



U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

Subject: Hazardous Wildlife Attractants on or
near Airports

Date: 02/21/2020

AC No: 150/5200-33C

Initiated By: AAS-300

Change:

1 **Purpose.**

This Advisory Circular (AC) provides guidance on certain land uses that have the potential to attract hazardous wildlife on or near public-use airports. It also discusses airport development projects (including airport construction, expansion, and renovation) affecting aircraft movement near hazardous wildlife attractants. Appendix 1 provides definitions of terms used in this AC.

2 **Cancellation.**

This AC cancels AC 150/5200-33B, *Hazardous Wildlife Attractants on or near Airports*, dated August 28, 2007.

3 **Application.**

The Federal Aviation Administration recommends the guidance in this AC for land uses that have the potential to attract hazardous wildlife on or near public-use airports. This AC does not constitute a regulation, is not mandatory, and is not legally binding in its own right. It will not be relied upon as a separate basis by the FAA for affirmative enforcement action or other administrative penalty. Conformity with this AC is voluntary, and nonconformity will not affect rights and obligations under existing statutes and regulations, except as follows:

1. Airports that hold Airport Operating Certificates issued under Title 14, Code of Federal Regulations (CFR), Part 139, Certification of Airports, Subpart D, may use the standards, practices and recommendations contained in this AC as one, but not the only, acceptable means of compliance with the wildlife hazard management requirements of Part 139.
2. The FAA recommends the guidance in this AC for airports that receive funding under Federal grant assistance programs, including the Airport Improvement Program. See Grant Assurance #34.

CHAPTER 1. GENERAL SEPARATION CRITERIA FOR HAZARDOUS WILDLIFE ATTRACTANTS ON OR NEAR AIRPORTS

1.1 Introduction.

- 1.1.1 Airport operators should maintain an appropriate environment for the safe and efficient operation of aircraft, which entails mitigating wildlife strike hazards by fencing, modifying the landscape in order to deter wildlife or by hazing or removing wildlife hazardous to aircraft from congregating on airports. When considering proposed land uses, operators and sponsors of airports certificated under Part 139, local planners, and developers must take into account whether the proposed land uses, including new development projects, will increase wildlife hazards. Land-use practices that attract or sustain hazardous wildlife populations on or near airports, specifically those listed in Chapter 2, can significantly increase the potential for wildlife strikes.
- 1.1.2 The FAA urges regulatory agencies and planning and zoning agencies to evaluate proposed new land uses within the separation criteria and prevent the creation of land uses that attract or sustain hazardous wildlife within the separation distances.
- 1.1.3 The FAA recommends the use of minimum separation criteria outlined below for land-use practices that attract hazardous wildlife to the vicinity of airports. Please note that FAA criteria include land uses that cause movement of hazardous wildlife onto, into, or across the airport's approach or departure airspace or aircraft operations area. (See the discussion of the synergistic effects of surrounding land uses in Paragraph 2.8 of this AC.). For the purpose of evaluating distance criteria, the delineation of the aircraft operations area may also consider future airport development plans depicted on the Airport Layout Plan (e.g., planned runway extension).
- 1.1.4 The separation distances are based on (1) flight patterns and performance criteria of piston-powered aircraft and turbine-powered aircraft, (2) the altitude at which most strikes happen (78 percent occur under 1,000 feet and 90 percent occur under 3,000 feet above ground level), and (3) National Transportation Safety Board recommendations.

1.2 Airports Serving Piston-Powered Aircraft.

Airports that do not sell Jet-A fuel normally serve piston-powered aircraft. Notwithstanding more stringent requirements for specific land uses, the FAA recommends a separation distance of 5,000 feet from these airports for any of the hazardous wildlife attractants discussed in Chapter 2 or for new airport development projects meant to accommodate aircraft movement. This distance is to be maintained between the closest point of the airport's aircraft operations area and the hazardous wildlife attractant. Figure 1 depicts an example of the 5,000-foot separation distance measured from the nearest aircraft operations area.

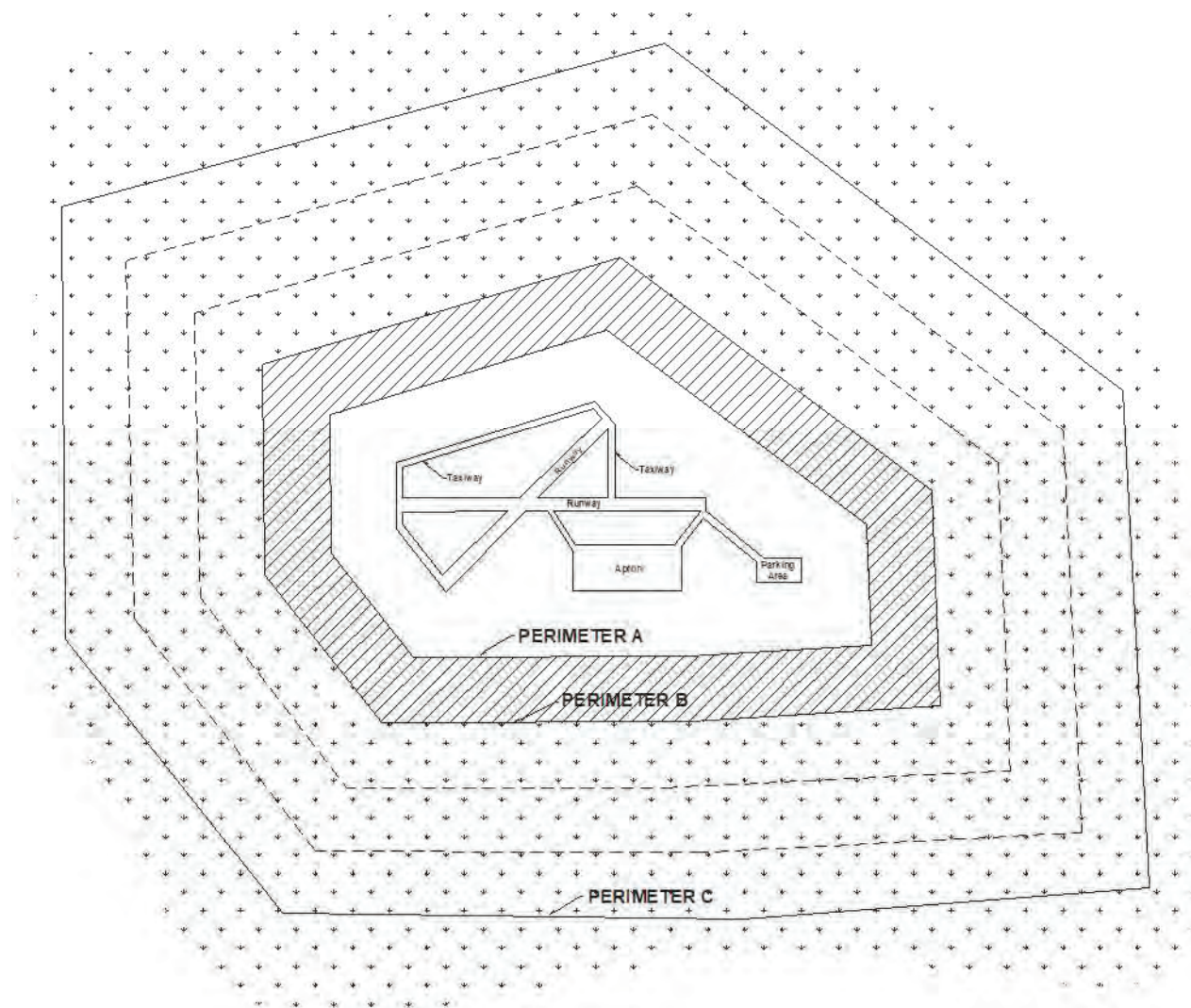
1.3 Airports Serving Turbine-Powered Aircraft.

