DEPARTMENT OF TRANSPORTATION

System Metrics White Paper

2020 State Aviation System Plan (SASP) Phase I

April 10, 2019

Contents

System Metrics White Paper

This white paper outlines the system metrics that will be included in the 2020 State Aviation System Plan (SASP). The system metrics include both measures and indicators which will help evaluate the progress, at a system level, towards the objectives set forth for the plan. The SASP objectives include open decision making, transportation safety, critical connections, system stewardship and healthy communities. Separate metrics are set for airports and are discussed in the Airport Metrics white paper.

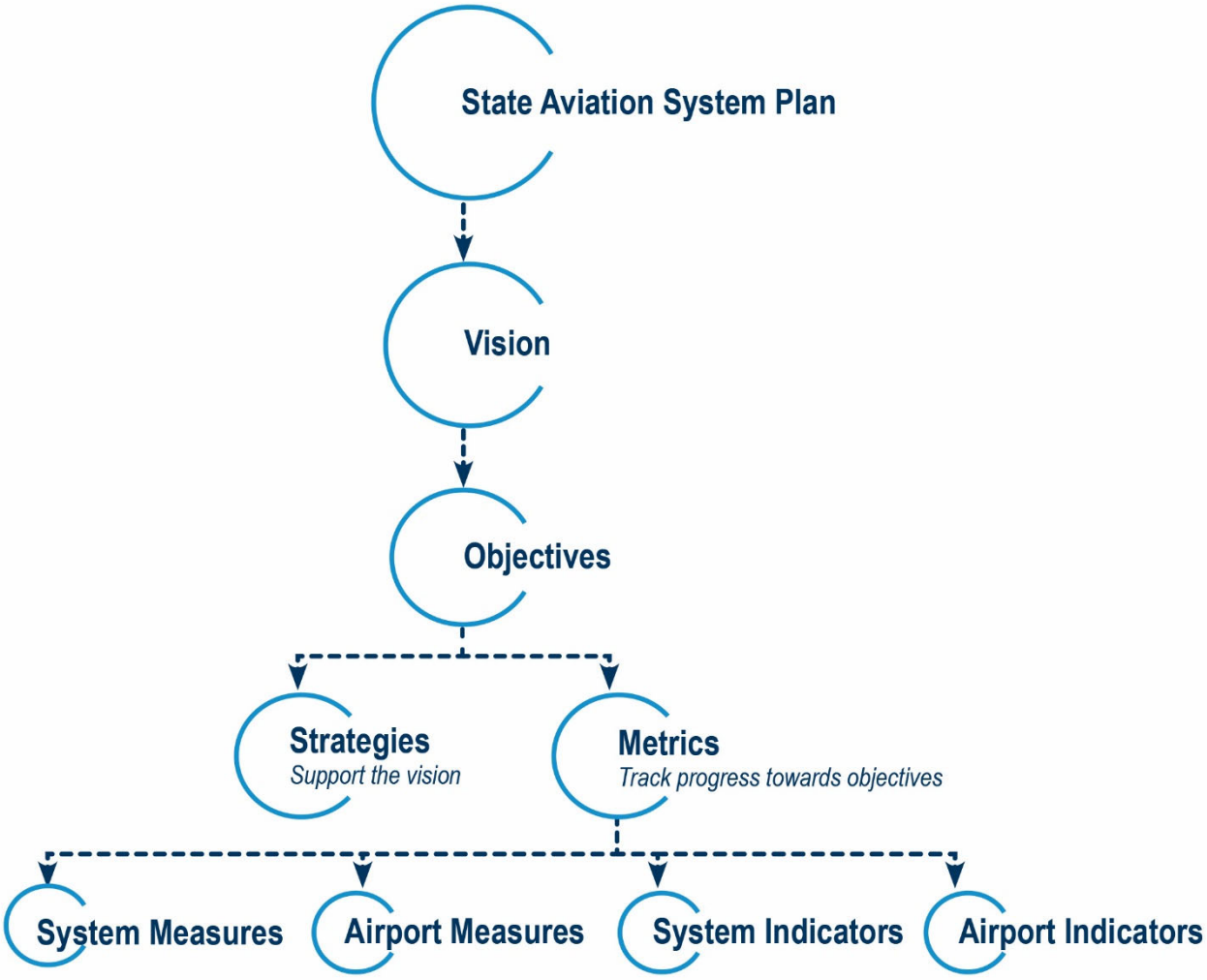

Figure 1 – System Vision, Objectives, Strategies and Metrics
Source: MnDOT Office of Aeronautics, SEH

Both performance measures and indicators were included in the 2012 SASP and are also included in the 2020 SASP. It is important to understand the difference between system performance measures and indicators. MnDOT has the ability, through investment, to directly impact system performance in a number of areas. For these areas, system performance measures have been developed and MnDOT will track progress toward

meeting system objectives. In some areas of performance analysis, MnDOT has limited or no ability to influence the outcome but expectations for transparency and information sharing still exist. These data sets are referred to as system performance indicators, rather than measures. System indicators can be driven by market demand, local community growth, or other factors. . They are designed to show trends and help describe how well the overall system is functioning. Over time, indicators provide quantitative information for MnDOT authorities and decision makers.

System Performance Measures

Several of the system performance measures have been used to track performance for multiple system planning efforts while others are newly developed as part of this plan. Two measures from the previous plan were removed and one additional added based on stakeholder feedback during the Phase I SASP process. Figure 2 depicts the evolution of system performance measures since the 1991 SASP.

