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airport master plan

sbn
south bend
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airport master plan

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Chapter 1

Inventory of Facilities

The initial step in preparing the master plan was an inventory of facilities that included data collection summarizing the existing facilities, services, and conditions at the South Bend International Airport (SBN or Airport). The Inventory process included a review of the previous master plan report, the Airport Layout Plan (ALP), the Federal Aviation Administration's (FAA) National Plan of Integrated Airport Systems (NPIAS), and the Indiana Department of Transportation, Office of Aviation's 2012 Indiana State Aviation System Plan. In addition, data on based aircraft, enplanements, aircraft fleet mix, enplaned cargo, and aircraft operations from SBN records and FAA databases were reviewed. Use of aerial photography and an on-site visual inspection of the airfield and landside facilities were also used to conduct the inventory review.

This chapter summarizes the data collected on the existing condition of SBN facilities and services, organized as follows:

- 1.1 Airport Description and Location
- 1.2 Airport History
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1.1 Airport Description and Location

SBN is classified in the FAA's NPIAS as a primary, non-hub commercial service airport and plays an important role in supporting the demands of the nation's air transportation system. SBN is the air carrier airport serving the City of South Bend, St. Joseph County, Indiana, and its surrounding region. South Bend is in northern Indiana, less than five miles south of the Michigan border, along the U.S. Highway 31 (U.S.

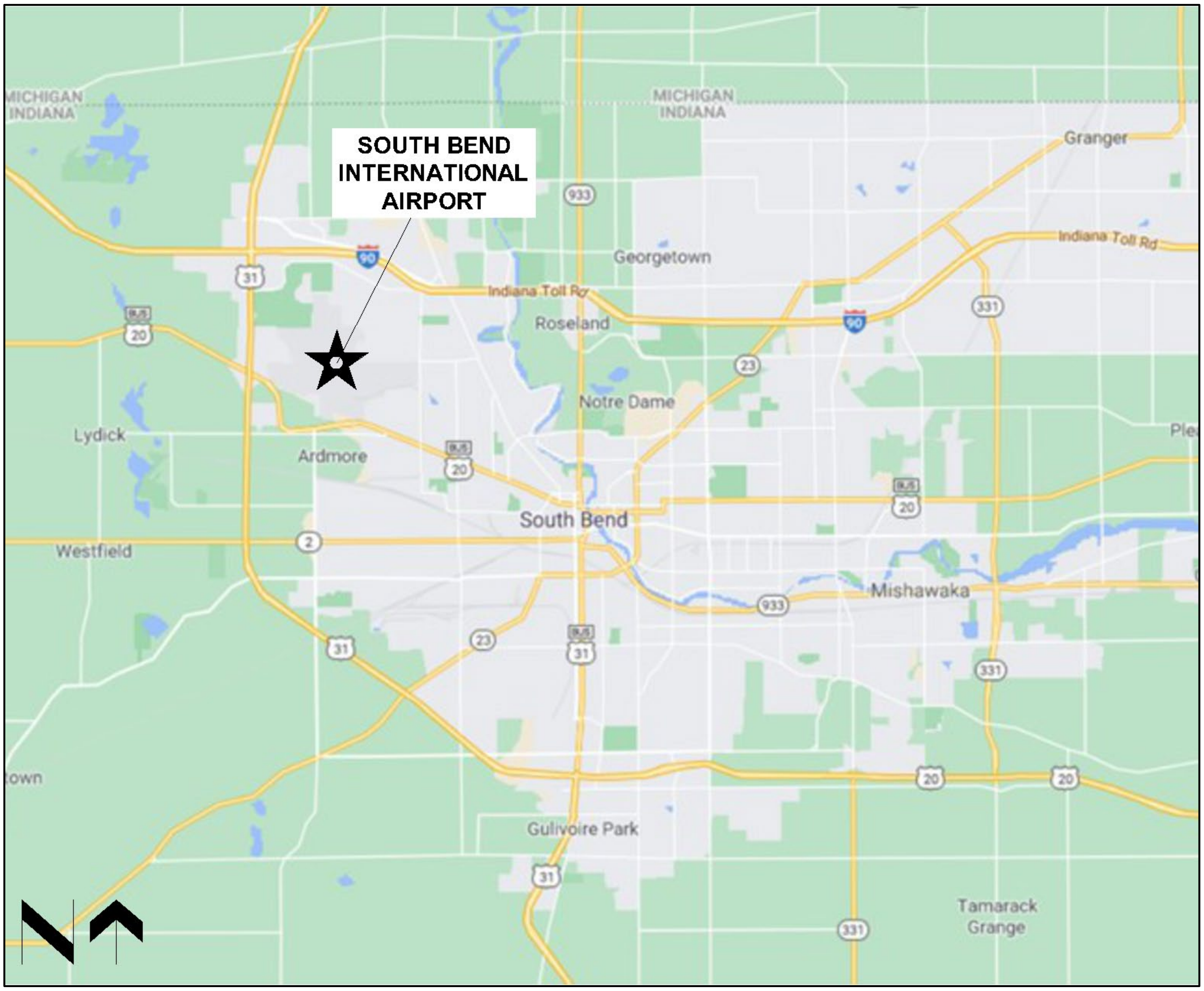
31) and Interstate 90 corridors. The city is approximately 130 miles to the north of Indianapolis, 70 miles northwest of Fort Wayne, and 70 miles east of Chicago.

SBN sits on approximately 2,200 acres of land in South Bend, roughly three miles northwest of the city's central business district. The Airport lies to the east of U.S. 31 and to the south of Interstate 90. Airport Boulevard provides access to SBN off U.S. Highway 20 (U.S. 20), also known as Lincoln Way West, which connects to U.S. 31. The coordinate location of the airport reference point at SBN is Latitude 41° 42' 29.6" North and Longitude 86° 19' 2.4" West with a field elevation of 798.3 feet mean sea level. **Figure 1-1** depicts SBN's location regionally while **Figure 1-2** illustrates its location locally.

Figure 1-1: Regional Airport Location Map

Source: Mead & Hunt, Inc. (2021)

Figure 1-2: Local Airport Location Map



Source: Google Maps (2021), with labeling by Mead & Hunt

According to the 2012 Indiana State Aviation System Plan and 2017 Michigan Aviation System Plan, there are several publicly owned, public-use general aviation airports in proximity of SBN in both Indiana and Michigan. These are shown in **Table 1-1**.

Table 1-1: General Aviation Airports in Proximity of SBN

FAA Identifier	Airport	City	State	Distance from SBN
3TR	Jerry Tyler Memorial Airport	Niles	Michigan	8.7 nautical miles
EKM	Elkhart Municipal Airport	Elkhart	Indiana	14.1 nautical miles
C91	Dowagiac Municipal Airport	Dowagiac	Michigan	19.1 nautical miles
PPO	La Porte Municipal Airport	La Porte	Indiana	20.4 nautical miles
C65	Plymouth Municipal Airport	Plymouth	Indiana	20.6 nautical miles
MGC	Michigan City Municipal Airport	Michigan City	Indiana	22.6 nautical miles
BEH	Southwest Michigan Regional Airport	Benton Harbor	Michigan	25.7 nautical miles
GSH	Goshen Municipal Airport	Goshen	Indiana	25.9 nautical miles

Source: Mead & Hunt, Inc. (2021)

Airports in Indiana, Michigan, and Illinois offering commercial airline service within 110 miles driving distance of SBN are shown in **Table 1-2**.

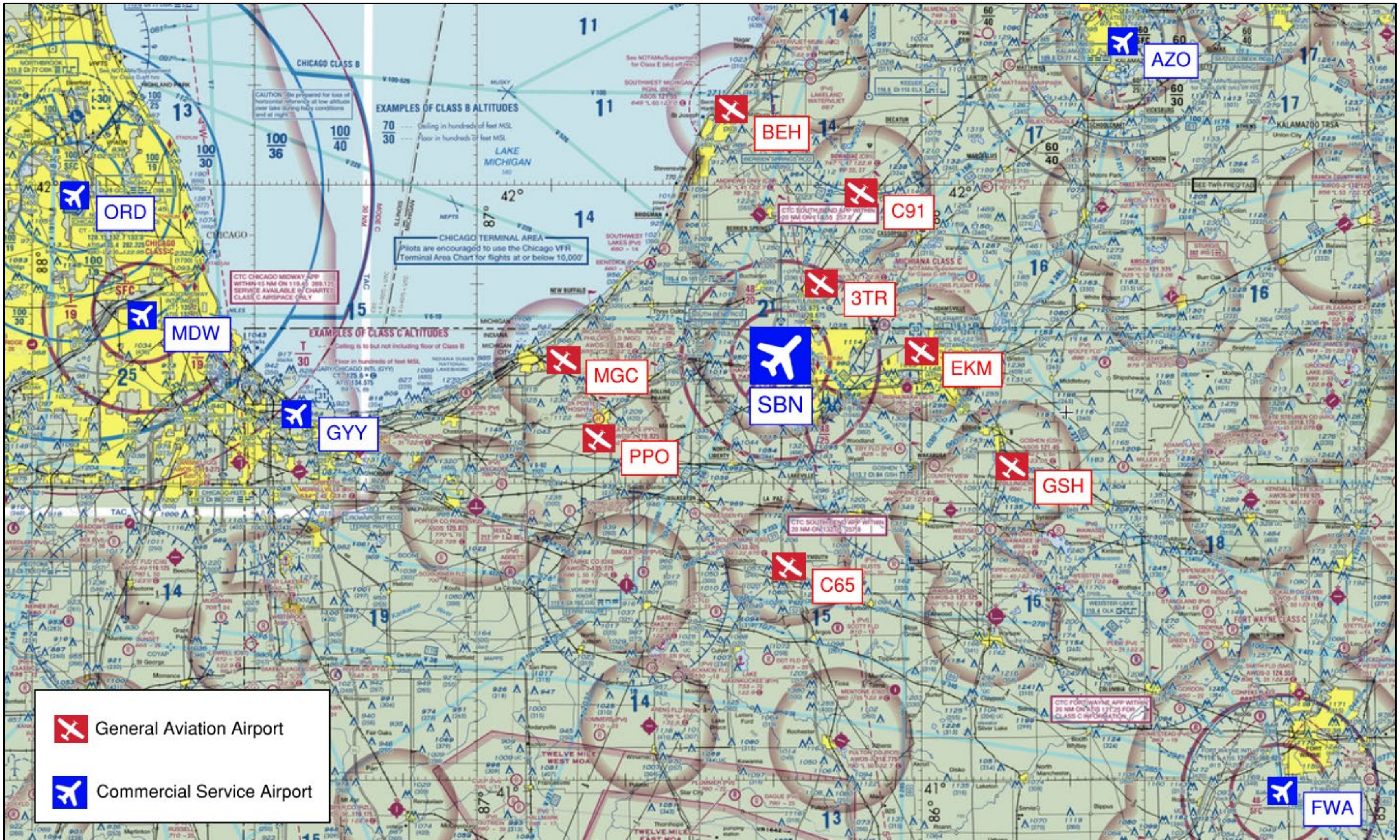
Table 1-2: Commercial Service Airports Within 110 Miles Driving Distance of SBN

FAA Identifier	Airport	City	State	Driving Distance from SBN
GYY	Gary/Chicago International Airport	Gary	Indiana	64.8 miles
AZO	Kalamazoo/Battle Creek International Airport	Kalamazoo	Michigan	73.1 miles
MDW	Chicago Midway International Airport	Chicago	Illinois	95.1 miles
FWA	Fort Wayne International Airport	Fort Wayne	Indiana	98.9 miles
ORD	Chicago O'Hare International Airport	Chicago	Illinois	105.0 miles

Source: Mead & Hunt, Inc. (2021)

The locations of the general aviation and commercial service airports in proximity of SBN are shown in **Figure 1-3**.

Figure 1-3: General Aviation and Commercial Service Airports in Proximity of SBN



Source: SkyVector.com, with labeling by Mead & Hunt

Aerial view of the University of Notre Dame
Source: SBN official Twitter account

South Bend, the fourth largest city in Indiana, is home to the world-renowned University of Notre Dame. Founded in 1842, the University of Notre Dame is a private research university with approximately 12,700 students. Several other top-notch institutions of higher learning call the South Bend region home, including Bethel University, Holy Cross College, Indiana University South Bend, Indiana Tech, and Purdue Polytechnic Institute.

Major industries in the South Bend region in addition to academics and research include advanced manufacturing, logistics, and health care. Thor Industries, Inc. is the largest employer in the region, with 17,000 employees. Other major employers include the University of Notre Dame (8,466 employees); Lippert Components Manufacturing, Inc. (7,394 employees); Quality Dining, Inc. (7,176 employees); and Patrick Industries, Inc. (6,889 employees).

1.2 Airport History

Aviation plays an important role in the region and has since the first flight in the area was completed by French aviator René Simon in 1911. SBN saw its beginning in 1929 when Vincent Bendix founded the Bendix Aviation Corporation and purchased 610 acres of land on which to build an airport. Bendix christened the airport “Bendix Municipal Airport” in a 1933 ceremony attended by more than 20,000 spectators. Shortly before this, the City of South Bend signed a three-year lease to rent the airport, with the option to buy at the end of the lease. The City of South Bend purchased the airport and later transferred ownership to St. Joseph County, who renamed the airport Bendix Field-St. Joseph County Airport. The airport’s name changed to Michiana Regional Airport in 1974 and to South Bend Regional Airport in 1999 before it was renamed South Bend International Airport in 2014. Today, the airport is managed by the St. Joseph County Airport Authority, which was created in 1974.

Bendix Field-St. Joseph County Airport administration building, 1941
Source: flysbn.com

Since its establishment nearly 100 years ago, SBN has experienced significant growth, with numerous airside and landside improvements having been constructed. After the Federal Airport Act was passed in 1946, St. Joseph County secured a grant that funded the construction of a new terminal building with a control tower, as well as adjacent aprons and an access roadway. A new control tower to replace the original control tower opened in 1979. In the last 20 years, airfield upgrades have included the extension of the primary and crosswind runways to 8,400 and

7,100 feet, respectively, as well as the lengthening of two taxiways. To meet the demands of modern air travel and improve the customer experience, a 45,000-square-foot concourse expansion featuring nine gates and popular passenger amenities was built. In addition, corporate/private international flights are offered through SBN's General Aviation Facility, which opened in 2017. A more detailed history of aviation in the region is presented in **Figure 1-4**.

1.3 Present Ownership and Management

SBN is owned and operated by the St. Joseph County Airport Authority (SJCAA), a municipal corporation established in 1974. The SJCAA's bi-partisan Board consists of four members who are appointed by the St. Joseph County Commissioners.

The Chief Executive Officer & Executive Director reports to the Authority Board and is assisted by the:

- Vice President of Operations
- Vice President of Finance
- Vice President of Marketing and Air Service Development
- Vice President of Human Resources
- Department of Public Safety Chief
- Airport Project Manager
- Airport Operations Manager
- Airport Properties Manager
- Airport Maintenance Manager

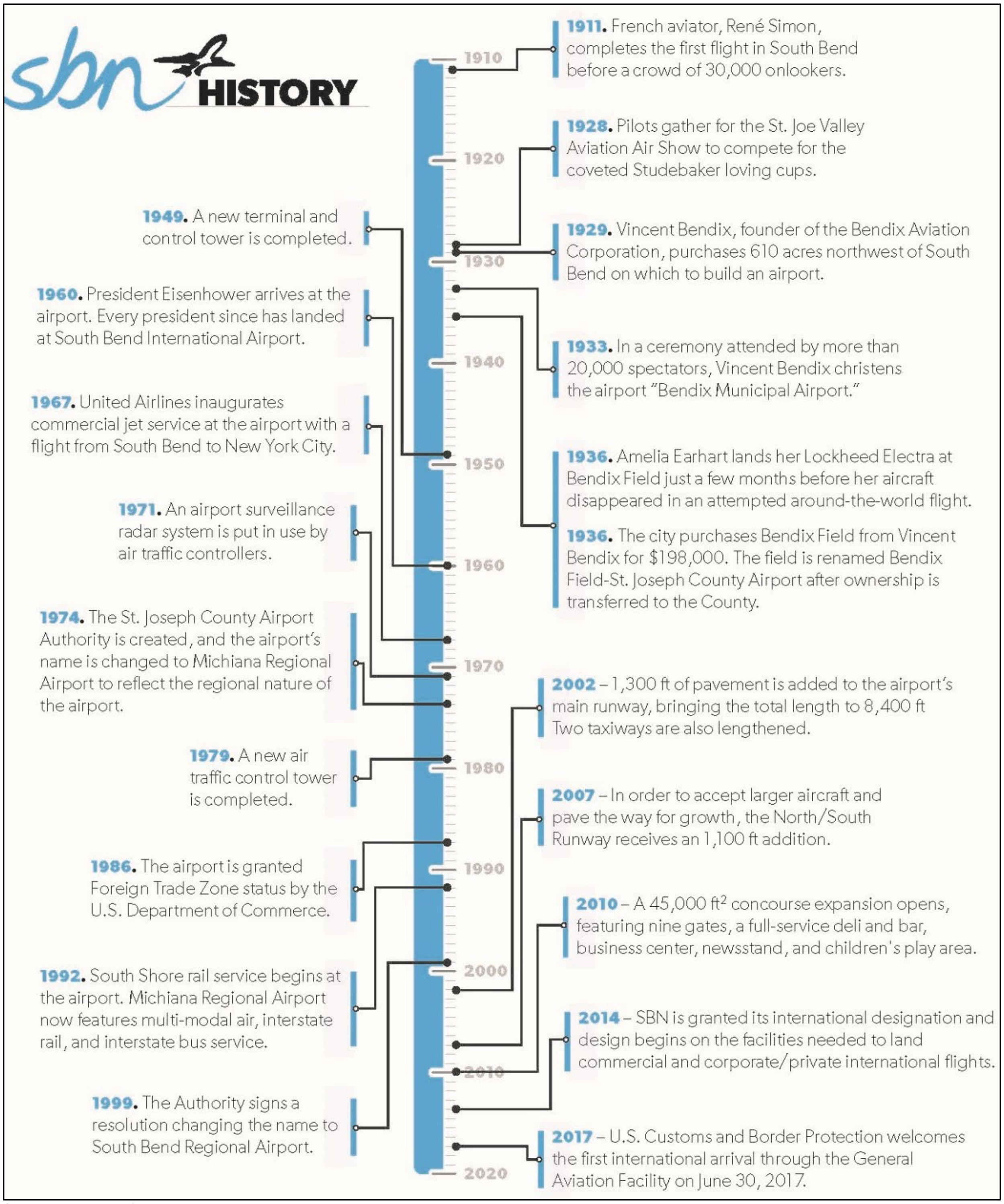
These positions are also supported by coordinators, supervisors, and assistants who have more specific administrative duties. In all, the Authority employs more than 50 staff members.

1.4 Socioeconomic Data

Establishing a baseline of existing socioeconomic conditions in SBN's service area is important prior to preparing aviation demand projections to determine infrastructure improvements needed over the next 20 years. SBN's service area encompasses a total of eight counties in northern Indiana and southwest Michigan:

- Berrien County (Michigan)
- Cass County (Michigan)
- Elkhart County (Indiana)
- La Porte County (Indiana)
- Kosciusko County (Indiana)
- Marshall County (Indiana)
- St. Joseph County (Indiana)
- Starke County (Indiana)

Figure 1-4: South Bend International Airport Historical Timeline



Source: Mead & Hunt, Inc. (2021)

Data from the United States Census Bureau indicates that the total population of the eight counties comprising SBN's service area grew from 932,835 in 2010 to 941,952 in 2019, an increase of 0.98 percent (0.98%). A breakdown of the population changes in each county from 2010 to 2019 is presented in **Table 1-3**. As shown in the table, only the populations of Elkhart, Kosciusko, and St. Joseph counties in Indiana have increased since 2010, growing 4.45 percent, 2.71 percent, and 1.83 percent, respectively.

Table 1-3: Historical Population of Airport Service Area

County	Population		% Change
	2010	2019	
Berrien (Michigan)	156,813	153,401	-2.18%
Cass (Michigan)	52,293	51,787	-0.97%
Elkhart (Indiana)	197,559	206,341	4.45%
Kosciusko (Indiana)	77,358	79,456	2.71%
La Porte (Indiana)	111,467	109,888	-1.42%
Marshall (Indiana)	47,051	46,258	-1.69%
St. Joseph (Indiana)	266,931	271,826	1.83%
Starke (Indiana)	23,363	22,995	-1.58%
TOTAL	**932,835**	**941,952**	**0.98%**

Source: U.S. Census Bureau, QuickFacts

Employment is another variable that can be used to understand a region's socioeconomic conditions. **Table 1-4** presents the change in employment from 2010 to 2019 (the most recent year for which data is available from the Bureau of Economic Analysis) for the eight counties in SBN's service area. As illustrated in the table, total employment rose 12.88 percent (12.88%) over the 10-year period, with all counties experiencing job growth and Elkhart County seeing the largest increase (27.89 percent).

Table 1-4: Historical Employment of Airport Service Area

County	Employment		% Change
	2010	2019	
Berrien (Michigan)	80,301	83,526	4.02%
Cass (Michigan)	14,280	15,933	11.58%
Elkhart (Indiana)	126,843	162,215	27.89%
Kosciusko (Indiana)	44,469	50,793	14.22%
La Porte (Indiana)	53,238	53,548	0.58%
Marshall (Indiana)	23,189	24,720	6.60%
St. Joseph (Indiana)	149,665	165,424	10.53%
Starke (Indiana)	6,776	6,852	1.12%
TOTAL	**498,761**	**563,011**	**12.88%**

Source: Bureau of Economic Analysis

Per capita personal income can be used to provide further insight into the socioeconomic conditions of SBN's service area. **Table 1-5** compares the per capita personal income for each county in the service area from 2010 to 2019. Since 2010, the average per capita personal income for the service area grew from

$32,217 to $44,917 (in 2021 dollars), an increase of 39.42 percent. Elkhart County experienced the largest jump in per capita personal income during this period, growing 54.51 percent.

Table 1-5: Historical Per Capita Personal Income of Airport Service Area

County	Per Capita Personal Income*		% Change
	2010	2019	
Berrien (Michigan)	$36,122	$48,237	33.54%
Cass (Michigan)	$31,566	$45,409	43.85%
Elkhart (Indiana)	$30,403	$46,975	54.51%
Kosciusko (Indiana)	$34,303	$48,425	41.17%
La Porte (Indiana)	$32,016	$43,910	37.15%
Marshall (Indiana)	$31,212	$42,196	35.19%
St. Joseph (Indiana)	$34,718	$48,535	39.80%
Starke (Indiana)	$27,395	$35,648	30.13%
AVERAGE	**$32,217**	**$44,917**	**39.42%**

*Figures are in 2021 dollars.
Source: Bureau of Economic Analysis

1.5 Meteorological Conditions

Meteorological conditions, wind velocities, and wind direction influence design, operational configurations, flight patterns, runway direction utilization, and the type of navigational aids (NAVAIDs) necessary for approach and landing during inclement weather. Consequently, meteorological conditions have a direct impact on operations at SBN.

Operations at an airport are affected by the direction of the winds relative to the alignment of the runways. Therefore, the runway orientation should align with the prevailing wind for the greatest percentage of the time. At SBN, the direction of prevailing winds varies throughout the course of a year. During the winter, prevailing winds can be out of the north and northwest, and prevailing winds from the southwest can be experienced during the warmer summer months.

Winters at SBN can be chilly. Average temperatures in January, the month with the coldest average temperature, range from a high of 32 degrees Fahrenheit (°F) to a low of 17°F. Summers offer warmer temperatures. The average temperatures in July, the month with the warmest average temperature, reaches a high of 84°F and a low of 63°F.

According to the Midwestern Regional Climate Center, between 1900 and 2020, precipitation at SBN has been fairly distributed throughout the year, with the greatest amounts occurring during the spring. The Airport receives an average of 37.2 inches of precipitation annually with measurable precipitation falling on average 148 days of the year. Mid-winter through early spring is the wettest time of the year, with autumn the driest.

Winter at SBN is marked by considerable cloudiness and rather high humidity along with frequent periods of snow. Heavy snowfalls are not uncommon as the result of a cold northwest wind passing over Lake Michigan, known as the lake effect, which significantly influences the regional climate due its nearest shore being 20 miles to the northwest of the Airport. The predominant snow season is from November through March with lighter amounts in April and October. The heaviest snowfall is typically received in January. Overall, SBN receives an average of 62.6 inches of snow each year.

1.6 Land Use and Zoning

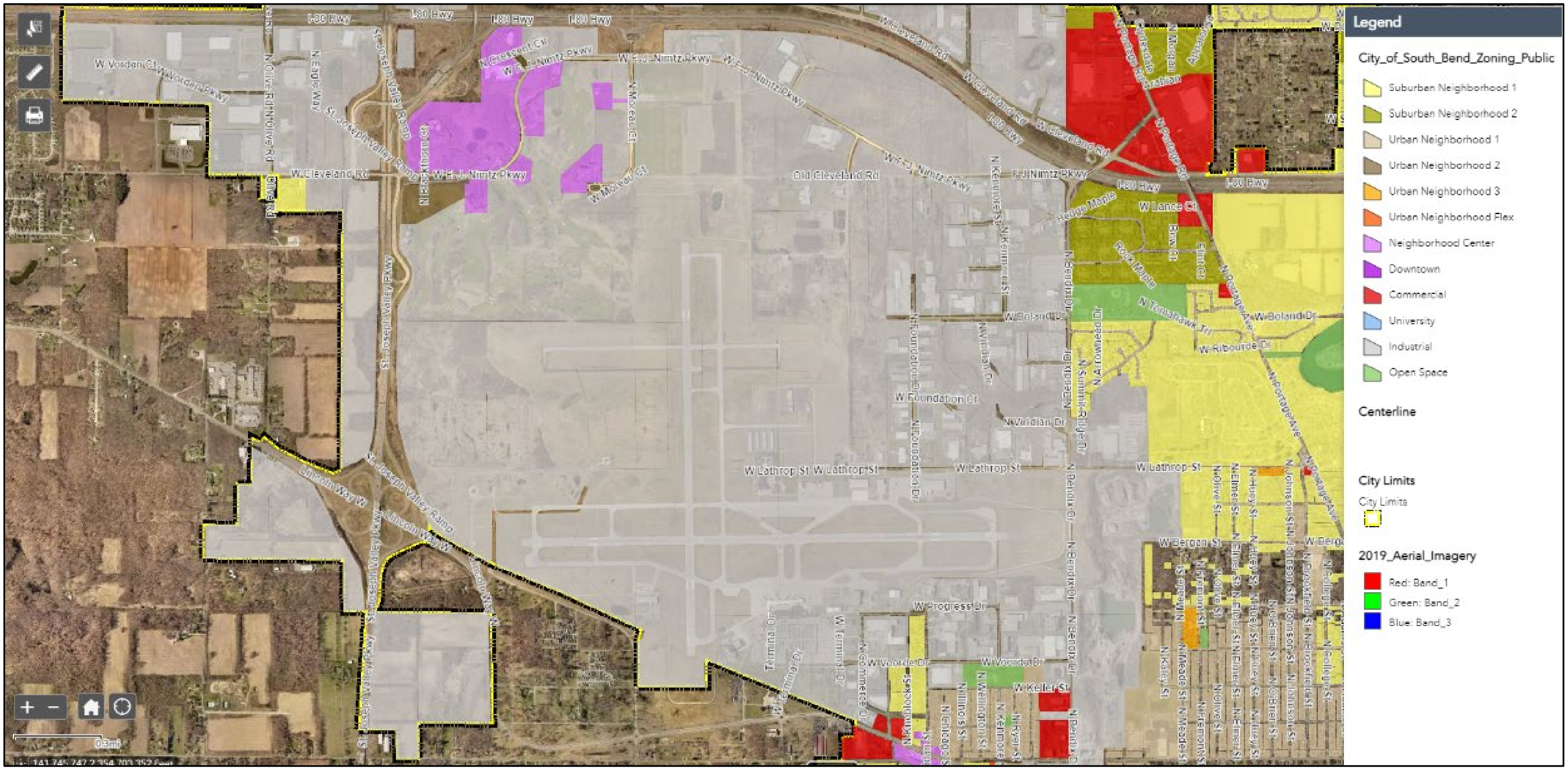
Local zoning and land use ordinances play a crucial role in maintaining and preserving SBN property and the surrounding area to allow for future expansion and development. A review of zoning districts on the City of South Bend's current Zoning Districts Map shows SBN is in a large district zoned as "Industrial" (**Figure 1-5**). Surrounding zoning districts within the South Bend city limits include "Suburban Neighborhood 1," "Suburban Neighborhood 2," "Urban Neighborhood 1," "Open Space," "Neighborhood Center," and "Commercial." According to the St. Joseph County Zoning Map (**Figure 1-6**), zoning districts south of SBN include "Single Family," "Commercial," "Industrial," and "Business." To the west of SBN are "Single Family," "Agricultural," and "Industrial" districts, while a "Single Family" district is found to the north of Interstate 90.

Current zoning and land uses surrounding SBN align with the Airport's ability to accommodate growth and expansion. It is important for SBN to be proactive in keeping surrounding land uses from becoming more incompatible. Incompatible land uses are those which impede aircraft operations at an airport and threaten the safety and quality of life for people living and working in proximity to the airport.

1.7 Airport Role

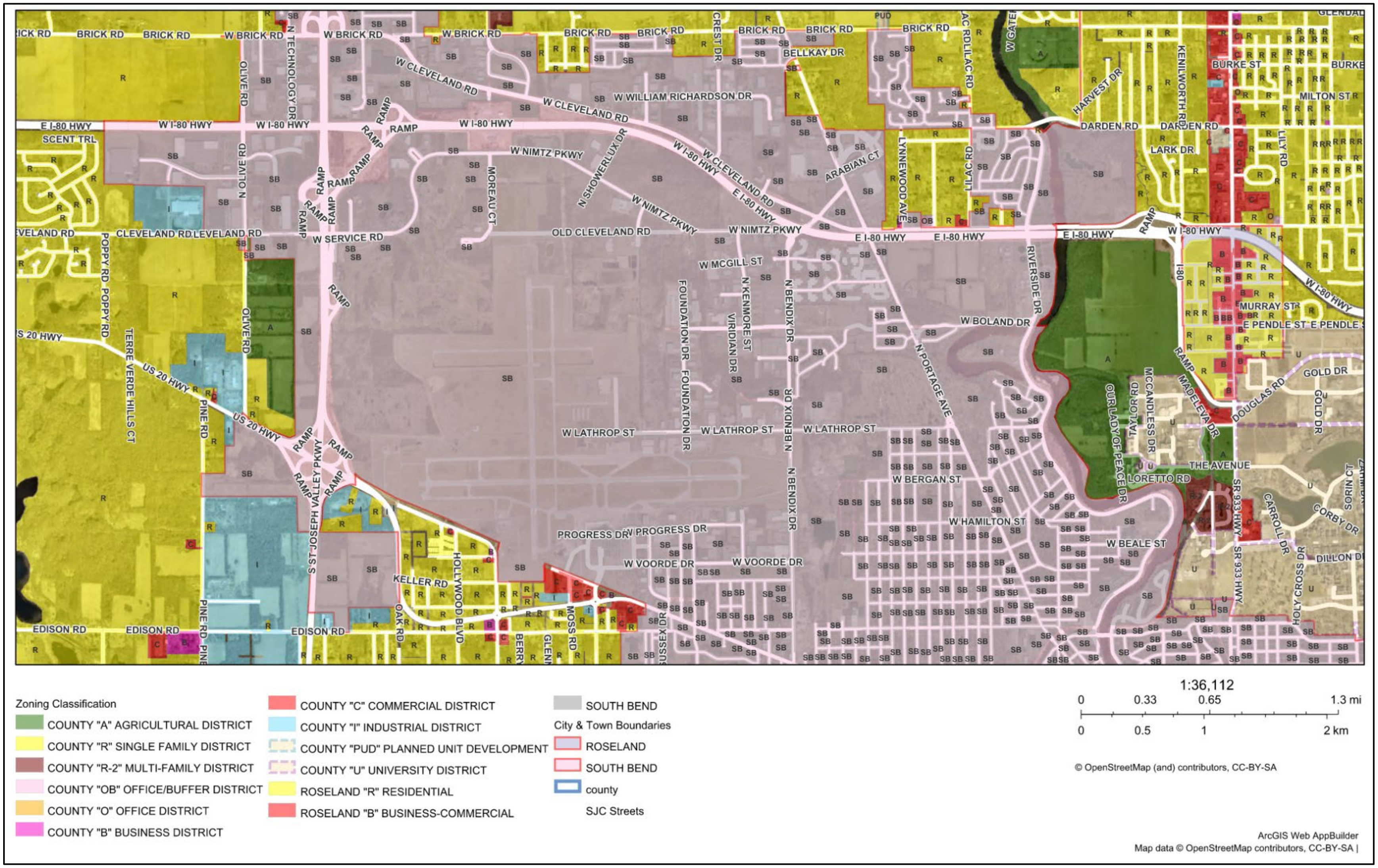
SBN is a vital air transportation gateway for northern Indiana and southwest Michigan. To receive federal funding, an airport must be included in the NPIAS. The FAA prepares a NPIAS report for Congress every two years. This report identifies those airports considered to be vital to the nation's airspace system and classifies airports according to their relationship within the broader transportation network. Along with 266 other airports nationwide, the FAA classifies SBN in the NPIAS as a primary, non-hub commercial service airport that is required to support the demands of the nation's aviation system. The FAA defines a primary, non-hub airport as having more than 10,000 passenger boardings (enplanements) that make up less than 0.05 percent nationwide boardings. Within the state aviation system, the Indiana Department of Transportation classifies SBN as a Primary airport that supports and sustains operations by commercial service carriers. SBN holds a Part 139 operating certificate, meeting the requirements of a Class I airport capable of serving scheduled and unscheduled operations of small and large air carrier aircraft.

Figure 1-5: City of South Bend Zoning Districts Map



Source: City of South Bend (2021)

Figure 1-6: St. Joseph County Zoning Map



Source: St. Joseph County (2021)

1.8 Airport Facilities

The inventory of existing facilities focused on the collection of information related to landside and airside infrastructure, in addition to support elements needed to ensure the safe and efficient operation of SBN. Airport facilities at SBN relate to aircraft movement or non-movement areas and include, but are not limited to: airside facilities, runways, taxiways, aprons, airfield lighting, NAVAIDs, and safety areas. This section summarizes the data collected regarding airport facilities.

1.8.1 Runways

A runway is defined as a rectangular area at an airport prepared for the landing and takeoff of aircraft along its length. SBN has three asphalt runways**.** Runway 9R/27L is the primary runway, Runway 9L/27R is the secondary runway, and Runway 18/36 is the crosswind runway. **Tables 1-6**, **1-7**, and **1-8** summarize information regarding the runways, such as length, width, weight bearing capacity, lighting, and approach slope.

Table 1-6: Runway 9R/27L Data Summary

Runway 9R/27L Element	Dimension/Condition
Length	8,412 feet
Width	150 feet
Surface	Grooved Asphalt
Runway Design Code (RDC)	D-IV
Weight Bearing Capacity	Single Wheel: 120,000 lbs. Double Wheel: 193,000 lbs. Double Tandem: 313,000 lbs.
Pavement Condition Index (PCI) Rating	34 – 94
End Elevations	Runway 9R: 789.8 feet mean sea level (MSL) Runway 27L: 769 feet MSL
Lighting	High-intensity runway edge lighting (HIRL)
Marking	Runway 9R: Precision Runway 27L: Precision
Approach Slope	Runway 9R: 50:1 Runway 27L: 50:1

Source: FAA Aeronautical Information Services; SBN Airport Layout Plan; Indiana Department of Transportation Office of Aviation 2021 pavement inspection for South Bend International Airport

Table 1-7: Runway 9L/27R Data Summary

Runway 9L/27R Element	Dimension/Condition
Length	4,300 feet
Width	75 feet
Surface	Asphalt
Runway Design Code (RDC)	B-II
Weight Bearing Capacity	Single Wheel: 32,500 lbs. Double Wheel: 49,000 lbs.
Pavement Condition Index (PCI) Rating	34 – 46
End Elevations	Runway 9L: 787.9 feet mean sea level (MSL) Runway 27R: 780.2 feet MSL
Lighting	Medium-intensity runway edge lighting (MIRL)
Markings	Runway 9L: Non-precision Runway 27R: Non-precision
Approach Slope	Runway 9L: 34:1 Runway 27R: 34:1

Source: FAA Aeronautical Information Services; SBN Airport Layout Plan; Indiana Department of Transportation Office of Aviation 2021 pavement inspection for South Bend International Airport

Table 1-8: Runway 18/36 Data Summary

Runway 18/36 Element	Dimension/Condition
Length	7,101 feet
Width	150 feet
Surface	Asphalt
Runway Design Code (RDC)	D-IV
Weight Bearing Capacity	Single Wheel: 118,000 lbs. Double Wheel: 186,000 lbs. Double Tandem: 326,000 lbs.
Pavement Condition Index (PCI) Rating	20 – 100
End Elevations	Runway 18: 798.3 feet mean sea level (MSL) Runway 36: 759.3 feet MSL
Lighting	Medium-intensity runway edge lighting (MIRL)
Markings	Runway 18: Non-precision Runway 36: Non-precision
Approach Slope	Runway 18: 34:1 Runway 36: 34:1

Source: FAA Aeronautical Information Services; SBN Airport Layout Plan; Indiana Department of Transportation Office of Aviation 2021 pavement inspection for South Bend International Airport

1.8.2 Taxiways

A taxiway is a path for aircraft at an airport to transverse between runways and aprons, hangars, terminals, and other airside facilities. Runway 9R/27L has two full length parallel taxiways. Taxiway A runs on the north side of the runway, and Taxiway B runs on the south side. Both taxiways are 75 feet wide. Taxiway B and several connector taxiways provide access to each end of Runway 9R/27L and to the Terminal Apron, West Cargo Apron, and East Cargo Apron located south of Taxiway B. Taxiway A provides access to both ends of Runway 9R/27L as well as to the General Aviation Apron and UPS Apron via its own system of connector taxiways.

Runway 18/36 has a full parallel taxiway identified as Taxiway N. Taxiway N is 75 feet wide, provides access to both ends of Runway 18/36, and intersects Taxiways A, B, and J to connect all three runways. Additionally, Taxiway N intersects Taxiway T, which provides access to T-hangars and two corporate aprons located between Runway 9R/27L and Runway 9L/27R.

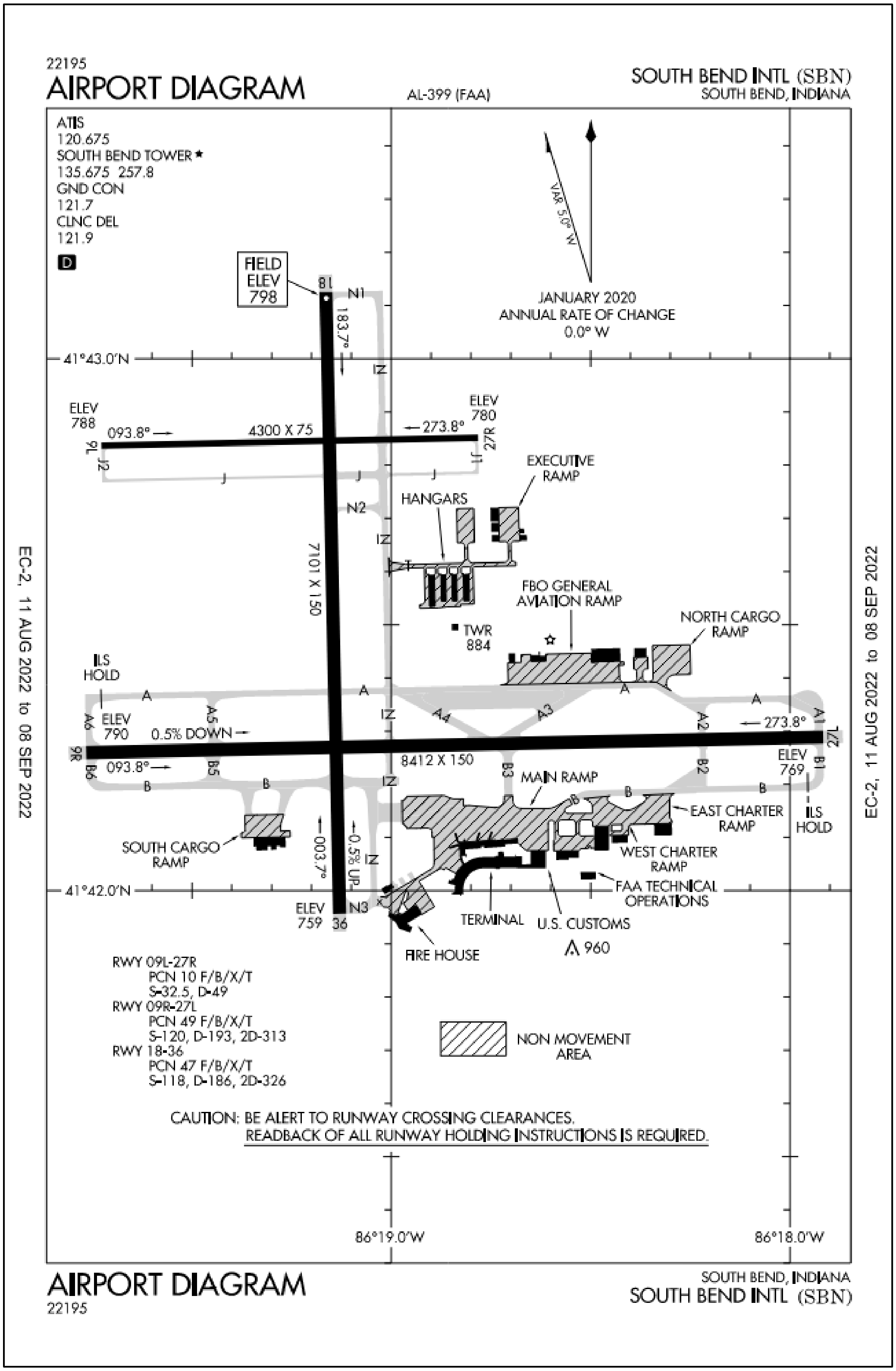
Taxiway J is 35 feet wide and serves as the full parallel taxiway for Runway 9L/27R, providing access to both ends of the runway. Taxiway J intersects Taxiway N, providing a route to the south end of the airfield.

Figure 1-7 shows the existing taxiway system.

1.8.3 Aprons

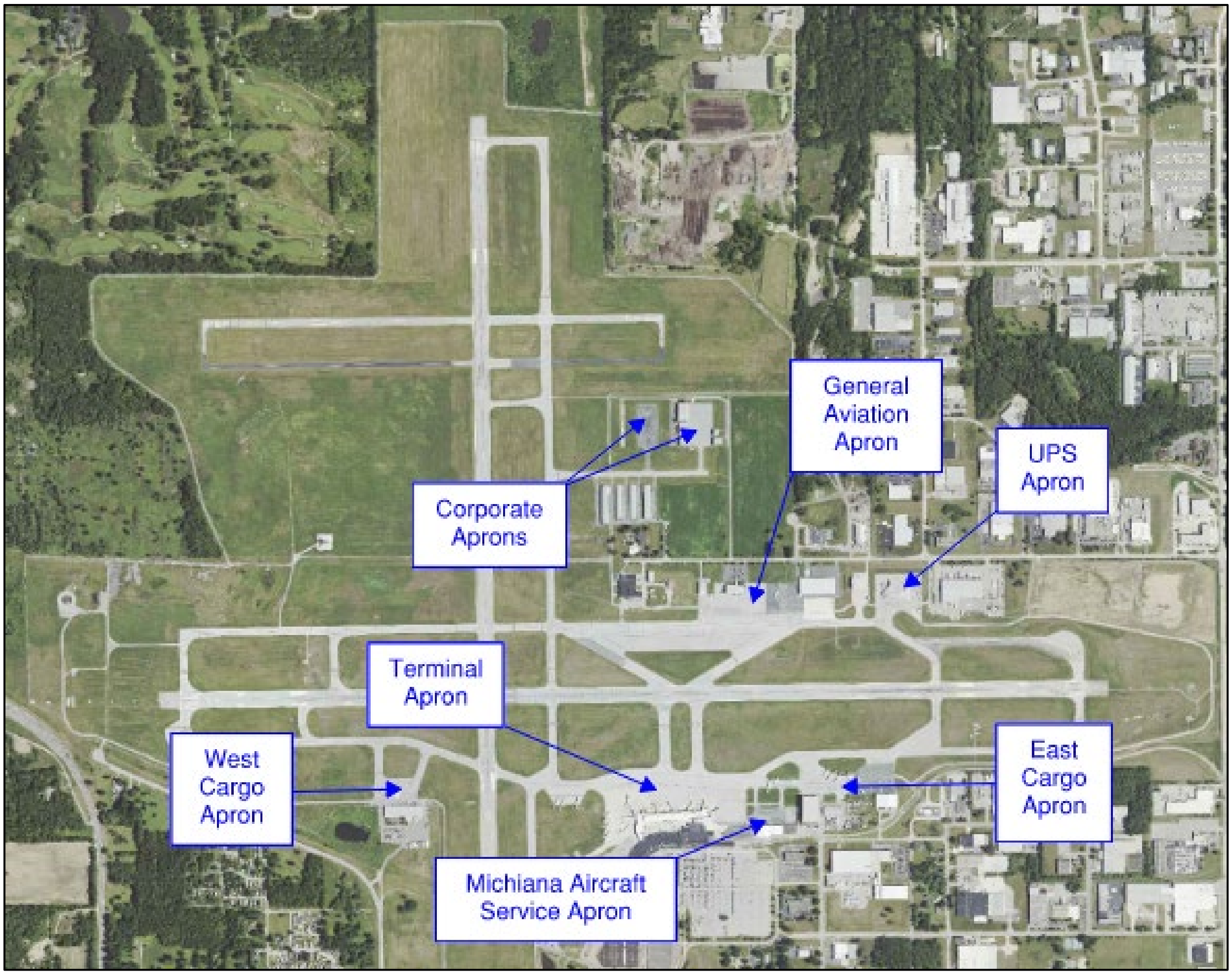
Aprons, also known as ramps, are large, paved surfaces designed for parking and servicing of aircraft. Generally found near terminal buildings, hangars, and fixed base operators, aprons also provide an area for loading and unloading of passengers and cargo, aircraft fueling, and aircraft maintenance. SBN has several aprons throughout the airfield. The Terminal Apron, adjacent to the terminal building, is approximately 550,000 square feet and is used to service scheduled commercial flights. The apron includes 10 aircraft parking spaces that can accommodate a variety of large aircraft. The West Cargo Apron, located west of the approach end of Runway 36 and south of Taxiway B, provides approximately 122,000 square feet for FedEx's cargo operations. Michiana Aircraft Service, an aircraft maintenance and avionics service provider at SBN, has an approximately 72,000-square-foot apron just east of the Terminal Apron. The East Cargo Apron is approximately 244,000 square feet and is located east of the Michiana Aircraft Service apron. Providing approximately 173,000 square feet of space for UPS' cargo operations, the UPS Apron is located to the north of the approach end of Runway 27L and adjacent to Taxiway A. The General Aviation Apron, located west of the UPS Apron, is approximately 370,000 square feet and supports general aviation activities along with FBO operations. Just south of the approach end of Runway 27R are two corporate aprons that serve the surrounding hangars for parking, loading and unloading, maintenance, and fueling. One corporate apron is approximately 80,000 square feet and the other, approximately 96,000 square feet. **Figure 1-8** illustrates the locations of the various aprons.

Figure 1-7: Taxiway System



Source: FAA Aeronautical Information Services

Figure 1-8: Apron Locations



Source: Mead & Hunt, Inc. (2021)

1.8.4 Navigational Aids

NAVAIDs assist pilots in locating an airport both visually and electronically as well as determining the glide path when on approach to land. NAVAIDs are most important during times of inclement weather and nighttime conditions when a pilot's visibility is limited. SBN has visual and electronic NAVAIDs.

Visual NAVAIDs

Visual NAVAIDs are those that air crews use to visually identify the airfield during approach, landing, and taxiing at night and in adverse weather conditions. These NAVAIDs use different lights to communicate visual cues to pilots.

Rotating Beacon

To identify the location of an airport at night, a rotating beacon flashes colored lights signaling the airport is a public use facility. The beacon, equipped with a green lens and a white lens 180 degrees apart from each other, rotates 360 degrees to be seen by air from any direction. This NAVAID is useful for pilots when trying to locate an airport visually from a distance. It is also activated during daylight hours to indicate that weather conditions at the airport have fallen below the minimums for visual flight rules (cloud ceiling of 1,000 feet and visibility of three miles). SBN's rotating beacon is near the entrance to Atlantic Aviation south of Lathrop Street.

Precision Approach Path Indicator (PAPI)

A PAPI is an approach lighting system that provides pilots with visual cues for a safe glide slope when on approach to a runway. The typical PAPI is installed as a row of four individual lighting units equipped with red and white lights directed at different angles. Greater than 2 red lights indicate the aircraft is below the optimum glide slope, and greater than 2 white lights indicate the aircraft is above the optimum glide slope. When two red and two white lights are visible, the pilot knows the aircraft is on the optimum glide path (in a two-light PAPI system, one white light and one red light means the aircraft is on the optimum glide path). Every runway end at SBN is equipped with a four-light PAPI, except for Runway 9L/27R, which has two-light PAPIs on either end of the runway.

Runway Approach Lighting

Approach lighting systems aid pilots in identifying the airport environment and aligning properly with the runway centerline during final approach. They are typically used on runways with instrument approach procedures. Their design helps pilots, during periods of low visibility, see the approach lighting systems before seeing the runway and use the lights to continue the approach safely. At SBN, Runway 27L is equipped with a medium intensity approach lighting system with runway alignment indicator lights (MALSR). This system has 1,400 feet of medium intensity lights. These lights guide the pilot to the runway centerline and help identify the runway threshold. The system also has a set of runway alignment indicator lights that assist the pilot in keeping the aircraft level while visually searching for the runway threshold. Runway 9R has a 1,400-foot medium intensity approach lighting system with sequenced flashers (MALSF). Sequenced flashers are a series of lights that turn off and on in a pattern that appears to show a point of light repeatedly moving toward the runway threshold along the approach path.

Electronic NAVAIDs

Electronic NAVAIDs provide radio signals that pilots can receive in the cockpit (if appropriately equipped). They can use these signals during periods of poor visibility to navigate their aircraft to the vicinity of the airport and to a position from which the pilot can conduct a visual landing to the runway. Electronic NAVAIDs allow an airport to remain open and conduct operations during inclement weather conditions, although usually at a lower capacity than during clear weather. This minimizes the number of delayed or canceled flights by properly equipped aircraft. SBN employs several types of electronic NAVAIDs.

Instrument Landing System (ILS)

An ILS is an electronic approach system. An ILS includes a localizer for lateral guidance to the runway and a glideslope for vertical guidance. Other components include markers that signal when an aircraft reaches a specific point in the approach procedure. An ILS provides one of the most precise guidance systems available to pilots. At SBN, the ILS to Runway 9R is capable of guiding aircraft to as low as 200 feet off the ground, and the Runway 27L ILS can bring aircraft down to 150 feet, although this approach requires special training and certification of the crew. Note that the only two runway ends with ILS approaches at SBN are also the only two runways with approach lighting systems.

Global Positioning System (GPS)

Aircraft equipped with GPS equipment can navigate using signals emitted from satellites instead of ground-based equipment to determine their position, altitude, flight heading, and speed. SBN has GPS approaches to every runway end, with minimums nearing, and, in the case of Runway 9R, matching the minimums of the ILS approach. The GPS approaches to Runway 9R/27L and Runway 9L/27R have both vertical and lateral guidance, while the GPS approaches to Runway 18/36 only provide lateral guidance.

SBN ASR-7 radar
Source: Lawhon & Associates, Inc.

Very High Frequency Omni-directional Radio Range (VOR)

VOR is a ground based navigational system that emits radio signals that pilots can use to determine their direction from the VOR. VORs are used in non-precision approaches (no vertical navigation signal provided) to runways. The GIPPER VOR is three nautical miles north of SBN and is a key navigational component of the Runway 18 VOR approach.

ASR-7 Radar

An ASR-7 is located on the airfield northwest of the intersection of Runway 18/36 and Taxiway A, nearly due north of Taxiway A5. While the ASR-7 radar does not provide navigational guidance directly to pilots, air traffic controllers use it to track aircraft as far out as approximately 60 miles and provide weather information to pilots.

1.8.5 Weather Equipment

SBN's weather equipment consists of a combination of electronic apparatus and traditional windsocks. The most comprehensive source of weather reporting is SBN's automated surface observation system (ASOS). The ASOS, which is located on the airfield northeast of the intersection of Taxiways A and N, reports weather observations 24 hours per day. Each observation records the time, wind velocity and gusts, visibility, sky condition, precipitation, temperature, dew point, air pressure and any relevant remarks. This information is available by recording either through a phone call (574-251-2656) or through SBN's automatic terminal information system (ATIS). The SBN ATIS automatically broadcasts the ASOS weather and other important information to pilots on radio channel 120.675 to alleviate frequency congestion.

Runway 9R/27L is equipped with runway visual range (RVR) equipment. This device reports visibility along the runway, which is more precise than the visibility provided by ASOS. On Runway 9R/27L, the RVR equipment is located at the approach end of Runway 27L.

SBN is also equipped with windsocks. Windsocks are simple devices consisting of a fabric cone (typically orange or both white and orange) attached to a pole. They provide a visual indication of wind direction and strength and may be lit for use at night.

SBN has six orange windsocks located around the airfield to provide pilots with an easy reference for wind velocity:

- South of Runway 27L at approach end
- South of Runway 27L between Taxiways B-3 and B-4 (lighted)
- North of Runway 27L at departure end
- East of Runway 36 south of Taxiway N-2 (lighted)
- South of Runway 27R at approach end
- South of Runway 27R at departure end

1.8.6 Commercial Terminal

The airport terminal building is at the south end of the airport along Terminal Drive with access from the intersection of Lincoln Way West and Airport Boulevard. Lincoln Way West provides access via a roundabout north to Terminal Drive. Terminal Drive becomes a one-way counterclockwise roadway heading east, then north, cutting a path around the terminal and train station parking lots, with terminal curbside access located along the north side of the roadway.

The L-shaped terminal building follows the curb, turning south parallel to Terminal Drive, with the longer axis running east to west. This section discusses the various components of SBN's commercial airline terminal.

Terminal Building

There have been several additions to the terminal since the original building was constructed in 1981. The middle portion of the concourse was built in 2010 and the east end was completed in 2012. The U.S. Customs Facility was constructed in 2016. Today, the net area of the terminal building is 204,763 square feet and its gross area is 217,221 square feet.

SBN terminal building
Source: SBN official Twitter account

The terminal has a linear east-west layout with the westernmost portion turning 90 degrees south. The security checkpoint is in the connector between the terminal and concourse. A partially elevated nine-gate concourse pier runs parallel to the terminal. Basement areas house building systems and storage and a small second-floor area houses several offices and a public viewing area as part of the airport's aviation museum.

The domestic travel section of the terminal is concentrated in the 90-degree bend of the building. The main corridor runs the length of the terminal, connecting all major components together on the north and west side of the corridor. The departures hall houses passenger circulation and queuing areas, baggage screening, check-in kiosks, and airline ticket counters and offices (ATOs). Four airlines use the terminal building: Allegiant, American, Delta, and United. A small bank of restrooms, a vending area, meditation room, and fitness center are located on the opposite side of the main corridor. A gift shop is located adjacent to the checkpoint entrance.

The arrivals hall is in the western portion of the 90-degree bend in the building and contains a baggage claim area, rental car counters, and bus station waiting areas. The inbound baggage room, two baggage claim carousels, and a bar/restaurant are located on one side of the main circulation corridor, with the rental car counters located on the other side. Public restrooms are found west of the restaurant, across the corridor from the bus station and a short walk from the baggage claim area.

Tenants, such as concessionaires, local law enforcement, TSA, and car rental agencies, lease space in the terminal that typically includes office or operational support space for commercial terminal operations. Airlines and/or third-party airline service providers are the largest tenants in terms of space.

Spaces and functions within the terminal building are discussed in the sections below. These are security screening, concourse, U.S. Customs Federal Inspection Service and General Aviation Facility, a station for the South Shore Train, bus stations, and building support. A complete layout plan of the terminal is shown in **Figures 1-9**, **1-10**, and **1-11.** The existing terminal and concourse areas and sizes are listed in **Table 1-9**.

Security Screening

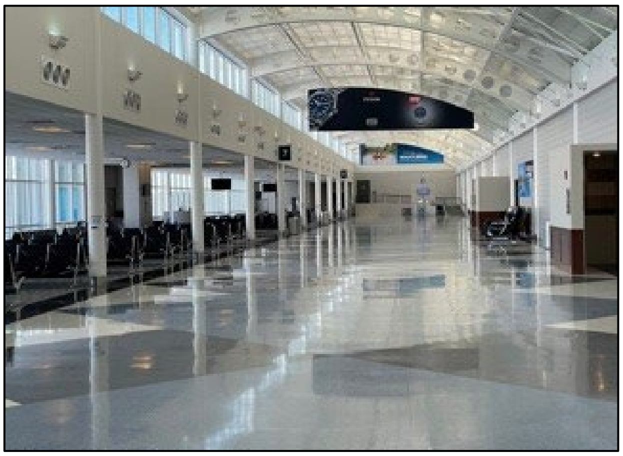
Security screening for checked baggage is in the airline operations areas behind their ticket counters. The semi-automated part of the process consists of conveyors that bring baggage to the screening areas located within the airline operations areas, but the screening process itself is not automated. American's baggage is screened within United's screening area. A takeaway belt delivers the baggage to this area from American's ticket counters.

SBN security checkpoint
Source: SBN official Twitter account

A single passenger security checkpoint is in the connector corridor between the public, non-secure area of the terminal and the secure concourse. The checkpoint floor is elevated above the terminal floor and below the main concourse floor. The checkpoint space is approximately 45 feet wide and 56 feet long. There are three standard passenger security screening lanes in the security checkpoint, as well as several Transportation Security Administration (TSA) offices. Approximately 600 square feet of queuing area is available for the checkpoint with ample space for queue overflow into the non-secure corridor.

Concourse

The concourse is directly beyond the checkpoint, providing departure lounges, restrooms, a café, business center, and a gift shop, linked together by a main concourse corridor that runs the length of the building. From the checkpoint, passengers walk to one of three gates at a slightly higher elevation than the checkpoint and proceed up a ramp on the main portion of the concourse to the remaining departures lounges. All the gates use boarding bridges to load passengers onto aircraft.



SBN concourse
Source: Mead & Hunt, Inc.

The concourse was originally designed to serve smaller aircraft than those currently in the commercial fleet. As a result, the boarding bridge located at Gate 4 has been removed to reconfigure the aircraft parking positions. Gate 4 now serves as an entry to a service animal relief area located just outside the gatehouse. The remaining gates are approximately 140 feet apart except for Gate 9, which is located on the end of the concourse, enabling it to serve larger aircraft. There are currently seven boarding bridges and a total of nine parking positions on the commercial apron.

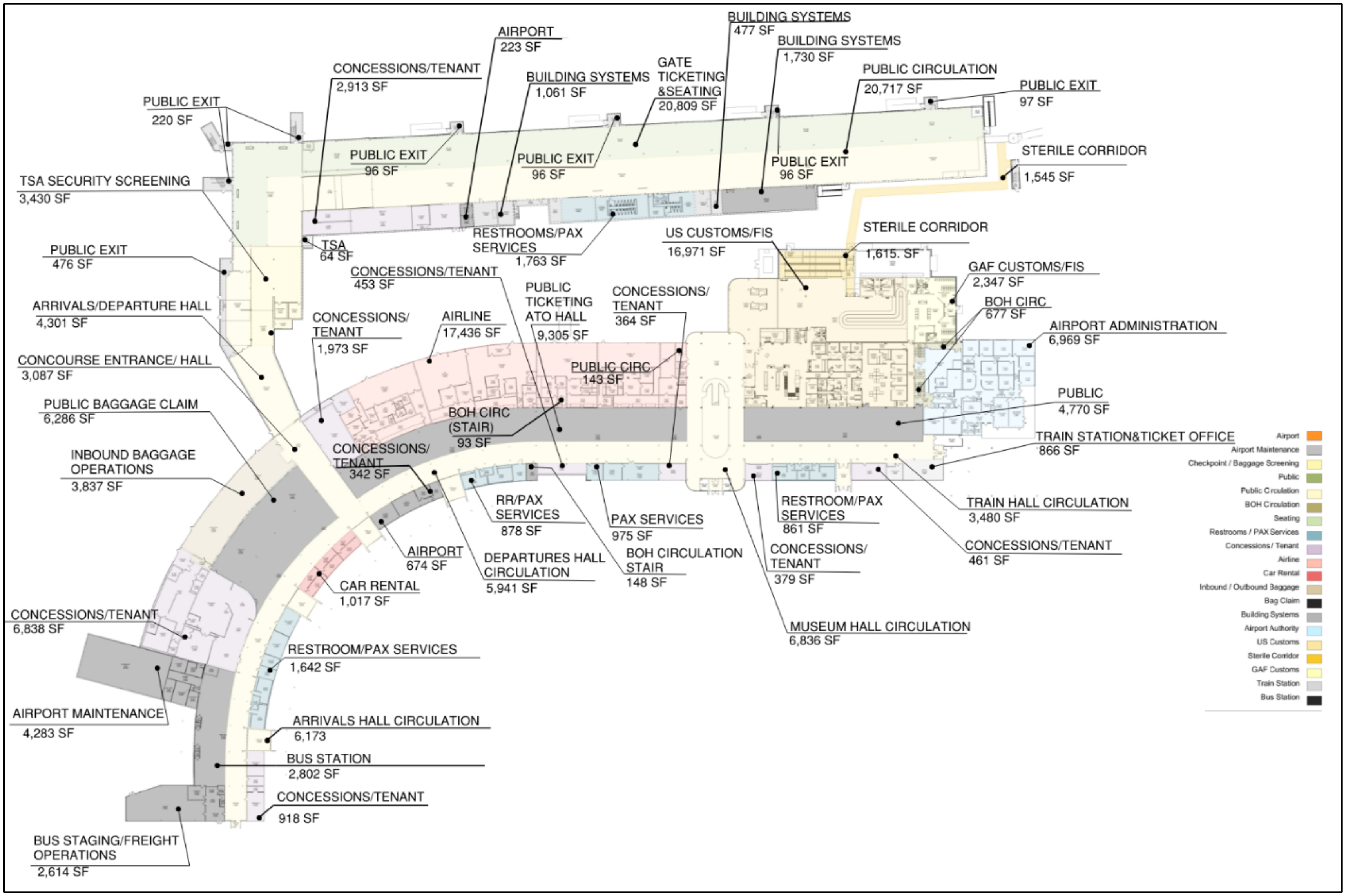
U.S. Customs Federal Inspection Service and General Aviation Facility

U.S. Customs operates a General Aviation Facility (GAF), designed to clear up to 20 international general aviation passengers, crew, and their baggage, as well as a Federal Inspection Service (FIS) for clearing commercial flights. The 26,000-square-foot facility is on the east side of the terminal between the airline ticket counters and the train station. General aviation aircraft park in the “red box” apron location east and south of Gate 9. Passengers and crew walk from the aircraft to the GAF portion of the U.S. Customs facility where they are screened with their baggage before entering the terminal. Commercial passengers arrive at Gate 9 and are directed to the FIS portion of the facility where they are screened with their baggage before they enter the terminal. The FIS is primarily used for large charter flights, as there are not yet scheduled international commercial flights at SBN.

Train and Bus Stations

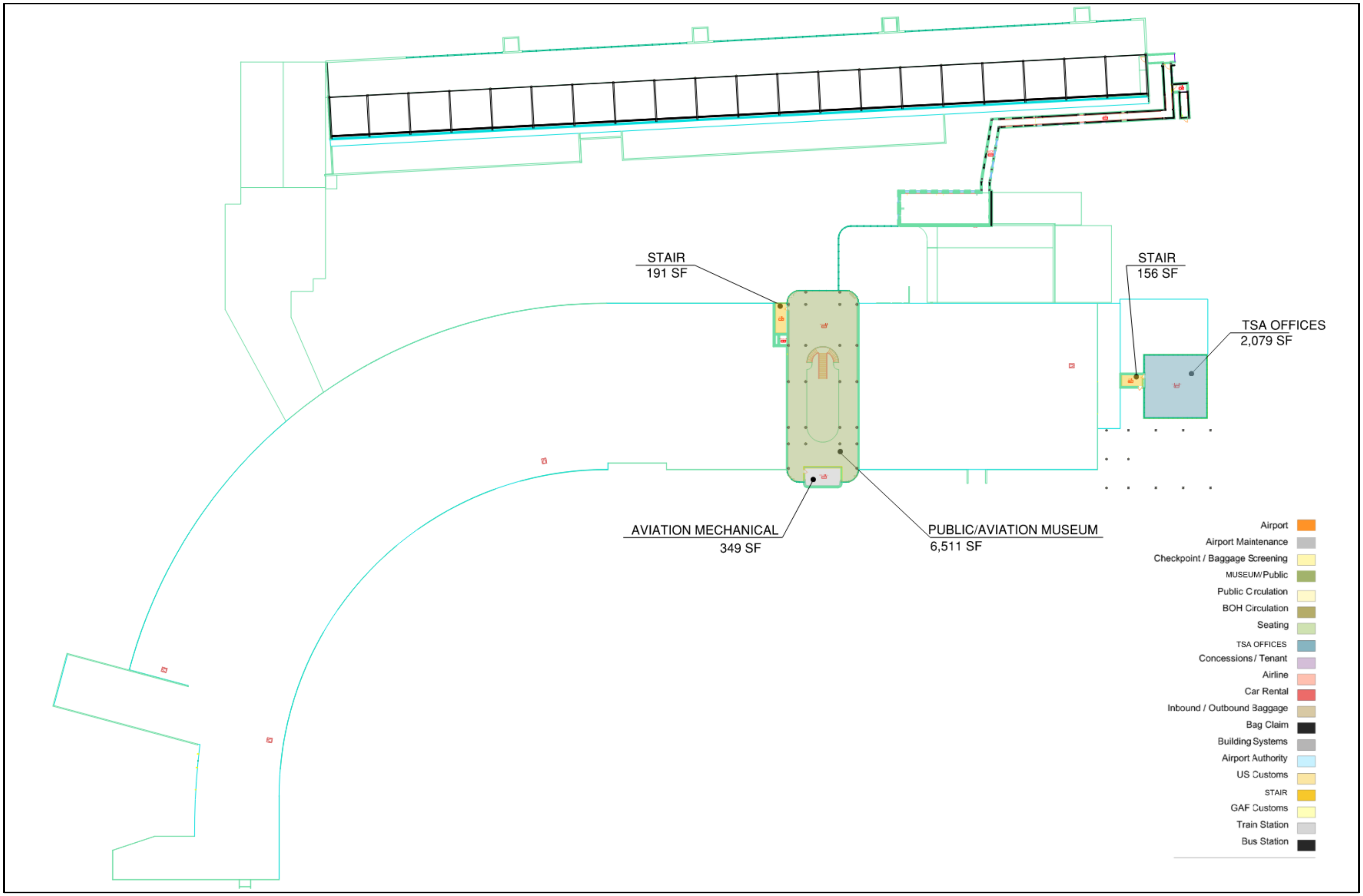
The South Shore train station is located at the far east end of the terminal building. The South Shore rail line connects SBN with several cities throughout northwestern Indiana, with a final destination at Millennial Park in downtown Chicago. The bus station is located on the far west side of the terminal. Greyhound bus service moved to downtown South Bend in 2019, and Coach is not operating from SBN due to the COVID-19 pandemic. The bus station offers inter-city bus services to destinations throughout the South Bend area.

Figure 1-9: Existing Terminal and Concourse Area First Floor Plan



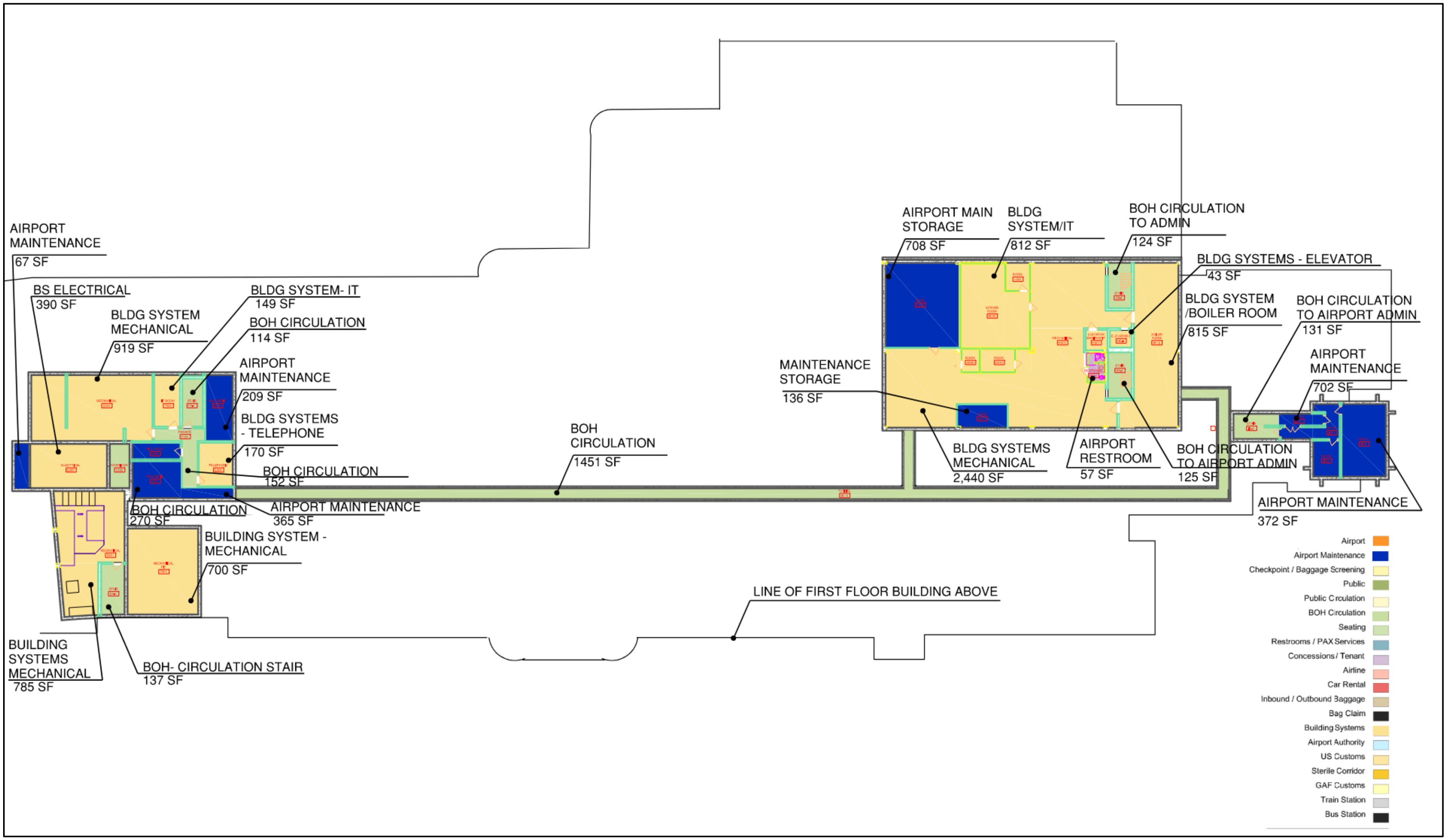
Source: Mead & Hunt, Inc. (2021)

Figure 1-10: Existing Terminal and Concourse Area Second Floor Plan



Source: Mead & Hunt, Inc. (2021)

Figure 1-11: Existing Terminal and Concourse Area Basement Floor Plan



Source: Mead & Hunt, Inc. (2021)

Table 1-9: Existing Commercial Terminal Building Plan Area

Terminal Space	Net Area Square Footage	Terminal Space	Net Area Square Footage
First Floor		**First Floor (continued)**	
Airport	1,535	Concourse Entrance Hall	3,087
Airport Maintenance	4,283	Bus Staging/Freight Operations	2,614
Public	5,246	**First Floor Total**	**183,134**
Public Circulation	20,717	**Second Floor**	
Gate Ticketing & Seating	20,809	Public Aviation Museum	6,511
Restrooms/Passenger Services	5,241	Aviation Mechanical	349
Concessions/Tenant	14,299	Stair	347
Airline	17,436	TSA Offices	2,079
Car Rental	1,017	**Second Floor Total**	**9,286**
Inbound/Outbound Baggage	3,837	**Basement**	
Public Baggage Claim	6,286	Airport Maintenance	1,715
Building Systems	3,268	BS Electrical	390
Airport Authority	878	Building System Mechanical	4,844
U.S. Customs/FIS	16,971	Building System IT	961
Sterile Corridor	3,160	BOH Circulation	1,987
GAF Customs/FIS	2,347	Airport Maintenance Storage	844
Train Station	4,346	BOH Circulation to Admin	380
Bus Station	2,802	Airport Restroom	57
Arrivals Hall Circulation	6,173	Building System Boiler Room	815
Departures Hall Circulation	5,941	Building System Telephone	170
Museum Hall Circulation	6,836	Building System Elevator	43
Airport Administration	6,969	BOH Circulation Stair	137
Public Ticketing ATO Hall	9,305	**Basement Total**	**12,343**
Passenger Security Screening	3,430		
Arrivals/Departure Hall	4,301	**Building Total**	**204,763**

Source: Mead & Hunt, Inc. (2021)

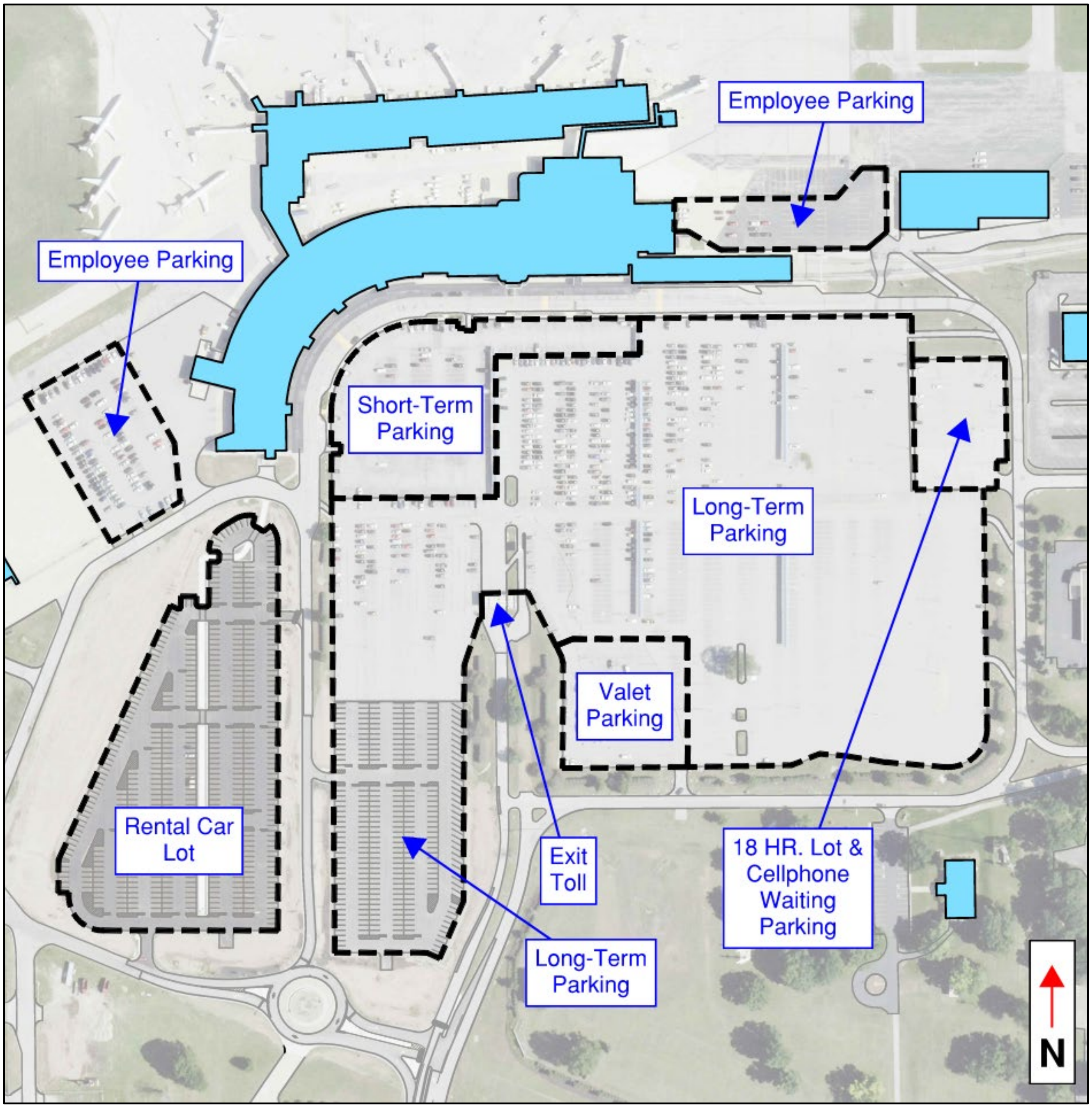
Building Support

Building support spaces are the portions of the building that house essential services, including the mechanical, plumbing, electrical, and information systems. Operational support, administrative offices, janitorial spaces, maintenance areas, storage rooms, delivery areas, and waste collection facilities are other supports spaces within the terminal building.

Vehicle Parking

Several vehicle parking options are available to users at SBN (shown on **Figure 1-12**): short-term, long-term, valet, 18-hour, and cell phone waiting. The 18-hour lot serves passengers using the South Shore Line and is located at the northeast corner of infield parking. The cell phone waiting lot is located within the 18-hour lot.

Figure 1-12: Vehicle Parking Lot Layout



Source: Mead & Hunt, Inc. (2021)

SJCAA employee parking is in two lots. One lot is east of the terminal building and north of the train station, with the other lot west of the terminal building. The rental car lot is south of the far western end of the terminal building. **Table 1-10** summarizes the number of parking stalls available to each parking category.

Table 1-10: Vehicle Parking Spaces

Parking Type	Parking spaces
Short-Term Hourly	261
Long-Term (Including Valet)	2,363
Daily 18-Hour & Cell Phone Waiting	120
Rental Car	486
Employee	169
Total Parking Spaces	**3,399**

Source: Mead & Hunt, Inc. (2021)

Landside

The landside facilities supporting SBN's commercial airline terminal are described below. These facilities are the access roadway and curbside.

Access Roadway

Terminal Drive is a two-lane roadway leading to the terminal at which point it becomes a three-lane curbside access (**Figure 1-13**). The roadway follows a traditional loop around infield terminal parking. Passengers and visitors can enter short- and long-term parking at various points along Terminal Drive, dropping passengers off and parking before joining their parties to see them off or to travel together.

Passengers entering the terminal access roadway from the south follow the roadway east, then north. Entrances to the long-term and train station parking lots are the first access to parking along the east side of the roadway. The roadway turns west along the train station where a taxi queue is positioned to serve both the train station and air travelers at curbside further to the west. Drivers who drop passengers off at the curb have access to short-term parking across from the curb. Meeters and greeters will also use this lot to meet their party in the terminal. Valet parking is available at the curb for passengers when air travel supports this service. A secondary entrance to long-term parking is just around the turn to the south, away from the terminal, for departing passengers whose drivers will drop-off at the curb and join their party in the terminal.

Recent development expanded the rental car ready/return and long-term parking lots and added a new roundabout to re-route rental car return traffic from the terminal access roadway. Travelers returning rental cars use Progressive Drive from Airport Boulevard to the rental car entrance at the south end of the lot. The new route directs all traffic exiting the commercial terminal and rental car lots through the new roundabout to Airport Boulevard and on to Lincoln Way West.

Figure 1-13: Terminal Roadway Lanes and Signage

Source: Mead & Hunt, Inc. (2021)

Lincoln Way West, which connects to Airport Boulevard and Terminal Drive, is the primary landside access for SBN's terminal building. Lincoln Way West runs east through the city center of South Bend and west to U.S. 31. North Bendix Drive gives access to the east side of SBN and runs in a north-south direction between Lincoln Way West and Interstate 90. From North Bendix Drive, Voorde Drive provides an alternate access route to the terminal building and parking facilities.

Curbside

Vehicle curbside access is provided via three lanes of the access roadway, which expands from two to three lanes as it turns west toward the terminal. The lane closest to the curb allows for passenger pickup and drop-off. The second lane provides for vehicle stacking and/or maneuvering into or pulling out of the curbside lane. The third, outside lane serves as a bypass lane for vehicles that will drive beyond cars stacked at the departures curb to pull up to the curb, for those drivers who have pulled out from the curbside to bypass all other traffic, and for other vehicles heading to the arrivals curb.

SBN terminal building curbside
Source: Mead & Hunt, Inc.

Vehicles for hire such as taxis, limousines, and shared ride network company vehicles such as Lyft and Uber also use the outside lane to bypass departures or arrivals activity to engage passengers at designated curbside areas.

The terminal building is parallel to the roadway. The terminal frontage at curbside provides multiple entrances to the building corresponding to activity within the terminal. The ticketing and baggage claim components at SBN are located closely together at the west end of the building. Most airport users arrive and depart through the main entrance to the building. This entrance is between ticketing and baggage claim. The secure concourse has one entrance and exit, also between ticketing and baggage claim, which draws departing passengers to the main entrance. The departures hall is west of the international arrivals curb. The arrivals hall is also at the west end of the terminal, driving most of the domestic arriving passenger activity toward this area. This accumulation of functions is experienced most acutely at the curb.

In addition to personal vehicles, several other transportation options offer access to SBN. As previously noted, Transpo offers bus service to destinations throughout the South Bend area as well as taxis and ridesharing services that are available for use by passengers at designated curbside areas outside the terminal.

1.8.7 Fixed Base Operators

In addition to serving commercial passengers, SBN also offers several amenities to support general aviation customers including two fixed-base operators (FBOs). An FBO is a business that provides aeronautical services such as fueling, hangar storage, tie down, aircraft parking, aircraft rental, aircraft maintenance, flight instruction, and other services.

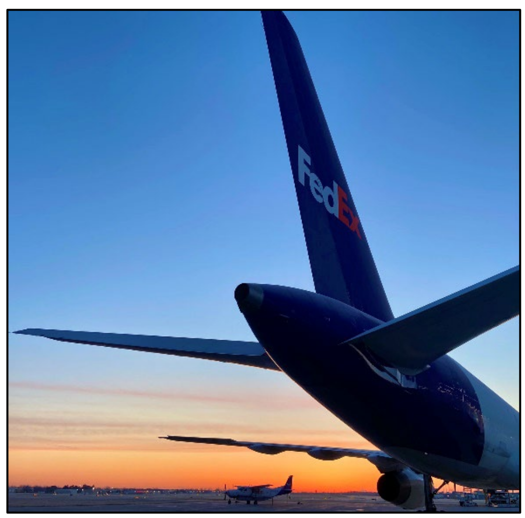
The FBOs at SBN are Atlantic Aviation and Corporate Wings. Atlantic Aviation is located on the northwest side of the General Aviation Apron (Figure 1-8), and Corporate Wings is located on the northeast side of the same apron. Each FBO provides the services and amenities indicated in **Table 1-11**.

In addition to the two FBOs, Michiana Aircraft Service, Inc. is an FAA repair station that provides aircraft maintenance and avionics repair including:

- Avionics troubleshooting/installs
- Oxygen and nitrogen service
- Weight and balance
- Heater decay testing
- Landing gear checks
- Annual inspections.

1.8.8 Cargo Facilities

SBN serves a prominent role in supporting the air cargo demands of northern Indiana, southwest Michigan, and the greater Chicago metropolitan area. Its central location to large markets, an abundance of space, and large runways make SBN an ideal site for cargo operations. Both FedEx and UPS have package sorting facilities on airport property responsible for the regional collection and distribution of air cargo between hubs.



FedEx jet parked at SBN
Source: SBN official Twitter account

Each facility has separate cargo areas. FedEx uses the West Cargo Apron (Figure 1-8) for its operations where it has a sorting and distribution facility. Daily flights are conducted between South Bend and Memphis, Tennessee. UPS uses its own designated apron (Figure 1-8) near the approach end of Runway 27L on the north side of the runway, directly adjacent to its sorting and distribution center. UPS conducts daily cargo flights between South Bend and Louisville, Kentucky. Both cargo operators conduct flights using Boeing 757 aircraft, but larger widebody aircraft such as the Boeing 767 and Airbus A300 series aircraft also conduct operations at SBN.

Table 1-11: FBO Services and Amenities

FBO	Services and Amenities
Atlantic Aviation	Fueling
	Aircraft servicing/storage
	Charter services
	Internet café
	Conference room
	De-icing
	Pilot's lounge
	Large aircraft ramp/heated hangar storage
	Air stairs
	Crew cars
	Rental cars
	Wi-Fi – in facility & on ramp
Corporate Wings	Fueling
	Lavatory service
	Potable water
	Quick-turn service
	Courtesy transportation
	Ramp-side vehicle access
	De-icing and anti-icing
	Catering
	Concierge service
	Customs and immigration clearance
	Indoor parking for passenger vehicles
	Heated hangar
	Passenger lobby
	Pilot lounge
	Restrooms
	Flight planning center
	Business center
	Office space
	Conference room
	Wi-Fi service

Source: Atlantic Aviation; Corporate Wings

1.8.9 Aircraft Storage

Aircraft storage at SBN is accommodated by T-hangars and corporate hangars (**Figure 1-14**). Hangars are enclosed structures for the parking, servicing, and maintenance of aircraft and are designed for the protection of aircraft from environmental elements such as wind, rain, snow, ice, dust, and shelter-seeking small animals and birds. Most aircraft hangar structures are either box-style or T-style designs. Box-style hangars have a rectangular or box-shaped building footprint that range in size from structures that can house one or two single-engine aircraft to those capable of accommodating multiple jet aircraft. T-style hangars, also known as T-hangars, are a series of small, interconnected single-engine aircraft hangars with footprints in the shape of a "T." Box-style hangars are most often constructed for multi-engine and jet aircraft, while T-hangars are a popular covered storage option for multi- and single-engine aircraft. Several hangars are located on the north airfield adjacent to Taxiway T. The box-style hangars are situated on the corporate aircraft ramp on the north side of Taxiway T, and the T-hangars are found on the south side.

Figure 1-14: Aircraft Hangar Locations

Source: Mead & Hunt, Inc. (2021)

1.8.10 Airport Maintenance

Airport maintenance involves the activities necessary for the day-to-day operation of SBN, such as snow removal, landscaping, repairs to airfield surface pavements, and repairs to the airport terminal building. SBN's airfield maintenance facility for vehicles, equipment, and personnel is on the north side of the airfield at the western end of Lathrop Street. The 33,256-square-foot facility features storage and service areas for equipment, vehicle bays, workspaces, and personnel areas for Airport maintenance staff. Additional maintenance and storage buildings near the airfield maintenance facility include the north storage building, paint building, and sand storage building. A terminal maintenance building is between the approach end of Runway 36 and the terminal building.

SBN uses several pieces of equipment for snow removal at the Airport. **Table 1-12** provides an inventory of this equipment.

Table 1-12: Snow Removal Equipment

Equipment Type	Year
Blowers	
Ford, Jet Air	1986
Sterling Truck Co., Air Blower	2021
Plows	
Stewart Stevenson, Rotary Plow	2000
RPM Tech, Rotary Plow	2000
Oshkosh, Plow Truck	2008
Oshkosh, Plow Truck	2008
Mack, Plow Truck/Material Spreader	1982
Brooms	
Oshkosh Runway Broom	1990
Oshkosh Runway Broom	1996
Oshkosh Runway Broom	2002
Oshkosh Runway Broom	2008
Oshkosh Runway Broom	2008
Multi-Function Units	
M-B Companies MB5 (All-in-One Plow, Broom, and Forced Air Blowers)	2021
M-B Companies MB5 (All-in-One Plow, Broom, and Forced Air Blowers)	2021

Source: St. Joseph County Airport Authority (2021)

In addition to this equipment, SBN uses various trucks, plows, backhoes, forklifts, lawn mowers, and other machinery for landscaping and general maintenance at the Airport.

1.8.11 Fuel Facilities

Airports store fuel for aircraft, airport vehicles, and ground service equipment in above ground or underground tanks that can be located on or off airport property. These tanks may be co-located within a fuel farm, which is a consolidated location of bulk fuel storage and equipment or found individually. SBN's fuel farm, which the Airport owns and leases to the FBOs, is northwest of the intersection of North Sheridan Street and Progress Drive. The fuel farm consists of the following above ground tanks:

- Five 30,000-gallon tanks containing Jet-A fuel
- Two 15,000-gallon tanks containing 100 low lead (LL) fuel
- One 6,000-gallon tank containing diesel fuel
- One 6,000-gallon tank containing unleaded gasoline
- Two 12,000-gallon tanks containing Jet-A fuel
- One 1,000-gallon tank containing unleaded gasoline
- One 1,000-gallon tank containing off-road diesel fuel

In addition to the fuel farm, there are three additional above ground fuel tanks located on SBN. Two 12,000-gallon fuel tanks used for Jet-A bulk storage are on the easternmost corporate apron north of Taxiway T. A 12,000-gallon tank on the LECO Corporation's apron between Corporate Wings' facility and the UPS Apron is used for Jet-A bulk storage. **Figure 1-15** shows SBN's fuel facilities.

1.8.12 Public Safety Building

SBN's Public Safety Building is a 19,556-square-foot facility located southwest of the commercial airline terminal building near the Runway 36 threshold. The Public Safety Building houses the SJCAA's Department of Public Safety, which is responsible for police, fire, and first response medical services at the Airport in addition to providing Aircraft Rescue and Fire Fighting (ARFF) services for aircraft operations. SBN holds a Part 139 operating certificate, meeting the requirements of a Class I airport capable of serving scheduled and unscheduled operations of small and large air carrier aircraft. The Airport meets ARFF Index B requirements for firefighting equipment and fire extinguishing agents. **Table 1-13** provides information on SBN's ARFF equipment.

