DRAFT
Crystal Airport
2035 Long-Term Comprehensive Plan (LTCP)

Narrative Report
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Prepared jointly by the Airport Development & Environment Departments
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ES  EXECUTIVE SUMMARY

ES.1  INTRODUCTION

Crystal Airport is one of seven airports owned and operated by the Metropolitan Airports Commission (MAC). The airport is located in Hennepin County, approximately seven miles northwest of downtown Minneapolis. It lies within the City of Crystal, with small portions of airport property overlapping into the City of Brooklyn Park and the City of Brooklyn Center.

The Airport plays an important role in the MAC system of airports by attracting general aviation traffic away from Minneapolis-St. Paul International Airport (MSP) to relieve congestion, which helps reduce operating costs and promotes sustainability. Crystal is the closest MAC airport to downtown Minneapolis.

During 2015, Crystal Airport had approximately 185 based aircraft and accommodated approximately 40,000 aircraft operations (takeoffs and landings). It encompasses 436 acres of land and has four runways – three paved and one turf. The primary runways, 14L-32R and 14R-32L, are 3,267 feet and 3,266 feet long, respectively, and both are 75 feet wide. The paved crosswind runway, 06L-24R, is 2,499 feet long and 75 feet wide. The turf runway, 06R-24L, is 2,123 feet long and 137 feet wide. The existing airport layout is depicted in Figure ES-1.

The most recent Long-Term Comprehensive Plan (LTCP) for Crystal Airport prepared by the MAC and approved by the Metropolitan Council is dated December 2008, with a planning horizon year of 2025 (“2025 LTCP”). The 2025 LTCP recommended a plan to “right-size” the airfield to better align airport infrastructure and complexity with activity levels. To do this, the preferred alternative in the plan is to decommission both the turf runway (06R-24L) and south parallel runway (14R-32L), leaving a two-runway system in place. This plan not only simplifies the airfield, but opens up some property for both aeronautical and non-aeronautical development opportunities.

The purpose of the Crystal Airport 2035 Long-Term Comprehensive Plan is to validate and refresh the findings of the previous 2025 LTCP, and to extend the planning horizon for an additional ten years through 2035.

The LTCP is an infrastructure planning tool updated on a regular basis. It is forward-looking in nature, and does not authorize actual construction. The 2035 Crystal Airport LTCP aims to:

- Right-size the airfield to match existing and forecasted activity levels;
- Preserve and, if possible, improve operational capabilities for the current family of aircraft using the facility; and
- Enhance safety by simplifying the runway and taxiway layout.

The plan will provide a “road map” to guide MAC’s development strategy and capital improvements planning for Crystal Airport over the next 5-10 years by renewing aviation

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1 Turf Runway 06R-24L is open seasonally from May through October.
activity forecasts, confirming facility needs and refining alternatives identified from the previous LTCP to meet those needs.

**ES.2 AIRPORT ROLE**

Operating within a diverse system of metropolitan area airports, Crystal Airport’s primary role is to serve personal, recreational, and some business aviation users in the northwest metropolitan area, including the cities of Crystal, Brooklyn Park, Brooklyn Center, and Minneapolis. Example business services include flight training, aircraft rentals, charter flights, aircraft and propeller maintenance, sale of aircraft avionics and parts, and medical flight transportation.

The primary role of Crystal Airport is not expected to change during the planning period. The Airport’s classification will continue to be that of:

- A Complimentary Reliever in the Metropolitan Airports Commission (MAC) system;
- An Intermediate Airport per Minnesota Department of Transportation/Office of Aeronautics (MnDOT); and
- A Minor Airport per the Metropolitan Council Regional Aviation System Plan.

The aircraft mainly anticipated to use Crystal Airport – and that which it is designed for – will continue to be a family of small, propeller-driven airplanes with fewer than 10 passenger seats.

The proposed plan does not contemplate upgrading the role of Crystal Airport to accommodate a larger aircraft family or scheduled passenger or cargo flights. Nor does the plan contemplate downgrading the role of Crystal Airport.
Figure ES-1: Existing Airport Layout
ES.3 FORECASTS

Aviation activity forecasts were prepared for both based aircraft and total aircraft operations.

The forecast calculations take into account assumptions relating to the economy, fuel costs, aircraft ownership trends, general aviation fleet trends, and general aviation taxes and fees. The forecast assumes reasonable growth in all of these categories.

Along with a Base Case forecast, a range of scenarios to identify the potential upper and lower bounds of future activity levels at Crystal Airport was developed. These scenarios used the same forecast approach that was used in the Base Case, but alter the assumptions related to socioeconomic conditions to reflect either a more aggressive or more conservative outlook.

Subsequent to the preparation of the high and low forecast scenarios, an additional scenario was developed to evaluate the potential impact associated with designating the existing overrun pavement areas beyond each end of Runway 14L-32R as stopways. Pavement designated as stopway can be considered as useable length for decelerating an aircraft during an aborted takeoff.

In the stopway scenario, the number of additional aircraft operations above the base case is approximately 230 annually, translating to just over four additional takeoffs and landings per week. Of the additional operations, the majority are expected to be turboprops (approximately three-quarters), with the remaining increase coming from small jets. All other forecast assumptions are the same as in the base case.

Table ES-1 compares the total number of aircraft and operations under different scenarios for Crystal Airport, along with the Terminal Area Forecast (TAF) prepared by the Federal Aviation Administration (FAA).
Table ES-1: Crystal Airport 2035 LTCP Forecast Summary

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Based Aircraft</th>
<th>Total Number of Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Base Case</td>
<td>High Range</td>
</tr>
<tr>
<td>2015 (a)</td>
<td>185</td>
<td>185</td>
</tr>
<tr>
<td>2020</td>
<td>180</td>
<td>184</td>
</tr>
<tr>
<td>2025</td>
<td>177</td>
<td>184</td>
</tr>
<tr>
<td>2030</td>
<td>171</td>
<td>183</td>
</tr>
<tr>
<td>2035</td>
<td>171</td>
<td>187</td>
</tr>
</tbody>
</table>

Average Annual Growth Rate

-0.4%  0.1%  -0.8%  -0.2%  0.2%  -0.6%  -0.2%  0.3%

Notes:

a) 2015 operations represent twelve months ending June 2015 and includes an estimate of nighttime activity.

CY2015 tower count was 39,659 with no nighttime adjustment.

Source: HNTB Activity Forecasts

Recent activity levels at Crystal Airport indicate that levels of based aircraft and aircraft operations have largely stabilized since 2010 after steady decreases in the 1990 to 2010 timeframe. Based on the economic outlook for both Hennepin County and the Seven-County Metropolitan Area, along with projected trends for General Aviation flying, the forecasts predict a period of stable activity levels for Crystal Airport. If current activity levels are maintained, Crystal Airport will continue to be one of the busiest airports in the state and an important component of the regional airport system.

The forecast scenarios indicate that future economic growth, fuel prices, technology, and national aviation policy may have a major impact on the development of general aviation. Absent major changes in the economy or aviation industry, small fluctuations – particularly within the developed range of scenarios – should not be construed as indicating the forecast is off course. Minor fluctuations in activity levels above or below the long-term forecast will not affect the overall recommendations of the LTCP, however, these fluctuations may require minor adjustments to the phasing of proposed improvements.
ES.4 FACILITY REQUIREMENTS

Airside Facilities
Based on the aviation activity forecasts, the future critical design aircraft for Crystal Airport will continue to be represented by the family of propeller-driven aircraft with fewer than 10 passenger seats. This family of aircraft includes a diverse range of equipment types, ranging from small single-engine piston aircraft used primarily for recreational and personal flying up to larger single and twin-engine turboprop aircraft that are used more predominantly for business. Typical aircraft in the latter category include the single-engine turboprop Pilatus PC-12 and the twin-engine turboprop Beechcraft King Air 200.

Since the airport predominantly serves small airplanes (an airplane of 12,500 pounds or less maximum certificated takeoff weight), the runway designations at Crystal Airport should be those associated with small aircraft. Although aircraft with a maximum gross takeoff weight of greater than 12,500 pounds can and do occasionally use Crystal Airport (such as the Beechcraft King Air 350 turboprop), the total is well below the regular use threshold (500 operations per year) due to runway length limitations. The existing runway designations are for aircraft with a maximum gross takeoff weight of greater than 12,500 pounds.

The design objective for the primary runway is to provide a runway length that will not result in operational weight restrictions for the design family of aircraft.

Based on runway length guidance provided by the Federal Aviation Administration (FAA), the appropriate runway length at the Crystal Airport should be between 3,300 feet (to accommodate most of the aircraft types in this family, or 95% of the fleet) and 3,900 feet (to accommodate all types in the family, or 100% of the fleet).

While the guidance from the FAA serves as a good baseline, more detailed information related to runway length requirements can be derived from manufacturer performance charts published for specific aircraft types. Based on a comprehensive assessment of runway length requirements for several representative aircraft types in the design aircraft family for Crystal Airport, a suitable runway length was determined to be 3,600 feet. This length fits into the range predicted by the FAA and will accommodate the majority of small turboprop and multi-engine piston aircraft departing at an operationally-feasible weight.

Ideally, the entire runway length would be available to accommodate all takeoff and landing distance categories (takeoff run available, takeoff distance available, accelerate-stop distance, and landing distance available). However, for the designated critical aircraft family, accelerate-stop distance (ASDA) typically emerges as the most critical (longest) length requirement to consider. Thus, at a minimum, the preferred concept should seek to provide at least 3,600 feet of accelerate-stop distance.

The crosswind runways at Crystal Airport accommodate the lower crosswind capable light single-engine aircraft used primarily for personal, recreational, and flight training activities. Wind analysis indicates that the primary Runway 14-32 alignment provides the desired level of wind coverage during most, but not all, weather conditions. The crosswind Runway 06-24 alignment offers supplemental wind coverage so that the total runway system provides nearly 100 percent wind coverage in all conditions. The wind data also suggests that the strongest winds experienced at Crystal Airport frequently come from a
southwesterly direction. Runway 24 is particularly well aligned to accommodate aircraft operations during these high-wind conditions; furthermore, it is the only runway with a southwest/northeast orientation in the west metropolitan area to provide this wind coverage.

At 2,500 feet, the paved crosswind runway 06L-24R is short by modern standards. However, due to constraints and obstacles at both ends of the runway, providing additional length is not feasible.

The number of aircraft operations on turf Runway 06R-24L have been declining in recent years. Manual counts taken during June through August of 2015 by ATCT controllers suggest that there were approximately two (2) average daily operations on this runway (one takeoff and landing cycle). While the turf runway may represent a nice-to-have amenity at an urban Reliever airport, there is no known aircraft type using the airport on a regular basis that cannot operate safely on the adjacent paved runway. Given the aging condition of the turf runway and the added complexity that it adds to the airfield configuration, maintaining Runway 06R/24L is not considered to be essential to the viability of Crystal Airport.

Development of a new, non-precision GPS-type instrument approach procedure for the existing Runway 32R end would enhance the operational capabilities of the airport. Planning for the establishment of this non-precision approaches is recommended for consideration, if feasible.

**Landside Facilities**

According to the Base Case forecast results, the number of based aircraft is anticipated to decline slightly through 2030 and then stabilize. By 2035, the number of based aircraft is forecasted to be 171 aircraft.

At first glance, it appears that only a portion of the available hangar capacity at Crystal Airport will be filled by 2035. However, some of the available hangar stall inventory is currently leased by airport tenants to support aviation business activities other than aircraft storage. Secondly, reasonable enforcement of MAC’s Maintenance Standards Ordinance in the future may result in some of the existing hangar inventory being removed. Lastly, there could be demand for construction of certain hangar types and/or sizes that are not currently available. Therefore, areas to accommodate the construction of new hangars should be considered in the plan. It is important to note that including additional hangar space in this LTCP is not a commitment to build or fund such a development. Rather, it is simply ensuring that should the indicated immediate demand lead to an actual hangar construction project, an appropriate place for them is shown in this plan and subsequent Airport Layout Plan (ALP).

Several former FBO facilities still exist at Crystal Airport, although they are currently leased to tenants who are using them for other purposes. Should demand ever warrant additional services, one or more of these facilities could be converted back to FBO use. However, the updated forecasts do not suggest that existing or anticipated future demand levels are sufficient to support more than one full-service FBO facility at Crystal Airport. The existing Thunderbird Aviation FBO apron is relatively small, constrained, and operationally inefficient. An expansion to improve aircraft circulation patterns and the
number of tie-down locations should be considered by the tenant if the turf runway is decommissioned.

The existing MAC Maintenance facilities are in good condition and provide adequate capacity to accommodate newer-generation snow removal equipment that in many cases are longer and taller than older models. An enclosed materials storage facility is programmed to be constructed to store sand and other solid materials.

Finally, an area should be identified to accommodate a future self-service fuel dispensing facility should this service not be provided by an FBO and deemed appropriate by MAC.

**ES.5 ALTERNATIVES REFINEMENT**

The 2025 LTCP considered numerous concepts related to the number of runways to retain at Crystal Airport, as follows:

- Keep all four existing runways / No Build;
- Maintain two parallel runways and close the two crosswind runways;
- Maintain just one primary runway;
- Maintain one primary runway and one crosswind runway;
- Maintain two parallel runways and only one crosswind runway;
- Extend the primary runway 14L-32R by 990 feet using declared distances;
- Maintain one runway and reduce its length to 2,500 feet; and
- Airport Closure.

After reviewing all of the concepts, costs, benefits and negative considerations, the 2025 LTCP for MIC was finalized in December 2008 and recommended that the airfield be “right-sized” to match infrastructure with activity levels. As illustrated in **Figure ES-2**, the preferred alternative in the plan is to decommission both the turf (06R-24L) and south parallel (14R-32L) runways, leaving a two-runway system in place. The existing south parallel taxiway will then be converted to a full-length parallel taxiway. This plan not only simplifies the airfield, but opens up some property for both aeronautical and non-aeronautical development opportunities. This alternative provides the best environment for airport users operationally, provides for the maximum wind coverage, and maintains a more balanced noise contour.

Due to the thorough nature of the alternatives analysis completed in the previous LTCP, it will not be repeated in this document. The recommendation from the previous LTCP will be carried forward into the 2035 LTCP. The focus of this chapter will be to identify possible refinements to the preferred alternative from the previous LTCP.

Refinements considered during this planning cycle include the following:

**Runway Designation/Runway Protection Zones**

A total of 36 off-airport residential parcels are wholly or partially contained in the existing Runway Protection Zones (RPZs) at Crystal Airport. In addition, public roadways traverse the RPZs for Runways 06L-06R (County Road 81/Bottineau Boulevard) and Runways
14L/14R (Douglas Drive). A freight rail line also runs through the Runways 06L and 06R RPZs.

Implementation of the previous LTCP preferred development alternative would reduce incompatible RPZ land uses by decommissioning Runways 14L-32R and 6R/24L, but would not improve RPZ compatibility off the remaining runway ends.

The FAA has designated lesser RPZ dimensions for runways designed to be used regularly by small aircraft with maximum certificated takeoff weights of 12,500 pounds or less (Utility Runway category). The existing and future critical aircraft expected to use Crystal Airport on a regular basis are those that have a maximum certificated gross takeoff weight of less than 12,500 pounds. Therefore, it is appropriate to use small aircraft design standards and designate the runways at Crystal Airport as Utility category. This designation allows the use of smaller-dimension RPZs than shown in the previous plan.

If the previous LTCP preferred development alternative is combined with the smaller-dimension RPZs, the Runway 14R RPZ will only impact a portion of one residential parcel and does not include any residential dwellings. A non-public airport access roadway will continue to traverse the Runway 14R RPZ as well, but this road is access controlled such that it only accommodates airport-related traffic. The Runway 14L RPZ will contain approximately 150 linear feet of Douglas Drive. Douglas Drive, however, is a low volume, local roadway. Thus, the probability of an airplane accident within the outer edge of the RPZ where the road is located, when a vehicle is present is very low. Realignment of the road outside of the RPZ is not a viable option given the location of existing residential development and adjacent transportation corridors immediately west of the airport, including Bottineau Boulevard, Lakeland Avenue, a freight rail line, and the planned Bottineau Light Rail Transit Line. In 2016, FAA reviewed this condition and concurred that Douglas Drive does not need to be realigned outside of the RPZ.

Also, reverting to the smaller RPZs results in larger parcels of land becoming available for aeronautical or non-aeronautical development, particularly on the existing Runway 06L end adjacent to County Road 81/Bottineau Boulevard.

**Convert Existing Paved Overruns to Stopways**

The existing Runway 14L and 32R ends feature a paved overrun. As currently designated, these paved overruns are not considered to be useable pavement when calculating aircraft takeoff or landing distances.

However, pavement designated as stopway can be considered as useable length for decelerating an aircraft during an aborted takeoff. Stopway pavement can be used for accelerate-stop distance calculations, but not for other takeoff or landing distance calculations.

Designating stopways for Runway 14L-32R may allow some aircraft to depart at a higher takeoff weight when accelerate-stop distance is a limiting factor, and will promote safety by formally making this pavement available for use in the event of an aborted takeoff attempt. Stopways do not change the published runway length, nor are they intended to attract aircraft types different than those operating at the airport today. However, the

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2 The Runway 14L paved overrun is 493 feet long, while the Runway 32R paved overrun is 500 feet long.
availability of stopways may result in a small increase in aircraft operations from some users who find the existing runway length to be limiting based on accelerate-stop distance criteria.

Activating the stopways will include the addition of stopway edge lighting (red unidirectional lights), relocating the existing runway threshold lights to be outboard of the pavement footprint, and grading the Runway Safety Area (RSA) beyond the stopway ends. The Stopway Conversion concept is shown in Figure ES-3.

**Convert Paved Overruns to Runway with Displaced Thresholds**

Another concept evaluated for the 2035 LTCP considers the impacts of converting the paved overruns on each end of Runway 14L-32R to usable runway pavement for use by aircraft beginning the takeoff roll or completing the landing rollout, along with displaced landing thresholds to improve Runway Protection Zone (RPZ) compatible land use compliance. Taxiway extensions would be added to the ends of the existing overrun pavement to make it accessible for aircraft taking off and landing. Declared distances would be applied and published, which increases the accelerate-stop distance (ASDA) to approximately 4,300 feet and also increases the takeoff distance available (TODA), landing distance available (LDA), and takeoff run available (TORA). The Runway Conversion concept is shown in Figure ES-4.

Although this concept maximizes the operational capabilities of the existing airport footprint, the potential for the improved airfield to attract aircraft types larger than the targeted design aircraft family, specifically those with a maximum certificated takeoff weight greater than 12,500 pounds – and thus change the role of the airport – is too great. Further, the additional development cost associated with implementing this concept is not considered to be warranted, given that the less costly stopway concept can accomplish the objective of providing additional accelerate-stop distance. Although this concept does result in the Runway 14L-32R RPZs shifting fully onto airport property, FAA has determined that the existing incompatible land uses are minimal in nature from a risk standpoint and do not require mitigation. Finally, the full application of declared distances for all takeoff and landing operations appears to be an unnecessary complication factor for pilots.

For the reasons outlined above, the Runway Conversion concept is not identified as the Preferred Alternative in the Draft 2035 LTCP.

**Taxiway Configuration**

The 2025 LTCP Preferred Alternative contemplated converting the existing Runway 14R-32L pavement into a full-length 40-foot wide parallel taxiway, but did not suggest any other taxiway configuration changes.

For the 2035 LTCP, the following taxiway changes are being considered:

- Convert existing Taxiway E into an apron-edge taxilane. This will provide additional useable apron frontage due to the less-demanding object free area.
- Removing the section of existing Taxiway E between Taxiway A and Taxiway B that crosses Runway 06L-24R. This section of pavement will be redundant
with the full-length parallel taxiway in place, and removing it will eliminate a runway crossing where incursions may occur.

- Remove the section of existing Taxiway E3 between Runway 14L-32R and the future parallel taxiway (existing Runway 14R-32L). This will eliminate an instance where a taxiway leads directly from an apron to a runway.
- Remove the section of existing Taxiway E2 between Taxiway/Taxilane E and the future parallel taxiway (existing Runway 14R-32L). This will eliminate another instance where a taxiway leads directly from an apron to a taxiway.
- Extend Taxiway B between Taxiway/Taxilane E and the future parallel taxiway (existing Runway 14R-32L).
- Install lighting on the future parallel taxiway (existing Runway 14R-32L) to promote situational awareness during low-visibility conditions. In addition, the installation of runway guard lights, enhanced centerline markings, and/or surface painted markings at select locations may help to further mitigate the risk of incursions.

These taxiway improvements are depicted on Figure ES-5.

**2035 LTCP Preferred Alternative Summary**
The 2035 LTCP Preferred Alternative for airfield improvements at Crystal Airport includes the following items:

- Items from the 2025 LTCP Preferred Alternative
  - Decommission existing Runways 14R-32L and 06R-24L (turf) to reduce airfield complexity and increase safety;
  - Convert existing Runway 14L-32R into a full-length parallel taxiway and add taxiway lights;
  - Preserve areas for future hangar development should demand arise; and
  - Identify parcels for possible conversion to non-aeronautical revenue generating land uses.

- Refinements included in the 2035 LTCP Preferred Alternative
  - Update the runway designation to Utility and use small aircraft design standards to reduce RPZ dimensions;
  - Convert existing paved overruns on Runway 14L-32R to stopways, including edge lighting and additional Runway Safety Area (RSA) grading;
  - Taxiway configuration changes as described above;
  - Expand the FBO apron;
  - Preserve areas for future hangar development; and
  - Pursue the establishment of a new non-precision instrument approach to the Runway 32 end, if feasible.

The improvements associated with the 2035 LTCP Preferred Alternative are shown on Figure ES-5.
Figure ES-2: 2025 LTCP Preferred Development Alternative
Figure ES-3: Convert Runway 14L-32R Paved Overruns to Stopways

Note: In this scenario, the existing paved overruns were reconfigured and lighted as stopways, extending the ASDA in both directions.

Legend:
- Airport Property Boundary
- Runway Protection Zone (RPZ)
- Runway Safety Area (RSA)
- Runway Object Free Area (OFA)
- Runway Obstacle Free Zone (OTFZ)
- Obstacle identified through the Planimetric Survey completed in January 2014
- Proposed Airfield Pavement
Figure ES-4: Convert Runway 14L-32R Paved Overruns to Runway

Legend:

- Airport Property Boundary
- Runway Protection Zone (RPFZ)
- Runway Safety Area (RSA)
- Runway Object Free Area (OFA)
- Runway Obstacle Free Zone (OFZ)

Note: In this scenario, the existing paved overruns were converted to available runway that can be used for takeoff or landing rollout. Since the existing departure surfaces would remain in place, the TODA distance would only increase by 493 feet and 500 feet for Runway 14 and Runway 32, respectively.
Figure ES-5: 2035 LTCP Preferred Alternative Overview
ES.6 ENVIRONMENTAL CONSIDERATIONS

Prior to any construction taking place, the MAC will complete an Environmental Assessment (EA) and/or an Environmental Assessment Worksheet (EAW) in compliance with state statues and FAA requirements for utilizing Airport Improvement Program (AIP) grant funds. The primary environmental impact category associated with implementation of the 2035 LTCP Preferred Alternative is noise exposure when compared to the existing condition.

Noise

To evaluate potential aircraft noise impacts associated with the 2035 LTCP Preferred Development Alternative, the MAC prepared Baseline Condition noise contours for Crystal Airport, along with 2035 Preferred Alternative Condition noise contours for comparison. The contours represent noise levels, expressed in the Day-Night Average Sound Level (DNL) metric. The FAA requires the DNL noise metric for determining and analyzing noise exposure to aid in the determination of aircraft noise and land use compatibility issues around United States airports.

The FAA suggests three different DNL levels (65, 70, and 75 DNL) be modeled but considers the 65 dB DNL contour line as the threshold of significance for noise impact. As such, sensitive land use areas (e.g., residential) around airports that are located in the 65 dB or greater DNL contours are considered by the FAA as incompatible.

The Metropolitan Council suggests that the 60 DNL contour be included for airports in an urban environment and the 55 DNL in cases where airports are located outside the Metropolitan Urban Service Area (MUSA). Crystal Airport is within the MUSA, so the 60 DNL noise contour will be shown for advisory purposes.

In summary, when the Final 2035 Preferred Alternative Condition contours are compared to the Baseline (existing) Condition contours:

- For the 65 DNL contour, the acreage contained within the contour increases by 16 percent, but the contour contains three (3) fewer residential structures located adjacent to the airport’s southern boundary. This change is largely due to the consolidation of flight activity on two runways instead of four in the existing condition.

- For the 60 DNL contour, the acreage contained within the contour increases by 26 percent, and the contour contains 54 more residential structures, primarily located to the east of the airport. Again, this change is largely due to the consolidation of flight activity on two runways instead of four in the existing condition.

- Converting the existing paved overruns on Runway 14L-32R to stopways may result in a small increase in aircraft operations from some users who find the existing runway length to be limiting based on accelerate-stop distance criteria. In the stopway scenario, the number of additional aircraft operations above the base case is approximately 230 annually, translating to just over four additional takeoffs and landings per week. As a sensitivity analysis, the noise model was run for the 2035 Preferred Alternative airfield configuration both with and
without the additional aircraft operations associated with the stopway activation. The additional operations did not have a significant impact on the size or shape of the noise contours. This is due to the relatively small number of operations, as well as the overall higher performance and noise characteristics of the types of aircraft types that would likely be attracted to the airport due to the stopways.

The 2035 LTCP Preferred Alternative noise contours are shown in Figure ES-6.

**Other Environmental Considerations**

The project will have to go through an environmental review process per federal National Environmental Policy Act (NEPA) and Minnesota Environmental Policy Act (MEPA) requirements to more specifically identify the environmental footprint of the improvements before construction can begin. During that process, alternatives must be reviewed and any potential impacts must be avoided if possible. If impacts cannot be avoided, they must be minimized to the extent possible and mitigated in full compliance with federal and state requirements.

The following impact categories will be assessed during the environmental review:

- Air Quality;
- Biological resources (including fish, wildlife, and plants);
- Climate;
- Department of Transportation Section 4(f) Properties (park and recreational lands, wildlife and waterfowl refuges, and historic sites);
- Farmlands;
- Hazardous materials, solid waste, and pollution prevention;
- Historical, architectural, archeological, and cultural resources;
- Land use;
- Natural resources and energy supply;
- Noise and compatible land use;
- Socioeconomics, environmental justice, and children’s environmental health and safety risks;
- Visual effects (including light emissions);
- Water resources (including wetlands, floodplains, surface waters, groundwater, and wild and scenic rivers);
- Construction impacts; and
- Cumulative effects.

An environmental review process cannot begin until there is a sufficiently detailed plan available to evaluate. MAC envisions initiating the environmental review for the proposed Crystal Airport improvements soon after the plan is reviewed by the Metropolitan Council and formally adopted by the MAC Board. A full study of these environmental impact items at this time falls outside the scope of this long-term planning document.
Figure ES-6: 2035 Preferred Alternative Noise Contour
ES.7 LAND USE COMPATIBILITY

The proposed improvements at Crystal Airport result in changes to the noise contour (described in Section ES.6), along with the locations of the Runway Protection Zones (RPZs, described in Section ES.5) and designated land use Safety Zones.

A Joint Airport Zoning Board (JAZB), including the Cities of Crystal, Brooklyn Park, Brooklyn Center, New Hope, Minneapolis, Robbinsdale and the Metropolitan Airports Commission, adopted an airport zoning ordinance in December 1983. The purpose of the ordinance is to protect against the construction of structures that will interfere with the operations at the airport. Although a number of homes are located within the designated safety zones, these areas were accepted as “established residential neighborhoods in built-up urban areas.”

Upon adoption of the zoning ordinance by the JAZB, it was the responsibility of each individual city to adopt the ordinance and conform their zoning to the ordinance requirements. According to the City of Crystal’s current Comprehensive Plan, the airport zoning regulations were adopted by the City in 1983 and one of the City’s aviation policies is to continue to protect airspace in accordance with the Joint Airport Zoning Ordinance.

The Airport Zoning Ordinance for Crystal Airport establishes Safety Zones A, B, and C. The length of Safety Zone A is 2/3 of the total runway length, while Safety Zone B is 1/3 of the total runway length and extends from Zone A. Safety Zone C is a horizontal plane established 150 feet above the airport elevation for a specified distance from each runway end.

For this report, the existing size and shape of Safety Zones A and B from the Crystal Airport Zoning Ordinance were used for the purpose of analyzing land use compatibility. The sizes, shapes and/or locations of these zones may be revised by the JAZB during an update of the Airport Zoning Ordinance for Crystal Airport.

In summary, when the 2035 Preferred Alternative Condition is compared to the Baseline Condition from a land use compatibility perspective:

- The Baseline Condition RPZs have 9.6 acres off airport property, while 4.2 acres are off airport property in the 2035 Preferred Alternative Condition – a reduction of 5.4 acres.
- The Baseline Condition Safety Zones have 169.0 acres off airport property, while 84.7 acres are off airport property in 2035 Preferred Alternative Condition – a reduction of 84.3 acres.
- With the exception of seven (7) residential structures that remain in the 65 DNL noise contour, existing land uses around Crystal Airport are compatible with the Baseline and 2035 Preferred Alternative Condition and resultant airport operations considering airport noise impacts as outlined in the FAA land use guidelines. Additionally, there are 177 residential structures in the 2035 Preferred Alternative Condition 60 DNL noise contour. Per the Metropolitan Council land use guidelines, new residential developments in the 60 DNL noise contour are considered incompatible and in cases of infill are considered
conditional which, if allowed, must meet certain structural performance standards.

**Figure ES-7** shows the 2035 Preferred Alternative RPZs, Safety Zones, and noise contours projected over planned future land use data.
Figure ES-7: 2035 Preferred Alternative RPZs, Safety Zones, and Noise Contours

Safety Zones are from the 1983 Crystal Airport Zoning Ordinance. The sizes, shapes and/or locations of these zones may be revised by the Joint Airport Zoning Board during an update of the Crystal Airport Zoning Ordinance.

Preferred Alternative Condition

- 2035 Preferred Alternative Noise Contours
- Runway Protection Zones
- Safety Zones
- Planned Land Use
  - Agricultural
  - Rural or Large-Lot Residential
  - Single Family Residential
  - Multifamily Residential
  - Commercial
  - Industrial
  - Institutional
  - Mixed Use
  - Multi-Optional Development
  - Park and Recreation
  - Open Space or Restrictive Use
  - Rights-of-Way (i.e., Roads)
  - Railway (inc. LRT)
  - Airport
  - Vacant or Unknown
  - Open Water

0.1 Miles
ES.8 IMPLEMENTATION PLAN

The LTCP is a planning document and does not authorize construction. Adoption of the LTCP is simply the first step in the project implementation process. Before any construction can begin, the project(s) must first be depicted on an FAA-approved Airport Layout Plan (ALP), evaluated via an environmental review process, and then compete for funding through FAA and/or State grant programs. Once funding is secured, final project engineering and design will take approximately one year to complete with contractor bidding and construction following thereafter.

Near-Term Development encompasses the project elements necessary to decommission Runways 14R-32L and turf Runway 6R-24L, convert existing Runway 14R-32L into a full-length parallel taxiway, and convert the existing paved overruns at the ends of Runway 14L-32R into stopways, including edge lighting and safety area grading. It is anticipated that this development may occur within the next 5 years.

Mid to Long-Term Development involves miscellaneous improvements to expand the FBO apron (by the tenant), install a self-fueling facility if this service is not provided by an FBO, and ongoing obstacle removal projects. It is anticipated that this development may occur in the 6-20 year timeframe.

Project cost estimates for the Preferred Alternative are summarized in Table ES-2.

Figure ES-8 illustrates the next steps for the planning and project implementation process, including at what points additional approvals are needed and at what points public feedback will be solicited.
Table ES-2: Preferred Alternative Cost Estimates

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<tr>
<th>Item #</th>
<th>Project Element</th>
<th>Estimated Cost</th>
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<tr>
<td>Near-Term Development (Plan Years 1 - 5)</td>
<td>Decommission Runways &amp; Convert RWY 14R-32L into Taxiway (w/MITL)</td>
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<td></td>
<td>Convert RWY 14L-32R Paved Overruns into Stopways (Lighting &amp; Grading)</td>
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<td>Other Taxiway Improvements</td>
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<td></td>
<td><strong>Near-Term Development Total:</strong></td>
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<tr>
<td>Mid/Long-Term Development (Plan Years 6 - 20)</td>
<td>Expand FBO Apron (Tenant Cost)</td>
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<tr>
<td></td>
<td>Hangar Development (Tenant Cost)</td>
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<tr>
<td></td>
<td>Install Self-Service Fueling Facility</td>
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<td></td>
<td>Hangar Removal(s)</td>
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<td></td>
<td>Obstacle Removal</td>
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<tr>
<td></td>
<td><strong>Mid/Long-Term Development Total:</strong></td>
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</tr>
<tr>
<td></td>
<td><strong>Total Development Cost:</strong></td>
<td><strong>$3,100,000</strong></td>
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Notes: Cost estimates reflect 2016 pricing and include engineering costs and contingencies.

Source: SEH and MAC cost estimates

**Non-Aeronautical Land Use Areas Available on Airport Property**

MAC continues to analyze the potential for non-aeronautical revenue-generating development at Crystal Airport and all of its Reliever Airports. Any parcels reviewed by the MAC at the Crystal Airport will be compatible with ongoing airport operations and the MAC will work with the surrounding communities to ensure proper zoning exists. Reducing the RPZ dimensions for the remaining runways based on small aircraft design/Utility runway standards will only increase this potential.

All airport property is currently zoned according to the adjacent cities as “Airport” land with no other noted land use. If MAC pursues non-aeronautical development, discussions will be initiated with the cities to discuss the potential uses and how the cities feel the parcels could best be utilized. If a modification is required for zoning, MAC will work with the cities to make changes as appropriate. The development of non-aeronautical uses will not only benefit MAC, but it will also generate a tax base for the local municipality in which the parcel lies, as well as address some of the aesthetic issues with some hangars at the airport.
Figure ES-7: Planning and Project Implementation Process
ES.9 PUBLIC INVOLVEMENT PROCESS

In order to fulfill the Guiding Principle related to Stakeholder and Community Engagement, a series of meetings will be conducted throughout the development of the 2035 LTCP for Crystal Airport.

Initial stakeholder outreach efforts have involved meeting with partner agencies, municipal representatives, and airport tenants before the draft LTCP report was finalized in order to provide information about the plan’s purpose, process, preliminary findings, and timeline.

Initial stakeholder outreach meetings are listed in Table ES-3.

Table ES-3: Initial Stakeholder Engagement Meetings

<table>
<thead>
<tr>
<th>Audience</th>
<th>Materials Covered</th>
<th>Date</th>
<th>Location</th>
</tr>
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<td>Pilot Group Meeting</td>
<td>LTCP Process, Review of Alternatives, Preliminary Findings</td>
<td>6/8/2016</td>
<td>Airport</td>
</tr>
<tr>
<td>MAC Reliever Advisory Council</td>
<td>LTCP Process, Review of Alternatives, Preliminary Findings</td>
<td>6/14/2016</td>
<td>MAC</td>
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<tr>
<td>FAA</td>
<td>LTCP Status Update</td>
<td>6/29/2016</td>
<td>FAA</td>
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<tr>
<td>Municipal Planners (Cities, County)</td>
<td>LTCP Process, Review of Alternatives, Preliminary Findings</td>
<td>7/15/2016</td>
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<tr>
<td>MAC PD&amp;E Committee</td>
<td>LTCP Process, Review of Alternatives, Preliminary Findings</td>
<td>8/1/2016</td>
<td>MAC</td>
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<tr>
<td>Pilot Group/Tenant Meeting</td>
<td>LTCP Process, Review of Alternatives, Preliminary Findings</td>
<td>9/6/2016</td>
<td>Airport</td>
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<tr>
<td>Crystal City Council</td>
<td>LTCP Overview</td>
<td>9/8/2016</td>
<td>Crystal City Hall</td>
</tr>
</tbody>
</table>

The second phase will consist of the formal public review period after the draft plan has been completed and the MAC Board has approved it for public distribution. This public review period will include a 45-day written comment period with two public information meetings scheduled during this timeframe.

The third phase will occur after the public comment period closes. During this time, public feedback will be considered and incorporated into the plan as appropriate. The end result will be a final draft LTCP for Commission adoption and Metropolitan Council formal review. During this time, stakeholder outreach will continue to occur on an as-needed basis.
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SECTION 1:
INTRODUCTION AND BACKGROUND
1. INTRODUCTION AND BACKGROUND

1.1 OVERVIEW

The Metropolitan Airports Commission (MAC) was created in 1943 by the Minnesota Legislature to promote air transportation in the seven-county metropolitan area. The MAC’s 15-member board of commissioners, which sets the MAC’s policies, consists of 13 appointments by Minnesota's Governor and one appointment each by the mayors of Minneapolis and St. Paul. The MAC’s policies are implemented by the MAC's Executive Director/Chief Executive Officer and staff.

Crystal Airport is one of seven airports owned and operated by the MAC (Figure 1-1). The airport identifier is MIC. The airport is located in Hennepin County, approximately seven miles northwest of downtown Minneapolis. It lies within the City of Crystal, with small portions of airport property overlapping into the City of Brooklyn Park and the City of Brooklyn Center (Figure 1-2). Hennepin County Road 81 (CR 81) runs northwest/southeast adjacent to the airport on the airport’s western border, Interstate 94/694 is a half-mile north of the airport, and State Highway 169 is 2-1/2 miles to the west. Crystal Airport encompasses approximately 436 acres of land – a physical footprint that has not changed since the mid-1960s.

The Airport plays an important role in the MAC system of airports and serves as a reliever airport to MSP by attracting general aviation traffic. This helps relieve congestion at MSP, which, in turn, helps reduce operating costs and promotes sustainability. Crystal is the closest MAC airport to downtown Minneapolis.

The Crystal Airport began operations in 1950, and the existing airfield configuration has been in place since the mid 1960’s. Due to the density of development adjacent to the airport and lack of additional land for facility development, no future expansions were contemplated and thus no long-term planning studies were undertaken.

In 1995 MAC initiated preparation of the first Long-Term Comprehensive Plan (LTCP) for Crystal Airport to evaluate future activity levels and address community questions about the long-term future of the facility through the year 2015 (“2015 LTCP”). The draft 2015 LTCP concluded that while Crystal Airport had little room for new development, it was a valuable contributor to the Metropolitan system of Airports and that closure was not a viable alternative. Although the draft plan did not recommend major development of the Airport, it did include several small projects that would enhance efficiency and aesthetics. Ultimately, the draft 2015 LTCP was never adopted by MAC or formally reviewed by the Metropolitan Council due to outstanding issues with runway obstructions and utilities.

The most recent LTCP for Crystal Airport prepared by the MAC and approved by the Metropolitan Council is dated December 2008, with a planning horizon year of 2025 (2025 LTCP). The 2025 LTCP recommended a plan to “right-size” the airfield to better align airport infrastructure and complexity with activity levels. To do this, the preferred alternative in the plan is to decommission both the turf runway (6R-24L) and south parallel runway (14R-32L), leaving a two-runway system in place. This plan not only simplifies the airfield, but opens up some property for both aeronautical and non-aeronautical development opportunities.
The purpose of the Crystal Airport 2035 Long-Term Comprehensive Plan is to validate and update, as needed, the findings of the previous 2025 LTCP, and to extend the planning horizon for an additional ten years through 2035. The LTCP is an infrastructure planning tool updated on a regular basis. It is forward-looking in nature, and does not authorize actual construction.

The plan will provide a “road map” to guide MAC’s development and capital improvements planning strategy for Crystal Airport over the next 5-10 years by renewing aviation activity forecasts, confirming facility needs and refining alternatives identified from the previous LTCP to meet those needs.

A glossary of terms used throughout this report is provided in Appendix 1.

1.2 GUIDING PRINCIPLES

Guiding principles establish a foundation for and parameters against which planning-related decisions are evaluated. These principles provide focus and direction in formulating a recommended development plan – in this case for Crystal Airport. The principles also act as a high-level explanation of the purpose and objectives of the planning process.

By nature, these guiding principles are dynamic and may be adjusted over time.

Airport Role

Operating within a diverse system of metropolitan area airports, Crystal Airport’s primary role is to serve personal, recreational, and some business aviation users in the northwest metropolitan area, including the cities of Crystal, Brooklyn Park, Brooklyn Center, and Minneapolis. Examples of business services provided at Crystal Airport include flight training, aircraft rentals, charter flights, aircraft and propeller maintenance, sale of aircraft avionics and parts, and medical flight transportation.

The primary role of Crystal Airport is not expected to change during the planning period. The Airport’s classification will continue to be that of:

- A Complimentary Reliever in the Metropolitan Airports Commission (MAC) system;
- An Intermediate Airport per Minnesota Department of Transportation/Office of Aeronautics (MnDOT); and
- A Minor Airport per the Metropolitan Council Regional Aviation System Plan.

The aircraft mainly anticipated to use Crystal Airport – and that which it is designed for – will continue to be a family of small, propeller-driven airplanes with fewer than 10 passenger seats.

The proposed plan does not contemplate upgrading the role of Crystal Airport to accommodate a larger aircraft family or scheduled passenger or cargo flights. Nor does the plan contemplate downgrading the role of Crystal Airport.
Airport Infrastructure

Key airfield improvement objectives for Crystal Airport are to:

- Right-size the airfield to match existing and forecasted activity levels;
- Preserve and, if possible, improve operational capabilities for the current family of aircraft using the facility; and
- Enhance safety by simplifying the runway and taxiway layout.

The planning process will ensure proposed airfield development conforms to Federal Aviation Administration (FAA) and MnDOT regulations, design standards, and system plans to the extent practical and feasible.

Wherever prudent, development plans will make use of existing facilities through renewal, modernization and/or infill development.

Stakeholder and Community Engagement

The planning process will seek to foster consensus among stakeholders, including tenants and users, the FAA, MnDOT, the Metropolitan Council, the Metropolitan Airports Commission, and local governmental bodies.

Airport development and maintenance plans should consider the objectives of local governmental bodies, including partnering with these bodies to promote regional economic development and local land use compatibility.

The planning process will include a public involvement program to inform and educate interested parties of possible plans for Crystal Airport’s future and any associated community impacts, and to consider community feedback received.

Land Use Compatibility & Environmental Considerations

A significant investment has been made in Crystal Airport, warranting the need to protect the facility from new non-compatible off-airport developments that could impact existing and future operations at the Airport.

Existing zoning and land use controls should be maintained, unless otherwise modified, to facilitate the long-term plan implementation in a manner that acknowledges the urban nature of the neighborhoods surrounding Crystal Airport and encourages compatible development.

In service to all parties, operation and development of Crystal Airport will promote initiatives to incorporate environmental stewardship and infuse sustainable thinking.

Financial Viability

Development at Crystal Airport will continue to be self-funded by users of the airport and aviation system; no local sales or property taxes will be used to fund airport improvements.

- All facility improvements will be funded through pursuing FAA and MnDOT grants first, with MAC funding as a secondary source.
• Future development at Crystal Airport should promote financial self-sufficiency to the maximum extent practical, including strategies to encourage tenant investments in facility improvements and/or new facilities, and other non-aeronautical revenue generation.

1.3 AIRPORT HISTORY

The first airfield in the Crystal area began operations in the early 1920s, when Eugene Shank moved his flying service to an open field near the intersection of West Broadway and 49th Avenue N, about one mile to the southwest of the current Crystal Airport. Closed by World War II, the site of Shank’s Flying Service is now a city park and memorial garden.

During the mid-1940’s, two sites were considered as possible locations for a new MAC airport in the northwest metropolitan suburbs. The first site was located to the north of the City of Crystal, while the second site was further to the south. While MAC first focused on the northern site, other influences ultimately led to the selection of the south site for the airport. In December 1948, MAC initiated efforts to acquire the property for Crystal Airport and by 1949 had approved plans for the construction of a stabilized base for a northwest-southeast runway, aprons, and taxiways. In 1950, MAC awarded contracts for the construction of an administration building and runway lights and flight operations began. By 1952, Crystal Airport consisted of a 2,500-foot long by 75-foot wide paved northwest-southeast runway, a parallel turf runway, and two crosswind northeast-southwest turf runways. The existing Administration Building was in place, as were the adjacent aprons and edge taxiways.

During the early 1950’s, activity at Crystal Airport began to increase dramatically. MAC recognized that additional land was needed for runway extensions and better approach protection. In October 1951, MAC approved the acquisition of 34 additional acres of land for these purposes. To further protect runway approaches and to provide additional buffer space to adjacent residential developments, the purchase of the northeast and southeast corners of the airport was approved by MAC in March 1954.

By 1961, the primary runway had been extended to its current length and the northernmost crosswind runway was paved at a length of 2,500-feet long by 75-feet wide. Taxiways leading to the East and West Building Areas were also established.

By 1968, the turf northwest-southeast runway had been paved and the taxiway leading to the North Building Area was in place. Except for paved runways that were added to Runway 13L-31R (now 14L-32R) in the early 1990’s, the airfield configuration at Crystal Airport has remained unchanged from the late 1960s. Airport plans throughout the 1960s and early 1970s contemplated an extension of both northwest-southeast parallel runways to a length of 3,750 feet, but these extensions were removed from the plans in 1978.

