the ground based on population density of the land uses within an RPZ.

A software tool was developed to implement the models. The software requires one year of movement and weather data at the airport as well as population density of the land uses within the RPZs. A users' guide, submitted as a separate document, supports users to assemble the required inputs and to run the tool.

CHAPTER 1

Introduction

Mechanical malfunction, low visibility, fuel starvation and loss of situational awareness are just a few of the reasons cited as causes of aircraft accidents. Often these accidents take place in sight of the runway environment while a pilot is either landing or departing from an airport. In 1952, a report by the President's Airport Commission, The Airport and Its Neighbors, noted that clear areas beyond the end of runway ends were important and were worthy of federal management. These areas, formerly known as clear zones and now called RPZs, were originally established to delineate areas of land below aircraft approach paths in order to prevent the creation of airport hazards or development of incompatible land uses within these critical locations.

The U.S. Department of Commerce concurred with the recommendations of the President's Airport Commission on the basis that these areas were "primarily for the purpose of safety for people on the ground." With the study findings and the Department of Commerce support, the Federal Aviation Administration (FAA) adopted clear zones with dimensional standards to implement the Commission's recommendation. These clear zones were intended to preclude the construction of obstructions potentially hazardous to aircraft operations and to control building construction for the protection of people on the ground.

Unfortunately, for many years these clear zones were largely overlooked by both airports and surrounding communities who have the police power to control the land development around airports, especially when the property is not airport-owned. As such, there are airports across the U.S. that have development within their RPZs. In many instances, these uses have been located in the RPZs for years with no adverse impacts to the airport or the development. In other instances, land uses have been allowed to develop in RPZs (usually on property that is not airport-owned) that have been detrimental to the airport and the development. Traditionally, there has been little research conducted or guidance provided that assists an airport, developer, or local municipality in the process of assessing what the impacts of development may be, relative to its location within the RPZ. The results of this ACRP project will provide a much needed resource for the industry in assessing the risk associated with developments in RPZs.

Located at the end of each runway, and ideally controlled by the airport, RPZs are designed with the intent to protect people and property on the ground. Acquisition of sufficient property interest to maintain an area that is clear of all incompatible land uses, objects, and activities is most desirable, however since RPZs can often extend beyond airport property, this can become challenging for airports to achieve. The FAA recommends that, whenever possible, the entire RPZ be owned by the airport and be clear of all obstructions if practicable. Where ownership is impracticable, avigation easements are recommended to obtain the right to regulate the height of structures and vegetation within the RPZ footprint. Obtaining easements that are restrictive enough to limit building opportunities, as well as limit the height of objects that may affect approach and departure paths, are often just as costly to procure as purchasing the

property outright. Consequently, airports may be hesitant to undertake acquisition of any kind for property in their RPZs.

It is desirable to clear all objects from the RPZ, per the criteria noted in FAA AC 150/5300-13A, Airport Design, however the following land uses are permissible in the RPZ without further evaluation:

- Farming that meets the minimum buffers as discussed in the AC
- Irrigation channels as long as they do not attract birds
- Airport service roads, as long as they are not public roads and are directly controlled by the airport operator
- Underground facilities, as long as they meet other design criteria, such as RSA requirements, as applicable
- Unstaffed NAVAIDs and facilities, such as equipment for airport facilities that are considered fixed-by-function in regard to the RPZ.

New or modified land uses within RPZs that require coordination with the National Airport Planning and Environmental Division (APP-400) include the following, according to the FAA's Interim Guidance on Land Uses within a Runway Protection Zone:

- Buildings and structures, examples include but are not limited to: residences, schools, churches, hospitals or other medical care facilities, commercial/industrial buildings, etc.)
- Recreational land use, examples include but are not limited to: golf courses, sports fields, amusement parks, other places of public assembly, etc.)
- Transportation facilities. Examples include, but are not limited to:
- Rail facilities -light or heavy, passenger or freight
- Public roads/highways
- Vehicular parking facilities
- Fuel storage facilities (above and below ground)
- Hazardous material storage (above and below ground)
- Wastewater treatment facilities
- Above-ground utility infrastructure (i.e. electrical substations), including any type of solar panel installations.

A provision has historically been provided wherein, if it is determined to be impracticable for an airport sponsor to acquire and plan the land uses within the entire RPZ, provisions can be made to maintain existing residential structures so long as they do not pose a hazard to safe air navigation. The land use standards can provide a recommendation status for that portion of the RPZ that is not controlled by the airport sponsor. If this option is impractical, the airport sponsor should consider the acquisition of an avigation easement to provide control over the RPZ area. Challenges to this option are often the method and criteria that are used to determine what is considered to be impractical.

This report serves as the technical background of the software tool that was developed for the risk assessment of runway protection zones (RPZ_RAT). It describes the accidents and incidents data collection effort and presents the modeling framework that was developed for the risk assessment. The modeling intent is to develop crash likelihood contours within the boundaries of the airport RPZs. Then, the crash likelihood contours is combined with land use characteristics to assess risk to the people on the ground within each RPZ. The RPZ risk is further refined to every land use within a RPZ.

The data collection effort built upon the database that was developed for the ACRP Report 3- Analysis of Aircraft Overruns and Undershoots for Runway Safety Areas- and ACRP Report 50- Improved Models

for Risk Assessment of Runway Safety Areas- projects. In development of the accident database, more than 300,000 aviation accident and incident reports were screened from 35 countries to identify the cases relevant to current study. More than half of the screened events were from the U.S. Accident and incident data were collected from the following sources:

- FAA Accident/Incident Data System (AIDS).
- FAA/National Aeronautics & Space Administration (NASA) Aviation Safety Reporting System (ASRS).
- National Transportation Safety Board (NTSB) Accident Database & Synopses.
- MITRE Corporation Runway Excursion Events Database.
- Transportation Safety Board of Canada (TSB).
- International Civil Aviation Organization (ICAO) Accident/Incident Data Reporting (ADREP) system.
- Australian Transport Safety Bureau (ATSB).
- Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile (France BEA).
- UK Air Accidents Investigation Branch (AAIB).
- New Zealand Transport Accident Investigation Commission (TAIC).
- Air Accident Investigation Bureau of Singapore.
- Ireland Air Accident Investigation Unit (AAIU).
- Spain Comisión de Investigación de Accidentes e Incidentes de Aviación Civil (CIAIAC).
- Indonesia National Transportation Safety Committee (NTSC).
- Netherlands Aviation Safety Board (NASB).
- Aviation Safety Network (ASN)
- Civil Aviation Daily Occurrence Reporting System of Canada (CADORS)

CHAPTER 2

Literature Review

For airports, an important element of safety is the crash risk to populations living in its close proximity. Since most accidents occur during the landing and takeoff phases of a flight, an airport serves to concentrate that risk on its surrounding population. There are various reasons in developing and implementing a tool that can quantify this risk; one of which is the need for airport expansions. Many major airports in the U.S. and around the world are built close to metropolitan areas. A runway extension project or a new runway construction as examples may expose the general public to additional safety risks. Changes to the airport operation such as the introduction of a larger aircraft may also affect the risk of surrounding areas. Other reasons that affect the risk are the changes in the land use around the airport such as the construction of a mass transit system or a major highway that borders the airport.

Several agencies have attempted to quantify the risk over the past two decades. Australian Centre of Advanced Risk and Reliability Engineering Ltd (ACARRE) Inc. developed a consequence model for using at Sydney airport (Federal Airports Corporation, 1990). The consequence model considered the damage from the impact and the fire that may erupt. Impact areas and affected areas were defined, and it was assumed everybody in the impact area and 30% of people in the affected area would be fatally injured. These assumptions combined with the average population density of the people on the ground provided an estimate of fatality on the ground.

Motivated by the 1992 crash of an El Al freight airliner into an apartment building near Amsterdam killing more than 40 people, RAND organization was tasked by Netherland officials to develop a framework for the assessment of safety risk to the public on the ground in 1993. The RAND organization (1995) developed the Safety Assessment of the Ground Environment of Airports (SAGE-A) model as a general tool for the evaluation of airport risk to its surrounding areas. The RAND location model only included 53 accidents that resulted in the aircraft hull loss farther than 500 meter from the runway. The study did not differentiate between landing and takeoff accidents and used a Cartesian system for modeling. The RAND consequence model consisted of fatality rates and crash influence areas for large, medium and small aircraft types. Fatality rate is defined as the proportion of the people killed to the people present in a given structure within the area affected by a crash. A matrix of crash influence areas for steep and shallow crash angles, and in ‘open fields’ was prepared. The RAND report did not provide specifics about how these rates and areas were obtained.

In an effort to develop crash location distributions, AEA Technology (Byrne and Jackson, 1992) derived distributions for commercial/military aircraft and also for light aircraft with MTOW of less than 2.3 ton. These distributions were based only on accidents that occurred in the US and in Canada. A future study by the company focused on accidents within 5 miles of airports involving aircraft types with maximum takeoff weight (MTOW) of greater than 2.3 ton. Separate models were developed for landing and takeoff using 121 accidents. The study adopted a Cartesian (x,y) coordinate and tried to account for the fact that as accidents occur farther away from the runway, they tend to deviate farther from the

extended centerline. However, limited number of accidents compelled the study not to account for the dependency of the location coordinates.

DNV Technica Inc. (Purdy, 1994) developed deterministic location models for landings and takeoffs that involved several assumptions. The model was used in risk assessments at Amsterdam and Manchester airports. DNV also used a Cartesian system with lateral and longitudinal components. Crashes were divided into two types; steep dive and shallow dive crashes. It was assumed that pilots had little to no control in steep crashes and some degree of control in shallow crashes. The deviation of the steep crashes from extended centerline was assumed to be much larger than the shallow ones. It was assumed that 90% of crashes at Amsterdam airport and 50% of crashes at Manchester airport would be shallow where the pilot might have some degree of control to navigate away from the populated areas. To evaluate the consequences of the crash, crash area was assessed according to the size of the impacting aircraft, the impact angle, and the fuel load. The model assumed everybody in the impact area would be killed.

Eddowes (1994) developed a consequence model for implementation at Manchester airport. The model was based on historical events and provided estimates of the number of houses destroyed, number of fatalities on the ground and the size of the area affected. The model was based on 30 accidents with ground fatalities and established a linear relationship between MTOW and fatality.

In 1997, Center for Transport Studies of Imperial College of London performed a study sponsored by the UK National Air Traffic Services (NATS) to review the Public Safety Zone (PSZ) policy and to identify a suitable risk modeling approach and to implement the approach for the risk assessment at five UK airports. The goal of the study was to derive a general policy for land use in the vicinity of the airports based on the levels of risk calculated for the surrounding area. PSZs in U.K. have the same function as RPZs in the U.S. The modeling approach was implemented for risk assessment at five U.K. airports. The study adopted a three part modeling approach consisting of crash frequency, location, and consequence models. Crash frequency models were in essence simple crash rates driven from the number of relevant accidents in defined aircraft groups and total number of movements. Relevant accidents were identified from the database of aircraft accidents maintained by Airclaims Ltd. Movement data were obtained from Official Airline Guide (OAG) database. In developing the frequency models, eight groups of aircraft types were devised according to the year of production, engine type and size. Jet aircraft types produced in the eastern countries were separated as a group.

NATS location models were based on 354 past accidents including aircraft with more than 4 ton MTOW. This geared the study mainly towards commercial flights. The study developed four sets of distributions for landing and takeoff overruns and landing and takeoff crashes from flights. Models were developed relative to the runway end and extended centerline. NATS consequence model separated crash influence areas to impact and debris areas. Impact areas were assumed to be destroyed. The study identified impact and debris areas from 126 and 56 crashes, respectively. Linear and logarithmic relationships were examined between the sizes of the areas and the MTOW. Logarithmic relationship was found a better fit for the data. Even though the number of fatalities were normally noted in historic events, fatality rates were not available since the number of people present at the crash site was rarely noted. Since all historic fatal accidents in the NATS database occurred at impact areas, the study adopted a 100% fatality rate in the impact area, and in return excluded the debris area from the model. NATS also studied the effect of the terrain on the impact and debris areas and found no significant correlation existed.

The National Aerospace Dutch Laboratory (NLR) developed a risk assessment model (Piers et al., 1993) which was later updated in 1999. The earlier study used 181 commercial aircraft accidents and coordinate system based on the nominal route of the aircraft when available for developing location models. Engineering judgement was used for many of the accidents where the nominal route was not available. Accidents within 12 kilometer (km) of the runway end for landing accidents and within 6 km for takeoff accidents were considered. All these accidents were for aircraft types with MTOW of more than 5.7 ton. NLR developed a proprietary software tool for conducting the analysis. Many elements of the NLR studies are not publicly available. NLR consequence model related the consequence area to the MTOW of the accident aircraft in historical events. A linear relationship between MTOW and the consequence area was assumed, and models for built-up, open, and wooded and water terrains were developed. A constant fatality rate of 30% was assumed over the entire consequence area. The rate was the average from historical accidents. NLR consequence model was based on a small number of accidents whose consequences were known in great level of details resulting in statistical uncertainty. The study considered the models to be cautious.

The updated NLR study risk model improved and extended the previous effort by adapting new parameters and by implementing some conceptual changes to the previous risk models. The improvements in the later study was due to the availability of more comprehensive historical data on aircraft operations and accidents (Pikar et al, 2000). The model was intended for implementation at Schiphol Airport; thus, only historic accidents at airports comparable with Schiphol were used. The study period gathered accidents from 1980 to 1997 and identified 75 accidents with 95 million corresponding movements in 40 reference airports. The major goal of the NLR study was to develop a methodology that could be used to assess the risk of Amsterdam airport to the people on the ground. Therefore, in selecting the reference airports, the mix of movements as well as accidents, several filtering criteria was put in place. For example only airports with at least 150,000 annual commercial movements equipped with terminal approach radar were considered.

In 2003, Environmental Resources Management (ERM) Ltd was contracted by the Ireland Department of Transportation to investigate PSZs of Ireland's main three airports; Cork, Dublin, and Shannon. ERM implemented the methodology developed for UK NATS and provided recommendations regarding the PSZs policy.

CHAPTER 3

Data Collection and Analysis

3.1. Accident and Incident Data Collection

As noted earlier, various national and international sources were used in collecting accident and incident data. Criteria for filtering accidents and incidents were required to make the events comparable. The criteria used are shown in Table 3.1. Only events that occurred within 2 miles of the runways were collected. This represents the area where the overwhelming majority of accidents in proximity of the airports have occurred.

Table 3.1- Accident and Incident Filtering Criteria

Filter #	Description	Justification
1	Remove non-fixed wing aircraft entries	Study is concerned with fixed wing civil aircraft accidents and incidents only
2	Remove occurrences for unwanted phases of flight	Study focus is on the runway protection zones. Cases where the accident occurred during landing and takeoff within 2 mile of the runway were collected.
3	Remove occurrences on unpaved runway surfaces	Flight characteristics on unpaved runway surfaces are different from flights on paved runways.

Accidents of light aircraft types weighing less than 6,000 lbs. had to be sampled due to their high frequency of occurrence. A group of 78 airports in the U.S. sampled by Wong (2007) were used for the collection of these accidents and incidents. The sampled airports include general aviation airports as well as various sizes of hub and non-hub airports in various FAA regions.

Using these criteria, 1,069 accidents and incidents were identified that provide complete or partial set of information needed to develop the models. Accident and incident investigation reports usually do not include all the details needed for populating the database that was developed for storing the collected data. Other sources were explored to obtain the missing data. Information regarding aircraft performance, airport characteristics such as runway length, elevation and surrounding terrain as well as meteorological conditions were often obtained through other sources. More information regarding the accident and incident data collection effort is presented in the ensuing sections of this report. Appendix A presents the list of accidents and incidents that are used for the development of the risk models.

The information from the accident and incident reports were organized in a Microsoft Access database. Various relational tables were developed in the database to ease the data collection effort. The database was designed to hold more than 60 data fields for each event such as the reporting source, the airport that the accident took place, the runway orientation and surface conditions, the aircraft characteristics, onboard and on the ground injuries and damages. Figure 3.1 is a screenshot of the database.

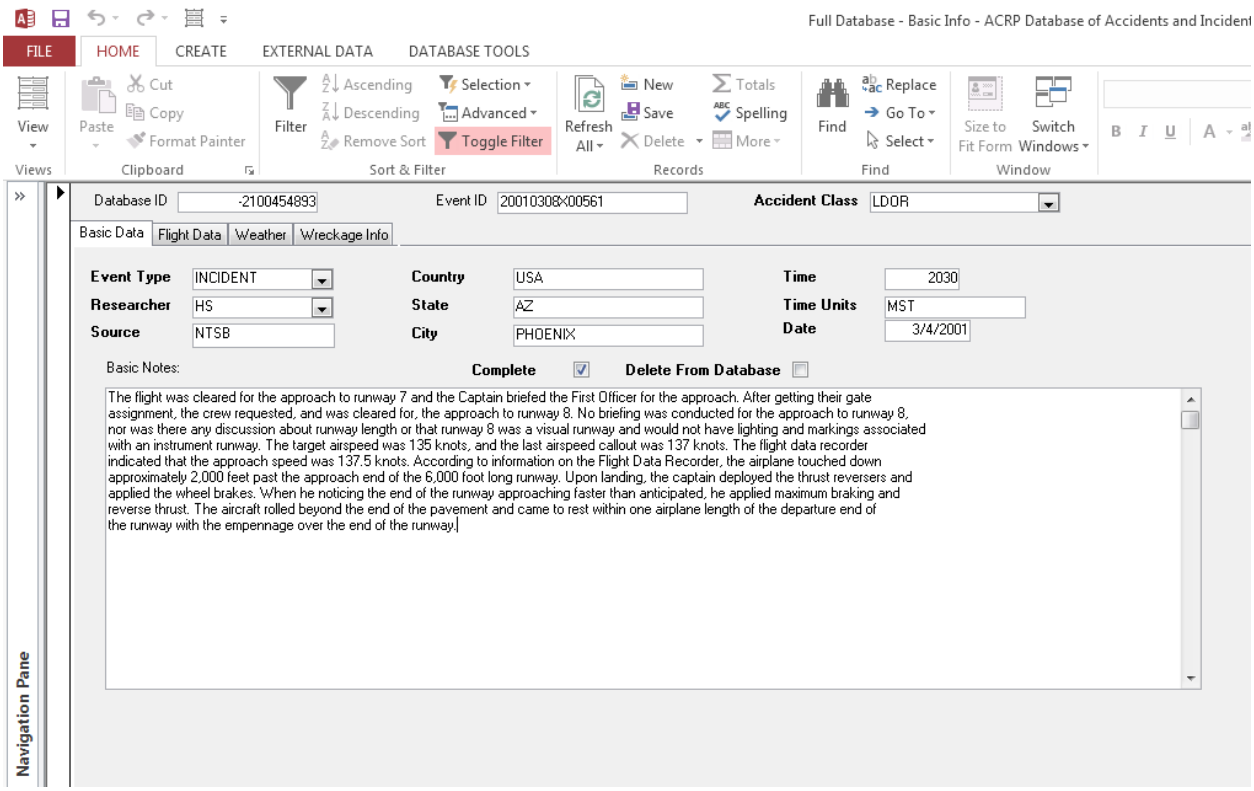

Figure 3.1– Snapshot of accident and incident database

To facilitate modeling, accident and incident events were classified into the following types:

- Landing overrun (LDOR)
- Landing undershoot (LDUS)
- Takeoff overrun (TOOR)
- Takeoff overshoot (TOOS)

Figure 3.2 schematically illustrates these events. LDOR are events where the landing aircraft fails to stop and leaves the far end of the runway. LDUS events are occurrences of aircraft touching down or crashing in a landing attempt prior to the beginning of the runway. If the aircraft leaves the runway end on the ground in a takeoff roll, the event is classified as a TOOR. If the aircraft takes off and crashes after becoming airborne, the event is classified as a TOOS.

Source: NLR – Modified
Figure 3.2 – Event (accident/incident) types.

Figure 3.3 shows the distribution of the accident types from the database. As shown, more than half of the collected events are landing overruns. Landing events combined account for more than three quarters of all events.

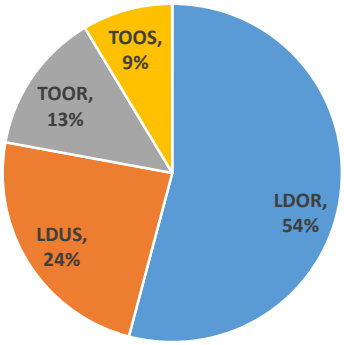

Figure 3.3- Distribution of event (accident/incident) types in database.

Figure 3.4 presents the number of events per year of occurrence. The dashed line presents all the events of the database. The solid line with the triangle marker presents events in the U.S. and the grey line at the bottom presents the number of light aircraft events from the sampled airports. The light aircraft events were collected from the last 2 decades only.

As shown, the number of events in the U.S. is relatively steady for the decade from 1994 to 2004 and then decreases during the following 10 years. The number of events over the last few years is considerably lower than the prior years. The number of light aircraft events in the sampled airports shows an overall downward trend over the past 2 decades.

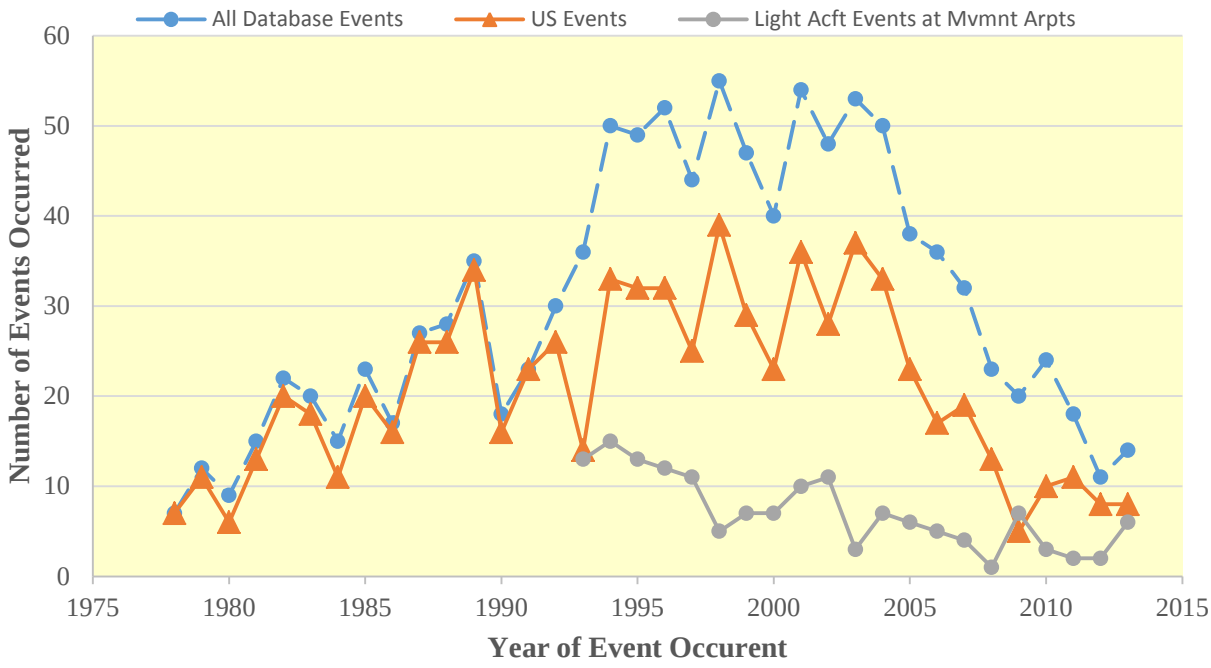

Figure 3.4- Number of collected events over time.

Aircraft types were grouped according to their MTOW and size into 5 classes using the following classification scheme:

- A: Small aircraft of MTOW 12.5k lbs. or less (Beech-90, Cessna Caravan)
- B: Medium aircraft of MTOW 12.5k-41k lbs. (business jets, Embraer 120, Learjet 35)
- C: Large commuter with MTOW of 41k-255k lbs. (Regional Jets, ERJ-190, ATR42)
- D: Large jets with MTOW of 41k-255k lbs. (B737, A320)
- E: Heavy jets with MTOW of 255k lbs. and more (B777, A340)

Tables 3.2 and 3.3 provide the breakdown of collected events based on equipment class and operation type. As shown, the medium and small aircraft types account for the majority of the collected events. Also, general aviation and commercial operations make up the majority of the collected events.

Table 3.2- Distribution of accidents and incidents by aircraft class.

Aircraft class	Percent
A	32%
B	31%
C	10%
D	17%
E	10%

Table 3.3- Distribution of accidents and incidents by operation type.

Operation type	Percent
Air taxi/commuter (TC)	11%
Cargo (F)	9%
Commercial (C)	37%
General aviation (GA)	43%

3.2. Normal Operation Data (NOD) Collection

A key approach in this study is the use of NOD for accident likelihood modeling. The use of NOD makes it possible to account for exposure of the aircraft movements to various elements that contribute to accidents. For example, although the existence of a factor such as an icy runway could be identified as a contributing factor to an accident, in the absence of information on non-accident movements exposed to the same factor, it is not possible to know how critical the factor is. With NOD, the number of operations that experience the factor singularly, and in combination with other factors can be calculated; risk ratios can be generated; and the importance of risk factors can be quantified. The use of NOD allows the models to navigate away from simply relying on crash rates based on just aircraft, engine, or operation type, and to account for factors that have been typically ignored in some risk assessment studies.

It is neither possible nor necessary to use the movement data from the entire country. Therefore the movement data had to be sampled. The sampling strategy devised by Wong (D. Wong, Ph.D. dissertation, 2007) resulted in 78 airports being selected from various airport sizes, FAA regions, and the presence of terrain features around the airport. The NOD database used in a prior study published as ACRP Report 50- Improved Models for Risk Assessment of Runway Safety Areas- was complemented with information for aircraft types with MTOW lower than 6,000 lbs. as well as with movements with piston engines.

The ultimate NOD database contains 263,375 movement records with more than 500 aircraft types. The performance characteristics of the aircraft types in the NOD database, including MTOW, standard landing and takeoff distance required, wingspan and length were investigated and assigned for each aircraft. Weather elements were also identified and assigned to the movements in the NOD database. As shown in Table 3.4, commercial operations account for the majority of movements in the database. Table 3.5 presents the breakdown of the NOD database according to aircraft engine type. Aircraft class C makes up the majority of the movements in the NOD database as shown in Table 3.6.

Table 3.4- NOD movements by operation types.

Operation Type	Percent
Air taxi/commuter (TC)	23%
Cargo (F)	4%
Commercial (C)	62%
General aviation (GA)	11%

Table 3.5- NOD movements by engine types.

Engine type	Percent
Jet	80%
Piston	6%
Turboprop	14%

Table 3.6- NOD movements by aircraft classes.

Aircraft Class	Percent
A	8%
B	18%
C	20%
D	42%
E	12%

CHAPTER 4

Risk Modeling

The modeling framework adopted for this study is a 3 part model as shown in Figure 4.1. The modeling framework include accident likelihood models, location likelihood models, and the consequence models. The accident likelihood models estimate the likelihood that an accident occurs. The accident location models estimate the likelihood that the accident aircraft extends a certain distance beyond the runway. The combination of the accident likelihood models and the location models provides the RPZ crash likelihood. RPZ crash likelihood estimates the annual likelihood of a crash occur within the boundaries of an RPZ. The RPZ crash likelihood is combined with the consequence models encompassing the population densities of the land uses identified within an RPZ to provide the RPZ risk. This section provides details of the models developed in this study.

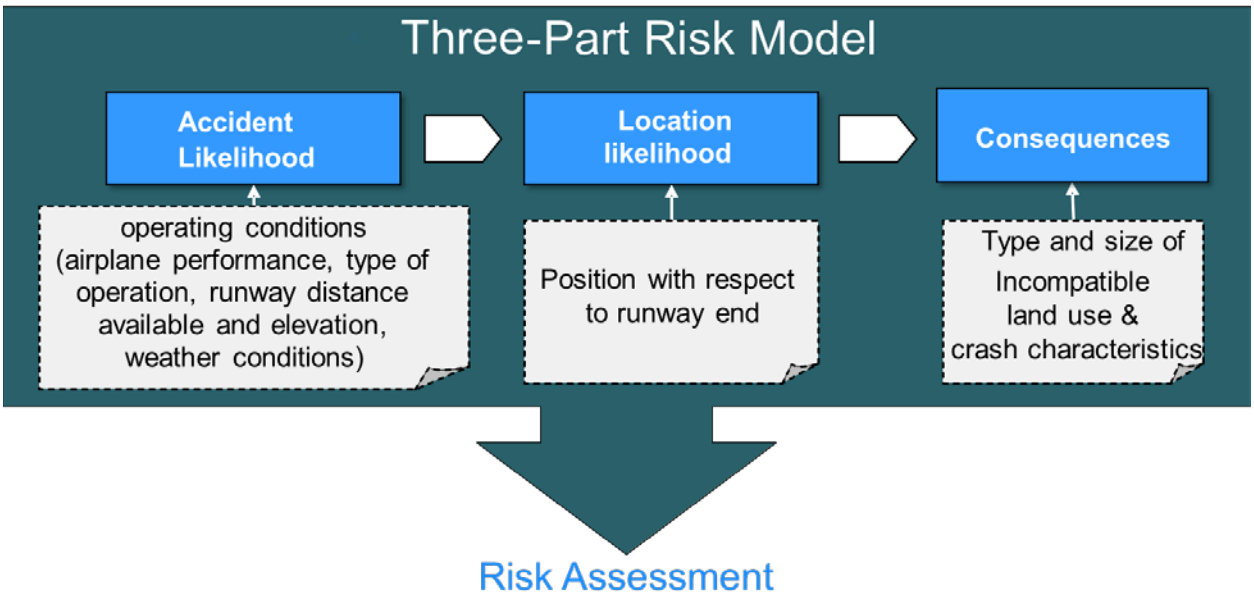

Figure 4.1- RPZ risk assessment modeling framework.

4.1. Accident Likelihood Models

The accident likelihood models estimate the likelihood that an event occurs given certain operational conditions. The models implement independent variables identified as either causal or contributing factors for the occurrence of the event. The data collection effort was focused on obtaining the following information from the historic accident and incident investigation reports:

- Airport specific data: Elevation, hub/non-hub classification, runways declared distances
- Flight specific data: Aircraft make and model, runway distance required for landing and takeoff, type of operation, and domestic/international flight
- Weather elements: Ceiling and visibility, wind direction and magnitude, temperature, light level, type of precipitation, fog, gust and windshear

Runway criticality factors were also assigned to the accidents. Runway criticality factor is defined as the logarithm of the ratio between the distance required for the operation and the distance available. To correctly identify the distance required for the operation, the standard distance for the aircraft type had to be identified and adjusted for the condition of the operation. The required distances are adjusted for elevation, temperature, wind and various contaminated surface conditions. The adjustment factors applied to the standard distance required, based on a study conducted by Flight Safety Foundation (1996), are presented in Table 4.1.

Table 4.1- Adjustment factors for identification of runway distance required.