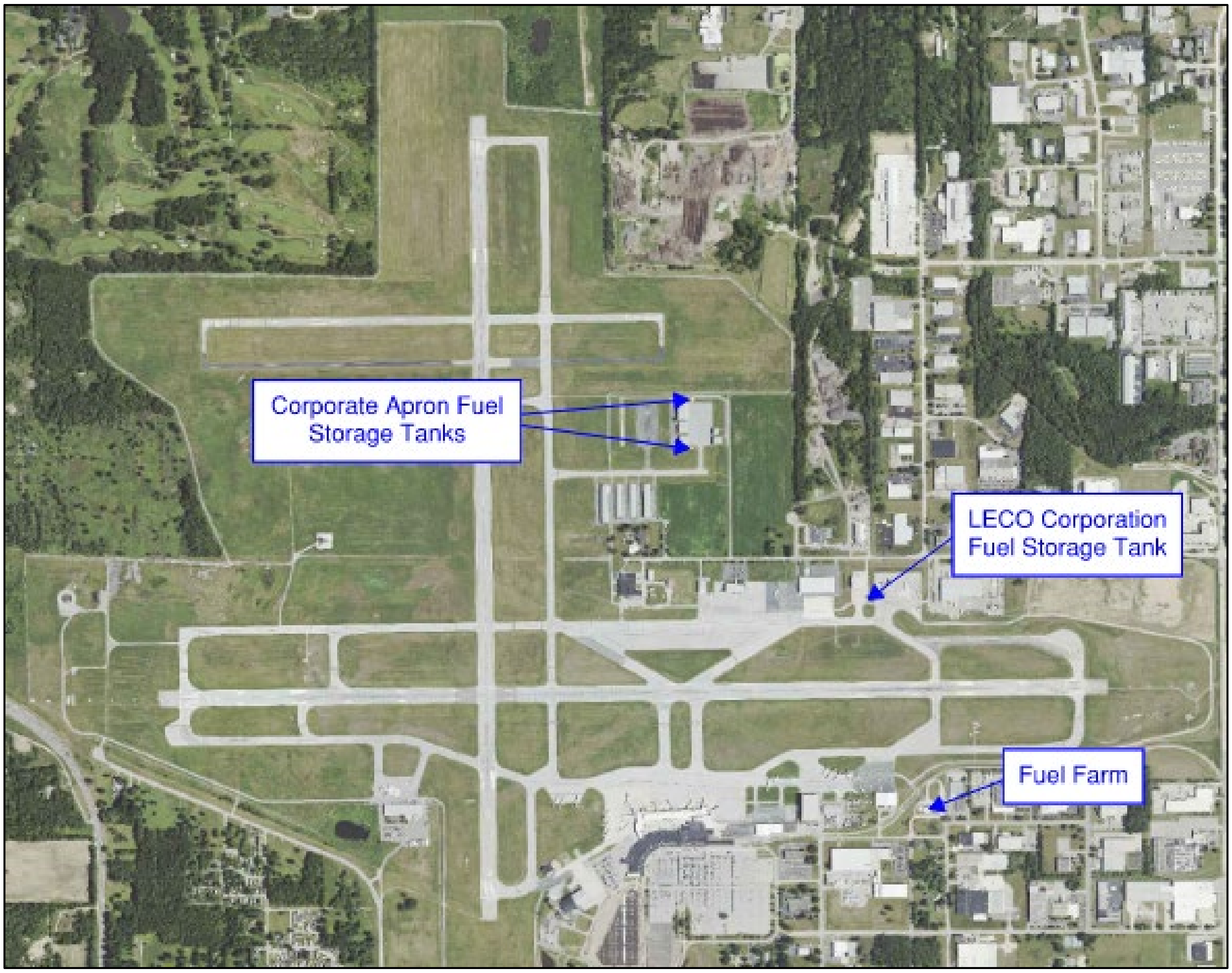
Table 1-13: Aircraft Rescue and Fire Fighting Equipment

Vehicle	Year
Oshkosh Global Striker 1500-Gallon Fire Truck	2019
Oshkosh Legacy Striker 1500-Gallon Fire Truck	2008
Oshkosh T-1500S Fire Truck (Reserve)	1996
Spartan / Wolverine Rescue, Medical, Command Vehicle	1990

Source: St. Joseph County Airport Authority (2021)

In addition to providing storage for SBN's ARFF vehicles, the Public Safety Building has space for personnel, such as restroom and shower facilities, a training room, fitness area, day room / kitchen area, sleeping quarters, and offices. Storage space for equipment and raw materials is also provided.

Figure 1-15: Fuel Facilities



Source: Mead & Hunt, Inc. (2021)

1.9 Airspace

In addition to information that was collected on physical infrastructure elements, an inventory was taken of the airspace surrounding SBN, which included information on the classification of airspace as designated by the FAA. The following section provides a summary of these airspace components.

1.9.1 FAA Airspace Classification

Controlled airspace is an airspace of defined dimensions within which air traffic control (ATC) service is provided to flights operating under Instrument Flight Rules (IFR) and Visual Flight Rules (VFR) in accordance with the airspace classification. Within the controlled airspace, all aircraft operators are subject to certain pilot qualifications, operating rules, and equipment requirements. Controlled airspace in the United States is classified according to the following categories.

Class A Airspace Area

Class A Airspace is located between the altitudes of 18,000 feet and 60,000 feet mean sea level (MSL), including the airspace overlying the waters within 12 nautical miles of the coast of the 48 contiguous States and Alaska. Unless otherwise authorized, all aircraft must operate under IFR.

Class B Airspace Area

Class B Airspace is located between ground level and 10,000 feet MSL surrounding the busiest airports in terms of airport operations or passenger enplanements. Class B airspace consists of a surface area and two or more layers and is designed to contain all published instrument procedures. An ATC clearance is required for all aircraft to operate in the area, and all aircraft that are cleared receive separation service within the airspace.

Class C Airspace Area

Class C Airspace is airspace from the surface to 4,000 feet above the airport elevation surrounding airports that have an operational control tower, are serviced by a radar approach control, and have a certain number of IFR operations or passenger enplanements. Class C Airspace is individually tailored with a five-nautical-mile radius core from the surface to 4,000 feet above airport elevation and a 10-nautical-mile radius shelf extending from 1,200 feet MSL to 4,000 feet above airport elevation. Two-way radio communications with the ATC facility providing air traffic service must be established prior to entering the airspace and must be maintained while within the airspace.

Class D Airspace Area

Class D Airspace is airspace from the surface to 2,500 feet above the airport elevation surrounding airports with an operational control tower. Airspace is individually tailored and will contain instrument approach procedures when they are published. Arrival extensions for instrument approach procedures may be Class D or Class E airspace. Unless authorized, aircraft must establish two-way radio communications with the ATC facility providing air traffic services prior to entering the airspace and must maintain those communications while in the airspace. No separation services are provided for VFR aircraft.

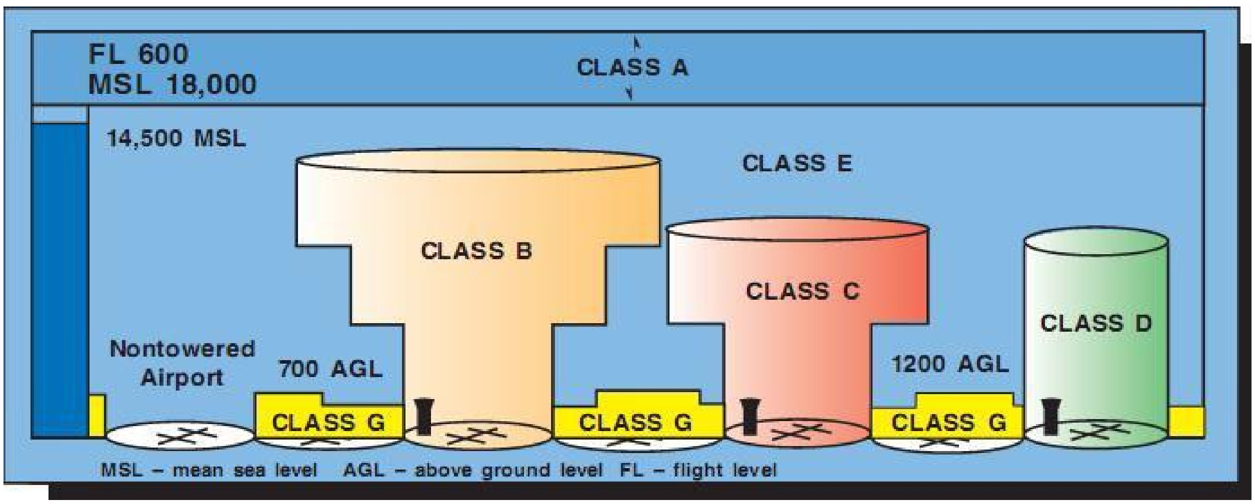
Class E Airspace Area

Class E Airspace is airspace that is not classified as A, B, C, or D, and is general controlled airspace. It starts at the surface, 700 feet above ground level (AGL), or 1,200 feet AGL, and extends to the overlying airspace, which is generally Class A airspace at 18,000 feet MSL. Aircraft operating under IFR are required to communicate with ATC while within Class E airspace; aircraft operating under VFR are not required to contact ATC while in Class E Airspace.

Class G Airspace Area

Class G Airspace is airspace that has not been designated as Class A, Class B, Class C, Class D, or Class E airspace. It is located between ground level up to an altitude of 14,500 feet MSL and is generally assigned from ground level to an altitude of 1,200 feet MSL. This class of airspace is uncontrolled because it is located around large, remote areas and does not require aircraft operating within it to contact ATC. **Figure 1-16** depicts the six classifications of airspace.

Figure 1-16: Airspace Classifications



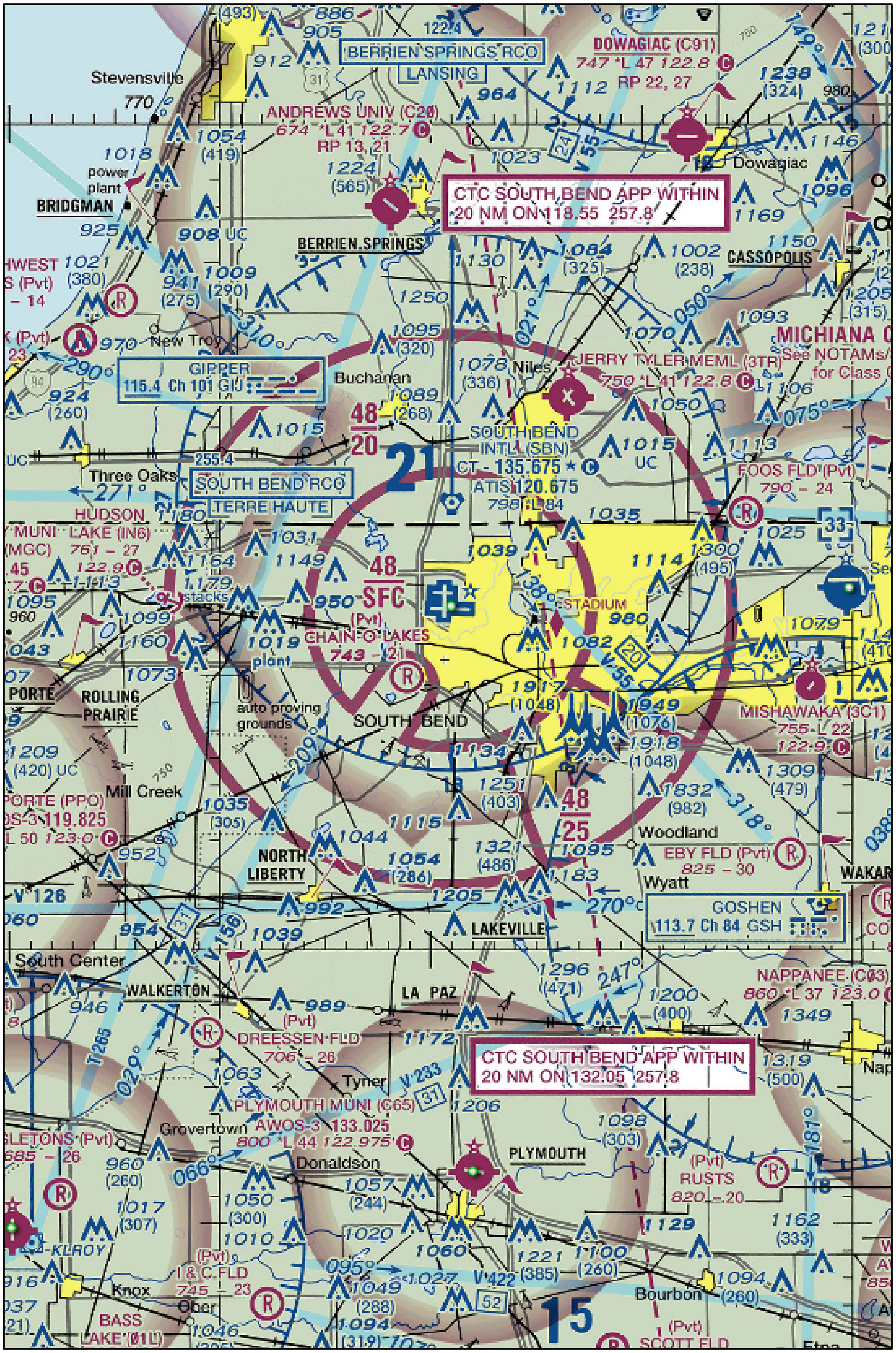
Source: Federal Aviation Administration

1.9.2 SBN Airspace

SBN is located under Class C airspace, as shown in **Figure 1-17**, and referred to as Michiana Class C. It is effective every day from 5:30 a.m. to midnight, except Saturdays, when the hours are 5:30 a.m. to 11:45 p.m. Outside of those times, the Michiana Class C airspace operates as Class E airspace.

The Class C inner ring has a five-nautical mile radius and reaches from the surface to 4,800 feet MSL. A portion to the southwest of SBN is cut out to permit operations at Chain-O-Lakes, a private grass airstrip. The Class C airspace above Chain-O-Lakes starts at 2,000 feet MSL.

Figure 1-17: SBN Sectional Chart



Source: SkyVector.com

The Class C outer ring has a 10-nautical mile radius and starts at 2,000 feet MSL (with one exception) and extends to 4,800 feet MSL. The exception is a portion in the southeast that starts at 2,500 feet MSL to accommodate VFR operations around several radio towers taller than 1,000 feet. Beneath the outer ring is Class E airspace that extends down to 700 feet AGL, with it extending down to 1,200 feet AGL in areas near the outer periphery of the Class C, denoted by the magenta-shaded boundaries on Figure 1-17.

Beyond the Class C airspace is predominately Class E airspace starting at 1,200 feet AGL, or 700 feet AGL inside the magenta shaded boundaries shown on Figure 1-17. Below the Class E airspace is Class G airspace to the surface.

There is also Class D airspace that butts up against the east side of the SBN Class C airspace. Depicted in Figure 1-17 with a dashed blue line, this is Elkhart Municipal Airport's Class D airspace that extends from the surface to 3,300 feet MSL. It is in effect when Elkhart Municipal's air traffic control tower (ATCT) is operational, which occurs from 7:00 a.m. to 9:00 p.m. on weekdays, and from 8:00 a.m. to 6:00 p.m. on weekends. At other times, the airspace is Class G from the surface up to 700 feet AGL, and Class E above that.

1.10 Part 77 Surfaces

14 Code of Federal Regulations (CFR) Part 77 establishes standards for determining which structures pose potential obstructions to air navigation. Specific areas of airspace are geometrically defined in the airport environs; these areas of airspace are defined by established "imaginary surfaces." Consequently, all objects are discouraged from penetrating those surfaces and protruding into that volume of airspace. The imaginary surfaces outlined in Part 77 include:

- Primary surface
- Transitional surface
- Horizontal surface
- Conical surface
- Approach surface

1.10.1 Primary Surface

The primary surface is longitudinally centered on a runway. When the runway has a hard surface, the primary surface extends 200 feet beyond each end of the runway. The width of a primary surface ranges from 250 feet to 1,000 feet, depending on the existing or planned approach, as well as the runway type (i.e., visual, non-precision, or precision). The existing primary surface for Runway 9R/27L is 1,000 feet wide and 500 feet wide for Runway 9L/27R and Runway 18/36.

1.10.2 Transitional Surface

Transitional surfaces extend outward and upward at right angles to the runway centerline at a slope of 7 feet horizontally to 1 foot vertically (i.e., 7:1) from the sides of the primary and approach surfaces. The transitional surfaces extend upward and outward to where they intercept the horizontal surface at a height of 150 feet above the established airport elevation.

1.10.3 Horizontal Surface

The horizontal surface is a horizontal plane 150 feet above the established airport elevation (i.e., 798.3 feet MSL at SBN), 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. Tangents then connect the adjacent arcs. The radius of each arc is 5,000 feet from each primary surface end for runways designated as utility or visual and 10,000 feet from each primary surface end for all other runways.

1.10.4 Conical Surface

The conical surface is a surface extending upward and outward from the periphery of the horizontal surface at a slope of 20 feet horizontally and 1 foot vertically (i.e., 20:1) over a horizontal distance of 4,000 feet.

1.10.5 Approach Surface

Longitudinally centered on the extended runway centerline, the approach surface extends outward and upward from the end of the primary surface. An approach surface is applied to each end of each runway based on the type of approach. The approach slope of a runway is either 20:1, 34:1, or 50:1 depending on the sophistication of the approach. The inner edge of the approach surface adjoins the primary surface and expands uniformly to a width of 1,500 feet for runways with a 20:1 approach surface, either 3,500 or 4,000 feet for runways with a 34:1 approach slope, and 16,000 feet for runways with a 50:1 approach slope. The approach surface extends for a horizontal distance of 5,000 feet for runways with a 20:1 approach slope and 10,000 feet for runways with a 34:1 approach slope. The approach surface extends for a horizontal distance of 10,000 feet for runways with a 50:1 approach slope with an additional 40,000 feet at a slope of 40:1 for all precision instrument runways.

Tables 1-14, **1-15**, and **1-16** present the dimensions of the Part 77 surfaces for SBN's runways. **Figure 1-18** illustrates a plan view graphic of the Part 77 surfaces while **Figure 1-19** presents a three-dimensional view.

Table 1-14: Runway 9R/27L Part 77 Dimensions

Surface	Dimension	
Primary Surface	Width:	1,000 feet
Approach Surface	Inner Edge:	1,000 feet
	Outer Edge:	Runway 9R: 16,000 feet Runway 27L: 16,000 feet
	Slope/Horizontal Distance:	Runway 9R: 50:1 for 10,000 feet then 40:1 for additional 40,000 feet Runway 27L: 50:1 for 10,000 feet then 40:1 for additional 40,000 feet
Transitional Surface	Slope:	7:1
Horizontal Surface	Vertical Distance:	150 feet above elevation of Airport
	Radius of arcs:	10,000 feet
Conical Surface	Slope:	20:1
	Horizontal Distance:	4,000 feet

Source: 14 CFR Part 77; SBN Airport Layout Plan

Table 1-15: Runway 9L/27R Part 77 Dimensions

Surface	Dimension	
Primary Surface	Width:	500 feet
Approach Surface	Inner Edge:	500 feet
	Outer Edge:	Runway 9L: 3,500 feet Runway 27R: 3,500 feet
	Slope/Horizontal Distance:	Runway 9L: 34:1 for 10,000 feet Runway 27R: 34:1 for 10,000 feet
Transitional Surface	Slope:	7:1
Horizontal Surface	Vertical Distance:	150 feet above elevation of Airport
	Radius of arcs:	10,000 feet
Conical Surface	Slope:	20:1
	Horizontal Distance:	4,000 feet

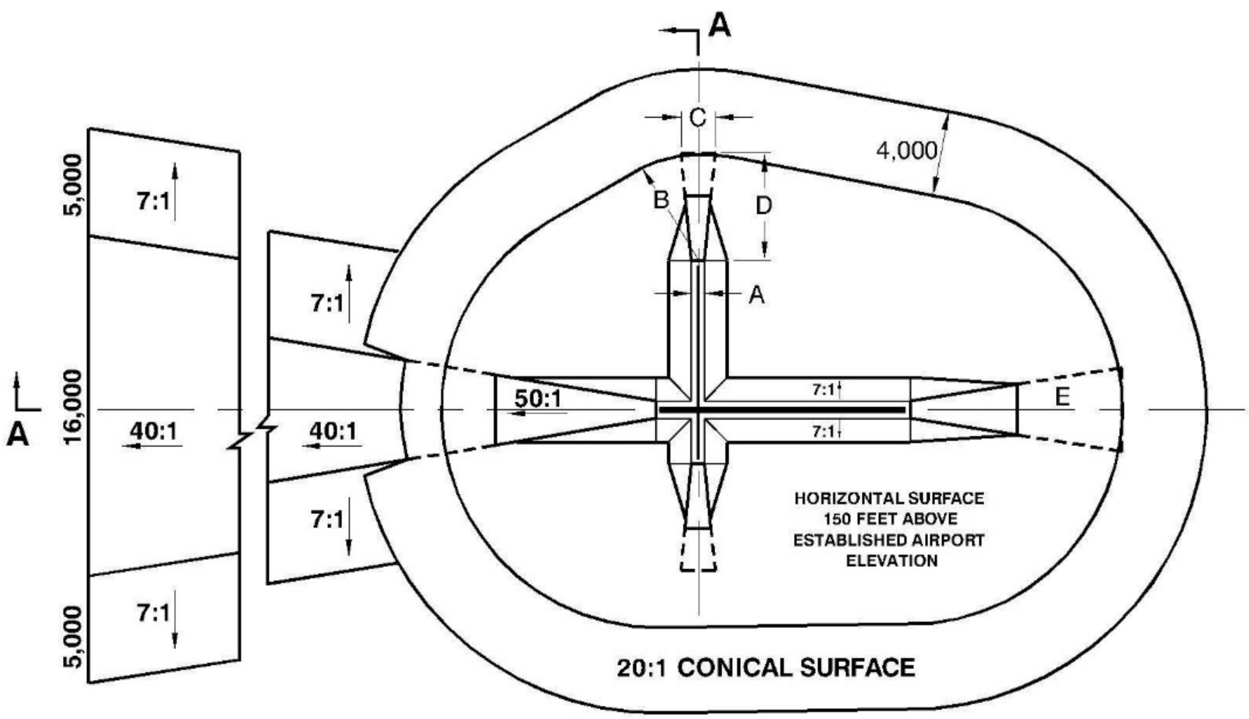
Source: 14 CFR Part 77; SBN Airport Layout Plan

Table 1-16: Runway 18/36 Part 77 Dimensions

Surface	Dimension	
Primary Surface	Width:	500 feet
Approach Surface	Inner Edge:	500 feet
	Outer Edge:	Runway 18: 3,500 feet Runway 36: 3,500 feet
	Slope/Horizontal Distance:	Runway 18: 34:1 for 10,000 feet Runway 36: 34:1 for 10,000 feet
Transitional Surface	Slope:	7:1
Horizontal Surface	Vertical Distance:	150 feet above elevation of Airport
	Radius of arcs:	10,000 feet
Conical Surface	Slope:	20:1
	Horizontal Distance:	4,000 feet

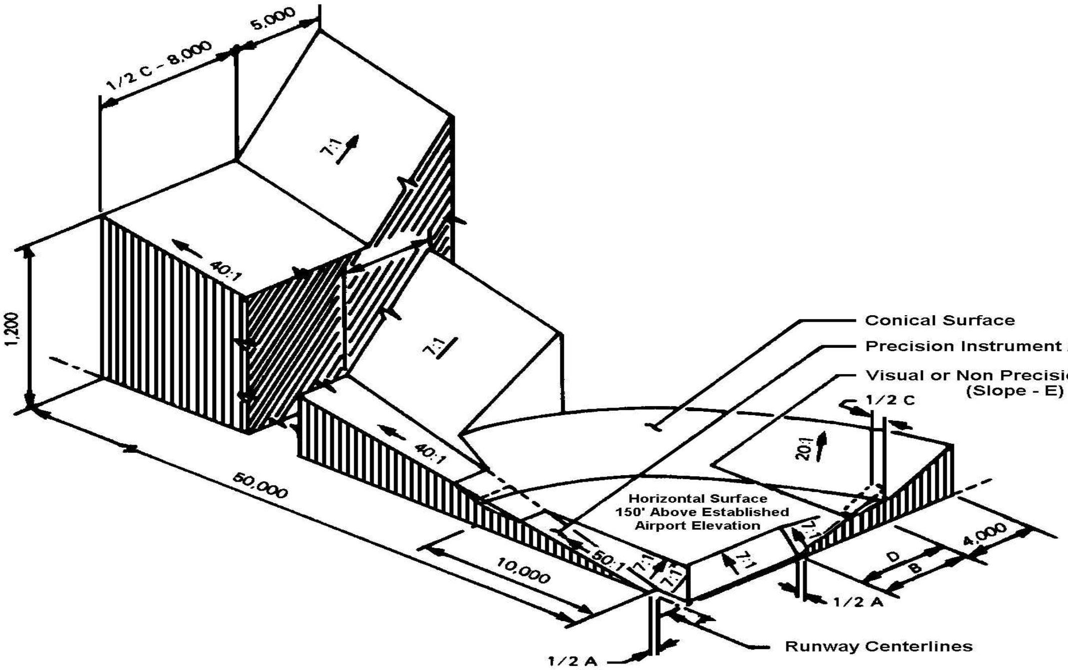
Source: 14 CFR Part 77; SBN Airport Layout Plan

Figure 1-18: Part 77 Surfaces (Plan View)



Source: 14 CFR Part 77

Figure 1-19: Part 77 Surfaces (Three-Dimensional View)



Source: 14 CFR Part 77

1.11 Air Traffic Control and Approach Procedures

The inventory effort also reviewed how airspace is controlled around SBN to gain a better understanding about how aircraft maneuver for landing, takeoff, and taxi. Information obtained included a review of the ATCT and the existing instrument approach procedures. A summary of these elements is presented in this section.

1.11.1 Airport Traffic Control Tower

The FAA staffs the SBN ATCT every day between 5:30 a.m. and midnight except Saturday when it operates from 5:30 a.m. to 11:45 p.m. (the same hours of the Michiana Class C airspace). The following discussion describes the services FAA air traffic controllers provide to flights operating into and out of SBN.

Clearance Delivery

Clearance delivery provides air traffic control instructions to flights prior to their departure. It is used at busy airports to avoid congestion on the ground control frequency. It is responsible for filing flight plans, issuing flight plan clearances, sharing en route weather information, and other pertinent information to flight crews prior to taxiing for takeoff. Flight crews communicate with SBN clearance delivery on frequency 121.9 megahertz (MHz).

Ground Control

Ground control is responsible for the safe movement of aircraft, vehicles, and personnel on taxiways and aprons located within the aircraft movement area. All aircraft, vehicles, and personnel are required to be in constant radio contact with ground control while operating within the movement area. Flight crews communicate with SBN ground control on frequency 121.7 MHz after contacting clearance delivery and prior to taxiing for their departure runway. Upon arrival, flight crews switch from the SBN tower frequency to the SBN ground control frequency once clear of the runway.

SBN ATCT

Source: SBN official Twitter account

Tower

The tower controller is responsible for the safe separation of arriving and departing aircraft from SBN. Tower controllers are contacted on frequency 135.675 MHz. When the ATCT is closed, this frequency is used by aircraft as the common traffic advisory frequency to communicate with each other and coordinate separation. Tower air traffic controllers are also typically responsible for updating the automated terminal information system, a system that continuously broadcasts local weather conditions, runway use at SBN, and other relevant aeronautical information on frequency 120.675 MHz.

Approach/Departure

Approach and departure air traffic controllers provide separation services to aircraft prior to arriving or after departing an airport. Flight crews will contact SBN departure shortly after takeoff while contact is made with SBN approach prior to entering the Class C airspace. Due to the volume of traffic at SBN, there are two frequencies for communicating with SBN approach and departure controllers. Aircraft operating north of SBN use frequency 118.55 MHz, and aircraft operating south use 132.05 MHz. **Table 1-17** summarizes the radio frequencies at SBN, and **Table 1-18** summarizes the frequencies of nearby radio NAVAIDs.

1.11.2 Approach Procedures

Approach procedures define specific maneuvers needed by aircraft to land at an airport when IFR weather conditions limit the ability of a pilot to visually identify a runway. Figures showing these approach procedures can be found in **Appendix A**. At SBN, ten approach procedures have been developed for arriving aircraft, which are as follows:

- ILS OR LOC RWY 9R
- ILS OR LOC RWY 27L
- ILS RWY 27L (SA CAT I & II)
- RNAV (GPS) RWY 9L
- RNAV (GPS) RWY 9R
- RNAV (GPS) RWY 18

- RNAV (GPS) RWY 27L
- RNAV (GPS) RWY 27R
- RNAV (GPS) RWY 36
- VOR RWY 18

Table 1-17: Airport Communications

Communications Channel	Frequency
CTAF	135.675 MHz
ATIS	120.675 MHz
ASOS	Phone: 574-251-2656
SOUTH BEND GROUND	121.7 MHz
SOUTH BEND TOWER	135.675 MHz
SOUTH BEND APPROACH/DEPARTURE	118.55 MHz; 270-099 132.05 MHz; 100-269 257.8 MHz
CHICAGO ARTCC APPROACH/DEPARTURE	124.1 MHz
CLEARANCE DELIVERY	121.9 MHz
CLASS C	118.55 MHz; 270-099 132.05 MHz; 100-269 257.8 MHz
CLASS C/S	124.1 MHz
IC	118.55 MHz
AWOS-3 at EKM (14nm E)	124.475 MHz 574-264-9002
Remarks: APCH/DEP SVC PRVDD BY CHICAGO ARTCC ON REMOTED SOUTH BEND APCH CTL FREQ 118.55 & CHICAGO ARTCC FREQ 263.1 (GOSHEN RCAG) WHEN APCH CTL CLSD.	

Source: FAA Aeronautical Information Services (2021); AirNav.com (2021)

Table 1-18: Nearby Radio Navigation Aids

Radio Navigational Aid	Frequency
GIPPER VORTAC	115.4 MHz
MISHA NDB	341 KHz
GOSHEN VORTAC	113.7 MHz
KNOX VOR/DME	115.60 MHz
SEDLY NDB	212 KHz
WEBSTER LAKE VOR	110.4 MHz
KEELER VOR/DME	116.60 MHz

Source: FAA Aeronautical Information Services (2021); AirNav.com (2021)

1.12 Summary

Information obtained during the inventory effort provides a baseline to evaluate how well existing facilities can accommodate future demand. Through this evaluation, an understanding can be gained of the infrastructure improvements that will be needed for SBN to meet the air transportation requirements of northern Indiana for the next 20 years. Completion of other study tasks such as the demand/capacity analysis, evaluation of alternatives, and capital improvement plan are also dependent upon information obtained through the inventory effort. With a history that spans nearly 100 years, SBN has continually evolved to meet the demands of its users. This master plan will serve as a guide to help SBN plan for future infrastructure development as well as strengthen its commitment to being a vital transportation hub.

Chapter 2 Projections of Aviation Demand

This chapter discusses the findings and methodologies used to project aviation demand at South Bend International Airport (SBN). The forecasts developed in this master plan provide a framework to guide the analysis for future development needs and alternatives. Guidance for development of aviation activity forecasts was found in Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5070-6B Change 2, Airport Master Plans. Guidance published by the FAA Chicago Airport Districts Office (ADO) related to forecasting and the COVID-19 pandemic was also considered in forecast development. The FAA requires that all airport planning efforts be based upon an approved forecast methodology as the resulting analysis assists in determining the facility requirements for meeting future demand.

Projections of aviation activity for SBN were prepared for the near-term (2025), mid-term (2030), and long-term (2040) timeframes. These projections are generally unconstrained and assume SBN will be able to develop the various facilities necessary to accommodate based aircraft and future operations.

The projections of aviation demand developed for SBN are documented in the following sections:

- Overview of Airport Market Area
- Trends/Issues with the Potential to Influence Future Airport Growth
- Historic and Current Aviation Activity
    - Commercial Service
    - General Aviation
    - Air Cargo
- Projections of Aviation Demand
    - Commercial Service Enplanements
    - Operations
    - Based Aircraft and Fleet Mix
- Critical Aircraft Analysis
- Summary and Comparison to the FAA Terminal Area Forecast (TAF)

There are always short- and long-term fluctuations in an airport's activity due to a variety of factors that cannot be anticipated. Actual activity that develops in future years may differ from the forecasts developed in this chapter because of changes in local conditions, the dynamics of the commercial and general aviation industry, as well as economic and political changes for the market area and the nation. Future facility improvements should be implemented as demand warrants rather than any specific point in time. This will allow SBN to respond to changes in demand, either higher or lower than the forecast, regardless of the year in which those changes take place.

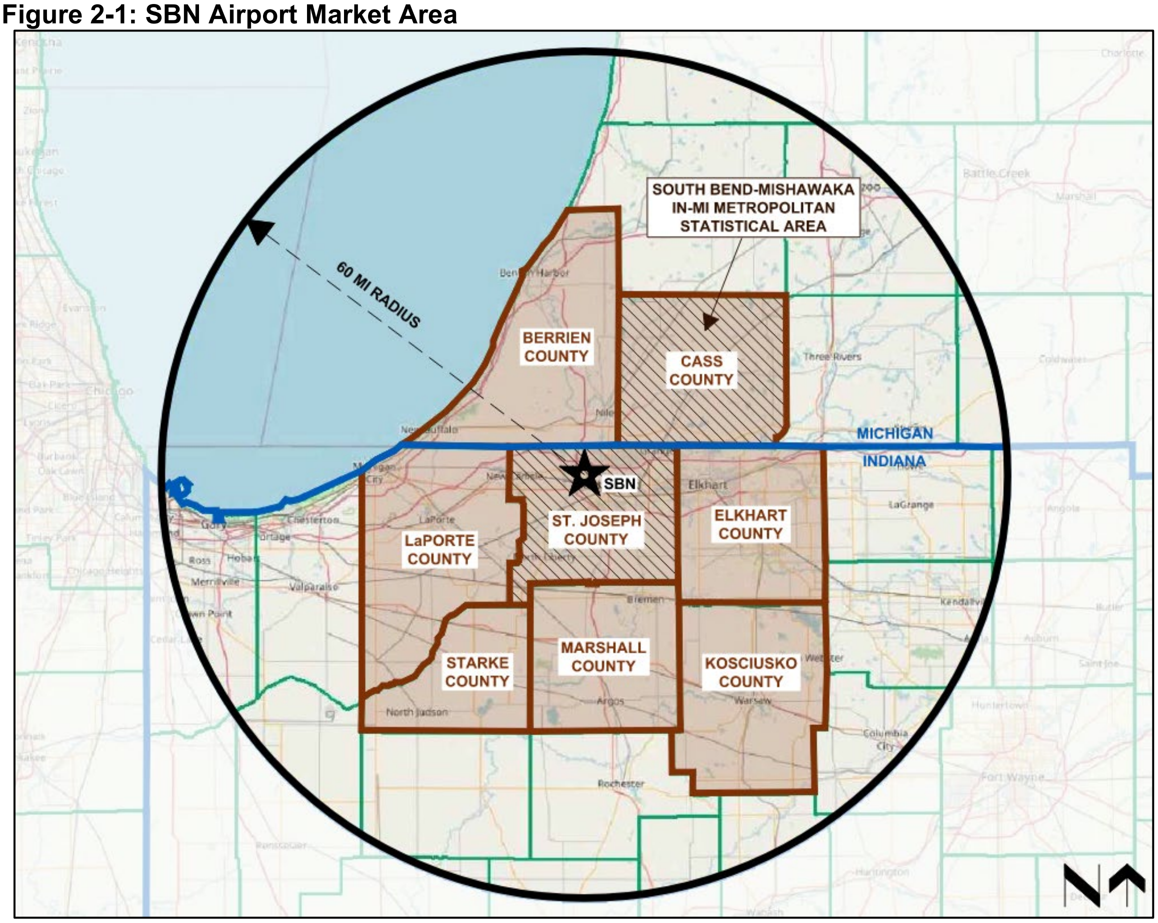
This chapter was developed during the COVID-19 pandemic, which began in early 2020. The pandemic crippled commercial service aviation and has created conditions for a global recession. This chapter includes research on U.S. economic and passenger projections that will help to make assumptions when SBN will return to its 2019 enplanement levels and includes several recovery scenarios.

2.1 Overview of the Airport Market Area

2.1.1. SBN Airport Market Area

The Airport Market Area is the geographic region served by South Bend International Airport. While there are over 2 million people located within a 60-mile radius of SBN, commercial air service demand is focused around an eight-county region known as Michiana, which has a population of 942,000 (presented in **Figure 2-1**). For this master plan, Michiana will be considered the primary market area for SBN.

Figure 2-1: SBN Airport Market Area



Source: Mead & Hunt, Inc., 2021

SBN is the only airport in this market area that has scheduled commercial passenger service. It is assumed that SBN will remain the only commercial service airport in the region throughout the forecast period. Airport management noted that passengers located in the Airport Market Area use several other airports outside of the 60-mile radius for cheaper fares, more convenient schedules, or nonstop service options including airports in Chicago, Detroit, Indianapolis, Grand Rapids, Kalamazoo, and Fort Wayne.

There are 11 public-use general aviation airports located in the Airport Market Area. The largest general aviation airports in the Airport Market Area include: Elkhart Municipal, La Porte Municipal, Warsaw Municipal, Goshen Municipal, and Southwest Michigan Regional. It is assumed that SBN will continue to serve the needs of general aviation users located in the Airport Market Area, specifically corporate and general aviation users in St. Joseph County.

2.1.2. Regional Demographics

Socioeconomic characteristics are often collected during the airport planning process and examined to derive an understanding of the dynamics of historic and projected growth within an airport's market area. The economy of the SBN Market Area plays a vital role and has a direct impact on long-term passenger and air cargo demand at SBN. In general, there is a correlation among areas with greater populations, employment, personal income per capita, and Gross Regional Product, and a strong aviation service demand. Specifically, these key socioeconomic indicators or drivers tend to have an influence on passenger enplanements and their future projections.

The COVID-19 pandemic, which began in the U.S. in March 2020, is leading to a prolonged economic recovery. While dropping from its peak in April 2020, unemployment will likely remain above pre-pandemic levels throughout 2021 as hiring is anticipated to remain slow. Nearly every industry is impacted by the pandemic, and most are facing a great deal of uncertainty, including those located in the Airport Market Area in manufacturing, healthcare, education, finance, hospitality and tourism, and research and development. Socioeconomic projections developed pre-COVID may not be as realistic due to the pandemic and recession. However, for the purpose of this master plan, assumptions are made that the economy in the Airport Market Area will recover to pre-COVID levels by the end of 2022, similar to the global recovery expected[1], and grow, albeit likely at a slower rate than once projected.

The following sections analyze the historic growth patterns of the socioeconomic variables for the SBN Market Area versus the state of Indiana and the United States and then presents the projections for growth. A summary of historic and projected socioeconomic trends for the Airport Market Area and the Combined Statistical Area (CSA), when data was unavailable for the Airport Market Area, is presented below. The projections were derived from the most recent edition of Woods & Poole Economics' *Complete Economic and Demographic Data Source (CEDDS*), which was published in August 2020 with projected data from 2019 to 2050. Woods & Poole confirmed that these projections considered the impact of the COVID pandemic, but it did not shift their long-term projections based on what was known at the date of publication.

[1] *FAA Aerospace Forecast Fiscal Years 2021–2041*, IHS Markit

Population

Between 1990 and 2019, the population of the Airport Market Area grew at a compound average growth rate (CAGR) of 0.34 percent per year. Between 2010 and 2019, growth slowed to 0.11 percent per year, on average. In 2019, it was estimated that the Airport Market Area population was 942,000. St. Joseph County accounted for nearly 29 percent of the Airport Market Area population in 2019. Kosciusko and Elkhart counties have seen the greatest growth in population, up 0.67 percent and 0.96 percent per year on average respectively, since 1990. Five of the Airport Market Area counties have experienced declines in population over the last nine years. This data, reported by Woods & Poole, Economics from the U.S. Census, is presented in **Table 2-1**.

According to Woods & Poole Economics, the Airport Market Area population is projected to grow 0.13 percent per year on average between 2020 and 2040. By 2040, the eight-county Airport Market Area is expected to have a population of 969,110, an increase of nearly 25,000 people over current levels. In comparison, population growth of the state of Indiana and the U.S. overall is expected to outpace the market area, experiencing a CAGR of 0.31 percent and 0.59 percent, respectively, between 2020 and 2040.

Table 2-1: Historic Population by SBN Market Area County

County	1990	2000	2010	2019	2019 % of Total	CAGR[1] 1990-2019	CAGR[1] 2000-2019	CAGR[1] 2010-2019
St. Joseph, IN	247,510	265,920	266,914	271,826	28.9%	0.32%	0.12%	0.20%
Elkhart, IN	156,382	183,525	197,444	206,341	21.9%	0.96%	0.62%	0.49%
Berrien, MI	161,347	162,644	156,742	153,401	16.3%	-0.17%	-0.31%	-0.24%
LaPorte, IN	107,253	110,154	111,455	109,888	11.7%	0.08%	-0.01%	-0.16%
Kosciusko, IN	65,379	74,201	77,341	79,456	8.4%	0.67%	0.36%	0.30%
Cass, MI	49,495	51,091	52,245	51,787	5.5%	0.16%	0.07%	-0.10%
Marshall, IN	42,245	45,248	46,999	46,258	4.9%	0.31%	0.12%	-0.18%
Starke, IN	22,843	23,532	23,362	22,952	2.4%	0.02%	-0.13%	-0.20%
Total	**852,454**	**916,315**	**932,502**	**941,909**	**100.0%**	**0.34%**	**0.15%**	**0.11%**

Source: U.S. Census Bureau; Woods & Poole Economics, Inc.
Notes: [1] CAGR = Compound Average Growth Rate

Employment

Between 1990 and 2019, employment in the Airport Market Area grew at an average annual rate of 0.57 percent. Over the last nine years (2010-2019), employment grew at greater average annual rate of 1.3 percent. This growth was fueled largely by employment increases in Elkhart County. In 2019, 558,500 people were employed in the Airport Market Area (See **Table 2-2**).

Projections made by Woods & Poole Economics call for positive long-term employment growth despite the impact of the COVID-19 pandemic on current employment levels. Airport Market Area employment is anticipated to grow at 0.48 percent per year on average from 2020 to 2040. Employment in Indiana is projected to grow 0.75 percent annually while the U.S. is projected to experience an average annual growth of 1.17 percent over the next 20 years.

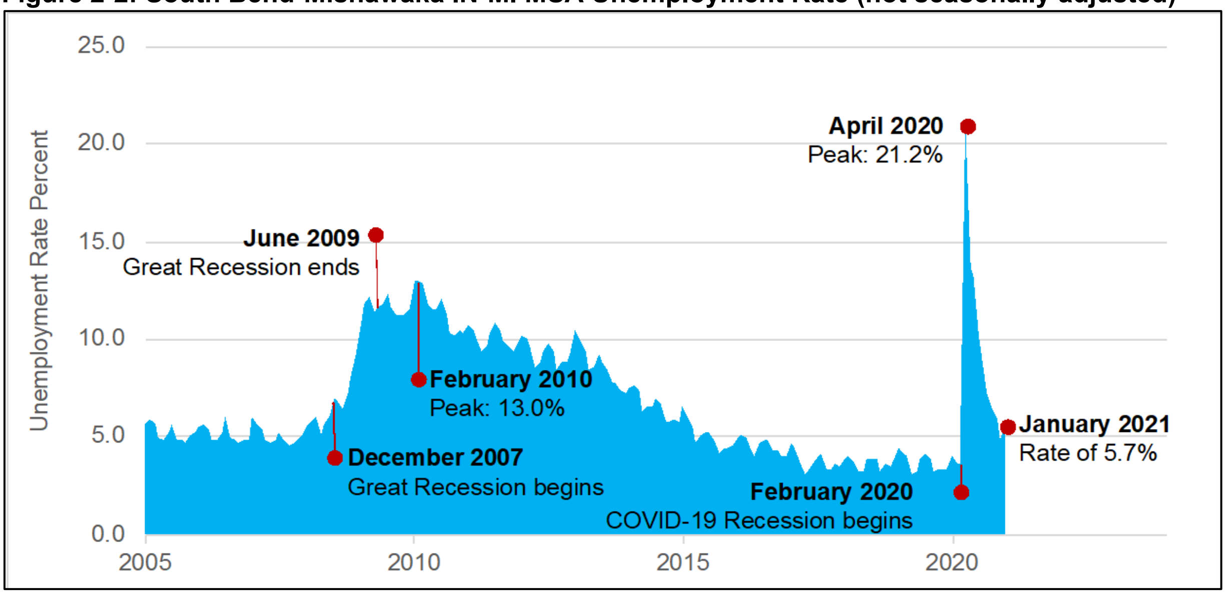
Table 2-2: Historic Employment by Market Area County

County	1990	2000	2010	2019	2019 % of Total	CAGR[1] 1990-2019	CAGR[1] 2000-2019	CAGR[1] 2010-2019
St. Joseph, IN	139,395	160,078	149,665	164,079	29.4%	0.56%	0.49%	1.03%
Elkhart, IN	117,792	147,775	126,843	161,355	28.9%	1.09%	1.27%	2.71%
Berrien, MI	82,670	90,416	80,301	82,752	14.8%	0.00%	0.16%	0.33%
LaPorte, IN	53,684	59,905	53,238	53,246	9.5%	-0.03%	0.00%	0.00%
Kosciusko, IN	36,850	43,948	44,469	50,406	9.0%	1.09%	0.66%	1.40%
Cass, MI	14,283	17,028	14,280	15,622	2.8%	0.31%	0.47%	1.00%
Marshall, IN	22,219	25,902	23,189	24,314	4.4%	0.31%	0.25%	0.53%
Starke, IN	6,580	6,932	6,776	6,722	1.2%	0.07%	-0.04%	-0.09%
Total	**473,473**	**551,984**	**498,761**	**558,496**	**100.0%**	**0.57%**	**0.60%**	**1.26%**

Source: U.S. Department of Commerce; Woods & Poole Economics, Inc.
Notes: [1] CAGR = Compound Average Growth Rate

The unemployment rate (non-seasonally adjusted) for the Airport Market Area in 2019 was 3.6 percent. Comparatively, the unemployment rates for Indiana and the U.S. in 2019 were 3.3 percent and 3.7 percent, respectively. After 10 years of declining rates, unemployment in the Airport Market Area, state, and entire country rose in 2020 due to the COVID-19 pandemic. After peaking in April 2020, by December, the U.S. unemployment rate was 6.7 percent, while the rate in the South Bend-Mishawaka, IN-MI Metropolitan Statistical Area (MSA) was lower at 4.9 percent. **Figure 2-2** presents the changes in unemployment in the MSA since 2005. As shown, unemployment associated with 2007-2009 Great Recession slowly fell each year since its peak in 2010. The recovery associated with the impact of the pandemic will look different with the sharp peak occurring in April 2020.

Figure 2-2: South Bend-Mishawaka IN-MI MSA Unemployment Rate (not seasonally adjusted)

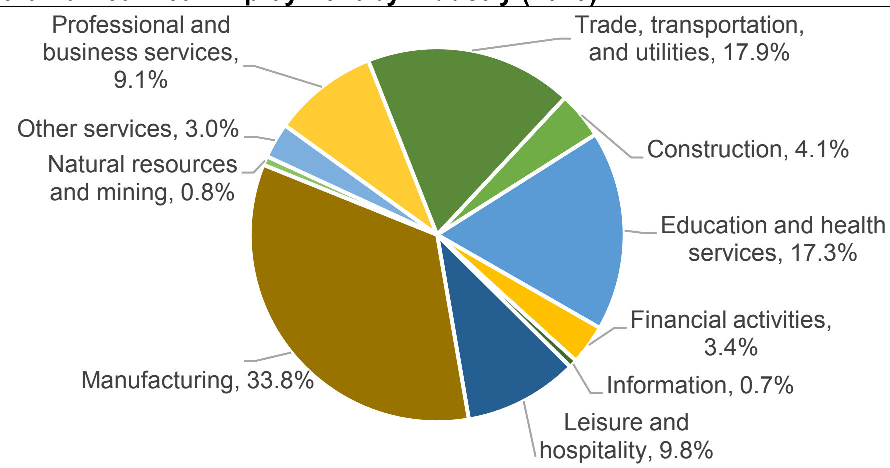


Source: FRED Economic Data; U.S. Bureau of Labor Statistics

Industry Mix

In 2019, 61 percent of the private sector jobs in the Airport Market Area were in service-providing industries, while goods-producing jobs accounted for 39 percent of the Airport Market Area jobs. As shown in the **Figure 2-3**, manufacturing accounts for the highest percentage of private sector jobs in 2019. As shown in **Table 2-3**, the largest manufacturing employers in the region are focused on the manufacture of recreational vehicles (RVs) including Thor Industries, Forest River, Lippert Components, Patrick Industries, and Jayco. In December 2020, electric vehicle manufacturer, ELMS, announced plans to manufacture electric delivery vans that would be made in Mishawaka at the closed AM General plant. This new facility could bring several thousand additional jobs to the region.

Figure 2-3: Airport Market Area Employment by Industry (2019)



Source: U.S. Bureau of Labor Statistics

Table 2-3: Top Employers in the SBN Airport Market Area

Company	County	Number of Employees
Thor Industries	Elkhart	14,000
Forest River	Elkhart	10,000
University of Notre Dame	St. Joseph	8,466
Lippert Components Manufacturing	Elkhart	7,394
Quality Dining	St. Joseph	7,176
Patrick Industries	Elkhart	6,889
HMR Acquisition Company	St. Joseph	5,010
Whirlpool Corporation	Berrien	2,700
Lakeland Hospitals at Niles and St. Joseph	St. Joseph	2,250
Andrews University	Berrien	2,100
Saint Joseph Regional Medical Center	St. Joseph	2,000
Jayco	Elkhart	1,550
Towne Holdings	St. Joseph	1,456
Elkhart General Hospital	Elkhart	1,300
Supreme Corporation	Elkhart	1,300
Beacon Medical Group	St. Joseph	1,200
Gulf Stream Coach	Elkhart	1,064
H-C Liquidating	Elkhart	1,025

Source: Airport Management; EDC of Elkhart County

The regional economy is becoming increasingly more diversified. In addition to manufacturing, other key industry sectors include education, healthcare, restaurant management, transportation, government, business services, and e-commerce. The University of Notre Dame is the largest employer in St. Joseph County and Andrews University in Berrien County is also a major employer. With the cost of doing business well below the U.S. average, due to low rental rates and taxes, the Market Area is a prime location for companies looking to expand or relocate.

Income

According to the U.S. Bureau of Economic Analysis, between 2000 and 2019, personal income per capita (PIPC) in the South Bend-Elkhart-Mishawaka, IN-MI CSA rose at an average annual growth rate of 3.0 percent. The CSA's 2019 per capita income, approximately $48,035, was less than the $48,700 per capita income than the state of Indiana and $56,500 for the U.S. This is likely due to the comparatively lower cost of living than the state average and the U.S. average. Woods & Poole Economics projects PIPC of the CSA to grow at a CAGR of 4.4 percent between 2018 and 2040. This projected growth outpaces the historic PIPC growth of the CSA and tracks closely with the growth that is projected to be experienced by the state and the U.S. A growing PIPC is related to the ability to attract employees to the region and drives an increase in housing prices.

Gross Regional Product (GRP)

GRP measures the size, net wealth, and productivity of a regional economy and is the regional equivalent of the U.S. gross domestic product (GDP). The South Bend-Elkhart-Mishawaka, IN-MI CSA GRP grew at 1.8 percent CAGR between 1990 and 2018, compared to 2.3 percent in Indiana, and 2.6 percent in the U.S. GRP in the CSA is projected to grow at a CAGR of 1.1 percent through 2040, slightly lower than the growth anticipated for the state and U.S overall. This growth indicates continued economic health of the Airport Market Area.

Cost of Living

The region has consistently been one of the most cost-effective places to live in the U.S. with the MSA's cost of living being 22 percent less than the national average. Factors contributing to this include affordable housing, low cost of health care, and high quality of life. These factors help the area attract and retain new residents and employees.

Projections of Socioeconomic Indicators

Table 2-4 displays the comparison of growth rates of the socioeconomic variables between the historical and projected analysis. Despite slow projected population growth, Airport Market Area/CSA employment, income, and economic growth are anticipated to experience stronger rates of growth, albeit lower than those anticipated at the state and national level. This growth mirrors the growth expected for many midwestern metropolitan areas, including Detroit, Chicago, Akron, Dayton, Milwaukee, and Louisville.

Table 2-4: Comparison of Socioeconomic Growth Rates

	Historic 1990-2018	Projected 2018-2040
South Bend Region[1]		
Total Population (SBN Market Area)	0.3%	0.1%
Total Employment (SBN Market Area)	0.6%	0.5%
Personal Income Per Capita (CSA)	3.6%	4.4%
Gross Regional Product (CSA)	1.8%	1.1%
Indiana		
Total Population	0.7%	0.3%
Total Employment	0.9%	0.8%
Personal Income Per Capita	3.5%	4.5%
Gross State Product	2.3%	1.5%
United States		
Total Population	1.0%	0.6%
Total Employment	1.3%	1.2%
Personal Income Per Capita	3.7%	4.6%
Gross Domestic Product	2.6%	2.0%

Source: U.S. Census Bureau; U.S. Department of Commerce; Woods & Poole Economics, Inc.
Notes: [1] Population and employment is for the eight-county Airport Market Area, while personal per capita income and gross regional product is for the South Bend-Elkhart-Mishawaka CSA.

2.2 Trends/Issues with the Potential to Influence Future Airport Growth

There are several factors that may influence aviation activity which are independent of airport activity. It is worthwhile to review outside influences to determine how they may impact future growth. These factors include the COVID-19 pandemic, national aviation trends, and local factors.

2.2.1. COVID-19 Pandemic

The COVID-19 pandemic caused a national and global health crisis in 2020 and into 2021. As a result of lockdowns, stay-at-home orders, and other restrictions, the pandemic has caused a severe shock to the economy as well as air travel. Unlike previous crises experienced in the aviation industry including 9/11 and the Great Recession, both aviation demand and supply have been impacted due to passenger safety concerns and the suspension and restrictions of flights. Airlines made deep capacity cuts and grounded fleets. Nearly all aspects of corporate travel were suspended.

While COVID-19 vaccines were aggressively rolled out in early 2021, it is becoming clear that the drivers of air travel will not likely be returning to normal in 2021. More cases of COVID-19 continue to be reported as of the writing of this chapter (May 2021). However, airline travel is experiencing a rebound, but demand for corporate and international air travel continue to lag. In May 2021, U.S. airline passenger volumes were 29 percent below pre-pandemic levels and airline departures were down 25 percent.[2]

The rapid decline in demand has deeply impacted airline revenues, and it will take years to be able to retire the billions of dollars in debt that has been accumulated. According to Airlines for America, U.S. airlines expect cash burn to persist through much of 2021, so further cost reductions are vital to their financial recovery.

[2] Airlines for America, *Tracking the Impacts of COVID-19*, updated May 26, 2021.

Transportation Security Administration (TSA) checkpoint volumes provide a snapshot of recent activity by airport. As shown in **Table 2-5**, monthly passenger declines at SBN fared better than the declines experienced by the U.S. as a whole during the pandemic. For the entire year, throughput levels for all U.S. airports were down 61 percent from 2019 and were just 39 percent of 2019 levels, while 2020 throughput at SBN was 51 percent of 2019 annual levels. The declines at SBN for each month since the COVID-19 pandemic started were not nearly as great as those experienced at U.S. airports.

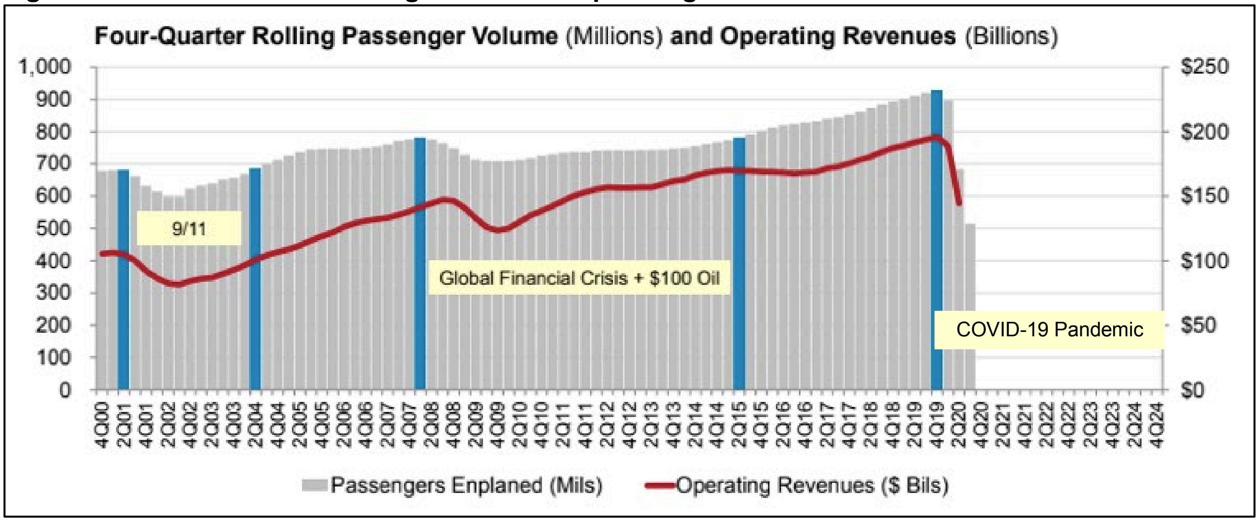
Table 2-5: TSA Monthly Traveler Throughput

	U.S.			SBN		
Month	**2019**	**2020**	**% of 2019**	**2019**	**2020**	**% of 2019**
January	59,624,052	62,848,846	105.4%	30,691	32,962	107.4%
February	56,606,220	59,986,869	106.0%	33,021	36,998	112.0%
March	70,504,394	35,241,271	50.0%	42,788	23,242	54.3%
April	67,582,455	3,284,363	4.9%	36,446	2,589	7.1%
May	72,302,073	7,184,877	9.9%	37,057	7,812	21.1%
June	74,217,463	14,502,420	19.5%	39,445	11,565	29.3%
July	76,496,136	20,784,079	27.2%	41,366	16,231	39.2%
August	73,759,187	21,747,167	29.5%	39,028	18,106	46.4%
September	64,543,999	21,565,703	33.4%	37,378	18,690	50.0%
October	69,854,911	25,698,025	36.8%	41,368	23,524	56.9%
November	65,629,331	25,006,780	38.1%	39,569	21,782	55.0%
December	70,950,657	26,433,421	37.3%	38,855	21,362	55.0%
Year Total	**822,070,878**	**324,283,821**	**39.4%**	**457,012**	**234,863**	**51.4%**

Source: Transportation Security Administration

The recovery timeline of airline travel is largely unknown. A look back at the recovery after 9/11 and the Great Recession can provide an indication of what airline recovery could look like after the COVID-19 disruption. According to Airlines for America, following 9/11, it took about three years for passenger volume to return to pre-9/11 traffic levels (see **Figure 2-4**). In 2008, passengers fell in response to the global financial crisis and skyrocketing oil prices. It took nearly seven years for passenger volume to return to pre-recession levels. An effective vaccine against COVID-19 could result in short term growth in passenger traffic. However, this is unlikely to offset the ongoing damage to lucrative business travel, which may take three or more years to recover.

Figure 2-4: Historic U.S. Passenger Volumes Operating Revenues



Source: Airlines for America, *Impact of COVID-19: Data Updates*

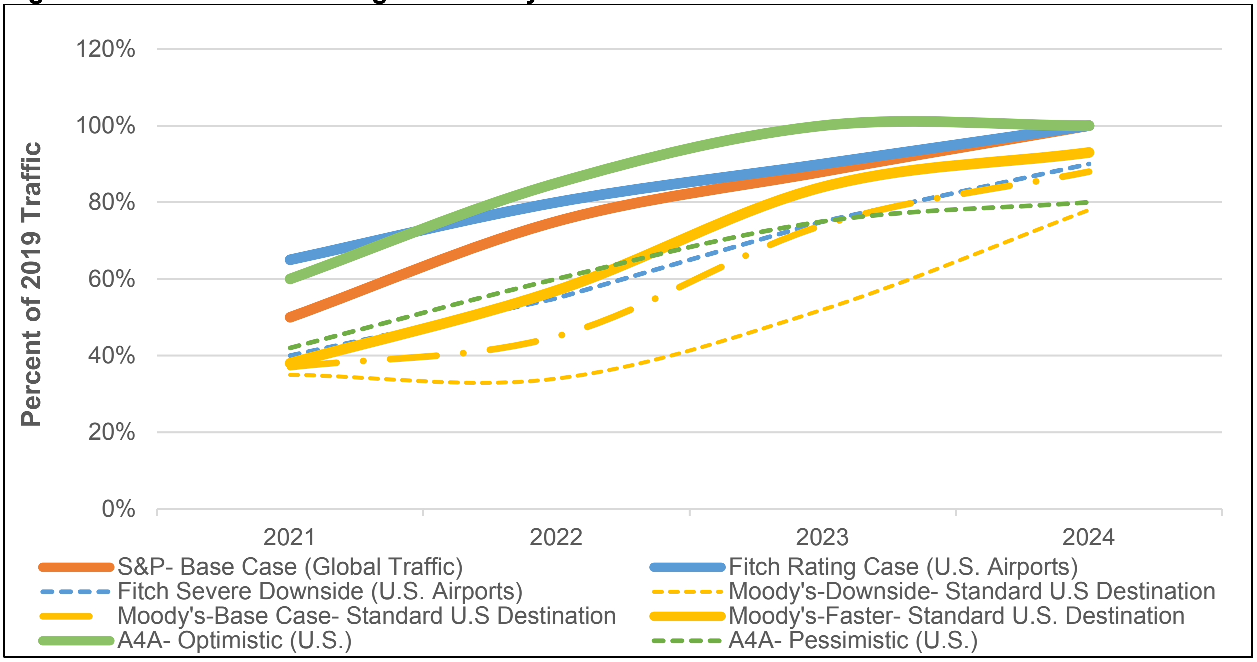
The Impact of COVID-19 on SBN Projections

The pandemic has impacted all aspects of aviation at SBN. Commercial service operations and enplanements at SBN have been impacted the most; however, general aviation activity has also declined. The long-term implications of the pandemic and subsequent recession on the aviation industry are still largely unknown, which adds a level of uncertainty to these projections. The virus' impact to the economy and aviation is fundamentally different and much greater than any other crisis in history. Standard & Poor's (S&P) noted that, in November 2020, "it is still impossible to predict the pace, extent, and timing of recovery in travel patterns with any certainty." Economic recovery to pre-crisis levels in the past have ranged from three years post 9/11 to more than seven years after the financial crisis of 2008[3].

It is important to gain an understanding of when demand for aviation services can be expected to return to pre-2020 levels. A summary of enplanement projections by rating agency analyst and industry insiders that focus on the timing of the return of airline passenger demand to pre-COVID levels are presented in **Figure 2-5**. The base case scenarios shown in the graph do not show substantial increases until late 2021 or 2022 and expect 2019 levels to be regained around 2024. All the forecasts note that the level of uncertainty is high and completely dependent on virus behavior, vaccination effectiveness and rollout, and government responses.

[3] Airlines for America, "Tracking the Impacts of COVID-19," June 18, 2020.

Figure 2-5: COVID-19 Passenger Recovery Scenarios

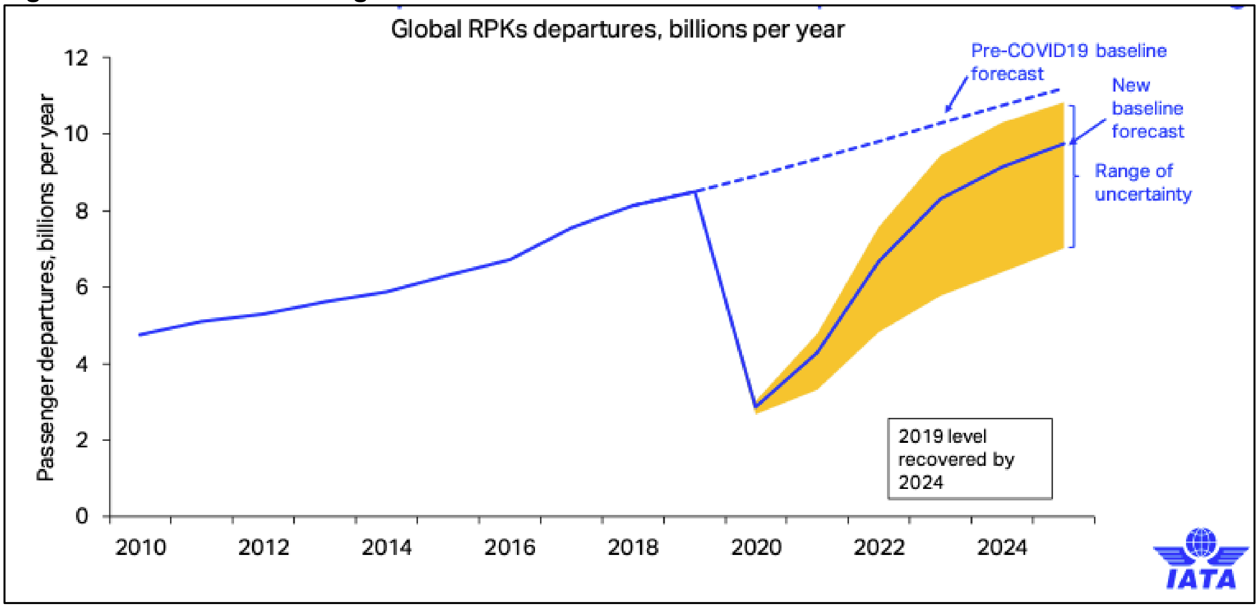


Sources: Airlines for America, Impact of COVID-19: Data Updates (2020); S&P Global As COVID-19 Cases Increase, Global Air Traffic Recovery Slows (12 Nov, 2020), Moody's Investment Service, 2021 Outlook Negative with High Degree of Traffic Uncertainty, Airline Financial Health (1 Dec, 2020); FitchRatings Outbreaks, Travel Limits to Delay Global Air Traffic Recovery (12 Oct, 2020).

The IATA projections, presented in **Figure 2-6**, shows the wide range of uncertainty regarding recovery. IATA notes that the return of corporate and international travel is largely unknown. According to a December 2020 IdeaWorks study[4] and reported by the *Wall Street Journal*, between 19 percent to 36 percent of corporate airline travel will not return due to many reasons including technology being utilized more often for virtual meetings and more people successfully working productively from home.

[4] IdeaWorks, "The Journey Ahead: How the Pandemic and Technology Will Change Airline Business Travel," December 2020. https://ideaworkscompany.com/wp-content/uploads/2020/12/Journey-Ahead-Airline-Business.pdf

Figure 2-6: IATA Air Passenger Forecast



Source: IATA/Tourism Economics 'Air Passenger Forecasts' October 2020

The industry projections presented above will help make assumptions when projecting enplanements and commercial service operations for SBN. The aviation industry is resilient, and it is anticipated that activity will eventually return and exceed pre-pandemic levels. The forecasts that are developed for SBN take into consideration these uncertainties, historical and regional economic trends, and the mix of operations. Based on information to date, the forecasts presented make assumptions as to when SBN can expect to return to pre-COVID levels. It is important to note that airport development should occur when operational activity reaches certain planning milestones. Activity should be monitored to understand when these planning triggers are reached.

2.2.2. Additional Aviation-Related Trends

Typically, historic and anticipated trends related to commercial service, general aviation, and air cargo are important considerations in developing forecasts of demand. However, the COVID-19 pandemic has disrupted nearly all of the trends. This section will briefly discuss the trends and the factors that have emerged during the pandemic and that have the potential to continue to shape aviation in the U.S.

Commercial Service Industry Trends

While SBN's future commercial air travel demand will be primarily driven by local demand and regional events, it will also be influenced by industry trends, particularly regarding what type of aircraft will be utilized by airlines flying into SBN. The following trends will have the potential to impact air service at SBN as airlines continue to recover from the COVID-19 pandemic.

- **Airline Capacity Discipline –** Similar to the airlines' response to the Great Recession of 2007-2009, it is anticipated that air service trends will shift in conjunction with airline management attempts to focus on recovery and profitability by selectively adding back routes, reducing redundant flying, and minimizing the number of empty seats. A conservative approach in their capacity planning will be implemented. It will likely be a "limited growth" environment in terms of capacity in the near term. While some carriers may try to grow market share by keeping some of their older equipment in service, high fuel costs will reinforce stated intentions to retire older equipment, leading most airlines to remain capacity disciplined. Longer term, the environment should improve, as airlines continue to add aircraft in the 70-100 seat range. Many new aircraft will be delivered over the next several years and serve to modernize the existing fleet.

- **Regional Airlines –** Several regional airlines have ceased operations due to the pandemic. Compass shuttered operations on April 7, 2020, while sister carrier Trans States was grounded on April 1, 2020, nine months earlier than planned. In addition, on September 30, 2020, United ended its contract with ExpressJet, whose entire business was operating United Express-branded flights to consolidate regional operations. Trans States and ExpressJet both served SBN in the first quarter of 2020.
- **Fleet Simplification –** The COVID-19 pandemic has led to the early retirement of several types of aircraft to cut costs and simplify fleets. This will allow airlines to benefit from higher pilot productivity, lower training costs, lower maintenance expenses, and better fuel efficiency as new aircraft are purchased in the next several years. Delta announced the most accelerated fleet retirement schedule, which includes phasing out all 50-seat CRJ-200 aircraft flown by regional partners by 2023. Delta is currently serving SBN with these aircraft on routes to Atlanta and Detroit. While Delta does not have a one-to-one replacement of the CRJ-200s, it is likely they will be replaced by other larger regional jet aircraft. This may mean Delta could choose to operate fewer frequencies or consolidate flights on a certain route. SkyWest owns its own fleet of CRJ-200s, and their fleet retirement plans are unknown. American Airlines retired 20 100-seat Embraer E190 regional jets in 2020 to simplify its fleet. [5] These aircraft did not serve SBN in 2020.

General Aviation Industry Trends

At the national level, fluctuating trends regarding general aviation usage and economic upturns/downturns have historically impacted general aviation demand. Nearly all aspects of general aviation activity in 2020 have been impacted by the COVID-19 pandemic, turning many of the trends experienced over the prior decade upside down and leaving many unknowns regarding the future of general aviation. Some segments of general aviation have been hit harder than others. Pre-COVID, the FAA's 20-year projections of aircraft and operational activity were already conservative. The *FAA Aerospace Forecasts 2021-2041*, published in 2019, projected total based aircraft to grow at 0.0% per year and general aviation operations at towered airports to grow at 0.8% per year on average between 2021 and 2041. This conservative approach will undoubtedly continue into the future. A summary of notable changes to general aviation activities include:

- **Corporate –** The largest decline in general aviation has been corporate-related air travel. Due to health concerns of face-to-face meetings and office closures, many business meetings once done in person have gone virtual or have been postponed until concerns are eased. While there is some increased interest in new jet purchases because travel is essential for their job/business, this aspect of flying has not offset the decline in overall business flying.

[5] McMurtry. *Evanescent Embraer: The E190's Quickly Fading Presence in North America.* https://airlinegeeks.com/2020/05/22/evanescent-embraer-the-e190-s-disappearing-time-in-north-america/

- **Air Charter –** Although they have been hit by a drop in corporate-related travel, companies such as NetJets, WheelsUp, and Flexjet have seen an uptick in leisure travel in 2020. A large portion of the charter growth (50-60 percent) is by first time customers[6], typically those with high net worth who can afford the convenience and safety provided by private aviation. Many private jet charter companies have been offering new programs including private jet membership, aircraft management, and aircraft sales as many of the new customers now look to become repeat customers.
- **Recreation –** Pilots with their own aircraft are continuing to fly recreationally or for commuting. However, with health concerns and many restaurant and hotel restrictions, recreational flying for more than a day trip has become rarer. Due to the COVID-19 pandemic, for some, the use of personal aircraft has replaced the reliance on commercial air travel.
- **Flight Training –** Despite the disruption of the pandemic, many flight schools around the country remain busy. There has been an increased interest in general aviation flying as commercial service becomes a more difficult option for people flying with health concerns or as commercial service schedules have been cut.

Air Cargo Industry Trends

Total air cargo volumes in the U.S. declined over the last 20 years because of industry changes such as increased jet fuel costs, market maturity, increased security regulations, market saturation, and improved ground efficiency. However, one bright spot in aviation through the pandemic is the growth of domestic air cargo. In the third quarter of 2020, U.S. domestic air cargo hit its highest volumes, fueled by strong domestic e-commerce sales and exports from Asia. Although freighter volumes were up 20 percent worldwide, cargo capacity remained 25 percent less than a year ago, due to the decline in available space on passenger aircraft (belly cargo)[7].Economic indicators point to positive future conditions for air freight, but there is uncertainty about how the coronavirus and vaccine rollout will continue to affect air cargo in 2021 as passenger airlines continue to be hard hit by demand.

Emerging Technologies

Several technologies are on the horizon that have the potential to shape transportation in the future. These include unmanned aerial vehicles (UAVs), autonomous vehicles, and sustainable fuel. While it is not currently known how these technologies will ultimately develop, this section provides insight into a few of the technological developments and potential impacts SBN will face in the coming years.

- **Unmanned Aerial Vehicles –** UAV technology is becoming more widely-used every day, and the benefits of this technology extend well beyond recreational use. As more companies look to capitalize on commercial opportunities, investment in UAVs continues to grow. UAVs offer safe, cost-effective solutions for applications ranging from data collection to delivery. As autonomy and collision-avoidance technologies improve, so too will UAVs' abilities to perform increasingly complex tasks. In the aviation industry, UAVs are commonly used for inspecting aircraft, airfields,

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[6] Sumers. *Private Jet Operators Are Stealing Passengers from U.S. Airlines*. https://skift.com/2020/08/19/private-jet-operators-are-stealing-passengers-from-u-s-airlines/

[7] American Shipper, "Air cargo momentum builds; air travel stumbles," November 4, 2020.

powerlines, and buildings as well as for wildlife control. UAVs are also being used for agricultural spraying, search and rescue, and aerial photography. The use of UAVs for the transport of goods is in development and UAVs for passengers is also getting closer to fruition each year and will likely be available in the next decade and prevalent in 20 years.

- **Autonomous Vehicles –** As driverless cars become more capable and common, they will change people's travel habits not only around their own communities but across much larger distances. The impacts of these new technologies will likely affect many facets of aviation and could substantially change the aviation industry and the airport system. A future with driverless cars means people will have more options instead of driving on their own. Airlines may reduce route availability and frequency as more people choose to drive to regional destinations or larger airports. In turn, airports may receive lower revenue from vehicular parking and will likely need to accommodate autonomous vehicles for passenger drop-off and pick-off. Vehicles that support aviation activities such as maintenance equipment; baggage, cargo handling, and other carts; and other ground transportation options such as airport shuttles may also become autonomous.
- **Alternative Fuel –** Using sustainable and alternative fuels and advanced vehicles (zero emissions and zero gas, such as electric cars) instead of conventional fuels and vehicles helps conserve fuel and lowers vehicle and aircraft emissions. New aircraft are becoming more efficient by improving engines, enhancing aerodynamics, and using lighter materials. These new technologies combined with alternative fuels will offer aircraft more cost efficiencies and be better for the environment. Sustainable alternative fuels currently cost more than conventional fuel (likely due to a lack of competitiveness in the market), which directly acts as a barrier to their utilization. However, in the next 20 years, advancements will continue, and airports will need to accommodate vehicles using alternative fuels by offering charging stations or alternative fuel for aircraft, equipment, ground transportation, cars, and UAVs.

2.2.3. Competing Airports

There are other local factors unique to SBN that also have the potential to impact the forecasts developed in this chapter. The proximity to competing airports is one of the key determinants of the demand and size of an airport's market or catchment area. It is estimated that the Airport Market Area has a population of approximately one million people. Larger airports in the Chicago area including Midway (MDW) and O'Hare (ORD), Indianapolis International (IND), Detroit International (DTW), and to a much lesser extent, Kalamazoo/Battle Creek International (AZO), Fort Wayne International (FWA), and Gerald R. Ford International (GRR), are within proximity to SBN and impact the ability of the airport to retain Airport Market Area passengers, especially leisure passengers.

2.3 Historic and Current Aviation Activity at SBN

Historic activity data for SBN provides the baseline from which future activity can be projected. While historic trends are not always reflective of future periods, historic data does provide insight into how local, regional, and national demographic and aviation-related trends may be tied to SBN.

For this this master plan, historic enplanement, commercial service operations, and air cargo data reported by each airline station manager to SBN airport management was used. These numbers differ slightly from the data reported by airlines to the U.S. Department of Transportation (DOT) and recorded in the Bureau of Transportation Statistics (BTS). A summary of the difference in reported enplanements and commercial service operations is presented in **Table 2-6**. The difference in enplanements over the last 10 years ranged from -2.7 to 2.3 percent, with the average being 0.7 percent more enplanements reported by SBN than by BTS. The difference in recorded commercial service operations was between -0.9 and 3.4 percent. The 10-year average was 0.5 percent more operations recorded by SBN than by BTS.

Table 2-6: Comparison of Enplanements and Commercial Service Operations by Data Source

	Enplanements			Commercial Service Operations		
Year	**BTS**	**Airport[1]**	**% Difference**	**BTS**	**Airport**	**% Difference**
2010	312,878	315,081	0.7%	14,581	14,636	0.4%
2011	301,201	301,881	0.2%	13,686	13,682	0.0%
2012	294,980	296,590	0.5%	12,678	12,716	0.3%
2013	322,708	314,114	-2.7%	12,416	12,836	3.4%
2014	302,578	301,578	-0.3%	11,785	11,676	-0.9%
2015	309,585	314,300	1.5%	11,557	11,556	0.0%
2016	325,347	328,897	1.1%	12,221	12,228	0.1%
2017	301,824	305,491	1.2%	12,107	12,132	0.2%
2018	360,428	368,877	2.3%	14,160	14,256	0.7%
2019	410,462	417,929	1.8%	15,444	15,522	0.5%
2020	206,609	207,128	0.3%	10,266	10,326	0.6%
Avg. Difference			**0.7%**			**0.5%**

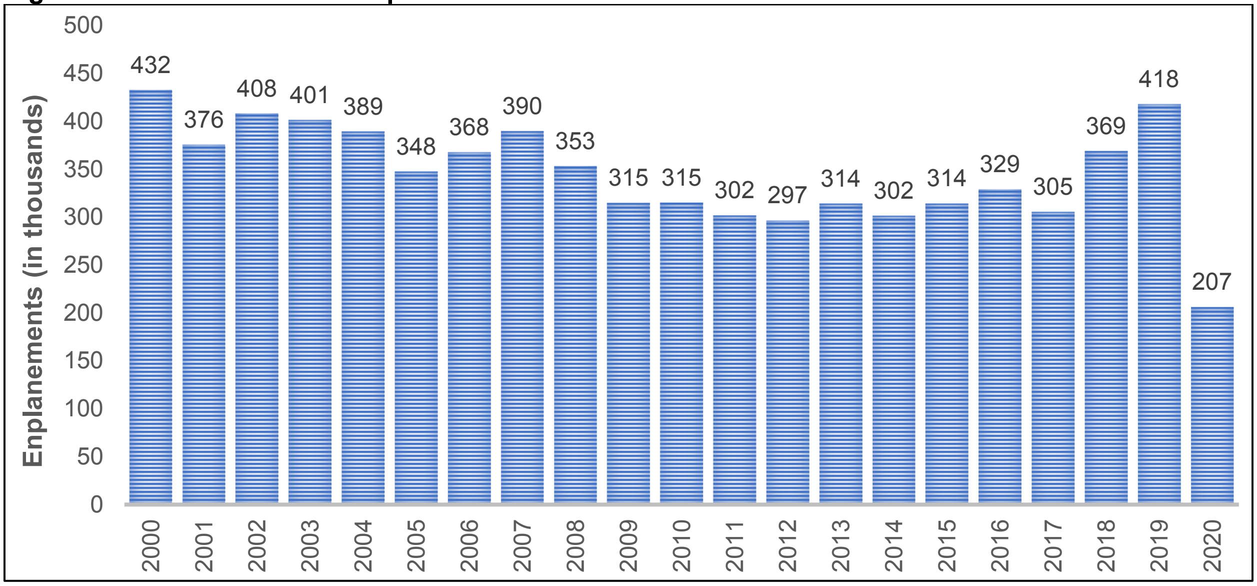
Source: Bureau of Transportation Statistics T-100 Market data, SBN airport management
Notes: [1] Includes passengers on scheduled commercial airlines and charter flights

2.3.1. Commercial Airline Passengers

Over the last 20 years, passenger enplanements at SBN have fluctuated, as illustrated in **Figure 2-7**. Enplanements were at their highest levels in 2000, with 432,000 passengers. Passenger and service levels were impacted by 9/11 (2001) as well as the Great Recession (2008-2012) with cutbacks associated with subsequent carrier mergers (United-Continental, Delta-Northwest, American-US Airways). After 10 years of relatively flat enplanement levels, passengers at SBN grew significantly in 2018, up 21 percent from 2017 and another 13 percent in 2019.

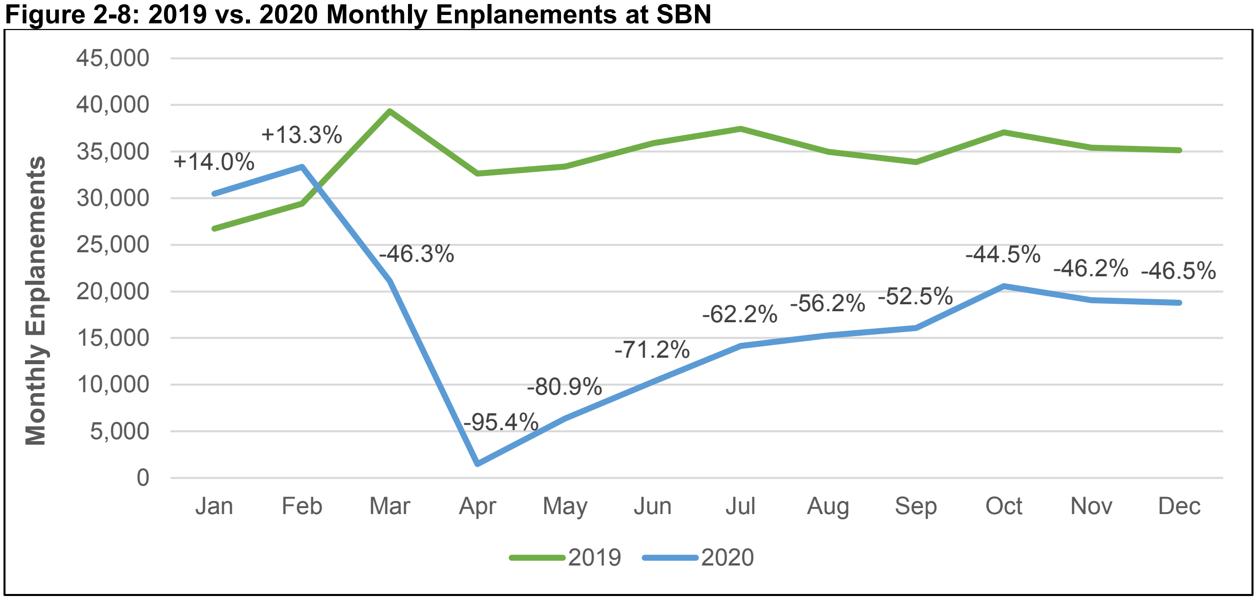
2020 enplanements plummeted to 207,000, down 51 percent from 2019 due to the COVID-19 pandemic. **Figure 2-8** presents a comparison of monthly enplanements from 2019 to 2020. In the first two months of 2020, SBN was experiencing record enplanements. In March, stay-at-home orders were given to combat the spread of COVID-19. Although enplanements have recovered from their lowest point in April, by December 2020, enplanements were still 47 percent lower than 2019 levels.

Figure 2-7: Historic Annual Enplanements at SBN



Source: Airport management records
Note: Includes passengers on scheduled commercial airlines and charter flights

Figure 2-8: 2019 vs. 2020 Monthly Enplanements at SBN

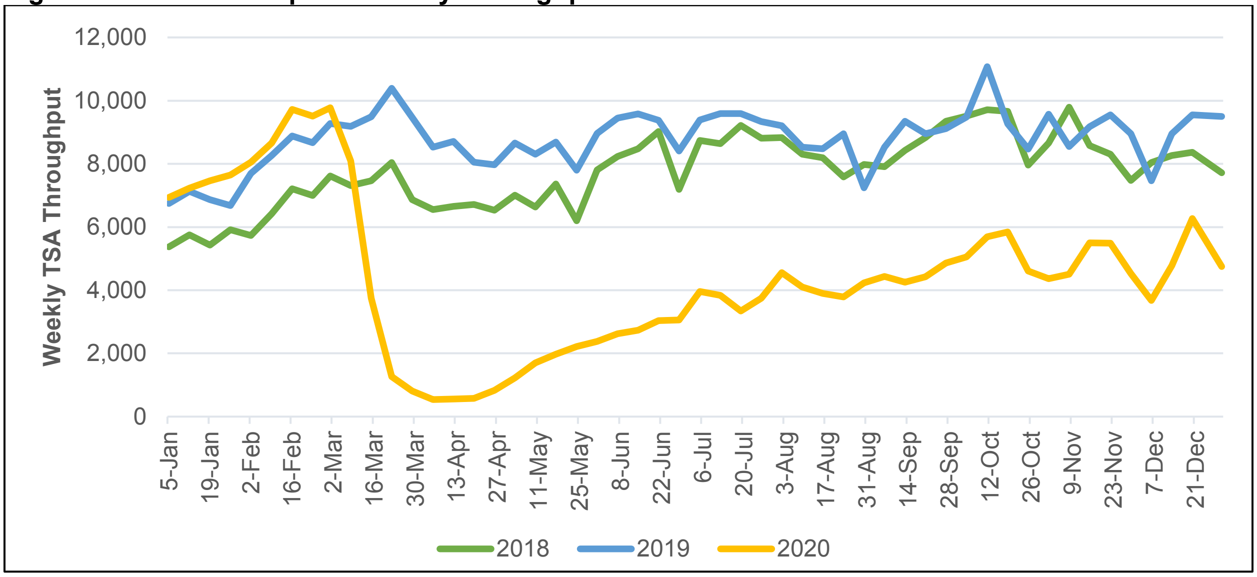


Source: Airport management records

TSA Checkpoint Throughput

TSA records and publishes the number of people screened at TSA checkpoints at airports across the U.S. each day. At SBN, this number is similar to enplanements since there are minimal connecting passengers. **Figure 2-9** presents a comparison of weekly throughput at SBN for 2018, 2019, and 2020. As shown, weekly throughput at SBN in 2019 and pre-COVID 2020 was trending above the throughput levels from the year before. While throughput numbers have trended upward since the beginning of March, during the last three months of 2020, throughput numbers have not grown significantly, down an average of 46 percent from 2019.

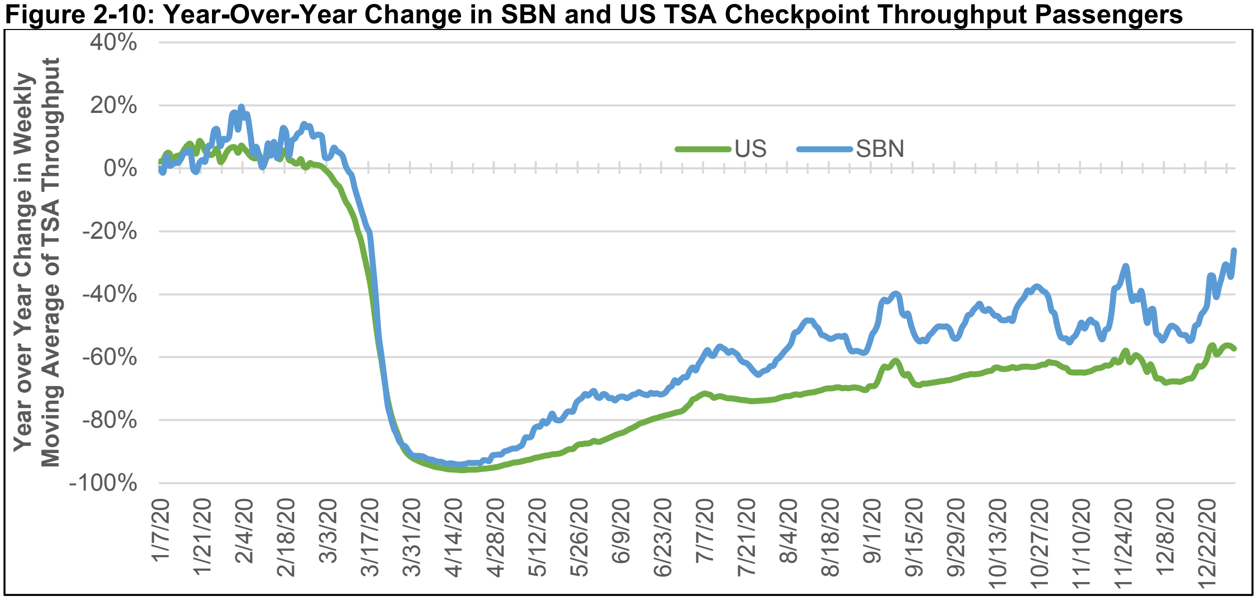
Figure 2-9: TSA Checkpoint Weekly Throughput at SBN 2018-2020



Source: TSA FOIA Reading Room, via ADI

It is important to note the decline at SBN is not as large when compared to all U.S. airports. As shown in **Figure 2-10**, since Summer 2020, the comparison of the weekly moving average of checkpoint throughput at SBN for 2020 versus 2019 was around 10 to 12 percentage points less that the U.S. total throughput.

Figure 2-10: Year-Over-Year Change in SBN and US TSA Checkpoint Throughput Passengers



Source: TSA FOIA Reading Room, via ADI

Air Carrier Activity

SBN is served by four major airlines: one low-cost carrier (LCC), Allegiant, and three network carriers, American, United (and regional partners), and Delta (and regional partners). The nonstop routes from SBN are presented in **Figure 2-11**. SBN had nonstop service to 12 destinations in May 2021. Allegiant offered nonstop service to six airports. Delta offered nonstop service to three airports, while American offered service to two airports, and United provided nonstop service to one destination. United service to Newark was suspended during the COVID-19 pandemic and a date for resumption of service has not been identified as of the writing of this chapter.

Figure 2-11: Nonstop Routes From SBN, May 2021

Source: SBN Airport website
Note: United's service to Newark was discontinued during the COVID pandemic. As of May 2021, it is unknown when flights on this route will resume.

A summary of scheduled departures, seats, average seats per flight, and pre-COVID-19 load factors for each route is shown in the **Table 2-7**. There were 15.5 average daily departures scheduled in March 2021. This compares to 19.2 daily departures, one year earlier, despite the impact of the COVID-19 pandemic on enplanement levels. The cities with the most destinations include Detroit (2.9 daily departures), Atlanta (2.5 daily departures), and Chicago (2.5 daily departures). The average load factor in 2019 at all markets combined was 83 percent.

SkyWest, a United and Delta regional partner, operates a large maintenance base at SBN. The convenience provided by this maintenance base solidifies future operations by SkyWest partners. As of the writing of this chapter, United planned to add two additional daily departures by the end of Summer 2021. SBN airport management was also in discussions with United to add service to Denver by the end of 2021.

Table 2-7: SBN Average Daily Scheduled Nonstop Service, March 2021

Airport	Code	Carrier	Scheduled Departures	Scheduled Departing Seats	Avg. Seats per Flight	Pre-COVID Load Factor[1]
Detroit	DTW	Delta	2.9	143.5	50	81%
Atlanta	ATL	Delta	2.5	190.3	75	87%
Chicago-O Hare	ORD	United	2.5	127.4	50	78%
Charlotte	CLT	American	2.0	151.3	76	78%
Dallas/Ft. Worth	DFW	American	2.0	130.0	65	82%
Punta Gorda	PGD	Allegiant	1.1	199.8	177	85%
Orlando-Sanford	SFB	Allegiant	0.7	122.5	165	81%
St. Petersburg	PIE	Allegiant	0.6	114.2	177	84%
Phoenix-Mesa	AZA	Allegiant	0.5	79.9	177	89%
Sarasota/Bradenton	SRQ	Allegiant	0.3	51.4	177	70%
Las Vegas	LAS	Allegiant	0.3	44.3	172	85%
Minneapolis/St. Paul[2]	MSP	Delta	-	-	-	85%
New York-Newark[2]	EWR	United	-	-	-	74%
Total			**15.5**	**1,354.8**	**87**	**83%**

Source: Official Airline Guide, US DOT-100
Notes: [1] Load factor data was used for CY2019; CY2020 data was not available
[2] Service by Delta to Minneapolis and by United to Newark was discontinued during the COVID-19 pandemic. Service to Minneapolis is resuming May 5, 2021, and no announcement has been made regarding the resumption of service to Newark.

Table 2-8 summarizes scheduled air service by carrier for March 2021. As shown, while Delta and American offer the most daily departures, Allegiant, which operates only Airbus A319 and A320 narrow-body jet aircraft, offers the most scheduled departing seats. All United flights are provided on 50-seat regional jet aircraft, operated by regional partners, SkyWest and Air Wisconsin. American's operations are flown with a combination of CRJ-700 (65 seats) and CRJ-900 (76 seats) aircraft while Delta utilizes both the 50-seat CRJ-200 and CRJ-900 (76 seats). The average number of seats per flight in March 2021 was 87. In 2019, Delta and Allegiant had the highest load factors. Data for 2020 was not available, but it is assumed that Delta's load factors dropped significantly as they were the only U.S. airline to implement a protocol to block middle seats and limit onboard capacity through April 30, 2021, to help reduce the spread of COVID-19.