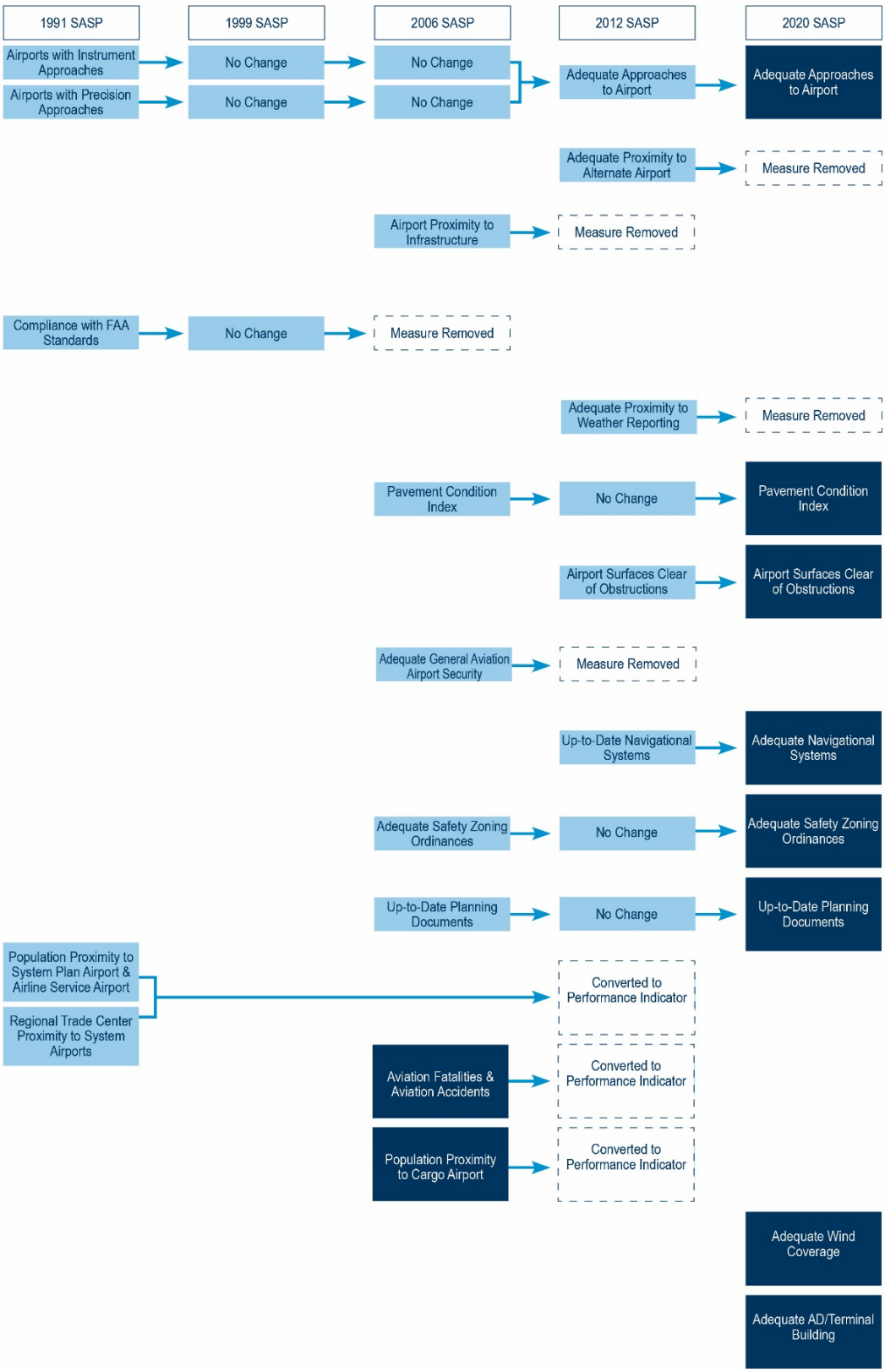

Figure 2 – Evolution of System Performance Measures

Source: MnDOT Office of Aeronautics, SEH

Removed Measures

The following measures were removed based on stakeholder feedback during Phase I of the 2020 SASP.

Adequate Proximity to Alternate Airport

In the 2012 SASP, a measure of adequate proximity to an alternate airport was added. This measured the percent of system airports within 50 nautical miles of an airport that serves as an alternate for an Instrument Flight Rules (IFR) flight plan. In this measure, to be considered an alternate airport, an airport must have an Instrument Landing System (ILS) that is monitored at all times through a dedicated telephone line and have on-site weather.

The definition of what type of airport qualifies as an 'alternate' in this measures was confusing to stakeholders. While an airport with a monitored ILS adds value and may increase accessibility, Localizer Performance with Vertical Guidance (LPV) approaches also qualify as an alternate and have grown in their availability and usage throughout the state.

Adequate Proximity to Weather Reporting

In the 2012 SASP, a measure of adequate proximity to weather reporting was added. This measured the percent of system airports that have a weather reporting station on-site or within 30 nautical miles. The target of 100% performance was met in this measure. While the existence of weather reporting is still valued at a system level and measured as an airport measure, proximity to weather reporting was removed as a system measure since it was fully met and not likely to change in the future.

2020 SASP Measures

This white paper outlines each of the system performance measures and includes the following information:

Title: Name of each measure as it will be referenced in the 2020 SASP

Measure: What is being measured

Relevance: Why the measure is relevant and important to the system

Target: Desired performance outcome

Technical Description: Explains target development and role in aviation

Source(s): Data that will be used to evaluate the measure and target in Phase 2 of the 2020 SASP

Adequate Approaches to Airports

Measure: Percent of system airports with adequate approaches appropriate for their classification.

Relevance: An approach is a route in the sky guiding an aircraft from the air to the runway. There are three types of approaches: precision instrument, non-precision instrument and visual. Precision instrument approaches provide both vertical and horizontal guidance to aircraft. Non-precision approaches provide lateral guidance to the runway end and include both vertically guided and non-vertically guided approaches. In visual approaches, pilots navigate by sight to guide the aircraft to the runway end.

The more accurate the approach, the more information a pilot can use to get their aircraft to the runway. Weather is one of the most prevalent factors that determine if an airport can be used at any given time. Instrument approaches allow airports to be more accessible under a variety of weather conditions thereby creating a safer system and improving accessibility across the state.

This measure aligns with the critical connections objective.

Target: 100 percent of system airports should have adequate approaches for their classification. Adequate is defined for each classification below:

> **Key Commercial Service and GA:** Precision instrument approach to at least one runway end.
>
> **Intermediate Large and Small:** At least one runway end with a non-precision approach.
>
> **Landing Strip Turf and Seaplane Bases:** Visual approaches.

Technical Description: There are two major categories of flight rules governing civil aviation operations, visual flights rules (VFR) and instrument flight rules (IFR).

VFR applies when a pilot is able to safety fly with outside visual cues, such as the horizon or terrain. All licensed pilots are allowed to operate during VFR conditions. Visual approaches are possible during VFR conditions.

Pilots may use cockpit instruments as additional aids to navigation when flying VFR but are not required to. Pilots are required to fly a safe distance form clouds in VFR conditions. The minimum weather conditions are defined in Federal Aviation Regulation (FAR) Title 14, Part 91.155 and vary depending on the airspace and time of day (day or night) an aircraft is operating in. In many situations, daytime VRF flights can occur when there is three (3) statute miles of visibility and the aircraft can remain a safe distance from clouds (500 feet below, 1,000 feet above, and 2,000 feet horizontally).