Local Factor	Unit	Reference	Adjustment
Elevation (E) [(i)]	1000 ft	E = 0 ft (sea level)	Fe = 0.07 E + 1
Temperature (T) [(i)]	deg C	T = 15 deg C	Ft = 0.01 (T – (15 – 1.981 E)) + 1
Tailwind (TWLDJ) for Jets [(iii)]	knot	TWLDJ = 0 knot	FTWJ = (RD + 22. TWLDJ)/RD [(ii)]
Tailwind (TWLDT) for non-jets [(iii)]	knot	TWLDT = 0 knot	FTWJ = (RD + 30. TWLDT)/RD
Headwind (HWTOJ) for Jets [(iii)]	knot	HWTOJ = 0 knot	FTWJ = (RD + 6. HWTOJ)/RD
Headwind (HWTOT) for non-jets [(iii)]	knot	HWTOJ = 0 knot	FTWJ = (RD + 6. HWTOT)/RD
Runway Surface Condition – Wet [(iv)]	Yes/No	Dry	FW = 1.4
Runway Surface Condition – Snow [(iv)]	Yes/No	Dry	FS = 1.6
Runway Surface Condition – Slush [(iv)]	Yes/No	Dry	FSl = 2.0
Runway Surface Condition – Ice [(iv)]	Yes/No	Dry	FI = 3.5

i – Temperature and elevation corrections used for runway design
ii – RD is the runway distance required in feet
iii – Correction for wind are average values for aircraft type (jet or turboprop\piston)
iv – Runway contamination factors are those suggested by Flight Safety Foundation

The same information discussed above was obtained for the movements in the NOD. A large database that combined both the historic events and the NOD as well as their associated information at the time of the operation was developed.

Every piece of information in the combined database that was represented by a continuous variable was dichotomized except for the criticality factor. Dichotomization is the process of transferring a continuous variable into discrete counterparts of either one or zero values through the use of dummy variables. Dummy variables are dichotomous; one if the visibility of the operation is within the range that is being presented by the variable and zero if otherwise. For example, visibility is a continuous variable and was presented with the following four dummy variables:

- VisLT2: Visibility less than 2 statute mile
- VisGT2LT4: Visibility between 2 and 4 statute mile
- VisGT4LT8: Visibility between 4 and 8 statute mile
- VisGT8: Visibility greater than 8 statute mile

As a result, every record in the combined database of NOD and accidents was presented by 43 variables as shown in Table 4.2. Another variable was introduced as the target variable. The target variable was recorded as one for accidents and incidents, and zero for NOD movements.

It was intended to develop one accident likelihood model for each accident type. Therefore, in developing the landing overrun and undershoot likelihood models, arrival movements from the NOD were used in combination with LDOR and LDUS accidents and incidents. In developing takeoff overrun and overshoot likelihood models, departure movements from NOD were used in combination with TOOR and TOOS accidents and incidents.

Binomial logistic regression modelling structure was used for developing the likelihood models with a general form as shown in Equation 4.1. Binomial logistic regression represents the situations in which the target outcome is a dichotomous variable. This fits well with the problem at hand where there are only two possible outcomes for every set of variables; normal operation or accident.

$$f_{excursion} = \frac{1}{1+e^{-(b_0+b_1X_1+b_2X_2+b_3X_3+...)}} \tag{4.1}$$

where $f_{excursion}$ is the likelihood of an accident type occurring given the independent variables; X_i are independent variables shown in Table 4.2; and b_i are the estimated regression coefficients.

Forward stepwise regression and backward stepwise regression models were developed for every accident type. The forward model starts with no variables in the model, tests the addition of each variable using a chosen comparison criterion, adds the variable that improves the model the most, and repeats this process until no variable improves the model. The backward model starts with using all the variables, deletes variables that improve the model using a chosen comparison criterion and repeats the process until no further improvement is possible. The following three criteria were implemented to choose between forward and backward models:

- Number of input variables. Better model implements fewer input variables. In other words, simpler model is better.
- R^2 values. Better model has higher R^2 value.
- Area under the receiver operating characteristic (ROC) curve. The higher the area under the ROC curve, the better the model. A perfect model has a ROC curve value of one. A random estimator has a value of 0.5.

Table 4.3 presents the performance of the forward and backward models for each accident type. As shown in the table, the backward models had either equal or a very slightly better performance with respect to R^2 and the area under the ROC curve, however the forward models achieved the R^2 and the area under the ROC curve with fewer input variables. For all accident types, forward stepwise models were preferred.

Table 4.2- Dichotomized independent variables generated for developing likelihood models.

Category	Input variables	Category	Input variables
Operation Characteristics	Foreign Origin/Destination	Weather Characteristics	Visibility greater than 8 sm
	Commercial operation (C)		Temperature less than 5 deg C
	General aviation operation (GA)		Temperature between 5 and 15 deg C
	Cargo operation (F)		Temperature between 15 and 25 deg C
	Taxi/commuter operation (T/C)		Temperature greater than 25 deg C
Aircraft and airport Characteristics	Aircraft class A		Fog
	Aircraft class B		Icing
	Aircraft class C		Electric Storm
	Aircraft class D		Frozen Precipitation
	Aircraft class E		Snow
	Piston engine type		Night
	Prop engine type		Rain
	Jet engine type		Crosswind less than 2 knots
	Criticality factor		Crosswind between 2 and 5 knots
	Hub airport		Crosswind between 5 and 12 knots
Weather Characteristics	Ceiling less than 200 ft		Crosswind greater than 12 knots
	Ceiling between 200 and 1000 ft		Tailwind less than 2 knots
	Ceiling between 1000 and 2500 ft		Tailwind between 2 and 5 knots
	Ceiling greater than 2500 ft		Tailwind between 5 and 12 knots
	Visibility less than 2 sm		Tailwind greater than 12 knots
	Visibility between 2 and 4 sm		Presence of gusty winds
	Visibility between 4 and 8 sm		

Table 4.3- Comparison of backward and forward stepwise regression likelihood models.

Event type	Backward stepwise regression			Forward stepwise regression		
	No. of inputs	R^2	ROC curve	No. of inputs	R^2	ROC curve
LDOR	30	48.3%	95.1%	19	48.0%	95.1%
LDUS	21	35.9%	94.5%	18	35.7%	94.4%
TOOR	16	28.3%	92.0%	15	28.3%	92.0%

TOOS	20	42.0%	97.3%	14	40.3%	97.2%

Table 4.4 presents the variables that were selected by the forward regression routines and their associated coefficients. The following were assigned as the reference category against which the odds ratios should be interpreted: Aircraft class D, commercial operation, ceiling height greater than 2,500 feet, visibility greater than 8 statute mile, crosswind and tailwind less than 2 knots, air temperature of 15 to 25 degree Celsius, domestic origin and destination flights, hub airport and absence of the weather elements. As shown in the table, some variables such as crosswind between 2 and 5 knots are found to be relevant in all four accident types while others may be relevant in one accident type and not in others. The standard errors associated with each coefficient estimate is included in Appendix C.

The software tool developed for this project implements the accident likelihood models and assigns estimates of accidents to every movement at a study airport. To conduct the analysis at an airport, movements over one typical year is used by the software to cover the seasonal variation as well as airport movement mix variation. For arrivals, likelihoods of LDOR and LDUS are calculated. For departures, likelihoods of TOOR and TOOS are calculated. Then, the tool stores the number of arrivals and departures on each runway and their corresponding average likelihoods for the accident types. These statistics are used later in the development of the risk models.

Table 4.4- Regression models coefficients for accident types.

Variables	LDOR	LDUS	TOOR	TOOS
Hub	-3.32	-0.99	-1.46	-1.84
Foreign O/D	1.71	1.67	1.50	
Aircraft class A	-1.18			
Aircraft class B		0.66	1.49	
Aircraft class C		-1.53		
Aircraft class B or C				-2.38
Piston	2.55	3.50	3.78	2.90
Prop	-1.22		-1.02	1.77
Operation type F				1.95
Operation type GA		1.47	0.74	2.82
Operation type TC		0.66	1.23	1.96
Fog	1.60	2.17	1.65	2.22
Icing	1.50			
Night	1.61	2.06	2.13	2.45
Rain	0.76			
Snow	1.57	1.13		2.54
Electric Storm	-1.23			
Ceiling less than 200 feet				2.44
Ceiling between 1000 and 2500 feet			-0.79	
Temperature less than 5 C		0.68	0.90	
Temperature greater than 25 C	-0.86	-0.46		
Tailwind between 5 and 12 knots	0.94			0.65
Tailwind greater than 12 knots	3.22	3.45		
Tailwind greater than 2 less than 5		-0.68		
Visibility less than 2 statute mile	1.60	1.29		
Visibility between 2 and 4 statute mile	0.98	1.35		
Visibility between 4 and 8 statute mile			0.70	
Crosswind between 2 and 5 knots	-1.11	-0.46	-0.86	-0.87
Crosswind between 5 and 12 knots	-0.47		-0.72	
Criticality factor	5.82	3.00	4.68	2.77
Constant	-11.96	-16.37	-16.41	-18.22

4.2. Location Models

Location models quantify the likelihood of an accident at a given location beyond a runway and within an RPZ. In review of the historic events, the location of the accidents were recorded using a Cartesian coordinate system with the origin at the centerline of the runway threshold. As shown in Figure 4.2, X measures the longitudinal distance of the accident location from the runway threshold and Y measures its lateral distance from the runway extended centerline. Accidents along the runway (i.e. veer-offs and accidents on runways) are not within the scope of this project. Also, the significance of the runway length is accounted for in developing the accident likelihood models by incorporating runway criticality factor as a variable. Therefore, the location models merely estimate the distribution of the accident locations beyond the runway. It was assumed the aircraft is equally likely to veer to the left and to the right after the end of the runway. Therefore, the models provide the same likelihood estimate for both sides of the runway.

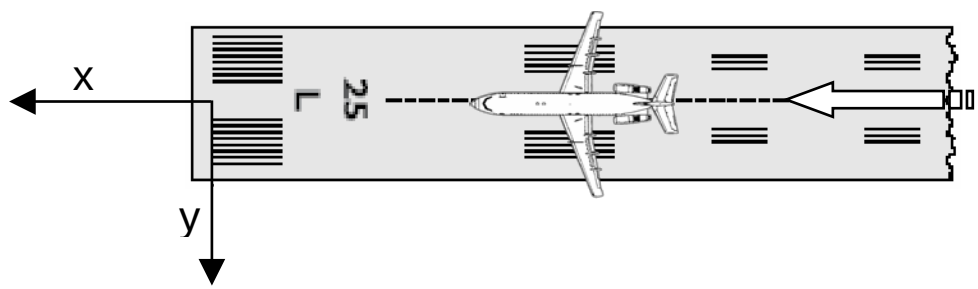

Figure 4.2– Location models coordinates.

4.2.1. Historic accidents location data

Table 4.5 shows the number of historic events with known location coordinates. Investigation reports more frequently describe the longitudinal distance of the accident location than the lateral distance from the extended runway centerline. As a result, for all types of accidents, the longitudinal component is more frequently known than the lateral component.

Figures 4.3 to 4.6 illustrate the scatter plot of the accidents collected from the historic events when both coordinates were known. Majority of the events occurred close to the runway threshold and along the centerline of the runway. Takeoff overshoot events are most scattered around the runway as shown in Figure 4.6. Appendix D presents the accidents that were used for developing the location models.

Table 4.5- Number of events with known location coordinates.

Event Type	Longitudinal (X)	Lateral (Y)
LDOR	428	342
LDUS	198	164
TOOR	105	89
TOOS	61	56

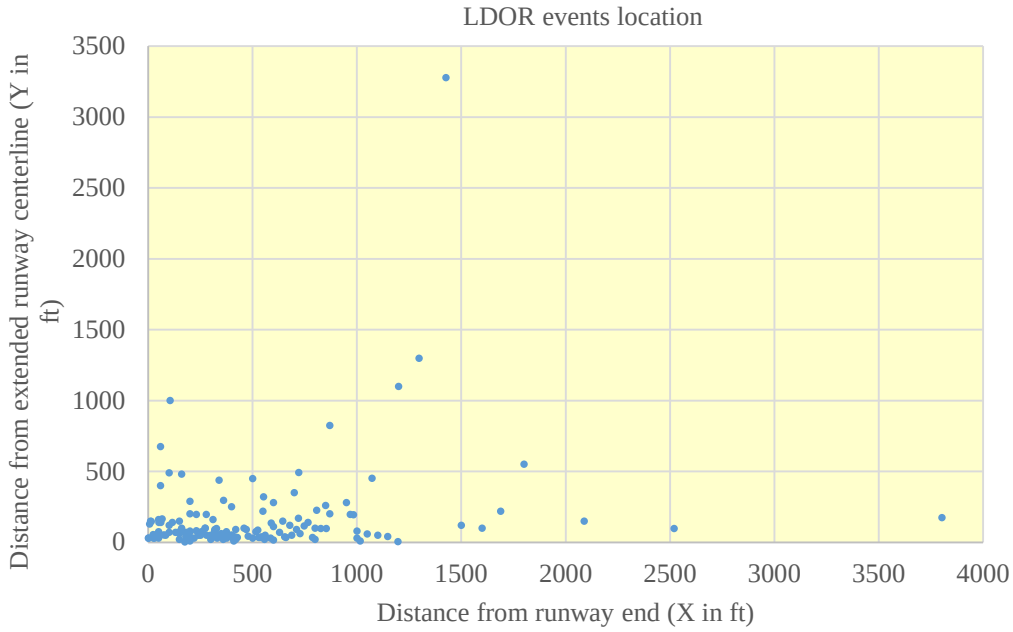

Figure 4.3- LDOR location scatter plot.

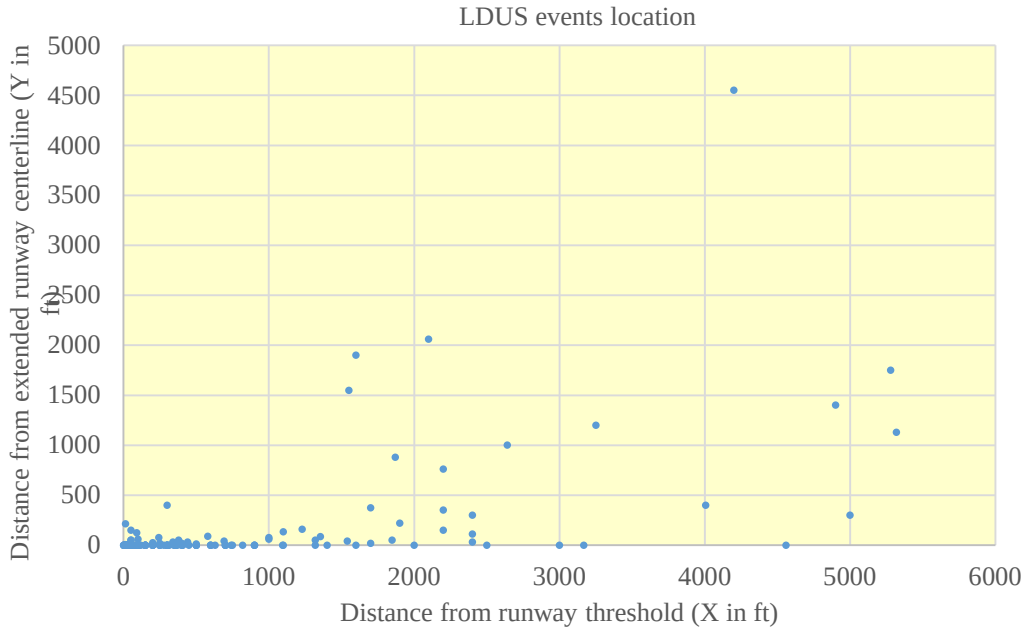

Figure 4.4- LDUS location scatter plot.

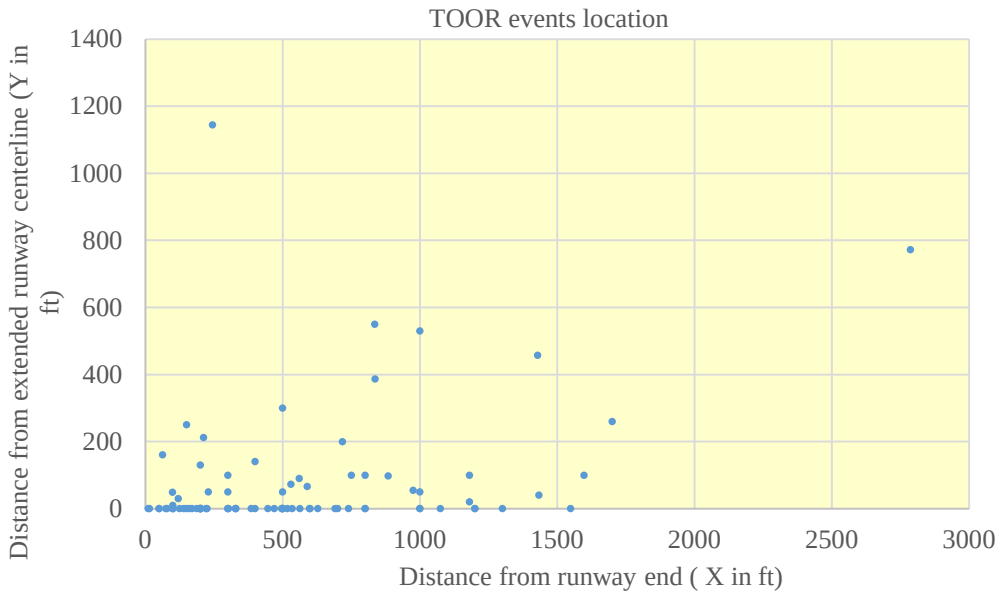

Figure 4.5- TOOR location scatter plot.

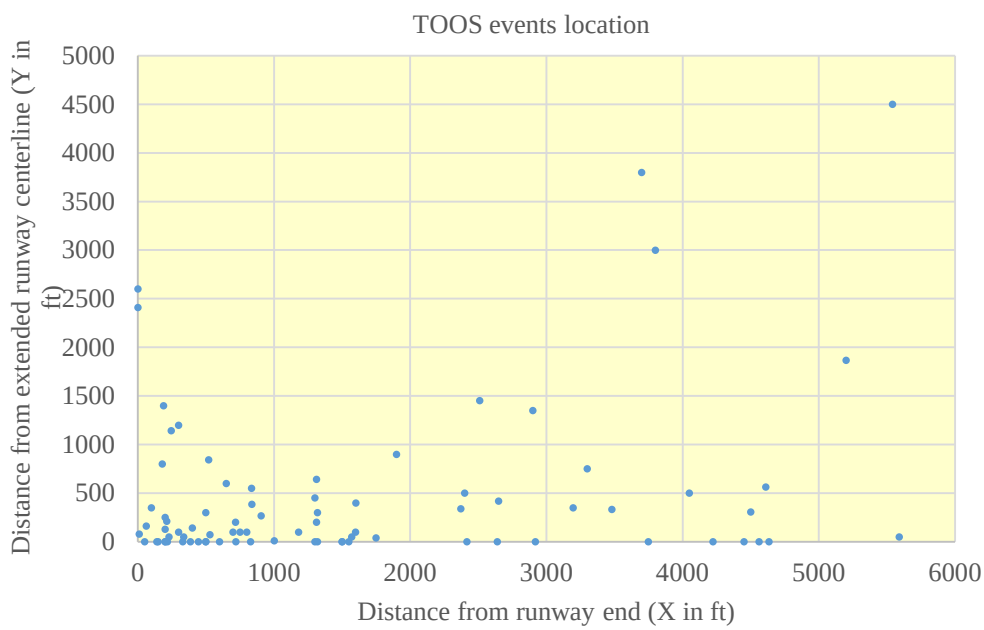

Figure 4.6- TOOS location scatter plot.

Figures 4.7 to 4.10 show the histograms of the events location. As shown in the Figure 4.7, 201 LDORs are contained within 200 feet from the runway which equates to 47% of the events. Less than 7% of LDORs extend more than 1,000 feet beyond the runway. More than 90% of LDORs are contained within 150 feet from the runway centerline, respectively.

Thirty eight percent of LDUSs occurred within 200 feet from the landing threshold and 19% occurred more than 2,500 feet from the runway threshold as shown in Figure 4.8. The remaining 43% of LDUSs occurred between 200 and 2,500 feet from the runway threshold. About 76% of LDUSs are reported to have touched down within 50 feet of the extended centerline.

Figure 4.9 depicts that TOORs are relatively uniformly distributed between the first 3 groups extending from 0 to 1,000 feet beyond the runway with 15% of the events extending farther than that. Laterally, the TOORs remained within 50 feet of the centerline in 75% of the events. Comparing Figures 4.7 and 4.9 illustrates that TOORs tend to extend farther away from the runway than the LDORs; however, the lateral distance in TOORs is less dispersed around the extended centerline than the LDORs.

As shown in Figure 4.10, more than 31% of TOOSs with identified location extended farther than 2,500 feet away from the runway and more than 18% extended more than 1,000 feet from the centerline. TOOSs are the most dispersed event type both in longitudinal and lateral directions.

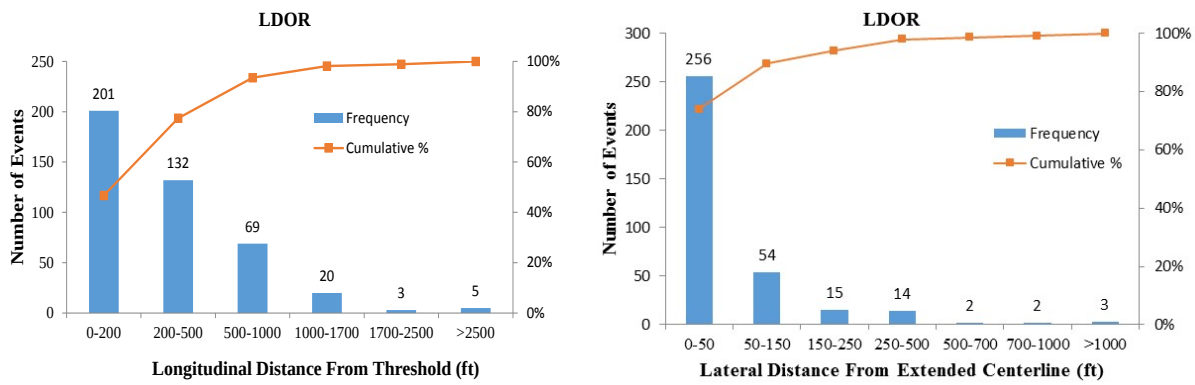

Figure 4.7- Lateral and longitudinal distance distribution for LDOR events.

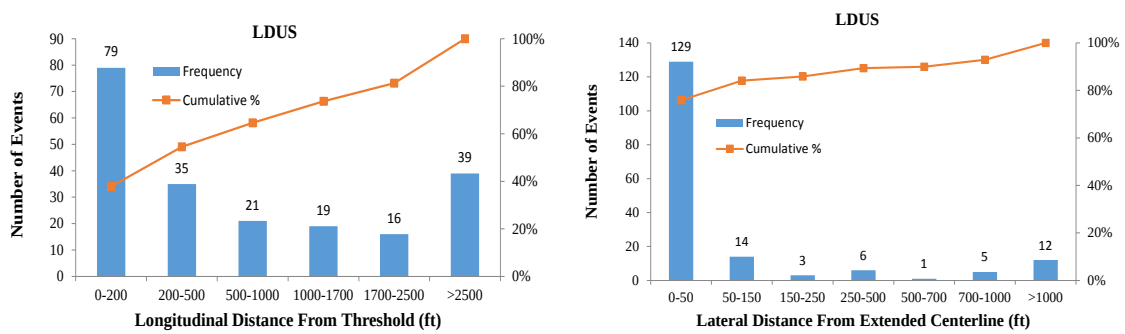

Figure 4.8- Lateral and longitudinal distance distribution for LDUS events.

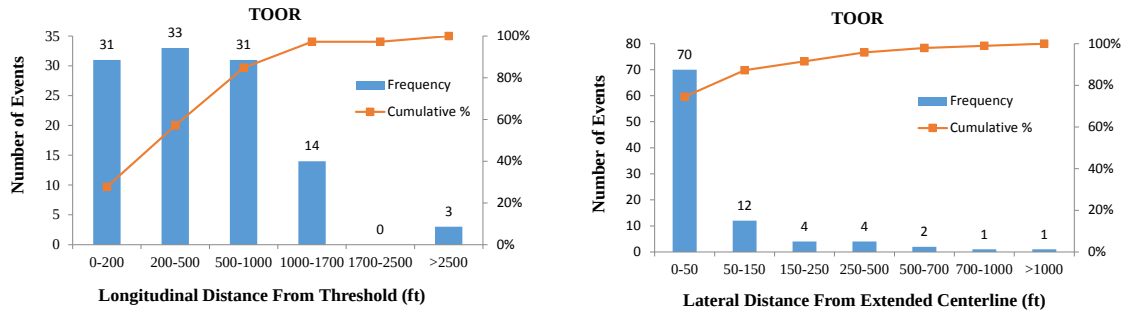

Figure 4.9- Lateral and longitudinal distance distribution for TOOR events.

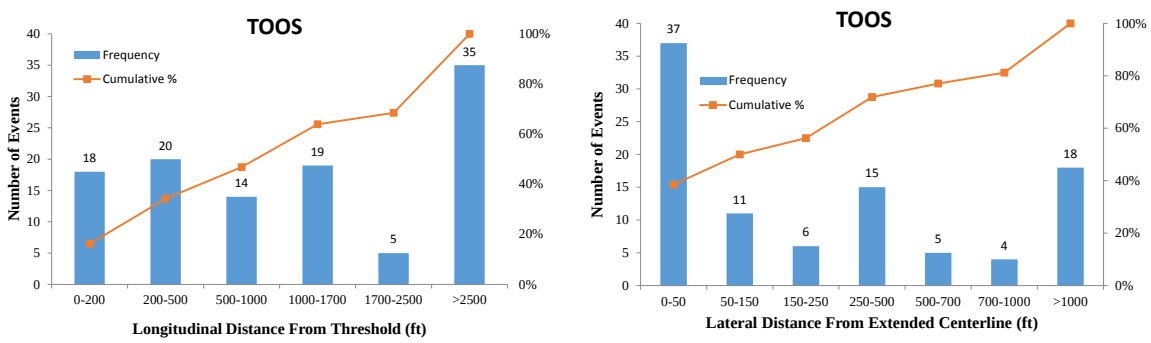

Figure 4.10- Lateral and longitudinal distance distribution for TOOS events.

4.2.2. Longitudinal and lateral location modeling

A general modeling structure as shown in equation 4.2 was implemented to model accident locations. The model is built to account for the possible interdependency between longitudinal and lateral coordinates:

$$L(x \geq x_1, y \geq y_1) = g(x \geq x_1) \times h(y \geq y_1 | x \geq x_1) \tag{4.2}$$

where $L(x \geq x_1, y \geq y_1)$ is the likelihood of an accident occurring x_1 feet or more from the runway threshold and y_1 feet or more from the extended runway centerline. $g(x \geq x_1)$ presents the longitudinal component of the location model estimating the likelihood of an accident at least x_1 feet from the runway. The conditional lateral component of the location model, $h(y \geq y_1 | x \geq x_1)$, is the likelihood of an accident at least y_1 feet away from the extended centerline given that the location is at least x_1 feet from the runway. For every type of accident, longitudinal and lateral components of the location model were developed separately.

Based on the location of historic events, four complementary cumulative probability distribution (CCPD) models were developed for the longitudinal component of location model. With CCPDs, the fraction of accidents involving locations exceeding a given distance from the runway end or threshold can be estimated. Various modeling structures were examined to fit the CCPDs. Nonlinear exponential functions in general forms as shown in equation (4.3) provided excellent fit with R^2 values of above 99% for all accident types. Models parameters are shown in Table 4.6 with their corresponding R^2 values.

$$g(x \geq x_1) = e^{a \cdot {x_1}^b} \tag{4.3}$$

Table 4.6- Summary statistics for longitudinal components of location models.

Accident type	a	b	R^2
LDOR	-0.0034	0.979	99.7
LDUS	-0.0230	0.548	99.2
TOOR	-0.0007	1.131	99.8
TOOS	-0.0003	1.017	99.3

Figures 4.11 through 4.14 present the CCPD from historic events as well as the models' fit to the data. As shown in all figures, very good fits were achieved for the longitudinal component of location model for all accident types.

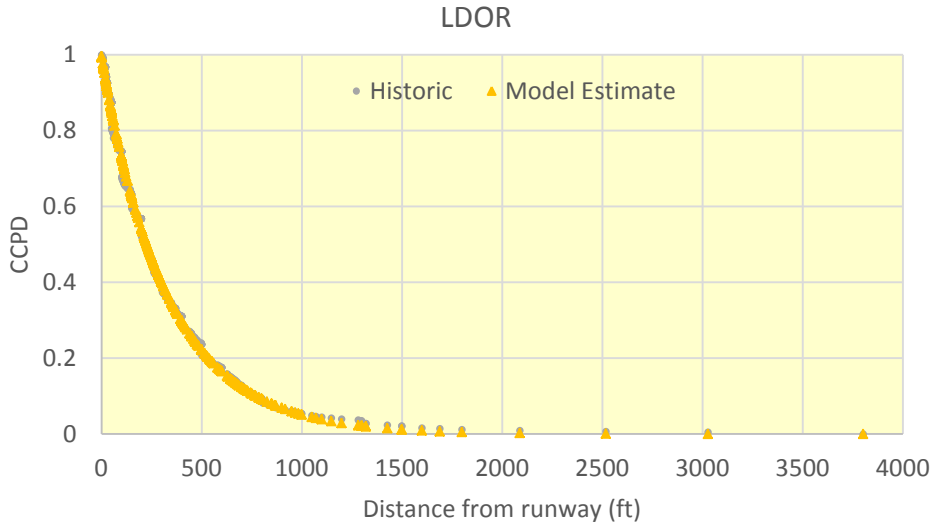

Figure 4.11- LDOR longitudinal component of location model_ $g(x)$.

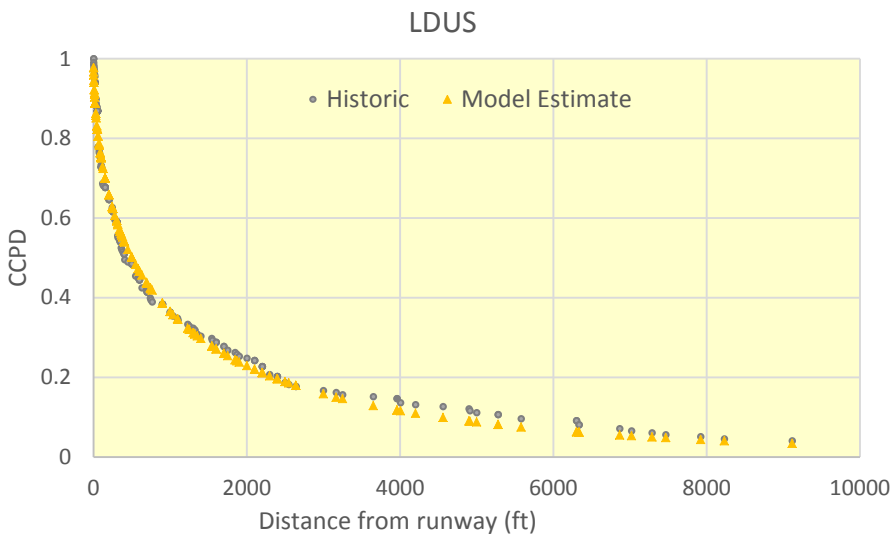

Figure 4.12- LDUS longitudinal component of location model_ $g(x)$.

