

# Vertiports Land Use Compatibility Supplement

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# About

The **Vertiport Land Use Guide** Supplement provides a framework for ensuring land use compatibility around vertiports to facilitate the safe and efficient integration of Advanced Air Mobility (AAM) operations.

The document highlights the importance of mitigating potential conflicts with surrounding land uses, such as residential areas or sensitive infrastructure, by defining designated compatibility zones. These zones account for factors such as aircraft noise, downwash and outwash effects, safety risks, and environmental concerns. The guide introduces three primary compatibility zones based on aircraft altitude and associated risks, alongside restrictions on land uses that could interfere with vertiport operations. It also presents compatibility tables to guide planners and policymakers in making informed decisions. The recommendations are based on research, expert consensus, and regulatory considerations, forming a foundation for future vertiport planning and integration into urban and regional transportation networks.





# Abbreviations and definitions

## Abbreviations

- **AAM:** Advanced Air Mobility
- **DWOW:** Downwash and Outwash
- **eVTOL:** Electric Vertical Take-Off and Landing Aircraft
- **FAA:** Federal Aviation Administration
- **FATO:** Final Approach and Take off Area
- **OEM:** Original Equipment Manufacturer
- **RAM:** Regional Air Mobility
- **TLOF:** Touchdown and Lift off Area
- **UAM:** Urban Air Mobility

## Definitions

- **Advanced Air Mobility (AAM):** A new mode of transportation that uses eVTOL aircraft.
- **Downwash:** The downward flow of air from a rotorcraft's rotors.
- **Electric Vertical Take-Off and Landing (eVTOL):** Aircraft that can take off and land vertically without runways, often powered by electric motors.
- **FATO:** The designated area on a vertiport where an aircraft makes its final approach to a hover or landing, and from where it initiates its take-off. This area is typically marked with specific signage and lighting to guide pilots.
- **Land Use Compatibility:** The suitability of land uses in proximity to a vertiport, considering factors like noise, vibration, and safety.
- **Outwash:** The outward flow of air from a rotorcraft's rotors.
- **TLOF:** is the specific area within the FATO where an aircraft touches down or lifts off the ground. It is a marked area on the vertiport surface.



# Introduction

**Land use compatibility at vertiports is crucial for ensuring the safe and efficient operation of AAM services.**

The location of incompatible land uses, such as residential areas or sensitive infrastructure, near vertiports can lead to noise pollution, safety risks, and community opposition. By carefully considering land use compatibility, planners can minimize these negative impacts and maximize the benefits of AAM. This process involves identifying suitable locations for vertiports, establishing appropriate buffers, and implementing noise mitigation measures to protect nearby communities. Ultimately, land use compatibility is essential for successfully integrating AAM into urban and regional landscapes.

A critical aspect of integrating eVTOLs into cities is the development of vertiports—specialized facilities for takeoff, landing, and passenger handling. WSDOT Aviation Division has conducted a number of studies on safety, noise, and downwash/outwash of eVTOL operations which lays the foundation for ensuring land use compatibility for vertiports by examining the operational and environmental characteristics of eVTOLs.

Our research presents a comprehensive framework for establishing land use compatibility guidelines tailored to vertiports serving electric Vertical Takeoff and Landing (eVTOL) aircraft in urban environments. Addressing significant gaps in current regulatory standards, the research systematically analyzes accident risk, noise propagation, and aerodynamic effects such as downwash and outwash, using advanced quantitative methods and AI-augmented assessments. The findings reveal that existing aviation infrastructure guidelines do not adequately account for the unique operational characteristics of eVTOLs, highlighting the need for revised zoning parameters and compatibility zones specific to vertiports.

By proposing a multi-tiered safety zoning framework, the study offers precise, evidence-based recommendations that enhance safety, minimize noise impacts, and promote environmental sustainability. This work equips stakeholders with practical tools to support the safe and effective integration of advanced air mobility infrastructure into complex urban landscapes, ensuring that vertiport development aligns with community needs and urban planning best practices.