In IFR conditions, pilots must have appropriate training and fly relying on instruments in the aircraft. This allows aircraft to fly in conditions that do not meet VFR conditions by using instruments in the aircraft. In addition, use of IFR is required when and aircraft is flying in “Class A” airspace (airspace above 18,000 feet up mean sea level to 60,000 feet pressure altitude).

An airport is not usable in IFR conditions unless the pilot is instrument rated and the aircraft the pilot is operating has the appropriate instruments, the airport has an instrument approach procedure (non-precision or precision) and there is adequate proximity to an airport that will qualify as an alternate airport that can be used for landing. Additionally, either an on-airport weather reporting station, or one nearby, will increase the accuracy of weather information. With instrument approach procedures and equipment in place, an airport may be more accessible to more pilots more of the time.

Non-precision approaches include both vertically guided and non-vertically guided approaches. Non-precision instrument approaches provide lateral guidance to the runway end even if vertical guidance is not given. Precision instrument approaches provide both vertical and horizontal guidance to aircraft.

On a system-wide basis, a vertically guided instrument approach procedure has the greatest impact for improving access during IFR conditions. Vertically guided instrument approach procedures allow instrument-rated pilots in aircraft equipped with the proper avionics to navigate by instruments both to and from the airport, except for the final segment of an instrument approach, which is done visually. While it is possible to navigate by lateral guidance (i.e., non-precision) alone, the incorporation of electronic or computed vertical guidance into an instrument approach procedure allows the approach to provide a constant glide path angle; stabilize the descent rate, and decrease landing minimums. Vertical guidance helps to avoid obstacles within known tolerances and allows pilots to descend to lower altitudes while relying only on instruments. Airports can remain open more often with vertically guided instrument approach procedures in place.

According to the FAA, providing vertical guidance increases safety by supporting a stabilized approach[1]. Finally, the importance of vertically guided instrument approach procedures led the International Civil Aviation Organization (ICAO) to pass a safety resolution encouraging its members to implement vertically-guided approaches to all runways by 2016. As of January, 2019, the FAA has published nearly 4,000 LPV approaches which serve over 1,900 airports, nearly 1,200 of which do not have an ILS[2].

Ideally, a runway with a Localizer Performance with vertical guidance (LPV) (a GPS precision-like approach) or an Instrument Landing System (ILS) precision approach has an approach lighting system and an approach area clear of obstructions. When these conditions are met, the approaches have the lowest possible landing minimums - the height at which a pilot either can see the runway or aborts the landing. When these conditions are not met, either due to the lack of an approach lighting system or due to the existence of controlling obstacles in the approach area, then the decision height (the height at which a pilot must initiate a missed approach if the runway cannot be seen)and forward looking visibility for the approaches will increase. Raising the instrument approach procedure minimums decreases accessibility by increasing the percentage of time that the airport is unusable due to weather conditions (i.e., low forward looking visibility or low cloud ceiling (cloud height above ground)).

Sources and Update Frequency: FAA Terminal Procedures Publications. This data will be updated annually.

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[1] FAA Performance Based Navigation (PBN) National Airspace System (NAS) Navigation Strategy 2016

[2] FAA, https://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/navservices/gnss/approaches/

Pavement Condition Index (PCI)

Measure*:* Runway and parallel taxiway pavement conditions within Pavement Condition Index (PCI) targets

Relevance: Regular pavement maintenance increases a pavement's useful life and can delay the higher costs associated with pavement rehabilitation or reconstruction. In addition, keeping pavement in good condition reduces the potential for loose pavement to become dislodged during aircraft operations and ingested into jet aircraft engines causing considerable damage. Pavement condition is monitored on a zero to 100 rating scale known as a Pavement Condition Index (PCI) with a score of 100 being excellent condition.

MnDOT currently collects PCI data for pavements at all system airports with paved runways with the exception of the seven owned and operated by the Metropolitan Airports Commission (MAC). These airports use different methodologies to evaluate pavements and are not currently included in this analysis.

This measure aligns with the system stewardship objective.

Target: The targets are outlined below:

> **Key Commercial Service and GA:** Eighty-five percent of primary runway pavements (weighted by area) are in "very good" or "excellent" condition (PCI of 70 or greater).
>
> **All paved airports:** Eighty-four percent of all runway and parallel taxiway pavements (weighted by area) are in at least "good" condition (PCI of 55 or greater), and no more than four percent of all runway and parallel taxiway pavements (weighted by area) are in "poor" condition (PCI of 40 or less).

Technical Description: The FAA provides guidance for evaluation of airport pavements. PCI values are assigned based on a visual inspection of the condition of the pavement and these values assist engineers in determining the stage and rate at which pavements are degrading. New pavements are rated between a 95 and 100 on the PCI scale. Pavements that degrade beyond a certain PCI rating are unable to be effectively repaired through routine maintenance and must be rehabilitated, which can be costly. If pavements are allowed to degrade even more, pavements must be fully reconstructed due to the behavior of the pavement and subgrade. As the pavement conditions deteriorate, water and ice can cause additional damage beyond that of normal wear and tear. Each progression of degradation repair is significantly more costly and require higher local, Federal and State funding resources.

With properly timed maintenance and repair, pavement rehabilitations and other costly repairs, though eventually unavoidable in the lifecycle of pavements, can be delayed and costs may be minimized. However, occasionally pavement reconstructions are necessary when pavement has reached the end of it useful life and lower the overall life-cycle costs moving forward. This approach is less costly in the long-term compared to not maintaining the pavements and waiting for pavement rehabilitation. It is also worth noting that airport pavements constructed using Federal funds are required to be maintained through the FAA's grant assurance program.

Sources and Update Frequency: MnDOT Office of Aeronautics PCI Reports will be the source of this data. This data will be updated annually to reflect the most recent PCI inspections (1/3 of system airports are completed each year).

Airport Surfaces Clear of Obstructions

Measure: Percent of system airports that have no obstruction to protected airspace

Relevance: Obstructions in protected airspace are flight hazards and must be accounted for by the pilot during the two most critical phases of flight – take-off and landing. Obstructions may pose a safety risk and raise the landing minimum altitude of instrument approach procedures, when lower landing minimum altitudes are more desirable. This may impact the amount of time an airport is accessible during inclement weather.

This measure aligns with the transportation safety and critical connections objectives.

Target: 100 percent of system airports should be clear of obstructions to approach and primary surfaces as defined in Minnesota Administrative Rules 8800.1200.

Technical Description: Clear approach and primary surfaces, as defined in Minnesota Administrative Rules 8800.1200, are required for a Public Airport License.