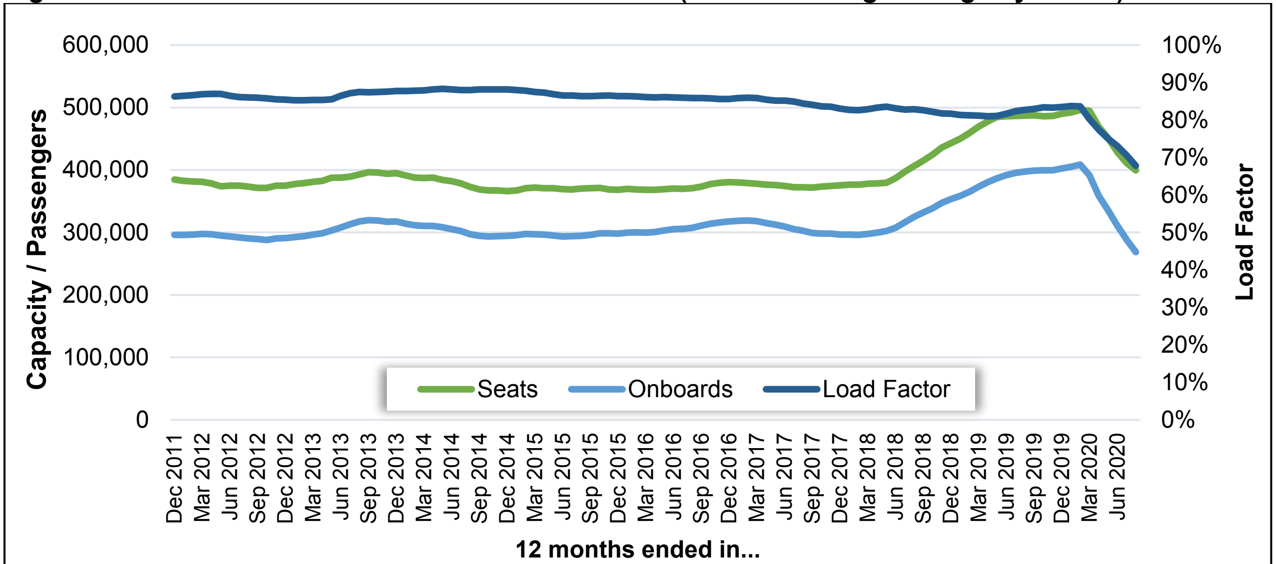
Table 2-8: SBN Average Daily Scheduled Nonstop Service by Carrier, March 2021

Carrier	Scheduled Departures	% of Total	Scheduled Departing Seats	% of Total	Avg. Seats per Flight	Pre-COVID Load Factor[1]
Allegiant	3.5	22.7%	612.2	45.2%	174	84%
Delta	5.4	35.0%	333.9	24.6%	62	86%
American	4.0	25.8%	281.3	20.8%	70	81%
United	2.5	16.5%	127.4	9.4%	50	77%
Total	**15.5**	**100.0%**	**1,354.8**	**100.0%**	**87**	**83%**

Source: Official Airline Guide, US DOT-100
Notes: [1] Load factor data was used for CY2019; CY2020 data was not available

Figure 2-12 presents the changes in seats, onboard passengers, and load factors since 2011 at SBN. As shown, after years of relatively flat activity, new service beginning in 2017 led to an increase in capacity (seats) and onboard passengers. Load factors have historically been strong – above 80 percent between 2011 and 2019. Load factors, onboard passengers, and seats have declined since the beginning of the COVID-19 pandemic as carriers dropped service in response to the limited demand due to passenger safety concerns and limited corporate travel.

Figure 2-12: SBN Commercial Service Market Trends (Annual Moving Average by Month)



Source: Official Airline Guide, US DOT-100
Note: Most recent data available was through August 2020

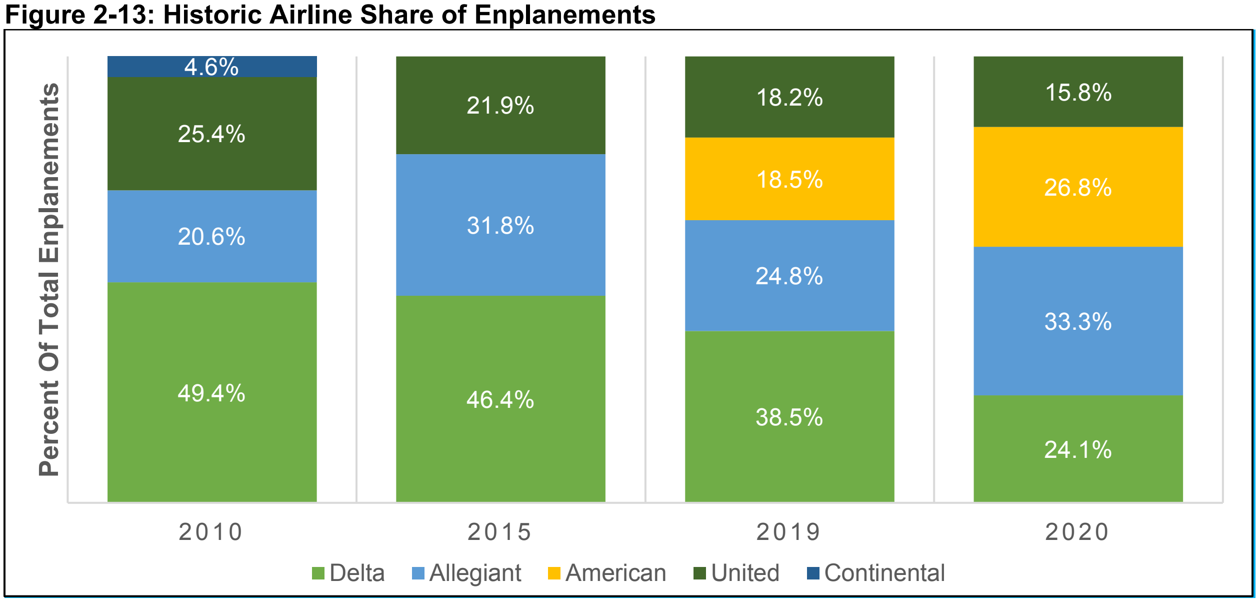
Table 2-9 presents the historic enplanements at SBN by the major carriers and their regional partners. For the master plan, SBN management records of historic airline enplanements (reported by the airlines) were used. **Figure 2-13** highlights how the airlines' shares have shifted since 2010. While Delta enplaned nearly half of the passengers at SBN in 2010, by 2019 their share of enplanements was 39 percent and just 24 percent in 2020. Delta regional partner, SkyWest, cut the most flights in 2020 (60 percent). American entered the SBN market in 2018 and carried 28 percent of all enplanements in 2020. Allegiant carried one-third of the enplanements at SBN in 2020 and fared better than United and Delta as recreation-related travel recovered more quickly than corporate travel.

Table 2-9: SBN Enplanements by Carrier

Airline	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Allegiant	**64,950**	**70,097**	**77,723**	**92,021**	**96,629**	**97,663**	**98,652**	**95,134**	**99,516**	**102,188**	**68,968**
American	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**37,761**	**75,998**	**55,496**
Delta	**155,627**	**149,248**	**138,902**	**126,204**	**133,862**	**142,483**	**154,672**	**142,836**	**153,290**	**158,335**	**49,868**
SkyWest	0	9,949	16,028	21,057	123,399	119,010	147,094	138,109	138,776	149,498	37,084
Endeavor Air	0	0	0	61,780	2,499	813	1,971	2,130	10,352	6,406	12,784
Delta	1,120	1,196	1,053	0	0	1,507	1,490	2,597	4,126	2,431	0
Express Jet	0	0	40,708	43,367	7,964	17,749	4,117	0	36	0	0
Pinnacle	86,778	78,091	66,868	0	0	0	0	0	0	0	0
Comair	16,359	44,994	8,973	0	0	0	0	0	0	0	0
Other	51,370	15,018	5,272	0	0	3,404	0	0	0	0	0
United	**80,061**	**70,971**	**72,828**	**73,363**	**66,256**	**67,197**	**69,313**	**61,853**	**71,930**	**74,869**	**32,796**
SkyWest	24,889	10,955	7,291	5,036	16,161	37,583	43,493	39,995	41,191	39,396	21,606
Air Wisconsin	0	0	0	0	0	0	0	771	1,450	17,192	8,335
Trans States	13,834	1,222	0	0	883	0	0	0	968	4,438	1,882
ExpressJet	9,573	24,226	53,669	51,149	35,384	22,036	23,483	21,087	26,933	6,861	867
GoJet	0	0	0	0	0	0	0	0	135	3,448	20
Mesa	29,154	11,859	8,112	6,547	6,292	0	0	0	0	0	86
Other	2,611	22,709	3,756	10,631	7,536	7,578	2,337	0	1,253	3,534	0
Frontier	**0**	**0**	**5,328**	**17,035**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Continental	**14,443**	**11,565**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total	**315,081**	**301,881**	**294,781**	**308,623**	**296,747**	**307,343**	**322,637**	**299,823**	**362,497**	**411,390**	**207,128**

Source: Airport management records

Figure 2-13: Historic Airline Share of Enplanements



Source: Airport management records

2.3.2. Operations

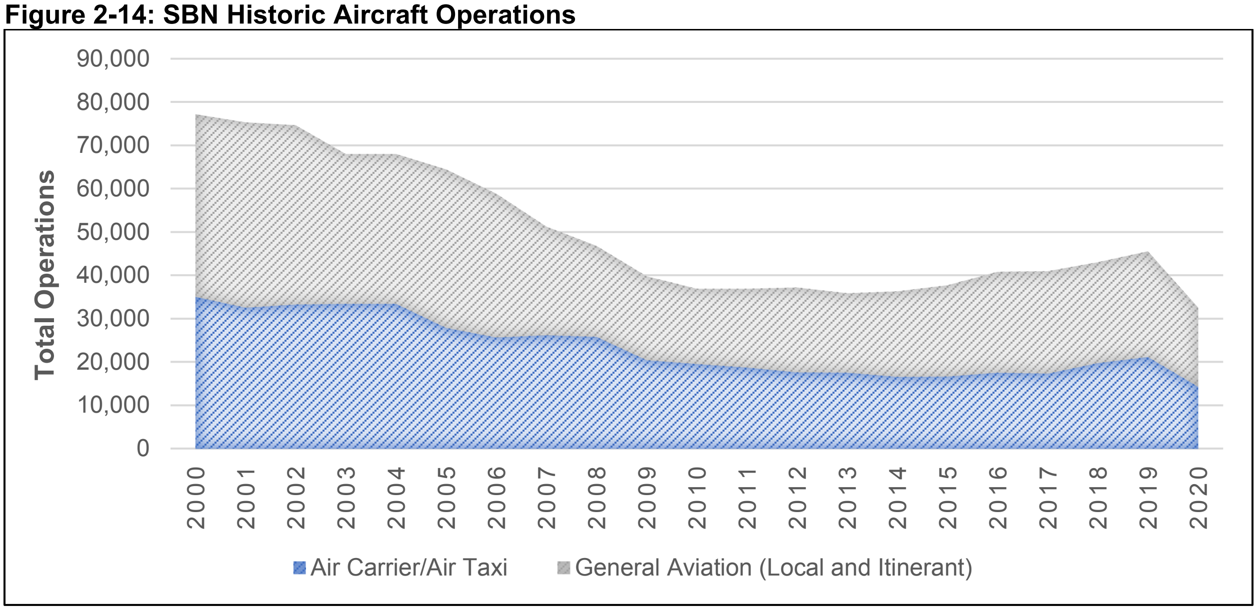
An operation is defined as either a takeoff or a landing. Historic aircraft operations data, as reported by the FAA air traffic control tower at SBN, are summarized in **Table 2-10** and graphically depicted in **Figure 2-14**. In 2020, a total of 32,888 operations occurred at SBN, down nearly 29 percent from 2019 operations.

Table 2-10: SBN Historic Total Operations (2000-2020)

Year	Air Carrier[1]	Air Taxi[2]	Subtotal	General Aviation	Military	Total Operations
2000	10,682	24,395	35,077	42,088	237	77,402
2001	7,026	25,517	32,543	42,791	274	75,608
2002	7,363	25,903	33,266	41,349	366	74,981
2003	3,014	30,420	33,434	34,566	186	68,186
2004	3,313	30,123	33,436	34,536	152	68,124
2005	3,160	24,739	27,899	36,528	212	64,639
2006	2,841	22,844	25,685	33,189	97	58,971
2007	4,394	21,813	26,207	25,023	152	51,382
2008	4,471	21,390	25,861	20,926	167	46,954
2009	3,477	16,976	20,453	19,379	403	40,235
2010	3,813	15,782	19,595	17,334	171	37,100
2011	2,960	15,798	18,758	18,169	195	37,122
2012	2,941	14,739	17,680	19,541	190	37,411
2013	3,532	14,047	17,579	18,310	230	36,119
2014	3,242	13,405	16,647	19,707	196	36,550
2015	4,026	12,680	16,706	20,996	341	38,043
2016	2,931	14,658	17,589	23,207	402	41,198
2017	2,559	14,818	17,377	23,592	634	41,603
2018	4,698	15,084	19,782	23,255	611	43,648
2019	6,207	15,019	21,226	24,354	594	46,174
2020	5,148	9,191	14,339	18,232	317	32,888
CAGR[3]						
2000-2010	-9.8%	-4.3%	-5.7%	-8.5%	-3.2%	-7.1%
2010-2019	5.6%	-0.5%	0.9%	3.9%	14.8%	2.5%
2000-2019	-2.8%	-2.5%	-2.6%	-2.8%	5.0%	-2.7%
2019-2020	-17.1%	-38.8%	-32.4%	-25.1%	-46.6%	-28.8%

Source: FAA OPSNET, 2021
Notes: [1] Includes all-cargo carrier cargo operations and charter operations on aircraft with greater than 60 seats.
[2] Includes scheduled commercial service and nonscheduled/charter passenger service on aircraft with less than 60 seats as well as general aviation air taxi activity.
[3] CAGR = Compound Average Growth Rate

Figure 2-14: SBN Historic Aircraft Operations



Source: FAA OPSNET database
Note: Excludes military operations

Commercial Service Operations

Overall, commercial service operations (which include air carrier, air cargo, and air taxi/commuter operations) experienced a decline between 2000 and 2019. This was due to the economic recession, carrier mergers and efforts to right-size, and retirement of the 50-seat regional jet and turboprop aircraft. Over the last 10 years, commercial service operations stabilized and then increased between 2017 through 2019 as Allegiant, Delta, United, and American added additional flights and capacity at SBN. Commercial operations were down 32 percent in 2020 over 2019 due to capacity cuts associated with the COVID-19 pandemic. In 2020, 64 percent of the commercial operations were operated by aircraft in the air taxi category. This number also includes some general aviation operations by business aircraft.

Air Cargo Operations

According to airport management, all-cargo carriers operated 1,494 flights in 2020, down from 1,520 flights in 2019. This equates to 4.1 daily operations by all-cargo carriers. The three all-cargo carriers that serve SBN are United Parcel Service (UPS), Federal Express (FedEx), and CSA Air, a FedEx feeder airline. FedEx accounted for 35 percent of the annual operations, operating an average of 21 monthly operations between SBN and primarily their hub in Memphis, typically with B757-200 aircraft. FedEx feeder carrier, CSA Air, serves the market as well with Cessna Caravans. UPS operated an average 18 monthly cargo flights at SBN with B757-200 aircraft. The operations by all-cargo carriers are included in the air carrier and air taxi itinerant operations in Table 2-10 above.

General Aviation Operations

Total general aviation operations (both local and itinerant) have declined over the last 20 years. In 2019, there were 42 percent fewer general aviation operations than there were in 2000. This is not a situation unique to SBN, as general aviation declines are reflective of the decline in general aviation activity across the nation due to economic weakness during the recession coupled with high fuel prices. General aviation operations rebounded slightly following the recession but were still well below 2000 levels. In 2020, general aviation operations were down 25 percent from 2019 due to pandemic concerns.

Military Operations

Minimal military activity occurs at SBN. Military aircraft historically have used SBN for occasional training operations.

International Operations

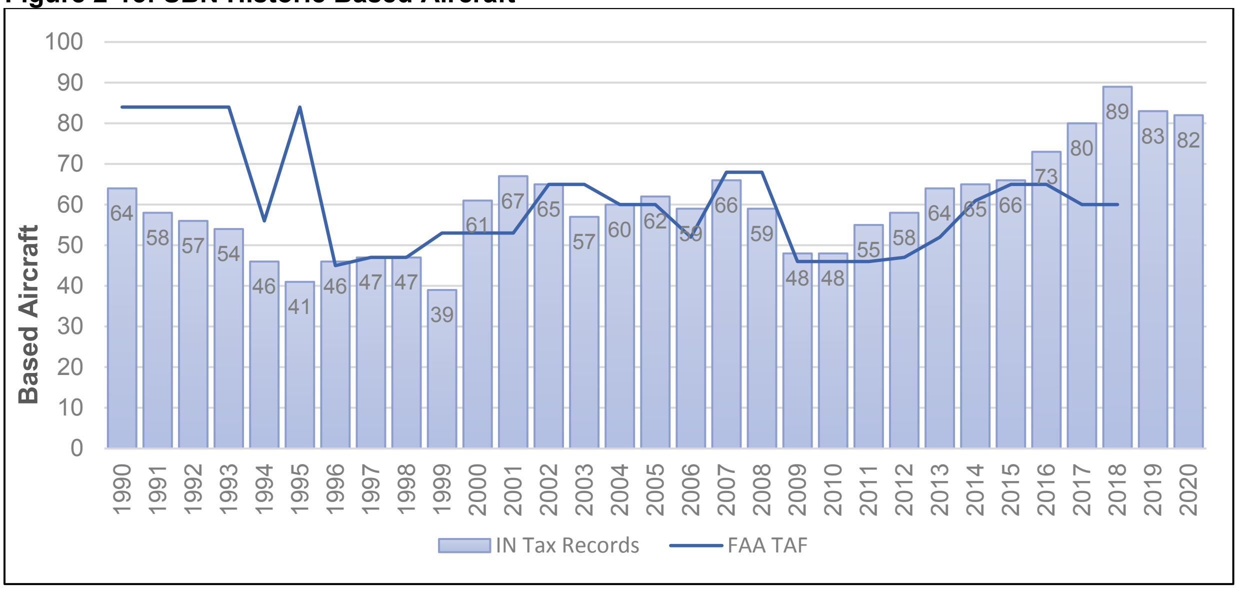
SBN can accommodate international flights and passengers. SBN became a U.S. Customs and Border Protection (CBP) General Aviation Facility (GAF) in June 2017. The GAF provides on-demand, onsite CBP clearance for private aircraft. A few of the largest users of this service are local employers, Whirlpool and the University of Notre Dame. In 2019, 135 international flights utilized the GAF at SBN. In July 2019, SBN opened a Federal Inspection Station (FIS) that allows commercial aircraft the ability to fly nonstop to and from international destinations and passengers can clear Customs. The first flight to utilize the FIS at SBN was a Boeing 747 that carried the Liverpool Football Club, from Manchester, England. In addition, SBN become the state’s first Global Entry Enrollment Center.

2.3.3. Based Aircraft

Based aircraft are those permanently stored at an airport. The based aircraft at SBN each have a lease with the Airport and were verified by Aircraft Excise Tax records as reported to the Indiana Department of Revenue. The number of aircraft based at SBN has fluctuated since 1990 as shown in **Figure 2-15**. In 2020, 82 aircraft were based at SBN including six jet aircraft, 24 multi-engine aircraft, 51 single engine aircraft, and one helicopter. Based aircraft peaked in 2018 but have remained at or above 80 since 2017.

The FAA 5010 Airport Master Record for SBN lists 60 total based aircraft. Figure 2-15 also depicts the historic based aircraft reported in the FAA's Terminal Area Forecast (TAF). In recent years, Williams Aerial and Mapping, a photogrammetric mapping and geospatial data firm located in South Bend, has added aircraft to its fleet. In 2020, the company had 30 single engine aircraft and 19 multi-engine aircraft based at SBN that are deployed all over the country supporting the aerial imaging needs of its clients. These recent additions have not been recorded in FAA sources.

Figure 2-15: SBN Historic Based Aircraft



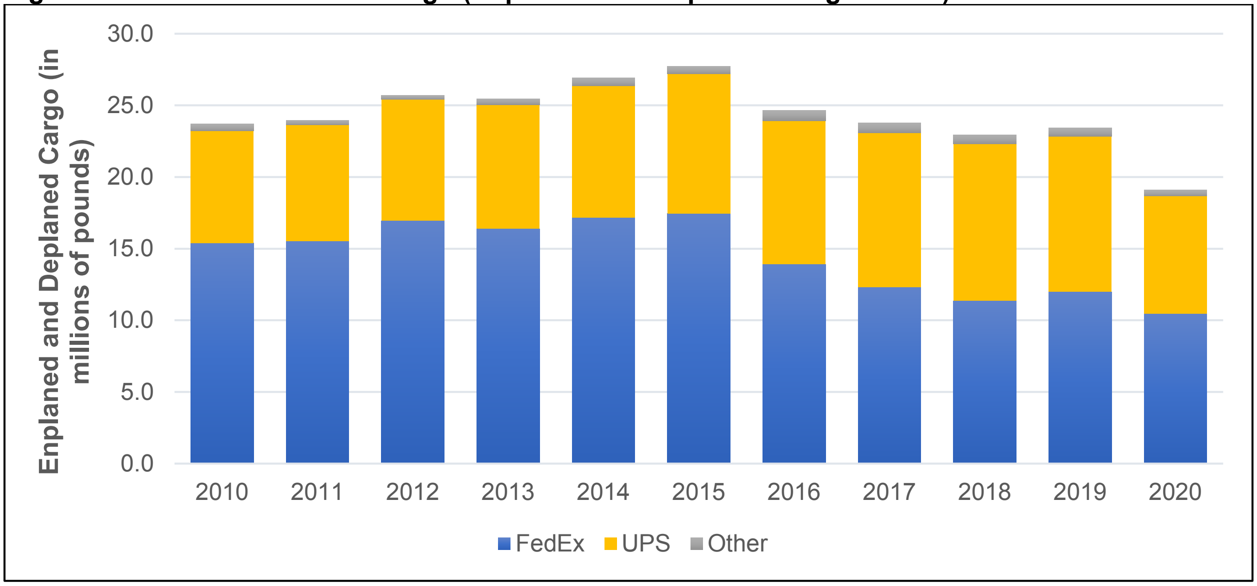
Source: Indiana Department of Revenue; FAA TAF, 2021

2.3.4. Air Cargo

A total of 19.1 million pounds of air freight were enplaned and deplaned at SBN in 2020 which was a decrease of 18.4 percent from 2019 cargo levels. Since 2010, the peak in air cargo activity occurred in 2015 when 27.7 million pounds were carried. **Figure 2-16** shows historic enplaned and deplaned cargo at SBN by the airport's two primary all-cargo carriers: FedEx and UPS. The amount of cargo carried by FedEx has declined since 2015. FedEx carried 55 percent of the air cargo in 2020 at SBN, compared to 64 percent in 2015. UPS enplaned and deplaned 43 percent of the cargo in 2020.

The all-cargo carriers accounted for about 4.5 percent of the total airport operations at SBN in 2020.

Figure 2-16: SBN Historic Air Cargo (Enplaned and Deplaned Cargo in lbs.)



Source: Airport management records

2.4 Projections of Aviation Demand

Projections of aviation demand for the 20-year planning period are typically presented by comparing various methodologies and choosing a preferred projection based on historical trends in passenger enplanements, operations, and air cargo and correlated with econometric data such as population, employment, income, and GRP. Due to the COVID-19 pandemic and its impact on airport activity, projections for SBN will be presented as an estimated return to 2019 activity levels and growth following that return. Three recovery scenarios will be presented for enplanements and operations: Base Case, an Optimistic Recovery, and a Pessimistic Recovery. This will allow for a range of projected growth based on the airlines' recovery from the COVID-19 pandemic, which is difficult to predict at this time due to a variety of factors that were discussed in detail previously and include:

- Changes to airline planning and air service due to large financial losses
- Aircraft retirements including Delta's retirement of its 50-seat CRJ-200 fleet by 2023
- SBN Airport Market Area employment and changes in the economy
- Willingness of passengers to travel by air and concerns about personal safety
- Changes to corporate travel policies and practices
- International travel restrictions

The following assumptions were made when developing 20-year projections:

- The national and local economies will continue to grow through the overall forecast period.
- Economic disturbances may cause year-to-year traffic variations, but the long-term projections will likely be realized.
- Aviation activity at SBN will generally reflect the national aviation industry.

- SBN will continue air service development efforts to reduce leakage and obtain additional service and capacity.
- The SBN air service schedule will recover to 2019 levels and new service additions will be pursued.
- SBN enplanement demand will be met by the airlines through the addition of flight frequencies and/or capacity on existing routes, service to new destinations, and more fuel-efficient aircraft.
- No consideration was made for additional airline mergers. It is assumed that three mainline airlines and Allegiant will continue to operate at SBN through the forecast period.
- The 50-seat regional jet will continue to be phased out of airline fleets and will likely be replaced by the 70-90 seat regional jets. These changes will impact the average seats per flight over the forecast period.
- Due to its proximity to downtown South Bend, the University of Notre Dame, and a robust Airport Market Area, SBN will continue to serve a strong base of corporate general aviation travel, causing jet operations to continue to grow.

The projections of demand have been developed for five-year increments (2025, 2030, 2035, and 2040). For future facility planning purpose, these forecasts are presented as Planning Activity Levels (PALs) 1 through 4. This recognizes the uncertainties associated with forecasting and ties project milestones to activity levels rather than years, realizing activity levels may occur earlier or later than the forecast predicts. The PALs will note when activity levels at SBN will trigger the need for additional capacity or other development. PALs will guide the proposed development alternatives and help plan for future projects based on how demand occurs in the future.

2.4.1. Passenger Enplanements

Forecasts of passenger enplanements serve as the foundation for other commercial service activity forecasts and provide a basis for determining future requirements for facilities integral to the accommodation of passengers. Due to the impact of the COVID-19 pandemic on enplanements at SBN, the projections presented here depart from the typical methods that exist for master plan forecasting of passenger enplanement activity at an airport. Near-term projections will consider the recovery of enplanements to pre-COVID-19 levels. The mid- and long-term projections will present future enplanement growth.

The enplanement projections for SBN include passengers on scheduled commercial service airline flights as well as passengers onboard charter flights. In 2019, charter passengers made up 1.6 percent of the total enplanements at SBN and over the last five years have averaged 1.9 percent of the total enplanements. These passengers are typically associated with sporting events or other activities at nearby University of Notre Dame.

Despite South Bend's growing population base and relatively robust corporate economy, SBN experienced historic declines in service and enplanements that mirrored national trends following 9/11 and the Great Recession. Between 2001 and 2017, airline mergers, carrier attempts to reduce capacity and increase load factors and profits, and the rapid retirement of the 50-seat regional jet contributed to the decline and leveling of service and enplanement levels at SBN. However, the downward trend at SBN ended in in 2017 and between 2017 and 2019 enplanements grew 37 percent with the introduction of additional service. The decline in 2020 due to the COVID-19 pandemic was dramatic, but SBN fared better than many other U.S. airports (See Figure 2-10). It is anticipated that SBN will experience growth again, albeit at smaller rates than experienced prior to the pandemic due to the cautious decisions of air carriers.

Recovery to Pre-COVID Enplanements

As noted above, three recovery scenarios have been developed that will estimate the return to pre-pandemic traffic levels. These scenarios consider a variety of factors that will lead to recovery. As shown in **Table 2-11**, the Base Case scenario assumes a full recovery to 2019 enplanement levels in 2024.This scenario follows several industry projections including the S&P Base Case Scenario, Fitch Rating Case Scenario, A4A Optimistic Scenario, and the IATA projections (presented in Figures 2-5 and 2-6).

Table 2-11: Near-Term Enplanement Recovery Scenarios (% of 2019 Enplanements)

Year	Base Case	Optimistic Recovery	Pessimistic Recovery
2019	100%	100%	100%
2020 Actual	49%	49%	49%
2021	70%	75%	65%
2022	85%	90%	75%
2023	93%	100%	83%
2024	100%		90%
2025			96%
2026			100%

Source: Marr Arnold Planning, 2021; Airlines for America; S&P Global; Moody's Investment Service; FitchRatings; IATA.

The Optimistic Recovery Scenario presents a return to 2019 enplanement levels by 2023. This scenario makes the following assumptions:

- Accelerated rates of vaccination and better than expected rates vaccine efficacy
- Lifting of most travel restrictions
- Better-than-expected economic outlook/stimulus
- Quicker return of business travel than anticipated
- Strong resurgence of personal and recreational travel

The Pessimistic Recovery Scenario projects SBN's pre-pandemic traffic levels returning in 2026. This scenario assumes the following:

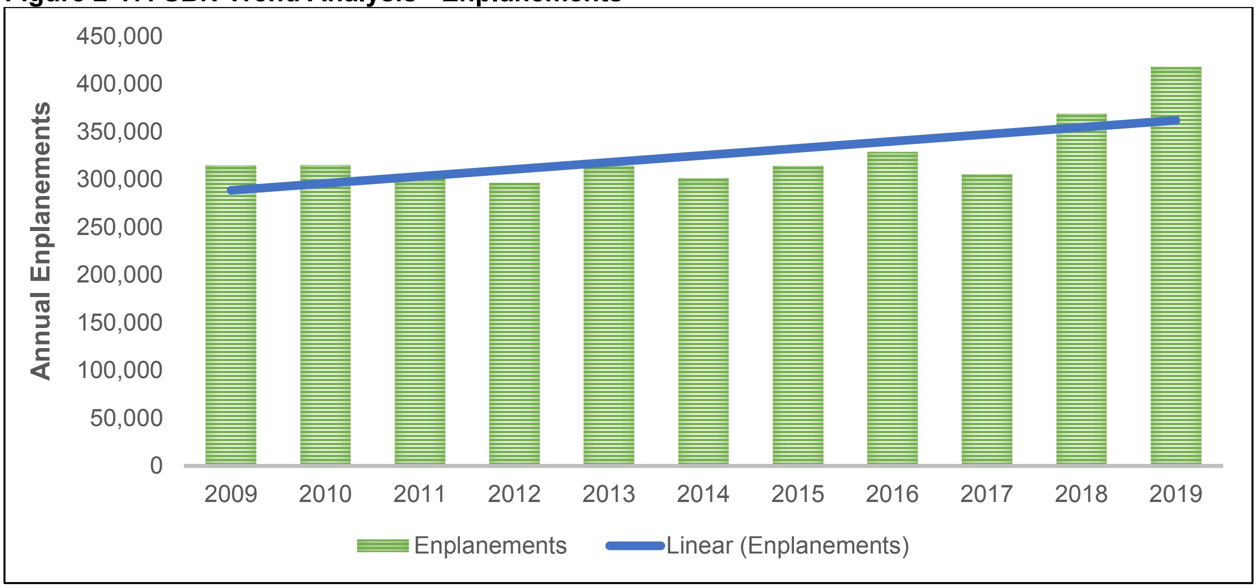
- Vaccines fail to address COVID variants
- Lower rates of vaccination and public acceptance
- Travel restrictions remain for a longer period
- Longer economic recovery
- Business travel continues to lag due to safety and cost concerns

Mid- and Long-Term Enplanement Projections

To estimate the long-term forecast for SBN and the Airport Market Area, a historical trendline analysis was used. Other methodologies were considered including multiple regression and market share; however, their practical application is difficult due to unknowns regarding the pandemic and the recovery. Although the trend analysis methodology does not consider economic factors, fuel prices or industry changes, it is a valuable modeling tool that allows a conservative approach to projecting long term enplanement growth. This methodology does consider the growth experienced at SBN between 2017 and 2019 and recognizes that once enplanement levels recover from the impact of the pandemic, enplanements will begin to grow, albeit at lower rates than experienced during the jump from 2017-2019.

The trend analysis method assumes that the historical enplanement growth between 2009 and 2019 is representative of the rate of future growth at SBN, once the enplanement levels recover to pre-COVID-19 levels. While the number of enplanements may not be a constant rate of growth and may fluctuate historically by year, a "best fit" or simple mathematical trend line can be developed using the historical totals, carried forward from the base year through the forecast horizon. The trendline analysis for enplanements at SBN yielded a CAGR of 2.3 percent compared to the historical CAGR of 2.9 percent over the 10-year period. The trend shows growth from 2009-2019 and is presented in **Figure 2-17**.

Figure 2-17: SBN Trend Analysis - Enplanements



Source: Airport management records; Marr Arnold Planning, 2021

Preferred Enplanement Projection

The near-term recovery estimates were combined with a long-term growth rate that applies the 2.3 percent CAGR after enplanements at SBN recover to 2019 levels to develop three enplanement forecast scenarios. The Base Case forecast is supplemented by two sensitivity forecasts to be used by SBN to represent a range of potential passenger activity at SBN through the planning horizon. The Base Case as well as the Optimistic Recovery and Pessimistic Recovery scenarios of enplanements are presented in **Table 2-12** and **Figure 2-18**.

The Base Case forecast shows that between 2019 and 2040, SBN enplanements are projected to grow at 1.7 percent per year on average, reaching just over 600,000 annual enplanements at the end for the forecast period. The CAGR is less than the FAA's most recent *Aerospace Forecast Fiscal Years* 2020-2040 which presents U.S. enplanement projected growth (developed prior to the COVID-19 pandemic) of 2.0

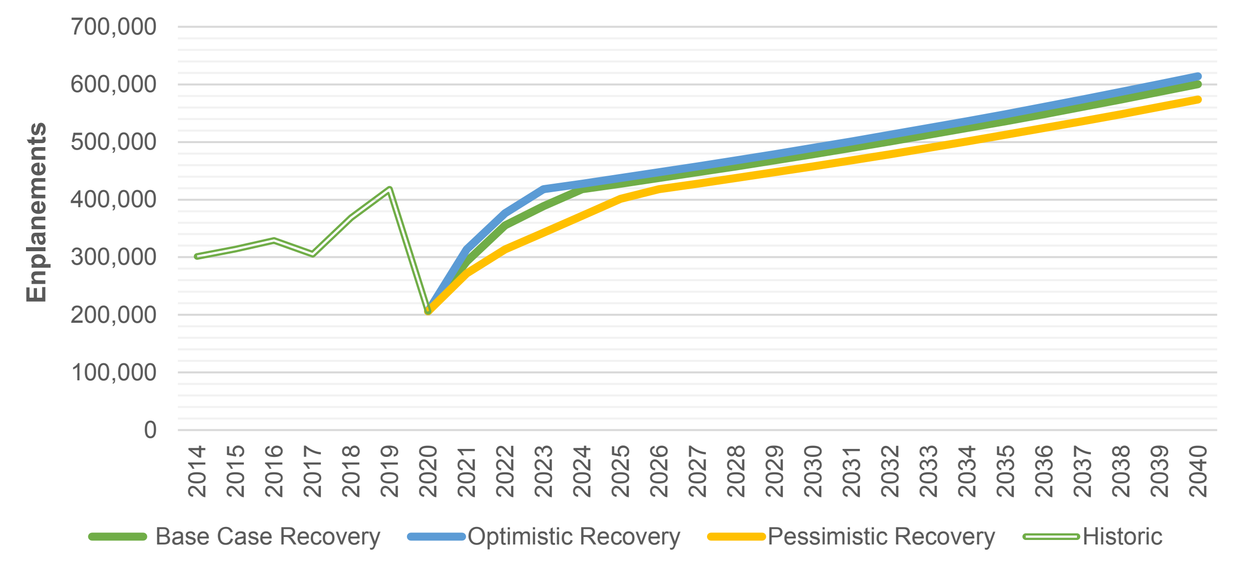
percent CAGR. The Optimistic Recovery Scenario grows at a slightly higher CAGR of 1.8 percent while the Pessimistic Recovery Scenario grows at a CAGR of 1.5 percent over the next 20 years.

Table 2-12: SBN Passenger Enplanement Forecast Summary

Year	Base Case[1]	Optimistic Recovery[1]	Pessimistic Recovery[1]
2019 (Actual)	417,929	417,929	417,929
2020 (Actual)	207,128	207,128	207,128
2025 (PAL1)	427,500	437,300	401,300
2030 (PAL 2)	478,800	489,700	457,600
2035 (PAL 3)	536,100	548,400	512,400
2040 (PAL 4)	600,400	614,100	573,800
CAGR[2]			
2019-2025	0.4%	0.8%	-0.7%
2025-2030	2.3%	2.3%	2.7%
2030-2040	2.3%	2.3%	2.3%
2019-2040	1.7%	1.8%	1.5%

Source: Airport management records; Marr Arnold Planning, 2021
Notes: [1] Includes passengers on scheduled airlines and charter flights
[2] CAGR = Compound Average Growth Rate

Figure 2-18: SBN Passenger Enplanement Projections



Source: Airport management records; Marr Arnold Planning, 2021

Passenger Peaking Characteristics

An additional element necessary for determining future passenger terminal requirements is the identification of peak period activity. A peak period is an interval of time, normally defined as month, day, or hour (60-minute period), that represents an event of the busy flow passengers that must be accommodated.

The peak month represents the busiest month during a calendar year, which can vary from year to year. Between 2014 and 2019, the peak month at SBN is either March or October, when there is an increased amount of recreational travel associated with spring break trips in March or visitors flying in to attend

University of Notre Dame football games in October. The peak represents approximately 10 percent of annual operations.

The average day peak month (APDM) enplanements are determined by dividing the peak month by 31. This is developed for design day planning efforts. A separate peak day enplanement projection has also been developed based on the actual peak day at SBN that coincides with University of Notre Dame home football games, which causes a large influx of visitors through SBN as well as the city. The peak hour represents the busiest one-hour period from the busiest month. The peak hour at SBN typically occurs during the early morning hours when flights originate at the airport. University of Notre Dame football game day can also change the peak hour dynamics used for planning at SBN. The peak hour at SBN usually represents about 15 percent of the daily enplanements. This is anticipated to continue through the forecast period. **Table 2-13** presents peak month, ADPM, peak day, and peak hour enplanements at SBN for each of the three enplanement projection scenarios.

Table 2-13: SBN Peak Passenger Demand

		Forecast			
	Actual 2019	2025 PAL 1	2030 PAL 2	2035 PAL 3	2040 PAL 4
Base Case					
Peak Month Enplanements	40,371	42,750	47,880	53,610	60,040
Average Day Peak Month (ADPM)	1,302	1,379	1,545	1,729	1,937
Peak Day Enplanements	1,762	1,866	2,090	2,340	2,620
Peak Hour	267	280	313	351	393
Optimistic Recovery					
Peak Month Enplanements	40,371	43,730	48,970	54,840	61,410
Average Day Peak Month (ADPM)	1,302	1,411	1,580	1,769	1,981
Peak Day Enplanements	1,762	1,909	2,137	2,394	2,680
Peak Hour	267	286	321	359	402
Pessimistic Recovery					
Peak Month Enplanements	40,371	40,130	45,760	51,240	57,380
Average Day Peak Month (ADPM)	1,302	1,295	1,476	1,653	1,851
Peak Day Enplanements	1,762	1,751	1,997	2,236	2,504
Peak Hour	267	263	300	335	376

Source: Airport management records; Marr Arnold Planning, 2021

2.4.2. Air Cargo

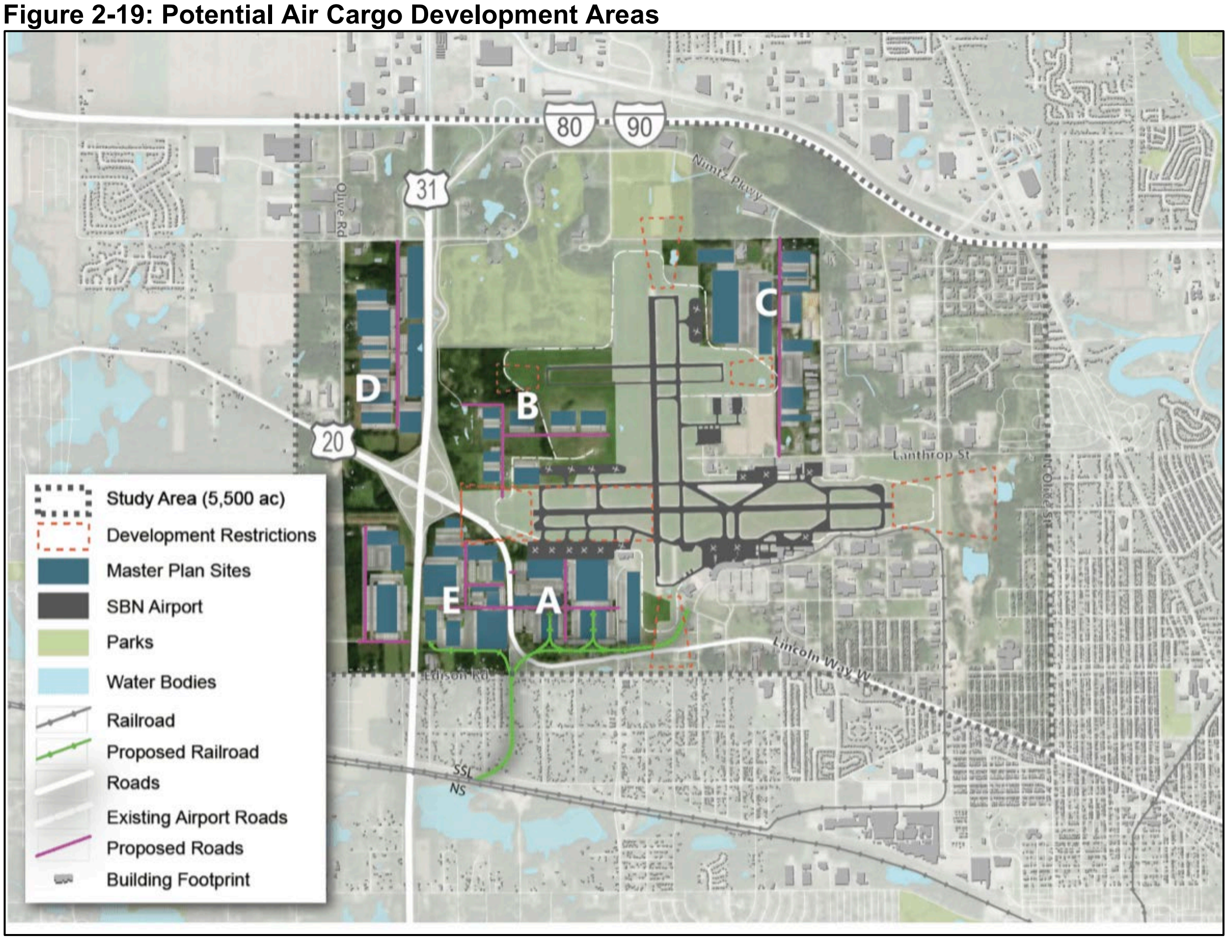
In 2020, 1,494 air cargo operations were performed at SBN, and all cargo airlines carried 19.1 million pounds of air cargo (enplaned and deplaned). SBN released the South Bend International Airport Freight Master Plan in 2020 which identified opportunities for air cargo development. The Freight Master Plan highlighted how e-commerce has grown rapidly in recent years. Air freight has emerged as an efficient and cost-effective alternative for shipping bulk orders to regional hubs due in large part to the development of mega-scale warehousing distribution centers by retailers such as Amazon. These retailers then use innovative last-mile freight mobility distribution strategies to deliver products.

The Freight Master Plan noted the competitive advantages SBN has compared to other regional air freight competitors including Rockford International Airport, Gerald R. Ford International Airport, and Rickenbacker International Airport. These advantages include:

- Located in the epicenter of manufacturing in the U.S. and within a 90-minute drive of Chicago
- Located along major transportation corridors including I-80/I-90 and within 25 miles of I-94
- Leads competing airports in terms of the amount of trucking freight that passes within a 60-mile radius of SBN
- Located within close proximity (seven miles) to the Indiana Enterprise Center (IEC), which supports agribusiness, advanced manufacturing, and smart logistics
- Greater amount of airport-adjacent land with airside access immediately available (See **Figure 2-19**)
- More compatible surrounding land uses (industrial, commercial) compared to competing airports
- Customs clearance for international flights

According to the Freight Master Plan, SBN can leverage its central location and the amount of developable land to identify opportunities to secure additional domestic and international cargo service. SBN is actively pursuing additional air cargo opportunities and looking to establish itself as a global logistics hub. The Freight Master Plan did not include projections of air cargo for SBN. However, a high growth air cargo forecast scenario has been developed as part of this master plan that illustrates the possible growth in air cargo should SBN capitalize on the opportunities highlighted in the Freight Master Plan.

Figure 2-19: Potential Air Cargo Development Areas



Source: South Bend International Airport Freight Master Plan, 2020

As COVID-19 spread, there was a dramatic impact on the air cargo industry. A loss of long-haul passenger belly capacity from widebody fleets created capacity shortfalls. Freighter operators responded by operating above normal utilization levels to fill the shortfall. E-commerce, which was already growing at double-digit rates prior to the pandemic, boomed during the economic downturn as shoppers turned to online retail. The maritime and trucking industries also experienced significant disruptions during the pandemic leading to an increased demand for air cargo. Express carriers, including UPS and FedEx that serve SBN, fared well because of the market turmoil in 2020. Boeing's *World Air Cargo Forecast 2020-2039* assumes that long-haul widebody passenger traffic will return in the coming years and air cargo will then reflect market dynamics much closer to what we have seen in the years prior to the COVID-19 disruption. Boeing's base forecast projects that the U.S domestic air cargo market will grow 2.7 percent per year on average through 2039. This growth will be driven by continued fast-paced growth of e-commerce over the next 10 years.

Three growth scenarios are presented that show a range of growth for air cargo for SBN. Since cargo did not experience the same industry-wide decline experienced by commercial service passengers, the scenarios are not based on a recovery to pre-COVID-19 levels but will grow from 2020 actual enplaned and deplaned cargo. The Base Case forecast anticipates that air cargo growth at SBN will be equal to Boeing's projected rate for North American annual air cargo growth published in the *World Air Cargo Forecast 2020-2039*, which predicts U.S. domestic air cargo will grow at a CAGR of 2.7 percent over the 20-year forecast. The High Growth Scenario anticipates SBN will gain additional service and on-airport cargo development as outlined in the Freight Master Plan. Air cargo will grow at 5.4 percent per year on average under this scenario. The Low Growth Scenario anticipates that FedEx and UPS will use the same aircraft type and will grow slightly at approximately 1.4 percent annually to accommodate future cargo growth, which is half the rate projected by Boeing for the U.S. domestic air cargo market.

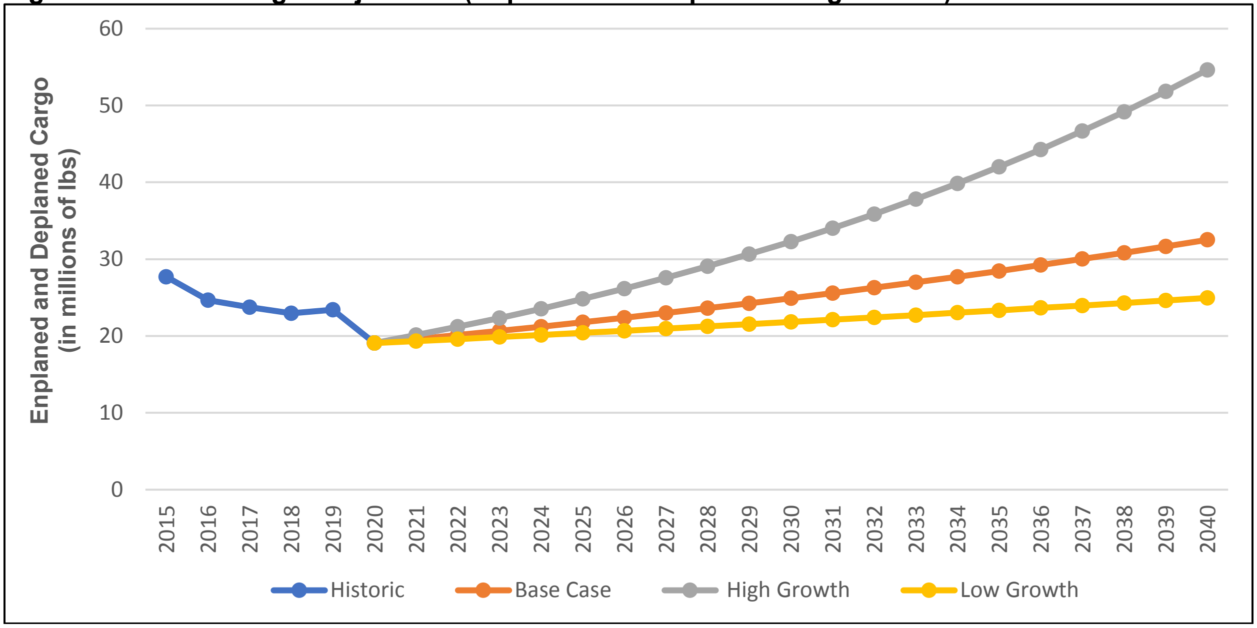
SBN cargo projections are shown in **Table 2-14** and graphically depicted in **Figure 2-20**. As shown in the graph, projected enplaned and deplaned air cargo (in pounds) under the Base Case Scenario would not reach 2019 levels until the last seven years of the forecast period.

Table 2-14: SBN Cargo Forecast Summary (Enplaned and Deplaned Cargo in lbs.)

Year	Base Case	High Growth	Low Growth
2020 (Actual)	19,083,937	19,083,937	19,083,937
2025 (PAL1)	21,800,000	24,800,000	20,400,000
2030 (PAL 2)	24,900,000	32,300,000	21,800,000
2035 (PAL 3)	28,500,000	42,000,000	23,300,000
2040 (PAL 4)	32,500,000	54,600,000	25,000,000
CAGR[1] 2020-2040	**2.7%**	**5.4%**	**1.4%**

Source: Airport management records; Marr Arnold Planning, 2021
Notes: [1] CAGR = Compound Average Growth Rate

Figure 2-20: SBN Cargo Projections (Enplaned and Deplaned Cargo in lbs.)



Source: Airport management records; Marr Arnold Planning, 2021

2.4.3. Operations

The forecasts of annual aircraft operations are derived from the passenger enplanement forecasts and cargo activity described above and an evaluation of charter, general aviation, and military operations. The summary table of all operations projections is presented below. Each activity sector was developed as follows:

- Commercial service aircraft operations (both regional and mainline) are based on the enplaned passenger forecast and assumptions regarding average seats per departing aircraft and enplaned passenger load factor.
- Cargo airline operations are based on the air cargo forecast and assumptions regarding average cargo pounds per operation.
- Charter/nonscheduled operations are dependent largely on activities associated with the University of Notre Dame. In addition, the new FIS facility at SBN will likely attract additional international charter flights over the next 20 years. It is anticipated that charter operations will grow slightly over the forecast period as they are dependent on school travel policies and airline decision-making. Although the charter passengers are included in the enplanement projections, the charter operations have been forecasted separately from the commercial service operations projections for the purpose of this master plan.
- General aviation operations are forecast to increase at an average rate of 0.8 percent per year after they return to pre-COVID levels, which varies from 2022 to 2025 based on the recovery scenario. This increase is based on the pre-COVID growth at SBN from 2010-2019, which was up 3.9 percent per year on average, as well as FAA projections of general aviation operations.
- Military operations are based on data for the base year (2019) of the forecast and carried forward through the 2040 horizon year. While these operations can vary in any given year, the numbers for

each category have been relatively stable over the five years prior to the COVID-19 pandemic. Military operations are projected to remain unchanged.

Commercial Service Aircraft Operations

The level of commercial service operations is an aggregate function of passenger demand and the types of aircraft to be utilized to accommodate the commercial service enplanement projections presented above. When developing the commercial service operations projections, it is important to also consider the airline fleet mix that could potentially serve SBN.

As stated previously, both Delta and United have announced plans in the next several years to retire a significant portion of their small regional jet fleet. The use of small regional jets has become less economically viable for airlines as the fleet ages. The small regional jet made up 70 percent of the airline departures at SBN in 2019 and 61 percent of the departures in 2020. This, in turn, has the potential to impact long term forecasts as the airlines are transitioning to larger fleet types in the 70-120 seat range.

The commercial service aircraft operations projections were developed utilizing the Boarding Load Factor (BLF) Methodology. This methodology calculates a boarding load factor based on the total passenger boardings divided by the total seats available[8]. The historic BLFs for SBN for 2015 to 2020 are presented in **Table 2-15** and are developed with data provided by airport management. Based on 2019 enplanements and departures, SBN had a BLF of 81.0 percent.

Table 2-15: Historic Scheduled Commercial Service Aircraft Operations and Boarding Load Factors

	2015	2016	2017	2018	2019	2020
Operations	**11,556**	**12,228**	**12,132**	**14,256**	**15,522**	**10,326**
Narrow Body Jets	1,360	1,406	1,410	1,420	1,468	1,342
65+ Seat Regional Jets	402	106	2	2,040	3,254	2,710
50-seat Regional Jets	9,794	10,716	10,720	10,196	10,800	6,274
Boarding Load Factor (BLF)	**81.1%**	**82.4%**	**77.8%**	**78.8%**	**81.0%**	**54.8%**
Average Seats Per Departure	66	64	64	65	66	73
Enplanements[1]	307,343	322,637	299,823	362,497	411,390	207,128

Source: Airport management records
Notes: [1] Excludes non-revenue passengers but includes passengers on charter flights

It is important to note that the actual load factors at SBN are likely even higher than the BLF presented in Table 2-15. The BLF is calculated based on total enplanements divided by operations at SBN. Onboard passengers include non-revenue passengers who fill additional seats at SBN. A non-revenue passenger is considered airline staff that is often flying for free or at a discounted rate. In 2019, it was estimated that an additional 8,700 non-revenue passengers flew each way to and from SBN. This translates to an estimated 24 passenger enplanements per day. Non-revenue passengers are not accounted for in the passenger enplanement projections or the load factor for SBN. Note that these passengers are also occupying seats

[8] The Boarding Load Factor (BLF) is used to forecast commercial service operations for this master plan. The calculation differs from the load factor calculated by the U.S. DOT found on the Bureau of Transportation (BTS) website. BTS uses a calculation of revenue passenger miles (RPMs) divided by available seat miles (ASMs) as reported by the airlines to determine load factor. The BLFs are generally 2-5 percent less than the SBN load factors found on the BTS website.

on airplanes, and the actual departing load factor is probably somewhat higher than shown. Also, although the historic and projected enplanements include charter passengers, the historic operations used to calculate BLF and forecast future commercial service operations only include scheduled airlines operations. Charter operations projections have been developed separately below.

Several assumptions are made to project commercial service operations. The BLF and the average number of seats per departure will increase just slightly over the forecast period. These assumptions follow industry trends that were discussed earlier in this chapter. The assumptions are as follows:

- The average seats per departure is projected to increase from 66 in 2019 to 82 in 2040 based largely on the retirement of 50-seat regional jets (RJs) and the projected replacement with 65+ seat RJs in airline fleets. The use of narrow body jet aircraft will also increase over the next 20 years. Average seats per departure will increase at an average annual rate of 0.6 percent over the forecast period to account for the shift.
- The share of operations by aircraft type are expected to change drastically as airlines continue to retire the 50-seat RJ over the next 20 years and replace them with a combination of larger RJs and narrow body jets. This changing fleet mix estimate is based on what airlines have recently reported regarding their plans for aircraft deliveries and retirements as of the writing of this report. The 50-seat RJs will only account for 16.4 percent of the flights in 2040, compared to 69.6 percent in 2019. Narrow body jets will make up 18.8 percent of the market while larger RJs will account for 64.8 percent of the commercial service operations by the end of the forecast period.
- The BLF is projected to increase to 83.6 percent by 2040. The BLF is expected to grow 0.2 percent per year on average as airlines try to keep capacity aligned with demand and add service cautiously. It is estimated that the BLF will reach 2019 levels by 2024, similar to the Base Case enplanement forecast. A growing BLF at SBN is in line with *FAA Aerospace Forecasts 2021-2041* projections of domestic load factors (found in Table 6: U.S. Commercial Carriers Scheduled Passenger Capacity, Traffic and Load Factors). The FAA projects domestic load factors (RPMs/ASMs) will grow at a faster rate at 1.1 percent per year on average over the next 20 years, reaching 86.6 percent, which is 3.5 percent higher than the BLF projected for SBN.

Projected seats per departure, BLFs, and the projected change in fleet mix are presented in **Table 2-16**.

Table 2-16: Assumptions for Projecting Commercial Service Operations

			Forecast Year				CAGR[1]
	2019	2020	2025 PAL 1	2030 PAL 2	2035 PAL 3	2040 PAL 4	2019-2040
Avg Seats Per Departure	66	73	75	78	80	82	0.6%
Boarding Load Factor (BLF)	81.0%	54.8%	82.0%	82.8%	83.4%	83.6%	0.2%
Share by Type							
Narrow Body Jets	9.5%	13.0%	15.1%	16.6%	17.9%	18.8%	3.3%
65+ Seat Regional Jets	21.0%	26.2%	33.5%	42.7%	53.3%	64.8%	5.5%
50-Seat Regional Jets	69.6%	60.8%	51.4%	40.6%	28.8%	16.4%	-6.7%

Source: Airport management records; Marr Arnold Planning, 2021
Notes: [1] CAGR = Compound Average Growth Rate

The BLF methodology used to calculate commercial service operations is as follows:

Commercial Service Operations =

Projected Enplanements / Boarding Load Factor / Average Seats Per Departure x 2

Example:

2025 Projected Base Case Enplanements	427,500
Divided by Projected BLF (rounded)	82.0%
Divided by Projected Seats per Departure (rounded)	74.5
Times	2
Equals 2025 Projected Commercial Service Operations	13,837

(**may not calculate to total due to rounding**)

Based on the assumptions, the Base Case forecast projects commercial service operations will reach approximately 17,400 by 2040, resulting in a CAGR of 0.5 percent. This scenario, along with the Optimistic Recovery forecast (mirrors the quicker recovery from the COVID-19 pandemic as projected for enplanements) and Pessimistic Recovery scenario (projects a slightly longer pandemic recovery), is presented in **Table 2-17.** In the Base Case projection, total commercial service operations are not expected to reach 2019 pre-pandemic levels until 2033. This is due to the lack of aircraft available to serve the SBN market in the near term as the 50-seat RJs are retired and a one-for-one replacement is not readily available.

Table 2-17: SBN Projections of Scheduled Commercial Service Operations

			Forecast Year				
	2019	2020	2025 PAL 1	2030 PAL 2	2035 PAL 3	2040 PAL 4	CAGR[1] 2019-2040
Base Case							
Total Operations	15,522	10,326	13,837	14,891	16,061	17,414	0.5%
Narrow Body Jets	1,468	1,342	2,085	2,477	2,878	3,280	3.9%
65+ Seat Regional Jets	3,254	2,710	4,635	6,366	8,556	11,287	6.1%
50-Seat Regional Jets	10,800	6,274	7,118	6,048	4,627	2,847	-6.2%
Optimistic Recovery							
Total Operations	15,522	10,326	14,154	15,230	16,430	17,811	0.7%
Narrow Body Jets	1,468	1,342	2,133	2,533	2,944	3,355	4.0%
65+ Seat Regional Jets	3,254	2,710	4,741	6,511	8,753	11,545	6.2%
50-Seat Regional Jets	10,800	6,274	7,281	6,186	4,733	2,912	-6.1%
Pessimistic Recovery							
Total Operations	15,522	10,326	12,989	14,232	15,351	16,643	0.3%
Narrow Body Jets	1,468	1,342	1,957	2,367	2,751	3,134	3.7%
65+ Seat Regional Jets	3,254	2,710	4,351	6,084	8,178	10,787	5.9%
50-Seat Regional Jets	10,800	6,274	6,681	5,781	4,422	2,721	-6.4%

Source: Airport management records; Marr Arnold Planning, 2021
Notes: [1] CAGR = Compound Average Growth Rate

Air Cargo Operations

The projection of air cargo operations is based on growing the freight per operation over the forecast period. In 2020, there were 12,700 pounds of freight per operation on average, down from 15,400 pounds per operation in 2019. It is estimated that the pounds per operation will increase from 12,700 in 2020 to 18,000 pounds in 2040 (the same average amount as carried in 2014 and 2015) as e-commerce continues to grow the demand for air cargo as noted in Boeing's *2020 Air Cargo Forecast*. To estimate air cargo operations, the total air cargo (enplaned and deplaned) from Table 2-14 was divided by the estimate of freight per operation. The Base Case scenario anticipates that annual operations by all-cargo carriers are projected to grow 1.0 percent per year on average through the forecast period.

Charter Operations

As noted above, SBN accommodates charter activity including charter operations and passengers associated with various University of Notre Dame activities, including sporting events. These flights are on a variety of aircraft depending on the team size and range from smaller turboprops to narrow body jets. In addition, as an FIS facility (opened in 2019), SBN can accommodate international charter flights. On average, charter passengers comprised 1.9 percent of the total enplanements between 2014 and 2019. In 2019, charter passengers were 1.6 percent of the total passengers. Charter flights were down 43 percent in 2020 due to the pandemic.

It is anticipated that charter operations associated with the University of Notre Dame will remain relatively unchanged over the next 20 years and the growth will largely be driven by international charter flights using the new FIS facility. The forecast assumes that charter enplanements as a percentage of total enplanements will decline slightly over the forecast period (from 1.6 percent to 1.3 percent) and the number of charter enplanements per operation (2019) will remain the same (25.2) over the next 20 years. The growth in charter operations is expected to be less than the growth projected for commercial service operations.

General Aviation Aircraft Operations

For this forecast, total general aviation operations include 'General Aviation Itinerant' and 'Local Civil' operations as recorded by the SBN air traffic control tower (ATCT) and downloaded from the FAA Operations Network (OPSNET) database. In addition, general aviation air taxi operations, which are included in the 'Air Taxi/Commuter" category of the OPSNET database, have been estimated and included in the total general aviation itinerant operations category. The air taxi operations were estimated by subtracting the scheduled commercial service, charter, and air cargo operations (as reported by SBN airport management) from the total itinerant air carrier and air taxi operations (as reported by OPSNET).

Following a growth period from 2010 to 2019 (3.9 percent CAGR), general aviation operations at SBN declined in 2020 due to the pandemic. Three recovery scenarios of general aviation operations reflecting a return to pre-pandemic levels have been developed. The Base Case forecast shows a recovery to 2019 levels by 2023. This is due to the slower recovery of corporate aviation nationally, as business travel patterns shifted during the pandemic and the continued limits and safety concerns regarding large gatherings such as University of Notre Dame football games. The Optimistic Recovery scenario predicts a recovery by 2022 and the Pessimistic Recovery Scenario prolongs the recovery until 2025.

It is anticipated that general aviation operations will grow at a 0.8 percent CAGR post-recovery. This average annual growth rate is adopted from the *FAA Aerospace Forecasts Fiscal Years 2021-2041* projection of general aviation operations at towered airports (Table 32) from 2021-2041. This growth includes international operations that use SBN's GAF facility. It is forecast that SBN will continue to experience a significant number of business jet operations relative to other aircraft types. This is the result of a higher percentage of use for business-related purposes and a lower percentage of use for training and pleasure flying.

Total Operations

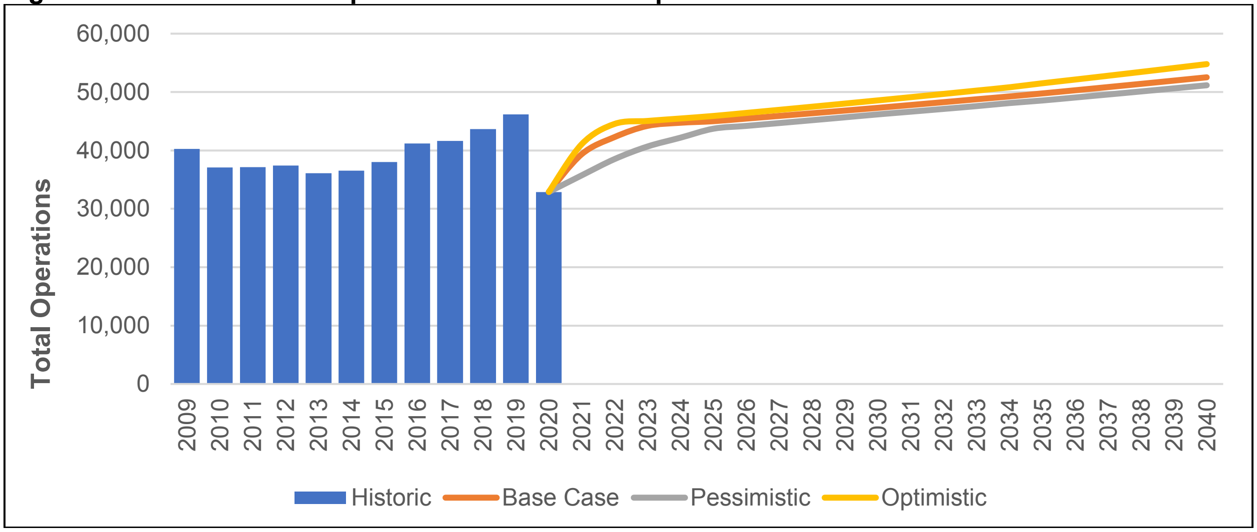
The forecast of total operations for SBN are a summation of the air carrier, cargo, charter, general aviation, and military operations forecasts. **Table 2-18** and **Figure 2-21** show projected totals over the next 20 years.

Table 2-18: Summary of Operations Forecast by Type

Scenario / Operation Type	2019	2020	Forecast Years 2025 PAL 1	2030 PAL 2	2035 PAL 3	2040 PAL 4	CAGR[1] 2019-2040
Base Case Forecast							
Air Carrier	15,522	10,326	13,837	14,891	16,061	17,414	0.5%
Cargo	1,520	1,494	1,557	1,606	1,676	1,806	0.8%
Charter	520	298	544	571	597	621	0.8%
General Aviation	28,018	20,453	28,468	29,625	30,829	32,082	0.6%
Local	10,351	7,867	10,517	10,945	11,390	11,853	0.6%
Itinerant[2]	17,667	12,586	17,951	18,680	19,440	20,230	0.6%
Military	594	317	600	600	600	600	0.0%
Total	**46,174**	**32,888**	**45,006**	**47,294**	**49,764**	**52,523**	**0.6%**
Low Growth/Pessimistic Recovery							
Air Carrier	15,522	10,326	12,989	14,232	15,351	16,643	0.3%
Cargo	1,520	1,494	1,569	1,615	1,664	1,724	0.6%
Charter	520	298	544	571	597	621	0.8%
General Aviation	28,018	20,453	28,468	29,157	30,342	31,575	0.6%
Local	10,351	7,867	10,351	10,772	11,210	11,665	0.6%
Itinerant[2]	17,667	12,586	17,667	18,385	19,132	19,910	0.6%
Military	594	317	600	600	600	600	0.0%
Total	**46,174**	**32,888**	**43,720**	**46,175**	**48,554**	**51,163**	**0.5%**
High Growth/Optimistic Recovery							
Air Carrier	15,522	10,326	14,154	15,230	16,430	17,811	0.7%
Cargo	1,520	1,494	1,908	2,307	2,800	3,413	3.9%
Charter	520	298	544	571	597	621	0.8%
General Aviation	28,018	20,453	28,468	29,862	31,076	32,339	0.7%
Local	10,351	7,867	10,601	11,032	11,481	11,947	0.7%
Itinerant[2]	17,667	12,586	18,094	18,830	19,595	20,392	0.7%
Military	594	317	600	600	600	600	0.0%
Total	**46,174**	**32,888**	**45,902**	**48,571**	**51,503**	**54,784**	**0.8%**

Source: Marr Arnold Planning, 2021; 2019 & 2020 Air Carrier, Air Cargo, and Charter operations: Airport management records; 2019 & 2020 General Aviation & Military Operations: FAA OPSNET
Notes: [1] CAGR = Compound Average Growth Rate
[2] Includes estimated general aviation air taxi operations that are normally included in the 'Air Taxi/Commuter' category of the FAA OPSNET database. Air taxi operations were estimated by subtracting the air carrier, air cargo, and charter operations recorded by airport management from the Total Air Carrier and Air Taxi/Commuter operations recorded by the FAA OPSNET database from ATCT counts.

Figure 2-21: SBN Aircraft Operations Forecast Comparison



Source: Marr Arnold Planning, 2021; 2019 & 2020 Air Carrier, Air Cargo, and Charter operations: Airport management records; 2019 & 2020 General Aviation & Military Operations: FAA OPSNET

Peak Period Operations Forecast

An additional element in assessing airport use and determining various capacity and demand considerations is to establish peak period activities. According to Air Traffic Control (ATC) records, the peak month for aircraft activity is historically in September. The peak is associated with itinerant aircraft in town for football games at the University of Notre Dame. In 2018, September was the peak month, with 5,400 monthly operations. For this analysis, this translates to approximately 180 operations during an average day during the peak month and roughly 27 peak hour operations. Peaking characteristics have been developed using FAA statistics and assumptions which suggest activity patterns will likely mirror years prior to the pandemic. The projected peak period operational activities are illustrated in **Table 2-19.**

Table 2-19: SBN Peak Hour Operations Forecast

	Baseline	2025 PAL1	2030 PAL 2	2035 PAL 3	2040 PAL 4
Base Case					
Peak Month	5,400	5,568	5,851	6,157	6,498
Average Day of Peak Month	180	186	195	205	217
Peak Hour	27	28	29	31	32
Optimistic Recovery					
Peak Month	5,400	5,679	6,009	6,372	6,778
Average Day of Peak Month	180	189	200	212	226
Peak Hour	27	28	30	32	34
Pessimistic Recovery					
Peak Month	5,400	5,409	5,713	6,007	6,330
Average Day of Peak Month	180	180	190	200	211
Peak Hour	27	27	29	30	32

Source: FAA OPSNET; Marr Arnold Planning, 2021

2.4.4. Based Aircraft

Estimating the number and type of aircraft expected to be based at SBN over the next 20 years impacts planning for future facility and infrastructure requirements. Based aircraft at SBN did not experience a decline in 2020 like operations due to the pandemic. For the master plan, it is assumed that based aircraft will grow at a conservative rate over the forecast period and will not be impacted by recovery scenarios. Current general aviation industry trends were used to develop the based aircraft forecast at SBN. It is anticipated that single engine piston aircraft will experience declines over the next 20 years, while turbine aircraft, especially jet aircraft, are anticipated to grow due to advancements in fuel efficiency and aircraft technology. The number of aircraft in the business aviation market has grown on all fronts including new and used purchases and leases, fractional ownership, and charter options. Based on this growth, and the *FAA Aerospace Forecast 2020-2040* projections for based turbine aircraft following a positive trend, it is anticipated that turbine aircraft and rotorcraft at SBN will increase throughout the planning period. The based aircraft projection for SBN is presented in **Table 2-20** and is carried forward in the master planning process to examine future airport facility needs.

Table 2-20: SBN Based Aircraft Projections

Year	Single Engine	Multi-Engine	Turboprop	Jet	Helicopter	Total
2020	51	22	2	6	1	82
2025	51	22	3	7	1	84
2030	51	22	3	8	2	86
2035	51	22	4	9	2	88
2040	51	22	4	10	3	90

Source: Indiana Department of Revenue; Marr Arnold Planning, 2021

2.5 Critical Aircraft Analysis

Knowledge of the types of aircraft currently using and those that are expected to use SBN provides insight in determining the critical aircraft for each runway. The critical aircraft as defined by FAA AC 150/5000-17, *Critical Aircraft and Regular Use Determination*, can be a single aircraft type or a family grouping of aircraft types based on similar operational and physical characteristics. The Runway Design Code (RDC) as presented in FAA AC 150/5300-13B, *Airport Design*, offers a method to classify aircraft by their operational and physical characteristics that is used in the design of runways and other airfield surfaces. The RDC classification system can be used to determine the critical aircraft using or projected to use a runway on a regular basis. FAA AC 150/5000-17 defines regular basis as 500 or more annual aircraft operations (landings and takeoffs are considered as separate operations). Combining the Aircraft Approach Category (AAC) and Airplane Design Group (ADG) classifications that comprise the RDC of a family grouping of aircraft types can be used in determining the critical aircraft.

In addition to determining the critical aircraft, the RDC provides the information required to determine the dimensional criteria standards that apply to a runway. The first component, depicted by a letter, is the AAC and relates to the aircraft approach speed. The second component, depicted by a roman numeral, is the ADG and relates to the aircraft wingspan and tail height. The AAC and ADG are presented in **Tables 2-21** and **2-22**.

Table 2-21: Aircraft Approach Category (AAC)

AAC	Approach Speed
A	Approach speed less than 91 knots
B	Approach speed 91 knots or more but less than 121 knots
C	Approach speed 121 knots or more but less than 141 knots
D	Approach speed 141 knots or more but less than 166 knots
E	Approach speed 166 knots or more

Source: FAA AC 150/5300-13B, *Airport Design*

Table 2-22: Airplane Design Group (ADG)

ADG	Tail Height	Wing Span
I	Less than 20 Feet	Less than 49 Feet
II	Greater than 20, but less than 30 Feet	Greater than 49, but less than 79 Feet
III	Greater than 30, but less than 45 Feet	Greater than 79, but less than 118 Feet
IV	Greater than 45, but less than 60 Feet	Greater than 118, but less than 171 Feet
V	Greater than 60, but less than 66 Feet	Greater than 171, but less than 214 Feet
VI	Greater than 66, but less than 80 Feet	Greater than 214, but less than 262 Feet

Source: FAA AC 150/5300-13B, *Airport Design*

FAA Instrument Flight Rules (IFR) flight data for SBN for the last four calendar years was obtained to determine the critical aircraft for each runway. IFR flight data is recorded when pilots file a flight plan with the FAA. The RDC of the critical design aircraft will influence the design standards of each runway.

Table 2-23 summarizes the operations by aircraft RDC. **Table 2-24** presents the confirmed operations from the IFR data by RDC and aircraft type for the largest aircraft serving SBN. Traffic Flow Management System Count (TFMSC) data shows there were 216 unique aircraft that operate at SBN. There was a total of 28,500 IFR operations reported at SBN in 2019 and 18,400 operations in 2020. These numbers are slightly higher than the numbers found in the TFMSC database. For this master plan, the TFMSC data has been normalized to allow for equal monthly takeoffs and landings by equipment type. This reconciliation allows for every takeoff to also have a landing and vice versa.

There were nearly 1,000 operations by C-IV aircraft in 2019 and 2020. The most demanding aircraft expected to use SBN within the planning period is the B757-200 used by FedEx and UPS. Based on TFMSC data, the B757-200 conducted 962 operations in 2019 and 928 in 2020. Based on this information, the overall critical aircraft of SBN is the B757-200, which has an RDC of C-IV. The FedEx fleet currently includes 108 B757-200 aircraft. There are no plans to retire the B757-200 in the near term, and this aircraft is expected to continue service at SBN.

Table 2-23: Summary of Aircraft Operations by Airport Reference Code

AAC+ADG	2017	2018	2019	2020
A-I	1,966	1,738	1,688	1,328
A-II	302	250	214	96
A-III	-	-	2	-
B-I	1,962	1,938	1,540	910
B-II	4,468	4,750	4,812	2,720
B-III	14	16	24	14
B-IV	10	14		4
C-I	1,192	948	824	534
C-II	11,962	13,892	15,396	8,882
C-III	1,038	1,706	2,012	2,368
C-IV	970	990	978	978
C-V	4	14	6	2
D-I	86	80	46	22
D-II	178	194	214	80
D-III	986	660	402	178
D-IV	4	6	4	18
D-V	2	-	4	2
Other/No Data	224	286	348	274
Summary by AAC				
A	2,268	1,988	1,904	1,424
B	6,454	6,718	6,376	3,648
C	15,166	17,550	19,216	12,764
D	1,256	940	670	300
Summary by ADG				
I	5,206	4,704	4,098	2,794
II	16,910	19,086	20,636	11,778
III	2,038	2,382	2,440	2,560
IV	984	1,010	982	1,000
V	6	14	10	4
Total Ops	**25,368**	**27,482**	**28,514**	**18,410**

Source: FAA Traffic Flow Management System Counts, reconciled by Marr Arnold Planning to allow equal takeoffs and landings, 2021

Table 2-24: Summary of AAC C and D Aircraft Operations by Aircraft Type

C-I	2019	2020	C-III	2019	2020
LJ45 - Bombardier Learjet 45	298	212	A320 - Airbus A320 All Series	880	990
H25B - BAe HS 125/700-800/Hawker 800	358	180	CRJ9 - Bombardier CRJ-900	294	954
LJ60 - Bombardier Learjet 60	120	96	A319 - Airbus A319	546	332
C-I Other	48	46	B734 - Boeing 737-400	38	24
C-I Total	**824**	**534**	C-III Other	254	68
D-I	**2019**	**2020**	**C-III Total**	**2,012**	**2,368**
LJ35 - Bombardier Learjet 35/36	32	22	**D-III**	**2019**	**2020**
D-I Other	14	0	GLF5 - Gulfstream V/G500	274	90
D-I Total	**46**	**22**	B738 - Boeing 737-800	46	38
C-II	**2019**	**2020**	GLF6 - Gulfstream	38	20
CRJ2 - Bombardier CRJ-200	9,974	6,006	P8 - Boeing P-8 Poseidon	10	18
CRJ7 - Bombardier CRJ-700	3,120	1,966	D-III Other	34	12
E145 - Embraer ERJ-145	584	226	**D-III Total**	**402**	**178**
CL35 - Bombardier Challenger 300	222	174	**C-IV**	**2019**	**2020**
CL30 - Bombardier Challenger 300	320	162	B752 - Boeing 757-200	962	928
E135 - Embraer ERJ 135/140/Legacy	280	100	A306 - Airbus A300 B4-600	0	46
CL60 - Bombardier Challenger 600/601/604	320	94	C-IV Other	16	4
LJ75 - Learjet 75	40	48	**C-IV Total**	**978**	**978**
GALX - IAI 1126 Galaxy/Gulfstream G200	80	36	**D-IV**	**2019**	**2020**
E45X - Embraer ERJ 145 EX	306	8	B764 - Boeing 767-400	-	18
C-II Other	150	62	D-IV Other	4	0
C-II Total	**15,396**	**8,882**	**D-IV Total**	**4**	**18**
D-II	**2019**	**2020**			
GLF4 - Gulfstream IV/G400	214	80			
D-II Total	**214**	**80**			

Source: FAA Traffic Flow Management System Counts, reconciled by Marr Arnold Planning to allow equal takeoffs and landings, 2021

2.5.1. Usage By Runway

The number of aircraft operations by runway end are presented in **Tables 2-25**, **2-26**, and **2-27**. This data was provided by the FAA and derived from the FAA's IFP (Instrument Flight Procedures), Operations, and Airspace Analytics (IOAA) Tool. The Runway Usage Module within the tool provides detailed departure and arrival views with flight-level analysis capabilities to help analyze runway usage trends. Counts are derived from Threaded Track, which uses National Offload Program (NOP), Traffic Flow Management System (TFMS), ASDE-X and ADS-B data for consistency with 2019 data onwards. For data before January 2019, flight plans from the TFMS feed are the data source.

It is anticipated that the critical aircraft for each runway presented in the following sections will remain the same through the forecast period.

Runway 9R/27L (Primary)

As shown in **Table 2-25,** the critical aircraft for Runway 9R/27L, SBN's primary runway, is C-IV, with the representative type being the Boeing 757-200.

Table 2-25: Summary of IFR Operations by Aircraft Type for Runway 9R/27L (2019-2021)

ARC		2019		2020		2021	
		09R	27L	09R	27L	09R	27L
A	I	887	2,175	709	1,952	637	2,237
	II	50	126	17	60	35	120
B	I	368	1,005	228	644	208	683
	II	1,190	2,774	624	1,549	845	2,639
	III	6	10	4	6	5	6
C	I	196	461	104	328	100	410
	II	3,667	9,728	1,807	5,717	1,564	4,809
	III	535	1,259	496	1,530	919	3,113
	IV	283	645	299	614	242	577
	V	2	4	-	2	-	6
D	I	14	18	4	7	10	15
	II	55	122	22	35	23	97
	III	77	242	22	142	49	168
	IV	-	4	2	13	-	6
	V	-	2	1	-	-	-
No Data	No Data	95	328	87	279	146	317
#N/A	#N/A	105	274	88	312	106	344
Grand Total		**7,530**	**19,177**	**4,514**	**13,190**	**4,889**	**15,547**

Source: FAA IOAA Database

Runway 18/36 (Crosswind)

Runway 18/36, SBN's crosswind runway, has an RDC of C-III in 2021, as shown in **Table 2-26**. The design aircraft for Runway 18/36 is the CRJ-900 based on 2021 IFR operational data.

Table 2-26: Summary of IFR Operations by Aircraft Type for Runway 18/36 (2019-2021)

ARC		2019		2020		2021	
		18	36	18	36	18	36
A	I	421	405	530	388	929	558
	II	20	6	10	5	31	12
B	I	160	90	113	117	268	142
	II	340	322	288	253	999	488
	III	2	1	2		2	1
C	I	82	39	54	33	144	68
	II	879	789	719	566	1,275	692
	III	86	84	137	141	750	425
	IV	10	19	23	22	78	61
D	I	2		5	2	4	2
	II	20	6	11	10	48	14
	III	21	19	25	7	69	36
No Data	No Data	28	43	34	63	65	81
#N/A	#N/A	66	56	72	89	132	109
Grand Total		**2,137**	**1,879**	**2,024**	**1,696**	**4,794**	**2,689**

Source: FAA IOAA Database

Runway 9L/27R

Located on the north side of SBN and accommodating general aviation aircraft, the critical aircraft for Runway 9L/27R is a family grouping of A-I types (see **Table 2-27)**, with no single aircraft type recording more than 500 annual IFR operations in 2021. The representative aircraft in this category accounting for the most operations is the Diamond Star DA40.

Table 2-27: Summary of IFR Operations by Aircraft Type for Runway 9L/27R (2019-2021)

ARC		2019		2020		2021	
		09L	27R	09L	27R	09L	27R
A	I	129	373	124	401	111	468
	II	-	-	1	-	-	-
B	I	1	8	1	2	-	4
	II	-	-	-	-	-	1
C	I	-	-	-	-	-	-
	II	-	2	-	-	-	-
No Data	No Data	1	12	3	3	3	5
#N/A	#N/A	39	113	41	129	71	218
Grand Total		**170**	**508**	**170**	**536**	**185**	**696**

Source: FAA IOAA Database

2.6 Summary and Comparison to the FAA Terminal Area Forecast (TAF)

It is anticipated that SBN will see growth in all activity areas during the 20-year planning period. This chapter was developed during the COVID-19 pandemic. SBN, like every other commercial service airport in the country, was drastically impacted by the pandemic, and it is unknown when the aviation industry will recover as of the writing of this report. The projections of enplanements and operations presented above took a forecasting approach that estimated the return to pre-COVID-19 levels. Base Case, Optimistic Case, and Pessimistic Case Recovery scenarios were developed that made assumptions regarding vaccine roll-out, herd immunity, and the return of personal and corporate travel. These three recovery scenarios provide a range of future enplanements and operations that could occur at SBN. The Base Case scenario, the moderate forecast, will be carried through as the preferred forecast throughout the rest of the master plan and is summarized below.

The FAA requires that study-related forecasts be consistent with the TAF or include sufficient documentation to explain the difference. **Table 2-28** summarizes the Base Case forecast comparison to the TAF, most recently published in March 2021 as recommended in Appendix C of the FAA document, *Forecasting Aviation Activity by Airport*. A forecast is considered to be consistent with the FAA TAF if it:

- Differs by less than 10% in the 5-year forecast and 15% in the 10-year forecast, or
- Does not affect the timing or scale of an airport project, or
- Does not affect the role of the airport as defined in the current version of FAA Order 5090.3, *Field Formulation of the National Plan of Integrated Airport Systems.*

Table 2-28: Base Case Forecast Comparison with TAF

Forecast Element		Year	Airport Forecast	2021 TAF[1]	% Difference
Passenger Enplanements					
Base Year		2019[2]	411,390	410,179	0.3%
		2020	207,128	262,168	-21.0%
Base Year + 6 Years	PAL 1	2025	427,500	423,269	1.0%
Base Year + 11 Years	PAL 2	2030	478,800	468,622	2.2%
Base Year + 16 Years	PAL 3	2035	536,100	508,581	5.4%
CAGR[3] 2019-2035			1.7%	1.4%	
Commercial Operations[4]					
Base Year		2019[2]	23,745	20,841	13.9%
		2020	15,642	16,021	-2.4%
Base Year + 6 Years	PAL 1	2025	22,221	14,432	54.0%
Base Year + 11 Years	PAL 2	2030	23,607	15,666	50.7%
Base Year + 16 Years	PAL 3	2035	25,139	16,806	49.6%
CAGR[3] 2019-2035			0.4%	-1.3%	
Total Operations[5]					
Base Year		2019[2]	46,174	45,126	2.3%
		2020	32,888	35,862	-8.3%
Base Year + 6 Years	PAL 1	2025	45,006	40,744	10.5%
Base Year + 11 Years	PAL 2	2030	47,294	42,402	11.5%
Base Year + 16 Years	PAL 3	2035	49,764	43,973	13.2%
CAGR[3] 2019-2035			0.5%	-0.2%	

Source: Airport management records; FAA OPSNET; FAA TAF, 2021; Marr Arnold Planning, 2021
Notes: [1] TAF data is on a government fiscal year basis (October through September) and the airport data is on a calendar year basis.
[2] Due to COVID-19, the growth rate has been calculated on the 2019 base year.
[3] CAGR = Compound Average Growth Rate
[4] For the purpose of this comparison, commercial operations include air carrier, air cargo, charter, and air taxi general aviation operations.
[5] Total operations include commercial operations plus general aviation and military operations.

2.6.1. Enplanements

By 2035, approximately 536,000 enplanements and over 50,000 operations are projected to occur. The Base Case forecast of enplanements was generated through an extensive analysis of COVID-19 recovery scenarios, socioeconomic statistics, and historic trends. An Optimistic and Pessimistic Recovery scenario forecast were also developed to provide varying enplanement levels due to uncertainty in the industry's recovery. Enplanements in the Base Case forecast are within the FAA's approved forecast parameters.

2.6.2. Operations

Operations forecasts and derivatives were created using the results of the enplanement forecast and air cargo forecast. Industry trends were used to develop general aviation forecasts, and military activity is expected to remain unchanged over the forecast period. The FAA shows a dramatic decline in commercial service operations in the first five-year forecast period likely due to airline plans for the rapid retirement of the 50-seat regional jet fleet in the next several years.

The operations forecast developed for the master plan also considers a decline due to aircraft retirements. Many retirements occurred during 2020 and the decrease in actual operations at SBN reflected that decline. The master plan assumes the 50-seat RJ retirement will not be as rapid as predicted by the FAA. It also assumes that airlines will be replacing the retired 50-seat RJs with 70-seat to 100-seat aircraft more expeditiously than estimated by the FAA.

It is important to note that scheduled airline operations at SBN comprise an estimated 50 percent of the total commercial operations (the 'Air Carrier' plus 'Commuter' figures noted in TAF) shown in Table 2-28. The other 50 percent of commercial operations is comprised of air cargo, charter, and general aviation air taxi flights. Based on the large drop in the TAF's projected commercial operations, it would be difficult for SBN to accommodate the forecasted TAF enplanements with the forecasted commercial operations without a large shift by the existing legacy carriers (mainly United and Delta) to use of narrow body jet aircraft at SBN, which is not a likely occurrence in the near term.

As shown in Table 2-28, although the total operations projections for the five-year period exceeds the 10 percent allowance required by the FAA (10.5 percent), the 15-year projection differs by less than 15 percent from the TAF's total operations projections (13.2 percent).

SBN's projections included in the master plan took a thorough and conservative approach to estimating the recovery and the future growth of enplanements, operations, air cargo and based aircraft at SBN. **Table 2-29** summarizes the preferred projections to be carried forward in this master plan.

Table 2-29: Base Case Summary of Forecast Levels and Growth Rates

			Base Year:		2019							
								Average Annual Compound Growth Rates (2019 Base)				
	2019	2020	Base Yr. +1yr	Base Yr. +5yrs	Base Yr. +10yrs	Base Yr. +15yrs	Base Yr. +20yrs	Base Yr. to +1	Base Yr. to +5	Base Yr. to +10	Base Yr. to +15	Base Yr. to +20
Enplanements												
Air Carrier/Commuter	411,390	207,128	292,550	427,500	478,800	536,100	600,400	-15.7%	0.6%	1.4%	1.7%	1.8%
Operations												
Itinerant												
Air Carrier	15,522	10,326	11,616	13,837	14,891	16,061	17,414	-13.5%	-1.9%	-0.4%	0.2%	0.5%
Air Cargo	1,520	1,494	1,507	1,557	1,606	1,676	1,806	-0.4%	0.4%	0.5%	0.6%	0.8%
Charter	520	298	347	544	571	597	621	-18.3%	0.8%	0.9%	0.9%	0.8%
General Aviation	17,667	12,586	12,608	17,951	18,680	19,440	20,230	-15.5%	0.3%	0.5%	0.6%	0.6%
Military	228	203	225	225	225	225	225	-0.7%	-0.2%	-0.1%	-0.1%	-0.1%
Local												
General Aviation	10,351	7,867	12,608	10,517	10,945	11,390	11,853	10.4%	0.3%	0.5%	0.6%	0.6%
Military	366	114	375	375	375	375	375	1.2%	0.4%	0.2%	0.2%	0.1%
Total Operations	**46,174**	**32,888**	**39,286**	**45,006**	**47,294**	**49,764**	**52,523**	**-7.8%**	**-0.4%**	**0.2%**	**0.5%**	**0.6%**
Peak Hour Operations	**27**	**27**	**27**	**28**	**29**	**31**	**32**	**0.0%**	**0.5%**	**0.7%**	**0.8%**	**0.9%**
Freight Cargo (in million lbs.)	**23.4**	**19.1**	**19.6**	**21.8**	**24.9**	**28.5**	**32.5**	**-8.5%**	**-1.2%**	**0.6%**	**1.2%**	**1.6%**
Based Aircraft												
Single Engine (Nonjet)	52	51	51	51	51	51	51	-1.0%	-0.3%	-0.2%	-0.1%	-0.1%
Multi Engine (Nonjet)	24	24	24	25	25	26	26	0.0%	0.7%	0.4%	0.5%	0.4%
Jet Engine	6	6	6	7	8	9	10	0.0%	1.8%	2.6%	2.5%	2.4%
Helicopter	1	1	1	1	2	2	3	4.1%	1.4%	6.5%	4.4%	5.4%
Other	0	0	0	0	0	0	0					
Total Based Aircraft	**83**	**82**	**82**	**84**	**86**	**88**	**90**	**-0.6%**	**0.2%**	**0.3%**	**0.4%**	**0.4%**
Operational Factors												
Average Aircraft Size	65	73	69	75	78	80	82					
Average Boarding Load Factor	81.0%	54.8%	73.0%	82.0%	82.8%	83.4%	83.6%					
GA Operations per Based Aircraft	338	249	307	340	347	355	363					

Source: Airport management records, FAA OPSNET, Indiana Department of Revenue, Marr Arnold Planning, 2021

Chapter 3

Facility Requirements

This chapter presents the facilities requirements analysis that measures the ability of existing facilities to meet current and projected demand over the 20-year planning period. The conditions of airside and landside facilities are documented in this chapter, with recommendations provided for facility improvements needed to meet current and future demand. Infrastructure elements unable to accommodate demand will be the focus of the identification and evaluation of improvement options in the alternatives analysis to meet the needs of users of the South Bend International Airport (SBN or Airport).

The recommendations from the facility requirements analysis are presented and organized in this chapter by the following sections:

3.1 Airfield Demand / Capacity Analysis

The purpose of an airfield demand / capacity analysis is to assess the capability of the airfield layout to accommodate existing and projected levels of aircraft operations. Factors such as the number and orientation of runways, number and location of exit taxiways, local weather conditions, and traffic flow patterns can impact the capacity of an airfield. Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5060-5, *Airport Capacity and Delay*, provides methodology through mathematical formulas to determine the capacity of an airfield based on the number and orientation of runways and fleet mix of aircraft types operating at an airport.