For airports serving turbine-powered aircraft, the FAA recommends a separation distance of 10,000 feet from these airports for any of the hazardous wildlife attractants discussed in Chapter 2 or for new airport development projects meant to accommodate aircraft movement. This distance is to be maintained between the closest point of the airport's aircraft operations area and the hazardous wildlife attractant. Figure 1 depicts an example of the 10,000-foot separation distance from the nearest aircraft movement areas.

1.4 Protection of Approach, Departure, and Circling Airspace.

For all airports, the FAA recommends a distance of 5 miles between the closest point of the airport's aircraft operations area and the hazardous wildlife attractant. **Special attention should be given to hazardous wildlife attractants that could cause hazardous wildlife movement into or across the approach or departure airspace.** Figure 1 depicts an example of the 5-mile separation distance measured from the nearest aircraft operations area.

Figure 1. Example of recommended separation distances described in Chapter 1 within which hazardous wildlife attractants should be avoided, eliminated, or mitigated.



PERIMETER A: For airports serving piston-powered aircraft, it is recommended hazardous wildlife attractants be 5,000 feet from the nearest aircraft operations area.

PERIMETER B: For airports serving turbine-powered aircraft, it is recommended hazardous wildlife attractants be 10,000 feet from the nearest aircraft operations area.

PERIMETER C: Recommended for all airports, 5-mile range to protect approach, departure and circling airspace.

and fountains for ornamental purposes, and ponds that result from mining activities often attract large numbers of potentially hazardous wildlife. Development of new open water facilities within the separation criteria identified in Paragraphs 1.2 through 1.4 should be avoided to prevent wildlife attractants. If necessary, land-use developers and airport operators may need to develop management plans, in compliance with local and state regulations, to support the operation of storm water management facilities on or near all public-use airports to ensure a safe airport environment. The FAA recommends these plans be developed in consultation with a Qualified Airport Wildlife Biologist³, to minimize hazardous wildlife attractants.

2.3.1 Existing Stormwater Management Facilities.

2.3.1.1 On-airport stormwater management facilities allow the quick removal of surface water, including discharges related to aircraft deicing, from impervious surfaces, such as pavement and terminal/hangar building roofs. Existing on-airport detention ponds collect stormwater, protect water quality, and control runoff. Because they slowly release water after storms, they may create standing bodies of water that can attract hazardous wildlife. Where the airport has developed a Wildlife Hazard Management Plan, Part 139 regulations require the immediate correction of any wildlife hazards arising from existing stormwater facilities located on or near airports using appropriate wildlife hazard mitigation techniques. Airport operators should develop measures to minimize hazardous wildlife attraction in consultation with a Qualified Airport Wildlife Biologist.

2.3.1.2 Where possible, airport operators should modify stormwater detention ponds to allow a maximum 48-hour detention period for the design storm. The combination of open water and vegetation is particularly attractive to waterfowl and other hazardous wildlife. Water management facilities holding water longer than 48 hours should be maintained in a manner that keeps them free of both emergent and submergent vegetation. The FAA recommends that airport operators avoid or remove retention ponds and detention ponds featuring dead storage to eliminate standing water. Detention basins should remain totally dry between rainfalls. Where constant flow of water is anticipated through the basin, or where any portion of the basin bottom may remain wet, the detention facility should include a concrete or paved pad and/or ditch/swale in the bottom to prevent vegetation that may provide nesting habitat. Drainage basins with a concrete or paved pad should be maintained to prevent or remove any sediment build-up to prevent vegetation growth.

2.3.1.3 When it is not possible to drain a large detention pond completely, airport operators may use physical barriers, such as bird balls, wire grids, pillows,

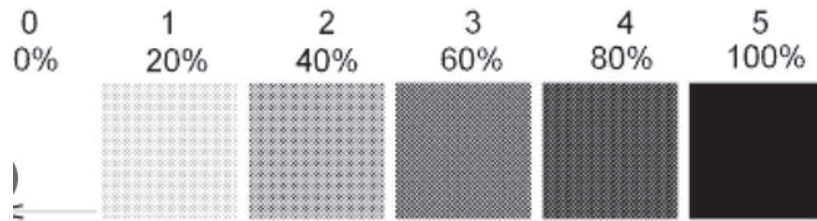
³ See Advisory Circular 150/5200-36, *Qualifications for Wildlife Biologist Conducting Wildlife Hazard Assessments and Training Curriculums for Airport Personnel Involved in Controlling Wildlife Hazards on Airports.*

Nampa Airport Commissioner, Aubree Miller, Live Testimony

February 23, 2024

On behalf of the airport commission, I gave live testimony on February 23, 2024, as to the safety concerns to the airport. I was limited to two minutes and gave an abbreviated version. I am providing what I would have liked to have conveyed that evening. Please consider these safety concerns during your decision:

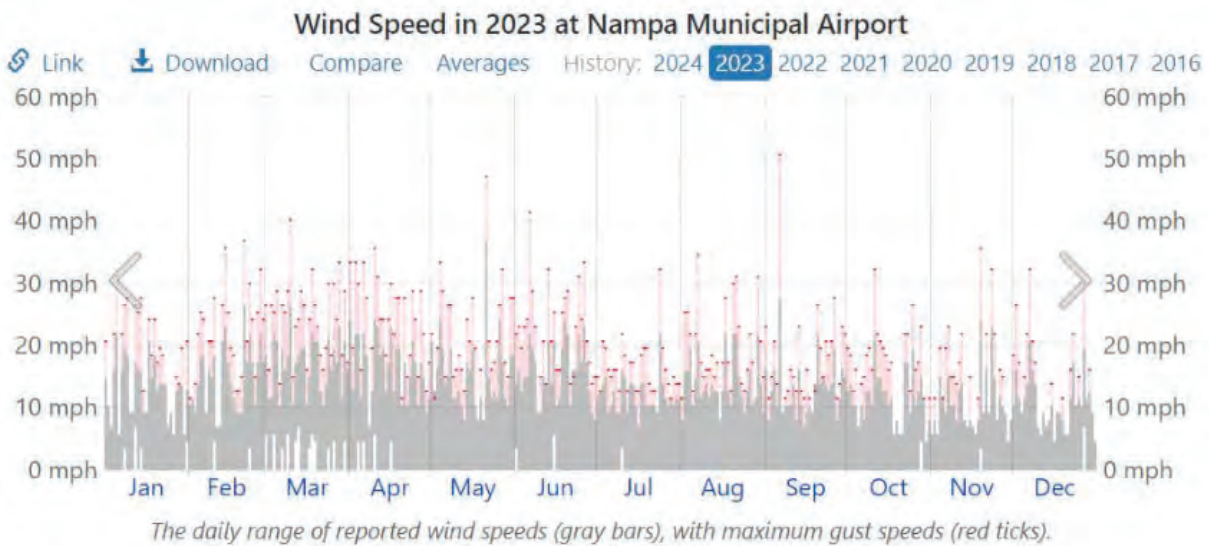
- *Mr. Chair, thank you! I'm Aubree Miller, a native Idahoan and pilot.*
- *Part of the pleasure of serving on the airport commission for the last four years is to ensure a future flying legacy for my kids, help shape the landscape around the airport, and perhaps to even leave it a little better than when I started. Maybe we share this commonality as volunteer commissioners?*
- *On behalf of the airport commission, a letter in strong opposition was submitted detailing key stakeholders and their concerns. We'd like these addressed before project approval.*
- *AOPA is a national non-profit formed in the 30's striving for aviation safety. The Northwest Region submitted a letter and it should carry quite a bit of weight. Airport commissioners support this letter.*
- *There's an Aviation Easement in your packets (on handwritten page 279-281). To summarize, it grants the city all rights until the airport's no longer an airport to prevent erection or growth of something on or extending into airspace causing a safety issue. This easement created in the 70's is a bit of a "common sense hold-out" to ensure safe, and proper building around the airport. However, if there is a need to spend the money on a land use compatibility analysis, performed by the Division of Aeronautics as AOPA suggests, we'd support this. I would like to know what city attorneys think about this easement and the importance of it.*
- *The main things I want to leave you with are:*
 - o *8 buildings with exhaust will be placed directly below traffic pattern altitude. This starts at 500 feet above the ground for ultralight aircraft. Exhaust below a traffic pattern is an unnecessary distraction that can cause difficulty in recognizing aircraft, especially in transition. The visual emissions to adhere to by the state is 20% transparency (on handwritten page 14) or 1 and never greater than 3 (handwritten page 6) on the Ringelmann Chart. Visually, this is what a pilot could be looking through with minimum standards – see chart below - while entering and looking for traffic in a traffic pattern.*