Obstructions do not include those objects or terrain which have an existing waiver to licensing criteria or those which have been studied through an airspace case and determined to not be a hazard.

If there is an obstruction to a protected surface, depending on the height and location, the obstruction may become a controlling obstacle in the development of an instrument approach procedure. The FAA will develop an approach procedure designed with minimums set high enough to avoid the obstacle and an added margin of safety above it. If the obstruction did not exist, the aircraft could approach the runway closer to the ground, maximizing the usability of the airport in periods of inclement weather or low visibility. Thus, a single obstruction can considerably degrade the accessibility of an airport if not mitigated.

Sources and Update Frequency: MnDOT Aeronautics will utilize the 5010 inspection that is completed every 3 years to determine if obstructions exist to the approach or primary surfaces.

Adequate Navigational Systems

Measure: Percent of system airports with adequate navigation systems

Relevance: The navigational systems included in this measure provide visual guidance to pilots operating in the airspace system. In addition, some Navigational Aids (NAVAIDs), such as approach lighting, allow for reduced visibility minimums in instrument approach procedures.

This measure aligns with the critical connections objective.

Target: 100 percent of system airports have adequate navigation aids for their classification. Adequate is defined for each classification below:

Key Commercial Service and GA: Approach lights, runway end identifier lights (REIL), vertical glide slope indicator (VGSI), beacon and wind cone

Intermediate Large and Small: VGSI, beacon and wind cone

Landing Strip Turf: Beacon (if a runway is lit) and wind cone

Landing Strip Seaplane Base: Wind cone

Technical Description: Navigation systems are ground based electronic systems or visual guidance lighting systems. The advent of GPS has made it possible to replace most ground based electronic systems. Ground based equipment will likely continue to serve as a necessary backup system for GPS, and is important because some aircraft are not equipped with the avionics required to utilize GPS. MnDOT owns and maintains visual NAVAIDs at many airports including approach lighting systems and VGSIs.

The following visual NAVAIDs are evaluated in this measure.

Approach Lighting Systems: Lighting improves early identification of the runway environment for landing purposes and help visually guide a pilot to a runway end. Each of the following lighting systems serve a similar purpose but has a different configuration.

ALSF: High-intensity Approach Lighting System with Sequenced Flashers

MALSF: Medium-intensity Approach Lighting System with Sequenced Flashers

MALSR: Medium-intensity Approach Lighting System with Runway alignment indicator lights

ODALS: Omni-Directional Approach Lighting System

REIL: Runway End Identifier Lights

Runway End Identifier Lights: flashing lights at the end of the runway used to identify the end of a runway from the air

Vertical Glide Slope Indicator (VGSI): systems of light boxes on the side of a runway which, when viewed from an approaching aircraft, provide a visual reference of an aircraft's position on the glide path

PAPI: Precision Approach Path Indicator

VASI: Visual Approach Slope Indicator

Wind Cone: Fabric tube used to indicate wind direction and speed

Rotating Beacon: used to identify the location of an airport from the air

Sources and Update Frequency: The data source for this measure will be the 5010 form. The data will be updated with each 5010 update or when a NAVAIDs project occurs.

Adequate Safety Zoning Ordinances

Measure: Percent of system airports with an adequate Airport Zoning Ordinance

Relevance: Airport safety zoning ordinances serve to protect people and property from aviation accidents by limiting land uses and population density around airports, particularly in aircraft approach and departure areas beyond the ends of runways. Adopting an airport safety zoning ordinance also helps ensure that compatible land uses develop around an airport. Ideally, the zoning adopted in the airport safety zoning ordinance are incorporated and enforced as a part of the community's comprehensive plan.

This measure aligns with the transportation safety objective.

Target: 100 percent of system airports should have an adequate airport zoning ordinance adopted by a Joint Airport Zoning Board (JAZB) or equivalent authority. Additionally, 'adequate' will include those airports that are in good faith pursing development and adoption of a new ordinance. During Phase 2 of the 2020 SASP, a tiered performance evaluation will be completed in order to document which airports have the highest zoning needs and which airports have 'near' adequate zoning ordinances. For example, this analysis will help differentiate airports with no airport zoning from those which have zoning but it may not meet the strictest definition of adequate. This evaluation will help MnDOT prioritize funding with an emphasis on zoning projects throughout the state.

Technical Description: Minnesota Statutes Chapter 360 and Minnesota Administrative Rules, Chapter 8800 define the process, procedures, and standards a joint airport zoning board or equivalent authority must use to develop and adopt an airport safety zoning ordinance. One notable difference between airport zoning and other municipal zoning processes is that the board is likely to include representation from multiple jurisdictions. Airport communities in Minnesota have been allowed by statute to enact airport safety zoning since 1945. In 1973, the legislature made airport safety zoning a condition to receive federal and state funds for airport development and maintenance.

To assist local governments in the airport zoning process, MnDOT Aeronautics publishes a model zoning ordinance and provides related technical assistance to local zoning authorities. Minnesota's zoning rules require three distinct safety zones (Zone A, Zone B, and Zone C) which restrict specific uses in the areas surrounding airports (see **Figure 2**). These zones apply to both existing and ultimate airport conditions (i.e. a planned for but not yet constructed runway must also be zoned). Additional airport zoning information can be found on the MnDOT Office of Aeronautics Airport Zoning Information Warehouse webpage.