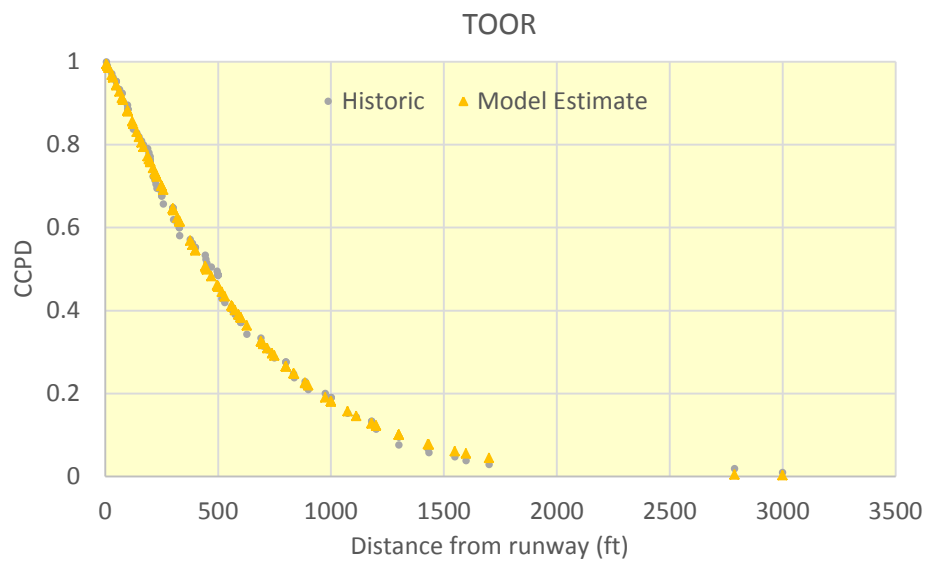

Figure 4.13- TOOR longitudinal component of location model_ $g(x)$.

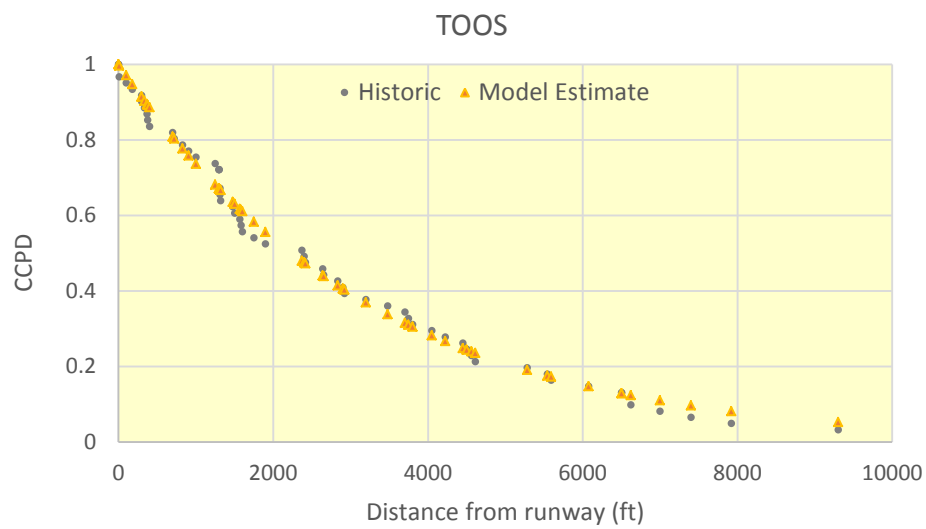

Figure 4.14- TOOS longitudinal component of location model_ $g(x)$.

Historical events with known X and Y coordinates of crash location were used to calculate the conditional lateral components of the location models. Regression modeling was used to fit the data. Equation 4.4 presents the general form of the regression model that was used. Table 4.7 provides summary statistics of the models.

$$\mathrm{h}(y \geq y_1 | x \geq x_1) = \frac{1}{1+e^{(a1\,.\,x_1{}^{b1}+a2\,.\,y_1{}^{b2}+c)}} \tag{4.4}$$

Table 4.7- Summary statistics for lateral components of location models_ $h(y|x)$.

	a_1	b_1	a_2	b_2	C	R^2
LDOR	-0.024	0.625	2.999	0.143	-4.040	98.6
LDUS	-1.536	0.169	0.560	0.261	3.440	87.9
TOOR	-0.001	0.980	3.676	0.102	-4.329	98.0
TOOS	-4.32E-07	1.778	0.889	0.219	-3.100	97.4

As shown in the table, all models have achieved good fit. However, the a_1 coefficient for TOOS model is very small (-4.32×10^{-7}). The statistical significance test on a_1 of TOOS model indicated that the 95% confidence interval for a_1 included zero. Therefore, it was concluded that for TOOS, the Y coordinate of the location is independent of the X coordinate. Therefore, lateral component of TOOS model was modeled using a nonlinear exponential model similar to the longitudinal component. Table 4.8 presents the summary statistics.

Table 4.8- Summary statistics for lateral component of TOOS location model _ $h(y)$.

	a	b	R^2
TOOS	-0.0475	0.4634	99.2

Figures 4.15 through 4.17 present the model estimates of the lateral component of the location versus the likelihood from the historic events for LDOR, LDUS and TOOR. With a perfect model, the points fall on the bisector line.

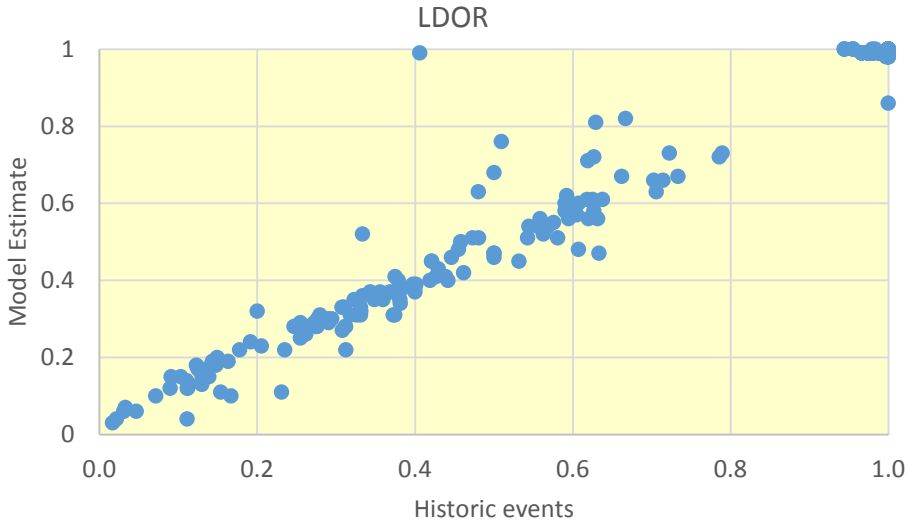

Figure 4.15- LDOR conditional lateral model estimates, $h(y|x)$, versus historic events.

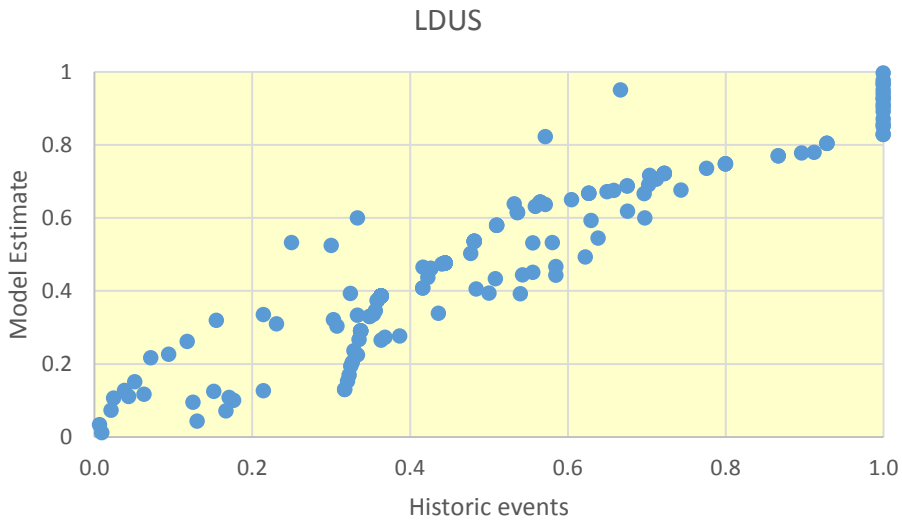

Figure 4.16- LDUS conditional lateral model estimates, $h(y|x)$, versus historic events.

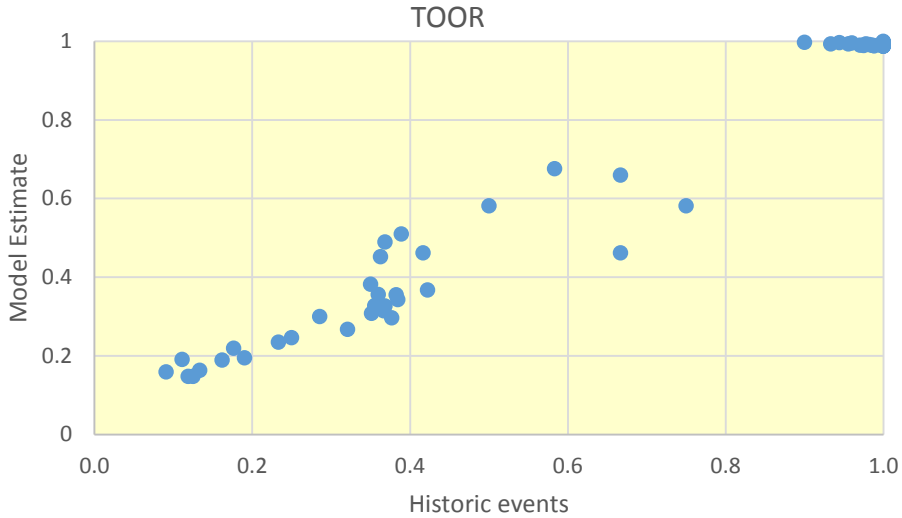

Figure 4.17- TOOR conditional lateral model estimates, $h(y|x)$, versus historic events.

As was explained so far, multiplying the longitudinal and lateral components provides the location model, L(.), which is the likelihood that an accident occurs more than a certain distance from the runway and more than a certain distance from the extended centerline. Four models were developed for each accident type and were denoted as L_{LDOR}, L_{LDUS}, L_{TOOR}, and L_{TOOS}. To obtain the likelihood of an accident in a location confined on all sides, shown as A in Figure 4.18, further refinements is necessary. It is important to highlight the following:

- It is nearly impossible to model the actual wreckage path of the accident aircraft because of unavailability of the data from historic events as well as its complexity and dependence on a variety of factors. In developing the models, it is assumed that the accident occurs parallel to the runway.

- In developing the location models, it was assumed the same proportion of accidents occur on either side of the runway. Therefore the findings from models, when used to estimate the likelihood of an accident in an area on one side of the runway, should be divided by 2.

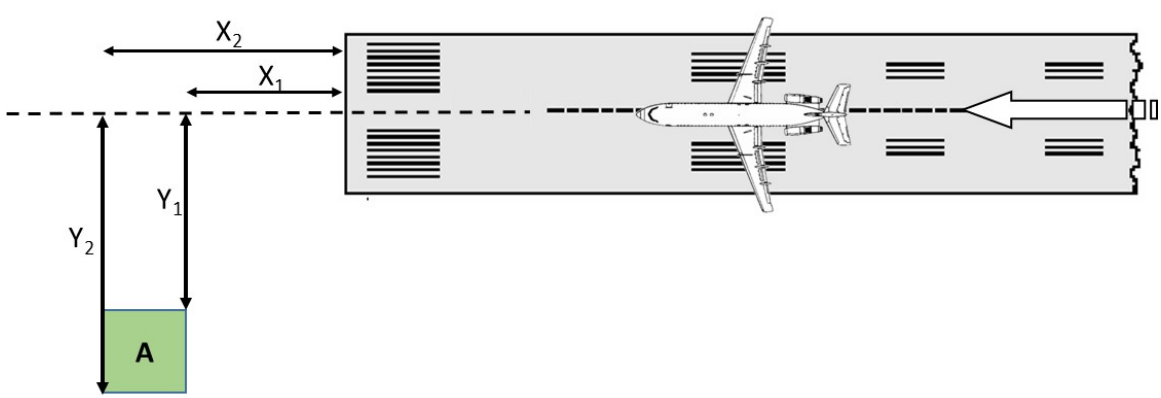

Figure 4.18- Schema used for developing accident location models for a specific location.

Conservatively, it is assumed that location A in Figure 4.18 is impacted in a LDOR or a TOOR accident if the aircraft travels at least x_1 feet off the runway and remain within y_1 and y_2 feet from the extended centerline. Therefore, the likelihood that location A is impacted in a LDOR or a TOOR event can be obtained from the followings:

$$L_A^{LDOR} = \frac{1}{2} \times [L_{LDOR}(x_1, y_1) - L_{LDOR}(x_1, y_2)] \tag{4.5a}$$

$$L_A^{TOOR} = \frac{1}{2} \times [L_{TOOR}(x_1, y_1) - L_{TOOR}(x_1, y_2)] \tag{4.5b}$$

where x_1 and y_1 are the distance of the closest edge of A with respect to the runway and the extended centerline, respectively, and y_2 is the distance of the farthest edge of A with respect to the extended centerline.

In LDUS historic events, total wreckage length was measured and recorded, when available. This is the length parallel to the runway that the aircraft traveled from the first point of impact until it stopped. The data was available from 66 events. It was identified that the median distance traveled from the first point of impact was 550 feet. Therefore, a LDUS impacts location A if the first point of impact is between the closer side of A to the runway and 550 feet of the farther side of A. This is shown mathematically in equation 4.6:

$$L_A^{LDUS} = \frac{1}{2} \times \{[L_{LDUS}(x_1, y_1) - L_{LDUS}(x_1, y_2)] - [L_{LDUS}(x_2 + 550, y_1) - L_{LDUS}(x_2 + 550, y_2)]\} \tag{4.6}$$

In the case of a TOOS event, Location A is impacted if the accident location is within the confines of location A. Therefore, the likelihood of a TOOS crash may be obtained from equation 4.7:

$$L_A^{TOOS} = \frac{1}{2} \times \{[L_{TOOS}(x_1, y_1) - L_{TOOS}(x_1, y_2)] - [L_{TOOS}(x_2, y_1) - L_{TOOS}(x_2, y_2)]\} \tag{4.7}$$

4.3. RPZ Crash Likelihood

The RPZ crash likelihood is defined as the likelihood of a crash within an airport RPZ in a year. RPZ crash likelihood combines the findings from the first part of the modeling framework (accident likelihood models) with the second part (location models), and takes into account the annual number of landings and takeoffs that may crash in an RPZ. The RPZ crash likelihood is shown as contours inside the RPZs.

The RPZ crash likelihood incorporates the likelihoods for all types of accidents inside an RPZ. The likelihoods of LDOR and LDUS for every arrival and the likelihoods of TOOR and TOOS for every departure is obtained using the accident likelihood models. Then averages for each accident type is calculated for each runway. An RPZ is subjected to LDUS accidents for arrivals on the runway. The RPZ is also subjected to LDOR accidents for arrivals from the opposite runway, as well as TOOR and TOOS accidents for departures from the opposite runway. Following the schematic shown in Figure 4.19, when LD_2 is the number of landings on the runway in direction 2, and TO_1 and LD_1 are the number of takeoffs and landings on the opposite runway in direction 1, crash likelihood at point A within the RPZ is obtained from the following:

$$Crash\ Likelihood_A = (LD_1 \times f_1^{LDOR} \times L_A^{LDOR}) + \left(LD_2 \times f_2^{LDUS} \times L_A^{LDUS}\right) + (TO_1 \times f_1^{TOOR} \times L_A^{TOOR}) + (TO_1 \times f_1^{TOOS} \times L_A^{TOOS}) \tag{4.8}$$

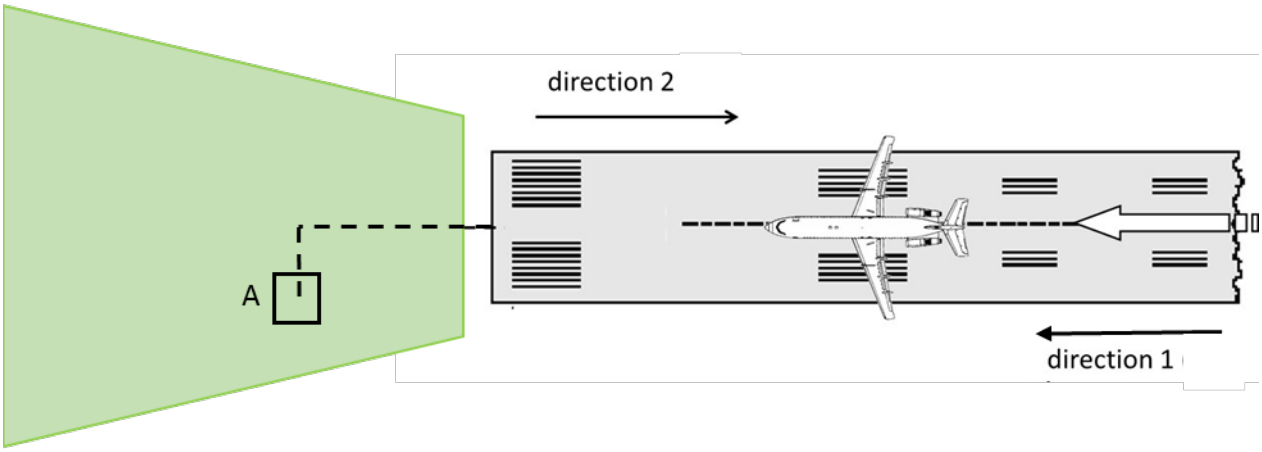

Figure 4.19- RPZ Crash Likelihood Schematic.

where f is the average likelihood from the accident likelihood models with superscript identifying the accident type and subscript identifying the runway direction. For example, f_1^{LDOR}denotes the average likelihood of a LDOR event for landings in runway direction 1. L_A is the location likelihood at location A with superscript identifying the accident type. When crash likelihood at all locations within an RPZ is summed up, the RPZ crash likelihood is obtained as shown below.

$$RPZ\ Crash\ Likelihood = \sum_{All\ A} Crash\ Likelihood_A \tag{4.9}$$

4.4. Consequence Models

4.4.1. Historic events consequences

The historic events were investigated to obtain consequences to the people and property on the ground. As shown in Table 4.9, only about 3% of the events resulted in injuries to the people on the ground. Fatal injury to the people on the ground was reported in only 1% of the events gathered. In about 24% of the events, there was some damage to the property on the ground, and in about 2% the impacted property was reported destroyed. The land use and the environment of the events were also examined and recorded. As shown in Table 4.10, the majority of events were contained within the airport property in an open area.

Table 4.9- Events consequences to people and property on the ground.

	Injury	Percent		Damage	Percent
On-the-Ground Injury	Fatality	1%	**On-the-Ground Damage**	Destroyed	2%
	Major	1%		Major	9%
	Minor	1%		Minor	13%
	None	97%		None	76%

Table 4.10- Land use and environ of collected events in accident database.

Land Use	Percent
On-Airport property	71%
Infrastructure	19%
Agricultural	4%
Residential	2%
Other	4%

Environ	Percent
Open Area	59%
Permissible Use	12%
Trees /Vegetation	6%
Public roads	5%
Buildings/Structures	4%
Utilities	3%
Open water	2%
Other	10%

4.4.2. Consequence modeling approach

The consequences of an accident to the people and property on the ground depends on the characteristics of the accident and the designated land use and population density of the accident location. As was shown from the historical data, consequences range from no injury to fatality to the people and no damage to destruction to the property on the ground. Thus, the worst credible outcome in the case of these accidents is in fact human fatality which is set as the goal of consequence modeling.

Modelling consequences was performed in two steps:

- First, the size of the crash influence area and the fatality rate within this area were estimated.
- Then, the population density of the area was amalgamated to estimate the consequences.

Mathematically:

$$C_A = IA \times PD_A \times FR \tag{4.10}$$

where C_A is the consequence at location A, IA is the size of the influence area, PD_A is the population density at location A and FR is the fatality rate. The multiplication of the first two terms (influence area and the population density) estimates the number of people present in the area. Then multiplying the number of people present by the fatality rate estimates the expected fatality as the result of a crash.

Among accidents with notable consequences on the ground, accident reports rarely provided description of the dimension and the extent of the crash influence area. Also, although the number of people fatally injured are usually noted, the number of people present in the area uninjured are rarely investigated making it very difficult to establish fatality rates. Lack of sufficient relevant data made it challenging to develop empirical consequence models from the accident data collected so simplifying assumptions had to be made.

One of the variables recorded in the review of the historic events was whether or not fire erupted as the consequence of the crash. It was assumed that fire eruption would affect the size of the influence area and

the fatality rate. Table 4.11 presents the percentage of the events with fire for the accident types. In identifying the percentages, events that extended at least 200 feet from the runway were considered to coincide with the RPZ threshold. Fire occurred more frequently in TOOS and LDUS events as shown in the table.

Table 4.11- Percent of events with fire eruption.

Accident type	% of events with fire
LDOR	6%
LDUS	27%
TOOR	13%
TOOS	36%

Influence area without fire

When no fire is erupted, it is argued that people on the ground are impacted only if the aircraft directly collides with them or the structure or the vehicle that contains them. In this case, the influence area is estimated by aircraft dimensions: wingspan (WS) and length. Twelve historic events were identified where a collision with people and property on the ground took place and no fire erupted. Five of these events resulted in ground fatality and the other seven caused minor or major injuries. Therefore, a fatality rate of 42% is driven.

Influence area with fire

Accidents that result in fire can potentially influence a larger area. In some of these events, the aircraft breaks in pieces and spreads over a larger area than would be covered by its wingspan. The area that includes the main body of aircraft is defined as impact area and other areas affected are defined as debris area. The historic accident database includes 11 accidents that resulted in fire with injuries to the people on the ground. Only 4 resulted in fatality. Given the small number of events in the database that could describe the impact and debris area, the research team reviewed other studies to support the analysis. Many of these studies included accidents that crashed much farther away from the runway than covered in the scope of this study.

UK NATS study identified 182 crashes. In 56 crashes the impact area was identified, and in 126 crashes the size of the debris area was established. NATS examined both linear and logarithmic relationship between the impact and debris areas and the MTOW of the accident aircraft. It was noted that given the scatter of the events, the following logarithmic relationship provided a better fit for the impact area:

$$\ln(A_{MTOW}) = \ln(1000) - 6.16 + 0.474\ln(MTOW) \tag{4.11}$$

Thirty-two events in NATS database resulted in fatality of the people on the ground and they were all within the impact area. Obviously, NATS database is a sample of the events and fatalities can occur in debris area surrounding the impact area. Therefore, the study suggested limiting the influence area to only the impact area, and adopt a 100% fatality rate. It was argued that the conservative assumption

regarding the fatality rate makes up for abandoning the debris area. Therefore, the NATS model was adopted to quantify the influence area that involves fire break out.

Population density of land uses within RPZs

Population density is the last piece of information that the consequence model requires. It is defined as the number of people present per unit area within the boundaries of a land use. Various land uses that encroach the RPZs should be identified and their population densities established. The users' guide provide resources that are useful for estimating the population densities according to the land use.

When the 3 pieces of the consequence model are put together, equation 4.12 is derived. When an accident occurs, fire may or may not erupt. The likelihood of fire erupting was drawn from the historic percentage of the accidents that caught fire as shown in Table 4.11. The size of the influence area and the mortality rate were also obtained for both potential outcomes. NATS relationship was used for estimating the influence area for outcomes involving fire with a 100% fatality rate. Aircraft dimensions were used for estimating the influence area for outcomes not involving fire with a 42% fatality rate. One consequence model is developed for every accident type by expanding the consequence model presented in equation 4.10 to the following:

$$C_A^{acc} = [P_{fire}^{acc} \times A_{MTOW} \times 100\% + \left(1 - P_{fire}^{acc}\right) \times A_{ws.l} \times 42\%] \times PD_A \qquad (4.12)$$

where C_A^{acc} is the consequence of a specific accident type at location A, P_{fire}^{acc} is the percentage of those accident types that result in fire, A_{MTOW} is the influence area obtained from MTOW of aircraft, and $A_{ws.l}$ is the influence area obtained from aircraft dimensions. PD_A is population density at location A.

Although the equation could be implemented for every movement at the airport and then accumulated for all movements, it would increase the computational time enormously. Instead, the following steps were undertaken using the schematic presented in Figure 4.19:

- Landings in direction 1 and landings and takeoffs in direction 2 are identified in NOD file. These are movements that could potentially crash at location A.
- The influence areas based on MTOW and aircraft dimensions are calculated for these movements.
- Averages of the influence areas are calculated separately for landings in direction 1 and the landings and takeoffs in direction 2. These averages are used accordingly in equation 4.12 for every accident type. This results in four consequence models that could impact location A; C_A^{LDOR}, C_A^{LDUS}, C_A^{TOOR}, C_A^{TOOS}

4.5. Risk Assessment

Risk is the combination of the likelihood and the severity of the consequences. An aviation accident can potentially cause a myriad of consequences. To assess the risk, FAA in various publications and guidelines recommends to identify the worst credible outcome, and then quantify the likelihood of the outcome. The worst credible outcome with respect to the people on the ground is fatal injury as is supported by historic events. Therefore, the analysis aims at evaluating the annual likelihood of fatality of the people on the ground. For location A as shown in the Figure 4.19, this is achieved by combining the three parts of the modeling structure as presented below:

$$Risk_A = LD_1 \times f_1^{LDOR} \times L_A^{LDOR} \times C_A^{LDOR} + LD_2 \times f_2^{LDUS} \times L_A^{LDUS} \times C_A^{LDUS} + TO_1 \times f_1^{TOOS} \times L_A^{TOOS} \times C_A^{TOOS} + TO_1 \times f_1^{TOOR} \times L_A^{TOOR} \times C_A^{TOOR} \quad (4.13)$$

As shown, the model aggregates the risk from all accident types. The multiplication of the first three terms (number of movements, average likelihood of accident for the movements, and likelihood that the accident impacts location A) provides the likelihood that location A is impacted in a year of airport operation. Multiplying this with the consequence term (expected fatality as a result of crash) provides risk at location A.

To implement the risk model, the airport RPZs are converted to a grid system where the user chooses its density. Then, the user identifies land uses within the RPZs and assigns their population densities. The software tool identifies the cells in the grid system that underlie the land use, and obtains the risk for the cells. The software tool outputs the land use risk which is the summation of the risks from all underlying cells. The software tool also outputs the RPZ risk which is the summation of the risks for the land uses within the RPZ.

CHAPTER 5

Conclusions

Because most aircraft accidents occur during the landing and takeoff phases of the flight, accident risk tends to be concentrated near airports. The FAA has recognized the risk of accidents in the immediate airport vicinity through the establishment of safety zones intended to remain free of unnecessary objects and obstacles, including, for example, object-free areas and runway safety areas. Most of the FAA-defined safety zones apply to the immediate runway environment on airport property and are intended to ensure the safety of airport personnel and aircraft crews and passengers. Runway protection zones (RPZs) however are defined "to enhance the protection of people and property on the ground (FAA Advisory Circular 150/5300.13A)". RPZs extend up to 2,500 feet from the primary surface at the end of runways, depending on the design aircraft and the nature of the runway approach.

Improved methods of understanding and quantifying risk in RPZs can promote enhancements to airport safety. More specifically, this improved understanding can support the immediate needs of the FAA and airport operators. The FAA provides guidance to airports on acceptable land uses in RPZs. A more robust understanding of the nature of risk in RPZs would be helpful to the FAA in refining and improving their guidance. Airport operators are responsible for implementing FAA land use guidance in RPZs. An improved understanding of the accident risk in RPZs can assist airports in determining how to prioritize RPZ improvements and mitigation actions relative to the many other facilities and operational needs with which they are faced. The risk assessment tool developed in this project is valuable to airport operators in evaluating the merits of alternative risk mitigation actions in RPZs. In addition, the risk analysis tool can help both the FAA and airport operators better understand the potential consequences of proposed changes in the RPZs.

Many airports are subject to encroachment from urban development. A better understanding of the risks within RPZs enables airport operators to argue more convincingly for critical land use control measures in RPZs or for airport acquisition of those lands before they are developed.

The objectives of this study was threefold:

- Develop a risk assessment framework based on historic events
- Develop a software tool to assess the risk of accidents to the people on the ground within RPZs
- Develop a users' guide

Each of these goals was accomplished, and the major achievements are presented below.

5.1. Major Achievements

5.1.1. Data collection and risk modeling

The database developed under the study presented in ACRP Report 50- Improved Models for Risk Assessment of Runway Safety Areas- included about 700 aircraft overrun and undershoot accidents and incidents from 1980 to 2009. The database was re-examined and additional data fields relevant to the scope of this study were collected. The study period was also expanded to include accidents and incidents that occurred between 2009 and 2014. Prior study only included events up to 2,000 feet from the runway end. This area was expanded to distances of up to 2 miles from the runway end. Another major accomplishment with respect to the database was inclusion of the light and piston aircraft types. From a sample of airports, 150 relevant events involving light and piston engine aircraft types were gathered and included in the database. All considered, the number of events in the database grew to a total of 1,066 events.

Another accomplishment with respect to data collection was with respect to the database of normal operation. The normal operation database was complemented with addition of about 25,000 movements of light and piston engine aircraft types at sampled airports. This laid the ground for improved data-driven models to be developed and implemented for the risk assessment.

5.1.2. RPZ risk assessment software tool

The models were implemented in a software tool. The RPZ risk assessment tool, named RPZ_RAT, is user-friendly and practical, and allows users to account for various factors that may impact the RPZ risk. The software tool is coded using C# programming language which is the language most commonly used to build modern Windows applications. For data management, the software uses SQL Server Express which offers all SQL server programmability features yet runs in user mode and has a fast, zero-configuration installation. The tool database is installed and can be accessed locally rather than requiring a server to host the database. A sidebar navigation tree is implemented in the software for data input and modification, rather than simplistic pop-up boxes. The navigation tree environment provides greater ease of use and flexibility for the users.

A geographical information system (GIS)-based graphical user input format is implemented for defining runways, RPZ boundaries, as well as the boundaries of the land uses within the RPZs. To facilitate such data entries, ESRI map viewer is imbedded with the software tool.

In presenting the results from the software, GIS-based color-coded graphical contours is superimposed on the airport map. This provides the users with a powerful tool for visualizing and understanding the geographical extent of the areas that are more likely to be impacted by an accident.

5.1.3. Users' guide

A users' guide was developed as part of this study. The document was designed to assist with conducting a risk assessment for airport RPZs using the software tool. The guide provides background information on risk assessment, supports the users in running the tool and in understanding the results. It also supports with the selection of risk mitigation strategies to manage safety risk to the people on the ground. The document provides guidance in using the findings from the risk assessment in a broader safety management system (SMS) context especially when other safety risk management (SRM) programs are in place.