In general, airfields with a single runway have a capacity between 195,000 to 240,000 annual aircraft operations based on the fleet mix of types operating at the airport, which also factors the frequency of large aircraft operations requiring increased separation between other aircraft due to the generation of wake turbulence. Airfields with two parallel runways that have a separation of greater than 3,400 feet between centerlines with a single intersecting runway like SBN have an airfield capacity between 305,000 to 370,000 annual operations based on the fleet mix of types operating at the airport and the frequency of large aircraft operations.

Generally, planning to increase airfield capacity occurs when an airfield reaches 60 percent of its annual capacity. This would occur at SBN when 183,000 to 222,000 aircraft operations are conducted annually. In 2019, before the COVID-19 pandemic caused a global downturn in the aviation industry, 46,174 annual operations occurred at SBN, with 53,144 annual operations projected by the end of the 20-year planning period. This range is within 12 to 14 percent of the total capacity of the airfield, being well under the 60 percent capacity threshold. Thus, no capacity improvements to the configuration of the airfield are needed to meet existing demand and demand projected for the planning period.

3.2 Airport Design Standards

FAA AC 150/5300-13B, *Airport Design*, identifies the standards for the design of airfield infrastructure. These standards are based on the physical and operational characteristics of the most demanding critical design aircraft intended to operate on its surface. Chapter 2: Projections of Aviation Demand provided an analysis of the Runway Design Code (RDC) that is used in making these determinations as well as the critical aircraft type that conducted at least 500 annual operations for federal funding eligibility for Runways 9R/27L, 18/36, and 9L/27R which is summarized in **Table 3-1**. It is projected that the critical aircraft for each runway will remain the same through the planning period.

Table 3-1: Runway Design Code Classifications and Critical Aircraft Determination

Runway	Runway Design Code	Representative Critical Aircraft
9R/27L	C-IV	Boeing 757-200
18/36	C-III	CRJ-900
9L/27R	A-I	Diamond Star DA40

Source: Marr Arnold Planning (2022)

For the evaluation of facility requirements, it is important to note the differences between the critical design aircraft that was determined through the forecasting effort and the critical design aircraft used in the design of each runway. As presented in **Table 3-2**, primary Runway 9R/27L was determined through the forecasting effort to have a critical design aircraft of a family grouping of C-IV types represented by the Boeing 757-200; however, Runway 9R/27L is designed to D-IV standards represented by the Boeing 767. Since the dimensions of design elements of C-IV and D-IV runways are the same, this is not a factor in reviewing the ability of existing infrastructure to meet existing and projected demand.

Runway 18/36 is also designed to D-IV standards; however, the projections of aviation demand determined that the critical design aircraft, based on existing and future projected operations, is a family grouping of C-III types represented by the CRJ-900. Runway 9L/27R also is designed greater (B-II) than the family grouping of aircraft types (A-I) that were determined to be the critical design aircraft type. Though the design of Runway 18/36 and Runway 9L/27R exceeds the dimensional standards for its critical aircraft types, it would be prudent for SBN to maintain Runway 18/36 and Runway 9L/27R at its existing configuration since each runway is occasionally used by larger aircraft types.

Table 3-2: Critical Design Aircraft Comparisons

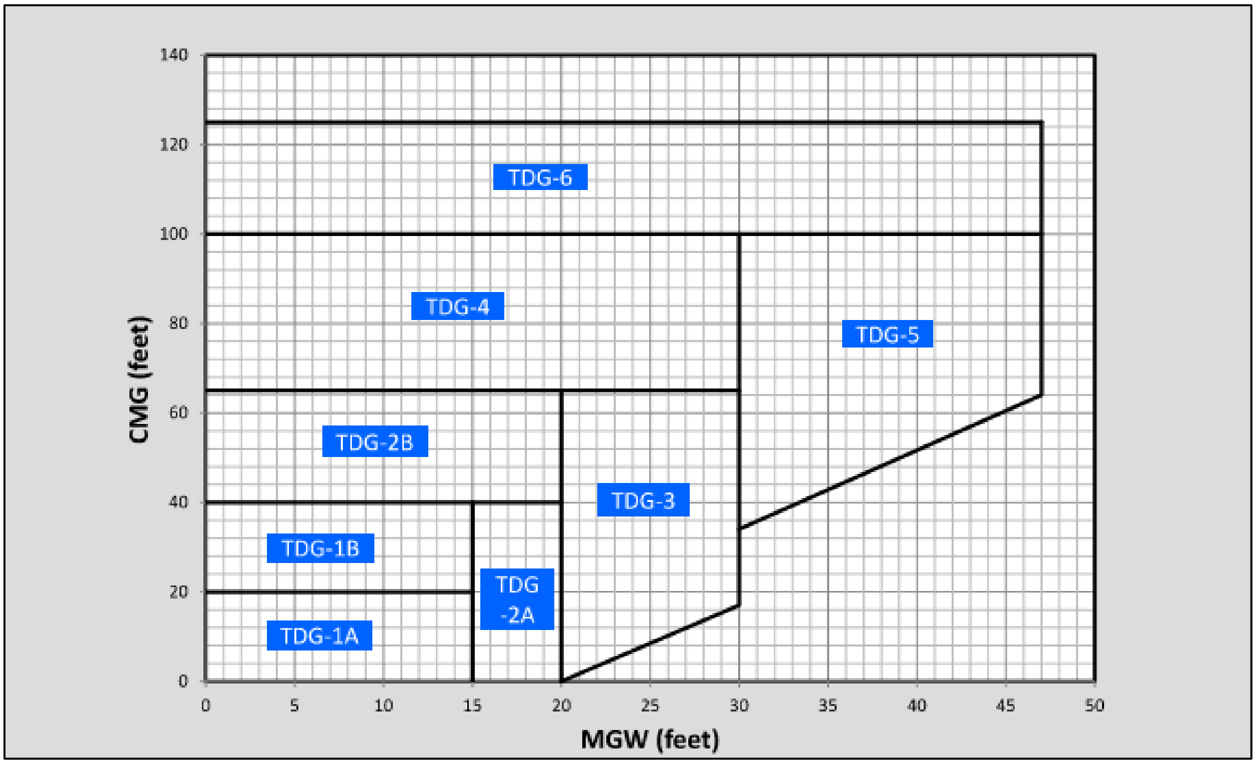
Runway	Runway Design Code	Representative Critical Aircraft Type
9R/27L		
Forecast Projections	C-IV	Boeing 757-200
Design of Runway	D-IV	Boeing 767
18/36		
Forecast Projections	C-III	CRJ-900
Design of Runway	D-IV	Boeing 767
9L/27R		
Forecast Projections	A-I	Diamond Star DA40
Design of Runway	B-II	Beechcraft Super King Air 200

Source: FAA AC 150/5300-13B, *Airport Design*; Marr Arnold Planning (2021)

For this facility requirements analysis, changing the design of Runway 18/36 and Runway 9L/27R to match the design standards of the critical design aircraft is not recommended due to limitations in available funding and the need to invest limited capital for other more immediate infrastructure needs which are discussed in this chapter and in Chapter 6 (Capital Improvement Plan). It is recommended that SBN maintain each runway, to the extent practical, in its current configuration through the planning period, understanding that at the time improvements are needed an additional critical aircraft evaluation may be needed should federal funding be requested.

The Taxiway Design Group (TDG) is a classification system like the RDC that is used to determine the design of a taxiway. This includes pavement width as well as taxiway intersection fillet design geometry and separation from runways, taxilanes, and other taxiways. For the critical aircraft, the TDG is based on the width of the main landing gear and the distance of the main landing gear to the cockpit. Note that the TDG designation for a series of taxiways at an airport will often vary based on the aircraft type intended to regularly conduct operations on its surface as well as the purpose of the taxiway. Typically, the parallel taxiway of a runway is designed for the largest types of aircraft intended to regularly use the runway, while connector taxiways will be designed for specific aircraft types using aprons or hangar facilities. **Figure 3-1** illustrates the main gear width and cockpit to main gear distance dimensions for the seven TDG classifications identified by FAA AC 150/5300-13B, *Airport Design*.

Figure 3-1: Taxiway Design Group Classifications



Source: FAA AC 150/5300-13B, *Airport Design*

The existing and future critical aircraft for SBN is a family grouping of C-IV aircraft types represented by the Boeing 757-200 which has a main gear width of 28 feet and a cockpit to main gear length of 72 feet. These measurements place it in the TDG-4 category, for which the recommended taxiway width is 50 feet. Thus, taxiways intended for use by this aircraft type should be 50 feet in width. Section 3.5 of this chapter reviews in more detail how the design of the taxiway system at SBN accommodates the critical design aircraft. **Table 3-3** summarizes the TDG classification for taxiways associated with each runway based on the critical aircraft types.

Table 3-3: Taxiway Design Group Classifications Associated with Each Runway

Runway	Runway Design Code	Representative Critical Aircraft	Taxiway Design Group
9R/27L	C-IV	Boeing 757-200	4
18/36	C-III	CRJ-900	2B
9L/27R	A-I	Diamond Star DA40	1A

Source: Mead & Hunt (2022)

3.3 Wind Coverage

FAA AC 150/5300-13B, *Airport Design*, recommends the primary runway be oriented so that 95 percent of the time aircraft taking off or landing on the runway are operating in the direction of local prevailing winds. If the primary runway is unable to be aligned in the direction of local prevailing winds 95 percent of the time, a crosswind runway is recommended for those aircraft types impacted by crosswinds on the primary runway. Since aircraft typically land and takeoff into the wind, crosswind runways are beneficial for small aircraft that are more impacted by winds that are perpendicular to an aircraft's path of travel.

Data obtained from the National Climatic Data Center (NCDC) formed the basis to evaluate the wind coverage provided by SBN's three runways. This evaluation assessed how well the runways' orientation provided wind coverage when four wind velocities were present, based on the maximum allowable velocities for various aircraft categories. This maximum allowable crosswind varies by aircraft type, ranging from small single propeller engine aircraft (10.5 knots), twin propeller engine aircraft (13 knots), and jet aircraft (16 knots and 20 knots). During all weather conditions (**Table 3-4**), with an allowable crosswind of up to 10.5 knots, the orientation of Runways 9R/27L, 9L/27R, and 18/36 provide 97.99 percent (97.99%) coverage. Individually, the orientation of parallel Runways 9R/27L and 9L/27R provides coverage 87.38 percent (87.38%) of the time, thus indicating that Runway 18/36 is needed to achieve 95 percent wind coverage when 10.5-knot winds are present. In addition, the orientation of parallel Runways 9R/27L and 9L/27R does not achieve 95 percent wind coverage (93.23 percent) with an allowable crosswind of up to 13 knots. This indicates Runway 18/36 is needed to accommodate crosswinds for up to B-II aircraft, which includes most single- and twin-engine propeller driven aircraft and some small jets.

Table 3-4: Wind Coverage in All Weather Conditions

Crosswind (knots)	Runway 9L	Runway 27R	Runway 9R	Runway 27L	Runway 18	Runway 36
10.5	54.17%	70.69%	54.17%	70.69%	65.01%	56.07%
	87.38%		87.38%		87.69%	
	97.99%					
13	56.37%	75.54%	56.38%	75.54%	68.79%	59.01%
	93.23%		93.23%		93.41%	
	99.53%					
16	58.52%	79.59%	58.52%	79.59%	71.85%	61.65%
	98.00%		98.00%		97.92%	
	99.93%					
20	59.12%	81.01%	59.12%	81.01%	72.92%	62.64%
	99.56%		99.56%		99.55%	
	99.99%					

Note: Single runway end coverages calculated with a three-knot tailwind
Source: National Climatic Data Center, FAA Airports Geographic Information System wind analysis tool
Station: South Bend International Airport, South Bend, Indiana
Period of Record: 2009-2018 based on 129,382 observations

Table 3-5 presents the wind coverage at SBN when visual flight rules (VFR) conditions are present, which is when the cloud ceiling is greater than, or equal to, 1,000 feet above ground level (AGL), and the visibility is greater than, or equal to, three statute miles. Individually, the orientation of Runways 9R/27L and 9L/27R provide 87.27 percent (87.27%) coverage for allowable crosswinds up to 10.5 knots and 93.18 percent (93.18%) coverage for allowable crosswinds up to 13 knots during VFR conditions. This demonstrates that Runway 18/36 is needed to achieve 95 percent wind coverage at SBN for allowable crosswinds up to 13 knots.

Table 3-5: Wind Coverage in Visual Flight Rules Conditions

Crosswind (knots)	Runway 9L	Runway 27R	Runway 9R	Runway 27L	Runway 18	Runway 36
10.5	54.90%	71.28%	54.90%	71.28%	66.41%	56.05%
	87.27%		87.27%		89.01%	
	98.17%					
13	57.16%	76.19%	57.17%	76.19%	69.99%	58.58%
	93.18%		93.18%		94.26%	
	99.60%					
16	59.39%	80.33%	59.40%	80.33%	72.79%	60.75%
	98.07%		98.07%		98.22%	
	99.95%					
20	60.00%	81.74%	60.00%	81.74%	73.80%	61.53%
	99.61%		99.61%		99.62%	
	99.99%					

Note: Single runway end coverages calculated with a three-knot tailwind
VFR = Ceiling greater than or equal to 1,000 feet and visibility greater than or equal to three statute miles
Source: National Climatic Data Center, FAA Airport Geographic Information System wind analysis tool
Station: South Bend International Airport, South Bend, Indiana
Period of Record: 2009-2018 based on 95,815 observations

When instrument flight rules (IFR) are present, the cloud ceiling height is less than 1,000 feet AGL and/or the visibility is less than three statute miles. During these conditions, the orientation of parallel Runways 9R/27L and 9L/27R provide wind coverage 87.35 percent (87.35%) of the time when crosswinds up to 10.5 knots are present. Likewise, 93.12 percent (93.12%) wind coverage is achieved by these parallel runways when 13-knot crosswinds are present in IFR conditions. Again, Runway 18/36 is needed to achieve 95 percent wind coverage at SBN when up to 13-knot crosswinds and IFR conditions are present (**Table 3-6**).

Table 3-6: Wind Coverage in Instrument Flight Rules Conditions

Crosswind (knots)	Runway 9L	Runway 27R	Runway 9R	Runway 27L	Runway 18	Runway 36
10.5	50.46%	68.09%	50.46%	68.09%	58.64%	56.20%
	87.34%		87.35%		82.09%	
	97.09%					
13	52.48%	72.81%	52.48%	72.81%	63.24%	60.86%
	93.11%		93.12%		89.77%	
	99.18%					
16	54.33%	76.61%	54.34%	76.61%	67.29%	65.44%
	97.61%		97.61%		96.53%	
	99.82%					
20	54.94%	78.15%	54.94%	78.15%	68.70%	67.37%
	99.30%		99.30%		99.24%	
	99.96%					

Note: Single runway end coverages calculated with a three-knot tailwind
IFR = Ceiling less than 1,000 feet but greater than or equal to 200 feet, and/or visibility less than three statute miles but greater than or equal to ½ statute mile
Source: National Climatic Data Center, FAA Airport Geographic Information System wind analysis tool
Station: South Bend International Airport, South Bend, Indiana
Period of Record: 2009-2018 based on 24,036 observations

3.4 Runways

As previously explained, there are two parallel runways and a crosswind runway at SBN. The following section presents the analysis of the three runways at SBN and their ability to meet existing and future demand. This evaluation included a review of each individual runway's length, width, grade, surface, strength, and condition. Other runway design standards such as safety areas, object free areas, and airspace protection surfaces were also evaluated to determine if improvements are needed. The recommended course of action and any improvements found to be needed to meet existing and/or future demand are discussed at the conclusion of each subsection.

For purposes of evaluating runway needs, this analysis considers three user groups. Those groups are:

- Commercial airlines
- Cargo airlines
- Corporate and recreational general aviation

In general, the commercial and cargo airlines make use of Runway 9R/27L, the primary runway, and Runway 18/36, the crosswind runway, while corporate and general aviation (GA) aircraft use Runway 9L/27R. Each runway is examined with the needs of these user groups in mind.

3.4.1 Runway Length

The length of a runway should be capable of accommodating the landing and takeoff distance requirements of the most demanding types of aircraft (existing or projected) intended to regularly conduct operations on the surface. FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*, provides guidelines to determine the recommended length of a runway based on a critical design aircraft that is anticipated to regularly operate from that runway. For critical aircraft above 60,000 pounds (lbs.), needed runway length is based on individual aircraft performance charts. For critical aircraft below 60,000 lbs., needed runway length is based on a family group of aircraft using runway length performance charts found in the AC.

Runway 9R/27L is the primary runway at SBN and is 8,412 feet long. It is supported by Runway 18/36, the crosswind runway, that is 7,101 feet long. The crosswind runway allows for commercial aircraft to conduct operations at SBN when strong winds exceeding aircraft crosswind operating limitations are not aligned with Runway 9R/27L.

The passenger and cargo airlines regularly use these two runways. To determine the adequacy of the existing runway lengths, specific runway length requirements have been documented based upon guidance from FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*, and information from aircraft manufacturers. FAA AC 150/5325-4B states the following regarding recommended runway lengths:

> *Airplanes today operate on a wide range of available runway lengths. Various factors, in turn, govern the suitability of those available runway lengths, most notably airport elevation above mean sea level, temperature, wind velocity, airplane operating weights, takeoff and landing flap settings, runway surface condition (dry or wet), effective runway gradient, presence of obstructions in the vicinity of the airport, and, if any, locally imposed noise abatement restrictions or other prohibitions.*

The following summarizes some of the important concepts from FAA AC 150/5325-4B regarding regular use and FAA recommended runway length:

- The goal is to provide an available runway length that is suitable for the forecasted critical design airplanes.
- The critical design airplanes (or a single airplane) are the aircraft that result in the longest recommended runway length.
- Federally funded projects require that critical design airplanes have at least 500 or more annual operations for an individual or a family grouping of airplanes.
- The design objective for the main primary runway is to provide a runway length for all airplanes that will regularly use it, without causing operational weight restrictions.

The runway length requirements associated with the current air carrier jet fleets were evaluated to determine the adequacy of the existing 8,412-foot primary runway and the 7,101-foot crosswind runway. The commercial passenger airlines that are key users of these runways are Allegiant, American, Delta, and United. The longest route served is by Allegiant, with an Airbus 319/320 flying to Las Vegas Harry Reid International Airport, a flight of approximately 1,600 statute miles. **Table 3-7** provides some basic operational data for the aircraft that these airlines use.

Allegiant Air passenger jets at SBN
Source: SBN official Twitter account

Table 3-7: Airline Aircraft Operational Data

Aircraft	SBN 2020 Ops	Airline	Destination	Distance (statute miles)	MTOW (lbs.)	Required Runway Length on Hot Day (ft.)	Max Range at MTOW (statute miles)
CRJ200	5,994	Delta Air Lines	DTW	157	47,450	5,800	1,600
		Delta Air Lines	ATL	567			
		United Airlines	ORD	84			
CRJ700	1,958	American Airlines	ORD	84	72,750	6,500	2,600
		American Airlines	CLT	535			
		American Airlines	DFW	847			
CRJ900	906	American Airlines	CLT	535	84,500	8,000	2,300
		Delta Air Lines	DTW	157			
		Delta Air Lines	MSP	411			
		Delta Air Lines	ATL	567			
A319	330	Allegiant Air	LAS	1,593	75,500	8,000	3,200
A320	988	Allegiant Air	SFB	936	78,000	8,000	3,200
		Allegiant Air	PIE	973			
		Allegiant Air	PGD	1,049			
		Allegiant Air	IWA	1,499			
		Allegiant Air	LAS	1,593			

Note: Hot day is 86° F for Airbus aircraft and 95° F for CRJ aircraft.
Source: Airbus and Canadair Airport Planning Manuals, and FAA TFMSC.

The table lists the passenger aircraft the airlines were using on a regular basis to serve SBN in October 2021. As noted in the table, except for the Airbus 319, each aircraft type performed more than 500 operations at SBN in 2020, according to FAA traffic flow management system counts (TFMSC). This is the FAA threshold for an aircraft to qualify as the critical aircraft, which can then be used to justify airfield facilities. The table displays the maximum takeoff weight (MTOW) for each aircraft, which is one of the largest drivers in determining needed runway length. The next column uses that MTOW in approximating how much runway the aircraft needs to depart on a hot day. The last column shows the maximum range that the aircraft could reach when operating at its MTOW. The existing length of Runway 9R/27L, 8,412 feet, meets the MTOW warm day takeoff demands of all aircraft listed in the table while the Runway 18/36, at a length of 7,101 feet can provide for the takeoff length demands of the CRJ200 and CRJ700 on a warm day. With some concessions to fuel load and passenger load, the CRJ900, A319, and A320 can also operate from Runway 18/36. Thus, the length of both Runway 9R/27L and Runway 18/36 are sufficient to meet commercial air carrier demand.

Estimated Required Runway Length for Long-Range Cargo Flights

In addition to passenger airlines using Runway 9R/27L, dedicated air cargo airlines use the primary runway. Both FedEx and UPS conduct cargo operations out of SBN, typically with Boeing 757 aircraft flying to Memphis or Louisville. During peak periods, heavier aircraft, such as Boeing 767 aircraft, are called into service. SBN is interested in exploring options for other aircraft models in use for air cargo operations, with a focus on flights to the Far East.

To illustrate the range of runway requirements, the analysis considered the runway length requirements within the operational limits of three models of Boeing 747 and three models of Boeing 767 aircraft flying from SBN to three Far East destinations. These destinations consist of Incheon International Airport (ICN), Pudong International Airport (PVG), and Hong Kong International Airport (HKG).

These destinations were selected because of their strong air cargo market. Additionally, operations to Ted Stevens Anchorage International Airport (ANC) by Boeing 767 aircraft were also considered for the analysis, which is a frequent refueling stop for cargo flights on polar flight routes. ANC also has exemptions that allow American and foreign airlines to transfer cargo at the airport (something not allowed at other U.S. airports), making the location even more appealing to air cargo flights. **Table 3-8**. Illustrates some possible destinations for air cargo flights from SBN.

Table 3-8: Selected Destinations from SBN

IATA Code	City	Destination Airport	Longest Runway	Great Circle Distance (nautical miles)
SBN	**South Bend**	**South Bend International**	**8,412' x 150'**	**-**
ICN	Seoul	Incheon International	12,303' x 197'	5,738
PVG	Shanghai	Pudong International	13,123' x 197'	6,177
HKG	Hong Kong	Hong Kong International - Chek Lap Kok	12,467' x 197'	6,813
ANC	Anchorage	Ted Stevens Anchorage International	12,400’ x 200’	2,532

Source: FAA, http://www.gcmap.com. (2021)

Factors Impacting Required Runway Length

In general, commercial airliners use more runway distance to takeoff than to land, so the required runway length analysis begins with the premise that aircraft takeoff performance determines how long of a runway is required.

Many factors impact how much runway length is needed for an aircraft takeoff. **Appendix A** provides details on these factors, but in very basic terms, an aircraft needs sufficient runway length to reach the flying speed that generates the lift necessary to overcome the aircraft's total weight. Heavier aircraft need more airspeed to get into the air, and, therefore, need longer runways to accelerate to the appropriate airspeed.

The weight of an aircraft depends on several factors, but the biggest variables are typically required fuel (including reserves) and payload. The amount of fuel an aircraft needs to fly a certain distance is not fixed. A heavier aircraft needs more fuel than a lighter aircraft to fly the same distance, because a heavier aircraft requires more thrust to keep the heavier weight moving, and this burns fuel faster. So, as the payload an aircraft carries increases, so does the fuel needed for a given distance. At some point, the aircraft reaches its maximum fuel capacity and the only way to increase its range is to reduce its weight. The crew generally accomplishes this by reducing the payload carried. What is perhaps counterintuitive is that as aircraft weight is reduced to increase range, the runway length needed for departure decreases. Under these conditions, an aircraft will need less runway to reach a more distant destination but will sacrifice payload to do so.

Aircraft Evaluated

Various models of Boeing 747 and 767 aircraft were chosen to provide a range of performance for aircraft commonly used for air cargo operations. Three models of Boeing 747 were selected for analysis. These models were the 747-200C in an all-cargo configuration, the 747-400 Freighter, and the 747-8F.

Three models of Boeing 767 were analyzed. These models were the 767-200ER in an all-cargo configuration, the 767-300 Freighter, and the 767-400ER.

Required Runway Lengths for Primary Runway

The method used to determine the required runway lengths for the aircraft described above relied on the information provided in *Boeing's Airplane Characteristics for Airport Planning* documents for each respective aircraft. This information, along with the runway lengths determined in this section, are for planning purposes only.

The basic procedure used a payload/range performance chart for a specific airframe and engine combination that yielded an aircraft takeoff weight and permissible payload for any given range, considering the aircraft's operational limits. Each aircraft also has takeoff runway length performance charts that use the aircraft takeoff weight to determine takeoff runway length under specified environmental conditions. To account for varying environmental conditions, a required runway length was calculated for both a standard temperature day, and a hot day. A hotter day results in less dense air, which degrades aircraft and engine performance, and requires a longer runway. Performance charts and aircraft operating tables for the models analyzed are found in **Appendix B**. **Table 3-9** summarizes the payload (in pounds) and the required runway length (in feet) to various destinations on standard and hot days for each of the aircraft analyzed.

As can be seen in Table 3-9, SBN's current runway length of 8,412 feet is sufficient for the 767-200ER flight to ANC, and the 767-300F and 747-200C flights to HKG. SBN would need to extend its primary runway to accommodate the other aircraft at their takeoff weights to reach the respective destinations with the indicated payload. It is important to note that these aircraft could reach their destinations using SBN's existing runway by reducing their takeoff weight. However, reducing their takeoff weight means reducing payload, and, at some point, the flight is no longer economical to operate.

Focusing on the 767 flights to ANC, extending Runway 9R/27L by 788 feet would allow the 767-400ER to depart SBN with its maximum payload, even on a warm day, and reach ANC. If SBN desires to accommodate this type of cargo activity to ANC, an extension of the primary runway to 9,200 feet is recommended.

Table 3-9: Payload and Runway Length Requirements for Boeing Aircraft Departing from SBN

Aircraft	ICN (Incheon)		PVG (Shanghai)		HKG (Hong Kong)		ANC (Anchorage)	
	Payload (lbs.)	Required Runway Length (std./hot)	Payload (lbs.)	Required Runway Length (std./hot)	Payload (lbs.)	Required Runway Length (std./hot)	Payload (lbs.)	Required Runway Length (std./hot)
767-200ER	54,900	9,600/ 10,000 Note 2	47,900	9,600/ 10,000 Note 2	37,300	9,600/ 10,000 Note 2	78,390	6,400/ 6,800 Note 1
767-300F	69,900	9,800/ 10,300 Note 3	47,900	9,000/ 9,300 Note 3	18,900	7,200/ 7,500 Note 3	120,900	8,500/ 8,800 Note 1
767-400ER	44,000	10,100/ 11,000 Note 4	17,000	8,500/ 9,000 Note 4	Out of Range		101,000	8,600/ 9,200 Note 1
747-200C	104,380	10,700/ 11,700	56,380	9,100/ 9,800 Note 5	380	7,400/ 8,000 Note 5	Not analyzed	
747-400F Note 6	178,046	11,100/ 11,800	162,046	11,100/ 11,800	135,046	11,100/ 11,800	Not analyzed	
747-8F Note 6	225,400	10,500/ 11,100	206,400	10,500/ 11,100	180,400	10,500/ 11,100	Not analyzed	

Source: *747 Airport Characteristics Airport Planning*, Boeing Commercial Airplane Company.
Notes:
Standard day temperature = 59° Fahrenheit at sea level.
Hot day temperatures = 86° Fahrenheit for all aircraft except the 767-200ER and 747-400F, which used 90° Fahrenheit.
SBN airfield elevation is 798 feet mean sea level.

Note 1: All 767 flights to ANC operate at maximum design zero fuel weight, carrying maximum structural payload.
Note 2: The 767-200ER operates at its maximum takeoff weight for flights to ICN, PVG, and HKG, trading payload for fuel to increase range.
Note 3: The 767-300 Freighter is at max takeoff weight for ICN, and is fuel limited to PVG and HKG, which limits its payload.
Note 4: The 767-400ER is fuel limited for flights longer than approximately 5,400 nm. It uses its maximum fuel capacity (161,738 lbs.) to reach ICN and PVG, leaving it with a payload capacity that is not likely to be economically sustainable.
Note 5: The 747-200C is fuel limited for flights longer than approximately 5,800 nm. It uses its maximum fuel capacity (348,630 lbs.) to reach PVG and HKG, leaving it with a payload capacity that is not likely to be economically sustainable.
Note 6: The 747-400F and 747-8F operate at their maximum design takeoff weight to all destinations.

Required Runway Length for Crosswind Runway

The crosswind runway, Runway 18/36, at 7,101 feet long, can accommodate most of the operations by the commercial aircraft frequently using SBN. **Table 3-10** lists the aircraft from Table 3-7 that need more than 7,100 feet of runway to takeoff at their MTOW.

Table 3-10: Airline Aircraft Takeoff Weight Data for Crosswind Runway

Aircraft	MTOW (lbs.)	Takeoff Weight Limit on Runway 18/36 (lbs.)	Loss in Weight Capacity (lbs./%)
CRJ900	84,500	81,000	3,500/4%
A319	75,500	74,000	1,500/2%
A320	78,000	75,000	3,000/4%

Note: Warm day is 86° F for Airbus aircraft and 95° F for CRJ aircraft.
Source: Airbus and Canadair Airport Planning Manuals.

The table lists the takeoff weight that the shorter crosswind runway could accommodate on a hot day, along with the loss in weight capacity due to the shorter runway. The loss in capacity is less than 5 percent for the listed aircraft, indicating that the length of Runway 18/36 is adequate for its role in supporting these aircraft types that conduct operations on its surface. No improvements to the length of the crosswind runway are needed to meet demand.

Required Runway Length for Secondary Runway

For determining the runway length need of Runway 9L/27R, which supports GA activity from smaller aircraft types, guidance from FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*, was used. This AC uses the runway's critical aircraft, mean daily maximum temperature for the hottest month at the airport, and the airport's elevation to estimate required runway length. Details of this analysis are in **Appendix C**. The analysis determined that Runway 9L/27R requires a length of approximately 4,200 feet. At a current length of 4,300 feet, no changes to the length of Runway 9L/27R are needed to accommodate existing and projected demand.

Runway Eligibility for FAA Funding

At its existing length of 8,412 feet, Runway 9R/27L meets the needs of existing commercial service, air cargo, and general aviation users throughout the planning period. If SBN decides to pursue air cargo flights to Anchorage or Asia, however, a runway extension of 788 feet (total runway length of 9,200 feet) would be needed for flights to Anchorage and an extension of 3,388 feet (total runway length of 11,800 feet) would be needed for flights to Asia, according to the analysis above. As SBN's primary runway, future projects such as resurfacing, rehabilitation, or runway extensions, will be eligible for FAA funding, according to FAA Order 5100.38D, *Airport Improvement Program Handbook*.

The earlier wind analysis demonstrated that Runway 18/36 is required to service up to B-II aircraft, which includes most single- and twin-engine propeller driven aircraft and some small jets, when crosswinds are present that limit the use of parallel Runways 9R/27L and 9L/27R. B-II aircraft require approximately 4,000 feet of runway length, which means that only 4,000 feet of the runway's full 7,101-foot length would likely be justified and eligible to receive FAA funding for future runway projects, based on guidance in FAA Order

5100.38D, *Airport Improvement Program Handbook*. At the time an improvement is needed to Runway 18/36, a federal funding eligibility justification effort may be needed to review the aircraft types conducting operations on the runway in reviewing the critical type. Funding for any ineligible portions of the runway based on its justified length that are included as a part of any future infrastructure improvement project may be the responsibility of SBN.

Finally, according to FAA Order 5100.38D, *Airport Improvement Program Handbook*, a secondary runway is justified if an airport's primary runway is operating at 60 percent or more of its annual capacity. As previously explained, a single runway has a capacity between 195,000 to 240,000 annual aircraft operations. In 2019 and 2020, SBN's primary runway accommodated 28,475 annual aircraft operations and 19,082 annual aircraft operations, respectively, which is well below the 60 percent capacity threshold. As such, SBN's secondary runway is not justified and therefore is projected to not be eligible for FAA funding throughout the planning period. SBN should plan that federal funding would not be available for any future projects with this runway.

3.4.2 Runway Width

The width of a runway is based on design standards identified in FAA AC 150/5300-13B, *Airport Design*, according to the RDC of the runway's critical design aircraft and the visibility minimum of the approach to the runway. **Table 3-11** presents the comparison of the RDC for the design of each runway and its pavement width with the RDC of the critical design aircraft and associated runway pavement width design standard. As shown, the width of Runway 9R/27L meets the design standard of the critical design aircraft and no improvements are needed. The widths of Runway 18/36 (150 feet) and Runway 9L/27R (75) exceed what is needed for C-III aircraft (100 feet) and A-I aircraft (60 feet) for A-I runways with approach visibility minimums of not lower than 1 mile. Thus, each runway provides adequate width to meet the standards of the critical design aircraft.

Table 3-11: Runway Widths and Design Standards

Runway	Existing Runway Design		Critical Design Aircraft	
	RDC	Pavement Width (ft.)	RDC	Pavement Width (ft.)
RWY 9R/27L	D-IV	150	C-IV	150
RWY 18/36	D-IV	150	C-III	100
RWY 9L/27R	B-II	75	A-I	60*

* Note: For approaches not lower than one mile

Source: FAA Advisory Circular 150/5300-13B, *Airport Design*

3.4.3 Runway Grade

Runway gradient standards established in FAA AC 150/5300-13B, *Airport Design*, are designed to provide smooth flat surfaces for the takeoff and landing of aircraft and to provide pilots and air traffic controllers the ability to see that any one point of the runway surface is clear of aircraft, vehicles, wildlife, or other hazardous objects. The longitudinal and transverse grades of a runway are based on the Aircraft Approach Category (AAC) of the Airplane Design Group (ADG) classification of the runway. A discussion of AAC and ADG was provided in Chapter 2: Projections of Aviation Demand. For runways designed for aircraft in approach categories A and B, the maximum allowable longitudinal grade change is plus/minus 2.0 percent. However, for runways designed for aircraft in approach categories C, D, and E, the maximum allowable longitudinal grade change is plus/minus 1.50 percent. In addition, during the first and last quarter of runways designed for C, D, and E aircraft, longitudinal grades may not exceed plus/minus 0.80 percent.

The runway gradients for each runway end as reported on SBN's existing Airport Layout Plan (ALP) are presented in **Table 3-12**. As shown in the table, all three runways have an overall longitudinal grade of 0.30 percent or less, which meets FAA design standards. No changes to the runway grade of any of the runways are needed.

Table 3-12: Runway Gradients and Design Standards

Runway End	Maximum Allowable Longitudinal Grade Change	Existing Runway Gradient
Runway 9R	1.5% (0.80% first and last quarter of runway)	0.26%
Runway 27L	1.5% (0.80% first and last quarter of runway)	0.26%
Runway 18	1.5% (0.80% first and last quarter of runway)	0.30%
Runway 36	1.5% (0.80% first and last quarter of runway)	0.30%
Runway 9L	2.00%	0.16%
Runway 27R	2.00%	0.16%

Source: FAA Advisory Circular 150/5300-13B, *Airport Design*; SBN Airport Layout Plan

3.4.4 Runway Surface, Strength, and Condition

Runways are designed and built to meet the demands of the MTOW of the most demanding type of aircraft intended to regularly conduct operations on its surface. A 20-year lifetime expectation, the number of annual departures, and landing gear configurations of those aircraft are also factors determining the required strength of a runway. FAA AC 150/5320-6F, *Airport Pavement Design and Evaluation*, provides in-depth guidance on how to determine pavement strength. **Table 3-13** lists the surface type and weight bearing capacities for each runway at SBN. There are several categories of weight bearing capacity based on the landing gear configuration of the aircraft, along with the pavement classification number (PCN).

Table 3-13: Runway Strength Design Criteria

Runway	Surface	Single Wheel	Dual Wheel	Double Tandem	PCN
RWY 9R/27L	Asphalt, Grooved	120,000 lbs.	193,000 lbs.	313,000 lbs.	49 /F/B/X/T
RWY 18/36	Asphalt, Grooved	118,000 lbs.	186,000 lbs.	326,000 lbs.	47 /F/B/X/T
RWY 9L/27R	Asphalt	32,500 lbs.	49,000 lbs.	N/A	10 /F/B/X/T

Source: FAA Aeronautical Information Services

All commercial air carrier aircraft operating at SBN have dual wheel main landing gear configurations (CRJ900, A319, and A320), with the heaviest being the Airbus 320 with a MTOW of 78,000 lbs. This is below the dual wheel capacities for both Runway 9R/27L and Runway 18/36, which are the two runways this type of aircraft would use. No improvements to pavement strength of these runways are needed to accommodate commercial air carrier aircraft.

The critical aircraft for Runways 9R/27L and 18/36 are the Boeing 757-200 and CRJ-900, respectively. The heaviest version of the Boeing 757-200 has a MTOW of 255,000 pounds while the CRJ-900 has a MTOW of 84,500 pounds. The Boeing 757 has a double tandem landing gear configuration while the CRJ-900 has a dual-wheel main landing gear configuration. The MTOW of the Boeing 757 (313,000 pounds) is within the design limit for Runway 9R/27L while the MTOW of the CRJ-900 (84,500 pounds) is within the 186,000 pounds dual wheel design limit of Runway 18/36. Thus, no improvements to the pavement strength to these runways are needed.

However, takeoff weight of air cargo flights using Boeing 767 aircraft as analyzed previously, would easily surpass the weight bearing capacity of SBN's primary and crosswind runways. Like the other aircraft, the Boeing 767 employs a dual wheel landing gear configuration. As shown in Appendix B, 767-300F flights to ANC operating at their MTOW would weigh 412,000 pounds, well beyond the double tandem weight capacities of the primary and crosswind runways of 313,000 pounds and 326,000 pounds, respectively. Therefore, strengthening of the runway pavement would be needed to accommodate regular operations by these aircraft types at SBN.

The weight bearing capacity of the secondary runway, Runway 9L/27R, is 32,500 pounds for single wheel landing gear aircraft, and 49,000 pounds for dual wheel landing gear aircraft. The Diamond Star DA40 has a single wheel main landing gear configuration and a MTOW of 2,888 pounds which is less than the 32,500 pounds limit for the weight bearing capacity of Runway 9L/27R; thus, no improvements to the strength of the pavement on this runway is needed to meet demand.

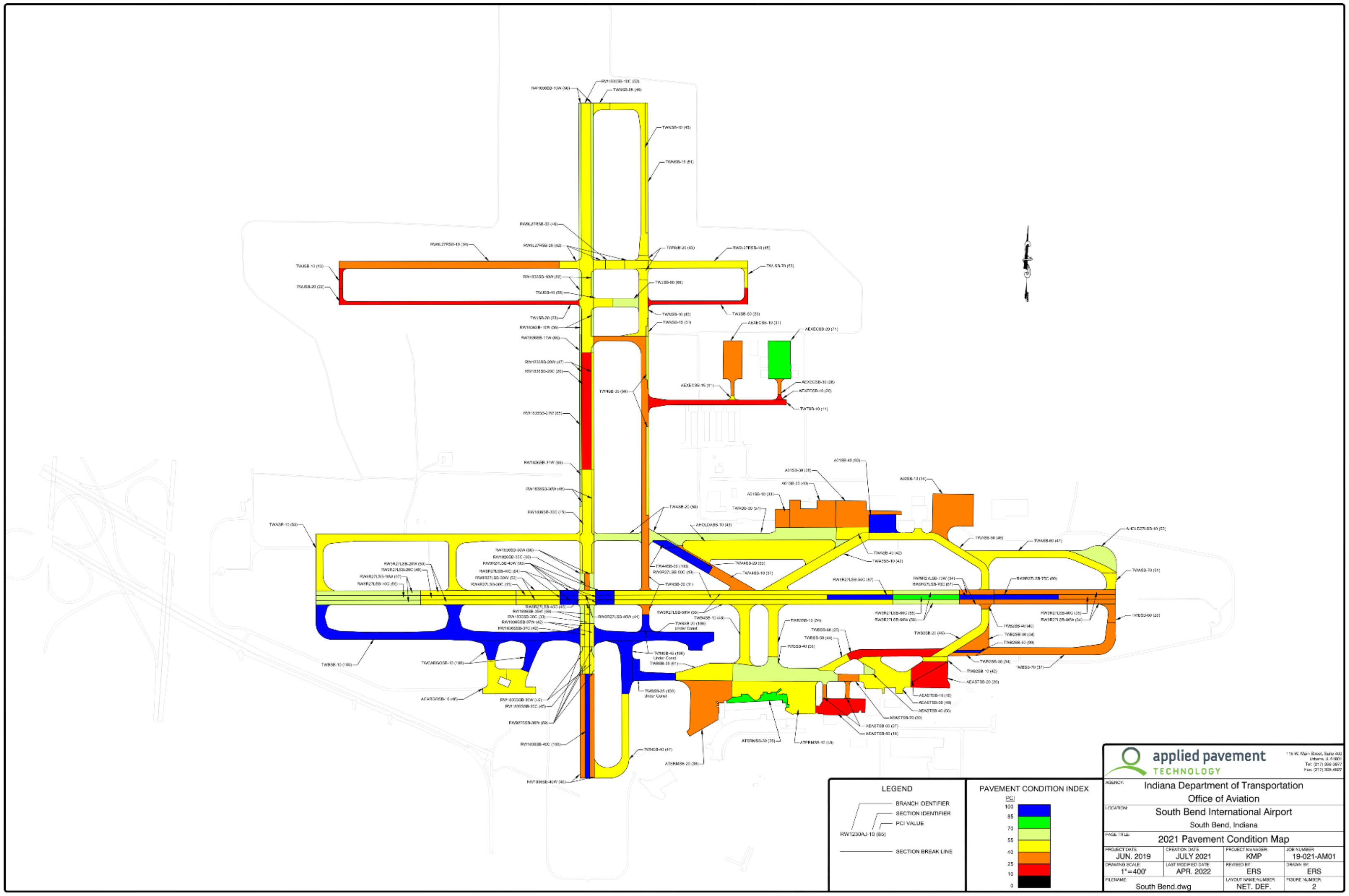
As for runway pavement condition, the Indiana Department of Transportation's (INDOT) Office of Aviation completed a pavement condition inspection at SBN in 2021. SBN uses the results of this inspection to assist with implementation of its pavement maintenance management program. To receive Federal funding for any construction project, airports are required to have such a program in place. The main purpose of a pavement maintenance management program is to provide airport management with objective data for pavement strengthening, rehabilitation, and maintenance as appropriate.

The results of INDOT's inspection were reported in terms of the Pavement Condition Index (PCI) in a spreadsheet and a map of the airfield.[1] PCI is a rating system that assigns a numerical value to the condition of a runway, taxiway, or apron based on observed pavement distresses. The PCI scale ranges from 0, which is assigned to pavements in a completely failed condition, to 100, which is assigned to pavements with no distress. It is recommended that pavements be maintained with a PCI value above 70. Pavements with PCI values between 70 and 40 are more likely to need a major rehabilitation, while pavements with PCI values less than 40 need a reconstruction.

According to INDOT's inspection, the average overall PCI value for SBN's pavements, including runways, taxiways, and aprons, is 51. When broken out by pavement type, runways and taxiways were found to have average PCI values of 55 and 53, respectively, while the Airport's aprons have an average PCI value of 41. **Figure 3-2** presents the PCI map of SBN's airfield pavement surfaces from INDOT's 2021 inspection.

[1] No final pavement condition report from INDOT was available at the time of the writing of this master plan report.

Figure 3-2: Pavement Condition Index Map



Source: INDOT Office of Aviation 2021 pavement inspection for South Bend International Airport

3.4.5 Runway Safety Area

The dimensions of an RSA are based upon the critical aircraft using, or expected to use, the runway, along with the instrument approach procedure at each runway end. Design standards found in AC 150/5300-13B, *Airport Design*, dictate each runway's RSA referencing the RDC and approach visibility minimums. **Table 3-14** lists the RSA design dimensions for each of SBN's runways and the RSA design dimensions for the critical design aircraft of each runway.

Table 3-14: Runway Safety Area Design Criteria

Runway	Runway Design Code	Runway End Visibility Minimum	RSA Width	RSA Length Beyond Runway Threshold
RWY 9R/27L				
Critical Aircraft	C-IV	Not lower than ¾ mile/ Lower than ¾ mile	500'	1,000'
Runway Design	D-IV		500'	1,000'
RWY 18/36				
Critical Aircraft	C-III	Not lower than 1 mile	500'	1,000'
Runway Design	D-IV		500'	1,000'
RWY 9L/27R				
Critical Aircraft	A-I	Not lower than 1 mile	120'	240'
Runway Design	B-II		150'	300'

Source: FAA Advisory Circular 150/5300-13B, *Airport Design*; 2010 Airport Layout Plan for South Bend International Airport

The RSA dimensions of the design of each runway meet or exceed the design standards for the critical design aircraft of each runway. No changes to the dimensions of the surfaces are needed.

3.4.6 Runway Object Free Area

The Runway Object Free Area (ROFA) is a two-dimensional surface surrounding a runway at the same elevation of the safety area that prohibits objects from being placed near the runway environment. Only objects necessary for aircraft navigational purposes such as signs, equipment, and taxiing aircraft are permitted. The size of a ROFA is based upon the RDC of the critical design aircraft as defined in FAA AC 150/5300-13B, *Airport Design*. **Table 3-15** lists the design dimensions of each runway's ROFA and design dimensions of the ROFA for each critical design aircraft.

Table 3-15: Runway Object Free Area Design Criteria

Runway	RDC	Visibility Minimum	ROFA Width	ROFA Length (Beyond Rwy End)
RWY 9R/27L				
Critical Aircraft	C-IV	Not lower than ¾ mile/ Lower than ¾ mile	800'	1,000'
Runway Design	D-IV		800'	1,000'
RWY 18/36				
Critical Aircraft	C-III	Not lower than 1 mile	800'	1,000'
Runway Design	D-IV		800'	1,000'
RWY 9L/27R				
Critical Aircraft	A-I	Not lower than 1 mile	400'	240'
Runway Design	B-II		500'	300'

Source: FAA Advisory Circular 150/5300-13B, *Airport Design*

The ROFAs of the primary and crosswind runways are 800 feet wide and extend 1,000 feet beyond each runway threshold. This meets the design standard for these runways and no changes to these dimensions are needed to meet demand anticipated during the planning period.

The secondary runway has a design ROFA that is 500 feet wide and stretches 300 feet past each runway threshold. This exceeds the design standards for A-I aircraft; thus, no improvements are needed to Runway 9L/27R's ROFA.

3.4.7 Runway Obstacle Free Zone

The Runway Obstacle Free Zone (OFZ) is a designated three-dimensional area centered on the runway that protects from object penetration into the runway environment and approach areas. The ROFZ projects upwards and outwards at a ratio determined based on the type of runway, visibility minimums, and type of runway approach and is the same width as the ROFA. All objects, including parked and taxiing aircraft, are not allowed in this volume of airspace, except for frangible visual navigational aids that need to be in the OFZ due to their function. The OFZ is comprised of the runway OFZ, the inner approach OFZ, and the inner-transitional OFZ.

The FAA design standards for the OFZ are as follows:

- The runway OFZ is a volume of airspace above the runway centerline. It extends 200 feet beyond each end of the runway. The width of the ROFZ is 400 feet for runways that serve large aircraft over 12,500 pounds, which includes Runway 9R/27L and Runway 18/36. The secondary runway, Runway 9L/27R, has a runway OFZ width of 250 feet.

- The inner-approach OFZ overlies the approach area and only applies to runways with an approach lighting system, which, in the case of SBN, is Runway 9R/27L. The inner-approach OFZ begins 200 feet from runway threshold and extends 200 feet beyond the last unit in the approach lighting system. Its width is the same as the Runway OFZ, and it rises at a slope of 50 (horizontal) to 1 (vertical) from its beginning.

- The inner-transitional OFZ applies only to runways with approach visibility minimums less than ¾ mile. It is a defined volume of airspace along the sides of the Runway OFZ and inner-approach OFZ. The only runway at SBN with an inner-transitional OFZ is Runway 9R/27L. Its Category II approach results in the inner-transitional OFZ beginning at the edges of the runway OFZ and inner-approach OFZ, rising vertically for a height "H," then sloping at a 5:1 ratio out to a distance "Y" from the runway centerline, and then sloping at a 6:1 ratio out to a height of 150 feet above the established airport elevation. H and Y are defined using S, the most demanding wingspan of the RDC of the runway, and E, the runway threshold elevation above sea level.

$$H = 53 - 0.13(S) - 0.0022(E)$$
$$H = 53 - 0.13(171) - 0.0022(769)$$
$$H = 29.08 \text{ feet}$$

Y = 440 + 1.08 (S) – 0.024(E)
Y = 440 + 1.08 (171) – 0.024(769)
Y = 606.22 feet

The runway OFZs for Runway 9R/27L, Runway 18/36, and Runway 9L/27R are compliant with FAA standards, and no object penetrations exist. The inner-approach OFZ and inner-transitional OFZ for Runway 9R/27L also comply with FAA standards. Thus, no changes to the Runway OFZ on any runways are needed to accommodate demand anticipated on each surface during the planning period.

3.4.8 Runway Protection Zone

The runway protection zone (RPZ) is a trapezoidal surface that extends outward from the approach end of the runway that is designed to protect aircraft, people, and property on the ground by clearing this area of incompatible land uses. There are two RPZs located at each end of a runway, an approach RPZ and a departure RPZ. The two RPZs normally overlap, and each begins 200 feet past the threshold of a runway. When a runway has a displaced threshold, the departure RPZ is located 200 feet beyond the end of the runway, while the approach RPZ starts 200 feet beyond the displaced threshold. Approach RPZs are sometimes larger than departure RPZs in cases where the instrument approach procedure has very good visibility minimums.

The FAA requires airport operators to have sufficient interest in the control of activities in this area through property interest or avigation easements to prevent incompatible uses. Some land uses (such as agricultural activities) are allowed in this area while other uses (such as residential developments, churches, schools, and roads) and objects of height (such as trees, towers, and tall buildings) are prohibited. The size of an RPZ is based on design standards as defined in FAA AC 150/5300-13B, *Airport Design*. **Table 3-16** shows the design dimensions for the RPZ at each runway end in comparison with the design dimensions for the RDC of each critical design aircraft.

The RPZs for Runway 9R/27L fall outside the SBN property line on the approach to Runway 9R. The RPZs for Runway 18/36 extend beyond the SBN property line at the south end of the runway. SBN has an easement on a portion of the RPZ outside of airport property that extends to Edison Road. The secondary runway, Runway 9L/27R, has RPZs that are entirely on SBN property. On the primary runway, the approach to Runway 9R has Lincoln Way West passing through the RPZs. On the Runway 27L end, North Bendix Drive is in the RPZs. The crosswind runway, Runway 18/36, has Lincoln Way West cutting through the RPZs on the approach to Runway 36. No roadways are in any of the Runway 9L/27R RPZs. There are roads, however, located in the RPZs at the approach ends of Runway 9R, Runway 27L, and Runway 36, Given constraints surrounding SBN such as roadways, residential areas, commercial areas, and other development, no changes are planned to relocate the routing of these roadways around the RPZ. At the time any improvement is planned for these runways, an RPZ Analysis may be required by the FAA to evaluate these conditions and determine if any feasible alternatives are available to meet the purpose and need of the improvement project and control land uses within the RPZs.

Table 3-16: Runway Protection Zone Design Criteria

Runway	Runway Design Code	Runway End Visibility Minimum	Approach RPZ Dimensions (inner width x length x outer width)	Departure RPZ Dimensions (inner width x length x outer width)
RWY 9R				
Critical Aircraft	C-IV	Not lower than 3/4 mile	1,000’x1,700’x1,510’	500’x1,700’x1,010’
Runway Design	D-IV		1,000’x1,700’x1,510’	500’x1,700’x1,010’
RWY 27L				
Critical Aircraft	C-IV	Lower than 3/4 mile	1,000’x2,500’x1,750’	500’x1,700’x1,010’
Runway Design	D-IV		1,000’x2,500’x1,750’	500’x1,700’x1,010’
RWY 18				
Critical Aircraft	C-III	Not lower than 1 mile	500’x1,700’x1,010’	500’x1,700’x1,010’
Runway Design	D-IV		500’x1,700’x1,010’	500’x1,700’x1,010’
RWY 36				
Critical Aircraft	C-III	Not lower than 1 mile	500’x1,700’x1,010’	500’x1,700’x1,010’
Runway Design	D-IV		500’x1,700’x1,010’	500’x1,700’x1,010’
RWY 9L				
Critical Aircraft	A-I	Not lower than 1 mile	500’x1,000’x700’	500’x1,000’x700’
Runway Design	B-II		500’x1,000’x700’	500’x1,000’x700’
RWY 27R				
Critical Aircraft	A-I	Not lower than 1 mile	500’x1,000’x700’	500’x1,000’x700’
Runway Design	B-II		500’x1,000’x700’	500’x1,000’x700’

Source: FAA Advisory Circular 150/5300-13B, *Airport Design*

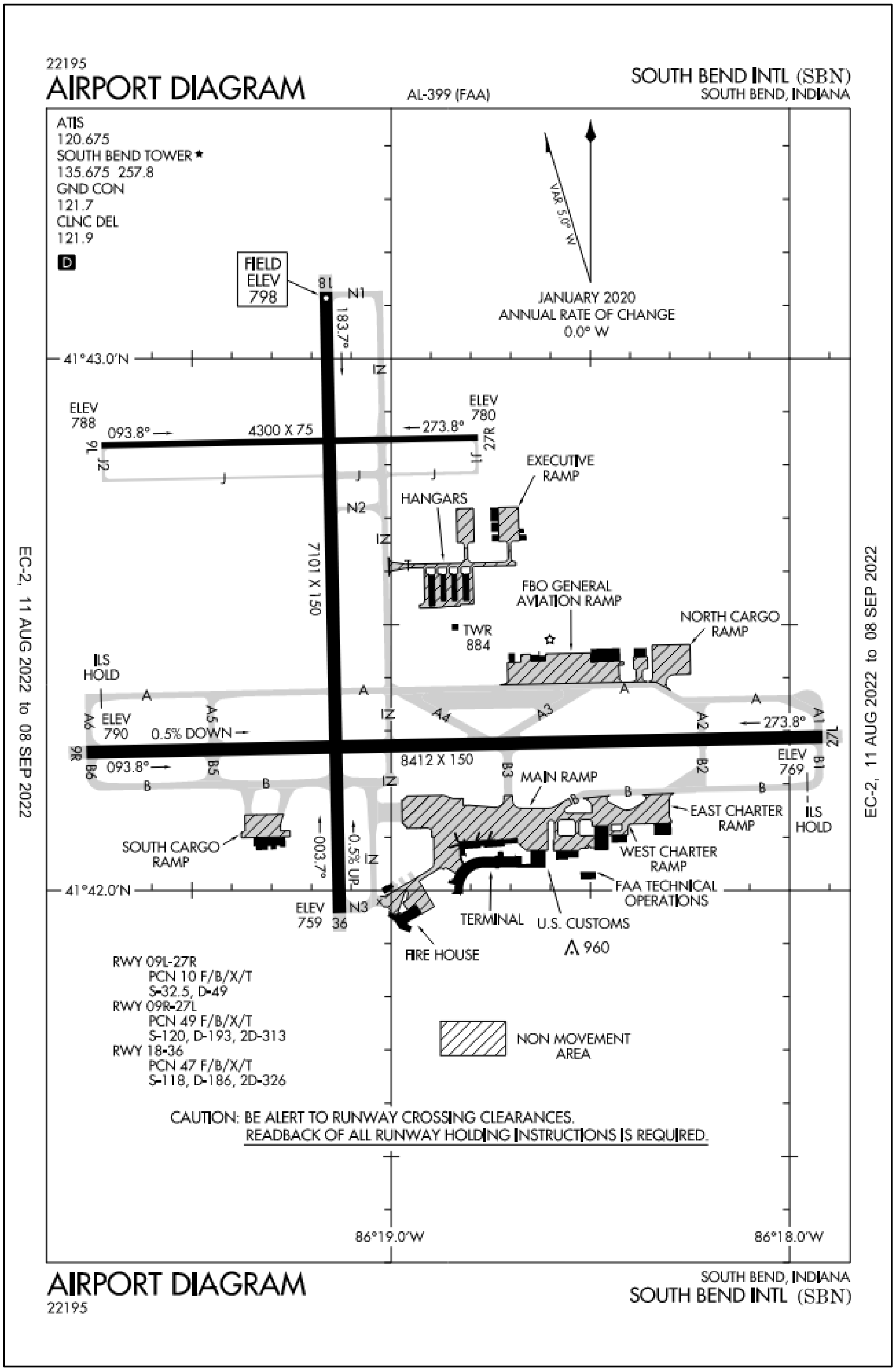
3.5 Taxiways

The taxiway system at an airport is designed to move aircraft safely and efficiently between runways and aprons. Taxiway design standards are identified in FAA AC 150/5300-13B, *Airport Design*. Each runway at SBN is served by a system of parallel taxiways and connector taxiways. A parallel taxiway runs parallel to a runway and provides for safe movement of aircraft from and to various points along that runway. A connector taxiway is used by aircraft for access between a parallel taxiway and the runway or the apron. This section provides a review of the taxiway system at SBN.

3.5.1 Taxiway Configuration

Runway 9R/27L has two parallel taxiways. Taxiway A is to the north of the runway and provides access to the GA ramp (**Figure 3-3**). Significant users of Taxiway A are Atlantic Aviation, Corporate Wings, and UPS. Taxiway B is to the south of the runway and provides access to the commercial airline terminal apron. In addition to the airlines, significant users of Taxiway B are FedEx and Michiana Aircraft Services. FAA design standards call for taxiway widths of 50 feet serving TDG 4 aircraft. FAA design standards also call for a 400-foot separation between a parallel taxiway and a C-IV RDC runway, as measured from the centerline of the taxiway and the runway. The separation of Taxiway A with Runway 9R/27L varies, but always exceeds 400 feet. Starting from the west end of the runway, Taxiway A is separated by 637.5 feet until approximately 1,900 feet from the Runway 27R threshold where it angles toward the runway. It turns parallel to the runway at Taxiway A-2, at 451 feet. Taxiway B’s separation distance from Runway 9R/27L ranges from 400 feet to a separation of 830 feet and then back to 588 feet.

Figure 3-3: Taxiway System



Source: FAA Aeronautical Information Services

Both Taxiways A and B exceed their design separation standard of 400 feet from Runway 9R/27L. The separation distances between Runway 9R/27L and its two parallel taxiways should be reduced to 400 feet to meet FAA design standards. At the time of this master plan study, a Taxiway B improvements project was underway at SBN that included relocating Taxiway B to achieve a 400-foot separation distance from Runway 9R/27L.

The review of facility requirements looked at other design elements of the taxiway configuration around Runway 9R/27L. To begin with, FAA AC 150/5300-13B, *Airport Design*, states:

> "Design right-angle intersections for runway / taxiway intersections, except where there is a need for acute angled exit taxiways, such as a high-speed exit… For opposite direction acute angle exit taxiways in close proximity, provide sufficient separation between the exits to limit a large expanse of pavement and allow standard locations for signs and markings."

Right-angle taxiways provide the best visual perspective to a pilot approaching an intersection with the runway to observe aircraft in both the left and right directions. They also provide the optimum orientation of the runway holding position signs to maximize visibility to pilots. An airfield improvements feasibility study, approved by the FAA in March 2018, found:

> *The existing alignment of Taxiway B is not in a direct linear path parallel to Runway 9R/27L like most parallel taxiway configurations. Due to the angled alignment of Taxiway B, intersections with Runway 18/36 and Taxiway N are not at the 90-degree angles recommended by FAA airfield design standards. Likewise, the angled routing towards the commercial airline terminal apron and use of its associated pavement reduces the amount of area that is available for the maneuvering of commercial airline aircraft within this surface. Thus, there is a need for improvements to Taxiway B to correct the symmetry of angled intersections and to provide additional area on the commercial airline terminal apron for the maneuvering of aircraft.*

The Taxiway B improvements project in progress at the time of this master plan study will bring Taxiway B into compliance with FAA design standards.

Additionally, Taxiways A3, A4, B3, and B4 meet at roughly the same point, creating a six-way intersection, with Taxiways A3 and A4, not making use of standard right-angle intersections. It is recommended that Taxiways A3 and A4 be reconfigured to correct the non-standard intersection.

The FAA AC 150/5300-13B, *Airport Design*, also states: "Taxiways connecting an apron directly to a runway can lead to confusion by creating a false expectation of a parallel taxiway prior to a runway… Design taxiways leading from an apron to a runway to make at least one turn between 75 and 90 degrees prior to reaching the runway hold line."

This is the situation with multiple connector taxiways to Runway 9R/27L. Taxiways B3 and B4 permit direct access from the apron to the runway. This was addressed in the *Airfield Improvements Feasibility Study*.

The planned improvements in progress for Taxiway B will correct this design, as well as the six-way taxiway intersection to which they lead.

The crosswind runway, Runway 18/36, is served by parallel Taxiway N. For C-III aircraft, FAA design standards stipulate that the parallel taxiway should be positioned at least 400 feet away from the runway. At the south end of the runway, Taxiway N is 400 feet from Runway 18/36 and angles out to 600 feet from the runway at the intersection with Taxiway B. It is recommended that Taxiway N be relocated to 400 feet from Runway 18/36 along its entire length. This will result in Taxiway N meeting FAA design standards and increase space available for airside development.

In addition, the pavement width of Taxiway N is 50 feet wide. For TDG 2B aircraft like the CRJ-900, which is the representative type of the critical design aircraft for Runway 18/36, the taxiway width design standard is 35 feet. No improvements are needed to the existing design of the taxiway to accommodate TDG 2B aircraft; however, at the time an improvement project is needed for Taxiway N, the design of the project may need to accommodate a 35-foot taxiway width if federal funding is desired for the project.

Parallel Taxiway J is on the south side of the secondary runway, Runway 9L/27R, and has a width of 35 feet. The design standard for taxiways supporting TDG 1A aircraft is 25 feet, so no improvements are needed to the width of taxiway. A-I aircraft, the critical design type of Runway 9L/27R, require 200 feet of separation between a parallel taxiway and a runway with an approach visibility minimum of not lower than 1 mile. Taxiway J has 400 feet of separation with Runway 9L/27R so no changes to the separation of the taxiway are needed to accommodate the critical design aircraft type.

3.5.2 Taxiway Safety Area

Taxiway safety areas (TSA) are like RSAs as they are centered on the taxiway centerline and should be graded, drained, capable of supporting aircraft, snow, and fire equipment, and free of objects. The width of the TSA is based on the design of the critical aircraft expected to use the surface. The primary and crosswind runways at SBN have TSAs designed to D-IV standards. Taxiways A, B, and N have TSAs that are 171 feet wide, which meet the TSA width standards for C-IV (171 feet) and C-III (118) aircraft types. Taxiway J, which parallels the secondary runway, Runway 9L/27R, has a TSA width designed to B-II standards (79 feet). This exceeds the TSA width of A-I aircraft (49 feet). Thus, no TSA improvements are needed.

3.5.3 Taxiway Object Free Area

Taxiway object free areas (OFA) are like ROFAs as they are also centered on the taxiway centerline and prohibit vehicle roads, parked aircraft, and above ground objects except those needed for air navigation. The width of these areas is based on the most demanding aircraft expected to use the surface. Taxiways that service Runways 9R/27L and 18/36 (Taxiway A, B, and N) have OFAs that are 259 feet in width. This exceeds the design standards for C-IV (243 feet) and C-III (171 feet) aircraft. Likewise, Taxiway J, which parallels Runway 9L/27R, has an OFA width of 131 feet which exceeds the design standard for A-I aircraft types (89 feet). Therefore, consideration should be given at the time of a future taxiway improvement project to adjusting the width of the OFA of these surfaces to match the design standards of the critical design aircraft type.

3.6 Aprons

The function of an apron is to provide an area for aircraft to maneuver, load, and unload passengers and/or cargo, and to support fueling, maintenance, and parking. The size and layout of an apron is dependent upon several factors including purpose of the apron, number of aircraft parking positions, size and type of aircraft intended to use the surface, movement patterns of aircraft and ground service vehicles, and locations of support facilities such as hangars and terminal buildings. Peak operations should also be considered during apron design to determine the size of aprons during these times of high demand. Considering these factors, analyses were conducted to determine the amount of terminal area, cargo, and GA apron space that will be needed to accommodate demand throughout the planning period.

3.6.1 Commercial Airline Terminal Apron

The commercial airline terminal apron is located to the north of the commercial airline terminal building and includes an area used for the routing of Taxiway B. Combined, the pavement envelope of the area is approximately 73,900 square yards, approximately 1,300 feet wide by 281 feet long. The pavement within this non-movement area intended for commercial airline use is approximately 50,770 yards. The remainder of the pavement area in the movement area that encompasses Taxiway B and its associated OFA is approximately 23,130 square yards.

United Express arrival at SBN
Source: SBN official Twitter account

The commercial airline terminal apron needs improvements for two significant reasons. The first is that the grade of the commercial airline terminal apron slopes towards the commercial airline terminal building. This results in the accumulation of water runoff adjacent to the commercial airline terminal building from rain and melting snow and ice. Water then seeps into the commercial airline terminal building and poses a safety consideration in the pushback of aircraft from the boarding gates.

Tugs positioned close to the terminal push aircraft away from the boarding gates. Water accumulates where the tugs need to be near the terminal building after a storm or when snow/ice melts causing reduced traction for the tugs. This is particularly an issue during winter ice buildup. When tugs have trouble maneuvering due ice buildup and the incline of the apron, multiple tugs are needed to position a single aircraft. This can create potential departure delays if multiple aircraft are pushed back at the same time.

Additionally, aircraft need to park and maneuver on the commercial airline terminal apron. Currently, Taxiway B and its associated safety areas encompass a portion of the pavement area for the commercial airline terminal apron. This reduces the non-movement area for the positioning of aircraft at the terminal building. As a result, aircraft positioned away from the building enter the movement area associated with Taxiway B. This creates a safety concern for the push back of aircraft away from the boarding gates as the potential exists for an unintentional push back onto Taxiway B and in its associated movement area without authorization from Air Traffic Control (ATC). This increases the risk of a taxiway incursion and collision with another taxiing aircraft.

Likewise, there is a need for additional area on the terminal apron near the Federal Inspection Station (FIS). Currently, GA aircraft needing to access the FIS must taxi around the Boarding Gate 9 position on the east end of the apron; however, there are spacing challenges for a commercial aircraft parked at Boarding Gate 9, particularly for the larger narrow-, or wide-body type typically parked here. While a repositioning of aircraft parking positions and boarding gates can provide some additional area, expansion of the apron in this location would provide sufficient room for larger business jet aircraft types to access the FIS when narrow- or wide-body aircraft are at Boarding Gate 9. Since SBN desires a power in/power out option for the FIS, this additional area for maneuvering is critical.

Finally, due to the size and configuration of the commercial apron, a dedicated area for the application of aircraft deicing fluid and collection of its runoff is not available. These needed improvements were being addressed as part of the Taxiway B improvements project at the time of this master plan study. No further apron improvements are needed to meet demand anticipated during the planning period, assuming the current decoupling project of the terminal apron and Taxiway B is completed.

3.6.2 Cargo Aprons

SBN serves a prominent role in supporting the air cargo demands of not only the Northern Indiana / Southwest Michigan Michiana region, but also the greater Chicago metropolitan area. UPS and FedEx are SBN's two cargo airlines, both of which have aprons to support their operations. The UPS Apron is north of the approach end of Runway 27L along Taxiway A and is approximately 173,000 square feet. FedEx uses the West Cargo Apron located west of the approach end of Runway 36 and south of Taxiway B. The West Cargo Apron is approximately 122,000 square feet. UPS and FedEx use their respective aprons for aircraft parking, loading, unloading, fueling, and deicing, as well as ground service equipment storage and maintenance. Both airlines primarily use Boeing 757 aircraft, but larger widebody aircraft such as the Boeing 767 and Airbus A300 series aircraft also occasionally conduct operations for these carriers during peak periods such as the holiday gift season. For this master plan study, neither UPS nor FedEx identified a need for additional apron space at SBN in 2021. However, with the continued growth in e-commerce, it is anticipated that expansion of their aprons may be necessary to accommodate additional aircraft parking and associated operational area. A specific apron size at the UPS and FedEx facilities would likely be driven by business demand and ultimately the decision of these two cargo operators.

As discussed in Chapter 2: Projections of Aviation Demand, SBN released the South Bend International Airport Freight Master Plan in 2020, which identified opportunities for air cargo development and noted the competitive advantages the Airport has compared to competing air cargo airports in the region, such as Gerald R. Ford International Airport, Rockford International Airport, and Rickenbacker International Airport. SBN's advantages include:

- Located in the epicenter of manufacturing in the U.S. and within a 90-minute drive of Chicago
- Located along major transportation corridors including I-80/I-90 and within 25 miles of I-94

- Leads competing airports in the amount of trucking freight that passes within its 60-mile radius
- Located within seven miles of the Indiana Enterprise Center, which supports agribusiness, advanced manufacturing, and smart logistics
- Greater amount of airport-adjacent land with airside access immediately available
- More compatible surrounding land uses (industrial, commercial) compared to competing airports
- Customs clearance for international flights

The Freight Master Plan provided a development strategy that leverages SBN's unique location and available land to increase air cargo activity. In response, SBN is actively pursuing additional domestic and international cargo service and has long-term plans to increase air cargo activity. It is recommended that SBN preserve adequate space for the development of additional cargo facilities, including aprons, to accommodate this growth.

3.6.3 General Aviation Apron

Guidance established in FAA AC 150/5300-13B, *Airport Design*, was used to evaluate the demand for GA apron space based on the total amount of space needed on the busiest day of operation. The total number of itinerant GA aircraft operations in 2019 as well as the projected annual number of itinerant GA aircraft operations that can be anticipated throughout the planning period under the preferred master plan forecast were obtained from Chapter 2: Projections of Aviation Demand. The percent of total operations in the peak month (10.93 percent) was then multiplied by these annual counts to determine the total number of operations in the peak month (September). This number was then multiplied by 30 (since there are 30 days in September) to determine the average number of daily operations in the peak month. Assuming that the existing apron area is at 100 percent capacity to meet existing demand, an apron demand per aircraft square footage can be calculated to determine the amount of additional apron area needed (**Table 3-17**).

Table 3-17: Projected Itinerant General Aviation Aircraft Apron Demand Average Day

Criteria	2019	2020	2025	2030	2035	2040
Annual GA Itinerant Operations	14,015	10,088	14,268	14,922	15,606	16,321
Percentage of Total Operations in Peak Month	10.93%	11.05%	10.93%	10.93%	10.93%	10.93%
Peak Month Operations	1,532	1,115	1,560	1,631	1,706	1,784
Peak Month Average Day Operations *(Peak Month Operations Divided by 30)*	51	37	52	54	57	59
Existing Apron Area (square feet)	370,000	370,000	370,000	370,000	370,000	370,000
Itinerant Apron Demand per Aircraft (square feet)	6,680	6,680	6,680	6,680	6,680	6,680
Total Itinerant Apron Demand (square feet)	341,125	248,273	347,283	363,202	379,850	397,253
Apron Surplus (+) / Deficiency (-)	**28,875**	**121,727**	**22,717**	**6,798**	**-9,850**	**-27,253**

Source: Mead & Hunt, Inc. (2021); Marr Arnold Planning (2021)

As illustrated, this analysis projects a deficiency in apron space beginning in 2035, when an additional 9,850 feet of apron area will be needed. However, several times each year, the demand for apron space at SBN well exceeds the peak month average day demand; this is often the case when the University of Notre Dame hosts a football game. During these events, SBN experiences a significant number of itinerant aircraft operations from alumni, fans, and corporate sponsors associated with both Notre Dame and the visiting team. As such, all available GA apron space is used for aircraft parking. In addition, Runway 9L/27R is often closed during Notre Dame football games and used for overflow parking, which creates operational issues at the Airport.

SBN desires to address the lack of apron space for itinerant GA aircraft parking on football game days in the near term. It is therefore recommended that space be preserved for additional itinerant GA aircraft parking.

3.7 Navigational Aids

The type and volume of aviation activity, local meteorological conditions, and the demand for precision and non-precision instrument approaches factor into the types of Navigational Aids (NAVAIDs) needed at an airport. FAA AC 150/5300-13B, *Airport Design*, FAA Order 7031.2C *Airway Planning Standard Number One – Terminal Air Navigation Facilities and Air Traffic Control Services*, 14 Code of Federal Regulations (CFR) Part 139 *Certification of Airports*, and the Aeronautical Information Manual (AIM) offer guidance on the type of visual and electronic NAVAIDs that should be present at an airport. The review of visual and electronic NAVAIDs focused on their ability to meet the existing and projected demands of SBN users.

3.7.1 Visual Navigational Aids

The review of visual NAVAIDs focused on elements that provide visual cues for the locations and thresholds of airfield infrastructure elements. These comprise lights, signs, wind indicators, and pavement markings.

Wind Indicators

Wind indicators (also known as windsocks or wind cones) are orange cone-shaped fabric devices that visually indicate wind strength and direction. Wind indicators are most beneficial to pilots just prior to landing and during takeoff, when aircraft are most impacted by surface winds. SBN has a total of six wind indicators, all illuminated. SBN's primary wind indicator is located north of the commercial airline terminal building between Taxiways B3 and B4. Four wind indicators are located near each end of Runways 9R/27L and 9L/27R, and another is located between Runway 18/36 and Taxiway N, south of Taxiway N2. No additional wind indicators are necessary to retain the safe conditions of the airfield. Other than routine maintenance, no changes to wind indicators are expected during the planning period.

Wind indicator at SBN
Source: SBN official Twitter account

Rotating Beacon

A rotating beacon is a high intensity light that rotates 360 degrees and is operated during low visibility situations, such as at night and in inclement weather, to assist pilots in identifying the location of an airport from the air. Rotating beacons are equipped with a green and white lens separated 180 degrees from each other so that alternating green and white flashes can be viewed from the air signaling to pilots that an airport is available for public use. The airport-owned rotating beacon at SBN is located on a freestanding tower near Lathrop Street and the parking lot for Atlantic Aviation. There are no obstructions or surrounding terrain that obstruct viewing of the light beam; as such, no improvements, such as relocation of the rotating beacon or mitigation of possible obstructions, are necessary.

Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights

A Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR) is a series of light bars located at the threshold of a runway used in assisting pilots to confirm the centerline of a runway during landing. An approach lighting system such as a MALSR is required for approach visibility minimums below ¾ mile. At SBN, a MALSR is located at the approach end of Runway 27L, while the Runway 9R end is equipped with a Medium Intensity Approach Lighting System with Sequenced Flashing Lights (MALSF). The existing MALSR system meets design standards and no improvements are needed.

Precision Approach Path Indicators

Precision Approach Path Indicators (PAPIs) are visual aids that provide the proper descent slope for an aircraft on approach for landing. PAPIs are generally two- or four- light units that, depending on the combination of lights, indicate whether an aircraft is above, below, or on the correct descent path. Four-light PAPI units are located at the ends of Runways 9R/27L and 18/36, and a two-light PAPI unit is located at the ends of Runway 9L/27R. All installed PAPIs meet standards and no improvements are anticipated.

Runway Edge Lighting

Runway edge lights assist pilots in identifying the runway during periods of restricted visibility. Runway 9R/27L is equipped with a High Intensity Runway Lighting system (HIRL), while Runways 18/36 and 9L/27R are each equipped with a Medium Intensity Runway Lighting system (MIRL). The intensity of the lighting can be controlled by the airport traffic control tower (ATCT) or remotely by the pilot via the Common Traffic Advisory Frequency (CTAF). Runways equipped with precision instrument approaches are typically equipped with HIRL systems. Since Runway 9R/27L is equipped with an instrument landing system (ILS) at both ends, no improvements to the runway lighting are necessary. MIRL systems are typically installed on runways with non-precision approaches. Since these types of approaches are found on either end of Runways 18/36 and 9L/27R, no improvements to the lighting system are needed. As lights are replaced in the future, the Airport should consider installing energy efficient light-emitting diode (LED) fixtures to reduce energy use and decrease airfield operating expenses.

Taxiway Edge Lighting

Like runway edge lighting, the taxiway edge lighting helps identify the edge of taxiways in low visibility/night conditions and can also be controlled via the CTAF. All runway and taxiway edge lighting meets FAA standards with only routine maintenance anticipated during the planning period. The taxiway edge lighting installed is a Medium Intensity Taxiway Lighting (MITL) system, offering three illumination intensities. The entire airfield is equipped with a MITL system, and no improvements are necessary; however, during routine maintenance and projects, the Airport should convert the lighting to LED as funding allows. LED lighting provides brighter illumination intensity and require the use of less energy than a standard incandescent lighting. SBN is installing LED lighting along Taxiway B as part of the Taxiway B reconstruction project in progress at the time of this master plan study.

Pavement Markings

Airfield pavement markings provide visual and perceptual cues to pilots when on approach, taxiing, and during takeoff. Some examples of pavement markings include aiming point and touchdown zone indicators, runway designation indicators, runway side stripes, holding position markings, and air traffic control movement boundary markings. Markings applied to a runway are based on the type of instrument or visual approach procedure. Runway markings for Runway 9R/27L are precision markings identifying the threshold, runway designation, aiming point, touchdown zones, centerline, and side stripes that are in good condition. For Runways 9L/27R and 18/36, non-precision markings identify the threshold, runway designation, centerline, and aiming point and are in good condition. Airfield pavement markings are in accordance with FAA airport marking standards, and it is anticipated that only routine maintenance will be needed during the planning period.

Airfield Signage

Airfield signage complements pavement markings by providing location and directional information. Some examples of signage throughout the airfield include hold position signs, runway distance remaining signs, taxiway locations, taxiway directional signs and runway designation signs. FAA AC 150/5340-18F, *Standards for Airport Sign Systems*, provides guidance for the installation and maintenance of sign systems at an airport. Currently, all airfield signage meets design standards, and no improvements are needed. It is recommended that the airfield signage at SBN be maintained in accordance with the AC with only routine inspections and maintenance anticipated during the planning period to ensure signs continue to meet reflectivity and visibility standards.

Runway sign at SBN
Source: Mead & Hunt, Inc.

3.7.2 Electronic Navigational Aids

Electronic NAVAIDs transmit signals received by aircraft with proper avionics equipment so landings can be conducted when visibility is limited, such as during inclement weather, low cloud ceilings, and at night. Electronic NAVAIDs can be equipment installed on or off an airport as well as orbiting satellites. The sections below summarize the condition of electronic NAVAIDs found at SBN.

Instrument Landing System

An ILS consists of a localizer and a glide slope antenna. The localizer is an antenna placed off the departure end of a runway along its centerline that transmits a signal providing lateral guidance to the centerline of the runway. The glide slope antenna is positioned alongside the runway near the aiming point marking at the approach end of a runway to provide vertical guidance along the descent path. An ILS allows properly equipped aircraft and appropriately trained airmen to make precision instrument approaches during periods of limited visibility. The type of precision instrument approach offered by an ILS is categorized based on the minimum cloud ceiling height and visibility requirement necessary for a pilot to fly the approach, with Category III approaches offering lower decision heights and visibility requirements than Category I approaches. SBN is equipped with a Category II ILS approach to Runway 27L, which will be sufficient for the Airport's users throughout the planning period.

Global Positioning System

The Global Positioning System (GPS) is a satellite-based navigation system that transmits location signals to properly equipped aircraft so that location, altitude, direction of travel, and speed can be determined. GPS offers the ability for aircraft to conduct approaches to runways that are not equipped with ground-based navigational equipment. SBN has six published satellite-based instrument approach procedures, four of which offer Localizer Performance with Vertical Guidance (LPV). LPV allows high-accuracy approaches with minimums as low as one half mile. These approaches each offer properly trained pilots the ability to conduct a GPS-based approach and receive vertical and horizontal guidance. The GPS approaches to SBN's runways meet the demands of users throughout the planning period.

Very High Frequency Omni-Directional Radio Range Antenna

The Very High Frequency Omni-Directional Radio Range antenna, also known as a VOR, is a ground-based NAVAID that emits radio signals so that a pilot can determine course and position in relation to the distance from the VOR. While no VOR is located on SBN property, a FAA-owned VOR is installed approximately three nautical miles from Runway 18. VORs do not offer the accuracy of GPS, and the FAA is currently evaluating the necessity, benefits, and costs of these NAVAIDs throughout the National Airspace System (NAS). While a specific need to use the VOR was not identified, it is recommended that future airport planning activities monitor the FAA's desires to keep this navigational instrumentation operational and any impacts removal of the NAVAID may have on operations at SBN.

3.8 Weather Equipment

Weather observation equipment is installed on airfields to disseminate accurate and timely weather conditions to pilots. At SBN, an automated surface observing system (ASOS) unit, owned by the National Weather Service (NWS), is located near the intersection of Taxiways A and N, just west of the Airfield Maintenance Facility. The existing ASOS unit meets the accuracy of weather reporting required for aircraft to conduct Category II precision instrument approaches and does not need to be replaced with a system offering more weather reporting accuracy to meet the demands of users within the planning period. This includes Runway Visual Range (RVR) equipment located adjacent to the touchdown zone at the approach end of Runway 27L. The presence of RVR equipment increases the accuracy of visibility measurements during low visibility conditions, and aids pilots in making more informed decisions. The existing RVR equipment is anticipated to meet the future needs of SBN throughout the 20-year planning period.

3.9 Part 77 Surfaces

Three dimensional surfaces defined in 14 CFR Part 77 protect airspace surrounding an airport from obstructions that could interfere with aircraft operations. Obstructions such as trees, buildings, and towers that impact Part 77 surfaces can prevent instrument approaches from being developed or modify or eliminate existing approaches that can lead to a reduction in capacity. Part 77 defines five surfaces that protect airspace surrounding airports from obstructions. The dimensions of the surfaces are based upon the type of approach to each runway end. These surfaces are described in the sections below. **Table 3-18** lists the dimensions for Part 77 surfaces while **Figure 3-4** provides a graphical representation of these surfaces.

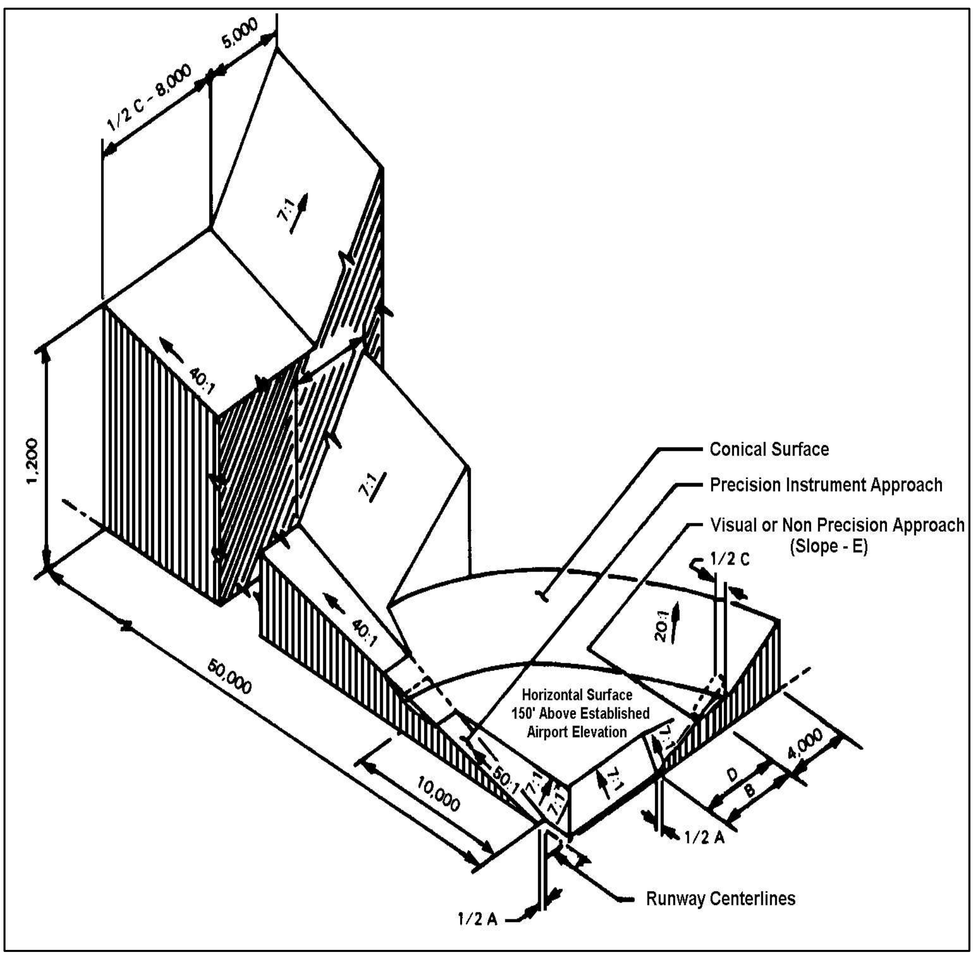
Table 3-18: Part 77 Surfaces

DIM	Item	Dimensional Standards (Feet)					
		Visual Runway		Non-Precision Instrument Runway			Precision Instrument Runway
		A	B	A	B		
					C	D	
A	Width of Primary Surface and Approach Surface Inner Width	250	500	500	500	1,000	1,000
B	Radius of Horizontal Surface	5,000	5,000	5,000	10,000	10,000	10,000
C	Approach Surface Outer Width	1,250	1,500	2,000	3,500	4,000	16,000
D	Approach Surface Length	5,000	5,000	5,000	10,000	10,000	*
E	Approach Slope	20:1	20:1	20:1	34:1	34:1	*

Notes:
A – Utility Runways
B – Runways Larger Than Utility
C – Visibility Minimums Greater Than 3/4 Mile
D – Visibility Minimums as Low as 3/4 Mile
* - Precision Instrument Approach Slope is 50:1 for inner 10,000 Feet and 40:1 for an additional 40,000 feet

Source: 14 CFR Part 77

Figure 3-4: Part 77 Surfaces



Source: 14 CFR Part 77

3.9.1 Primary Surface

The primary surface is one dimensional and centered longitudinally on the runway centerline and lies at the same elevation as the runway. The length of the surface is the same length of runway with no prepared hard surface. For runways with prepared hard surfaces, the length extends 200 feet beyond each runway end. The width of the surface varies between 250 feet to 1,000 feet based on the type of runway and type of runway approach. Runway 9R/27L is a precision instrument runway; therefore, the width of the primary surface is 1,000 feet. Runways 9L/27R and 18/36 are non-precision instrument runways with visibility minimums greater than ¾ miles; therefore, the primary surface for these runways has a width of 500 feet and no changes in design are needed.

3.9.2 Approach Surface

The approach surface is centered longitudinally on the runway centerline and extends upward beyond each runway end. An approach surface is applied to each end of the runway based upon the type of existing or planned approach for that runway end. The inner edge of the approach surface is the same width as the primary surface and expands uniformly to a width based on the designation and type of approach to that runway. As such, the inner edge of the approach surface to each end of Runway 9R/27L is 1,000 feet and expands to a width of 16,000 feet. For Runways 9L/27R and 18/36, the inner edge of the approach surface to each runway end is 500 feet and expands to a width of 3,500 feet. This meets design standards, and no improvements are needed.

The slope of the surface is dependent on the type of approach to the runway end and measures at a ratio of 20:1, 34:1, or 50:1. The horizontal distance of the surface also varies on the type of runway approach and can be from 5,000 feet to 50,000 feet in length. For Runway 9R/27L, the approach surface extends upward at a slope of 50:1 for 10,000 feet and then extends upward at a slope of 40:1 for an additional distance of 40,000 feet. The approach surface for Runways 9L/27R and 18/36 extends upward at a slope of 34:1 for 10,000 feet. This surface meets design standards and no changes are needed.

3.9.3 Transitional Surface

The transitional surface also extends upward and outward, but perpendicular to the runway. The slope of this surface extends at a 7:1 ratio from the side of the primary and approach surfaces. The surface extends vertically until a height of 150 feet above the elevation of the runway. The transitional surfaces for all runways meet these standards and no improvements are needed.

3.9.4 Horizontal Surface

The horizontal surface begins 150 feet above the elevation of the runway at the termination of the transitional surface. The surface extends outward horizontally from the transitional surface to a perimeter established by generating arcs from the end of each primary surface and connecting the arcs with lines of tangent. The radii of the arcs are 5,000 feet long for utility and visual runways and 10,000 feet long for all other types of runways. Since none of SBN's runways are utility or visual runways, the radii of the arcs for all runway ends are 10,000 feet. This meets standards and no changes to the dimensions or design of these surfaces are needed.

3.9.5 Conical Surface

The conical surface extends outward and upward from the outermost perimeter of the horizontal surface at a 20:1 slope for a horizontal distance of 4,000 feet. The conical surfaces for the runways at SBN meet these design standards and no changes to their dimensions are needed.

Any penetrations of the Part 77 surfaces are considered obstructions and are presumed hazards to air navigation unless further aeronautical study concludes that the object is not a hazard. Once a further aeronautical study has been initiated, the FAA will use the standards in Part 77, along with FAA policy and guidance material, to determine if the object is a hazard to air navigation. There is no specific authorization in any statute that permits the FAA to limit structure heights or determines which structures should be lighted or marked. In every aeronautical study determination, the FAA acknowledges that state or local officials have control over the appropriate use of property beneath an airport's airspace.

SBN's ALP depicts the Part 77 surfaces for each runway and any identified obstructions within the runway approach surfaces. Obstruction evaluations to these surfaces are recommended as part of any future ALP update. SBN is responsible for protecting their Part 77 surfaces to avoid the introductions of obstructions into their airspace. Part 77 obstructions identified on the airspace plan such as the number of trees noted for trimming should be removed or pruned below the airspace surfaces if possible. Those obstructions that are fixed by function or are unable to be removed should be identified with an obstruction light if possible.

3.10 Instrument Approaches

Reviewing instrument approaches at an airport is an important element when analyzing demand capacity. Instrument approaches allow properly equipped aircraft to land during times of reduced visibility, nighttime, and inclement weather conditions, thus increasing capacity. Instrument approaches also decrease the minimum visibility and cloud ceiling heights required to conduct a landing, also known as minimums. Ground equipment installed at airports can provide for two types of instrument approaches: non-precision and precision. Non-precision instrument approaches are those that provide horizontal guidance for an aircraft to properly align with the runway while precision approaches provide both horizontal and vertical guidance.

SBN has ten published instrument approach procedures:

- ILS or localizer approach to Runway 9R
- ILS or localizer approach to Runway 27L
- Special Authorization Category I and II ILS approach to Runway 27L
- Area Navigation (RNAV) GPS approach offering Localizer Performance with Vertical Guidance (LPV) to Runway 27L
- RNAV GPS offering LPV to Runway 9R
- RNAV GPS offering LPV to Runway 18
- RNAV GPS offering LPV to Runway 36
- RNAV GPS offering Localizer Performance (LP) to Runway 9L

- RNAV GPS offering LP to Runway 27R
- Non-precision VOR approach to Runway 18

The instrument approach procedures meet demand anticipated during the planning period; however, consideration should be given for the incorporation of GPS-based instrument approaches should such be developed for SBN in the future by the FAA. The incorporation of any future GPS-based instrument approaches offering vertical and horizontal guidance for runway ends where vertical guidance is not currently available would require changes to airfield design surfaces. It is recommended that SBN continually monitor and coordinate with the FAA if such GPS approaches are to be developed at SBN so planning can occur to address infrastructure design elements that may be needed.

3.11 Terminal Area Facilities

The following sections provide a review of facilities requirements for SBN's terminal area. These facilities are as follows:

- Commercial Airline Terminal Building
- Rental Car Facilities
- Parking Lots
- Aircraft Hangars

3.11.1 Commercial Airline Terminal Building

As described in Chapter 1: Inventory, SBN has one commercial terminal building. It is a L-shaped terminal building that has a linear east-west layout with the westernmost portion turning 90 degrees to the south. There have been several additions to the terminal since the original building was constructed in 1981. The middle portion of the concourse was built in 2010 and the east end was completed in 2012. The U.S. Customs Facility was constructed in 2016. Today, the net area of the terminal building is 204,763 square feet and its gross area is 217,221 square feet. The existing terminal building currently accommodates the operations of four airlines: Allegiant, American, Delta, and United.

