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Development of Criteria for Parachute Landing Areas on Airports

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16. Abstract

Airport sponsors who accept federal funding are obligated to make the aircraft facility available to all aeronautical activities, including parachuting and skydiving. Due to the lack of guidance concerning parachute landing areas (PLA) for airports that are able to accommodate nontraditional aeronautical activities (such as skydiving), research was conducted to determine the recommended size and location of PLAs on airports and provide guidance material.

To do this, transition data were collected from airports currently supporting parachute operations, and international and military standards were examined. Site visits were conducted and subject matter experts were consulted.

It was determined that the experience of the parachutist and type of parachute used should be considered in developing the size of the PLA. It was also determined that the edge of the PLA should be located no closer than 40 feet from a hazard. In addition, the report includes recommendations for operational procedures and practices.

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LIST OF ACRONYMS

AC	Advisory Circular
A/FD	Airport/Facility Directory
BPA	British Parachute Association
BSR	Basic Safety Requirements
CAA	Civil Aviation Authority
CAR	Canadian Aviation Regulations
CFR	Code of Federal Regulations
CoP	Certificate of Proficiency
CSPA	Canadian Sport Parachuting Association
DED	Deland Municipal Airport
DZ	Drop zone
FAA	Federal Aviation Administration
FAI	Federation Aeronautique Internationale
IAA	Irish Aviation Authority
LOA	Letters of Agreement
NAVAID	Navigational aid
NPIAS	National Plan of Integrated Airport Systems
NTSB	National Transportation Safety Board
PASA	Parachute Association of South Africa
PIM	Parachutist Information Manual
OFA	Object-Free Area
PLA	Parachute Landing Area
ROFA	Runway Object-Free Area
RSA	Runway Safety Area
SACAA	South African Civil Aviation Authority
SIM	Skydiver's Information Manual
TC	Transport Canada
UK	United Kingdom
USPA	United States Parachute Association
VOR	Very high frequency omnidirectional radio range

EXECUTIVE SUMMARY

An airport sponsor who accepts federal funding is obligated to make the airport facility available to all aeronautical activities, including parachuting or skydiving. Current Federal Aviation Administration (FAA) guidance is tailored more toward traditional aeronautical uses, such as fixed-wing and rotary-wing operations, although parachuting and skydiving is included. Airports and skydiving operators need additional guidance for establishing and operating parachute landing areas (PLA) on airport property.

The first step of this research was to collect information on National Plan of Integrated Airport Systems* airports that currently support parachuting or skydiving activities. Site visits were conducted at several airports to gather additional information and interview airport operators, skydiving operators, and parachutists. Subject matter experts at the United States Parachute Association (USPA) were consulted, and international and military standards were reviewed.

Several of the defined, on-airport PLAs were located within the protected areas of a runway. It was concluded that parachutist experience and parachute maneuverability should be considered when determining the size of the PLA.

It is recommended that the edge of the PLA should be located no closer than 40 feet from a hazard instead of allowing a skydiver to land within inches of a hazard, thus providing a safety buffer for both airfield equipment and the skydiver.

Updates to relevant FAA advisory circulars and pilot and skydiver education are recommended. It is also recommended that airports and the skydiving operators develop Letters of Agreement concerning PLA procedures.

*The most recent National Plan of Integrated Airport Systems (NPIAS) is available at http://www.faa.gov /airports/planning_capacity/npias/.

1. INTRODUCTION.

An airport sponsor who accepts funding through the Airport Improvement Program or other federal programs is obligated to make the airport facilities available for all aeronautical activities. Some aeronautical activities, when operating within close proximity to other aeronautical activities, can compromise the safety of aircraft, property, and aviators. Current guidance on aeronautical activities that may access an airport is tailored toward traditional fixed-wing and rotary-wing aircraft activities. There is a lack of Federal Aviation Administration (FAA) guidance for airports that are able to accommodate both nontraditional aeronautical activities, such as sport parachuting (skydiving) and traditional aeronautical activities.

This report describes the research conducted on skydiving and provides recommendations for developing criteria for the size and location of parachute landing areas (PLA) on airports. It discusses the background of the project, the methodology and data collection phase, and the results of the research. This research was conducted as part of the Visual Guidance Program under the FAA Airport Safety Technology Research and Development Section.

The objectives of this research were

- to identify current practices for PLA designation at airports.
- to evaluate whether parachute experience and maneuverability of equipment is a factor in determining the size and location for PLAs.
- to provide recommendations for the minimum distances required from hazards of PLAs on airports.
- to provide recommendations for the minimum size of PLAs on airports.

2. RESEARCH ON PARACHUTING.

2.1 TYPES OF PARACHUTES.

There are two main types of descending parachutes or canopies: square, also known as ram-air, and round. Sport parachutists rarely use round canopies because they do not provide lift and are not maneuverable unless modified. The round canopies were the first parachutes designed and are mainly used by the military for paratrooper and cargo applications. They are designed for combat/training situations in which the paratroopers exit at a very low altitude and at a relatively high speed, usually with 100 pounds or more of gear.

Ram-air canopies are self-inflating airfoils in which the parachutist can control speed and direction via two sets of lines called toggles. They consist of two layers of fabric with individual cells that are connected lengthwise and filled with air. Square canopies are the most common type used by sport parachutists because they are more maneuverable, behave like a wing in flight, and can execute extremely precise landings.

2.2 DEFINITIONS.

The following terms are used within this report.

- Drop Zone—Skydiving established or intended PLA [1]. Any predetermined area upon which parachutists or objects land after making an intentional parachute jump or drop. The center point target of a drop zone is expressed in nautical miles from the nearest very high frequency omnidirectional radio range (VOR) facility, when 30 nautical miles or less, or from the nearest airport, town, or city depicted on the appropriate Coast and Geodetic Survey World Aeronautical Chart or Sectional Aeronautical Chart, when the nearest VOR facility is more than 30 nautical miles from the PLA [2].

- Parachutist—A person who intentionally exits an aircraft while in flight using a single-harness, dual-parachute system to descend to the surface [2]; also referred to as a skydiver [1].

- Swoop—To rapidly dive toward the PLA and then make a controlled approach relative to a target [1].

- Swoop Pond—A water obstacle used as a high-performance landing area [1].

- Tandem Parachute Operation—A parachute operation in which more than one person simultaneously uses the same tandem parachute system while descending to the surface from an aircraft in flight [2].

3. THE FAA REGULATIONS/RESOURCES FOR PARACHUTING.

3.1 TITLE 14 CODE OF FEDERAL REGULATIONS PART 105.

Title 14 Code of Federal Regulations (CFR) Part 105 governs parachute operations in the United States, except those conducted for in-flight emergency or military operations in uncontrolled airspace. 14 CFR Part 105 defines parachuting terms and contains many operational rules. It requires individuals executing parachute operations over or onto airports to obtain prior approval from airport management and the airport air traffic control tower, if applicable. 14 CFR Part 105 does not govern or provide guidance for the landing areas located on airports. Further, 14 CFR Part 105 does not include licensing requirements for skydivers.

3.2 THE FAA ADVISORY CIRCULAR 105-2D, SPORT PARACHUTING.

FAA Advisory Circular (AC) 105-2D [3] was revised in May 2011 and provides guidance for compliance with 14 CFR Part 105. The AC emphasizes that the FAA recognizes sport parachuting, or skydiving, as an aeronautical activity and that airports accepting federal funding need to accommodate the activity unless the FAA deems it incompatible. Under the Skydiver Safety section of the AC, the FAA recommends PLAs "remain unobstructed, with sufficient minimum radial distances to the nearest hazard." Traditionally, the FAA has referred to the United States Parachute Association (USPA) for the recommended distances to hazards. These

distances are given in the USPA Basic Safety Requirements (BSR) found in the Skydiver's Information Manual (SIM) [1].

3.3 AIRPORT/FACILITY DIRECTORY.

The FAA maintains an Airport/Facility Directory (A/FD) [4] that lists data on record for all public airports, seaplane bases, heliports, military facilities, and selected private-use airports. The information available may include airport diagrams, navigational aids (NAVAIDs), communications data, weather data sources, airspace, special notices, and operational procedures. The Airport Remarks section usually states if the airport supports parachute operations. Some listings may describe where the PLA is located on the airport, but very few have the PLA location indicated on an airport diagram. See figures 1 and 2 for examples of illustrated PLAs on airports.