- Yes, state-of-the-art filters will be in place, minimum standards will be met. If I understand correctly, the plan still allows 25% (on page 7 of their General Permit Statement), could be more or less, of unsuppressed potential to emit fugitive emissions of particulate matter. Digging in the footnotes, I found 4.17% of this is sand and 1.77% of this is aggregate and is allowed up to 1 pound per hour per acre. Sunroc sits on 7.83 acres and for time, I will let you apply the multiplier. When exhaust truly is vertical, aircraft will be forced to fly through the particulates in the air to land. If this project is allowed, it's like putting a fine layer of corrosive sandpaper in and on, all fragile, moving and stationary surfaces made of: metals, composites, plexiglass, fabric aircraft, and metal buildings in and around the airport.

This was where my testimony had to end...

- A recycling plant adjacent the runway and Sunroc's property gave similar assurances to mitigate debris, but we've still run into safety and visibility issues. Correct, windspeed averages 7 miles per hour. Looking at wind speeds over 2023, winds are consistently in the teens with high gusts as you can see on the chart. With winds like this, dust, grit, and particulates will not remain on Sunroc's property. The plan identifies exhaust, aggregate storage piles very close to the runway, material transfers, and a crusher – to be permitted independently. Why? More on this if allowed time, otherwise, refer to Dennis Parker's comments.



- As a commission, we've learned our lesson that higher standards are needed for safety and protection of current and future stakeholders. There's well over \$100 million dollars in physical airport assets and the airport's annual direct economic impact is valued at over \$25 million dollars per year. The airport's been here since 1928 and will be here long after us. Decisions made today will no doubt affect the airport's future. The concrete batch plant next to the airport is not in the best interest of the city of Nampa. Thank you.

More time for Crusher: Under the Facility Information Description (on handwritten page 195) indicates the rock crushers are being permitted independently. Why would the crushers be permitted separately? Yes, the permitting process requires it this way, but this information was missing on the 2022 CUP. Mr. Dennis Parker articulates (on handwritten page 298-99) the combined toxic cement dust, with not just one crusher, but two, with the items listed on their conditional use permit would have put the acceptable volume way over the safe limit and the permit would have been denied. The reason the crushers were omitted in the original plan is so there would be a separate toxic dust calculation. Are the crusher toxicity levels included in the General Permit statement? Not that I completely understand the levels, numbers, or calculations, but if Mr. Parker is correct in his deduction, this non-disclosure is truly unethical. It leads me to question what else is a little less than the truth and how they will perform their own self-reporting measures.

Chronic Effects: Dry portland cement can cause inflammation of the lining of the nose and the cornea. Repeated exposure to portland cement may result in drying of the skin and may lead to thickening, cracking, or fissuring of the skin. Hypersensitive individuals may develop an allergic dermatitis (possibly due to trace amounts of hexavalent chromium at less than 0.005%). This reaction may appear in several forms including a mild rash to severe skin ulcers. Persons already sensitized may react to their first contact with the product. Other persons may experience this effect after years of exposure to portland cement products.

While portland cement typically has less than 0.2% crystalline silica, other additives to portland cement and those components (e.g. aggregates) added to produce portland cement concrete may significantly increase the amount of crystalline silica that is present. Exposure to respirable crystalline silica without the use of a respirator can cause silicosis and may aggravate other lung conditions.

Signs and Symptoms of Exposure: Burning sensation around moist tissue areas (i.e., eyes, nose, upper respiratory system); painful burning on exposed skin that can develop with little warning. **Exposure of sufficient duration to wet portland cement can cause serious, potentially irreversible tissue (skin or eye) destruction in the form of chemical (caustic) burns, including third degree burns.** The same kind of destruction can occur if wet or moist areas of the body are exposed for sufficient duration to dry portland cement. **DO NOT ALLOW WET PORTLAND CEMENT TO GET INSIDE BOOTS, SHOES, OR GLOVES AND DO NOT ALLOW WET, SATURATED CLOTHING TO REMAIN AGAINST THE SKIN.**

Medical Conditions Generally Aggravated by Exposure: Pre-existing skin conditions may be worsened. Silicosis may aggravate other chronic pulmonary conditions and may increase the risk of pulmonary tuberculosis infection.

Chemical Listed as Carcinogenic or Potential Carcinogen: Portland cements are not considered carcinogenic.

However, the International Agency for Research on Cancer (IARC) has determined, primarily through animal studies, that silica is a known human carcinogen. The National Toxicology Program (NTP) has characterized respirable quartz silica as reasonably anticipated to be a carcinogen. OSHA does not regulate silica as a carcinogen.

Emergency and First Aid Procedures: Irrigate eyes immediately and repeatedly with large amount of clean water for at least 15 minutes and get prompt medical attention. Wash exposed skin areas with pH-neutral soap and clean water. Apply sterile dressings; seek medical treatment in all cases of prolonged exposure to wet portland cement, portland cement mixtures, liquids from fresh portland cement products, or prolonged wet skin exposure to dry portland cement. If ingested, consult a physician immediately. Do not induce vomiting. If conscious, have the victim drink plenty of water and call a physician immediately. In the event of inhalation, remove to fresh air. Seek medical attention if coughing and other symptoms do not subside. Inhalation of gross amounts of portland cement requires immediate medical attention.

Section VII-Reactivity Data

Stability: Product is stable. Keep dry until used.

Incompatibility: Aluminum powder and other alkali and alkaline earth elements will react in wet mortar or concrete, liberating hydrogen gas. Portland cement is highly alkaline and will react with acids to produce a violent, heat-generating reaction. Toxic gases or vapors may be given off depending on the acid involved.

Hazardous Decomposition Products: None

Hazardous Polymerization: Will not occur.