In Chapter 2: Projections of Aviation Demand, the projections of passenger demand were developed for five-year increments (2025, 2030, 2035, and 2040). For future terminal facility planning purposes, the forecasts are presented as Planning Activity Levels (PALs) 1 through 4. Assigning PALs, rather than projected years, recognizes the uncertainties associated with forecasting and ties project milestones to activity levels rather than years. This allows the forecast to remain flexible, realizing activity levels may occur sooner or later than the forecast predicts. The PALs identify when the air carrier and subsequent passenger activity levels at SBN will trigger the need for additional capacity or other development.

The forecast of peak hour enplanements contains the Base Case Recovery forecast scenario. This scenario guided planning facility requirements for the terminal building. A peak hour passenger enplanement level was derived from current airline flight schedules and was used to determine facility requirements for terminal building. The Base Case Recovery Forecast is presented in **Table 3-19**.

Table 3-19: Base Case Recovery Forecast, from Table 2-13: SBN Peak Passenger Demand

		FORECAST			
	Actual	2025	2030	2035	2040
	2019	PAL 1	PAL 2	PAL 3	PAL 4
Base Case					
Peak Month Enplanements	40,371	42,750	47,880	53,610	60,040
Average Day Peak Month (ADPM)	1,302	1,379	1,545	1,729	1,937
Peak Day Enplanements	1,762	1,866	2,090	2,340	2,620
Peak Hour	267	280	313	351	393

Source: Marr Arnold Planning, 2021

A detailed *Terminal Planning Study* was prepared for SBN to review the PALs developed in Chapter 2. It assesses terminal demand in comparison to the existing terminal facilities and recommends facility requirements necessary to accommodate existing and future PALs. The following terminal components were analyzed as part of the *Terminal Planning Study*, included in **Appendix D**:

- Terminal Apron Gate Parking Positions
- Terminal Concourse Gates
- Terminal Curbside
- Terminal Building – Airline Ticketing & Baggage Check-in
- TSA Security Checkpoint
- Gate Departure Lounges/Concourse
- Arrivals Hall and Baggage Claim
- Customs & Border Protection (CBP) / Federal Inspection Services (FIS)

Facility requirement recommendations derived from the forecasted PALs and prepared under the guidelines presented in *Airport Cooperative Research Program (ACRP) Report 25, (Volumes 1 & 2, Airport Passenger Terminal Planning & Design; Transportation Research Board (TRB), 2010)* are further discussed below.

The following steps were necessary to develop the facility program for this master plan:

- Airline Flight Schedule Peak Hour Review
- Demand/Capacity & Level of Service Analysis
- Facility Program Space Requirements Development

Demand / Capacity Analysis & Level of Service Assessment

Demand / capacity analysis studies a facility's ability to support demand. This includes the terminal building system's ability to accommodate passengers. The multiple components of a terminal building processing system allow the airlines to operate with a minimum of delay, depending on whether components are performing at a sufficient capacity. Calculations of existing and forecasted demand are applied to known system component capacities. The resultant data indicates whether additional capacity is necessary to support demand. Industry standards are used to analyze a peak passenger demand period.

Demand/capacity analysis provides a basis for determining a system's processing capacity and space requirements, which yield the facility program.

Terminal Building Assessment

Early planning decisions have long lasting impacts to building functions, including future expansion and services. Planning a terminal building must remain flexible to allow for growth and be adaptive to industry changes.

SBN terminal building
Source: Northwest Indiana Business Magazine

Analysis of terminal building operations begins with the review of the current airline schedule and determination of peak hour operations. The examination of peak hour operations allows us to understand how periods of the greatest demand affect passenger processing functions within the terminal area. Planning of terminal facilities must consider the airport's desired level of service, air carrier standards, and applicable airport minimum standards. Proper planning should result in terminal designs that deliver a seamless passenger experience and enhance airport and air carrier operations.

Terminal Apron Gate Parking Positions

At SBN, a large apron area of approximately 550,000 square feet supports commercial service aircraft at the terminal building. As discussed in Chapter 1, the terminal apron includes 10 aircraft parking spaces that can accommodate a variety of large aircraft.

Terminal Concourse Gates

SBN's terminal building currently has seven gates with passenger boarding bridges. Gates 1 and 4 are non-operational, while Gates 2 and 3, originally built as ground-boarding gates, operate with a single-person lift within a gatehouse for passengers boarding aircraft. Gates 5 through 8 were built with traditional concourse level boarding onto a bridge leading directly to the aircraft door. Gate 9 requires passengers board using an interior ramp up to the level of the boarding bridge. To determine the required number of gates through the planning period, the three gates that do not meet industry standards, Gates 2, 3, and 9, should be removed from future terminal development consideration.

In order to maximize the utilization of existing gates, the airlines can increase the number of flights to seven or eight per gate, depending on aircraft size, markets served, and hub operations. As the number of operations approaches the capacity of the existing gate configuration, SBN should begin planning for additional gates and air carriers should begin to consider upsizing aircraft to manage passenger demand until new gates become available. Facility requirements analysis for terminal concourse gates indicates that PAL 1 requires an increase from seven existing gates to nine gates and PAL 2 requires a total of 10 gates necessary to meet the future passenger demand.

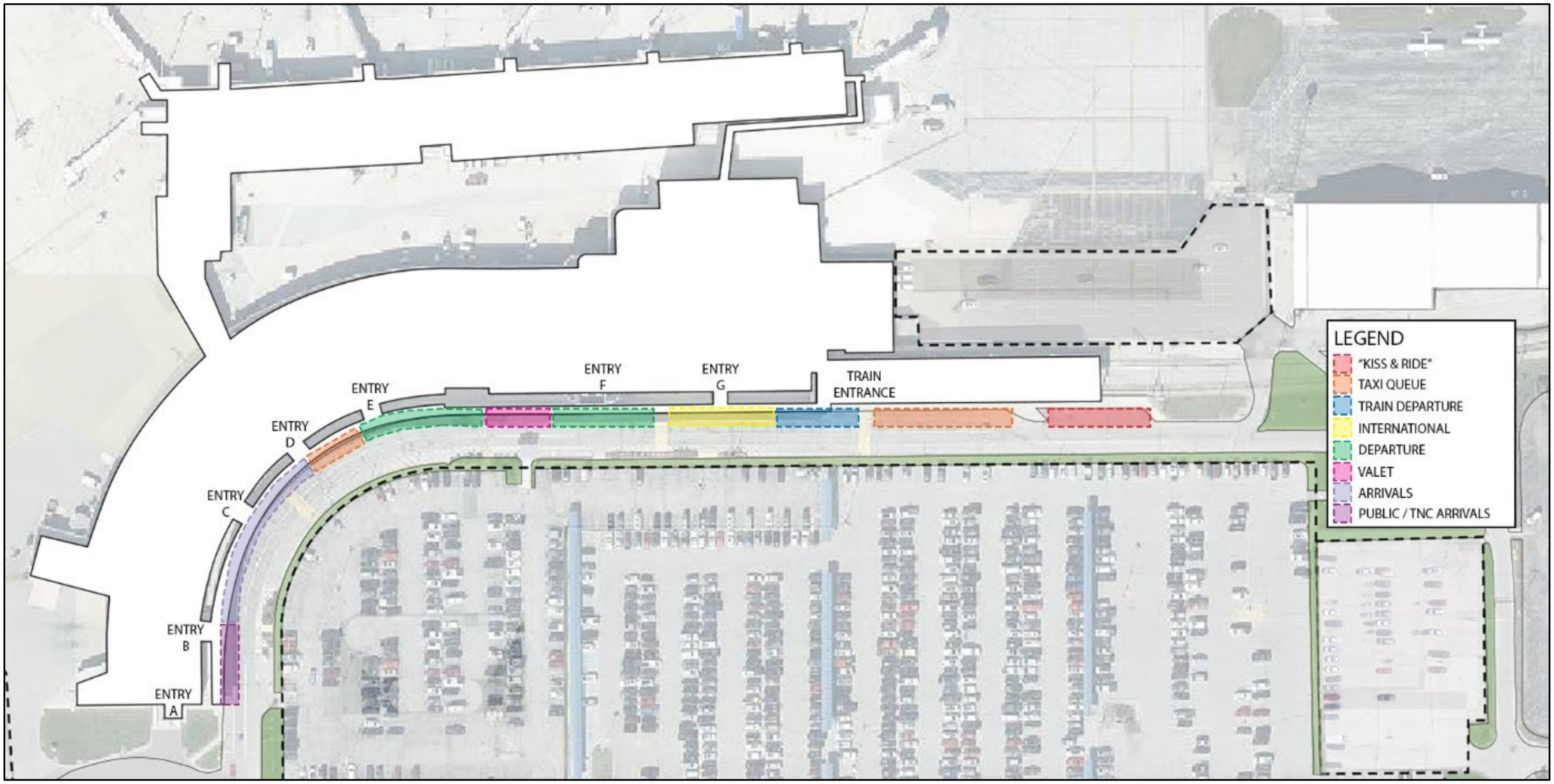
Terminal Curbside

Approximately 1,000 linear feet of terminal vehicle curb serves eight entrances along Terminal Drive. The terminal access roadway curb length is divided into two segments along the south side of the terminal: one serving train station passengers, the other serving airport passengers. The vehicle curb is divided between the departure and arrival curbs. However, there are multiple curb designations representing activity within the terminal, beginning with the train station departures and arrivals curb, then the international arrivals curb, followed by departures (to include international) curb, and domestic arrivals curb.

Future terminal development will increase curbside demand. Provision of additional curb capacity will help alleviate vehicle congestion at the arrivals curb, particularly directly in front of the arrival hall entrance. Additional signage and striping of parking spaces along the curb would assist travelers in choosing the appropriate place to drop off and pick up passengers. Additional curb length in the form of another lane or a second curb would increase total curb length and vehicle capacity. This will impact short-term parking, requiring adjustment of the barriers between short- and long-term parking lots. The terminal curb is illustrated in **Figure 3-5**.

Terminal curbside at SBN
Source: SBN official Twitter account

Figure 3-5: Terminal Curb Frontage and Building Entrance Designations



Source: Mead & Hunt, Inc.

Terminal Building – Airline Ticketing & Baggage Check-In

Ticketing and baggage check-in statistics from American, Delta, and United's ticket counters were analyzed to determine the user preferences for each airline serving SBN. The analysis of these statistics shows that with one to two agents per carrier (two for Delta) processing passengers, capacity is sufficient over the planning period because the existing, fully staffed ticket counters are capable of meeting demand. Under existing conditions, airline agents consistently perform better than the service level wait time set as the precedent for the analysis, further confirming that the airline ticketing and baggage check-in facilities have sufficient capacity to process existing demand. In addition, additional ticketing positions are available to expand capacity in the future.

Airline ticket counter at SBN
Source: Mead & Hunt, Inc.

Transportation Security Administration Checkpoint

The Transportation Security Administration (TSA) checkpoint currently processes passengers during the morning peak without delay. A total of 418 departing passengers are identified in the current summer flight schedule's morning peak hour. During this peak period, three checkpoint lanes were operational. The maximum number of passengers in the queue was 36, and the average wait time was 4.2 minutes. This processing time is far less than the standard 10-minute wait time necessary to achieve an appropriate level of service at a checkpoint. The TSA passenger and carry-on luggage security screening are sufficient to manage today's passenger demand.

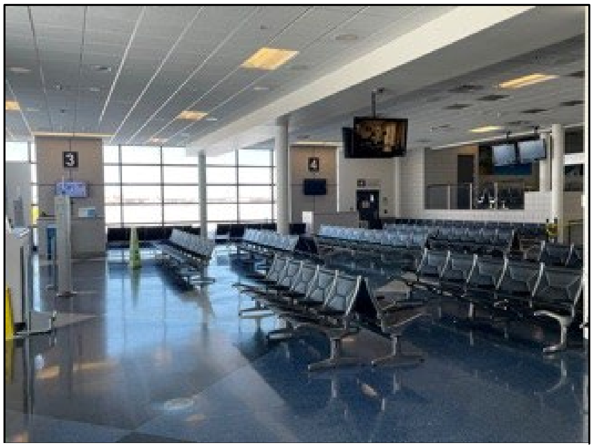
Specific future requirements for the TSA security checkpoint components are identified in the *Terminal Planning Study* in Appendix D. Improvements to passenger and carry-on screening processes, along with increased enrollment in the TSA's *Pre-Check Known-Traveler* program will provide increases in security checkpoint capacity over time.

SBN's security checkpoint processing capacity should be able to manage passenger demand forecasted through the PAL 2 period, as the facility requirements analysis shows that the existing three passenger screening lanes are adequate for passenger screening up to the PAL 4 scenario. Future expansion of the security checkpoint area will allow space for the installation of a fourth lane should the flight schedule grow beyond what is programmed as part of this master plan.

Gate Departure Lounges/Concourse

The gate departure lounges for the terminal concourse were built in 2011 to accommodate small regional aircraft operating from SBN. As of today, only Allegiant operates a narrow-body aircraft from the concourse. Larger charter flights for sports events also occur during the fall. The schedule for summer 2021 travel has resulted in a high level of departing passengers that have pushed the limits of the concourse capacity for gate departure lounge areas, the number of functional operating gates, and restrooms.

An increase in the square footage of the departure lounge areas will be required to meet future passenger demand. The use of floor ramp circulation space for departure lounges should be modified as soon as possible.



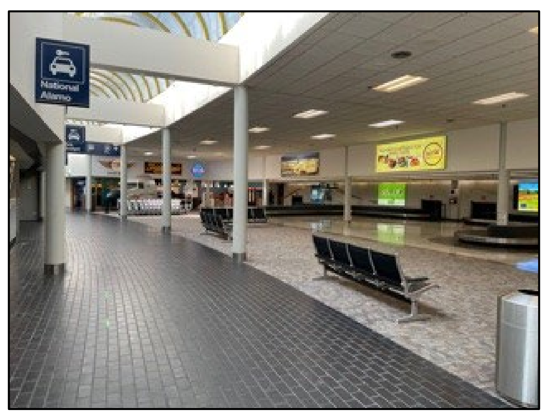
Gate departure lounge in SBN terminal concourse
Source: Mead & Hunt, Inc.

In addition, it was observed that the layout and space within the concourse present challenges, particularly the original design that uses ramps and lifts to serve travelers. The existing ramps should also be eliminated or elongated so that passengers will not experience a sense of slipping on the surface when descending the ramps. The Airport, airlines, and passengers have made the best of working within the concourse's limitations, but fundamental flaws remain.

The building was not designed to fully support airline operations during winter weather conditions. The concourse building impedes ground services operations, requiring long drives from gates to baggage claim and ticketing to aircraft gates, with the clearance between the apron and concourse level too low to use the area beneath it. The benefits gained by maintaining a low-profile building are exceeded by an ability to use sheltered space under a concourse for airline and other tenant operations and to provide an apron clear of ground service equipment (GSE) equipment during snow removal.

Arrivals Hall and Baggage Claim

The percentage of passengers checking baggage at their origination airport and the number of bags per passenger determine the demand for baggage claim space and the required claim device frontage. The observed number of passengers checking bags at SBN was lower than anticipated. This is likely because passenger observations took place during the early morning departures bank. Typically, passengers during the early morning flights at SBN carry bags onto their flights rather than utilize baggage check-in services. The data collected from the morning observations confirmed the majority of passengers checked fewer bags than they carried onto the aircraft.



Baggage claim at SBN
Source: Mead & Hunt, Inc.

Travel trends typically lean towards a higher percentage of passengers checking bags during seasonal leisure travel, rather than business travel that dominates early morning flights. Consequently, a more traditional figure of 60 percent of passengers checking bags was used to estimate necessary baggage claim frontage. The length of the existing baggage claim devices meets demand for the current 20-minute peak arrivals period. As the Airport grows, baggage claim requirements will also grow. A third baggage claim device will be required to meet PAL 1 arriving passengers claiming baggage.

Customs and Border Protection/Federal Inspection Services

None of the PAL facility programs include area for the Airport's Customs and Border Protection (CPB), Federal Inspection Services (FIS), and General Aviation (GAF) facilities. Together, these facilities total 22,500 square feet (including sterile corridors). They are not identified for expansion within the planning period.

Summary of Findings & Recommendations for Growth

Analysis of the terminal's operations centered around airline ticketing and baggage check, security screening, concourse gate departure lounges, and baggage claim. The analysis addressed whether these facilities need to be expanded and renovated to provide sufficient space for operations and passenger processing.

Deficiencies in terminal space identified during the facility requirements review process that should be remedied to accommodate SBN's PALs are outlined below.

Areas requiring expansion or inclusion are as follows:

- **Allegiant Air's Ticket Queue** – The queue requires more space to accommodate the rush of passengers checking in during the early morning departures bank. The high demand in this short period is due to Allegiant's larger aircraft, historically higher load factors, and the carrier's 45 – 60-minute cut-off time prior to departure.

- **Additional Airline Ticketing Office (ATO)** - At approximately 2,000 square feet per airline, the ATO areas will require expansion. Expansion of these facilities can be achieved by building out storage for airline GSE beyond the present ATOs and TSA's future checked-baggage inspection system.

- **TSA Checked Baggage Inspection System (CBIS)** - Consolidation of the CBIS housed beyond the airline's ATOs will reduce the number of explosive detection machines in use today and provide space for airlines to load carts in a consolidated outbound baggage make-up and GSE storage room.

- **Gate Departure Lounges** - The gate departures lounge area is too small to accommodate demand during the early morning departures peak hour when all gates have scheduled service within the period.

- **Terminal Gate** - Allegiant's operation requires a minimum of one gate to be built at the end of the concourse to accommodate the carrier's flights and not obstruct passenger handling operations at Gate 8.

- **Mother's Room** - A mother's room should be provided separately, away from restrooms.

- **Restrooms** - Single-use restrooms should be provided at multiple points in the concourse to limit walk time for passengers with reduced mobility.

- **Concessions** - Secure concourse concessions should be expanded to provide more seating and retail space.

Analysis of the terminal building plans, airline and tenant operations, and demand/capacity analysis of terminal components has provided insight on recommendations for growth. Projects below represent issues identified in the planning process that require updates. The list also represents priorities for interim improvements to be incorporated into SBN's capital improvement plan. Priority projects for improvement consideration include:

- Renovate and expand gatehouses 2 and 3 to provide American Airlines' passengers a higher level of service and to help American meet their performance requirements.

- Upgrade the upper concourse to include new and expanded restrooms, single-user restrooms, mother's room, Gate 9 expansion and concourse renovation to include expanding departures lounges out onto the concourse, and food and beverage concessions expansion (existing or new tenants).

- Add new claim device to the arrivals hall and move concessions south or to the secure concourse.

- Renovate and expand the connector building, including the security checkpoint, passenger exit, and employee screening hall. Development of this project will depend upon which terminal plan concept is chosen by SBN for future development.

- Renovate and expand the Gates 2 and 3 departures lounges and concourse corridor to include raising the concourse level in this area to match that of the upper concourse.

- Expand and renovate the ATOs, consolidate TSA CBIS (just beyond ATO space), and build a new consolidated airline outbound baggage make-up room beyond the CBIS.

- Expand the terminal curbside to provide more curb length by expanding into existing short-term parking or adding drive-through drop-off lanes; redevelop the terminal's main entrance D.

The comprehensive *Terminal Planning Study* that was conducted as part of this master plan further describes the terminal facility requirements and provides detailed results of the analyses. It is included for review in Appendix D.

3.11.2 Rental Car Facilities

As a part of the evaluation of needs associated with the terminal building area, exploration of an area for the construction of a shared rental car service facility, commonly referred to as a quick turnaround (QTA) facility should be considered. Rental car operators at SBN have expressed a desire to maintain all of their rental car turnaround needs at a single facility, instead of at separate facilities operated by each rental car provider. This offers greater efficiency in turning around return rental vehicles for new renters as well as reduce operational costs for this activity. In addition, providing a QTA close to the terminal offers increased efficiency for rental car vendors.

The existing 168 rental car spaces appears adequate for the existing ready/return requirements but does not accommodate the long-term storage or service area needs of the rental car vendors. All of the vendors currently have off-airport service and storage facilities. The rental car vendors have expressed a strong desire for a QTA facility. Being able to service vehicles in much closer proximity to the ready/return lot would increase the efficiency of their operations, as would being able to provide for some or all of the long-term storage parking spaces. Development options addressing the need for a QTA and additional rental car parking are presented in Chapter 4.

3.11.3 Parking Lots

The review of the commercial airline terminal building also included an evaluation of parking demand. Currently, SBN has 2,363 long-term vehicle parking spaces (including valet), 261 short-term parking spaces, and 120 parking spaces in the 18-hour / cell phone parking lot. While demand projected for the planning period does not indicate a need for additional parking capacity, consideration should be given for evaluating options to increase parking capacity. This will preserve areas to increase capacity in the event unexpected changes in air carrier service, passenger trends, and parking needs through the planning period to require additional parking capacity.

3.11.4 Aircraft Hangars

Finally, SBN has expressed a need for additional hangars for use by aeronautical businesses in the terminal area. One of these hangars should be a large aircraft storage hangar (LASH). As part of this facility requirements analysis, it is therefore recommended that space be preserved in the terminal area for construction of a LASH and a conventional hangar.

UPS facility at SBN
Source: Mead & Hunt, Inc.

3.12 Air Cargo Facilities

UPS and FedEx have package sortation facilities at SBN responsible for the regional collection and distribution of air cargo between hubs located in Louisville, Kentucky, for UPS and Memphis, Tennessee, for FedEx. The UPS sortation facility is east of the UPS

Apron and north of Taxiway A near the approach end of Runway 27L. FedEx's sortation facility is south of the West Cargo Apron and west of the approach end of Runway 36. Both facilities include parking for trucks, trailers, and other equipment as well as employee vehicles. Vehicle access to the UPS facility is provided via Lathrop Street, which connects to North Bendix Drive less than a half mile to the east. The FedEx facility is accessed from Mayflower Road, which intersects Lincoln Way West less than a half mile to the south. UPS and FedEx each lease their air cargo facilities from SBN and are responsible for any improvements that may be needed to the facilities. In communicating with FedEx and UPS as a part of the master planning process, they indicated they had no immediate needs for improvements to either of these facilities. Internal business decisions by UPS and FedEx will ultimately drive the need for any improvements to their respective air cargo facilities based on factors such as market demand and corporate initiatives.

FedEx facility at SBN
Source: Mead & Hunt, Inc.

As previously discussed, SBN released the SBN Freight Master Plan in 2020 and has long-term plans to increase air cargo activity at the Airport. This has been driven by the increase of air cargo activity at Chicago O'Hare International Airport (ORD), which is located within a 90-minute drive of SBN. ORD is one of the busiest air cargo airports in the United States in addition to being one of the busiest airports in the world. With concerns about capacity at ORD, air cargo operators have approached SBN about the establishment of air cargo facilities. Since SBN is close in proximity to the metropolitan Chicago area, it offers many of the benefits desired by air cargo operators at ORD such as a geographic centralized location to transfer cargo with other destinations in the United States as well as access to other transportation infrastructure such as highways, railroads, and shipping. SBN's proximity to other transportation infrastructure, available operational capacity, land for development, and lower costs are attractive to air cargo operators. With world air cargo projected to continue to grow, it is recommended that SBN preserve space for air cargo facility development should it be approached in the future about such developmental opportunities by air cargo operators.

3.13 General Aviation Facilities

According to FAA Operations Network data, local and itinerant GA aircraft operations accounted for 53 to 57 percent of annual activity at SBN during the 2015 to 2020 period. This fact was taken into consideration with the evaluation of GA facilities at SBN. The size and type of GA facilities needed are directly proportional to the size and type of GA aircraft that operate at an airport. Environmental factors such as climate driving the need for hangar space, geographic factors such as available land to construct GA facilities, and anticipated demand also guide facility planning when reviewing GA infrastructure. The review of GA facilities at SBN focuses on fixed base operator facilities, aircraft storage, and fuel facilities.

3.13.1 Fixed Base Operators

Aeronautical-related businesses that provide services to GA aircraft, pilots, and passengers, as well as provide support services for commercial airlines and air cargo operators are referred to as fixed base operators (FBOs). Typically, FBOs offer aviation fuel and line services to both GA and commercial airline users, but may also provide aircraft maintenance, flight training, aircraft rental, catering, air taxi, charter services, sale of aircraft parts, and storage facilities for itinerant and based aircraft. The services offered by an FBO vary from airport to airport based on the level and type of aviation activities conducted.

Atlantic Aviation facility at SBN
Source: Mead & Hunt, Inc.

Two FBOs currently operate at SBN: Atlantic Aviation and Corporate Wings. Both FBOs provide services for GA passengers and crew members such as passenger/crew lounges, flight planning facilities, conference rooms, business centers, and ground transportation. They also provide ground services for GA aircraft such as Jet-A and 100 low lead (100LL) fueling services as well as deicing and aircraft storage.

Corporate Wings facility at SBN
Source: Mead & Hunt, Inc.

Given the growth in GA operations projected at SBN during the planning period, it appears the level of services provided by Atlantic Aviation and Corporate Wings will be sufficient to meet the anticipated demand. Several variable and unforeseen factors can impact the FBO business model such as changes in local, national, and global economies; the cost of aviation fuel; competition with competing FBO service providers at other airports; the number and type of aircraft based at an airport; and the demand for specific aeronautical services. Continual evaluation should take place throughout the planning period as activity levels change to assess how well aeronautical needs are being addressed and determine if improvements for the provision of FBO services are needed.

3.13.2 Aircraft Storage

Storage for based aircraft at SBN varies between box and T-hangars. It is assumed that all based aircraft users at SBN desire hangar storage, as South Bend receives approximately 37 inches of precipitation and 63 inches of snowfall annually.

Forecasts presented in Chapter 2: Projections of Aviation Demand projected the number of based aircraft by fleet mix that can be anticipated at SBN during the planning period. As summarized in **Table 3-20**, based aircraft are anticipated to grow from a total of 82 aircraft in 2020 to 90 aircraft by 2040. This equates to two additional based turboprop aircraft, four additional based jets, and two additional based helicopters.

Table 3-20: Projections of Based Aircraft by Fleet Mix

Year	Single Engine	Multi Engine	Turboprop	Jet	Helicopter	Total
2020	51	22	2	6	1	82
2025	51	22	3	7	1	84
2030	51	22	3	8	2	86
2035	51	22	4	9	2	88
2040	51	22	4	10	3	90

Source: Marr Arnold Planning (2021)

Given the projected number of based aircraft by fleet mix that can be anticipated throughout the planning period, the demand for box and T-hangars by square feet can be estimated. **Table 3-21** summarizes the approximate parking area needed to park each type of aircraft fleet mix classification. The area required to park an aircraft varies based on the size and type of aircraft; as a result, planning ratios were used for each fleet mix classification as identified in Table 3-20. The size approximations for each aircraft classification included a safety margin for wingtip, nose, and tail clearances.

Table 3-21: Parking Area Sizes for Aircraft Fleet Mix Classifications

Aircraft Type	Examples	Approximate Square Feet
Single Engine	Cessna 172, Cirrus SR-22	1,400 sq feet
Multi Engine	Piper Seneca, Beechcraft King Air	2,500 sq feet
Small & Mid-Sized Jets	Cessna Citation, Learjet	3,600 sq feet
Large Business Jet	Gulfstream G550, Global Express	10,000 sq feet
Helicopter	Sikorsky S-76, Bell 206	1,400 sq feet
Other	Experimental, UAV, etc.	1,000 sq feet

Source: Mead & Hunt, Inc. (2021)

Table 3-22 illustrates the total demand in square feet for hangar space by aircraft fleet mix classification that can be anticipated at SBN through 2040. The hangar space demand for single- and multi-engine piston aircraft should be considered by square feet and the number of T-hangar units needed to house each aircraft. In addition, the analysis assumed that 10 percent of projected based jets parked in hangars are large business jets. As the table shows, the total demand for hangar space will grow from approximately 156,600 square feet in 2020 to approximately 187,400 square feet by 2040, which is an increase of nearly 20 percent. Jets will require an additional 20,800 square feet of hangar space, with turboprops and helicopters needing an additional 7,200 square feet and 2,800 square feet, respectively. These needs for hangar space will be taken into consideration as a part of the development of aeronautical use concepts presented in Chapter 4.

While a projection for electric aircraft and electric vertical take-off and landing (eVTOL) aircraft were not completed as a part of this master plan the accommodation of these aircraft types are considered as a necessary part of future infrastructure planning. Electric aircraft are aircraft that use batteries to power an electric motor instead of jet fuel to power an engine. Similarly, eVTOL aircraft use electric power to hover, take off, and land vertically. Use of these aircraft types is anticipated to grow in the future due largely to increasing emphasis on reducing the carbon footprint of the aviation industry. According to an October 2021 report on the global electric aircraft market, the global market for electric aircraft is estimated to be valued at $7.9 billion in 2021, and is projected to reach $27.7 billion by 2030, rising at a compound annual growth rate of 14.8 percent. The electric aircraft market in North America is projected to hold the highest market share during the 2021 to 2030 period. North America accounted for the largest share of 34.3 percent of the electric aircraft market and is expected to grow at a CAGR of 16.1 percent during the 2021 to 2030 period.[2] Accommodation of the demand for these aircraft types at SBN should be continually monitored throughout the planning period based on industry trends and user demands.

Table 3-22: Estimated Hangar Area Demand by Aircraft Fleet Mix Classification

Aircraft Type	2020	2025	2030	2035	2040
Single-Engine					
Projected Based Aircraft	51	51	51	51	51
Approximate Area per Aircraft (sq. ft.)	1,400	1,400	1,400	1,400	1,400
Total Demand (sq. ft.)	**71,400**	**71,400**	**71,400**	**71,400**	**71,400**
Multi-Engine					
Projected Based Aircraft	22	22	22	22	22
Approximate Area per Aircraft (sq. ft.)	2,500	2,500	2,500	2,500	2,500
Total Demand (sq. ft.)	**55,000**	**55,000**	**55,000**	**55,000**	**55,000**
Turboprop					
Projected Based Aircraft	2	3	3	4	4
Approximate Area per Aircraft (sq. ft.)	3,600	3,600	3,600	3,600	3,600
Total Demand (sq. ft.)	**7,200**	**10,800**	**10,800**	**14,400**	**14,400**
Small & Mid-sized Jets					
Projected Based Aircraft	6	6	7	8	9
Approximate Area per Aircraft (sq. ft.)	3,600	3,600	3,600	3,600	3,600
Total Demand (sq. ft.)	**21,600**	**21,600**	**25,200**	**28,800**	**32,400**
Large Business Jets					
Projected Based Aircraft	0	1	1	1	1
Approximate Area per Aircraft (sq. ft.)	10,000	10,000	10,000	10,000	10,000
Total Demand (sq. ft.)	**0**	**10,000**	**10,000**	**10,000**	**10,000**
Helicopters					
Projected Based Aircraft	1	1	2	2	3
Approximate Area per Aircraft (sq. ft.)	1,400	1,400	1,400	1,400	1,400
Total Demand (sq. ft.)	**1,400**	**1,400**	**2,800**	**2,800**	**4,200**
Grand Total Demand (sq. ft.)	**156,600**	**170,200**	**175,200**	**182,400**	**187,400**

Note: Assumed 10 percent of total based jets projected at SBN during the planning period will be large business jets.
Source: Mead & Hunt, Inc. (2021)

[2] October 2021. "Global Electric Aircraft Market by Platform (Regional Transport Aircraft, Business Jets, Light & Ultralight Aircraft), Type, System (Batteries, Electric Motors, Aerostructures, Avionics, Software), Technology, Application, and Region – Forecasts to 2030." *ResearchAndMarkets.com*.

3.13.3 Fuel Facilities

The aircraft fuel farm at SBN is located east of the commercial airline terminal building near the intersection of Progress Drive and North Sheridan Street. It consists of the following above ground tanks, which SBN owns and leases to the FBOs:

- Five 30,000-gallon tanks containing Jet-A fuel
- Two 15,000-gallon tanks containing 100 low lead (LL) fuel
- One 6,000-gallon tank containing diesel fuel
- One 6,000-gallon tank containing unleaded gasoline
- Two 12,000-gallon tanks containing Jet-A fuel
- One 1,000-gallon tank containing unleaded gasoline
- One 1,000-gallon tank containing off-road diesel fuel

SBN owns three additional above ground tanks in the Airport's midfield area. Two 12,000-gallon tanks used for storage of Jet-A fuel are on the corporate aircraft ramp north of Taxiway T. Another 12,000-gallon tank containing Jet-A fuel is leased to the LECO Corporation and is located on LECO's apron between Corporate Wings' facility and the UPS Apron.

Combined, the fuel tanks offer SBN the capability to store 210,000 gallons of Jet-A fuel; 30,000 gallons of 100LL aviation fuel; 6,000 gallons of diesel fuel; 7,000 gallons of unleaded gasoline; and 1,000 gallons of off-road diesel fuel.

The review of facility requirements, in coordination with SBN administrative staff and users at SBN such as the FBOs, commercial air carriers, and cargo operators did not identify any needs for additional fuel capacity. With 174,000 total gallons of Jet-A fuel capacity and 30,000 gallons of 100 low lead (LL) fuel storage capacity, SBN has enough capacity to accommodate several days of fuel supply in the event in the temporary interruption of fuel deliveries. As such, no fuel capacity improvements are anticipated during the planning period. It is recommended that SBN continually monitor the demand for fuel during the planning period to identify if any unexpected increases in fuel demand occur to evaluate if fuel storage capacity improvements are needed.

3.14 Support Facilities

Infrastructure components that are necessary to support the operation and maintenance of SBN are considered support facilities. A review of these facilities including the public safety building and airfield maintenance facility was conducted as a part of evaluating the adequacy of existing infrastructure to meet future demand. This section reviews each support facility element and discusses improvements that will be needed, if any, to meet the forecasted level of demand.

3.14.1 Public Safety Building

Public Safety Building at SBN
Source: Mead & Hunt, Inc.

SBN's Department of Public Safety (DPS) is responsible for police, fire, and first response medical services at the Airport in addition to providing ARFF services for aircraft operations. As noted in Chapter 1: Inventory, the DPS is housed in the 19,556-square-foot public safety building, which is southwest of the commercial airline terminal building near the Runway 36 threshold. Built in 1991, the existing facility has outlived its expected useful life and is not capable of housing newer generation ARFF vehicles that will need to be purchased to replace aging vehicles during the planning period. Since the building is 30 years old, there are issues with roof leaks; peeling paint; indoor humidity; and an outdated heating, ventilation, and air conditioning (HVAC) system. Finally, certain personnel areas, such as the day room / kitchen and fitness room, are insufficiently sized. As such, it is recommended that planning be initiated to improve DPS facilities at SBN.

As part of this master plan study, SBN is seeking to update its public safety building by planning construction of a consolidated public safety, airfield maintenance, and snow removal equipment (SRE) building. Cost savings and efficiencies for SBN staff could be realized through construction of such a facility that provides a centralized location for public safety and airfield maintenance functions. For the public safety function of a consolidated facility, several design elements need to be considered, which are outlined in FAA AC 150/5210-15A, *Aircraft Rescue and Firefighting Station Building Design*. The following sections summarize these design elements.

ARFF Index

Several factors contribute to determining an airport's ARFF Index, or classification of type of response. As outlined in FAR Part 139, the ARFF Index is a combination of the length of air carrier aircraft operating at an airport and the average daily departures of air carrier aircraft.

To determine ARFF Index, air carrier aircraft lengths are grouped as follows:

- Index A includes aircraft less than 90 feet in length
- Index B includes aircraft at least 90 feet but less than 126 feet in length
- Index C includes aircraft at least 126 feet but less than 159 feet in length
- Index D includes aircraft at least 159 feet but less than 200 feet in length
- Index E includes aircraft at least 200 feet in length

If there are five or more average daily departures of air carrier aircraft in a single Index group serving that airport, the longest aircraft with an average of five or more daily departures determines the Index required for the airport. When there are fewer than five average daily departures of the longest air carrier aircraft serving the airport, the Index required for the airport will be the next lower Index group than the Index group prescribed for the longest aircraft.

Based on TFMSC data for SBN, there were more than five daily departures by air carrier aircraft that are at least 90 feet but less than 126 feet long operating at the Airport in 2020. These were the CRJ-200, CRJ-700, CRJ-900, A319, and A320. As such, SBN is classified as Index B. It is anticipated that the ARFF Index at SBN will remain Index B throughout the planning period based on the fleet mix of commercial aircraft types that are projected to operate at the Airport. No changes in the ARFF Index are anticipated during the planning period.

ARFF Vehicles

A significant deficiency with the existing public safety building is that the vehicle bays are not sized large enough for next generation ARFF vehicles that SBN will need to purchase during the planning period. It is recommended that the vehicle bays be designed so that they are capable of housing at least two next generation vehicles. It is also recommended that each vehicle bay be equipped with doors on each side of the facility so that ARFF apparatuses can be driven through the bays in a single direction of travel. This will increase safety and reduce the potential for damage when these vehicles are maneuvered into and out of the facility since large ARFF apparatuses often have many blind spots.

Personnel Areas

The DPS officers at SBN have access to support areas such as restroom and shower facilities, a training room, fitness area, day room / kitchen area, sleeping quarters, and office space. Although the intent of these spaces is to accommodate DPS officers for the duration of their shifts, which can be multiple days, the spaces are outdated, and some are insufficiently sized. It is recommended that adequate spaces are provided for personnel functions in a new facility.

Building Location and Orientation

The location and orientation of an ARFF facility should be such that responding emergency vehicles have immediate access to the airfield with unimpeded access routes that have a minimum of turns. Access routes from the building should be such that crossing of taxiways, aprons, and other areas of potential congestion, such as vehicle parking areas, aircraft fuel storage areas, and service roads, are kept to a minimum. This is critical because of the need for a timely and safe response route so that ARFF response requirements as identified in Part 139 can be maintained. In addition, it is desired that the building be oriented so that it has maximum surveillance of the airfield to assist responding personnel in locating the scene of an emergency.

Equipment and Raw Material Storage

In addition to having vehicle bays and personnel areas, adequate storage area for equipment and raw material storage should be included in the design of an ARFF facility. As identified in FAA AC 150/5210-15A, *Aircraft Rescue and Firefighting Station Building Design*, storage areas should be planned to accommodate firefighting turnout gear, first aid medical equipment, rescue tools, and self-contained breathing apparatuses (SCBA). Likewise, it is also important that an area be included in the design of the facility for the storage of raw material firefighting agents such as foam. The design of this room should be large enough to store and move several foam shipment pallets and efficiently accept raw material deliveries.

3.14.2 Airfield Maintenance Facility

Airfield maintenance facility at SBN
Source: Mead & Hunt, Inc.

SBN's airfield maintenance facility is located at the western end of Lathrop Street, south of the ATCT. Originally constructed in 1978, with expansions occurring in 1994 and 1998, the building is 33,256 square feet and has office/workspace for airfield maintenance and airport operations personnel; storage areas for equipment, supplies, and materials; conference room; common room/kitchen area; locker room; and a restroom. Multiple vehicle bays provide covered, heated areas to store SRE such as plow trucks, brooms, snow blowers, and front-end loaders.

Like the public safety building, the size of the airfield maintenance facility is limited and does not provide sufficient space to park next generation larger-sized SRE apparatuses. As of this master plan study, SBN had recently purchased two new MB5 apparatuses equipped with a front-mounted plow and a mid-mounted broom coupled with forced air blowers between the axles. SBN staff indicated the ability to store these large apparatuses in the existing facility would be limited, and the plow would need to be detached for the equipment to fit in the vehicle bays. Some of the other issues cited with the existing facility include a lack of storage and office space, inadequate locker and restroom facilities, an outdated HVAC system that requires frequent repairs, and insufficient ceiling heights for vehicle bays. It is therefore recommended that planning begin for a new airfield maintenance facility.

As explained above, SBN is interested in constructing a facility that consolidates the public safety and airfield maintenance functions. Consolidating these functions would offer several advantages. Most importantly, cost savings can be realized since construction costs for a single building tend to be lower than for two separate buildings. Likewise, cost savings in HVAC and energy usage can be realized with a single structure. A consolidated facility also reduces the footprint necessary for each building, since some design elements would be shared that allow the most efficient use of limited available land for other infrastructure development, such as hangars and aprons.

FAA AC 150/5220-18A, *Buildings for Storage and Maintenance of Airport Snow and Ice Control Equipment and Materials*, provides guidance that should be considered in the site selection and design of buildings used to store and maintain airport snow and ice control equipment. The most significant component of a new SRE facility at SBN are the equipment bays, which should be adequately sized to meet the dimensions of larger next generation equipment the Airport recently purchased and other equipment that may need to be purchased during the planning period. The equipment bays should be oriented so that vehicles can drive through the facility in a single direction of travel to enter and exit. In addition to size and orientation, there should be enough equipment bays so that all SRE equipment can be stored and maintained in the SRE facility. It is recommended that at least two of the bays be dedicated for vehicle maintenance with at least one equipped with an overhead crane and another equipped for the washing of equipment. In addition to the equipment bays, other features that should be considered in the design of an SRE facility are personnel areas for SRE crews, such as a break room, training room, locker area, restrooms, and a snow desk. Also, personnel work areas such as tool benches, machine areas, parts storage areas, and areas for lubrication materials, oils, and pneumatic systems should be included.

3.15 Airport Traffic Control Tower

The ATCT is located at the western end of Lathrop Street north of the airfield maintenance facility and operated by the FAA who is responsible for the safe and efficient movement of aircraft and vehicles on taxiways and runways while directing aircraft within a 10-nautical mile radius of SBN. The ATCT's hours of operation are 5:30 A.M. to midnight, Sunday through Friday, and 5:30 A.M. to 11:45 P.M. on Saturday. Constructed in 1979, many of the technologies in use at the ATCT are outdated and, at over 40 years old, the structure is nearing the end of its useful life. It is therefore recommended that the location for the construction of a new ATCT be investigated so that adequate space is preserved when construction / relocation of a new ATCT occurs. Ultimately, the timing of constructing a new tower, the determination of its location through a siting requirements evaluation, and funding for the construction of such facility will be the responsibility of the FAA. It is recommended that SBN work with the FAA when a decision is made to evaluate the construction of a new ATCT, so stakeholder interests and concerns are represented. Also, construction of a new ATCT has the benefit of opening developable areas for aeronautical uses at the location of the existing tower if it were to be moved. Again, coordination with the FAA is recommended at the time a decision is made to evaluate and implement ATCT improvements.

3.16 Summary of Recommendations

Planning and investment made to improve infrastructure facilities at SBN will allow it to meet the air transportation demands of the region for the next 20 years. This chapter has provided a review of existing infrastructure at the Airport and its ability to accommodate anticipated demand and has identified a few areas that should be the focus of future facility planning and development. The following summarizes the facility improvements that are needed to meet this future demand as identified in this chapter:

- **Runway Length –** Planning should be initiated to evaluate alternatives for extending Runway 9R/27L to a length of 9,200 feet to support air cargo flights to Anchorage or 11,800 feet for flights to Asia. These runway extensions would be required to accommodate operations by Boeing 747 and / or Boeing 767 aircraft.

- **Runway Pavement Strength –** Significant strengthening of Runway 9R/27L would be required if flights by Boeing 747 and / or Boeing 767 air cargo aircraft were to regularly occur during the planning period.

- **Runway Pavement Condition –** The results of INDOT's 2021 pavement inspection should be used to identify and prioritize future airfield pavement maintenance and rehabilitation projects at SBN.

- **Taxiways –** Several improvements to the Airport's taxiways are needed. These are as follows:

  - The separation distance of parallel Taxiway A from Runway 9R/27L varies, but always exceeds 400 feet. It is recommended that Taxiway A be realigned to meet the design separation standard of 400 feet.
  - Like Taxiway A, the separation distance of parallel Taxiway B from Runway 9R/27L varies, exceeding 830 feet at one point. In addition, Taxiway B's intersections with Runway 18/36 and Taxiway N are not at the 90-degree angles recommended by FAA standards. Furthermore, the angled routing of Taxiway B towards the commercial airline terminal apron and use of that apron's pavement reduces the space available for the maneuvering of commercial airline aircraft. During this master plan study, Taxiway B improvements were in progress at SBN to correct these issues.
  - Taxiways A3, A4, B3, and B4 meet at roughly the same point, creating a six-way intersection, with Taxiways A3 and A4 not making use of standard right-angle intersections and Taxiways B3 and B4 permitting direct access from the apron to the runway. Taxiways A3 and A4 should be reconfigured to correct the non-standard intersection. The Taxiway B improvements in progress during this master plan study will address the issues with Taxiways B3 and B4 at the six-way intersection.
  - The separation distance of Taxiway N from Runway 18/36 is 400 feet between the Runway 36 threshold and Taxiway B and then increases to 600 feet along the runway's remaining length. It is recommended that the separation distance between Taxiway N and Runway 18/36 be 400 feet along the entire length of the runway.
  - The taxiway OFAs for Taxiways A, B, N, and J exceed standard widths. It is recommended at the time of a future improvement project to these taxiways that consideration be made to adjust the width of the OFA to match the design standards of the critical design aircraft.

- **Aprons –** The commercial airline terminal, air cargo, and general aviation aprons require the following improvements:

  - The grade of the commercial airline terminal apron slopes towards the commercial airline terminal building and requires improvement. In addition, a larger apron is needed for aircraft parking and maneuvering as well as deicing operations. These improvements were in progress during this master plan study as part of the Taxiway B improvements project.
  - To accommodate potential growth in domestic and international air cargo activity, SBN should protect adequate space for future development of air cargo aprons.
  - Additional apron space is needed for itinerant GA aircraft parking during Notre Dame football game days. A site for a new general aviation apron should be identified.

- **Runway and Taxiway Edge Lighting –** During future routine maintenance, airfield pavement, or lighting infrastructure improvement projects, SBN should consider installing energy efficient LED fixtures like those installed as part of the Taxiway B improvements project that was underway during this master plan study.

- **Part 77 Surface Obstructions –** Continual monitoring of existing and potential obstructions to Part 77 surfaces throughout the planning period is recommended. Any obstructions should be removed if possible or identified with an obstruction light.

- **Terminal Area Facilities –** Preservation of space for a future expansion of the terminal building should be identified to preserve a space for such development, understanding that ultimately a concept / budget report to explore potential sites will be needed. Likewise, preservation of space to accommodate a rental car QTA facility and two aircraft hangars (one LASH and one conventional hangar) near the terminal is recommended. Finally, preservation of areas for vehicle parking expansion is recommended.

- **Air Cargo Facilities –** SBN has long-term plans to increase air cargo activity. SBN's proximity to Chicago, existing transportation infrastructure, available operational capacity, land for development, and lower costs are attractive to air cargo operators. Space should be preserved for air cargo facility development if SBN is approached by air cargo operators in the future.

- **General Aviation Facilities –** Most based aircraft are currently stored in privately-owned hangars of various types and sizes, which makes it difficult to determine SBN's existing hangar capacity. Any demand for additional hangar space at SBN during the planning period will be market-driven and will likely require construction of new T-hangars and / or box hangars. Private developers would likely construct these new hangars, with SBN receiving revenue from ground leases. The Airport should plan for a variety of sizes and types of hangars to accommodate a range of users during the planning period. This should include planning for electric aircraft and eVTOL aircraft.

- **Support Facilities –** The public safety building and airfield maintenance facility have reached the end of their service lives and will not meet anticipated demand. It is recommended that SBN construct a new consolidated public safety, airfield maintenance, and SRE facility. Construction of a facility that provides a centralized location for the public safety and airfield maintenance departments could produce cost savings and efficiencies for SBN staff. The consolidated facility should be located with access to the airfield that allows timely ARFF and snow removal response and space to maneuver equipment safely and efficiently. The building should also be adequate in size to store all public safety and airfield maintenance equipment, including newer generation apparatuses, and provide sufficient space for personnel areas and materials / supplies storage.

- **Airport Traffic Control Tower –** Sites for a preferred long-term location for the ATCT should be coordinated with the FAA when such evaluation is taken since the existing structure is outdated and nearing the end of its useful life.

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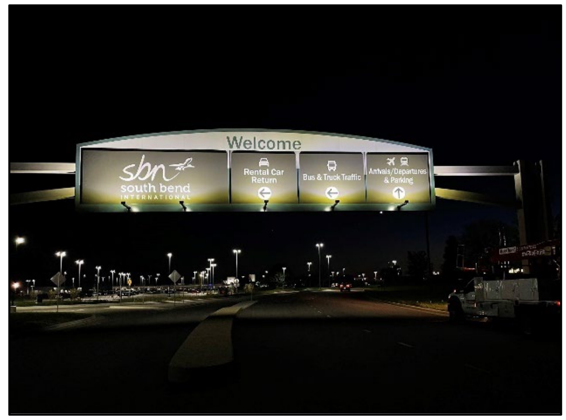
Chapter 4 Concepts Analysis and Recommended Development



With the future needs of South Bend International Airport (SBN or Airport) identified in Chapter 3: Facility Requirements, the next step is to analyze how SBN can meet these needs. This chapter presents a range of airside, landside, and terminal concepts developed to meet the recommended facility requirements documented in Chapter 3. Each concept considers the short-, medium-, and long-term needs of SBN and was developed based on operational, economic, environmental, and implementation factors. The development of concepts focuses on the airfield (runways and taxiways), terminal area, air cargo, general aviation, support facilities, airport traffic control tower, and revenue generating development.

This chapter also compares the advantages and disadvantages of each concept to identify a preferred development option for each facility need. Some preferred concepts were selected based on a single, logical development action that met the facility needs identified in Chapter 3 and accomplished the Airport's long-term goals. In these cases, only that action underwent a comprehensive analysis—no others were analyzed. All concepts presented in this chapter, including the preferred concepts, are subject to further refinement through financial, environmental, and engineering means prior to implementation.

The presentation, analysis, and selection of the preferred concepts are described in the following sections:

- 4.1 Evaluation Criteria Methodology
- 4.2 Runways
- 4.3 Taxiways
- 4.4 Air Cargo Development
- 4.5 General Aviation Development
- 4.6 Support Facilities
- 4.7 Airport Traffic Control Tower
- 4.8 Revenue Generating Development
- 4.9 Terminal Area Development

4.1 Evaluation Criteria Methodology

Qualitative and quantitative criteria provided comprehensive means to compare the merits and deficiencies of each concept. The following summarizes the specific criteria used in the process:

- **Operational Factors** – This criterion evaluated each concept's ability to accommodate the projected level of demand during the 20-year planning period, assessing factors such as aircraft operations, passenger enplanements, based aircraft, air cargo activity, and the demand for hangar and apron space. Screening with this criterion helped identify each concept's success in addressing such operational factors as aircraft delay, airfield circulation, and convenience to Airport users.

- **Economic Factors** – Economic factors such as construction costs and return on investment were considered in comparing the financial feasibility of the proposed concepts. Understanding that significant investment is needed to improve the Airport, this evaluation criterion focused on the selection of the most cost-effective option that meets the Airport's financial goals and the demands of its users.

- **Environmental Factors** – This criterion focused on environmental conditions that could be directly impacted by the proposed development, such as noise, air quality, water quality, land use, and socioeconomic impacts. Evaluation of these factors identified development concepts that can minimize environmental disruption and comply with environmental regulations. A more in-depth overview of the environmental factors that may impact development at the Airport will be presented in Chapter 5: Environmental Overview.

- **Implementation Feasibility** – This criterion comprised a qualitative analysis of intangible factors that affect implementation of the proposed concepts, such as logic, common sense, and probability of unknown contingencies that helped support or negate the feasibility of implementing each concept.

The following sections present the concepts prepared to address the needs identified through the facility requirement analysis. The presentation of each concept is organized to identify the components of the proposed infrastructure improvements and then compare advantages and disadvantages considering the previously described evaluation criteria. Through the review of advantages and disadvantages, selection of the preferred concept is identified at the conclusion of each section with its justification.

4.2 Runways

Chapter 3: Facilities Requirements provided an analysis of the ability of SBN's three runways to meet existing and future demand. This analysis examined each runway's length, width, grade, surface, strength, and condition. In addition, other runway design standards such as safety areas, object free areas, and airspace protection surfaces were evaluated to determine if improvements are needed. The evaluation showed that SBN's runways are constructed to the standards for the design of airfield infrastructure outlined in Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5300-13B, *Airport Design*, and no improvements are needed to accommodate the existing and future critical aircraft for each runway.

However, Chapter 3 also explained SBN's long-term plans to increase air cargo activity at the Airport and provided an analysis of runway length needs for flights by Boeing 747 and Boeing 767 aircraft to Anchorage, Alaska, and various destinations in Asia should such activity occur. This section discusses runway development concepts that could support international air cargo flights.

Also, although it was determined in Chapter 3 that Runway 9L/27R is constructed to the design standards in AC 150/5300-13B and no improvements are necessary, SBN desired to explore the potential of converting the runway to an air carrier runway 10 or more years in the future as part of this master plan. This section also contains a discussion of the feasibility of this conversion of Runway 9L/27R.

4.2.1 Runway Development Concepts Supporting International Air Cargo Flights

To support international cargo flights to Anchorage and Asia by Boeing 767 and 747 aircraft on a regular basis at SBN, two runway concepts are discussed below. The documented analysis includes advantages and disadvantages and a cost estimate. Potential runway extensions that were eliminated from further consideration are also briefly discussed.

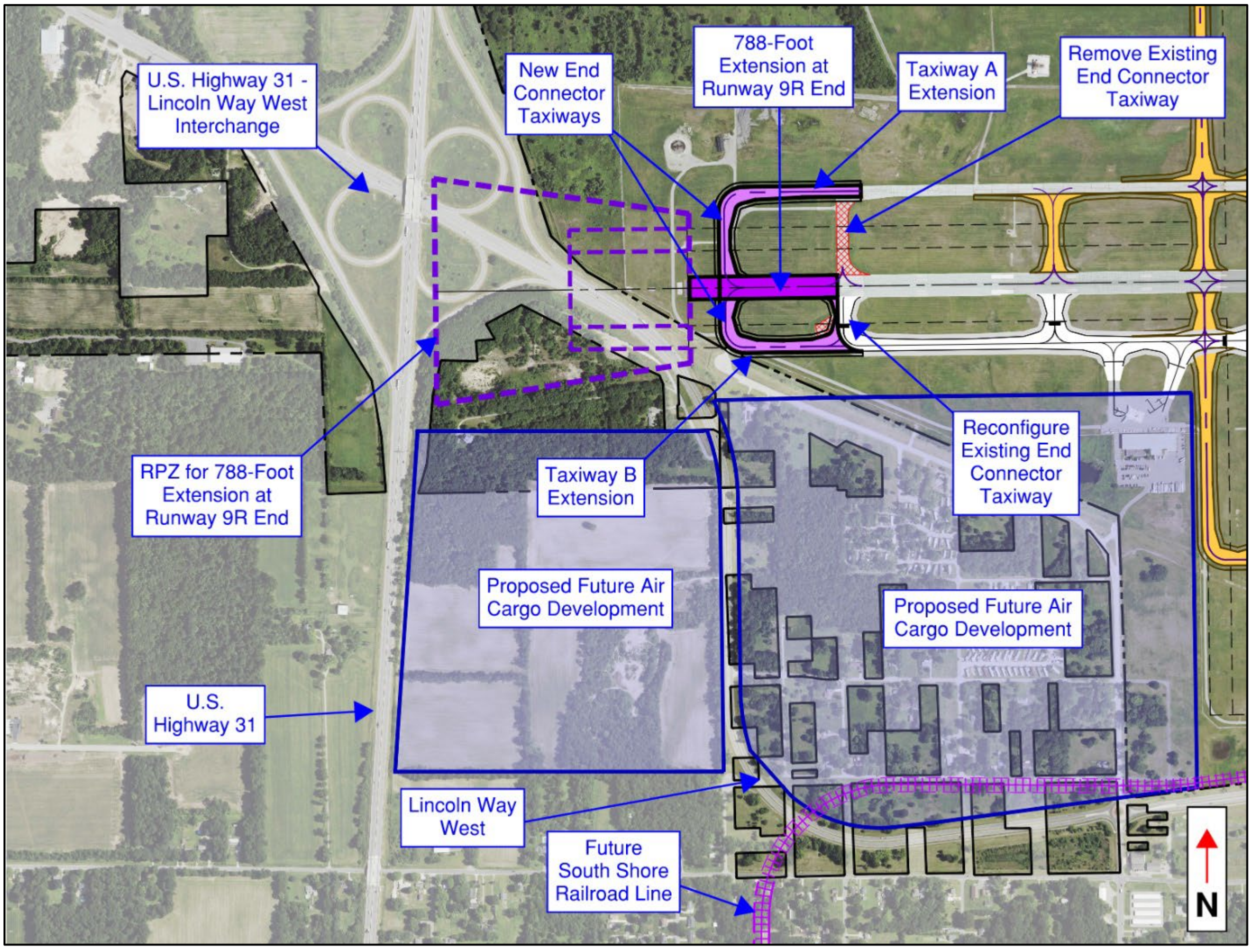
Runway Development Concept 1 – 788-Foot Extension at Approach End of Runway 9R

Runway 9R/27L is 8,412 feet long and serves as SBN's primary runway with a Runway Design Code (RDC) of C-IV. Based on the runway length analysis conducted in Chapter 3: Facilities Requirements, Runway 9R/27L would need to be extended up to 788 feet to support operations by Boeing 767 cargo aircraft to Anchorage.

As shown in **Figure 4-1**, Runway Development Concept 1 proposes to extend Runway 9R/27L by 788 feet at the approach end of Runway 9R. Runway 9R/27L would have a proposed length of 9,200 feet under this concept. To accommodate the extension, parallel Taxiways A and B would be extended to match the new length of Runway 9R/27L. Several improvements to the connector taxiways at the approach end of Runway 9R are also proposed under Runway Development Concept 1. These include the following:

- New connector taxiways would be constructed on the north and south side at the approach end of Runway 9R.
- Existing connector taxiway A6 would be removed.
- Existing connector taxiway B6 would be reconfigured, with excess pavement associated with Taxiway B6 removed.

Figure 4-1: Runway Development Concept 1 – 788-Foot Extension at Approach End of Runway 9R



Source: Mead & Hunt, Inc. (2022)

In addition, since Runway 9R/27L is equipped with an instrument landing system (ILS), the localizer and glide slope antenna at the Runway 9R end would need to be relocated further west to support the runway extension. The Medium Intensity Approach Lighting System with Sequenced Flashing Lights (MALSF) that supports the ILS at the approach end of Runway 9R end would also be relocated to the west.

Finally, the presence of Lincoln Way West and its interchange with U.S. Highway 31 immediately west of the existing Runway 9R threshold poses a significant issue for a 788-foot runway extension to the west for two reasons. First, the runway extension would cause impacts to the three-dimensional surfaces defined in 14 Code of Federal Regulation (CFR) Part 77, which protect airspace surrounding an airport from obstructions that could interfere with aircraft operations. As explained in Chapter 3: Facilities Requirements, Runway 9R/27L is a precision instrument runway, which means the approach surface extends upward at a slope of 50:1 for 10,000 feet from the runway end and then extends upward at a slope of 40:1 for an additional distance of 40,000 feet. The proposed 788-foot extension of Runway 9R/27L would shift the runway end closer to Lincoln Way West and the U.S. Highway 31 – Lincoln Way West interchange, causing the approach surface to extend upward at a 50:1 slope closer to this roadway infrastructure than it currently exists. This would in turn cause the existing U.S. Highway 31 bridge over Lincoln Way West and vehicles traveling on U.S. Highway 31 and Lincoln Way West to penetrate the approach surface, based on obstruction standards outlined in Part 77.

In addition to airspace impacts, Lincoln Way West would be located inside the Runway Safety Area (RSA) and Runway Object Free Area (ROFA) for the extended runway. As explained in Chapter 3: Facilities Requirements, RSAs and ROFAs must be free of objects, except those necessary for aircraft navigational purposes such as signs and equipment. This roadway would thus need to be relocated.

Relocating Lincoln Way West and the U.S. Highway 31 – Lincoln Way West interchange from their existing locations to avoid these impacts represents significant political, environmental, and economic challenges. Therefore, Runway Development Concept 1 proposes to lower Lincoln Way West and the U.S. Highway 31 – Lincoln Way West interchange in this area by 20 feet, which would satisfy Part 77 surface design standards and route Lincoln Way West below the RSA and ROFA for Runway 9R/27L.

Note that Figure 4-1 does not show the design for the lowered interchange and Lincoln Way West. Since any extension of Runway 9R/27L would not occur for at least 10 years from the time of the completion of this master plan, Figure 4-1 only depicts the runway extension, taxiway improvements, and relocated runway design surfaces. If or when SBN decides to proceed with the runway extension, a further review of design options involving the incorporation of this concept and a solution for the configuration of Lincoln Way West and the interchange would be determined during project design.

Advantages - Runway Development Concept 1

- Provides the necessary runway length for Boeing 767 aircraft commonly used for cargo operations to conduct non-stop flights to Ted Stevens Anchorage International Airport, which not only is a frequent refueling stop for cargo flights on polar routes, but also has exemptions that allow American and foreign airlines to transfer cargo at the airport
- Provides the region with a valuable economic development tool that can help facilitate the efficient movement of air cargo between South Bend and Asia
- Reduces the potential for aircraft noise impacts due to relatively undeveloped land west of U.S. Highway 31

Disadvantages - Runway Development Concept 1

- Requires land acquisition costs to accommodate the design surfaces associated with the runway and taxiway improvements
- Requires lowering Lincoln Way West and the U.S. Highway 31 – Lincoln Way West interchange 20 feet due to approach surface height limitations outlined in Part 77 and the presence of Lincoln Way West within the relocated RSA and ROFA at the approach end of Runway 9R
- Requires an avigation easement since Lincoln Way West and a portion of the U.S. Highway 31 – Lincoln Way West interchange would fall inside the relocated approach and departure Runway Protection Zones (RPZs) at the approach end of Runway 9R

- Requires significant strengthening of the entire length of the runway, since Boeing 767 cargo aircraft, which are heavier than the runway's critical aircraft (Boeing 757-200), exceed the runway's weight bearing capacity
- Ultimately, requires a RPZ analysis to further document and evaluate RPZ options for FAA approval when SBN decides to proceed with the runway extension due to the presence of the interchange and Lincoln Way West in the relocated approach and departure RPZs at the approach end of Runway 9R

Estimated Cost

The estimated cost of Runway Development Concept 1 is $163.9 million, which includes the following:

- Construction – runway
- Construction – road lowering
- Construction – cut walls, pre-cast tunnels, and bridges
- Construction – storm sewer and utility relocation
- Professional services
    - Design
    - Permitting
    - Construction administration
    - Construction inspection
    - Quality assurance testing
- Contingency – 15 percent

Runway Development Concept 2 – 3,388-Foot Extension at Approach End of Runway 9R

If SBN desires to serve cargo operations to destinations in Asia in the future, a runway longer than 9,200 feet would be required. Based on the runway length analysis conducted in Chapter 3: Facilities Requirements, Boeing 747 cargo aircraft, which are larger than Boeing 767 cargo aircraft and require more runway length, would need up to 11,800 feet of runway length to reach Asia. Therefore, Runway Development Concept 2, which is similar to Concept 1, proposes a 3,388-foot extension of Runway 9R/27L at the Runway 9R end, which would bring the runway's total length to 11,800 feet.

As shown in **Figure 4-2**, similar improvements to the taxiway system at the Runway 9R end proposed in Runway Development Concept 1 are proposed for Concept 2, with the primary difference being that parallel Taxiway B would need to be extended a longer distance to match the length of the runway extension. Also, similar to Concept 1, Concept 2 would require relocation of the MALSF and ILS localizer and glide slope antenna at the Runway 9R end.

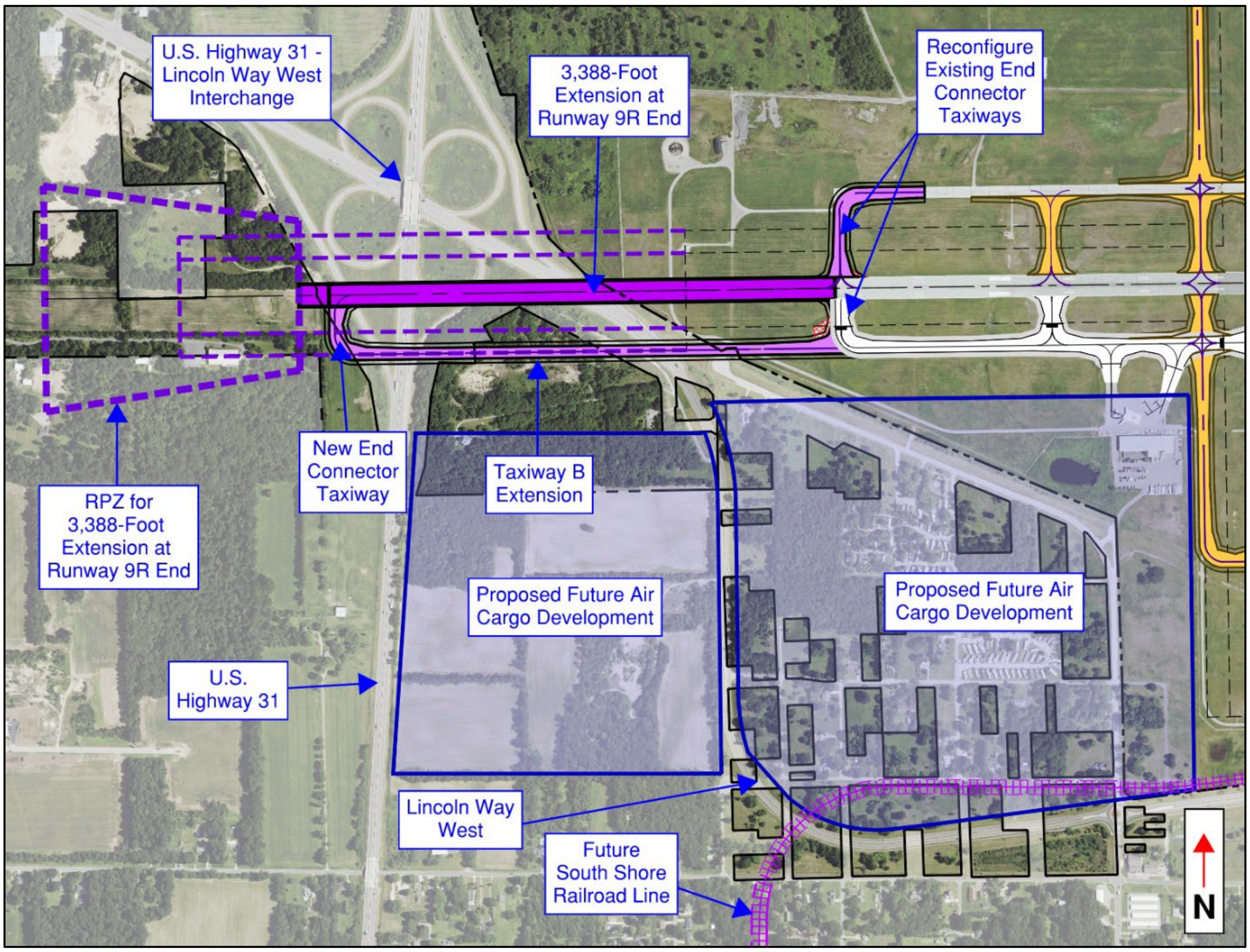
A significant difference from Concept 1, however, would be that in Concept 2, the proposed runway extension would cut through the existing location of Lincoln Way West and the U.S. Highway 31 – Lincoln Way West interchange. This would push the relocated runway end west of the interchange and Lincoln Way West, which would remove impacts to Part 77 surfaces from consideration. However, Lincoln Way

West and the interchange would still need to be lowered 20 feet to accommodate the extended runway pavement.

Advantages - Runway Development Concept 2

- Provides the runway length required for Boeing 747 and 767 cargo aircraft to reach destinations in Asia
- Reduces the potential for aircraft noise impacts due to relatively undeveloped land west of U.S. Highway 31

Figure 4-2: Runway Development Concept 2 – 3,388-Foot Extension at Approach End of Runway 9R



Source: Mead & Hunt, Inc. (2022)

Disadvantages - Runway Development Concept 2

- Requires the construction of significantly more runway and taxiway pavement than Concept 1
- Requires lowering Lincoln Way West and the U.S. Highway 31 – Lincoln Way West interchange 20 feet since the proposed runway extension would pass through the existing locations of these roadways

- Requires land acquisition or an avigation easement west of the relocated runway end since SBN does not own certain parcels of property that would be located inside the shifted approach and departure RPZs at the approach end of Runway 9R
- Requires significant strengthening of the entire length of the runway, since Boeing 747 cargo aircraft are heavier than the runway's existing critical aircraft (Boeing 757-200)

Estimated Cost

Runway Development Concept 2's estimated cost is $403.5 million, which includes the following:

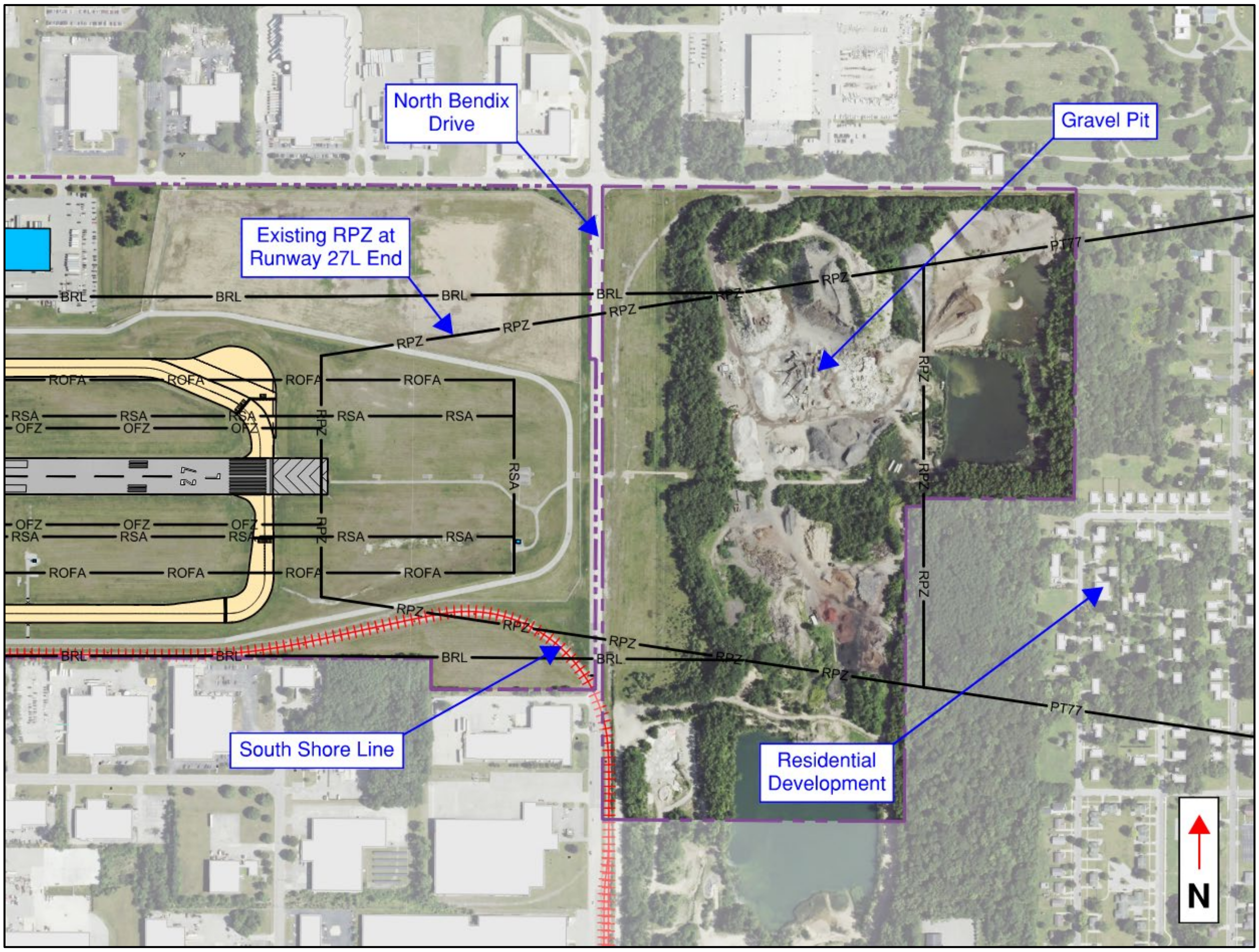
- Construction – runway
- Construction – road lowering
- Construction – cut walls, pre-cast tunnels, and bridges
- Construction – storm sewer and utility relocation
- Professional services
    - Design
    - Permitting
    - Construction administration
    - Construction inspection
    - Quality assurance testing
- Contingency – 15 percent

Extension at Approach End of Runway 27L

During the master planning process, SBN considered the possibility of an extension at the approach end of Runway 27L. However, it became readily apparent that a runway extension to the east was impracticable for several reasons and would not be considered a concept for future development in this master plan.

First, North Bendix Drive, a major thoroughfare on the east side of SBN, runs in a north-south direction approximately 1,300 feet east of the Runway 27L threshold (**Figure 4-3**). A runway extension of 788 feet or more at the approach end of Runway 27L would require rerouting or closure of North Bendix Drive. Based on feedback obtained from the Master Plan Advisory Committee (MPAC) established for this master plan, rerouting or closure of North Bendix Road was not considered a viable option. Second, a runway extension to the east would be impacted by Part 77 approach surface height limitations due to the presence of North Bendix Drive and the South Shore Line, which turns west towards SBN's commercial airline terminal building south of the extended centerline for Runway 27L, as shown in Figure 4-3. Also, a large gravel pit sits east of North Bendix Drive, which would add significant construction costs to any runway extension project in this area. Finally, there is substantial residential development east of Runway 27L beyond the gravel pit. A runway extension in this direction would increase the potential for aircraft noise impacts and would likely require acquisition and relocation of some residences due to construction of runway pavement and / or shifting the runway design surfaces farther east.

Figure 4-3: Constraints to a Runway Extension at Approach End of Runway 27L



Source: Mead & Hunt, Inc. (2021)

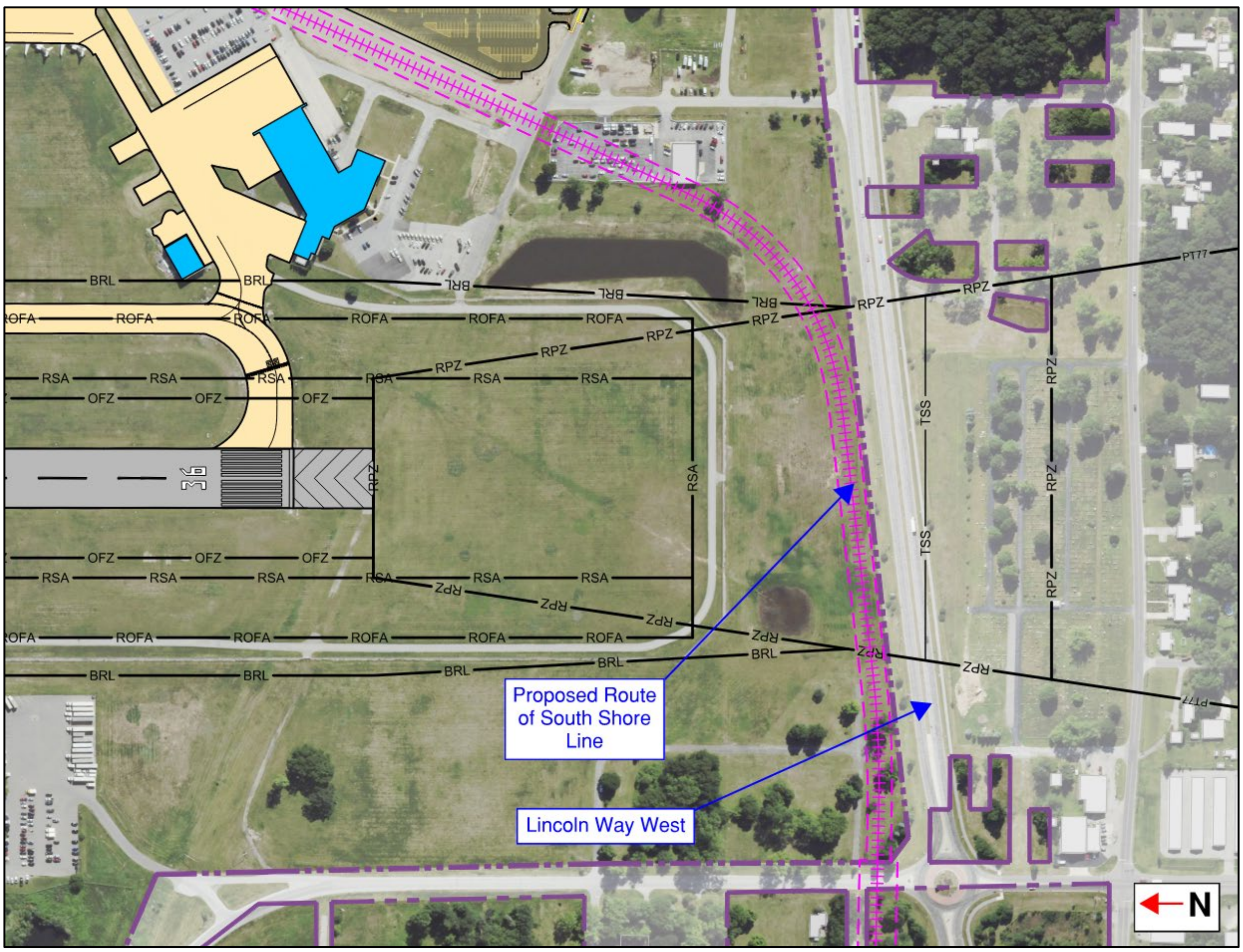
Extending Runway 9R/27L at both ends was also considered to avoid some of these limitations (such as the presence of North Bendix Drive). Under this scenario, an extension to the east of approximately 200 feet would only be possible, requiring an extension of 588 feet or 3,188 feet (depending on the destination being Anchorage or Asia) at the approach end of Runway 9R. An extension of 588 feet or 3,188 feet at the approach end of Runway 9R, however, would still pose the same Part 77 and runway design surface issues as noted previously for Runway Development Concepts 1 and 2. These options are not recommended and are presented in this master plan to document that they were considered.

Extensions at Approach Ends of Runways 18 and 36

Since Runway Development Concepts 1 and 2 propose extensions to Runway 9R/27L to support potential international air cargo flights to Anchorage or Asia in the future, SBN explored the possibility of extending Runway 18/36 to accommodate these operations. Like a potential extension at the approach end of Runway 27L, however, it became evident that extensions of Runway 18/36 in either direction were not feasible, and they would not be considered concepts in the master plan.

An extension of any length at the approach end of Runway 36 was not deemed viable because of the presence of Lincoln Way West and the proposed future routing of the South Shore Line to SBN's commercial airline terminal building immediately south of the Runway 36 threshold (**Figure 4-4**). The South Shore Line is a commuter rail line operated by the Northern Indiana Commuter Transportation District (NICTD) between Millennium Station in downtown Chicago, Illinois, and SBN. According to the NICTD's 20-Year Strategic Business Plan prepared in cooperation with the Northwest Indiana Regional Development Authority in 2014, South Shore trains must currently travel a circuitous reverse "C" to access the existing South Shore Line station located on the east side of SBN's commercial airline terminal building. This route is long, and trains are slowed by 23 grade crossings. NICTD plans to provide a more direct route to SBN in the future by relocating the South Shore Line station to the west side of the Airport's terminal building and eliminating three track miles. This would reduce travel time by up to 10 minutes and reduce the number of grade crossings from 23 to seven. As shown in Figure 4-4, Lincoln Way West and the proposed routing of the South Shore Line would need to be moved to accommodate an extension of runway pavement and avoid impacts to FAR Part 77 and runway design surfaces.

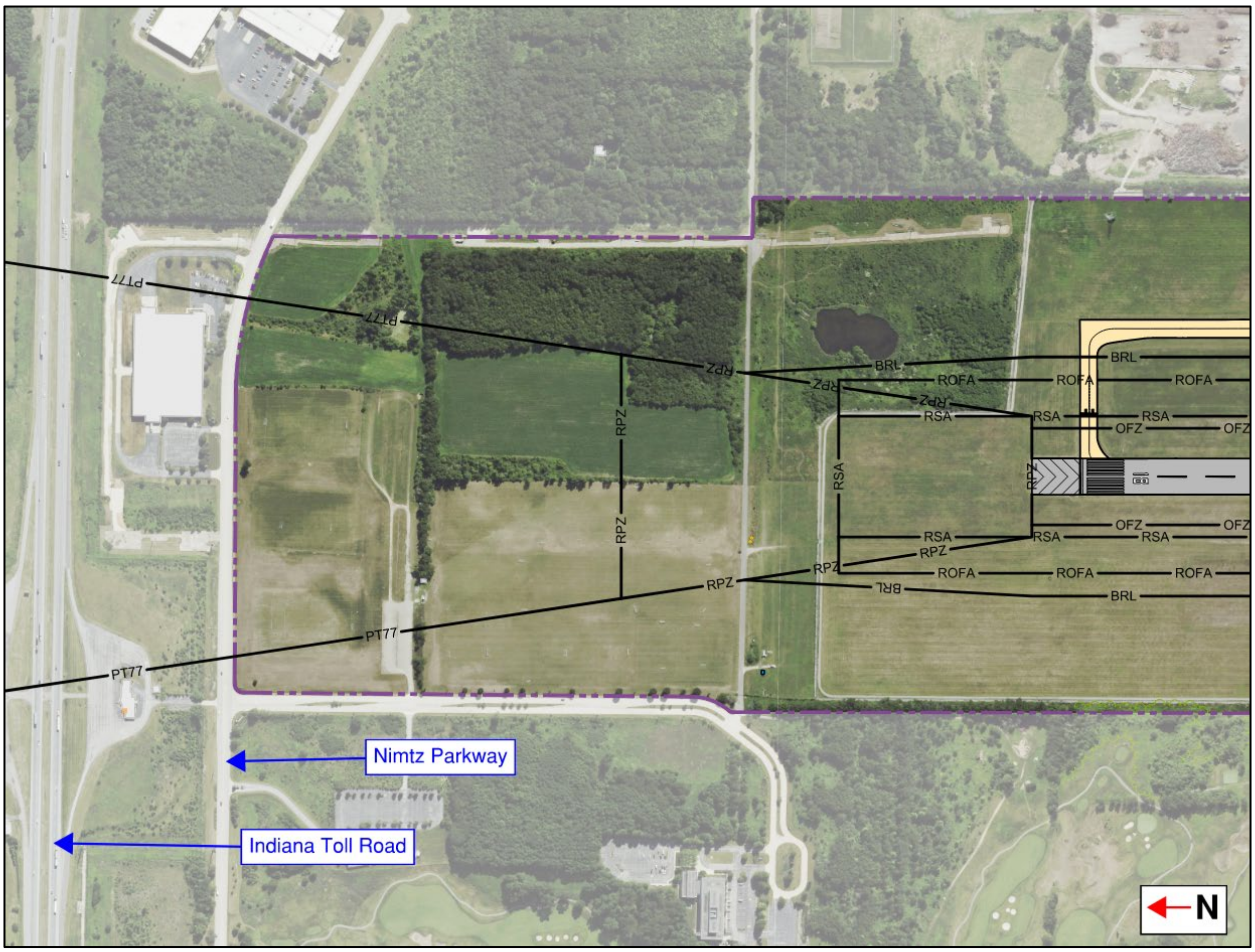
Figure 4-4: Constraints to a Runway Extension at Approach End of Runway 36



Source: Mead & Hunt, Inc. (2021)

At the approach end of Runway 18, more land is available for a runway extension. However, Runway 18/36, at a length of 7,101 feet, is considerably shorter than Runway 9R/27L. The approach end of Runway 18 would need to be extended far to the north to achieve the required length to reach Anchorage or Asia, which would involve significant construction costs. **Figure 4-5** shows Nimtz Parkway and the Indiana Toll Road, a major east-west Interstate Highway, north of the Runway 18 threshold. In the case of cargo flights to Anchorage, an extension at the approach end of Runway 18 would require relocation of Nimtz Parkway and the Indiana Toll Road, since both roads would have impacts to Part 77 and runway design surfaces. For cargo flights to Asia, Nimtz Parkway and the Indiana Toll Road would need to be relocated to provide space for the extended runway pavement. In both cases, the MPAC did not consider relocating the Indiana Toll Road practicable.

Figure 4-5: Constraints to a Runway Extension at Approach End of Runway 18



Source: Mead & Hunt, Inc. (2021)

In addition to the constraints above, as explained in Chapter 3: Facilities Requirements, Runway 18/36 is required as a crosswind runway at SBN due to wind coverage, but it is only justified at a length of 4,000 feet. Therefore, future maintenance projects involving the remaining length of Runway 18/36 are not eligible for FAA funding, according to FAA Order 5100.38D, *Airport Improvement Handbook*. A future extension of Runway 18/36 would also not be eligible for FAA funding.

Recommended Runway Development Concept to Support International Air Cargo Flights

Runway Development Concept 1, which proposes to extend the approach end of Runway 9R by 788 feet, is recommended to be the preferred development option to meet the objective of providing a runway extension to support international air cargo flights. Implementation of Concept 1 would achieve a total runway length of 9,200 feet, which would support Boeing 767 cargo flights to Anchorage. Although Concept 1 does not provide sufficient runway length to reach destinations in Asia, the primary advantage of this concept is that Boeing 767 cargo aircraft could refuel in Anchorage and then continue to destinations in Asia. The goal of reaching markets in Asia could still be realized, but at significantly lower cost compared to Concept 2 since less construction of runway and taxiway pavement would be required.

A significant drawback of Concept 1 would be the requirement to lower Lincoln Way West and the interchange by 20 feet, for which Concept 2 offers no advantages since its implementation would also require lowering this infrastructure. Both concepts would also require significant runway strengthening to support regular operations by heavier Boeing 767 or 747 aircraft. With these factors in mind, cost becomes the differentiator.

Therefore, since Concept 1 would accomplish SBN's objective of accommodating international cargo flights at a lower cost than Concept 2, Concept 1, which proposes a 788-foot extension at the approach end of Runway 9R, is the recommended concept to support international cargo flights to Asia.

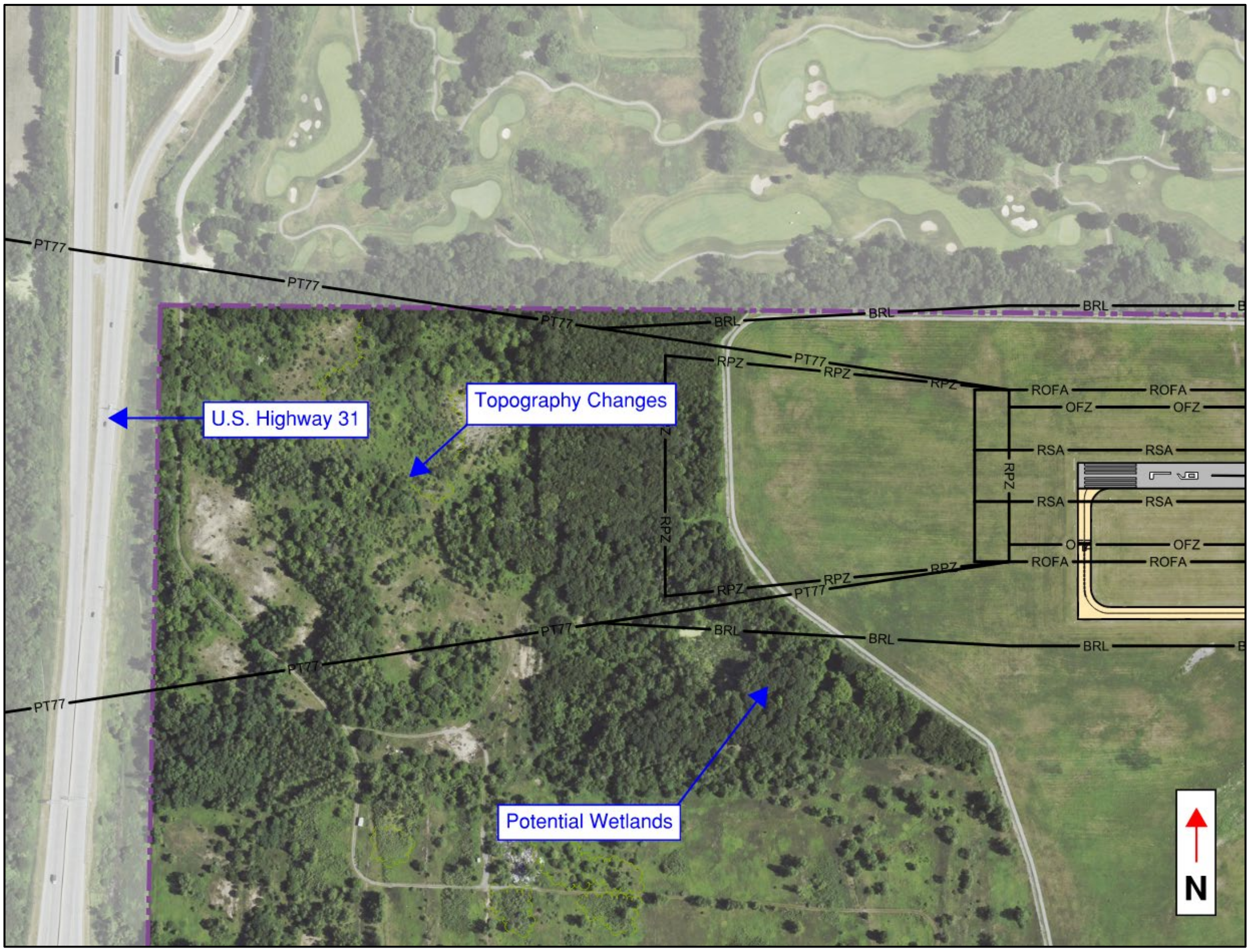
4.2.2 Conversion of Runway 9L/27R into an Air Carrier Runway

Runway 9L/27R is 4,300 feet long and 75 feet wide and is the preferred runway for general aviation users at SBN. During the initial stages of the master planning process, exploration of the potential for converting Runway 9L/27R into an air carrier runway to provide long-term capacity for future growth at SBN was proposed.

To convert Runway 9L/27R into an air carrier runway, options were proposed to extend the runway 2,700 feet at either the approach end of Runway 9L or 27R and widen it from 75 feet to 150 feet. Taxiway J would be extended to match the new runway length and be widened from 35 feet to 75 feet.

Several constraints limiting an extension of Runway 9L/27R at either end exist, however. As shown in **Figure 4-6**, the location of U.S. Highway 31, which is approximately a half mile west of the Runway 9L threshold, limits an extension at the approach end of Runway 9L. U.S. Highway 31 would need to be relocated to the west since the RPZ, RSA, and ROFA for the extended runway would be shifted west of their existing locations. A relocation of U.S. Highway 31 poses significant political, environmental, and economic challenges. Also, the topography changes between U.S. Highway 31 and the existing Runway 9L threshold and may contain areas of wetlands. At the approach end of Runway 27R, the industrial development located approximately 2,000 feet east of the Runway 27R threshold (**Figure 4-7**) limits an extension. A runway extension to the east would extend off Airport property, requiring acquisition of land. An extension would also cause the runway design surfaces to shift to the east, which would require acquisition and relocation of numerous businesses. Farther east of the industrial development is residential development, which aircraft noise would potentially impact.