5.2. Limitations

Although the goal of the study was to develop a very comprehensive modeling framework and a user-friendly tool to implement the models, there are some limitations that should be noted. Some of those limitations are rooted in data availability, and some are rooted in reducing the computational time needed to perform the analysis.

As an important limitation, the tool is only intended for airport planning. The models and the software are not intended to be used for estimating the risk during real-time operations. Only models and tools from aircraft manufacturers can use actual aircraft data during real-time operations to model aircraft performance.

The models framework is based on actual data from accident and incident reports. Models are in essence derived from evidence gathered from these reports. Therefore, the validity of the models depend on the accuracy of the information contained in these reports. Some simplifying assumptions were needed. For example, a basic landing distance required for the type of aircraft was obtained and corrected for temperature, runway elevation, wind, and surface conditions. Wind corrections implemented are considered to be average adjustments, and surface conditions are estimated based on weather conditions, rather than relying on actual runway friction. Another example is that touchdown location or the approach speed during landing were not implemented in modeling the likelihood of accidents. These are important factors that may lead to an accident, but there are no means to account for them.

Additional simplifications were necessary to address the interaction of incidents with existing land uses. In many cases, the pilot is able to have some directional control of the aircraft and avoid land uses that may contain population with higher densities. The approach simply assumes that the aircraft location is a random process and the deviation from the runway centerline follows a normal probability distribution and that, during overruns and undershoots, the aircraft follows a path that is parallel to the runway centerline. Another modeling limitation is the difficulty in accounting for human factors that normally contribute to aviation accidents.

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ABBREVIATIONS AND ACRONYMS

ESRI: Environmental Systems Research Institute

SQL: Structured Query Language

FAA: Federal Aviation Administration

GA: General aviation

GIS: geographical information system

LDOR: Landing overrun

LDUS: Landing undershoot

MTOW: Maximum takeoff weight

NATS: National Air Traffic Services of UK

NLR: National Aerospace Dutch Laboratory

NOD: Normal Operation Data

PD: Population Density

PSZ: Public Safety Zone

RPZ: Runway protection zones

RPZ_RAT: Runway protection zone Risk assessment tool

SMS: Safety management system

SRM: Safety risk management

TOOR: Takeoff overrun

TOOS: Takeoff overshoot

WS: Wingspan

APPENDIX A

Inventory of Collected Accidents and Incidents

Date	Country	City/State	Event type	Aircraft Code	Airport Code
18-Jul-71	Australia	Sydney, New South Wales	LDOR	B742	YSSY
17-Jan-78	USA	TYLER, TX	LDOR	AC68	TYR
27-Jan-78	USA	NASHVILLE, TN	TOOR	B722	BNA
03-Apr-78	USA	DETROIT, MI	LDUS	DC10	DTW
02-May-78	USA	LAKE CHARLES, LA	LDOR	CV24	
31-May-78	USA	LEWISTOWN, MT	LDUS	MU2	LWT
29-Jun-78	USA	EBENSBURG, PA	LDUS	MU2	9G8
16-Aug-78	USA	SODA SPRINGS, ID	LDOR	NA	U78
10-Jan-79	USA	LUBBOCK, TX	LDUS	LJ24	LBB
27-Jan-79	USA	AGANA, GU	LDUS	B722	GUM
15-Feb-79	USA	WAUKEGAN, IL	LDOR	GLF	UGN
01-Aug-79	USA	MATTOON, IL	LDOR	SBR1	MTO
10-Aug-79	USA	HAYWARD, CA	LDOR	NA	HWD
17-Aug-79	USA	BETHANY, OK	LDUS	FA20	PWA
28-Aug-79	USA	SAIPAN, MP	LDUS	B722	GSN
11-Sep-79	USA	FAYETTEVILLE, AR	LDOR	SW3	FYV
08-Oct-79	Greece	Athens	LDOR	DC86	LGAT
21-Nov-79	USA	CARLSBAD, CA	LDOR	LJ24	CRQ
21-Dec-79	USA	BURLINGTON, VT	LDUS	BA11	BTV
22-Dec-79	USA	DENVER, CO	LDUS	B722	DEN
13-Feb-80	USA	CHICAGO, IL	TOOR	C500	
07-Apr-80	Canada	Athabasca, Alta	LDOR	MU2	CYWM
25-Jul-80	USA	TAMPA, FL	LDUS	B722	TPA
29-Jul-80	USA	HOUMA, LA	LDOR	WW24	HUM
07-Aug-80	UK	Leeds Bradford	LDOR	VC10	LBA
06-Sep-80	Canada	Seal River, Manitoba	LDOR	DHC6	
19-Oct-80	USA	Phoenix, AZ	LDUS	B722	PHX

Date	Country	City/State	Event type	Aircraft Code	Airport Code
22-Oct-80	USA	PHOENIX, AZ	LDUS	DC93	PHX
20-Dec-80	USA	TETERBORO, NJ	LDOR	FA20	TEB
01-Feb-81	USA	PONTIAC, MI	LDOR	C550	PTK
19-Feb-81	USA	Pittsburg, PA	TOOR	DC93	PTS
04-Mar-81	USA	HAGERSTOWN, MD	TOOR	C500	HGR
12-Mar-81	USA	CINCINNATI, OH	LDUS	SBR1	LUK
29-Mar-81	England	Borough of Luton, Bedfordshire	LDOR	L29B	EGGW
18-Apr-81	USA	SAND POINT, AK	LDUS	YS11	SDP
01-May-81	USA	LITTLE ROCK, AR	LDOR	AC68	LIT
06-May-81	USA	NEW CASTLE, DE	LDOR	MU2	ILG
02-Jul-81	USA	RICHMOND HEIGHTS, OH	LDOR	CL60	CGF
17-Jul-81	USA	LINCOLN, NE	LDOR	LJ25	LNK
01-Aug-81	Canada	Sugluk Airport, Quebec	LDOR	DHC6	YZG
13-Sep-81	USA	BOSTON, MA	LDOR	DC10	BOS
26-Nov-81	USA	AUGUSTA, GA	LDUS	B722	AGS
09-Dec-81	USA	ALBUQUERQUE, NM	LDOR	AC68	ABQ
11-Dec-81	USA	SAN JUAN, PR	LDOR	DC10	JSJ
01-Jan-82	UK	Cambridge	LDOR	C550	CBG
12-Jan-82	USA	ADDISON, TX	LDOR	HS25	ADS
12-Jan-82	USA	DALLAS, TX	LDOR	HS25	ADS
13-Jan-82	USA	Washinton, D.C.,	TOOS	B737	DCA
23-Jan-82	USA	Boston, Massachusetts	LDOR	DC10	BOS
03-Feb-82	USA	PHILADELPHIA, PA	TOOR	DC10	PHL
15-Feb-82	USA	LOS ANGELES, CA	LDOR	B737	LAX
19-Feb-82	USA	HARLINGEN, TX	LDOR	B722	HRL
19-Feb-82	USA	PONTIAC, MI	LDOR	FA20	OAK
26-Feb-82	USA	ATLANTA, GA	LDOR	BE90	PDK
16-Apr-82	USA	MARANA, AZ	TOOR	DC85	TUS

Date	Country	City/State	Event type	Aircraft Code	Airport Code
16-May-82	USA	HOOPER BAY, AK	LDUS	DHC6	HPB
04-Jun-82	USA	WICHITA, KS	TOOR	BE60	AAO
05-Jul-82	USA	Boise, ID	TOOR	DC9	BOI
09-Jul-82	USA	NEW ORLEANS, LA	TOOS	B722	MSY
13-Sep-82	USA	DENVER, CO	TOOR	SW3	DEN
01-Oct-82	UK	Scatsa	LDOR	HS25	SCS
03-Oct-82	USA	Jefferson Parish, LA	TOOR	B722	MSY
11-Nov-82	USA	SAN JUAN, PR	LDOR	L101	SJU
20-Nov-82	USA	ATLANTA, GA	LDOR	AC80	ATL
18-Dec-82	USA	PELLSTON, MI	LDOR	DC93	PLN
27-Dec-82	USA	DUBUQUE, IA	LDOR	E110	DBQ
11-Jan-83	USA	DETROIT, MI	TOOS	DC85	DTW
23-Jan-83	USA	JAMAICA, NY	LDUS	DC86	JFK
20-Mar-83	USA	CHICAGO, IL	LDUS	SBR1	ORD
19-Apr-83	Canada	Gaspe Airport, Quebec	LDOR	HS25	YGP
24-Jun-83	USA	KAILUA/KONA, HI	LDOR	YS11	KOA
02-Jul-83	USA	KING SALMON, AK	TOOR	DC85	AKN
07-Jul-83	USA	ROCHELLE, IL	LDUS	BE20	RPJ
15-Jul-83	USA	BLOUNTVILLE, TN	LDOR	GLF	TRI
20-Jul-83	USA	CHICAGO, IL	LDOR	DC87	ORD
10-Sep-83	USA	BURLINGTON, CO	LDOR	BE90	ITR
20-Sep-83	USA	MASSENA, NY	LDOR	LJ35	MSS
21-Oct-83	USA	BLOOMINGTON/NORMAL, IL	LDOR	SW3	BMI
25-Oct-83	USA	NORFOLK, VA	LDOR	DC86	NGU
23-Nov-83	USA	PERRIS, CA	TOOR	DHC6	
29-Nov-83	UK	Sumburgh	LDOR	A748	LSI
03-Dec-83	USA	OLNEY, TX	TOOR	FA10	SPS
12-Dec-83	USA	COATESVILLE, PA	LDUS	SBR1	40N

Date	Country	City/State	Event type	Aircraft Code	Airport Code
21-Dec-83	USA	DETROIT, MI	LDUS	BE20	DET
22-Dec-83	USA	EAGLE, CO	LDOR	LJ25	EGE
23-Dec-83	USA	ANCHORAGE, AK	TOOR	DC10	ANC
05-Jan-84	USA	SEATTLE, WA	LDUS	B722	SEA
30-Jan-84	USA	AVALON, CA	LDOR	LJ24	AVX
12-Feb-84	USA	OSHKOSH, WI	LDOR	DC93	OSH
28-Feb-84	USA	JAMAICA, NY	LDOR	DC10	JFK
30-Mar-84	USA	KAILUA/KONA, HI	LDOR	DC93	KOA
02-Apr-84	USA	LITTLE ROCK, AR	LDOR	CL60	LIT
08-Apr-84	USA	AUSTIN, TX	LDUS	LJ25	AUS
31-May-84	USA	DENVER, CO	TOOR	B722	DEN
23-Jun-84	USA	CHICAGO, IL	LDOR	B703	ORD
06-Jul-84	Canada	Blanc-Sablon, Quebec	LDOR	A748	YBX
12-Jul-84	USA	MCALESTER, OK	LDUS	BE40	MLC
28-Jul-84	USA	WATERVILLE, ME	TOOR	LJ25	WVL
02-Aug-84	Puerto Rico	Vieques	TOOS	BN2T	TJVQ
01-Nov-84	UK	Bristol	LDOR	A300	BRS
15-Dec-84	Canada	Sioux Lookout, Ontario	LDOR	C500	YXL
05-Jan-85	USA	OKLAHOMA CITY, OK	LDOR	LJ25	OK15
17-Jan-85	USA	FLUSHING, NY	TOOR	B722	LGA
21-Jan-85	USA	JOHNSTOWN, PA	TOOR	LJ25	JST
31-Jan-85	USA	LONDON, KY	LDOR	SW3	LOZ
03-Apr-85	USA	GRAND RAPIDS, MI	TOOR	DHC6	GRR
08-May-85	USA	CHICAGO, IL	LDOR	LJ24	
12-May-85	USA	LAKE GENEVA, WI	LDUS	FA50	C02
27-May-85	UK	Leeds Bradford	LDOR	L101	LBA
11-Jun-85	USA	VAN NUYS, CA	LDOR	WW24	VNY
27-Jun-85	England	Leeds	LDOR	L101	EGNM

Date	Country	City/State	Event type	Aircraft Code	Airport Code
27-Jun-85	Puerto Rico	Luis Munoz Marin International Airport, San Juan ,	TOOR	DC10	SJU
27-Jun-85	USA	SAN JUAN, PR	TOOR	DC10	SJU
28-Jun-85	USA	CHARLOTTE, NC	LDUS	PA42	CLT
12-Jul-85	USA	FORT WORTH, TX	LDOR	LJ35	FTW
02-Aug-85	USA	DALLAS/FT WORTH, TX	LDUS	L101	DFW
13-Aug-85	USA	MADISON, WI	TOOR	LJ24	MSN
25-Aug-85	USA	Auburn, Maine	LDUS	BE99	LEW
28-Aug-85	USA	GREEN BAY, WI	LDOR	BA11	GRB
06-Sep-85	USA	Milwaukee, Wisconsin	TOOS	DC91	MKE
23-Sep-85	USA	WEST CHICAGO, IL	LDOR	FA10	DPA
25-Sep-85	USA	UNALASKA, AK	LDUS	B737	DUT
19-Oct-85	USA	BLOOMINGTON, IN	LDOR	VC10	BMG
07-Nov-85	USA	SPARTA, TN	LDOR	HS25	SRB
02-Jan-86	USA	DETROIT, MI	LDOR	DC10	DTW
31-Jan-86	USA	LANCASTER, CA	LDOR	C550	WJF
07-Feb-86	USA	MEKORYUK, AK	LDUS	DHC6	MYU
08-Feb-86	USA	HARLINGEN, TX	LDUS	B722	HRL
08-Feb-86	USA	CARLSBAD, CA	LDOR	MU30	CRQ
21-Feb-86	USA	ERIE, PA	LDOR	DC93	ERI
27-Feb-86	USA	COATSVILLE, PA	LDOR	FA10	40N
13-Mar-86	USA	CHARLESTON, SC	LDOR	DC93	CHS
07-May-86	USA	HOLLYWOOD, FL	LDOR	LJ24	HWO
20-May-86	USA	HUTCHINSON, KS	LDUS	SW3	HUT
01-Jul-86	USA	LINCOLN, NE	LDUS	SW3	LNK
20-Jul-86	Canada	Wabush, Newfoundland	TOOR	B737	YWK
02-Aug-86	USA	BEDFORD, IN	LDOR	HS25	BFR
06-Aug-86	USA	RUTLAND, VT	TOOR	LJ55	RUT

Date	Country	City/State	Event type	Aircraft Code	Airport Code
29-Sep-86	USA	LIBERAL, KS	LDOR	SBR2	LBL
14-Oct-86	USA	BEVERLY, MA	LDOR	BE90	BVY
25-Oct-86	USA	CHARLOTTE, NC	LDOR	B737	CLT
04-Jan-87	USA	HUDSON, NY	LDUS	LJ55	1B1
05-Jan-87	USA	LEBANON, NH	LDOR	LJ35	LEB
29-Jan-87	USA	CHICAGO, IL	LDOR	DC9	MDW
11-Feb-87	USA	ONEONTA, NY	LDUS	BE90	N66
04-Mar-87	USA	Romulus, Michigan	LDUS	C212	DTW
12-Mar-87	USA	DES MOINES, IA	LDOR	DC87	DSM
08-May-87	Puerto Rico	Mayaguez	LDUS	C212	MAZ
12-May-87	USA	WEST MIFFLIN, PA	TOOS	LJ25	AGC
26-May-87	USA	KENNER, LA	TOOR	JS31	MSY
22-Jun-87	USA	ATLANTA, GA	LDUS	DHC8	ATL
16-Jul-87	USA	JACKSON, MS	TOOR	WW24	JAN
03-Aug-87	USA	DENVER, CO	TOOR	A300	DEN
16-Aug-87	USA	Romulus, Michigan	TOOS	MD82	DTW
09-Sep-87	USA	TULSA, OK	LDOR	LJ36	TUL
21-Sep-87	USA	TYNDALL AFB, FL	TOOR	LJ35	PAM
24-Sep-87	USA	TWIN FALLS, ID	TOOR	SW3	TWF
28-Sep-87	USA	SAINT LOUIS, MO	LDUS	MD80	STL
05-Oct-87	USA	OAKLAND, CA	TOOR	LJ25	OAK
06-Oct-87	USA	KENNEWICK, WA	LDOR	JS31	S98
21-Oct-87	USA	SAN LUIS OBISPO, CA	LDOR	SW3	SBP
28-Oct-87	USA	BARTLESVILLE, OK	LDOR	CV64	BVO
04-Nov-87	USA	WILLIAMSPORT, PA	LDOR	BE90	IPT
15-Nov-87	USA	DENVER, CO	TOOS	DC91	Stapleto n
23-Nov-87	USA	HOMER, AK	LDUS	B190	HOM

Date	Country	City/State	Event type	Aircraft Code	Airport Code
23-Nov-87	USA	NASHVILLE, TN	LDOR	B722	BNA
05-Dec-87	USA	LEXINGTON, KY	LDUS	HS25	LEX
19-Dec-87	USA	Bethel, AK	TOOR	C208	BET
03-Feb-88	USA	DENVER, CO	LDOR	DC8	DEN
16-Feb-88	USA	GROTON, CT	LDUS	SF34	GON
21-May-88	USA	DFW AIRPORT, TX	TOOR	DC10	DFW
01-Jun-88	USA	JAMAICA, NY	LDUS	B742	JFK
17-Jun-88	USA	W. PALM BEACH, FL	LDOR	LJ24	PBI
27-Jun-88	UK	Newcastle	TOOR	BA11	NCL
15-Jul-88	USA	SAN DIEGO, CA	LDOR	MU2	MYF
26-Jul-88	USA	MORRISTOWN, NJ	LDUS	LJ35	MMU
01-Aug-88	USA	PENSACOLA, FL	LDOR	MD88	PNS
16-Aug-88	USA	CLEVELAND, OH	TOOR	SW3	CLE
19-Aug-88	USA	Pensacola, FL	LDOR	DC9	PNS
19-Aug-88	USA	Cleveland, OH	TOOR	PA46	CLE
31-Aug-88	USA	DALLAS/FT WORTH, TX	TOOS	B722	DFW
11-Sep-88	USA	NEW ORLEANS, LA	TOOR	L29B	MSY
19-Sep-88	USA	San Diego, CA	LDUS	DC9	SAN
19-Sep-88	USA	Paducah, KY	LDOR	PA46	PAH
22-Sep-88	USA	FREMONT, MI	LDOR	C550	3FM
23-Sep-88	USA	PADUCAH, KY	LDOR	SW3	PAH
14-Oct-88	USA	SEATTLE, WA	LDOR	B722	SEA
19-Oct-88	USA	Columbus, GA	LDOR	B722	LSF
21-Oct-88	Canada	Happy Lake, Northwest Territories	LDOR	DHC6	Happy Lake
10-Nov-88	USA	BURBANK, CA	LDOR	C17	BUR
13-Nov-88	USA	NASHVILLE, TN	LDOR	SW3	BNA
15-Nov-88	USA	MINNEAPOLIS, MN	TOOR	DC93	MSP

Date	Country	City/State	Event type	Aircraft Code	Airport Code
17-Nov-88	USA	BEND, OR	LDOR	LJ25	BDN
19-Dec-88	USA	Charleston, SC	LDOR	DC9	CHS
19-Dec-88	USA	Sandusky, OH	LDUS	C212	SKY
30-Dec-88	USA	SAN JOSE, CA	LDOR	LJ35	SJC
09-Jan-89	USA	BATON ROUGE, LA	LDOR	DC93	BTR
12-Jan-89	USA	CROSSVILLE, TN	LDOR	C500	CSV
19-Jan-89	USA	Baton Rouge, LA	LDOR	DC9	BTR
15-Feb-89	USA	BINGHAMTON, NY	LDOR	FA20	BGM
19-Feb-89	USA	Covington, OH	LDOR	B722	CVG
20-Feb-89	USA	BLOOMINGTON/NORMAL, IL	LDOR	SH36	BMI
27-Feb-89	USA	POUGHKEEPSIE, NY	TOOS	C550	POU
15-Mar-89	USA	WEST LAFAYETTE, IN	LDUS	YS11	LAF
19-Mar-89	USA	Chicago, IL	LDOR	B722	ORD
19-Mar-89	USA	Daytona Beach, FL	LDOR	DC9	DAB
19-Mar-89	USA	Washington, DC	LDOR	DC9	DCA
23-Mar-89	USA	ROANOKE, VA	LDOR	LJ25	ROA
29-Mar-89	USA	OWENSBORO, KY	LDOR	MU30	OWB
01-Apr-89	UK	Leeds Bradford	LDOR	SH36	LBA
12-Apr-89	USA	SAN DIEGO, CA	LDOR	B752	SAN
13-Apr-89	USA	SCOTTSDALE, AZ	LDUS	H25B	SCF
19-Apr-89	USA	San Diego, CA	LDOR	B722	SAN
04-May-89	USA	EL MONTE, CA	LDOR	C500	EMT
06-May-89	USA	MT. PLEASANT, TN	LDUS	E110	MRC
18-May-89	USA	JACKSON, MS	LDOR	MU30	JAN
05-Jun-89	USA	GREENSBORO, NC	LDOR	BE20	GSO
18-Jul-89	USA	CHICAGO, IL	LDOR	DC10	ORD
19-Jul-89	USA	SIOUX CITY, IA	LDUS	DC10	SUX
27-Jul-89	USA	JACKSON, WY	LDOR	B737	JAC

Date	Country	City/State	Event type	Aircraft Code	Airport Code
19-Aug-89	USA	New Orleans, LA	TOOR	B722	MSY
21-Aug-89	USA	GOLD BEACH, OR	LDUS	BE90	4S1
25-Aug-89	USA	New Orleans, LA	TOOR	B722	MSY
13-Sep-89	USA	WARSAW, IN	TOOR	WW24	ASW
20-Sep-89	USA	FLUSHING, NY	TOOR	B737	LGA
18-Oct-89	USA	MONTE VISTA, CO	LDOR	DC93	MVI
19-Oct-89	USA	Dover, DE	LDOR	GALX	DOV
23-Oct-89	USA	ANCHORAGE, AK	LDOR	B742	ANC
13-Dec-89	USA	CHICAGO, IL	LDOR	DC93	MDW
26-Dec-89	USA	PASCO, WA	LDUS	JS31	PSC
30-Dec-89	USA	TUCSON, AZ	LDOR	B737	TUS
06-Jan-90	USA	MIAMI, FL	TOOR	L29B	MIA
17-Jan-90	USA	WEST POINT, MS	LDUS	BE40	M83
19-Jan-90	USA	Denver, CO	LDOR	B722	DEN
19-Jan-90	USA	LITTLE ROCK, AR	LDUS	GLF	LIT
30-Jan-90	USA	ROCHESTER, NY	TOOR	DC9	ROC
13-Mar-90	USA	TETERBORO, NJ	TOOR	LJ35	TEB
05-Apr-90	USA	PENSACOLA, FL	LDOR	DC3	PNS
22-Apr-90	Australia	Lord Howe Island, Lord Howe Island	LDOR	C501	LDH
28-Apr-90	New Zealand	Queenstown	LDOR	B461	ZQN
04-May-90	USA	WILMINGTON, NC	LDUS	N24A	ILM
18-Jul-90	USA	MILWAUKEE, WI	LDOR	MU30	MWC
19-Jul-90	USA	Jackson, WY	LDOR	DC9	JAC
29-Jul-90	USA	JACKSON, WY	LDOR	B737	JAC
19-Aug-90	USA	Santa Ana, CA	LDOR	B722	SNA
04-Oct-90	USA	DALLAS, TX	LDOR	GNAT	ADS
29-Nov-90	USA	SEBRING, FL	LDUS	C550	SEF
16-Dec-90	USA	MARSHFIELD, WI	LDUS	C500	MFI

Date	Country	City/State	Event type	Aircraft Code	Airport Code
20-Dec-90	USA	MCMINNVILLE, OR	LDUS	F900	MMV
14-Feb-91	USA	CLEVELAND, OH	LDOR	GLF	BKL
12-Mar-91	USA	JAMAICA, NY	TOOR	DC86	JFK
12-Mar-91	USA	ALEXANDRIA, MN	LDOR	MU30	AXN
19-Mar-91	USA	Raleigh, NC	LDOR	B722	RDU
29-Mar-91	USA	SIOUX CITY, IA	LDOR	WW24	SUX
15-May-91	USA	NASHVILLE, TN	LDUS	B722	BNA
19-Jun-91	USA	Kansas City, MO	LDOR	B722	MCI
26-Jun-91	USA	KANSAS CITY, MO	LDOR	B722	MCI
02-Jul-91	USA	COLUMBIA, TN	LDOR	LJ24	MRC
10-Jul-91	USA	Birmingham, Alabama	LDUS	BE99	BHM
22-Jul-91	USA	DETROIT, MI	TOOS	LJ24	DET
31-Jul-91	USA	DENVER, CO	TOOR	B722	DEN
10-Aug-91	USA	CHARLOTTE, NC	LDOR	B763	CLT
19-Aug-91	USA	Seattle, WA	LDOR	PA46	SEA
19-Aug-91	USA	Charlotte, NC	LDOR	B722	CLT
01-Sep-91	USA	BRAWLEY, CA, CA	LDOR	C340	BWC
06-Oct-91	USA	AUGUSTA, ME	LDOR	SW3	AUG
11-Oct-91	USA	Dallas, TX	TOOR	JS31	DFW
19-Oct-91	USA	ALLAKAKET, AK	LDUS	BE99	AET
15-Nov-91	USA	BRIGHAM CITY, UT	LDUS	HS25	BMC
19-Nov-91	USA	Los Angeles, CA	LDOR	DC9	LAX
26-Nov-91	USA	LOS ANGELES, CA	LDOR	B737	LAX
23-Dec-91	USA	CARLSBAD, CA	LDOR	LJ25	CRQ
31-Jan-92	USA	BELLINGHAM, WA	TOOR	B461	BLI
31-Mar-92	UK	Aberdeen	LDOR	B461	ABZ
04-Apr-92	USA	TITUSVILLE, FL	LDOR	NA	TIX
15-Apr-92	USA	CHARLOTTE, NC	TOOR	F27	CLT

Date	Country	City/State	Event type	Aircraft Code	Airport Code
19-Apr-92	USA	Charlotte, NC	TOOR	DC9	CLT
19-Apr-92	USA	FORT LAUDERDALE, FL	LDOR	ASTR	FLL
23-Apr-92	USA	YPSILANTI, MI	LDOR	DC86	YIP
16-May-92	USA	CALDWELL, NJ, NJ	LDOR	C172	CDW
19-May-92	USA	Bozeman, MT	LDOR	DC9	BZN
07-Jun-92	Puerto Rico	Mayaguez,	LDUS	C212	TJMZ
10-Jun-92	USA	HASTINGS, MI	LDUS	C172	9D9
16-Jun-92	USA	NEW CASTLE, DE	LDUS	BE20	ILG
17-Jun-92	USA	CEDAR RAPIDS, IA	LDOR	SBR1	CID
01-Jul-92	USA	CHICAGO, IL	LDOR	B752	ORD
11-Jul-92	USA	CHEYENNE, WY	LDOR	B190	CYS
19-Jul-92	Northern Mariana Islands	Rota, FO	LDOR	B722	ROP
19-Jul-92	USA	Chicago, IL	LDOR	B722	ORD
29-Jul-92	USA	JACKSON, WY	LDOR	B752	JAC
30-Jul-92	USA	JAMAICA, NY	TOOS	L101	JFK
07-Aug-92	USA	MILWAUKEE, WI	LDOR	B722	MKE
08-Aug-92	USA	NUIQSUT, AK	LDUS	BE90	AQT
19-Aug-92	USA	Washington DC	TOOR	SW3	DCA
19-Aug-92	USA	Milwaukee, WI	LDOR	B722	MKE
23-Aug-92	USA	LOUISVILLE, KY	LDOR	MD88	SDF
08-Sep-92	USA	WILMINGTON, NC	LDOR	MU30	ILM
05-Nov-92	USA	SAN ANTONIO, TX	LDUS	SW3	SAT
07-Nov-92	USA	PHOENIX, AZ	LDOR	SBR1	PHX
22-Nov-92	USA	CLEVELAND, OH	LDOR	LJ25	CLE
27-Nov-92	UK	Southampton	LDOR	L188	SOU
18-Dec-92	USA	MCCALL, ID	TOOR	FA10	MYL
03-Jan-93	CANADA	ST. ANDREWS AIRPORT 20NM N,	LDOR	AC68	CYAV

Date	Country	City/State	Event type	Aircraft Code	Airport Code
		MANITOBA			
22-Jan-93	USA	WILLOUGHBY, OH	LDUS	BE36	CGF
05-Feb-93	USA	FAIRBANKS, AK	TOOR	PA18	FAI
13-Feb-93	USA	PORTLAND, ME	LDOR	B737	PWM
19-Feb-93	USA	Portland, ME	LDOR	DC9	PWM
15-Apr-93	USA	FLAGSTAFF, AZ	LDUS	C172	FLG
19-Apr-93	USA	MERCED, CA	TOOS	JS31	MCE
27-Apr-93	USA	DENVER, CO	LDOR	DC98	DEN
29-Apr-93	USA	PINE BLUFF, AR	LDOR	E120	PBF
24-May-93	USA	KILLEEN, TX	LDOR	FA10	ILE
26-May-93	UK	Southampton, England	LDOR	C550	SOU
04-Jun-93	USA	SPRINGFIELD, MO	LDOR	FA10	SGF
07-Jun-93	USA	MANASSAS, VA	TOOS	BE24	HEF
19-Jul-93	USA	Nantucket, MI	LDUS	DC9	ACK
21-Jul-93	CANADA	TOFINO, B.C., BRITISH COLUMBIA	LDOR	CV44	CYAZ
21-Jul-93	Canada	Tofino	LDOR	CV58	YAZ
30-Jul-93	USA	NANTUCKET, MA	LDUS	B737	ACK
24-Aug-93	USA	LANDOVER, MD	LDUS	M20	ADW
26-Aug-93	USA	HAILEY, ID	LDOR	FA10	SUN
26-Aug-93	USA	SPRINGDALE, AR	LDUS	C210	ASG
12-Sep-93	France	Tahiti	LDOR	B742	PPT
12-Sep-93	USA	FAIRBANKS, AK	TOOS	C152	FAI
14-Sep-93	Poland	Warsaw	LDOR	A320	EPWA
19-Sep-93	USA	Washington, DC	LDOR	DC9	DCA
19-Sep-93	France	Troyes, Aube	TOOR	SW3	QYR
26-Sep-93	USA	SALT LAKE CITY, UT	TOOS	PA23	SLC
29-Sep-93	France	Besançon, Franche-Comté	TOOR	FA10	QBQ
29-Sep-93	UK	Norwich	LDOR	BA11	NWI