After a series of aircraft accidents in 1982, a Tri-City Commission was formed. The Commission was made up of representatives from MAC, airport users, and the cities of Crystal, Brooklyn Park and Brooklyn Center. It was charged with heightening awareness of pilots and citizens with regard to the Airport and the surrounding environment.

Several flight schools, charter services, and aircraft repair stations have done business at Crystal Airport over the years. Crystal Shamrock, established in 1959 by partners Lee
Gilligan, Lyle Norman, and Robert Peterson, was one of the more dynamic operations. Gilligan established a flight school that allowed pilots to be trained and eligible for a Private Pilot Certificate in just five hours of training. Crystal Shamrock’s flight training program was instrumental in training many pilots who went on to airline and corporate flying careers. Later, in 1972, Crystal Shamrock acquired two DC-3 aircraft to be used in an air taxi role. Typical charter flights for these aircraft included Canadian fishing trips and transporting college sports teams. Crystal Shamrock closed in 2007.

In 1951, Ken Maxwell established Maxwell Aircraft Service, otherwise known as the “Prop Shop”, at Crystal Airport. Today, it is the oldest active business at the Airport and is known nationwide as a leader in the servicing and overhauling of aircraft propellers and governors.

The existing FBO, Thunderbird Aviation, began operations at Crystal Airport in 1975 through the purchase of Lakeland Flight Services. Throughout the 1980s and 1990s, Thunderbird became a recognized leader in its core business of flight training. To meet the influx of demand for new pilots, Thunderbird started the Academy College of Aviation that offered a two-year career-focused degree program in aviation and provided financial aid to assist students with flying costs. Although new pilot starts slowed dramatically after the events of 9/11, flight training remains as one of Thunderbird’s major activities at Crystal Airport.

Table 1-2 summarizes key airfield development milestones at Crystal Airport. Figure 1-3 illustrates the progression of airfield pavement construction at Crystal.

Table 1-1: Airfield Development Timeline

<table>
<thead>
<tr>
<th>Year</th>
<th>Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950-1952</td>
<td>Runway 14L-32R constructed 2,500 feet long, with full-length parallel taxiway.</td>
</tr>
<tr>
<td></td>
<td>The air traffic control tower, administration building, and taxiways on either side also constructed along with airport access road.</td>
</tr>
<tr>
<td>1957</td>
<td>Runway 06L-24R constructed with full-length parallel taxiway. Access road to the west building area also constructed.</td>
</tr>
<tr>
<td>1960-1961</td>
<td>Runway 14L-32R and parallel taxiway extended to current length. East building area and west building area taxiways constructed.</td>
</tr>
<tr>
<td>1968</td>
<td>Runway 14R-32L constructed. Access roads constructed to the east and north building areas.</td>
</tr>
</tbody>
</table>

Source: MAC records

Several additional historical airport planning records are reproduced in Appendix 3.
1.4 AIRPORT CLASSIFICATION AND CONTEXT

The definition of “classification” for an airport differs slightly between the MAC, FAA, MnDOT, and the Metropolitan Council.

1.4.1 MAC Classification

In January 2006, the MAC accepted the Recommendations Regarding the Future Operation and Development of the Reliever Airport System prepared by the MAC Reliever Airports Task Force. That document identifies Crystal Airport as a “complimentary reliever” in the MAC-owned airport system. Other “complimentary reliever” airports listed are Airlake Airport in Lakeville and Lake Elmo Airport in Washington County. The other MAC-owned relievers, the St. Paul Downtown Airport, the Anoka County – Blaine Airport and the Flying Cloud Airport in Eden Prairie, are “primary relievers”. By the MAC’s definition, this “primary reliever” classification identifies them as better equipped to serve small business jets and corporate aircraft in addition to general aviation.

1.4.2 FAA Classification

The FAA’s National Plan of Integrated Airport Systems (NPIAS) identifies airports that are significant to national air transportation. Airports designated as part of the NPIAS are eligible for FAA Airport Improvement Program (AIP) funding. The NPIAS is updated by the FAA every two years and comprises all commercial airline service airports, reliever airports and qualifying general aviation airports.

In cooperation with the aviation community, the FAA completed two top-down reviews of the existing network of general aviation facilities included in the NPIAS. The results of these efforts are contained in the May 2012 report titled General Aviation Airports: A National Asset (ASSET 1) and the March 2014 report entitled ASSET 2: In-Depth Review of 497 Unclassified Airports.

As part of these efforts, the FAA documented the important airport roles and aeronautical functions these facilities provide to their communities and the national airport system. These functions include emergency preparedness and response, direct transportation of people and freight, commercial applications such as agricultural spraying, aerial surveying and oil exploration, and many others. Many of these functions cannot be supported efficiently or economically at larger commercial service airports.

The latest version of the NPIAS, which was released in September 2014 and covers the five-year period between 2015 and 2019, identifies both a Service Level and Asset Role for each airport in the plan. The Service Level describes the type of service the airport currently provides to the community and is anticipated to provide at the end of the five-year planning period. The Asset Role was assigned using operational categories developed in the ASSET 1 report.

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3 Additional information is available at: http://www.faa.gov/airports/planning_capacity/npias/reports/
4 Additional information is available at: http://www.faa.gov/airports/planning_capacity/ga_study/
In the 2015-2019 NPIAS, the FAA classifies Crystal Airport as follows:

- **Service Level: Reliever**
  
  The FAA has encouraged the development of high-capacity general aviation airports in major metropolitan areas. These specialized airports, called relievers, provide pilots with attractive alternatives to using congested commercial airports. They also provide general aviation access to the surrounding area. To be eligible for reliever designation, these airports must be open to the public, have 100 or more based aircraft, or have 25,000 annual itinerant operations.

- **Asset Role: Regional**
  
  Regional airports support regional economies by connecting communities to statewide and interstate markets. These airports accommodate a full range of regional and local business activities. They serve corporate and multi-engine aircraft, as well as single-engine propeller aircraft.

Definitions for other FAA airport classification categories are provided in the Glossary of Terms (Appendix 1) under the term “Airport Classifications”.

1.4.3 **MnDOT Classification**

MnDOT classifies Crystal Airport as an Intermediate Airport. Intermediate Airports have a paved and lighted primary runway that is less than 5,000 feet in length. These airports are capable of accommodating all single-engine aircraft, some multi-engine aircraft (including turboprops), and some business jets. Intermediate Airports serve as landing facilities for flight training, aircraft maintenance, and general aviation aircraft up to the smaller business jet size.

Of the other relievers in the MAC system, Airlake and Lake Elmo are also classified as Intermediate Airports per MnDOT criteria. Definitions for other MnDOT airport classification categories are provided in the Glossary of Terms (Appendix 1) under the term “Airport Classifications”.

1.4.4 **Metropolitan Council Classification**

The Metropolitan Council has been involved in aviation system planning since the 1970s. The Council develops a regional development framework every 10 years, the most recent being Thrive MSP 2040, which was adopted in 2014. The regional transportation policy plan (TPP) which provides transportation policy guidance to regional governmental units is updated every four years. Included in the TPP is the aviation system plan, which is updated every eight years. The Council prepares and maintains the plan, which provides strategies to help the Twin Cities enhance access to domestic and international markets. The last update to the Regional Aviation System Plan was the 2030 Twin Cities Aviation System Technical Report (December 2009). The Council works closely with the Metropolitan Airports Commission (MAC) and other airport owners to ensure that the region's airports provide state-of-the-art, secure and affordable services for business and leisure travelers, freight transport and general aviation activities. The Council coordinates aviation planning and community development with local, state and federal governmental units, airport users and citizens.
The Metropolitan Council classifies Crystal Airport as a Minor Airport. Under this definition, the airport has a primary runway length between 2,500 and 5,000 feet, with either a precision or non-precision approach. The airport can accommodate personal use and recreational aircraft, business general aviation and air taxi traffic, flight training and military operations. All of the other relievers in the MAC system, with the exception of the St. Paul Downtown Airport, are classified as Minor Airports per Metropolitan Council criteria. Definitions for other Metropolitan Council airport classification categories are provided in the Glossary of Terms (Appendix 1) under the term “Airport Classifications”.

1.4.5 Airport Context

According to the latest *Minnesota State Aviation System Plan (SASP)*\(^6\) published in 2013, Crystal Airport is one of 83 Intermediate Airports in the state. Of these 83 Intermediate Airports, Crystal Airport ranked:

- 3\(^{rd}\) in terms of the number of total based aircraft; and
- 2\(^{nd}\) in terms of the number of general aviation aircraft operations.

Only South St. Paul/Fleming Field has more aircraft operations, while only South St. Paul/Fleming Field and Lake Elmo Airport have more based aircraft. If activity at Crystal Airport is compared to all airports in the state, not just peer Intermediate airports, it still ranks in the top 10 for aircraft operations and in the top 5 for based aircraft.

\(^6\) Additional information available at: [http://www.dot.state.mn.us/aero/planning/sasp.html](http://www.dot.state.mn.us/aero/planning/sasp.html)
Figure 1-1: Metropolitan Airports Commission Airports in the Seven-County Area

Metropolitan Council Airport Classification

- MAJOR
- INTERMEDIATE
- MINOR
Figure 1-2: Airport Vicinity
Figure 1-3: Crystal Airport Airfield Development Progression
SECTION 2:

EXISTING CONDITIONS
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2. EXISTING CONDITIONS

2.1 INTRODUCTION

This chapter summarizes the existing facility, land use, infrastructure, and environmental data that are relevant to the preparation of this LTCP. The information presented in this chapter is current as of June 2016, except where noted.

2.2 IMPROVEMENTS SINCE LAST LTCP

The following facility improvements have been completed at Crystal Airport since the completion of the last LTCP:

- Reconstruction of Runway 14L-32R, including segments of Taxiway E connectors in the Runway Safety Area and paved overruns, and new runway lighting in 2008;
- Reconstruction of taxilanes in the West and South Building Areas in 2009;
- Rehabilitation of hangar alleyways in the North Building Area in 2011;
- Reconstruction of Taxiway A from Taxiway F to the FBO, and rehabilitation of Taxiway A between Taxiways E and F, in 2012;
- Airfield Signage and Electrical System improvements in 2012;
- Reconstruction of portions of Taxiway C, B, and E4, along with removal of former Crystal Shamrock FBO apron, in 2014;
- Installation of a Precision Approach Path Indicator (PAPI) visual glideslope indicator system for Runway 14L in 2014 (by FAA); and
- Demolition of a portion of the former Helicopter Flight Inc. (HFI) hangar in 2016.

2.3 EXISTING AIRSIDE FACILITIES

Airside facilities include the operational aircraft areas of runways, taxiways, and aprons. These are areas where vehicular traffic is generally not allowed due to safety concerns of mixing with aircraft. Airside facilities also include airfield lighting and navigational aids.

2.3.1 Pavement Areas and Design Standards

Crystal Airport has four runways – three paved and one turf. The primary runways, 14L-32R and 14R-32L, are 3,267 feet and 3,266 feet long, respectively, and both are 75 feet wide. These runways have a full-length parallel taxiway (Taxiway E) with four sets of connectors (Taxiways E1 through E4). The Taxiway E system varies in width between 30 and 40 feet. The paved crosswind runway, 06L-24R, is 2,499 feet long and 75 feet wide. The Runway 06L landing threshold is displaced by 388 feet, while the Runway 24R landing threshold is displaced by 386 feet, to clear off-airport obstructions. The turf runway, 06R-24L, is 2,123 feet long and approximately 137 feet wide. Turf Runway 06R-24L is open seasonally from May through October.

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7 Turf Runway 06R-24L is open seasonally from May through October.
also have a full-length parallel taxiway (Taxiway A) that is 30 feet wide. There are also taxiways connecting the north, east, and west building areas to the runway ends.

The Runway 14L and 32R ends feature a paved overrun\(^8\). These paved overruns are not considered to be useable pavement when calculating aircraft takeoff or landing distance requirements.

The airport has several apron areas that are used primarily for aircraft maneuvering between parking and taxiways. Run-ups and pilot checks can also be performed in these areas. Aprons areas are primarily associated with existing or former commercial operations, including the following:

- **South Building Area:**
  - Thunderbird Aviation FBO apron (southwest end of Taxiway A);
  - Public apron (southwest of ATCT/Administration Building);
  - North of Sixty apron (southeast of ATCT/Administration Building);
  - Maxwell (under private lease); and
  - North Memorial Air Care (under private lease).

- **West Building Area:**
  - The former Crystal Shamrock FBO apron has been removed.

- **North Building Area:**
  - Former Flying Scotchman FBO apron (under private lease).

The existing airport layout is depicted in Figure 2-1.

All of the airfield areas at Crystal Airport are asphalt, with the exception of the turf runway. Pavements vary in age, thickness, and structural section. Over time, pavement overlays, rehabilitation, reconstruction and/or crack repair methods have changed the characteristics of the pavement from section to section.

The Airport Pavement Management Program for the MAC Relievers has included periodic pavement condition inspections, most recently in 2013. The inspections were completed in accordance with FAA guidelines and utilized the Pavement Condition Index (PCI) Method.

PCI evaluation includes a visual inspection of pavements and assignment of a numerical indicator that reflects the structural and operational condition of the pavement, including the type, severity, and quantity of pavement distress. The numerical PCI value range for a specific, distinct section of airfield pavement can be defined as follows:

- **PCI 81-100:** Pavement in Excellent Condition (No or Minor Stress) – 30 percent of existing pavement areas;

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\(^8\) The Runway 14L paved overrun is 493 feet long, while the Runway 32R paved overrun is 500 feet long.
• PCI 61-80: Pavement in Satisfactory Condition (Minor Stress) – 17 percent of existing pavement areas;
• PCI 41-60: Pavement in Fair Condition (Moderate Stress) – 7 percent of existing pavement areas;
• PCI 21-40: Pavement in Poor Condition (Major Stress) – 46 percent of existing pavement areas; and
• PCI 0-20: Pavement in Serious Condition (Failed) – No airfield pavement areas fall within this classification.

An exhibit depicting the condition of pavements by PCI at Crystal Airport is provided in Figure 2-2.

Table 2-1 provides a summary of existing runway characteristics at Crystal Airport.
Table 2-1: Existing Runway Characteristics

<table>
<thead>
<tr>
<th>Runway Characteristics</th>
<th>14L-32R</th>
<th>14R-32L</th>
<th>06L-24R</th>
<th>06R-24L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Runway Length (feet)</td>
<td>3,267</td>
<td>3,266</td>
<td>2,499</td>
<td>2,123</td>
</tr>
<tr>
<td>Runway Width (feet)</td>
<td>75</td>
<td>75</td>
<td>75</td>
<td>137</td>
</tr>
<tr>
<td>Published Pavilion Strength (lbs.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single-Wheel Loading (SW)</td>
<td>13,000</td>
<td>13,000</td>
<td>12,500</td>
<td>12,500</td>
</tr>
<tr>
<td>Pavement Type</td>
<td>Asphalt</td>
<td>Asphalt</td>
<td>Asphalt</td>
<td>Turf</td>
</tr>
<tr>
<td>Effective Gradient</td>
<td>0.04%</td>
<td>0.04%</td>
<td>0.08%</td>
<td>0.09%</td>
</tr>
<tr>
<td>Runway End Elevation (ft. AMSL)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14L-32R</td>
<td>868.5</td>
<td>867.2</td>
<td>868.1</td>
<td>866.9</td>
</tr>
<tr>
<td>14R-32L</td>
<td>868.1</td>
<td>869.2</td>
<td>867.1</td>
<td></td>
</tr>
<tr>
<td>06L-24R</td>
<td>868.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>06R-24L</td>
<td>867.0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The physical design strength of paved runways is 30,000 lbs. (single-wheel loading)

Source: AGIS Aeronautical Survey (2013); FAA Airport Master Record; MAC Records
**FAA Design Standards**

FAA airport design standards provided in Advisory Circular (AC) 150/5300-13A, Change 1, *Airport Design*, provide basic guidelines for a safe and efficient airport system. Conformity to the FAA’s standards ensures that aircraft in a particular category can safely operate at the airport.

Planning improvements to an existing airport requires the selection of one or more “design aircraft” that represent a collection, or composite family, of aircraft that are intended to be accommodated by the airport on a regular basis. In the case of an airport with multiple runways, a design aircraft is selected for each runway.

For the purposes of airport geometric design, the design aircraft is classified by three parameters:

- Aircraft Approach Category (AAC): A classification of aircraft based on a referenced approach landing speed;
- Airplane Design Group (ADG): A classification of aircraft based on wingspan and tail height; and

The selected AAC, ADG, and desired approach visibility minimums (generally expressed in statute miles or feet) are combined to form the Runway Design Code (RDC) for a particular runway. The RDC is used to determine the standards that apply to a specific runway and parallel taxiway to allow unrestricted operations by the design aircraft under defined meteorological conditions.

The Airport Reference Code (ARC) is a designation that signifies the airport’s highest RDC. The ARC is used for planning and design only and does not limit the aircraft that may be able to operate safely on the airport.

In the case of Crystal Airport, the existing design aircraft is represented by the family of propeller-driven aircraft with fewer than 10 passenger seats. This is an FAA-defined category of aircraft with similar operating characteristics. Design parameters associated with this aircraft family are as follows:

- AAC: A/B (approach speed less than 121 knots);
- ADG: I/II (wingspan up to but not including 79 feet and tail height less than 30 feet);
- TDG: 2 (main landing gear width 20 feet or less and cockpit-to-main gear distance less than 64 feet); and
- Approach visibility minimums: 5,000 feet, which corresponds to visibility minimums of not lower than one statute mile.

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9 Regular use is considered as at least 500 or more annual itinerant operations of the runway by the critical design aircraft.
From an airfield facility requirements perspective, this composite aircraft family is represented by the Beechcraft King Air 200 (ARC B-II), Pilatus PC-12 (ARC A-II), and the Piper PA31 Navajo (ARC B-I). Based on these parameters, the Airport Reference Code (ARC) for Crystal Airport is B-II.

The corresponding RDC for Runway 14L-32R is A/B-II-5,000. According to the FAA, for airports with two or more runways, it is often desirable to design all airport elements to meet the requirements of the most demanding RDC and TDG. In order to preserve operational flexibility, the RDC for Runways 14R-32L and 06L-24R will also be designated as A/B-II-5,000. The RDC for turf Runway 6R-24L is A-I-VIS (visual).

**Table 2-2** summarizes selected FAA runway design standards for RDC A/B-II-5,000 facilities. In some cases, the FAA has designated a less stringent standard for runways designed to be used regularly by small aircraft with maximum certificated takeoff weights of 12,500 pounds or less. Variations in the standards for small aircraft are noted with parentheses in **Table 2-2**.

**Runway Safety Areas, Object Free Areas, and Obstacle Free Zones**

The Runway Safety Area (RSA) is a defined surface surrounding the runway prepared or suitable for reducing the risk of damage to aircraft in the event of an undershoot, overshoot, or excursion from the runway.

Existing RSAs at Crystal Airport extend 300 feet beyond each runway end and are 150 feet wide. The existing RSAs meet FAA standards for the specified RDC.

The Runway Object Free Area (ROFA) is an area centered on the runway provided to enhance the safety of aircraft operations by remaining clear of objects, except for objects that need to be located in the ROFA for air navigation or aircraft ground maneuvering purposes.

Existing ROFAs at Crystal Airport extend 300 feet beyond each runway end and are 500 feet wide. The existing ROFAs meet FAA requirements for the specified RDC.

The RSA and ROFA layout is depicted in **Figure 2-3**.

The Runway Obstacle Free Zone (ROFZ) is three-dimensional airspace along the runway and extended runway centerline that is required to be clear of obstacles, including aircraft, for protection of landing takeoff operations from the runway and for missed approaches.

Existing ROFZs at Crystal Airport extend 200 feet beyond each runway end and are 250 feet wide based on the location of the runway hold short markings on the connector taxiways. The existing ROFZs meet FAA requirements for the specified RDC, but only for small aircraft. To meet the requirements for large aircraft, the ROFZs would have to be 400 feet wide and the hold short lines moved to match this distance.
Table 2-2: FAA Runway Design Standards

<table>
<thead>
<tr>
<th>Design Standard</th>
<th>RDC A/B-II-5,000</th>
<th>Dimension (Fig. 2-3)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Runway Protection</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Runway Safety Area (RSA)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length Beyond Departure End (feet)</td>
<td>300</td>
<td>R</td>
</tr>
<tr>
<td>Length Prior to Threshold (feet)</td>
<td>300</td>
<td>R</td>
</tr>
<tr>
<td>Width (feet)</td>
<td>150</td>
<td>B</td>
</tr>
<tr>
<td>Runway Object Free Area (ROFA)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length Beyond Runway End (feet)</td>
<td>300</td>
<td>R</td>
</tr>
<tr>
<td>Length Prior to Threshold (feet)</td>
<td>300</td>
<td>R</td>
</tr>
<tr>
<td>Width (feet)</td>
<td>500</td>
<td>A</td>
</tr>
<tr>
<td>Runway Obstacle Free Zone (ROFZ)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length Beyond Runway End (feet)</td>
<td>200</td>
<td>n/a</td>
</tr>
<tr>
<td>Width (feet)</td>
<td>400 (250)</td>
<td>C</td>
</tr>
<tr>
<td>Runway Protection Zone (RPZ)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length (feet)</td>
<td>1,000</td>
<td>L</td>
</tr>
<tr>
<td>Inner Width (feet)</td>
<td>500 (250)</td>
<td>Q</td>
</tr>
<tr>
<td>Outer Width (feet)</td>
<td>700 (450)</td>
<td>V</td>
</tr>
<tr>
<td><strong>Runway Separation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Centerline to Holding Position (feet)</td>
<td>200 (125)</td>
<td>n/a</td>
</tr>
<tr>
<td>Centerline to Parallel Taxiway (feet)</td>
<td>240</td>
<td>n/a</td>
</tr>
<tr>
<td>Centerline to Aircraft Parking (feet)</td>
<td>250</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Notes:
Standards listed are for visibility minimums not less than one mile
Standards in parenthesis are for utility runways designated to accommodate small aircraft
See Figure 2-3 for a graphical depiction of these dimensions

Source: FAA Advisory Circular 150/5300-13A, Change 1

**Runway Protection Zones**
The Runway Protection Zone (RPZ) is an area at ground level prior to the threshold or beyond the departure runway end to enhance the safety and protection of people and property on the ground. According to the FAA, this is best achieved through airport owner control over RPZs. Control is preferably exercised through the acquisition of sufficient property interest in the RPZ and includes clearing of RPZ areas, and maintaining them clear, of incompatible objects and activities. The FAA expects airport sponsors to take
all possible measures to protect against and remove or mitigate incompatible land uses in the RPZ.

The RPZ is trapezoidal in shape and centered about the extended runway centerline. It is comprised of two components. The Central Portion of the RPZ extends from the beginning to the end of the RPZ at a width equal to the width of the ROFA. The Controlled Activity Area is the remaining area of the RPZ on either side of the Central Portion. The RPZ dimension for a given runway end is defined by the RDC. The RPZ layout is depicted in Figure 2-3.

Based on the current runway designations (see Section 2.3.5), RPZs at Crystal Airport have dimensions as listed in Table 2-3:

**Table 2-3: Existing RPZ Dimensions**

<table>
<thead>
<tr>
<th>Runway End</th>
<th>Distance from End (feet)</th>
<th>Inner Width (feet)</th>
<th>Outer Width (feet)</th>
<th>Length (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Runway 06L</td>
<td>200</td>
<td>500</td>
<td>700</td>
<td>1,000</td>
</tr>
<tr>
<td>Runway 24R</td>
<td>200</td>
<td>500</td>
<td>700</td>
<td>1,000</td>
</tr>
<tr>
<td>Runway 06R (Turf)</td>
<td>200</td>
<td>250</td>
<td>450</td>
<td>1,000</td>
</tr>
<tr>
<td>Runway 24L (Turf)</td>
<td>200</td>
<td>250</td>
<td>450</td>
<td>1,000</td>
</tr>
<tr>
<td>Runway 14L</td>
<td>200</td>
<td>500</td>
<td>700</td>
<td>1,000</td>
</tr>
<tr>
<td>Runway 32R</td>
<td>200</td>
<td>500</td>
<td>700</td>
<td>1,000</td>
</tr>
<tr>
<td>Runway 14R</td>
<td>200</td>
<td>500</td>
<td>700</td>
<td>1,000</td>
</tr>
<tr>
<td>Runway 32L</td>
<td>200</td>
<td>500</td>
<td>700</td>
<td>1,000</td>
</tr>
</tbody>
</table>

Source: FAA Advisory Circular 150/5300-13A, Change 1; FAA Airport Master Record

Runway 06L-24R has both approach and departure RPZs in place due to the threshold displacements.

In 2012, the FAA issued Interim Guidance to clarify its policy on what constitutes a compatible land use within an RPZ and how to evaluate proposed land uses that would reside in an RPZ\(^\text{10}\). Coordination with the FAA in the form of an Alternatives Analysis is required when any of the following land uses would enter the limits of the RPZ due to a triggering airfield project, an off-airport development proposal, or other operational change at the airport:

- Buildings and Structures;
- Recreational Land Uses;

\(^{10}\) Additional information available at: https://www.faa.gov/airports/planning_capacity/media/interimLandUseRPZGuidance.pdf
• Transportation Facilities, including rail facilities, public roadways, and vehicular parking facilities;
• Fuel storage facilities;
• Hazardous materials storage;
• Wastewater treatment facilities; and
• Above-ground utility infrastructure, including solar panel installations.

The existing RPZ’s at Crystal Airport include several land uses that are not automatically considered compatible under the FAA’s current guidance. However, since these land uses predate the FAA’s current guidance, they are acceptable to remain as an existing condition.

• Existing Runway 14L and 14R Ends: Douglas Drive and two (2) private residential parcels. Douglas Drive is designated as a local road that provides access to the airport and adjacent residential development. By definition, a local roadway serves less than 1,000 vehicles per day. Although no recent traffic study is known to exist for this section of Douglas Drive, vehicle counts taken on other local roadways in the vicinity of the Airport suggest average daily traffic levels in the range of 300 – 500 vehicles. There are no current plans to increase the capacity of this roadway.

• Existing Runway 32R and 32L Ends: Eight (8) off-airport residential parcels. A non-public airport access roadway will continue to traverse the 32R RPZ as well, but this road is access controlled such that it only accommodates airport-related traffic.

• Existing Runway 06L and 06R Ends: County Road 81 (Bottineau Boulevard), freight rail (BNSF), ten (10) private residential parcels.

• Existing Runway 24L and 24R Ends: Sixteen (16) off-airport residential parcels.

In early 2014, the Hennepin County Regional Railroad Authority submitted an RPZ Alternatives Analysis to FAA for the proposed construction of the Bottineau Transitway (Blue Line Extension) Light Rail Transit (LRT) corridor adjacent to and within the existing BNSF freight rail line that runs parallel to County State Aid Highway (CASH) 81 and traverses the Runway 06L RPZ. This analysis considered alternatives such as tunneling the LRT Transitway under the RPZ, realigning it outside of the RPZ, or shortening Runway 06L-24R to shift the RPZ so that the LRT Transitway would be clear. The study concluded that constructing the LRT Transitway within the existing BNSF right-of-way was the preferred option due to cost and operational impracticalities associated with the alternatives. FAA concurred with the conclusions of the RPZ Alternatives Analysis in a letter provided on November 24, 2014. Further information about the Bottineau Transitway (Blue Line Extension) LRT corridor is available via the following link:

Runway Separation Standards
For Runway 14R-32L, the separation distance to parallel Taxiway E is currently 214 feet, deficient of the 240-foot FAA criteria by 26 feet. Analyzing the existing condition further, the wingtip of the representative critical design aircraft (Beechcraft King Air 200 with a 58-foot wingspan) taxiing on Taxiway E remains clear of the ROFZ by approximately 60 feet. Thus, the existing runway to taxiway separation is considered adequate for the type of aircraft that operate at the airport. If Runway 14R-32L is converted into a parallel taxiway as recommended in the 2025 LTCP, this deviation from standards would be eliminated. Further, it would have a separation distance of 300 feet to Runway 14L-32R, exceeding the FAA criteria for the specified RDC.

For Runway 06L-24R, the separation distance to partial parallel Taxiway B is currently 225 feet, deficient of the 240-foot FAA criteria by 15 feet. The wingtip of a King Air 200 taxiing on Taxiway E remains clear of the ROFZ by approximately 70 feet. Thus, the existing runway to taxiway separation is considered adequate considering the type of aircraft that operate at the airport. A formal Modification to Design Standards will be sought from the FAA to document this condition as this configuration is not expected to change in the long-term plan.

For turf Runway 6R-24L, the separation distance to parallel Taxiway A is currently between 215 feet (south of Taxiway E) and 250 feet (north of Taxiway E). The section south of Taxiway E is deficient of the 240-foot FAA criterion by 25 feet. As with the instances above, the wingtip of a King Air 200 taxiing on Taxiway A remains clear of the ROFZ. If Runway 6R-24L is decommissioned as recommended in the 2025 LTCP, this deficiency will be eliminated.

Runway Shoulders
Runway shoulders are intended to provide a transition surface between the runway pavement and the adjacent surface, to support aircraft running off the pavement, provide blast protection, and enhance erosion control and drainage. For RDC A/B-II-5,000, the required runway shoulder width is 10 feet. Crystal Airport provides 10-foot wide stabilized turf shoulders on both runways.

Taxiway Standards
The FAA design standard for TDG-2 width is 35 feet. Taxiway widths at Crystal Airport currently range from 30 to 75 feet wide. Taxiways A, B, C, D, and E are 30 feet wide. These taxiway widths are deficient by five feet for this TDG. Connector Taxiway E1 is 75 feet wide, while Connector Taxiways E2, E3, and E4 are 40 feet wide. These taxiways exceed FAA width criteria for the specified RDC.

The Taxiway Safety Area (TSA) width for ADG II aircraft is 79 feet, which is met for all taxiways.

The Taxiway Object Free Area (TOFA) width for ADG II aircraft is 131 feet (65.5 feet each side of centerline), which is met for all taxiways expect in the following areas:

---

11 When these taxiways were originally designed and constructed, airport design standard for a basic utility airport specified a 30-foot taxiway width.
12 The current MAC standard for minimum taxiway width at the Reliever Airports is 40 feet.
• Taxiway A to east apron edge/movement area line is 56 feet;
• Taxiway E to south apron edge/movement area line is variable from 43 to 60 feet; and
• Taxiway C to north apron edge/movement area line is 48 feet.

Analyzing the existing condition further, the wingtip of the representative critical design aircraft (Beechcraft King Air 200 with a 58-foot wingspan requires a TOFA of approximately 51 feet (58-foot wingspan X 0.7 + 10 feet). Therefore, some adjustments to the location of the apron edge/movement area line may be warranted.

The FAA-recommended Taxilane OFA width is 115 feet for ADG II. However, based on when they were built, the majority of the hangar areas at Crystal Airport were designed for smaller ADG I aircraft, and therefore, offer less Taxilane OFA (79 feet).

Paved or stabilized shoulders are recommended along taxiways. ADG II aircraft require 15-foot shoulders. Existing taxiways at Crystal Airport provide 15-foot stabilized turf shoulders.

**Table 2-4** summarizes selected FAA taxiway design standards for Taxiway Design Group 2/Airplane Design Group II facilities.

**Airfield Geometry**
Improving runway safety continues to be one of FAA’s highest priorities, and the agency is working with airport sponsors to further reduce runway risks through risk-based decision making. Risk factors that contribute to runway incursions\(^\text{13}\) may include unclear taxiway markings, airport signage, and more complex issues such as the runway or taxiway layout.

At Crystal Airport, the legacy airfield configuration with two sets of parallel runways results in a degree of complexity that can be a contributing factor to pilot confusion and runway incursions. **Figure 2-4** provides a diagram showing the location of designated Hot Spots at Crystal Airport, which are designated locations on an airfield where heightened attention by pilots and drivers is necessary due to a complex or confusing configuration. Reducing the number of Hot Spots by simplifying the airfield layout and reducing the number of runway crossings for aircraft and vehicles should be a key consideration when evaluating future airfield development concepts.

---
\(^{13}\) Runway incursions occur when an aircraft, vehicle, or person enters the protected area of an airport designated for aircraft landings and take offs.
Table 2-4: FAA Taxiway Design Standards

<table>
<thead>
<tr>
<th>Taxiway Design Standard</th>
<th>TDG-2 / ADG-II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taxiway Width (feet)</td>
<td>35</td>
</tr>
<tr>
<td>Taxiway Edge Safety Margin (feet)</td>
<td>7.5</td>
</tr>
<tr>
<td>Taxiway Shoulder Width (Turf) (feet)</td>
<td>15</td>
</tr>
<tr>
<td><strong>Taxiway Protection</strong></td>
<td></td>
</tr>
<tr>
<td>Taxiway/Taxilane Safety Area Width (feet)</td>
<td>79</td>
</tr>
<tr>
<td>Taxiway Object Free Area Width (feet)</td>
<td>131</td>
</tr>
<tr>
<td>Centerline to Object (feet)</td>
<td>65.5</td>
</tr>
<tr>
<td>Wingtip Clearance (feet)</td>
<td>26</td>
</tr>
<tr>
<td>Taxilane Object Free Area Width (feet)</td>
<td>115</td>
</tr>
<tr>
<td>Centerline to Object (feet)</td>
<td>57.5</td>
</tr>
<tr>
<td>Wingtip Clearance (feet)</td>
<td>18</td>
</tr>
<tr>
<td>Taxiway Centerline Separation (feet)</td>
<td>105</td>
</tr>
<tr>
<td>Taxilane Centerline Separation (feet)</td>
<td>97</td>
</tr>
</tbody>
</table>

Notes:
- Taxilanes provide access from taxiways to aircraft parking areas.
- Taxilanes are designed for low speed and precise taxiing, making reduced clearances acceptable.

Source: FAA Advisory Circular 150/5300-13A, Change 1

2.3.2 Lighting and On-Airport Navigational Aids

Navigational aids (NAVAIDS) and runway lighting are intended to guide pilots from point to point, increase the visibility of runway features, and control runway activity both on the ground and in the air.

Runways 14L-32R and 06L-24R are lighted with Medium Intensity Runway Edge Lights (MIRLs) to increase the visibility of runway edges during nighttime or restricted-visibility conditions. The runway edge lights are white, except on instrument runways where yellow replaces white on the last 2,000 feet or half the runway length, whichever is less, to form a caution zone for landings. The lights marking the ends of the runway emit red light toward the runway to indicate the end of runway to a departing aircraft and emit green outward from the runway end to indicate the threshold to landing aircraft. The runway
lights operate on a photocell so they are on low intensity during nighttime hours. Radio control offers pilots the choice to click them to medium intensity.

Runway 14L-32R has Runway End Identifier Lights (REILs) at each end. REILs are synchronized flashing lights to help pilots visually acquire the runway end as they approach for landing.

There is currently no taxiway lighting at Crystal, but all taxiways have blue guidance reflectors.

Runway 14L is equipped with a Precision Approach Path Indicator (PAPI), while Runways 32R, 06L, and 24R are equipped with older technology Visual Approach Slope Indicators (VASIs). These systems use a combination of red and white lights visible only at certain angles that help pilots determine appropriate angles of descent during landings. These visual glide slope indicators are owned and maintained by FAA. The REILs and PAPI are operated by radio control along with the runway lights.

Runways 14R-32L and 6R-24L are not lighted, nor do they have navigational aids.

The airport also has a Remote Transmitter/Receiver (RTR) site that is owned and operated by the FAA. The antennae are located on the east side of the airport adjacent to the hangar area. An RTR is used to boost the airport radio signals so that pilots can file a flight plan from the airport.

The airport has a lighted airfield beacon and a lighted wind cone.

2.3.3 Airspace

The national airspace structure is complex and requires the use of highly technical air traffic control (ATC) procedures. Airspace is either controlled or uncontrolled. Controlled airspace is managed by ground-to-air communications, NAVAIDS and air traffic services. Figure 2-5 provides a graphical overview of the National Airspace System.

The Crystal Airport is located in what is considered Class D controlled airspace when the Airport Traffic Control Tower is open (7:00 am to 9:00 pm from October 1 to April 30 and 7:00 am to 10:00 pm from May 1 to September 30) and Class E airspace during the other times. Runways 14R-32L and 6R-24L are closed to aircraft operations when the Airport Traffic Control Tower is closed.

Class D airspace is under the jurisdiction of a local Airport Traffic Control Tower (ATCT). The purpose of the ATCT is to sequence arriving and departing aircraft and direct aircraft on the ground. Aircraft operating within this area are required to maintain radio communication with the ATCT. It is normally a circular area with a radius of five miles around the airport and extends upward from the surface to about 2,500 feet AGL. The ceiling elevation of Crystal’s Class D airspace is 3,400 feet MSL (2,531 feet above the airport elevation of 869 feet).

When the ATCT at Crystal is closed, the airspace classification is Class E. Class E airspace is a general category of controlled airspace that is intended to provide air traffic
service and separation for Instrument Flight Rules (IFR) aircraft from other aircraft. IFR means that the pilot is certified to fly under Instrument Meteorological Conditions (IMC) (less than three miles visibility and/or 1,000 foot ceilings). Pilots rated only for Visual Flight Rules (VFR) can operate in Class E airspace only when visibility is three statute miles and above and cloud heights are 1,000 feet above ground level (AGL) and higher. These pilots are not required to maintain contact with ATC. Class E airspace extends to 18,000 feet mean sea level (MSL) and generally fills in the gaps between other classes of airspace in the United States.

When the ATCT is closed, services are provided by Minneapolis Terminal Radar Approach Control (TRACON) located at Minneapolis-St. Paul International Airport, and assisted by the Flight Service Station (FSS) at Princeton, Minnesota. Aircraft operating at Crystal when the ATCT is closed are advised to broadcast their intentions and monitor Common Traffic Advisory Frequency (CTAF) frequency, which is also the UNICOM frequency (120.7). Pilots making instrument approaches or departures are in contact with the ATCT or Minneapolis TRACON.

The Crystal Airport also lies under Minneapolis/St. Paul International Airport’s (MSP) Class B Airspace which consists of controlled airspace extending upward from different floor elevations to a ceiling height of 10,000 feet MSL. There are very specific operating instructions and rules pilots must follow when flying within this airspace. Crystal Airport lies under the area where the floor elevation is 4,000 feet MSL. As long as pilots stay below 4,000 feet they remain outside this MSP Class B airspace.

Figure 2-6 shows the airports, airspace and navigational aids in the vicinity of Crystal Airport.

The local traffic pattern altitude at Crystal Airport is 1,869 feet above Mean Sea Level (MSL), which is 1,000 feet above the airport elevation. All traffic patterns operate in standard left hand flow. When the winds are calm (less than 5 knots), the preferred runway is 14L. Intersection takeoffs at Crystal Airport are discouraged at all times, and prohibited between the hours of 10:00pm and 7:00am.

A voluntary Noise Abatement Plan is in place to promote aircraft operating procedures that help reduce aircraft noise and overflights for residents living near Crystal Airport. Pilots may also reference the pilot guide for easy access to noise abatement information. The pilot guide is available at:


2.3.4 Approach Instrumentation

Crystal Airport has two non-precision instrument approaches that can be used during Instrument Meteorological Conditions. The first is a VOR or GPS-A approach that is not aligned with a specific runway end and requires a circling maneuver to land. The second approach is an RNAV (GPS) approach to Runway 14L. There are no on-site navigational aids associated with the RNAV (GPS) approach.

Table 2-5 summarizes the approach minimums for these approaches. The instrument approach charts for these procedures are reproduced in Figure 2-7.
Crystal Airport has standard IFR takeoff minimums (one statute mile for aircraft having two or less engines), with the exception that Runway 6R-24L is not available for instrument takeoffs.

2.3.5 14 CFR Part 77 Airspace Surfaces

Regulations for the protection of airspace around a public-use civilian or military airport are specified in 14 CFR Part 77 Safe, Efficient Use, and Preservation of the Navigable Airspace (Part 77). These defined surfaces are used by the FAA to identify obstructions to airspace around an airport facility. Part 77 surfaces are comprised of primary, approach, transitional, horizontal and conical three-dimensional imaginary surfaces. Figure 2-8 illustrates these surfaces in a general nature; their exact configuration varies based upon the category and type of approach to the runway. Obstructions are defined as objects that penetrate these surfaces. Mitigation measures such as obstruction marking/lighting, removal or relocation may be required for obstructions that are studied and not determined to be a hazard to air navigation.

The requirements for filing an aeronautical study with the Federal Aviation Administration (FAA) for proposed structures in the vicinity of Crystal Airport vary based on a number of factors: site elevation, structure height, proximity to an airport, and frequencies emitted from the structure, etc. The FAA provides a “Notice Criteria Tool” on its Obstruction Evaluation/Airport Airspace Analysis (OE/AAA) website that can be used to determine if an aeronautical study is warranted. The OE/AAA website can be accessed via the following link:

https://oeaaa.faa.gov/oeaaa/external/portal.jsp

The Airport Layout Plan (ALP), which will be developed and published separately from this report, depicts the location and future disposition of known obstructions to Part 77 surfaces.
Based on Part 77 criteria, runways are categorized as either Utility or Other-Than-Utility (OTU). A Utility Runway is a runway that is constructed for, and intended to be used by, propeller-driven aircraft of 12,500 pounds maximum gross weight and less. An OTU Runway is a runway that is intended to be used by propeller-driven aircraft with a maximum gross weight greater than 12,500 pounds and/or jet aircraft of any gross weight. All paved runways at Crystal Airport are currently designated as OTU, while the turf runway is designated as Utility.

**Table 2-6** provides dimensional information for selected 14 CFR Part 77 surfaces.
Table 2-6: Existing 14 CFR Part 77 Surface Dimensions

<table>
<thead>
<tr>
<th>Part 77 Surface</th>
<th>RWY 14L</th>
<th>RWY 32R</th>
<th>RWY 14R</th>
<th>RWY 32L</th>
<th>RWY 06L</th>
<th>RWY 24R</th>
<th>RWY 06R</th>
<th>RWY 24L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Surface</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Width (feet)</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>250</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length Beyond End (feet)</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>0</td>
<td></td>
<td></td>
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<tr>
<td>Approach Surface</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inner Width (feet)</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>Outer Width (feet)</td>
<td>3,500</td>
<td>1,500</td>
<td>1,500</td>
<td>1,500</td>
<td>1,500</td>
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<td>1,250</td>
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<tr>
<td>Length (feet)</td>
<td>10,000</td>
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<td>5,000</td>
<td>5,000</td>
<td>5,000</td>
<td>5,000</td>
<td>5,000</td>
</tr>
<tr>
<td>Slope</td>
<td>34:1</td>
<td>20:1</td>
<td>20:1</td>
<td>20:1</td>
<td>20:1</td>
<td>20:1</td>
<td>20:1</td>
<td>20:1</td>
</tr>
<tr>
<td>Part 77 Category</td>
<td>OTU-NP</td>
<td>OTU-V</td>
<td>OTU-V</td>
<td>OTU-V</td>
<td>OTU-V</td>
<td>OTU-V</td>
<td>Utility-V</td>
<td>Utility-V</td>
</tr>
</tbody>
</table>

Notes: OTU - Other Than Utility; V - Visual Approach; NP - Non-Precision Approach

Source: 14 CFR Part 77
2.4 EXISTING LANDSIDE FACILITIES

Landside facilities include aircraft storage hangar areas, aprons, Fixed Base Operator (FBO) areas, terminal buildings, airport maintenance equipment storage areas, roadway access to the airport, and vehicle parking areas.

2.4.1 Fixed Base Operator (FBO)

Historically, Crystal Airport has had up to four FBOs in operation at one time. Currently, there is one full-service FBO. The full-service FBO, Thunderbird Aviation, is located at the southwest corner of the South Building Area at the end of Taxiway A (Figure 2-9). Services offered by Thunderbird Aviation include fueling, aircraft maintenance, aircraft storage and line services, aircraft sales, flight training, aircraft rental, charters, pilot accessory sales, and car rentals. Thunderbird sells 100LL and Jet A fuel. The 100LL fuel tank and dispensing equipment is located at the southwest edge of the FBO apron. The Jet A fuel tank and dispensing equipment is located to the east of the Airport Traffic Control Tower/Administration Building14. Thunderbird Aviation provides into-plane fueling services via trucks. There is no self-service fueling equipment currently operating at the airport.

Thunderbird Aviation offers aircraft parking and storage as one of its services with both indoor storage and outdoor apron/tie-down parking available. Outdoor apron storage typically accommodates short-term parking for visiting aircraft or for parking of planes awaiting maintenance or other services. It can also be used for long-term storage of aircraft. The existing FBO apron is relatively small and is often congested due to its configuration.

The capacity of the apron is limited to six single or small twin-engine aircraft simultaneously, and fewer if a larger twin-engine piston or turboprop is parked. The fuel dispensing equipment located at the southwest edge of the apron limits expansion potential in that direction. Expansion to the northwest is constrained by the RPZ for Runway 6R, while the FBO and hangars limit expansion potential to the east.

For outdoor parking, the FBO also has a grass tie-down area. Tie-downs are small metal rings set into the pavement or grass with ropes that tie to the underside of wings and the aircraft tail. Most planes being stored outdoors want tie-downs to protect the aircraft from wind damage. In Minnesota, pilots prefer indoor storage for both long and short-term periods because of the summer storms with wind and hail, and in the winter because of cold and snow. Grass tie-down areas are unavailable in the winter months. The FBO offers tie-down service on an as-requested basis, and it is estimated that there is space for six aircraft.