Figure 4-6: Constraints to a 2,700-Foot Extension at Approach End of Runway 9L

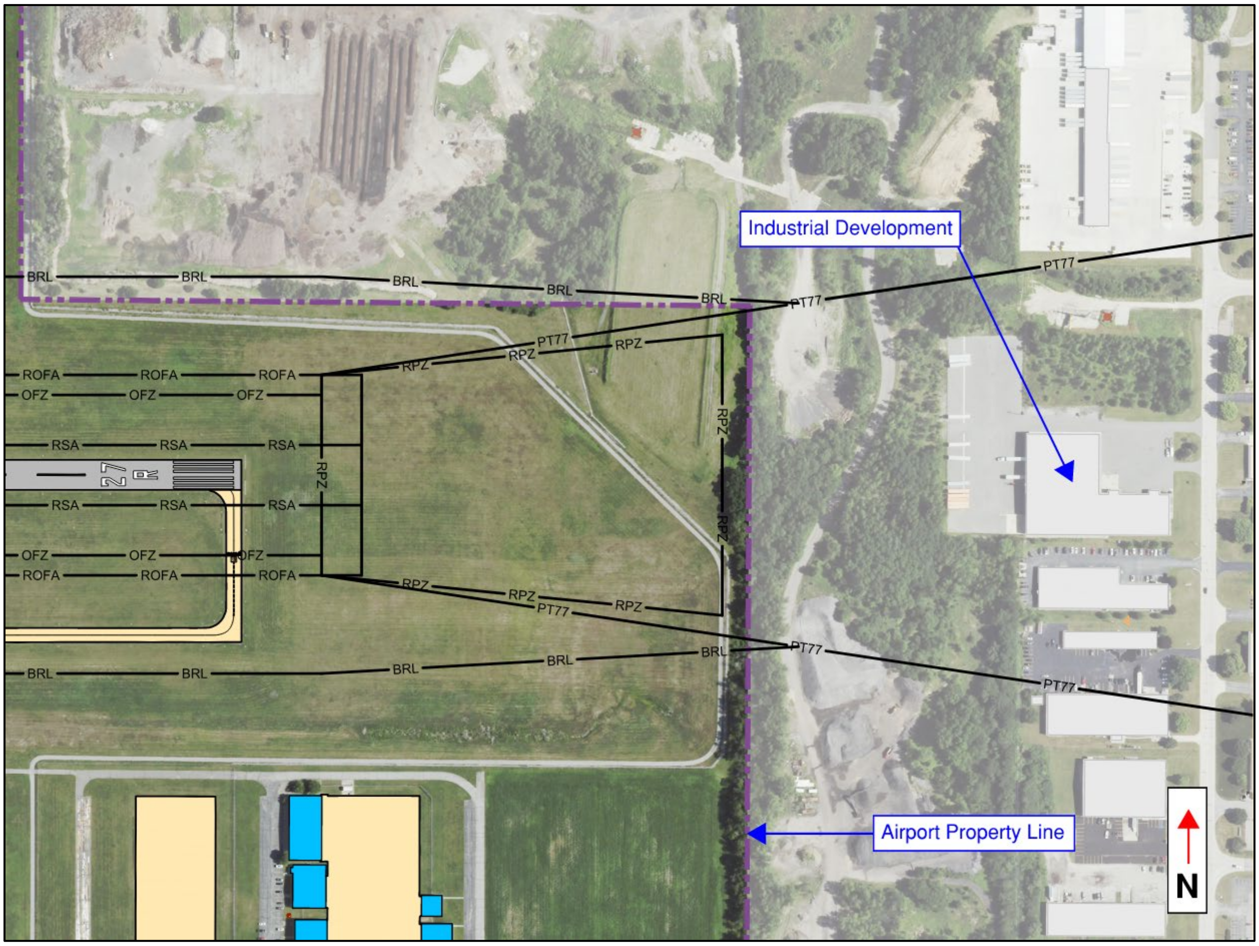


Source: Mead & Hunt, Inc. (2021)

The most significant barrier to converting Runway 9L/27R into an air carrier runway, however, is that the runway is not justified for capacity reasons, as explained in Chapter 3: Facilities Requirements. Therefore, SBN would be solely responsible for funding the conversion into an air carrier runway and future runway maintenance projects.

As mentioned, the conversion of Runway 9L/27R to an air carrier runway is not needed to meet demand projected for the planning period. This alternative, rather, is presented to document the considerations and infrastructure improvements necessary to discuss if it becomes a topic in longer-term visions of the Airport. Due to the factors explained above, conversion of Runway 9L/27R into an air carrier runway was determined to be not a feasible development option and would not be considered an alternative for the master plan.

Figure 4-7: Constraints to a 2,700-Foot Extension at Approach End of Runway 27R



Source: Mead & Hunt, Inc. (2021)

4.3 Taxiways

A review of the taxiway system found that some improvements are needed to meet design standards outlined in FAA AC 150/5300-13B, *Airport Design*. Some involve the separation distance between runways and their parallel taxiways, while others pertain to direct access from aprons to runways and intersections less than 90 degrees. The following are the taxiway system improvements recommended as a part of the facility requirements analysis:

- The separation distance of Taxiway N from Runway 18/36 is 400 feet between the Runway 36 threshold and Taxiway B and then increases to 600 feet along the runway's remaining length. It is recommended that the separation distance between Taxiway N and Runway 18/36 be 400 feet along the entire length of the runway.

- The separation distance of parallel Taxiway A from Runway 9R/27L varies, but always exceeds 400 feet. Realigning Taxiway A to meet the design separation standard of 400 feet is recommended.

- Like Taxiway A, the separation distance of parallel Taxiway B from Runway 9R/27L varies, exceeding 830 feet at one point. In addition, Taxiway B's intersections with Runway 18/36 and Taxiway N are not at the 90-degree angles recommended by FAA standards. Furthermore, the angled routing of Taxiway B towards the commercial airline terminal apron and use of that apron's pavement reduces the space available for the maneuvering of commercial airline aircraft. During this master plan study, Taxiway B improvements were in progress at SBN to correct these issues.

- Taxiways A3, A4, B3, and B4 meet at roughly the same point, creating a six-way intersection, with Taxiways A3 and A4 not making use of standard right-angle intersections and Taxiways B3 and B4 permitting direct access from the apron to the runway. Taxiways A3 and A4 should be reconfigured to correct the non-standard intersection. The Taxiway B improvements in progress during this master plan study will address the issues with Taxiways B3 and B4 at the six-way intersection.

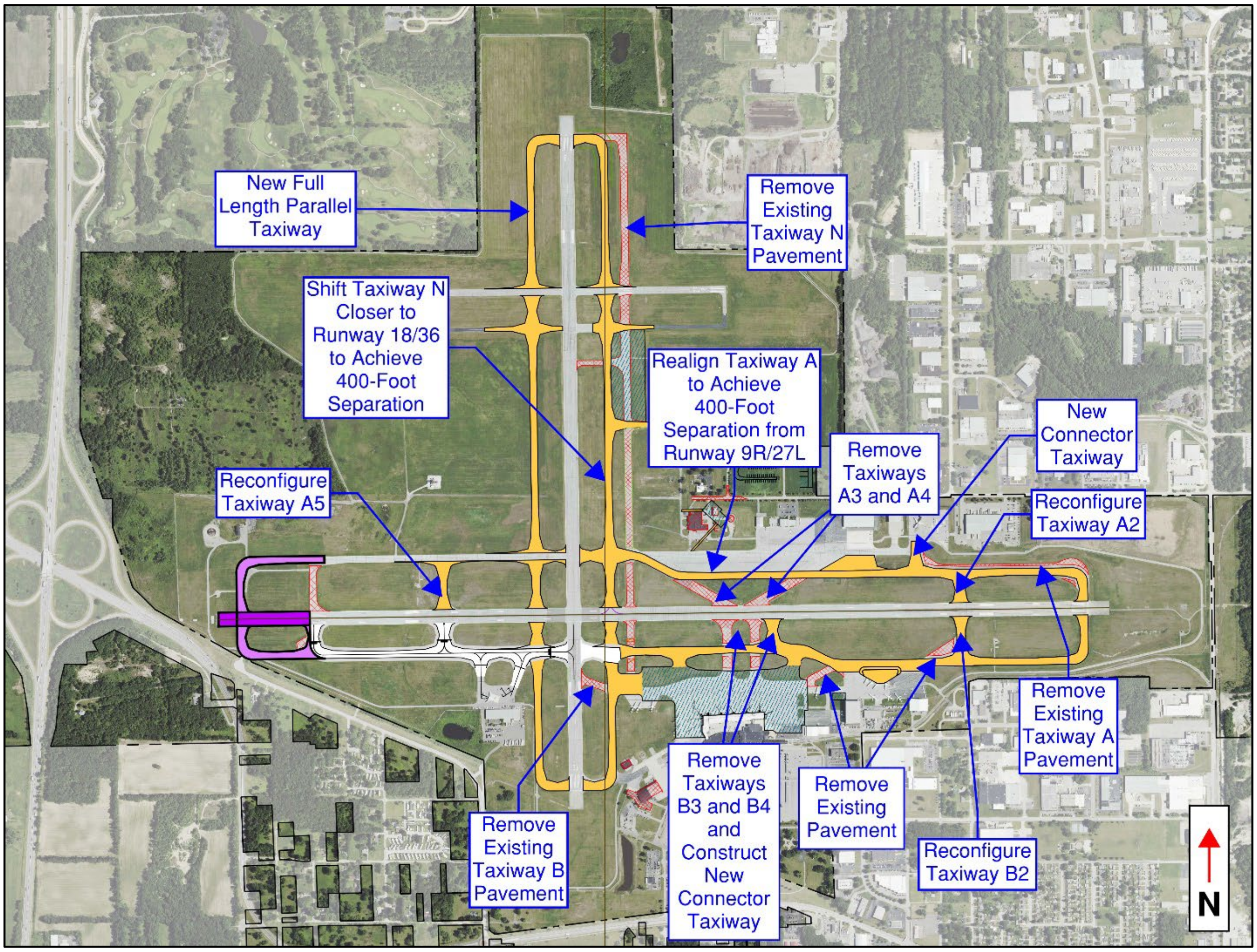
- The taxiway object free areas (OFAs) for Taxiways A, B, N, and J exceed standard widths. It is recommended that airfield signage be repositioned to meet design standards during a future airfield construction project.

Figure 4-8 illustrates the taxiway system improvements concept proposed to meet design standards in FAA AC 150/5300-13B, *Airport Design*. These improvements are based on a single, logical development action. As shown in the graphic, Taxiway N would be shifted closer to Runway 18/36, such that the separation distance between Taxiway N and Runway 18/36 is 400 feet along the entire length of the runway. The existing Taxiway N pavement having a separation distance of 600 feet from Runway 18/36 would be removed.

Taxiway A would also be realigned, shifting the taxiway closer to Runway 9R/27L to achieve a 400-foot separation distance along most of its length. The exception would be the western end of Taxiway A at the approach end of Runway 9R, where the existing 637.5-foot separation would be maintained due to the glide slope critical area for the ILS. Portions of existing Taxiway A pavement east and west of Runway 18/36 would be removed, as would sections at the approach end of Runway 27L. Also, a new connector taxiway between the UPS Apron and Taxiway A would be constructed to meet the FAA's standards for 90-degree angles at intersections. Taxiways A3 and A4 would be removed to eliminate their intersections with Runway 9R/27L that are less than 90-degreee angles, while Taxiways A2 and A5 would be reconfigured. Finally, sections of new pavement would be added to the large expanse of pavement south of the General Aviation Apron, creating an expanded General Aviation Apron due to the shift of Taxiway A closer to Runway 9R/27L.

Regarding the taxiway OFAs for Taxiways A, B, N, and J, the existing OFA widths exceed the standards in FAA AC 150/5300-13B, *Airport Design*. Since the OFA widths exceed standards, there is no immediate need to reposition airfield signage to meet design standards. However, it is recommended this occur during a future airfield construction project.

Figure 4-8: Taxiway Improvements Concept



Source: Mead & Hunt, Inc. (2022)

Since the recommended improvements to Taxiway B are already being implemented (Figure 4-8), no costs for them are included in this master plan. These Taxiway B improvements are in progress:

- Decouple Taxiway B from the Terminal Apron.
- Move Taxiway B closer to Runway 9R/27L to achieve a 400-foot separation (maintain 568-foot separation at 27L end due to glide slope critical area).
- Reconfigure Taxiway B2.
- Remove pavement between Taxiway B2 and the East Cargo Area Apron.
- Fill in the missing area of pavement at the East Cargo Area Apron.
- Construct a new connector taxiway between the shifted Taxiway B and the East Cargo Area Apron.
- Remove the portion of Taxiway B between the Terminal Apron and the East Cargo Area Apron.
- Remove Taxiways B3 and B4 and construct a new connector taxiway east of Taxiway B3.
- Construct two new connector taxiways between the shifted Taxiway B and the Terminal Apron.
- Remove Taxiway B's intersections with Runway 18/36 and Taxiway N that are not at 90-degree angles.

Finally, although not identified as a recommendation in the facilities requirements analysis, Figure 4-8 shows construction of a new full parallel taxiway on the west side of Runway 18/36. SBN envisions construction of this taxiway in the future to support potential revenue-generating aeronautical development at the approach end of Runway 18. Its presentation in the figure is intended to illustrate the concept and identify space that would need to be preserved to implement this infrastructure element.

Advantages - Taxiway Improvements

- Relocation of Taxiways A, B, and N closer to Runways 9R/27L and 18/36 complies with FAA design standards.
- Relocation of Taxiway A closer to Runway 9R/27L allows for creation of an expanded General Aviation Apron, which provides more parking space for itinerant general aviation aircraft.
- Removal of Taxiways A3, A4, B3, and B4 eliminates the complex geometry at the intersection with Runway 9R/27L.
- Construction of a new full parallel taxiway west of Runway 18/36 would support potential revenue-generating aeronautical development at the approach end of Runway 18.
- Decoupling Taxiway B from the Terminal Apron provides more space for positioning and push back of aircraft at the terminal building.

Disadvantages - Taxiway Improvements

- Cost for implementation

Estimated Cost

The total estimated cost of the proposed improvements to Taxiways A and N and construction of the full parallel taxiway west of Runway 18/36 is $89.0 million. This cost includes the following:

- Construction
- Professional services
  - Design
  - Permitting
  - Construction administration
  - Construction inspection
  - Quality assurance testing
- Contingency – 15 percent

4.4 Air Cargo Development

As explained in the review of facility requirements in Chapter 3, SBN is actively pursuing additional domestic and international air cargo service and has long-term plans to increase air cargo activity at the Airport. Chapter 3 also noted the competitive advantages SBN has compared to other air cargo airports in the region, such as Rockford International Airport, Gerald R. Ford International Airport, and Rickenbacker International Airport. A few of these advantages are a location within a 90-minute drive of Chicago, Illinois; a greater amount of airport-adjacent land with immediate airside access available; and a location along major transportation corridors, including I-80/I-90 and within 25 miles of I-94. It was recommended that SBN preserve adequate space for the development of additional cargo facilities should air cargo growth at the Airport occur.

Figure 4-9 illustrates a concept for proposed future air cargo development at the southwest quadrant of SBN's property, which is south of Taxiway B, east of U.S. Highway 31, and west of the approach end of Runway 36. As shown in the diagram, SBN currently does not own all the property in the shaded areas. Numerous parcels of property would need to be acquired along with relocation of residences, but once assembled, approximately 304 acres of land would be available for future air cargo development.

Advantages - Air Cargo Development

- Provides approximately 304 acres of land for future revenue-generating air cargo development
- Supports SBN's goal of increasing domestic and international air cargo activity

Disadvantages - Air Cargo Development

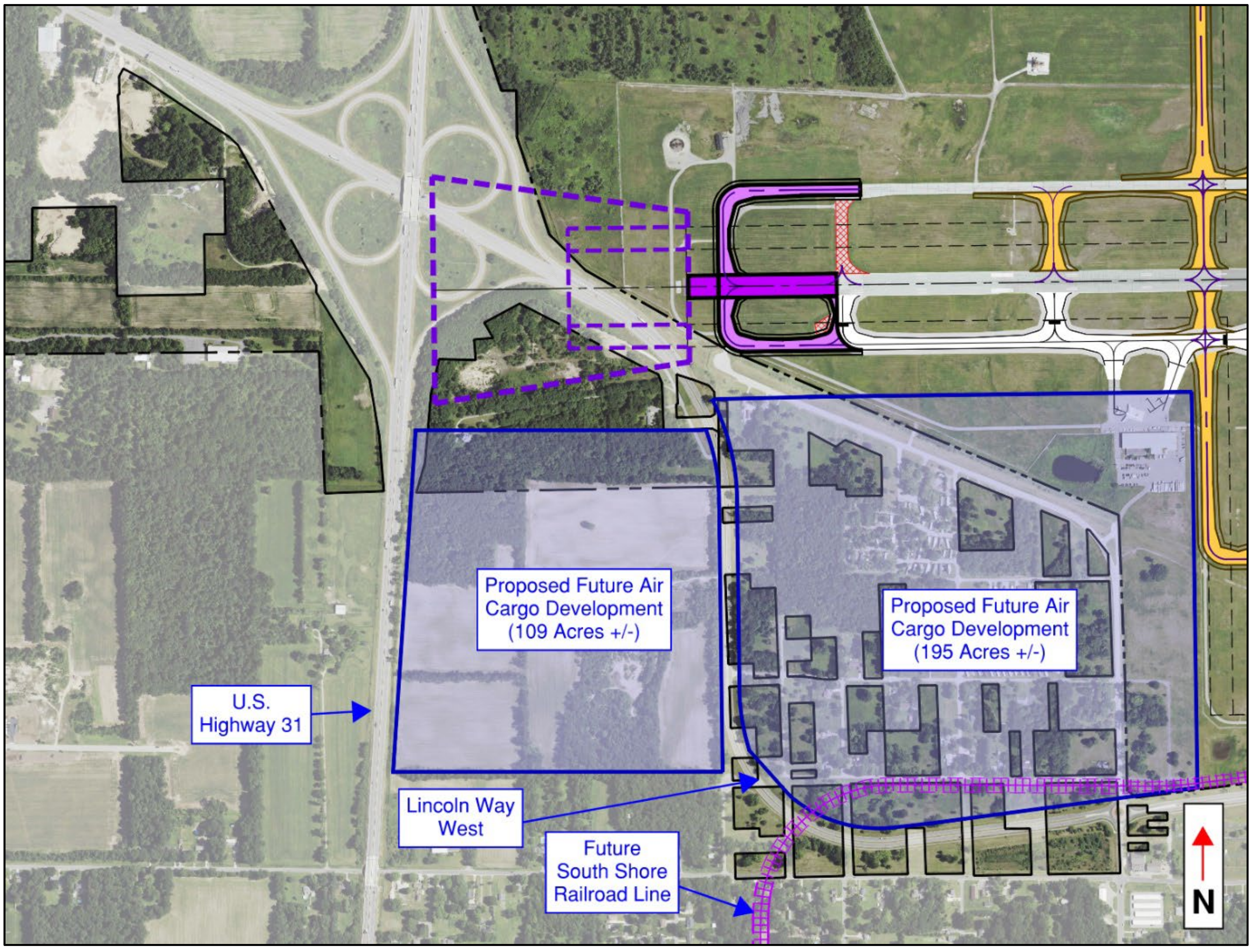
- Requires acquisition and relocation of numerous residences in this area
- Requires acquisition of numerous parcels of land

Estimated Construction Cost

Since the type and scale of air cargo development that would occur in the southwest quadrant is not known at the time of this master plan, no construction costs were estimated.

In conclusion, this proposed concept offers an opportunity to greatly expand aeronautical area for air cargo development given the size of infrastructure needed for these operations. Relocation of residences for the acquisition of land will be the greatest logistical and cost challenge associated with this development option. Coordination for this to occur would be needed well in advance of an air cargo operator deciding to construct infrastructure in this area given the time and cost needed for the acquisition of property.

Figure 4-9: Future Air Cargo Development Concept



Source: Mead & Hunt, Inc. (2022)

4.5 General Aviation Development

The review of facility requirements in Chapter 3 identified an immediate need for additional parking spaces for itinerant general aviation aircraft during Notre Dame football game days. Chapter 3 also explained the difficulty in determining SBN's existing hangar capacity due to the variety of privately-owned hangars that store most of the Airport's based aircraft. Any future demand for additional hangar space at the Airport will be market-driven and will likely require construction of new T-hangars and / or box hangars.

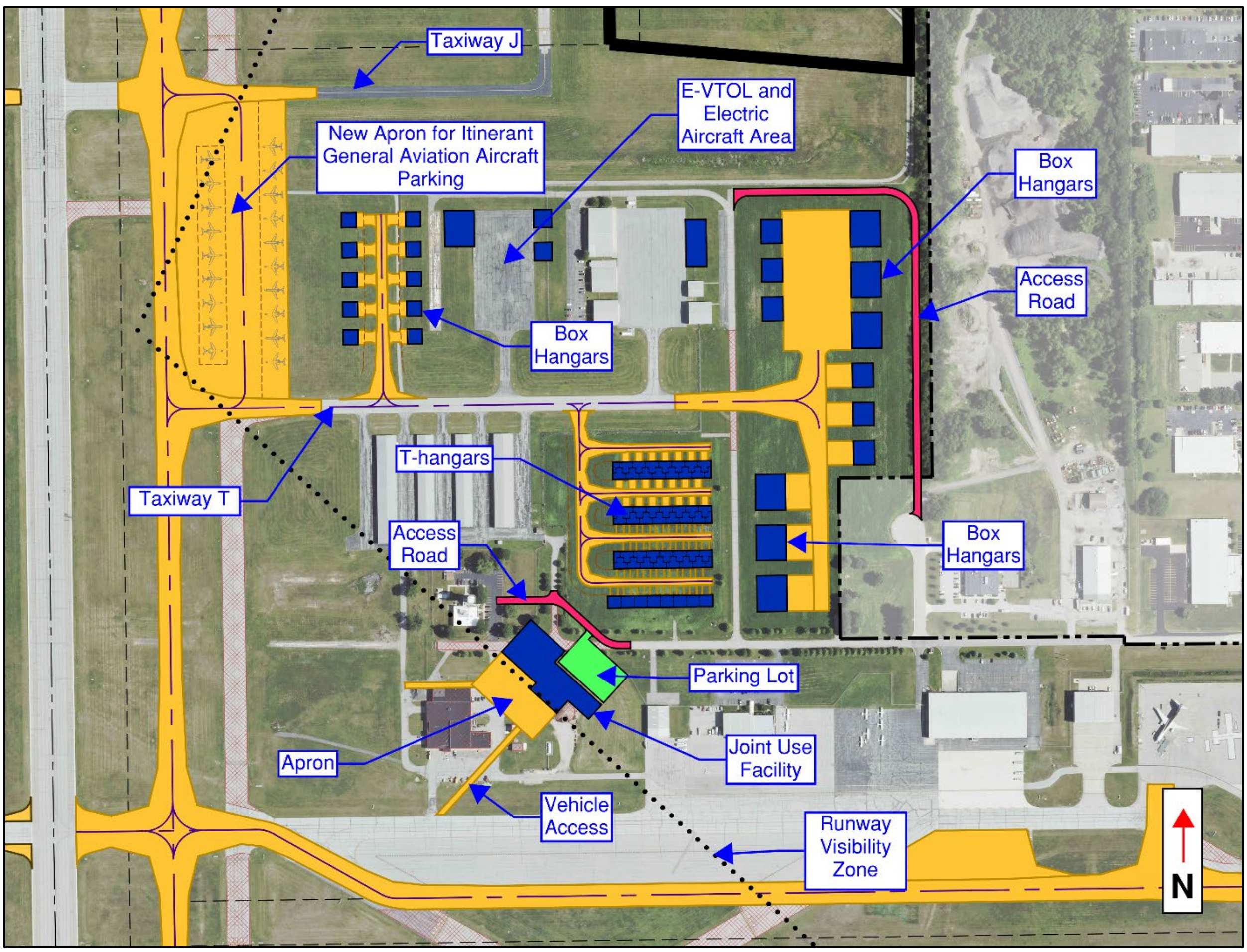
It is therefore recommended that planning be initiated to expand General Aviation (GA) development so that immediate needs for apron space and future demand for hangars can be met. In addition, planning should be initiated to accommodate new types of aircraft anticipated to become more prevalent in the future, particularly electric aircraft and electric vertical take-off and landing (eVTOL) aircraft. The area of the Airport that is well suited for future GA development is the midfield area located east of Taxiway N between Runways 9R/27L and 9L/27R, where existing GA infrastructure and available land are located.

The following sections present concepts that could be implemented to provide additional apron space for itinerant GA aircraft parking, add additional hangars, and support activity by electric aircraft and eVTOL aircraft. These concepts are all based on a single and logical development option. As a reminder, these concepts are not intended to be a concrete plan of how development will occur within the midfield area.

4.5.1 New Apron for Itinerant General Aviation Aircraft Parking

A concept was prepared that focuses on providing additional itinerant GA aircraft parking through construction of a new apron between Taxiways T and J. The proposed apron would be approximately 33,000 square feet (**Figure 4-10**), the construction of which would be contingent upon shifting Taxiway N closer to Runway 18/36 (see Taxiway Improvements Concept). Parking for approximately 15 to 20 aircraft would be provided on the new apron. Taxiway N2 would be removed to comply with FAA design standards that prohibit direct access from an apron to a runway without requiring a turn.

Figure 4-10: Midfield Development Concepts



Source: Mead & Hunt, Inc. (2022)

Advantages – New Apron for Itinerant General Aviation Aircraft Parking

- Provides additional parking spaces for itinerant GA aircraft during Notre Dame football game days
- Potentially avoids the need to close Runway 9L/27R for aircraft parking during Notre Dame football game days

Disadvantages – New Apron for Itinerant General Aviation Aircraft Parking

- Contingent upon relocation of Taxiway N
- Distance of apron from SBN's fixed base operator facilities
- Cost for implementation

Estimated Construction Cost

The estimated cost for implementation of the new apron for itinerant GA aircraft parking is $9.1 million. This cost includes the following:

- Construction
- Professional services
    - Design
    - Permitting
    - Construction administration
    - Construction inspection
    - Quality assurance testing
- Contingency – 15 percent

4.5.2 Hangar Development

Figure 4-10 also proposes that box hangars of various sizes, T-hangars, and supporting aprons and taxilanes be constructed within SBN's midfield area to accommodate future demand for hangar space. In this concept, construction of 10 box hangars, each measuring 50 feet by 50 feet, is proposed north of Taxiway T between the proposed location for the new itinerant GA aircraft apron and the existing corporate aprons. A taxilane connecting Taxiway T to the hangars would be constructed, along with supporting hangar aprons. East of the existing corporate aprons, six 120-foot-by-100-foot and six 80-foot-by-70-foot box hangars are proposed. Taxiway T would be extended to the east to provide access to these hangars, requiring closure of Corporate Drive in this area. Aprons and taxilanes supporting the new hangars would be constructed, and a new access road would be constructed east of these proposed hangars to provide access from Lathrop Street to the north side of the proposed midfield development. Finally, construction of several T-hangar structures south of Taxiway T and east of the existing T-hangar area are proposed in this concept. At this location, one 40-foot-by-352-foot and three 58-foot-by-330-foot T-hangar structures with supporting taxilanes and aprons are proposed.

Advantages – Proposed Hangar Development

- Provides a variety of hangar styles and sizes that would be constructed as needed
- Provides additional revenue for SBN through ground leases

Disadvantages – Proposed Hangar Development

- Requires construction of supporting taxilanes and aprons
- Orients the T-hangar structures to face north
- Cost for implementation

Estimated Construction Cost

The estimated cost of the hangar structures and supporting infrastructure is $72.0 million, which includes the following:

- Construction
- Professional services
  - Design
  - Permitting
  - Construction administration
  - Construction inspection
  - Quality assurance testing
- Contingency – 15 percent

4.5.3 Electric Aircraft and eVTOL Aircraft Area

Figure 4-10 also proposes development of an electric aircraft and eVTOL area at the westernmost corporate apron. This area would support the new generation of electric aircraft and eVTOL aircraft anticipated to grow in popularity during the planning period. In this concept, a landing pad would be constructed on the apron, along with electric charging stations for refueling of these aircraft. The existing apron would require resurfacing and pavement strengthening to accommodate the high tire pressure of eVTOL aircraft.

Advantages – Proposed Electric Aircraft and eVTOL Aircraft Area

- Provides space at SBN to support the new generation of electric aircraft and eVTOL aircraft
- Avoids construction of additional apron space by using one of the existing corporate aprons
- Supports environmentally sustainable aircraft operations

Disadvantages – Proposed Electric Aircraft and eVTOL Aircraft Area

- Cost for implementation

Estimated Construction Cost

The estimated cost to implement the proposed electric aircraft and eVTOL area is $3.0 million. This cost includes the following:

- Construction
- Professional services
  - Design
  - Permitting

- Construction administration
- Quality assurance testing

- Contingency – 15 percent

As noted, the proposed apron for itinerant GA aircraft parking, hangar development areas, and electric aircraft / eVTOL areas are conceptual in nature and intended to preserve space for such developments when needed. Ultimately, the design of the apron will be dependent upon an engineering effort while the location, type, and number of hangars will be dependent upon hangar developers. As industry continues to evolve with the electric aircraft and eVTOL aircraft concepts, additional coordination will be needed to determine design standards and infrastructure needs for these supporting facilities.

4.6 Support Facilities

As noted in the review of facility requirements, improvements are needed to the public safety and airfield maintenance buildings at SBN. Both have outlived their expected useful lives, are undersized, and provide inadequate space to meet the vehicle and equipment storage needs of firefighting, airfield maintenance, and snow removal operations at the Airport. It was therefore recommended that the public safety and airfield maintenance buildings be replaced. The section below discusses replacement of these buildings.

4.6.1 Joint Use Public Safety / Airfield Maintenance / Snow Removal Equipment Facility

Based on a review of the needs and items that should be considered when planning for an ARFF facility (FAA AC 150/5210-15A, *Aircraft Rescue and Firefighting Station Building Design*) and a snow removal equipment (SRE) facility (FAA AC 150/5220-18A, *Buildings for Storage and Maintenance of Airport Snow and Ice Control Equipment and Materials*), the preferred site identified for construction of a new facility consolidates SBN's public safety, airfield maintenance, and snow removal functions in one building in the Airport's midfield area (Figure 4-10). This site was selected based on a single, logical development option.

The combination of the public safety, airfield maintenance, and snow removal elements into a single facility offers both construction and operational cost efficiencies and the benefits of providing a centralized location for SBN staff. Combining these functions into the same structure also reduces the footprint necessary for each facility since some design elements, such as crew work areas, a training room, locker rooms, bathrooms, and break rooms could be shared.

To implement this concept, an approximate 43,000-square-foot building would be constructed immediately northeast of SBN's existing airfield maintenance facility, which would be demolished. This new building would be sufficiently sized to store all public safety, airfield maintenance, and SRE equipment, including newer generation apparatuses, and provide adequate space for personnel areas and materials / supplies storage. Supporting infrastructure would include an apron, vehicle access roads, and a parking lot for SBN employees. The new facility would be constructed at the western end of Lathrop Street, which provides access to SBN's airport traffic control tower (ATCT). Lathrop Street pavement would be removed in this area, and a new access road to the ATCT would be constructed. As shown previously in Figure 4-10, the joint use building, apron, and parking lot would be oriented in a northwest-southeast direction to keep the

Runway Visibility Zone (RVZ) clear of structures. Maintaining a clear RVZ allows departing and arriving aircraft to verify the location and actions of other aircraft and vehicles on the ground that could create a conflict.

Construction of a joint use public safety / airfield maintenance / SRE facility has the following advantages and disadvantages:

Advantages – Joint Use Public Safety / Airfield Maintenance / SRE Facility

- Provides a centralized location that meets ARFF response requirements as identified in Part 139
- Maximizes use of developable land in this area
- Allows for direct landside access

Disadvantages – Joint Use Public Safety / Airfield Maintenance / SRE Facility

- Requires closure of the western end of Lathrop Street and construction of a new ATCT access road
- RVZ limits the amount of land available for development in this area

Estimated Construction Cost

Development of a joint use public safety / airfield maintenance / SRE facility is estimated at $19.8 million, which includes the following:

- Construction
- Professional services
    - Design
    - Permitting
    - Construction administration
    - Construction inspection
    - Quality assurance testing
- Contingency – 15 percent

As with other infrastructure developments proposed in the chapter, the completion of a concept / budget report will ultimately determine the location, design, and cost of such a facility. This effort will also further review the design of the building and the elements in need of inclusion as a part of the evaluation of the needs of the public safety and maintenance departments. Identification of a potential site of a joint use public safety / airfield maintenance / SRE facility as a part of this master planning effort is intended to preserve space for such a development in consideration of other master plan concepts.

4.7 Airport Traffic Control Tower

Chapter 3: Facilities Requirements noted that the existing ATCT, currently north of the airfield maintenance facility at the west end of Lathrop Street, is over 42 years old and is nearing the end of its useful life. Investigation of a preferred long-term location for the ATCT was recommended to preserve and protect adequate space for a potential ATCT replacement and/or relocation if or when necessary.

FAA Order 6480.4B, *Airport Traffic Control Tower Siting Process*, establishes requirements for determining site location, tower height, and cab orientation of a proposed new, replacement of existing, and modernization of ATCTs where the overall structure height is changed. FAA Order 6480.4B also establishes a siting process utilizing the standard Airport Facilities Terminal Integration Laboratory (AFTIL) method, which is required for FAA-operated ATCTs such as SBN's. Therefore, this master plan's ATCT siting analysis will be a preliminary evaluation only as ultimately the FAA is responsible for the completion of such siting analysis. A full FAA AFTIL method siting process will need to be conducted if or when the ATCT is to be replaced or relocated.

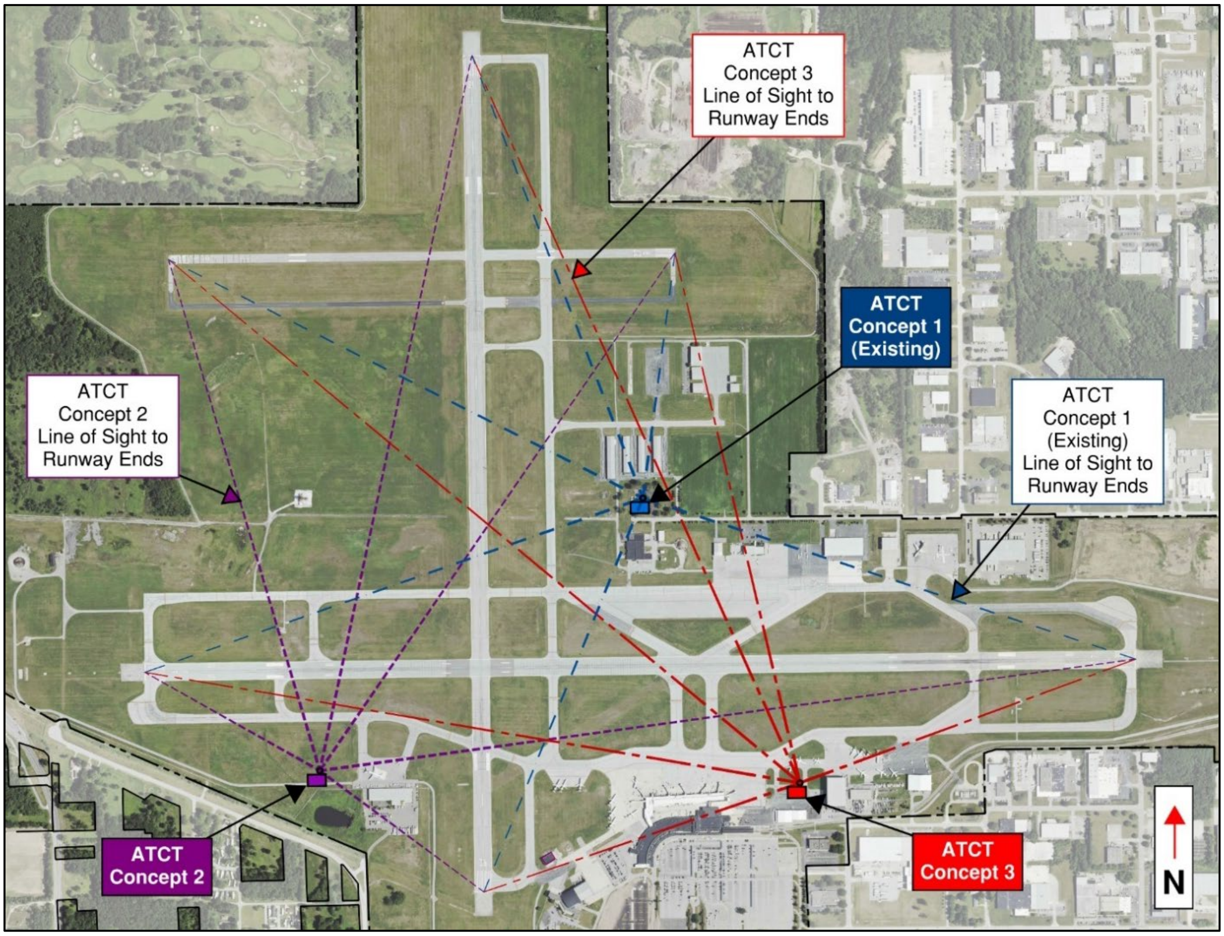
The existing ATCT site and two alternative sites for the ATCT were identified for preliminary evaluation in this master plan. The existing ATCT site (ATCT Concept 1) and alternative sites (ATCT Concepts 2 and 3) are shown in **Figure 4-11**. No cost estimates are provided since the FAA would be responsible for construction of any ATCT replacement and / or relocation.

4.7.1 FAA Airport Traffic Control Tower Siting Criteria

FAA Order 6480.4B, *Airport Traffic Control Tower Siting Process*, prescribes the FAA ATCT siting process and takes into consideration criteria relating to the safety of air traffic operations for each potential ATCT site. While all siting criteria must be considered, the greatest emphasis is on the following items, in descending order of importance:

- Impacts to instrument approach procedures (Terminal Instrument Procedures [TERPS]) and airport design standards
- Impacts to communications, navigation, and surveillance equipment
- Visibility performance
- Comparative Safety Assessment (CSA)
- Operational requirements
- Economic considerations

Figure 4-11: Airport Traffic Control Tower Concepts



Source: Mead & Hunt, Inc. (2021)

Instrument Approach Procedures and Airport Design Standards

ATCTs should be sited such that they do not adversely impact any current or planned TERPS or airport design and safety surfaces, including Part 77 surfaces and design surfaces such as the Runway Obstacle Free Zone (ROFZ), ROFA, RPZ, RSA, and building restriction line. In the case of SBN, TERPS surfaces to protect for potential ILS Category (CAT) II/III and Special Authorization CAT I-II missed approaches to both Runways 9R and 27L (27L currently has Special Authorization CAT I-II procedure) were reviewed.

Impacts to Communication, Navigation, and Surveillance Equipment

The ATCT must be sited where it does not degrade or affect the performance of existing or planned facilities and/or equipment unless deviations are necessary to meet other siting criteria and mitigation strategies are implemented.

Visibility Performance Requirements

Visibility siting requirements for ATCTs require that the following visibility performance requirements be met:

- **Unobstructed View** – The ATCT must have an unobstructed view of all controlled movement areas of an airport, including all runways, any other landing areas, and air traffic in the vicinity of the airport. Visibility from the ATCT cab should allow an unobstructed view of all taxiways and ramp areas.

- **Object Discrimination** – An object discrimination analysis must be performed to assess observers' probability of detection of an object on the airport surface. The FAA standard is a detection requirement of 95.5 percent probability to notice the front view of a minivan, as determined by the FAA's Airport Traffic Control Tower Visibility Analysis Tool (ATCT VAT).

- **Line of Sight (LOS) Angle of Incidence** – The ATCT distance from critical airport locations and ATCT height must support requirements for viewing objects on the airport movement areas, taxiways, and critical non-movement areas from the ATCT cab. A LOS angle of incidence must be equal to or greater than 0.80 degrees.

Comparative Safety Assessment (CSA)
The FAA Air Traffic Organization (ATO) Safety Management System (SMS) requires that safety assessments be performed on changes to the National Airspace System (NAS) that have safety impacts. The Safety Risk Management (SRM) process documents safety-related changes, identifies hazards, assesses and analyzes risks, mitigates high risks to an acceptable level, mitigates medium risks if possible, and verifies all predicted residual risks through monitoring. Each of the siting criteria must be reviewed for potential hazards. The hazards identified for the preferred locations must be assessed and mitigated to an acceptable level of risk to satisfy SRM requirements.

As an FAA ATCT, any relocation of SBN's ATCT will be required to go through the FAA ATCT Siting Process outlined in FAA Order 6480.4B. This process will include a CSA involving the Airport and numerous lines of business within the FAA. Therefore, this master plan preliminary ATCT siting evaluation does not include a full CSA, but rather evaluates the comparative siting criteria identified for each candidate site within this preliminary evaluation.

Operational Requirements
For any given site and cab size, the ATCT must be constructed at the minimum height required to satisfy the criteria outlined in FAA Order 6480.4B. Operational criteria include ATCT orientation, weather, look-down angle, look across line-of-sight, cab mullion/column orientation, look-up angle, construction, access, and non-movement area visibility. The orientation criteria states that consideration must be given to direct sun glare, indirect sun glare off natural and manmade surfaces, night-time lighting glare, external light sources, and thermal distortion. The ATCT must be oriented where the primary operational view faces north or alternately east, or west, or finally south, in that order of preference for an ATCT in the northern hemisphere. In areas where snow accumulates on the ground or the ATCT site is surrounded by sand or a large body of water, a southern orientation should be avoided.

Economic Considerations

Consideration must be given to economic factors when evaluating ATCT sites. Relative costs should consider height, land use planning, utilities and cabling, site access, security, and mitigation strategies.

4.7.2 ATCT Concept 1 – Existing Location

ATCT Concept 1 proposes to rehabilitate the existing ATCT or replace the existing ATCT in the general vicinity of its current location with a new facility north of the airfield maintenance facility at the west end of Lathrop Street. This is a midfield location between the two parallel runways (9R/27L and 9L/27R) and east of Runway 18/36.

Advantages - ATCT Concept 1

- Site is below CAT II/III missed approach surface (MAS) and obstacle clearance surface (SA CAT I-II has same missed approach surface as CAT II/III)
- Site is below Part 77 surfaces by approximately 35 feet
- Site complies with airport design standards
- Site is not anticipated to significantly impact any communication, navigation, and surveillance equipment
- Site has some slight obstructions to visibility of Runway 36 approach surface, but visibility to all other controlled movement areas is clear
- Site meets minimum object discrimination criteria and has highest average object detection probability for all the key controlled movement points
- With existing ATCT eye height of 83.5 feet above ground level, site has lowest minimum required height to meet LOS angle of incidence minimum of 0.80 degrees
- Site would be lowest cost option since it has lowest minimum required height and, because it is current ATCT location, has required utilities, access, and security

Disadvantages - ATCT Concept 1

- Buildings on north side of Taxiway A east of Taxiway A3 are just clear of obstructing Runway 27L Approach Surface
- Site has southern orientation towards primary runway, Runway 9R/27L, which is not preferred
- New ATCT at site would create temporary line-of-sight adverse impacts during construction while existing ATCT was still operational and once new ATCT was operational until existing ATCT was removed

4.7.3 ATCT Concept 2 – Southwest Quadrant

ATCT Concept 2 proposes to relocate the ATCT south of Runway 9R/27L and west of Runway 18/36 near the existing FedEx facility.

Advantages - ATCT Concept 2

- Site complies with airport design standards
- Site is not anticipated to significantly impact any communication, navigation, and surveillance equipment

- Site has unobstructed views of all controlled movement areas
- Site meets minimum object discrimination criteria
- Site does not have any known significant deficiencies in terms of its ability to satisfy operational requirements

Disadvantages - ATCT Concept 2

- Relocation of ATCT near FedEx's facility would limit potential air cargo-related development in SBN's southwest quadrant
- Site is approximately a four-foot penetration to CAT II/III MAS at minimum required eye height, assuming typical 25 feet above eye height to top of structure and antennas
- Site penetrates Part 77 surfaces by approximately 64 feet
- Site's LOS to east end of Taxiway J could potentially be obstructed by any GA development south of Runway 27R and Taxiway J
- Site would require an ATCT eye height of 118 feet to meet LOS angle of incidence minimum of 0.80 degrees
- Site would require utilities, including airfield lighting and communications, to be brought to site

4.7.4 ATCT Concept 3 – Southeast Quadrant

With ATCT Concept 3, the ATCT would be relocated south of Runway 9R/27L and east of Runway 18/36, to the area immediately north of Michiana Aircraft Services' existing hangar and east of the commercial airline terminal building.

Advantages - ATCT Concept 3

- Site complies with airport design standards
- Site is not anticipated to significantly impact any communication, navigation, and surveillance equipment
- Site has unobstructed views of all controlled movement areas associated with Runway 9R/27L and Runway 18/36
- Site meets minimum object discrimination criteria
- Site does not have any known significant deficiencies in terms of its ability to satisfy operational requirements

Disadvantages - ATCT Concept 3

- Relocation of ATCT near Michiana Aircraft Services hangar would limit potential terminal expansion to east
- Site is approximately 11-foot penetration to CAT II/III MAS at minimum required eye height, assuming typical 25 feet above eye height to top of structure and antennas
- Site penetrates Part 77 surfaces by approximately 72 feet
- Site's LOS to east end of Taxiway J is obstructed by existing hangars on easternmost corporate apron south of Runway 27R and Taxiway J
- GA hangar development on corporate aprons would create additional LOS obstructions to east end of Taxiway J and Runway 27R

- Site is located within Airport Operations Area (AOA) and would require demolition of large box hangar and reconfiguration of AOA fence to make site landside accessible or require crossing of an apron within AOA for access
- Site would require adding utilities, including airfield lighting and communications, to site

4.7.5 Comparison of Siting Criteria for the ATCT Concepts

A detailed comparison of the siting criteria for the ATCT concepts is provided in **Table 4-1**.

4.7.6 Recommended Airport Traffic Control Tower Concept

Based upon a comparative qualitative review of the siting criteria discussed, ATCT Concept 1, the existing ATCT site, is the preferred location for a replacement or refurbishment of the ATCT when or if necessary. It is recommended for the following reasons:

- Does not impact any planned instrument approach procedures
- Does not impact any navigational aids (NAVAIDs)
- Meets the visibility performance requirements and has the highest average object discrimination detection probability of all three ATCT concepts
- Requires the lowest ATCT eye height to meet the visibility performance metrics
- Despite having a southern orientation, which is the least desirable orientation, performs best in higher priority siting criteria
- Has the lowest comparative cost

4.8 Revenue Generating Development

Although not identified in Chapter 3: Facilities Requirements, SBN is interested in non-aeronautical and aeronautical development at SBN as an opportunity to diversify revenue sources while also enhancing the economic contributions that the Airport makes to the region. An area of Airport property that is available for revenue-generating development is at the approach end of Runway 18. As shown in **Figure 4-12**, land is available north and west of the Runway 18 threshold. The identification of this area is intended to preserve this land for potential future revenue-generating development.

The area north of the Runway 18 threshold encompasses approximately 76 acres and is bounded by Nimtz Parkway to the north, Moreau Court to the west, the Runway 18 RPZ to the south, and the SBN property line to the east. This area is currently used as soccer fields. Dense tree cover exists in the eastern section of the area, with additional tree cover found in the central portion. This area would be suitable for non-aeronautical development since it is separated from the airfield.

West of the Runway 18 threshold is a narrow strip of approximately 20 acres of land. This tract of land stretches from Old Cleveland Road to the north stopping just north of Runway 9L/27R. The proposed taxiway to be constructed on the west side of Runway 18/36 would support potential aeronautical development in this area.

Table 4-1: ATCT Concepts Comparison

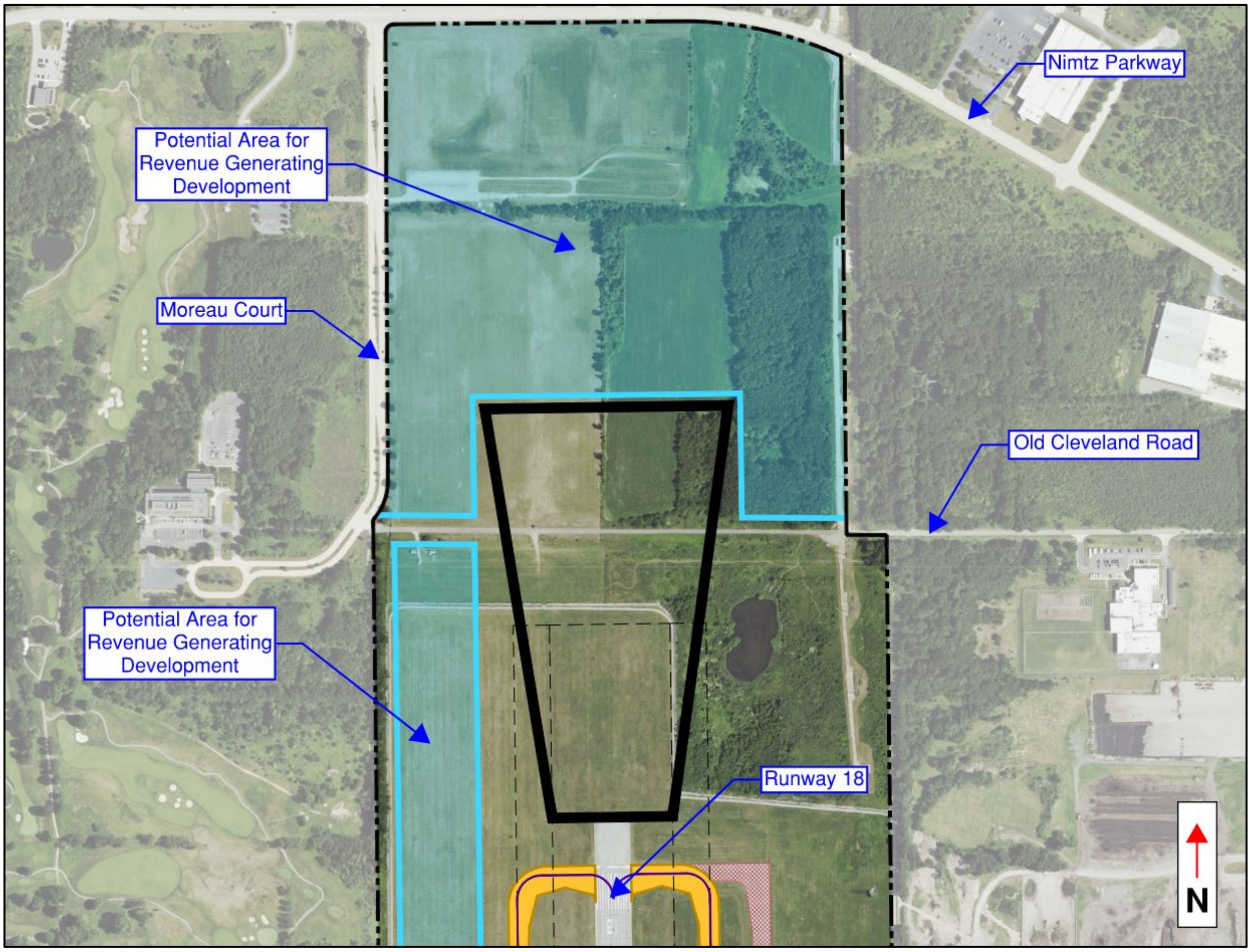
	Concept 1	Concept 2	Concept 3
Item Description			
Location Description	Existing Site	SW Quadrant	SE Quadrant
Ground Elev (MSL)	777	771	768
Eye-Level (AGL)	83.5	118	125
Eye-Level (MSL)	860.5	889	893
Top of Tower (AGL)	101.6	143	150
Top of Tower (MSL)	878.6	914	918
Line of Sight Angle of Incidence (Minimum 0.80)	0.87	0.80	0.80
Line of Sight Angle of Incidence (Pass/Fail)	Pass	Pass	Pass
ATCT Orientation Direction (Rwy 9R/27L)	South & West	North & East	North & West
Landside Access to ATCT	Yes	Yes	No
Environmental Issues	None Known	Potential	None Known
Potential Impacts to NAVAIDs	No	Unknown	Unknown
Allowable Part 77 Elev (MSL)	914	850	846
Part 77 Penetration (FT)	-35.4	64	72
Allowable TERPS Elev (MSL) (9R/27L CAT II/III Missed Appr Surf)	921	910	907
TERPS Penetration (FT)	-42.4	4	11

Object Discrimination Analysis Criteria (Detection Probability - Minimum 95.5%)

		Concept 1			Concept 2			Concept 3		
Key Point	**Elev**	**Dist**	**Detection**	**Pass/Fail**	**Dist**	**Detection**	**Pass/Fail**	**Dist**	**Detection**	**Pass/Fail**
Rwy 27L / Twy A / Twy B	769	4,502	99.7%	Pass	7,040	98.0%	Pass	3,203	99.9%	Pass
Rwy 9R / Twy A / Twy B	790	4,649	99.6%	Pass	2,206	100.0%	Pass	5,756	99.2%	Pass
Rwy 36 / Twy N	759	3,647	99.9%	Pass	1,967	100.0%	Pass	2,853	100.0%	Pass
Rwy 18 / Twy N	798	4,090	99.8%	Pass	6,480	98.6%	Pass	6,788	98.3%	Pass
Rwy 27R	780	2,130	100.0%	Pass	5,431	99.3%	Pass	4,649	99.7%	Pass
Rwy 9L	788	4,525	99.7%	Pass	4,683	99.6%	Pass	6,963	98.1%	Pass
Average			**99.8%**			**99.3%**			**99.2%**	

Source: FAA Air Traffic Control Visibility Analysis Tool (ATCTVAT); Mead & Hunt, Inc. (2021)

Figure 4-12: Revenue Generating Development Concept



Source: Mead & Hunt, Inc. (2021)

Advantages – Revenue-Generating Development

- Provides an additional source of revenue for SBN
- Uses property that SBN already owns
- Enhances SBN's economic impact on the surrounding region

Disadvantages – Revenue-Generating Development

- There is a lack of existing infrastructure in the areas available for development.
- The soccer fields are a potential Department of Transportation Act Section 4(f) resource protected under the National Environmental Policy Act.
- Aeronautical development is contingent upon construction of the parallel taxiway west of Runway 18/36.

Again, as with other alternatives, this development concept is being presented to preserve area for non-aeronautical revenue-generating areas for when such opportunities present themselves. Ultimately, the layout, configuration, and non-aeronautical uses within this area will be on a case-by-case scenario based on the desires of the developer and SBN.

4.9 Terminal Area Development

Chapter 3: Facilities Requirements measured the ability of facilities in SBN's terminal area to meet current and projected demand over the 20-year planning period. Facilities assessed were the commercial airline terminal building and support facilities consisting of rental car operations, parking lots, and aircraft hangars. Terminal area development concepts prepared as part of this master plan to accommodate current and projected demand at SBN are presented in the following sections. A consolidated discussion of existing conditions, facility requirements, and future development concepts for the commercial airline terminal building can be found in the *Terminal Planning Study* in **Appendix D**.

4.9.1 Commercial Airline Terminal Building

The facilities requirements analysis identified deficiencies in terminal building space that should be remedied to accommodate SBN's Planning Activity Levels (PALs) associated with the forecasts prepared for this master plan. Areas requiring expansion or inclusion were as follows:

- **Allegiant Airlines' Ticket Queue** – The queue requires more space to accommodate the rush of passengers checking in during the early morning departures bank. The high demand in this short period is due to Allegiants' larger aircraft, historically higher load factors, and the carrier's 45 – 60-minute cut-off time prior to departure.

- **Additional Airline Ticketing Office (ATO)** - At approximately 2,000 square feet per airline, the ATO areas will require expansion. Expansion of these facilities can be achieved by building out storage for airline ground support equipment (GSE) beyond the present ATOs and TSA's future checked-baggage inspection system.

- **TSA Checked Baggage Inspection System (CBIS)** - Consolidation of the CBIS housed beyond the airline's ATOs will reduce the number of explosive detection machines in use today and provide space for airlines to load carts in a consolidated outbound baggage make-up and GSE storage room.

- **Gate Departure Lounges** - The gate departures lounge area is too small to accommodate demand during the early morning departures peak hour when all gates have scheduled service within the period.

- **Terminal Gate** - Allegiant's operation requires a minimum of one gate to be built at the end of the concourse to accommodate the carrier's flights and not obstruct passenger handling operations at Gate 8.

- **Mother's Room** - A mother's room should be provided separately, away from restrooms.

- **Restrooms** - Single-use restrooms should be provided at multiple points in the concourse to limit walk time for passengers with reduced mobility.

- **Concessions** - Secure concourse concessions should be expanded to provide more seating and retail space.

Priorities for interim terminal building projects to be incorporated into SBN's capital improvement plan were as follows:

- Renovate and expand gatehouses 2 and 3 to provide American Airlines' passengers a higher LOS and to help American meet their performance requirements.

- Upgrade the upper concourse to include new and expanded restrooms, single-user restrooms, mother's room, Gate 9 expansion and concourse renovation to include expanding departures lounges out onto the concourse, and food and beverage concessions expansion (existing or new tenants).

- Add a new claim device to the arrivals hall and move concessions south or to the secure concourse.

- Renovate and expand the connector building, including the security checkpoint, passenger exit, and employee screening hall. Development of this project will depend upon which terminal plan concept is chosen by SBN for future development.

- Renovate and expand the Gates 2 and 3 departures lounges and concourse corridor to include raising the concourse level in this area to match that of the upper concourse.

- Expand and renovate the ATOs, consolidate TSA CBIS (just beyond ATO space), and build a new consolidated airline outbound baggage make-up room beyond the CBIS.

- Expand the terminal curbside to provide more curb length by expanding into the existing short-term parking or adding drive-through drop-off lanes; redevelop the terminal's main entrance D.

The terminal concepts developed for this master plan are a result of the Planning Team's observations and documentation of passenger behavior during the facility requirements analysis and discussions of operational issues with the St. Joseph County Airport Authority (Authority). Recommendations for facility expansion concepts increase the amount of space required to meet program requirements above the baseline terminal configuration. A more comprehensive analysis of functional area requirements should be undertaken in an advanced planning phase to confirm the calculations presented in this terminal area plan.

Terminal Improvement Planning Considerations

Several considerations guided development of the terminal concept plans. These are discussed below.

Train Station

Although multiple potential locations have been identified, the future location of the train terminal has not yet been determined. The Authority has reported that the station is likely to remain at its current location at the east end of the terminal building for the foreseeable future.

Bus Station

Bus service ended at SBN in 2020 due to lack of demand. Consequently, the Authority has indicated that terminal concepts do not need to show a location for a bus station as a part of the terminal building.

Curbside

Vehicle access to the curb is limited during peak travel due to congestion. The curved drive lanes at the east complicate this congestion by compressing activity. Increasing the amount of vehicle curbside length by adding lanes to this area is one potential consideration, as is incorporating a second drop-off and/or pickup curb. Eliminating or “softening” the curve to improve vehicle circulation is considered a potential option to decreasing congestion.

Curb Access - Passengers with Restricted Mobility

Linear access from curb to entrances is limited, and multiple entrance stairs do not meet Americans with Disabilities Act (ADA) requirements. The curbside will meet requirements for passenger safety and operational efficiency in all planning options. This involves increasing sidewalk width and building alternate ramps to provide sufficient space for vertical transitions to meet ADA requirements.

Arrivals Hall / Baggage Claim

Baggage claim areas are supplemented with additional devices and space to address growth. Claim devices are planned to recirculate bags within public claim areas, eliminating traditional recirculation into secure baggage drop-off areas of the terminal.

U.S. Customs & Border Patrol Facility (CBP)

The Federal Inspections Service (FIS) remains in place in all future concepts. The present location of the General Aircraft Facility (GAF), adjacent to the FIS, is the preferred location as both facilities are a recent addition.

Passenger Security Screening

The security checkpoint and queuing areas currently have sufficient area for processing passengers and meet future checkpoint requirements.

TSA Checked Baggage Security Screening

A location for a future consolidated baggage screening and shared airline outbound baggage make-up room is included for each concept.

Passenger Queueing

Existing terminal areas were designed to serve smaller regional jets. A lack of adequate queueing for larger flights has caused congestion in the departures and arrivals halls, at the security checkpoint, and at gate departure lounges. As seating capacity of aircraft in the commercial fleet increases, the frequency of crowded conditions at queuing areas will increase. Adequate space for queueing is a primary consideration for future concept planning.

Concourse Gate Departure Lounges

Some additional seating can be placed in the concourse corridor to meet near-term seating needs. Ultimately, new concourse space should be built to directly support the forecasted commercial fleet and passengers. The existing concourse can continue to serve smaller regional jets, or it can be widened in areas that serve larger aircraft.

Concourse Height and Gate Utilization

The Planning Team created aircraft parking layout plans as part of a separate project for phased apron reconstruction. The final plan has been incorporated into this master plan. Replacement of boarding bridges will address issues with current gate equipment.

Future concourse concepts may include lifting the existing concourse to a full second level height. This would improve ADA access inside the building and passenger boarding bridges. It would also allow GSE to be parked under and pass below the concourse level, shortening GSE travel routes and reducing baggage delivery times to the claim devices.

ADA Access at Gates 2, 3, and 9

ADA access to the aircraft boarding level at Gates 2 and 3 involve passengers using a single-occupancy elevator from the departure lounge to the passenger boarding bridge level. This is inefficient and disruptive to boarding flights. A building pedestrian ramp at Gate 9 provides an accessible route to the passenger boarding bridge.

Responding to vertical movement needs at Gates 2, 3 and 9 has been necessary to meet requirements set by varying floor heights. Using central vertical circulation nodes, such as escalators and elevators, is recommended. Stairs and ramps may be provided to supplement these devices.

New Concourse Option

A new concourse and vertical circulation core, built to today's standards, should be built to meet the Airport's mid- to long-term requirements. This achieves key development objectives: building at a greenfield site while providing for uninterrupted operations at the existing concourse during construction. Accommodating American's operations at the east side of the concourse during construction would open space to the west for development.

Building a new concourse will allow the Airport to meet requirements of a higher capacity fleet over time, adding gates with sufficient apron area and separation between aircraft parking positions to accommodate larger aircraft. New gate boarding bridges provide alternatives to existing limited-range bridges.

Terminal Concepts

Three terminal concepts were proposed based on the considerations above. For each concept, instead of attempting to categorize advantages and disadvantages of the proposed development, the key elements of the concept are identified.

Terminal Concept 1

Terminal Concept 1 is presented in **Figure 4-13**. Elements of this concept are as follows:

- A prominent central 2-story entrance, passenger security checkpoint, and vertical circulation node are added.
- The existing FIS/GAF and South Shore train station remain in their current locations.
- The former bus station would be available for another use, potentially for rental car VIP parking.
- The first-floor security checkpoint and arriving passenger exit lane from the concourse are relocated to the new central structure east of the existing checkpoint.
- The east addition provides space for a consolidated baggage screening and airline outbound baggage make-up area used by all airlines.
- The airline offices are reworked and expanded to the other side of the central core into the existing baggage make-up areas.
- The second floor provides space for new gates and gate departures lounges on the west side and offices on the east side for airport tenants.
- Expansion to the west is adjacent to the existing hangar apron, south of the proposed concourse.
- Long-term expansion of the concourse is planned to the east of the existing terminal and north of the existing train station.
- The new east concourse can be built with a separate security screening checkpoint and vertical circulation.

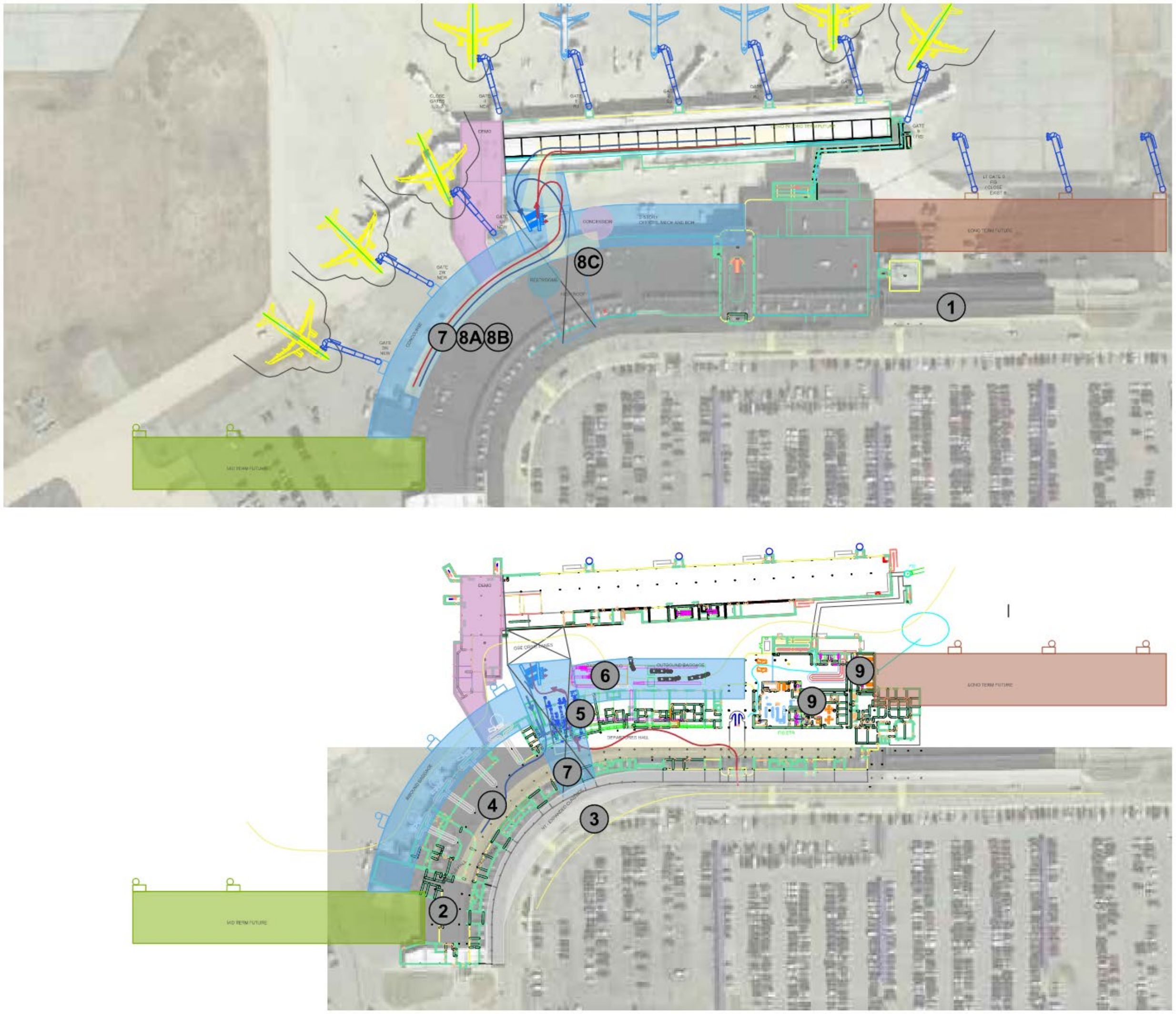
Gate expansion associated with Terminal Concept 1 is shown in **Table 4-2**.

Table 4-2: Terminal Concept 1 Gate Development

Phase	Number of Gates
I – Near-Term	9
II – Mid-Term	12
III – Long-Term	15

Source: Mead & Hunt, Inc. (2021)

Figure 4-13: Terminal Concept 1



Considerations

1. Train Station: Remains in place.
2. Former Bus Station is repurposed.
3. Curbside: Entry drive curve is softened. Curbside is widened, providing space for vertical transitions and improving access.
4. Arrivals Hall: New carousels in baggage claim.
5. Passenger Screening: The checkpoint is relocated and expanded.
6. Baggage Screening: A location is chosen for consolidated baggage screening and an outbound baggage make-up room shared by the airlines.
7. Passenger Queuing: Additional space is provided for passenger queuing in all affected areas.
8. Concourse:
   - A. All new gates serve ADG Group III.
   - B. The new concourse is located on a full second floor, allowing GSE to pass below and improving passenger access at each new gate. A central vertical circulation node with stairs, elevators and escalators provides efficient passenger access between floors.
   - C. Space in the new concourse is provided for departure lounges, concessions, restrooms and other passengers services.
9. US Customs: Both the FIS and GAF remain in place.

GATES: 9

Source: Mead & Hunt, Inc. (2021)

Terminal Concept 2

Figure 4-14 shows Terminal Concept 2. This concept addresses the concentration of arriving and departing passenger activity at the west end of the existing terminal building. Specific elements of the concept are the following:

- Departing passenger activity, including ticketing, baggage check-in, TSA CBIS, passenger security checkpoint, and vertical circulation, is relocated east of the FIS in this plan.
- Terminal Concept 2 relies on St. Joseph County to move the existing train station to a new location further to the east along the existing railway right-of-way.
- Building just beyond the CBP facility separates departure and arrival functions.
- Baggage claim is moved to the former ATO areas, decreasing congestion while increasing passenger LOS.
- Separating arrivals and departures activity increases the building's total functional capacity above what can be achieved in other concepts.
- Developing new departure processing and concourse areas constitutes building new infrastructure, a departure hall, and a 3-4 gate, two-story concourse.
- This concept allows use of the existing terminal until additional curb capacity requires extending it to the west.
- The concourse would serve until it reaches the end of its useful life.

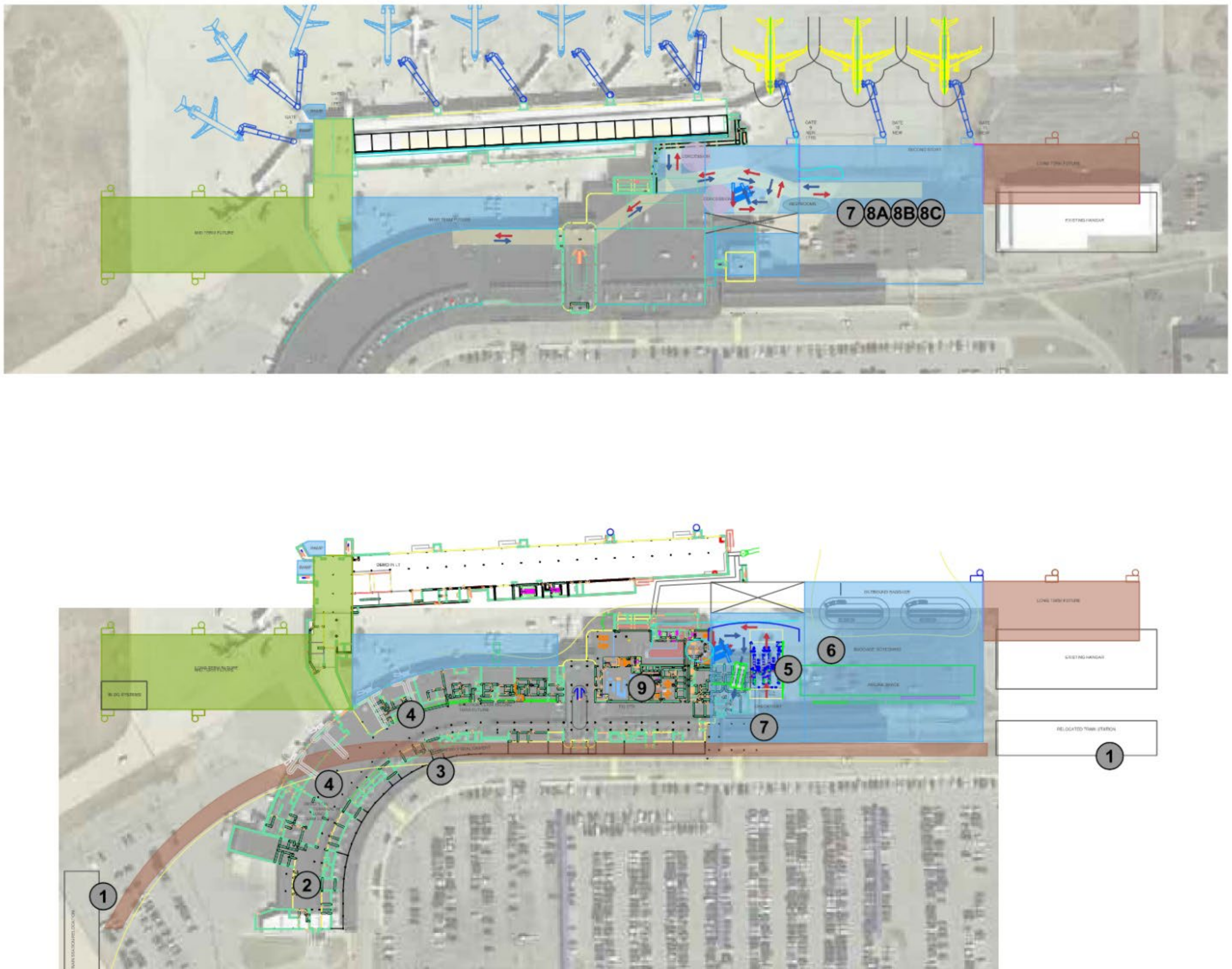
Gate expansion associated with Terminal Concept 2 is presented in **Table 4-3**.

Table 4-3: Terminal Concept 2 Gate Development

Phase	Number of Gates
I – Near-Term	10
II – Mid-Term	12
III – Long-Term	16

Source: Mead & Hunt, Inc. (2021)

Figure 4-14: Terminal Concept 2



Considerations

1. Train Station: Moves east or southwest.
2. Former Bus Station is demolished.
3. Curbside: Entry drive curve is realigned. Curbside is widened, providing space for vertical transitions and improving access.
4. Arrivals Hall: Baggage claim moves east.
5. Passenger Screening: The checkpoint is relocated and expanded.
6. Baggage Screening: A location is chosen for consolidated baggage screening and an outbound baggage make-up room shared by the airlines.
7. Passenger Queuing: Additional space is provided for passenger queuing in all affected areas.
8. Concourse:

A. All new gates serve ADG Group III.

B. The new concourse is located on a full second floor, allowing GSE to pass below and improving passenger access at each new gate.
A central vertical circulation node with stairs, elevators and escalators provides efficient passenger access between floors.

C. Space in the new concourse is provided for departure lounges, concessions, restrooms and other passengers services.

9. US Customs: The FIS remains in place and the GAF is relocated.

GATES: 10

Source: Mead & Hunt, Inc. (2021)

Terminal Concept 3

Terminal Concept 3 is depicted in **Figure 4-15**. This concept is comprised of the following near-, mid- and long-term development aspects:

- This concept adds a prominent, central, two-story structure on the west side of the existing checkpoint that extends from the curb to beyond the existing concourse.
- The FIS, GAF, and train station remain in their current locations.
- The former bus station and restaurant can be converted to expand the baggage claim.
- The relocated and expanded security screening checkpoint and arriving passenger exit lane are on the first floor of the new central structure.
- A central vertical circulation node is located on the secure side of the checkpoint.
- The arrival hall remains near its current location with new baggage carousels added to the southwest side.
- A one-story addition on the east side of the central structure provides space for a consolidated baggage screening and an outbound baggage area for the airlines.
- Airline offices are reworked and expanded to the north, into the existing baggage make-up areas.
- This concept provides gate departure lounges and aircraft stands that accommodate larger aircraft and increase the total gate count to 15.
- The existing concourse would remain in place to continue to serve regional jets while the east and west ends are built to serve mainline aircraft.
- The existing international arrivals at Gate 9 continue to be used for passengers who will clear the FIS.
- Gate 4 is overhauled.
- The service animal relief area would be relocated.
- Expansion of the double-loaded pier concourse to the west provides four additional aircraft gates for a total of 19 gates.
- The long-term expansion shown in this concept is not feasible, as it would impact Taxiway N.

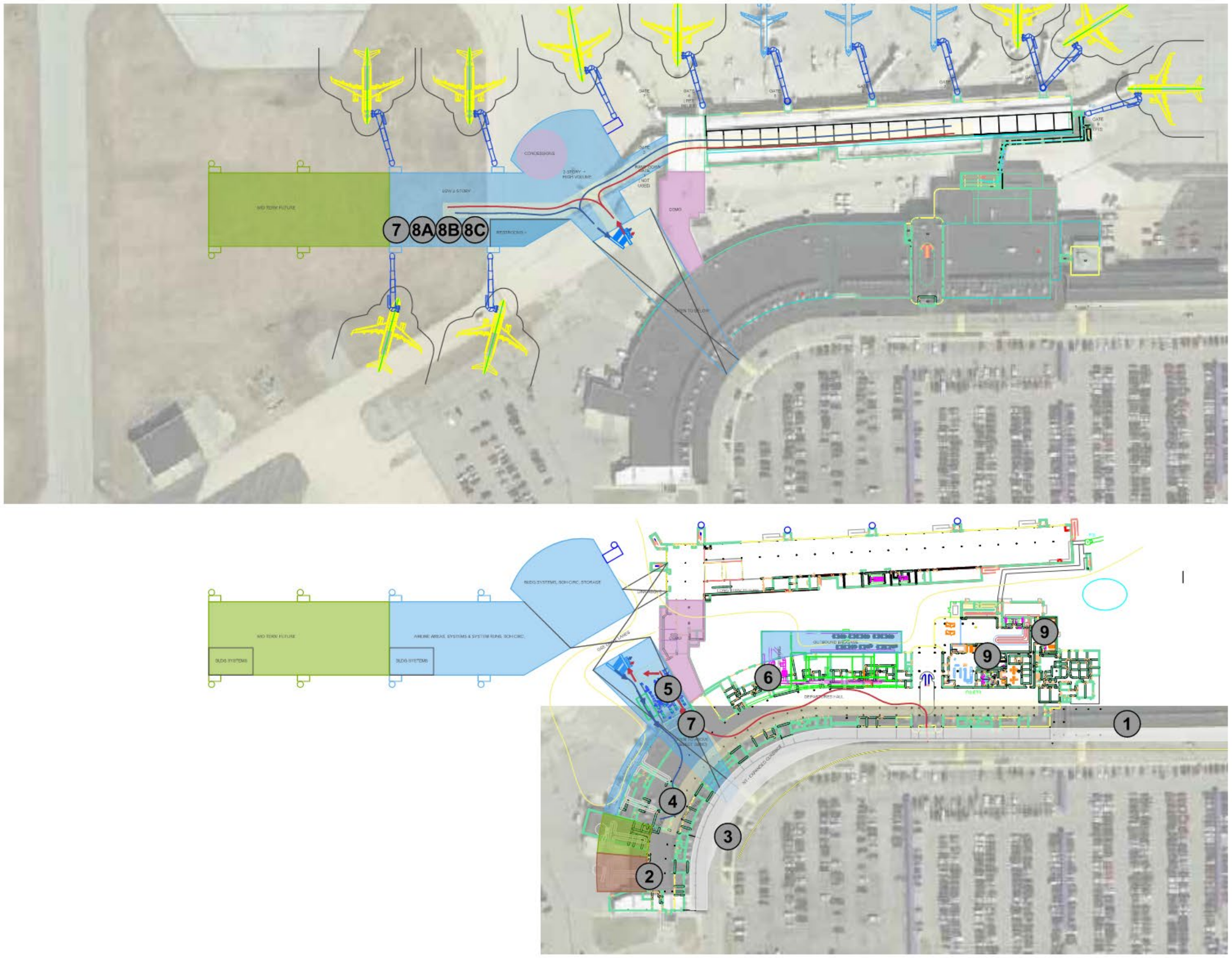
Gate expansion associated with Terminal Concept 3 is shown in **Table 4-4**.

Table 4-4: Terminal Concept 3 Gate Development

Phase	Number of Gates
I – Near-Term	11
II – Mid-Term	15
III – Long-Term	19

Source: Mead & Hunt, Inc. (2021)

Figure 4-15: Terminal Concept 3



Considerations

1. Train Station: Remains in place.
2. Former Bus Station is repurposed.
3. Curbside: Entry drive curve is softened. Curbside is widened, providing space for vertical transitions and improving access.
4. Arrivals Hall: New carousels in baggage claim.
5. Passenger Screening: The checkpoint is relocated and expanded.
6. Baggage Screening: A location is chosen for consolidated baggage screening and an outbound baggage make-up room shared by the airlines.
7. Passenger Queuing: Additional space is provided for passenger queuing in all affected areas.
8. Concourse:

A. All new gates serve ADG Group III.

B. The new concourse is located on a full second floor, allowing GSE to pass below and improving passenger access at each new gate.
A central vertical circulation node with stairs, elevators and escalators provides efficient passenger access between floors.

C. Space in the new concourse is provided for departure lounges, concessions, restrooms and other passengers services.

9. US Customs: Both the FIS and GAF remain in place.

GATES: 11

Source: Mead & Hunt, Inc. (2021)

Preferred Terminal Concept

Of the three initial plan concepts proposed, Terminal Concept 3 was chosen as the preferred development concept since it provides the most flexibility for future growth. **Figure 4-16** and **Figure 4-17** show Phase I and Phase II development, respectively, for the preferred Terminal Concept. The proposed Phase III work will not be performed due to constraints on the airfield, specifically, as long as Taxiway N is still in use. Instead, Phase III work will involve replacement of the existing concourse and expansion to connect to the terminal in direct response to future aircraft gate and concourse demand.

Estimated Construction Cost

The estimated cost for the preferred Terminal Concept is $80.7 million, which includes the following:

- Construction
- Professional services
  - Design
  - Permitting
  - Construction administration
  - Construction inspection
  - Quality assurance testing
- Contingency – 15 percent

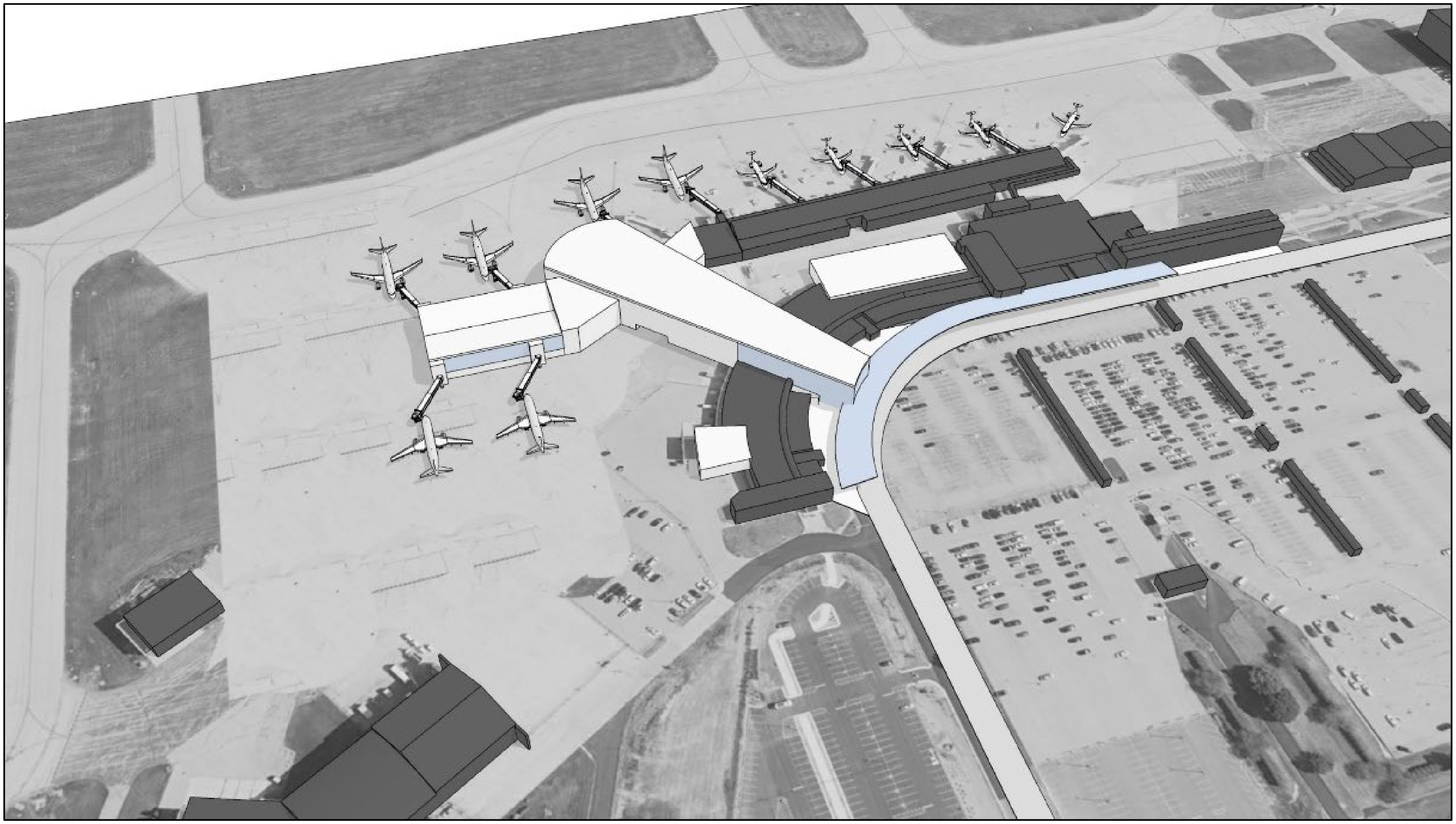
4.9.2 Terminal Area Support Facilities

The facility requirements analysis in Chapter 3 also reviewed support facilities in the terminal area to determine their ability to accommodate projected demand during the planning period. It was recommended that space be preserved in the terminal area for the construction of a rental car quick turnaround (QTA) facility. The analysis also identified a need to preserve areas for future vehicle parking expansion to accommodate any growth in demand that will ultimately drive the need for terminal area improvements. Finally, it was explained during the facilities requirements analysis that SBN desires additional hangar space in the terminal area for aeronautical businesses. It was recommended that space be preserved in the terminal area for construction of a large aircraft storage hangar (LASH) and one conventional hangar.

Support Facilities Concepts

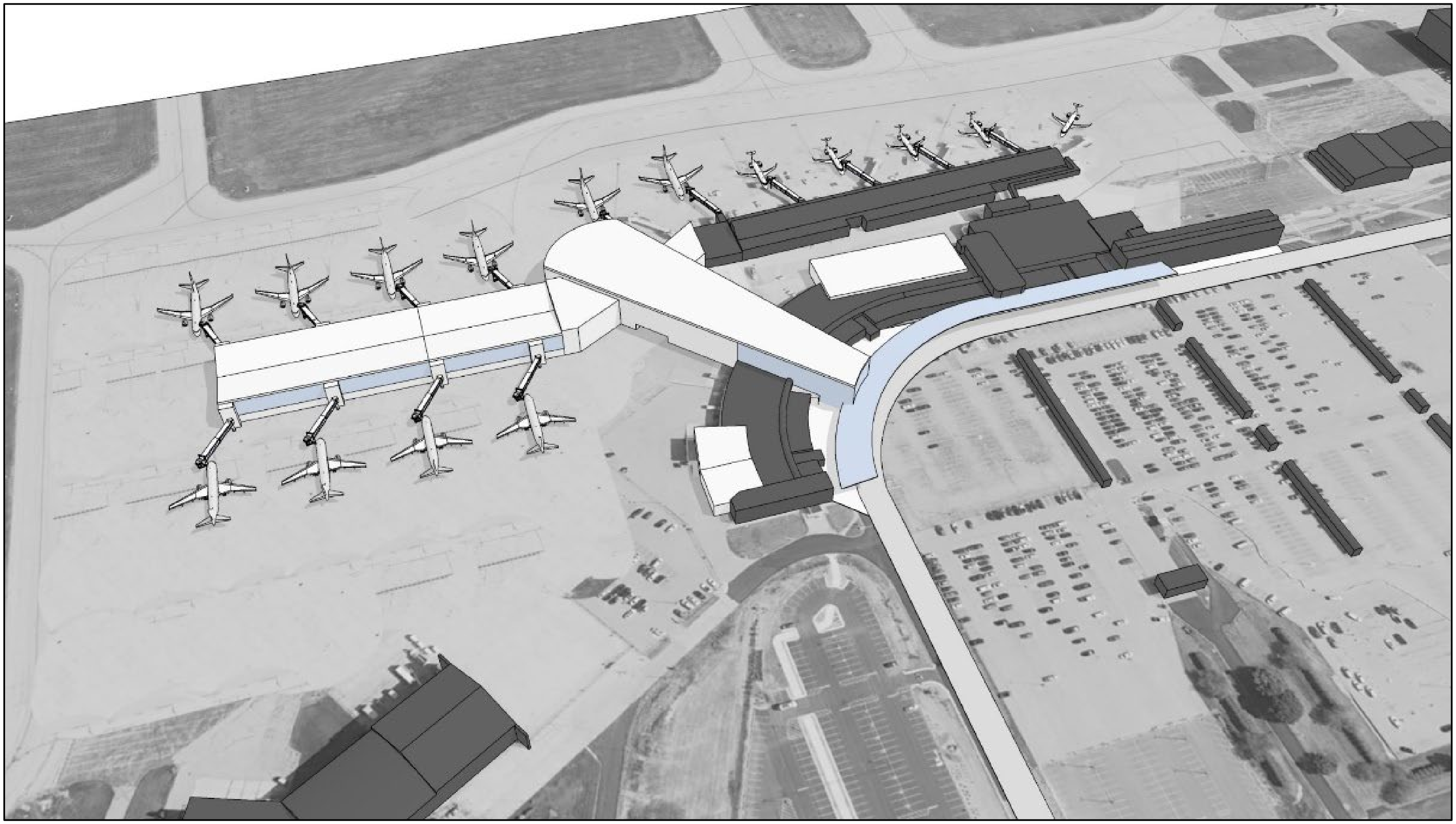
Proposed support facilities concepts in the terminal area are presented along with the terminal building expansion concept in **Figure 4-18**. The proposed support facilities presented in this figure are based on a single, logical location for these needs based on other considerations such as available area for development, the location of existing infrastructure such as roadways, parking lots, and other buildings, and surrounding constraints such as the location of the airfield and other planned infrastructure developments. These facilities are discussed in the sub-sections below.

Figure 4-16: Preferred Terminal Concept Phase I, PAL 1



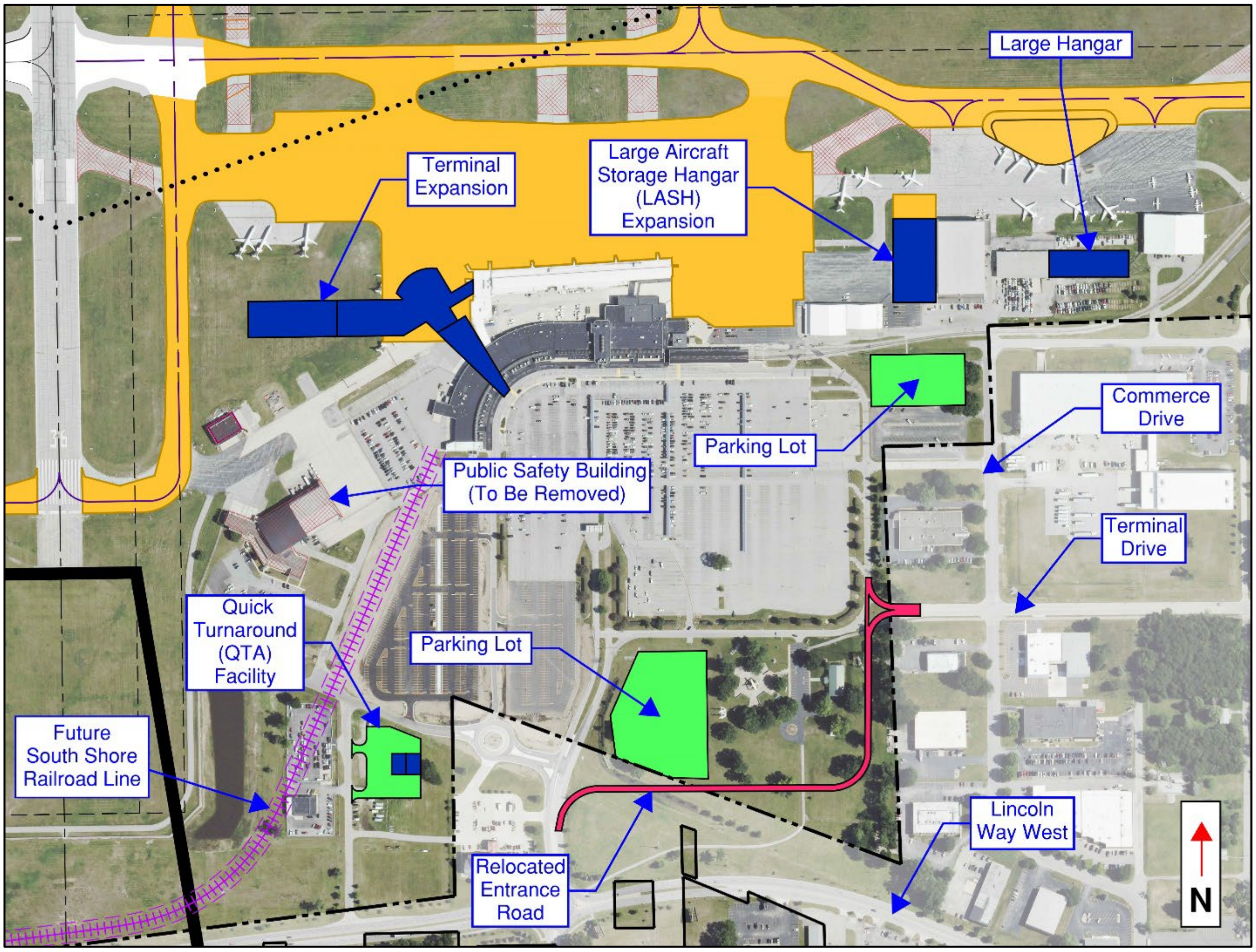
Source: Mead & Hunt, Inc. (2021)

Figure 4-17: Preferred Terminal Concept Phase II, PAL 2



Source: Mead & Hunt, Inc. (2021)

Figure 4-18: Terminal Area Support Facilities Concepts



Source: Mead & Hunt, Inc. (2022)

The development costs provided for each support facility include the following:

- Construction
- Professional Services
    - Design
    - Permitting
    - Construction administration
    - Construction inspection
    - Quality assurance testing
- Contingency – 15 percent

Rental Car QTA Facility

Space for a rental car QTA facility is illustrated south of the existing rental car parking lot in Figure 4-18. This facility would be accessed by existing service roads on the landside of airfield infrastructure. The estimated development cost of the QTA facility is $4.4 million.