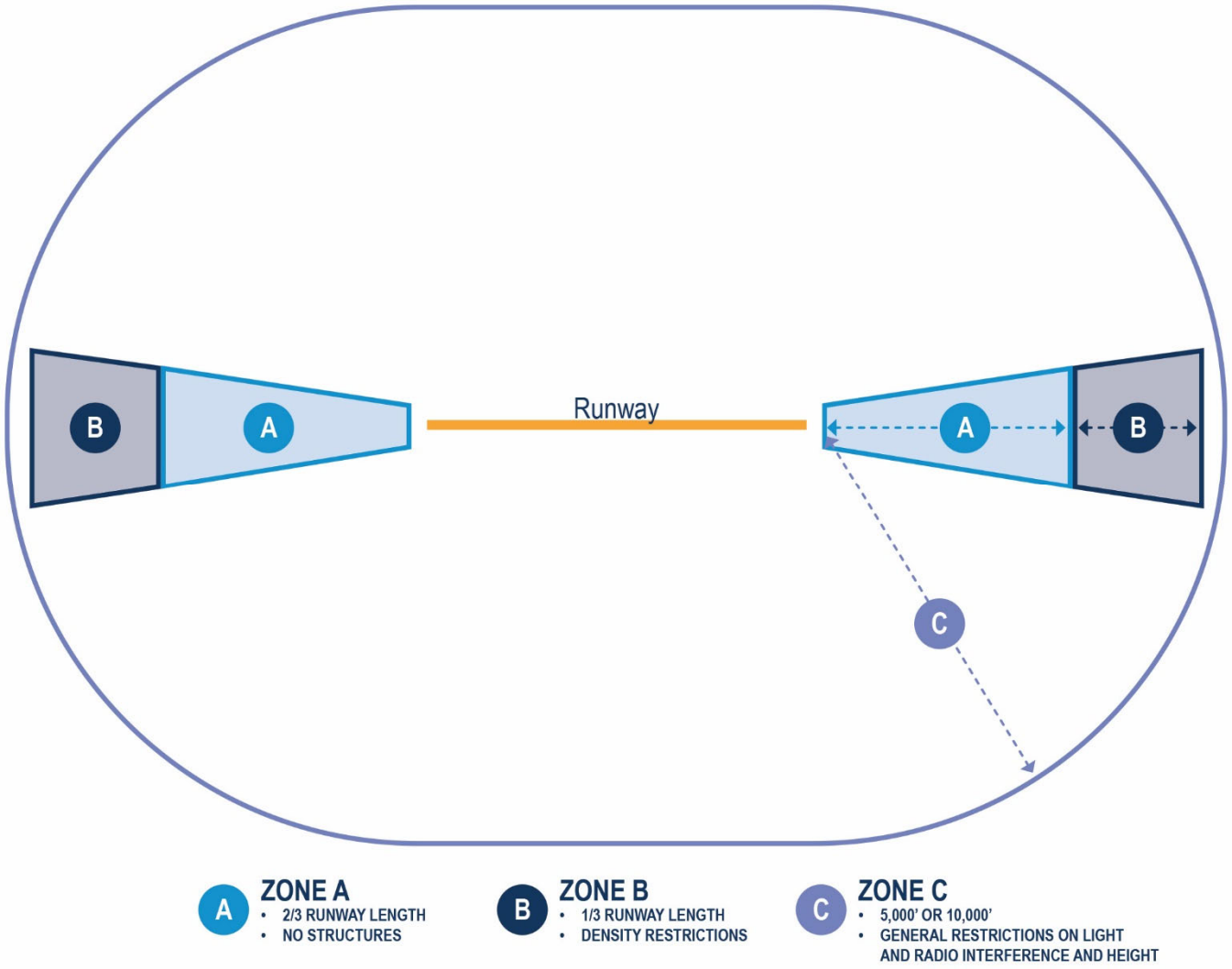

Figure 3 – Airport Land Use Safety Zones

Sources and Update Frequency: MnDOT Aeronautics will utilize its Zoning Warehouse, records of adopted airport zoning ordinances and airport layout plans, to determine adequacy of airport zoning ordinances for each airport. This data will be updated annually, or whenever an ALP is approved or a zoning ordinance is adopted, whichever comes first, following Phase 2 of the 2020 SASP.

Up-to-Date Planning Documents

Measure: Percent of system airports with up-to-date planning documents

Relevance: Master Plans (MPs) and Long Term Comprehensive Plans (LTCPs) document the anticipated needs of an airport over a specific planning period. They provide supporting documentation as to the purpose and appropriate timing of proposed development. Airport Layout Plans (ALPs) provide guidance, or a "blueprint", for future growth and illustrate the existing conditions. Keeping these planning documents current provides FAA,

MnDOT and the airports the information needed to operate their existing airport and document and prepare for future growth.

This measure aligns with the system stewardship objective.

Target: 100 percent of system airports have adequate federal and state approved planning documents that exhibit existing and future development. Up-to-date is defined for each classification below:

> **Key Commercial Service and GA:** should have an ALP and Master Plan updated or revisited at least every ten years
>
> **Intermediate Large and Small:** should have an ALP and Master Plan updated or revisited at least every fifteen years
>
> **Landing Strip Turf and Seaplane Bases:** should have an ALP

Technical Description: ALPs and Master Plans identify airport design standards for existing and future conditions and depict airport improvements to meet forecasted needs. These plans are based on FAA standards and policies and MnDOT guidance. While it is important that these planning documents are tailored to each individual airport and can vary in scale and scope, some common elements of each plan for Minnesota's airports are shown in **Table 1**.

Master Plans	Airport Layout Plans (ALPs)
Inventory of existing conditions	Existing airport layout
Aviation forecasts	Future airport layout
Facility requirements	Wind data and wind rose
Airport development alternatives	Terminal/Facility plan
Environmental considerations	Airport airspace maps
Recommended alternatives	Airport land use
	Airport property map

Table 1 – Common Planning Document Elements

Any proposed development must be depicted on an ALP in order for NPIAS airports to receive federal funding. Up-to-date planning documents allow the state to better assess project funding needs across the system and for airport sponsors to plan to meet existing and future needs.

Sources and Update Frequency: MnDOT, Office of Aeronautics records. This data will be updated when a planning project is completed or an ALP is approved at an airport.

Adequate Wind Coverage

Measure: Percent of system airports that have adequate wind coverage

Relevance: Crosswind conditions can be a contributing factor in small aircraft accidents. Primary runways are generally aligned with the prevailing winds at the airport's location but there are times when winds are not blowing in the direction of the primary runway orientation. It is during those times that a crosswind runway adds the most value. Wind conditions affect all aircraft to some degree. Generally, the smaller the aircraft, the more it is affected by wind. The availability of a crosswind runway can add to the safety and usefulness of an airport. Additionally, a nearby airport with a runway of a different orientation may also provide adequate wind coverage.

This measure aligns with the transportation safety and critical connections objectives.

Target: A target for this measure will be developed as part of Phase 2 of the SASP 2020.

Technical Description: The minimum recommended wind coverage for an airport is at least 95 percent. The 95 percent coverage is computed on the basis of the crosswind component not exceeding 10.5 knots for A-I and B-I aircraft (the smallest category of aircraft), 13 knots for A-II and B-II aircraft (commonly the critical (most demanding) aircraft at an Intermediate airport), 16 knots for A-III, B-III, and C-I through D-III aircraft, and 20 knots for A-IV through D-VI aircraft. While these crosswind speeds for each aircraft grouping are based on an FAA recommendation, pilots are responsible for determining a maximum crosswind component, which may differ from the FAA's recommendations for airport design.