North of Sixty Aviation, located in the south building area, provides some partial FBO services such as aircraft storage and some fueling.

14 The Jet A fuel tank and dispensing equipment is still owned and operated by North of Sixty Aviation. Thunderbird Aviation purchases jet fuel from North of Sixty.
Two former FBO facilities still exist at Crystal Airport, although they are currently leased to tenants who are using them for aeronautical purposes other than a public FBO. Should demand ever warrant additional services, one or more of these facilities could be converted back to FBO use.

### 2.4.2 Hangar Storage Areas

Crystal Airport currently has four distinct hangar storage areas – the South, West, North, and East Building Areas (Figure 2-9).

The original South Building Area is located on the south side of the airport, and is divided into a west half and an east half by the entrance road to the Airport Traffic Control Tower and administration building. The South Building Area is home to the full-service FBO (Thunderbird Aviation), a partial-service FBO (North of Sixty Aviation), plus individual storage hangars. The storage hangars consist of five T-hangars with 42 storage spaces with 41 conventional storage hangars of various sizes. The conventional hangars include one operated by North Memorial Air Care for medical helicopter maintenance and storage, another for Maxwell Aircraft Services, and another by North of Sixty Aviation. In total, the South Building Area contains 65 hangar buildings that provide storage spaces for approximately 116 aircraft.

The West Building Area consists of five T-hangars with 26 storage spaces, and 12 conventional storage hangars of various sizes. In addition, an office/administration building currently operated by Wentworth Aircraft (the former Crystal Shamrock FBO building) is in this area. In total, the West Building Area contains 17 hangar buildings that provide storage spaces for approximately 45 aircraft. During 2016, a portion of the hangar formerly used by HFI was demolished due to its poor condition. The remaining portion of this hangar is used by MAC for airport equipment storage.

The North Building Area contains seven T-Hangars with 90 storage spaces and four conventional hangars of various sizes, including the former Flying Scotchman FBO hangar that is currently under a private lease. In total, the North Building Area contains 11 hangar buildings that provide storage spaces for approximately 100 aircraft. There is room for an additional row of T-Hangars, and several conventional hangars, within the developed portions of the North Hangar Area with taxilane access. Other amenities in this area include an aircraft washing pad and an indoor restroom facility.

The East Building Area contains three T-Hangars with 10 storage spaces and 63 conventional hangars of various sizes. In total, the building area contains 66 buildings that provide storage spaces for approximately 96 aircraft. There is also an indoor restroom facility adjacent to the East Building Area.

MAC allows tenants to sublease space within a hangar if they choose. However, not all tenants sub-lease extra hangar space, nor is it required for them to do so. For this reason, the number of aircraft storage spaces is presented as a range. The low occupancy scenario assumes minimal sub-leasing of available space in conventional hangars, while the maximum occupancy scenario assumes that all available space in conventional hangars is sub-leased. The practical capacity scenario is an average of the low and high scenarios to represent the variance in tenant hangar occupancy practices.
Other factors affecting indoor storage spaces at Crystal Airport include:

- Several airport tenants have leased hangar stalls at Crystal Airport to support growth in aeronautical-related businesses that do not involve aircraft storage. As of July 2016, approximately 34 hangar stalls were leased for aeronautical purposes other than aircraft storage.
- MAC adopted a Reliever Airports Maintenance Standards Ordinance in 2011 to provide standards for the structural integrity, aesthetics, and maintenance of leased property and improvements at the Relievers, including Crystal. Ongoing enforcement of the Maintenance Standards Ordinance going forward will improve the compliance rate, resulting in improved functionality and aesthetics of tenant facilities.

Table 2-7 summarizes the aircraft hangar storage capacity at Crystal Airport.

<table>
<thead>
<tr>
<th>Table 2-7: Indoor Aircraft Storage Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hangar Types</td>
</tr>
<tr>
<td>---------------</td>
</tr>
<tr>
<td><strong>South Building Area</strong></td>
</tr>
<tr>
<td>T-Hangars</td>
</tr>
<tr>
<td>Conventional Hangars</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
</tr>
<tr>
<td><strong>West Building Area</strong></td>
</tr>
<tr>
<td>T-Hangars</td>
</tr>
<tr>
<td>Conventional Hangars</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
</tr>
<tr>
<td><strong>North Building Area</strong></td>
</tr>
<tr>
<td>T-Hangars</td>
</tr>
<tr>
<td>Conventional Hangars</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
</tr>
<tr>
<td><strong>East Building Area</strong></td>
</tr>
<tr>
<td>T-Hangars</td>
</tr>
<tr>
<td>Conventional Hangars</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
</tr>
<tr>
<td><strong>Total T-Hangars</strong></td>
</tr>
<tr>
<td><strong>Total Conventional Hangars</strong></td>
</tr>
<tr>
<td><strong>Total Hangars</strong></td>
</tr>
</tbody>
</table>

Notes:
Approximately 34 hangar stalls are leased by tenants to support aeronautical business functions other than aircraft storage.

Source: MAC Data and Field Observations
2.4.3 Maintenance and Equipment Areas

MAC has three maintenance and equipment storage areas at Crystal (see Table 2-8). They are located in the South, North, and East Building Areas, as shown on Figure 2-9. The North and South buildings each have a small office and restroom/shower facilities for the maintenance crew. The building on the north side of the airport is the newest on the airfield, constructed in 1993.

![Table 2-8: MAC Maintenance Buildings](image)

<table>
<thead>
<tr>
<th>Location</th>
<th># of Equipment Bays</th>
<th>Equipment Fuel</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Building Area</td>
<td>4</td>
<td>None</td>
</tr>
<tr>
<td>North Building Area</td>
<td>6</td>
<td>Diesel</td>
</tr>
<tr>
<td>East Building Area</td>
<td>3</td>
<td>None</td>
</tr>
</tbody>
</table>

Notes: Additional equipment is stored in the former HFI hangar

Source: MAC

The administration building shares space with the maintenance facility in the South Building Area, and is adjacent to the air traffic control tower. There are two large office areas in addition to the restroom and break room.

2.4.4 Roadway Access and Vehicle Parking Areas

As shown in Figure 1-2, the Crystal Airport lies in Hennepin County, within the City of Crystal and partially in Brooklyn Park and Brooklyn Center. Primary roadway access comes off of County Road 81 (Bottineau Boulevard). Bass Lake Road provides access from CR 81 on the south, and 63rd Avenue provides access from CR 81 on the north. The east building area can be accessed from Bass Lake Road. The east frontage road from CR 81 is used to access the west building area. Interstate 94/694 is a half-mile north of the airport, Highway 169 is 2.5 miles to the west, and Highway 100 is 2 miles to the southeast. These main roads link the airport to the metropolitan area and the entire region. Drive time to downtown Minneapolis is approximately 10 minutes.

The FBO parking lot can accommodate approximately 20 vehicles. The former FBO sites also have parking available for any future uses of those spaces. The Airport Traffic Control Tower and administration building parking lot has approximately 40 vehicle parking spaces for employees and visitors.

Most of the aircraft storage hangars are accessed via the taxilanes, with tenants parking inside or adjacent to their individual hangars.

2.4.5 Park/Conservation Area

In 1970, MAC entered into an agreement with the Cities of Crystal and Brooklyn Center, through their respective conservation commissions, in cooperation with area school
districts, to lease approximately 40 acres of airport property for the purpose of developing an open-space area to provide environmental, nature study, and wildlife preservation facilities for community education and enjoyment. As Shingle Creek flows through this area, it is primarily used for storm water management and drainage purposes. Several public walking trails have been established around and through the site.

### 2.5 AIRPORT ENVIRONMENT

This section highlights the airport environment, including available utilities, drainage, and local services provided.

#### 2.5.1 Drainage

Crystal Airport is located on relatively flat land. Soils are generally comprised of sand, gravelly sand and loamy sand overlain by thin deposits of silt loam or organic sediment. Most of the airfield drains to the northeast, into a DNR wetland (639W). This then drains south to Twin Lakes, which is located approximately 0.3 miles downstream from the airport. The remaining areas of the airport drain internally to the west and south sides of the airport, infiltrating into the ground. Stormwater from surrounding residential areas flows onto airport property. About 920 acres of Crystal, Brooklyn Center, Brooklyn Park and New Hope flow directly into the DNR wetland 639W from the north at 63rd Avenue. Another 120 acres drain into the airport at various locations. Figure 2-10 shows the general ditch drainage, direction of flows, and inventoried wetland areas.

The airport lies within the jurisdiction of the Shingle Creek Watershed Management Commission (SCWMC). This commission was formed in 1982 under a Joint Powers Agreement between the Cities of Crystal, Brooklyn Park, Brooklyn Center, and is governed by a nine-member board. Their responsibility is protecting and managing the water resources within the watershed.

There are several small wetland areas around the airport, making up about 3 acres. This is in addition to the very large 420-acre DNR-regulated wetland 639W, of which 37 acres lie within airport property. The City of Crystal has implemented some changes within this wetland area to improve the quality of water flowing into Twin Lakes. The smaller wetlands are regulated under the Wetland Conservation Act by the neighboring cities as the local governmental units (LGUs). There is at least one Department of Natural Resources (DNR) regulated wetland on site. A field delineation was completed in 1998.

Each of the three cities has their own flood insurance rate maps. The maps for Brooklyn Park and Brooklyn Center generally identify the northeast wetland area and the inlet channel from 63rd Avenue as being within the 100-year floodplain. The Crystal maps do not show any 100-year floodplain areas at the airport, however, it is expected that the wetland complex and outlet channel also lie within the 100-year floodplain boundary. There have been no reports of historical flooding at the airport.

The MAC has a Multi-Sector General stormwater discharge Permit (MSGP) from the Minnesota Pollution Control Agency (MPCA) and maintains a Stormwater Pollution Prevention (SWPP) Plan and a voluntary Spill Prevention Control and Countermeasure (SPCC) Plan. These documents include Best Management Practices (BMPs) for
protecting the stormwater conveyances, wetlands, and groundwater related to MAC industrial activity. Permit details along with water quality results for Crystal Airport (Permit MNR0539X7) can be found on the following website:

http://cf.pca.state.mn.us/water/stormwater/isw/search.cfm

Depending on FBO and tenant activities, they may be required to obtain and maintain their own MSGP from the MPCA, along with other requirements, such as an SPCC plan.

Chemicals used in deicing activities at airports is of national concern because of the potential effects on receiving water bodies. There is little to no aircraft deicing at Crystal Airport. Most aircraft can be stored inside heated hangars prior to takeoff or cannot fly when icing conditions exist, which reduces the need for glycol use. The MAC uses minor amounts of urea or other types of pavement deicing materials applied only on runways during icing conditions. The amount is, on average, less than approximately 2,000 pounds annually. Salt is not used due to its corrosive nature. Sand is used on a limited basis depending on weather conditions. Stormwater runoff from paved surfaces is routed through on-airport ditches that act as infiltration and sediment basins. This provides some treatment in addition to rate and volume control of flow off the airport. Given these efforts and minor use of deicers, the potential impact on water quality from the airport is minimal.

2.5.2 Utilities

Crystal Airport currently lies within the Metropolitan Urban Service Area (MUSA) for sanitary sewer service and has both water and sanitary systems available for tenants. These utilities were installed in 1999 after MAC adopted its Sanitary Sewer and Water Policy in 1998. This policy was subsequently revised in October 2000. The maintenance buildings, administration building and Airport Traffic Control Tower all have connections to the sewer and water. There are two restroom facilities available on the airport for tenants to use in lieu of connecting their individual hangar to the utilities. However, many of the tenants did connect, and most have the services available for connection should they decide to construct a bathroom inside their hangar.

The sewer and water pipes connect to the City of Crystal system in all building areas except for the North Building Area, which connects to the City of Brooklyn Park system. MAC has an agreement with the City of Brooklyn Park for the on-going maintenance and cost for future connections to the utilities. To date, no agreement has been executed between MAC and the City of Crystal. The city responds to any MAC or tenant requests for service, which is then paid for by the requesting party. Each city bills the tenants, MAC (for maintenance and administration buildings) and the FAA (for the Airport Traffic Control Tower) directly on a monthly or quarterly basis.

Most tenants at the Airport have either electric or natural gas service. The electrical lines are above ground in some locations at the airport, and below ground in others. The tenants are billed directly by the utility companies.

The West Metro Fire – Rescue District provides emergency services for Crystal Airport, including fire and rescue. Police and law enforcement is provided by the individual cities surrounding the airport.
2.6 OFF-AIRPORT LAND USE

One of the most significant challenges facing airports today is the presence of incompatible land use, either adjacent to the airport or in runway flight paths. Working closely with municipal officials, airport users, developers, and any nearby residents, airports can reduce these types of conflicts through the use of zoning regulations that disallow certain types of nearby development.

The Crystal Airport is located in an area of relatively dense residential development. Crystal, Brooklyn Park and Brooklyn Center have zoning jurisdiction in and around the airport. All three cities have adopted Comprehensive Plans that address land uses in the vicinity of Crystal Airport. Links to these Comprehensive Plans are provided in Section 7.3.

In general the land use and zoning all around the airport is predominantly single-family residential. There are areas to the north in Brooklyn Park zoned Business Park, Neighborhood Retail Business, Townhouse and multiple family residential. In addition, there is an area along Highway 81 in Crystal zoned General Commercial.

A Joint Airport Zoning Board (JAZB), including the Cities of Crystal, Brooklyn Park, Brooklyn Center, New Hope, Minneapolis, Robbinsdale and the Metropolitan Airports Commission, adopted an airport zoning ordinance in December 1983. The purpose of the ordinance is to protect against the construction of structures that will interfere with the operations at the airport. Although a number of homes are located within the designated safety zones, these areas were accepted as “established residential neighborhoods in built-up urban areas.” Upon adoption of the ordinance by the JAZB, it was the responsibility of each individual city to adopt the ordinance and conform their zoning to the ordinance requirements. According to the City of Crystal’s current Comprehensive Plan, the airport zoning regulations were adopted by the City in 1983 and one of the City’s aviation policies is to continue to protect airspace in accordance with the Joint Airport Zoning Ordinance. A copy of the Crystal Airport Joint Airport Zoning Ordinance is provided in Appendix 7.

Existing land uses in the vicinity of Crystal Airport are depicted on Figure 2-11.

2.7 ECONOMIC IMPACTS

Development at Crystal Airport will continue to be self-funded by users of the airport and aviation system; no local sales or property taxes are or will be used to fund airport improvements.

MAC expends between $500,000 and $600,000 annually to operate and maintain Crystal Airport to a high level of safety and operational efficiency with no direct cost to local taxpayers.

MAC-owned land that is not leased to airport users or tenants is exempt from property taxes under State law. Leaseholds and the structures located within those leases are subject to property taxes which are paid by the tenants.
Hennepin County assesses property taxes on hangar owners based on the taxable market value of the hangars. For 2015, the total property tax billed on hangars at Crystal Airport was approximately $80,000.00. Of these tax revenues, the largest recipient is the City of Crystal, which received approximately $26,000.00 from airport tenants. The local school district (ISD 281 Robbinsdale) received approximately $26,000.00 in revenue as well, and Hennepin County approximately $23,000.00. The remaining tax revenues supported Hennepin County Parks, Metro Transit, and the Metropolitan Council.

MnDOT Aeronautics provides an Airport Economic Impact Calculator to estimate the economic value of airports in the State: (http://www.dot.state.mn.us/aero/econimpactcalc.html).

According to output obtained from this tool, the total economic impact from activity occurring at Crystal Airport is approximately $81,000,000 annually and accounts for approximately 250 jobs in the county.

This is based on the following activity inputs:

- $570,000 average annual operations and maintenance (O&M) expenses;
- $400,000 average annual capital expenses;
- Tenant activities: 62 full-time employees, 20 part-time employees, 8 owned aircraft;
- 70 annual transient overnight aircraft;
- 380 annual charter visitors; and
- One non-profit organization aircraft (Civil Air Patrol).
Figure 2-1: Airport Layout
Figure 2-2: Crystal Airport Pavement Condition Index (2014 PCI)
Figure 2-3: Runway Safety Area, Object Free Area, and Protection Zone Key Map

(See Table 2-2 for dimensions)
Figure 2-4: Crystal Airport Designated Hot Spots
Figure 2-5: National Airspace System Overview
Figure 2-6: Regional Airspace
Figure 2-7: Instrument Approach Procedures
Figure 2-8: FAR Part 77 Airspace Surfaces

NOTE:
DIMENSIONS FOR THESE SURFACES VARY AND CAN BE FOUND IN FAR 14 CFR PART 77
Figure 2-9: Crystal Airport Building Areas

South Building Area

LEGEND

- Airport Property Line
- AOA Fence
- Railroad
- Wetlands
North Building Area
East Building Area
Figure 2-10: Airport Drainage and Wetlands
Figure 2-11: Existing Off-Airport Land Use
SECTION 3:

AVIATION FORECASTS
3. AVIATION FORECASTS

3.1 INTRODUCTION
This chapter summarizes the LTCP activity forecast for Crystal Airport. The base year is represented by the twelve months ending June 2015 and forecasts were prepared for 2020, 2025, 2030, and 2035. These forecasts assume an unconstrained demand for aviation services but assume that the type of aircraft that can fly in and out of the airport is constrained by the lengths of the existing runways. The chapter begins with a description of the forecast approach, followed by a discussion of the forecasts for based aircraft and aircraft operations, and then concludes with a set of alternative forecast scenarios.

The assumptions inherent in the following calculations are based on data provided by the MAC, federal and local sources, and professional experience. Forecasting, however, is not an exact science. Departures from forecast levels in the local and national economy and in the aviation industry would have a significant effect on the forecasts presented herein.

A summary of the methodology used to prepare the aviation activity forecasts is presented in Appendix 3. The complete Minneapolis-St. Paul Reliever Airport: Activity Forecasts – Technical Report (October 2015) that contains full forecast development documentation can be downloaded from the MAC website through the following link:


3.2 HISTORICAL ACTIVITY LEVELS
The total number of aircraft based at Crystal airport declined from 1990 to 2015. The total counts stayed above 300 aircraft before 2000 but declined to around 185 recently. Aircraft operations fell more rapidly than based aircraft over the same period, indicating reduced utilization for those aircraft that remained based at MIC.

A number of factors have contributed to the decline. These include the slowing economy, increased fuel prices and other operating costs, and reduced interest in recreational flying by younger generations.

Table 3-1 summarizes historical based aircraft and aircraft operations at Crystal Airport.
Table 3-1: Historical Activity Levels

<table>
<thead>
<tr>
<th>Year</th>
<th>Based Aircraft</th>
<th>Aircraft Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>324</td>
<td>189,906</td>
</tr>
<tr>
<td>1995</td>
<td>327</td>
<td>172,024</td>
</tr>
<tr>
<td>2000</td>
<td>296</td>
<td>176,554</td>
</tr>
<tr>
<td>2005</td>
<td>265</td>
<td>71,704</td>
</tr>
<tr>
<td>2010</td>
<td>219</td>
<td>44,229</td>
</tr>
<tr>
<td>2011</td>
<td>199</td>
<td>43,986</td>
</tr>
<tr>
<td>2012</td>
<td>219</td>
<td>48,220</td>
</tr>
<tr>
<td>2013</td>
<td>189</td>
<td>42,308</td>
</tr>
<tr>
<td>2014</td>
<td>185</td>
<td>41,117</td>
</tr>
<tr>
<td>2015</td>
<td>185</td>
<td>41,838(a)</td>
</tr>
</tbody>
</table>

Notes:
(a) Twelve months ending June 2015. Includes estimate of nighttime activity.

Source: MAC Records, HNTB Activity Forecasts

Through the late 1990s, a significant amount of Crystal’s aircraft operations were attributable to robust levels of flight training activity – a role that the Airport was well-suited to fill. However, the events 9/11 and the subsequent economic downturn rippled through the aviation industry and resulted in diminished demand for flight training.

As illustrated in Figure 3-1 below, the number of local aircraft operations at Crystal Airport declined rather drastically between 2000 and 2010, illustrating the impact that the end of the flight training boom had on total activity at Crystal Airport. Although itinerant aircraft operations declined as well, the reduction was not nearly as dramatic as in local activity.

In 1995, the operational mix of traffic at Crystal Airport was approximately 60% local and 40% itinerant. By 2015, these trends had reversed, with 58% of the traffic itinerant and 42% local.

During 2015, FAA records indicate that approximately 2,400 flights at Crystal Airport, or about 6% of total operations, filed an instrument flight plan. Aircraft operating on an instrument flight plan are more likely to flying for a business-related purpose than aircraft filing visual flight plans.

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15 Local operations are those operations performed by aircraft that remain in the local traffic pattern, execute simulated instrument approaches or low passes at the airport, and the operations to or from the airport and a designated practice area within a 20-mile radius of the tower.
16 Itinerant operations are operations performed by an aircraft, either IFR, SVFR, or VFR, that lands at an airport, arriving from outside the airport area, or departs an airport and leaves the airport area.
3.3 SOcioeconomic Projections

Population forecasts from the Metropolitan Council and per capita income forecasts from Woods & Poole Economics were used to develop hybrid income forecasts for each county in the metropolitan area. The income forecasts were used to estimate the share of based aircraft growth accounted for by each county. A summary of key socioeconomic projections for Hennepin County is provided in Table 3-2.

Table 3-2: Hennepin County Socioeconomic Growth Trends

<table>
<thead>
<tr>
<th>Socioeconomic Indicator</th>
<th>Hennepin County 2013 - 2035</th>
<th>% Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2013</td>
<td>2035</td>
</tr>
<tr>
<td>Population</td>
<td>1,198,778</td>
<td>1,407,582</td>
</tr>
<tr>
<td>Employment</td>
<td>1,090,069</td>
<td>1,330,651</td>
</tr>
<tr>
<td>Real Personal Income</td>
<td>$73,616,213</td>
<td>$122,619,582</td>
</tr>
<tr>
<td>Per Capita Personal Income</td>
<td>$61,409</td>
<td>$87,114</td>
</tr>
</tbody>
</table>

Source: HNTB Activity Forecasts

A comparison of the projected socioeconomic indicator growth rates for Hennepin County, the Seven-County Metropolitan Area, and the United States as a whole is presented in Table 3-3.
Table 3-3: Comparison of Project Socioeconomic Growth Rates

<table>
<thead>
<tr>
<th>Socioeconomic Indicator</th>
<th>Average Annual Growth Rates 2013 - 2035</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hennepin County</td>
</tr>
<tr>
<td>Population</td>
<td>0.8%</td>
</tr>
<tr>
<td>Employment</td>
<td>1.1%</td>
</tr>
<tr>
<td>Real Personal Income</td>
<td>2.3%</td>
</tr>
<tr>
<td>Per Capita Personal Income</td>
<td>1.5%</td>
</tr>
</tbody>
</table>

Source: HNTB Activity Forecasts

Based on this analysis, Hennepin County is expected to experience near-average growth in population and employment, and above-average growth in income throughout the forecast period. These trends can be viewed as an overall positive indicator for the continued viability of aviation demand in the vicinity of Crystal Airport.

3.4 BASE CASE FORECAST

Forecasts include based aircraft and operations for each major category: single-engine piston, multi-engine piston, turboprop, jets, helicopters, sport aircraft, experimental, and other. It was assumed that the share of each county’s registered aircraft in every aircraft category based at all of the airports under study will remain constant.

In the Base Case forecast scenario, the number of based aircraft at Crystal Airport is projected to decline slightly, from 185 aircraft in 2015 to 171 aircraft in 2035. The dominant aircraft in the fleet, piston engine aircraft, are projected to decline, consistent with the FAA Aerospace Forecast Fiscal Years 2015-2035. Helicopters and experimental aircraft are expected to increase but not fast enough to offset the decline in the piston category.

Table 3-4 provides a summary of the based aircraft forecast.

Operations at Crystal Airport are projected to decrease slightly from 41,838 in 2015 to 39,904 in 2035, an average annual decrease of approximately 0.2 percent. Increases are projected in all categories except single-engine and multi-engine piston aircraft, for which the anticipated decrease in the based aircraft offsets slightly higher utilization forecasted by FAA.

Table 3-5 provides a summary of the aircraft operations forecast.
Table 3-4: Summary of Based Aircraft Forecast (Base Case)

<table>
<thead>
<tr>
<th>Aircraft Category</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>AAG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-Engine Piston</td>
<td>154</td>
<td>148</td>
<td>143</td>
<td>138</td>
<td>136</td>
<td>-0.6%</td>
</tr>
<tr>
<td>Multi-Engine Piston</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>12</td>
<td>12</td>
<td>-0.8%</td>
</tr>
<tr>
<td>Turboprop</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Jets</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Helicopter</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2.0%</td>
</tr>
<tr>
<td>Other</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>20</td>
<td>1.4%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>185</strong></td>
<td><strong>180</strong></td>
<td><strong>177</strong></td>
<td><strong>171</strong></td>
<td><strong>171</strong></td>
<td><strong>-0.4%</strong></td>
</tr>
</tbody>
</table>

Notes:
- AAG - Average Annual Growth Rate from 2015 to 2035
- Other category includes experimental and light sport aircraft types

Source: HNTB Activity Forecasts

Table 3-5: Summary of Aircraft Operations Forecast (Base Case)

<table>
<thead>
<tr>
<th>Aircraft Category</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>AAG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-Engine Piston</td>
<td>35,039</td>
<td>32,046</td>
<td>30,993</td>
<td>30,283</td>
<td>30,633</td>
<td>-0.7%</td>
</tr>
<tr>
<td>Multi-Engine Piston</td>
<td>2,460</td>
<td>2,398</td>
<td>2,398</td>
<td>2,116</td>
<td>2,235</td>
<td>-0.5%</td>
</tr>
<tr>
<td>Turboprop</td>
<td>89</td>
<td>90</td>
<td>96</td>
<td>109</td>
<td>126</td>
<td>1.8%</td>
</tr>
<tr>
<td>Jets</td>
<td>8</td>
<td>10</td>
<td>12</td>
<td>14</td>
<td>16</td>
<td>3.5%</td>
</tr>
<tr>
<td>Helicopter</td>
<td>829</td>
<td>1,002</td>
<td>1,142</td>
<td>1,440</td>
<td>1,440</td>
<td>2.8%</td>
</tr>
<tr>
<td>Other</td>
<td>3,413</td>
<td>3,949</td>
<td>4,384</td>
<td>4,774</td>
<td>5,454</td>
<td>2.4%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>41,838</strong></td>
<td><strong>39,495</strong></td>
<td><strong>39,025</strong></td>
<td><strong>38,736</strong></td>
<td><strong>39,904</strong></td>
<td><strong>-0.2%</strong></td>
</tr>
</tbody>
</table>

Notes:
- AAG - Average Annual Growth Rate from 2015 to 2035
- Other category includes experimental and light sport aircraft types

Source: HNTB Activity Forecasts

The percentage of operations occurring in August, the peak month at Crystal Airport, was estimated from FAA air traffic control tower records. Average Day Peak Month (ADPM) operations were estimated by dividing by 31 days. Peak hour operations were obtained from the FAA Distributed Operations Network (OPSNET). The peak hour percentage in the peak month over the past four years has averaged 11.6 percent. As depicted in Table 3-6, peak hour operations are projected to fluctuate between 27 and 29 operations.
### 3.5 FORECAST SCENARIOS

Historically, general aviation activity has been difficult to forecast, since the relationships with economic growth and pricing factors are more tenuous than in other aviation sectors, such as commercial aviation. This uncertainty is likely to carry over into the near future, given the volatility of fuel prices and the continued shift in GA from personal and recreational use to business use. To address these uncertainties, and to identify the potential upper and lower bounds of future activity at the study airports, detailed high and low scenarios are presented. These scenarios use the same forecast approach that was used in the base case, but alter the assumptions to reflect either a more aggressive or more conservative outlook.

The high forecast scenario is based on the assumption that income would grow 0.5 percent per year faster than in the base case. All other assumptions are the same as in the base case. The low forecast scenario is based on the assumption that income would grow 0.5 percent more slowly each year than under the base case.

Subsequent to the preparation of the high and low forecast scenarios, an additional scenario was developed to evaluate the potential impact associated with designating the existing overrun pavement beyond each end of Runway 14L-32R as stopway. Pavement designated as stopway can be considered as useable length for decelerating an aircraft during an aborted takeoff. Stopway pavement can be used for accelerate-stop distance calculations, but not for other takeoff or landing distance calculations.

Stopways do not change the published runway length, nor are they intended to attract aircraft types different than those operating at the airport today. However, the availability of stopways may result in a small increase in aircraft operations from some users who

---

**Table 3-6: Peak Period Forecasts (Base Case)**

<table>
<thead>
<tr>
<th>Peak Periods</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Operations</td>
<td>41,838</td>
<td>39,495</td>
<td>39,025</td>
<td>38,736</td>
<td>39,904</td>
</tr>
<tr>
<td>Peak Month Operations</td>
<td>4,865</td>
<td>4,592</td>
<td>4,538</td>
<td>4,486</td>
<td>4,640</td>
</tr>
<tr>
<td>ADPM Operations</td>
<td>157</td>
<td>148</td>
<td>147</td>
<td>145</td>
<td>150</td>
</tr>
<tr>
<td>Peak Hour Operations</td>
<td>29</td>
<td>27</td>
<td>27</td>
<td>27</td>
<td>28</td>
</tr>
</tbody>
</table>

**Notes:**
- ADPM - Average Day of the Peak Month

**Source:** HNTB Activity Forecasts
find the existing runway length to be limiting based on accelerate-stop distance criteria. In the stopway scenario, the number of additional aircraft operations above the base case is approximately 230 annually, translating to just over four additional takeoffs and landings per week. Of the additional operations, the majority are expected to be turboprops (approximately three-quarters), with the remaining increase coming from light business jet aircraft. All other forecast assumptions are the same as in the base case.

**Table 3-7** compares the total number of based aircraft and operations under different scenarios for MIC. The MIC base case, high and stopway scenario LTCP forecasts are consistent with the FAA 2015 Terminal Area Forecast (TAF) as they differ by less than 10 percent in the 5-year forecast period and 15 percent in the 10-year forecast period. More detailed fleet mix tables for each forecast scenario are presented in **Appendix 3**.
## Table 3-7: Forecast Comparison by Scenario

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Based Aircraft</th>
<th>Total Number of Operations</th>
<th>Variance from TAF (Operations)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Base Case</td>
<td>High Range</td>
<td>Low Range</td>
</tr>
<tr>
<td>2015</td>
<td>185</td>
<td>185</td>
<td>185</td>
</tr>
<tr>
<td>2020</td>
<td>180</td>
<td>184</td>
<td>177</td>
</tr>
<tr>
<td>2025</td>
<td>177</td>
<td>184</td>
<td>169</td>
</tr>
<tr>
<td>2030</td>
<td>171</td>
<td>183</td>
<td>162</td>
</tr>
<tr>
<td>2035</td>
<td>171</td>
<td>187</td>
<td>158</td>
</tr>
</tbody>
</table>

### Average Annual Growth Rate

-0.4% 0.1% -0.8% -0.2% 0.2% -0.6% -0.2% 0.3%

**Notes:**

TAF - 2015 Terminal Area Forecast published by FAA

**Sources:** HNTB Analysis.
3.6 FORECAST SUMMARY

Recent activity levels at Crystal Airport (per Table 3-1) indicate that levels of based aircraft and aircraft operations have largely stabilized since 2010 after steady decreases in the 1990 to 2010 timeframe. Based on the economic outlook for both Hennepin County and the Seven-County Metropolitan Area, along with projected trends for General Aviation flying, the forecasts predict a period of stable activity levels for Crystal Airport. If current activity levels are maintained, Crystal Airport will continue to be one of the busiest airports in the state and an important component of the regional airport system.

The forecast scenarios indicate that future economic growth, fuel prices, technology, and national aviation policy may have a major impact on the development of general aviation. Absent major changes in the economy or aviation industry, small fluctuations – particularly within the developed range of scenarios – should not be construed as indicating the forecast is off course. Minor fluctuations in activity levels above or below the long-term forecast will not affect the overall recommendations of the LTCP, however, these fluctuations may require minor adjustments to the phasing of proposed improvements.
SECTION 4:

FACILITY REQUIREMENTS
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4. FACILITY REQUIREMENTS

4.1 INTRODUCTION

This chapter describes the facility requirements needed to accommodate the demand forecasts for year 2035. The sections of this chapter are intended to:

- Describe relevant design criteria;
- Present airfield requirements in context of the critical aircraft;
- Review NAVAID requirements;
- Identify general aviation facility requirements;
- Review parking and airport access needs;
- Review obstruction issues; and
- Present miscellaneous requirements for the airport.

4.2 CRITICAL AIRCRAFT FAMILY DESIGN CRITERIA

Based on the aviation activity forecasts, the future critical design aircraft for Crystal Airport will continue to be represented by the family of propeller-driven aircraft with fewer than 10 passenger seats. This family of aircraft includes a diverse range of equipment types, ranging from small single-engine piston aircraft used primarily for recreational and personal flying up to larger single and twin-engine turboprop aircraft that are used more predominantly for business aviation. Typical aircraft in the latter category include the single-engine turboprop Pilatus PC-12 and the twin-engine turboprop Beechcraft King Air 200. Figure 4-1 depicts several aircraft within this family by their Approach Category and Design Group, while Table 4-1 highlights physical characteristics for representative types.

As with the existing condition, design parameters associated with this aircraft family will continue to be as follows:

- Aircraft Approach Category (AAC): A/B (approach speed less than 121 knots);
- Airplane Design Group (ADG): I/II (wingspan up to but not including 79 feet and tail height less than 30 feet); and
- Taxiway Design Group (TDG): 2 (main landing gear width 20 feet or less and cockpit-to-main gear distance less than 64 feet).

FAA airfield design standards for this family of critical aircraft are summarized in Table 2-2 of the Existing Conditions chapter.
Table 4-1: Representative Types in Critical Aircraft Family

<table>
<thead>
<tr>
<th>Aircraft Type</th>
<th>Configuration</th>
<th>Wingspan</th>
<th>Maximum Takeoff Weight (lbs.)</th>
<th>Typical Passenger Seats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beechcraft King Air 200</td>
<td>MET</td>
<td>57' 11&quot;</td>
<td>12,500</td>
<td>7-9</td>
</tr>
<tr>
<td>Pilatus PC-12</td>
<td>SET</td>
<td>53' 04&quot;</td>
<td>10,450</td>
<td>7-9</td>
</tr>
<tr>
<td>Cessna 441 Conquest II</td>
<td>MET</td>
<td>49' 04&quot;</td>
<td>9,850</td>
<td>6-9</td>
</tr>
<tr>
<td>Piper PA-31T Cheyenne</td>
<td>MET</td>
<td>42' 08&quot;</td>
<td>9,000</td>
<td>6-8</td>
</tr>
<tr>
<td>Cessna 421C</td>
<td>MEP</td>
<td>41' 01&quot;</td>
<td>7,450</td>
<td>6-8</td>
</tr>
<tr>
<td>Piper PA-31-350 Chieftain</td>
<td>MEP</td>
<td>40' 08&quot;</td>
<td>7,000</td>
<td>5-7</td>
</tr>
<tr>
<td>Cessna 414A</td>
<td>MEP</td>
<td>44' 01&quot;</td>
<td>6,750</td>
<td>6-8</td>
</tr>
<tr>
<td>Cessna 310</td>
<td>MEP</td>
<td>36' 11&quot;</td>
<td>5,500</td>
<td>4-6</td>
</tr>
<tr>
<td>Beechcraft Baron 58</td>
<td>MEP</td>
<td>37' 10&quot;</td>
<td>5,400</td>
<td>4-6</td>
</tr>
<tr>
<td>Piper PA-30 Twin Comanche</td>
<td>MEP</td>
<td>36' 00&quot;</td>
<td>3,725</td>
<td>4-6</td>
</tr>
</tbody>
</table>

Notes: MET - Multi-Engine Turboprop, SET - Single-Engine Turboprop, MEP - Multi-Engine Piston

Source: Aircraft Manufacturer Data

4.3 MEETEOROLOGICAL DATA, WIND COVERAGE, AND RUNWAY ORIENTATION

Weather conditions have a significant influence on the operational capabilities at an airport. Wind speed and direction help determine runway orientation. Temperature plays a role in determining runway length; higher temperatures in the summer months result in longer runway length requirements. Cloud cover and low visibility are factors used to determine the need for navigation aids and instrument approaches.

Aircraft generally take off and land directly into the wind, or at least as directly into the wind as a given runway alignment allows. Crosswind runways are used when the wind is blowing perpendicular to the primary runway. Because small, single-engine aircraft have less power and are lighter than larger aircraft, they often have the most pressing need for crosswind runways.

The FAA recommends that the primary runway provide at least 95 percent wind coverage for the aircraft anticipated to use the airport. If the primary runway does not provide this level of coverage, a crosswind runway may be justified.

Because larger, heavier and more powerful aircraft need a crosswind runway less often than smaller, lighter and less powerful ones, different winds speeds are used in the crosswind runway analysis for different aircraft. These different wind speeds are called crosswind components. Crosswind components are defined by wind direction and speed taken at a right angle to a runway.
Per FAA criteria, the maximum allowable crosswind component for Reference Code A/B-I aircraft is 10.5 knots and 13 knots for Reference Code A/B-II aircraft.

Available data from the Crystal Airport Automated Surface Observing System (ASOS) was obtained to analyze the amount of wind coverage provided by the current runway system. Table 4-2 summarizes the wind coverage of runways for the applicable crosswind components and weather conditions:

Table 4-2: Wind Coverage Summary

<table>
<thead>
<tr>
<th>Wind Coverage</th>
<th>All Weather Conditions</th>
<th>VFR Conditions</th>
<th>IFR Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.5 Kt. Crosswind Component</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Runway 14-32</td>
<td>95.3%</td>
<td>95.3%</td>
<td>94.9%</td>
</tr>
<tr>
<td>Runway 06-24</td>
<td>87.0%</td>
<td>86.4%</td>
<td>90.3%</td>
</tr>
<tr>
<td>Both Runways</td>
<td>99.0%</td>
<td>99.0%</td>
<td>99.0%</td>
</tr>
<tr>
<td>13 Kt. Crosswind Component</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Runway 14-32</td>
<td>97.9%</td>
<td>98.0%</td>
<td>97.7%</td>
</tr>
<tr>
<td>Runway 06-24</td>
<td>92.9%</td>
<td>92.6%</td>
<td>94.6%</td>
</tr>
<tr>
<td>Both Runways</td>
<td>99.9%</td>
<td>99.9%</td>
<td>99.9%</td>
</tr>
<tr>
<td>Total Number of Hourly Observations</td>
<td>107,269</td>
<td>90,626</td>
<td>17,473</td>
</tr>
</tbody>
</table>

Notes: Bold numbers reflect 95% or greater wind coverage

Source: MIC ASOS Wind Data 2006 - 2015

This analysis indicates that the Runway 14-32 alignment provides the desired 95 percent wind coverage for both crosswind component categories and during all weather and VFR conditions, but not under IFR conditions. The crosswind Runway 06-24 alignment offers supplemental wind coverage so that the total runway system provides nearly 100 percent wind coverage in all conditions. When considered on a stand-alone basis, the Runway 14-32 alignment provides better wind coverage than the Runway 06-24 alignment, confirming that the primary runway alignment provides optimal wind coverage.

An evaluation of the all-weather wind rose data (see Figure 4-2) suggests that the strongest winds experienced at Crystal Airport frequently come from a southwesterly direction. Runway 24 is particularly well aligned to accommodate aircraft operations during these high-wind conditions; furthermore, it is the only runway with a southwest/northeast orientation in the west metropolitan area to provide this wind coverage.

Table 4-3 evaluates the wind coverage provided by the specific runway end orientations.
Table 4-3: Wind Coverage By Runway End

<table>
<thead>
<tr>
<th>Wind Coverage</th>
<th>All Weather Conditions</th>
<th>VFR Conditions</th>
<th>IFR Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>10.5 Kt. Crosswind Component</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Runway 14</td>
<td>53.4%</td>
<td>52.5%</td>
<td>57.9%</td>
</tr>
<tr>
<td>Runway 32</td>
<td>56.7%</td>
<td>57.4%</td>
<td>53.0%</td>
</tr>
<tr>
<td>Runway 06</td>
<td>46.6%</td>
<td>43.4%</td>
<td><strong>64.2%</strong></td>
</tr>
<tr>
<td>Runway 24</td>
<td>55.4%</td>
<td>57.7%</td>
<td>42.2%</td>
</tr>
<tr>
<td><strong>13 Kt. Crosswind Component</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Runway 14</td>
<td>54.5%</td>
<td>53.6%</td>
<td>59.0%</td>
</tr>
<tr>
<td>Runway 32</td>
<td>58.2%</td>
<td>58.9%</td>
<td>54.5%</td>
</tr>
<tr>
<td>Runway 06</td>
<td>48.5%</td>
<td>45.2%</td>
<td><strong>66.3%</strong></td>
</tr>
<tr>
<td>Runway 24</td>
<td>59.5%</td>
<td><strong>62.1%</strong></td>
<td>44.3%</td>
</tr>
<tr>
<td><strong>Total Number of Hourly Observations</strong></td>
<td>107,269</td>
<td>90,626</td>
<td>17,473</td>
</tr>
</tbody>
</table>

Notes: Bold numbers reflect 60% or greater wind coverage

Source: MIC ASOS Wind Data 2006 - 2015

This data suggests that during IFR conditions, the best wind coverage is provided by the Runway 06 alignment, followed by Runway 14 and then Runway 32. However, the Runway 06 end is not eligible for establishment of a straight-in instrument approach procedure due to its short length\(^\text{17}\).

Another important factor to consider when planning facilities at airports is temperature. The standard used is the mean daily maximum temperature of the hottest month at the Airport. For Crystal Airport, the hottest month of the year is typically July. Based on long-term temperature trends available from the National Climatic Data Center (NCDC) reporting station at Crystal Airport for the 20-year period between 1981 and 2010, the mean maximum daily temperature in the month of July is 83.4°F (28.5°C).

### 4.4 AIRFIELD CAPACITY

Airfield capacity is defined as the maximum number of operations that can be accommodated by a particular airfield configuration during a specified interval of time when there is constant demand. Annual service volume (ASV) is one capacity measure and the average hourly capacity is another.

The Annual Service Volume (ASV) for a given airport is the annual level of aircraft operations that can be accommodated with minimal delay. For an airport with annual

\(^{17}\) FAA criteria sets forth a minimum runway length of 2,400 feet for establishment of a straight-in instrument approach procedure.
operations below its ASV, delay is minimal within one to four minutes per operation. Anything above four minutes of delay per operation can result in increased congestion that can adversely impact airfield capacity.

An airfield system’s capacity is determined by a multitude of various factors, including prevailing winds and associated orientation of runways, number of runways, taxiway system, fleet mix, operational characteristics of based aircraft and weather conditions.

Crystal Airport’s ASV is currently estimated to be 355,000 operations annually, which is well above its current and projected future levels of annual operations. Even if the high forecast level of operations materializes (approximately 43,500), the airport will operate at approximately 12 percent of its annual service volume.

From the FAA Advisory Circular 150/5060-5 Airport Capacity and Delay, Crystal Airport’s average hourly capacity is estimated to be 98 operations during VFR conditions and 59 operations during IFR conditions. Peak activity forecasts show 28 peak hour operations for the year 2035.

Thus, Crystal Airport has adequate runway capacity to support all of the forecast scenarios. This means that additional runway capacity will not be a contributing factor to any airport improvements throughout the planning period.

A typical two-runway system with one primary and one crosswind runway, as recommended for Crystal Airport in the previous LTCP, provides an ASV of approximately 230,000 aircraft operations. This level of capacity would still be more than sufficient to accommodate the projected level of aircraft operations in a safe, efficient manner.

4.5 AIRFIELD FACILITY REQUIREMENTS

4.5.1 Runway Requirements

Runway length requirements are based on several factors, including the type of aircraft using or expected to use an airport, temperature, airport elevation, wind direction and velocity, and runway gradient. In addition, runway surface conditions also impact runway requirements. This last factor is an important consideration for determining runway lengths at airports in northern climates where wet and icy conditions exist.

FAA Advisory Circular (AC) 150/5325-4B, Runway Length Requirements for Airport Design, recommends identifying a critical family of aircraft. Although this methodology is general in nature, it recognizes that there is uncertainty about the composition of the airport’s fleet mix during the forecast period. Determining runway length based on an aircraft family ensures the greatest measure of flexibility.

As noted in Section 4.2, the future critical design aircraft for Crystal Airport will continue to be represented by the family of propeller-driven aircraft with fewer than 10 passenger seats. Based on an assessment of fleet mix at Crystal Airport, the aircraft types that use the facility on a regular basis have maximum gross takeoff weights of less than 12,500 pounds. From an airfield facility requirements perspective, this composite aircraft family is represented by the Beechcraft King Air 200 (ARC B-II), Pilatus PC-12 (ARC A-II), and the Piper PA-31 Navajo (ARC B-I).
Although aircraft with a maximum gross takeoff weight of greater than 12,500 pounds can and do occasionally use Crystal Airport (such as the Beechcraft King Air 350 turboprop), the total is well below 500 operations per year due to runway length limitations. Therefore, the critical design aircraft for Crystal Airport should be designated as small aircraft. This is a change from the existing runway designations, which are for aircraft with a maximum gross takeoff weight of greater than 12,500 pounds.