Status under WHMIS

Portland cement is considered to be a hazardous material under the Hazardous Products Act as defined by the Controlled Products Regulations (Class E – Corrosive Material) and is therefore subject to the labeling and MSDS requirements of the Workplace Hazardous Materials Information System (WHMIS).

Other Important Information

Portland cement should only be used by knowledgeable persons. A key to using the product safely requires the user to recognize that portland cement reacts with water, and that some of the intermediate products of this reaction (that is, those present while portland cement is "setting") pose a far more severe hazard than does portland cement itself.

While the information provided in this material safety data sheet is thought to provide a useful summary of the hazards of portland cement as it is commonly used, the sheet cannot anticipate and provide all the information that might be needed in every situation. Inexperienced product users should obtain training before using this product.

In particular, the data provided in this sheet do not address hazards that may be posed by other materials that may be added to portland cement to produce portland cement products. Users should review other relevant material safety data sheets before working with this portland cement or on portland cement products, for example portland cement concrete.

SELLER MAKES NO WARRANTY, EXPRESS OR IMPLIED, CONCERNING THE PRODUCT OR THE MERCHANTABILITY OR FITNESS THEREOF FOR ANY PURPOSE OR CONCERNING THE ACCURACY OF ANY INFORMATION PROVIDED BY ASH GROVE CEMENT COMPANY, except that the product shall conform to contracted specifications. The information provided herein was believed by Ash Grove Cement Company to be accurate at the time of preparation or prepared by sources by believed to be reliable, but it is the responsibility of the user to investigate and understand other pertinent sources of information to comply with all laws and procedures applicable to the safe use and handling of product and to determine the suitability of the product for its intended use.

This product neither contains nor is directly manufactured with any controlled ozone depleting substances, Class I and II.

DAYBELL TRIAL: LATEST UPDATES & VIDEO

LOCAL

Parents of pilot killed in plane crash blame city of Burley, others in wrongful death lawsuit

🕒 Published at 2:37 pm, August 16, 2023

Updated at 4:40 pm, August 16, 2023



Rett Nelson, EastIdahoNews.com



Chelsea Brittney Infanger, 30, of Salmon, was killed in a plane crash on April 13, 2022. Her parents blame the city of Burley, Gem State Processing in Heyburn for her death. | Photo obtained from court documents

IDAHO FALLS – The parents of a pilot killed in a plane crash last year say the city of Burley, an Idaho food processing plant and other entities are responsible for their daughter's death, and now they're suing.

In a 38-page lawsuit filed on June 22, Jim and Sharon Infanger of Salmon say the crash could have been avoided if it weren't for the placement of multiple smokestacks at the Gem State potato processing plant, which is adjacent to the Burley J.R. Simplot Airport. The city owns the property where the smokestacks sit. The stacks reportedly pose a safety hazard to pilots because they emit exhaust that reduces visibility for approaching aircraft.

Despite this, court documents say the towers were built without the city's approval, and no paperwork had been submitted to the Federal Aviation Administration.

RELATED | Pilot killed in plane crash was 'adventurous, beautiful' woman who 'brightened the room with her smile'

In court documents, an unnamed witness alleges to have seen the crash. In April 2022, 30-year-old Brittney Infanger approached the runway and allegedly hit a wall of steam "produced from a set of six smokestacks on the roof of the Gem State Processing Plant."

Though her parents say she was an experienced pilot who was familiar with the surroundings at the Burley airport, Brittney crashed her single-engine Cessna 208B plane into the processing plant and died.

"The witness heard the engine increase in sound and saw the nose of the aircraft lift shortly before the airplane struck the smokestack and crashed to the rooftop," the lawsuit says.



Aircraft on roof of Gem State Processing showing exhaust stack and the steam cloud. | Taken from court documents

The Infangers allege the city was aware of the safety risks the smokestacks created but did nothing to prevent their placement or construction. The couple blames the city and several government agencies, including the Idaho Department of Transportation and the Division of Aeronautics, for their “bureaucratic disregard, inaction and recklessness.” They allege Gem State Processing, the city of Burley and its real estate partner were negligent and demonstrated “corporate indifference” on the matter.

“The city of Burley placed the economic interest of its role as a landlord above the safety of its pilots using its airport,” the Infangers say in court documents.

Gem State Processing and the city responded to the lawsuit several weeks ago denying the allegations. Gem State Processing has not responded to a request for comment. Burley city officials declined to comment on the case, saying they’re “in the process of going through discovery and providing documents” to the court.

A deeper look at the case

The lease agreement between Gem State and the city dates back to August 2004, according to court documents. By 2010, Gem State had allegedly built multiple towers on the property without giving any advanced notice.

Court records show that in 2013, the city of Burley determined the smokestacks posed a safety hazard, and the airport needed to be relocated. The city recommended closing the airport because the cost of building a new one was too high. Two potential sites were identified in early 2016.

On March 11, 2016, the lawsuit says Airport Manager Kevin Gebhart learned six additional stacks were being added at the Gem State plant. No paperwork had been submitted to the FAA for the new or previous stacks.

Gebhart reached out to the FAA and the city, and Burley City Manager Mark Mitton replied to airport personnel several days later.

"We did not know that Gem State had any plans to install additional stacks at their facility in Heyburn. We were advised last week of what was happening. Gem State did not advise the city of Burley or Heyburn or Minidoka Counties of their plans," Mitton replied, according to court documents.

But Jack Hunsaker, president of the Burley Airport User's Association, apparently didn't believe Mitton. He said the city had a "fiduciary responsibility" to protect the airport from encroachments, and the city violated that.

"It appears to be a breach of tremendous proportions of the fiduciary responsibility and a clear lack of desire to even minimally maintain the current airport until a suitable replacement is functional," Hunsaker wrote.

Over the next month, Gem State Processing allegedly filed the necessary paperwork. The FAA determined the new stacks encroached on the runway. Court records indicate multiple pilots sent letters to the city saying the smokestacks "interfere with approaches" and "reduce visibility" at the airport.



Photo taken from the departure end of Runway 02 at Burley Airport, looking northeast at the Gem State Processing Plant and its steam stacks. | Taken from court documents

After losing federal funding for the airport between 2017 and 2018, city officials submitted changes to its proposed layout for a new airport.

The project stalled for the next three years, according to court records.

The current airport was rededicated in 2022 and named the J.R. Simplot Airport, several months before the plane crash that killed Brittney.

The Infangers are hoping the city is forced to either make the airport safe or close it down. They're seeking "the maximum recovery of damages under applicable Idaho ... law" and "a trial by jury on all contested issues."

Cases involving the State of Idaho can be filed in Ada County, per Idaho law. Ada County District Judge Jonathan Medema ordered the trial will be held there after denying a motion from the defendants to hold the trial in Heyburn or Burley.

The Infangers want the trial to be held in June 2024, but the defendants want to wait until February 2025. A trial date will be determined at a hearing on Monday.

[SUBMIT A CORRECTION](#)





**Federal Aviation
Administration**

Wind Shear



Introduction

“Tonto 55, how do you read?”

“55, loud and clear.”

It has been a good flight, thinks the Instructor Pilot (IP) as the pilot in front smoothly and efficiently makes the transition to the Ground Controlled Approach (GCA) final. I enjoy being an instructor on days like this one.

“Tonto 55, begin descent. Slightly above glide path, on course. Seven miles from touchdown.”

He is really smooth on this GCA, thinks the IP—just a little trouble getting down to the glide slope.

“Slightly above glide path, on course. Five miles from touchdown.”