The addition of a crosswind runway increases the percentage of time an airport is available for use by increasing the overall wind coverage of the airport. The availability of crosswind runways, or two airports with varying runway orientation located in close proximity to each other, throughout the state, more directly improves accessibility to the aviation system.

Sources and Update Frequency: The appropriate source and update frequency will be developed in Phase 2 of the 2020 SASP as part of target development.

Adequate Arrival Departure/Terminal Building

Measure: Percent of system airports with an arrival/departure (A/D) or terminal building in adequate condition

Relevance: A/D buildings, or terminal buildings, at airports provide space and shelter for pilots, passengers and travelers and also serve as the 'front door' to a community for the traveling public. Many of these buildings also provide space for flight planning, meetings and other activities. An A/D or terminal building in adequate condition allows the building to most fully serve airport user needs.

This measure aligns with the system stewardship objective.

Target: The target and definition of adequate will be identified in Phase 2 of the 2020 SASP.

Technical Description: The technical description will be developed further as part of the target development in Phase 2 of the 2020 SASP.

Sources and Update Frequency: The appropriate source and update frequency will be developed in Phase 2 of the 2020 SASP as part of target development.

System Indicators

Several of the system performance indicators have been used to track performance for multiple system planning efforts while others have been newly developed as part of this plan. Changes to the system indicators were made based on stakeholder feedback during the Phase I 2020 SASP outreach efforts. Overall, stakeholder feedback indicated that the previous SASP had too many indicators and that it was important to focus on fewer indicators that were meaningful and easy to understand. Stakeholder input also influenced the addition of five new indicators.

Figure 4 depicts the evolution of system indicators from the 2012 SASP to the 2020 SASP.

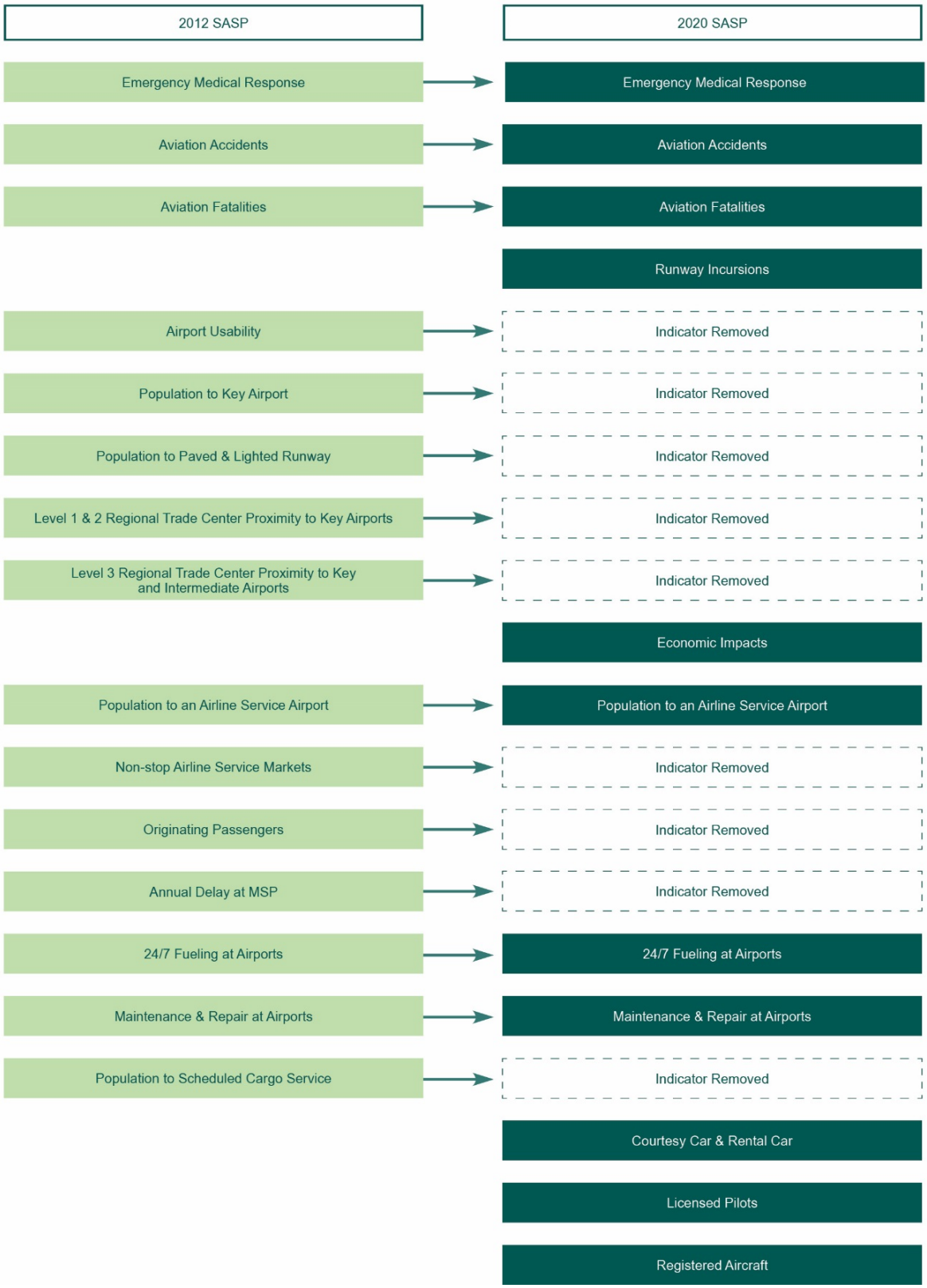

Figure 4 – Evolution of System Indicators

Source: MnDOT Office of Aeronautics, SEH

Removed Indicators

The following indicators were removed based on stakeholder feedback during Phase I of the 2020 SASP.

Airport Usability

The 2012 SASP included an indicator of airport usability that evaluated the percent of time a pilot could utilize an airport. Stakeholder feedback indicated that this measure was hard to accurately quantify. Because there is a system measure for adequate instrument approaches, this indicator was removed as the accessibility of airports is already assessed through that measure.

Population to a Key Airport

Population within 90 minutes surface travel time to a Key Airport was included as an indicator of accessibility in the 2012 SASP. The system performance was 99 percent. Stakeholders did not find this indicator useful. Additionally, continued tracking of this indicator does not meet a need for transparency and information sharing.

Population to a Paved and Lighted Runway

The 2012 SASP included an indicator of the percent of the population within 30 minutes surface travel time to a paved and lighted runway. The system performance was 71 percent. Stakeholders did not find this indicator useful. Additionally, continued tracking of this indicator does not meet a need for transparency and information sharing.