The design objective for the primary runway is to provide a runway length that will not result in operational weight restrictions for this family of aircraft.

The corresponding Runway Design Code (RDC) for the primary runway should be A/B-II-5,000\(^\text{18}\) (small aircraft). According to the FAA, for airports with two or more runways, it is often desirable to design all airport elements to meet the requirements of the most demanding RDC and TDG. In order to preserve operational flexibility, the RDC for the crosswind runway will be also be designated as A/B-II-5,000 (small aircraft).

**Primary Runway**

Figure 2-1 in FAA AC 150/5325-4B provides recommended runway lengths for small propeller-driven airplanes with fewer than 10 passenger seats. The calculations consider airport elevation above mean sea level, mean daily maximum temperature of the hottest month and percentage of the overall fleet (family of aircraft) to be accommodated. A copy of this figure is reproduced in Appendix 4.

Based on runway length guidance provided by the FAA AC, the appropriate runway length at the Crystal Airport should be between 3,300 feet (to accommodate most of the aircraft types in this family, or 95% of the fleet) and 3,900 feet (to accommodate all types in the family, or 100% of the fleet).

In the AC, the FAA states that “if the fleet mix to operate at the airport is known, consult the manufacturer’s literature to determine actual runway length requirements.” To comply with this guidance, staff assessed manufacturer’s performance charts from several representative aircraft types using, or expected to use, Crystal Airport. The following conditions were assessed:

- Accelerate-stop distance (the runway length declared available and suitable for the acceleration and deceleration of an aircraft aborting a takeoff).
- Temperature of 83.5°F (the mean daily maximum temperature of the hottest month at the airport).
- Field elevation of 869 feet above mean sea level (AMSL).
- A 5-knot headwind.
- Typical takeoff flap settings.

**Table 4-3** summarizes takeoff length requirements for the representative aircraft types in the critical aircraft family for Crystal Airport. Takeoff distance requirements are presented for several different takeoff weights representing percentages of the aircraft’s total useful

\(^{18}\) 5,000 feet corresponds to visibility minimums of not lower than one statute mile.
Representative aircraft performance charts used for this analysis are reproduced in Appendix 4.

Table 4-4: Takeoff Length Requirements

<table>
<thead>
<tr>
<th>Aircraft Type</th>
<th>Maximum Takeoff Weight (lbs.)</th>
<th>Takeoff Distance (ft.) for % Useful Load</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td>Beechcraft King Air 200</td>
<td>12,500</td>
<td>3,700</td>
</tr>
<tr>
<td>Pilatus PC-12</td>
<td>10,450</td>
<td>3,900</td>
</tr>
<tr>
<td>Cessna 441 Conquest II</td>
<td>9,850</td>
<td>4,000</td>
</tr>
<tr>
<td>Piper PA-31T Cheyenne</td>
<td>9,000</td>
<td>3,600</td>
</tr>
<tr>
<td><strong>Subtotal Turboprops</strong></td>
<td></td>
<td>3,800</td>
</tr>
<tr>
<td>Cessna 421C</td>
<td>7,450</td>
<td>4,000</td>
</tr>
<tr>
<td>Piper PA-31-350 Chieftain</td>
<td>7,000</td>
<td>3,700</td>
</tr>
<tr>
<td>Cessna 414A</td>
<td>6,750</td>
<td>4,600</td>
</tr>
<tr>
<td>Cessna 310</td>
<td>5,500</td>
<td>4,000</td>
</tr>
<tr>
<td>Beechcraft Baron 58</td>
<td>5,400</td>
<td>3,500</td>
</tr>
<tr>
<td>Piper PA-30 Twin Comanche</td>
<td>3,725</td>
<td>3,300</td>
</tr>
<tr>
<td><strong>Subtotal Multi-Engine Piston</strong></td>
<td></td>
<td>3,850</td>
</tr>
<tr>
<td><strong>Average Length</strong></td>
<td></td>
<td>3,830</td>
</tr>
</tbody>
</table>

Notes: Takeoff Distance based on Accelerate/Stop length from aircraft performance manuals. Takeoff distance calculations based on the following conditions: Temperature = 83.4°F, Field Elevation = 869 feet MSL, Wind = 5-knot headwind component, Flaps = Typical takeoff

Source: Aircraft Performance Manuals/Data

Based on this assessment, a suitable primary runway length for Crystal Airport is approximately 3,600 feet. This length fits into the range predicted by the FAA guidance and will accommodate the majority of small turboprop and multi-engine piston aircraft departing at a weight representing 90 percent of their useful load. Using the 90 percent of useful load criteria is considered appropriate given that aircraft in this family do not routinely need to depart at their maximum takeoff weight to complete a typical flight mission.

Ideally, the entire runway length would be available to accommodate all takeoff and landing distance categories (takeoff run available, takeoff distance available, accelerate-stop distance, and landing distance available). However, for the designated critical aircraft family, accelerate-stop distance (ASDA) typically emerges as the most critical

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19 Useful load is defined as the aircraft maximum takeoff weight minus the aircraft empty weight. An aircraft’s useful load can be used to transport either fuel or payload (passengers, baggage, and/or cargo).
(longest) length requirement to consider. Thus, at a minimum, the preferred concept should seek to provide 3,600 feet of accelerate-stop distance.

The FAA establishes 75 feet as the required width for RDC A/B-II-5,000 runways. Runway 14L-32R is currently 75 feet wide. This width should be maintained in the future.

To ensure consistency with the critical design aircraft, it is recommended that the 14 CFR Part 77 designation for Runway 14L-32R revert to the “Utility” category. This action will result in the pavement strength being reported as 12,500 pounds, but does not restrict the capability of the runway to occasionally accommodate aircraft with a maximum gross takeoff weight greater than 12,500 pounds.

**Crosswind Runway**

The FAA acknowledges that even if the 95 percent crosswind coverage standard is achieved for the design airplane family, certain airplanes with lower crosswind capabilities may not be able to use the primary runway under all conditions. In these cases, a crosswind runway can be justified. The runway length for crosswind runways is based on the recommended length for the lower crosswind capable airplanes using the primary runway.

At Crystal Airport, the lower crosswind capable aircraft include light single-engine aircraft used primarily for personal, recreational, and flight training activities. At 2,500 feet, crosswind runway 06L-24R is short by modern standards. However, due to constraints and obstacles at both ends of the runway, it does not appear that providing additional length is feasible.

Runway 06L-24R is currently 75 feet wide, which meets design criteria for RDC A/B-II-5,000. It is recommended that the existing width of 75 feet be maintained throughout the planning period.

It is envisioned that Runway 06L-24R, as the crosswind runway, will also revert to a 14 CFR Part 77 “Utility” category and meet FAA design standards for small aircraft.

The number of aircraft operations on turf Runway 06R-24L have been declining in recent years. Manual counts taken during June through August of 2015 by ATCT controllers suggest that there were approximately two (2) average daily operations on this runway (one takeoff and landing cycle). While the turf runway may represent a nice-to-have amenity at an urban Reliever airport, there is no known aircraft type using the airport on a regular basis that cannot operate safely on the adjacent paved runway. Given the aging condition of the turf runway and the added complexity that it adds to the airfield configuration, maintaining Runway 06R/24L is not considered to be essential to the viability of Crystal Airport.

**Runway Separation Standards**

In the future, a minimum of 240 feet of separation should be provided between runways and parallel taxiways.
Runway Shoulders
For RDC A/B-II-5,000, the required shoulder width is 10 feet. The airport provides 10-foot wide turf shoulders on both runways. All future conditions should continue to meet or exceed FAA standards.

Runway Safety Areas, Object Free Areas, and Obstacle Free Zones
The existing Runway Safety Areas (RSAs) and Runway Object Free Areas (ROFAs) at Crystal Airport meet FAA standards for RDC A/B-II-5,000. All future conditions should continue to meet or exceed FAA standards.

The existing ROFZs meet FAA requirements for the specified RDC for small aircraft (250 feet wide). All future conditions should continue to meet or exceed FAA standards.

Runway Protection Zones
As described in Section 3.2.1, a total of 36 off-airport residential parcels are wholly or partially contained in the existing Runway Protection Zones (RPZs) at Crystal Airport. In addition, public roadways traverse the RPZs for Runways 06L-6R (County Road 81/Bottineau Boulevard) and Runways 14L/14R (Douglas Drive). A freight rail line also runs through the Runway 06L-06R RPZs.

As shown in Table 2-2, the FAA has designated lesser RPZ dimensions for runways designed to be used regularly by small aircraft with maximum certificated takeoff weights of 12,500 pounds or less (Utility Runway designation).

Implementation of the previous LTCP preferred development alternative would reduce incompatible RPZ land uses by decommissioning Runways 14L-32R and 6R/24L, but would not improve RPZ compatibility off the remaining runway ends.

By reverting to the smaller-dimension RPZs off each runway end, the number of impacted residential parcels can be reduced to 18, a 50 percent decrease. Of these parcels, all but one are off the ends of crosswind Runway 06L-24R. As the designated critical design aircraft at Crystal Airport is the family of small propeller-driven aircraft with fewer than ten passenger seats, it is appropriate to use the smaller-dimension RPZs.

If the previous LTCP preferred development alternative is combined with the smaller-dimension RPZs, the Runway 14R RPZ will only impact a portion of one residential parcel and does not include any residential dwellings. A non-public airport access roadway will continue to traverse the Runway 14R RPZ as well, but this road is access controlled such that it only accommodates airport-related traffic. The Runway 14L RPZ will contain approximately 150 linear feet of Douglas Drive. Douglas Drive, however, is a low volume, local roadway. Thus, the probability of an airplane accident within the outer edge of the RPZ where the road is located, when a vehicle is present is very low. Realignment of the road outside of the RPZ is not a viable option given the location of existing residential development and adjacent transportation corridors immediately west of the airport, including Bottineau Boulevard, Lakeland Avenue, a freight rail line, and the planned Bottineau Light Rail Transit Line. In 2016, FAA reviewed this condition and concurred that Douglas Drive does not need to be realigned outside of the RPZ.
If the previous LTCP preferred development alternative is combined with the smaller-dimension RPZs, the Runway 14R RPZ will only impact a portion of one residential parcel and does not include any residential dwellings. A non-public airport access roadway will continue to traverse the Runway 14R RPZ as well, but this road is access controlled such that it only accommodates airport-related traffic. The Runway 14L RPZ will contain approximately 150 linear feet of Douglas Drive. Douglas Drive is a low volume, local roadway. There is a low risk of an airplane accident within the outer edge of the RPZ where the road is located, when a vehicle is present. Realignment of the road outside of the RPZ is not viable given the location of existing residential development and adjacent transportation corridors immediately west of the airport, including Bottineau Boulevard, Lakeland Avenue, a freight rail line, and the planned Bottineau Light Rail Transit Line.

In 2016, FAA reviewed this condition and concurred that Douglas Drive does not need to be realigned outside of the RPZ.

Reasonable efforts should be made to prevent incompatible land uses from being introduced within RPZs. In the event that incompatible land uses cannot be reasonably mitigated, or new incompatible uses are proposed, an RPZ Alternatives Analysis should be prepared and submitted to the FAA to assess whether the proposed land uses could increase safety risk levels at the airport and result in incompatible land uses.

**Runway Edge Lighting**

It is recommended that the existing Medium-Intensity Runway Lights (MIRL) be maintained on Runways 14L-32R and 06L-24R. If the existing paved overruns are converted to stopways, appropriate edge lighting should be installed.

**Navigational Aids**

Currently, there is a PAPI system on Runway 14L. It is recommended that the VASIs on the other runway ends be replaced with PAPIs during the planning period.

Currently, there are REILs on both ends of Runway 14L-32R. It is recommended REILS be added to both ends of Runway 06L-24R during the planning period.

**Airfield Geometry**

As outlined in Section 2.3.1, reducing the number of Hot Spots by simplifying the airfield layout and reducing the number of runway crossings for aircraft and vehicles should be a key consideration when evaluating future airfield development concepts.

**4.5.2 Taxiway Requirements**

As noted in Section 4.2, the existing and future critical design aircraft family for Crystal Airport is within the parameters of the FAA’s Taxiway Design Group (TDG) 2 (main landing gear width 20 feet or less and cockpit-to-main gear distance less than 64 feet).

**Taxiway Width**

The FAA design standard for TDG-2 width is 35 feet. Taxiways A, B, C, D, and E are 30 feet wide. This means these taxiway widths are deficient by five feet. As taxiway reconstruction projects become necessary, the MAC will widen the pavement to at least 35 feet and consider further widening to the MAC Reliever Airport standard of 40 feet.
**Taxiway Safety and Object Free Areas**
The existing Taxiway Safety Areas (TSAs) and Taxiway/Taxilane Object Free Areas (TOFAs) at Crystal Airport meet or exceed FAA standards, with the exception of the conditions noted in Section 2.3.1. All future conditions should meet or exceed FAA standards.

**Taxiway Shoulders**
Paved or stabilized shoulders are recommended along taxiways. TDG II aircraft require 15-foot stabilized shoulders. Crystal Airport has 15-foot wide turf shoulders on its taxiways, which should be maintained.

**Taxiway Connectors**
Taxiway connectors should be present to facilitate efficient aircraft exit off of the supported runway, to reduce incursions and to minimize time on runway. However, several of the connector taxiways provide direct access from an aircraft apron to a runway. FAA has issued guidance stating that it is not desirable to design taxiways that lead directly from an apron to a runway without requiring a turn, as these configurations can lead to confusion when a pilot typically expects to encounter a parallel taxiway but instead accidently enters a runway. Options to improve these geometry items will be considered when preparing airfield development concepts.

This, and other recent guidance related to taxiway design best practices contained in FAA AC 150/5300-13A, Change 1 will be utilized for plans to convert existing Runway 14R-32L into a full-length parallel taxiway.

**Taxiway Lighting**
There is currently no taxiway lighting at Crystal, but all taxiways have blue guidance reflectors. It is recommended that the potential for installation of taxiway lighting be considered in the future, particularly for the future full-length parallel taxiway to Runway 14L-32R. This would improve safety during the evening and after a light snow fall and also aid pilots that are unfamiliar with the airport.

**4.5.3 Instrument Approaches**
Crystal Airport has two non-precision instrument approaches that can be used during Instrument Meteorological Conditions. The first is a VOR or GPS-A approach that is not aligned with a specific runway end and requires a circling maneuver to land. The second approach is an RNAV (GPS) approach to Runway 14L with one-mile visibility minimums.

Upgrading instrument approach capabilities to provide minimums of less than one mile are not contemplated with this plan due to the corresponding increase in the dimensions of the RPZs that would have to be provided.

Development of a new, non-precision GPS-type instrument approach procedures to Runway 32R would enhance the operational capabilities of the airport. Planning for the establishment of these non-precision approaches is recommended for consideration. GPS has made it possible to provide instrumentation to almost any runway end at relatively low cost because on-airport equipment is not required.
4.5.4 Obstacles

The FAA recently consolidated its position, notification process, and mitigation process for obstacles identified as penetrations to the 20:1 Visual Area Surface. The FAA has long maintained the position that airports should keep obstacles clear, marked, or lit for those that penetrate a variety of surfaces including Part 77, Threshold Siting Surface, and TERPS Departure Surface, among others. While these other surfaces are dealt with as instrument procedures are developed, the 20:1 Visual Surface Area can be widely applied to all airports. As such, a formal procedure and process was outlined to notify airports of the obstacles that the FAA identifies that penetrate the 20:1, and required a period of review and mitigation to enable procedures to remain in place.

An obstruction removal project is underway in 2016 to remove trees that penetrate, or nearly penetrate, the 20:1 Visual Surface Areas for Crystal Airport.

FAA has also established requirements for airport sponsors to develop an “Obstacle Action Plan” (OAP) that details how and when each of the approach and departure surfaces will be cleared and maintained. As this is a new requirement, the OAP for Crystal Airport will be developed along with the Airport Layout Plan (ALP).

4.6 LANDSIDE FACILITY REQUIREMENTS

4.6.1 Hangar Facilities

Crystal Airport, like all of the MAC airports, has a wide variety of hangar sizes. Over the years, the MAC has attempted to standardize the size of hangars within new hangar areas. However, aircraft also come in many different sizes, and trying to accommodate every one leads to variability. As depicted in Table 2-6, Crystal Airport is estimated to have approximately 356 indoor aircraft storage spaces. This number includes an assumption that some, but not all, airport tenants sublease extra space for additional aircraft within their.

Tenants own their hangars and lease the ground space from the MAC. Currently, it is the MAC’s policy that no tenant can lease more space than they can justify with actual aircraft ownership. This practice has reduced the number of large hangar demands, and subsequently, reduces some of the subleasing opportunities at the airport.

According to the Base Case forecast results reported in Table 3-4, the number of based aircraft is anticipated to decline slightly through 2030 and then stabilize. By 2035, the number of based aircraft is forecasted to be 171 aircraft.

At first glance, it appears that only a portion of the available hangar capacity at Crystal Airport will be filled by 2035. However, some of the available hangar stall inventory is currently leased by airport tenants to support aviation business activities other than aircraft storage. Secondly, reasonable enforcement of MAC’s Maintenance Standards Ordinance in the future may result in some of the existing hangar inventory being removed. Lastly, there could be demand for construction of certain hangar types and/or sizes that are not currently available. Therefore, areas to accommodate the construction of new hangars should be considered in the plan.
It is important to note that including additional hangar space in this LTCP is not a commitment to build or fund such a development. Rather, it is simply ensuring that should the indicated immediate demand lead to actual hangar construction, an appropriate place for them is shown in this plan and subsequent Airport Layout Plan (ALP).

If a new hangar area is constructed, utility installations will be included in the project, including electricity, telephone/telecommunications, and natural gas. The issues related to sanitary sewer and water are discussed in Section 6.3.

**4.6.2 Fixed Base Operator**

Two former FBO facilities still exist at Crystal Airport, although they are currently leased to tenants who are using them for other purposes. Should demand ever warrant additional services, one or more of these facilities could be converted back to FBO use. However, the updated forecasts do not suggest that existing or anticipated future demand levels are sufficient to support more than one full-service and one partial-service FBO facility at Crystal Airport.

As noted in Section 2.4.1, the existing FBO apron is small, constrained, and operationally inefficient. An expansion to improve aircraft circulation patterns and the number of tie-down locations should be considered by the tenant if the turf runway is decommissioned.

**4.6.3 Airport Access, Roadway Circulation, and Parking**

At this time, airport access and parking facilities appear to be adequate. Primary roadway access comes from County Road 81/Bottineau Boulevard, which continues to see increases in the average daily traffic every year. Airport entrances currently have passing and turning lanes, which should be maintained.

**4.6.4 Maintenance and Fuel Storage Areas**

The existing MAC Maintenance facilities are in good condition and provide adequate capacity to accommodate newer-generation snow removal equipment that in many cases are longer and taller than older models. An enclosed materials storage facility is programmed to be constructed to store sand and other solid materials.

An area should be identified to accommodate a future self-service fuel dispensing facility if this service is not provided by an FBO and deemed appropriate by MAC.

**4.6.5 Security Requirements**

There is a fence that runs along the airport boundary all around the airport. Six access-controlled gates provide access to the hangar areas. Access into the gates is achieved with a pin code. All gates are clearly marked that unauthorized access to the airport is prohibited.

At this time, there is no demand or requirement for security-related improvements at the airport. This should be monitored, however, in future long term plan updates if there are any changes to national aviation security recommendations or local issues generate a need for such improvements.
### Figure 4-1: Representative Aircraft Types

#### Airport Reference Code A-I (Maximum Takeoff Weight (MTOW) less than or equal to 12,500lbs)

<table>
<thead>
<tr>
<th>Aircraft</th>
<th>MTOW (lbs.)</th>
<th>Approach Speed (knots)</th>
<th>Wingspan</th>
<th>Tail Height</th>
<th>Aircraft Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cessna 172</td>
<td>2,550</td>
<td>62</td>
<td>36' - 1&quot;</td>
<td>8' - 11&quot;</td>
<td>Single-Engine</td>
</tr>
<tr>
<td>Cirrus SR22</td>
<td>3,400</td>
<td>78</td>
<td>38' - 4&quot;</td>
<td>8' - 11&quot;</td>
<td>Single-Engine</td>
</tr>
<tr>
<td>TBM 850</td>
<td>7,394</td>
<td>85</td>
<td>41' - 7&quot;</td>
<td>14' - 4&quot;</td>
<td>Single-Engine Turboprop</td>
</tr>
<tr>
<td>Diamond DA42</td>
<td>4,189</td>
<td>79</td>
<td>44' - 4&quot;</td>
<td>8' - 2&quot;</td>
<td>Multi-Engine</td>
</tr>
<tr>
<td>Eclipse 550</td>
<td>6,000</td>
<td>77</td>
<td>37' - 11&quot;</td>
<td>11' - 0&quot;</td>
<td>Very Light Jet</td>
</tr>
</tbody>
</table>

#### Airport Reference Code A-II (Maximum Takeoff Weight (MTOW) less than or equal to 12,500lbs)

<table>
<thead>
<tr>
<th>Aircraft</th>
<th>MTOW (lbs.)</th>
<th>Approach Speed (knots)</th>
<th>Wingspan</th>
<th>Tail Height</th>
<th>Aircraft Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilatus PC-12</td>
<td>10,450</td>
<td>87</td>
<td>53' - 4&quot;</td>
<td>14' - 0&quot;</td>
<td>Single-Engine Turboprop</td>
</tr>
<tr>
<td>Cessna Caravan 208</td>
<td>8,000</td>
<td>79</td>
<td>52' - 1&quot;</td>
<td>14' - 11&quot;</td>
<td>Single-Engine Turboprop</td>
</tr>
</tbody>
</table>

#### Airport Reference Code B-I (Maximum Takeoff Weight (MTOW) less than or equal to 12,500lbs)

<table>
<thead>
<tr>
<th>Aircraft</th>
<th>MTOW (lbs.)</th>
<th>Approach Speed (knots)</th>
<th>Wingspan</th>
<th>Tail Height</th>
<th>Aircraft Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piper PA-30 Twin Comanche</td>
<td>3,600</td>
<td>95</td>
<td>36' - 0&quot;</td>
<td>8' - 2&quot;</td>
<td>Multi-Engine</td>
</tr>
<tr>
<td>Piper PA-31T Cheyenne</td>
<td>9,000</td>
<td>98</td>
<td>42' - 8&quot;</td>
<td>12' - 9&quot;</td>
<td>Multi-Engine Turboprop</td>
</tr>
<tr>
<td>Piper PA-31-350 Chieftain</td>
<td>7,000</td>
<td>96</td>
<td>40' - 8&quot;</td>
<td>13' - 0&quot;</td>
<td>Multi-Engine</td>
</tr>
<tr>
<td>Cessna 414A</td>
<td>6,785</td>
<td>94</td>
<td>44' - 2&quot;</td>
<td>11' - 6&quot;</td>
<td>Multi-Engine</td>
</tr>
<tr>
<td>Cessna 421C</td>
<td>7,450</td>
<td>96</td>
<td>41' - 1&quot;</td>
<td>11' - 5&quot;</td>
<td>Multi-Engine</td>
</tr>
<tr>
<td>Cessna Citation Mustang</td>
<td>8,645</td>
<td>95</td>
<td>43' - 2&quot;</td>
<td>13' - 5&quot;</td>
<td>Very Light Jet</td>
</tr>
</tbody>
</table>

#### Airport Reference Code B-II (Maximum Takeoff Weight (MTOW) less than or equal to 12,500lbs)

<table>
<thead>
<tr>
<th>Aircraft</th>
<th>MTOW (lbs.)</th>
<th>Approach Speed (knots)</th>
<th>Wingspan</th>
<th>Tail Height</th>
<th>Aircraft Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raytheon Beechcraft King Air 200</td>
<td>12,500</td>
<td>103</td>
<td>57' - 11&quot;</td>
<td>14' - 10&quot;</td>
<td>Multi-Engine Turboprop</td>
</tr>
<tr>
<td>Cessna 441</td>
<td>9,850</td>
<td>99</td>
<td>49' - 4&quot;</td>
<td>13' - 2&quot;</td>
<td>Multi-Engine Turboprop</td>
</tr>
</tbody>
</table>
Figure 4-2: Crystal Airport All-Weather Wind Rose (2006-2015)
SECTION 5:

ALTERNATIVES ANALYSIS
5. ALTERNATIVES ANALYSIS

5.1 INTRODUCTION
The previous LTCP considered numerous concepts related to the number of runways to retain at Crystal Airport, as follows:

- Keep all four existing runways / No Build;
- Maintain two parallel runways and close the two crosswind runway;
- Maintain just one primary runway;
- Maintain one primary runway and one crosswind runway;
- Maintain two parallel runways and only one crosswind runway;
- Extend the primary runway 14L-32R by 990 feet using declared distances;
- Maintain one runway and reduce its length to 2,500 feet; and
- Airport Closure.

After reviewing all of the concepts, costs, benefits and negative considerations, the preferred alternative formally adopted by the Commission for the Crystal Airport in December 2008 is to maintain a primary runway and a crosswind runway. This alternative provides the best environment for airport users operationally, provides for the maximum wind coverage, and maintains a more balanced noise contour.

Due to the thorough nature of the alternatives analysis completed in the previous LTCP, it will not be repeated in this document. The recommendation from the previous LTCP will be carried forward into the 2035 LTCP. The focus of this chapter will be to identify possible refinements to the preferred alternative from the previous LTCP.

5.2 ALTERNATIVES REFINEMENT

5.2.1 Refinement Objectives
Key objectives behind the analysis of refinements to the preferred development alternative include the following:

- Maintain ARC B-II aircraft design standards (small aircraft/Utility runway) and one-mile non-precision visibility minimums;
- Provide additional accelerate-stop distance available length (3,600 feet) to better meet existing and future tenants' operational needs and further improve safety;
- Maintain or improve upon existing Runway Protection Zone land use compatibility;
- Clear, improve, and/or mitigate approach and departure surface penetrations where feasible; at a minimum, maintain existing conditions;
- Improve airfield safety by reducing the rate of and risk for runway incursions; and
• Reduce off-airport land-use impacts.

5.2.2 2025 LTCP Preferred Alternative

The 2025 LTCP for MIC was finalized in December 2008 and recommended that the airfield be “right-sized” to match infrastructure with activity levels. To do this, the preferred alternative in the plan is to decommission both the turf (6R-24L) and south parallel (14R-32L) runways, leaving a two-runway system in place. The existing south parallel runway will then be converted to a full-length parallel taxiway. This plan not only simplifies the airfield, but opens up some property for both aeronautical and non-aeronautical development opportunities.

As shown in Figure 5-1, the future hangar areas are labeled A, C, D, F, and Alt. F. The non-aeronautical parcels are labeled G, Alt. I, J, and K. Alt. I is larger than in previous concepts because the closing of the turf crosswind allows for more non-aeronautical development adjacent to the remaining RPZ for the paved crosswind runway. Similarly, area C opens up for hangar space, and area J becomes potentially available for non-aeronautical development.

The concept of maintaining one primary and one crosswind runway results in the following:

<table>
<thead>
<tr>
<th>2025 LTCP Preferred Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Advantages</strong></td>
</tr>
<tr>
<td>• Maintains maximum utility of</td>
</tr>
<tr>
<td>the airport for all uses by</td>
</tr>
<tr>
<td>keeping a crosswind runway</td>
</tr>
<tr>
<td>• Provides maximum wind</td>
</tr>
<tr>
<td>coverage</td>
</tr>
<tr>
<td>• Accommodates future hangar</td>
</tr>
<tr>
<td>development opportunities</td>
</tr>
<tr>
<td>• Allows for non-aeronautical</td>
</tr>
<tr>
<td>development</td>
</tr>
<tr>
<td>• Maintains a balanced noise</td>
</tr>
<tr>
<td>contour</td>
</tr>
<tr>
<td>• Potential redevelopment of</td>
</tr>
<tr>
<td>hangar areas would improve</td>
</tr>
<tr>
<td>aesthetics</td>
</tr>
</tbody>
</table>

**Estimated Development Cost: $2,800,000.00**

5.2.3 Preferred Alternative Refinements Evaluated

**Runway Designation/Runway Protection Zones**

As outlined in Section 4.5.1, the existing and future critical aircraft expected to use Crystal Airport on a regular basis are those that have a maximum certificated gross takeoff weight of less than 12,500 pounds. Therefore, it is appropriate to use small aircraft design standards and designate the runways at Crystal Airport as Utility category. This designation allows the use of smaller-dimension Runway Protection Zones (RPZs) than shown in the previous plan (see Exhibit 5-1).

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20 Includes costs to reconstruct existing Runway 14L-32R and paved overruns, which was completed in 2008
If the 2025 LTCP preferred development alternative is combined with the small/utility RPZs, the total number of off-airport residential parcels contained in the RPZs will be reduced from 36 to 18. The Runway 14R RPZ will only impact a portion of one residential parcel and does not include any residential dwellings. The remaining 16 parcels are in the RPZs associated with the crosswind runway.

A non-public airport access roadway will continue to traverse the 32R RPZ as well, but this road is access controlled such that it only accommodates airport-related traffic. The 32L RPZ will contain approximately 150 linear feet of Douglas Drive, which is a local street with low traffic volumes.

Also, reverting to the smaller RPZs results in larger parcels of land becoming available for aeronautical or non-aeronautical development, particularly on the existing Runway 06L end adjacent to County Road 81/Bottineau Boulevard.

Exhibit 5-2 depicts the smaller-dimension RPZs associated with this change.

**Convert Paved Overruns to Stopways**

The Runway 14L and 32R ends feature a paved overrun. As currently designated, these paved overruns are not considered to be useable pavement when calculating aircraft takeoff or landing distances.

However, pavement designated as stopway can be considered as useable length for decelerating an aircraft during an aborted takeoff. Stopway pavement can be used for accelerate-stop distance calculations, but not for other takeoff or landing distance calculations.

Designating stopways for Runway 14L-32R may allow some aircraft to depart at a higher takeoff weight when accelerate-stop distance is a limiting factor, and will promote safety by formally making this pavement available for use in the event of an aborted takeoff attempt. Stopways do not change the published runway length, nor are they intended to attract aircraft types different than those operating at the airport today. However, as outlined in Section 3.5, the availability of stopways may result in a small increase in aircraft operations from users who find the existing runway length to be limiting based on accelerate-stop distance criteria.

By converting the Runway 14L-32R paved overruns to stopways, an accelerate-stop distance of nearly 3,800 feet can be provided, fulfilling the facility requirement recommendation. The published runway length will remain as 3,267 feet. Activating the stopways will include the addition of stopway edge lighting (red unidirectional lights), relocating the existing runway threshold lights to be outboard of the pavement footprint, and grading the Runway Safety Area (RSA) beyond the stopway ends.
Convert Runway 14L-32R Paved Overruns to Stopways

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>- No change to runway ends (published runway length does not change)</td>
<td>- Implements declared distances, increasing complexity</td>
</tr>
<tr>
<td>- No change to existing Runway Protection Zone locations</td>
<td>- Public perception of “expansion” to accommodate larger aircraft</td>
</tr>
<tr>
<td>o FAA has determined that no RPZ Alternatives Analysis is required</td>
<td>- Stopways do not increase LDA, TORA or TODA</td>
</tr>
<tr>
<td>- No increase to existing pavement footprint</td>
<td></td>
</tr>
<tr>
<td>- Limited operational impacts during construction</td>
<td></td>
</tr>
<tr>
<td>- Limited capital cost impacts</td>
<td></td>
</tr>
<tr>
<td>- Stopway marking and lighting may make the runway environment more conspicuous, both in the air and on the ground, further enhancing pilot situational awareness and runway safety</td>
<td></td>
</tr>
</tbody>
</table>

Estimated Development Cost: $200,000.00

The Stopway Conversion concept is shown in Figure 5-3.

Convert Paved Overruns to Runway

Another concept evaluated for the 2035 LTCP considers the impacts of converting the paved overruns on each of Runway 14L-32R to usable runway pavement for use by aircraft beginning the takeoff roll or completing the landing rollout, along with displaced landing thresholds to improve Runway Protection Zone (RPZ) compatible land use compliance. Taxiway extensions would be added to the ends of the existing overrun pavement. As noted in Section 4.5.1, it would be ideal if the entire runway length would be available to accommodate all takeoff and landing distance categories (takeoff run available, takeoff distance available, accelerate-stop distance, and landing distance available)\(^2\). Declared distances would be applied and published, which increases the accelerate-stop distance (ASDA) to approximately 4,300 feet and also increases the takeoff distance available (TORA), landing distance available (LDA), and takeoff run available (TORA).

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\(^2\) However, accelerate-stop distance (ASDA) typically emerges as the most critical (longest) length requirement to consider for the designated critical aircraft family.
### Convert Runway 14L-32R Paved Overruns to Runway

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Exceeds recommended ASDA length (4,267 feet vs. 3,600 feet)</td>
<td>• Changes runway ends with published runway length of 4,267 feet</td>
</tr>
<tr>
<td>• Optimize use of existing runway and overrun pavement surfaces</td>
<td>• Increased perception of expansion beyond stated requirements</td>
</tr>
<tr>
<td>• Increases LDA and TORA/TODA; optimizes operational capability for airport users</td>
<td>• May attract aircraft types outside of design aircraft family/utility category (larger turboprops and small jets)</td>
</tr>
<tr>
<td>• Provides airport control over RPZ property; public road and private property are outside of RPZ</td>
<td>• Increases existing pavement footprint by adding taxiway extensions</td>
</tr>
<tr>
<td>• Airspace surface shift to displaced thresholds may reduce obstacle impacts</td>
<td>• Capital costs to add runway lights, taxiway extensions/lights, safety area/object free area grading, displace landing threshold including additional lighting, VGSI relocation and flight testing, etc.</td>
</tr>
<tr>
<td>• Additional marking and lighting may make the runway environment more conspicuous, both in the air and on the ground, further enhancing pilot situational awareness and runway safety</td>
<td>• Operational impacts during construction (displaced thresholds in particular)</td>
</tr>
<tr>
<td></td>
<td>• Potential noise contour footprint increase due to aircraft starting the takeoff roll closer to residential areas</td>
</tr>
</tbody>
</table>

**Estimated Development Cost:** $2,100,000.00

The Runway Conversion concept is shown in Figure 5-4.

Although this concept maximizes the operational capabilities of the existing airport footprint, the potential for the improved airfield to attract aircraft types larger than the targeted design aircraft family, specifically those with a maximum certificated takeoff weight greater than 12,500 pounds – and thus change the role of the airport – is too great. Further, the additional development cost associated with implementing this concept is not considered to be warranted, given that the less costly Stopway concept can accomplish the objective of providing additional accelerate-stop distance. Although this concept does result in the Runway 14L-32R RPZs shifting fully onto airport property, FAA has determined that the existing land uses within the RPZ do not increase the level of risk at the airport and do not require mitigation. Finally, the full application of declared distances for all takeoff and landing operations appears to be an unnecessary complication factor for pilots.

For the reasons outlined above, the Runway Conversion concept is not identified as the Preferred Alternative in the Draft 2035 LTCP.

**Taxiway Configuration**

The 2025 LTCP Preferred Alternative contemplated converting the existing Runway 14R-32L pavement into a full-length 40-foot wide parallel taxiway, but did not suggest any other taxiway configuration changes.

For the 2035 LTCP, the following taxiway changes are being considered:
• Convert existing Taxiway E into an apron-edge taxilane. This will provide additional useable apron frontage due to the less-demanding object free area.

• Removing the section of existing Taxiway E between Taxiway A and Taxiway B that crosses Runway 06L-24R. This section of pavement will be redundant with the full-length parallel taxiway in place, and removing it will eliminate a runway crossing where incursions may occur.

• Remove the section of existing Taxiway E3 between Runway 14L-32R and the future parallel taxiway (existing Runway 14R-32L). This will eliminate an instance where a taxiway leads directly from an apron to a runway.

• Remove the section of existing Taxiway E2 between Taxiway/Taxilane E and the future parallel taxiway (existing Runway 14R-32L). This will eliminate another instance where a taxiway leads directly from an apron to a taxiway.

• Extend Taxiway B between Taxiway/Taxilane E and the future parallel taxiway (existing Runway 14R-32L).

• Install lighting on the future parallel taxiway (existing Runway 14R-32L) to promote situational awareness during low-visibility conditions. In addition, the installation of runway guard lights, enhanced centerline markings, and/or surface painted markings at select locations may help to further mitigate the risk of incursions.

The proposed taxiway configuration changes are shown on Exhibit 5-5.

5.3 PREFERRED ALTERNATIVE REFINEMENTS

The 2035 LTCP Preferred Alternative for airfield improvements at Crystal Airport includes the following items:

• Items from the 2025 LTCP Preferred Alternative:
  o Decommission existing Runways 14R-32L and 06R-24L (turf);
  o Convert existing Runway 14L-32R into a full-length parallel taxiway and add taxiway lights;
  o Preserve areas for future hangar development should demand arise; and
  o Identify parcels for possible conversion to non-aeronautical revenue generating land uses.

• Refinements included in the 2035 LTCP Preferred Alternative:
  o Change the runway designation to Utility and use small aircraft design standards to reduce RPZ dimensions;
  o Convert existing paved overruns on Runway 14L-32R to stopways, including edge lighting and additional Runway Safety Area (RSA) grading;
  o Taxiway configuration changes as described in the previous section;
  o Expand the FBO apron; and
  o Pursue the establishment of a new non-precision instrument approach to the Runway 32 end, if feasible.
The improvements associated with the 2035 LTCP Preferred Alternative are shown on Figure 5-6.

Finally, it is important to note that the LTCP is a planning document and does not authorize any construction. Adoption of the LTCP is only the first step in the project implementation process. Before any construction can begin, the project(s) must first be evaluated through an environmental review process and then compete for funding through Federal Aviation Administration and/or State grant programs. In order to compete effectively for funding, the project(s) must have solidly documented justification. Once funding is secured, final project engineering and design will take approximately one year to complete. Based on this timeline, it is feasible that construction could occur sometime between 2018-2019 timeframe (subject to change).
Figure 5-1: 2025 LTCP Preferred Alternative
Figure 5-2: Existing vs. Future RPZ Areas
Figure 5-3: Convert Paved Overruns to Stopways

Note: In this scenario, the existing paved overruns were reconfigured and lighted as stopways, extending the ASDA in both directions.
Figure 5-4: Convert Paved Overruns to Runway

Note: In this scenario, the existing paved overruns were converted to available runway that can be used for takeoff or landing rollout. Since the existing departure surfaces would remain in place, the TODA distance would only increase by 493 feet and 500 feet for Runway 14 and Runway 32, respectively.

Legend:
- Airport Property Boundary
- Runway Protection Zone (9PFZ)
- Runway Safety Area (RSA)
- Runway Obstacle Free Area (OFA)
- Runway Obstacle Free Zone (OFZ)
- Obstacle identified through the Photometric Survey that was completed in January 2014
- Proposed Airfield Pavement

Runway 32 ASDA = 4,200'
Runway 32 TODA = 3,940'
Runway 32 TODA = 3,557'
Runway 32 LDA = 3,657'
Runway 32 Displaced Threshold = 640'
Runway 32R RSA/OFA = 310'
Runway 32L RSA/OFA = 310'

Runway 14 LDA = 3,557'
Runway 14 TODA = 3,650'
Runway 14 LDA = 3,960'
Runway 14 ASDA = 4,260'
Runway 14 Displaced Threshold = 789'

Install Edge Lighting and new taxiway lights

党校子道 (Public Roadway)
Figure 5-5: Taxiway Configuration Changes
Figure 5-6: 2035 LTCP Preferred Alternative Overview
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SECTION 6:

ENVIRONMENTAL CONSIDERATIONS
6. ENVIRONMENTAL CONSIDERATIONS

6.1 INTRODUCTION
An integral part of the airport planning process focuses on the manner in which the airport and any planned enhancements to the facility pose environmental impacts. This chapter provides a high-level introductory assessment of potential environmental implications of the planned operation and development of Crystal Airport. Prior to any construction taking place, the MAC will complete an Environmental Assessment (EA) and/or an Environmental Assessment Worksheet (EAW) in compliance with state statues and FAA requirements for utilizing Airport Improvement Program (AIP) grant funds.

6.2 AIRCRAFT NOISE

6.2.1 Quantifying Aircraft Noise

Basics of Sound
Sound is a physical disturbance in a medium; a pressure wave typically moving through a fluid - air. A sound source vibrates or otherwise disturbs the air immediately surrounding the source, causing variations in pressure above and below the static (at-rest) value of atmospheric pressure. These disturbances force air to compress and expand setting up a wavelike movement of air particles that move away from the source. Sound waves, or fluctuations in pressure, vibrate the eardrum creating audible sound.

The decibel, or dB, was introduced as a measure of sound pressure level that is compressed into a convenient range, the tremendous span of human sensitivity to pressure. Using a logarithmic relationship, and the ratio of sensed pressure compared against a fixed reference pressure value, the dB scale accounts for the range of hearing with values from 0 to around 200. Most human sound experience falls into the 30 dB - 120 dB range.

Decibels are logarithmic, and thus cannot be added directly. Two identical noise sources each producing 70 dB do not add to a total of 140 dB, but to 73 dB. Each time the number of sources is doubled, the sound pressure level is increased 3 dB.

- 2 sources: 70 dB + 70 dB = 73 dB
- 4 sources: 73 dB + 73 dB = 76 dB
- 8 sources: 76 dB + 76 dB = 79 dB

The just-noticeable change in loudness for normal hearing adults is about 3 dB. That is, changes in sound level of 3 dB or less are difficult to notice. A doubling of loudness for the average listener of A-weighted sound is about 10 dB\(^{22}\). Measured, A-weighted sound levels changing by 10 dBA effect a subjective perception of being “twice as loud”.\(^{23}\)

Figure 6-1 provides the noise levels for various common sources.

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\(^{22}\) A-weighted decibels represent noise levels that are adjusted relative to the frequencies that are most audible to the human ear.

\(^{23}\) Peppin and Rodman, Community Noise, p. 47-48; additionally, Harris, Handbook, Beranek and Vér, Noise and Vibration Control Engineering, among others.
Day-Night Average Sound Level (DNL)

As detailed above, the FAA currently requires the DNL noise metric to determine and analyze noise exposure and aid in the determination of aircraft noise and land use compatibility issues around United States airports. Because the DNL metric correlates well with the degree of documented community annoyance from aircraft noise, DNL has been formally adopted by most federal agencies dealing with noise exposure. In addition to the FAA, these agencies include the U.S. Environmental Protection Agency (EPA), U.S. Department of Defense, U.S. Department of Housing and Urban Development, and Veterans Administration.

The DNL metric is calculated by cumulatively averaging sound levels over a 24-hour period. This average cumulative sound exposure includes the application of a 10-decibel penalty to sound exposures occurring during the nighttime (10:00 PM to 7:00 AM). The nighttime sound exposures are increased by 10 decibels because nighttime noise is more intrusive.

Figure 6-2 provides examples of typical DNL levels in various environments.

The FAA currently considers the 65 dB DNL contour line as the threshold of significance for noise impact. As such, sensitive land use areas (e.g., residential) around airports that are located in the 65 dB or greater DNL contours are considered by the FAA as incompatible structures.

Integrated Noise Model (INM)
The FAA’s Integrated Noise Model (INM) version 7.0d was used for evaluating aircraft noise impacts in this plan.

The model utilizes flight track information, runway use information, operation time of day data, aircraft fleet mix, standard and user defined aircraft profiles, and terrain as inputs. The INM model produces DNL noise exposure contours that are used for land use compatibility maps.

The INM considers multiple airport and aircraft operational and noise propagation variables. The primary inputs into the model include aircraft activity levels, fleet mix, day/night split of operations, runway use and flight tracks.

The noise analysis contained in this plan was started prior to the FAA’s release of the Aviation Environmental Design Tool (AEDT). Noise analyses beginning after this release will use AEDT.
6.2.2 Noise Contour Development

The noise contours presented in this document were developed using INM Version 7.0d. The contours represent noise contours, expressed in DNL. The FAA currently suggests that three different DNL levels (65, 70, and 75 DNL) be modeled but considers the 65 dB DNL contour line as the threshold of significance for noise impact. The Metropolitan Council suggests that the 60 DNL contour be included for airports in an urban environment and the 55 DNL in cases where airports are located outside the Metropolitan Urban Service Area (MUSA). Crystal Airport is within the MUSA, so the 60 DNL noise contour will be shown for advisory purposes.

The Metropolitan Airports Commission (MAC) owns and operates a Noise and Operations Monitoring System (MACNOMS) at Minneapolis-St. Paul International Airport (MSP). In addition to monitoring noise levels at 39 remote noise monitoring towers located around MSP, the system collects flight track data to approximately 40 miles around MSP up to 20,000 feet. Crystal Airport is located approximately 14 miles from MSP. As such, flight track data in the vicinity of Crystal Airport were provided by MACNOMS to aid in the INM input file development process.