Parking Lots

Two (2) sites for the expansion of vehicle parking are also identified in Figure 4-18. The first site is located immediately adjacent to Airport Boulevard and the main entrance to the Airport from Lincoln Way West. Relocation of the airport entrance road is illustrated to circulate incoming traffic more efficiently around this proposed parking area to assist in the revenue control of exiting vehicles from the lot. Additionally, area for a second parking lot adjacent to the existing routing of the South Shore Line railroad tracks is identified that could be used for multiple parking purposes such as additional space for airline and South Shore Line passengers, additional / relocated cell phone waiting lot, and vehicle parking for adjacent aeronautical businesses to the north. The total estimated cost to construct the two parking lots is $6.7 million. The cost to relocate the airport entrance road is estimated at $2.6 million.

Aircraft Hangars

The final improvements in the terminal area are one LASH and one large conventional hangar to support aeronautical businesses. Space is preserved for these hangars to the east of the terminal area, as depicted in Figure 4-18. The estimated cost for the LASH is $12.1 million, and the estimated cost for the large conventional hangar is $7.9 million.

As noted, the illustration of terminal area developments is intended to identify potential locations for these infrastructure needs and preserve space for when demand requires the construction of these elements. This preservation in space is in consideration of other proposed airside and landside developments identified through this master planning effort. Ultimately, use of resources such as a concept / budget report will be needed to further evaluate site locations and elements such as space, size, and cost for these infrastructure needs prior to design and construction.

4.10 Summary of Recommended Development

Proposed infrastructure improvements summarized in this chapter will allow SBN and the Michiana region to meet the existing and future demands of users and the surrounding community for the next 20 years. **Figure 4-19** depicts the summary of improvements identified for SBN's recommended development plan. If selected, the concepts shown in Figure 4-19 offer the most logical option to address each facility in terms of the operational, economic, environmental, and implementation factors. The recommended development plan consists of the following improvements:

- **Extension of Runway 9R/27L** – It is recommended that Runway 9R/27L be extended by 788 feet at the approach end of Runway 9R for a total length of 9,200 feet. The extension would support regular international cargo flights to Anchorage, Alaska, by Boeing 767 aircraft.

- **Taxiway Improvements** – To improve the safety and efficiency of the airfield, and prepare for potential future revenue generating development, the following taxiway system improvements are recommended:
    - Realign Taxiway A along its entire length

- Reconfigure Taxiway A2
- Remove Taxiways A3 and A4
- Reconfigure Taxiway A5
- Construct new connector taxiway between Taxiway A and UPS Apron
- Add pavement south of existing GA Apron to create expanded GA Apron
- Remove sections of existing Taxiway A pavement at approach end of Runway 27L
- Remove portions of existing Taxiway A pavement east and west of Runway 18/36
- Realign Taxiway B along its entire length (in progress)
- Decouple Taxiway B from Terminal Apron (in progress)
- Reconfigure Taxiway B2 (in progress)
- Remove pavement between Taxiway B2 and the East Cargo Area Apron (in progress)
- Fill in missing area of pavement at the East Cargo Area Apron (in progress)
- Construct new connector taxiway between shifted Taxiway B and East Cargo Area Apron (in progress)
- Remove portion of Taxiway B between Terminal Apron and East Cargo Area Apron (in progress)
- Remove Taxiways B3 and B4 and construct a new connector taxiway east of Taxiway B3 (in progress)
- Construct two new connector taxiways between shifted Taxiway B and Terminal Apron (in progress)
- Remove Taxiway B's intersections with Runway 18/36 and Taxiway N that are not at 90-degree angles (in progress)
- Relocate Taxiway N closer to Runway 18/36
- Construct new parallel taxiway west of Runway 18/36
- Relocate airfield signage to meet taxiway OFA design standards during a future airfield construction project

- **Air Cargo Development** – It is recommended that SBN acquire several parcels of property south of Taxiway B, east of U.S. Highway 31, and west of the approach end of Runway 36 to assemble an approximately 304-acre area for future air cargo development.

- **General Aviation Development** – Recommended GA development in SBN's midfield area is as follows:
  - Construct a new apron for itinerant GA aircraft parking between Taxiways T and J. Construction of this apron requires that Taxiway N first be relocated closer to Runway 18/36.
  - Construct several box hangars, T-hangars, and supporting aprons and taxilanes, and an access road east of these improvements to accommodate future demand for hangar space.
  - Develop an electric aircraft and eVTOL area at the westernmost corporate apron. This area would consist of a landing pad and electric charging stations.

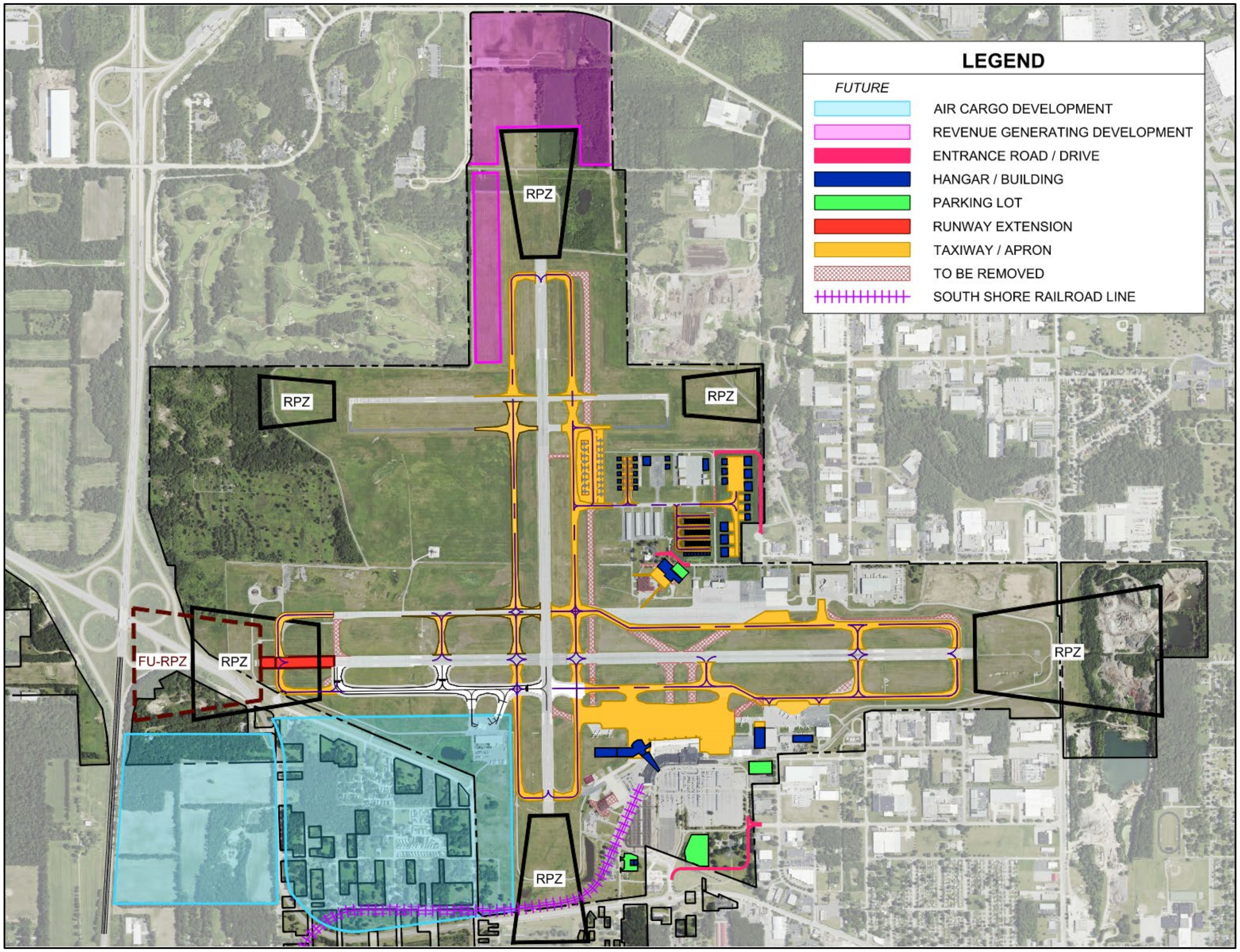
- **Support Facilities** – A site immediately northeast of the existing airfield maintenance facility is recommended for the construction of a joint use public safety, airfield maintenance, and operations facility.

- **Airport Traffic Control Tower** – It is recommended that, when or if necessary, a replacement or refurbishment of the ATCT occur at the existing ATCT site. However, this master plan's ATCT siting analysis is a preliminary evaluation only. The FAA will need to conduct a full AFTIL method siting process prior to any replacement or relocation of the ATCT.

- **Revenue Generating Development** – SBN seeks to diversify its sources of revenue and increase the Airport's economic impact on the Michiana region. It is recommended that approximately 100 acres of land identified near the approach end of Runway 18 be preserved for potential future aeronautical and non-aeronautical revenue-generating development.

- **Terminal Area Development** – The following terminal area development is recommended:
  - Expansion of the commercial airline terminal building to the west toward Taxiway N
  - Construction of a rental car QTA facility south of the existing rental car parking lot
  - Construction of two terminal area parking lots, one south and one east of the existing parking lots, and associated relocation of Airport Boulevard
  - Construction of one LASH and one large conventional hangar east of the existing commercial airline terminal building.

Figure 4-19: Summary of Recommended Development



Source: Mead & Hunt, Inc. (2022)

Chapter 5 Environmental Overview

An overview of the known environmental concerns that could impact the development recommended in this master plan is presented in this chapter. General assessments of the 23 required National Environmental Policy Act of 1969 (NEPA) categories presented in the following sections provide information on constraints that exist in the area and data that can be used in developing a NEPA compliant document. This review does not determine or delineate any detailed environmental concern, nor can it be used in place of a Categorical Exclusion (CATEX), Environmental Assessment (EA), or an Environmental Impact Statement (EIS) to fulfill NEPA requirements. Instead, this chapter will focus on environmental constraints that should be taken into consideration during planning and design phases of the recommended development plan.

The proposed improvements evaluated in this chapter include:

- Primary Runway Extension (788-foot extension and runway protection zone)
- Taxiway Improvements
- Air Cargo Development
- Midfield Development
- Revenue-generating Development
- Terminal Area Development

The environmental impact determinations presented in this chapter are based on information collected from several resources. Early coordination letters distributed to federal and state environmental agencies provided feedback on specific areas of concern, technical information about South Bend International Airport (SBN or Airport) and the surrounding area, and specific mitigation and permitting requirements that may be necessary to implement the recommended development plan.

Geographic Information System (GIS) databases such as Federal Emergency Management Agency (FEMA) flood maps, the Indiana Department of Natural Resources - Natural Heritage Data Center, State Historic Architectural and Archaeological Research Database (SHAARD), Indiana Department of Environmental Management Hazardous Materials databases, and the U.S. Fish and Wildlife Service's (USFWS) National Wetlands Inventory (NWI) identified the locations of specific environmental concerns.
Finally, the following projects were referenced to collect information on noted environmental concerns:

- 2017 Airfield Feasibility Study, Terminal Apron and Taxiway B Realignment CATEX
- 2019 Resources Evaluation for the Rental and Paid Parking Expansion
- 2019 Design Taxiway B and Terminal Apron
- 2019 Parking and Rental Car Lot Expansion CATEX
- 2020 Infiltration Basins and Excess Material Storage CATEX.

As noted previously, the following sections of this chapter are based on the 23 NEPA categories outlined in Federal Aviation Administration (FAA) Order 5050.4B, *Airport Environmental Handbook*:

5.1 Noise
5.2 Compatible Land Use
5.3 Social Impacts
5.4 Socioeconomic Impacts
5.5 Environmental Justice
5.6 Air Quality
5.7 Water Quality
5.8 Department of Transportation (DOT) Act, Section 4(f)
5.9 Historic and Archaeological Resources
5.10 Biotic Resources
5.11 Endangered and Threatened Species
5.12 Wetlands
5.13 Floodplains
5.14 Coastal Barriers and Coastal Zone Management
5.15 Wild and Scenic Rivers
5.16 Farmlands
5.17 Energy Supply and Natural Resources
5.18 Light Emissions and Visual Effects
5.19 Solid Waste
5.20 Construction Impacts
5.21 Hazardous Materials
5.22 Cumulative Impacts
5.23 Per- and Poly-fluoroalkyl Substances (PFAS)
5.24 Anticipated Environmental Documents
5.25 Summary of Anticipated Impacts

5.1 Noise

Noise is considered unwanted sound that disturbs or interrupts routine activities. Aviation noise includes sounds made by aircraft during departure, arrival, flight, taxiing, and other activities. The compatibility of land use around an airport is typically determined based on the level of aircraft noise. The degree of annoyance that people suffer from aircraft noise varies depending upon their activities at any given time.

The FAA uses the Day Night Average Sound Level (DNL) as its primary noise metric. DNL accounts for the levels of aircraft events, the number of times those events take place, and the timeframe in which they occur (day or night). Noise levels greater than 65 DNL are considered a potential impact.

Noise sensitive areas are those where noise interferes with normal activities and include residential, educational, health, religious structures and sites, parks, recreational areas, wilderness areas, wildlife refuges, and cultural and historical sites. In the context of airport noise, such facilities, or areas within the 65 DNL contour are considered noise sensitive.

Passenger jet arrival at SBN
Source: SBN Official Twitter Account

Per FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures*, and the FAA's *Environmental Desk Reference for Airport Actions*, any airport that exceeds 90,000 annual piston-powered aircraft operations or 700 annual jet-powered aircraft operations, 10 or more daily helicopter operations, or any project that includes the construction of a new airport, a runway relocation, runway strengthening, or a major runway expansion requires a noise analysis.

Based on FAA Order 1050.1F and the *Environmental Desk Reference for Airport Actions*, the Primary Runway Extension would require a noise analysis prior to construction, the timing of which is unknown at the time of this master plan.

Regarding the remaining proposed improvements, SBN's total operations are forecasted to be 53,144 annual operations by 2040 according to the forecasts prepared in Chapter 2: Projections of Aviation Demand. Of these total operations, local and itinerant general aviation (GA) operations are projected to be 32,628 by 2040; therefore, the propeller aircraft activity levels are below the stated threshold for a noise analysis. Also, as noted in Chapter 2, Indiana Department of Revenue data shows there was one based helicopter at the Airport in 2020, which means it is unlikely the 10 daily helicopter operations threshold for a noise analysis will be exceeded. Finally, data from the FAA's Traffic Flow Management System Counts (TFMSC) shows there were 23,939 Instrument Flight Rules (IFR) jet operations at SBN in 2019; 15,189 IFR jet operations in 2020; and 20,591 IFR jet operations in 2021, all of which exceed the 700 annual jet operations threshold. Based on the TFMSC data, a noise analysis may be necessary for the remaining proposed improvements due to the number of operations that occur each year by jet aircraft at SBN. An increase in the intensity and duration of aircraft noise resulting from these improvements is not anticipated, however.

For any future noise analyses conducted for the proposed improvements, 14 Code of Federal Regulations (CFR) Part 150 would define the process to determine the incompatibility of areas within the 65 DNL contour. Examples of land uses considered incompatible within the 65 DNL contour include residential areas, schools, and public gathering spaces.

5.2 Compatible Land Use

Land use planning has two objectives: to protect aircraft, people, and property on the ground and to improve the quality of life for those living and working around an airport. Land use planning associated with environmental issues generally focuses on the impacts of aircraft noise and wildlife attractants.

The impact of aircraft noise not only impacts those who live and work near an airport, it also affects the ability of an airport to plan for future development. Land use compatibility planning helps to minimize the impacts of aircraft noise to those in proximity to an airport, identifies land for expansion and improvement projects, and attempts to mitigate potential height obstructions. Land use compatibility planning also focuses on the proximity of landfills, water treatment plants, wetlands, and other incompatible land uses that may attract wildlife. Identifying these areas helps airports reduce wildlife hazards for both existing operations and future development.

The FAA directs airport sponsors to use their best efforts to promote compatible land uses and zoning measures to influence compatible development adjacent to airport property. It is preferred that airports own and control all affected land surrounding an airport to maintain compatible land use. The FAA, however, recognizes that not all airports have land use control authority and encourages airports to promote compatible land uses through other means, such as working with authorities to persuade local jurisdictions to impose airport-compatible zoning near airports.

A mix of industrial, residential, and agricultural land use surrounding SBN restricts land acquisition opportunities to control incompatible land use. Easements offer an alternative method for the Airport to control obstructions from penetrating runway approach surfaces without the need to purchase land from existing property owners. It is recommended that the Airport continue to enter into agreements with surrounding property owners to prevent obstructions from impacting aircraft operations.

Based upon a review of land use data compared to the proposed improvements, the following land use implications are anticipated:

- Air Cargo Development – This project would require changing land use from residential to industrial and would require land acquisition and potential relocations.

- Revenue-generating Development – This project would impact an area that is currently privately managed soccer fields and change the land use from recreational to commercial or industrial.

No additional land use concerns are anticipated for the remaining proposed improvements. The acquisition of land for future GA development also helps the Airport limit surrounding incompatible land uses as it prevents opportunities for growth and development that may be incompatible to Airport operations. Land use compatibility should be continually reviewed to confirm compatible land uses have been maintained in proximity to SBN.

5.3 Social Impacts

Social impacts are the result of development actions that may impact the health and safety of children and the vitality of local businesses and the surrounding community. An evaluation of impacts must be conducted to determine if proposed actions could cause the relocation of homes and businesses, divide or disrupt established communities, change surface transportation patterns, interfere with planned development, or noticeably change employment. Any impacts should fully balance the level of impact with the benefits of the proposed actions to determine the level of mitigation that will be necessary.

Potential social impacts of the proposed improvements include:

- Air Cargo Development – This project would require land acquisition and relocation of approximately 13 single family homes and several dozen manufactured homes or trailers. This would include whole neighborhoods, such as the Hollywood Trailer Park, South Bend Estates, and Hamann Mobile Home Park.
- Revenue-generating Development – This project may impact the community by removing the private soccer fields. The impact to residents depends primarily on the usage among the local community and the potential location to which the owner would move the facility.

Other proposed improvements are primarily within existing Airport property and unlikely to create impacts to the community.

5.4 Socioeconomic Impacts

Major airport developments can often cause induced or secondary socioeconomic impacts to surrounding communities, such as population movement and growth, public service demands, and changes in businesses and local economic activity. For example, actions that require a land purchase could displace residents outside a community. This in turn lowers the tax base of the community resulting in a decrease of municipal funds and a possible reduction in the number of educational and business opportunities in the community. In determining socioeconomic impacts, the proposed development is analyzed to see how it will affect the socioeconomic makeup of local communities. Determinations are then made of the extent of the impact and how proposed mitigation will reduce or eliminate socioeconomic effects.

Improvements to the Airport are not expected to create a substantial impact or change in population, public service, or economic activity in the area but are anticipated to have positive effects on the surrounding community through the development of additional employment opportunities, business growth, and economic activity. Therefore, no detrimental socioeconomic impacts are anticipated at the community scale.

5.5 Environmental Justice

The purpose of Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations*, is to identify, address, and avoid disproportionately high and adverse human or environmental effects on minority and low-income populations. Environmental Justice is defined as the "*right to a safe, healthy, productive, and sustainable environment for all where 'environment' is considered in its totality to include the ecological, physical, social, political, aesthetic, and economic environments."*

Minority populations are commonly defined as African American, Hispanic, Asian, or Native American individuals. Each or all of these ethnic groups may live in geographic proximity to one another or may be geographically dispersed. Generally, when defining a minority population in relation to project impacts, the minority population or populations must exceed 50 percent of the total population within the vicinity of expected impacts.

Low-income populations are defined as any group of persons identified as low-income, based on the most recent U.S. Census Bureau data, which live in geographic proximity to a proposed project. Several methods are used to calculate low-income populations that consider the Department of Health and Human Services poverty levels and the U.S. Census Bureau's annual statistical poverty thresholds.

The Air Cargo Development Area is of greatest concern for potential Environmental Justice concerns. A review of the U.S. Environmental Protection Agency's (USEPA) Environmental Justice Screening (EJScreen) Tool indicates that 24 percent of the population in the mobile home community is considered minority based on 2010 Census data. However, 74 percent of the residents in the mobile home community are classified as low-income. Given that 74 percent of the population is considered low-income, an environmental justice population exists near the project area that may be impacted by the project.

The remaining projects are within existing Airport property and unlikely to have impacts on minority or low-income populations.

5.6 Air Quality

Air quality analyses are needed when a project, due to its size, scope, or location, has the potential to impact the attainment and maintenance of established National Ambient Air Quality Standards (NAAQS) for six criteria pollutants. Compliance with these standards means ambient outdoor levels of these pollutants are safe for human health, the public welfare, and the environment. Compliance with state regulations may also be necessary in areas that have been designated as attainment, nonattainment, or maintenance for each of the criteria pollutants.

St. Joseph County, Indiana, has been designated as a maintenance area for the 8-hour Ozone NAAQS since July 2007. The County is either in attainment or not designated for all other criteria pollutants.

Typically, development actions occurring at airports having 180,000 annual GA and air taxi operations or more than 1.3 million enplanements are required to perform an air quality analysis. Forecasts developed for the Airport project enplanements and GA operations will be significantly less than these thresholds, therefore not requiring an air quality analysis to be performed for any of the proposed improvements. Any increase in aircraft operations or vehicle traffic because of the proposed improvements is not anticipated to reach levels that could significantly reduce air quality. As such, no long-term impacts to air quality are anticipated.

Emissions from vehicles and equipment during construction may temporarily reduce air quality but are not anticipated to result in any long-term impacts. Any temporary increase in pollutants is not anticipated to be at levels that would pose significant short-term or long-term health risks to the Airport or the surrounding community. To help mitigate any potential temporary impacts, all emission control equipment on vehicles and construction apparatuses should be maintained to manufacturer standards to help limit the level of air pollutants discharged into the environment.

5.7 Water Quality

Actions that impact water quality can have environmental and legal consequences. The Clean Water Act (CWA) mandates development of comprehensive solutions to prevent, reduce, or remove pollution in U.S. waters. Several other regulations exist to protect water quality including those that offer special protection to drinking water supplies and those that require establishment of spill response plans. In addition, consultation is needed with the U.S. Army Corps of Engineers (USACE) when bodies of water are controlled, altered, diverted, or drained. Several activities conducted at airports have the potential to impact water quality such as construction and fuel/hydraulic spills. If not properly controlled, runoff from these activities can impact the water quality of drainage waterways at airports.

To determine the potential for any impacts to water quality from the proposed improvements, the USEPA NEPAssist database, Google Earth imagery, and the USFWS NWI were reviewed for the presence of water resources within a 1.5-mile radius of SBN. The following resources are on SBN property or within the vicinity of the Airport:

- Several small ponds are located northwest of SBN property, some of which are on Blackthorn Golf Club property, with others located across Nimtz Parkway.
- A stormwater retention basin is located on SBN property immediately northeast of the Runway 18 threshold.

- North of the stormwater retention pond but south of Nimtz Parkway is a small pond on Airport property that would be located within the area proposed for revenue-generating development.
- Three ponds on City of South Bend property are east of the Runway 18 threshold along Trade Drive.
- Several lakes associated with a gravel pit are east and southeast of the Runway 27L threshold, across North Bendix Drive.
- A stormwater retention basin is south of Runway 9R/27L near the FedEx facility at SBN.
- SBN is located within the Pinhook Lake-Saint Joseph River watershed.
- The entirety of SBN property overlays a sole source aquifer that serves as the source of drinking water for a large portion of northern Indiana.

Figure 5-1 shows the locations of the ponds, lakes, and stormwater retention basins. The sole source aquifer and Pinhook Lake-Saint Joseph River watershed are depicted in **Figures 5-2** and **5-3**, respectively.

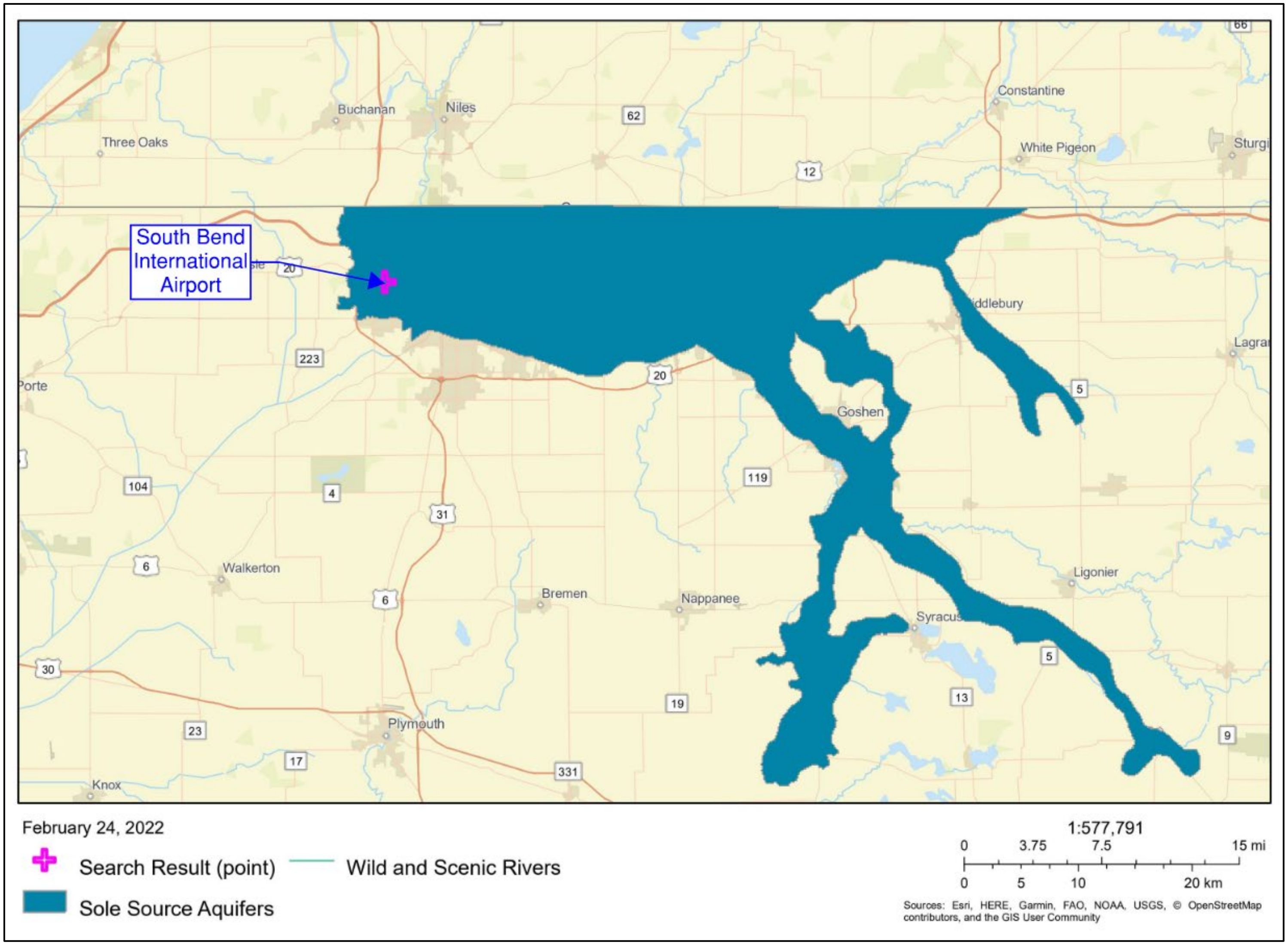
Due to the presence of the above-referenced water resources, water quality planning and analysis to include consultation with the USACE may be needed prior to development of the proposed improvements to determine potential impacts and appropriate mitigation. SBN may need a National Pollutant Discharge Elimination System (NPDES) permit for stormwater discharges associated with construction activities of the proposed improvements. The Airport may also need additional water quality permits from other state and local regulatory agencies.

In addition, the proposed improvements will result in significant changes to drainage patterns across the airfield and overall increases in impervious surfaces. SBN's current stormwater management strategy is to retain all stormwater runoff on Airport property. The only stormwater discharge is to waters of the state through infiltration into groundwater. This management strategy puts a high importance on stormwater storage and infiltration basins located around the airfield. Stormwater storage locations and required sizes must be included in this master plan to designate areas that can be developed and areas that must be converted to stormwater storage. As such, a master plan drainage analysis was conducted and is provided in **Appendix E**.

Figure 5-1: Water Resources

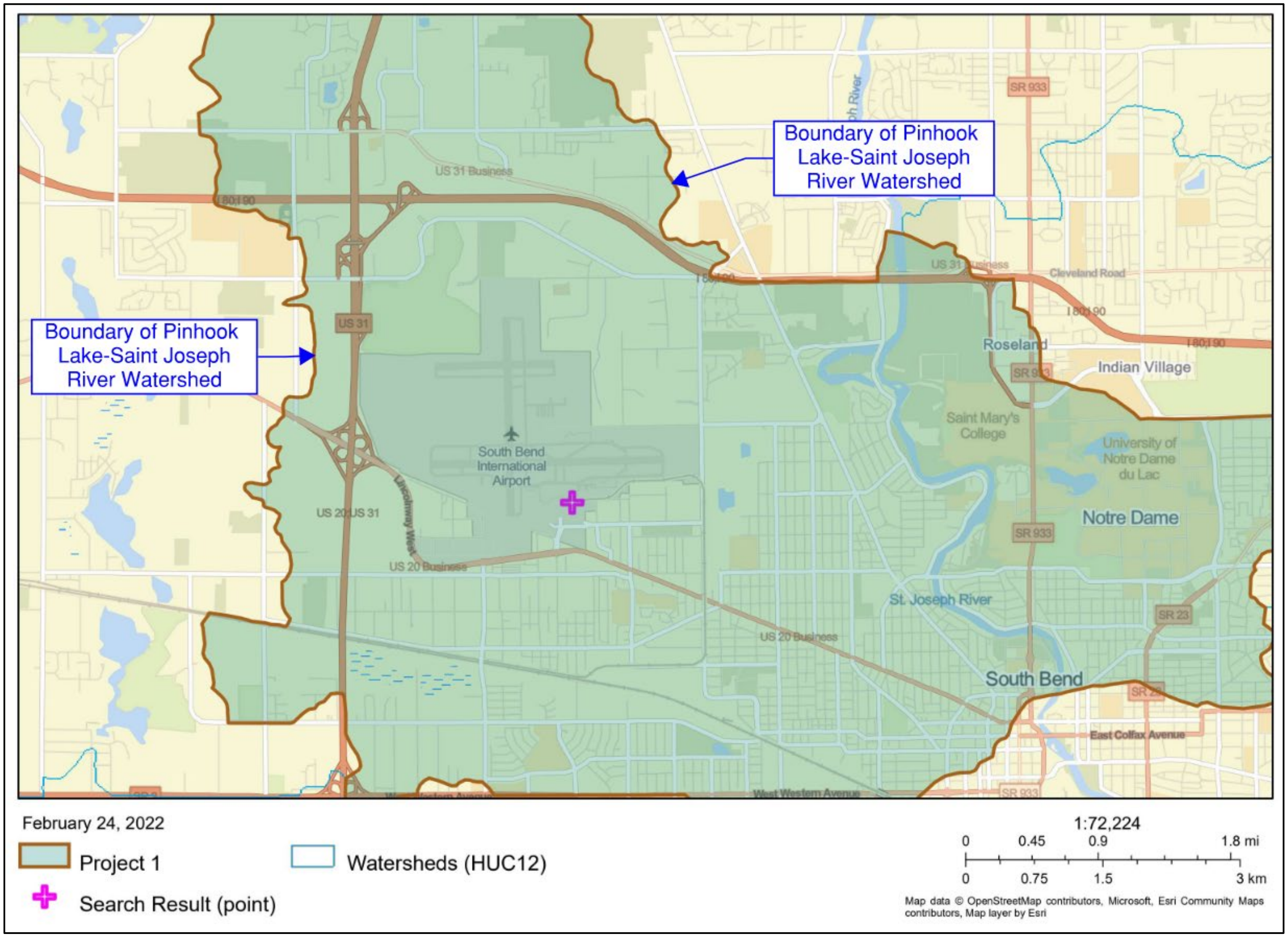
Source: Google Earth (2021), with labeling by Mead & Hunt.

Figure 5-2: Northern Indiana Sole Source Aquifer



Source: USEPA NEPAssist, with labeling by Mead & Hunt.

Figure 5-3: Pinhook Lake-Saint Joseph River Watershed



Source: USEPA NEPAssist, with labeling by Mead & Hunt.

5.8 Department of Transportation (DOT) Act, Section 4(f)

Section 4(f) of the Department of Transportation (DOT) Act provides that the Secretary of Transportation may not approve any program or project that requires the use of any publicly owned land from a public park, recreation area, or wildlife and waterfowl refuge of national, state, or local significance unless avoidance alternatives and minimization measures have been considered. In addition, land from a historic site of national, state, or local significance may not be used unless there are no other feasible and prudent alternatives.

Voorde Park
Source: City of South Bend Venues Parks & Arts

Based upon an analysis of potential property acquisition, land acquisition impacting a Section 4(f) property is not anticipated for any development recommended in this master plan.

There are four public parks within a one-mile radius of the Airport, none of which will be impacted:

- Voorde Park is a 14-acre neighborhood park located 0.3 miles southeast of the Airport. This park includes a playground, two tennis courts, a multiuse field, picnic tables, and a restroom.
- Freemont Park is a 2-acre block park located 0.5 miles east of the Airport. This park is a small block park with a playground and picnic tables.
- Westhaven Park is a 5-acre block park located 0.7 miles south of the Airport. This park features two unlighted softball fields, one unlighted soccer field, two tennis courts, and multiuse fields.
- Borland Park is a 21-acre community park located 0.8-miles northeast of the Airport. This park includes one lighted and two unlighted softball fields, an unlighted football field, two basketball courts, two lighted tennis courts, a multiuse field, three restrooms, a picnic shelter, and picnic tables.

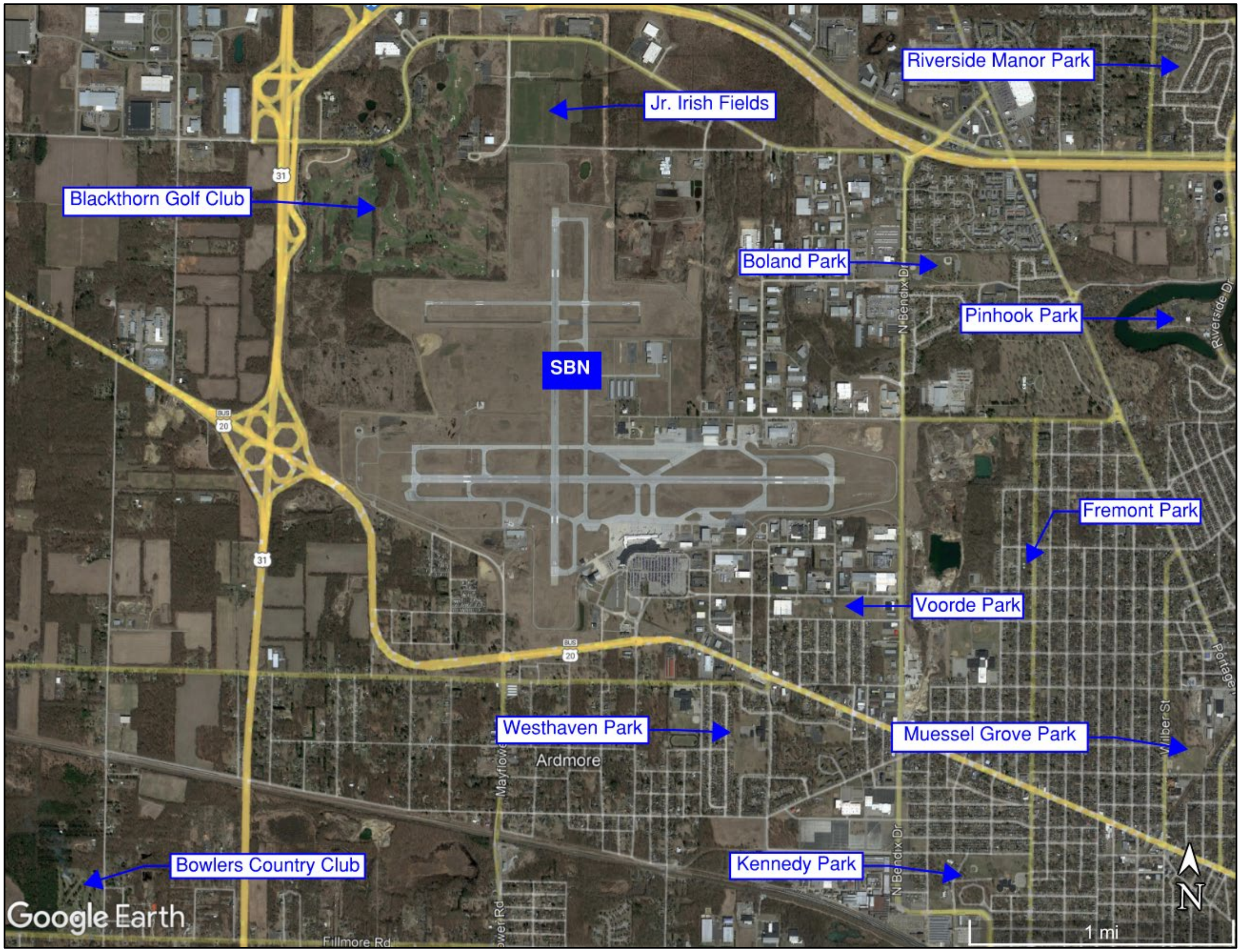
There are four public schools with a playground and/or playfields within one mile of the Airport, none of which will be impacted by the project.

Construction and operation of the proposed improvements will not use any Section 4(f) resources. Impacts to parks, recreation areas, or schools are not anticipated from the proposed improvements.

Two privately owned recreational resources are located within the area, the Blackthorn Golf Club and Jr. Irish Soccer Club fields. Privately owned recreation areas are not subject to Section 4(f) protection but are evaluated during the NEPA process as community resources.

The recreation areas and parks in the vicinity of SBN are shown in **Figure 5-4**.

Figure 5-4: Recreation Areas and Parks



Source: Google Earth (2021), with labeling by Mead & Hunt.

5.9 Historic and Archaeological Resources

Section 106 of the National Historic Preservation Act (NHPA) requires federal actions to consider potential impacts on historic properties. Any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places (NRHP) maintained by the Secretary of the Interior is included in Section 106 of the NHPA. Properties or sites having traditional religious or cultural importance to Native American Tribes, Hawaiian organizations, or other living communities may also qualify. Regulations require consultation with State Historic Preservation Officers (SHPOs) and Tribal Historic Preservation Offices (THPOs) to determine if a proposed development could impact a site of historic or cultural significance.

Prior cultural resources studies were completed for several hundred acres of Airport property under the following projects:

- 2017 Airfield Feasibility Study, Terminal Apron and Taxiway B Realignment CATEX – 92.7 acres
- 2019 Resources Evaluation for the Rental and Paid Parking Expansion
- 2019 Design Taxiway B and Terminal Apron
- 2019 Parking and Rental Car Lot Expansion CATEX
- 2020 Infiltration Basins and Excess Material Storage CATEX.

None of the studies for these projects indicated the presence of any historic or archaeological sites that are eligible for the NRHP.

No known resources will be impacted; however, the proposed Air Cargo Development, Midfield Development, and Revenue-generating Development areas contain properties that have not been subject to prior study. The improvements proposed in these areas may require Phase I Cultural Resources surveys and coordination with the Indiana Department of Natural Resources (DNR) Division of Historic Preservation and Archaeology to determine whether any historic resources are present and would be impacted.

5.10 Biotic Resources

Biotic resources are various types of flora (plants) and fauna (fish, birds, reptiles, amphibians, marine mammals, coral reefs, etc.) in a particular area that includes rivers, lakes, wetlands, forests, upland communities, and other habitats supporting flora and aquatic and avian fauna. Developments that could affect a stream or water body supporting biotic resources must consult with the USFWS to assess potential impacts on aquatic areas. Consultation with the Indiana DNR may also be required.

The majority of Airport property consists of mowed areas, maintained turfgrass, and impervious surfaces with minimal treed and scrub-shrub habitats. Common plants include tall fescue, red fescue, red clover, birdsfoot trefoil, common dandelion, sweet clover, and English plantain. There are scattered trees within the airport fencing with larger stands outside airport fencing, which appear to consist primarily of American elm, oak species, silver maple, sugar maple, pine species, black walnut, and ornamental trees such as Callery pear and Japanese maple.

SBN airfield turfgrass
Source: Mead & Hunt, Inc.

Additional review of the flora and wildlife found in this area, as required in the development of a NEPA compliant document, will determine if the area supports a biotic community and can further evaluate the level of impact the proposed developments would have on this area.

5.11 Endangered and Threatened Species

The Endangered Species Act of 1973, as amended, provides for the protection of certain plants and animals, as well as the habitats in which they are found. Species of special concern are not formally afforded regulatory protection; however, any reduction in their number or habitat is of concern from a state, regional, and/or national perspective. In compliance with the Endangered Species Act, agencies overseeing federally funded projects are required to obtain from the USFWS information concerning any species listed, or proposed to be listed, which may be present in the area of a proposed project.

Indiana bat
Source: Center for Biological Diversity

Based upon coordination with USFWS conducted as part of recent projects (2017-2020), the following federally listed species have known ranges in St. Joseph County, Indiana:

- Indiana bat (*myotis sodalis*) – Endangered
- Northern long-eared bat (*myotis septentrionalis*) – Threatened
- Copperbelly watersnake (*nerodia erythrogaster*) – Threatened
- Eastern massasauga (*sistrurus catenatus*) - Threatened

Several acres of trees may be impacted by the proposed Air Cargo Development and Revenue-generating Development. A small area may be impacted by the runway protection zone clearing for the Primary Runway Extension. These areas may provide habitat for the Indiana bat and Northern long-eared bat. Coordination will be required with USFWS prior to implementation of these projects. Tree clearing is likely to be restricted to the time period when bats would not be using the habitat, typically October 1 through March 31. Suitable habitat for the copperbelly watersnake and eastern massasauga was not observed.

Based upon coordination with the DNR for recent projects (2017-2020), the following state-listed species have known occurrences within one mile of the airport:

- Henslow's sparrow (*ammodramus henslowii*) – state endangered
- Upland sandpiper (*bartramia longicauda*) – state endangered
- Sedge wren (*cistothorus platensis*) – state endangered
- Tree clubmoss (*dendrolycopodium obscurum*) – state rare
- Warty panic-grass (*panicum verrucosum*) – state threatened
- Blackseed needlegrass (*piptochaetium avenaceum*) – state rare
- American Bittern (*botaurus lentiginosus*) – state endangered

The preferred habitat of Henslow's sparrow is flat fields that lack woody vegetation and have a dense litter layer. The maintained turf within many of the areas does not have a well-developed litter layer but may provide forage and stopover habitat for this species during migratory periods.

The preferred habitat of upland sandpipers is grassy prairies and open meadows with native grassland favored for nesting habitat. However, due to the regional scarcity of natural grassland this species is most frequently observed foraging and nesting on airports. St. Joseph County is on the border of this species' breeding range and migratory range. During migratory periods, this species is commonly observed on lawns, within parks, and on airports.

Sedge wrens are typically found in sedge meadows and wet grasslands. They are also frequently found in agricultural areas with similar qualities, such as hayfields and early successional old field habitat. They prefer areas with dense cover of forbs and grasses where they place their nests. This species generally avoids open areas that lack dense vegetation but may forage in open grassland during migratory periods.

Suitable habitat for the American bittern includes extensive freshwater wetlands, marshes, and reedy lakes. Shallow wetlands with a high occurrence of tall marsh vegetation (cattails, sedges, grasses) or areas of open water are their preferred habitat. Small, scattered wetlands on existing airport property may provide suitable habitat for this species, although these features appear to be subject to a high level of regular disturbance such as mowing and selected shrub removal.

The preferred habitat for tree clubmoss most commonly includes the understory of moist to dry deciduous and mixed forest understories. This species can also be found in more open habitats such as rock balds, fields, and forest margins. The mixed woodlot observed within the southern study area outside of the airport fencing may provide suitable habitat for this species.

Blackseed needlegrass is typically found in upland woods, especially those with oaks and dry openings. This species can also be found in rocky slopes and outcrops, savannas and clearings, and dry thickets.

Warty panic-grass is usually only found in areas with a fluctuating water table such as coastal plain marshes, sandy lake edges, seepages, sandy marshes, wetland edges, and intermittent wetlands.

None of the listed vascular plant species were observed within Airport property during site visits for prior projects. Given the intense level of disturbance, and regular maintenance (mowing) of the areas proposed for improvements, it is unlikely that suitable habitat for blackseed needlegrass, warty panic-grass, or tree clubmoss is present. However, further studies are warranted for the areas outside current Airport boundaries, such as the Air Cargo Development area.

Threatened and endangered species are not anticipated to be impacted by implementation of the proposed improvements. However, as federal and state protected species lists change, it will be important that an updated assessment of species and habitats on or in the vicinity of the Airport be conducted before any future development occurs.

5.12 Wetlands

U.S. DOT Order 5660.1A, *Preservation of the Nation's Wetlands*, defines wetlands as lowlands covered with shallow and sometimes temporary or intermittent waters. This includes swamps, marshes, bogs, sloughs, potholes, wet meadows, river overflows, tidal overflows, estuarine areas, and shallow lakes and ponds with emergent vegetation.

Wetland in South Bend, Indiana
Source: Shirley Heinze Land Trust

Evaluation by a qualified wetland biologist is needed to determine if an area is a wetland. Development is to be avoided in wetlands if practicable alternatives exist. If wetlands are to be disturbed, permits from federal and state agencies may be required in addition to the purchase of wetland credits or the creation of wetlands off Airport property to achieve a no net loss ratio in accordance with Executive Order 11990 *Protection of Wetlands*.

According to wetlands mapping in the USEPA's NEPAssist database, which uses USFWS NWI data, potential small, scattered wetlands are found within Airport property (**Figure 5-5**). NWI maps indicate the presence of wetlands within the proposed Revenue-generating Development area; however, a delineation will be needed to verify this. Further analysis conducted as part of the NEPA process will determine if wetlands are present within the areas proposed for development and if mitigation measures are needed to reduce any adverse impacts that could occur to wetland areas.

5.13 Floodplains

Executive Order 11988, *Floodplains*, and U.S. DOT Order 5650.2, *Floodplain Management and Protection*, state that all airport development actions must avoid floodplains if practicable alternatives exist. If no practicable alternatives exist, actions within a floodplain must be designed to minimize adverse environmental impacts and minimize potential risks for flood-related property loss and impacts on human safety, health, and welfare.

Airport development is discouraged within a 100-year floodplain, or areas of inundation that have a frequency of occurring, on average, once every 100 years. Flood insurance rate maps developed by FEMA indicate that no floodplains are present on Airport property nor within the proposed development areas; therefore, impacts to floodplains are not anticipated.

5.14 Coastal Barriers and Coastal Zone Management

Coastal zones are defined as islands, beaches, transitional and intertidal areas, and salt marshes that are located along the coastlines of the Atlantic Ocean, Pacific Ocean, Gulf of Mexico, and the Great Lakes. The Coastal Zone Management Act of 1972 established the Federal Coastal Zone Management Program to encourage and assist states in preparing and implementing management programs to “preserve, protect, develop, and where possible, to restore or enhance the resources of the nation’s coastal zone.”

The Airport is located inland, approximately 20 miles from the shore of Lake Michigan, and is not within the coastal zone management area; therefore, implementation of the proposed improvements will not impact coastal resources.

5.15 Wild and Scenic Rivers

Wild and scenic rivers are those waterways that are designated as having remarkable scenic, recreational, geological, fish, wildlife, historic or cultural values. The National Wild and Scenic Rivers System (NWSRS), maintained by the Secretary of the Interior, identifies rivers that are offered protection from the Wild and Scenic Rivers Act of 1968. Review of the NWSRS database indicated that there are no wild and scenic rivers in proximity to the Airport; therefore, no impacts are anticipated.

Figure 5-5: Wetlands Map

Source: USEPA NEPAssist

5.16 Farmlands

Land having ideal soil composition to support agriculture is protected by the Farmland Protection Policy Act (FPPA) of 1981 from unnecessary and irreversible conversion to non-agricultural uses. Farmland, pastureland, cropland, and forests can be considered "prime," "unique," or "statewide and locally important" if it meets certain soil composition characteristics. Land designated as "prime" farmland has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage, oilseed, and other agricultural crops with minimal use of fuel, fertilizer, pesticides, or products. "Unique" farmland has a special combination of soil quality, location, growing season, and moisture necessary to produce high-value food and fiber crops or high yields of them economically. Land determined by state or local officials to be of agricultural importance can be designated as "statewide and locally important" if approved by the U.S Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) or a designated representative such as a State Conservationist.

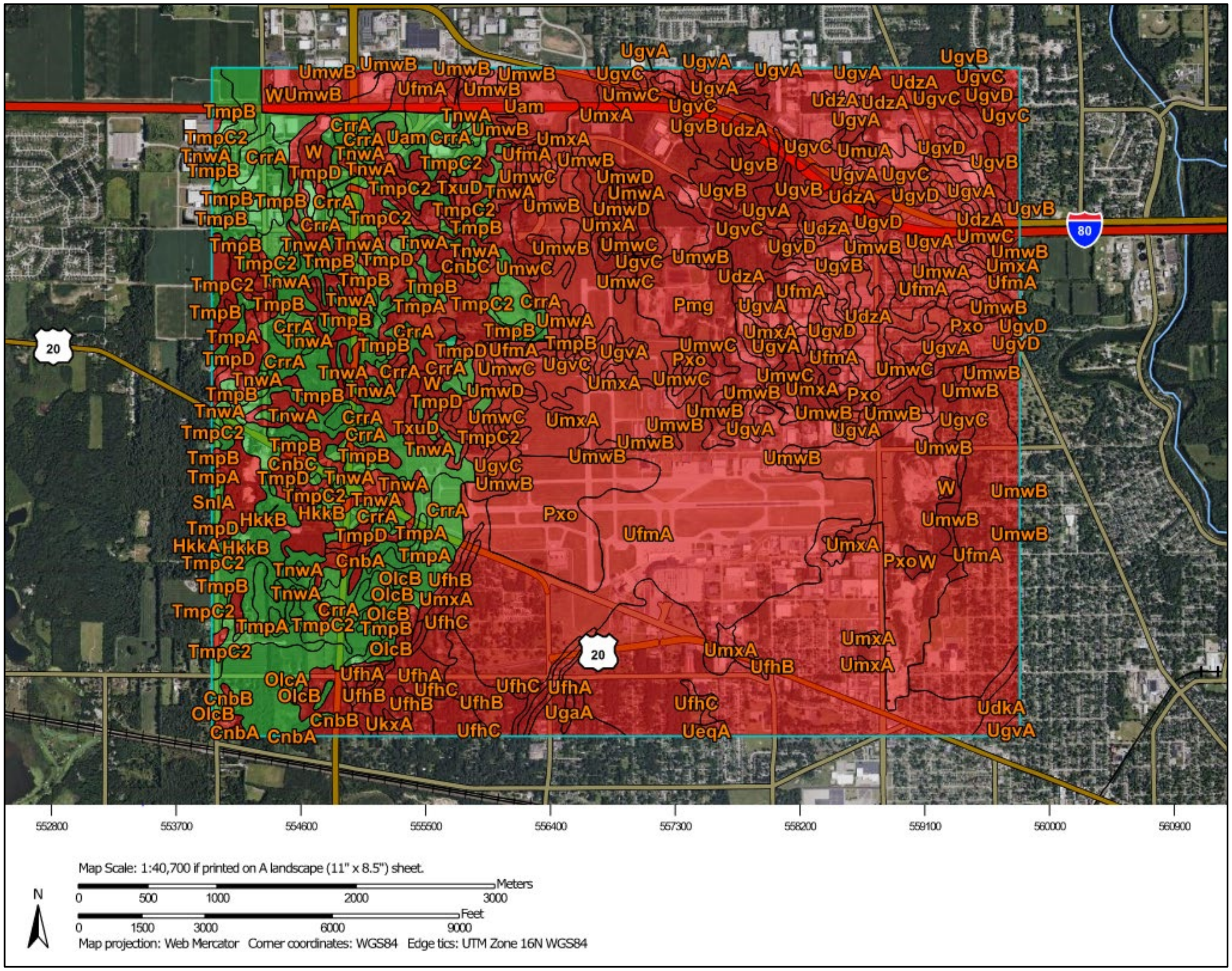
Farm in St. Joseph County, Indiana
Source: South Bend Tribune

Using the NRCS Web Soil Survey database, farmland that may be impacted by the proposed improvements was evaluated. **Figure 5-6** presents the farmland classification map generated from the NRCS Web Soil Survey database for SBN and surrounding property. **Figure 5-7** presents the legend for this map. It is anticipated that the Primary Runway Extension, Air Cargo Development, and Revenue-generating Development areas contain portions classified as "prime" farmland. However, many of the areas designated as "prime" farmland have been previously disturbed and are not currently being cultivated. Submission of a USDA Farmland Conversion Impact Rating Form AD-1006 is recommended to further evaluate whether the land still rates as "prime" and whether alternate measures, such as reducing the acreage of impacted land or using land with a lower relative value, could be considered. Additional coordination with the NRCS is encouraged as a part of the NEPA environmental review process prior to construction.

In addition, according to the Farmlands Protection Policy Act (FPPA), farmland resources located in urbanized areas that may be impacted by Airport projects are exempt from regulatory protection. Specifically, the FPPA exempts farmlands "already in or committed to urban development… [including] lands identified as 'urbanized area' on the Census Bureau Map." A significant portion of SBN property is located within the South Bend, Indiana - Michigan urbanized area designated by the U.S. Census Bureau and is assumed to be exempt from protection and mitigation requirements. Areas of SBN property classified as "prime" farmland may fall inside the urbanized area, which would require coordination with the NRCS.

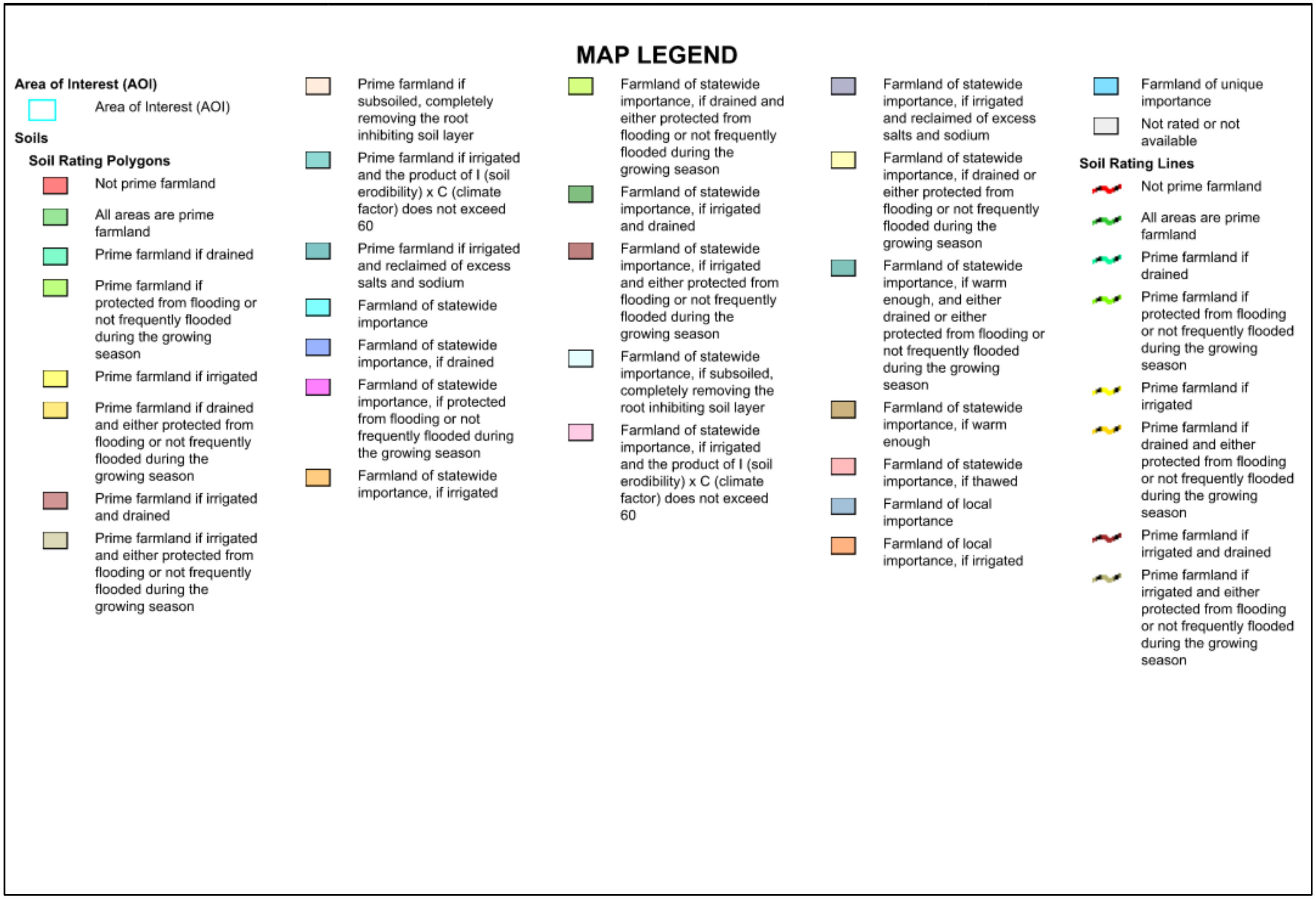
No additional farmland impacts are anticipated for the remaining proposed improvements, as they have project areas planned to occur on soils not protected for agricultural purposes.

Figure 5-6: NRCS Web Soil Survey Farmlands Map



Source: USDA NCRS Web Soil Survey

Figure 5-7: Legend For NRCS Web Soil Survey Farmlands Map



Source: USDA NCRS Web Soil Survey

5.17 Energy Supply and Natural Resources

Any airport development project subject to FAA approval or receiving funding from the Airport Improvement Program (AIP) must be evaluated to determine potential impacts to energy supplies and natural resources. Regulations set forth by the Council on Environmental Quality (CEQ) require an assessment of a proposed action's energy requirements, efforts to conserve energy, and impacts on natural or consumable resources. Though airport improvement projects may have the potential to increase energy requirements and natural resource consumption, it is typically not to a point that would significantly cause demand to exceed supply. To reduce or limit any potential impacts, the FAA encourages airports to incorporate environmental sustainability into any airfield or landside development project.

The proposed Primary Runway Extension and Taxiway Improvements projects would require additional lighting potentially increasing energy consumption. Installation of energy-efficient Light Emitting Diode (LED) runway and taxiway lights, where applicable, can help greatly reduce the level of additional energy supply that may be needed. Additional conversion of traditional incandescent airfield lighting to LED fixtures may help reduce the level of energy needed for airfield lighting, resulting in cost savings for the Airport. Any increase in energy usage that may occur as a result of additional airfield lighting is not anticipated to considerably impact local supplies or increase strain on local and regional power grids.

The proposed Air Cargo Development, Midfield Development, Revenue-generating Development, and Terminal Area Development projects would involve various businesses, warehousing, logistics, and aeronautical development. The facilities in these developments have the potential to increase energy consumption at the Airport; however, use of environmentally sustainable building design and construction techniques can greatly reduce the level of any potential adverse impacts. Guidelines set forth by the Leadership in Energy and Environmental Design (LEED) rating system, Green Globes, and Energy Star provide a framework for environmentally sustainable practices that can be used in building construction techniques. Incorporation of other design elements such as automated building controls, geothermal heating and cooling, occupancy/daylight light sensors and low flow water fixtures can be included to reduce the level of energy needed for these new facilities. Energy and cost savings may even be realized for the Airport with construction of environmentally sustainable buildings to replace those that are energy inefficient. As a result, no significant impacts to energy supplies are anticipated with construction of additional buildings.

Reuse of existing airfield construction materials can also help reduce or prevent any potential impact to natural resources. Recycling of raw materials such as milled concrete and asphalt for use as a sub-base or in the creation of new pavement itself are examples of construction practices that can limit the necessity for natural raw materials. Reuse of existing pavements also is an environmentally friendly practice that reduces the necessity for natural resources. Using such practices, consumption of raw materials for the development of additional airfield infrastructure is not anticipated to meaningfully impact natural resources.

5.18 Light Emissions and Visual Effects

Aviation lighting required for security, obstruction clearance, and navigation are chief contributors to light emissions radiating from airports. An analysis is necessary when projects include the introduction of new or relocated airport lighting facilities that may affect residential or other sensitive areas. For example, high-intensity strobe lights may shine directly into residences, or overhead apron, parking, or streetlights may create glares that affect pilots and air traffic controllers. Only in these types of unusual circumstances should the impact of light emissions be considered enough to warrant a special study for a more detailed examination of alternatives.

The location and orientation of existing and potential future lighting systems are not expected to adversely affect local residences or other areas in proximity of the Airport; therefore, no impact is anticipated. Additional analysis may be needed if it is determined through the environmental review process that lighting from the proposed improvements could create adverse light emissions and visual effects.

5.19 Solid Waste

Solid waste is defined as any material resulting from industrial, commercial, mining, agricultural, or community activities. Solid waste generated from airport-related construction projects and operation may result in a negative environmental effect. Without careful planning and management, solid waste can present a danger to human health and the environment. When proposed development could cause a change or increase in the solid waste stream, an environmental review is typically required that discusses the amount of waste that will be generated by construction and operations and how it will be handled and disposed of properly to minimize environmental impacts.

Section 133 of the FAA Modernization and Reform Act (FMRA) of 2012 outlines the requirement to develop a waste plan as part of a master plan or sustainable master plan when receiving AIP funding for eligible projects. Documents that supplement the FMRA include the *FAA Guidance on Airport Recycling, Reuse, and Waste Reduction Plans* (September 2014), FAA Reauthorization Act of 2018, and Reauthorization Program Guidance Letter (R-PGL 19-02). These documents advise airports to record the feasibility of and their practices related to diverting waste from landfills. In accordance with the FMRA and supplemental documents, an Airport Waste Reduction, Reuse, and Recycling Plan was prepared for this master plan, which is provided in **Appendix F**. This Plan can assist SBN with solid waste minimization and diversion practices.

Another consideration for analyzing solid waste is the proximity of landfills to airports. Landfills attract birds and create wildlife hazards for aircraft. FAA AC 150/5200-33B, *Hazardous Wildlife Attractants on or Near Airports,* addresses separation standards between landfills and airports. For airports like SBN that serve turbine-powered aircraft, 10,000 feet of separation is needed between a landfill and an airport. No landfills are located within 10,000 feet of SBN. The closest landfill is the Southeast Berrien County Landfill located approximately 5.5 miles north of the Airport, which exceeds the required separation distance identified in AC 150/5200-33B.

5.20 Construction Impacts

Airport construction projects have the potential to cause various environmental effects primarily due to dust, heavy equipment emissions, stormwater runoff containing sediment, spilled and/or leaking petroleum products, and noise. Though temporary, construction impacts should be evaluated as part of the environmental review process to determine general types and nature of construction related impacts and the measures proposed to minimize potential adverse effects. Standards specified in FAA AC 150/5370-2E, *Operational Safety on Airports During Construction*, provide safety guidelines and best management practices that should be followed for all construction activities occurring at an airport. Additional federal, state, and local ordinances and regulations may also govern construction procedures and operations to reduce any potential environmental impacts.

Mill and overlay project for Runway 9R/27L at SBN
Source: Mead & Hunt, Inc.

No substantial short-term environmental impacts are anticipated during construction of the proposed improvements. Any potential soil erosion or sediment runoff that may occur should be controlled by appropriate erosion prevention devices such as sediment basins and silt fences along with soil erosion and sedimentation control permits from federal, state, or local agencies to minimize any potential adverse effects. Stormwater discharges associated with construction activities may require a Stormwater Pollution Prevention Plan (SWPPP) and a NPDES permit to effectively prevent stormwater and wastewater runoff from polluting area waterways. Emissions from heavy equipment and vehicles may temporarily reduce air quality during construction, but not at levels that could cause significant respiratory health issues for the surrounding community. Temporary increases in solid waste generated from debris, building demolition, pavement surface removal, and packaging materials are not anticipated to strain the capacity of local disposal facilities.

Construction of the proposed improvements may also result in beneficial economic impacts to the local community. The use of local contractors and suppliers during construction may help create additional construction-related employment opportunities for the area workforce. Additional full-time employment as a direct or indirect result of the proposed developments will not only benefit the exchange of commerce at the Airport, but also help to support economic activity throughout South Bend and the Northern Indiana region.

5.21 Hazardous Materials

Since at least the 1950s, the study area has operated as part of the St. Joseph County Airport where numerous hangars and maintenance areas have utilized totes and drums of jet fuel, other petroleum products, and de-icing fluid. Although no release is presently identified, the full extent of historical activities, including the handling and disposal methods of chemicals and waste products, is not known and suggests the potential for environmental concern. Furthermore, leaking underground storage tank (LUST) incidents associated with the closure of thirty-one (31) underground storage tanks (USTs) between 1988 and 1991 identified gasoline, diesel, kerosene, and used oil USTs, ranging from 300 gallons to 30,000 gallons. It is not clear whether some of the tanks were removed or closed in place, or whether residual contamination was identified. As such, there is a potential for hazardous substances and/or petroleum products within the study area.

Prior to any construction activity, a Phase I Environmental Site Assessment (ESA) should be completed to identify possible contamination associated with any proposed development.

Review of the Indiana Department of Environmental Management (IDEM) databases also indicates that one (1) former landfill is located adjacent to SBN. Soil and groundwater contamination has been documented and could potentially impact western airport improvements. It is recommended that soils be sampled prior to any construction activities as part of a Phase II ESA, or that soils be managed under a soils management plan during construction activities.

If the soils management approach is utilized during construction, provisions for an on-site monitor to evaluate excavated soils and determine if they have been impacted by historical releases should be identified. Sampling procedures for potentially impacted soils should be identified, as well as the identification of a disposal location.

If impacted soils are encountered (i.e., odors, staining) during construction activities, soil samples should be collected and analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), total petroleum compounds (TPH), and Resource Conservation and Recovery Act listed metals (RCRA Metals) prior to off-site disposal and/or on-property relocation. Off-site transport and disposal of soils must be coordinated to ensure compliance with applicable state and federal regulations.

If no contamination is observed during construction activities, and all soil is anticipated to remain on Airport property, these soils may be relocated without being sampled for the chemicals of concern. However, if at any time these soils must be sent off-site, soils must be analyzed for VOCs, SVOCs, TPH, and RCRA Metals to identify appropriate disposal methods.

While groundwater is anticipated to be greater than 40 feet below ground surface and not encountered during construction activities, it is recommended that any encountered groundwater on the west side of the Airport be sampled and properly disposed of due to the Covenant-Not-to-Sue issued by IDEM for former landfill operations.

5.22 Cumulative Impacts

Cumulative impacts are those that a proposed action would have on a particular resource when added to past, present, and reasonably foreseeable actions within a defined period of time and geographical area. An example would be the incremental loss of wetlands over a period of several years resulting from multiple projects. The environmental review process may require qualitative and quantitative analyses of past activities along with the consultation with various agencies, tribes, and developers to determine if cumulative impacts have occurred to any of the 23 environmental categories presented in this chapter. The primary environmental effects of the proposed projects are:

- Primary Runway Extension – Potential need for tree clearing in runway protection zone.
- Taxiway Improvements – Potential impact to small, scattered wetlands if any are present.
- Air Cargo Development – Residential relocations, tree clearing, potential small stream and wetland impacts, potential need for cultural resources surveys.
- Midfield Development - Potential impact to small, scattered wetlands if any are present.
- Revenue-generating Development – Loss of private recreation resource, tree clearing.
- Terminal Area Development - Potential impact to small, scattered wetlands if any are present.

Assessing all the proposed improvements together, the greatest concerns are residential relocations and tree clearing. No foreseeable impacts are anticipated to either of those categories nor any of the other environmental categories above from any known recent or planned improvements in the area. Therefore, no cumulative impacts are anticipated. Additional review of past, existing, and planned future development conducted during the NEPA review process can further evaluate the potential of cumulative impacts that may result with implementation of the proposed improvements.

5.23 Per- and Poly-fluoroalkyl Substances (PFAS)

PFAS are a group of thousands of compounds that have been used in a variety of materials and industrial processes around the globe since the 1950s. PFAS have water-repellant, stain-resistant, non-stick, and surfactant properties that are used in many products such as paper tableware, food packaging, polishes, waxes, paints, adhesives, and in industrial processes such as metal plating and electronics manufacturing. PFAS are also a key ingredient to improve the performance of aqueous film-forming foam (AFFF) since they can remain stable at high temperatures. This ability to remain stable and slowly degrade in the environment are reasons why PFAS can be an environmental concern. When released into the environment, PFAS can be easily transferred through surface water and soil to groundwater. This can allow it to enter the food chain and be consumed by humans through food and drinking water. While much has yet to be learned about the human health concerns of PFAS, there is evidence to support that PFAS can cause cancers, tumors, reproductive and immunological effects, increased cholesterol, and affect the development of children.

At airports, PFAS can be found in many products; however, the source of greatest concern is with the release of AFFF into the environment. This is because AFFF has PFAS known to cause the greatest human health concerns, can be used at great volumes, and can directly enter surface water, soil, and groundwater when used for training, testing, and in response to an emergency. FAA regulations require that Part 139 airports like SBN use AFFF containing PFAS to meet fire extinguishing agent performance requirements. Likewise, these regulations also require that firefighting equipment be maintained in optimal operational condition, requiring annual testing of foam proportioning systems on aircraft rescue and firefighting (ARFF) vehicles.

At the time of the publishing of this master plan, PFAS were not an environmental category that was required to be reviewed under NEPA nor were they regulated at federal or state levels. However, it is anticipated that federal and state regulations will be developed in the future for PFAS compounds. Thus, SBN should monitor federal and state environmental regulatory developments about PFAS should it be required to be investigated as part of the NEPA environmental review process for future infrastructure improvement projects.

5.24 Anticipated Environmental Documents

The proposed improvements, either individually or cumulatively with other proposed actions, are not anticipated to result in any significant environmental impacts. Therefore, preparation of a CATEX is anticipated to satisfy the environmental review process and NEPA documentation requirements as defined in FAA Orders 1050.1F – *Environmental Impacts: Policies and Procedures*, and 5050.4B – *NEPA Implementing Instructions for Airport Actions,* for the Taxiway Improvements, Midfield Development, and Terminal Area Development projects as proposed in this master plan.

CATEXs are typically prepared for actions that do not induce impacts to planned growth or land use; natural, cultural, recreational, or historic resources; travel patterns; air, noise, or water quality; do not require the relocation of substantial numbers of people; and, based on previous experiences with similar projects, do not significantly impact the environment. Any unforeseen circumstances such as significant environmental impacts, substantial public controversy, impacts to Section 4(f) or Section 106 historic properties, or inconsistencies with federal, state, or local regulations that are encountered during the preparation of a CATEX may require a more extensive environmental review.

The Primary Runway Extension, Air Cargo Development, and Revenue-generating Development projects are likely to require an EA to determine the significance of any potential impacts. EAs are typically prepared when the magnitude of potential impacts is unknown, and they also help determine whether an EIS is needed. If it is determined that the proposed developments will not significantly impact the environment, a Finding of No Significant Impact (FONSI) will be prepared to document the decision.

If significant impacts are anticipated or identified through the EA process, an EIS may be required. Based upon currently available information, an EIS is not anticipated for any of the proposed improvements presented in this document.

5.25 Summary of Anticipated Impacts

The environmental overview provided in this chapter is not intended to meet or satisfy requirements addressed by NEPA or FAA Order 5050.4B, *National Environmental Policy Act (NEPA) Implementing Instructions for Airport Actions*. Development of a NEPA compliant document such as a CATEX, EA, or an EIS is required for each proposed action to further evaluate the level of environmental impact and determine if mitigation measures are necessary to reduce adverse effects. Instead, the purpose of this environmental overview is to provide data and information that can be used in developing a strategy for preparation of a NEPA compliant document for future Airport projects.

The summary below provides a recap of the environmental concerns that may arise with the implementation of the proposed improvements. The following environmental concerns include:

- **Noise** – A noise analysis will be required for the proposed Primary Runway Extension as directed by FAA Order 1050.1E, *Policies and Procedures for Considering Environmental Impacts*. Based on the TFMSC data, a noise analysis may be necessary for the other proposed improvements due to the number of operations that occur each year by jet aircraft at SBN. An increase in the intensity and duration of aircraft noise resulting from the proposed improvements is not anticipated, however.

- **Water Quality** – Water quality permits, certifications, and approvals from federal, state, and local agencies may be required to discharge stormwater and wastewater, especially from aircraft and runway anti-icing/de-icing activities. Consultation with the USACE may also be needed prior to implementation of the proposed improvements to determine potential impacts and appropriate mitigation. Additionally, since the proposed improvements will result in substantial changes to drainage patterns across the airfield and overall increases in impervious surfaces, stormwater storage locations and required sizes have been included in this master plan (see Appendix E) to designate areas that can be developed and areas that must be converted to stormwater storage.

- **Historic and Archaeological Resources** – Although no known archaeological or historic resources will be impacted, the proposed Air Cargo Development, Revenue-Generating Development, and Midfield Development project areas have not been previously surveyed for cultural resources. Coordination with the Indiana DNR's Division of Historic Preservation and Archaeology will be required to confirm the need for future investigations.

- **Wetlands** – NWI maps indicate the presence of wetlands within the proposed Revenue-generating Development area. In addition, prior surveys on existing Airport property have found small, scattered wetlands. Delineation of the project areas will be conducted as part of the NEPA environmental review process. Wetland permits and mitigation may also be necessary before any construction or development occurs.

- **Threatened and Endangered Species** – Coordination with the USFWS and Indiana DNR will be required to verify the potential species within the project areas. For projects with tree clearing, commitments will be needed to avoid and minimize impacts to habitat of protected bat species.

- **Hazardous Materials** – Given the Airport's history, a Phase I ESA is recommended as part of any future environmental analysis. Previous studies have also recommended that soils be sampled as part of a Phase II ESA, or that soils be managed under a soils management plan during construction activities. A strategy for addressing contaminated materials should be developed during preliminary design for each project as more information is available on proposed excavation.

- **PFAS** – SBN should monitor federal and state environmental regulatory developments about PFAS should it be required to be investigated as part of the NEPA environmental review process for future infrastructure improvement projects.

Chapter 6 Recommended Development and Capital Improvement Plan

Implementation of the recommended infrastructure improvements from the airport master planning effort is guided by a Capital Improvement Plan (CIP) that establishes a timeline and cost estimate for each planned project. CIPs assist with identifying the level of financial, staffing, and scheduling resources needed for each improvement while organizing the timing of necessary preliminary projects, such as planning, design, land acquisition, and environmental reviews. CIPs also illustrate the capital needs of an airport, informing and guiding funding allocation decisions of federal, state, and local officials.

This chapter provides the overall development program for implementation of the recommended infrastructure improvements from the master plan for the South Bend International Airport (SBN) and is organized by the following sections:

- 6.1 Capital Improvement Plan
- 6.2 Funding Resources
- 6.3 Summary

6.1 Capital Improvement Plan

As previously explained, CIPs summarize the cost and timing of the infrastructure development plans of an airport that can include not only airfield infrastructure needs, but also terminal improvements, hangar needs, and non-aeronautical development demands. In addition to identifying the estimated cost and implementation schedule, CIPs also identify the level of funding to be used toward each project from eligible funding resources. CIPs are fluid and are subject to change based on changing priorities, funding availability, and eligibility guidelines such as those for Airport Improvement Program (AIP) funding administered by the Federal Aviation Administration (FAA). As a result, CIPs need to be regularly updated based on changing conditions and priorities.

Table 6-1 presents the CIP of the recommended infrastructure improvements from the master planning effort with estimated costs presented in early 2022 dollars. Shortly after these cost estimates were developed, the cost of products such as petroleum and building materials increased significantly due to world events and other product supplier challenges. As such, the cost of these projects at the time of implementation may vary from these estimates based on the status of product and labor markets.

The funding breakdown for each project presented in the CIP is based on AIP eligibility and eligibility under the grant funding program of the Indiana Department of Transportation (INDOT) Office of Aviation. Other project costs, along with the airport sponsor matching share, are considered local costs. With SBN receiving on average $2.6 million annually in AIP entitlement funding, it is assumed for projects eligible to receive AIP funding that work will be completed in a year, except for the expansion of the terminal building which is planned to take two years to complete. FAA project eligibility determinations for the expansion of the terminal building and construction of a joint use Public Safety / Airfield Maintenance / Snow Removal Equipment (SRE) facility also will factor into the level of federal AIP funding participation for these projects.

As shown in the table, approximately $481.4 million in infrastructure improvements is planned over the 20-year period. At the time of the master planning effort, SBN was undertaking a multi-year, $70 million project to realign the routing of Taxiway B south of Runway 9R/27L and reconstruct the air carrier terminal apron; due to this, the timing of most projects proposed in the master plan are planned for beyond the 10-year period and for the 20-year period. In summary, $9.1 million in improvements is planned for the construction of a new general aviation apron and $32.6 million is planned for the relocation of Taxiway N to support the transition of aircraft between the apron and the remainder of the airfield. An additional $186.8 million in improvements are also planned for the 788-foot extension of Runway 9R/27L, construction of a new joint use Public Safety / Airfield Maintenance / SRE facility, and the development of an area for electric-powered conventional and vertical takeoff and landing (VTOL) aircraft.

In the long-term (20-year) timeframe, $252.8 million in improvements is planned, with emphasis on improvements to the air carrier terminal area which includes the terminal building, adjacent airside hangar facilities, and landside terminal area support infrastructure such as parking lots, the entrance road, and construction of a rental vehicle quick turnaround (QTA) facility. Construction of a full parallel taxiway to the west of Runway 18/36, a realignment of parallel Taxiway A to the north of Runway 9R/27L, and construction of hangars and supporting taxiways are also planned during this period. While construction of taxilanes to support the hangars may be eligible for FAA AIP funding, construction of the hangars themselves may not be eligible and would affect the overall federal funding participation for the project. As with all projects, at the time of implementation, FAA determinations on AIP eligibility will be needed to determine the level of federal funding participation.

Table 6-1: Capital Improvement Plan for SBN Master Plan Redevelopment Projects (2022 Dollars)

Project	Total Estimated Cost	Federal (AIP)		State Funds	Local Funds
		Entitlement[1]	Discretionary		
Construct New General Aviation Apron	$9,105,358	$2,600,000	$5,594,822	$455,268	$455,268
Relocate Taxiway N	$32,590,094	$2,600,000	$26,731,084	$1,629,505	$1,629,505
Runway 9R/27L 788-Foot Extension	$163,939,754	$2,600,000	$144,945,779	$8,196,988	$8,196,988
Construct New Joint Use Public Safety / Airfield Maintenance / SRE Facility[2]	$19,851,969	$2,600,000	$15,266,772	$992,598	$992,598
Develop eVTOL and Electric Aircraft Area[2]	$3,017,538	$2,600,000	$115,784	$150,877	$150,877
Realign Taxiway A	$24,297,795	$2,600,000	$19,268,016	$1,214,890	$1,214,890
Construct Full Length Runway 18/36 Parallel Taxiway	$32,120,175	$2,600,000	$26,308,158	$1,606,009	$1,606,009
Construct New Hangars and Taxilanes[3]	$71,999,804	$2,600,000	$62,199,823	$3,599,990	$3,599,990
Expand Terminal Area					
Expand Terminal Building[4,5]	*$80,745,309*	*$5,200,000*	*$67,470,779*	*$4,037,265*	*$4,037,265*
Large Aircraft Storage Hangar Expansion[5]	*$15,682,035*	*$0*	*$0*	*$0*	*$15,682,035*
Construct Large Aircraft Hangar[5]	*$10,180,445*	*$0*	*$0*	*$0*	*$10,180,445*
Construct Quick Turnaround (QTA) Facility[5]	*$5,745,347*	*$0*	*$0*	*$0*	*$5,745,347*
Construct Parking Lots[5]	*$8,702,855*	*$0*	*$0*	*$0*	*$8,702,855*
Construct Relocated Entrance Road[5]	*$3,411,341*	*$0*	*$0*	*$0*	*$3,411,341*
Expand Terminal Area Subtotal:	$124,467,332	$5,200,000	$67,470,779	$4,037,265	$47,759,288
TOTAL:	**$481,389,818**	**$26,000,000**	**$367,901,017**	**$21,883,389**	**$65,605,412**

Notes:
1 = Entitlement amount of $2,600,000 is an average based on recently awarded amounts at the time of the master plan update. Entitlements are awarded annually.
2 = AIP amount pending FAA eligibility determination
3 = Hangars not eligible for AIP funding; further refinement of cost estimate needed based on hangar development plans
4 = Some design costs associated with terminal building expansion may be eligible for AIP funding pending FAA eligibility determination; construction of project planned over two years
5 = Costs for engineering services are prorated across the development costs for expansion of the terminal area
Sources:
Cost estimates – BF&S Engineers (2022 dollars)
Project implementation schedule – Mead & Hunt, Inc. (2022)

6.2 Funding Resources

As noted, funding for CIP projects can come from multiple sources. In planning for these infrastructure improvements, an understanding is needed of the availability of funding from each funding source and the rules governing how funds from each source can be used toward a project, as well as other project eligibility considerations. The following sections provide a summary of these considerations for funding sources that are available to finance master plan projects presented in the CIP.

6.2.1 Airport Improvement Program

The largest source of federal funding for airports is AIP, which was created by the Airport and Airway Improvement Act of 1982. AIP is administered by the FAA by Chapter 471 of Title 49 of the United States Code (U.S.C.) and is used to assist in the development of public-use airports served by air carriers, commuters, air cargo, and general aviation. AIP funding is awarded by the FAA for eligible projects at an airport, including planning, airfield construction, navigational aids (NAVAIDs), and environmental mitigation.

AIP is awarded through two mechanisms based upon level of activity (entitlements) and project prioritization process (discretionary). Both entitlement and discretionary AIP funds are available to SBN with entitlement amounts on average of $2,600,000 awarded annually and discretionary amounts awarded by project. AIP grants provide funding for 90 percent (90%) of eligible project costs with the local sponsor responsible for providing 10 percent (10%) in matching funds. In Indiana, the 10 percent (10%) match is typically split 50/50 between the state and the airport sponsor, each paying 5 percent (5%), respectively. Entitlement funding can be accumulated over a period of four years with use of the accumulated funds required by the fourth year. Any accumulation of funds beyond the four-year deadline that is not used is returned to the AIP program and awarded to other airports. Discretionary funding, however, is awarded on a case-by-case basis with the FAA's decision to award discretionary funding based on its priority using formulas defined by the AIP handbook. Discretionary funding is competitive in nature with airports competing with one another for a limited amount of available funding.

The analysis of AIP funding through the planning period assumes no major changes occur in appropriation levels by Congress; however, in the past, the AIP has experienced fluctuations in levels of funding and interruptions in availability of resources. Regardless of if entitlement or discretionary funds are used, any requests for AIP funding will be dependent upon coordination with the FAA, which may include demonstrating the eligibility of the project, critical aircraft determination, grant obligations, and useful life history for infrastructure improvements that have already received AIP funding.

6.2.2 Other Federal Sources

Though limited in opportunity, other sources of federal funding may be available such as Congressional earmarks and other one-time authorizations of funds, a most recent example being the Coronavirus Aid, Relief, and Economic Security (CARES) Act that included $10 billion in funds to be awarded as economic relief to eligible U.S. airports affected by the COVID-19 pandemic. Criteria for applying and using funding from these resources is a case-by-case basis that will be driven by the intent of the funding and other project eligibility requirements.

6.2.3 State of Indiana Funding

The State of Indiana has three funding resources available for infrastructure improvements at airports administered through the INDOT Office of Aviation. The first is an AIP Matching Funds program that provides a matching share for the local share of AIP eligible project costs for Indiana airports (excluding Indianapolis International Airport) ranging from 1.25 percent (1.25%) to 5 percent (5%) of the total project cost. For AIP projects presented in the CIP, it is assumed funds from this source would cover 5 percent (5%) of the total project cost. Second, a State/Local program is available that provides funds for airport improvement projects when federal funding participation is not available. This program is a 50/50 split of the total project cost between the State and an airport sponsor. Projects receiving funding under this program are typically not eligible for federal funding or are considered a low priority for federal funding. Finally, a revolving loan program is available for airports in Indiana that provides funds for projects in which repayment is accomplished by revenues generated from the completed project.

6.2.4 Passenger Facility Charges

Passenger Facility Charges (PFCs) allow an airport to collect a fee from each enplaned passenger to be used towards AIP eligible projects. Collection and use of PFC revenues is authorized under the Aviation Safety and Capacity Expansion Act of 1990 and Title 14 of the Code of Federal Regulations (CFR), Part 158. PFCs are collected from enplaning passengers and used to finance all or portions of capital improvements that are approved by the FAA through an application process. To be eligible for PFC funding, a project must preserve or enhance safety, security, or capacity of the national air transportation system; reduce or mitigate airport noise from an airport; or provide opportunities for enhanced competition between or among air carriers. This funding mechanism helps an airport raise local funds for improvement projects that can be used with other federal and state resources. Currently, federal regulations allow an airport to collect a PFC fee up to $4.50 per enplaned passenger.

6.2.5 Customer Facility Charges

Customer Facility Charges (CFCs) are another local source of funding that is set forth by an agreement with the airport and tenants (e.g., rental car concessionaires) to collect a fee from transactions to help finance the construction of related infrastructure. An example would be collection of a fee from rental car agencies for the construction of QTA service facilities and parking garages. The level of these fees collected will vary based upon the agreement between the airport and tenants, with the method of collection ranging from a per transaction basis or a per transaction day basis. CFCs are not subject to federal or state requirements limiting the application of their use or the fee amount that can be placed on a transaction.

6.2.6 Airport Revenue Resources

Revenue earned from other SBN revenue generating resources that help finance the day-to-day operations can also be used towards improvement projects listed on the CIP. These sources of revenue include rents from air carriers, concessionaires, Fixed Based Operators (FBOs), and hangar tenants as well as landing fees from aircraft operations and automobile parking charges. Funds generated from these sources are not subject to federal or state requirements limiting their applicability and can be used to fund all improvement projects at an airport. Revenue available from these sources is most beneficial for projects that are not eligible to receive federal or state funding as well as those that are only able to take advantage of a limited portion of available federal or state funds.

6.3 Summary

Development of a CIP allows an implementation schedule to be created in addressing the timing of infrastructure developments presented in this master plan. Through the identification of the level of financial resources needed for each improvement project, the CIP demonstrates the infrastructure development needs of SBN to federal, state, and local officials. This also helps determine the staffing and scheduling resources needed for each project as well as the timing for preparatory items such as planning, design, and environmental review. With the identification of funding resources available through federal, state, and local resources, an understanding can be made of the level of capital needed from each of these resources to fund the improvement projects presented in this master plan. Periodic updates of the CIP to reflect changing dynamics such as the timing of demands and other priorities will allow SBN to be well-positioned to continually meet the aviation demands of the Michiana region.