Level 1 and 2 Regional Trade Center Proximity to Key Airports and Level 3 Regional Trade Center Proximity to Key and Intermediate Airports

Two indicators in the 2012 SASP included an evaluation of the distance from Level 1, 2 and 3 Regional Trade Centers to Key and Intermediate airports. Regional Trade Center (RTC) Analysis was developed in 1963 at the Center for Urban and Regional Planning (CURA), University of Minnesota, by John R. Borchert and Russell B. Adams, to classify communities according to a hierarchy of trade center levels, which are based on community size and community economic diversity. Due to advancing technology, RTC analysis methodology has undergone two revisions by CURA, in 1990 and 1999, by expanding the scope economic activity and focusing on larger trade center levels. In 2003 MnDOT did their own update by making further adjustments in geographic aggregations and demographic and business data concluding in the RTC hierarchy levels used in this analysis.

Because the definition of Regional Trade Center is not widely understood, stakeholders indicated that this measure could be deleted. Stakeholders suggested that an indicator that better relates to the economic impact of airports would be more appropriate, and an indicator related to economic impact is in development as part of the Statewide Economic Impact Study and will be included as part of Phase 2 of the 2020 SASP.

Non-stop Airline Service Markets

The total number of non-stop airline service markets served from Minnesota airports was included as an indicator in the 2012 SASP. Non-stop markets served from Minnesota have remained relatively stable. Because nearly all non-stop markets are served from MSP and this information is included in the Metropolitan Airport Commission's Annual Report to the Legislature, it was removed as a SASP indicator as it is tracked annually in this report.

Originating Passengers

The 2012 SASP included an indicator of the total number of originating passengers from MSP. Stakeholders did not find this indicator useful. Additionally, continued tracking of this indicator does not meet a need for transparency and information sharing.

Annual Delay at MSP

Annual delay at Minneapolis St. Paul International Airport (MSP) was included as an indicator in the 2012 SASP. Similar to non-stop airline service markets, this data is also reported annually by the Metropolitan Airports Commission in its Annual Report to the Legislature. Because it is reported and tracked annually in this report, it was removed from the SASP.

Population to Scheduled Cargo Service

The 2012 SASP included an indicator of the percentage of the population within 60 minutes surface travel time to scheduled air cargo service. Stakeholders did not find this indicator useful. Additionally, continued tracking of this indicator does not meet a need for transparency and information sharing.

System Performance Indicators

This white paper outlines each of the proposed system performance indicators and includes the following information:

Title*:* Name of each indicator as it will be referenced in the 2020 SASP.

Indicator: What is being tracked

Relevance: Why the indicator is relevant and important to the system

Source(s): Data that will be used to evaluate the track and indicator in Phase 2 of the 2020 SASP.

Emergency Medical Response

Indicator: An indicator evaluating medical access to the aviation system will be developed in Phase 2 of the 2020 SASP.

Relevance: Emergency Medical Response within the state of Minnesota relies on air and ground transportation for moving accident victims to a hospital or for moving patients from a lower to a higher level trauma center hospital. In many cases, helicopters and fixed wing aircraft are used when it is determined that ground transportation may take too long due to the patient's condition or other factors. The previous system planning efforts identified the following three aviation conditions that may negatively impact the ability to move patients using helicopters or fixed wing aircraft.

Having only private approaches limits the flexibility to use multiple air ambulance providers during large scale emergency responses when the weather is poor. The percentage of hospital heliports with FAA approved approaches is minimal within the state and private approaches are restricted to certain service providers who have paid for development of the approach. Hospitals may grant access to outside users if permission is requested prior to landing.

Hospitals within the state that need to transfer a patient to a higher level trauma center will use fixed wing aircraft at a local airport to either minimize total travel time between hospitals or avoid weather conditions that may limit the use of a helicopter. Hospitals within 15 minutes of an airport with an instrument approach increase the reliability of using this method for transferring patients during both good and bad weather. An airport with an instrument approach also allows a helicopter to land at that airport when weather is poor and the nearby hospital does not have a heliport with an instrument approach.

Access to Twin Cities metropolitan area hospitals located north of Minneapolis St. Paul International Airport (MSP) by aircraft traversing MSP airspace are hindered by current airspace restrictions.

During the Phase I 2020 SASP stakeholder outreach efforts, two additional considerations were identified that should be incorporated into this indicator.

1. Adequate access to weather reporting - Often AWOS systems in proximity to hospitals are used for weather information. The ability of the existing weather reporting system to adequately serve the aeromedical needs of the state should be considered.
2. Aero medical access throughout the state and the impact that increased response time has to the survivability of a crash – A reduced response time and decreased transfer time to a medical facility can support Towards Zero Deaths, the state's cornerstone traffic safety program.

This indicator aligns with the transportation safety and critical connections objectives.

Sources: The sources will be identified as part of the indicator development in Phase 2 of the 2020 SASP.

Aviation Related Accidents

Indicator: Total number of aviation related accidents in Minnesota

Relevance: Identifying trends in aviation accidents may be a way to indicate how well the system is functioning relative to safety.

The MnDOT, Office of Aeronautics strives to eliminate all accidents related to aviation. This is done through funding projects which enhance airport safety, restricting land uses and construction near airports, and providing both pilots and the public education on safe flying. MnDOT's website has links to safety seminars which are hosted at different system airports. These can be found on the Office of Aeronautics website.

Aircraft accidents can be caused by a wide range of factors including aircraft equipment malfunctions, inattentive grounds crew members, and pilot error. Aviation accidents are investigated and reported first by the National Transportation Safety Board (NTSB) and then by MnDOT. These investigations allow MnDOT to track the location of accidents and understand the cause and any contributing factors. Using this data, MnDOT is able to identify common accident locations and help identify strategies to mitigate potential problems.

This indicator aligns with the transportation safety objective.

Sources: National Transportation Safety Board (NTSB) will be the source of the aviation accident data. This data will be updated on an annual basis.

Aviation Fatalities

Indicator: The total number of annual aviation related fatalities in Minnesota

Relevance: This indicator is another way of looking at trends to indicate how well the system is functioning relative to safety.

This indicator aligns with the transportation safety objective.

Sources: National Transportation Safety Board (NTSB) will be the source of the aviation accident data. This data will be updated on an annual basis.

Runway Incursions

Indicator: Total number of reported runway incursions at towered airports in Minnesota

Relevance: A runway incursion is the unauthorized presence of an aircraft, vehicle or person in the protected area of a runway. Runway incursions are one of the greatest risk areas to runway safety.