MACNOMS flight track data from the 12-month period ending in August 2015 was used to develop the Baseline Condition INM Inputs. Due to the existing constraints in the flight tracking system in the vicinity of Crystal Airport, acquisition and availability of detailed flight track data is reduced. However, for the year ending August 2015, MACNOMS reported approximately 23,533 aircraft operations in the vicinity of Crystal Airport which represents approximately 56 percent of total estimated operations in 2015. This provided an adequate data sample for purposes of contributing to the construction of the INM inputs.

The following details the methodology utilized in developing the data inputs for the INM contour modeling.

**Aircraft Activity Levels**

As summarized in Table 3-7 in Chapter 3, the total number of Crystal Airport operations in the Baseline Condition is estimated to be 41,838 and the 2035 Preferred Alternative Condition forecast number of total operations is 40,135.

**Fleet Mix**

Using the MACNOMS flight track data available in the vicinity of Crystal Airport for a 12-month period ending August 2015, various data processing steps were taken to develop the Baseline Condition fleet mix. The flight track analysis process began by first excluding all MSP air carrier jet flight tracks. Then all flight tracks with a start point or end point that did not fall within a 5km (3.1 mile) radius and 1km (0.6 mile) ceiling (above ground level) around Crystal Airport were filtered out of the data. If the starting point of a track was within the radius and ceiling thresholds, it was considered a departure operation. If the endpoint of a track was within the radius and ceiling thresholds, it was considered an arrival operation. If both start and end points of a track were within the radius and ceiling thresholds, it was considered a touch and go operation. The aircraft type information from the MACNOMS flight track system was then adjusted to reflect the number of operations per aircraft category from the Base Case Year 2015 operations estimates, as described in Appendix 3 to develop the Baseline Condition fleet mix. The Baseline
Condition fleet mix was then scaled to reflect the forecast assumptions outlined in Chapter 3 to arrive at the projected Forecast 2035 fleet mix.

A summary of the Baseline Condition and Forecast 2035 fleet mixes is provided in Table 6-1. A more detailed presentation of the Baseline Condition and 2035 Preferred Alternative Condition aircraft fleet mixes is provided in Appendix 6.

**Day/Night Split of Operations**

Based on the MACNOMS flight track data for Crystal Airport, the split of day and nighttime operations was determined. Daytime hours are defined as 7:00 AM to 9:59:59 PM and nighttime hours are 10:00 PM to 6:59:59 AM.

The day/night operations distribution derived from the MACNOMS flight track data was then applied to the total number of operations to develop the Baseline Condition day/night split.

The Baseline Condition day/night split was used to arrive at the 2035 Preferred Alternative Condition day/night split. The day/night split is not expected to change significantly throughout the forecast period.

A summary of the Baseline Condition and 2035 Preferred Alternative Condition day/night splits is also provided in Table 6-1. A more detailed presentation of the Baseline Condition and 2035 Preferred Alternative Condition day/night splits is provided in Appendix 6.
### Table 6-1: Summary of Average Daily Flight Operations

<table>
<thead>
<tr>
<th>Average Daily Flight Operations</th>
<th>Day</th>
<th>Night</th>
<th>Total</th>
<th>% of Total Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Baseline Condition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Helicopter</td>
<td>1.8</td>
<td>0.4</td>
<td>2.2</td>
<td>2.5%</td>
</tr>
<tr>
<td>Multi-Engine Piston</td>
<td>5.6</td>
<td>0.2</td>
<td>5.8</td>
<td>6.5%</td>
</tr>
<tr>
<td>Single-Engine Piston</td>
<td>71.6</td>
<td>2.7</td>
<td>74.3</td>
<td>82.8%</td>
</tr>
<tr>
<td>Experimental</td>
<td>6.6</td>
<td>0.6</td>
<td>7.2</td>
<td>8.0%</td>
</tr>
<tr>
<td>Turboprop</td>
<td>0.2</td>
<td>0.0</td>
<td>0.2</td>
<td>0.2%</td>
</tr>
<tr>
<td>Jet</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>85.8</td>
<td>3.9</td>
<td>89.7</td>
<td>100.0%</td>
</tr>
<tr>
<td>% of Total Operations</td>
<td>95.7%</td>
<td>4.3%</td>
<td>100.0%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2035 Preferred Alternative Condition</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Helicopter</td>
<td>3.6</td>
<td>0.2</td>
<td>3.8</td>
<td>4.4%</td>
</tr>
<tr>
<td>Multi-Engine Piston</td>
<td>5.0</td>
<td>0.2</td>
<td>5.2</td>
<td>6.0%</td>
</tr>
<tr>
<td>Single-Engine Piston</td>
<td>61.4</td>
<td>3.5</td>
<td>64.9</td>
<td>75.0%</td>
</tr>
<tr>
<td>Experimental</td>
<td>11.6</td>
<td>0.0</td>
<td>11.6</td>
<td>13.4%</td>
</tr>
<tr>
<td>Turboprop</td>
<td>0.8</td>
<td>0.0</td>
<td>0.8</td>
<td>0.9%</td>
</tr>
<tr>
<td>Jet</td>
<td>0.2</td>
<td>0.0</td>
<td>0.2</td>
<td>0.2%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>82.6</td>
<td>3.9</td>
<td>86.5</td>
<td>100.0%</td>
</tr>
<tr>
<td>% of Total Operations</td>
<td>95.5%</td>
<td>4.5%</td>
<td>100.0%</td>
<td></td>
</tr>
</tbody>
</table>

Notes: Totals may not add due to rounding

Source: MACNOMS Data Analysis, HNTB Activity Forecasts

### Runway Use
Using the Crystal Airport flight track data, a runway use analysis was conducted. Runway assignments were made utilizing trapezoids off the end of each runway to determine on which runway a flight operated. Each trapezoid runs along the axis of the centerline beginning at the runway end and extending 5km (3.1 miles). The trapezoid is 500m (.31 miles) wide at the runway end and 1800m (1.1 miles) wide at the extent furthest from the runway. For the purpose of the runway use analysis, the last five or first five data points of each flight track in the vicinity of Crystal Airport were analyzed relative to the runway trapezoids.

Since Crystal Airport has closely-spaced parallel runways, runway assignments employ a best-fit methodology to more accurately assign the runway for each flight operating at the Crystal Airport. This process calculates the spatial distance between the flight track and the runway centerlines and selects the runway that has the shortest distance differential.
In cases when the last five radar points of a track were in the vicinity of Crystal Airport, and at least one of the radar points was located within a respective runway trapezoid, the track was assigned as an arrival operation on that runway. Conversely, in cases when the first five radar points were in the vicinity of Crystal Airport, and at least one of the radar points was located within a respective runway trapezoid, the track was assigned as a departure operation on that runway. In cases when the last five and first five radar points were in the vicinity of Crystal Airport, and at least one of the last and at least one of the first radar points were located within a respective runway trapezoid, the track was assigned as a touch and go operation on the respective runway(s).

The Baseline Condition runway use assumptions were then adjusted to arrive at the projected 2035 Preferred Alternative runway use. All new jet and turboprop aircraft operations in the 2035 Preferred Alternative Condition are assigned to Runway 14-32.

A summary of the Baseline Condition and 2035 Preferred Alternative Condition runway use percentages is provided in Table 6-2. A more detailed presentation of the Baseline Condition and 2035 Preferred Alternative Condition runway use is provided in Appendix 6.

**Flight Tracks**
The Baseline Condition INM flight track locations were developed based on the trends established by the MACNOMS flight tracks that met the fleet mix data sample criteria for Crystal Airport.

The Baseline Condition INM flight tracks were then adjusted to reflect the final airfield configuration per the Preferred Alternative, as detailed in Chapter 5. Specifically, flight tracks related to Runways 14R-32L and 06R-24L were removed and aircraft previously assigned to these tracks were moved to corresponding flight tracks on Runways 14L-32R and 06L-24R.

Figures depicting flight track locations and additional detail related to flight track use for the Baseline and 2035 Preferred Alternative Conditions are provided in Appendix 6.
Table 6-2: Summary of Average Annual Runway Use

<table>
<thead>
<tr>
<th>Average Annual Runway Use %</th>
<th>Arrivals</th>
<th></th>
<th></th>
<th>Departures</th>
<th></th>
<th></th>
<th>Touch and Gos</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Day</td>
<td>Night</td>
<td>Total</td>
<td>Day</td>
<td>Night</td>
<td>Total</td>
<td>Day</td>
<td>Night</td>
<td>Total</td>
</tr>
<tr>
<td><strong>Baseline Condition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Runway 06L</td>
<td>3.5%</td>
<td>3.6%</td>
<td>3.5%</td>
<td>3.5%</td>
<td>2.4%</td>
<td>3.5%</td>
<td>5.2%</td>
<td>0.0%</td>
<td>5.1%</td>
</tr>
<tr>
<td>Runway 06R</td>
<td>0.5%</td>
<td>0.0%</td>
<td>0.5%</td>
<td>0.6%</td>
<td>0.0%</td>
<td>0.6%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Runway 14L</td>
<td>36.9%</td>
<td>41.7%</td>
<td>37.2%</td>
<td>27.2%</td>
<td>28.5%</td>
<td>27.3%</td>
<td>23.8%</td>
<td>50.0%</td>
<td>24.7%</td>
</tr>
<tr>
<td>Runway 14R</td>
<td>5.9%</td>
<td>0.3%</td>
<td>5.6%</td>
<td>9.4%</td>
<td>6.4%</td>
<td>9.3%</td>
<td>14.6%</td>
<td>0.0%</td>
<td>14.1%</td>
</tr>
<tr>
<td>Runway 24L</td>
<td>0.5%</td>
<td>0.0%</td>
<td>0.5%</td>
<td>0.6%</td>
<td>0.0%</td>
<td>0.6%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Runway 24R</td>
<td>11.8%</td>
<td>3.2%</td>
<td>11.3%</td>
<td>9.6%</td>
<td>3.7%</td>
<td>9.4%</td>
<td>13.9%</td>
<td>0.0%</td>
<td>13.4%</td>
</tr>
<tr>
<td>Runway 32L</td>
<td>9.8%</td>
<td>15.5%</td>
<td>10.1%</td>
<td>16.6%</td>
<td>6.1%</td>
<td>16.1%</td>
<td>16.6%</td>
<td>0.0%</td>
<td>16.0%</td>
</tr>
<tr>
<td>Runway 32R</td>
<td>31.1%</td>
<td>35.7%</td>
<td>31.3%</td>
<td>32.5%</td>
<td>52.9%</td>
<td>33.3%</td>
<td>25.9%</td>
<td>50.0%</td>
<td>26.7%</td>
</tr>
<tr>
<td><strong>2035 Preferred Alternative Condition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Runway 06L</td>
<td>3.5%</td>
<td>1.6%</td>
<td>3.4%</td>
<td>4.6%</td>
<td>0.7%</td>
<td>4.4%</td>
<td>8.5%</td>
<td>0.3%</td>
<td>8.1%</td>
</tr>
<tr>
<td>Runway 14L</td>
<td>42.2%</td>
<td>41.1%</td>
<td>42.2%</td>
<td>37.2%</td>
<td>52.6%</td>
<td>37.8%</td>
<td>38.2%</td>
<td>43.8%</td>
<td>38.5%</td>
</tr>
<tr>
<td>Runway 24R</td>
<td>10.2%</td>
<td>1.2%</td>
<td>9.9%</td>
<td>8.9%</td>
<td>6.1%</td>
<td>8.8%</td>
<td>12.2%</td>
<td>15.6%</td>
<td>12.4%</td>
</tr>
<tr>
<td>Runway 32R</td>
<td>44.0%</td>
<td>56.1%</td>
<td>44.5%</td>
<td>49.3%</td>
<td>40.6%</td>
<td>49.0%</td>
<td>41.1%</td>
<td>40.4%</td>
<td>41.0%</td>
</tr>
</tbody>
</table>

Notes: Totals may not add due to rounding

Source: MACNOMS Data Analysis
6.2.3 Baseline Condition Noise Impacts

In the Baseline Condition noise contours there are 10 residential structures located within the 65 DNL noise contours around Crystal Airport, and another 123 residential structures contained within the 60 DNL contour. Residential structures are typically considered incompatible within the 65 DNL noise contour, but compatible within the 60 DNL contour. The 65 DNL contour contains approximately 64.3 acres, mostly on airport property, while the 60 DNL contour contains approximately 146.8 acres. The entire 70 and 75 DNL contours are contained on the airport property, essentially overlying the areas immediately adjacent to the runways. The 70 and 75 DNL contours contain 46.6 and 20.2 acres respectively.

The Baseline Condition noise contours are shown in Figure 6-3.

A summary of the Baseline Condition noise impact is provided in Table 6-3.

<table>
<thead>
<tr>
<th>Noise Impact Summary by Contour</th>
<th>75 DNL</th>
<th>70 DNL</th>
<th>65 DNL</th>
<th>60 DNL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline Condition</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contour Overall Area (Acres)</td>
<td>20.2</td>
<td>46.6</td>
<td>64.3</td>
<td>146.8</td>
</tr>
<tr>
<td>Contour Contained on Airport?</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Number of Residential Structures</td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>123</td>
</tr>
</tbody>
</table>

Source: MAC Analysis

6.2.4 2035 Preferred Alternative Condition Noise Impacts

In the 2035 Preferred Alternative noise contours there are 7 residential structures located within the 65 DNL noise contours around Crystal Airport, and another 177 residential structures contained within the 60 DNL contour. The 65 DNL contour contains approximately 74.7 acres, mostly on airport property, while the 60 DNL contour contains approximately 185.5 acres. The entire 70 and 75 DNL contours are contained on the airport property, essentially overlying the areas immediately adjacent to the runways. The 70 and 75 DNL contours contain 44.8 and 26.6 acres respectively.

The 2035 Preferred Alternative noise contours are shown in Figure 6-4.

A summary of the 2035 Preferred Alternative noise impact is provided in Table 6-4.
Table 6-4: 2035 Preferred Alternative Condition Noise Impact Summary

<table>
<thead>
<tr>
<th>Noise Impact Summary by Contour</th>
<th>75 DNL</th>
<th>70 DNL</th>
<th>65 DNL</th>
<th>60 DNL</th>
</tr>
</thead>
<tbody>
<tr>
<td>2035 Preferred Alternative Condition</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contour Overall Area (Acres)</td>
<td>26.6</td>
<td>44.8</td>
<td>74.7</td>
<td>185.5</td>
</tr>
<tr>
<td>Contour Contained on Airport?</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Number of Residential Structures</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>177</td>
</tr>
</tbody>
</table>

Source: MAC Analysis

A comparison of the Baseline and 2035 Preferred Alternative noise contours is shown in Figure 6-5. Table 6-5 provides a comparison of noise impacts from the Baseline to the 2035 Preferred Alternative Condition.

Table 6-5: Noise Contour Comparison (Baseline to 2035 Preferred Alternative)

<table>
<thead>
<tr>
<th>Noise Impact Comparison by Contour</th>
<th>75 DNL</th>
<th>70 DNL</th>
<th>65 DNL</th>
<th>60 DNL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change from Baseline to 2035 Preferred Alternative Conditions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contour Overall Area (Acres)</td>
<td>6.4</td>
<td>-1.8</td>
<td>10.3</td>
<td>38.7</td>
</tr>
<tr>
<td>Percentage Change</td>
<td>31%</td>
<td>-4%</td>
<td>16%</td>
<td>26%</td>
</tr>
<tr>
<td>Number of Residential Structures</td>
<td>0</td>
<td>0</td>
<td>-3</td>
<td>54</td>
</tr>
</tbody>
</table>

Source: MAC Analysis

In summary, when the 2035 Preferred Alternative Condition contours are compared to the Baseline Condition contours:

- For the 65 DNL contour, the acreage contained within the contour increases by 16 percent, but the contour contains three (3) fewer residential structures located adjacent to the airport’s southern boundary. This change is largely due to the consolidation of flight activity on two runways instead of four in the existing condition.

- For the 60 DNL contour, the acreage contained within the contour increases by 26 percent, and the contour contains 54 more residential structures, primarily located to the east of the airport. Again, this change is largely due to the consolidation of flight activity on two runways instead of four in the existing condition.

As described in Section 3.5, converting the existing paved runways on Runway 14L-32R to stopways may result in a small increase in aircraft operations from some users who
find the existing runway length to be limiting based on accelerate-stop distance criteria. In the stopway scenario, the number of additional aircraft operations above the base case is approximately 230 annually, translating to just over four additional takeoffs and landings per week. As a sensitivity analysis, the noise model was run for the 2035 Preferred Alternative airfield configuration both with and without the additional aircraft operations associated with the stopway activation. As illustrated in Figure 6-6, the additional operations did not have a significant impact on the size or shape of the noise contours. This is due to the relatively small number of operations, as well as the overall higher performance and noise characteristics of the types of aircraft types that would likely be attracted to the airport due to the stopways.

6.3 SANITARY SEWER AND WATER

Crystal Airport currently lies within the Metropolitan Urban Service Area (MUSA) for sanitary sewer service and has both water and sanitary system available for tenants. Development of any new hangar areas will include extension of existing water and sanitary sewer services.

6.4 WETLANDS

As noted in Section 2.5.1, the airport lies within the jurisdiction of the Shingle Creek Watershed Management Commission (SCWMC). This commission was formed in 1982 under a Joint Powers Agreement between the Cities of Crystal, Brooklyn Park, Brooklyn Center, and is governed by a nine-member board. Their responsibility is to protect and manage water resources within the watershed.

Any projects completed at the airport require conformance with the SCWMC, as well as Wetland Conservation Act (WCA) and/or DNR regulations regarding wetlands. If wetland impacts are suspected with MAC projects, avoidance, minimization efforts and appropriate mitigation will be assessed.

No wetland impacts are anticipated with implementation of the 2035 Preferred Alternative.

6.5 OTHER ENVIRONMENTAL CONSIDERATIONS

The MAC will conduct an environmental review per federal National Environmental Policy Act (NEPA) and Minnesota Environmental Policy Act (MEPA) requirements to more specifically identify the environmental footprint of the proposed improvements before construction can begin. During this process, alternatives must be reviewed and any potential impacts must be avoided if possible. If impacts cannot be avoided, they must be minimized to the extent possible and mitigated in full compliance with federal and state requirements.

The following impact categories will be assessed during the environmental review:

- Air Quality;
- Biological resources (including fish, wildlife, and plants);
- Climate;
- Department of Transportation Section 4(f) Properties (park and recreational lands, wildlife and waterfowl refuges, and historic sites);
- Farmlands;
- Hazardous materials, solid waste, and pollution prevention;
- Historical, architectural, archeological, and cultural resources;
- Land use;
- Natural resources and energy supply;
- Noise and compatible land use;
- Socioeconomics, environmental justice, and children’s environmental health and safety risks;
- Visual effects (including light emissions);
- Water resources (including wetlands, floodplains, surface waters, groundwater, and wild and scenic rivers);
- Construction impacts; and
- Cumulative effects.

An environmental review process cannot begin until there is a sufficiently detailed plan available to evaluate. MAC envisions initiating the environmental review for the proposed Crystal Airport improvements soon after the plan is reviewed by the Metropolitan Council and formally adopted by the MAC Board. A full study of these environmental impact items at this time falls outside the scope of this long-term planning document.
Figure 6-1: Sound Levels of Typical Noise Sources

- Concorde, landing (3,280 ft from runway)
- 747-100, takeoff (21,000 ft from start of roll)
- Ambulance Siren (100 ft)
- Power Lawn Mower (3 ft)
- Diesel Truck, 40 Mph (50 ft)
- Vacuum Cleaner (3 ft)
- A/C Unit (100 ft)
- Bird Calls (distant)
- DC-9Q, takeoff (21,000 ft from start of roll)
- A320, takeoff (21,000 ft from start of roll)
- Car, 65 Mph (25 ft)
- Normal Conversation (5 ft)
- Light Traffic (100 ft)
- Soft Whisper (5 ft)
- Just Audible

dBA
- 140: Threshold of Pain
- 130: Civil Defense Siren (100 ft)
- 120: Pile Driver (50 ft)
- 110: Motorcycle (25 ft)
- 100: Ambulance Siren (100 ft)
- 90: Power Lawn Mower (3 ft)
- 80: Vacuum Cleaner (3 ft)
- 70: A/C Unit (100 ft)
- 60: Bird Calls (distant)
- 50: Normal Conversation (5 ft)
- 40: Light Traffic (100 ft)
- 30: Soft Whisper (5 ft)
- 20: JUST AUDIBLE
- 10: Threshold of Hearing
- 0: Threshold of Hearing
Figure 6-2: Typical Outdoor Community Day-Night Average Sound Levels

Figure 6-3: Baseline Condition Noise Contours
Figure 6-4: 2035 Preferred Alternative Noise Contour
Figure 6-5: LTCP Noise Contour Comparison
Figure 6-6: Stopway Scenario – Noise Contour Sensitivity Analysis
SECTION 7:

LAND USE COMPATIBILITY
7. LAND USE COMPATIBILITY

7.1 INTRODUCTION

Planning for the maintenance and development of airport facilities is a complex process. Successfully developing airports requires insightful decision-making predicated on various facts that drive the need for the development of additional airport infrastructure. Furthermore, these efforts should consider surrounding community land uses. Airports cannot be developed in a vacuum; the development effort must consider the needs of the surrounding populations and the land uses in the area surrounding the airport. The success of airport planning relies on close consideration and coordination of surrounding land use to ensure compatibility with the community surrounding the airport.

As city governments are responsible for the development and enhancement of city infrastructure, airport proprietors are responsible for the federally-endorsed enhancement of our nation’s airport system. Airport operators would be remiss in their duties if such efforts did not consider the land use consequences of decisions made regarding airport development.

This chapter evaluates the land use implications of the planned operation and development of Crystal Airport.

7.2 LAND USE COMPATIBILITY CRITERIA

The Federal Aviation Administration (FAA) has established Land Use Compatibility criteria in 14 CFR Part 150 detailing acceptable land uses around airports considering noise impacts in terms of DNL. In the case of airports located in the Minneapolis-St. Paul Metropolitan Area, additional criteria also must be evaluated in relation to noise exposure as established by the Metropolitan Council’s Transportation Policy Plan (TPP).

7.2.1 Federal Aviation Administration Land Use Compatibility Guidelines

Federal guidelines for compatible land use that take into account the impact of aviation noise have been developed for land near airports. They were derived through an iterative process that started before 1972. Independent efforts by the FAA, U.S. Department of Housing and Urban Development, U.S. Air Force, U.S. Navy, U.S. Environmental Protection Agency and other Federal agencies to develop compatible land use criteria were melded into a single effort by the Federal Interagency Committee on Urban Noise in 1979, and resulted in the FICUN Guidelines document (1980). The Guidelines document adopted DNL as its standard noise descriptor, and the Standard Land Use Coding Manual (SLUCM) as its standard descriptor for land uses. The noise-to-land use relationships were then expanded for FAA’s Advisory Circular (AC) 150/5020-1, Noise Control and Compatibility Planning for Airports. The current individual agency compatible land use criteria have been, for the most part, derived from those in the FICUN Guidelines. Only certain categories of these guidelines pertain to airport environments.

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In 1985 the FAA adopted 14 C.F.R. Part 150 outlining land use compatibility guidelines around airports. **Table 7-1** provides the land use compatibility guidelines as established by the FAA.

According to FAA standards, areas with noise levels less than 65 DNL are considered compatible with residential development.
Table 7-1: FAA Aircraft Noise and Land Use Compatibility Guidelines

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Yearly day-night average sound level (DNL) in decibels</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Below 65</td>
</tr>
<tr>
<td>Residential</td>
<td></td>
</tr>
<tr>
<td>Residential, other than mobile homes and transient lodgings</td>
<td>Y</td>
</tr>
<tr>
<td>Mobile home park</td>
<td>Y</td>
</tr>
<tr>
<td>Transient Lodgings</td>
<td>Y</td>
</tr>
<tr>
<td>Public Use</td>
<td></td>
</tr>
<tr>
<td>Schools</td>
<td>Y</td>
</tr>
<tr>
<td>Hospitals and nursing homes</td>
<td>Y</td>
</tr>
<tr>
<td>Churches, auditoriums, and concert halls</td>
<td>Y</td>
</tr>
<tr>
<td>Governmental services</td>
<td>Y</td>
</tr>
<tr>
<td>Transportation</td>
<td>Y</td>
</tr>
<tr>
<td>Parking</td>
<td>Y</td>
</tr>
<tr>
<td>Commercial Use</td>
<td></td>
</tr>
<tr>
<td>Offices, business and professional</td>
<td>Y</td>
</tr>
<tr>
<td>Wholesale and retail–building materials, hardware and farm equipment</td>
<td>Y</td>
</tr>
<tr>
<td>Retail trade–general</td>
<td>Y</td>
</tr>
<tr>
<td>Utilities</td>
<td>Y</td>
</tr>
<tr>
<td>Communication</td>
<td>Y</td>
</tr>
<tr>
<td>Manufacturing and Production</td>
<td></td>
</tr>
<tr>
<td>Manufacturing, general</td>
<td>Y</td>
</tr>
<tr>
<td>Photographic and optical</td>
<td>Y</td>
</tr>
<tr>
<td>Agriculture (except livestock) and forestry</td>
<td>Y</td>
</tr>
<tr>
<td>Livestock farming and breeding</td>
<td>Y</td>
</tr>
<tr>
<td>Mining and fishing, resource production and extraction</td>
<td>Y</td>
</tr>
</tbody>
</table>
### Land Use

<table>
<thead>
<tr>
<th>Recreational</th>
<th>Yearly day-night average sound level (DNL) in decibels</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Below 65</td>
</tr>
<tr>
<td>Outdoor sports arenas and spectator sports</td>
<td>Y</td>
</tr>
<tr>
<td>Outdoor music shells, amphitheaters</td>
<td>Y</td>
</tr>
<tr>
<td>Nature exhibits and zoos</td>
<td>Y</td>
</tr>
<tr>
<td>Amusements, parks, resorts and camps</td>
<td>Y</td>
</tr>
<tr>
<td>Golf courses, riding stables, and water recreation</td>
<td>Y</td>
</tr>
</tbody>
</table>

*The designations contained in this table do not constitute a Federal determination that any use of land covered by the program is acceptable or unacceptable under Federal, State, or local law. The responsibility for determining the acceptable and permissible land uses and the relationship between specific properties and specific noise contours rests with the local authorities. FAA determinations under part 150 are not intended to substitute federally determined land uses for those determined to be appropriate by local authorities in response to locally determined needs and values in achieving noise compatible land uses.*

**Table Key**

- **SLUCM**: Standard Land Use Coding Manual.
- **Y (Yes)**: Land use and related structures compatible without restrictions.
- **N (No)**: Land use and related structures are not compatible and should be prohibited.
- **NLR**: Noise Level Reduction (outdoor to indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.
- **25, 30, or 35**: Land use and related structures generally compatible; measures to achieve NLR of 25, 30, or 35 dB must be incorporated into design and construction of structure.

Table Notes on Following Page
Table Notes

(1) Where the community determines that residential or school uses must be allowed, measures to achieve outdoor to indoor Noise Level Reduction (NLR) of at least 25 dB and 30 dB should be incorporated into building codes and be considered in individual approvals. Normal residential construction can be expected to provide a NLR of 20 dB, thus, the reduction requirements are often stated as 5, 10, or 15 dB over standard construction and normally assume mechanical ventilation and closed windows year round. However, the use of NLR criteria will not eliminate outdoor noise problems.

(2) Measures to achieve NLR of 25 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

(3) Measures to achieve NLR of 30 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

(4) Measures to achieve NLR of 35 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

(5) Land use compatible provided special sound reinforcement systems are installed.

(6) Residential buildings require an NLR of 25.

(7) Residential buildings require an NLR of 30.

(8) Residential buildings not permitted.

Source: 14 CFR Part 150
7.2.2 Metropolitan Council Land Use Compatibility Guidelines

The Metropolitan Council has developed a set of land use planning guidelines for responsible community development in the Minneapolis-St. Paul Metropolitan Area. The intent is to provide city governments with a comprehensive resource with regard to planning community development in a manner that considers adequacy, quality and environmental elements of planned land uses.

Specifically, the Minnesota State Land Planning Act, the underlying law that requires local units of government to prepare a comprehensive plan and submit it for Metropolitan Council review, was enacted in 1976. By 1980, all community plans had been approved. The 1973 Aviation Chapter of the Metropolitan Development Guide was updated in 1977. In 1983, the Metropolitan Council amended the Aviation Policy Plan to include “Land Use Compatibility Guidelines for Aircraft Noise.”

In 1994, the Land Planning Act of 1976 had been amended to require communities to update their comprehensive plans at least every 10 years. Therefore, all Metropolitan Development Guide chapters were updated by December 1996.

Under the 1976 legislation, communities designated land uses and defined the zoning applicable to the particular land use parcel; the zoning took precedence. The land use measure was a request that local jurisdictions review existing zoning in Airport Noise Zones to determine their consistency with the regional compatibility guidelines, and rezone the property for compatible development if consistent with other development factors. This policy changed in 1994.

Under the amended Land Planning Act, communities determine the land use designation, and the zoning must be consistent with that designation. Thus, the communities had to re-evaluate designated use, permitted uses within the designation, zoning classifications, and adequacy.

In 2004 the Aviation Policy Plan was incorporated into the Transportation Policy Plan (TPP) of the Metropolitan Development Guide. In January 2015 the Metropolitan Council adopted the 2040 TPP land use compatibility guidelines for all metropolitan system airports that are included in the TPP.

In the case of airports located in the Minneapolis-St. Paul Metropolitan Area, the Metropolitan Council Development Guidelines in relation to airport noise exposure need to be considered. The TPP provides land use guidelines based on four noise zones around an airport. The following provides the Metropolitan Council’s description of each noise zone:

- Zone 1 – Occurs on and immediately adjacent to the airport property. Existing and projected noise intensity in the zone is severe and permanent. It is an area affected by frequent landings and takeoffs and subjected to aircraft noise greater than 75 DNL. Proximity of the airfield operating area, particularly runway thresholds, reduces the probability of relief resulting from changes in the operating characteristics of either the aircraft or the airfield. Only new, non-sensitive land uses should be considered – in addition to preventing future noise problems the severely noise-impacted areas should be fully evaluated to
determine alternative land use strategies including eventual changes in existing land uses.  

- Zone 2 – Noise impacts are generally sustained, especially close to runway ends. Noise levels are in the 70 to 74 DNL range. Based upon proximity to the airfield, the seriousness of the noise exposure routinely interferes with sleep and speech activity. The noise intensity in this area is generally serious and continuing. New development should be limited to uses that have been constructed to achieve certain exterior-to-interior noise attenuation and that discourage certain outdoor uses.

- Zone 3 – Noise impacts can be categorized as sustaining. Noise levels are in the 65 to 69 DNL range. In addition to the intensity of the noise, location of buildings receiving the noise must also be fully considered. Aircraft and runway use operational changes can provide some relief for certain uses in this area. Residential development may be acceptable if it is located outside areas exposed to frequent landings and takeoffs, is constructed to achieve certain exterior-to-interior noise attenuation, and is restrictive as to outdoor use. Certain medical and educational facilities that involve permanent lodging and outdoor use should be discouraged.

- Zone 4 – Defined as a transitional area where noise exposure might be considered moderate. Noise levels are in the 60 to 64 DNL range. The area is considered transitional since potential changes in airport and aircraft operating procedures could lower or raise noise levels. Development in this area can benefit from insulation levels above typical new construction standards in Minnesota, but insulation cannot eliminate outdoor noise problems.

- Noise Buffer Zones: Additional area that can be protected at the option of the affected community; generally, the buffer zone becomes an extension of noise zone 4. At MSP, a one-mile buffer zone beyond the DNL 60 has been established to address the range of variability in noise impact, by allowing implementation of additional local noise mitigation efforts. A buffer zone out to DNL55 is optional at those reliever airports with noise policy areas outside the MUSA.

The listed noise zones also use the DNL noise exposure metric. The Metropolitan Council Land Use Compatibility Guidelines for Aircraft Noise are provided in Table 7-2.

The Metropolitan Council suggests that the 60 DNL contour be used for planning purposes in areas inside the MUSA. As Crystal Airport is located within the MUSA, the 60 DNL contour is provided in the context of evaluating Land Use Compatibility considerations.
### Table 7-2: Metropolitan Council Land Use Compatibility Guidelines for Aircraft Noise

<table>
<thead>
<tr>
<th>Land Use Category</th>
<th>New Development and Major Redevelopment</th>
<th>Infill Development and Reconstruction or Additions to Existing Structures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>DNL</td>
<td>DNL</td>
</tr>
<tr>
<td>Residential</td>
<td>75+</td>
<td>74-70</td>
</tr>
<tr>
<td>Single / Multiplex with Individual Entrance</td>
<td>INCO</td>
<td>INCO</td>
</tr>
<tr>
<td>Multiplex / Apartment with Shared Entrance</td>
<td>INCO</td>
<td>INCO</td>
</tr>
<tr>
<td>Mobile Home</td>
<td>INCO</td>
<td>INCO</td>
</tr>
<tr>
<td>Educational, Medical, Schools, Churches, Hospitals, Nursing Homes</td>
<td>INCO</td>
<td>INCO</td>
</tr>
<tr>
<td>Cultural / Entertainment / Recreational</td>
<td>COND</td>
<td>COND</td>
</tr>
<tr>
<td>Indoor</td>
<td>COND</td>
<td>COND</td>
</tr>
<tr>
<td>Outdoor</td>
<td>COND</td>
<td>COND</td>
</tr>
<tr>
<td>Office / Commercial / Retail</td>
<td>COND</td>
<td>PROV</td>
</tr>
<tr>
<td>Services</td>
<td>COND</td>
<td>PROV</td>
</tr>
<tr>
<td>Transportation-Passenger Facilities</td>
<td>COND</td>
<td>PROV</td>
</tr>
<tr>
<td>Transient Lodging</td>
<td>INCO</td>
<td>COND</td>
</tr>
<tr>
<td>Other Medical, Health &amp; Educational</td>
<td>COND</td>
<td>PROV</td>
</tr>
<tr>
<td>Other Services</td>
<td>COND</td>
<td>PROV</td>
</tr>
<tr>
<td>Industrial / Communication / Utility</td>
<td>PROV</td>
<td>COMP</td>
</tr>
<tr>
<td>Agriculture Land / Water Areas / Resource Extraction</td>
<td>COMP</td>
<td>COMP</td>
</tr>
</tbody>
</table>

Notes: Table Key on Following Page
<table>
<thead>
<tr>
<th>Table Key</th>
<th>Description</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMP</td>
<td>&quot;Compatible&quot; - Uses are acoustically acceptable for both indoors and outdoors.</td>
<td>Metropolitan Council 2040 Transportation Policy Plan, Appendix L - January 2015.</td>
</tr>
<tr>
<td>PROV</td>
<td>&quot;Provisional&quot; - Uses that should be discouraged if at all feasible; if allowed, must meet certain structural performance standards to be acceptable according to MS 473.192 (Metropolitan Area Aircraft Noise Attenuation Act). Structures built after December 1983 shall be acoustically constructed so as to achieve interior sound levels as follows (per Metropolitan Council's 2040 Transportation Policy Plan, Appendix L, Table L-4):</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Residential, Educational and Medical = 45 dBA Interior Sound Level</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cultural, Entertainment, Recreational, Office, Commercial, Retail and Services = 50 dBA Interior Sound Level</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Industrial, Communications, Utility, Agricultural Land, Water Areas, Resource Extraction = 60 dBA Interior Sound Level</td>
<td></td>
</tr>
<tr>
<td>COND</td>
<td>&quot;Conditional&quot; - Uses that should be strongly discouraged; if allowed, must meet the structural performance standards, and requires a comprehensive plan amendment for review of the project under the factors described in the Metropolitan Council's 2040 Transportation Policy Plan, Appendix L, Table L-3.</td>
<td></td>
</tr>
<tr>
<td>INCO</td>
<td>&quot;Incompatible&quot; - Land uses that are not acceptable even if acoustical treatment were incorporated in the structure and outside uses restricted.</td>
<td></td>
</tr>
</tbody>
</table>

Each local government unit having land within the airport noise zones is responsible for implementing and enforcing the structure performance standards in its jurisdiction.
7.2.3 Crystal Airport Zoning Ordinance and Safety Zones

A zoning ordinance to regulate the height of structures and trees and the use of property in the vicinity of Crystal Airport was adopted by the MAC in September 1952. A copy of this zoning ordinance is included in Appendix 7.

A Joint Airport Zoning Board (JAZB), including the Cities of Crystal, Brooklyn Park, Brooklyn Center, New Hope, Minneapolis, Robbinsdale and the Metropolitan Airports Commission, adopted an airport zoning ordinance in December 1983. The purpose of the ordinance is to protect against the construction of structures that will interfere with the operations at the airport. Although a number of homes are located within the designated safety zones, these areas were accepted as “established residential neighborhoods in built-up urban areas.”

Upon adoption of the zoning ordinance by the JAZB, it was the responsibility of each individual city to adopt the ordinance and conform their zoning to the ordinance requirements. According to the City of Crystal’s current Comprehensive Plan, the airport zoning regulations were adopted by the City in 1983 and one of the City’s aviation policies is to continue to protect airspace in accordance with the Joint Airport Zoning Ordinance.

In the existing Airport Zoning Ordinance for Crystal Airport, the following safety zone dimensions are listed:

- Runways 13L-31R and 13R-31L (now Runways 14L-32R and 14R-32L)
  - Safety Zone A = 2,167 feet
  - Safety Zone B = 1,083 feet
  - Total Safety Zone = 3,250 feet

- Runways 5L-23R and 5R-23L (now Runways 06L-24R and 06R-24L)
  - Safety Zone A = 1,400 feet
  - Safety Zone B = 700 feet
  - Total Safety Zone = 2,100 feet

The zoning surfaces included in the ordinance are shown in Figure 7-1.

7.2.4 MnDOT Aeronautics Safety Zones

The State of Minnesota Department of Transportation, Office of Aeronautics (MnDOT) has established regulations that control the type of development allowed off runway ends in order to prevent incompatible development. These guidelines are meant to be used to establish zoning ordinances to protect areas around an airport.

The most restrictive areas created by MnDOT regulations are called Safety Zones A and B. The recommended safety zones should exist off each runway end and follow the approach zones out to the total length of the respective runway. The length of Safety

---

30 The published runway length for these runways was 3,250 feet at the time the zoning ordinance was adopted.
31 The beginning point of Zone A extends outward from a point 200 feet from the displaced thresholds on these runways in place at the time the zoning ordinance was adopted.
Zone A is 2/3 of the total runway length; Safety Zone B is 1/3 of the total runway length and extends from Safety Zone A. There is also an area called Safety Zone C, which is a horizontal plane established 150 feet above the established airport elevation for a specified distance from each runway end.

A complete description and copy of the Minnesota Rules Chapter 8800 Department of Transportation Aeronautics Section 2400 Airport Zoning Standards can be accessed via the following website link: https://www.revisor.mn.gov/rules/?id=8800.2400.

MnDOT has undertaken efforts to update the state’s airport zoning regulations. It is anticipated that revisions to the statutes governing airport zoning will be submitted for consideration during a future Minnesota Legislative session. The administrative rules used to implement the zoning regulations and define the particulars of the Safety Zones will likely be updated after the statutory changes are complete.

Once Crystal Airport’s future development plan is finalized, and the process to update the state’s airport zoning regulations is complete, MAC intends to re-convene the Joint Airport Zoning Board (JAZB). Through a collaborative process, the JAZB will seek to update the existing Airport Zoning ordinance (see Section 7.2.3), in accordance with state statutes and administrative rules, that considers land uses around Crystal Airport to achieve a balance between providing a reasonable level of public safety and facilitating compatible off-airport development.

For this report, the existing size and shape of Safety Zones A and B from the Crystal Airport Zoning Ordinance were used for the purpose of analyzing land use compatibility. The sizes, shapes and/or locations of these zones may be revised by the JAZB during an update of the Airport Zoning Ordinance for Crystal Airport.

MnDOT Aeronautics promotes the preservation of Clear Zones off runway ends to enhance operational safety of aircraft and to protect life and property in runway approach areas. The dimensions of the MnDOT Clear Zone for a non-precision utility runway are as follows: 500-foot inner width, 800-foot outer width, 1,000 feet long with a 20:1 slope. The MnDOT Clear Zones are shown in Figure 7-2. MnDOT Clear Zones should be kept clear of incompatible land uses to the extent practical.

7.3 LAND USE COMPATIBILITY ANALYSIS

The Crystal Airport is located in Hennepin County, northwest of the City of Minneapolis. The airport is bordered by three cities, Crystal to the west, south and east of the airport, Brooklyn Park to the northwest and Brooklyn Center to the northeast. The airport is bordered by primarily residential land uses to the north, east and south. A commercial corridor along County Road 81 is located to the west of the airport. As noted above, the City of Crystal adopted the Airport Zoning Ordinance addressing structural height and land use in the vicinity of the Crystal Airport.

The City of Crystal 2030 Comprehensive Plan was updated in 2009, and amended in 2011. The plan contains a section (Chapter M) on aviation pertaining to Crystal Airport. In the plan, the City of Crystal reiterates that closure of the airport and redevelopment of the site is its long-term policy goal. However, the city recognizes that it does not have the authority to close Crystal Airport, and set forth several aviation policies aimed at
protecting airspace in accordance with the 1983 Joint Airport Zoning Ordinance. The full plan can be accessed via the following website link:


The Cities of Brooklyn Park and Brooklyn Center also maintain Comprehensive Plans that address land uses and transportation infrastructure in the vicinity of Crystal Airport. The full Comprehensive Plans for the adjacent townships can be accessed from the website links below:

- Brooklyn Park  
  http://citysearch.brooklynpark.org/website/comdev/Planning/CompletedCompPlan12-31-08.pdf

- Brooklyn Center  

### 7.3.1 Existing Condition Land Use Compatibility

In general, the area around the airport is primarily residential with areas of commercial/industrial and park/open space land uses. Residential uses border portions of airport property to the north, east, south and west. Commercial/industrial uses border County Road 81 along the west side of the airport. Much of the commercial/industrial uses in the vicinity of the airport, along County Road 81, are on the east side of the road.

**Land Use Compatibility and Airport Noise Considerations**

**Figure 7-3** illustrates the Baseline Condition 60 and greater DNL noise contours around Crystal Airport (from Section 6.2.3) with existing RPZs and Safety Zones over existing land use data provided by the Metropolitan Council.

With the exception of the 10 residential structures located in the 65 DNL noise contour at the southwest corner of the airport, existing land uses around Crystal Airport are compatible with airport operations considering airport noise impacts as outlined in the FAA land use guidelines in Table 7-1. Additionally, there are 123 residential structures in the 60 DNL noise contour. Per the Metropolitan Council land use guidelines in Table 7-2, new residential developments in the 60 DNL noise contour are considered incompatible and in cases of infill are considered conditional which, if allowed, must meet certain structural performance standards.

**Land Use Compatibility and Existing Runway Protection/Safety Zones**

The existing RPZs and Safety Zones A and B for Runways 14R-32L, 14L-32R, 06L-24R, and 06R-24L at Crystal Airport encompass areas of airport property in addition to commercial/industrial, single and multi-family residential, park area, and undeveloped land uses.

The existing RPZ’s at Crystal Airport include several land uses that would not be considered compatible under the FAA’s current guidance. However, since these land uses predate the FAA’s current guidance, they are acceptable to remain as an existing condition.
• Existing Runway 14L and 14R Ends: Douglas Drive and two (2) private residential parcels. Douglas Drive is designated as a local road that provides access to the airport and adjacent residential development. By definition, a local roadway serves less than 1,000 vehicles per day. Although no recent traffic study is known to exist for this section of Douglas Drive, vehicle counts taken on other local roadways in the vicinity of the Airport suggest average daily traffic levels in the range of 300 – 500 vehicles. There are no current plans to increase the capacity of this roadway.

• Existing Runway 32R and 32L Ends: Eight (8) private residential parcels. A non-public airport access roadway will continue to traverse the 32R RPZ as well, but this road is access controlled such that it only accommodates airport-related traffic.

• Existing Runway 06L and 6R Ends: County Road 81 (Bottineau Boulevard), freight rail (BNSF), ten (10) private residential parcels.

• Existing Runway 24L and 24R Ends: Sixteen (16) private residential parcels.

Table 7-3 provides existing land use acreages encompassed by the Baseline Condition RPZs and Safety Zones.
Table 7-3: Baseline Condition Land Use Impacts

<table>
<thead>
<tr>
<th>Land Use Acreage</th>
<th>RWY 14L</th>
<th>RWY 32R</th>
<th>RWY 14R</th>
<th>RWY 32L</th>
<th>RWY 06L APP (DEP)*</th>
<th>RWY 24R APP (DEP)*</th>
<th>RWY 06R</th>
<th>RWY 24L</th>
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</tbody>
</table>

Notes: Totals may not add due to rounding.

*Runway 6L-24R has both approach and departure RPZs in place due to the threshold displacements.

Source: MAC Analysis
7.3.2 2035 Preferred Alternative Land Use Compatibility

The 2035 Preferred Alternative for Crystal Airport includes the closure of the south parallel Runway 14R-32L and the turf parallel crosswind Runway 6R-24L. These developments result in changes to the noise contour, RPZs and Safety Zone considerations. Converting the existing paved overruns on Runway 14L-32R to stopways does not affect the locations of the RPZs or Safety Zones, and only has minimal impact on the noise contour (see Section 6.2.4).