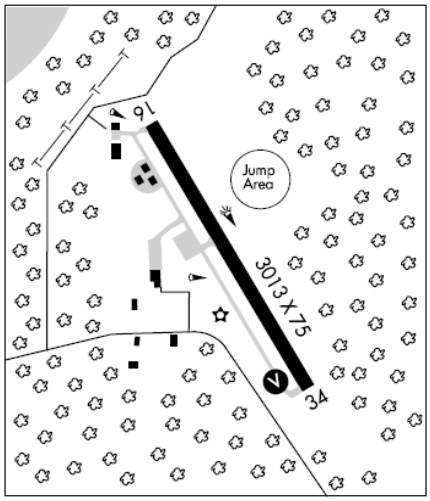

Figure 1. Montague-Turners Falls, MA, A/FD

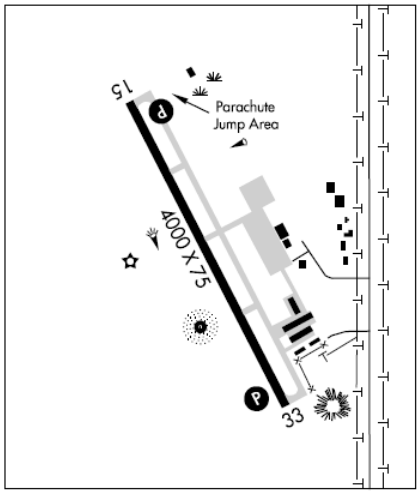

Figure 2. Hutchinson Muni-Butler Field, MN, A/FD

Areas used for parachute operations are often, but not always, depicted on Sectional Aeronautical Charts with a parachute symbol (figure 3). The actual location of the parachute symbols on the chart does not represent the precise location of the landing area, because it may have been the only spot on the chart clear of other markings.

Figure 3. Deland Municipal Airport, FL, Jacksonville Sectional Aeronautical Chart

The A/FD also includes a section titled "Parachute Jumping Areas." However, for a parachute jumping area to qualify for inclusion in this section and be depicted on the appropriate visual chart(s), the jump area must meet certain criteria. The jump area must

- have been in operation for at least 1 year
- operate year round (at least on weekends)
- log 4000 or more jumps each year

The FAA Regional Offices may also nominate PLAs for charting if they do not meet the criteria.

4. UNITED STATES PARACHUTE ASSOCIATION.

The USPA is a nonprofit organization dedicated to supporting the sport of parachuting. The USPA has several missions: "to promote safe skydiving through training, licensing, and instructor qualification programs; to ensure skydiving's rightful place on airports and in the airspace system; and to promote competition and record-setting programs" [1].

4.1 SKYDIVER'S INFORMATION MANUAL.

The USPA publishes the SIM, which encompasses the USPA BSRs, license requirements, training program recommendations, and FAA references relevant to parachuting.

In regards to the landing area, the SIM recommends the parachutist plan his or her landing pattern in advance using an aerial photograph, diagram, map, or model of the PLA. The SIM also instructs parachutists to avoid runways and approaches. This includes minimizing time on a runway as well as and looking both ways before crossing a runway. Parachutists should also note the local aircraft approach patterns in relation to their canopy approach and landing patterns.

4.2 LICENSE REQUIREMENTS.

The USPA is the United States' official skydiving representative to the Federation Aeronautique Internationale (FAI). With over 100 member countries, the FAI oversees all air sports. Its mission is to preserve and promote aeronautical activities. In January 2001, the International Parachute Commission under FAI agreed on worldwide standards for issuing skydiving licenses or Certificates of Proficiency (CoP). This change came about because member countries have a wide variety of licensing requirements for A, B, C, and D licenses while some have none at all.

As a division of the National Aeronautic Association (NAA)—the Air Sports Organization in the United States—USPA issues A through D skydiving licenses to skydivers. The SIM contains licensing requirements. Table 1 shows some of the licensing requirements (not a complete list) as they relate to the experience level and target accuracy.

Table 1. The USPA License Requirements Related to Experience and Target Accuracy

License	Previous License	No. of Jumps	Distance to Target Requirements
A	N/A	25	N/A
B	A	50	Land within 10 m (33 ft) of target center on 10 jumps
C	B	200	Land within 2 m (6.6 ft) of target center on 25 jumps
D	C	500	N/A

4.3 BASIC SAFETY REQUIREMENTS.

USPA BSRs are "minimum standards overseen and published by USPA and generally agreed upon as the acceptable standard for safe skydiving activities" [1]. Since the sport of skydiving is self-governed, the BSRs serve as the foundation for safe operations. The BSRs were created by evaluating past incidents and accidents and are updated when necessary. The BSRs address the following topics:

- Applicability
- Compliance with federal regulations
- Medical and age requirements
- Student skydivers
- Winds
- Minimum opening altitudes
- Drop zone requirements
- Prejump requirements
- Extraordinary skydives
- Parachute equipment
- Special altitude equipment and supplementary oxygen

For this research, the Drop Zone Requirements section of the USPA was referred to when examining the PLAs and determining the size and location criteria for PLAs on airports.

According to the SIM:

> "1. Areas used for skydiving should be unobstructed, with the following minimum radial distances to the nearest hazard:
>
> 1.1. Solo students and A-license holders—100 meters (320 ft)
> 1.2. B- and C-license holders—50 meters (160 ft)
> 1.3. D-license holders—Unlimited[1]
>
> 2. Hazards include telephone and power lines, towers, buildings, open bodies of water, highways, automobiles, and clusters of trees covering more than 3000 square meters.
>
> 3. Manned ground-to-air communications (e.g., radios, panels, smoke, and lights) are to be present on the drop zone during skydiving operations." [1]

In certain circumstances, the USPA also allows the above distances to be waivered by the PLA's designated USPA Safety and Training Advisor.

5. INTERNATIONAL STANDARDS.

International standards for establishing PLAs were examined as well as documentation from Canada, Ireland, the United Kingdom, South Africa, and New Zealand.

5.1 CANADA.

Transport Canada (TC) is the governing agency for enforcing the Canadian Aviation Regulations (CAR) [5]. TC acknowledges that "parachute operations can be carried out safely in airspace shared by other users (gliders, flight training, etc.) with proper coordination" [6]. Similar to the FAA, TC requires parachutists to obtain permission from the airport manager or landowner prior to landing on the property, but does not declare minimum distances to hazards for parachute operations that are not in a controlled airspace, a built-up area, or open-air assembly.

TC recognizes parachuting as a legitimate aeronautical activity, therefore, it issues Special Flight Operations Certificates—Parachuting for operations in controlled airspace or an air route. These operations are prohibited without the Special Flight Operations Certificate, and there are

[1] In July 2011, the USPA Board of Directors voted to change the minimum radial distance to hazards for D-license holders to 12 meters (40 ft) and added tandem parachutists to the B and C license requirements of 50 meters (160 ft). These changes will be applicable in 2012.

requirements and conditions that must be met to have it approved [6]. In reference to the landing areas, the minimum obstacle clearance of the intended parachute landing area, as measured from the center to the closest hazards, must be for:

- Student parachutists—200 meters (600 ft)
- A- and B-license holders (or equivalent level of experience)—150 meters (500 ft)
- C- through E-license holders (or equivalent)—25 meters (80 ft)

CAR Section 623.36(b) [5] outlines PLA requirements for parachute descents over or into a built-up area or open-air assembly of people (for exhibition jumps). The following are a few of the requirements as they relate to PLA size, location, and hazards for all wind directions.

- The PLA must be level, clear of obstacles, and have a minimum average radius of 25 meters (80 ft) (see figure 4).

- The PLA must be a level, rectangular area, clear of obstacles, with minimum dimensions of 40 meters (132 ft) long and 25 meters (82 ft) wide with the longer side of the rectangle positioned into the wind (see figure 5).

- The PLA must be clear of any buildings or any other obstructions bordering the perimeter of the landing zone that lie in a 45° plane extending outwards from the center of the landing zone chosen that obstructs the planned final approach path to the landing zone (see figure 6).