Date	Country	City/State	Event type	Aircraft Code	Airport Code
02-Nov-93	USA	HOUSTON, TX	TOOR	CL60	HOU
08-Nov-93	USA	MANASSAS, VA	LDUS	PA28	HEF
09-Nov-93	USA	SALT LAKE CITY, UT	LDUS	C182	SLC
04-Dec-93	USA	CORVALLIS, OR	LDOR	L29B	CVO
07-Dec-93	USA	SANTA MONICA, CA	LDOR	C177	SMO
08-Dec-93	USA	DFW AIRPORT, TX	LDUS	B737	DFW
15-Dec-93	USA	SANTA ANA, CA	LDUS	WW24	SNA
22-Dec-93	USA	CHESTERFIELD, MO	LDUS	M20E	SUS
07-Jan-94	USA	COLUMBUS, OH	LDUS	JS41	CMH
07-Jan-94	USA	Gahanna, Ohio	LDUS	JS41	CMH
19-Jan-94	USA	Wilmington, OH	LDOR	NA	ILN
19-Jan-94	USA	WINDSOR LOCKS, CT	LDOR	DC9	BDL
20-Jan-94	USA	TETERBORO, NJ	LDOR	MU30	TEB
21-Jan-94	Canada	Terrace, British Columbia	LDOR	B461	YXT
24-Jan-94	USA	KEY LARGO, FL	LDUS	LJ25	07FA
27-Jan-94	USA	CHICAGO, IL	LDOR	DC8	ORD
27-Jan-94	USA	PONTIAC, MI	LDOR	LJ35	PTK
31-Jan-94	USA	CHESTERFIELD, MO	LDUS	C210	SUS
01-Feb-94	USA	NEW ROADS, LA	LDOR	SF34	HZR
06-Feb-94	USA	CHESTERFIELD, MO	LDUS	BE95	SUS
08-Feb-94	USA	WASHINGTON, DC	LDOR	MD80	DCA
19-Feb-94	USA	Rifle, CO	LDOR	B461	RIL
19-Feb-94	USA	Washington, DC	LDOR	DC9	DCA
21-Feb-94	USA	KINSTON, NC	TOOS	PA24	ISO
02-Mar-94	USA	FLUSHING, NY	TOOR	MD82	LGA
11-Mar-94	USA	LOS ANGELES, CA	LDUS	PA28	SMO
19-Mar-94	USA	Columbus, OH	LDOR	NA	CMH
19-Mar-94	USA	State College, PA	LDOR	JS32	UNV

Date	Country	City/State	Event type	Aircraft Code	Airport Code
25-Mar-94	USA	NASHUA, NH	TOOS	G115	ASH
26-Mar-94	USA	BOCA RATON, FL	TOOS	C172	BCT
30-Mar-94	USA	AUSTIN, TX	LDUS	C182	AUS
06-Apr-94	USA	JACKSON, WY	TOOR	C421	JAC
11-Apr-94	USA	CHESTERFIELD, MO	LDUS	C182	SUS
18-Apr-94	USA	BEDFORD, PA, PA	LDUS	PA32	4G9
26-Apr-94	USA	ANDERSON, IN	LDOR	CV44	AID
30-Apr-94	USA	HOLLIS, NH	LDUS	C150	ASH
19-May-94	USA	Texarkana, TX	TOOR	SF34	TXK
13-Jun-94	USA	LEWISBURG, WV	LDOR	LJ35	LWB
02-Jul-94	USA	Charlotte, North Carolina	LDUS	DC93	CLT
12-Jul-94	USA	WHITE PLAINS, NY, NY	TOOR	PA60	HPN
13-Jul-94	USA	ATLANTIC CITY, NJ	TOOR	LJ35	ACY
13-Jul-94	USA	TUCSON, AZ	LDUS	M20J	TUS
22-Jul-94	USA	JACKSON, WY	LDOR	B737	JAC
30-Jul-94	USA	LIVERMORE, CA	LDUS	C182	LVK
10-Aug-94	South Korea	Jeju	LDOR	A300	CJU
19-Aug-94	USA	SAVANNAH, GA	LDOR	NA	SAV
26-Aug-94	USA	NEW ORLEANS, LA	TOOR	FA20	NEW
27-Aug-94	USA	CHESTERFIELD, MO	TOOR	BD10	SUS
19-Sep-94	USA	WINSTON-SALEM, NC, NC	LDUS	BE35	INT
20-Sep-94	USA	STERLING, MA, MA	LDOR	C172	3B3
08-Oct-94	USA	COALINGA, CA, CA	LDUS	C172	308
08-Oct-94	USA	PITTSBURGH, PA	LDOR	B190	PIT
10-Oct-94	USA	SAN ANTONIO, TX	LDOR	LJ35	SAT
04-Nov-94	USA	LITTLE ROCK, AR	LDOR	DC9	LIT
17-Nov-94	USA	BOZEMAN, MT	LDOR	DC93	BZN
27-Nov-94	USA	GREER, SC	LDUS	C182	GSP

Date	Country	City/State	Event type	Aircraft Code	Airport Code
07-Dec-94	USA	BATAVIA, NY	LDOR	C550	GVQ
08-Dec-94	USA	KANSAS CITY, MO	LDUS	BE36	MCI
11-Jan-95	USA	FLAGSTAFF, AZ	TOOS	C208	FLG
19-Jan-95	USA	ATLANTA, GA	LDOR	B737	ATL
24-Jan-95	USA	MILWAUKEE, WI	LDOR	NA	MKE
01-Feb-95	USA	Atlanta, GA	LDOR	DC86	ATL
13-Feb-95	USA	TUSAYAN, AZ	LDUS	PA31	GCN
17-Feb-95	USA	ATLANTA, GA	LDOR	DC8	ATL
19-Feb-95	USA	Chicago, IL	LDOR	MD80	ORD
19-Feb-95	USA	Chicago, IL	LDOR	DC10	ORD
19-Feb-95	USA	Portland, OR	LDUS	B722	PDX
22-Feb-95	USA	CHICAGO, IL	LDOR	DC10	ORD
01-Mar-95	Canada	Jasper Hinton Airport, Alberta	LDOR	MU30	CEC4
03-Mar-95	USA	GILLETTE, WY	LDUS	WW24	GCC
19-Mar-95	USA	Honolulu, HI	LDOR	DC10	HNL
20-Mar-95	USA	BETHEL, AK	LDUS	C207	BET
21-Apr-95	USA	TACOMA, WA	TOOS	PA28	TIW
23-Apr-95	USA	CLEVELAND, OH	LDUS	M20J	BKL
29-Apr-95	USA	CHICAGO, IL	LDOR	DC8	ORD
11-May-95	Canada	St Johns, Newfoundland	LDOR	B722	YWK
14-May-95	USA	OAKLAND, CA, CA	TOOR	C177	OAK
16-May-95	USA	FLAGSTAFF, AZ	TOOR	RYST	FLG
19-May-95	USA	ATLANTIC CITY, NJ	LDOR	BE23	AIY
23-May-95	USA	ROGERS, AR	TOOR	LJ35	ROG
29-May-95	USA	DOWNERS GROVE, IL	TOOS	BE35	C24
07-Jun-95	USA	HYANNIS, MA	LDOR	C500	HYA
19-Jun-95	Panama	PANAMA CITY	LDUS	B742	PTY
25-Jun-95	USA	Atlanta, GA	TOOR	LJ35	ATL

Date	Country	City/State	Event type	Aircraft Code	Airport Code
07-Jul-95	USA	BOCA RATON, FL	LDOR	C152	BCT
11-Jul-95	USA	COLUMBUS, OH	TOOR	C310	CMH
11-Jul-95	USA	COLUMBUS, OH	TOOR	C310	CMH
26-Jul-95	USA	MINNEAPOLIS, MN	LDOR	C550	FCM
21-Aug-95	USA	MESA, AZ	LDOR	LJ24	FFZ
18-Sep-95	USA	AMES, IA	TOOR	C402	AMW
18-Sep-95	USA	CHINO, CA	LDUS	SW3	CNO
19-Sep-95	USA	Fayetteville, AR	LDOR	MD80	FYV
19-Sep-95	USA	Charleston, SC	LDOR	MD88	CHS
21-Sep-95	USA	HOUSTON, TX	TOOR	LJ25	HOU
12-Oct-95	USA	CLEVELAND, OH	LDUS	GLF	CLE
19-Oct-95	Canada	Vancouver	TOOR	DC10	YVR
02-Nov-95	USA	GRAND CANYON, AZ	TOOS	F26T	GCN
03-Nov-95	USA	REDWOOD CITY, CA	LDUS	C402	SQL
12-Nov-95	USA	Windsor Locks, Connecticut	LDUS	MD83	BDL
18-Nov-95	USA	OXNARD, CA	TOOS	BE35	OXR
19-Nov-95	USA	CLEVELAND, OH	TOOS	BE58	BKL
19-Nov-95	USA	ANCHORAGE, AK	LDUS	C441	ANC
22-Nov-95	USA	GRAND CANYON, AZ	TOOS	C210	GCN
08-Dec-95	USA	CHICAGO, IL	LDOR	B722	ORD
09-Dec-95	USA	JACKSON, WY	LDOR	MU30	JAC
14-Dec-95	USA	DETROIT, MI	LDOR	LJ55	DET
19-Dec-95	USA	Los Angeles, CA	LDOR	B737	LAX
01-Jan-96	UK	Derbyshire, England	LDOR	F70	EMA
02-Jan-96	Australia	Bankstown, New South Wales	LDOR	C150	BWU
05-Jan-96	UK	East Midlands Airport	LDOR	DC87	EMA
07-Jan-96	USA	NASHVILLE, TN	LDUS	DC93	BNA
14-Jan-96	USA	NASHUA, NH	LDUS	C172	ASH

Date	Country	City/State	Event type	Aircraft Code	Airport Code
19-Jan-96	USA	JACKSON, WY	LDOR	E120	JAC
26-Jan-96	USA	SPARTA, TN	LDOR	FA20	SRB
31-Jan-96	USA	FLAGSTAFF, AZ	LDUS	BE90	FLG
07-Feb-96	USA	BRADFORD, PA	LDOR	B190	BFD
07-Feb-96	USA	MAMMOTH LAKES, CA	LDOR	SW3	MMH
19-Feb-96	USA	HOUSTON, TX	LDOR	DC93	IAH
19-Feb-96	USA	Savannah, GA	LDOR	DC9	SAV
20-Feb-96	USA	RIFLE, CO	LDOR	A748	RIL
20-Feb-96	USA	WASHINGTON, DC	LDOR	B737	DCA
20-Feb-96	USA	WASHINGTON, DC	LDOR	B737	DCA
28-Feb-96	USA	SAVANNAH, GA	LDOR	DC93	SAV
11-Mar-96	USA	BRIDGEPORT, WV	TOOS	PA23	CKB
25-Mar-96	USA	HAILEY, ID	LDOR	C500	SUN
03-Apr-96	Canada	Moncton, New Brunswick	LDOR	B722	YQM
03-Apr-96	USA	TRAVERSE CITY, MI	LDOR	AT43	TVC
01-May-96	USA	ALBUQUERQUE, NM	TOOR	SBR2	ABQ
11-May-96	USA	KINSTON, NC	TOOS	M18	ISO
27-Jun-96	USA	SAN CARLOS, CA	TOOS	C150	SQL
29-Jun-96	USA	GRAND CANYON, AZ	LDUS	C402	GCN
03-Jul-96	USA	KINSTON, NC	LDUS	BE58	ISO
08-Jul-96	USA	NASHVILLE, TN	TOOR	B737	BNA
24-Jul-96	USA	BREWER, ME	LDUS	C182	BGR
27-Jul-96	USA	PORTLAND, OR	LDUS	C182	PDX
01-Aug-96	UK	Cambridge	TOOR	C550	
13-Aug-96	UK	Northolt, Greater London	LDOR	LJ25	NHT
14-Aug-96	USA	POTTSTOWN, PA	TOOR	PA31	N47
15-Aug-96	USA	CUSTER, SD, SD	TOOS	BE35	SD02
16-Aug-96	UK	Liverpool Airport	TOOR	HS25	LPL

Date	Country	City/State	Event type	Aircraft Code	Airport Code
31-Aug-96	USA	YOUNGSTOWN, OH, OH	TOOS	C177	04G
31-Aug-96	USA	LUBBOCK, TX	LDUS	B722	LBB
28-Sep-96	USA	CHILLICOTHE, OH	LDOR	MU2	RZT
06-Oct-96	USA	SALINAS, CA	LDOR	SBR2	SNS
14-Oct-96	USA	LAS VEGAS, NV	LDOR	AC6L	VGT
19-Oct-96	USA	FLUSHING	LDUS	MD88	LGA
29-Oct-96	USA	CHICAGO/WAUKEGAN, IL	LDOR	CL60	UGN
01-Nov-96	USA	Cleveland, OH	LDOR	MD88	CLE
07-Nov-96	USA	PAWTUCKET, RI, RI	LDOR	C340	SFZ
11-Nov-96	USA	CLEVELAND, OH	LDOR	MD80	CLE
11-Nov-96	USA	CLEVELAND, OH	LDOR	MD88	CLE
15-Nov-96	USA	SIOUX FALLS, SD	LDOR	DC9	FSD
19-Nov-96	USA	Honolulu, HI	LDOR	DC10	HNL
26-Nov-96	USA	BETHEL, AK	TOOS	C208	BET
30-Nov-96	USA	IRVINE, CA	LDUS	MS76	SNA
06-Dec-96	USA	BEDFORD, MA	LDOR	GLF	BED
09-Dec-96	USA	BOISE, ID	TOOS	DC3	BOI
22-Dec-96	USA	HAILEY, ID	LDOR	CL60	SUN
23-Dec-96	CANADA	TRENTON AERODROME (DND), ONTARIO	LDOR	A124	CYTR
01-Jan-97	USA	KANSAS CITY, MO	LDOR	LJ35	MKC
03-Jan-97	USA	JACKSON, WY	LDOR	WW24	JAC
09-Jan-97	USA	MONROE, MI	LDUS	E120	DTW
10-Jan-97	USA	BANGOR, ME	TOOR	B190	BGR
19-Jan-97	Italy	Rome	TOOR	DC10	FCO
21-Jan-97	USA	BLOOMINGTON, IN	LDOR	BE30	BMG
25-Jan-97	USA	PROVINCETOWN, MA	LDOR	C402	PVC
07-Feb-97	USA	LOS ANGELES, CA	LDUS	C310	SMO

Date	Country	City/State	Event type	Aircraft Code	Airport Code
16-Feb-97	CANADA	WINNIPEG, MANITOBA	LDUS	BE60	CYWG
19-Feb-97	USA	Chicago, IL	LDOR	B737	ORD
27-Feb-97	USA	GREENVILLE, SC	LDOR	LJ25	GMU
02-Mar-97	USA	SALT LAKE CITY, UT	LDUS	B200	SLC
12-Mar-97	USA	HOUSTON, TX	LDOR	MU30	SGR
07-Apr-97	USA	STEBBINS, AK	LDUS	PA31	WBB
10-Apr-97	USA	BLOOMINGTON/NORMAL, IL	LDOR	JS41	BMI
25-Apr-97	USA	SAN JOSE, CA	TOOS	C172	SJC
05-May-97	USA	WESTMINISTER, MD, MD	LDOR	C172	2W2
07-May-97	USA	EL MONTE, CA	TOOR	C172	EMT
21-May-97	USA	SAN DIEGO, CA	LDOR	E120	NKX
13-Jun-97	USA	SAN ANTONIO, TX	TOOR	C421	SAT
25-Jun-97	England	London,	LDOR	B461	EGLC
03-Jul-97	USA	PENSACOLA, FL	LDOR	B190	PNS
05-Jul-97	USA	ARDMORE, OK	LDOR	SBR2	ADM
15-Jul-97	USA	AVON PARK, FL	LDOR	LJ35	AVO
16-Jul-97	USA	KNOXVILLE, TN	TOOS	C177	TYS
30-Jul-97	Italy	Florence, Tuscany	LDOR	AT43	FLR
03-Aug-97	USA	EAST HAMPTON, NY	LDOR	C560	HTO
07-Aug-97	USA	MIAMI, FL	TOOR	DC86	MIA
09-Aug-97	USA	EAGLE, CO	TOOS	C210	EGE
11-Aug-97	USA	SANTA ANA, CA	LDUS	C195	SNA
13-Aug-97	USA	LEXINGTON, KY	LDUS	FA20	LEX
14-Aug-97	USA	DALTON, GA	LDUS	BE20	DNN
19-Aug-97	USA	DES MOINES, IA	LDOR	SW3	DSM
19-Oct-97	Hong Kong	Hong Kong, FO	LDUS	B742	HKG
13-Nov-97	USA	WHEELING, WV	LDUS	BE60	HLG
18-Nov-97	USA	SAN CARLOS, CA	LDUS	AC11	SQL

Date	Country	City/State	Event type	Aircraft Code	Airport Code
29-Nov-97	Wales	Fairwood Common,	LDOR	DH8A	EGFH
29-Nov-97	Canada	Island Lake, Manitoba	TOOR	B190	YIV
07-Dec-97	England	Channel Islands	LDOR	F27	EGJB
18-Dec-97	USA	OXFORD, CT	TOOS	BT13	OXC
19-Dec-97	USA	Savannah, GA	LDOR	B722	SAV
19-Dec-97	USA	Memphis, TN	LDOR	DC10	MEM
28-Dec-97	USA	ELKINS, WV, WV	TOOR	C421	EKN
31-Dec-97	USA	CHESTERFIELD, MO	LDUS	BE35	SUS
06-Jan-98	USA	WEST MIFFLIN, PA	LDOR	C500	AGC
07-Jan-98	UK	London City	LDOR	B461	LCY
16-Jan-98	USA	VAN NUYS, CA	LDOR	GLF4	VNY
19-Jan-98	USA	Portland, ME	LDOR	B722	PWM
19-Jan-98	USA	Mekoryuk, AK	LDOR	B350	MYU
22-Jan-98	USA	DENVER, CO	LDOR	DC8	DEN
22-Jan-98	USA	DENVER, CO	LDOR	DC86	DEN
03-Feb-98	USA	OMAHA, NE	LDOR	C414	OMA
09-Feb-98	USA	CHICAGO, IL	LDUS	B722	ORD
18-Feb-98	Canada	Peterborough Airport, Ontario	LDOR	FA20	YPQ
19-Feb-98	Hong Kong	Hong Kong, FO	LDUS	B742	HKG
20-Feb-98	UK	Norwich	TOOR	JP	
23-Feb-98	USA	VAN NUYS, CA	LDOR	LJ35	VNY
26-Feb-98	USA	PITTSBURGH, PA	LDOR	WW24	AGC
04-Mar-98	USA	MANISTEE, MI	LDOR	C650	MBL
11-Mar-98	USA	ASPEN, CO	LDOR	B461	ASE
14-Mar-98	USA	PORTLAND, ME	LDOR	MD80	PWM
14-Mar-98	USA	PORTLAND, ME	LDOR	MD80	PWM
19-Mar-98	USA	PORTLAND, OR	TOOR	S601	PDX
25-Mar-98	USA	COLUMBUS, OH	LDOR	CL60	OSU

Date	Country	City/State	Event type	Aircraft Code	Airport Code
30-Mar-98	UK	Stansted	TOOR	HS25	STN
31-Mar-98	USA	DES MOINES, IA	LDOR	B722	DSM
01-Apr-98	USA	CHINLE, AZ	LDOR	C421	E91
19-Apr-98	USA	LINCOLN, NE	LDOR	C650	LNK
23-Apr-98	USA	COLUMBUS, OH	LDUS	BE58	CMH
11-May-98	USA	NASHUA, NH	LDUS	C310	ASH
12-May-98	USA	MONROE, MI	TOOR	FA20	TTF
19-May-98	USA	Atlanta, GA	LDOR	DC93	ATL
23-May-98	USA	ORLANDO, FL	LDOR	LJ24	ORL
07-Jun-98	USA	EXCELSIOR SPR, MO, MO	TOOR	BE23	3EX
19-Jun-98	USA	FISHERS ISLAND, NY	LDOR	C500	0B8
21-Jun-98	Spain	Ibiza,	LDOR	A320	LEIB
23-Jun-98	USA	WASHINGTON, DC	TOOR	LJ60	IAD
23-Jun-98	USA	SANTA ANA, CA	LDUS	C152	SNA
23-Jun-98	USA	WASHINGTON, DC	TOOR	LJ60	IAD
27-Jun-98	USA	FLAGSTAFF, AZ	TOOS	C172	FLG
12-Jul-98	USA	HAILEY, ID	TOOS	C170	SUN
14-Jul-98	USA	PITTSBURGH, PA	LDOR	B737	PIT
14-Jul-98	USA	PITTSBURGH, PA	LDOR	B737	PIT
19-Jul-98	USA	Raleigh, NC	TOOR	B722	RDU
22-Jul-98	UK	Belfast	LDOR	B461	BHD
01-Aug-98	USA	CHICAGO, IL, IL	TOOS	C340	CGX
06-Aug-98	Canada	Kasabonika, Ontario	LDOR	HS25	XKS
28-Aug-98	USA	El Paso, TX	TOOR	FA20	ELP
28-Aug-98	USA	MINNEAPOLIS, MN	LDOR	BE30	FCM
26-Sep-98	UK	Fairoaks, England	LDOR	C560	FRK
24-Oct-98	UK	Southampton	LDOR	F100	SOU
19-Nov-98	USA	Atlanta, GA	LDOR	DC86	ATL

Date	Country	City/State	Event type	Aircraft Code	Airport Code
03-Dec-98	Canada	Iqaluit, Nunavut	TOOR	HS25	YFB
15-Dec-98	USA	MARKSVILLE, LA	LDUS	C150	LA26
18-Dec-98	USA	ROCHESTER, NY	LDOR	B722	ROC
18-Dec-98	USA	ROCHESTER, NY	LDOR	B722	ROC
24-Dec-98	USA	PROVIDENCE, RI	LDOR	MD80	PVD
26-Dec-98	USA	JACKSON, WY	LDOR	B737	JAC
29-Dec-98	USA	JACKSON, WY	LDOR	BE30	JAC
04-Jan-99	CANADA	ST-AUGUSTIN, QUEBEC	LDUS	B190	CYIF
19-Jan-99	USA	Wilmington, OH	LDOR	DC86	ILN
20-Jan-99	USA	CHINO, CA	LDOR	GLF2	CNO
08-Feb-99	Netherland	Amsterdam,	LDOR	B742	EHAM
11-Feb-99	USA	GRAND ISLAND, NE	LDUS	AC50	GRI
16-Feb-99	USA	VAN NUYS, CA	LDOR	GLF	VNY
18-Feb-99	USA	COLUMBUS, NE	LDOR	MU30	OLU
19-Feb-99	USA	Miami, FL	LDUS	A300	MIA
09-Mar-99	USA	INDIANAPOLIS, IN	LDOR	DC8	IND
30-Mar-99	England	Newquay,	LDUS	C550	EGHQ
30-Mar-99	USA	ROGERS, AR	LDUS	LJ35	ROG
17-Apr-99	USA	BECKLEY, WV	LDOR	BE40	BKW
27-Apr-99	USA	JUNEAU, AK	LDUS	C185	JNU
28-Apr-99	USA	CROSSVILLE, TN	LDOR	FA10	CSV
04-May-99	USA	SPARTA, TN	LDOR	FA20	SRB
08-May-99	USA	JAMAICA, NY	LDOR	SF34	JFK
19-May-99	USA	New York, NY	LDUS	B763	JFK
25-May-99	USA	ALTUS, OK, OK	TOOS	M18	OK83
01-Jun-99	USA	LITTLE ROCK, AR	LDOR	MD82	LIT
19-Jun-99	Philippines	Manilla, FO	LDOR	B722	XCN
01-Jul-99	USA	HYANNIS, MA	LDOR	LJ60	HYA

Date	Country	City/State	Event type	Aircraft Code	Airport Code
01-Jul-99	USA	SALT LAKE CITY, UT	LDUS	C182	SLC
19-Jul-99	USA	Minneapolis, MN	LDOR	B722	MSP
23-Jul-99	USA	DOVER, DE, DE	LDOR	C172	0N4
30-Jul-99	USA	MINNEAPOLIS, MN	LDOR	B722	MSP
30-Jul-99	USA	MINNEAPOLIS, MN	LDOR	B722	MSP
01-Aug-99	Canada	ST. JOHN'S, Newfoundland	LDOR	F27	YYT
03-Aug-99	USA	TUSAYAN, AZ	TOOS	C177	GCN
05-Aug-99	USA	MINERAL POINT, WI	LDOR	BE9L	MRJ
09-Aug-99	USA	MINNEAPOLIS, MN	LDOR	DC10	MSP
14-Aug-99	USA	SARANAC LAKE, NY	LDOR	B722	SLK
18-Aug-99	USA	SAN CARLOS, CA	LDUS	DA20	SQL
19-Aug-99	USA	Minneapolis, MN	LDOR	DC10	MSP
06-Sep-99	Scottland	Shetland,	LDOR	C208	EGPB
19-Sep-99	Ireland	Shannon, FO	LDOR	DC11	SNN
19-Sep-99	USA	Minneapolis, MN	LDOR	DC93	MSP
23-Sep-99	Thailand	Bangkok, Nonthaburi	LDOR	B742	BKK
24-Sep-99	Canada	ST. JOHN'S, Newfoundland	LDUS	A320	YYT
26-Sep-99	USA	GAINESVILLE, GA	LDOR	LJ24	GVL
19-Oct-99	France	Paris, Ile de France	LDOR	DC11	CDG
11-Nov-99	USA	CHICAGO, IL	TOOR	BE20	CGX
22-Nov-99	Canada	Dryden, Ontario	LDOR	SW3	YHD
06-Dec-99	USA	BETHEL, AK	TOOR	C208	BET
09-Dec-99	USA	HASBROUCK HTS., NJ	LDUS	BE58	TEB
13-Dec-99	USA	ATLANTA, GA	LDOR	C550	PDK
24-Dec-99	USA	BETHEL, AK	TOOS	C207	BET
29-Dec-99	USA	TRAVERSE CITY, MI	LDOR	DC9	TVC
01-Jan-00	USA	Charlotte, NC	LDOR	DC98	CLT
19-Jan-00	USA	GARY, IN	LDOR	B722	GYY

Date	Country	City/State	Event type	Aircraft Code	Airport Code
20-Jan-00	USA	Sparta, TN	LDOR	FA20	SRB
27-Jan-00	USA	DALLAS, TX	LDOR	MU30	DAL
12-Feb-00	USA	OLATHE, KS	LDUS	BE36	OJC
16-Feb-00	Japan	Sapporo, Hokkaidō (Yesso)	LDOR	YS11	OKD
29-Feb-00	USA	HOUSTON, TX	LDOR	B737	IAH
05-Mar-00	USA	BURBANK, CA	LDOR	B737	BUR
12-Mar-00	USA	JACKSON, WY	LDOR	LJ60	JAC
13-Mar-00	USA	SAN FRANCISCO, CA	LDUS	B722	SFO
17-Mar-00	USA	HYANNIS, MA	LDOR	F900	HYA
21-Mar-00	USA	KILLEEN, TX	LDOR	SF34	ILE
27-Mar-00	USA	FAIRBANKS, AK	LDUS	PA32	PAFA
01-Apr-00	USA	EAGLE, CO	LDOR	HS25	EGE
11-Apr-00	USA	SEATTLE, WA	LDUS	C172	BFI
11-May-00	Canada	Edmonton, Alberta	TOOR	DC93	YEG
16-May-00	CANADA	DRYDEN REGIONAL, ONTARIO	LDOR	C152	CYHD
18-May-00	USA	MILWAUKEE, WI	LDOR	GLF5	MWC
31-May-00	USA	PALM SPRINGS, CA	LDUS	C152	PSP
29-Jun-00	USA	JOLIET, IL	LDOR	BE20	JOT
01-Jul-00	UK	Coventry, England	LDOR	F27	CVT
23-Jul-00	Canada	Dorval, Quebec	LDOR	B742	YUL
09-Aug-00	USA	PORTLAND, OR	LDOR	C402	PDX
14-Aug-00	USA	COLUMBUS, OH	TOOS	C337	TZR
17-Aug-00	USA	OTTAWA, IL	TOOR	SC7	8N2
24-Aug-00	USA	FALLON, NV	LDUS	C182	FLX
26-Aug-00	USA	BOISE, ID	LDUS	C411	BOI
01-Sep-00	Canada	Ottawa, ON	LDOR	B722	YOW
08-Sep-00	USA	HAILEY, ID	LDUS	M20L	SUN
15-Sep-00	Canada	Ottawa, Ontario	LDOR	B722	YOW

Date	Country	City/State	Event type	Aircraft Code	Airport Code
04-Oct-00	USA	SANTA ROSA, CA	TOOS	C182	STS
15-Oct-00	USA	ANCHORAGE, AK	TOOR	B742	ANC
19-Oct-00	USA	Concord, CA	TOOR	BE30	CCR
20-Oct-00	USA	St Louis, MO	LDOR	MD82	STL
28-Nov-00	Canada	Fredericton, New Brunswick	LDOR	F27	YFC
18-Dec-00	Canada	Windsor, Ontario	LDOR	A124	YQG
21-Dec-00	USA	SAN CARLOS, CA	LDUS	C177	SQL
24-Dec-00	France	Faaa, Tahiti	LDOR	DC10	PPT
29-Dec-00	USA	Charlottesville, VA	LDOR	JS41	CHO
30-Dec-00	USA	SALT LAKE CITY, UT	LDUS	MD88	SLC
01-Jan-01	USA	Glasgow, KY	LDOR	BE90	GLW
04-Jan-01	USA	Schenectady, NY	TOOR	LJ25	SCH
14-Jan-01	USA	Corona, CA	TOOS	C172	AJO
01-Feb-01	USA	SAN LUIS OBISPO, CA	TOOR	WW24	SBP
04-Feb-01	USA	FT. PIERCE, FL	LDOR	LJ25	FPR
08-Feb-01	USA	Santa Maria, CA	LDUS	C182	SMX
08-Feb-01	USA	San Diego, CA	LDUS	PA28	MYF
13-Feb-01	USA	Olympia, WA	LDOR	BE20	OLM
04-Mar-01	USA	PHOENIX, AZ	LDOR	B737	PHX
09-Mar-01	USA	Bridgeport, CT	LDOR	HS25	BDR
12-Mar-01	USA	TELLURIDE, CO	LDOR	LJ35	TEX
17-Mar-01	FRANCE	LYON, RHONE-ALPES	LDOR	B737	LYS
17-Mar-01	USA	Detroit, MI	TOOR	A320	DTW
19-Mar-01	USA	Manassas, VA	LDUS	PA28	HEF
20-Mar-01	USA	El Paso, TX	LDOR	DC9	ELP
20-Mar-01	USA	Shreveport, LA	LDOR	E110	SHV
22-Mar-01	France	Orleans, Centre	TOOR	PA31	LFOZ
29-Mar-01	USA	Aspen, CO	LDUS	GLF3	ASE