2035 Preferred Alternative Land Use Compatibility and Airport Noise Considerations

Figure 7-4 provides the 2035 Preferred Alternative forecast 60 and greater DNL noise contours around Crystal Airport (from Section 6.2.4) with forecast RPZs and Safety Zones over existing land use data provided by the Metropolitan Council.

There are minor changes proposed in future land uses within the 2035 noise contours: in the City of Brooklyn Park, northwest of the airport, areas of multifamily are planned to be converted to single family; an area of open space is planned for multi-optional development; in the City of Crystal, a small area of existing single family use west of the airport is planned for conversion to industrial use and small pockets of multifamily and undeveloped areas are planned to be converted to single family residential.

The Final Preferred Development Alternative continues to include residential structures in recognized airport noise areas, as outlined in both the FAA land use guidelines in Table 7-1 and the Metropolitan Council land use guidelines in Table 7-2, around Crystal Airport. A 2012 FAA Program Guidance Letter (PGL 12-09) requires that structures potentially eligible for sound insulation (i.e., within the 65 dB DNL noise contour) be evaluated to determine whether the interior noise levels are high enough to warrant sound insulation treatment. Structures already reducing interior noise exposure to 45 dB or less, are ineligible for sound insulation treatment. The MAC intends to address this issue as part of the required environmental documentation process that will be conducted to implement the preferred development alternative outlined in this plan. It is anticipated that the properties located in the 65 DNL contours around the Crystal Airport would be tested in accordance with American Society of the International Association for Testing and Materials (ASTM) standards using a methodology agreed upon by the MAC and the city or cities in which the homes reside.

Land Use Compatibility and 2035 Preferred Alternative Runway Protection/Safety Zones

The 2035 Preferred Alternative RPZs and Safety Zones A and B for Runways 14R-32L, 14L-32R, 06L-24R, and 06R-24L at Crystal Airport continue to encompass areas of airport property in addition to commercial/industrial, single and multi-family residential, park area, and undeveloped land uses; however, the area encompassed by these zones is reduced as two of the four existing runways are proposed to be decommissioned.

Additional analysis was conducted relative to the planned land uses around Crystal Airport as provided by the Metropolitan Council. The proposed changes in land uses within the Preferred Alternative RPZs and Safety Zones include a small area within the Runway 14L Safety Zone A, where existing multi-family residential is planned to become single family residential and within the Runway 32R Safety Zone A, where small pockets
of multi-family residential are planned to become single family residential and an undeveloped area is planned to be converted to commercial use.

**Table 7-4** provides existing land use acreages encompassed by the 2035 Preferred Alternative Condition RPZs and Safety Zones.

**Table 7-5** provides a comparison of on-airport and off-airport land use impacts from the Baseline to the 2035 Preferred Alternative Condition.

A comparison of the Baseline and Preferred Alternative RPZs, Safety Zones, and noise contours is shown in **Figure 7-5**.
### Table 7-4: 2035 Preferred Alternative Land Use Impacts

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<tr>
<th>Land Use Acreage</th>
<th>RWY 14L</th>
<th>RWY 32R</th>
<th>RWY 06L APP (DEP)*</th>
<th>RWY 24R APP (DEP)*</th>
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<td>2035 Preferred Alternative Condition</td>
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Notes: Totals may not add due to rounding.

*Runway 6L-24R has both approach and departure RPZs in place due to the threshold displacements.

Source: MAC Analysis
## Table 7-5: Change in Land Use Impacts (Baseline to 2035 Preferred Alternative)

<table>
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<tr>
<th>Land Use Impacts</th>
<th>RWY 14L</th>
<th>RWY 32R</th>
<th>RWY 14R</th>
<th>RWY 32L</th>
<th>RWY 6L APP (DEP)*</th>
<th>RWY 24R APP (DEP)*</th>
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<th>RWY 24L</th>
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</table>

Notes: Totals may not add due to rounding.

*Runway 6L-24R has both approach and departure RPZs in place due to the threshold displacements.

Source: MAC Analysis
In summary, when the 2035 Preferred Alternative Condition is compared to the Baseline Condition from a land use compatibility perspective:

- The Baseline Condition RPZs have 9.6 acres off airport property, while 4.2 acres are off airport property in the 2035 Preferred Alternative Condition – a reduction of 5.4 acres.
- The Baseline Condition Safety Zones have 169.0 acres off airport property, while 84.7 acres are off airport property in 2035 Preferred Alternative Condition – a reduction of 84.3 acres.
- With the exception of seven (7) residential structures that remain in the 65 DNL noise contour, existing land uses around Crystal Airport are compatible with the Baseline and 2035 Preferred Alternative Condition and resultant airport operations considering airport noise impacts as outlined in the FAA land use guidelines. Additionally, there are 177 residential structures in the 2035 Preferred Alternative Condition 60 DNL noise contour. Per the Metropolitan Council land use guidelines, new residential developments in the 60 DNL noise contour are considered incompatible and in cases of infill are considered conditional which, if allowed, must meet certain structural performance standards.

### 7.4 NON-AERONAUTICAL LAND USE AREAS AVAILABLE ON AIRPORT PROPERTY

MAC continues to analyze the potential for non-aeronautical revenue-generating development at Crystal Airport and all of its Reliever Airports. Any parcels reviewed by the MAC at the Crystal Airport will be compatible with ongoing airport operations and the MAC will work with the surrounding communities to ensure proper zoning exists. Reducing the RPZ dimensions for the remaining runways based on small aircraft design/Utility runway standards will only increase this potential. **Exhibit 7-6** illustrates potential non-aeronautical development parcels.

All airport property is currently zoned according to the adjacent cities as “Airport” land with no other noted land use. If MAC pursues non-aeronautical development, discussions will be initiated with the cities to discuss the potential uses and how the cities feel the parcels could best be utilized. If a modification is required for zoning, MAC will work with the cities to make changes as appropriate. The development of non-aeronautical uses will not only benefit MAC, but it will also generate a tax base for the local municipality in which the parcel lies, as well as address some of the aesthetic issues with some hangars at the airport.
Figure 7-1: Existing Crystal Airport Zoning Ordinance Surfaces
Figure 7-2: MnDOT Clear Zones
Figure 7-3: Baseline Condition RPZs, State Zones, and Noise Contours

Safety Zones are from the 1983 Crystal Airport Zoning Ordinance. The sizes, shapes and/or locations of these zones may be revised by the Joint Airport Zoning Board during an update of the Crystal Airport Zoning Ordinance.

60 DNL contours shown for informational purposes only.

Baseline Condition:
- Baseline 2015 Noise Contours
- Runway Protection Zones
- Safety Zones

Existing Land Use:
- Farmstead
- Seasonal/Vacation
- Single Family Detached

Legend:
- Manufactured Housing Park
- Single Family Attached
- Multifamily
- Retail and Other Commercial
- Office
- Mixed Use Residential
- Mixed Use Industrial
- Mixed Use Commercial and Other
- Industrial and Utility
- Extractive
- Institutional
- Park, Recreational or Preserve
- Golf Course
- Major Highway
- Railway
- Airport
- Agricultural
- Undeveloped
- Water

0.1 Miles
Figure 7-4: 2035 Preferred Alternative RPZs, State Zones, and Noise Contours

Safety Zones are from the 1983 Crystal Airport Zoning Ordinance. The sizes, shapes and/or locations of these zones may be revised by the Joint Airport Zoning Board during an update of the Crystal Airport Zoning Ordinance.

60 DNL contours shown for informational purposes only.

<table>
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<tr>
<th>Preferred Alternative Condition</th>
<th>2035 Preferred Alternative Noise Contours</th>
<th>Multifamily Residential</th>
<th>Commercial</th>
<th>Industrial</th>
<th>Institutional</th>
<th>Mixed Use</th>
<th>Multi-Optional Development</th>
<th>Park and Recreation</th>
<th>Open Space or Restrictive Use</th>
<th>Rights-of-Way (i.e., Roads)</th>
<th>Railway (inc. LRT)</th>
<th>Airport</th>
<th>Vacant or Unknown</th>
<th>Open Water</th>
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</thead>
<tbody>
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0.1 Miles
Figure 7-5: RPZs, State Zones, and Noise Contour Comparison
Figure 7-6: Aeronautical and Non-Aeronautical Development Parcels
SECTION 8:

IMPLEMENTATION PLAN
8. IMPLEMENTATION PLAN

8.1 INTRODUCTION

This chapter provides information related to the estimated costs and potential phasing for the 2035 Preferred Alternative at Crystal Airport.

The LTCP is a planning document and does not authorize construction. Adoption of the LTCP is simply the first step in the project implementation process. Before any construction can begin, the project(s) must first be depicted on an FAA-approved Airport Layout Plan (ALP), evaluated via an environmental review process, and then compete for funding through FAA and/or State grant programs. Once funding is secured, final project engineering and design will take approximately one year to complete with contractor bidding and construction following thereafter.

8.2 CAPITAL IMPROVEMENT PROGRAM COSTS AND FUNDING SOURCES

Project cost estimates for the 2035 Preferred Alternative are summarized in Table 8-1.

Near-Term Development encompasses the project elements necessary to decommission Runways 14R-32L and turf Runway 6R-24L, convert existing Runway 14R-32L into a full-length parallel taxiway, and convert the existing paved overruns at the ends of Runway 14L-32R into stopways, including edge lighting and safety area grading. It is anticipated that this development may occur within the next 5 years.

Mid to Long-Term Development involves miscellaneous improvements to expand the FBO apron (by the tenant), install a self-fueling facility, and ongoing obstacle removal projects. It is anticipated that this development may occur in the 6-20 year timeframe.

A combination of traditional airport funding sources and financing mechanisms including federal Airport Improvement Program (AIP) grants, state Airport Construction Program grants, and local MAC monies could be used to fund implementation of the Preferred Alternative. It is anticipated that a majority of the funding would come in the form of AIP discretionary grants, which are awarded to airports on the basis of priority and available funding.

The MAC maintains an ongoing Capital Improvement Program (CIP) which assigns projects to a given year, currently looking out seven years to 2022. Projects in the current CIP related to implementation of the Preferred Alternative include:

- Runway 14R-32L & Taxiway E Modifications in 2018; and
- Long-Term Comprehensive Plan (LTPC) Update in 2022.

Other projects in the CIP for Crystal Airport include the following:

- Alleyways Pavement Rehabilitation in 2018 and 2020;
- Taxiways Pavement Rehabilitation in 2019;
- Materials Storage Building in 2017; and
- LED Edge Lighting Upgrade in 2021 and 2022.

However, these timelines may vary according to the environmental review process and availability of funding sources.

This summary provides a guide for the MAC when planning the CIP, which is updated on an annual basis. Costs for Reliever Airport projects must be programmed carefully to ensure all necessary funding is available. Those projects that will be eligible for federal or state funding will be placed in years when the opportunity to receive such funds is greatest. Projects that are not eligible for federal or state funds must have other funding sources identified prior to implementation.

### Table 8-1: Preferred Alternative Cost Estimates

<table>
<thead>
<tr>
<th>Item #</th>
<th>Project Element</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Near-Term Development (Plan Years 1 - 5)</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Decommission Runways &amp; Convert RWY 14R-32L into Taxiway (w/MITL)</td>
<td>$1,800,000</td>
</tr>
<tr>
<td>2</td>
<td>Convert RWY 14L-32R Paved Overruns into Stopways (Lighting &amp; Grading)</td>
<td>$200,000</td>
</tr>
<tr>
<td>3</td>
<td>Other Taxiway Improvements</td>
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</tr>
<tr>
<td></td>
<td><strong>Near-Term Development Total:</strong></td>
<td><strong>$2,300,000</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Mid/Long-Term Development (Plan Years 6 - 20)</strong></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Expand FBO Apron (Tenant Cost)</td>
<td>---</td>
</tr>
<tr>
<td>5</td>
<td>Hangar Development (Tenant Cost)</td>
<td>---</td>
</tr>
<tr>
<td>6</td>
<td>Install Self-Service Fueling Facility</td>
<td>$100,000</td>
</tr>
<tr>
<td>7</td>
<td>Hangar Removal(s)</td>
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<td>8</td>
<td>Obstacle Removal</td>
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<td></td>
<td><strong>Mid/Long-Term Development Total:</strong></td>
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<tr>
<td></td>
<td><strong>Total Development Cost:</strong></td>
<td><strong>$3,100,000</strong></td>
</tr>
</tbody>
</table>

Notes: Cost estimates reflect 2016 pricing and include engineering costs and contingencies.

Source: SEH and MAC cost estimates
8.3 STAKEHOLDER ENGAGEMENT AND PUBLIC INFORMATION PROCESS

In order to fulfill the Guiding Principle related to Stakeholder and Community Engagement, a series of meetings has been conducted throughout the development of the 2035 LTCP for Crystal Airport.

Initial stakeholder outreach efforts involved meeting with partner agencies, municipal representatives, and airport tenants before the draft LTCP report was finalized in order to provide information about the plan's purpose, process, preliminary findings, and timeline. Materials from these initial stakeholder outreach meetings are reproduced in Appendix 8.

Initial stakeholder outreach meetings are listed in Table 8-2.

Table 8-2: Initial Stakeholder Engagement Meetings

<table>
<thead>
<tr>
<th>Audience</th>
<th>Materials Covered</th>
<th>Date</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilot Group Meeting</td>
<td>LTCP Process, Review of Alternatives, Preliminary Findings</td>
<td>6/8/2016</td>
<td>Airport</td>
</tr>
<tr>
<td>MAC Reliever Advisory Council</td>
<td>LTCP Process, Review of Alternatives, Preliminary Findings</td>
<td>6/14/2016</td>
<td>MAC</td>
</tr>
<tr>
<td>FAA</td>
<td>LTCP Status Update</td>
<td>6/29/2016</td>
<td>FAA</td>
</tr>
<tr>
<td>Municipal Planners (Cities, County)</td>
<td>LTCP Process, Review of Alternatives, Preliminary Findings</td>
<td>7/15/2016</td>
<td>Crystal City Hall</td>
</tr>
<tr>
<td>MAC PD&amp;E Committee</td>
<td>LTCP Process, Review of Alternatives, Preliminary Findings</td>
<td>8/1/2016</td>
<td>MAC</td>
</tr>
</tbody>
</table>

The second phase will consist of the formal public review period after the draft plan has been completed and the MAC Board has approved it for public distribution. This public review period will include a 45-day written comment period with two public information meetings scheduled during this timeframe.

The third phase will occur after the public comment period closes. During this time, public feedback will be considered and incorporated into the plan as appropriate. The end result will be a final draft LTCP for Commission adoption and Metropolitan Council formal review. During this time, stakeholder outreach will continue to occur on an as-needed basis.

Materials from these phases of the stakeholder engagement process will be included in Appendix 8 at a later date.

Appendix 9 will include a reproduction of each public comment received in its entirety. General responses will be developed to address questions and concerns that were
consistent among the comments received. Specific responses to comments received from municipalities and agencies will also be provided in Appendix 9.

**Figure 8-1** illustrates the next steps for the planning and project implementation process, including at what points additional approvals are needed and at what points public feedback will be solicited.
Figure 8-1: Planning and Project Implementation Process

1. Research & study refinements to previous plan recommendations
2. Engage MAC board, municipal staff & other key stakeholders
3. Draft report with alternatives including a proposed alternative
4. Request formal MAC board approval to publish draft report for public comment

5. Comment on draft report & proposed preferred alternative

6. Incorporate public comments & present final LTCP to MAC board for approval

7. MAC BOARD
   For approval

8. METROPOLITAN COUNCIL
   For reviews

9. Prepare draft environmental review documents per state & FAA requirements
   Establish Joint Airport Zoning Board with local governments to update existing airport zoning
   Prepare & submit Airport Layout Plan to the FAA for review & approval

10. Finalize environmental review documents & submit to State & FAA for approval

11. Comment on draft environmental & zoning documents

12. MAC BOARD
   For final adoption

13. AGENCIES
    Project funding programmed by FAA/MnDOT
    Local governments and adjacent communities review & comment on
    MAC annual Capital Improvement Program
    Develop final funding plan & request federal/state grant funds for project(s)

14. MAC BOARD
   For approval of bid award

15. MAC STAFF
    Request approval from MAC board to proceed with bidding projects

16. MAC STAFF
    Begin engineering & architectural designs

17. CONSTRUCTION BEGINS
LIST OF APPENDICES

Appendix 1: Glossary of Terms
Appendix 2: Historical Airport Planning Documents
Appendix 3: Crystal Activity Forecast Methodology
Appendix 4: Runway Length Calculation Details
Appendix 5: Cost Estimates
Appendix 6: Noise Contour Input Details
Appendix 7: Existing Zoning Ordinances
Appendix 8: Stakeholder Engagement Program Documentation
Appendix 9: Public Comments and Responses
### Appendix 1: Glossary of Terms

<table>
<thead>
<tr>
<th>Content</th>
<th>Page</th>
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</thead>
<tbody>
<tr>
<td>Glossary of Terms</td>
<td>1-1</td>
</tr>
</tbody>
</table>
Glossary of Terms

A-Weighted Decibels (dBA): A measure of noise levels adjusted relative to the frequencies most audible to the human ear.

Above Ground Level (AGL): A height above the ground as opposed to above Mean Sea Level (MSL).

Accelerate-Stop Distance: The runway length declared available and suitable for the acceleration and deceleration of an aircraft aborting a takeoff.

Advisory Circular: External publications issued by the FAA consisting of non-regulatory material providing for the recommendations relative to a policy and guidance and information relative to a specific aviation subject.

Aircraft Approach Category (AAC): An alphabetic classification of aircraft based upon 1.3 times the stall speed in a landing configuration at their maximum certified landing weight. The categories are as follows:

- Category A: Approach speed less than 91 knots
- Category B: Approach speed 91 knots or more but less than 121 knots
- Category C: Approach speed 121 knots or more but less than 141 knots
- Category D: Approach speed 141 knots or more but less than 166 knots
- Category E: Approach speed 166 knots or more

Airplane Design Group (ADG): A classification of aircraft based on wingspan and tail height. The groups are as follows:

- Group I: Wingspan up to but not including 49 feet or tail height up to but not including 20 feet
- Group II: Wingspan 49 feet up to but not including 79 feet or tail height from 20 feet up to but not including 30 feet
- Group III: Wingspan 79 feet up to but not including 118 feet or tail height from 30 feet up to but not including 45 feet
- Group IV: Wingspan 118 feet up to but not including 171 feet or tail height from 45 feet up to but not including 60 feet
- Group V: Wingspan 171 feet up to but not including 214 feet or tail height from 60 feet up to but not including 66 feet
- Group VI: Wingspan 214 feet up to but not including 262 feet or tail height from 66 feet up to but not including 80 feet

Aircraft Operation: The landing, takeoff, or touch-and-do procedure by an aircraft on a runway at an airport.
Airport Classifications: Definitions of airport classifications vary by agency. Classifications relevant to the Crystal Airport are highlighted in bold text.

- Federal Aviation Administration (FAA) General Aviation Airport Classifications:
  - National: National airports support the national and state system by providing communities with access to national and international markets. They accommodate a full range of aviation activity including large corporate jet and multi-engine aircraft operations, significant charter passenger services, or all-cargo operations. They often work in conjunction with, and in support of, hub airports serving the aviation needs of larger metropolitan areas.
  - Regional: Regional airports support regional economies by connecting communities to statewide and interstate markets. These airports accommodate a full range of regional and local business activities, limited scheduled passenger service, or cargo operations. They serve corporate jet and multi-engine aircraft, as well as single-engine propeller aircraft.
  - Local: Local airports supplement communities by providing access to primarily intrastate and some interstate markets. These airports accommodate small businesses, flight training, emergency service, charter service, cargo operations, and personal flying activities. They typically accommodate smaller general aviation aircraft.
  - Basic: Basic airports support general aviation activities such as emergency service, charter or critical passenger service, cargo operations, flight training, and personal flying. These airports typically accommodate mostly single-engine propeller aircraft. They may be located in and provide service to remote areas of the United States with limited or no surface transportation options, and therefore may be critical to the transportation of goods required for local day-to-day life.

- Minnesota State Aviation System Plan (SASP) Classifications:
  - Key Airports: These airports have paved and lighted primary runways 5,000 feet or longer in length. They are capable of accommodating all single-engine aircraft along with larger multi-engine aircraft and most corporate jets.
    - Key Airports include Minneapolis-St. Paul International, St. Paul Downtown, Flying Cloud, and Anoka County – Blaine Airports.
  - Intermediate Airports: These airports have paved and lighted runways all of which are between 2,500 and 5,000 feet long. Intermediate airports can accommodate all single engine aircraft, some multi-engine aircraft, and most corporate jets.
    - Intermediate Airports include Airlake, Lake Elmo, and Crystal Airports.
  - Landing Strips: These airports have turf runways which can accommodate most single-engine aircraft and some twin engine aircraft. They may be unusable during wet weather, winter months, and during the spring melt.
Metropolitan Council Regional Aviation System Plan (RASP) Classifications:

- **Major Airport**: An airport with a primary runway length of 8,000 feet or greater with a precision approach. A Major Airport serves a primary air service access area that is international and national in scope. Its role in the airport system is to provide facilities and services primarily to scheduled air carrier and regional commuter users, but also includes air cargo and charter carriers.
  - Major Airports include Minneapolis-St. Paul International Airport.
- **Intermediate Airport**: An airport with a primary runway length between 5,000 and 8,000 feet with a precision approach. The role of an Intermediate Airport is to provide facilities and services primarily to corporate and business general aviation aircraft. Typical users of these airports fly a variety of business jets, turboprop aircraft, and single- and twin-engine piston aircraft.
  - Intermediate Airports include St. Paul Downtown Airport.
- **Minor Airport**: An airport with runways all of which are 5,000 feet in length or less. Their system role is to provide general aviation facilities and services primarily to personal, business, and instructional users. The most common users of these airports fly single-engine and light twin-engine aircraft. Minnesota state statute prohibits upgrading a minor airport to intermediate airport status without legislative approval.
  - Minor Airports include Flying Cloud, Anoka County – Blaine, Airlake, Lake Elmo, and Crystal Airports.
- **Special Purpose Airport**: A facility open to public use, including heliports, seaplane bases, or airport landing areas whose primary geographic and service focus is normally state and metropolitan in scope. Personal, business and instruction uses are accommodated at these facilities.

Metropolitan Airports Commission (MAC) Reliever Airport Classifications:

- **Primary Relievers**: MAC Reliever airports that provide the infrastructure and serves that are key to corporate aviation needs.
  - Primary Relievers include St. Paul Downtown, Flying Cloud, and Anoka County – Blaine Airports.
- **Complimentary Relievers**: MAC Reliever airports that provide limited MSP relief and complement the three Primary Relievers by offering options for aviation activity but not to the level of infrastructure and services typically expected at a Primary Reliever.
  - Complimentary Relievers include Airlake, Lake Elmo, and Crystal Airports.

Airport Elevation: The highest point of an airfield’s usable landing area measured in feet above Mean Sea Level (MSL).

Airport Layout Plan (ALP): A scaled drawing of the existing and planned land and facilities necessary for the operation and development of an airport.
Airport Reference Code (ARC): A designation that signifies the airport’s highest Runway Design Code (RDC). The ARC is used for planning and design only and does not limit the aircraft that may be able to operate safely on the airport.

Air Route Traffic Control Center (ARTCC): A facility established to provide air traffic control service to aircraft operating on Instrument Flight Rule (IFR) flight plans within controlled airspace and principally during the en-route phase of flight.

Air Traffic Control (ATC): A service provided for the purpose of promoting the safe, orderly, and expeditious flow of air traffic, including airport, approach, and en-route air traffic control services.

Air Traffic Control Tower (ATCT): A structure from which air traffic control personnel control the movement of aircraft on or around the airport.

Annual Service Volume (ASV): The number of annual operations that can be reasonably expected to occur at an airport based on a given level of delay.

Approach Surface: An imaginary obstruction-limiting surface defined in 14 CFR Part 77 which is longitudinally centered on an extended runway centerline and extends outward and upward from the primary surface at each end of a runway at a designated slope and distance based on the type of available or planned approach by aircraft to a runway. See Figure 2-6.

Approach Visibility Minimums: A set of conditions specified for operations of aircraft during Instrument Flight Rule (IFR) weather conditions.

Apron: A specified portion of an airfield used for aircraft parking and the refueling, maintenance, servicing, and loading/unloading of aircraft.

Area Navigation (RNAV): A method of navigation that permits aircraft operations on any desired course within the coverage of station-referenced navigation signals.

Automated Weather Observation System (AWOS): Equipment that takes and broadcasts automated weather readings at an airport.

Average Day Peak Month (ADPM): Defined as peak month passengers or operations divided by the number of days in the month.

Based Aircraft: The general aviation aircraft that use a specific airport as a home base.

Circling Approach: A maneuver initiated by a pilot to align the aircraft with a runway for landing when a straight-in landing from an instrument approach is not possible or is not desirable.
Clear Zone: As defined by MnDOT Aeronautics, Clear Zones off runway ends are intended to enhance operational safety of aircraft and to protect life and property in runway approach areas. The MnDOT Clear Zones have a similar function to, but are not always the same dimensions, as the FAA Runway Protection Zone (RPZ).

Common Traffic Advisory Frequency (CTAF): A radio frequency designated for the purpose of carrying out airport advisory practices while operating to or from an airport without an operating control tower.

Compass Calibration Pad: An airport facility used for calibrating an aircraft compass.

Crosswind Runway: An additional runway at an airport that compensates for primary runways that provide less wind coverage than desired.

Day-Night Average Sound Level (DNL): The predicted average sound effect on an area near the airport for a typical 24-hour period. A weighting factor equivalent to a penalty of 10 decibels is applied to aircraft operations occurring between 10:00 PM and 7:00 AM.

Decibel (dB): A unit used to measure the intensity of a sound or the power level of an electrical signal by comparing it with a given level on a logarithmic scale.

Design Aircraft: An aircraft with characteristics that determine the application of airport design standards for a specific runway, taxiway, apron, or other facility. This aircraft can be a specific aircraft model or a composite of several aircraft using, expected, or intended to use the airport or part of the airport (also called critical aircraft or critical design aircraft).

Dual Wheel Gear (DW): The configuration of an aircraft landing gear where two wheels are used at each wheel position to support the aircraft load.

Federal Aviation Administration (FAA): The federal agency responsible for the safety and efficiency of the national airspace and air transportation system.

Federal Aviation Regulations (FAR): The general and permanent rules established by the executive departments and agencies of the Federal Government for aviation, which are published in the Federal Register. These are the aviation subset of the Code of Federal Regulations.

Fixed Base Operator (FBO): A commercial business enterprise located on an airport that provides services to pilots including aircraft rental, training, fueling, maintenance, parking, and the sale of pilot supplies. Also known as a Full Service Commercial Operator.

Fleet Mix: A collective term generally used to describe the proportions of aircraft types operating at an airport.
Flight Service Station (FSS): Air traffic facilities which provide pilot briefings, flight plan processing, inflight radio communications, search and rescue (SAR) services, and assistance to lost aircraft and aircraft in emergency situations.

General Aviation: The segment of aviation that encompasses all aspects of civil aviation except for certified air carriers and other commercial operators such as air cargo.

Global Positioning System (GPS): A satellite based navigational system that provides signals in the cockpit of aircraft defining aircraft position in terms of latitude, longitude, and altitude.

Instrument Flight Rules (IFR): Procedures for the conduct of flight in weather conditions below Visual Flight Rule weather minimums. The term IFR is often used to define weather conditions and the type of flight plan under which an aircraft is operating.

Instrument Meteorological Conditions (IMC): Meteorological conditions expressed in terms of specific visibility and ceiling conditions that are less than the minimums specified for visual meteorological conditions.

Integrated Noise Model (INM): The INM is a computer model that evaluates aircraft noise impacts in the vicinity of airports. It was developed based on the algorithm and framework from the SAE AIR 1845 standard, which uses noise-power-distance (NPD) data to estimate noise accounting for specific operation mode, thrust setting, and source-receiver geometry, acoustic directivity, and other environmental factors.

Itinerant Operation: An aircraft operation where the destination point is greater than 20 miles from the aircraft’s point of origin.

Joint Airport Zoning Board (JAZB): A Joint Airport Zoning Board is comprised of the municipality that owns or controls an airport along with surrounding municipalities within which an airport hazard area may be located. Once formed, the Joint Airport Zoning Board has the power to adopt, administer, and enforce airport zoning regulations applicable to the airport hazard areas in its jurisdiction.

Knots: Nautical miles per hour, equal to 1.15 statute miles per hour.

Lateral Navigation (LNAV): Azimuth navigation without positive vertical guidance. This type of navigation is associated with non-precision approach procedures.

Local Operation: An aircraft operation that remains in the local traffic pattern, executes simulated instrument approaches or low passes at the airport, and operations to or from the airport and a designated practice area within a 20-mile radius of the tower.

Long-Term Comprehensive Plan (LTCP): The airport sponsor’s concept of the long-term development and use of an airport’s land and facilities.
MACNOMS: The MAC Noise and Operations Monitoring System collects aircraft noise levels at 39 remote noise monitoring towers located around the Minneapolis-St. Paul International Airport (MSP). In addition, the system collects flight track data to approximately 40 miles around MSP up to 20,000 feet.

Metropolitan Airports Commission (MAC): The owner and operator of the Lake Elmo Airport. The Metropolitan Airports Commission (MAC) was created in 1943 by the Minnesota Legislature to promote air transportation in the seven-county metropolitan area.

MIC: The FAA airport location identifier for Crystal Airport.

Microjet: A category of small jet aircraft approved for single-pilot operation, typically seating 4-8 people, with a maximum takeoff weight of under 10,000 pounds. Also referred to as very light jets or personal jets.

Medium Intensity Runway Lights (MIRL): Lights that are located along the edge of a runway to assist pilots in identifying the edge of the surface available for takeoffs and landings.

Modification to Design Standards (MOS): Any approved nonconformance to FAA standards applicable to an airport design, construction, or equipment procurement project that is necessary to accommodate an unusual local condition for a specific project on a case-by-case basis while maintaining an acceptable level of safety.

Mean Seal Level (MSL): A measure used in aviation for pilots to identify the flight or airfield elevation above sea level as opposed to above ground level (AGL).

Movement Area: The runways, taxiways, and other areas of an airport that are used for taxiing or hover taxiing, takeoff, and landing of aircraft including helicopters, exclusive of aprons and aircraft parking areas.

MSP: Minneapolis-St. Paul International Airport

National Climatic Data Center (NCDC): The federal agency responsible for preserving, monitoring, assessing, and providing public access to the Nation's climate and historical weather data and information.

National Plan of Integrated Airport Systems (NPIAS): The national airport system plan developed by the Secretary of Transportation on a biannual basis for the development of public use airports to meet national air transportation needs.

Navigational Aid (NAVAID): A visual or electronic facility or device used as, available for use as, or designed for use as an aid to air navigation.

Non-Directional Beacon (NDB): A general purpose, low-frequency radio beacon that can be used by a pilot to determine a bearing from the transmitter.
Non-Precision Approach: A straight-in instrument approach procedure that provides course guidance, without vertical path guidance, with visibility minimums not later than ¾ mile.

Object Free Area (OFA): An area centered on the ground on a runway, taxiway, or taxilane centerline provided to enhance the safety of aircraft operations by remaining clear of objects except for objects that need to be located in the OFA for air navigation or aircraft ground maneuvering purposes.

Obstacle Free Zone (OFZ): The OFZ is the three-dimensional airspace along the runway and extended runway centerline that is required to be clear of obstacles for protection for aircraft landing or taking off from the runway and for missed approaches.

Other-Than-Utility Runway: A runway that is intended to be used by propeller driven aircraft with a maximum gross weight greater than 12,500 pounds and/or jet aircraft of any gross weight.

Part 77: Regulations for the protection of airspace around a public-use civilian or military airport are specified in 14 CFR Part 77 Safe, Efficient Use, and Preservation of the Navigable Airspace. These defined surfaces are used by the FAA to identify obstructions to airspace around an airport facility. Part 77 surfaces are comprised of primary, approach, transitional, horizontal and conical three-dimensional imaginary surfaces.

Pavement Condition Index (PCI): PCI evaluation includes a visual inspection of pavements and assignment of a numerical indicator that reflects the structural and operational condition of the pavement including the type, severity, and quantity of pavement distress.

Precision Approach: An instrument approach procedure that provides course and vertical path guidance with visibility below ¾ mile.

Precision Approach Path Indicator (PAPI): A navigational aid to visually identify the glideslope to the touchdown zone of the runway.

Primary Runway: A runway constructed to meet airport capacity needs. The design objective for a primary runway is to provide a runway length that will not result in operational weight restrictions.

Primary Surface: An imaginary obstruction limiting surface defined in 14 CFR Part 77 that is specified as a rectangular surface longitudinally centered about a runway. (See Figure 2-7.)

Regular Use: Regular use is considered as at least 500 or more annual itinerant operations of the runway by the critical design aircraft.
Reliever Airport: General Aviation airports in major metropolitan areas that provide pilots with attractive alternatives to using congested hub airports.

Remote Transmitter/Receiver (RTR): An air-to-ground communications system having transmitters and/or receivers and other ancillary equipment. These on-airport facilities allow radio communications between a pilot and ATCT and are usually located at non-towered airports.

Runway: A defined rectangular area at an airport designated for the landing and takeoff of an aircraft.

Runway Design Code (RDC): The selected AAC, ADG, and desired approach visibility minimums (in feet of runway visual range) are combined to form the Runway Design Code (RDC) for a particular runway. The RDC is used to determine the standards that apply to a specific runway and parallel taxiway to allow unrestricted operations by the design aircraft under defined meteorological conditions.

Runway End Identifier Lights (REIL): Two synchronized flashing lights, one of each side of a runway threshold, which provide positive identification of the runway approach end.

Runway Object Free Area (ROFA): An area centered on the ground on a runway centerline provided to enhance the safety of aircraft operations by remaining clear of objects, except for objects that need to be located in the ROFA for air navigation or aircraft ground maneuvering purposes.

Runway Object Free Zone (ROFZ): The ROFZ is the three-dimensional airspace along the runway and extended runway centerline that is required to be clear of obstacles for protection for aircraft landing or taking off from the runway and for missed approaches.

Runway Protection Zone (RPZ): An area at ground level prior to the threshold or beyond the runway end to enhance the safety and protection of people and property on the ground.

Runway Safety Area (RSA): A defined surface surrounding the runway prepared or suitable for reducing the risk of damage to aircraft in the event of an undershoot, overshoot, or excursion from the runway.

Runway Visual Range (RVR): An estimate of the maximum distance at which the runway, or the specified lights or markers delineating it, can be seen from a position above a specific point on the runway centerline.

Single Wheel Gear (SW): The configuration of an aircraft landing gear where a single wheel is used at each wheel position to distribute the aircraft load.

Small Aircraft: An aircraft with a maximum certificated takeoff weight of 12,500 pounds or less.
State Airport System Plan (SASP): The primary objective of the Minnesota State Aviation System Plan is to provide the state with excellent planning tools to assist in making informed decisions guiding the development of Minnesota’s system of airports and expending funds in a cost-effective manner.

State Safety Zones: Model standards promulgated by the Minnesota Department of Transportation per Minnesota Administrative Rules Chapter 8800, Section 2400 for the zoning of public airports as to airspace, land use safety, and noise sensitivity. A complete description and copy of the Minnesota Rules (Chapter 8800 Department of Transportation Aeronautics, Section 2400 Airport Zoning Standards) can be accessed via the following website link: https://www.revisor.mn.gov/rules/?id=8800.2400.

T-Hangar: A linear structure with interior bays that are of a “T” shape and provide shelter for aircraft.

Taxilane: A taxiway designed for low speed and precise taxiing. Taxilanes are usually, but not always, located outside the movement area, providing access from taxiways to aircraft parking positions and other terminal areas.

Taxiway: A defined path established for the taxiing of aircraft from one part of an airport to another.

Taxiway Design Group (TDG): A classification of airplanes based on outer-to-outer main landing gear width and cockpit to main gear distance.

Taxiway/Taxilane Safety Area (TSA): A defined surface alongside the taxiway prepared or suitable for reducing the risk of damage to an aircraft deviating from the taxiway.

Threshold: The beginning of that portion of the runway available for landing. In some cases, the threshold may be displaced from the physical end of the runway.

Touch and Go: A practice maneuver consisting of a landing and a takeoff performed simultaneously without coming to a complete stop. A touch and go is defined as two aircraft operations.

Traffic Pattern: Projections on the ground of the aerial path associated with an aircraft flying the crosswind, downwind, base, and final approach legs of the takeoff and landing process.

Turbine-Powered Aircraft: Aircraft powered by turbine engines including turbojets and turboprops but excluding turbo-shaft, rotary-wing aircraft. Such aircraft normally use Jet-A fuel.

Uncontrolled Airport: An airport without an airport traffic control tower at which the control of Visual Flight Rules (VFR) traffic is not exercised.
Useful Load: The aircraft maximum takeoff weight minus the aircraft empty weight. An aircraft’s useful load can be used to transport either fuel or payload (passengers, baggage, and/or cargo).

Utility Runway: A runway that is constructed for and intended to be used by propeller driven aircraft of 12,500 pounds maximum gross weight and less.

Visual Flight Rules (VFR): Procedures for the conduct of flights in weather conditions above Visual Flight Rules (VFR) weather minimums. The term VFR is often used to define weather conditions and the type of flight plan under which an aircraft is operating.

Visual Meteorological Conditions (VMC): Meteorological conditions expressed in terms of specific visibility and ceiling conditions which are equal to or greater than the threshold values for instrument meteorological conditions.

Visual Runway: A runway without an existing or planned straight-in instrument approach procedure.
# Appendix 2: Historical Airport Planning Documents

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<td>Airport Layout Plan – 1969</td>
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Appendix 3: Crystal Airport Activity Forecast Methodology

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<td>Crystal LTCP Forecast Methodology Summary</td>
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<td>FAA Forecast Approval Letter</td>
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Note: The complete Minneapolis-St. Paul Reliever Airport: Activity Forecasts – Technical Report that contains full forecast development documentation can be downloaded from the MAC website at:

1. Introduction

This chapter summarizes the LTCP activity forecast for Crystal Airport (MIC). The base year is represented by the twelve months ending June 2015 and forecasts were prepared for 2020, 2025, 2030, and 2035. The forecasts for the airport are unconstrained, except for runway length, and assume that the necessary facilities will be in place to accommodate demand. The chapter begins with a description of the forecast approach, followed by a discussion of the forecasts for based aircraft and aircraft operations, and then concludes with a set of alternative forecast scenarios.

The assumptions inherent in the following calculations are based on data provided by the MAC, federal and local sources, and professional experience. Forecasting, however, is not an exact science. Departures from forecast levels in the local and national economy and in the aviation industry would have a significant effect on the forecasts presented herein.

2. Historical Trends

Table 1 shows historical based aircraft and aircraft operations at MIC from 1990 through 2015.

<table>
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<th>Operations</th>
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</thead>
<tbody>
<tr>
<td>1990</td>
<td>324</td>
<td>189,906</td>
</tr>
<tr>
<td>1995</td>
<td>327</td>
<td>172,024</td>
</tr>
<tr>
<td>2000</td>
<td>296</td>
<td>176,554</td>
</tr>
<tr>
<td>2001</td>
<td>280</td>
<td>156,801</td>
</tr>
<tr>
<td>2002</td>
<td>278</td>
<td>127,095</td>
</tr>
<tr>
<td>2003</td>
<td>288</td>
<td>98,612</td>
</tr>
<tr>
<td>2004</td>
<td>263</td>
<td>74,879</td>
</tr>
<tr>
<td>2005</td>
<td>265</td>
<td>71,704</td>
</tr>
<tr>
<td>2006</td>
<td>261</td>
<td>62,900</td>
</tr>
<tr>
<td>2007</td>
<td>251</td>
<td>53,583</td>
</tr>
<tr>
<td>2008</td>
<td>238</td>
<td>49,244</td>
</tr>
<tr>
<td>2009</td>
<td>219</td>
<td>42,507</td>
</tr>
<tr>
<td>2010</td>
<td>219</td>
<td>44,229</td>
</tr>
<tr>
<td>2011</td>
<td>199</td>
<td>43,986</td>
</tr>
<tr>
<td>2012</td>
<td>219</td>
<td>48,220</td>
</tr>
<tr>
<td>2013</td>
<td>189</td>
<td>42,308</td>
</tr>
<tr>
<td>2014</td>
<td>185</td>
<td>41,117</td>
</tr>
<tr>
<td>2015</td>
<td>185</td>
<td>41,838(a)</td>
</tr>
</tbody>
</table>

(a) Twelve months ending June 2015. Includes estimate of nighttime activity.
Source: MAC and FAA ATADS.
The total number of aircraft based in Crystal airport declined from 1990 to 2015. The total counts stayed above 300 aircraft before 2000 but declined to around 185 recently. Aircraft operations fell more rapidly than based aircraft over the same period, indicating reduced utilization for those aircraft that remained based at MIC. A number of factors have contributed to the decline including the slowing economy, increased fuel prices and other operating costs, and reduced interest in recreational flying by younger people.

3. Forecast Approach

The Minneapolis-St. Paul metropolitan area is served by a system of airports. These airports provide a variety of roles and therefore both complement and compete with each other. Since these airports operate as a system, they were forecast as a system so that the interrelationships between the airports could be properly captured. The forecast focused on five of the airports in the MAC system – Crystal, Airlake (LVN), Anoka County (ANE), Flying Cloud (FCM), and St. Paul Downtown (STP) – but also incorporated the other MAC airports – Minneapolis-St. Paul International (MSP) and Lake Elmo (21D) into the analysis. The details of the forecast approach are provided in the main forecast report, *Minneapolis-St. Paul Reliever Airport: Activity Forecasts – Technical Report*, and are summarized below:

1. Identify Catchment Areas – Crystal Airport is located in Hennepin County and most of the based aircraft owners reside in the same county as the airport they use. Nevertheless, there is some overlap between the airport catchment areas. Jet and turboprop aircraft owners that require longer runways and more extensive maintenance and fueling facilities tend to gravitate towards airports such as St. Paul Downtown (STP) and Flying Cloud Airport (FCM). Likewise, operators of small single engine piston aircraft often shy away from larger more commercial airports because of congestion and costs, even though these airports may be closer to their place of residence. Aircraft registration data from the Minnesota Department of Transportation (MnDOT) and the Metropolitan Airports Commission (MAC) was used to identify the percentage of MIC based aircraft owners that resided in each county.

2. Develop Socioeconomic Projections – Population forecasts from the Metropolitan Council (Met Council) and per capita income forecasts from Woods & Poole Economics (W&P) were used to develop hybrid income forecasts for each county in the metropolitan area. The income forecasts were used to estimate the share of based aircraft growth accounted for by each county.

3. Project the number of based aircraft registered in each county by aircraft category based on the county income forecasts and the FAA Aerospace forecast adjusted for Minneapolis-St. Paul trends.

4. Allocate the projected based aircraft to each MAC-airport according to the existing distribution pattern for each aircraft category (piston, turboprop, jet, helicopter, etc.).

5. Estimate the number of aircraft on waiting list that would be added assuming airport capacity is unconstrained. Since MIC has extra capacity, there is no waiting list and the waiting list adjustment was not applied there.

6. Redistribute aircraft from the constrained MAC airports (MSP) to the remaining unconstrained airports based on the existing distribution patterns of the airports. Although MSP has sufficient airfield capacity to accommodate growth, the facilities that can accommodate based general aviation (GA) aircraft are limited.

7. Identify base year aircraft operations. Operations counts for Crystal were initially obtained from the FAA Air Traffic Control Tower. The air traffic control tower at MIC does not operate 24 hours per day; therefore late night operations were estimated based on the MAC’s flight tracking system data. To estimate operations by aircraft type, the FAA Traffic
Flow Management System Counts (TFMSC) which provides aircraft information was used and supplemented with flight tracking system data from the MAC’s environmental office.

8. Project future year aircraft operations. In each aircraft category, operations per active aircraft were projected to increase at the same rate as the FAA forecast of hours flown per based aircraft, implicitly assuming that the number of operations per hours flown remain constant. The percentage of touch and go operations in each aircraft category was assumed to remain constant.

Forecasts include based aircraft and operations for each major category: single engine piston, multi-engine piston, turboprop, jets, helicopters, sport aircraft, experimental, and other. It was assumed that the share of each county’s registered aircraft in every aircraft category based at all of the airports under study will remain constant.

4. Forecast Results

Table 2 shows the forecast of based aircraft for Crystal. The number of based aircraft at Crystal is projected to decline slightly, from 185 aircraft in 2015 to 171 aircraft in 2035. The dominant aircraft in the fleet, piston engine aircraft, are projected to decline, consistent with the FAA Aerospace Forecast Fiscal Years 2015-2035. Helicopters and experimental aircraft are expected to increase but not fast enough to offset the decline in the piston category.

Table 3 shows the forecast of aircraft operations at MIC. Total aircraft operations at Crystal are forecast to decrease from 41,838 in 2015 to 39,904 in 2035, an average annual rate of -0.2 percent. Increases are projected in all categories except single-engine and multi-engine piston aircraft, for which the anticipated decrease in the based aircraft offsets slightly higher utilization forecasted by FAA. Jet and helicopter operations are expected to increase the fastest.