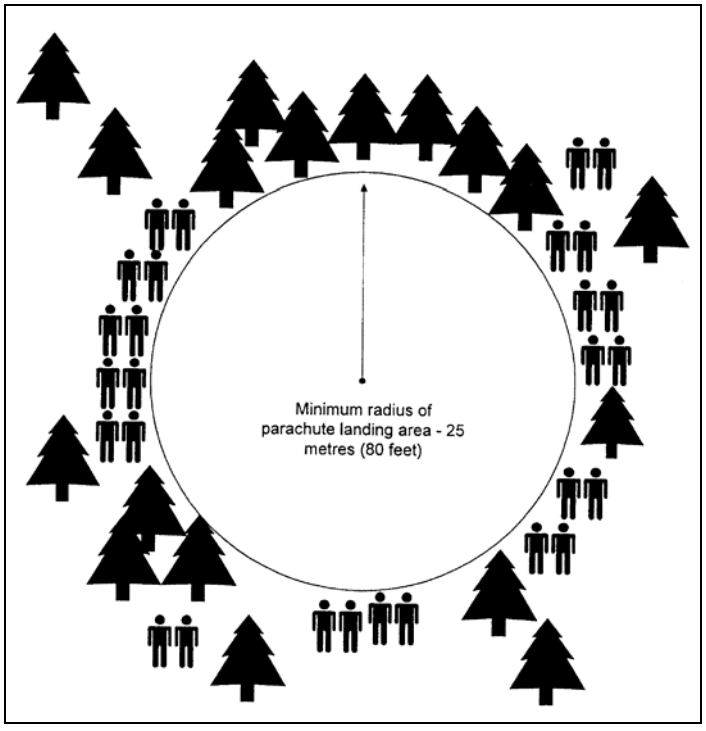

Figure 4. Canada—Option 1, Minimum PLA for Unrestricted Wind

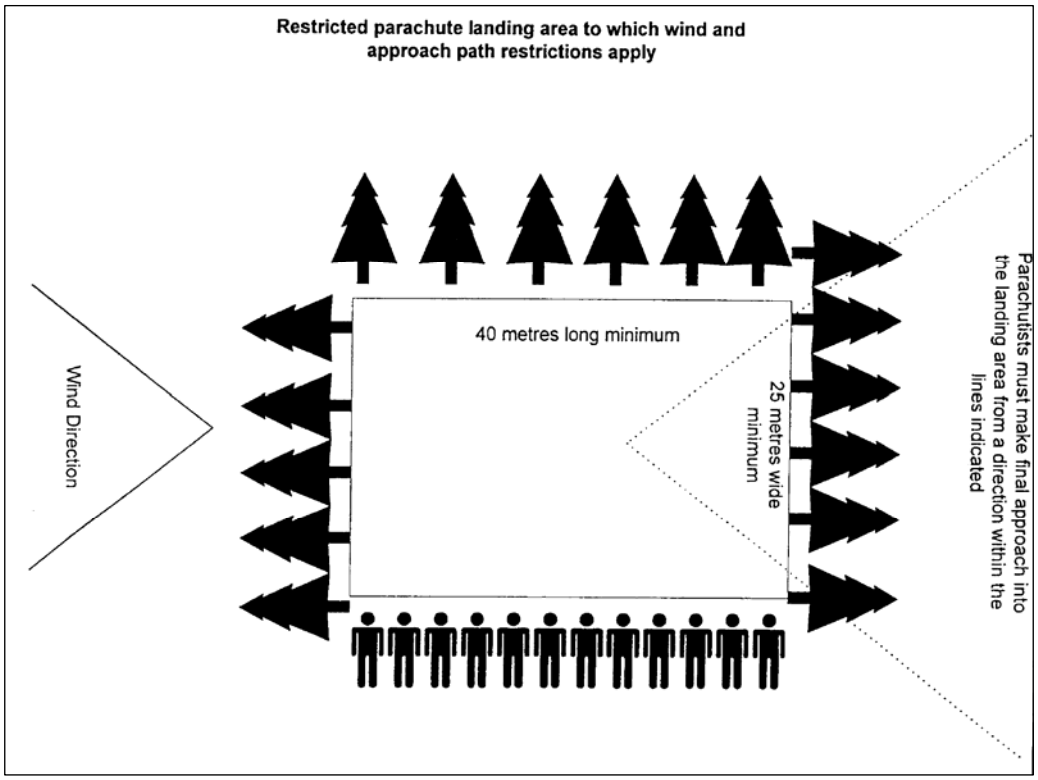

Figure 5. Canada—Option 2, Minimum PLA With the Longer Side Into the Wind

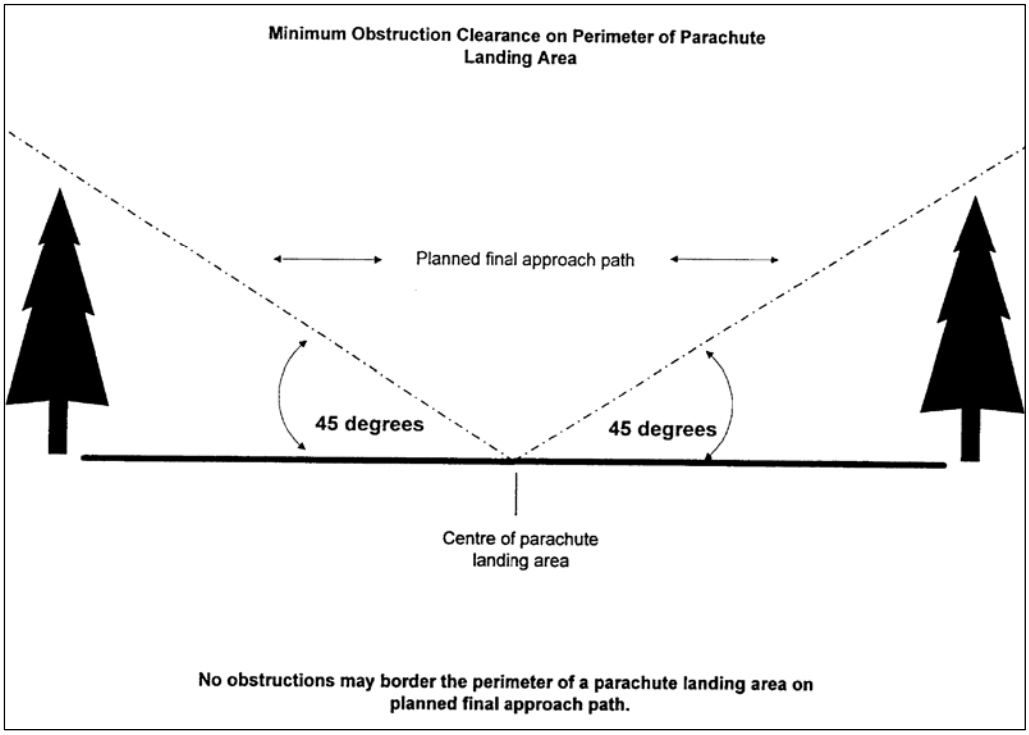

Figure 6. Minimum Clearances From Obstructions to PLA

TC measures from the center of the PLA for minimum distances to obstacles and does not allow obstructions bordering the perimeter of a PLA on the planned final approach path.

The Canadian Sport Parachuting Association (CSPA) is Canada's representative to FAI and the official sport parachuting organization for Canada. The CSPA has created a list of Basic Safety Rules and Regulations, which are contained in the Parachutist Information Manual (PIM) [7]. Section 3 of the PIM [7] addresses drop zone clearances and states

> "Areas used for regular parachuting operations shall be unobstructed, with the following minimum distances from the target in every direction to the nearest hazard:
>
> - Student, solo, A and B CoP holders—325 ft (100 m)
> - C and D CoP holders—80 ft (25 m)
>
> Hazards are defined as:
>
> - Transmission lines
> - Open bodies of water
> - Fences, over 2.5 meters in height
> - Towers, building, goalposts, and lamp standards
> - Well-traveled roadways
> - Trees above canopy height and large forested areas"

Similar to the USPA, the CSPA also requires their license holders to prove distance accuracy for a specified number of jumps. According to the CSPA, the drop zone clearances listed in the PIM have been in place for several years. Due to the transition from round to ram-air canopies, the CSPA re-examined the clearances and revised them. The current clearances were agreed upon after consulting with member groups about the degree to which the ram-air canopies made their operations safer and to what degree they could reduce the obstacle distances.

5.2 UNITED KINGDOM.

The Civil Aviation Authority (CAA) of the United Kingdom (UK) requires all parachuting operations from civil aircraft registered in the UK must be in accordance with Civil Aviation Publication 660 [8]. The UK CAA uses the term PLA to distinguish between the area on the ground and the "dropping zone," which is used to denote a portion of airspace. The PLA operator is responsible for ensuring the dimensions of the landing area and proximity to hazards is suitable for the intended purpose. The CAA states "PLAs to be used by all parachutists should normally provide a large open space of reasonably level ground that can contain a 250-meter (800-foot)-radius circle, free from major hazards, and largely free from minor hazards" [8]. Major hazards are objects or features that, because of their size, may be difficult to avoid and, if struck by a parachutist, may result in injury, e.g., large hangers, buildings, and forests. Minor hazards are objects or (e.g., hedges, fences, and ditches [8]) that should be easily avoided but, if struck by a parachutist, may result in injury. Ideally, the landing areas should also be bordered on at least three sides by suitable overshoot/undershoot areas.

The British Parachute Association (BPA) governs sport parachuting in the UK. The BPA Operations Manual [9] states the PLA should be a large open space of level ground that contains a 500-meter (1640-foot)-diameter circle, free from major hazards, and largely free from minor hazards if used by all levels of parachutists, putting them in compliance with CAA regulations. The PLA should also be bordered on at least three sides by suitable overshoot areas. The BPA also recommends having a location marker placed in the center of the PLA.

According to the current BPA [9], the minimum PLA diameter was 600 yards before the UK converted to metric units of measurement. The oldest BPA Operations Manual from 1967 also stated 600 yards. This was a reasonable area for student parachutists to be able to land within, and it was believed to have originated from the minimum size for a military drop zone. At the time of that recommendation, round canopies with a maximum speed of 5 miles per hour were the standard. With the introduction of ram-air canopies, parachutists can reach a speed of 15 miles per hour for students. The BPA chose not to reduce the area to ensure student safety, even though the new canopies are more accurate.

5.3 IRELAND.

The Irish Aviation Authority (IAA) is a commercial semi-state company that regulates the civil aviation industry in Ireland. The IAA requires all parachute dropping and training centers to apply for a Permission document. Every applicant for and every holder of a Permission must include a document that contains the center location, instructor and pilot names, aircraft, training courses, and standard operating procedures. This document becomes the Parachuting Operations Manual for their site. IAA provides guidance material for complying to the Parachuting Operations Manual. Like the UK CAA, IAA uses the term PLA to distinguish between the ground area and airspace. As stated in reference 10, "It is the operator's responsibility to be satisfied that the PLA is suitable for the intended purpose, taking into account the capability of the parachutists, the dimensions of the landing area, the dimensions and relative positions of available overshoot and undershoot areas, proximity to any buildings, power lines or anything else which may be a hazard to parachutists and the presence of other activities on or near the PLA." IAA also uses the same PLA size criteria as the UK—large, level ground that can contain a 250-meter (820-foot)-radius circle, free from major hazards, largely free from minor hazards, and bordered on three sides by a suitable overshoot/undershoot area.