Date	Country	City/State	Event type	Aircraft Code	Airport Code
04-Apr-01	Canada	St. John's, Newfoundland	LDOR	B737	YYT
13-Apr-01	USA	Gig Harbor, WA	LDOR	C172	TIW
22-Apr-01	USA	OXNARD, CA	TOOS	PA22	OXR
05-May-01	USA	RIVERSIDE, CA	LDOR	AC11	RAL
05-May-01	USA	Hesperia, CA	LDUS	PA28	L26
05-May-01	USA	Big Bear City, CA	TOOS	PA28	L35
12-May-01	CANADA	MONTRÉAL INTL (DORVAL), QUEBEC	LDOR	F100	CYUL
25-May-01	France	Cayenne, Guyane	LDUS	A340	CAY
28-May-01	USA	CHICAGO, IL	LDOR	B737	ORD
07-Jun-01	USA	Nashua, NH	TOOR	C172	ASH
09-Jun-01	USA	Springdale, AR	TOOS	BE35	ASG
12-Jun-01	USA	Salina, KS	LDUS	LJ25	SLN
14-Jun-01	USA	Stockton, CA	LDUS	PA46	SCK
14-Jun-01	USA	VAN NUYS, CA	LDOR	C550	VNY
14-Jun-01	USA	Stockton, CA	LDUS	PA46	SCK
25-Jun-01	USA	Napa, CA	LDOR	C172	APC
18-Jul-01	USA	Chandler, AZ	LDUS	PA34	CHD
20-Jul-01	USA	Portland, ME	LDOR	SF34	PWM
21-Jul-01	USA	Springdale, AR	TOOS	C152	ASG
05-Aug-01	USA	Weaverville, CA	TOOS	BE36	O54
16-Aug-01	USA	TRAVERSE CITY, MI	TOOR	LJ25	TVC
16-Aug-01	USA	SAINT PAUL, MN	LDOR	C404	STP
24-Aug-01	USA	Ithaca, NY	TOOS	LJ25	ITH
28-Aug-01	USA	Detroit, MI	LDOR	FA20	DET
30-Aug-01	USA	OLATHE, KS	LDOR	GLF5	OJC
19-Sep-01	USA	Indianapolis, IN	LDUS	BE20	IND
20-Oct-01	USA	Houston, TX	LDUS	B737	IAH
13-Nov-01	USA	Santa Monica, CA	TOOR	C340	SMO

Date	Country	City/State	Event type	Aircraft Code	Airport Code
18-Nov-01	USA	DELAVAN, WI	TOOR	DHC6	C59
19-Nov-01	USA	NA	LDOR	MU30	
19-Nov-01	CANADA	SARNIA (CHRIS HADFIELD), ONTARIO	LDOR	MU30	CYZR
22-Nov-01	CANADA	WINNIPEG/ST. ANDREWS, MANITOBA	LDUS	C177	CYAV
01-Dec-01	USA	Philadelphia, PA	LDOR	C550	PHL
13-Dec-01	USA	TELLURIDE, CO	LDOR	SW3	TEX
14-Dec-01	USA	PHILADELPHIA, PA	LDOR	C560	PHL
17-Dec-01	CANADA	GANDER INTL, NEWFOUNDLAND AND LABRADOR	LDOR	B744	CYQX
01-Jan-02	USA	MIAMI, FL	LDOR	MD83	MIA
15-Jan-02	USA	KINGS FORD, MI	LDUS	SW3	IMT
19-Jan-02	USA	ATLANTA, GA	LDOR	MU30	PDK
22-Jan-02	USA	ELBERTA, AL	LDOR	BE40	4AL7
07-Feb-02	USA	NOVATO, CA	LDOR	C525	DVO
10-Feb-02	USA	Cleveland, OH	LDOR	MU30	CGF
01-Mar-02	USA	Austin, TX	TOOS	BE36	AUS
09-Mar-02	USA	Teterboro, NJ	TOOS	C210	TEB
25-Mar-02	USA	Anderson, IN	LDOR	MU30	AID
26-Mar-02	USA	ERIE, PA	LDOR	DC93	ERI
01-Apr-02	USA	Cambridge, MD	TOOR	BE40	CGE
10-Apr-02	USA	Juneau, AK	TOOS	BE18	JNU
12-Apr-02	USA	OXFORD, CT	LDUS	PA34	OXC
01-May-02	USA	Baltimore, MD	LDOR	BE40	BWI
02-May-02	USA	LEAKEY, TX	LDOR	C560	49R
06-May-02	USA	Flagstaff, AZ	LDUS	C210	FLG
16-May-02	USA	Boise, ID	TOOS	GA7	BOI
20-May-02	USA	Bethany, OK	TOOR	C550	PWA
23-May-02	USA	OLATHE, KS	LDOR	C500	OJC

Date	Country	City/State	Event type	Aircraft Code	Airport Code
01-Jun-02	Australia	Darwin,	LDOR	B737	YPDN
17-Jun-02	USA	Oxford, CT	LDOR	LJ35	OXC
20-Jun-02	Dominican Republic	Santo Domingo	LDOR	B722	SDQ
12-Jul-02	Ireland	Dublin,	LDOR	SH36	EIDW
21-Jul-02	CANADA	TORONTO/BUTTONVILLE MUNICIPAL, ONTARIO	LDOR	C172	CYKZ
26-Jul-02	USA	Tallahassee, FL	LDUS	B722	TLH
02-Aug-02	USA	Mokelumne Hill, CA	LDUS	C182	PVT
12-Aug-02	USA	Bellingham, WA	LDUS	C182	BLI
13-Aug-02	USA	Big Bear City, CA	LDOR	C550	L35
23-Aug-02	USA	Mesa, AZ	TOOR	C172	FFZ
30-Aug-02	USA	Lexington, KY	LDOR	LJ25	LEX
10-Sep-02	Canada	Gander, Newfoundland and Labrador	LDOR	DC86	YQX
15-Sep-02	USA	LA PORTE, TX	LDOR	C550	PPO
03-Oct-02	USA	EVERETT, WA	TOOR	C500	PAE
15-Oct-02	Canada	Ontario, ONT	LDUS	B742	ONT
20-Oct-02	USA	Ontario, CA	LDUS	B742	ONT
21-Oct-02	USA	Riverside, CA	LDUS	C210	ONT
02-Nov-02	Ireland	Strandhill, Connacht	LDOR	F27	SXL
07-Nov-02	USA	Santa Ana, CA	LDUS	BE35	SNA
10-Nov-02	USA	Chino, CA	TOOS	BE36	CNO
13-Nov-02	USA	San Andreas, CA	TOOS	BE36	CPU
15-Nov-02	USA	Rosamond, CA	LDOR	C172	L00
20-Nov-02	CANADA	WINNIPEG/ST. ANDREWS, MANITOBA	LDOR	PA31	CYAV
22-Nov-02	USA	SOLDOTNA, AK	LDOR	ASTR	SXQ
01-Dec-02	USA	SPOKANE, WA	LDOR	DHC8	GEG
10-Dec-02	USA	Eagle, CO	TOOR	M20K	EGE

Date	Country	City/State	Event type	Aircraft Code	Airport Code
13-Dec-02	Singapore	Singapore, Changi	LDOR	DC86	SIN
20-Dec-02	USA	White Plains, NY	LDOR	HS25	HPN
20-Dec-02	USA	Spokane, WA	LDOR	DHC8	GEG
05-Jan-03	USA	OKLAHOMA CITY, OK	LDUS	SBR1	PWA
06-Jan-03	USA	Cleveland, OH	LDOR	E145	CLE
06-Jan-03	USA	RIFLE, CO	LDOR	GLF4	RIL
17-Jan-03	Spain	Melilla, Spanish Enclave	LDOR	F50	MLN
30-Jan-03	UK	Norwich, England	LDOR	E135	NWI
08-Feb-03	USA	BETHEL, AK	LDOR	LJ25	BET
12-Feb-03	CANADA	BOUNDARY BAY, BRITISH COLUMBIA	LDUS	BE35	CZBB
15-Feb-03	Italy	See Notes, Sicily	LDOR	B742	FLR
15-Feb-03	USA	RIFLE, CO	LDOR	CL60	RIL
17-Feb-03	USA	EAGLE, CO	LDOR	LJ60	EGE
20-Feb-03	CANADA	MUSKOKA, ONTARIO	LDUS	C150	CYQA
20-Feb-03	Italy	Sigonella	LDOR	B742	NSY
27-Feb-03	USA	LEWISBURG, TN	LDOR	FA20	LUG
04-Mar-03	USA	STOCKTON, CA	LDOR	GLF5	SCK
20-Mar-03	USA	Fayetteville, AR	LDUS	C182	FYV
23-Mar-03	USA	Van Nuys, CA	TOOS	C172	VNY
27-Mar-03	USA	CHICAGO/WAUKEGAN, IL	LDOR	MU2	UGN
02-Apr-03	USA	Gig Harbor, WA	LDUS	C210	TIW
08-Apr-03	USA	Delaware City, DE, DE	LDUS	BE35	ILG
09-Apr-03	USA	Du Bois, PA	LDUS	SH33	DUJ
06-May-03	CANADA	WILLIAMS LAKE, BRITISH COLUMBIA	LDUS	C172	CYWL
13-May-03	USA	Somerville, TN, TN	LDUS	C172	FYE
18-May-03	USA	Houston, TX	LDOR	BE30	IWS
20-May-03	USA	Minneapolis, MN	LDOR	B737	MSP
28-May-03	USA	Grand Canyon, AZ	TOOS	AC50	GCN

Date	Country	City/State	Event type	Aircraft Code	Airport Code
28-May-03	UK	Leeds, England	LDOR	C560	LBA
29-May-03	CANADA	WINNIPEG/ST. ANDREWS, MANITOBA	LDOR	PA23	CYAV
30-May-03	USA	JAMAICA, NY	LDOR	DC11	JFK
12-Jun-03	USA	FORT LAUDERDALE, FL	TOOR	LJ24	FXE
28-Jun-03	USA	GOODNEWS, AK	LDUS	SW3	GNU
01-Jul-03	USA	NA	LDOR	FA50	
10-Jul-03	USA	Tulelake, CA	TOOR	S2R	O81
13-Jul-03	USA	EVANSVILLE, IN	LDOR	LJ60	EVV
17-Jul-03	Netherland	Eelde, Drenthe	TOOR	MD88	EHGG
22-Jul-03	USA	Pittston, PA	TOOR	T MK	AVP
07-Aug-03	USA	DULUTH, MN	TOOR	WW24	DLH
17-Aug-03	USA	GROTON, CT	TOOR	LJ25	GON
26-Aug-03	USA	Yarmouth, Massachusetts	TOOS	B190	HYA
19-Sep-03	USA	Del Rio, TX	LDOR	LJ25	DRT
29-Sep-03	USA	Cle Elum, WA, WA	LDUS	PA22	S93
01-Oct-03	Belgium	Liège, Liège	LDOR	B742	LGG
09-Oct-03	USA	MONTAGUE, CA	LDUS	BE9L	1O5
26-Oct-03	USA	San Diego, CA	TOOS	M20K	MYF
05-Nov-03	USA	NAPLES, FL	LDOR	C650	APF
11-Nov-03	USA	Wheeling, IL	TOOR	C560	PWK
17-Nov-03	USA	TULSA, OK	LDOR	LJ24	RVS
18-Nov-03	USA	Mineral Wells, TX	LDUS	C550	DFW
23-Nov-03	CANADA	NORMAN WELLS, NORTHWEST TERRITORIES	LDUS	BE90	CYVQ
03-Dec-03	CANADA	PITT MEADOWS, BRITISH COLUMBIA	LDOR	C172	CYPK
14-Dec-03	USA	Claremont, CA	LDUS	C421	CCB
15-Dec-03	USA	Watsonville, CA	TOOS	C182	WVI
16-Dec-03	USA	TETERBORO, NJ	TOOR	CL60	TEB

Date	Country	City/State	Event type	Aircraft Code	Airport Code
02-Jan-04	USA	PENSACOLA, FL	LDOR	MD80	PNS
03-Jan-04	USA	MINOCQUA, WI	LDOR	C500	ARV
25-Jan-04	USA	GREENSBORO, NC	LDOR	JS41	GSO
26-Jan-04	USA	PRESCOTT, AZ	LDUS	C560	PRC
16-Feb-04	CANADA	FREDERICTON, NEW BRUNSWICK	LDUS	C172	CYFC
20-Feb-04	USA	FT. LAUDERDALE, FL	LDOR	LJ25	FXE
29-Feb-04	USA	SAN DIEGO, CA	LDOR	AC68	MYF
01-Mar-04	USA	MOBILE, AL	LDOR	C500	BFM
16-Mar-04	USA	Los Angeles, CA	LDUS	M20K	SMO
19-Mar-04	USA	PUEBLO, CO	LDOR	E120	PUB
20-Mar-04	USA	NA	LDOR	B190	
20-Mar-04	CANADA	OTTAWA/MACDONALD-CARTIER INTL, ONTARIO	LDOR	B461	CYOW
26-Mar-04	USA	WATERTOWN, NY	LDOR	B190	ART
08-Apr-04	CANADA	BRAMPTON, ONTARIO	LDOR	C172	CYBM
19-Apr-04	Canada	Chibougamau, Quebec	LDOR	BE10	YMT
20-Apr-04	USA	New Orleans, LA	LDOR	B737	MSY
22-Apr-04	CANADA	ABBOTSFORD, BRITISH COLUMBIA	LDUS	M20F	CYXX
11-May-04	USA	Cortland, AL	LDUS	PA28	9A4
12-May-04	USA	MESA, AZ	LDOR	FA10	FFZ
20-May-04	USA	Honolulu, HI	LDOR	B763	HNL
23-May-04	USA	Oxford, CT	LDUS	M20J	OXC
31-May-04	CANADA	WINNIPEG INTL, MANITOBA	LDOR	C182	CYWG
03-Jun-04	USA	LEXINGTON, KY	LDOR	LJ55	LEX
06-Jun-04	USA	SAN JOSE, CA	LDUS	HS25	SJC
23-Jun-04	USA	Houston, TX	LDOR	E145	IAH
14-Jul-04	Canada	Ottawa, Ontario	LDOR	E145	YOW
19-Jul-04	USA	FORT LAUDERDALE, FL	LDOR	LJ55	FXE

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20-Jul-04	USA	Tallahassee, FL	LDOR	DC91	TLH
05-Aug-04	USA	WATERTOWN, NY	LDOR	CL60	ART
05-Aug-04	USA	OXFORD, NC	LDOR	LJ25	HNZ
12-Aug-04	CANADA	HIGH LEVEL, ALBERTA	TOOR	A26	CYOJ
13-Aug-04	USA	San Francisco, California	LDUS	CV58	CVG
16-Aug-04	USA	Dubois, WY, WY	LDUS	M6	PVT
20-Aug-04	USA	NA	LDOR	B737	
25-Aug-04	USA	VENICE, FL	LDUS	C550	VNC
12-Sep-04	USA	Chesterfield, MO	TOOS	C182	SUS
22-Sep-04	USA	Flagstaff, AZ	TOOR	C210	FLG
25-Sep-04	USA	Fullerton, CA	TOOS	BU20	FUL
01-Oct-04	USA	Panama City, FL	LDOR	BE20	PFN
14-Oct-04	Canada	Halifax, Nova Scotia	TOOS	B742	YHZ
19-Oct-04	USA	Kirksville, Missouri	LDUS	JS32	IRK
27-Oct-04	USA	Asheville, NC	TOOS	BE60	AVL
09-Nov-04	USA	Boise, ID	LDUS	SW3	BOI
10-Nov-04	USA	PANAMA CITY, FL	LDOR	BE20	PFN
01-Dec-04	USA	Teterboro, NJ	LDOR	GLF4	
02-Dec-04	USA	Milton, FL, FL	TOOS	PA28	2R4
04-Dec-04	USA	Santa Monica, CA	LDOR	PA28	SMO
05-Dec-04	USA	PINE BLUFF, AR	LDOR	FA20	PBF
16-Dec-04	Canada	Oshawa, Ontario	LDOR	SH36	YOO
20-Dec-04	USA	El Paso, TX	TOOR	LJ25	ELP
01-Jan-05	USA	MADISON, WI	LDOR	CL60	MSN
03-Jan-05	USA	SAN DIEGO, CA	LDOR	PA31	MYF
12-Jan-05	USA	JACKSONVILLE, FL	LDOR	BE35	CRG
24-Jan-05	Germany	Düsseldorf, North Rhine-Westphalia	LDOR	B742	DUS
02-Feb-05	USA	Teterboro, NJ	TOOR	CL60	TEB

Date	Country	City/State	Event type	Aircraft Code	Airport Code
05-Feb-05	USA	Murrieta, CA	LDUS	AEST	F70
05-Feb-05	USA	Murrieta, CA	LDUS	AEST	F70
28-Feb-05	USA	LINCOLNTON, NC	LDOR	LJ36	IPJ
08-Mar-05	USA	TETERBORO, NJ	LDOR	H25B	TEB
09-Mar-05	USA	TUPELO, MS	TOOR	CL60	TUP
13-Mar-05	USA	Big Bear City, CA	TOOS	PA28	L35
15-Mar-05	CANADA	ST. ANTHONY, NEWFOUNDLAND AND LABRADOR	LDOR	SW3	CYAY
04-Apr-05	CANADA	DAUPHIN (LT. COL W.G. (BILLY) BARK, MANITOBA	TOOR	PA28	CYDN
18-Apr-05	USA	Tupelo, MS	LDUS	BE35	TUP
07-May-05	USA	Grand Canyon, AZ	TOOS	C172	GCN
09-May-05	USA	BROWNWOOD, TX	TOOR	SBR2	BWD
20-May-05	USA	WALLACE, NC	LDOR	C500	ACZ
27-May-05	CANADA	CHAPLEAU, ONTARIO	LDOR	G159	CYLD
14-Jun-05	USA	NORWOOD, MA	LDOR	FA10	OWD
26-Jun-05	USA	Hailey, ID	LDUS	M20J	SUN
21-Jul-05	USA	Las Vegas, NV	TOOS	AC6L	VGT
25-Jul-05	Australia	Nhill, VIC	TOOR	PA31	YNHL
02-Aug-05	Canada	Toronto, Ontario	LDOR	A340	YYZ
13-Aug-05	USA	PORTSMOUTH, VA	LDOR	L188	PVG
02-Sep-05	USA	S. Hackensack, NJ	LDUS	C177	TEB
09-Sep-05	USA	Boscobel, WI, WI	LDUS	C310	OVS
23-Sep-05	USA	SAN DIEGO, CA	LDOR	BE40	MYF
05-Oct-05	USA	Jacksonville, FL	LDOR	BE58	JAX
11-Oct-05	USA	Riverside, CA	LDOR	BL17	RIR
25-Oct-05	CANADA	MONCTON/GREATER MONCTON INTL, NEW BRUNSWICK	LDOR	PA31	CYQM
29-Oct-05	USA	NASHVILLE, TN	LDOR	BE20	JWN

Date	Country	City/State	Event type	Aircraft Code	Airport Code
07-Nov-05	CANADA	BOUNDARY BAY, BRITISH COLUMBIA	TOOR	C172	CZBB
15-Nov-05	Canada	Hamilton, Ontario	LDOR	GLF	CYHM
08-Dec-05	USA	Chicago, IL	LDOR	B737	MDW
08-Dec-05	USA	Chicago, Illinois	LDOR	B737	MDW
23-Dec-05	USA	Livermore, CA	LDUS	BE36	LVK
24-Dec-05	USA	Portland, OR	TOOS	C208	PDX
29-Dec-05	USA	INDIANAPOLIS, IN	LDOR	LJ25	EYE
08-Jan-06	USA	Mammoth Lakes, CA	TOOS	PA28	MMH
18-Jan-06	CANADA	SAULT STE. MARIE, ONTARIO	LDOR	C208	CYAM
21-Jan-06	CANADA	HAMILTON, ONTARIO	LDOR	B701	CYHM
24-Jan-06	USA	Carlsbad, CA	LDOR	C560	CRQ
01-Feb-06	USA	Burlington, NC	LDUS	PA31	KBUY
05-Feb-06	England	London,	LDOR	CL60	EGGW
07-Feb-06	CANADA	PITT MEADOWS, BRITISH COLUMBIA	LDUS	PA34	CYPK
11-Feb-06	Kuwait	Kuwait City,	LDOR	MD11	OKBK
20-Feb-06	FO	NA	LDOR	DC11	
28-Feb-06	USA	ALBUQUERQUE, NM	LDOR	LJ25	AEG
03-Mar-06	USA	TETERBORO, NJ	LDOR	F900	TEB
08-Mar-06	Canada	POWELL RIVER, BRITISH COLUMBIA	LDOR	PA31	CYPW
11-Mar-06	CANADA	LONDON, ONTARIO	TOOR	PA38	CYXU
21-May-06	CANADA	TORONTO/LESTER B. PEARSON INTL, ONTARIO	LDOR	C550	CYYZ
30-May-06	USA	MOSINEE, WI	LDOR	CL60	CWI
03-Jun-06	USA	Manassas, VA	TOOR	D328	HEF
12-Jun-06	USA	Parkville, MO	LDUS	PA32	MCI
22-Jun-06	UK	Aberdeen, Scotland	LDOR	D328	ABZ
24-Jun-06	USA	Upland, CA	LDOR	C560	CCB
01-Aug-06	USA	ANGOLA, IN	TOOR	C560	ANQ

Date	Country	City/State	Event type	Aircraft Code	Airport Code
27-Aug-06	USA	Lexington, KY	TOOR	CRJ1	LEX
27-Aug-06	USA	Fyette County, Kentucky	TOOR	CRJ1	LEX
06-Oct-06	USA	LAS VEGAS, NV	LDOR	B190	VGT
10-Oct-06	Norway	Sørstokken	LDOR	B461	SRP
10-Oct-06	England	Hampshire,	LDOR	SW3	EGHL
13-Oct-06	USA	BURBANK, CA	LDOR	GLF4	BUR
22-Oct-06	USA	St. Augustine, FL	LDUS	BE36	KSGJ
23-Oct-06	USA	Chino, CA	TOOS	AC11	CNO
04-Nov-06	CANADA	THUNDER BAY, ONTARIO	LDOR	CV34	CYQT
17-Nov-06	USA	Flagstaff, AZ	LDUS	BE35	FLG
26-Nov-06	USA	Buena Park, CA	LDUS	BE36	FUL
26-Nov-06	CANADA	MONTRÉAL/PIERRE ELLIOTT TRUDEAU IN, QUEBEC	LDOR	LJ35	CYUL
02-Dec-06	USA	SEATTLE, WA	LDOR	DHC8	SEA
10-Dec-06	USA	Chandler, AZ	TOOS	NA	CHD
12-Dec-06	USA	GREAT BEND, KS	LDOR	PA31	GBD
18-Dec-06	USA	Fayetteville, AR	LDUS	BE36	FYV
09-Jan-07	CANADA	PRINCE GEORGE, BRITISH COLUMBIA	LDOR	LJ35	CYXS
09-Jan-07	Canada	FORT ST. JOHN, BRITISH COLUMBIA	LDUS	JS31	CYXJ
25-Jan-07	France	Pau, Pyrénées Atlantiques department	TOOR	F100	PUF
26-Jan-07	USA	PONTIAC, MI	LDOR	CL60	PTK
18-Feb-07	USA	CLEVELAND, OH	LDOR	E170	CLE
20-Feb-07	England	London,	LDOR	B461	EGLC
21-Feb-07	USA	Granbury, TX, TX	LDUS	CTSW	0TX1
23-Feb-07	USA	Bellingham, WA	LDUS	C182	BLI
07-Mar-07	INDONESIA	Yogyakarta,	LDOR	B737	WARJ
24-Mar-07	USA	Monks Corner, SC	LDUS	BE24	50J

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29-Mar-07	USA	OKLAHOMA CITY, OK	LDOR	G200	PWA
31-Mar-07	CANADA	Gander, Newfoundland and Labrador, NEWFOUNDLAND AND LABRADOR	LDOR	A124	CYQX
12-Apr-07	USA	Traverse City, MI	LDOR	CL60	TVC
01-May-07	USA	PHILADELPHIA, PA	LDOR	C560	PHL
23-May-07	USA	Chesterfield, MO	LDUS	C421	SUS
15-Jun-07	CANADA	RED LAKE, ONTARIO	LDOR	C680	CYRL
20-Jun-07	USA	Laramie, WY	LDOR	B190	LAR
18-Jul-07	USA	MINNEAPOLIS, MN	LDOR	B737	MSP
28-Jul-07	USA	Tonasket, WA, WA	LDOR	M20E	W01
28-Jul-07	CANADA	TOFINO, BRITISH COLUMBIA	LDOR	PA31	CYAZ
28-Aug-07	USA	Blythe, CA	TOOS	AT50	56CL
30-Aug-07	USA	Cameron Park, CA	TOOS	BE36	KO61
18-Sep-07	USA	Flagstaff, AZ	TOOS	PA28	FLG
21-Sep-07	USA	Ft. Lauderdale, FL	TOOS	BE18	KFXE
22-Oct-07	CANADA	WATSON LAKE, YUKON	LDOR	AL39	CYQH
28-Oct-07	USA	Palm Springs, CA	TOOS	C172	KUDD
29-Oct-07	USA	Santa Ana, CA	TOOR	HS25	SNA
01-Nov-07	USA	Fort Lauderdale, FL	LDOR	GLF3	FXE
01-Dec-07	USA	MADISON, WI	LDOR	CL60	MSN
06-Dec-07	USA	Fallbrook, CA	LDUS	PA28	L18
10-Dec-07	USA	IDAHO FALLS, ID	LDOR	MD80	IDA
17-Dec-07	USA	VERNAL, UT	LDUS	BE9L	VEL
07-Jan-08	CANADA	FORT SMITH, NORTHWEST TERRITORIES	LDOR	JS32	CYSM
16-Jan-08	USA	Cleveland, OH	TOOS	BE58	BKL
27-Jan-08	USA	SPOKANE, WA	LDOR	B737	GEG
30-Jan-08	USA	DECATUR, IL	LDOR	B752	DEC

Date	Country	City/State	Event type	Aircraft Code	Airport Code
14-Feb-08	CANADA	MASCOUCHE, QUEBEC	LDOR	C182	CSK3
17-Feb-08	CANADA	Ottawa, ONTARIO	LDOR	B737	CYOW
22-Feb-08	CANADA	LANGLEY, BRITISH COLUMBIA	TOOR	C172	CYNJ
25-Feb-08	USA	Jackson, WY	LDOR	A320	JAC
07-Mar-08	USA	COLUMBUS, OH	LDOR	B737	CMH
15-Mar-08	USA	SAN ANTONIO, TX	LDOR	LJ35	SAT
30-Mar-08	USA	Redding, CA	LDUS	C182	O85
05-Apr-08	CANADA	EDMONTON INTL, ALBERTA	LDOR	CL60	CYEG
15-Apr-08	USA	San Dimas, CA	TOOS	PA23	POC
17-Apr-08	CANADA	ROCKCLIFFE, ONTARIO	LDOR	PA28	CYRO
04-May-08	USA	LOVELAND, CO	LDOR	MD80	FNL
24-Jun-08	USA	NANTUCKET, MA	LDOR	SW3	ACK
13-Jul-08	USA	Saratoga Springs, NY	LDUS	LJ45	5B2
22-Jul-08	CANADA	HAMILTON, ONTARIO	LDOR	B722	CYHM
12-Aug-08	CANADA	PRINCE GEORGE, BRITISH COLUMBIA	LDOR	B737	CYXS
15-Sep-08	USA	NANTUCKET, MA	LDUS	C414	ACK
19-Sep-08	USA	West Columbia, South Carolina	TOOR	LJ60	CAE
14-Dec-08	CANADA	NORTH BAY, ONTARIO	LDOR	DHC8	CYYB
28-Dec-08	USA	Houston, TX	LDOR	LJ35	BPT
04-Jan-09	USA	SYRACUSE, NY	LDOR	E145	SYR
27-Jan-09	USA	Lubbock, TX	LDUS	AT43	LBB
28-Jan-09	USA	Santa Monica, CA	TOOS	F26T	SMO
09-Feb-09	France	Paris	LDOR	A321	CDG
25-Feb-09	Netherlands	Haarlemmermeer,	LDUS	B737	EHAM
28-Feb-09	USA	SAVANNAH, GA	LDOR	CL60	SAV
21-Apr-09	CANADA	LANGLEY, BRITISH COLUMBIA	LDOR	YK18	CYNJ
28-Apr-09	USA	Mayfield Village, OH	TOOS	SR22	CGF

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12-Jun-09	USA	Bridgeport, CT	LDOR	NA	BDR
25-Jun-09	USA	St. Louis, MO	LDOR	NA	1H0
02-Jul-09	CANADA	ABBOTSFORD, BRITISH COLUMBIA	TOOR	C172	CYXX
03-Jul-09	USA	Tucson, AZ	TOOS	PA30	TUS
30-Jul-09	CANADA	PORT HARDY, BRITISH COLUMBIA	LDOR	C182	CYZT
21-Aug-09	USA	Teterboro, NJ	LDOR	BE58	TEB
09-Nov-09	USA	Greer, SC	LDUS	B200	GSP
05-Dec-09	CANADA	MONTRÉAL/ST-HUBERT, QUEBEC	TOOR	GA7	CYHU
07-Dec-09	USA	Mendoza, TX	LDUS	PA46	AUS
08-Dec-09	USA	Fresno, CA	TOOS	PA38	FAT
22-Dec-09	Jamica	Kingston,	LDOR	B737	MKJP
23-Dec-09	CANADA	RANKIN INLET, NUNAVUT	LDOR	BE99	CYRT
08-Jan-10	USA	Eagle, CO	TOOR	NA	KEGE
19-Jan-10	USA	Charleston, WV	TOOR	NA	CRW
22-Jan-10	CANADA	WINNIPEG INTL, MANITOBA	LDOR	CL60	CYWG
06-Feb-10	USA	Winslow, AR	LDUS	BE36	FYV
18-Apr-10	CANADA	SALMON ARM, BRITISH COLUMBIA	TOOR	C185	CZAM
23-May-10	USA	Lost Hills, CA	LDOR	NA	L84
02-Jun-10	CANADA	OSHAWA, ONTARIO	LDOR	SW3	CYOO
07-Jun-10	CANADA	WINNIPEG INTL, MANITOBA	LDOR	BE58	CYWG
16-Jun-10	CANADA	OTTAWA, ONTARIO	LDOR	E145	CYOW
01-Jul-10	USA	Venice, CA	TOOS	C152	SMO
26-Jul-10	CANADA	ABBOTSFORD, BRITISH COLUMBIA	TOOR	PA28	CYXX
30-Jul-10	CANADA	CAMPBELL RIVER, BRITISH COLUMBIA	LDOR	C550	CYBL
04-Aug-10	CANADA	ABBOTSFORD, BRITISH COLUMBIA	LDOR	B737	CYXX
04-Aug-10	CANADA	ABBOTSFORD, BRITISH COLUMBIA	LDOR	B737	CYXX
24-Aug-10	USA	Sequim, WA	LDUS	PA28	2WA1

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28-Aug-10	USA	Pompano Beach, FL	TOOS	NA	PMP
22-Sep-10	CANADA	MONTMAGNY, QUEBEC	TOOR	B100	CSE5
25-Sep-10	USA	Point Lookout, MO	LDOR	NA	PLK
01-Oct-10	USA	Teterboro, NJ	LDOR	NA	KTEB
01-Oct-10	USA	Manteo, NC	LDOR	NA	MQI
30-Oct-10	CANADA	GANDER INTL, NEWFOUNDLAND AND LABRADOR	LDOR	GLF4	CYQX
17-Nov-10	USA	Portland, OR	LDOR	NA	HIO
21-Nov-10	USA	Newport Beach, CA	LDUS	BE19	SNA
22-Nov-10	USA	Jackson, WY	LDOR	NA	JAC
14-Feb-11	USA	Appleton, WI	LDOR	NA	ATW
04-Mar-11	USA	Houston, TX	LDOR	NA	KHOU
14-Apr-11	CANADA	QUEBEC	LDOR	PA31	CYZV
12-May-11	CANADA	Montréal, QUEBEC	LDUS	DHC8	CYUL
25-May-11	USA	Sedona, AZ	LDOR	NA	SEZ
02-Jun-11	USA	Chandler, AZ	LDUS	BDOG	CHD
15-Jun-11	USA	Nashville, TN	LDOR	NA	JWN
16-Jun-11	USA	Big Lake, AK	LDUS	C182	PVT
09-Jul-11	USA	West Milford, NJ	LDOR	NA	4N1
16-Jul-11	CANADA	St John's, NEWFOUNDLAND AND LABRADOR	LDOR	B722	CYYT
16-Aug-11	USA	Valdez, AK	LDUS	PA18	VDZ
17-Aug-11	CANADA	Pitt Meadows, BRITISH COLUMBIA	LDUS	M20F	CYPK
20-Aug-11	Canada	Resolute Bay, Nunavut	LDUS	B737	YRB
29-Aug-11	USA	Santa Monica, CA	TOOS	C172	SMO
17-Sep-11	USA	Hillsboro, TX	LDUS	NA	KINJ
31-Oct-11	USA	Key West, FL	LDOR	NA	EYW
03-Nov-11	USA	Key West, FL	LDOR	NA	EYW
15-Dec-11	USA	Farmville, VA	LDUS	SR22	FVX

Date	Country	City/State	Event type	Aircraft Code	Airport Code
27-Jan-12	USA	Chehalis, WA	LDUS	PA28	KCLS
30-Jan-12	USA	Baltimore, MD	LDOR	NA	BWI
01-Feb-12	USA	Anchorage, AK	LDUS	NA	PAMR
01-Mar-12	USA	Boca Raton, FL	LDUS	KR2	BCT
18-Jun-12	USA	Atlanta, GA	LDOR	NA	PDK
12-Jul-12	USA	Minneapolis, MN	LDOR	NA	FCM
17-Aug-12	USA	Bakersfield, CA	TOOS	C210	BFL
15-Sep-12	USA	Cedar Bluff, AL	LDUS	RC3	n/a
18-Sep-12	USA	Macon, GA	LDOR	NA	MAC
16-Oct-12	France	Ploemeur	LDOR	CRJ7	LFRH
22-Oct-12	USA	Sturtevant, WI	LDOR	NA	C89
20-Feb-13	USA	Thomson, GA	TOOS	NA	HQU
24-Apr-13	USA	Milledgeville, GA	LDUS	SR22	MLJ
10-May-13	USA	Newcastle, WY	LDUS	C172	KECS
20-Jun-13	USA	Jamestown, NY	LDOR	NA	JHW
28-Jun-13	USA	Eagle, CO	LDUS	PA24	EGE
03-Jul-13	USA	Tillar, AR	TOOR	NA	5AR1
06-Jul-13	USA	San Francisco, California	LDUS	B772	SFO
06-Jul-13	USA	San Francisco, CA	LDUS	B772	SFO
20-Jul-13	USA	Tupelo, MS	LDUS	BE36	TUP
03-Aug-13	USA	Chesterfield, MO	TOOS	SR22	SUS
14-Aug-13	USA	Birmingham, Alabama	LDUS	A300	BHM
17-Oct-13	USA	Fairbanks, AK	TOOS	C172	FAI
23-Oct-13	USA	Tucson, AZ	TOOS	PA23	TUS
01-Nov-13	USA	Reno, NV	LDOR	NA	RTS
14-Jun-14	USA	Milton, FL	LDUS	CTSW	2R4

APPENDIX B

Sampled Airports

Sampled Airports Code			
ADS	CMH	LAW	SCK
ADW	CWF	LAX	SEA
ASE	DTW	LGA	SFF
ASG	EGE	LVK	SFO
ASH	EMT	LWB	SJC
ATL	ENA	MCI	SLC
AUS	EUG	MCO	SMO
AVL	EWR	MDT	SNA
BCT	FAI	MSP	SQL
BET	FAT	MYR	SUN
BFI	FLG	NQA	SUS
BFL	FYV	OJC	TEB
BGR	GCN	ONT	TIW
BKL	GLH	OXC	TTD
BLI	GSP	OXR	TUP
BOI	GYR	PDX	TUS
CGF	HEF	PHX	TYS
CHD	IND	PSP	TZR
CKB	ISO	RNT	-
CLE	JNU	SAW	-

APPENDIX C

Standard Error of Regression Coefficient of Accident Likelihood Models

Regression Coefficients Standard Error

Standard error associated with each variable measures how precisely the model estimates the coefficient's unknown value. A smaller standard error indicates that the regression model was able to estimate the corresponding coefficient with greater precision. The findings from the tables indicate that the models have achieved great precision in estimating the variables coefficients.