This iterative process involved multiple rounds of surveys and expert feedback, ensuring a consensus-based approach that incorporated diverse perspectives and knowledge. The resulting guidelines provide a robust framework for integrating vertiports into urban, suburban, and rural environments, balancing the potential benefits of advanced air mobility with the need to protect public safety and minimize environmental impact.



# Land use compatibility zones

To ensure that land uses near vertiports are compatible with its associated AAM operations, designated compatibility “zones” have been identified.

Compatibility zones are geographic spaces surrounding vertiports in which specific land uses are identified to be either compatible or incompatible. Compatibility zones help to mitigate concerns related to noise, light, vibration, safety, and low-flying aircraft. It is recommended that modifications to the compatibility zones be considered on a case-by-case basis contingent upon expected air traffic density, vertiport procedures, traffic pattern directions and location, and any additional issues.

Three land use compatibility zones have been identified for vertiport:

- **Zone A:** Aircraft may fly over this zone at or below 100 feet. This zone may be subject to DWOW exposure, noise, vibration, and other annoyances. This zone has the highest concentration of operations and thus is, in theory, the location of greatest safety risk.
- **Zone B:** Aircraft will generally fly over this zone above 100 feet. This zone will be less likely to be exposed to DWOW, noise, vibration, and other annoyances. Safety risk is presumed to be lower than in Zone A.
- **Zone C:** Aircraft may operate overhead in this zone, but will generally be higher and less intrusive to persons and property on the ground. Safety risk in this zone is assumed to be lower than in Zones A and B.
- **Buffer:** This is the zone of the lowest risk. However, real estate disclosures, signage, and other precautionary measures to protect persons and property should be considered within this zone.

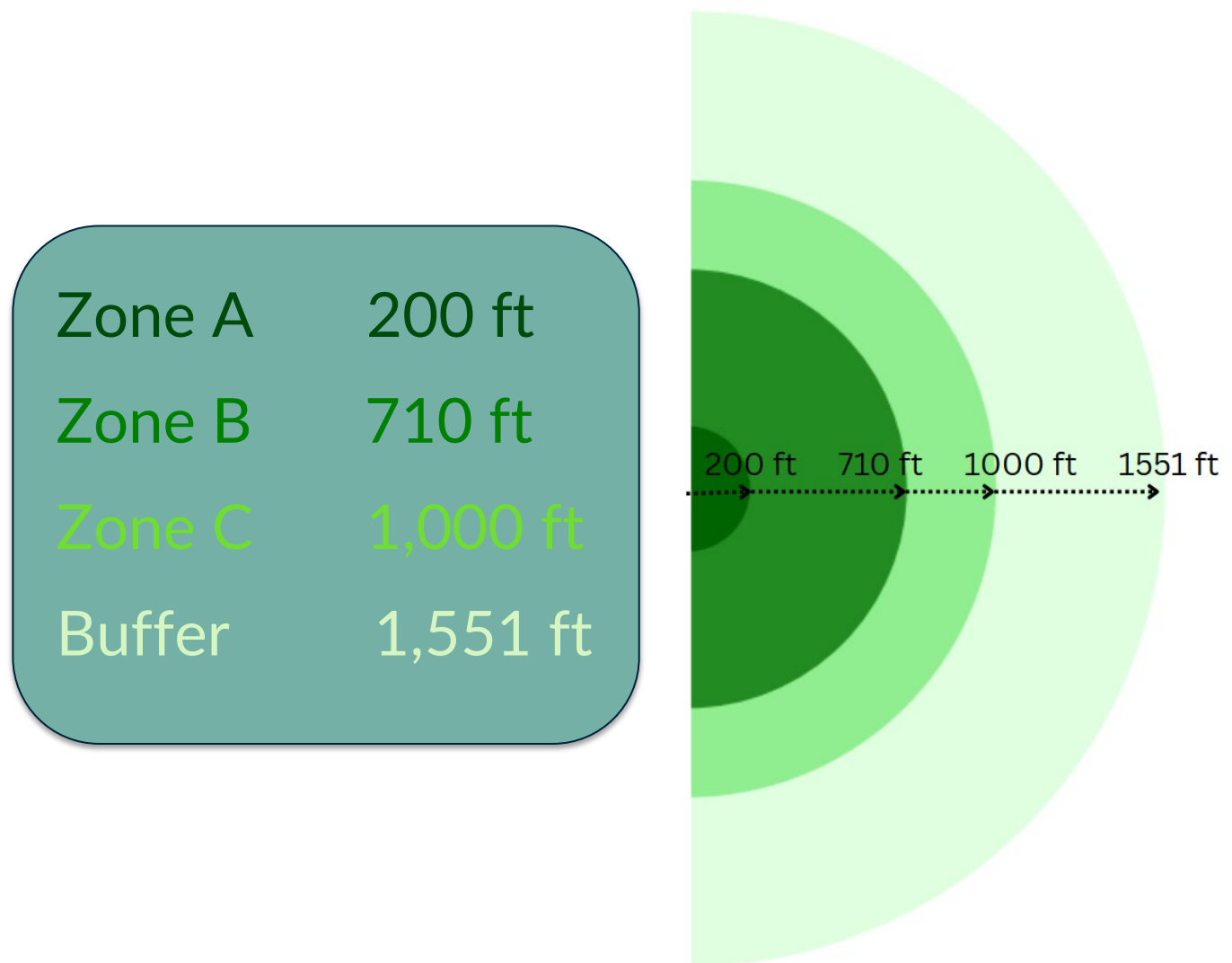
In addition to the formal compatibility zones, the following should not exist within close proximity to vertiports:

- Wildlife attractants
- Thermal plumes or other sources of turbulence
- Any source of glare, blinding illumination, haze, or other visual obstructions
- Electromagnetic disruption
- Storage of dangerous substances
- Extremely high intensity/density uses
- Any specialized functional applications



## Land use compatibility zones (infographic)

\* Measurements are in feet

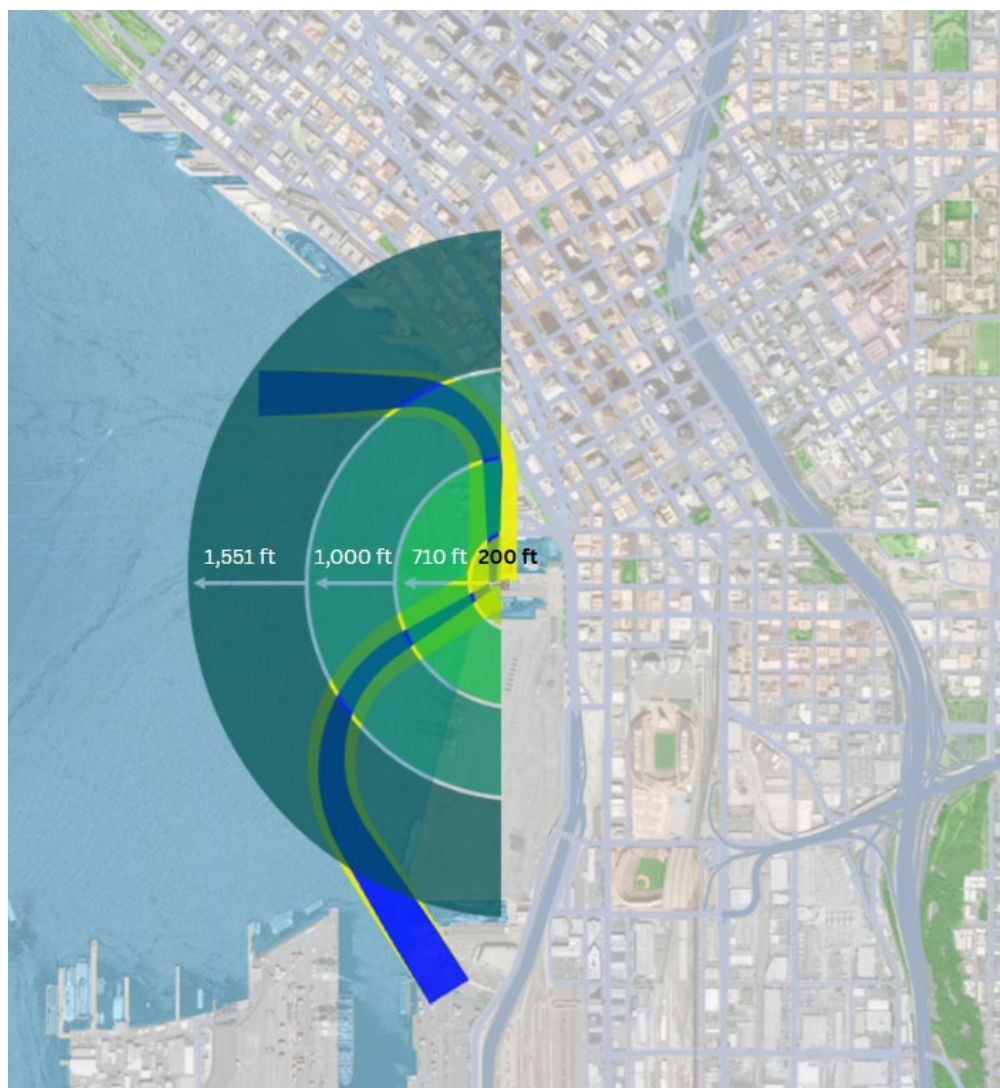




## CUSTOMIZING LAND USE COMPATIBILITY ZONES

Because of the unique operational capabilities of eVTOLs, land use compatibility zones can be customized on a case-by-case basis. For example, if eVTOLs will only operate on specific routes or directions to/from a vertiport, the land use compatibility zones could be tailored to cover only the zones near and underneath the flight paths. This avoids obtrusive restrictions on zones that will not be impacted by eVTOL operations.

An example of a customized land use compatibility zone is shown below. The image shows a fictitious vertiport on a pier in downtown Seattle. The FAA surfaces are depicted, indicating the curved flight paths that are planned for accessing the site. Land use compatibility zones are superimposed on top of zones impacted by eVTOL operations, avoiding burdensome restrictions on the adjacent densely developed downtown area.





# Land use compatibility tables

Key for the tables: P = permitted; L = permitted in limited circumstances subject to review; X = prohibited / not recommended. *Note: real estate disclosure and/or notice to title concerning proximity of property to vertiport is recommended in all zones.*

| Land use type  | Zone A | Zone B | Zone C | Buffer |
|--|--------|--------|--------|--------|
| <b>Residential</b>   |        |        |        |        |
| Single-family dwelling; up to 12 dwelling units/acre           | X      | X      | L      | L      |
| Two-four-family dwelling (duplex)                              | X      | X      | L      | L      |
| Multi-family dwelling: 15 or more                              | X      | X      | L      | L      |
| Mixed-use office/commercial/residential use                    | X      | P      | P      | P      |