The percentage of operations occurring in August, the peak month at Crystal Airport, was estimated from FAA air traffic control tower records. Average Day Peak Month (ADPM) operations were estimated by dividing by 31 days. Peak hour operations were obtained from the FAA Distributed Operations Network (OPSNET). The peak hour percentage in the peak month over the past four years has averaged 11.6 percent. As shown in Table 4, peak hour operations are projected to fluctuate between 27 and 29 operations.
Table 2: Summary of Based Aircraft Forecast (Crystal Base Case Condition)

<table>
<thead>
<tr>
<th>Year</th>
<th>Single Engine Piston</th>
<th>Multi-Engine Piston</th>
<th>Turboprop</th>
<th>Jets</th>
<th>Rotor</th>
<th>Sport</th>
<th>Experimental - Excluding Ultralights</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>154</td>
<td>14</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>15</td>
<td>0</td>
<td>185</td>
</tr>
<tr>
<td>2020</td>
<td>148</td>
<td>14</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>16</td>
<td>0</td>
<td>180</td>
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<tr>
<td>2025</td>
<td>143</td>
<td>14</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>17</td>
<td>0</td>
<td>177</td>
</tr>
<tr>
<td>2030</td>
<td>138</td>
<td>12</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>18</td>
<td>0</td>
<td>171</td>
</tr>
<tr>
<td>2035</td>
<td>136</td>
<td>12</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>171</td>
</tr>
</tbody>
</table>

**Average Annual Growth Rate**

-0.6%  -0.8%  0.0%  0.0%  2.0%  0.0%  1.4%  0.0%  -0.4%

Table 3: Summary of Operations Forecast (Crystal Base Case Condition)

<table>
<thead>
<tr>
<th>Year</th>
<th>Single Engine Piston</th>
<th>Multi-Engine Piston</th>
<th>Turboprop</th>
<th>Jets</th>
<th>Rotor</th>
<th>Sport</th>
<th>Experimental - Excluding Ultralights</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>35,324</td>
<td>2,382</td>
<td>86</td>
<td>2</td>
<td>829</td>
<td>-</td>
<td>3,440</td>
<td>-</td>
<td>42,063</td>
</tr>
<tr>
<td>2015</td>
<td>35,039</td>
<td>2,460</td>
<td>89</td>
<td>8</td>
<td>829</td>
<td>-</td>
<td>3,413</td>
<td>-</td>
<td>41,838</td>
</tr>
<tr>
<td>2020</td>
<td>32,046</td>
<td>2,398</td>
<td>90</td>
<td>10</td>
<td>1,002</td>
<td>-</td>
<td>3,949</td>
<td>-</td>
<td>39,495</td>
</tr>
<tr>
<td>2025</td>
<td>30,993</td>
<td>2,398</td>
<td>96</td>
<td>12</td>
<td>1,142</td>
<td>-</td>
<td>4,384</td>
<td>-</td>
<td>39,025</td>
</tr>
<tr>
<td>2030</td>
<td>30,283</td>
<td>2,116</td>
<td>109</td>
<td>14</td>
<td>1,282</td>
<td>-</td>
<td>4,774</td>
<td>-</td>
<td>38,578</td>
</tr>
<tr>
<td>2035</td>
<td>30,633</td>
<td>2,235</td>
<td>126</td>
<td>16</td>
<td>1,440</td>
<td>-</td>
<td>5,454</td>
<td>-</td>
<td>39,904</td>
</tr>
</tbody>
</table>

Average Annual Growth Rate

-0.7%  -0.5%  1.8%  3.5%  2.8%  0.0%  2.4%  0.0%  -0.2%

### Table 4: Peak Activity Forecast (Crystal Base Case Condition)

<table>
<thead>
<tr>
<th>Year</th>
<th>Annual Operations (a)</th>
<th>Peak Month Operations (b)</th>
<th>ADPM Operations (c)</th>
<th>Peak Hour Operations (d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>42,063</td>
<td>4,922</td>
<td>159</td>
<td>29</td>
</tr>
<tr>
<td>2015</td>
<td>41,838</td>
<td>4,865</td>
<td>157</td>
<td>29</td>
</tr>
<tr>
<td>2020</td>
<td>39,495</td>
<td>4,592</td>
<td>148</td>
<td>27</td>
</tr>
<tr>
<td>2025</td>
<td>39,025</td>
<td>4,538</td>
<td>146</td>
<td>27</td>
</tr>
<tr>
<td>2030</td>
<td>38,578</td>
<td>4,486</td>
<td>145</td>
<td>27</td>
</tr>
<tr>
<td>2035</td>
<td>39,904</td>
<td>4,640</td>
<td>150</td>
<td>28</td>
</tr>
</tbody>
</table>

(a) Table 3.
(b) Value for 2014 is actual. Forecast years estimated using average peak month percentage from 2011-2014.
(c) Peak month operations divided by 31 days.
(d) Estimated at 18.4 percent of ADPM operations based on MAC aircraft operation counts.

Sources: As noted and HNTB analysis.

### 5 Scenarios

General aviation activity has historically been difficult to forecast, since the relationships with economic growth and pricing factors are more tenuous than in other aviation sectors, such as commercial aviation. This uncertainty is likely to carry over into the near future, given the volatility of fuel prices and the continued shift in GA from personal and recreational use to business use. To address these uncertainties, and to identify the potential upper and lower bounds of future activity at the study airports, detailed high and low scenarios are presented. These scenarios use the same forecast approach that was used in the base case, but alter the assumptions to reflect either a more aggressive or more conservative outlook.

The high forecast scenario is based on the assumption that income would grow 0.5 percent per year faster than in the base case. All other assumptions are the same as in the base case. The low forecast scenario is based on the assumption that income would grow 0.5 percent more slowly each year than under the base case.

Subsequent to the preparation of the high and low forecast scenarios, an additional scenario was developed to evaluate the potential impact associated with designating the existing overrun pavement beyond each end of Runway 14L-32R as stopway. Pavement designated as stopway can be used for decelerating an aircraft during an aborted takeoff and can be considered for accelerate-stop distance calculations, but cannot be considered for takeoff or landing distance calculations. Designating stopways will allow aircraft to depart at a higher takeoff weight when accelerate-stop distance is a limiting factor, and will promote safety by formally making this pavement available for use in the event of an aborted takeoff attempt. Stopways do not change
the published runway length, nor are they intended to attract aircraft types different than those operating at the airport today. However, the availability of stopways may result in a small increase in aircraft operations from some users who find the existing runway length to be limiting based on accelerate-stop distance criteria. In the stopway scenario, the number of additional aircraft operations above the base case is approximately 230 annually, translating to just over four additional takeoffs and landings per week. Of the additional operations, the majority are expected to be turboprops (approximately three-quarters), with the remaining increase coming from small jets. All other forecast assumptions are the same as in the base case.

Table 5 compares the total number of based aircraft and operations under different scenarios for MIC. The MIC base case, high and stopway scenario LTCP forecasts are consistent the FAA 2015 Terminal Area Forecast (TAF) as they differ by less than 10% in the 5-year forecast period and 15% in the 10-year forecast period.

Figure 1 provides a graphic comparison of the base, high and low, and stopway scenario operations forecasts, along with the FAA’s 2015 Terminal Area Forecast (TAF) for the airport.
### Table 5: Forecast Comparison By Scenario

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Based Aircraft</th>
<th>Total Number of Operations</th>
<th>Variance from TAF (Operations)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Base Case</td>
<td>High Range</td>
<td>Low Range</td>
</tr>
<tr>
<td>2015</td>
<td>185</td>
<td>185</td>
<td>185</td>
</tr>
<tr>
<td>2020</td>
<td>180</td>
<td>184</td>
<td>177</td>
</tr>
<tr>
<td>2025</td>
<td>177</td>
<td>184</td>
<td>169</td>
</tr>
<tr>
<td>2030</td>
<td>171</td>
<td>183</td>
<td>162</td>
</tr>
<tr>
<td>2035</td>
<td>171</td>
<td>187</td>
<td>158</td>
</tr>
</tbody>
</table>

**Average Annual Growth Rate**

-0.4% | 0.1% | -0.8% | -0.2% | 0.2% | -0.6% | -0.2% | 0.3%

Sources: HNTB Analysis.
Figure 1: MIC Forecast Comparison (Operations)
## Appendix 4: Runway Length Calculation Details

<table>
<thead>
<tr>
<th>Content</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAA Advisory Circular 150/5325-4C Runway Length Chart</td>
<td>4-1</td>
</tr>
<tr>
<td>Beechcraft King Air 200 Accelerate/Stop Distance Chart</td>
<td>4-2</td>
</tr>
<tr>
<td>Piper PA-31T Cheyenne Accelerate/Stop Distance Chart</td>
<td>4-3</td>
</tr>
<tr>
<td>Piper PA-31-350 Chieftain Accelerate/Stop Distance Chart</td>
<td>4-4</td>
</tr>
<tr>
<td>Pilatus PC-12 Flight Planning/Takeoff Distance Data</td>
<td>4-5</td>
</tr>
<tr>
<td>Cessna 421C Accelerate/Stop Distance Table</td>
<td>4-6</td>
</tr>
<tr>
<td>Cessna 414A Accelerate/Stop Distance Table</td>
<td>4-7</td>
</tr>
<tr>
<td>Cessna 310R Accelerate/Stop Distance Table</td>
<td>4-8</td>
</tr>
<tr>
<td>Beechcraft Baron 58 Accelerate/Stop Distance Chart</td>
<td>4-9</td>
</tr>
<tr>
<td>Piper PA-30 Twin Comanche Accelerate/Stop Distance Chart</td>
<td>4-10</td>
</tr>
</tbody>
</table>

Note: Assumptions used to assess runway length requirements include the following:

- Takeoff Weight: Based on 90% of Useful Load
- Temperature: 83.4°F, 28.5°C
- Pressure Altitude: 869 feet AMSL
- Wind: 5-knot headwind
- Flap Setting: Typical
Figure 2-1. Small Airplanes with Fewer than 10 Passenger Seats
(Excludes Pilot and Co-pilot)

Example:

Temperature (mean day max hot month): 59°F (15°C)
Airport Elevation: Mean Sea Level

Note: Dashed lines shown in the table are mid values of adjacent solid lines.

Recommended Runway Length:

For 95% = 2,700 feet (823 m)
For 100% = 3,200 feet (975 m)
ACCELERATE - STOP - FLAPS UP

ASSOCIATED CONDITIONS:

<table>
<thead>
<tr>
<th>POWER</th>
<th>1. TAKE-OFF POWER SET BEFORE BRAKE RELEASE</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLAPS</td>
<td>UP</td>
</tr>
<tr>
<td>AUTOFEATHER</td>
<td>ARMED</td>
</tr>
<tr>
<td>BRAKING</td>
<td>MAXIMUM</td>
</tr>
<tr>
<td>RUNWAY</td>
<td>PAVED, LEVEL, DRY SURFACE</td>
</tr>
</tbody>
</table>

NOTE: FOR OPERATION WITH ICE VANES EXTENDED, PERFORM ANY OF THESE APPROPRIATE:

WEIGHT ~ POUNDS

V1 ~ KNOTS

EXAMPLE:

OUTSIDE AIR TEMPERATURE ~ °C

WEIGHT ~ POUNDS

WIND COMPONENT ~ KNOTS

CS88000C541S

OAT...38°C

PRESSURE ALTITUDE...14520 FT

WEIGHT...12,000 LBS

HEADING COMPONENT...3.4 KTS

FIELD LENGTH...4393 FT

V1...95 KTS

5-40
PC-12 Digital AFM - Flight Planning

Date: 08/20/14
Registration No: 1458
PC-12 Model: PC-12/41
Interior Code: EX-6S-2

Weight & Balance

BEW (lb): 0
BEM (lb-in): 0
Useful Load (lb): 0
Takeoff Total Weight (lb): 0
Landing Total Weight (lb): 0

Fuel Use

Fuel Flow (lb/h): 0
Fuel Use (lb): 0
Remaining Fuel (lb): 0
Max Fuel Load (lb): 0

Takeoff Distance

Weight (lb): 10100
OAT (°C): 29
Altitude (ft): 1000
Headwind (kts): 5
Slope (%): 0
Takeoff Ground Roll (ft): 1853
Takeoff Total Distance (ft): 3124
Accelerate-Stop Distance (ft): 3677
Flaps (°): 15
Vr (KIAS): 79

Climb Performance

Weight (lb): 0
ISA Deviation (°C): 0
Table 5-11 from Cessna 441 Conquest II Pilot’s Operating Handbook
### SECTION 5

**PERFORMANCE**

#### ACCELERATE STOP DISTANCE

**CONDITIONS:**
1. 2200 RPM and 30.0 inches Hg. Manifold Pressure Before Brake Release.
3. King Flaps - UP.
4. Level, hard surface, Dry Runway.
5. Engine failure at minimum runway speed.

**NOTE:**
1. If full power is applied without brakes set, distances apply from point where full power is applied.
2. Decrease distance by 1% for each 4 knots headwind.
3. Increase distance by 1% for each 2 knots tailwind.

<table>
<thead>
<tr>
<th>WEIGHT (LBS)</th>
<th>ENGINE FAILURE PRESSURE</th>
<th>TOTAL DISTANCE - FEET</th>
</tr>
</thead>
<tbody>
<tr>
<td>7500</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td>2900</td>
<td>3130</td>
</tr>
<tr>
<td>2000</td>
<td>3500</td>
<td>3700</td>
</tr>
<tr>
<td>3000</td>
<td>4000</td>
<td>4200</td>
</tr>
<tr>
<td>4000</td>
<td>4500</td>
<td>4700</td>
</tr>
<tr>
<td>5000</td>
<td>5000</td>
<td>5200</td>
</tr>
<tr>
<td>6000</td>
<td>5500</td>
<td>5700</td>
</tr>
<tr>
<td>7000</td>
<td>6000</td>
<td>6200</td>
</tr>
<tr>
<td>8000</td>
<td>6500</td>
<td>6700</td>
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<tr>
<td>9000</td>
<td>7000</td>
<td>7200</td>
</tr>
<tr>
<td>10,000</td>
<td>7500</td>
<td>7700</td>
</tr>
</tbody>
</table>

| 6000        | 100                      |                       |
| 1000        | 2900                     | 3130                  |
| 2000        | 3500                     | 3700                  |
| 3000        | 4000                     | 4200                  |
| 4000        | 4500                     | 4700                  |
| 5000        | 5000                     | 5200                  |
| 6000        | 5500                     | 5700                  |
| 7000        | 6000                     | 6200                  |
| 8000        | 6500                     | 6700                  |
| 9000        | 7000                     | 7200                  |
| 10,000      | 7500                     | 7700                  |

| 6000        | 100                      |                       |
| 1000        | 2900                     | 3130                  |
| 2000        | 3500                     | 3700                  |
| 3000        | 4000                     | 4200                  |
| 4000        | 4500                     | 4700                  |
| 5000        | 5000                     | 5200                  |
| 6000        | 5500                     | 5700                  |
| 7000        | 6000                     | 6200                  |
| 8000        | 6500                     | 6700                  |
| 9000        | 7000                     | 7200                  |
| 10,000      | 7500                     | 7700                  |

| 6000        | 100                      |                       |
| 1000        | 2900                     | 3130                  |
| 2000        | 3500                     | 3700                  |
| 3000        | 4000                     | 4200                  |
| 4000        | 4500                     | 4700                  |
| 5000        | 5000                     | 5200                  |
| 6000        | 5500                     | 5700                  |
| 7000        | 6000                     | 6200                  |
| 8000        | 6500                     | 6700                  |
| 9000        | 7000                     | 7200                  |
| 10,000      | 7500                     | 7700                  |

**Figure 5-11**

---

Crystal Airport 2035 LTCP

Appendix 4

Page 4-6
NORMAL ACCELERATE-STOP DISTANCE

Figure 5-17

REPORT: LK-1208
5-19
ACCELERATE STOP DISTANCE

**CONDITIONS:**
1. 2700 RPM and 38.0 Inches Hg. Manifold Pressure Before Brake Release.
4. Cowl Flaps - OPEN.
5. Level, Hard Surface, Dry Runway.

**NOTE:**
1. If full power is applied without brakes set, distances apply from point where full power is applied.
2. Decrease distance 3% for each 4 knots headwind.
3. Increase distance 5% for each 2 knots tailwind.

<table>
<thead>
<tr>
<th>WEIGHT - POUNDS</th>
<th>ENGINE FAILURE SPEED - KIAS</th>
<th>PRESSURE ALTITUDE - FEET</th>
<th>TOTAL DISTANCE - FEET</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-20°C -4°F</td>
<td>-10°C +14°F</td>
<td>0°C +32°F</td>
</tr>
<tr>
<td></td>
<td>3550</td>
<td>3590</td>
<td>3820</td>
</tr>
<tr>
<td>6750</td>
<td>Sea Level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td>3530</td>
<td>3760</td>
<td>4060</td>
</tr>
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Figure 5-11

5-24
## ACCELERATE STOP DISTANCE

**CONDITIONS:**
2. Mixture - LEAN for field elevation (See Figure 5-27).
3. Wing Flaps - UP.
4. Cowl Flaps - OPEN.
5. Level, Hard Surface, Dry Runway.
7. Idle Power and Heavy Braking After Engine Failure.

**NOTE:**
1. If full power is applied without brakes set, distances apply from point where full power is applied.
2. Decrease distance 25% for each 4 knots headwind.
3. Increase distance 5% for each 2 knots tailwind.

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**Figure 5-12**

5-26
ACCELERATE - STOP DISTANCE

(Normally Aspirated Model Equipped With Tip Tanks -- 3725 Lbs Gross Weight)

WING FLAPS RETRACTED
FULL THROTTLE AND MAX RPM
BOTH THROTTLES CLOSED AT DECISION SPEED

RUNWAY SURFACE: PAVED, LEVEL, DRY
ACCELERATE TO 90 MPH IAS
MAXIMUM BRAKING EFFORT

FIGURE 5-08
## Appendix 5: Cost Estimates

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Remove Runway 14R/32L & Taxiway Improvements

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*Runway & Taxiways Total:* $2,100,000
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Estimated Construction Total: $1,353,750.00

5% Contingency: $90,250.00

20% Engineering and Administration: $361,000.00

Estimated Total Project Cost: $1,805,000.00

### Remove & Construct Connector Taxiways

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<td>$3,000.00</td>
</tr>
<tr>
<td>29</td>
<td>2573.503</td>
<td>Silt Fence, Type Preassembled (Incl. Misc.)</td>
<td>LF</td>
<td>$3.00</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>30</td>
<td>2573.540</td>
<td>Filter Log, Type Wood Fiber Biocell</td>
<td>LF</td>
<td>$3.50</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>31</td>
<td>2575.605</td>
<td>Turf Est. (Billion) Incl. Seed, Fertilizer, Mulch, Water</td>
<td>ACRE</td>
<td>$3,500.00</td>
<td>4</td>
<td>$14,000.00</td>
</tr>
<tr>
<td>32</td>
<td>P-208-5.1</td>
<td>Aggregate Base Course (CV)</td>
<td>CY</td>
<td>$25.00</td>
<td>500</td>
<td>$12,500.00</td>
</tr>
<tr>
<td>33</td>
<td>P-208-5.2</td>
<td>Bituminous Surface Course PG 58-28</td>
<td>TON</td>
<td>$71.00</td>
<td>250</td>
<td>$17,750.00</td>
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<td>Bituminous Base Course PG 58-28</td>
<td>TON</td>
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<td>250</td>
<td>$17,250.00</td>
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<td>P-603-5.1</td>
<td>Bituminous Tack Coat</td>
<td>GAL</td>
<td>$5.50</td>
<td>500</td>
<td>$350.00</td>
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<td>36</td>
<td>P-605-5.1</td>
<td>Bituminous Joint (Saw, Route, Seal)</td>
<td>LF</td>
<td>$4.00</td>
<td>500</td>
<td>$2,000.00</td>
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<tr>
<td>37</td>
<td>P-620-5.1</td>
<td>Taxiway Painting</td>
<td>SF</td>
<td>$1.00</td>
<td>500</td>
<td>$500.00</td>
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<tr>
<td>38</td>
<td>L</td>
<td>Taxiway Lighting</td>
<td></td>
<td></td>
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Estimated Construction Total: $222,850.00

5% Contingency: $14,856.67

20% Engineering and Administration: $59,426.67

Estimated Total Project Cost: $297,133.33

TOTAL Runway & Taxiways: $2,102,133.33
## Stopway Application - Cost Estimate

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<th>Concept Element</th>
<th>Est. Cost</th>
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<tr>
<td>2</td>
<td>Earthwork - RSA Grading</td>
<td>$80,000</td>
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**Stopway Application Total:** $200,000
## Appendix 6: Noise Contour Input Details

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<th>Content</th>
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<tr>
<td>Table A6-1: Baseline Condition Average Daily Flight Operations</td>
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<td>Table A6-2: 2035 Preferred Alternative Condition Average Daily Flight Operations</td>
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<td>Table A6-3: Baseline Condition Average Annual Runway Use</td>
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<td>Table A6-4: 2035 Preferred Alternative Condition Average Annual Runway Use</td>
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<td>Table A6-5: Baseline Condition Departure Flight Track Use</td>
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<td>Figure A6-1: Baseline Condition INM Flight Tracks</td>
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<td>Figure A6-2: 2035 Preferred Alternative Condition INM Flight Tracks</td>
<td>6-8</td>
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Table A6-1
Baseline Condition Average Daily Flight Operations

Aircraft Type

Aircraft ID

Helicopter

Arrivals
Day

Departures

Night

Total

0.85

0.19

1.04

-

0.03

Day

Touch and Gos

Night

Total

0.82

0.22

1.04

0.03

-

0.03

Day

Total Operations

Night

Total

Day

0.10

-

0.10

1.76

Night
0.41

Total
2.17

-

-

-

0.06

-

0.06

Robinson R22

R22

0.03

Agusta 109

A109

0.82

0.19

1.01

0.79

0.22

1.01

0.10

-

0.10

1.70

0.41

2.11

2.35

0.04

2.39

2.26

0.12

2.39

0.98

-

0.98

5.59

0.16

5.76

Multi-Engine Piston
Beechcraft Baron BE-55

BEC55

0.12

-

0.12

0.12

-

0.12

-

-

-

0.24

-

0.24

Beechcraft Baron BE-58

BEC58

0.08

-

0.08

0.08

-

0.08

-

-

-

0.16

-

0.16

Cessna 310 Twin

CNA310

0.22

-

0.22

0.20

0.02

0.22

0.16

-

0.16

0.59

0.02

0.61

Cessna Super Skymaster 337

CNA337

0.08

-

0.08

0.08

-

0.08

-

-

-

0.16

-

0.16

Cessna 340 Twin

CNA340

0.27

-

0.27

0.27

-

0.27

0.16

-

0.16

0.69

-

0.69

Cessna 414 Twin

CNA414

0.06

-

0.06

0.06

-

0.06

-

-

-

0.12

-

0.12

Cessna Golden Eagle 421

CNA421

0.18

-

0.18

0.18

-

0.18

-

-

-

0.37

-

0.37

Piper Aztec Twin

PA23AZ

0.12

-

0.12

0.12

-

0.12

-

-

-

0.24

-

0.24

Piper Twin Comanche

PA30

0.08

-

0.08

0.08

-

0.08

-

-

-

0.16

-

0.16

Piper Navajo Twin

PA31

0.49

0.04

0.53

0.45

0.08

0.53

0.33

-

0.33

1.27

0.12

1.39
0.78

Piper Seneca Twin

PA34

0.31

-

0.31

0.29

0.02

0.31

0.16

-

0.16

0.76

0.02

Piper Seminole Twin

PA44

0.33

-

0.33

0.33

-

0.33

0.16

-

0.16

0.82

-

0.82

25.03

1.21

26.24

25.63

0.61

26.24

20.92

0.84

21.76

71.58

2.66

74.24

Single-Engine Piston
Grumman American Cheetah

AA5A

0.23

-

0.23

0.23

-

0.23

0.42

-

0.42

0.88

-

0.88

Beechcraft Debonair/Bonanza

BEC33

0.43

0.03

0.46

0.44

0.02

0.46

0.42

-

0.42

1.29

0.05

1.34

Beechcraft Bonanza 35

BECM35

0.31

0.03

0.34

0.34

-

0.34

0.42

-

0.42

1.07

0.03

1.11

Beechcraft Bonanza 36

BECM35

1.39

0.03

1.43

1.38

0.05

1.43

1.26

-

1.26

4.03

0.08

4.11

Cessna 152

CNA152

0.02

0.02

0.03

0.03

-

0.03

-

-

-

0.05

0.02

0.07

Cessna 195

CNA170

0.41

-

0.41

0.39

0.02

0.41

0.42

-

0.42

1.22

0.02

1.24

Cessna Skyhawk 172

CNA172

5.47

0.20

5.67

5.55

0.11

5.66

2.09

0.42

2.51

13.11

0.73

13.84

Cessna Cardinal 177

CNA177

0.15

-

0.15

0.15

-

0.15

0.42

-

0.42

0.71

-

0.71

Cessna Skywagon 180

CNA180

0.25

-

0.25

0.25

-

0.25

0.42

-

0.42

0.91

-

0.91

Cessna Skylane 182

CNA182

1.10

0.03

1.13

1.12

0.02

1.13

1.67

-

1.67

3.89

0.05

3.94

Cessna 185

CNA185

0.08

-

0.08

0.08

-

0.08

1.26

-

1.26

1.42

-

1.42

Cessna 206

CNA206

0.15

0.02

0.16

0.16

-

0.16

0.42

-

0.42

0.73

0.02

0.75

Cessna Centurion 210

CNA210

0.15

-

0.15

0.15

-

0.15

0.42

-

0.42

0.71

-

0.71

Aviat Husky A-1

GASEPF

0.03

-

0.03

0.03

-

0.03

-

-

-

0.07

-

0.07

Lancair Columbia 300

GASEPV

0.07

-

0.07

0.07

-

0.07

-

-

-

0.13

-

0.13

Lancair Columbia 400

GASEPV

0.20

-

0.20

0.20

-

0.20

0.42

-

0.42

0.81

-

0.81

Cirrus SR-20

GASEPV

0.45

0.02

0.47

0.44

0.03

0.48

0.42

-

0.42

1.32

0.05

1.37

Mooney M-20P

M20J

2.18

0.08

2.26

2.25

0.02

2.26

0.84

-

0.84

5.27

0.10

5.37

Mooney M-20T

M20J

0.61

0.03

0.64

0.59

0.05

0.64

0.42

-

0.42

1.62

0.08

1.70

Mooney M-20

M20J

1.35

0.07

1.41

1.39

0.02

1.41

0.84

-

0.84

3.58

0.08

3.66

Piper Comanche

PA24

0.38

-

0.38

0.34

0.03

0.38

0.84

-

0.84

1.56

0.03

1.59

Piper Cherokee

PA28

0.10

0.02

0.11

0.10

0.02

0.11

1.67

-

1.67

1.87

0.03

1.90

Piper Arrow

PA28CA

0.20

-

0.20

0.20

-

0.20

0.42

-

0.42

0.81

-

0.81

Piper Warrior

PA28CH

5.33

0.46

5.79

5.73

0.07

5.79

2.51

0.42

2.93

13.57

0.94

14.51

Piper Cherokee Dakota

PA28DK

0.03

-

0.03

0.03

-

0.03

-

-

-

0.07

-

0.07

Piper Lance/Saratoga

PA32SG

0.02

-

0.02

0.02

-

0.02

-

-

-

0.03

-

0.03

Piper Cherokee Six

PA32SG

1.58

0.07

1.64

1.56

0.08

1.64

1.26

-

1.26

4.39

0.15

4.54
1.01

Piper Malibu

PA46

0.28

0.02

0.30

0.30

-

0.30

0.42

-

0.42

0.99

0.02

Rockwell Aero Commander 112

RWCM12

0.03

-

0.03

0.03

-

0.03

-

-

-

0.07

-

0.07

Cirrus SR-22

SR22

2.07

0.10

2.17

2.08

0.08

2.17

1.26

-

1.26

5.41

0.18

5.59

2.30

0.26

2.56

2.17

0.38

2.56

2.12

2.12

6.59

0.64

7.23

Experimental

GASEPV

1.28

0.13

1.41

1.02

0.38

1.41

1.06

-

1.06

3.36

0.51

3.87

Vans RV-7

GASEPV

0.51

-

0.51

0.51

-

0.51

0.53

-

0.53

1.55

-

1.55

Vans RV-8

GASEPV

0.51

0.13

0.64

0.64

-

0.64

0.53

-

0.53

1.68

0.13

1.81

0.11

0.01

0.12

0.12

0.00

0.12

-

-

-

0.23

0.01

0.24

Experimental

Turboprop

0.00

Beechcraft King Air 300

BEC30B

0.01

-

0.01

0.01

-

0.01

-

-

-

0.01

-

0.01

Beechcraft King Air 200

BEC200

0.02

0.00

0.02

0.02

0.00

0.02

-

-

-

0.04

0.00

0.04

Beechcraft King Air 90

BEC90

0.02

-

0.02

0.02

-

0.02

-

-

-

0.03

-

0.03

Cessna 208

CNA208

0.00

-

0.00

0.00

-

0.00

-

-

-

0.01

-

0.01

Cessna Conquest 441

CNA441

0.01

0.00

0.01

0.01

-

0.01

-

-

-

0.02

0.00

0.02

Piper Malibu Meridian

CNA208

0.00

-

0.00

0.00

-

0.00

-

-

-

0.01

-

0.01

Pilatus PC-12

PC12

0.04

0.00

0.04

0.04

-

0.04

-

-

-

0.08

0.00

0.08

Socata TBM 700

STBM7

0.01

-

0.01

0.01

-

0.01

-

-

-

0.02

-

0.02

Socata TBM-850

CNA208

0.01

-

0.01

0.01

-

0.01

-

-

-

0.01

-

0.01

0.01

-

0.01

0.01

-

0.01

-

-

-

0.02

-

0.02

Cessna Citation Jet 525

CNA525C

0.01

-

0.01

0.01

-

0.01

-

-

-

0.02

-

0.02

30.65

1.71

32.35

31.02

1.34

32.35

24.12

0.84

24.96

85.79

3.88

89.67

Jets
Total
Note: Total may not add due to rounding.

Source: MACNOMS Data Analysis, HNTB Activity Forecasts

Crystal Airport 2035 LTCP

Appendix 6

Page 6-1


### Table A6-2

**2035 Preferred Alternative Condition Average Daily Flight Operations**

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<th>Aircraft Type</th>
<th>Aircraft ID</th>
<th>Arrivals</th>
<th>Departures</th>
<th>Touch and Go</th>
<th>Total Operations</th>
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<td></td>
<td>Day</td>
<td>Night</td>
<td>Total</td>
<td>Day</td>
<td>Night</td>
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<td>Helicopter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>R22</td>
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<td>0.06</td>
<td>0.12</td>
<td>0.12</td>
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<td>Agusta 109</td>
<td>A109</td>
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<td>0.06</td>
<td>1.57</td>
<td>0.06</td>
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<td>B429</td>
<td>0.06</td>
<td>0.06</td>
<td>0.12</td>
<td>0.06</td>
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<td>R44</td>
<td>0.12</td>
<td>0.12</td>
<td>0.12</td>
<td>0.12</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td>0.10</td>
<td>0.20</td>
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<td>0.06</td>
<td>0.12</td>
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<td>CNA310</td>
<td>0.18</td>
<td>0.18</td>
<td>0.36</td>
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<tr>
<td>Cessna Super Skymaster 337</td>
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<td>0.06</td>
<td>0.12</td>
<td>0.06</td>
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<td>Cessna 340 Twin</td>
<td>CNA340</td>
<td>0.21</td>
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<td>0.42</td>
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<td>0.05</td>
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<td>Cessna Golden Eagle 421</td>
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<td>Cessna Skyhawk 172</td>
<td>CNA172</td>
<td>1.79</td>
<td>1.79</td>
<td>3.58</td>
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<td>Cessna Cardinal 177</td>
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<td>0.15</td>
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<td>0.24</td>
<td>0.24</td>
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<td>Cessna Skyline 182</td>
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<td>1.09</td>
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<td>0.98</td>
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<td>Lancair Columbia 300</td>
<td>GASEPV</td>
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<td>0.73</td>
<td>1.46</td>
<td>0.73</td>
</tr>
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<td>GASEPV</td>
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<td>0.81</td>
<td>1.62</td>
<td>0.81</td>
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<td>Diamond Star DA-40</td>
<td>GASEPV</td>
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<td>0.03</td>
<td>0.06</td>
<td>0.03</td>
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<td>Mooney M-20</td>
<td>M20J</td>
<td>2.27</td>
<td>2.27</td>
<td>4.54</td>
<td>2.27</td>
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<td>0.60</td>
<td>1.20</td>
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<tr>
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<td>M20J</td>
<td>1.33</td>
<td>1.33</td>
<td>2.66</td>
<td>1.33</td>
</tr>
<tr>
<td>Piper Cherokee PA28</td>
<td>PA28</td>
<td>0.10</td>
<td>0.10</td>
<td>0.20</td>
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<tr>
<td>Piper Warrior</td>
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**Note:** Total may not add due to rounding.
| Aircraft Group | Runway | Arrivals | | | Departures | | | Touch and Gos | |
|---------------|--------|----------|----------|----------|----------|----------|----------|
|               |        | Day | Night | Total | Day | Night | Total | Day | Night | Total |
| Helicopters   | 6L     | 10% | 21%   | 12%   | 10% | 14%   | 11%   | 11% | 0%    | 11%   |
|               | 6R     | 0%  | 0%    | 0%    | 0%  | 0%    | 0%    | 0%  | 0%    | 0%    |
|               | 14L    | 23% | 0%    | 19%   | 26% | 0%    | 21%   | 20% | 0%    | 20%   |
|               | 14R    | 17% | 0%    | 14%   | 17% | 0%    | 14%   | 14% | 0%    | 14%   |
|               | 24L    | 0%  | 0%    | 0%    | 0%  | 0%    | 0%    | 0%  | 0%    | 0%    |
|               | 24R    | 0%  | 0%    | 0%    | 0%  | 0%    | 0%    | 0%  | 0%    | 0%    |
|               | 32L    | 11% | 35%   | 16%   | 15% | 0%    | 12%   | 14% | 0%    | 14%   |
|               | 32R    | 39% | 44%   | 40%   | 32% | 86%   | 43%   | 42% | 0%    | 42%   |
| Piston        | 6L     | 3%  | 1%    | 3%    | 3%  | 0%    | 3%    | 5%  | 0%    | 5%    |
|               | 6R     | 1%  | 0%    | 1%    | 1%  | 0%    | 1%    | 0%  | 0%    | 0%    |
|               | 14L    | 37% | 47%   | 38%   | 27% | 34%   | 27%   | 24% | 50%   | 25%   |
|               | 14R    | 6%  | 0%    | 5%    | 9%  | 8%    | 9%    | 15% | 0%    | 14%   |
|               | 24L    | 1%  | 0%    | 1%    | 1%  | 0%    | 1%    | 0%  | 0%    | 0%    |
|               | 24R    | 12% | 4%    | 12%   | 10% | 4%    | 10%   | 14% | 0%    | 13%   |
|               | 32L    | 10% | 13%   | 10%   | 17% | 7%    | 16%   | 17% | 0%    | 16%   |
|               | 32R    | 31% | 35%   | 31%   | 33% | 47%   | 33%   | 26% | 50%   | 27%   |
| Turboprop     | 6L     | 0%  | 0%    | 0%    | 0%  | 0%    | 0%    | 0%  | 0%    | 0%    |
|               | 6R     | 0%  | 0%    | 0%    | 0%  | 0%    | 0%    | 0%  | 0%    | 0%    |
|               | 14L    | 57% | 33%   | 56%   | 48% | 100%  | 49%   | 0%  | 0%    | 0%    |
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|               | 24R    | 0%  | 0%    | 0%    | 4%  | 0%    | 4%    | 0%  | 0%    | 0%    |
|               | 32L    | 10% | 67%   | 13%   | 20% | 0%    | 19%   | 0%  | 0%    | 0%    |
|               | 32R    | 29% | 0%    | 27%   | 24% | 0%    | 24%   | 0%  | 0%    | 0%    |
| Jets          | 6L     | 0%  | 0%    | 0%    | 0%  | 0%    | 0%    | 0%  | 0%    | 0%    |
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|               | 14R    | 0%  | 0%    | 0%    | 0%  | 0%    | 0%    | 0%  | 0%    | 0%    |
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|               | 24R    | 0%  | 0%    | 0%    | 0%  | 0%    | 0%    | 0%  | 0%    | 0%    |
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|               | 32R    | 50% | 0%    | 50%   | 50% | 0%    | 50%   | 0%  | 0%    | 0%    |

Note: Totals may not add up to 100% due to rounding.

Source: MAC Analysis
### Table A6-4

#### 2035 Preferred Alternative Condition Average Annual Runway Use

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Note: Totals may not add up to 100% due to rounding.

Source: MAC Analysis
Table A6-5
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Notes: Each departure track was dispersed to either side of the backbone tracks. Default INM Version 7.0d subtrack use percentages were used to assign aircraft to the subtracks created during dispersa. Totals may not add to 100% due to rounding.

Source: MAC Analysis, 2015
### Table A6-6

#### 2035 Preferred Alternative Condition Departure Flight Track Use

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Notes: Each departure track was dispersed to either side of the backbone tracks. Default INM Version 7.0d subtrack use percentages were used to assign aircraft to the subtracks created during dispersa. Totals may not add to 100% due to rounding.

Source: MAC Analysis, 2015
Figure A6-1: Baseline Condition INM Flight Tracks

Note: Each departure track was dispersed by adding 2 miles to the line on the map. Default INM version 7.0.0 was used to create the dispersion.
Figure A6-2: 2035 Final Preferred Alternative Condition INM Flight Tracks
## Appendix 7: Existing Zoning Ordinances

<table>
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<tbody>
<tr>
<td>1952 MAC Zoning Ordinance</td>
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<tr>
<td>1983 Crystal Airport Joint Airport Zoning Ordinance</td>
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ORDINANCE NO. 6

An Ordinance regulating the height of structures and trees and the use of the property in the vicinity of Crystal Airport.

WHEREAS, the Minneapolis-Saint Paul Metropolitan Airports Commission considers it necessary for the purpose of promoting public health, safety, order, convenience and general welfare by protecting the lives and property of users of the Crystal Airport and of owners and occupants of land in its vicinity to adopt the following airport zoning ordinance applicable to Crystal Airport as authorized by Minnesota Laws 1945, Chapter 303 as amended, M.S.A. 360.061-360.074.

The Minneapolis-Saint Paul Metropolitan Airports Commission does ordain:

Section 1. Definitions. As used in this ordinance, unless the context otherwise requires:

1. "Airport" means the Crystal Airport, a public airport owned and being operated, maintained and developed by the Commission.

2. "Airport hazard" means any structure of tree or use of land, which obstructs the air space required for the flight of aircraft in landing or taking off at the airport or is otherwise hazardous to such landing or taking off of aircraft.

3. "Airport hazard area" means the area of land or water or both upon which an airport hazard might exist if not prevented as provided in this ordinance.

4. "Person" means any individual, firm, partnership, corporation, company, association, joint stock association or body politic, and includes any trustee, receiver, assignee or other similar representative thereof.

5. "Nonconforming use" means any structure, tree or use of land, which does not conform to a regulation prescribed in this ordinance or any amendment thereto as of the effective date of such regulation or amendment.

6. "Structure" means any object constructed or installed by man including but without limitation buildings, towers, smoke stacks and overhead transmission lines.

7. "Tree" means and includes any object of natural growth.

8. Zoning "map" means the Crystal Airport Zoning Map hereto attached and made a part of this ordinance.

9. "Master Plan" means the established airport layout as shown by Commission's Plan #2745B, Drawing 2 hereto attached and made a part of this ordinance.

10. "Airport reference point" means the center point of the airport hazard area, as designated on the zoning map.

11. "Commission" means Minneapolis-Saint Paul Metropolitan Airports Commission, herein referred to as MAC.
(12) "Committee" means the MAC Airport Zoning Committee.

(13) "Board" means the MAC Airport Zoning Appeal Board.

(14) "Public notice" shall mean notice published at least twice with an interval of at least seven days between publication dates in the official newspaper of the cities of Minneapolis and Saint Paul, and of the county in which the airport is located.

Section 2. Airport Hazard Area, Airport Reference Point And Zones. The airport hazard area is the area surrounding the airport reference point as designated on the zoning map and is divided into zones, as shown on the zoning map, in respect to which zones height limits as hereinafter set forth will apply:

(1) The landing zones are strips within the confines of the airport boundaries, designated in black on the map, and along which landings and take-offs are made and taxiing is done.

(2) The approach zones are trapezoidal areas which extend beyond the ends of all landing zones as indicated on the zoning map.

(3) The horizontal surface zones are areas having radii of 5,000 feet from the airport reference point and are shown on the zoning map.

(4) The conical surface zones are areas lying immediately beyond the horizontal surface zones having to their outer-limits a radius of 8,000 feet from the airport reference point as shown on the zoning map.

(5) The transition zones are irregular areas lying just outside of approach zones as shown on the zoning map.

Section 3. Height Limits. Except as otherwise provided in this ordinance, no structure shall be located, constructed, altered or maintained, and no tree shall be allowed to grow above height limits hereinafter established within any landing zone, approach zones, horizontal surface zones, conical surface zone or transition zones, said heights being measured in feet above established elevations as follows:

(1) Within landing zones - the elevation of the surface of the landing strips except as required and as necessary and incidental to airport operations or as may be recommended by or is in accordance with rules of the Civil Aeronautics Administration.

(2) Within approach zones - the established elevation for the beginning of each approach zone as shown on the Master Plan, plus one foot of height for every 30 feet of horizontal distance measured along the centerline of the approach zone from the end nearest the landing zone to a point on said centerline at right angles to the structure or tree in question.

(3) Within horizontal surface zones - 150 feet above the established elevation of the airport, said established airport elevation being mean sea level elevation 869 feet.
(4) Within conical surface zones - The elevation of the horizontal surface zone at 5,000 feet from the airport reference point plus one foot of height for every 20 feet of horizontal distance to 8,000 feet from the airport reference point.

(5) Within transition zones - The height limit permitted at a point on the centerline of the nearest approach zone at right angles to the structure or tree in question plus one foot in height for every seven feet of horizontal distance from the nearest side boundary of said landing or approach zone to such structure or tree measured along a line at right angles to the centerline of such landing or approach zone.

(6) Where zones overlap, the height limit shall be that of the zone imposing the more stringent height limit.

**Section 4. Use Restrictions.** Except as provided in Section 8 hereof, from and after the taking effect of this ordinance it shall be unlawful to put any land located within the airport hazard area to any of the following uses:

(1) Any use which would create unreasonable interference with radio communication between aircraft and the airport or communication facilities in the vicinity thereof, or which would unreasonably interfere with other navigational aid or devices used by the airport or by aircraft using said airport, or with electronic navigational aids that may at the time of such interference be established for the vicinity thereof.

(2) Any use which would materially reduce the visibility within the aforementioned airport hazard area or which would make it difficult for flyers in the vicinity of or on the airport to distinguish between airport lights or markers or other navigational lights or markers in the vicinity of the airport or which would result in glare in the eyes of flyers using the airport.

(3) The conduct of any business or occupation, or any use, which business, occupation or use, by its very nature, is inherently dangerous or hazardous as respects likelihood of causing or resulting in injury or damage to aircraft or the occupants thereof flying to and from or in the vicinity of said airport, or persons present at or in the vicinity of said airport or lawfully in the vicinity thereof.

(4) Any other use or uses which would be dangerous or hazardous to the safety of aircraft using the airport or maneuvering in the vicinity thereof or to the health, safety or general welfare of airport personnel and other persons using said airport.

**Section 5. Existing Nonconforming Uses.** The height limits and use restrictions as provided herein or as may hereafter be provided in any amendment hereto, except as hereinafter provided in Section 6, subdivision 2 and Section 9, subdivision 2, shall in no event be construed to interfere with the continuance of any nonconforming use or to require the removal, lowering or other change or alteration of any existing nonconforming tree, or of any nonconforming structure the construction or alteration of which was begun through the letting of contracts therefor prior to the effective date of this ordinance or amendment thereto and where such construction or alteration is prosecuted with reasonable diligence; provided that the provisions hereof shall not be construed as a limitation upon the rights conferred upon MAC by M.S.A. 360.074.
Section 6. Permits. Application shall be made and permit procured from the MAC Zoning Committee created hereunder in each of the following instances and subject to the following conditions:

(1) Where it is desired to erect or locate structures, to increase the height of existing structures or to plant or transplant trees within the airport hazard area to a height in excess of ten feet below the height limit herein provided with respect thereto.

(2) Where it is desired to replace, substantially alter or repair, rebuild, or relocate any nonconforming structure or tree within the airport hazard area, provided, however, that whenever the Committee determines that a nonconforming structure or tree within the airport hazard area has been abandoned or more than 80% torn down, destroyed, deteriorated or decayed no permit shall be granted.

(3) No permit shall be granted that would allow the establishment or creation of an airport hazard or that would permit a nonconforming structure or tree or nonconforming use to be made or to become higher or to become a greater airport hazard than was the case under the applicable zoning regulations at the time when the application for permit was made.