“Slightly above glide path, on course, wind 050, 10 knots. Cleared to land Runway 05. Four miles from touchdown.”

The IP thinks—This approach is not taking much thrust. Maybe they tuned up the engines last night.

“On glide path, on course. Two miles from touchdown.”

“Slightly below glide path. One mile from touchdown.”

“Going well below glide path. Well below glide path.”

Wow, thinks the IP, the bottom dropped out of this approach. Add power. *“I’ve got it!”*
Light burners, light!

“Tonto 55, too low for safe approach. Climb immediately! Contact departure.”

The IP thinks again—Did we hit those lights?

“Uh, GCA, Tonto 55, on the go. Going to tower.”

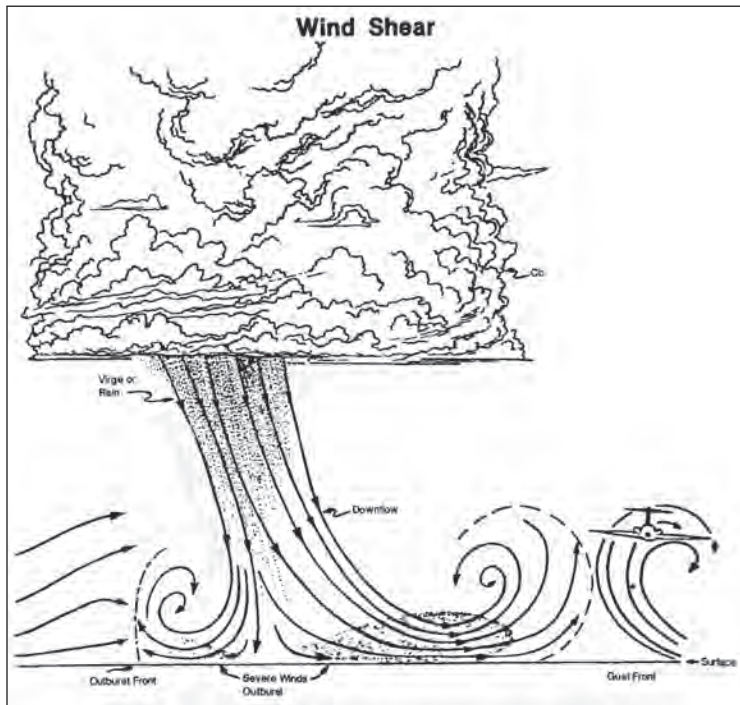
“What happened?” asks the pilot in training.

What happened, indeed? How could two experienced pilots let themselves get so far behind the aircraft that they crashed into the approach lights on a perfectly clear day? A few years ago, the answer would have been a simple “pilot error.” People would shake their heads and go on as usual. Now, thanks to increased research and experience, we are more aware of the complex problem of wind shear. This document explains the wind shear phenomenon. Learning about the dangers wind shear can present might save your life.

What Is Wind Shear?

Wind Shear Defined

Wind shear is a change in wind speed and/or direction over a short distance. It can occur either horizontally or vertically and is most often associated with strong temperature inversions or density gradients. Wind shear can occur at high or low altitude. *Note: This document discusses only low-altitude wind shear.*



Four common sources of low-level wind shear are—

1. **Frontal activity.**
2. **Thunderstorms.**
3. **Temperature inversions.**
4. **Surface obstructions.**

Frontal Wind Shear

Not all fronts have associated wind shear. In fact, shear is normally a problem only in those fronts with steep wind gradients. As with so many things associated with weather, there is no absolute rule, but a couple of clues tell you that wind shear may occur:

- The temperature difference across the front at the surface is 10 °F (5 °C) or more.
- The front is moving at a speed of at least 30 knots.

You can get clues about the presence of wind shear during the weather briefing by checking these two factors. Ask the briefer and, if these factors are present, be prepared for the possibility of shear on approach.

Wind Shear From Thunderstorms

Wind shear is just one of the many unpleasant aspect of thunderstorms. The violence of these storms and their winds are well documented. The two worst problems outside actual storm penetration are shear related. These are the “first gust” and the “downburst.” The rapid shift and increase in wind just before a thunderstorm hits is the first gust.

Figure 1. First gust hazards.

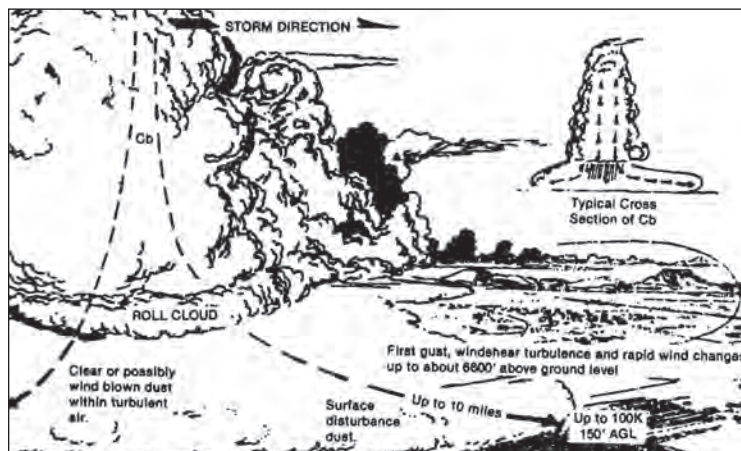
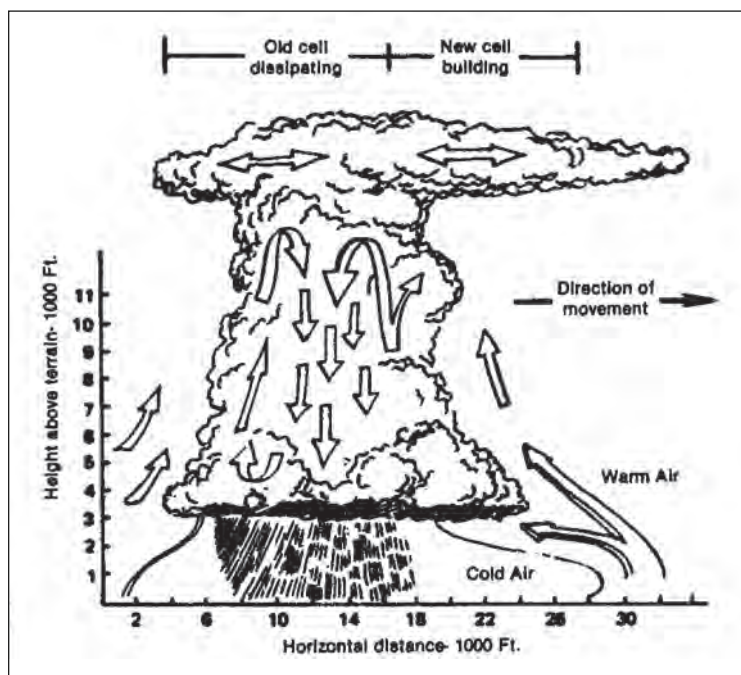


Figure 2. Downdrafts. Strong downdrafts from a dissipating thunderstorm cell spread horizontally as they approach the ground. This wedge of cold air provides a lifting force on surrounding warm air, which may be sufficient to initiate the formation of new thunderstorm cells.