5.4 SOUTH AFRICA.

The South African Civil Aviation Authority (SACAA) governs civil aviation, including parachuting, in South Africa. According to their Civil Aviation Regulations Part 105 [11], no

person can make a descent onto a PLA without prior authorization from the SACAA. Parachute and aircraft operations are permitted simultaneously at aerodromes if the PLA is clear of

- any movement area in use.
- the strip area of any runway in use.
- the taxiway minimum separation distances.
- the approach and takeoff area of any runway or heliport in use [11].

The SACAA also requires all parachutists to hold an active membership in one of the approved recreation organizations.

The Parachute Association of South Africa (PASA) is an approved recreation organization whose Manual of Procedures [12] has been ratified by the SACAA. The manual contains BSRs similar to those of the USPA and BPA. The PASA also issues licenses by way of the National Safety and Training Officer, but the PASA has not addressed PLA size and location in its manual [12].

5.5 NEW ZEALAND.

Similar to SACAA, the Civil Aviation Authority of New Zealand in its CAA of New Zealand Part 105 [13], states that parachute and aircraft operations are permitted at the same time at aerodromes when the PLA is clear of

- any movement area in use; and
- the strip area of any runway in use; and
- the taxiway minimum separation distances; and
- the approach and takeoff area of any runway or heliport in use.

If a ground signal is used to indicate parachute activity, the signal must consist of a white circle with an attached cone pointing into the wind.

6. MILITARY.

Military parachute (or pathfinder) operations differ greatly from civilian sport parachuting, especially with reference to their objectives. A military landing area is referred to as a drop zone (DZ). The commander selects a DZ location that best supports the tactical plan. The main objective in military parachute operations is to get all necessary personnel and equipment to a specific area in a set amount of time.

According to the Department of the Army, there are several factors to consider when selecting a landing zone, including type of aircraft and speed, drop altitude, estimation of DZ time requirement, methods of delivery, obstacles, access, size, approach/departure, etc. The type and drop speed of the aircraft determines how long the aircraft will remain over the DZ. The drop altitude is calculated by adding the distance from the highest field elevation in the DZ to aircraft to the highest point on the DZ above sea level. To estimate DZ time requirements, 1 second is allowed for each paratrooper after the first. For example, 9 seconds would be needed for ten

paratroopers to leave the aircraft. The time required for equipment is 3 seconds for each bundle after the first. There are four methods of delivery:

- Low-velocity airdrop—used for sensitive equipment and personnel because the parachute slows the rate of descent and allows for a softer landing.
- High-velocity airdrop—used for delivering certain supply items by rigging the container with an energy dissipater.
- Free drop—used for nonsensitive items only, no parachute is used to slow the rate of descent.
- Added risk—Potential damage to buildings.

The DZ and adjacent areas must be cleared of all obstacles. Obstacles include 35-ft or higher trees, water deeper than 4 feet within 1000 meters (3280 ft) of the DZ edge, power lines, fences, swamps, rocks, and ditches. Table 2 shows the size criteria for tactical airlift DZs for personnel.

Table 2. Size Criteria for Tactical Airlift DZs
(From U.S. Army Field Manual No. 3-21.38, Pathfinder Operations [14])

PERSONNEL			
ALTITUDE (AGL IN FEET)	**WIDTH**	**DROP ZONE LENGTH**	
		ONE PLATFORM	**ADDITIONAL PLATFORMS**
To 1,000	600 Yards	600 Yards	Add 75 yards to trailing edge for each additional parachutist. When using Chemilumninescent Light Assisted Personnel Exit System (CAPES), add 100 yards each, instead.
Above 1,000	Add 30 yards to DZ width and length for each 100 feet above 1,000 feet (add 15 yards to each side of the DZ).		

NOTES:
1. For day visual formations, increase width by 100 yards (50 yards each side).

   For Station Keeping Equipment (SKE) formation, increase width by 400 yards (200 yards each side).

   Official sunset to sunrise, increase width by 100 yards for single ship visual drops (50 yards each side) or 200 yards for visual formations (100 yards each side).

2. Official sunset to sunrise, increase length by 100 yards for visual drops (50 yards each end).

Additional size criteria for the length of the DZ is computed by multiplying the aircraft's rate of speed in meters per second by the time required to exit each load. Other factors the U.S. Army considers when selecting a DZ include enemy threats, mission requirements, aircraft and crew capabilities, parachutist capabilities, and type of parachute used.

7. DATA COLLECTION.

The Airport Safety Technology Research and Development Section started the research by collecting data on National Plan of Integrated Airport Systems (NPIAS) airports that have parachute activity listed in the A/FD. The following data was captured when available and applicable:

- PLA location
- PLA shape
- PLA dimensions
- Distance from center of PLA to edge of Runway Safety Area (RSA)
- Distance from closest edge of PLA to edge of RSA
- Additional notes such as composition of PLA, types of activity, and markings

7.1 SITE VISITS AND CURRENT PRACTICES.

Six site visits were conducted. At each site, the airport manager, skydiving operator/manager, and parachutists were interviewed, and the PLA was examined. Appendices A through D contain the surveys used during the site visits. The first visit was to Cross Keys Airport in Williamstown, NJ. While Cross Keys is not an NPIAS airport, it is in close proximity to the FAA William H. Hughes Technical Center and helped the research team become familiar with the sport of parachuting. The remaining site visits were conducted in Florida at the following airports: Sebastian Municipal Airport, Deland Municipal Airport (DED), Palatka Municipal Airport, Herlong Municipal Airport, and Fernandina Beach Municipal Airport. These airports were chosen due to the variety in their operating environments.

7.1.1 Cross Keys Airport, NJ.

Cross Keys Airport (see figure 7) hosts one of the largest skydiving schools in the country. Approximately 53,000 jumps occur here each year, as shown in table 3. Students can choose from tandem jumps or accelerated free-fall jumps where two instructors jump alongside the student. Experienced parachutists are also accommodated. The landing area at Cross Keys is very large, approximately 1500 by 800 feet (see red area in figure 7). It features two accuracy points composed of pea gravel and a swoop pond, which is located 225 feet from the edge of the runway. Experienced and tandem parachutists land closest to the skydiving facility, about 455 feet north of the runway edge. Parachutists have to land beyond a boundary line composed of traffic cones marking the edge of the PLA closest to the facility. The skydiving operator at Cross Keys does not allow the use of round main or reserve canopies because they are less maneuverable.

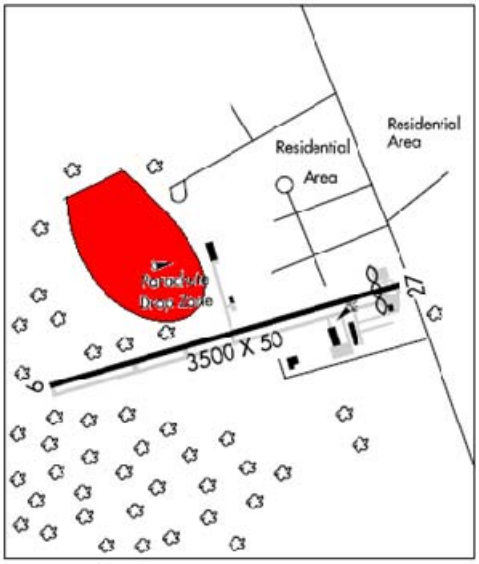

Figure 7. Cross Keys Airport, NJ, A/FD

Table 3. Operational Data for Cross Keys Airport

Total Annual Jumps
Approximately 53,000

Total Based Aircraft	Single Engine	Multi-Engine	Jet
45*	40	5	0

Total Operations	GA Local	GA Itinerant
30,600	20,600	10,000

GA = General Aviation

*Based aircraft and operations data gathered from Airport Master Record. In some cases, the total based aircraft and total operations does not equal the sum of the individual categories under each heading.

7.1.2 Sebastian Municipal Airport, FL.

The parachute activity at Sebastian Municipal Airport consists of student, tandem, and experienced parachutists who use a large triangle landing area located across from the skydiving facility. Approximately 20,000 to 40,000 jumps (as shown in table 4) occur here each year. The landing area is bordered by a closed runway, an active taxiway, and an open trench alongside an apron area. The dimensions are approximately 1900 by 1400 by 1350 feet (see red area in figure 8). It features a 17-foot-diameter pea gravel accuracy point, flags for light winds, and a windsock. The PLA is outside the protected RSA and Runway Object-Free Area (ROFA) but is within the Taxiway Safety Area (TSA) and Taxiway Object-Free Area (TOFA). The skydiving

operator allows the use of round canopies but stated their use is extremely rare. The airport does not allow parachutists to walk on areas of the airport outside the established PLA.