(4) In granting any permit, the Committee may, if it deems such action advisable to effectuate the purpose of this ordinance and reasonable in the circumstances, so condition such permit as to require the owner of a structure or tree in question to permit the MAC at its own expense to install, operate and maintain thereon such markers and lights as may be necessary to indicate to flyers the presence of an airport hazard.

(5) Whenever any person prior to erection, alteration or relocation of structures or planting or transplanting of trees within the airport hazard area makes a report of the contemplated erection, alteration or relocation of structures or the contemplated planting or transplanting of trees within said airport hazard area, to the committee, the committee shall promptly investigate and determine whether or not there would be a violation of the ordinance; and if a violation be found the committee shall so advise such person, who shall thereupon alter his plans so as to meet the requirements of the ordinance.

Section 7. Variances. Any person desiring to erect or to locate any structure or to increase the height thereof or to permit the growth of any tree or otherwise to use property within the airport hazard area contrary to the provisions of this ordinance may apply to the MAC Airport Zoning Appeal Board created hereunder for variance from the provisions of this ordinance. Such variance shall be allowed where literal application or enforcement of the provisions of this ordinance would result in practical difficulty or unnecessary hardship to the applicant, and where the relief granted would not be contrary to the public interest but would do substantial justice and would be in accordance with the spirit of these provisions. Any variance may be granted, however, subject to such reasonable conditions as the Board may deem necessary to effectuate the purposes of this ordinance, and the granting of such variance may be conditioned upon the owner of a structure or tree granting to the MAC the right at its expense to install, operate and maintain thereon such markers and lights as may be necessary to indicate to flyers the presence of an airport hazard.
(1) Two copies of an application for variance, indicating the facts surrounding such application in sufficient detail to permit a determination of the application on its merits, shall be filed with the MAC Airport Zoning Committee which shall forthwith transmit one copy to the MAC Airport Zoning Appeal Board, the second copy being retained by the Committee for its files.

Section 8. Administration. For the administration and enforcement of the provisions of this ordinance there is hereby created an administrative agency to be known as the MAC Airport Zoning Committee, the same to consist of three members. The said Committee shall include one member of the Commission appointed by the said Commission to represent the City of Minneapolis, a second member of the Commission appointed by the said Commission to represent the City of Saint Paul and a third member who shall be the Executive Director of the said Commission serving ex officio. The members of the Committee, except the ex officio member, shall serve at the pleasure of the Commission. No compensation shall be paid members of the MAC Zoning Committee except reimbursement of actual expense.

(1) The powers and duties of said administrative agency shall be as provided by Laws 1945, c. 303, as amended, M.S.A., sections 360.081-074.

(2) Where a nonconforming structure or tree within the airport hazard area has been abandoned or more than 80% torn down, destroyed, deteriorated or decayed, although no application for permit has been made, the Committee may order the owner of such nonconforming structure or tree at the owner's expense to lower, remove, reconstruct or equip the same as may be necessary to conform to this ordinance, in which case the Committee shall give notice thereof to the owner, and if the owner shall neglect or refuse to comply with such order for ten days after notice is given, then the Committee may proceed to have such nonconforming structure or tree lowered, removed reconstructed or equipped and assess the cost and expense thereof against such structure or against the land whereon such structure or tree is or was located. Unless such an assessment is paid within ninety days from the date of service of notice thereof on the owner or upon the person in possession of such structure or tree or of the land upon which the same is or was located, the sum due shall bear interest at the rate of 8% per annum until paid and may be collected either by suit in a court of competent jurisdiction or in the same manner as are general taxes. Notice aforesaid shall be in writing and served in the same manner as a summons in a civil action.

(3) Applications for permits shall be made to the Committee on forms prepared and furnished by it. The forms shall provide for a statement by applicant of the purpose for which the permit is applied, and for statement of applicant of all facts pertinent to the question whether or not the application should be granted. Such applications shall be promptly considered and the permit granted or denied by the Committee, notice in writing of the Committee's decision to be promptly delivered or mailed to the applicant.

(4) All reports made pursuant to Section 6 hereof shall be received by the Committee and shall be reviewed by it promptly to determine whether there is an airport hazard, and if found that there is one, notice in writing of such finding setting forth the reasons therefor shall be promptly delivered or mailed to the person making such report.
(5) All applications for variance shall be received by the Committee, which shall forthwith transmit the copy of such application to the MAC Airport Zoning Appeal Board, retaining a second copy of such application for the Committee's files. The Committee shall be represented at all hearings on applications for variance before the Board unless it shall attach its written approval to the application for variance on transmitting it to the Board.

(6) The Committee shall have its office at the office of the MAC. It shall keep and file in its said office records of all its proceedings, all applications for permits and reports and of action thereon. The Committee shall also keep on file a record of all variances granted by the MAC Airport Zoning Appeal Board. The files of the Committee shall be open to the public.

(7) The majority vote of the members shall control on all matters coming before it.

Section 9. Board of Adjustment. There is hereby created a MAC Airport Zoning Appeal Board consisting of five members. Two members shall be appointed by the Commission from the City of Minneapolis, two members shall be appointed by the Commission from the City of Saint Paul, and the fifth member shall be appointed by a majority vote of the other four members. No member of the MAC Airport Zoning Appeal Board may be a member of the MAC Airport Zoning Committee. Each member shall serve for a term of three years and until his successor is appointed and all members shall be removable by the Commission for cause upon written charges and after notice and opportunity for public hearing before the Commission. The powers and duties of said Board shall be as provided by Laws 1945, c. 303 as amended, M.S.A. Sections 360.061-.074.

Section 10. Appeals.

(1) Any person aggrieved or taxpayer affected by any decision of the MAC Airport Zoning Committee made in its administration of this ordinance, or the Commission or any governing body or administrative agency of a political subdivision, if of the opinion that a decision of said Committee is an improper application of airport zoning regulations of concern of such Commission, governing body or administrative agency, may appeal to the MAC Airport Zoning Appeal Board from the decision of the Committee.

(2) All appeals must be taken within a reasonable time, as provided by the rules of the Board, by filing with the Committee and with the Board a notice of appeal specifying the grounds thereof. The Committee shall forthwith transmit to the Board all papers constituting the record upon which the action appealed from was taken.

(3) An appeal shall stay all proceedings in furtherance of the action appealed from unless the Committee certifies to the Board after notice of appeal has been filed with it that by reason of the facts set forth in the certificate a stay would in its opinion cause imminent peril to life or property. In such case, proceedings shall not be stayed otherwise than by order of the Board on due notice to the Committee and on due cause shown.
(4) The Board shall fix a reasonable time for the hearing of appeals, give public notice and due notice to the parties in interest and decide the same within a reasonable time. Upon the hearing any party may appear in person or by agent or by attorney.

(5) The Board may in conformity with the provisions of this ordinance reverse or affirm wholly or partly or modify the order, requirement, decision or determination appealed from and may make such order, requirement, decision or determination as ought to be made, and to that end the Board shall have all the powers of the MAC Airport Zoning Committee from which the appeal is taken.

**Section 11. Judicial Review.** Any person aggrieved or taxpayer affected by any decision of the MAC Airport Zoning Appeal Board, or any governing body or administrative agency of a political subdivision which is of the opinion that a decision of the Committee is illegal will have such right of judicial review as is provided in Minnesota Laws 1945, Chapter 303 as amended upon exhausting the administrative remedies herein provided.

(1) In any case in which provision or provisions of this Ordinance are held by a court to interfere with the use or enjoyment of a particular structure or parcel of land to such an extent or to be so onerous in their application to such a structure or parcel of land as to constitute a taking or deprivation of that property in violation of the constitution of this state or of the United States, such holding shall not affect the application of such provisions as to other structures and parcels of land.

**Section 12. Violation and Penalty.** Every person who within the airport hazard area shall construct, locate or maintain, substantially change or substantially alter or repair any existing structure or plant, transplant or permit the growth of any tree or make use of property contrary to the terms of this ordinance, or who having been granted a permit or variance as herein provided, shall construct, locate, substantially change or substantially alter or repair any existing growth or structure or permit the growth of any tree except as permitted by such permit or variance, or who otherwise shall violate the terms hereof or regulations, orders or rules promulgated hereunder, shall be guilty of a misdemeanor and shall be punished by a fine of not more than $300 or imprisonment for not more than 90 days or by both such fine and imprisonment. Each day a violation continues to exist shall constitute a separate offense, provided however, that where a report has been made and filed with the MAC Airport Zoning Committee as herein provided, for the purposes of this section there shall be no violation within the meaning of this section until the Committee has given notice that the alteration, erection or location of structures or planing or transplanting of trees, in respect to which such report is made and filed, constitutes an airport hazard in violation of this ordinance, and reasonable opportunity has been given to remove the hazard. **(As amended by MAC Ordinance 39 adopted and in effect January 10, 1972)**

(1) In addition, the MAC may institute in any court of competent jurisdiction an action to prevent, restrain, correct or abate any violation of this ordinance or of regulations, orders or rulings promulgated hereunder, and the court shall adjudge to the Commission such relief by way of injunction (which may be mandatory) or otherwise as may be proper under all the facts and circumstances of the case in order to fully effectuate the purposes of this ordinance and of regulations, orders and rulings promulgated pursuant thereto.
Section 13. Severability. If any of the provisions of this ordinance or the application thereof to any person or circumstance is held invalid, such invalidity shall not affect other provisions or applications of the ordinance which can be given effect without the invalid provision or application, and to this end the provisions of this ordinance are declared to be severable.

Section 14. Effective Date. This ordinance shall be in full force and effect from and after its adoption.

Passed by the Minneapolis-Saint Paul Metropolitan Airports Commission on the 25th day of August, 1952.

Filed in the office of the Secretary of State on the 2nd day of September, 1952.

Map filed on the 10th day of September, 1952.
CRystal Airport Joint Airport Zoning Ordinance

December, 1983

As adopted by the Crystal Airport Joint Zoning Board
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AN ORDINANCE REGULATING AND RESTRICTING THE HEIGHT OF STRUCTURES AND OBJECTS OF NATURAL GROWTH, AND OTHERWISE REGULATING THE USE OF PROPERTY, IN THE VICINITY OF THE CRYSTAL AIRPORT BY CREATING THE APPROPRIATE ZONES AND ESTABLISHING THE BOUNDARIES THEREOF; PROVIDING FOR CHANGES IN THE RESTRICTIONS AND BOUNDARIES OF SUCH ZONES; DEFINING CERTAIN TERMS USED HEREIN; REFERRING TO THE CRYSTAL AIRPORT ZONING MAP WHICH IS INCORPORATED IN AND MADE A PART OF THIS ORDINANCE; PROVIDING FOR ENFORCEMENT; ESTABLISHING A BOARD OF ADJUSTMENT; AND IMPOSING PENALTIES.

IT IS HEREBY ORDAINED BY THE CRYSTAL AIRPORT JOINT ZONING BOARD PURSUANT TO THE AUTHORITY CONFERRED BY MINNESOTA STATUTES 360.061 - 360.074, AS FOLLOWS:
SECTION I: PURPOSE AND AUTHORITY

The Crystal Airport Joint Zoning Board, created and established by joint action of the Common Council of the Cities of Brooklyn Center, Brooklyn Park, Crystal, New Hope, Minneapolis, and Robbinsdale and the Metropolitan Airports Commission pursuant to the provisions and authority of Minnesota Statutes 360.063, hereby finds and declares that:

A. An airport hazard endangers the lives and property of users of the Crystal Airport, and property or occupants of land in its vicinity, and also if of the obstructive type, in effect reduces the size of the area available for the landing, takeoff, and maneuvering of aircraft, thus tending to destroy or impair the utility of the Crystal Airport and the public investment therein.

B. The creation or establishment of an airport hazard is a public nuisance and an injury to the region served by the Crystal Airport.

C. For the protection of the public health, safety, order, convenience, prosperity and general welfare, and for the promotion of the most appropriate use of land, it is necessary to prevent the creation or establishment of airport hazards.

D. The prevention of these airport hazards should be accomplished, to the extent legally possible, by the exercise of the police power without compensation.

E. The prevention of the creation or establishment of airport hazards and the elimination, removal, alteration, mitigation, or marking and lighting of existing airport hazards are public purposes for which political
subdivisions may raise and expend public funds.

SECTION II: SHORT TITLE

This ordinance shall be known as "Crystal Airport Joint Zoning Ordinance."

Those sections of land affected by this Ordinance are indicated in "Exhibit A"
which is attached to this Ordinance.

SECTION III: DEFINITIONS

As used in this Ordinance, unless the context otherwise requires:

"AIRPORT" means the Crystal Airport located in Hennepin County, Minnesota.

"AIRPORT ELEVATION" means the established elevation of the highest point on the usable landing area which elevation is established to be 869 feet above mean sea level.

"AIRPORT HAZARD" means any structure or tree or use of land which obstructs the airspace required for, or is otherwise hazardous to, the flight of aircraft in landing or taking off at the airport; and any use of land which is hazardous to persons or property because of its proximity to the airport.

"DWELLING" means any building or portion thereof designed or used as a residence or sleeping place of one or more persons.

"ESTABLISHED RESIDENTIAL NEIGHBORHOOD IN A BUILT-UP URBAN AREA" (ERN-BUUA) means an area, which, if it existed on or before January 1, 1978 (for low density structures and lots) and an area which, if it existed on or before July 2, 1979 (all other land uses), shall be considered a conforming use that shall not be prohibited except as provided below in V B 5 EXEMPTIONS-ESTABLISHED RESIDENTIAL NEIGHBORHOODS. The following criteria shall be applied and considered in determining what constitutes an ERN-BUUA:

(1) Location of the airport;
(2) Nature of the terrain within Safety Zones A and B;
(3) Existing land uses and character of the neighborhood around the airport;
(4) Population of the community;
(5) That the average population density in all areas within one mile of any point on a runway be equal to or greater than one dwelling unit per acre;
(6) Population density near the airport compared with population density in other areas of the community;
(7) The age and the economic, political and social stability of the neighborhood.
and the community as a whole;
(8) The proximity of supporting school, commercial, religious, transportation and other facilities and their degree of integration with residential land uses;
(9) Presence or absence of public utilities including, but not limited to, public sanitary sewer system, electric service and gas mains;
(10) Whether or not the factors listed in subparagraphs (8) and (9) above tend to make the community surrounding the airport a self-sufficient unit;
(11) Whether the areas within one mile of the perimeter of the airport property would be considered primarily residential in character; and
(12) Other material factors deemed relevant by the governmental unit in distinguishing the area in question as established, residential, urban and built-up.

"HEIGHT" for the purpose of determining the height limits in all zones set forth in this Ordinance and shown on the zoning map, the datum shall be mean sea level elevation unless otherwise specified.

"LANDING AREA" means the area of the airport used for the landing, taking off or taxiing of aircraft.

"LOW DENSITY RESIDENTIAL STRUCTURE" means a single-family or two-family home.

"LOW DENSITY RESIDENTIAL LOT" means a single lot located in an area which is zoned for single-family or two-family residences and in which the predominant land use is such type of residences.

"NONCONFORMING USE" means any pre-existing structure, tree, natural growth, or use of land which is inconsistent with the provisions of this Ordinance or an amendment hereto.

"NONPRECISION INSTRUMENT RUNWAY" means a runway having an existing or planned straight-in instrument approach procedure utilizing air navigation facilities with only horizontal guidance, and for which no precision approach facilities are planned or indicated on an approved planning document.

"PERSON" means an individual, firm, partnership, corporation, company, association, joint stock association, or body politic, and includes a trustee, receiver, assignee, administrator, executor, guardian, or other representative.

"PLANNED" as used in this Ordinance refers only to those proposed future airport developments that are so indicated on a planning document having the approval of the Federal Aviation Administration, the Department of Transportation, Division of Aeronautics and the Metropolitan Airports Commission.

"PRECISION INSTRUMENT RUNWAY" means a runway having an existing instrument approach procedure utilizing an Instrument Landing System (ILS), or a precision
Approach Radar (PAR). Also, a runway for which a precision instrument approach system is planned and is so indicated on an approved planning document.

"RUNWAY" means any existing or planned paved surface or turf-covered area of the airport which is specifically designated and used or planned to be used for the landing and/or taking off of aircraft.

"SLOPE" means an incline from the horizontal expressed in an arithmetic ratio of horizontal magnitude to vertical magnitude.

\[
\text{Slope} = \frac{3}{1} = 3 \text{ ft. horizontal to 1 ft. vertical}
\]

"STRUCTURE" means an object constructed or installed by man, including, but without limitations, buildings, towers, smokestacks, and overhead transmission lines.

"TRAVERSE WAYS" for the purpose of determining height limits as set forth in this Ordinance shall be increased in height by 17 feet for interstate highways; 15 feet for all other public roadways; 10 feet or the height of the highest mobile object that would normally traverse the road, whichever is greater, for private roads; 23 feet for railroads; and for waterways and all other traverse ways not previously mentioned, an amount equal to the height of the highest mobile object that would normally traverse it.

"TREE" means any object of natural growth.

"UTILITY RUNWAY" means a runway that is constructed for and intended to be used by propeller-driven aircraft of 12,500 pounds maximum gross weight and less.

"VISUAL RUNWAY" means a runway intended solely for the operation of aircraft using visual approach procedures, with no straight-in instrument approach procedure and no instrument designation indicated on an approved planning document.

"WATER SURFACES" for the purpose of this Ordinance shall have the same meaning as land for the establishment of protected zones.

"ZONING ADMINISTRATOR" for the purpose of this ordinance is the person in each affected municipality (Brooklyn Park, Brooklyn Center, Crystal, New Hope, Minneapolis, Robbinsdale) whose responsibility it is to issue building permits. (See Section XI B)
SECTION IV: AIRSPACE OBSTRUCTION ZONING

A. AIRSPACE ZONES: In order to carry out the purpose of this Ordinance, as set forth above, the following airspace zones are hereby established: Primary Zone, Horizontal Zone, Conical Zone, Approach Zone, and Transitional Zone and whose locations and dimensions are as follows:

1. PRIMARY ZONE: All that land which lies directly under an imaginary primary surface longitudinally centered on a runway and:
   a. extending 200 feet beyond each end of 13L-31R, 13R-31L, and 200 feet beyond the displaced threshold of 5L-23R and 5R-23L; The elevation of any point on the primary surface is the same as the elevation of the nearest point on the runway centerline. The width of the primary surface is:
   b. 250 feet for Runways 13L-31R, 13R-31L, 5L-23R, 5R-23L.

2. HORIZONTAL ZONE: All that land which lies directly under an imaginary horizontal surface 150 feet above the established airport elevation, or a height of 1019 feet above mean sea level or 40 feet above existing ground level where such ground is above 979 feet above mean sea level, the perimeter of which is constructed by swinging arcs of specified radii from the center of each end of the primary surface of each runway and connecting the adjacent arcs by lines tangent to those arcs. The radius of each arc is:
   a. 6,000 feet for Runways 13L-31R, 13R-31L, 5L-23R, 5R-23L.

3. CONICAL ZONE: All that land which lies directly under an imaginary
conical surface extending upward and outward from the periphery of the horizontal surface at a slope of 20 to 1 for a horizontal distance of 4,000 feet as measured radially outward from the periphery of the horizontal surface.

4. APPROACH ZONE: All that land which lies directly under an imaginary approach surface longitudinally centered on the extended centerline at each end of a runway. The inner edge of the approach surface for Runways 13L-31R and 13R-31L is at the same width and elevation as, and coincides with, the end of the primary surface. The inner edge of the approach surface for Runways 5L-23R and 5R-23L is the same width as the primary surface and is at the same elevation as, and coincides with a point 200 feet from the end of each runway. The approach surface inclines upward and outward at a slope of:
   a. 40:1 for Runways 13L-31R, 13R-31L, 5L-23R, 5R-23L.

The approach surface expands uniformly to a width of:
   b. 2,250 feet for Runways 13L-31R, 13R-31L, 5L-23R, 5R-23L at a distance of 10,000 feet to the periphery of the conical surface.

5. TRANSITIONAL ZONE: All that land which lies directly under an imaginary surface extending upward and outward at right angles to the runway centerline and centerline extended at a slope of 7 to 1 from the sides of the primary surfaces and from the sides of the approach surfaces until they intersect the horizontal surface or the conical surface.

B. HEIGHT RESTRICTIONS: Except as otherwise provided in this Ordinance, and except as necessary and incidental to airport operations, no structure or tree shall be constructed, altered, maintained, or allowed to grow in any airspace zone created in Subsection IV A so as to project above any of the
imaginary airspace surfaces described in said Subsection IV A hereof. Where
an area is covered by more than one height limitation, the more restrictive
limitations shall prevail.

C. BOUNDARY LIMITATIONS: The airspace obstruction zoning restrictions set
forth in this section shall apply for a distance not to exceed one and
one-half miles beyond the perimeter of the airport boundary and in that
portion of an airport hazard area under the approach zone for a distance not
exceeding two miles from the airport boundary.

SECTION V: LAND USE SAFETY ZONING:

A. SAFETY ZONE BOUNDARIES: In order to carry out the purpose of this
Ordinance, as set forth above and also, in order to restrict those uses
which may be hazardous to the operational safety of aircraft operating to
and from the Crystal Airport, and furthermore to limit population and
building density in the runway approach areas, thereby creating sufficient
open space so as to protect life and property in case of an accident, there
are hereby created and established the following land use safety zones:

1. SAFETY ZONE A: All land in that portion of the approach zones of a
runway, as defined in Subsection IV A hereof, which extends outward from
a point 200 feet from the displaced threshold for Runways 5L-23R and
5R-23L and from the end of the primary surface for a Runways 13L-31R and
13R-31L a distance equal to:
   a. 2,167 feet for runways 13L-31R, 13R-31L.
   b. 1,400 feet for runways 5L-23R, 5R-23L.

2. SAFETY ZONE B: All land in that portion of the approach zones of a
runway, as defined in Subsection IV A hereof, which extends outward from
Safety Zone A a distance equal to:

a. 1,083 feet for runways 13L-31R, 13R-31L.

b. 700 feet for runways 5L-23R, 5R-23L.

3. SAFETY ZONE C: All that land which is enclosed within the perimeter of
the horizontal zone, as defined in Subsection IV A hereof, and which is
not included in Zone A or Zone B.

4. EXCEPTIONS - ESTABLISHED RESIDENTIAL NEIGHBORHOODS: The following
described lands are designated as Established Residential Neighborhoods
in Built-Up Urban Areas, based upon the state of development of the
areas on July 2, 1979. Land uses which were in existence in these areas
on July 2, 1979 are exempt from the USE RESTRICTIONS of Sections V B 2
and 3 below, and are subject to the provisions of V B 5 below.

a. Runway 31:

Auditor's Subdivision Number 328, lots 15, 17, 22 - 25, 29
R.L.S. 893
Charles R. Knable Post #494 Addition
Twin Lake Addition, block 11, lots 3 and 4
Bodem's Addition, block 1, lots 1 - 7
Lois First Addition, lot 1
Lois Second Addition, lot 1
Lois Third Addition, lots 1, 2, 3
Erma M. Gallagher Addition, block 2, lot 5
Hillcrest Addition, lots 1, 3
Klink Addition, block 1, lots 1 - 4
Sowers Addition, lot 1
Tred Company Second Addition
Twin Oak Terrace Second Addition, block 1, lots 1 - 4
Twin Oak Terrace, block 1, lots 1 - 8;
   block 2, lots 1 - 7
Hoffinger Addition, block 1, lots 1 - 7
Twin Lake Manor, block 1, lots 2 - 10
   block 2, lots 1 - 12
Twin Lake Terrace, block 1, lots 1 - 4
   block 2, lots 1 - 5
Twin Lake Orchard Addition, lots 1, 2
Cragg and Ziebarth's, block 1, lots 1, 2, 3
Cragg Terrace, block 1, lots 1, 2, 3
Murray Lane Eighth Addition, block 2, lots 13, 14
  block 3, lots 1 - 9 and 12 - 17
Hiawatha Manor Second Addition, block 1, lots 1 - 11
  block 4, lots 1 - 4 and 5 - 10
Hiawatha Manor First Addition, block 2, lots 1 - 4
Hiawatha Manor, block 3, lots 1 - 3

b. Runway 13
Auditor's Subdivision 328, lots 1 - 8, 11, 13, 15, 16
Larburn Second Addition, block 1, lots 6 - 10
Larburn Addition, block 1, lots 1 - 12
  block 2, lots 1 - 12
  block 3, lots 1 - 6
  block 4, lot 1
Larburn Third Addition, block 1, lot 2 and outlot 2
  block 2, lots 1, 2, 3
A. M. Carlson's Addition, block 1, lots 1 - 12
  block 2, lots 1 - 11
  block 3, lots 1 - 9
  block 4, lots 1 - 10
Helmer Sorensen Addition, block 1, lots 1 - 7, outlot 1
Acme Investment First Addition, block 1, lot 1
  block 2, lots 1, 2, 3
A. M. Carlson's Second Addition, block 3, lot 7
A. M. Carlson's Third Addition, block 3, lots 9, 10, 11
Edgewood Estates Subdivision, block 1, lots 1, 2, 3
  block 2, lot 1
Metes and Bounds Legal Descriptions: parcels 3020, 6679, 1706, 1704,
  1708, Section 32, T-119, R-21

c. Runway 23
Auditor's Subdivision 328, lot 1
Bergstrom's Lynside Manor Second Addition, block 1, lots 1 - 22,
  block 2, lots 1 - 12
Bergstrom's Lynside Manor Third Addition, block 1, lots 13, 14, 15
  block 2, lots 1 - 4, 9 - 15
Waite's Addition, block 2, lots 7 - 10
Waite's Second Addition, block 2, lots 7-11

d. Runway 5
Kensey Manor Second Addition, block 1, lots 11 - 18, 1, 2
  block 2, lots 1 - 9, 12 - 19
  block 3, lots 11 - 13
  block 4, lots 1 - 15
Mork Campion Addition, block 1, lots 16, 17
Kensey Manor, block 3, lots 3 - 7, 17, 18
B. USE RESTRICTIONS:

1. GENERAL: Subject at all times to the height restrictions set forth in Subsection IV B, no use shall be made of any land in any of the safety zones defined in Subsection V A which creates or causes interference with the operations of radio or electronic facilities on the airport or with radio or electronic communications between airport and aircraft, makes it difficult for pilots to distinguish between airport lights and other lights, results in glare in the eyes of pilots using the airport, impairs visibility in the vicinity of the airport, or otherwise endangers the landing, taking off, or maneuvering of aircraft.

2. ZONE A: Subject at all times to the height restrictions set forth in Subsection IV B and to the general restrictions contained in Subsection V B 1 areas designated as Zone A shall contain no buildings, temporary structures, exposed transmission lines, or other similar above-ground land use structural hazards, and shall be restricted to those uses which will not create, attract, or bring together an assembly of persons thereon. Permitted uses may include, but are not limited to, such uses as agriculture (seasonal crops), horticulture, animal husbandry, raising of livestock, wildlife habitat, light outdoor recreation (nonspectator), cemeteries, and auto parking.

3. ZONE B: Subject at all times to the height restrictions set forth in Subsection IV B, and to the general restrictions contained in Subsection V B 1, areas designated as Zone B shall be restricted in use as follows:

a. Each use shall be on a site whose area shall not be less than three acres.
b. Each use shall not create, attract, or bring together a site population that would exceed 15 times that of the site acreage.

c. Each site shall have no more than one building plot upon which any number of structures may be erected.

d. A building plot shall be a single, uniform and non-contrived area, whose shape is uncomplicated and whose area shall not exceed the following minimum ratios with respect to the total site area:

<table>
<thead>
<tr>
<th>Site Area at least (Acres)</th>
<th>But Less Than (Acres)</th>
<th>Ratio of Site Area to Bldg. Plot Area</th>
<th>Building Plot Area (sq. ft.)</th>
<th>Max. Site Population (15 persons/A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>4</td>
<td>12:1</td>
<td>10,900</td>
<td>45</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td>10:1</td>
<td>17,400</td>
<td>60</td>
</tr>
<tr>
<td>6</td>
<td>10</td>
<td>8:1</td>
<td>32,700</td>
<td>90</td>
</tr>
<tr>
<td>10</td>
<td>20</td>
<td>6:1</td>
<td>72,600</td>
<td>150</td>
</tr>
<tr>
<td>20 and up</td>
<td></td>
<td>4:1</td>
<td>218,000</td>
<td>300</td>
</tr>
</tbody>
</table>

e. The following uses are specifically prohibited in Zone B: Churches, hospitals, schools, theaters, stadiums, hotels and motels, trailer courts, camp grounds, and other places of frequent public or semi-public assembly.

4. ZONE C: Zone C is subject only to height restrictions set forth in Subsection IV B, and to the general restrictions contained in Subsection V B 1.

5. EXEMPTIONS - ESTABLISHED RESIDENTIAL NEIGHBORHOODS:

a. Land uses which existed as of July 2, 1979 in the Established Residential Neighborhoods set forth in Section V A 4 above, and as
shown on the zoning map are subject to the height restrictions of Section IV B and the general restrictions of Section V B 1. Land uses which came into existence after July 2, 1979 are treated as though they were not in a designated Established Residential Neighborhood and are subject to the Zone A or Zone B restrictions as the case may be.

b. Land uses in Established Residential Neighborhoods which violate any of the following restrictions are prohibited as safety hazards and must be acquired, altered or removed at public expense. Those conditions are as follows:

(1) The following land uses if they exist in Safety Zone A or B and in an "Established Residential Neighborhood in a Built-Up Urban Area" are considered by the Commissioner to constitute airport safety hazards so severe, either to persons on the ground or to the air-traveling public, or both, that they must be prohibited under local airport zoning ordinances;

(a) any structure which a person or persons customarily use as a principal residence and which is located entirely inside Safety Zone A within 1000 feet of the end of the primary zone;

(b) any structure which a person or persons customarily use as a principal residence and which is located entirely within Safety Zones A or B and which penetrates an imaginary approach surface as defined by Section IV A;

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(c) any land use in Safety Zone A or B which violates any of the following standards:

(i) the land use must not create or cause interference with the operation of radio or electronic facilities on the airport or with radio or electronic communications between the airport and aircraft;

(ii) the land use must not make it difficult for pilots to distinguish between airport lights and other lights;

(iii) the land use must not result in glare in the eyes of pilots using the airport or impair visibility in the vicinity of the airport.

(d) any isolated residential building lot zoned for single-family or two-family residences on which any structure, if built, would be prohibited by subparagraphs b.(1)(a), (b) or (c) above. An "isolated" residential building lot is one located in an area in which the predominant land use is single-family or two-family residential structures; and

(e) any other land use which presents, in the opinion of the Commissioner, a material danger to the landing, taking off or maneuvering of aircraft or to the safety of persons on the ground. In making such a determination, the Commissioner shall consider the following factors:

(i) possibility that the land use may contribute to or cause a collision of two or more aircraft or an aircraft and some other object;
(ii) possibility that the land use may, in case of an aircraft accident, cause an explosion, fire or the release of harmful or noxious fumes, gases or substances;

(iii) tendency of the land use to increase the number of persons that could be injured in case of an aircraft accident;

(iv) effect of the land use on availability of clear areas for emergency landings; and

(v) flight patterns around the airport, the extent of use of the runway in question, the type of aircraft using the airport, whether the runways are lighted, whether the airport is controlled, and other similar factors.

C. BOUNDARY LIMITATIONS: The land use safety zoning restrictions set forth in this section shall apply for a distance not to exceed one mile beyond the perimeter of the airport boundary and in that portion of an airport hazard area under the approach zone for a distance not exceeding two miles from the airport boundary.

SECTION VI: AIRPORT ZONING MAP:

The several zones herein established are shown on the Crystal Airport Zoning Map consisting of 2 sheets, prepared by Toltz, King, Duvall, Anderson and dated May 1980, attached hereto and made a part hereof, which map, together with such amendments thereto as may from time to time be made, and all notations, references, elevations, data, zone boundaries, and other information thereon, shall be and the same is hereby adopted as part of this Ordinance.
SECTION VII: NONCONFORMING USES:

Regulations not retroactive. The regulations prescribed by this Ordinance shall not be construed to require the removal, lowering, or other changes or alteration of any structure or tree not conforming to the regulations as of the effective date of this Ordinance, or otherwise interfere with the continuance of any nonconforming use. Nothing herein contained shall require any change in the construction, alteration, or intended use of any structure, the construction or alteration of which was begun prior to the effective date of this Ordinance, and is diligently prosecuted and completed within two years thereof.

SECTION VIII: PERMITS:

A. FUTURE USES: Except as specifically provided in Paragraph 1 and 2 hereunder, no material change shall be made in the use of land and no structure shall be erected, altered, or otherwise established in any zone hereby created unless a permit therefor shall have been applied for and granted by the zoning administrator, hereinafter provided for. Each application for a permit shall indicate the purpose for which the permit is desired, with sufficient particularity to permit it to conform to the regulations herein prescribed. If such determination is in the affirmative, the permit shall be granted.

1. However, a permit for a tree or structure of less than 75 feet of vertical height above the ground shall not be required in the horizontal and conical zones or in any approach and transitional zones beyond a horizontal distance of 4,200 feet from each end of the runway except when such tree or structure, because of terrain, land contour, or topographic features, would extend the height or land use limit

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prescribed for the respective zone.

2. Nothing contained in this foregoing exception shall be construed as permitting or intending to permit any construction, alteration, or growth of any structure or tree in excess of any of the height limitations established by this Ordinance as set forth in Section IV and the land use limitations set forth in Section V.

B. EXISTING USES: Before any existing use or structure may be replaced, substantially altered or repaired, or rebuilt within any zone established herein, a permit must be secured authorizing such replacement, change, or repair. No permit shall be granted that would allow the establishment or creation of an airport hazard or permit a nonconforming use, structure, or tree to become a greater hazard to air navigation than it was on the effective date of this Ordinance or any amendments thereto, or than it is when the application for a permit is made. Except as indicated, all applications for such a permit shall be granted.

C. NONCONFORMING USES ABANDONED OR DETERIORATED: Whenever the zoning administrator determines that a nonconforming structure or tree has been abandoned or more than 80% torn down, deteriorated, or decayed, no permit shall be granted that would allow such structure or tree to exceed the applicable height limit or otherwise deviate from the zoning regulations. Whether application is made for a permit under this paragraph or not, the zoning administrator may order the owner of the nonconforming structure, at his own expense, to lower, remove, reconstruct, or equip the same in the manner necessary to conform to the provisions of this Ordinance. In the event the owner of the nonconforming structure shall neglect or refuse to
comply with such order for ten days after receipt of written notice of such order, the zoning administrator may, by appropriate legal action, proceed to have the nonconforming structure lowered, removed, reconstructed, or equipped and assess the cost and expense thereof against the land on which the structure is or was located. Unless such an assessment is paid within ninety days from the service of notice thereof on the owner of the land, the sum shall bear interest at the rate of eight per cent per annum from the date the cost and expense is incurred until paid, and shall be collected in the same manner as are general taxes.

SECTION IX: VARIANCES:
Any person desiring to erect or increase the height of any structure, or permit the growth of any tree, or use his property not in accordance with the regulations prescribed in this Ordinance may apply to the Board of Adjustment, hereinafter provided for, for a variance from such regulations. If a person submits an application for a variance by certified mail to the zoning administrator who shall forward it to the members of the Board and the Board fails to grant or deny the variance within four months, the variance shall be deemed to be granted by the Board. When the variance is granted by reason of the failure of the Board to act on the variance, the person receiving the variance shall notify the Board and Commissioner of Transportation by certified mail that the variance has been granted. The applicant shall include a copy of the original application for the variance with this notice to the Commissioner. The variance shall be effective 60 days after this notice is received by the Commissioner subject to any action taken by the Commissioner pursuant to Section 360.063, Subdivision 6. Such variances shall be allowed where it is duly found that a literal application or enforcement of the regulations would result in practical difficulty or unnecessary hardship and relief granted would not be
contrary to the public interest but do substantial justice and be in accordance with the spirit of this Ordinance provided any variance so allowed may be subject to any reasonable conditions that the Board of Adjustment or Commissioner may deem necessary to effectuate the purpose of this Ordinance.

SECTION X: HAZARD MARKING AND LIGHTING:

A. NONCONFORMING USES: The owner of any nonconforming structure or tree is hereby required to permit the installation, operation, and maintenance thereon of such markers and lights as shall be deemed necessary by the zoning administrator to indicate to the operators of aircraft in the vicinity of the airport the presence of such airport hazards. Such markers and lights shall be installed, operated, and maintained at the expense of the Metropolitan Airports Commission.

B. PERMITS AND VARIANCES: Any permit or variance granted by the zoning administrator or Board of Adjustment as the case may be, may, if such action is deemed advisable to effectuate the purpose of this Ordinance and be reasonable in the circumstances, so condition such permit or variance as to require the owner of the structure or tree in question at his own expense, to install, operate, and maintain thereon such markers and lights as may be necessary to indicate to pilots the presence of an airport hazard.

SECTION XI: AIRPORT ZONING ADMINISTRATOR:

A. DUTIES: It shall be the duty of the zoning administrator to administer and enforce the regulations prescribed herein. Applications for permits and variances shall be made to the zoning administrator upon a form furnished by him. Permit applications shall be promptly considered and granted or denied

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by him in accordance with the regulations prescribed herein. Variance applications shall be forthwith transmitted by the zoning administrator for action by the Board of Adjustment hereinafter provided for.

B. MUNICIPAL IDENTIFICATION: For the purpose of this Ordinance the Zoning Administrator shall be the following municipal officials: the Brooklyn Center Director of Planning and Inspection for lands located in Brooklyn Center; the Brooklyn Park Zoning Administrator for lands located in Brooklyn Park; the Crystal Building Inspector for lands located in Crystal; the Minneapolis Director of Inspection for lands located in Minneapolis; the New Hope Building Official for lands located in New Hope; and the Robbinsdale Director of Community Development for lands located in Robbinsdale. In the event that one or more of the above-described zoning administrators does not administer this ordinance, and if the municipality does not appoint a successor zoning administrator, the Crystal Airport Joint Zoning Board shall appoint an individual or a permit-issuing agency to administer the ordinance in the municipality or municipalities.

C. LIMITATION OF SCOPE: In the event that a permit application is denied by the zoning administrator because it violates the terms of this airport zoning ordinance and the terms of the municipal zoning ordinance, the applicant must receive variances from both the Board of Adjustment, as provided for in Minnesota Statutes 360.067 Subdivision 2, and the municipality before a permit may be issued.

SECTION XII: BOARD OF ADJUSTMENT:

A. ESTABLISHMENT: The Board of Adjustment shall consist of five members appointed by the Metropolitan Airports Commission and each shall serve for a
term of three years and until his successor is duly appointed and
qualified. Of the members first appointed, one shall be appointed for a
term of one year, two for a term of two years, and two for a term of three
years. Upon their appointment the members shall select a chairman to act at
the pleasure of the board. Members shall be removable by the Metropolitan
Airports Commission for cause, upon written charges, after a public hearing.

B. POWERS: The Board of Adjustment shall have and exercise the following
powers:

1. To hear and decide appeals from any order, requirement, decision, or
determination made by the Zoning Administrator in the enforcement of
the zoning regulations contained in this ordinance, as provided in
Minnesota Statutes 360.068.

2. To hear and decide special exceptions to the terms of zoning regulations
contained in this Ordinance upon which such Board of Adjustment under
such regulations may be required to pass.

3. To hear and decide specific variances under Minnestoa Statutes 360.067.

C. PROCEDURES:

1. The Board of Adjustment shall adopt rules for its governance and
procedure in harmony with the provisions of this Ordinance. Meetings of
the Board of Adjustment shall be held at the call of the Chairman and at
such other times as the Board of Adjustment may determine. The
Chairman, or in his absence the acting chairman, may administer oaths
and compel the attendance of witnesses. All hearings of the Board of
Adjustment shall be public. The Board of Adjustment shall keep minutes
of its proceedings showing the vote of each member upon each question
or, if absent or failing to vote, indicating such fact, and shall keep
records of its examinations and other official actions, all of which
shall immediately be filed in the office of the Zoning Administrator and
shall be a public record.

2. The Board of Adjustment shall make written findings of fact and
conclusions of law giving the facts upon which it acted and its legal
conclusions from such facts in reversing, affirming, or modifying any
order, requirement, decision or determination which comes before it
under the provisions of this Ordinance.

3. The concurring vote of a majority of the members of the Board of
Adjustment shall be sufficient to reverse any order, requirement,
decision or determination of the Zoning Administrator or to decide in
favor of the applicant on any matter upon which it is required to pass
under this Ordinance or to effect any variation in this Ordinance.

SECTION XIII: APPEALS:

A. Any person aggrieved, or any taxpayer affected by any decision of the Zoning
Administrator made in his administration of airport zoning regulations
contained in this Ordinance, may appeal to the Board of Adjustment. Such
appeals may also be made by any governing body of a municipality, county, or
airport zoning board, which is of the opinion that a decision of the zoning
administrator is an improper application of this ordinance as it concerns
such governing body or board.

B. All appeals hereunder must be commenced within 30 days of the Zoning
Administrator's decision by filing with the Zoning Administrator a notice of
appeal specifying the grounds thereof. The Zoning Administrator shall forthwith transmit to the Board of Adjustment all papers constituting the record upon which the action appealed from was taken. In addition, any person aggrieved, or any taxpayer affected by any decisions of the Zoning Administrator made in his administration of airport zoning regulations contained in this ordinance who desires to appeal such decision, shall submit an application for a variance by certified mail to the members of the Board of Adjustment in the manner set forth in Minnesota Statutes 360.068, Subdivision 2.

C. An appeal shall stay all proceedings in furtherance of the action appealed from, unless the Zoning Administrator certifies to the Board of Adjustment, after the notice of appeal has been filed with it, that by reason of the facts stated in the certificate a stay would in his opinion, cause imminent peril to life or property. In such case, proceedings shall not be stayed except by order of the Board of Adjustment on notice to the Zoning Administrator and on due cause shown.

D. The Board of Adjustment shall fix a reasonable time for hearing appeals, give public notice, notice to the municipalities of Brooklyn Center, Brooklyn Park, Crystal, Minneapolis, New Hope, Robbinsdale and the Metropolitan Airports Commission, and due notice to the parties in interest, and decide the same within a reasonable time. Upon the hearing any party may appear in person or by agent or by attorney.

E. The Board of Adjustment may, in conformity with the provisions of this ordinance, reverse or affirm, in whole or in part, or modify the order, requirement, decision or determination appealed from and may make such
order, requirement, decision or determination, as may be appropriate under the circumstances, and to that end shall have all the powers of the Zoning Administrator for the purpose of enforcing this airport zoning Ordinance.

SECTION XIV: JUDICIAL REVIEW:

Any person aggrieved, or any taxpayer affected by any decision of the Board of Adjustment, or any governing body of a municipality, county, or airport zoning board, which is of the opinion that a decision of the Board of Adjustment is illegal may present to the District Court of Hennepin County a verified petition setting forth that the decision or action is illegal, in whole or in part, and specifying the grounds of the illegality. Such petition shall be presented to the court within 30 days after the decision is filed in the office of the Board of Adjustment. The petitioner must exhaust the remedies provided in this Ordinance before availing himself of the right to petition a court as provided by this section.

SECTION XV: PENALTIES:

Every person who shall construct, establish, substantially change, alter or repair any existing structure or use, or permit the growth of any tree without having complied with the provision of this Ordinance or who, having been granted a permit or variance under the provisions of this Ordinance, shall construct, establish, substantially change or substantially alter or repair any existing growth or structure or permit the growth of any tree, except as permitted by such permit or variance, shall be guilty of a misdemeanor and shall be punished by a fine of not more than $500 or imprisonment for not more than 90 days or by both. Each day a violation continues to exist shall constitute a separate offense. The Airport Zoning Administrator may enforce all provisions of this ordinance through such proceedings for injunctive relief and other relief as may be proper under the laws of Minnesota Statutes 360.073 and other applicable law.
SECTION XVI: CONFLICTS:
Where there exists a conflict between any of the regulations or limitations prescribed in this Ordinance and any other regulations applicable to the same area, whether the conflict be with respect to the height of structures or trees, the use of land, or any other matter, the more stringent limitation or regulation shall govern and prevail.

SECTION XVII: SEVERABILITY:
A. In any case in which the provisions of this Ordinance, although generally reasonable, are held by a court to interfere with the use or enjoyment of a particular structure or parcel of land to such an extent, or to be so onerous in their application to such a structure or parcel of land as to constitute a taking or deprivation of that property in violation of the constitution of this state or the constitution of the United States, such holding shall not affect the application of this Ordinance as to other structures and parcels of land, and to this end, the provisions of this Ordinance are declared to be severable.
B. Should any section or provision of this Ordinance be declared by the courts to be unconstitutional or invalid, such decision shall not affect the validity of the Ordinance as a whole or any part thereof other than the parts so declared to be unconstitutional or invalid.

SECTION XVIII: EFFECTIVE DATE:
This Ordinance shall take effect on the 9th day of December, 1983. Copies thereof shall be filed with the Commissioner of Transportation, Division of Aeronautics, State of Minnesota, and the Register of Deeds, Hennepin County, Minnesota.
Appendix 8: Stakeholder Engagement Program Documentation

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Note: To be developed for final report distribution after the formal public review period
Appendix 9: Public Comments and Responses

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