Gusty winds are associated with mature thunderstorms and are the result of large downdrafts striking the ground and spreading out horizontally. These winds can change direction by as much as 180 degrees and reach velocities of 100 knots as far as 10 miles ahead of the storm. The gust wind speed may increase by as much as 50 percent between the surface and 1,500 feet, with most of the increase occurring in the first 150 feet. The implications for a shear on approach in such a case are obvious.

The other wind problem mentioned previously, the downburst, is also downdraft related. It is an extremely intense, localized downdraft from a thunderstorm. This downdraft exceeds 720-feet-per-minute vertical velocity at 300 feet AGL. The power of the downburst can actually exceed aircraft climb capabilities, not only those of light aircraft, but, as is documented in one case, even a high-performance Air Force jet.

The downburst is usually much closer to the thunderstorm than the first gust, but there is no absolutely reliable way to predict the occurrence. One clue is the presence of dust clouds, roll clouds, or intense rainfall. It would be best to avoid such areas.

Wind Shear From Temperature Inversions

Pilots who have flown in the Southwest, Southern California, or Colorado are familiar with this weather pattern. Overnight cooling creates a temperature inversion a few hundred feet above the ground. When coupled with high winds from what is known as the low-level jet stream, this inversion can produce significant wind shear close to the ground.

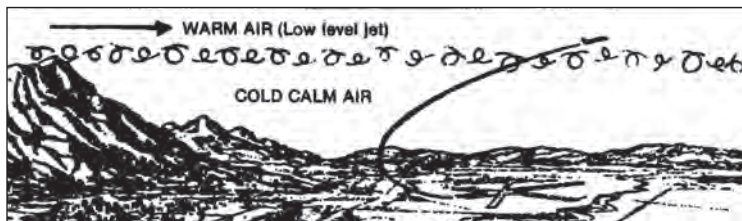


Figure 3. Temperature inversions.

Turbulence at boundary between calm, cold air and a low-level warm air jet stream.

One particularly bothersome aspect of temperature inversion shears is that as the inversion dissipates, the shear plane and gusty winds move closer to the ground. In some areas of the Southwest, a 90-degree change in direction and 20- to 30-knot increases in surface winds in a few minutes are not uncommon. Obviously, such a shift would make an approach difficult at best.

Wind Shear From Surface Obstructions

Wind shear from surface obstruction is generally associated with hangars or other buildings near the runway. The sudden change in wind velocity can seriously affect a landing.

Another type of surface obstruction—mountains—can also affect wind shear. Some airfields are close to mountain ranges, and mountain passes are close to the final approach paths. Strong surface winds blowing through these passes can cause serious localized wind shear during the approach. The real problem with such shear is that it is almost totally unpredictable in terms of magnitude or severity. A pilot can expect such shear whenever strong surface winds are present.

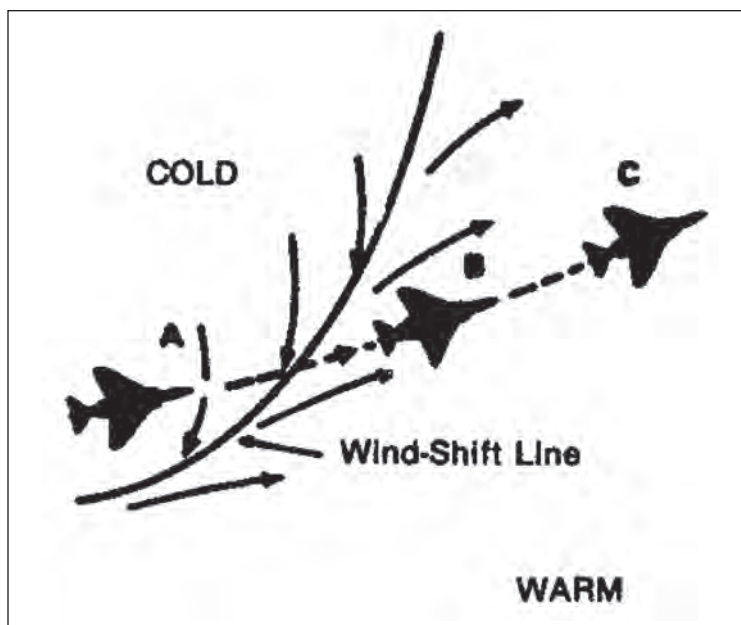
Types of Wind Shear

Wind shear can be divided into horizontal and vertical shears. Although both components can affect an aircraft simultaneously, it is easier to discuss each separately.

Horizontal Wind Shear

Horizontal shear occurs when the flight path of an airplane passes through a wind shift plane. Figure 4 shows how such a penetration would appear as an aircraft crosses a cold front.

Figure 4. Windshift.



Vertical Wind Shear

Vertical wind shear is the type most often associated with an approach. Vertical shear is normal near the ground and can have the most serious effect on an aircraft. The change in velocity or direction can drastically alter lift, indicated airspeed, and thrust requirements. It can exceed the pilot's capability to recover.

Effects of Wind Shear on Aircraft

In its many forms, wind shear can change a routine approach into an emergency recovery in a matter of seconds. An aircraft is affected by the change in wind direction/velocity because the wind also changes the aircraft motion relative to the ground. We will look at the effects of wind shear on an aircraft and on pilot techniques for coping with a shear situation.

Situation 1—High Enough for Recovery

Suppose that an aircraft is stabilized on an instrument landing system approach and encounters a shear that results from a decreasing head wind. In such a case, a transient loss of airspeed and lift causes the aircraft to descend. The pilot must compensate for this loss of lift. The critical factor is whether the aircraft has sufficient altitude to complete a recovery.

In Figure 5, the shear occurs at an altitude high enough for the pilot to complete the recovery (just past the final approach fix, for example).

As the aircraft passes through the shear level, airspeed and lift are lost. The aircraft starts to sink and drops below the glide path. The pilot recognizes this development as a deviation and corrects the situation with increased pitch and power. Very often, the correction is too large, so the aircraft overshoots the desired airspeed and glide path. Because the pilot has sufficient altitude to correct, however, the aircraft can be landed safely.

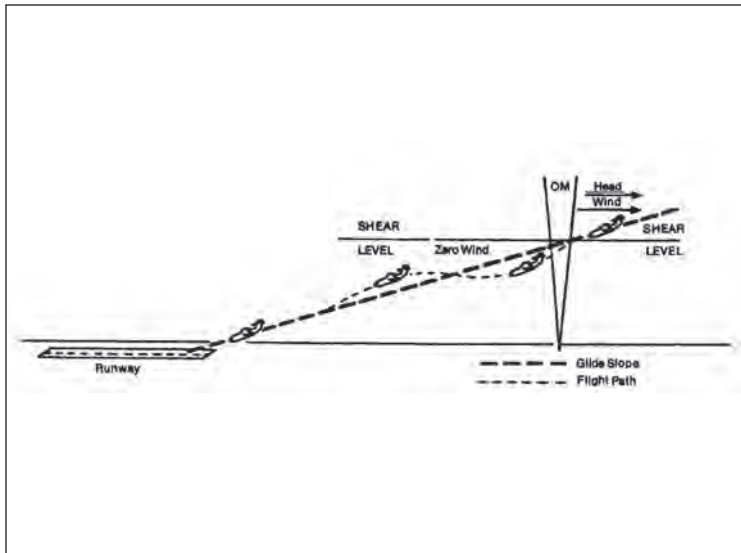


Figure 5. Moderate shear—altitude sufficient to recover.