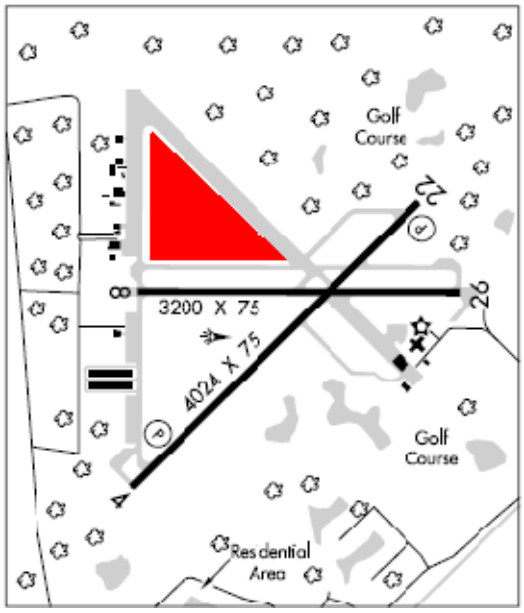

Figure 8. Sebastian Municipal Airport, FL, A/FD

Table 4. Operational Data for Sebastian Municipal Airport

Total Annual Jumps
20,000-40,000

Total Based Aircraft	Single Engine	Multi-Engine	Jet	Ultra Light
40	35	5	0	2

Total Operations	Air Taxi	GA Local	GA Itinerant
37,240	1000	12,240	24,000

GA = General aviation

As shown in table 4, in some cases, total based aircraft and total operations do not equal the sum of the individual breakouts (e.g., single engine, multi-engine, jet, ultra light, etc.)

7.1.3 Deland Municipal Airport, FL.

The skydiving operator at DED is the largest skydiving facility in the United States (see table 5). It also serves as a training facility and host site for many skydiving competitions and high-volume events in which there could be up to 200 skydivers in the air at once. The airport has three landing areas that are based on experience level (see red areas in figure 9). The first is a triangular area northwest of the Runway 05/23 midsection and is used only by students. The

PLA is approximately 900 by 1600 by 1000 feet. It features a pea gravel "X" in the center and a windsock. It is bordered by a closed runway, an active runway, and an active taxiway. The student PLA is within the RSA and ROFA of Runway 05/23. The second area is a rectangular shape south of the first area, east of Runway 05. This area is for more experienced/licensed skydivers. It is approximately 650 by 350 feet. It is bordered by an active runway, two active taxiways, and an apron area. This PLA is also within the RSA and ROFA of Runway 05/23. The third PLA is a triangular area located west of Runway 30. This area is exclusively for tandem jumps and very experienced skydivers. It is approximately 1000 by 600 by 600 ft. It features a pea gravel pit for tandem landings and a swoop course. This PLA is the closest to the skydiving facility and allows for spectators to watch the landings from an observation area. There is a visible white boundary line indicating the edge of the PLA from the observation area. The PLA is outside the protected runway areas but within the protected taxiway areas. The skydiving operator allows the use of round canopies but stated they are not used very often.

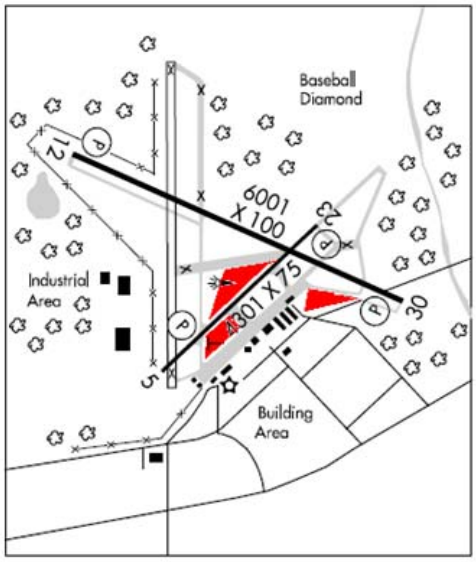

Figure 9. Deland Municipal Airport, FL, A/FD

Table 5. Operational Data for Municipal Airport

Total Annual Jumps
Approximately 93,000

Total Based Aircraft	Single Engine	Multi-Engine	Jet	Helicopters	Ultra Light
197	152	38	7	4	2

Total Operations	Air Taxi	GA Local	GA Itinerant	Military	Ultra Light
117,460	400	35,238	81,772	50	2

GA = General aviation

7.1.4 Palatka Municipal Airport, FL.

The parachute activity at Palatka Municipal Airport consists of students, tandem, advanced free fall, and experienced parachutists. There are approximately 16,000 jumps made per year (see table 6) at the two separate landing areas on the airport, shown in red (figure 10). The student PLA is a rectangular area approximately 1100 by 400 feet bordered by a ramp, two taxiways, and an active runway. The PLA penetrates both the RSA and ROFA of Runway 12/30. The PLA for experienced and tandem parachutists is east of the student area and is bordered by a ramp and taxiways. The approximate dimensions of the PLA are 680 by 200 feet. It is located outside all protected runway areas. Except for the occasional round canopy jump, almost all jumps are done exclusively with ram-air canopies.

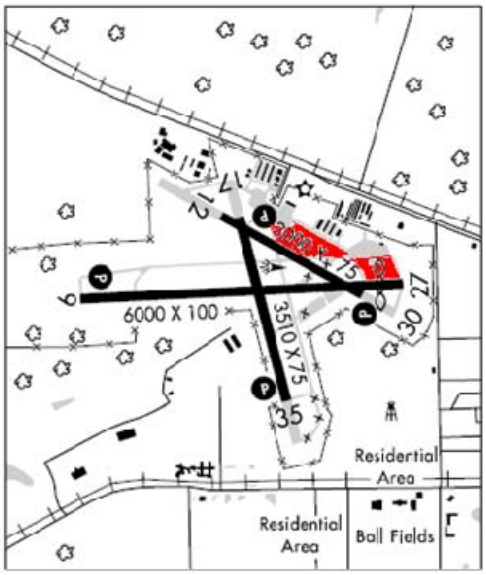

Figure 10. Palatka Municipal Airport, FL, A/FD

Table 6. Operational Data for Palatka Municipal Airport

Total Annual Jumps
Approximately 16,000

Total Based Aircraft	Single Engine	Multi-Engine	Jet
50	43	7	0

Total Operations	Air Taxi	GA Local	GA Itinerant	Military
32,619	300	2209	30,000	110

GA = General aviation

7.1.5 Herlong Municipal Airport, FL.

Herlong Municipal Airport has had skydiving operations for about 8 years. The skydiving operator has mostly tandem parachutists with approximately 2000 to 3000 jumps per year (see table 7). There is one PLA, which is shown on the Airport Layout Plan (ALP) in red (figure 11). The PLA is a grass 477- by 337-ft triangle marked with flags and bordered by two closed runways and a tree line. The airport and the skydiving operator have an agreement stating that if a parachutist needs to cross a runway, the parachutist is to remain at his or her location and wait for an airport escort.

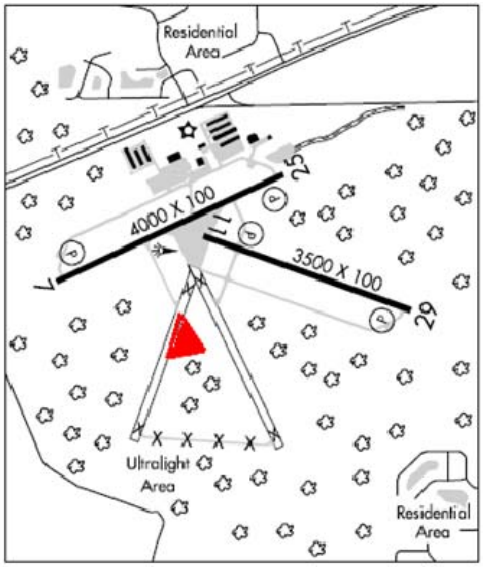

Figure 11. Herlong Municipal Airport, FL, A/FD

Table 7. Operational Data for Herlong Municipal Airport

Total Annual Jumps
2000-3000

Total Based Aircraft	Single Engine	Multi-Engine	Jet	Helicopters	Glider	Ultra Light
139	117	21	1	1	13	17

Total Operations	Air Taxi	GA Local	GA Itinerant	Military	Ultra Light
80,700	0	43,000	35,000	2700	17

GA = General aviation

7.1.6 Fernandina Beach Municipal Airport, FL.

The skydiving operations at Fernandina Beach Municipal Airport are limited to tandem only. The skydiving operator opened in September 2010 and had approximately 1500 jumps in the

first 9 months (see table 8). There are two grass circle PLAs about 200 feet in diameter; one on the north end of the airport and one on the southwest side (see figure 12). The northern PLA is within the RSA and ROFA of Runway 08/26 and is bordered by the ramp and two taxiways. The southwestern PLA is located east of a closed runway, west of an active taxiway, and out of the protected runway areas. The PLAs are much smaller since the instructors are very experienced skydivers. The landing areas are marked by keeping the height of the grass inside the PLA at 4 inches and the grass outside the PLA higher. Since winds vary, the skydiving operator believes it is important to have two PLAs in case the parachutist cannot land at his or her first PLA choice.