| Residential development cluster 40% > open space               | X      | X      | L      | P      |
| Residential infill   | X      | X      | P      | P      |
| Mobile home parks  | X      | X      | L      | L      |
| Boarding house   | X      | X      | L      | L      |
| Retirement homes   | X      | X      | L      | L      |
| <b>Education facilities</b>                                    |        |        |        |        |
| College, universities  | X      | X      | P      | P      |
| Schools, K-12 elementary, middle, senior high                  | X      | X      | L      | L      |
| Business school  | X      | X      | P      | P      |
| Vocational schools   | X      | X      | P      | P      |
| <b>Retail</b>  |        |        |        |        |
| Addressing, mailing, and stenographic services                 | X      | P      | P      | P      |
| Advertising agencies   | X      | P      | P      | P      |
| Airport uses and activities commercial/industrial              | P      | P      | P      | P      |
| Animal clinic/hospital   | X      | P      | P      | P      |
| Antique stores   | X      | P      | P      | P      |
| Automobile, truck, manufactured home, and travel trailer sales | P      | P      | P      | P      |
| Automobile and recreational vehicle (RV) sales; weekend        | P      | P      | P      | P      |
| Automotive: car wash   | P      | P      | P      | P      |
| Sales lot/auto center  | P      | P      | P      | P      |
| Parking lots and garages                                       | P      | P      | P      | P      |
| Maintenance and repair shops                                   | P      | P      | P      | P      |
| Paint and body repair shops                                    | P      | P      | P      | P      |
| Parts and accessories (tires, batteries, etc.)                 | P      | P      | P      | P      |
| Specialized repair shops (radiator, etc.)                      | P      | P      | P      | P      |
| Towing services  | P      | P      | P      | P      |
| Wrecking and dismantling yard                                  | P      | P      | P      | P      |