The runway incursion data will include the total number of each category of runway incursion reported at each towered airport. The categories of runway incursions include:

> **Category A:** a serious incident in which a collision was narrowly avoided
>
> **Category B:** an incident in which separation decreases and there is a significant potential for collision, which may result in a time critical corrective/evasive response to avoid a collision
>
> **Category C:** an incident characterized by ample time and/or distance to avoid a collision

Category D: an incident that meets the definition of a runway incursion such as incorrect presence of a single vehicle/person/aircraft in the protected area of a surface designated for the landing and take-off of aircraft but with no immediate safety consequences

In 2015, the FAA implemented the Runway Incursion Mitigation (RIM) program, which utilizes risk-based decision making methodology to determine which specific locations have a history of runway incursions. Where the program has implemented mitigation tactics, the total number of incursions have decreased. As of December, 2018, there are two (2) RIM program locations in Minnesota (Crystal Airport and Flying Cloud Airport).

This indicator aligns with the transportation safety objective.

Sources: The FAA Aviation Safety Information Analysis and Sharing (ASIAS) system, this data will be updated annually.

Economic Impact

Indicator: An indicator will be developed in Phase 2 of the 2020 SASP that will document and track the economic impact of aviation in Minnesota. The 2018 Economic Impact Study currently underway will be utilized in developing this indicator.

Relevance: This indicator will be developed as part of Phase 2 of the 2020 SASP and will align with the healthy communities objective.

Sources: The source of this data will be developed as part of Phase 2 of the 2020 SASP.

Population Access to an Airline Service Airport

Indicator: Percent of the population that is within 60 minutes surface travel time to a Key Commercial Service Airport with scheduled airline service.

Relevance: It is important for residents of the state to have access to airports with scheduled airline service. The population that is within a 60-minute drive of an airport with airline service indicates how convenient it is for the general public to reach destinations outside of the state.

Airports with airline service are often near major population centers, so the density needs for this service have historically been fairly well met. In the 2012 SASP, 72 percent of the state's population was within 60 minutes surface travel time of an airport with airline service.

This indicator aligns with the critical connections objective.

Sources: U.S. Census Bureau and ESRI

Fuel Availability at Airports

Indicator*:* Percent of airports within 50 nautical miles of an airport with Jet A fueling available 24 hours a day, 7 days a week (24/7) and 30 nautical miles of an airport with 100 low lead (LL) fueling available 24/7

Relevance: The percent of airports within 50 nautical miles of an airport with 24/7 Jet A fuel availability and 30 nautical miles of an airport with 100LL is a measure of convenience and safety. Having convenient access to fuel allows pilots to plan more efficient routes, carry less fuel, and reduce the likelihood of running out of fuel. This results in less fuel consumption and increases safety and accessibility in the system.

Access to fuel plays a role in activity levels at airports and also may influence the likelihood of a pilot basing an aircraft at a particular airport. In the 2012 SASP, there were 110 airports in the state that provided 24/7 fueling.

This indicator aligns with the critical connections objective.

Sources: Airport 5010 Forms and ESRI

Maintenance and Repair at Airports

Indicator*:* Percent of airports within 50 nautical miles of an airport that has aircraft maintenance and repair facilities

Relevance: The following are measured as part of this indicator:

- Percent of airports within 50 nautical miles of an aircraft services, repairing and maintaining location
- Percent of airports within 50 nautical miles of an avionics repair location
- Percent of airports within 50 nautical miles of an engine overhaul location

The number of airports within 50 nautical miles of an airport with various types of aircraft maintenance and repair facilities indicates the convenience aircraft owners have to repair and maintain their aircraft.

Access to maintenance facilities is a factor in activity levels at airports and also increases the likelihood of a pilot basing an aircraft at a particular airport. Easy access to aircraft or aviation repair facilities enables a higher quality of flying for pilots traveling to or from the state. If a maintenance facility is not located at an airport, it is important to have a facility close enough so a mechanic can drive to the airport without service and make emergency repairs so the aircraft can be ferried to an airport where complete repairs can be made.

This indicator aligns with the critical connections objective.

Sources: Minnesota Commercial operator license data

Courtesy and Rental Cars

Indicator*:* Percent of airports with a courtesy or rental car

Relevance: General aviation users traveling by air often experience challenges in reaching their final destination. While airports with commercial airline service typically have rental cars, rental cars are not as common at general aviation airports. General aviation airports may have a courtesy car available to travelers on a free or donation based system. This car can provide critical 'last-mile' connections from an airport to a community. Rental cars and courtesy cars ensure travelers can reach their final destination and increases the overall effectiveness of the aviation system.

This indicator aligns with the critical connections objectives.

Sources: Minnesota Airport Directory and Travel Guide

Licensed Pilots

Indicator*:* Number of licensed pilots in the State of Minnesota

Relevance: This indicator will track the total number of licensed pilots by type of certificates. The following certificate types will be tracked:

- Recreational
- Sport Pilot
- Private
- Commercial
- Airline Transport (ATP)
- Rotorcraft Only
- Glider Only
- Remote Pilot

The total number of pilot certificates correlates to the use of the Minnesota aviation system. As certain categories of use of the system increase or decrease, the number of pilots may also change to reflect the use.

This indicator aligns with the critical connections and system stewardship objectives.

Sources: FAA Airmen Certification Database

Registered Aircraft

Indicator*:* Number of registered aircraft in the State of Minnesota

Relevance*:* Aircraft operated in the airspace over Minnesota are required to be registered with the MnDOT Office of Aeronautics, except as exempted by Minnesota Statutes sections 360.54 and 360.55.

The total registered aircraft with each reported use will be measured in this indicator. The uses, as listed on the license application, include:

- Piloted Aircraft
    - Personal
    - Business
    - Flying Club
    - Agriculture
    - Instruction
    - Air Taxi
    - Rental
    - Air Ambulance
    - Not reported
- Unmanned aerial vehicles (UAVs)

The total number of registered aircraft utilizing the Minnesota aviation system reflects on the impact the system has to the state and trends in system utilization. The total number of aircraft registered in the system may fluctuate as new aircraft, such as unmanned aerial vehicles (UAVs), enter the system or as use of certain aircraft decline. The indicator will track the reported aircraft uses for registered aircraft in the state which may correlate to the use of the system for various purposes.

This indicator aligns with the critical connections and system stewardship objectives.

Sources: MnDOT Office of Aeronautics Aircraft Registration Database