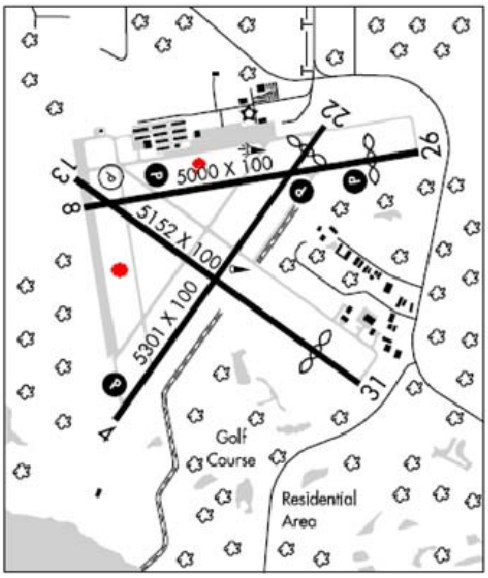

Figure 12. Fernandina Beach Municipal Airport, FL, A/FD

Table 8. Operational Data for Fernandina Beach Municipal Airport

Total Annual Jumps
1500

Total Based Aircraft	Single Engine	Multi-Engine	Jet
58	51	6	1

Total Operations	Air Taxi	GA Local	GA Itinerant	Military	Ultra-light
47,000	1600	10,000	35,000	400	3

GA = General aviation

7.2 FINDINGS.

7.2.1 Data Collection.

Initially, the list of NPIAS airports was cross-referenced with their A/FD entries to determine which airports included Parachuting or Parachute Jumping in their Airport Remarks. A total of 210 NPIAS airports listed Parachuting or Parachute Jumping. Of those, 202 airports were considered general aviation and 8 held an Airport Operating Certificate under 14 CFR Part 139 [15].

Of the 210 airports, 198 were contacted to request the location of the PLA (i.e., on airport or off airport and its location relative to protected areas of the airport) and the shape of the PLA. Table 9 lists the results.

Table 9. Data Collection Findings

	Total	General Aviation	14 CFR Part 139
NPIAS Airports with parachuting listed in A/FD	210	202	8
	Contacted	General Aviation	14 CFR Part 139
Airports with PLA onsite	112	109	3
Airports with PLA offsite	35	30	5
Airports no longer supporting parachuting activity	51	51	0
Total Contacted	198	190	8
	Collected	General Aviation	14 CFR Part 139
Airports with sufficient information for locating PLA	91	88	3
Airports with one or more defined PLAs	51	50	1
Airports with one or more undefined PLAs	40	38	2
Total Collected	91	88	3
	Collected	General Aviation	14 CFR Part 139
Number of circle PLAs	39	38	1
Number of rectangle PLAs	13	13	0
Number of triangle PLAs	5	5	0
Number of square PLAs	4	4	0
Total Collected	61	60	1

7.2.2 Existing PLAs in Protected Areas.

Once data was collected on the 51 airports with one or more defined PLA, the PLAs were explained on an aerial view of the airport layout to find out if any of the PLAs penetrated the protected areas of the runways and taxiways. Table 10 shows the existing PLAs that penetrated the protected areas.

Table 10. Existing PLAs Penetrating Protected Areas

Protected Area	Number of Existing PLAs Penetrating Area
ROFA	15
RSA (inside one or more)	7
TOFA	8
TSA	8
Total	38

*All existing PLAs are located at general aviation airports. There were no 14 CFR Part 139 airports identified. Only Ogden-Hinckley Airport, UT, provided substantial information, and its PLAs were outside all protected areas.

National Transportation Safety Board (NTSB) accident data for the seven PLAs that penetrated the RSA were reviewed, looking for any accidents related to parachute jumping operations. DED in Florida was the only site that had an accident investigated by the NTSB. According to an NTSB report [16], "On April 23, 2005, about 0915 eastern daylight time, a de Havilland DHC-6…collided with a cinematographer parachutist during the downwind leg for landing on runway 23." The probable cause was categorized as an inadequate visual lookout by the pilot-in-command. The location and size of the PLA was not a contributing factor in the accident.

7.2.3 The PLAs and Experience.

Twelve airports have multiple PLAs to accommodate different levels of parachutist experience. The USPA requires group members (skydiving operators) to separate high-performance and standard landings by either time or distance. For example, to separate by time, the high-performance parachutists exit the aircraft first at a lower altitude than the parachutists executing standard landings. The PLA is one large area, but uses bright orange concrete markers embedded in the ground to identify the boundary between experienced and student parachutists.

7.2.4 The PLA Composition.

Of the 112 airports, almost all the on-airport PLAs are made of grass. If the PLA features an accuracy point, it is usually composed of pea gravel or sand. Some skydiving operators mark the PLA with flags and/or temporary streamers, which serve as visual aids and a wind indicator. Windsocks are often located in or close to on-airport PLAs, which are in addition to the airport's official windsock. Other PLAs are designated by maintaining the grass of the PLA at a lower

height than the grass on the airport property. This helps parachutists locate the PLA. Currently, the edge of the PLAs can abut a hazard.

7.2.5 Other Findings.

All USPA group members are required to comply with the BSRs, which include the federal aviation regulations pertinent to parachuting. They are also required to pledge to "establish and disseminate landing procedures that will include separation of high-speed landings and normal landings" [1]. USPA recommends skydiving operators have an aerial photograph of the landing area for parachutists to reference at any time, which was found to be a standard practice at the sites visited.

During the survey of current practices, both the skydiving operators and airport operators expressed a need for more education about skydiving operations and its compatibility with traditional aeronautical uses. Some airports hold monthly meetings to facilitate a forum where all airport users can discuss safety issues and promote awareness.

After reviewing the NTSB investigation for DED and conducting site visits, it was found that some airports developed Letters of Agreement (LOA) with the skydiving operator. These LOAs typically describe the PLA, define preferred runway use, and detail any specific procedures for the parachute jumping activities (i.e., runway crossing procedures for skydivers). However, using an LOA is not standard practice at all airports.

8. RECOMMENDATIONS.

Based on data gathered and interviews conducted with subject matter experts, airport managers, skydiving operators, parachutists, International Standards and the USPA, the Airport Safety Technology Research and Development Section recommends the FAA adopt several PLA requirements. A summary of these recommendations and draft changes to FAA AC 150/5300-13 [17] is included in appendix E.

8.1 PARACHUTE LANDING AREA REQUIREMENTS.

Areas on an airport intended for parachute landings must be hazard free.

8.1.1 Hazards.

Hazards include

- Telephone and power lines
- Towers
- Buildings
- Open bodies of water

- Clusters of trees covering more than 3000 square meters (9840 ft)
- Fencing
- Paved surfaces (ramps/aprons, runways, and taxiways)
- Aircraft tie-down areas
- Equipment necessary for aircraft operations or navigation (NAVAIDs, airfield lighting, and signage), excluding equipment necessary for skydiving operations

8.1.2 Size and Location.

8.1.2.1 Size.

The USPA categorizes three minimum radial distances from hazards based on the parachutist's experience and type of activity. (Refer to section 4.3 for more information on how these distances are categorized.) These radial distances were used to calculate the minimum square footage for an on-airport PLA.

Table 11 shows the recommended minimum size of PLAs and the radial distances from hazards, based on the type of parachute activity and canopy used. If an on-airport PLA accommodates more than one type of parachuting activity, the largest minimum size area must be used or multiple PLAs designated.

Table 11. Minimum PLA Size and Distance From Hazards

Parachute Activity	Minimum PLA Size Using Ram-Air Canopies (sq. ft.)	Minimum PLA Size Using Round Canopies (sq. ft.)	Minimum Radial Distance From Hazards (ft)
Student/training	338,000	3,041,900	40
Tandem	84,500	N/A	40
All other activity	5,000	338,000	40

8.1.2.2 Students/Training.

For ram-air canopies, the minimum PLA size recommended for students/training activities is the area equivalent to the USPA's minimum radial distance from hazards for the least experienced parachutists ((100-m radius from hazards)^2 x $\pi = \approx$ 338,000 sq. ft.).

Examples of acceptable student/training PLAs are:

- 582- by 582-foot square
- 656-ft-diameter circle
- 700- by 483-ft rectangle
- Any other shape with an area equaling 338,000 sq. ft.

8.1.2.3 Tandem.

The minimum PLA size recommended for tandem activities is the area equal to the USPA's minimum radial distance from hazards for the B- and C-licensed parachutists and tandem operations ((50-m radius from hazards)^2 x $\pi \approx$ 84,500 sq. ft.).

Examples of acceptable tandem PLAs are:

- 292- by 292-ft square
- 328-ft-diameter circle
- 340- by 250-ft rectangle
- Any other shape with an area equaling 84,500 sq. ft.

8.1.2.4 All Other Activities.

The minimum PLA size recommended for all other parachute activities is the area equivalent to the USPA's minimum radial distance from hazards for the most experienced parachutists ((12-m radius from hazards)^2 x $\pi \approx$ 5000 sq. ft.).

Examples of acceptable PLAs for all other activities are:

- 70- by 70-ft square
- 80-ft-diameter circle
- 85- by 60-ft rectangle
- Any other shape with an area equaling 5000 sq. ft.