# Land use compatibility tables



| Land use type  | Zone A | Zone B | Zone C | Buffer |
|--|--------|--------|--------|--------|
| Bakery   | X      | P      | P      | P      |
| Beauty and barber shops  | X      | P      | P      | P      |
| Bed and breakfast inn  | X      | X      | P      | P      |
| Big box stores (Costco, Walmart Supercenter)                       | X      | P      | P      | P      |
| Boats and marine accessories                                       | P      | P      | P      | P      |
| Books, stationary, office supplies                                 | X      | P      | P      | P      |
| Building and trade (plumbing, heating, electrical painting, etc.)  | P      | P      | P      | P      |
| Clothing and accessories   | X      | P      | P      | P      |
| Communication towers   | X      | X      | P      | P      |
| Computer and electronics stores                                    | X      | P      | P      | P      |
| Department, discount, variety stores                               | X      | P      | P      | P      |
| Drug stores (optical goods, orthopedic supplies)                   | X      | P      | P      | P      |
| Employment agencies (private)                                      | X      | P      | P      | P      |
| Farm and implements, tools, heavy construction equipment           | P      | P      | P      | P      |
| Farm supplies  | P      | P      | P      | P      |
| Financial institutions   | P      | P      | P      | P      |
| Food store   | X      | P      | P      | P      |
| Furniture, home furnishings, appliances                            | X      | P      | P      | P      |
| General hardware, garden equipment and supplies                    | P      | P      | P      | P      |
| Grocery and convenience stores                                     | X      | P      | P      | P      |
| Heavy equipment storage, maintenance and repair                    | X      | P      | P      | P      |
| Insurance agents, brokers, and service agencies                    | X      | P      | P      | P      |
| Kennels  | X      | P      | P      | P      |
| Laundries, laundromats, dry cleaning plants                        | X      | X      | P      | P      |
| Liquor stores  | X      | P      | P      | P      |
| Lumber yards   | P      | P      | P      | P      |
| Medical and dental laboratory, offices and clinics                 | X      | X      | P      | P      |
| Mini storage   | P      | P      | P      | P      |
| Motels and hotels  | X      | X      | P      | P      |
| Motorcycle sales /repair (including maintenance)                   | X      | P      | P      | P      |
| Paint, glass, and wallpaper stores                                 | X      | P      | P      | P      |
| Pet stores, pet supplies, and dog grooming                         | X      | P      | P      | P      |
| Professional office buildings (architects, attorneys, gov't, etc.) | X      | P      | P      | P      |
| Rental: auto, truck, trailer, fleet, leasing services              | X      | P      | P      | P      |
| Repairs: small appliances, tv, business machines, watches, etc.    | X      | P      | P      | P      |
| Restaurant, café and drive-in eating facilities                    | X      | P      | P      | P      |