- Loss of indicated air speed is equivalent to shear value.
- Lift is lost; the aircraft pitches down and drops below the glide slope.
- The pilot applies power to regain speed, pulls the nose up, and climbs back to the glide slope.
- The aircraft overshoots the glide slope and target air speed, but the pilot recovers and lands without difficulty.

Situation 2—Landing Long and “Hot”

Figure 6 illustrates a situation in which the shear encounter takes place farther down the glide path. Reaction time is more critical. Again, the initial reaction of the aircraft to the shear and the pilot's correction are the same. In this case, however, if the pilot overcorrects and the aircraft goes above the glide slope with airspeed increasing sufficiently, the pilot does not have enough altitude to recover, and the aircraft may land long and hot.

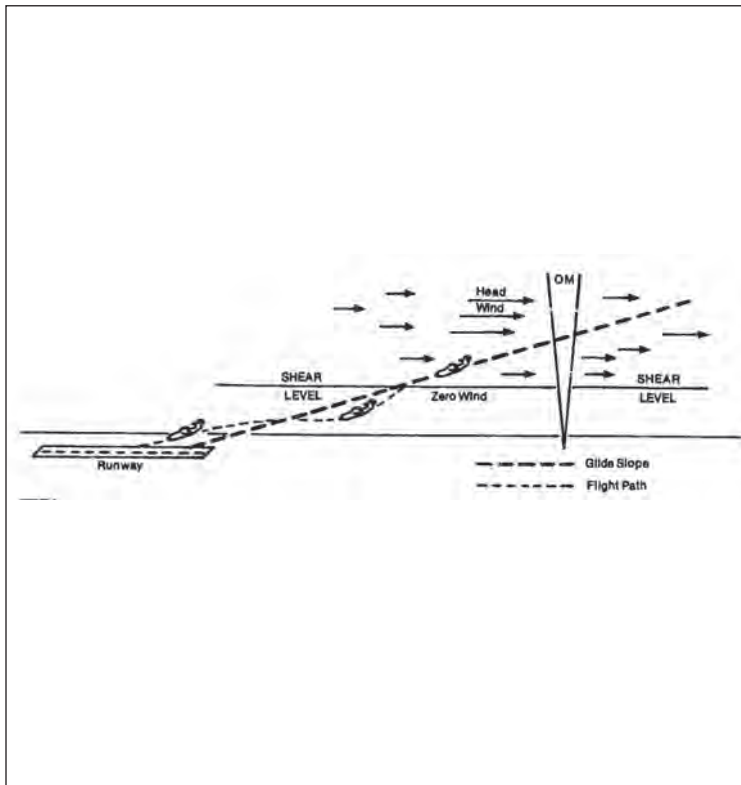


Figure 6. Moderate shear—over-correction leads to landing long.

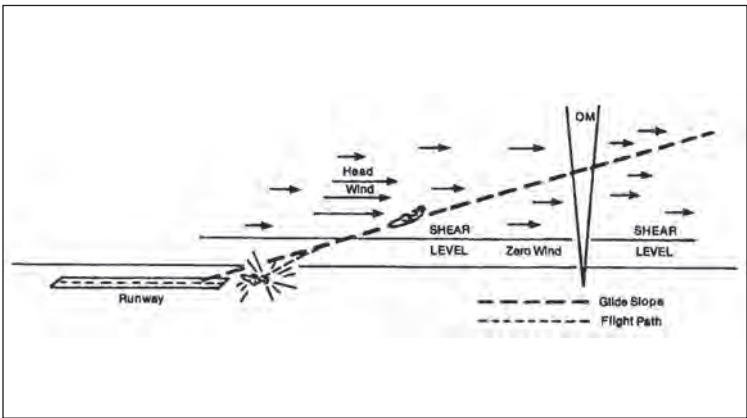
- Loss of indicated air speed is equivalent to shear value.
- Lift is lost; the aircraft pitches down and drops below the glide slope.
- The pilot applies power to regain speed and pulls the nose up to climb back to the glide slope. Nose-up trim may have been used.
- When airspeed is regained, the amount of thrust required is less than that required for previously existing headwind.
- Thrust is not reduced as quickly as required; nose-up trim compounds the problem and the aircraft climbs back above glide slope.
- The aircraft lands long and hot.

Situation 3—Aircraft Lands Short

The situation illustrated in Figure 7 is the most serious. When the altitude of the encounter is too low to make a recovery, or the shear itself is strong enough to overcome aircraft performance capability, the aircraft lands short.

When the aircraft crosses the shear plane and loses the tailwind, lift increases and the aircraft climbs above the glide path. As in the headwind situation, the pilot's reaction can mean an overcorrection. The worst case here is the one similar to Figure 6: the overcorrection leads to a descent below the glide path, but without enough altitude to correct. The result is the classic high sink rate, hard landing.

Figure 7. Strong shear at low altitude prevents recovery.

- Loss of airspeed is equivalent to shear value.
 - Lift is lost; the aircraft pitches down and drops below the glide slope.
 - The pilot applies power to regain airspeed and pulls the nose up to climb back to the glide slope; engine spool-up requires time.
- 
- The aircraft is in high drag configuration with altitude critical. Increasing the angle of attack produces only a slight or momentary increase in lift, accompanied by a tremendous increase in drag as the maximum value of the lift/drag ratio is exceeded. The result is a momentary arrest of the descent with decreasing airspeed, followed by a large increase in an already high descent rate.
 - The pilot's only hope is to pull on the yoke and push on the throttles.
 - Pilot action is too late; the aircraft crashes short of the runway.

The most hazardous form of wind shear is encountered in thunderstorms. The severe, sudden wind changes can exceed the performance capabilities of many sophisticated aircraft. Numerous documented cases of aircraft mishaps have been directly related to encounters with thunderstorm wind shear.

How To Cope With Wind Shear

Here are the best ways a pilot can prevent a hazardous encounter with wind shear:

- Know wind shear is there.
- Know the magnitude of the change.
- Be prepared to correct or go around immediately.

About This Series

The purpose of this series of Federal Aviation Administration (FAA) safety publications is to provide the aviation community with safety information that is informative, handy, and easy to review. Many of the publications in this series summarize material published in various FAA advisory circulars, handbooks, other publications, and audiovisual products developed by the FAA and used by the FAA Safety Team (FAASafetyTeam) for educational purposes.

Some of the ideas and materials in this series were developed by the aviation industry. The FAASafetyTeam acknowledges the support of the aviation industry and its various trade and membership groups in the production of this series.

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Manual on Low-level Wind Shear

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and published under his authority

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International Civil Aviation Organization

3.2 WIND FLOW AROUND OBSTACLES

3.2.1 A combination of strong surface winds and obstacles to the prevailing wind flow situated upwind of the approach or departure path (such as large buildings, low hills or close-planted stands of tall trees) can create localized areas of low-level wind shear. In these circumstances the wind shear is usually accompanied by clear air turbulence (CAT). The effect that the obstacles have on the prevailing wind flow depends on a number of factors, the most important being the speed of the wind and its orientation relative to the obstacle, and the scale of the obstacle in relation to the runway dimensions.