8.1.2.5 Round Canopies.

In 1996, the USPA removed references to round canopies because they were rarely used for sport parachuting. However, for student/training activities using round canopies, the minimum PLA size is the area equivalent to the USPA's minimum radial distance from hazards for round canopies used from 1970 until 1995 ((300-m radius from hazards)^2 x $\pi \approx$ 3,041,900 sq. ft.).

The minimum PLA size for tandem activities does not apply because round canopies are not used for tandem jumps.

All other parachute activities using round canopies have a minimum PLA size of 338,000 sq. ft., which is the area equivalent to the radial distance from hazards the USPA used for experienced,

C-licensed, and round canopy users until 1996 ((100-m radius from hazards)^2 x $\pi \approx$ 338,000 sq. ft.).

8.1.2.6 Location.

It is recommended that the edge of the PLA be a minimum distance of 40 ft from any hazard. The 40-ft radial distance from hazards is equivalent to USPA's minimum for a category D license. Instead of using a minimum of 40 ft as a radial distance to hazards from the center of the landing area, the nearest edge of the PLA will be no closer than 40 ft. This creates a buffer zone around the hazard for added safety (see figure 13). A skydiver can land within the boundaries of the PLA specified for the activity. This includes the edge of these areas. Without this buffer zone, a skydiver can land inches from a hazard that could impact signals from NAVAIDs or other operating equipment (if not protected), or could be unsafe for the skydiver.

PLAs should only be located in protected areas (e.g., RSA and OFA) of the runway if no other location is feasible (as long as the PLA remains 40 ft from any hazard). In addition, the PLA must not be located within the RSA at any 14 CFR Part 139 certificated airport.

As discussed in section 5.1, it is also noted that Transport Canada requires the PLA be sited to maintain a 45° clearance plane from the center of the PLA to any hazard bordering the perimeter of the landing area per CAR Section 623.36(b). In reference to locating PLAs near runways and taxiways, it is recommended the FAA conduct additional research to develop minimum distance criteria based on Airplane Design Group standards.

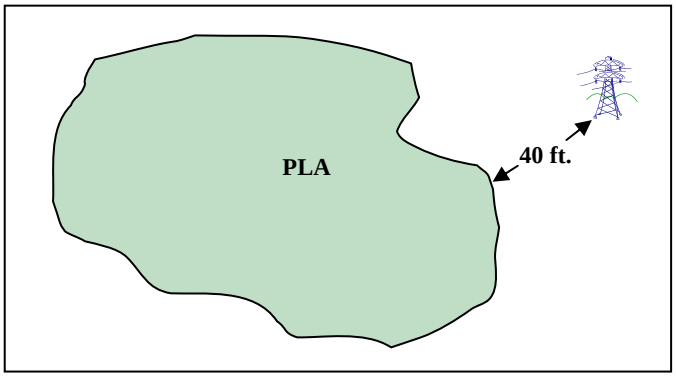

Figure 13. Minimum Distance From the Edge of the PLA to the Hazard

8.2 OPERATIONAL RECOMMENDATIONS.

Based on the interviews and research, there are other operational recommendations for the FAA to consider requiring in other agency guidance, which are beyond the scope of this report.

8.2.1 Education of Pilots/Skydivers.

Pilots could benefit from learning how the canopies operate, how maneuverable they are, and what to do when they come in close proximity to them.

Airports and skydiving operators should host regular meetings for airport users to discuss safety issues and promote awareness of the activities at the airport.

8.2.2 Letter of Agreement.

Airports should develop an LOA with the skydiving operator that describes specific operating requirements and boundaries of the PLAs. This could include movements required by the skydiver operator on the airfield as well as instructions and/or restrictions for crossing runways, operating vehicles on the airfield, radio communications, and emergency procedures. The LOA should also address the procedures if a parachutist lands outside the designated PLA or in a protected area of the runway.

When applicable, an additional LOA should be established between the skydiver operator and the nearest FAA Terminal Radar Approach Control or FAA Air Route Traffic Control Center. The LOA should define the skydiving procedures and boundary of the jump zone airspace as well as aircraft operating procedures.

8.2.3 Standard Markings.

All on-airport PLAs must have the PLA perimeter boundaries marked to distinguish the PLA from the surrounding area. This marking helps locate the PLA from the ground. Examples of markings include:

- Dashed line, a minimum of 3 inches wide in white or orange chalk, paint, or engineering tape
- Traffic-style cones
- Flags
- Streamers
- Landscaping
- Mowing

Using markings as a visual aid to help a pilot/parachutist locate the PLA from the air was not a part of this study and would require additional research.

Note: It is recommended to use different types of markers when designating areas within the PLA and the perimeter of the PLA.

8.3 AIRPORT/FACILITY DIRECTORY AND SECTIONAL CHART.

Several airports expressed concern that their parachute activity is not listed in the applicable A/FD. Because of the low number of jumps executed per year at these facilities, they do not meet the criteria for inclusion in the Parachute Jumping Areas section of the A/FD. This

criterion is quite restrictive, and it is recommended that the FAA consider including jump sites with less activity.

Additionally, it would be useful for the A/FD listings for airports with parachute activity to include more descriptive text as to where the PLA is located and/or an airport diagram with the PLA location indicated. Both of these revisions would increase the pilots' awareness about areas where they could potentially come into contact with parachuting activity.

8.4 COMPLIANCE.

The PLA requirements discussed in section 8.1 should apply to any new PLA. The research team did not evaluate whether any existing PLAs would fail to meet the new standard, but if it is adopted, the FAA should provide airports with sufficient time to make existing PLAs conform to the new standard. It is recommended that existing PLAs comply within 36 months of publishing the change to FAA AC 150/5300-13 [17].

9. SUMMARY.

A correlation was found between skydiving experience and the size of the PLA. More experienced skydivers do not require as large a PLA as less experienced skydivers.

Appendix E includes recommendations for PLA size, location, and distance from hazards that should be added to FAA AC 150/5300-13 [17].

Further, revisions to the AF/D and sectional charts are recommended as well as operational changes such as better education and training and using Letters of Agreement between the airport and skydiver operator. To incorporate these recommendations and common language, the FAA should also consider revising AC 105-2D [3].

10. REFERENCES.

1. United States Parachute Association (USPA), "Skydiver's Information Manual 2011," November 2010.

2. Title 14 Code of Federal Regulations Part 105, "Parachute Operations," May 9, 2001.

3. FAA Advisory Circular 105-2D, "Sport Parachuting," May 18, 2011.

4. FAA U.S. Airport/Facility Directories

5. Transport Canada, Canadian Aviation Regulation (CAR) – Part VI, Standard 623-General Operating and Flight Rules – Division III, "Parachute Descents, Section 623.36(b)," June 1, 2011.

6. Transport Canada, "The Review and Processing of an Application for a Special Flight Operations Certificate-Parachuting to Conduct Parachute Descents in or Into Controlled Airspace or an Air Route," May 3, 2010.

7. Canadian Sport Parachuting Association, "Parachutist Information Manual," April 2010.

8. United Kingdom Civil Aviation Authority (CAA), Civil Aviation Publication (CAP) 660, "Parachuting," July 2008.

9. British Parachute Association, "Operations Manual," March 2007.

10. Irish Aviation Authority, Flight Operations Department, "Parachuting Guidance Material," January 2010.

11. South African Civil Aviation Authority – Part 105, "Parachute Drop Zone," 2011.

12. Parachute Association of South Africa, "Manual of Procedures," July 2005.

13. Civil Aviation Authority of New Zealand – Part 105, "Parachuting – Operating Rules," March 25, 2010.

14. Department of the U.S. Army, Field Manual No. 3-21.38, Pathfinder Operations, October 2002.

15. Title 14 CFR Part 139, "Certification of Airports," May 3, 2004.

16. National Transportation Safety Board, "Factual Report Aviation NTSB ID: MIA05LA096," August 28, 2007.

17. FAA Advisory Circular 150/5300-13, Airport Design, (Consolidated Version with Changes 1-16), January 3, 2011.

APPENDIX A—QUESTIONNAIRE FOR AIRPORT OPERATORS

1. Has a drop zone (parachute landing area) been established on the airport?

2. Is it in a designated location? Is it marked?

3. Where is it located?

4. Who uses the drop zone?

5. Is the skydiving business affiliated with USPA?

6. Are you aware of any near-collisions between landing parachutists and aircraft on either runways or taxiways? Or between aircraft and parachutists walking across runways or taxiways?

7. How long does it typically take the skydivers to vacate the drop zone after landing their parachutes?

8. What is the agreement for the use of the drop zone with the airport?

9. Are there procedures in place for the skydivers' egress to the drop zone? Are these procedures codified (i.e., Airport Rules and Regulations, lease agreement, etc.)?

10. What type of aircraft is typically used?

11. How long have you had parachute operations on your airport?

12. How many jumps are made on the airport annually? Typically, which days of the week?

13. Are other aeronautical activities using the airport during parachute operations? If so, what kind and typically how many?

14. Have you ever received complaints from pilots concerning the drop zone (parachute landing area) location? Please describe.

15. What do you think is critical for safety and compatibility with other airport users when parachutists are using a drop zone?