# Land use compatibility tables



| Land use type  | Zone A | Zone B | Zone C | Buffer |
|--|--------|--------|--------|--------|
| Service station  | L      | P      | P      | P      |
| Sporting goods, bicycle shops                                  | X      | P      | P      | P      |
| Taverns, bars, dance establishments                            | X      | X      | P      | P      |
|  |        |        |        |        |
| <b>Industry/manufacturing</b>                                  |        |        |        |        |
| Aircraft parts   | P      | P      | P      | P      |
| Aircraft industrial  | P      | P      | P      | P      |
| Apparel and accessories  | P      | P      | P      | P      |
| Bakery products (wholesale)                                    | X      | P      | P      | P      |
| Beverage industry  | X      | P      | P      | P      |
| Canning, preserving, packaging fruits, vegetables, other foods | X      | P      | P      | P      |
| Cement and concrete plants                                     | X      | P      | P      | P      |
| Chemicals (industrial, agricultural, wood, etc.)               | X      | P      | P      | P      |
| Concrete, gypsum, and plaster products                         | X      | P      | P      | P      |
| Confectionery and related products (wholesale)                 | X      | P      | P      | P      |
| Mini storage   | P      | P      | P      | P      |
| Product assembly   | P      | P      | P      | P      |
| Prefabricated structural wood products and containers          | P      | P      | P      | P      |
| Printing, publishing, and binding                              | P      | P      | P      | P      |
| Rendering plants, slaughterhouses                              | X      | X      | P      | P      |
| Rubber products  | X      | P      | P      | P      |
| Sawmills and planing mills                                     | P      | P      | P      | P      |
| Sheet metal and welding shops                                  | P      | P      | P      | P      |
| Oil refinery   | X      | X      | L      | P      |
| Stone products (includes finishing monuments for retail sale)  | P      | P      | P      | P      |
|  |        |        |        |        |
| <b>Wholesale trade-storage</b>                                 |        |        |        |        |
| Warehouses   | P      | P      | P      | P      |
| Wholesale trade  | X      | P      | P      | P      |
| Storage facilities; bulk                                       | P      | P      | P      | P      |
| Commercial   | P      | P      | P      | P      |
| Mini storage   | P      | P      | P      | P      |
|  |        |        |        |        |
| <b>Transportation</b>  |        |        |        |        |
| Bus terminal   | P      | P      | P      | P      |
| Transportation storage and maintenance facilities              | P      | P      | P      | P      |
| Transportation brokerage offices; without truck parking        | P      | P      | P      | P      |
| Transportation brokerage offices; with truck parking           | P      | P      | P      | P      |

# Land use compatibility tables



| Land use type   | Zone A | Zone B | Zone C | Buffer |
|---|--------|--------|--------|--------|
| Contract truck hauling, rental of trucks with drivers           | P      | P      | P      | P      |
| Rail, truck terminals (for short-term storage, office)          | P      | P      | P      | P      |
| Car/logistics   | P      | P      | P      | P      |
| Air storage and office use                                      | P      | P      | P      | P      |
| Multimodal transit hub/station                                  | P      | P      | P      | P      |
| Railroad switch yards, maintenance, and repair facilities, etc. | P      | P      | P      | P      |
| EV charging   | P      | P      | P      | P      |
| Taxicab terminals, maintenance, and dispatching centers, etc.   | P      | P      | P      | P      |
| <b>Utilities</b>  |        |        |        |        |
| Power generating facilities                                     | X      | P      | P      | P      |
| Electric utility services (substations, etc.)                   | X      | P      | P      | P      |
| Wholesale trade   | P      | P      | P      | P      |
| Storage facilities, bulk  | P      | P      | P      | P      |
| Landfills, sewage treatment plants                              | X      | X      | X      | L      |
| <b>Community services</b>                                       |        |        |        |        |
| Cemetery  | P      | P      | P      | P      |
| Churches, synagogues, temples                                   | X      | X      | X      | L      |
| Community center meeting halls, fraternal organizations         | X      | X      | X      | L      |
| Convalescent, nursing homes, group homes                        | X      | X      | X      | L      |
| Day care facilities, family in-home                             | X      | X      | X      | X      |
| Day care center   | X      | X      | X      | X      |
| Funeral home  | X      | X      | P      | P      |
| Police, fire stations, ambulance service                        | P      | P      | P      | P      |
| Hospital  | X      | X      | L      | L      |
| Medical clinic  | X      | X      | L      | L      |
| Correction facilities   | X      | X      | P      | P      |
| Libraries   | X      | X      | X      | L      |
| Museums and art galleries                                       | X      | X      | X      | L      |
| Zoo   | X      | X      | X      | X      |
| <b>Amusement and recreation</b>                                 |        |        |        |        |
| Amusement park (permanent)                                      | X      | X      | X      | L      |
| Bowling alleys  | X      | X      | X      | P      |
| Campground  | X      | X      | L      | P      |
| Recreational vehicle parks; short term                          | X      | X      | L      | P      |
| Drive-in theaters   | X      | X      | X      | P      |
| Fairgrounds   | X      | X      | X      | P      |