3.2.2 The most commonly encountered wind shear of this type, particularly at smaller aerodromes, is that caused by large buildings in the vicinity of a runway. Although the height of buildings is restricted in proportion to their distance from the edge of the runway strip, to ensure that they do not constitute an obstacle to aircraft, their lateral dimensions tend to be rather large and, for many reasons, they tend to be grouped together in the same area. This means that while the buildings (hangars and fuel storage tanks, etc.) are comparatively low, they present a wide and solid barrier to the prevailing surface wind flow. The wind flow is diverted around and over the buildings causing the surface wind to vary along the runway (see Figure 3-3 a)). Such horizontal wind shear, which is normally very localized, shallow and turbulent, is of particular concern to light aircraft operating into smaller aerodromes but has also been known to affect larger aircraft.¹³

3.2.3 Airfields sometimes are literally carved out of extensive forests with the result that the runway is effectively situated within a “tunnel” of trees. When the treeline is beyond the runway strip and poses no obstacle to aircraft, because the height of the forest or plantation canopy can reach 30 m (100 ft), the surface wind along the runway often bears little or no relationship to the prevailing wind above the forest canopy. Most frequently the surface wind is light and variable or calm irrespective of the prevailing wind (see Figure 3-3 b)).

3.2.4 Of general interest are runways which, of necessity, were built in narrow valleys or alongside a range of low hills. In this case, the scale of the obstacle is such that it can affect the low-level wind flow over a large area. Where a range of low hills lies alongside a runway, the height of the range may be insufficient to divert the flow, but as the airflow is forced over the hills it acquires a vertical component (downwards) which, depending upon the proximity of the hills to the runway, can cause localized low-level downdrafts along the runway (see Figure 3-3 c)). Where the hills or mountains are sufficiently high to divert the low-level wind flow, the surface wind may be funnelled along the runway (see Figure 3-3 d)). In special cases where there are hills along both sides of the runway, the funnelled wind flow may exhibit a Venturi-like^e effect that results in an acceleration in the surface wind.¹⁴

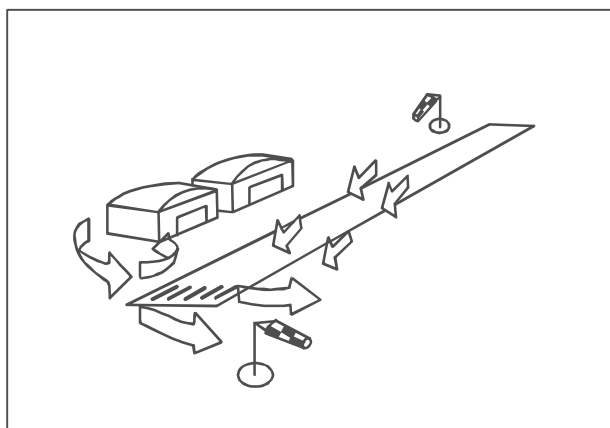
3.2.5 Strong surface winds at aerodromes where there are no substantial obstacles to the wind flow can also cause an increase in wind shear. This is because in the layers of the atmosphere nearest the ground, the strong wind increases mechanical turbulence. This in turn transfers momentum throughout the layer and decreases the wind shear near the ground, with a corresponding increase in wind shear at higher levels of the surface boundary layer.

3.2.6 The wind shear described in 3.2.1 to 3.2.4 is due to the mechanical effects of obstacles interfering with the prevailing wind flow. Under certain circumstances, in addition to the mechanical effect, the thermodynamic properties of the atmosphere can influence the wind flow around obstacles, thereby creating special wind shear conditions.

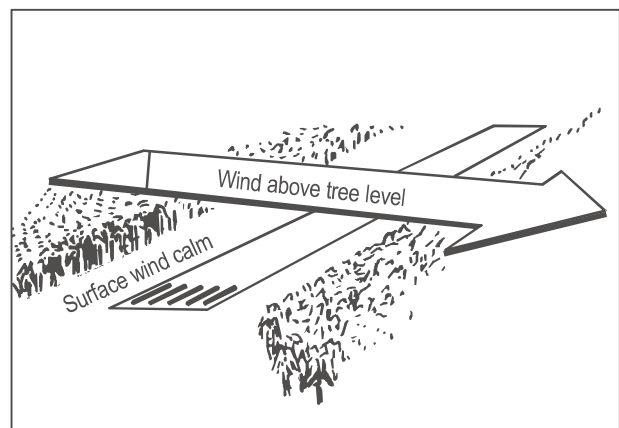
3.2.7 The most common of these conditions, called a katabatic wind, occurs at night over sloping ground when there is no cloud and a weak pressure gradient — especially anticyclonic. The wind is formed

e. Giovanni Venturi (1746–1822), Italian physicist who made contributions in fluid dynamics, including the development of the eponymous “Venturi tube”.

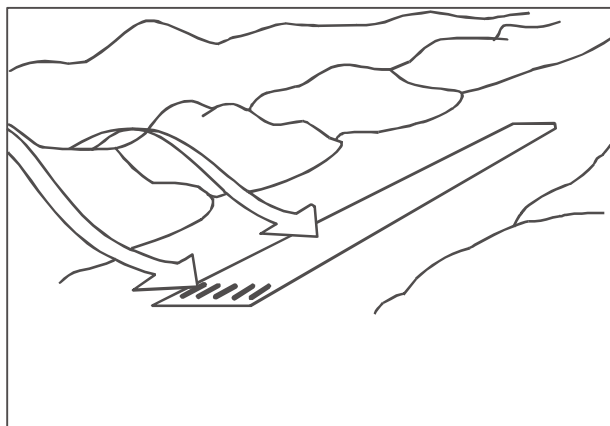
due to the downslope gravitational flow of colder, denser air in contact with the slope below the warmer, less dense air at the same level but some distance away from the surface of the slope. Low-level wind shear and turbulence are present along the leading edge and the top of the colder air as it moves downhill, and on occasion the onset may be sudden, resembling a weak gust front (see 3.5.8 to 3.5.10). The cold, dense air collects as a “pool” at the bottom of the valley, forming a temperature inversion near the ground. If the surface temperature inversion is sufficiently strong, the prevailing winds above the surface may glide over the top of the “stagnant pool” of cold air lodged in the valley bottom. This produces wind shear at some height above ground level along the top of the inversion. The effect occurs over a wide range of scales, from the valley or drainage winds at the smallest scale to the fjord winds of Norway, the mistral of southern France, the bora of the Adriatic and the continental-scale strong outflow winds of Greenland and Antarctica.¹⁵ The development of these large-scale effects normally requires other factors in addition to the katabatic effect, such as intensely cold air at high elevations, optimum orientation of the isobars and hence prevailing wind flow and, in the case of the mistral, the Venturi effect of the Rhone Valley, France, which can accelerate the cold north-westerly downslope wind to 140 km/h (70 kt) or more.



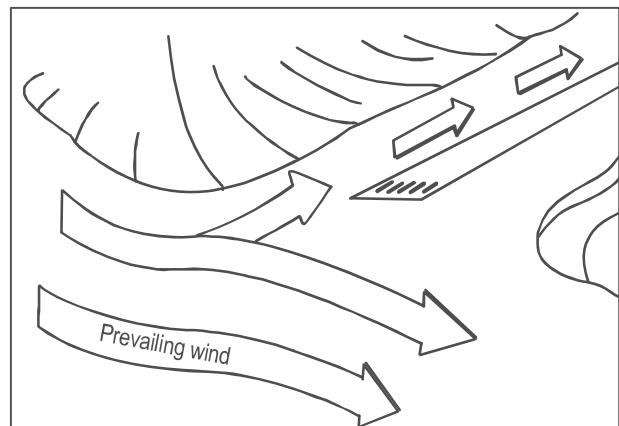
a)



b)



c)



d)

Figure 3-3. Wind flow around obstacles