16. If anything, how can the FAA improve the safety and compatibility of a drop zone with other airport users?

APPENDIX B—QUESTIONNAIRE FOR SKYDIVING OPERATORS

1. What parachute operations are conducted by your business (student, licensed skydivers, or tandem)?

2. What type of parachute does your group use? Do you allow the use of round parachutes?

3. Do most skydivers land within the drop zone (parachute landing area)?

4. Has anyone ever missed the drop zone? How often? Please explain?

5. How long does it take typically take the skydivers to vacate the drop zone after a jump?

6. What airports do you operate out of for skydiving?

7. Does the type of plane affect drop zone accuracy?

8. What type of plane is typically used by your operation?

9. When and where did you set up your skydiving operation?

10. How long have you been in operation?

11. How many skydives are made annually by your business at this airport? At other airports?

12. What do you think is critical for safety and compatibility with other airport users when parachutists are using a drop zone?

13. Are you aware of any near-collisions between landing parachutists and aircraft on either runways or taxiways? Or between aircraft and parachutists walking across runways or taxiways?

14. What recommendations do you have for FAA to improve safety and compatibility with other airport users when parachutists are using a drop zone?

15. Do you prefer a parachute landing zone that is a circle or a square?

16. Is your parachute landing area in a designated location? Is it marked?

17. Does the marking or lighting of a drop zone aid in the accuracy of landing within the site? If so, are there any particular methods of marking or lighting that are more beneficial than others?

18. What is the size of your drop zone (parachute landing area)?

19. What are the characteristics of your drop zone (grass, sand, pea gravel, marked with an “X”, wind indicators, etc.)?

20. If the drop zone is located near a runway or taxiway, has the airport operator briefed you on other training specific to your movements on the airfield (i.e., briefing on airport rules/regulations, standard pedestrian/skydiver movement procedures to cross runways, when applicable, etc.)?

21. Is your business affiliated with USPA?

22. Do you allow non-USPA licensed skydivers to skydive at your business?

APPENDIX C—QUESTIONNAIRE FOR PARACHUTISTS

1. What type of jumps do you execute (solo, tandem, etc.)?

2. What type of parachute do you use?

3. How close to the target are you able to land with this type of parachute?

4. Have you ever missed the parachute landing zone? Why?

5. How long does it take you to leave the parachute landing zone after a jump?

6. What airport do you use for parachute jumping?

7. Does the type of plane make a difference on your landing zone accuracy?

8. What type of plane is typically used?

9. Where did you learn to parachute jump?

10. How long have you been parachute jumping?

11. Are you a USPA member or member of a similar organization? If so, do you hold a license and what type?

12. How many jumps have you made? At this facility? At other facilities?

13. What do you think is critical for safety when you are parachute jumping onto a drop zone located on an airport?

14. Have you experienced any near misses?

15. What recommendations do you have for the FAA to improve the safety of parachute landing zones on airports?

16. Do you prefer a parachute landing zone that is a circle or a square?

17. Does the marking or lighting of the parachute landing zone aid in the accuracy of landing within the site? If so, are there any particular methods of marking or lighting that are more beneficial than others?

18. If the landing zone is located near the runway or taxiway, have you received a briefing or other training specific to your movements on the airfield (i.e., briefing on airport rules/regulations, standard pedestrian/skydiver movement procedures to cross runways, when applicable, etc.) ?

APPENDIX D—QUESTIONNAIRE FOR THE UNITED STATES PARACHUTE ASSOCIATION

1. According to the Skydiver Information Manual (SIM), the Basic Safety Requirements (BSRs) are "generally agreed upon as necessary for an adequate level of safety." How do you define an "adequate level of safety"?

2. How did the USPA set the drop zone distance requirements?
   a. Did you solicit members to provide input from "real-life" situations?
   b. Did you solicit information from airport operators or drop zone operators?
   c. Did you solicit information from other entities involved in skydiving such as the military?

3. What data are these distances based on?
   a. What form is the data (i.e., general articles, case studies, accident data)?
   b. How recent is the data?
   c. How often is the data updated?
   d. Who provided the data?
   e. Is any of the data weighted?
   f. Did the data consider various airport operating environments?

4. Can you supply us with the data?

5. Does the USPA maintain a database of accidents/incidents?

6. Are drop zones required to report incidents?

7. Are there reporting procedures in place if a skydiver lands outside the designated drop
   zone?

8. Has the USPA issued any Waivers to the BSRs in reference to the minimum radius from a hazard at a drop zone?
   a. If so, could you provide us with the drop zones that are on airports?

9. Has the drop zone minimum radius distances requirements changed over the history of the USPA?
   a. If so, when and why?

10. According to the SIM (Section 4.D.5.i.(2)), "In light winds it is important to have plenty of clear space past the target in case you overshoot." How much space is "plenty"? Is this space in addition to the minimum distances from hazards or additional space beyond the drop zone?

11. According to the SIM (Section 4.D.5.b), jumpers should plan the landing pattern using an aerial photograph, diagram, or map of the drop zone. Does the USPA maintain a master list of diagrams for its members' use in planning jumps?

12. Could you provide us examples of airports with a significant amount of parachute activity and aircraft operations that have drop zones on airport property?

13. Can a drop zone operator request a waiver for the drop zone requirements? If so, who makes the request? Who reviews the request? What is the standard by which you review the waiver request?

APPENDIX E—PROPOSED CHANGES TO ADVISORY CIRCULAR 150/5300-13, AIRPORT DESIGN

E.1 PARACHUTE LANDING AREA REQUIREMENTS.

Airports with a parachute landing area (PLA) on airport property must comply with the following requirements:

1. Hazards—areas on an airport intended for parachute landings must be hazard free. Hazards are defined as:

   - Telephone and power lines
   - Towers
   - Buildings
   - Open bodies of water
   - Clusters of trees covering more than 3000 square meters
   - Fencing
   - Paved surfaces (ramps/aprons, runways, and taxiways)
   - Aircraft tie-down areas
   - Equipment necessary for aircraft operations or navigation (NAVAIDs, airfield lighting, and signage), but excluding equipment necessary for skydiving operations

2. Size—Table E-1 shows the minimum size of parachute landing areas and the radial distances from hazards based on the type of parachute activity and canopy used. If an on-airport PLA will be accommodating more than one type of parachuting activity, the largest minimum size area must be used or multiple PLAs designated.

Table E-1. Minimum PLA Size and Distance From Hazards

Parachute Activity	Minimum PLA Size Ram-Air Canopies (sq. ft.)	Minimum PLA Size Using Round Canopies (sq. ft.)	Minimum Radial Distance From Hazards (ft)
Student/training	338,000	3,041,900	40
Tandem	84,500	N/A	40
All other activity	5,000	338,000	40

Students/Training—For ram-air canopies, the minimum recommended PLA size for students/training activities is (100-m radius from hazards)^2 x π or 338,000 sq. ft.

Examples of acceptable student/training PLAs would be:

- 582- by 582-foot square
- 656-ft-diameter circle
- 700- by 483-foot rectangle
- Any other shape with an area equaling 338,000 square feet

For student/training activities using round canopies, the minimum PLA size is (300-m radius from hazards)^2 x $\pi \approx$ 3,041,900 square feet.

Tandem—The minimum PLA size recommended for tandem activities is (50-m radius from hazards)^2 x π or 84,500 square feet.

Examples of acceptable tandem PLAs would be:

- 292- by 292-foot square
- 328-foot-diameter circle
- 340- by 250-foot rectangle
- Any other shape with an area equaling 84,500 square feet

The minimum PLA size for tandem activities does not apply for round canopies because they are not used for tandem jumps.

All Other Activities—The minimum PLA size recommended for all other parachute activities is (12-m radius from hazards)^2 x π or 5000 square feet.

Examples of acceptable PLAs for all other activities would be:

- 70- by 70-foot square
- 80-foot-diameter circle
- 85- by 60-foot rectangle
- Any other shape with an area equaling 5000 square feet

All other parachute activities using round canopies will have a minimum PLA size of 338,000 square feet, which is the area equivalent to (100-m radius from hazards)^2 x π.

3. Location—The edge of the PLA must be a minimum distance of 40 feet from any hazard.

PLAs should only be located in protected areas (e.g., RSA, OFA) of the runway if no other location is feasible (as long as the drop zone remains 40 feet from any hazard). In

addition, the PLA must not be located within the RSA at any 14 CFR Part 139 certificated airport.

However, based on the Transport Canada regulations, PLAs may be sited to maintain a 45° clearance plane from the center of the PLA to above-ground hazards bordering the perimeter of the landing area.

4. Markings—All on-airport PLAs must have marked PLA perimeter boundaries to distinguish the PLA from the surrounding area. This marking helps differentiate the PLA from the ground. Examples of marking include:

   - Dashed line, a minimum of 3 inches wide in white or orange chalk, paint, or engineering tape
   - Traffic styles cones
   - Flags
   - Streamers
   - Landscaping
   - Mowing

   Note: It is recommended to avoid using the same type of marker when designating both areas within the PLA and the perimeter of the PLA.

5. Compliance—This standard applies to any new PLA. Existing PLAs have 36 months to comply with the standard.