# Land use compatibility tables



| Land use type   | Zone A | Zone B | Zone C | Buffer |
|---|--------|--------|--------|--------|
| Golf courses  | X      | P      | P      | P      |
| Gymnasiums, exercise facilities   | X      | P      | P      | P      |
| Horse racing tracks, speedways  | X      | X      | L      | P      |
| Miniature golf courses  | X      | P      | P      | P      |
| Movie theaters, auditoriums, exhibition halls   | X      | X      | P      | P      |
| Parks   | P      | P      | P      | P      |
| Roller skating rink   | X      | P      | P      | P      |
| Outdoor stadium or event center   | X      | X      | X      | L      |
| Indoor event center (ice arena, indoor stadium)                                       | X      | X      | L      | P      |
|   |        |        |        |        |
| <b>Agricultural (commercial)</b>  |        |        |        |        |
| Agriculture, horticulture, general farming (crops only, not feedlots and stock yards) | P      | P      | P      | P      |
| Agricultural building   | P      | P      | P      | P      |
| Agricultural chemical sales/storage   | P      | P      | P      | P      |
| Agricultural housing/farm labor   | X      | X      | L      | P      |
| Agricultural market   | P      | P      | P      | P      |
| Agricultural related industries   | P      | P      | P      | P      |
| Animal husbandry  | X      | X      | P      | P      |
| Agricultural feeding operations or stockyards   | X      | X      | X      | L      |
| Agriculture or food processing facility   | P      | P      | P      | P      |
| Livestock auction   | X      | X      | X      | L      |
| Floriculture, aquaculture   | P      | P      | P      | P      |
| Fruit bin sales/storage   | P      | P      | P      | P      |
|   |        |        |        |        |
| <b>Forest (commercial)</b>  |        |        |        |        |
| General forest silver culture   | X      | P      | P      | P      |
| Forest product processing   | X      | P      | P      | P      |
|   |        |        |        |        |
| <b>Mining and related</b>   |        |        |        |        |
| Asphalt paving and roofing materials, rock crushing                                   | X      | X      | P      | P      |
| Mining including sand and gravel pits   | X      | X      | P      | P      |
| Stockpiling of earthen materials  | X      | X      | P      | P      |
| Hazardous waste storage/treatment   | X      | X      | X      | P      |



# CONCLUSION

The land use guidance for vertiports outlined in this document paves a path for the adoption of AAM, helping to ensure this efficient, sustainable, and accessible transportation alternative comes to fruition.

The data provided here was based on several academic studies with significant input from AAM, planning, regulatory, and aviation experts. The consistency between existing and proposed guidelines corroborates the recommendations of the various underlying research studies, and the findings can influence current and future land use planning initiatives. This supplement establishes a foundation for vertiport land use compatibility planning, facilitating the adoption of these essential components of AAM. In summary, this document can be a fundamental reference for integrating vertiports into communities and their transportation systems.

## Title VI Notice to Public

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