Table C.1- Landing overrun (LDOR) likelihood model variables.

Variables	Coefficient	Standard Error
Foreign O/D	1.71	0.16
HUB	-3.32	0.13
Aircraft Class A	-1.18	0.28
Piston	2.55	0.24
Prop	-1.22	0.31
Vis LT2	1.60	0.16
Vis GT2LT4	0.98	0.21
Temp GT25	-0.86	0.20
Fog	1.60	0.19
Icing	1.50	0.59
Electric Storm	-1.23	0.42
Snow	1.57	0.20
Night	1.61	0.13
Rain	0.76	0.15
Xwind GT2LT5	-1.11	0.15
Xwind GT5LT12	-0.47	0.14
Tailwind GT5LT12	0.94	0.19
Tailwind GT12	3.22	0.68
Criticality Factor	5.82	0.39
Constant	-11.96	0.15

Table C.2- Landing undershoot (LDUS) likelihood model variables.

Variables	Coefficient	Standard Error
Foreign O/D	1.67	0.24
Hub	-0.99	0.20
Operation type GA	1.47	0.21
Operation type TC	0.66	0.32
Aircraft Class C	-1.53	0.47
Aircraft Class B	0.66	0.24
Piston	3.50	0.26
Vis LT2	1.29	0.24
Vis GT2LT4	1.35	0.26
Temp LT5	0.68	0.21
Temp GT25	-0.46	0.22
Fog	2.17	0.24
Snow	1.13	0.34
Night	2.06	0.17
Xwind GT2LT5	-0.46	0.17
Tailwind GT2LT5	-0.68	0.32
Tailwind GT12	3.45	0.83
Criticality Factor	3.00	0.41
Constant	-16.37	0.31

Table C.3- Takeoff overrun (TOOR) likelihood model variables.

Variables	Coefficient	Standard Error
Foreign O/D	1.50	0.29
HUB	-1.46	0.25
Operation type GA	0.74	0.25
Operation type TC	1.23	0.32
Aircraft Class B	1.49	0.23
Piston	3.78	0.29
Prop	-1.02	0.50
Ceiling GT1000LT2500	-0.79	0.38
VisGT4LT8	0.70	0.24
TempLT5	0.90	0.24
Fog	1.65	0.35
Night	2.13	0.25
Xwind GT2LT5	-0.86	0.24
Xwind GT5LT12	-0.72	0.25
Criticality Factor	4.68	0.51
Constant	-16.41	0.37

Table C.4- Takeoff overshoot (TOOS) likelihood model variables.

Variables	Coefficient	Standard Error
Hub	-1.84	0.35
Operation type GA	2.82	0.54
Operation type F	1.95	0.59
Operation type TC	1.96	0.87
Piston	2.90	0.55
Prop	1.77	0.57
Ceiling LT200	2.44	0.58
Temp GT5LT15	0.65	0.27
Fog	2.22	0.47
Snow	2.54	0.54
Night	2.45	0.31
Xwind GT2LT5	-0.87	0.31
Criticality Factor	2.77	0.63
Aircraft class B/C	-2.38	0.62
Constant	-18.22	0.62

APPENDIX D

Coordinates of Accidents and Incidents Used for Development of Location Models

Accident Type	Date	State	City	X	Y
LDOR	1/1/1996	England	Derbyshire	377	30
LDOR	1/1/1997	MO	KANSAS CITY	105	1000
LDOR	1/1/2000	NC	Charlotte	225	N/A
LDOR	1/1/2001	KY	Glasgow	49	N/A
LDOR	1/1/2002	FL	MIAMI	590	135
LDOR	1/12/1982	TX	DALLAS	1283	N/A
LDOR	1/12/1989	TN	CROSSVILLE	300	0
LDOR	1/12/2005	FL	JACKSONVILLE	557	20
LDOR	1/17/2003	Spanish Enclave	Melilla	710	90
LDOR	1/18/2006	ONTARIO	SAULT STE. MARIE	150	0
LDOR	1/19/1989	LA	Baton Rouge	200	0
LDOR	1/19/1990	CO	Denver	100	0
LDOR	1/19/1994	OH	Wilmington	10	0
LDOR	1/19/1995	GA	ATLANTA	250	0
LDOR	1/19/1996	WY	JACKSON	30	30
LDOR	1/19/1998	AK	Mekoryuk	355	40
LDOR	1/19/1998	ME	Portland	215	0
LDOR	1/19/1999	OH	Wilmington	800	100
LDOR	1/19/2002	GA	ATLANTA	440	N/A
LDOR	1/2/1986	MI	DETROIT	100	0
LDOR	1/2/2004	FL	PENSACOLA	100	0
LDOR	1/20/1999	CA	CHINO	152	0
LDOR	1/21/1994	British Columbia	Terrace	415	39
LDOR	1/21/1997	IN	BLOOMINGTON	600	N/A
LDOR	1/21/2006	ONTARIO	HAMILTON	2	0
LDOR	1/22/1998	CO	DENVER	100	N/A
LDOR	1/22/1998	CO	DENVER	50	N/A
LDOR	1/22/2010	MANITOBA	WINNIPEG INTL	12	N/A
LDOR	1/23/1982	MA	Boston	59	675
LDOR	1/24/2005	North Rhine-Westphalia	Düsseldorf	1100	50
LDOR	1/24/2006	CA	Carlsbad	654	38
LDOR	1/25/1997	MA	PROVINCETOWN	80	0
LDOR	1/25/2004	NC	GREENSBORO	400	N/A
LDOR	1/26/1996	TN	SPARTA	279	N/A
LDOR	1/26/2007	MI	PONTIAC	30	N/A
LDOR	1/27/1994	MI	PONTIAC	30	0
LDOR	1/27/1994	IL	CHICAGO	3028	0
LDOR	1/27/2008	WA	SPOKANE	500	N/A

Accident Type	Date	State	City	X	Y
LDOR	1/3/1993	MANITOBA	ST. ANDREWS AIRPORT 20NM N	670	N/A
LDOR	1/3/1997	WY	JACKSON	60	N/A
LDOR	1/3/2004	WI	MINOCQUA	20	N/A
LDOR	1/3/2005	CA	SAN DIEGO	255	75
LDOR	1/30/1984	CA	AVALON	150	N/A
LDOR	1/30/2003	England	Norwich	427	33
LDOR	1/30/2008	IL	DECATUR	100	N/A
LDOR	1/31/1985	KY	LONDON	380	N/A
LDOR	1/4/2009	NY	SYRACUSE	50	N/A
LDOR	1/5/1996	FO	East Midlands Airport	100	N/A
LDOR	1/6/1998	PA	WEST MIFFLIN	375	75
LDOR	1/6/2003	OH	Cleveland	785	0
LDOR	1/6/2003	CO	RIFLE	160	0
LDOR	1/7/1998	FO	London City	144	0
LDOR	1/7/2008	NORTHWEST TERRITORIES	FORT SMITH	370	60
LDOR	1/9/1989	LA	BATON ROUGE	300	0
LDOR	1/9/2007	BRITISH COLUMBIA	PRINCE GEORGE	60	0
LDOR	10/1/2003	Liège	Liège	260	0
LDOR	10/1/2004	FL	Panama City	50	0
LDOR	10/10/2006		Hampshire	111	0
LDOR	10/10/2006	FO	Sørstokken	500	N/A
LDOR	10/11/2005	CA	Riverside	700	350
LDOR	10/14/1988	WA	SEATTLE	50	N/A
LDOR	10/14/1996	NV	LAS VEGAS	400	0
LDOR	10/16/2012		Ploemeur	230	N/A
LDOR	10/19/1985	IN	BLOOMINGTON	320	75
LDOR	10/19/1988	GA	Columbus	400	0
LDOR	10/19/1989	DE	Dover	200	0
LDOR	10/19/1999	Ile de France	Paris	190	50
LDOR	10/20/2000	MO	St Louis	807	225
LDOR	10/22/2007	YUKON	WATSON LAKE	450	0
LDOR	10/24/1998	FO	Southampton	262	0
LDOR	10/25/1983	VA	NORFOLK	7	129
LDOR	10/25/1986	NC	CHARLOTTE	516	75
LDOR	10/25/2005	NEW BRUNSWICK	MONCTON/GREATER MONCTON INTL	263	0

Accident Type	Date	State	City	X	Y
LDOR	10/28/1987	OK	BARTLESVILLE	918	0
LDOR	10/29/2005	TN	NASHVILLE	700	N/A
LDOR	10/30/2010 5:04:00 AM	NEWFOUNDLAND AND LABRADOR	GANDER INTL	27	N/A
LDOR	10/5/2005	FL	Jacksonville	400	50
LDOR	10/6/1987	WA	KENNEWICK	450	N/A
LDOR	10/6/1991	ME	AUGUSTA	20	0
LDOR	11/1/1996	OH	Cleveland	285	N/A
LDOR	11/1/2007	FL	Fort Lauderdale	500	0
LDOR	11/10/1988	CA	BURBANK	468	N/A
LDOR	11/11/1996	OH	CLEVELAND	200	N/A
LDOR	11/11/1996	OH	CLEVELAND	530	35
LDOR	11/15/1996	SD	SIOUX FALLS	50	N/A
LDOR	11/15/2002	CA	Rosamond	1298	1298
LDOR	11/15/2005	Ontario	Hamilton	272	100
LDOR	11/17/1988	OR	BEND	200	0
LDOR	11/17/1994	MT	BOZEMAN	293	0
LDOR	11/17/2003	OK	TULSA	183	0
LDOR	11/19/1991	CA	Los Angeles	150	0
LDOR	11/19/1996	HI	Honolulu	25	0
LDOR	11/19/1998	GA	Atlanta	85	0
LDOR	11/19/2001	ONTARIO	SARNIA (CHRIS HADFIELD)	150	N/A
LDOR	11/2/2002	Connacht	Strandhill	328	98
LDOR	11/20/1982	GA	ATLANTA	450	0
LDOR	11/20/2002	MANITOBA	WINNIPEG/ST. ANDREWS	145	0
LDOR	11/21/1979	CA	CARLSBAD	100	0
LDOR	11/22/1992	OH	CLEVELAND	200	0
LDOR	11/22/1999	Ontario	Dryden	300	0
LDOR	11/22/2002	AK	SOLDOTNA	100	N/A
LDOR	11/23/1987	TN	NASHVILLE	50	0
LDOR	11/26/2006	QUEBEC	MONTRÉAL/PIERRE ELLIOTT TRUDEAU IN	800	0
LDOR	11/27/1992	FO	Southampton	246	0
LDOR	11/28/2000	New Brunswick	Fredericton	320	0
LDOR	11/29/1983	FO	Sumburgh	131	70
LDOR	11/4/1987	PA	WILLIAMSPORT	286	0

Accident Type	Date	State	City	X	Y
LDOR	11/4/2006	ONTARIO	THUNDER BAY	50	N/A
LDOR	11/7/1985	TN	SPARTA	359	20
LDOR	11/7/1992	AZ	PHOENIX	1500	120
LDOR	12/1/2001	PA	Philadelphia	250	0
LDOR	12/1/2002	WA	SPOKANE	50	N/A
LDOR	12/1/2004	NJ	Teterboro	100	490
LDOR	12/1/2007	WI	MADISON	45	N/A
LDOR	12/10/2007	ID	IDAHO FALLS	50	0
LDOR	12/11/1981	PR	SAN JUAN	300	0
LDOR	12/13/1989	IL	CHICAGO	304	30
LDOR	12/13/1999	GA	ATLANTA	20	0
LDOR	12/13/2002	Changi	Singapore	968	197
LDOR	12/14/1995	MI	DETROIT	485	0
LDOR	12/14/2008	ONTARIO	NORTH BAY	260	0
LDOR	12/15/1984	Ontario	Sioux Lookout,	502	0
LDOR	12/16/2004	Ontario	Oshawa	600	0
LDOR	12/18/1982	MI	PELLSTON	80	0
LDOR	12/18/1998	NY	ROCHESTER	550	220
LDOR	12/18/1998	NY	ROCHESTER	600	110
LDOR	12/18/2000	Ontario	Windsor	340	0
LDOR	12/19/1988	SC	Charleston	150	0
LDOR	12/19/1995	CA	Los Angeles	160	100
LDOR	12/19/1997	TN	Memphis	75	0
LDOR	12/19/1997	GA	Savannah	20	0
LDOR	12/20/2002	WA	Spokane	100	0
LDOR	12/20/2002	NY	White Plains	200	0
LDOR	12/22/2009		Kingston	242	0
LDOR	12/23/1991	CA	CARLSBAD	50	75
LDOR	12/23/1996	ONTARIO	TRENTON AERODROME (DND)	500	N/A
LDOR	12/23/2009	NUNAVUT	RANKIN INLET	103	N/A
LDOR	12/24/1998	RI	PROVIDENCE	84	50
LDOR	12/24/2000	Tahiti	Faaa	230	82
LDOR	12/27/1982	IA	DUBUQUE	112	0
LDOR	12/28/2008	TX	Houston	50	N/A
LDOR	12/29/1998	WY	JACKSON	46	0
LDOR	12/29/2000	VA	Charlottesville	59	400
LDOR	12/29/2005	IN	INDIANAPOLIS	20	0
LDOR	12/30/1989	AZ	TUCSON	3803	175

Accident Type	Date	State	City	X	Y
LDOR	12/5/2004	AR	PINE BLUFF	240	0
LDOR	12/7/1993	CA	SANTA MONICA	250	0
LDOR	12/7/1997		Channel Islands	2519	98
LDOR	12/8/1995	IL	CHICAGO	40	0
LDOR	12/8/2005	IL	Chicago	478	0
LDOR	12/8/2005	IL	Chicago	500	5
LDOR	12/9/1995	WY	JACKSON	50	N/A
LDOR	2/1/1994	LA	NEW ROADS	420	20
LDOR	2/1/1995	GA	Atlanta	470	90
LDOR	2/10/2002	OH	Cleveland	106	N/A
LDOR	2/11/2006		Kuwait City	80	0
LDOR	2/13/1993	ME	PORTLAND	330	50
LDOR	2/13/2001	WA	Olympia	442	0
LDOR	2/14/1991	OH	CLEVELAND	11	150
LDOR	2/15/1989	NY	BINGHAMTON	200	80
LDOR	2/15/2003	CO	RIFLE	27	0
LDOR	2/15/2003	Sicily	See Notes	770	0
LDOR	2/16/1999	CA	VAN NUYS	1072	451
LDOR	2/16/2000	Hokkaidō (Yesso)	Sapporo	400	50
LDOR	2/17/2008	ONTARIO	Ottawa	215	0
LDOR	2/18/1998	FO	Peterborough Airport, Ontario	236	0
LDOR	2/18/1999	NE	COLUMBUS	150	0
LDOR	2/18/2007	OH	CLEVELAND	310	160
LDOR	2/19/1982	TX	HARLINGEN	299	0
LDOR	2/19/1982	MI	PONTIAC	50	N/A
LDOR	2/19/1989	OH	Covington	60	140
LDOR	2/19/1993	ME	Portland	260	0
LDOR	2/19/1994	CO	Rifle	630	70
LDOR	2/19/1994	DC	Washington	250	50
LDOR	2/19/1995	IL	Chicago	200	70
LDOR	2/19/1995	IL	Chicago	10	0
LDOR	2/19/1996	TX	HOUSTON	51	140
LDOR	2/19/1996	GA	Savannah	300	50
LDOR	2/19/1997	IL	Chicago	10	0
LDOR	2/20/1996	DC	WASHINGTON	250	0
LDOR	2/20/1996	DC	WASHINGTON	150	75
LDOR	2/20/1996	CO	RIFLE	1000	80
LDOR	2/20/2003	FO	Sigonella	800	0
LDOR	2/20/2004	FL	FT. LAUDERDALE	1689	220

Accident Type	Date	State	City	X	Y
LDOR	2/20/2006	FO	-1	220	0
LDOR	2/20/2007		London	729	0
LDOR	2/21/1986	PA	ERIE	180	70
LDOR	2/23/1998	CA	VAN NUYS	40	40
LDOR	2/25/2008	WY	Jackson	116	140
LDOR	2/26/1982	GA	ATLANTA	600	280
LDOR	2/26/1998	PA	PITTSBURGH	49	0
LDOR	2/27/1986	PA	COATSVILLE	400	250
LDOR	2/27/1997	SC	GREENVILLE	350	N/A
LDOR	2/27/2003	TN	LEWISBURG	150	N/A
LDOR	2/28/1984	NY	JAMAICA	660	35
LDOR	2/28/1996	GA	SAVANNAH	201	0
LDOR	2/28/2005	NC	LINCOLNTON	300	N/A
LDOR	2/28/2006	NM	ALBUQUERQUE	150	N/A
LDOR	2/28/2009	GA	SAVANNAH	750	N/A
LDOR	2/3/1988	CO	DENVER	30	N/A
LDOR	2/3/1998	NE	OMAHA	100	N/A
LDOR	2/5/2006		London	272	0
LDOR	2/7/1996	PA	BRADFORD	870	825
LDOR	2/7/1996	CA	MAMMOTH LAKES	20	0
LDOR	2/7/2002	CA	NOVATO	580	N/A
LDOR	2/8/1986	CA	CARLSBAD	100	119
LDOR	2/8/1994	DC	WASHINGTON	50	50
LDOR	2/8/1999		Amsterdam	100	0
LDOR	2/8/2003	AK	BETHEL	102	N/A
LDOR	2/9/2009		Paris	66	164
LDOR	3/1/1995	Alberta	Jasper Hinton Airport	256	0
LDOR	3/11/1998	CO	ASPEN	50	N/A
LDOR	3/12/1987	IA	DES MOINES	50	0
LDOR	3/12/1997	TX	HOUSTON	145	0
LDOR	3/12/2000	WY	JACKSON	160	0
LDOR	3/13/1986	SC	CHARLESTON	870	200
LDOR	3/14/1998	ME	PORTLAND	600	0
LDOR	3/14/1998	ME	PORTLAND	600	15
LDOR	3/15/2005	NEWFOUNDLAND AND LABRADOR	ST. ANTHONY	31	N/A
LDOR	3/15/2008	TX	SAN ANTONIO	240	50
LDOR	3/17/2000	MA	HYANNIS	667	0
LDOR	3/17/2001	RHONE-ALPES	LYON	279	197

Accident Type	Date	State	City	X	Y
LDOR	3/19/1989	DC	Washington	150	0
LDOR	3/19/1989	IL	Chicago	500	30
LDOR	3/19/1989	FL	Daytona Beach	50	0
LDOR	3/19/1991	NC	Raleigh	150	0
LDOR	3/19/1994	OH	Columbus	260	0
LDOR	3/19/1994	PA	State College	20	0
LDOR	3/19/1995	HI	Honolulu	100	70
LDOR	3/20/2001	LA	Shreveport	110	0
LDOR	3/20/2001	TX	El Paso	150	0
LDOR	3/20/2004	ONTARIO	OTTAWA/MACDONALD-CARTIER INTL	102	N/A
LDOR	3/21/2000	TX	KILLEEN	175	3
LDOR	3/23/1989	VA	ROANOKE	200	10
LDOR	3/25/1996	ID	HAILEY	40	0
LDOR	3/25/2002	IN	Anderson	30	50
LDOR	3/26/2002	PA	ERIE	40	0
LDOR	3/27/2003	IL	CHICAGO/WAUKEGAN	100	N/A
LDOR	3/29/1981	Bedfordshire	Borough of Luton	498	0
LDOR	3/29/1989	KY	OWENSBORO	56	N/A
LDOR	3/29/2007	OK	OKLAHOMA CITY	500	0
LDOR	3/31/1992	FO	Aberdeen	479	43
LDOR	3/31/1998	IA	DES MOINES	50	50
LDOR	3/31/2007	NEWFOUNDLAND AND LABRADOR	Gander, Newfoundland and Labrador	339	439
LDOR	3/4/1998	MI	MANISTEE	150	0
LDOR	3/4/2001	AZ	PHOENIX	75	0
LDOR	3/5/2000	CA	BURBANK	200	200
LDOR	3/7/2007		Yogyakarta	827	98
LDOR	3/7/2008	OH	COLUMBUS	267	N/A
LDOR	3/8/2005	NJ	TETERBORO	230	N/A
LDOR	3/8/2006	BRITISH COLUMBIA	POWELL RIVER	370	0
LDOR	3/9/1999	IN	INDIANAPOLIS	30	0
LDOR	3/9/2001	CT	Bridgeport	22	0
LDOR	4/1/2000	CO	EAGLE	9	0
LDOR	4/12/2007	MI	Traverse City	499	0

Accident Type	Date	State	City	X	Y
LDOR	4/14/2011 2:23:00 PM	QUEBEC		149	0
LDOR	4/17/1999	WV	BECKLEY	216	0
LDOR	4/17/2008	ONTARIO	ROCKCLIFFE	380	0
LDOR	4/19/1989	CA	San Diego	280	50
LDOR	4/19/1998	NE	LINCOLN	50	N/A
LDOR	4/19/2004	Quebec	Chibougamau	500	0
LDOR	4/2/1984	AR	LITTLE ROCK	50	60
LDOR	4/20/2004	LA	New Orleans	200	0
LDOR	4/21/2009	BRITISH COLUMBIA	LANGLEY	100	N/A
LDOR	4/22/1990	Lord Howe Island	Lord Howe Island	250	0
LDOR	4/27/1993	CO	DENVER	1	30
LDOR	4/28/1990	FO	Queenstown	318	82
LDOR	4/29/1993	AR	PINE BLUFF	687	50
LDOR	4/3/1996	New Brunswick	Moncton	154	0
LDOR	4/4/1992	FL	TITUSVILLE, FL	466	N/A
LDOR	4/4/2001	Newfoundland	St. John's	75	53
LDOR	4/5/2008	ALBERTA	EDMONTON INTL	53	0
LDOR	4/8/2004	ONTARIO	BRAMPTON	100	0
LDOR	5/1/2002	MD	Baltimore	680	0
LDOR	5/1/2007	PA	PHILADELPHIA	100	0
LDOR	5/11/1995	FO	St Johns, Newfoundland	299	21
LDOR	5/12/2001	QUEBEC	MONTRÉAL INTL (DORVAL)	715	0
LDOR	5/12/2004	AZ	MESA	50	0
LDOR	5/16/1992	NJ	CALDWELL, NJ	370	N/A
LDOR	5/16/2000	ONTARIO	DRYDEN REGIONAL	400	N/A
LDOR	5/18/2000	WI	MILWAUKEE	228	0
LDOR	5/18/2003	TX	Houston	20	0
LDOR	5/19/1992	MT	Bozeman	150	0
LDOR	5/19/1995	NJ	ATLANTIC CITY, NJ	200	N/A
LDOR	5/19/1998	GA	Atlanta	200	0
LDOR	5/2/2002	TX	LEAKEY	560	50
LDOR	5/20/2003	MN	Minneapolis	200	0
LDOR	5/20/2004	HI	Honolulu	75	0
LDOR	5/20/2005	NC	WALLACE	220	N/A
LDOR	5/21/1997	CA	SAN DIEGO	1300	0
LDOR	5/21/2006	ONTARIO	TORONTO/LESTER B. PEARSON INTL	100	N/A

Accident Type	Date	State	City	X	Y
LDOR	5/23/1998	FL	ORLANDO	500	0
LDOR	5/23/2002	KS	OLATHE	100	N/A
LDOR	5/26/1993	England	Southampton	630	0
LDOR	5/27/1985	FO	Leeds Bradford	538	33
LDOR	5/27/2005	ONTARIO	CHAPLEAU	10	0
LDOR	5/28/2001	IL	CHICAGO	205	0
LDOR	5/28/2003	England	Leeds	525	86
LDOR	5/30/2003	NY	JAMAICA	238	0
LDOR	5/30/2006	WI	MOSINEE	400	0
LDOR	5/31/2004	MANITOBA	WINNIPEG INTL	402	0
LDOR	5/4/2008	CO	LOVELAND	10	N/A
LDOR	5/5/1997	MD	WESTMINISTER, MD	220	30
LDOR	5/5/2001	CA	RIVERSIDE	983	195
LDOR	5/7/1986	FL	HOLLYWOOD	500	450
LDOR	5/8/1999	NY	JAMAICA	350	N/A
LDOR	6/1/1999	AR	LITTLE ROCK	800	20
LDOR	6/1/2002		Darwin	144	0
LDOR	6/11/1985	CA	VAN NUYS	1300	N/A
LDOR	6/13/1994	WV	LEWISBURG	130	0
LDOR	6/14/2005	MA	NORWOOD	400	N/A
LDOR	6/15/2007	ONTARIO	RED LAKE	30	0
LDOR	6/16/2010	ONTARIO	OTTAWA	552	320
LDOR	6/17/1988	FL	W. PALM BEACH	30	0
LDOR	6/17/1992	IA	CEDAR RAPIDS	212	0
LDOR	6/17/2002	CT	Oxford	1500	N/A
LDOR	6/19/1991	MO	Kansas City	500	0
LDOR	6/19/1998	NY	FISHERS ISLAND	115	0
LDOR	6/2/2010	ONTARIO	OSHAWA	234	0
LDOR	6/20/2002	FO	Santo Domingo	200	0
LDOR	6/20/2007	WY	Laramie	160	481
LDOR	6/21/1998		Ibiza	722	492
LDOR	6/22/2006	Scotland	Aberdeen	1148	40
LDOR	6/23/1984	IL	CHICAGO	600	0
LDOR	6/23/2004	TX	Houston	50	30
LDOR	6/25/1997		London	787	33
LDOR	6/27/1985		Leeds	515	0
LDOR	6/29/2000	IL	JOLIET	170	0
LDOR	6/3/2004	KY	LEXINGTON	100	0
LDOR	6/7/1995	MA	HYANNIS	300	0

Accident Type	Date	State	City	X	Y
LDOR	7/1/1992	IL	CHICAGO	25	0
LDOR	7/1/1999	MA	HYANNIS	745	0
LDOR	7/1/2000	England	Coventry	853	98
LDOR	7/12/1985	TX	FORT WORTH	459	100
LDOR	7/12/2002		Dublin	47	0
LDOR	7/13/2003	IN	EVANSVILLE	171	0
LDOR	7/14/2004	Ontario	Ottawa	300	0
LDOR	7/15/1997	FL	AVON PARK	1800	550
LDOR	7/16/2011	NEWFOUNDLAND AND LABRADOR	St John's	350	60
LDOR	7/18/1971	New South Wales	Sydney	727	60
LDOR	7/18/2007	MN	MINNEAPOLIS	120	N/A
LDOR	7/19/1990	WY	Jackson	310	0
LDOR	7/19/1992	FO	Rota	10	0
LDOR	7/19/1992	IL	Chicago	30	0
LDOR	7/19/1999	MN	Minneapolis	125	0
LDOR	7/19/2004	FL	FORT LAUDERDALE	950	280
LDOR	7/2/1991	TN	COLUMBIA	543	38
LDOR	7/20/1983	IL	CHICAGO	100	0
LDOR	7/20/2001	ME	Portland	50	0
LDOR	7/20/2004	FL	Tallahassee	400	0
LDOR	7/21/1993	FO	Tofino	150	20
LDOR	7/21/1993	BRITISH COLUMBIA	TOFINO, B.C.	150	N/A
LDOR	7/21/2002	ONTARIO	ORONTO/BUTTONVILLE MUNICIPAL	33	0
LDOR	7/22/1994	WY	JACKSON	61	0
LDOR	7/22/1998	FO	Belfast	23	0
LDOR	7/23/2000	Quebec	Dorval	700	0
LDOR	7/26/1995	MN	MINNEAPOLIS	800	0
LDOR	7/28/2007	WA	Tonasket, WA	1320	0
LDOR	7/28/2007	BRITISH COLUMBIA	TOFINO	25	N/A
LDOR	7/29/1980	LA	HOUMA	50	0
LDOR	7/29/1992	WY	JACKSON	100	N/A
LDOR	7/30/1997	Tuscany	Florence	394	0
LDOR	7/30/1999	MN	MINNEAPOLIS	100	N/A
LDOR	7/30/1999	MN	MINNEAPOLIS	100	0
LDOR	7/5/1997	OK	ARDMORE	60	0
LDOR	7/6/1984	FO	Blanc-Sablon, Quebec	30	0
LDOR	8/1/1988	FL	PENSACOLA	320	90

Accident Type	Date	State	City	X	Y
LDOR	8/1/1999	Newfoundland	ST. JOHN'S	420	90
LDOR	8/10/1991	NC	CHARLOTTE	50	0
LDOR	8/10/1994	Jeju	Jeju	1427	3278
LDOR	8/13/1996	Greater London	Northolt	748	115
LDOR	8/13/2002	CA	Big Bear City	406	30
LDOR	8/13/2005	VA	PORTSMOUTH	290	N/A
LDOR	8/14/1999	NY	SARANAC LAKE	30	0
LDOR	8/16/2001	MN	SAINT PAUL	370	N/A
LDOR	8/19/1988	FL	Pensacola	78	0
LDOR	8/19/1990	CA	Santa Ana	75	0
LDOR	8/19/1991	WA	Seattle	25	30
LDOR	8/19/1991	NC	Charlotte	80	0
LDOR	8/19/1992	WI	Milwaukee	250	0
LDOR	8/19/1994	GA	SAVANNAH	2	30
LDOR	8/19/1997	IA	DES MOINES	867	0
LDOR	8/19/1999	MN	Minneapolis	200	30
LDOR	8/2/1986	IN	BEDFORD	677	0
LDOR	8/2/2005	Ontario	Toronto	1000	30
LDOR	8/21/1995	AZ	MESA	250	N/A
LDOR	8/21/2009	NJ	Teterboro	2089	150
LDOR	8/26/1993	ID	HAILEY	850	260
LDOR	8/28/1985	WI	GREEN BAY	100	0
LDOR	8/28/2001	MI	Detroit	679	120
LDOR	8/3/1997	NY	EAST HAMPTON	330	30
LDOR	8/30/2001	KS	OLATHE	200	0
LDOR	8/30/2002	KY	Lexington	410	10
LDOR	8/4/2010	BRITISH COLUMBIA	ABBOTSFORD	500	0
LDOR	8/5/2004	NY	WATERTOWN	23	55
LDOR	8/5/2004	NC	OXFORD	100	N/A
LDOR	8/6/1998	Ontario	Kasabonika	449	0
LDOR	8/9/1999	MN	MINNEAPOLIS	200	0
LDOR	8/9/2000	OR	PORTLAND	250	N/A
LDOR	9/1/1991	CA	BRAWLEY, CA	627	40
LDOR	9/1/2000	ON	Ottawa	100	0
LDOR	9/10/1983	CO	BURLINGTON	225	N/A
LDOR	9/10/2002	Newfoundland and Labrador	Gander	900	0
LDOR	9/12/1993	Tahiti	Faa	230	197
LDOR	9/13/1981	MA	BOSTON	50	0

Accident Type	Date	State	City	X	Y
LDOR	9/14/1993		Warsaw	361	295
LDOR	9/15/2000	Ontario	Ottawa	234	0
LDOR	9/15/2002	TX	LA PORTE	100	0
LDOR	9/19/1988	KY	Paducah	200	0
LDOR	9/19/1993	DC	Washington	50	0
LDOR	9/19/1995	SC	Charleston	50	160
LDOR	9/19/1995	AR	Fayetteville	52	0
LDOR	9/19/1999	FO	Shannon	50	N/A
LDOR	9/19/1999	MN	Minneapolis	25	0
LDOR	9/19/2003	TX	Del Rio	1600	100
LDOR	9/20/1983	NY	MASSENA	587	30
LDOR	9/20/1994	MA	STERLING, MA	60	N/A
LDOR	9/22/1988	MI	FREMONT	644	150
LDOR	9/23/1985	IL	WEST CHICAGO	1200	1100
LDOR	9/23/1988	KY	PADUCAH	201	0
LDOR	9/23/1999	Nonthaburi	Bangkok	1050	59
LDOR	9/23/2005	CA	SAN DIEGO	200	N/A
LDOR	9/26/1998	England	Fairoaks	765	140
LDOR	9/26/1999	GA	GAINESVILLE	274	100
LDOR	9/28/1996	OH	CHILLICOTHE	15	147
LDOR	9/29/1986	KS	LIBERAL	1320	N/A
LDOR	9/29/1993	FO	Norwich	89	0
LDOR	9/6/1999		Shetland	650	0
LDUS	1/10/1979	TX	LUBBOCK	-120	0
LDUS	1/15/2002	MI	KINGS FORD	-100	0
LDUS	1/17/1990	MS	WEST POINT	-6	0
LDUS	1/19/1990	AR	LITTLE ROCK	-1600	0
LDUS	1/23/1983	NY	JAMAICA	-200	0
LDUS	1/24/1994	FL	KEY LARGO	-35	0
LDUS	1/26/2004	AZ	PRESCOTT	-50	0
LDUS	1/27/1979	GU	AGANA	-278	0
LDUS	1/27/2009	TX	Lubbock	-630	1
LDUS	1/27/2012	WA	Chehalis, WA	-300	0
LDUS	1/31/1994	MO	CHESTERFIELD	-700	0
LDUS	1/4/1987	NY	HUDSON	-100	0
LDUS	1/4/1999	QUEBEC	ST-AUGUSTIN	-1400	0
LDUS	1/5/1984	WA	SEATTLE	-360	0
LDUS	1/5/2003	OK	OKLAHOMA CITY	-200	-30
LDUS	1/7/1994	OH	COLUMBUS	-7286	0
LDUS	1/7/1994	Ohio	Gahanna	-6336	0

Accident Type	Date	State	City	X	Y
LDUS	1/7/1996	TN	NASHVILLE	-90	0
LDUS	1/9/2007	BRITISH COLUMBIA	FORT ST. JOHN	-380	50
LDUS	10/12/1995	OH	CLEVELAND	-900	N/A
LDUS	10/15/2002	ONT	Ontario	-50	0
LDUS	10/19/1980	AZ	Phoenix	-500	0
LDUS	10/19/1991	AK	ALLAKAKET	-340	30
LDUS	10/19/1996	FO	FLUSHING	-300	0
LDUS	10/19/1997	FO	Hong Kong	-150	0
LDUS	10/20/2001	TX	Houston	-100	0
LDUS	10/20/2002	CA	Ontario	-45	0
LDUS	10/22/2006	FL	St. Augustine, FL	-150	0
LDUS	10/8/1994	CA	COALINGA, CA	-20	0
LDUS	11/13/1997	WV	WHEELING	-90	125
LDUS	11/17/2006	AZ	Flagstaff	-2400	30
LDUS	11/18/2003	TX	Mineral Wells	-320	-100
LDUS	11/19/1995	AK	ANCHORAGE	-50	0
LDUS	11/21/2010	CA	Newport Beach	-14000	N/A
LDUS	11/22/2001	MANITOBA	WINNIPEG/ST. ANDREWS	-500	0
LDUS	11/23/1987	AK	HOMER	-1100	0
LDUS	11/23/2003	NORTHWEST TERRITORIES	NORMAN WELLS	-300	0
LDUS	11/26/1981	GA	AUGUSTA	-300	0
LDUS	11/26/2006	CA	Buena Park	-1870	880
LDUS	11/27/1994	SC	GREER	-3250	1200
LDUS	11/29/1990	FL	SEBRING	-1000	60
LDUS	11/30/1996	CA	IRVINE	-6867	N/A
LDUS	11/7/2002	CA	Santa Ana	-250	0
LDUS	11/8/1993	VA	MANASSAS	-1900	220
LDUS	11/9/1993	UT	SALT LAKE CITY	-580	90
LDUS	11/9/2004	ID	Boise	-500	0
LDUS	11/9/2009	SC	Greer	-2200	150
LDUS	12/12/1983	PA	COATESVILLE	-20	N/A
LDUS	12/14/2003	CA	Claremont	-5580	7399
LDUS	12/15/1993	CA	SANTA ANA	-21000	100
LDUS	12/15/1998	LA	MARKSVILLE, LA	-1038	N/A
LDUS	12/15/2011	VA	Farmville, VA	-2000	0
LDUS	12/16/1990	WI	MARSHFIELD	-50	0
LDUS	12/17/2007	UT	VERNAL	-50	0
LDUS	12/19/1988	OH	Sandusky	-60	0

Accident Type	Date	State	City	X	Y
LDUS	12/20/1990	OR	MCMINNVILLE	-50	0
LDUS	12/21/1979	VT	BURLINGTON	-100	0
LDUS	12/21/1983	MI	DETROIT	-125	N/A
LDUS	12/22/1979	CO	DENVER	-50	0
LDUS	12/22/1993	MO	CHESTERFIELD	-5280	N/A
LDUS	12/26/1989	WA	PASCO	-400	20
LDUS	12/30/2000	UT	SALT LAKE CITY	-400	0
LDUS	12/31/1997	MO	CHESTERFIELD	-4900	1400
LDUS	12/5/1987	KY	LEXINGTON	-1230	160
LDUS	12/6/2007	CA	Fallbrook	-1848	50
LDUS	12/8/1993	TX	DFW AIRPORT	-1095	0
LDUS	12/8/1994	MO	KANSAS CITY	-300	400
LDUS	12/9/1999	NJ	HASBROUCK HTS.	-2550	6025
LDUS	2/1/2006	NC	Burlington, NC	-20	0
LDUS	2/11/1987	NY	ONEONTA	-10	N/A
LDUS	2/12/2000	KS	OLATHE	-900	0
LDUS	2/12/2003	BRITISH COLUMBIA	BOUNDARY BAY	-20	0
LDUS	2/13/1995	AZ	TUSAYAN	-13200	N/A
LDUS	2/16/1988	CT	GROTON	-150	0
LDUS	2/16/1997	MANITOBA	WINNIPEG	-250	20
LDUS	2/16/2004	NEW BRUNSWICK	FREDERICTON	-200	0
LDUS	2/19/1995	OR	Portland	-350	0
LDUS	2/19/1998	FO	Hong Kong	-900	0
LDUS	2/19/1999	FL	Miami	-75	0
LDUS	2/25/2009		Haarlemmermeer	-4910	N/A
LDUS	2/5/2005	CA	Murrieta	-550	0
LDUS	2/5/2005	CA	Murrieta, CA	-20	0
LDUS	2/6/1994	MO	CHESTERFIELD	-7467	7467
LDUS	2/7/1986	AK	MEKORYUK	-50	50
LDUS	2/7/1997	CA	LOS ANGELES	-12700	1900
LDUS	2/7/2006	BRITISH COLUMBIA	PITT MEADOWS	-750	0
LDUS	2/8/1986	TX	HARLINGEN	-250	0
LDUS	2/8/2001	CA	San Diego	-2100	-40
LDUS	2/8/2001	CA	Santa Maria	-1540	40
LDUS	2/9/1998	IL	CHICAGO	-314	0
LDUS	3/1/2012	FL	Boca Raton	-90	0
LDUS	3/11/1994	CA	LOS ANGELES	-2200	350
LDUS	3/12/1981	OH	CINCINNATI	-50	0
LDUS	3/13/2000	CA	SAN FRANCISCO	-7021	921

Accident Type	Date	State	City	X	Y
LDUS	3/15/1989	IN	WEST LAFAYETTE	-500	13
LDUS	3/16/2004	CA	Los Angeles	-150	3200
LDUS	3/19/2001	VA	Manassas	-2500	0
LDUS	3/2/1997	UT	SALT LAKE CITY	-8230	800
LDUS	3/24/2007	SC	Monks Corner, SC	-100	0
LDUS	3/27/2000	AK	FAIRBANKS, AK	-75	N/A
LDUS	3/29/2001	CO	Aspen	-2400	300
LDUS	3/3/1995	WY	GILLETTE	-50	0
LDUS	3/30/1994	TX	AUSTIN	-1320	0
LDUS	3/30/1999	AR	ROGERS	-12	N/A
LDUS	3/30/1999		Newquay	-741	0
LDUS	3/30/2008	CA	Redding	-692	40
LDUS	4/11/1994	MO	CHESTERFIELD	-13200	N/A
LDUS	4/11/2000	WA	SEATTLE	-5000	300
LDUS	4/12/2002	CT	OXFORD	-1550	1550
LDUS	4/13/1989	AZ	SCOTTSDALE	-20	N/A
LDUS	4/15/1993	AZ	FLAGSTAFF	-1700	375
LDUS	4/18/1981	AK	SAND POINT	-300	0
LDUS	4/18/1994	PA	BEDFORD, PA	-5	0
LDUS	4/18/2005	MS	Tupelo	-1600	1900
LDUS	4/23/1998	OH	COLUMBUS	-700	0
LDUS	4/27/1999	AK	JUNEAU	-450	0
LDUS	4/3/1978	MI	DETROIT	-50	0
LDUS	4/7/1997	AK	STEBBINS	-20	N/A
LDUS	4/8/1984	TX	AUSTIN	-50	0
LDUS	4/8/2003	DE	Delaware City, DE	-36960	550
LDUS	4/9/2003	PA	Du Bois	-500	N/A
LDUS	5/11/1998	NH	NASHUA	-7920	140
LDUS	5/11/2004	AL	Cortland, AL	-600	N/A
LDUS	5/12/1985	WI	LAKE GENEVA	-13	5
LDUS	5/12/2011 9:30:00 AM	QUEBEC	Montréal	-20	0
LDUS	5/13/2003	TN	Somerville, TN	-60	0
LDUS	5/15/1991	TN	NASHVILLE	-408	0
LDUS	5/16/1982	AK	HOOPER BAY	-1320	50
LDUS	5/19/1999	NY	New York	-100	0
LDUS	5/20/1986	KS	HUTCHINSON	-3	0
LDUS	5/23/2004	CT	Oxford	-2640	1000
LDUS	5/23/2007	MO	Chesterfield	-1750	N/A
LDUS	5/25/2001	Guyane	Cayenne	-98	0

Accident Type	Date	State	City	X	Y
LDUS	5/31/1978	MT	LEWISTOWN	-600	0
LDUS	5/4/1990	NC	WILMINGTON	-370	0
LDUS	5/5/2001	CA	Hesperia	-2100	2062
LDUS	5/6/1989	TN	MT. PLEASANT	-1700	20
LDUS	5/6/2002	AZ	Flagstaff	-3000	0
LDUS	5/6/2003	BRITISH COLUMBIA	WILLIAMS LAKE	-2297	0
LDUS	5/8/1987		Mayaguez	-600	0
LDUS	6/1/1988	NY	JAMAICA	-100	60
LDUS	6/12/2001	KS	Salina	-1354	85
LDUS	6/16/1992	DE	NEW CASTLE	-1250	N/A
LDUS	6/19/1995	FO	PANAMA CITY	-350	0
LDUS	6/26/2005	ID	Hailey	-1300	N/A
LDUS	6/28/1985	NC	CHARLOTTE	-764	N/A
LDUS	6/28/2003	AK	GOODNEWS	-100	0
LDUS	6/28/2013	CO	Eagle	-2640	N/A
LDUS	6/29/1978	PA	EBENSBURG	-600	0
LDUS	6/29/1996	AZ	GRAND CANYON	-32	0
LDUS	6/6/2004	CA	SAN JOSE	-50	0
LDUS	6/7/1992		Mayaguez	-3960	N/A
LDUS	7/1/1986	NE	LINCOLN	-243	N/A
LDUS	7/10/1991	AL	Birmingham	-36114	0
LDUS	7/12/1984	OK	MCALESTER	-300	N/A
LDUS	7/13/1994	AZ	TUCSON	-6300	N/A
LDUS	7/19/1989	IA	SIOUX CITY	-2200	761
LDUS	7/19/1993	MI	Nantucket	-150	0
LDUS	7/20/2013	MS	Tupelo	-2200	N/A
LDUS	7/25/1980	FL	TAMPA	-50	0
LDUS	7/26/1988	NJ	MORRISTOWN	-242	75
LDUS	7/26/2002	FL	Tallahassee	-3650	N/A
LDUS	7/27/1996	OR	PORTLAND	-700	N/A
LDUS	7/3/1996	NC	KINSTON	-9116	0
LDUS	7/30/1993	MA	NANTUCKET	-50	0
LDUS	7/30/1994	CA	LIVERMORE	-500	0
LDUS	7/6/2013	CA	San Francisco	-350	0
LDUS	7/6/2013	CA	San Francisco	-2400	110
LDUS	7/7/1983	IL	ROCHELLE	-1	0
LDUS	8/11/1997	CA	SANTA ANA	-2100	N/A
LDUS	8/13/1997	KY	LEXINGTON	-13	215
LDUS	8/13/2004	CA	San Francisco	-6336	N/A
LDUS	8/14/1997	GA	DALTON	-1100	135

Accident Type	Date	State	City	X	Y
LDUS	8/14/2013	AL	Birmingham	-3168	0
LDUS	8/16/2004	WY	Dubois, WY	-45	0
LDUS	8/16/2011	AK	Valdez, AK	-150	0
LDUS	8/17/1979	OK	BETHANY	-200	0
LDUS	8/17/2011	BRITISH COLUMBIA	Pitt Meadows	-400	0
LDUS	8/18/1999	CA	SAN CARLOS	-3960	N/A
LDUS	8/2/1985	TX	DALLAS/FT WORTH	-6300	N/A
LDUS	8/2/2002	CA	Mokelumne Hill, CA	-2	0
LDUS	8/20/2011	Nunavut	Resolute Bay	-4200	4552
LDUS	8/21/1989	OR	GOLD BEACH	-50	150
LDUS	8/25/1985	ME	Auburn	-4007	400
LDUS	8/25/2004	FL	VENICE	-30	0
LDUS	8/26/1993	AR	SPRINGDALE	-4560	0
LDUS	8/26/2000	ID	BOISE	-5280	1750
LDUS	8/31/1996	TX	LUBBOCK	-10	0
LDUS	8/8/1992	AK	NUIQSUT	-1	0
LDUS	9/15/2008	MA	NANTUCKET	-50	0
LDUS	9/18/1995	CA	CHINO	-1000	75
LDUS	9/19/1988	CA	San Diego	-50	0
LDUS	9/19/2001	IN	Indianapolis	-900	0
LDUS	9/24/1999	Newfoundland	ST. JOHN'S	-250	0
LDUS	9/25/1985	AK	UNALASKA	-72	N/A
LDUS	9/29/2003	WA	Cle Elum, WA	-15	0
LDUS	9/8/2000	ID	HAILEY	-90	0
LDUS	9/9/2005	WI	Boscobel, WI	-30	0
TOOR	1/17/1985	NY	FLUSHING	563	0
TOOR	1/25/2007	Pyrénées Atlantiques department	Pau	1598	100
TOOR	1/30/1990	NY	ROCHESTER	249	N/A
TOOR	1/4/2001	NY	Schenectady	470	0
TOOR	1/6/1990	FL	MIAMI	1180	100
TOOR	10/15/2000	AK	ANCHORAGE	690	0
TOOR	10/19/1995	FO	Vancouver	400	141
TOOR	10/19/2000	CA	Concord	496	0
TOOR	10/29/2007	CA	Santa Ana	50	0
TOOR	10/3/1982	LA	Jefferson Parish	443	N/A
TOOR	11/11/1999	IL	CHICAGO	300	100
TOOR	11/11/2003	IL	Wheeling	500	0

Accident Type	Date	State	City	X	Y
TOOR	11/15/1988	MN	MINNEAPOLIS	330	0
TOOR	11/2/1993	TX	HOUSTON	200	0
TOOR	11/29/1997	FO	Island Lake, Manitoba	451	0
TOOR	12/16/2003	NJ	TETERBORO	188	0
TOOR	12/18/1992	ID	MCCALL	500	50
TOOR	12/20/2004	TX	El Paso	200	0
TOOR	12/23/1983	AK	ANCHORAGE	1434	40
TOOR	12/28/1997	WV	ELKINS, WV	303	0
TOOR	12/3/1998	Nunavut	Iqaluit	800	100
TOOR	12/5/2009	QUEBEC	MONTRÉAL/ST-HUBERT	30	N/A
TOOR	12/6/1999	AK	BETHEL	600	N/A
TOOR	2/1/2001	CA	SAN LUIS OBISPO	35	0
TOOR	2/19/1981	PA	Pittsburg	199	0
TOOR	2/2/2005	NJ	Teterboro	517	0
TOOR	2/22/2008	BRITISH COLUMBIA	LANGLEY	258	N/A
TOOR	2/3/1982	PA	PHILADELPHIA	600	0
TOOR	2/5/1993	AK	FAIRBANKS	100	0
TOOR	3/12/1991	NY	JAMAICA	835	550
TOOR	3/13/1990	NJ	TETERBORO	250	N/A
TOOR	3/17/2001	MI	Detroit	530	73
TOOR	3/19/1998	OR	PORTLAND	1000	530
TOOR	3/2/1994	NY	FLUSHING	500	0
TOOR	3/22/2001	Centre	Orleans	590	66
TOOR	3/30/1998	FO	Stansted	386	0
TOOR	3/4/1981	MD	HAGERSTOWN	15	0
TOOR	3/9/2005	MS	TUPELO	120	30
TOOR	4/1/2002	MD	Cambridge	75	N/A
TOOR	4/15/1992	NC	CHARLOTTE	100	0
TOOR	4/18/2010	BRITISH COLUMBIA	SALMON ARM	560	90
TOOR	4/19/1992	NC	Charlotte	200	130
TOOR	5/1/1996	NM	ALBUQUERQUE	212	212
TOOR	5/11/2000	Alberta	Edmonton	500	0
TOOR	5/14/1995	CA	OAKLAND, CA	691	0
TOOR	5/16/1995	AZ	FLAGSTAFF	1301	N/A
TOOR	5/19/1994	TX	Texarkana	79	0
TOOR	5/20/2002	OK	Bethany	700	0
TOOR	5/21/1988	TX	DFW AIRPORT	1112	0

Accident Type	Date	State	City	X	Y
TOOR	5/23/1995	AR	ROGERS	1200	0
TOOR	5/26/1987	LA	KENNER	1180	20
TOOR	5/31/1984	CO	DENVER	1074	0
TOOR	5/9/2005	TX	BROWNWOOD	1300	0
TOOR	6/12/2003	FL	FORT LAUDERDALE	1000	50
TOOR	6/23/1998	DC	WASHINGTON	250	N/A
TOOR	6/27/1985	PR	SAN JUAN	140	0
TOOR	6/27/1985	FO	Luis Munoz Marin International Airport, San Juan ,	63	161
TOOR	6/27/1988	FO	Newcastle	161	0
TOOR	6/3/2006	VA	Manassas	1700	260
TOOR	6/4/1982	KS	WICHITA	300	50
TOOR	6/7/1998	MO	EXCELSIOR SPR, MO	300	0
TOOR	7/10/2003	CA	Tulelake	2787	772
TOOR	7/11/1995	OH	COLUMBUS, OH	320	N/A
TOOR	7/11/1995	OH	COLUMBUS	328	0
TOOR	7/12/1994	NY	WHITE PLAINS, NY	221	0
TOOR	7/13/1994	NJ	ATLANTIC CITY	446	0
TOOR	7/16/1987	MS	JACKSON	1300	N/A
TOOR	7/17/2003	Drenthe	Eelde	328	0
TOOR	7/19/1998	NC	Raleigh	200	0
TOOR	7/20/1986	FO	Wabush, Newfoundland	376	0
TOOR	7/22/2003	PA	Pittston	740	0
TOOR	7/28/1984	ME	WATERVILLE	100	10
TOOR	7/31/1991	CO	DENVER	150	0
TOOR	7/5/1982	ID	Boise	50	0
TOOR	7/8/1996	TN	NASHVILLE	750	100
TOOR	8/1/2006	IN	ANGOLA	75	0
TOOR	8/12/2004	ALBERTA	HIGH LEVEL	1200	0
TOOR	8/13/1985	WI	MADISON	900	N/A
TOOR	8/14/1996	PA	POTTSTOWN	1429	457
TOOR	8/16/1988	OH	CLEVELAND	837	387
TOOR	8/16/1996	FO	Liverpool Airport	718	200
TOOR	8/16/2001	MI	TRAVERSE CITY	628	0
TOOR	8/17/2003	CT	GROTON	125	0
TOOR	8/19/1988	OH	Cleveland	500	300
TOOR	8/19/1989	LA	New Orleans	800	0

Accident Type	Date	State	City	X	Y
TOOR	8/19/1992	DC	Washington DC	170	0
TOOR	8/25/1989	LA	New Orleans	600	N/A
TOOR	8/26/1994	LA	NEW ORLEANS	500	0
TOOR	8/27/1994	MO	CHESTERFIELD	100	0
TOOR	8/27/2006	KY	Lexington	975	55
TOOR	8/27/2006	KY	Fyette County	1000	0
TOOR	8/28/1998	TX	El Paso	2999	0
TOOR	8/7/1997	FL	MIAMI	575	0
TOOR	8/7/2003	MN	DULUTH	6	N/A
TOOR	9/11/1988	LA	NEW ORLEANS	400	0
TOOR	9/13/1982	CO	DENVER	10	0
TOOR	9/13/1989	IN	WARSAW	1000	0
TOOR	9/19/1993	Aube	Troyes	885	98
TOOR	9/19/2008	South Carolina	West Columbia	1549	0
TOOR	9/20/1989	NY	FLUSHING	194	N/A
TOOR	9/21/1987	FL	TYNDALL AFB	230	50
TOOR	9/21/1995	TX	HOUSTON	225	0
TOOR	9/22/2004	AZ	Flagstaff	800	0
TOOR	9/22/2010	QUEBEC	MONTMAGNY	886	N/A
TOOR	9/29/1993	Franche-Comté	Besançon	99	49
TOOS	1/11/1983	MI	DETROIT	299	1200
TOOS	1/11/1995	AZ	FLAGSTAFF	6500	N/A
TOOS	1/13/1982		Washinton, D.C.	4561	0
TOOS	1/8/2006	CA	Mammoth Lakes	6997	3294
TOOS	10/14/2004	Nova Scotia	Halifax	1750	40
TOOS	10/17/2013	AK	Fairbanks	1585	0
TOOS	10/26/2003	CA	San Diego	1313	200
TOOS	10/27/2004	NC	Asheville	4224	0
TOOS	10/4/2000	CA	SANTA ROSA	1476	12048
TOOS	11/10/2002	CA	Chino	5542	4500
TOOS	11/13/2002	CA	San Andreas	1312	643
TOOS	11/15/1987	CO	DENVER	1300	325
TOOS	11/18/1995	CA	OXNARD	7920	N/A
TOOS	11/2/1995	AZ	GRAND CANYON	12144	N/A
TOOS	11/22/1995	AZ	GRAND CANYON	2650	420
TOOS	12/15/2003	CA	Watsonville	3196	350
TOOS	12/18/1997	CT	OXFORD	100	350
TOOS	12/2/2004	FL	Milton, FL	10	80
TOOS	12/24/2005	OR	Portland	1300	0
TOOS	12/8/2009	CA	Fresno	1500	0

Accident Type	Date	State	City	X	Y
TOOS	12/9/1996	ID	BOISE	2900	1350
TOOS	2/27/1989	NY	POUGHKEEPSIE	700	100
TOOS	3/1/2002	TX	Austin	0	2410
TOOS	3/11/1996	WV	BRIDGEPORT	1250	20200
TOOS	3/13/2005	CA	Big Bear City	4450	0
TOOS	3/9/2002	NJ	Teterboro	180	800
TOOS	4/10/2002	AK	Juneau	0	2600
TOOS	5/11/1996	NC	KINSTON	6077	N/A
TOOS	5/16/2002	ID	Boise	3800	3000
TOOS	5/25/1999	OK	ALTUS, OK	2920	0
TOOS	5/28/2003	AZ	Grand Canyon	2400	500
TOOS	5/29/1995	IL	DOWNERS GROVE, IL	378	N/A
TOOS	5/7/2005	AZ	Grand Canyon	1300	450
TOOS	6/27/1998	AZ	FLAGSTAFF	6500	1600
TOOS	6/7/1993	VA	MANASSAS	3700	3800
TOOS	6/9/2001	AR	Springdale	5280	N/A
TOOS	7/1/2010	CA	Venice	1600	400
TOOS	7/12/1998	ID	HAILEY	1900	900
TOOS	7/16/1997	TN	KNOXVILLE	7400	7400
TOOS	7/21/2005	NV	Las Vegas, NV	300	100
TOOS	7/22/1991	MI	DETROIT	828	0
TOOS	7/3/2009	AZ	Tucson	3480	332
TOOS	7/9/1982	LA	NEW ORLEANS	4610	564
TOOS	8/1/1998	IL	CHICAGO, IL	337	50
TOOS	8/15/1996	SD	CUSTER, SD	1570	50
TOOS	8/16/1987	MI	Romulus	5590	50
TOOS	8/2/1984		Vieques	400	N/A
TOOS	8/24/2001	NY	Ithaca	1003	10
TOOS	8/26/2003	MA	Yarmouth	3748	0
TOOS	8/28/2007	CA	Blythe	2416	0
TOOS	8/3/1999	AZ	TUSAYAN	9300	2300
TOOS	8/3/2013	MO	Chesterfield	4050	500
TOOS	8/30/2007	CA	Cameron Park, CA	719	0
TOOS	8/31/1988	TX	DALLAS/FT WORTH	2833	0
TOOS	8/31/1996	OH	YOUNGSTOWN, OH	370	N/A
TOOS	8/5/2001	CA	Weaverville	906	268
TOOS	8/9/1997	CO	EAGLE	2640	N/A
TOOS	9/12/2004	MO	Chesterfield	6620	700
TOOS	9/21/2007	FL	Ft. Lauderdale, FL	4500	308
TOOS	9/25/2004	CA	Fullerton	2371	340

Accident Type	Date	State	City	X	Y
TOOS	9/6/1985	WI	Milwaukee	1320	9690