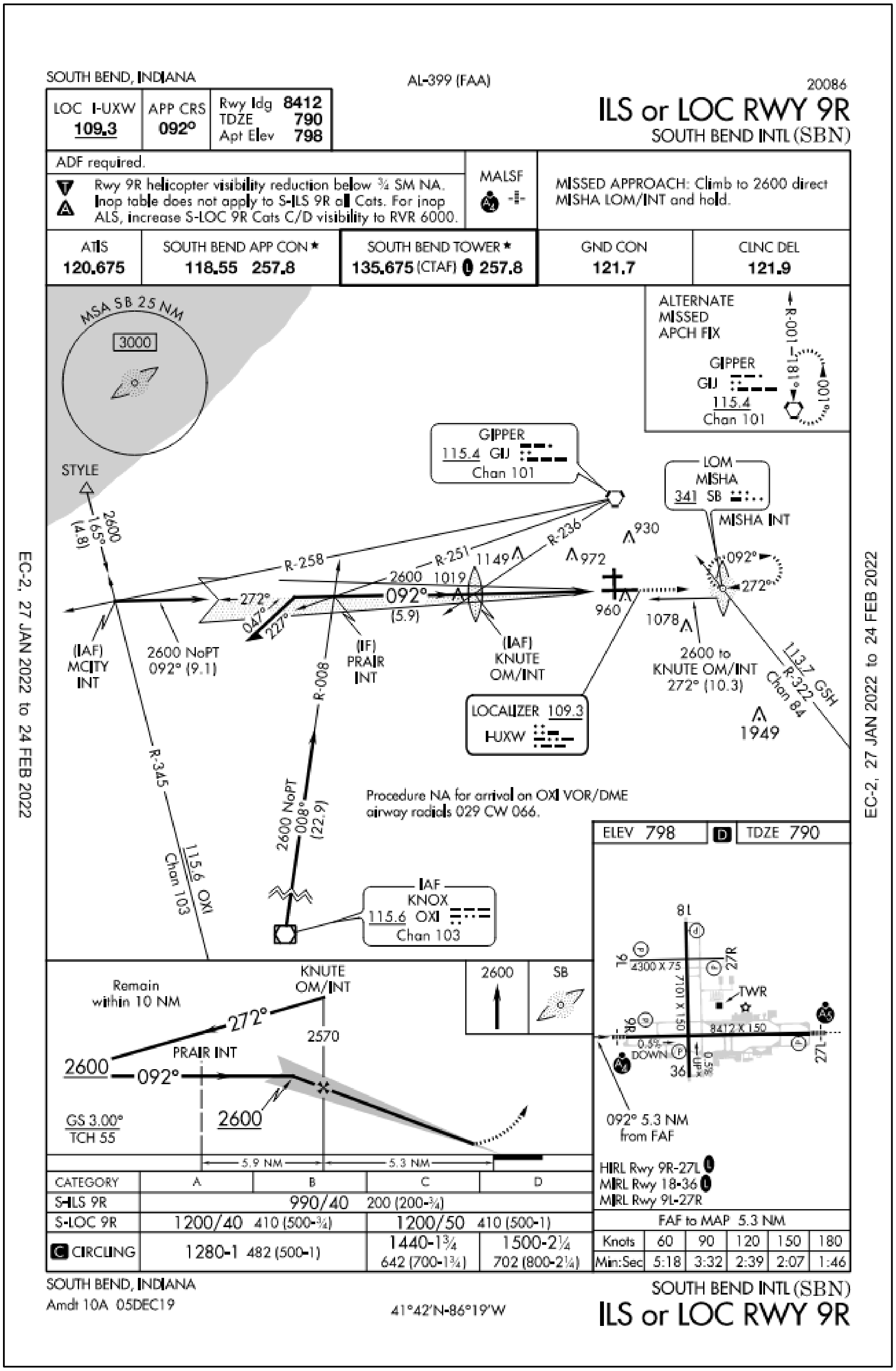
Appendix A

South Bend International Airport Approach Procedures

Approach procedures define specific maneuvers needed by aircraft to land at an airport when Instrument Flight Rules (IFR) weather conditions limit the ability of a pilot to visually identify a runway. At South Bend International Airport, 10 approach procedures have been developed for arriving aircraft. The following figures illustrate these approach procedures:

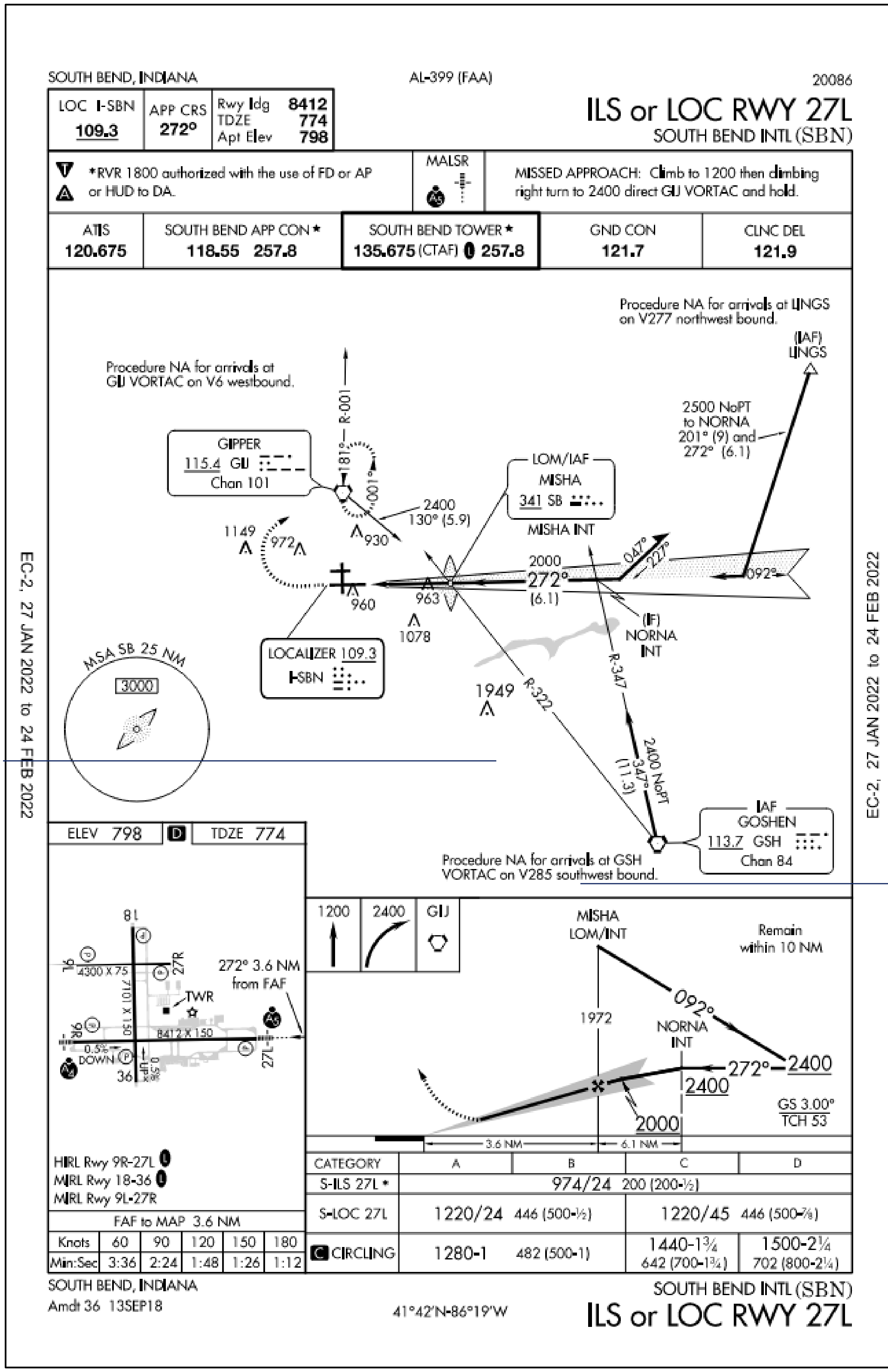
- ILS OR LOC RWY 9R (**Figure A-1**)
- ILS OR LOC RWY 27L (**Figure A-2**)
- ILS RWY 27L (SA CAT I & II) (**Figure A-3**)
- RNAV (GPS) RWY 9L (**Figure A-4**)
- RNAV (GPS) RWY 9R (**Figure A-5**)
- RNAV (GPS) RWY 18 (**Figure A-6**)
- RNAV (GPS) RWY 27L (**Figure A-7**)
- RNAV (GPS) RWY 27R (**Figure A-8**)
- RNAV (GPS) RWY 36 (**Figure A-9**)
- VOR RWY 18 (**Figure A-10**)

Figure A-1: ILS or LOC Runway 9R



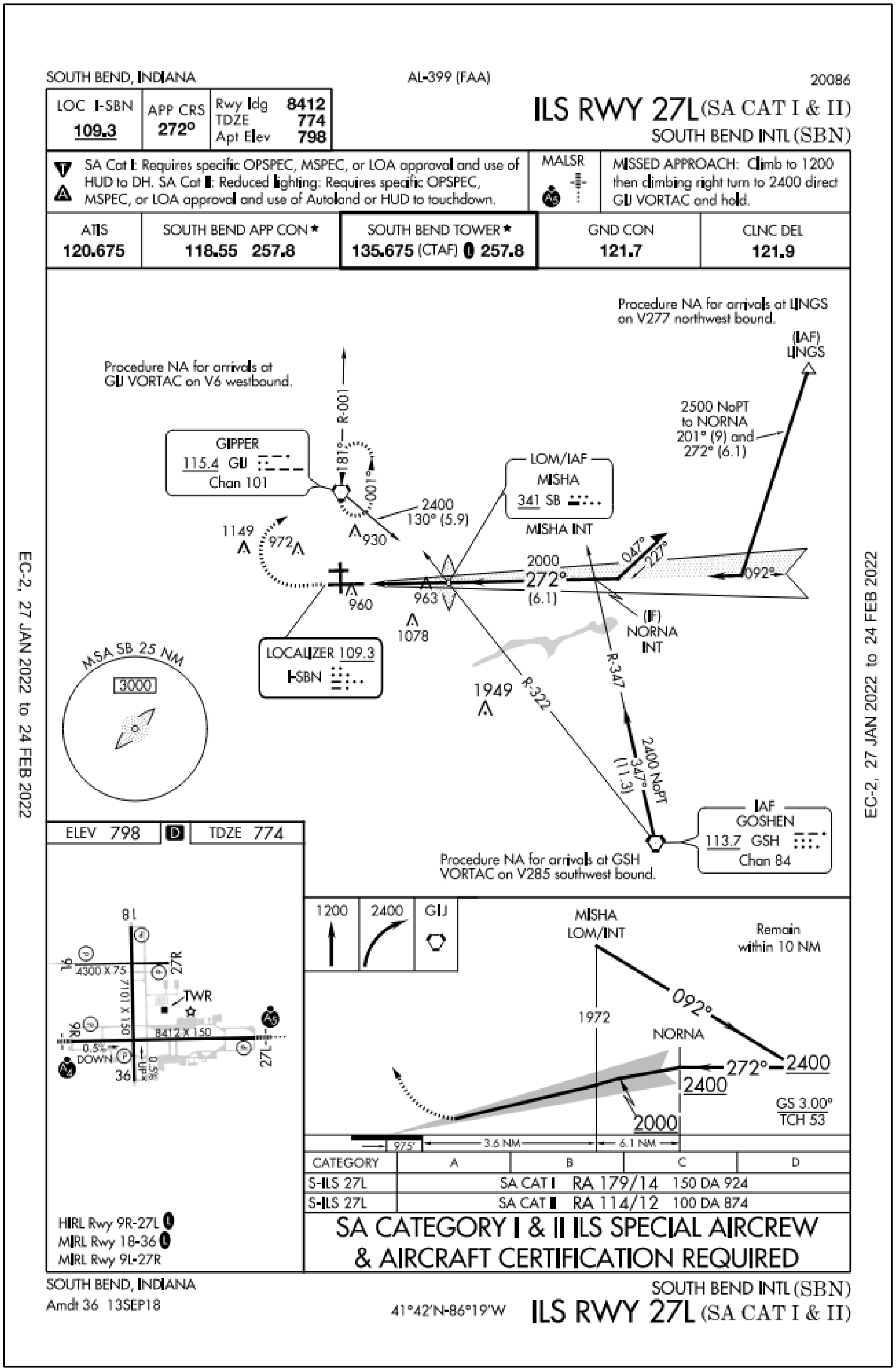
Source: AirNav.com (2022)

Figure A-2: ILS or LOC Runway 27L



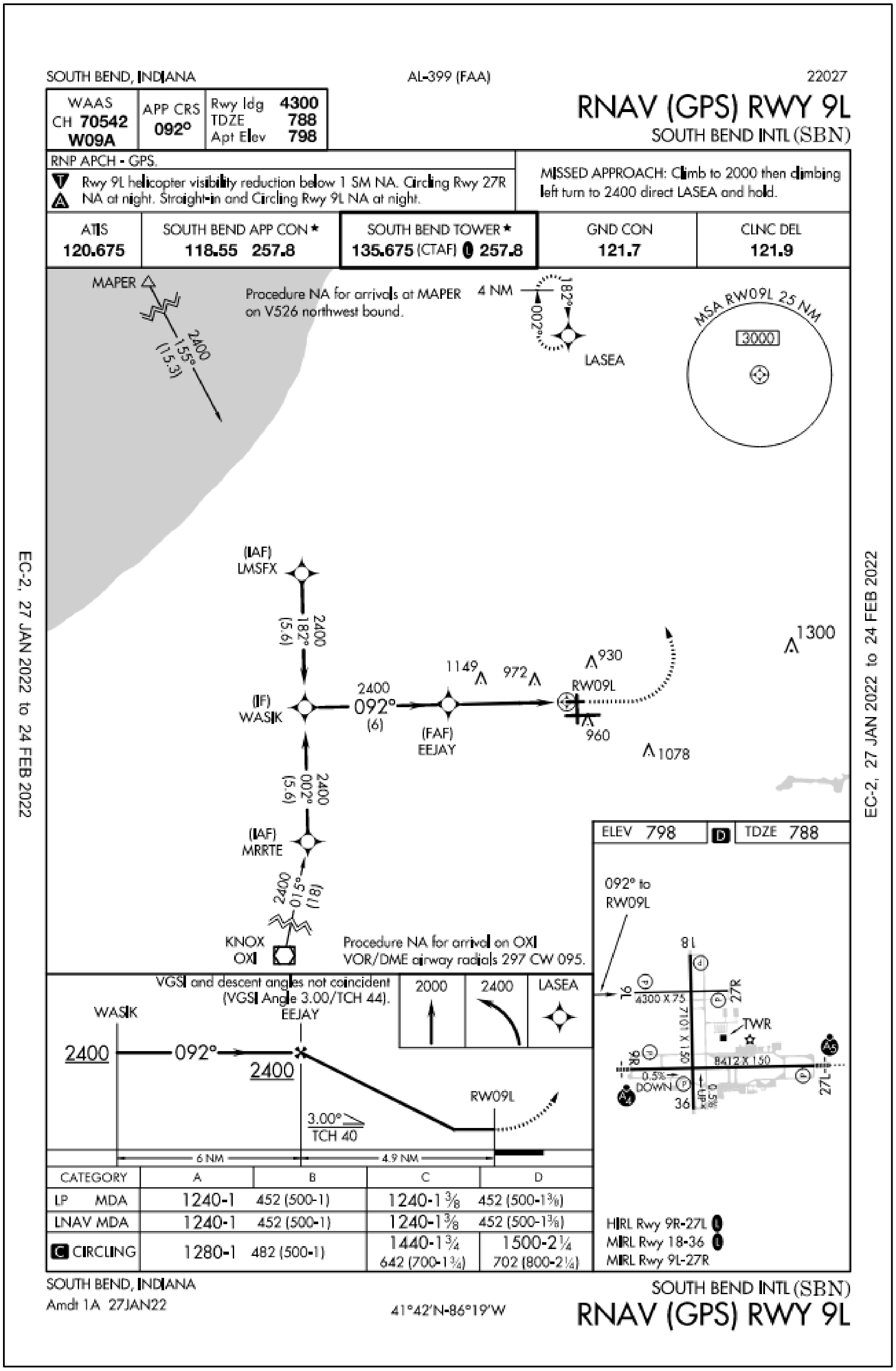
Source: AirNav.com (2022)

Figure A-3: ILS Runway 27L (SA CAT I & II)



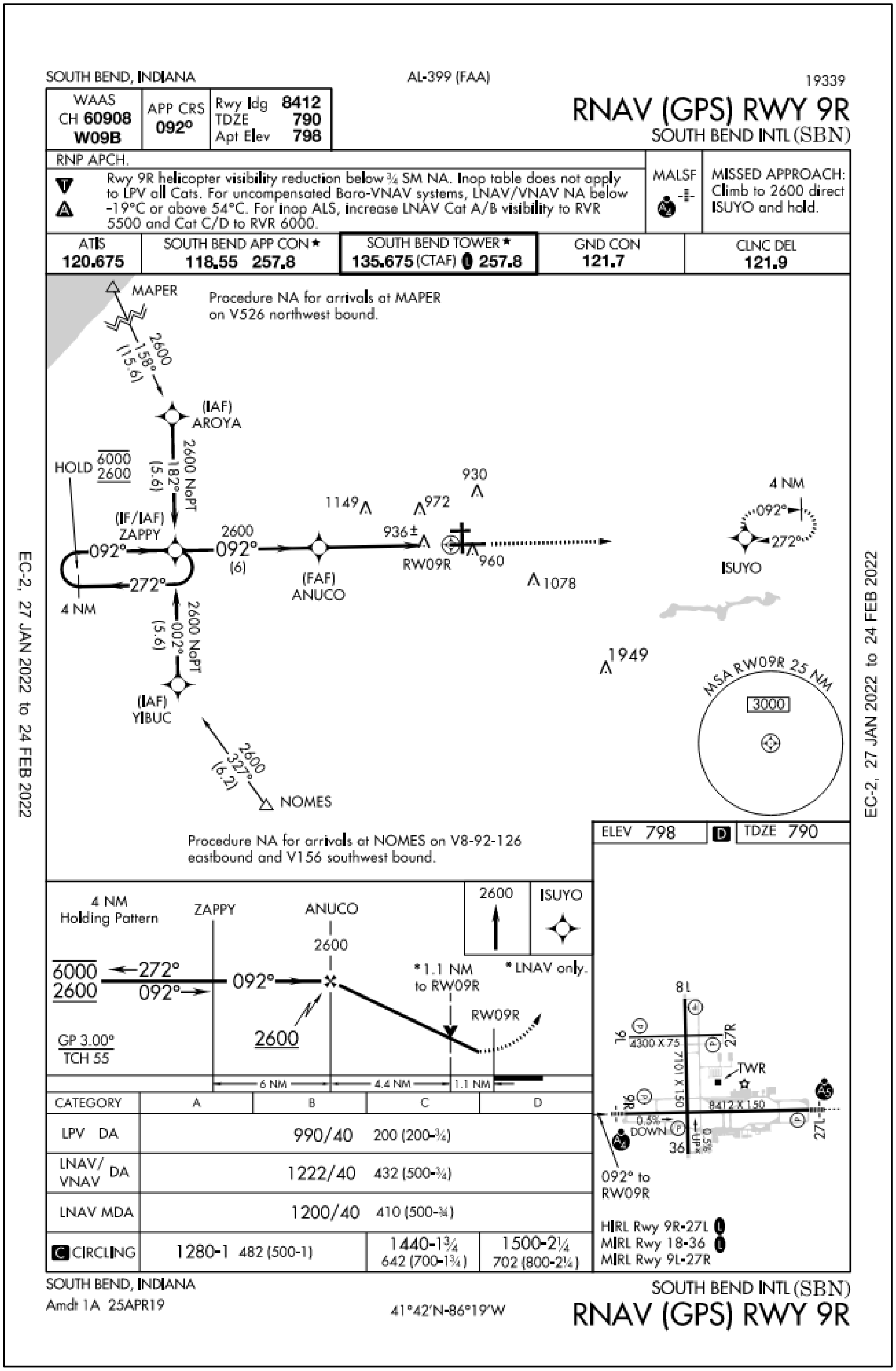
Source: AirNav.com (2022)

Figure A-4: RNAV (GPS) Runway 9L



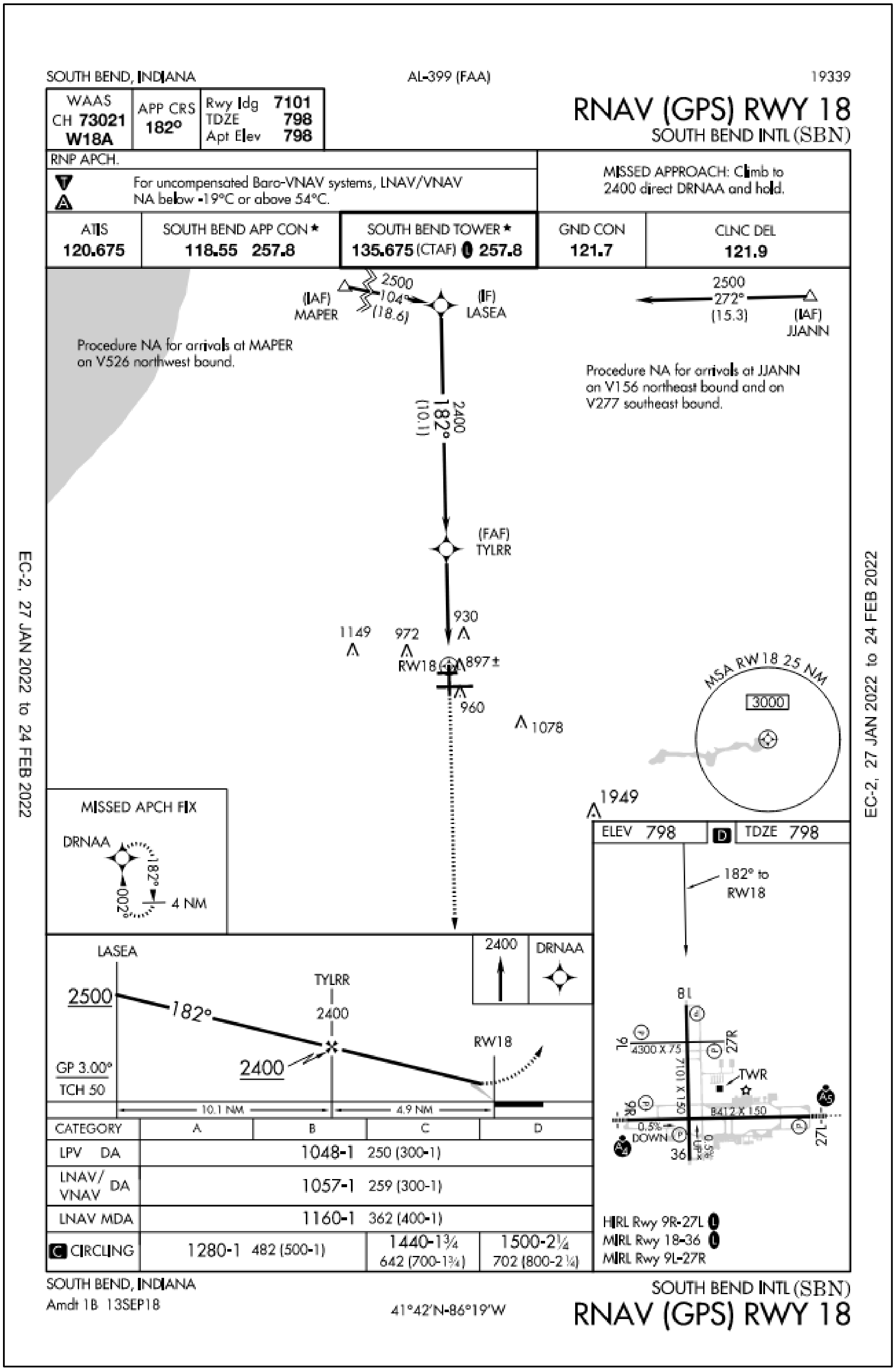
Source: AirNav.com (2022)

Figure A-5: RNAV (GPS) Runway 9R



Source: AirNav.com (2022)

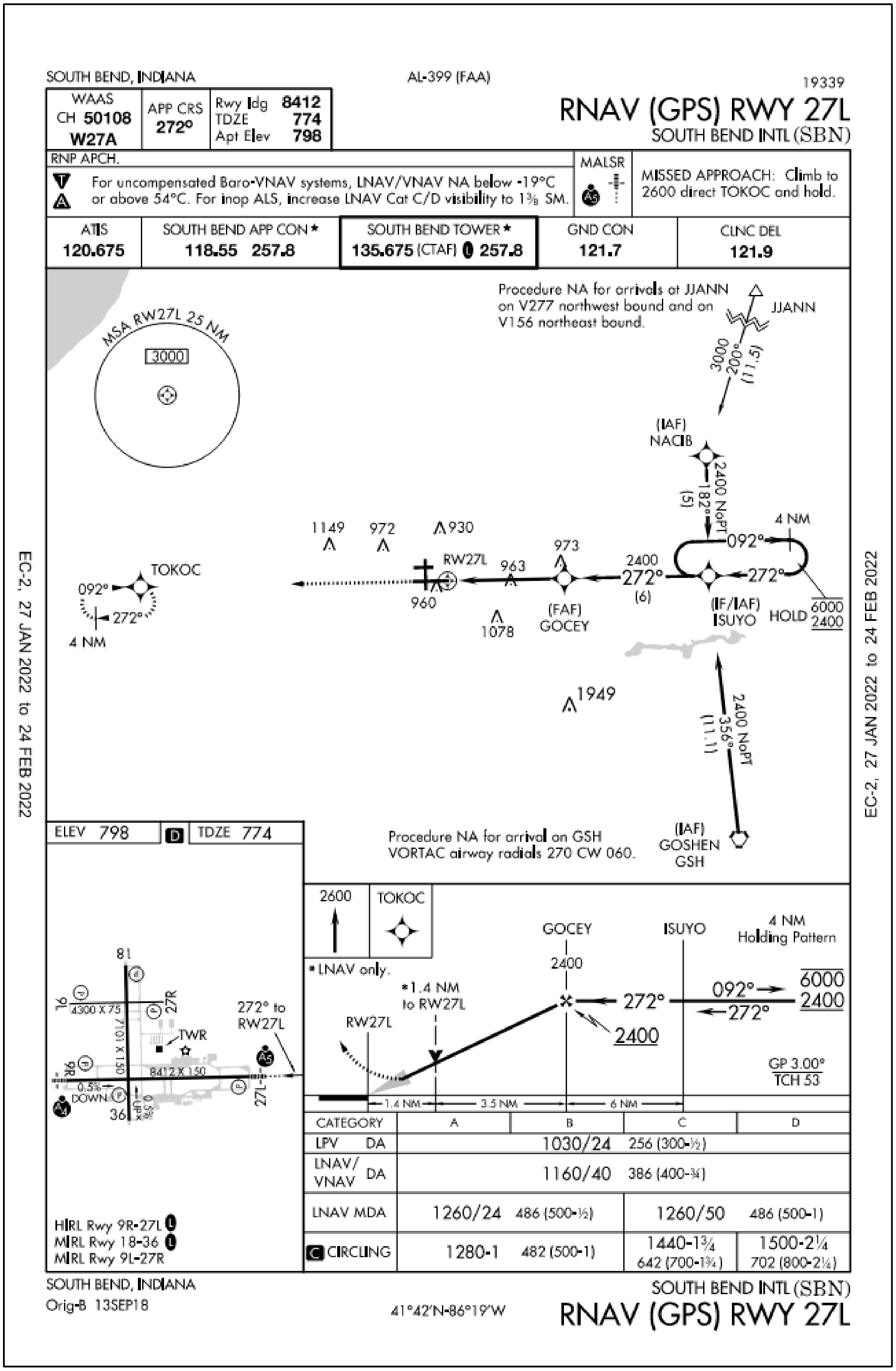
Figure A-6: RNAV (GPS) Runway 18



CATEGORY	A	B	C	D
LPV DA	1048-1 250 (300-1)			
LNAV/VNAV DA	1057-1 259 (300-1)			
LNAV MDA	1160-1 362 (400-1)			
CIRCLING	1280-1 482 (500-1)		1440-1¾ 642 (700-1¾)	1500-2¼ 702 (800-2¼)

Source: AirNav.com (2022)

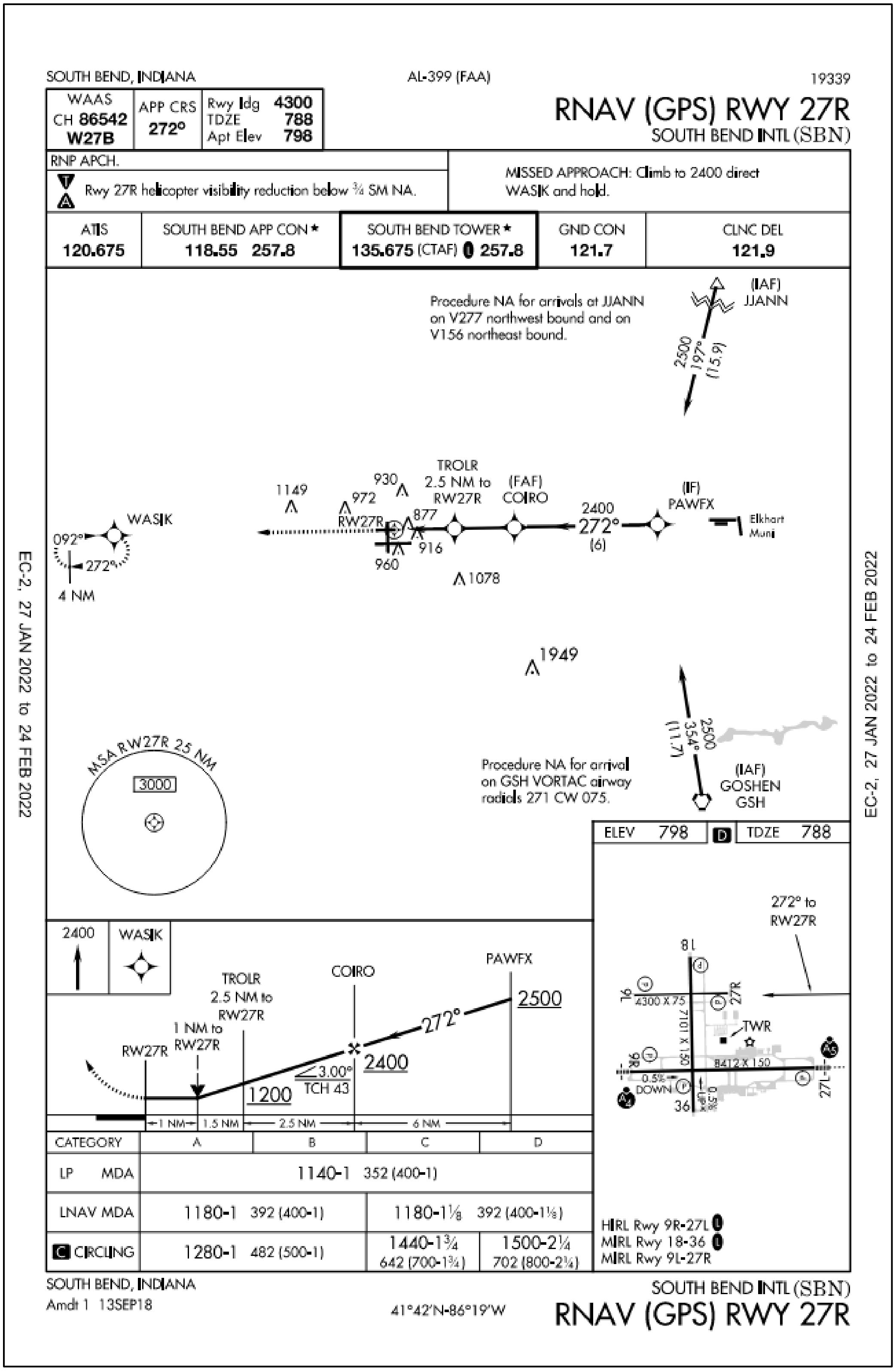
Figure A-7: RNAV (GPS) Runway 27L



CATEGORY	A	B	C	D
LPV DA	1030/24 256 (300-½)			
LNAV/VNAV DA	1160/40 386 (400-¾)			
LNAV MDA	1260/24 486 (500-½)		1260/50 486 (500-1)	
CIRCLING	1280-1 482 (500-1)		1440-1¾ 642 (700-1¾)	1500-2¼ 702 (800-2¼)

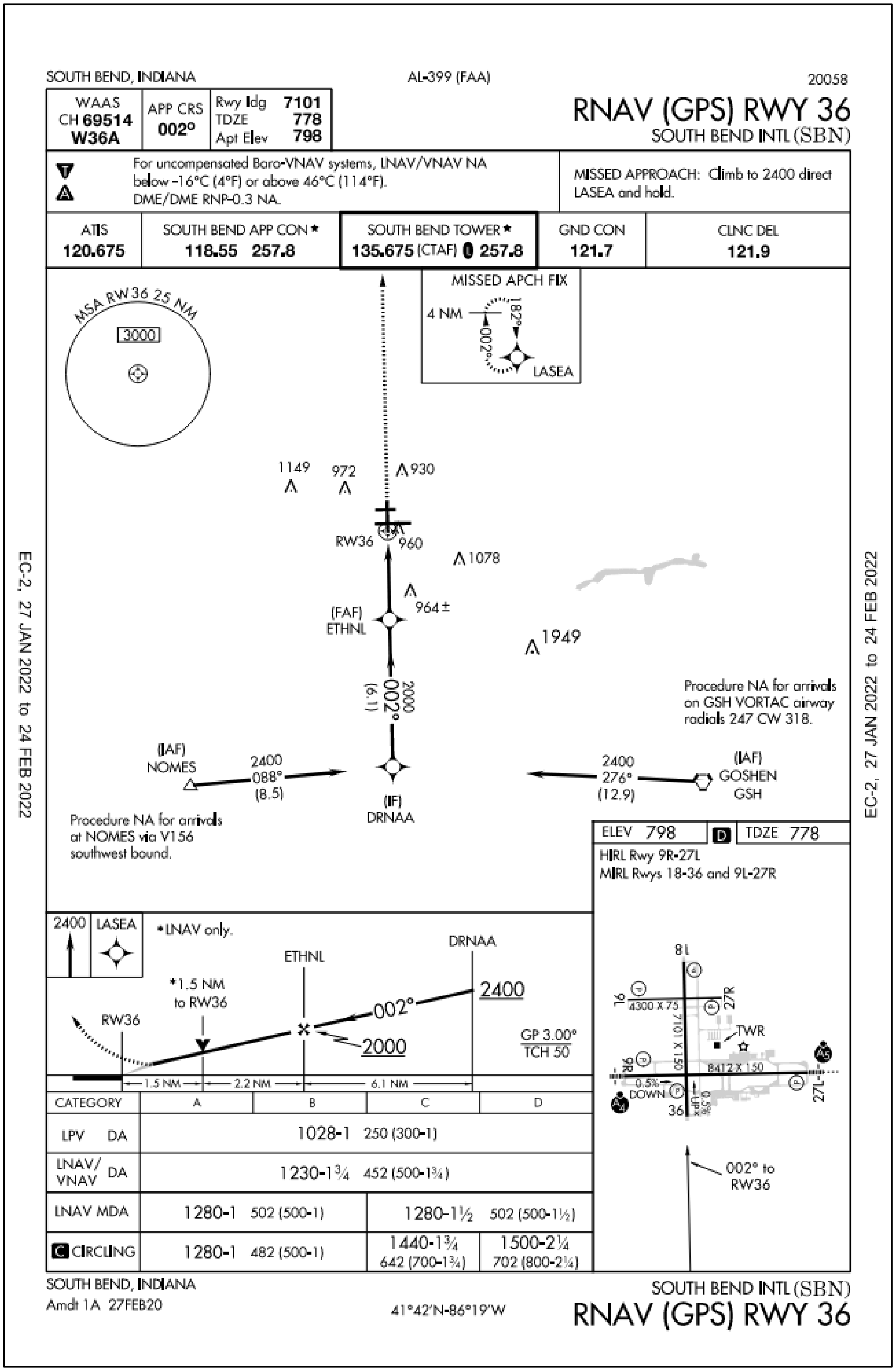
Source: AirNav.com (2022)

Figure A-8: RNAV (GPS) Runway 27R



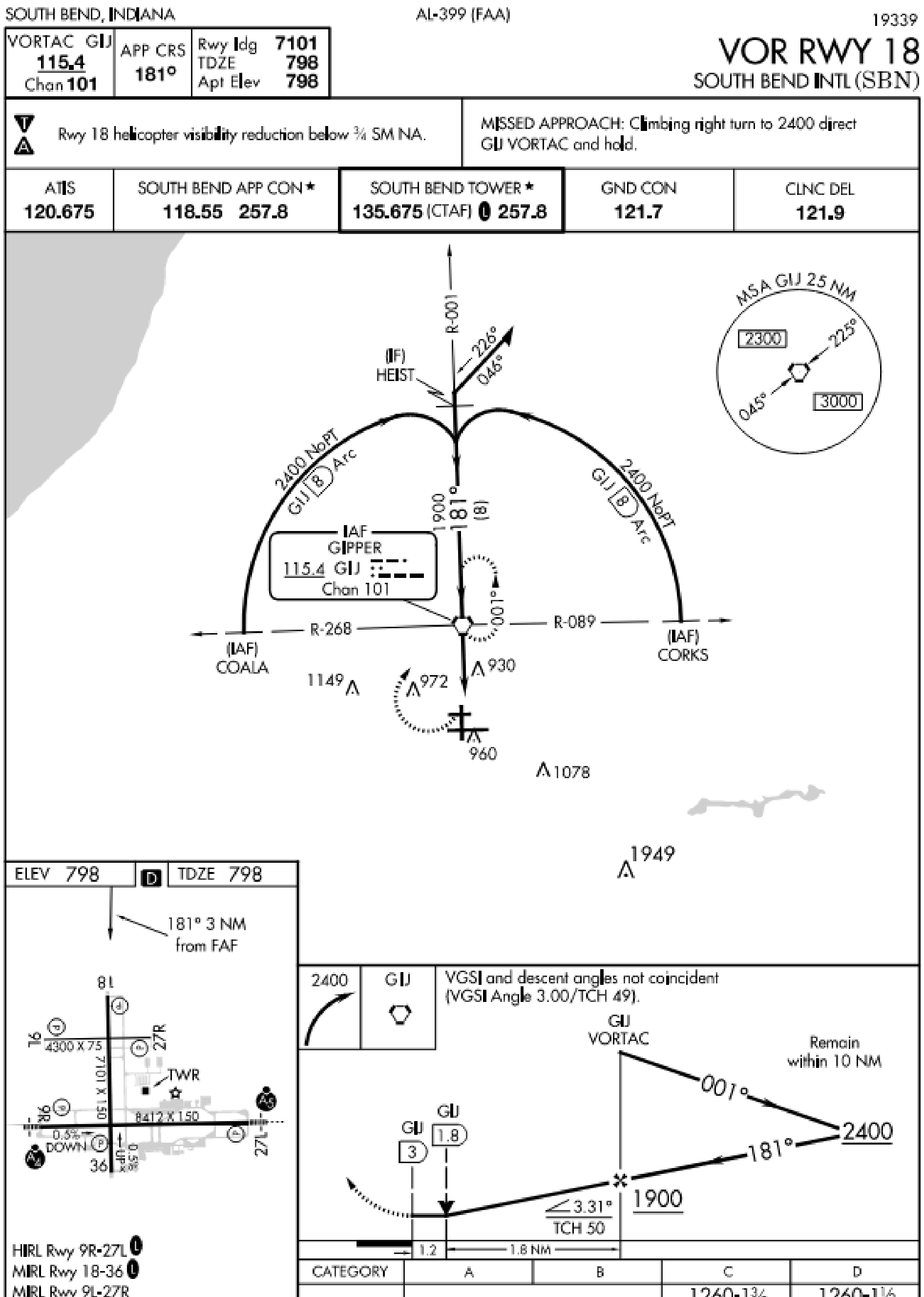
Source: AirNav.com (2022)

Figure A-9: RNAV (GPS) Runway 36



Source: AirNav.com (2022)

Figure A-10: VOR Runway 18



FAF to MAP 3 NM					
Knots	60	90	120	150	180
Min:Sec	3:00	2:00	1:30	1:12	1:00

CATEGORY	A	B	C	D
S-18	1260-1	462 (500-1)	1260-1⅜ 462 (500-1⅜)	1260-1½ 462 (500-1½)
CIRCLING	1280-1	482 (500-1)	1440-1¾ 642 (700-1¾)	1500-2¼ 702 (800-2¼)

SOUTH BEND, INDIANA
Amdt 7E 13SEP18
41°42'N-86°19'W
SOUTH BEND INTL (SBN)
VOR RWY 18

Source: AirNav.com (2022)

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Appendix B

Aircraft Performance Calculations for Estimating Runway Length Requirements

Chapter 3: Facilities Requirements provided an overview of the basis for runway length requirements and referred the reader to this appendix for a more detailed explanation of the process. This appendix explains the assumptions, methods, and conclusions reached for the runway length analysis of the primary runway at SBN. This analysis of Runway 9R/27L evaluated the runway length requirements for postulated long-distance air cargo service from SBN.

Several factors drive the runway length an aircraft needs to operate safely. In general, aircraft takeoff performance is more demanding than aircraft landing performance, so this analysis evaluates runway length required based on takeoff performance. Additional factors that can influence the runway length needed include environmental factors and factors within the control of the flight crew.

Environmental factors include temperature, air pressure, wind velocity, and runway contaminants, such as rain or ice. Temperature and pressure influence the density of the air, which affects aircraft and engine performance. With denser air, engine performance increases, producing greater thrust, and aircraft wings generate greater lift, resulting in less runway length needed for takeoff.

Wind velocity also impacts aircraft performance, with headwinds improving takeoff performance and tailwinds decreasing it. Likewise, environmental contaminants on the runway slow the acceleration of an aircraft taking off, degrading its performance. Another runway characteristic affecting takeoff performance is runway gradient. Runways that slope upwards impede aircraft takeoff performance, while those that slope downward improve it.

While the flight crew has limited or no ability to alter these conditions, they need to account for all these factors when determining the runway length needed for their aircraft to depart.

Finally, the type of aircraft, including the aircraft's specific engine model for larger commercial aircraft, and its takeoff weight, are major determinants in assessing the takeoff runway length required. For this analysis, the critical factor for required runway length is the aircraft takeoff weight, a factor that the flight crew can control.

In very basic terms, an aircraft needs sufficient runway length to reach the flying speed that generates the lift necessary to overcome the aircraft's total weight. Heavier aircraft need more airspeed to get into the air, and, therefore, need longer runways to accelerate to the appropriate airspeed.

The weight of an aircraft depends on several factors, but the biggest variables are typically required fuel (including reserves) and payload, which is the cargo, baggage, and any passengers. The amount of fuel an aircraft needs to fly a certain distance is not fixed. A heavier aircraft needs more fuel than a lighter aircraft to fly the same distance, because a heavier aircraft requires more thrust to keep the heavier weight aloft, and this burns fuel faster. So, as the payload an aircraft carries increases, so does the fuel needed for a given distance. At some point, the aircraft reaches its maximum fuel capacity, and the only way to increase its range is to reduce its weight. The crew generally accomplishes this by reducing the payload carried.

What is perhaps counterintuitive is that as aircraft weight is reduced to increase range, the runway length needed for departure decreases. Under these conditions, an aircraft will need less runway to reach a more distant destination but will sacrifice payload to do so. This tradeoff between range and aircraft takeoff weight will be illustrated in the example provided later in this appendix.

The runway length requirement process begins with the selection of several air cargo aircraft in common use for international trade for which performance planning charts are available. These are not the only aircraft capable of providing air cargo service from SBN to the destinations of interest, but they are representative of the performance generally expected from this class of aircraft. As explained in Chapter 3: Facilities Requirements*,* several long-range aircraft were selected to estimate their runway length requirements when flying to Incheon International Airport, Pudong International Airport, and Hong Kong International.

B.1 Aircraft Evaluated

Various models of Boeing 747 and 767 aircraft were chosen to provide a representative range of performance for aircraft commonly used in international air cargo operations. Three models of Boeing 747 were selected for analysis. These models were the 747-200C in an all-cargo configuration, the 747-400 Freighter, and the 747-8F.

The 747-200C can convert between all-passenger and all-cargo configurations, as well as combination configurations that accommodate both passengers and cargo. In the all-cargo configuration, the 747-200C functions as a main-deck cargo carrier with a main deck nose door. The 747-400 Freighter is equipped with a main deck nose door and a mechanized cargo handling system, making it tailored for air cargo operations. The 747-8F is similar to the 747-400 Freighter, but has a longer fuselage, increased wingspan, and greater weight limits for takeoff, landing, payload, and fuel capacity.

Additionally, three models of Boeing 767 were selected for analysis. These models were the 767-200ER in an all-cargo configuration, the 767-300 Freighter, and the 767-400ER.

The 767-200ER is a passenger airline equipped with a large forward cargo door that permits loading of cargo pallets. The 767-300 Freighter is equipped with a main deck cargo door allowing it to load cargo containers and pallets on its main deck. The 767-400ER is similar to the 767-300, but has a longer fuselage, redesigned wings, new engines, and greater weight limits for takeoff, landing, payload, and fuel capacity.

Having selected the aircraft for analysis, the next step is to refer to the performance charts to determine the weight of the aircraft based on the distance to the destination, taking into account any limiting operating criteria. This aircraft weight is used to determine runway length and how much cargo the aircraft can transport. Before referring to the performance charts, it is useful to define certain aircraft operating terms and how they relate to each other in a performance calculation.

B.2 Operating Limits for Aircraft Operating on Long Range Routes

When determining if an aircraft can operate between two airports from a given runway, there are several limitations that must be considered. Examples of these limitations include the aircraft's maximum takeoff weight, and the aircraft's fuel capacity. These aircraft operating limits are explained below in more detail. There are other considerations that may limit an aircraft's ability to operate between two points. Examples include the aircraft's tire speed limit and brake energy restrictions (i.e., the brakes are designed to safely decelerate up to a certain amount of aircraft speed, beyond which they may fail). None of these other limits were reached in this analysis and are not discussed in any additional detail.

The aircraft operating limits that must be considered are as follows:

- Maximum Design Taxi Weight - This is an aircraft weight limit for ground maneuvers. For large aircraft, it is typically several thousand pounds more than the MTOW limit to account for fuel burned while taxiing to the runway.

- Maximum Design Takeoff Weight (MTOW) - Every aircraft has a MTOW that it must adhere to when operating safely. This upper limit of weight is typically the reason an aircraft trades payload for fuel since the combination of the two together, plus the aircraft's operating empty weight (see below) are not allowed to exceed its MTOW.

- Maximum Design Landing Weight - This is the maximum weight at which a standard landing can be conducted and is based on the aircraft structural strength.

- Maximum Design Zero Fuel Weight - This aircraft limit describes the maximum weight of the aircraft, including payload, but without usable fuel.

- Operating Empty Weight (OEW) - The OEW of the aircraft plus any payload cannot exceed the maximum design zero fuel weight. The OEW is the weight of the aircraft structure, engines, unusable fuel, and integral equipment of the aircraft (in other words, the weight of the aircraft before fuel and payload are loaded).

- Usable Fuel Capacity - This is the maximum amount of fuel, expressed in pounds, available for aircraft propulsion.

- Maximum Structural Payload - An aircraft is also limited in the absolute weight of payload that it can carry. The payload is the weight of the passengers, baggage, and cargo. Exceeding this maximum limit, even if the aircraft is not at its MTOW, may compromise the structural integrity of the aircraft, or exceed the aircraft’s weight and balance limits.

B.3 Required Runway Lengths for Primary Runway

The method used to determine the required runway lengths for the aircraft described above relied on the information provided in *Boeing’s Airplane Characteristics for Airport Planning* documents for each aircraft, which are for general airport planning purposes. Actual operational performance is dependent upon each airline’s specific aircraft configuration and its approved operations manual. The runway lengths determined in this document also are for planning purposes only.

The basic procedure involves using performance charts for a specific airframe and engine combination that convert the distance to a destination (aircraft range on the chart) to both an aircraft takeoff weight (often labeled as brake-release gross weight on the chart), and the combined weight of OEW plus payload, accounting for aircraft operating limits. As noted above, the OEW plus payload cannot exceed the maximum design zero fuel weight limit.

Brake-release gross weight is used to determine required runway length, and the OEW plus payload is used to establish how much cargo can be transported. These charts take into account the various environmental and other factors explained above, either by adjusting for the factor or making an assumption regarding the factor. For example, all of the performance charts assumed that there was no wind, no runway gradient, and no runway contamination. Different charts allowed for calculating aircraft performance at two different temperatures (standard day and hot day), giving a range of required runway lengths.

To illustrate the process, an example performance calculation using the Boeing 747-200C to three Far East destinations is used – Incheon International Airport (ICN), Pudong International Airport (PVG), and Hong Kong International (HKG). The process starts with compiling the operating limitations for the aircraft of interest. **Table B-1** lists the 747-200C operating limits.

Table B-1: Boeing 747-200C with GE CF6-50E2 Engines Operating Limits

Aircraft Characteristic	Operating Limit (lbs.)
Maximum Design Taxi Weight	823,000
Maximum Design Takeoff Weight	820,000
Maximum Design Landing Weight	630,000
Maximum Design Zero Fuel Weight	590,000
Operating Empty Weight	367,620
Usable Fuel Capacity	348,630
Maximum Structural Payload	222,380

Source: *747 Airport Characteristics Airport Planning*, Boeing Commercial Airplane Company.

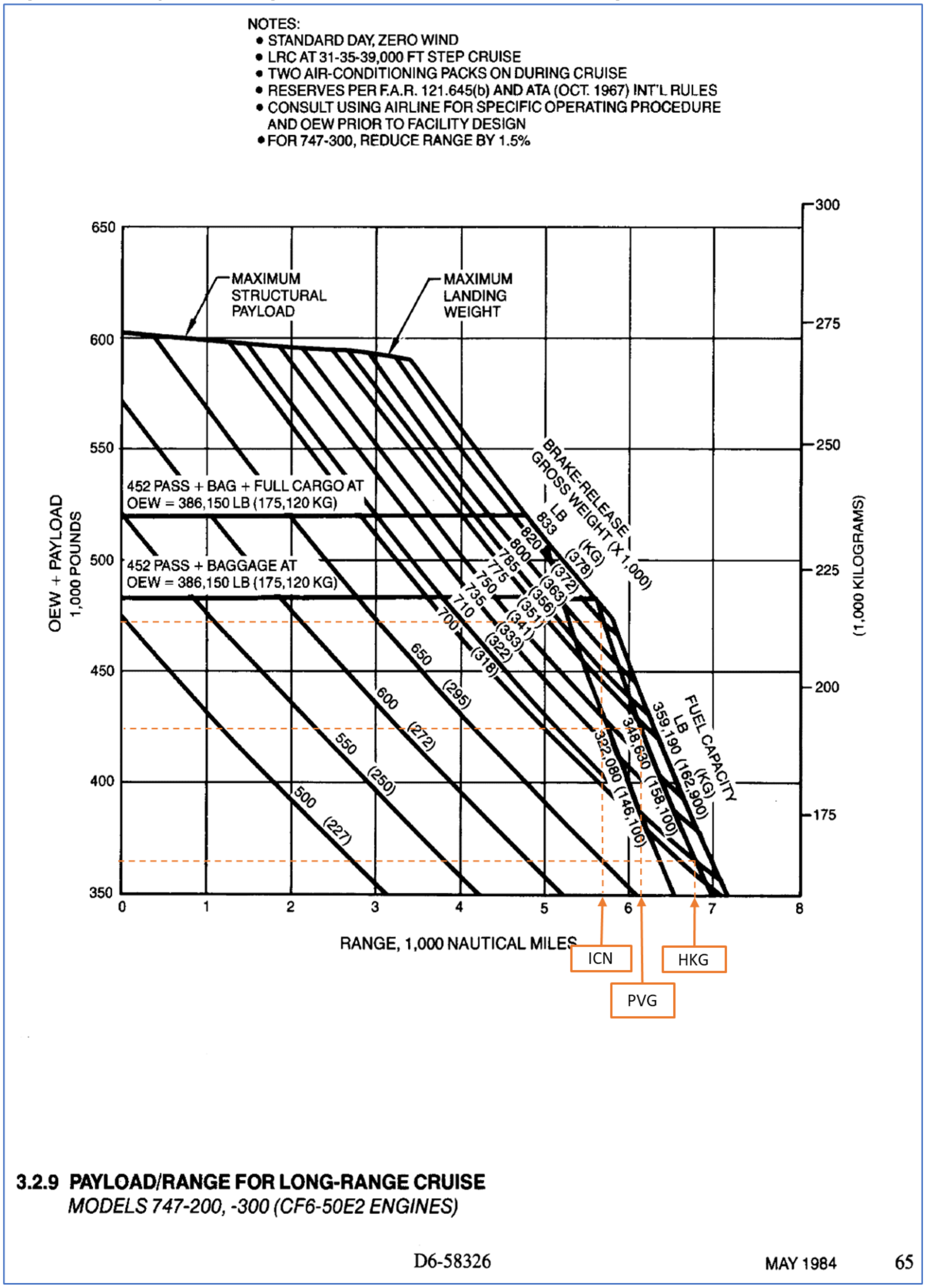
Starting with the payload/range performance chart, as shown in **Figure B-1**, the user begins on the horizontal axis of this chart. The user finds the distance to the destination on the horizontal axis (marked as Range in 1,000 of Nautical Miles) and follows that range vertically until hitting an aircraft limitation as marked on the chart. Several aircraft operating limits are shown on the chart. On the left side (which depicts shorter ranges), the chart denotes the maximum structural payload limit. As range increases, the most limiting factor becomes maximum landing weight. Beyond a range of about 3,400 nautical miles (where the curves turn downward), the MTOW (labeled brake-release gross weight), becomes the limiting factor. As the range approaches 6,000 nautical miles, fuel capacity limits are the most constraining.

Since this chart is used for several Boeing 747 models, the user needs to keep in mind the limits for the particular aircraft being analyzed. For example, the chart shows a maximum fuel capacity of 359,190 pounds (lbs.). However, the Boeing 747-200C has a maximum fuel capacity of only 348,630 lbs. (as shown in Table B-1), which is conveniently labeled on the performance chart below the maximum fuel capacity line.

The distance to each of the three Far East destinations are marked on the horizontal axis of the performance chart. For PVG and HKG, the line travels vertically until hitting the 747-200C fuel limit line of 348,630 lbs, indicating that the Boeing 747-200C is fuel limited to those destinations. For ICN, the line travels vertically until it hits the 747-200C MTOW limit line of 820,000 lbs. It is also very close to the fuel capacity limit line for the 747-200C but is slightly below it.

The point where the line hits a limit also determines the aircraft brake-release gross weight. This is read, or interpolated, from the lines that slope downward from left to right and are labeled "Brake-Release Gross Weight (X 1,000)". For example, the brake-release gross weight for HKG is 717,000 lbs., while the brake-release gross weight for PVG is 773,000 lbs. Because it hit its maximum design takeoff weight limit, the brake-release gross weight for ICN is 820,000 lbs., matching what is shown in Table B-1. This clearly illustrates how, in order to reach longer range destinations, the aircraft trades weight for range since the same amount of fuel can transport a lighter aircraft farther than a heavier aircraft. By keeping the brake-release gross weight below the MTOW, the Boeing 747-200C is able to reach more distant destinations, such as PVG and HKG.

Figure B-1: Payload/Range Performance Chart for Boeing 747-200C



Source: *747 Airport Characteristics Airport Planning*, Boeing Commercial Airplane Company.

After hitting the appropriate aircraft limit, the line travels horizontally to the vertical axis of the payload/range performance chart to determine the combined weight of OEW plus payload. For flights to ICN from SBN, it is estimated that the operating empty weight plus payload is 472,000 lbs. By subtracting the operating empty weight of 367,620 lbs. (from Table B-1) from this figure, the user can determine the payload (weight of cargo transported) is 104,380 lbs.

Required runway length is found from the takeoff runway length chart. **Figure B-2** shows this chart for the 747-200C on a standard day, which is defined as 59° F and barometric pressure of 29.92 inches of mercury at sea level. As can be seen in the chart, the user enters the aircraft brake-release gross weight on the horizontal axis and moves vertically until reaching the pressure altitude of the departure airport. In the case of SBN, the pressure altitude on a standard day is 798 feet. Once the user reaches the applicable pressure altitude, the line moves horizontally over to the vertical axis where the takeoff runway length is read.

For example, a 747-200C flying to ICN departs SBN with a brake-release gross weight of 820,000 lbs. (its MTOW) and, at a pressure altitude of 798 feet, needs approximately 10,700 feet of runway length for takeoff on a standard day. The same aircraft flying to HKG, which is a farther distance so the aircraft is lighter, would depart with a brake-release gross weight of 717,000 lbs. and need only approximately 7,400 feet of runway length for takeoff. It does so by sacrificing payload, since it can only carry approximately 380 pounds of payload to HKG as compared to the 104,380 pounds it can carry to ICN.

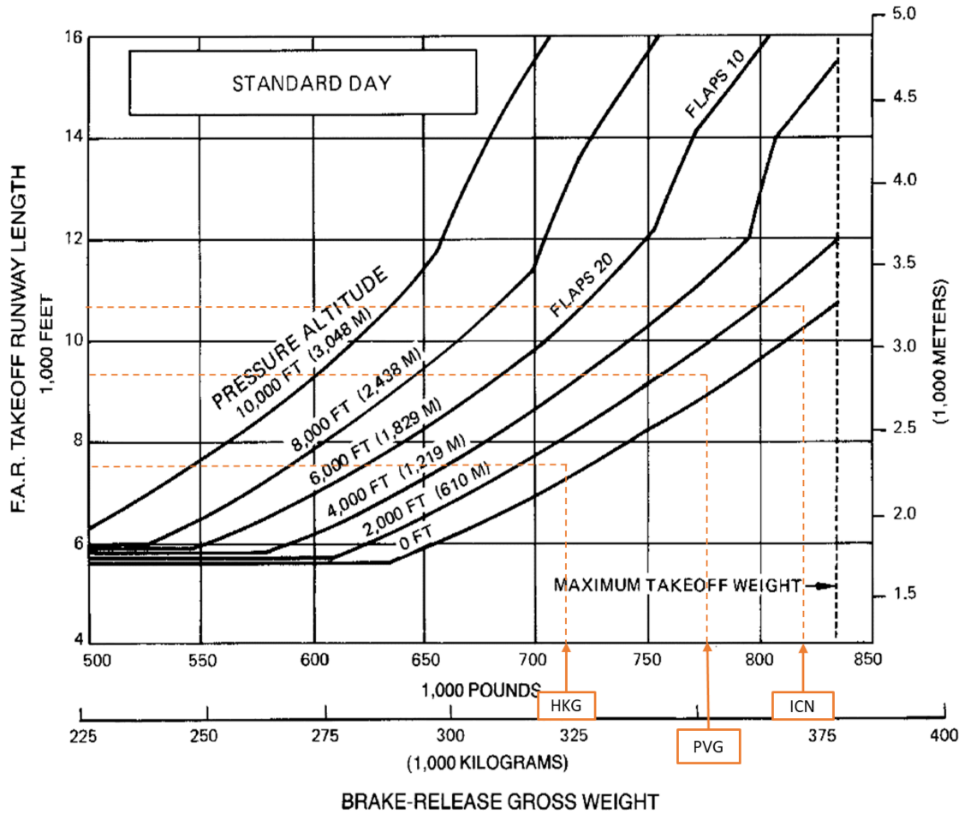
The Boeing performance charts also demonstrate runway length requirements under adverse temperature conditions. **Figure B-3** shows the required runway length required for takeoff on a day when temperatures are 27° F hotter than a standard day, resulting in a temperature of 86° F. The hotter temperature makes the air less dense, which degrades both engine performance and the ability of the wing to generate lift.

The same procedure is used as the standard day performance chart, but the curves have been adjusted to reflect the lower performance obtained from the aircraft due to the less dense air. For example, at its MTOW, the 747-200C on a day with temperatures at 86° F would need an additional 1,000 feet of runway, or 11,700 feet in total, to safely operate to ICN.

The payload for each flight was determined from the OEW plus payload number obtained from the range/payload chart. For example, the Boeing 747-200C flying to ICN was found to have an OEW plus payload of 472,000 pounds. The OEW of a Boeing 767-200C is 367,620 pounds (see **Table B-2**), which leaves 104,380 pounds for payload.

Figure B-2: Takeoff Runway Length (Standard Day) Performance Chart for Boeing 747-200C

NOTES:
- CONSULT USING AIRLINE FOR SPECIFIC OPERATING PROCEDURE PRIOR TO FACILITY DESIGN.
- AIR CONDITIONING OFF, ONE A/C PACK MAY BE OPERATED BY THE APU WITH NO THRUST PENALTY.
- ZERO RUNWAY GRADIENT



3.3.17 F.A.R. TAKEOFF RUNWAY-LENGTH REQUIREMENTS STANDARD DAY

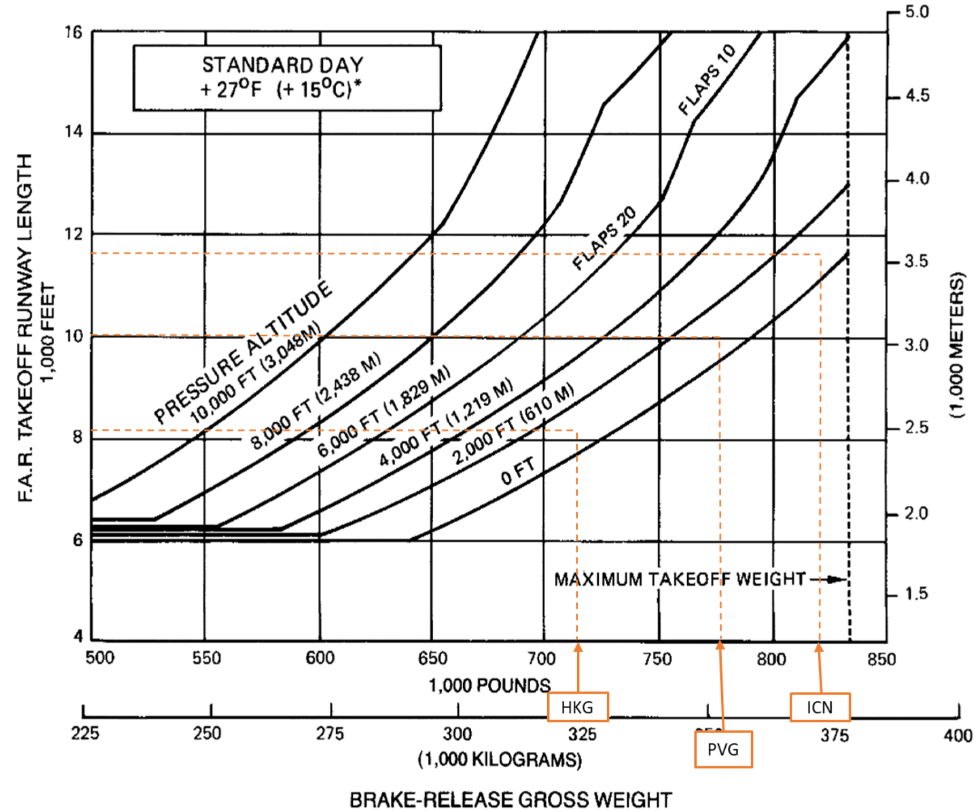
MODELS 747-200, -300(CF6-50E2 ENGINES)

88 MAY 1984 D6-58326

Source: *747 Airport Characteristics Airport Planning*, Boeing Commercial Airplane Company.

Figure B-3: Takeoff Runway Length (Hot Day) Performance Chart for Boeing 747-200C

NOTES:
- CONSULT USING AIRLINE FOR SPECIFIC OPERATING PROCEDURE PRIOR TO FACILITY DESIGN.
- AIR CONDITIONING OFF. ONE A/C PACK MAY BE OPERATED BY THE APU WITH NO THRUST PENALTY.
- ZERO RUNWAY GRADIENT



* THE CF6-50E2 ENGINE IS FLAT RATED TO STD + 27°F (+ 15°C).

3.3.18 F.A.R. TAKEOFF RUNWAY-LENGTH REQUIREMENTS
STANDARD DAY +27°F (+15°C)*
MODELS 747-200, -300 (CF6-50E2 ENGINES)

D6-58326 MAY 1984 89

Source: *747 Airport Characteristics Airport Planning*, Boeing Commercial Airplane Company.

Table B-2: Boeing Aircraft Operating Characteristics

Aircraft	Engine	Max Design Taxi Weight (in lbs.)	Max Design Takeoff Weight (in lbs.)	Max Design Landing Weight (in lbs.)	Max Design Zero Fuel Weight (in lbs.)	Operating Empty Weight (in lbs.)	Max Structural Payload (in lbs.)	Usable Fuel Capacity (in lbs.)
767-200ER	PW4056	388,000	387,000	285,000	260,000	181,610	78,390	161,738
767-300F	PW4060	413,000	412,000	326,000	309,000	188,100	120,900	161,740
767-400ER	PW4062	451,000	450,000	350,000	330,000	229,000	101,000	161,738
747-200C	CF6-50E2	823,000	820,000	630,000	590,000	367,620	222,380	348,635
747-400F	CF6-80C2B1F	877,000	875,000	666,000	635,000	363,954	271,046	382,336
747-8F	GEnx-2B67	990,000	987,000	763,000	727,000	434,600	292,400	400,218

Source: *Airplane Characteristics for Airport Planning*, Boeing Commercial Airplane Company.

The process described above was used to determine the range of runway requirements for the various aircraft and the destinations analyzed. Table B-2 shows the data for these aircraft. **Table B-3** shows the results of the analysis.

In addition to runway length requirements for flights to the Far East, the Boeing 767 aircraft was evaluated for runway length requirements to Ted Stevens Anchorage International Airport.

The payload/range and takeoff runway length charts for the other Boeing aircraft are found immediately following Table B-3. **Figures B-4** through **B-27** feature the performance characteristics of the Boeing 767 and Boeing 747 aircraft evaluated in this analysis. Each chart is marked to indicate the numbers used in evaluating the runway length required for these aircraft to operate from SBN to the respective destinations.

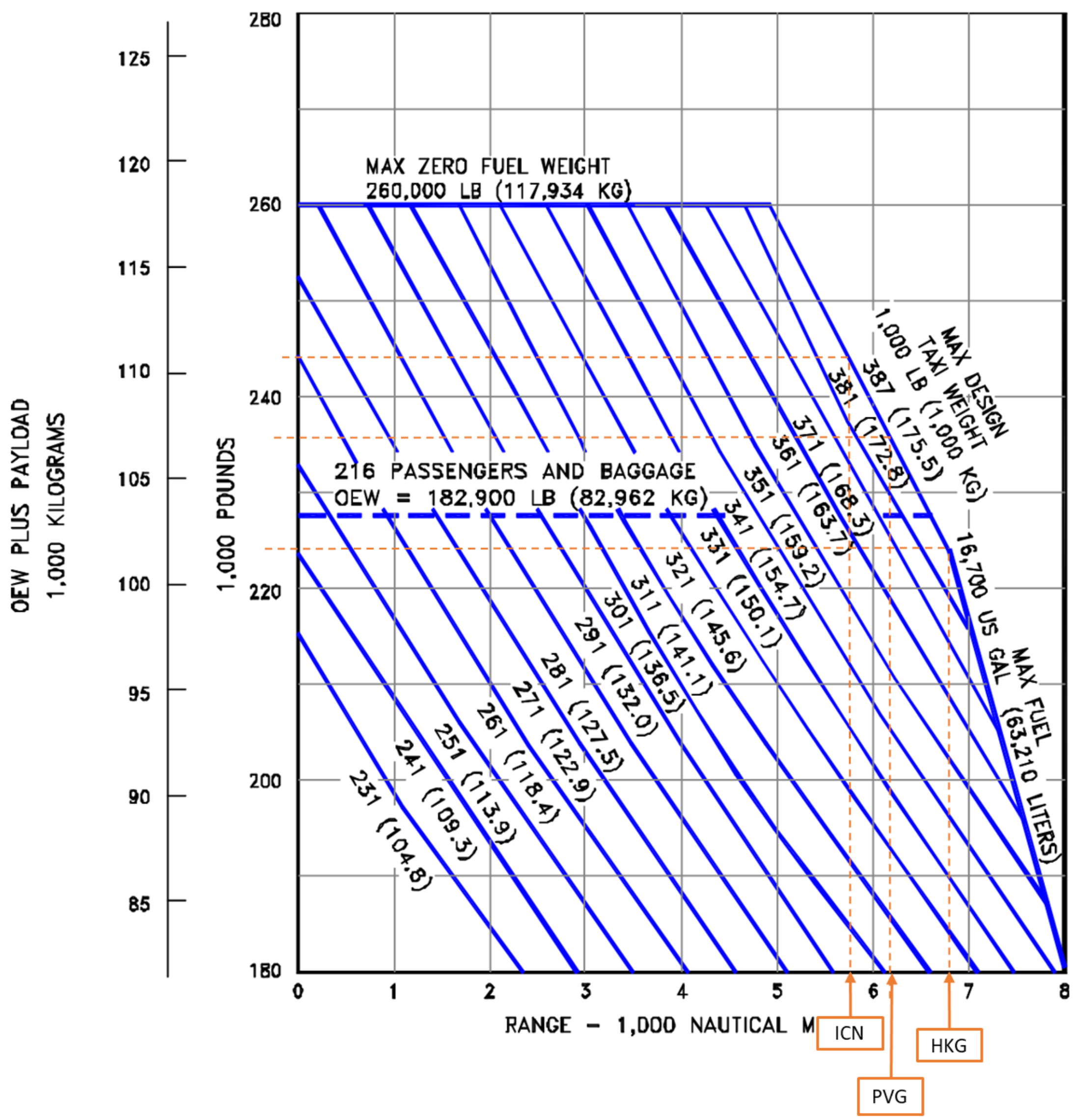
Table B-3: Boeing Aircraft Performance to Air Cargo Destinations

Aircraft and Destination	Distance from SBN (nautical miles)	Takeoff Weight (lbs.)	OEW plus Payload (lbs.)	Fuel Weight (lbs.)	OEW (lbs.)	Payload (lbs.)	Required Runway (feet)	
							Standard Day	Hot Day
767-200ER								
ANC[1]	2,532	339,500	260,000	79,500	181,610	78,390	6,400	6,800
ICN[2]	5,738	387,000	243,000	144,000	188,100	54,900	9,600	10,000
PVG[2]	6,177	387,000	236,000	151,000	188,100	47,900	9,600	10,000
HKG[2]	6,813	387,000	225,400	161,600	188,100	37,300	9,600	10,000
767-300F								
ANC[1]	2,532	391,000	309,000	82,000	188,100	120,900	8,500	8,800
ICN[2]	5,738	412,000	258,000	154,000	188,100	69,900	9,800	10,300
PVG[4]	6,177	397,000	236,000	161,000	188,100	47,900	9,000	9,300
HKG[4]	6,813	368,400	207,000	161,400	188,100	18,900	7,200	7,500
767-400ER								
ANC[1]	2,532	413,000	330,000	83,000	229,000	101,000	8,600	9,200
ICN[4]	5,738	434,000	273,000	161,000	229,000	44,000	10,100	11,000
PVG[4]	6,177	407,000	246,000	161,000	229,000	17,000	8,500	9,000
HKG[3]	6,813	Out of Range						
747-200C								
ICN[2]	5,738	820,000	472,000	348,000	367,620	104,380	10,700	11,700
PVG[4]	6,177	773,000	424,000	348,635	367,620	56,380	9,100	9,800
HKG[4]	6,813	717,000	368,000	348,635	367,620	380	7,400	8,000
747-400F								
ICN[2]	5,738	875,000	542,000	333,000	363,954	178,046	11,100	11,800
PVG[2]	6,177	875,000	526,000	349,000	363,954	162,046	11,100	11,800
HKG[2]	6,813	875,000	499,000	376,000	363,954	135,046	11,100	11,800
747-8F								
ICN[2]	5,738	987,000	660,000	327,000	434,600	225,400	10,500	11,100
PVG[2]	6,177	987,000	641,000	346,000	434,600	206,400	10,500	11,100
HKG[2]	6,813	987,000	615,000	372,000	434,600	180,400	10,500	11,100

Source: *Airplane Characteristics for Airport Planning*, Boeing Commercial Airplane Company.
Notes:
Standard day temperature = 59° Fahrenheit at sea level.
Hot day temperatures = 86° Fahrenheit for all aircraft except the 767-200ER and 747-400F, which used 90° Fahrenheit.
SBN airfield elevation is 798 feet mean sea level.
[1] All 767 flights to ANC operate at maximum design zero fuel weight, carrying maximum structural payload.
[2] These aircraft are operating at their MTOW on these routes, trading payload for fuel to increase range.
[3] The 767-400ER does not have sufficient range to reach HKG.
[4] These aircraft are fuel limited on these routes, using their maximum fuel capacity. To increase range, takeoff weight is reduced, which leaves a small payload capacity that is not likely to be economically sustainable.

Figure B-4: Payload/Range Performance Chart, Boeing 767-200ER to the Far East

NOTES:
- 0.80 MACH AT 35,000 AND 39,000 FT (10,668 AND 11,887 METERS)
- ATA DOMESTIC RESERVES
- STANDARD DAY
- TAKEOFF WEIGHTS ARE 1,000 LB (454 KG) LESS THAN TAXI WEIGHTS
- CONSULT USING AIRLINE FOR SPECIFIC OPERATING PROCEDURE PRIOR TO FACILITY DESIGN



3.2.2 PAYLOAD/RANGE FOR LONG-RANGE CRUISE
MODEL 767-200ER

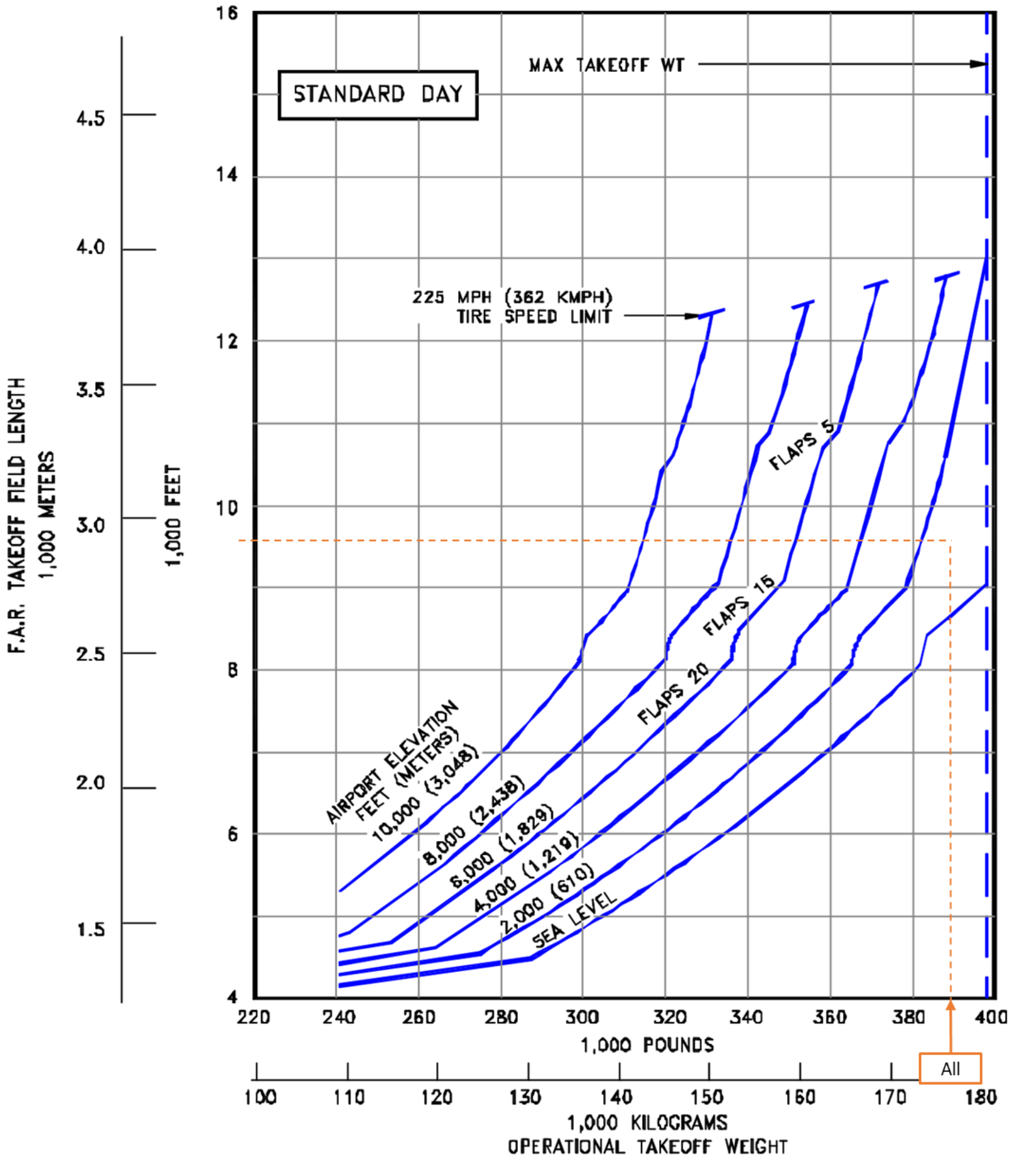
D6-58328

48 SEPTEMBER 2005

Source: *767 Airplane Characteristics for Airport Planning*, Boeing Commercial Airplane Company.

Figure B-5: Takeoff Runway Length (Standard Day) Performance Chart, Boeing 767-200ER to the Far East

NOTES:
- CF6-80C2B4, PW4056, RB211-524G ENGINES
- ZERO RUNWAY GRADIENT
- ZERO WIND
- AIR CONDITIONING OFF
- CONSULT USING AIRLINE FOR SPECIFIC OPERATING PROCEDURE PRIOR TO FACILITY DESIGN



3.3.5 F.A.R. TAKEOFF RUNWAY LENGTH REQUIREMENTS - STANDARD DAY

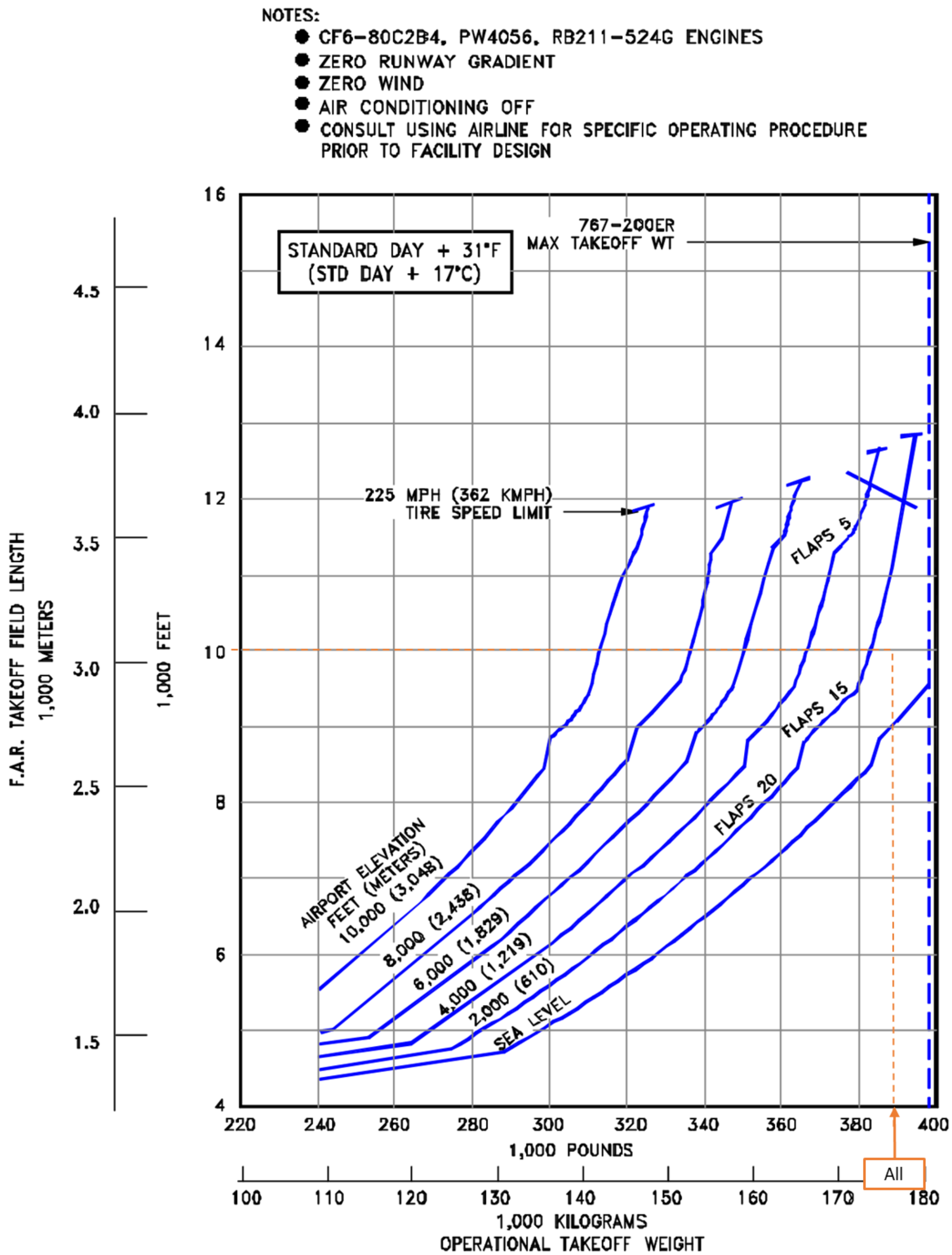
MODEL 767-200ER (CF6-80C2B4, PW4056, RB211-524G ENGINES)

D6-58328

SEPTEMBER 2005 61

Source: *767 Airplane Characteristics for Airport Planning*, Boeing Commercial Airplane Company.

Figure B-6: Takeoff Runway Length (Hot Day) Performance Chart, Boeing 767-200ER to the Far East



3.3.6 F.A.R. TAKEOFF RUNWAY LENGTH REQUIREMENTS

STANDARD DAY + 31^{O}F (STD + 17^{O}C)

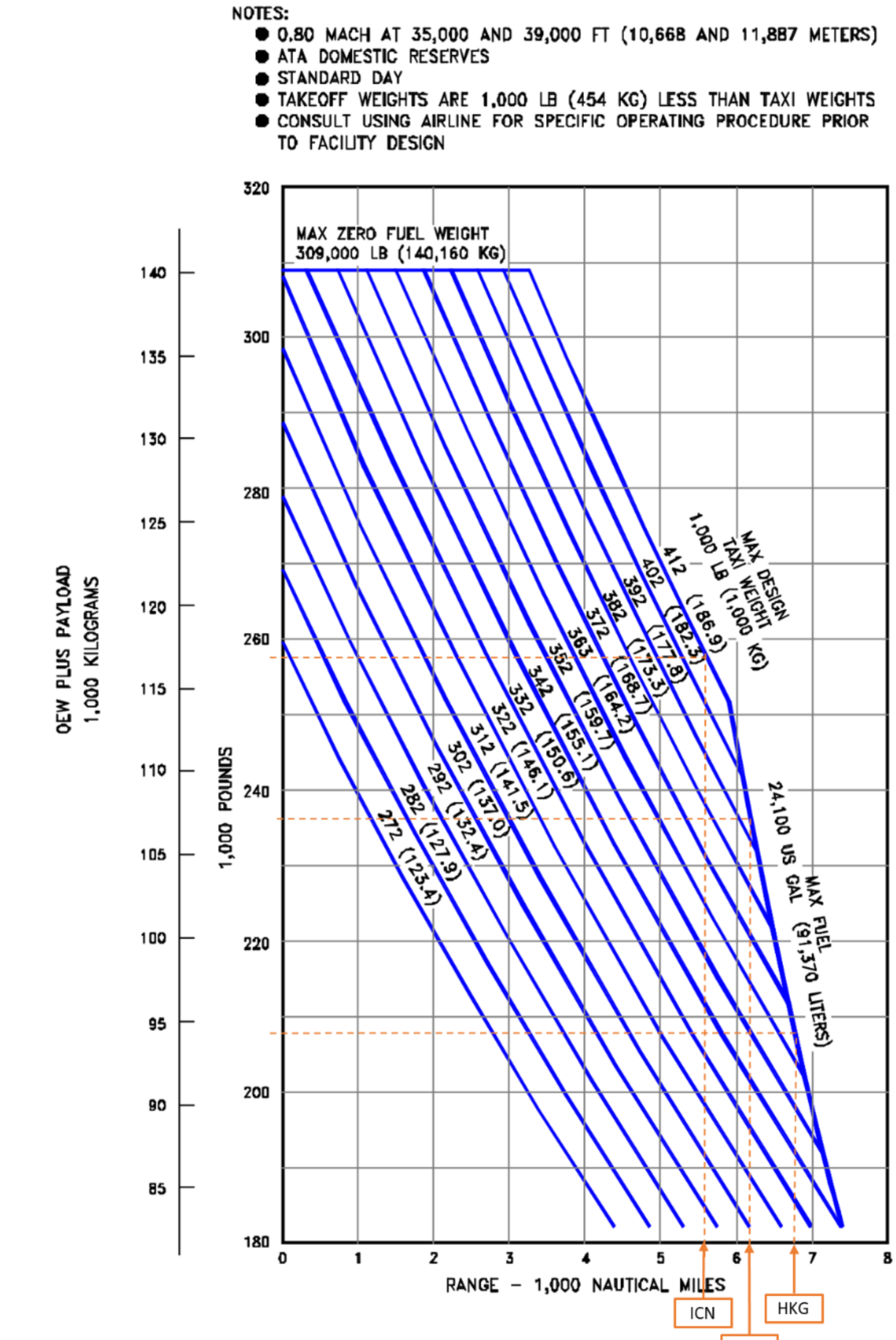
MODEL 767-200ER (CF6-80C2B4, PW4056, RB211-524G ENGINES)

D6-58328

62 SEPTEMBER 2005

Source: *767 Airplane Characteristics for Airport Planning*, Boeing Commercial Airplane Company.

Figure B-7: Payload/Range Performance Chart, Boeing 767-300 Freighter to the Far East



3.2.8 PAYLOAD/RANGE FOR LONG-RANGE CRUISE

MODEL 767-300 FREIGHTER (PW4062 ENGINES)

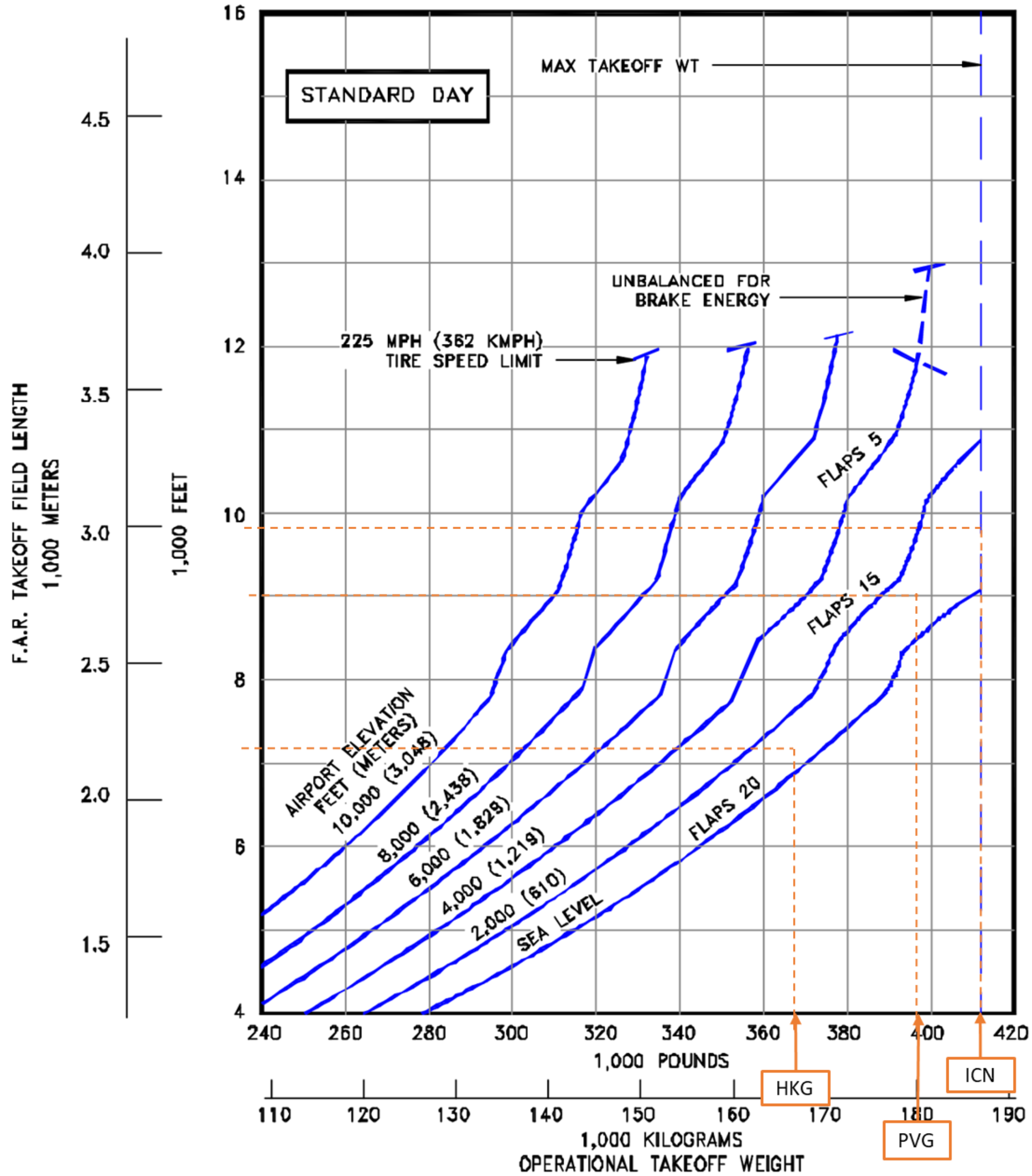
D6-58328

54 SEPTEMBER 2005

Source: *767 Airplane Characteristics for Airport Planning*, Boeing Commercial Airplane Company.

Figure B-8: Takeoff Runway Length (Standard Day) Performance Chart, Boeing 767-300 Freighter to the Far East

NOTES:
- CF6-80C2B6, PW4060, RB211-524H ENGINES
- ZERO RUNWAY GRADIENT
- ZERO WIND
- AIR CONDITIONING OFF
- CONSULT USING AIRLINE FOR SPECIFIC OPERATING PROCEDURE PRIOR TO FACILITY DESIGN



3.3.15 F.A.R. TAKEOFF RUNWAY LENGTH REQUIREMENTS - STANDARD DAY

MODEL 767-300ER, -300 FREIGHTER (CF6-80C2B64, PW4060, RB211-524H ENGINES)

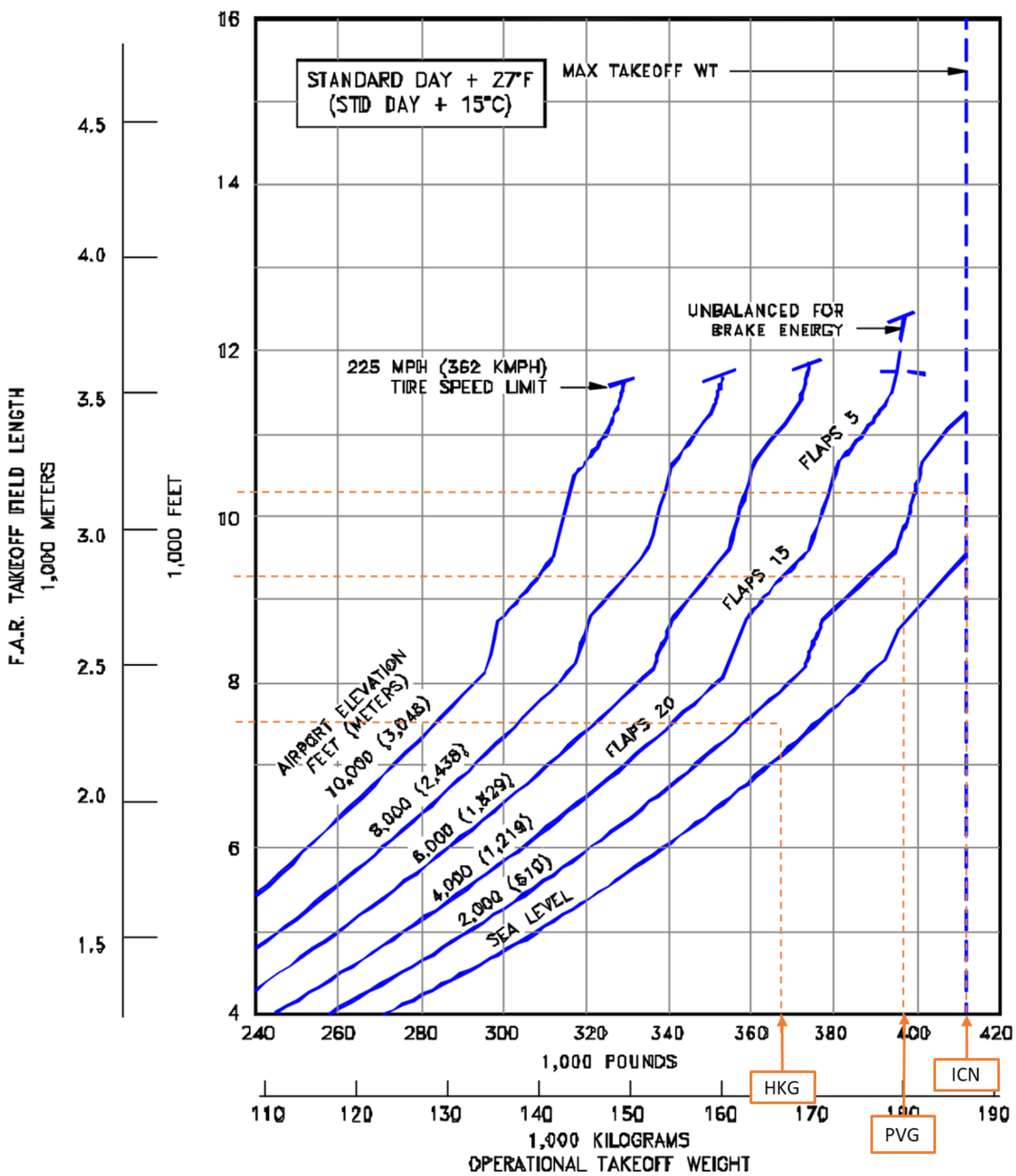
D6-58328

SEPTEMBER 2005 71

Source: *767 Airplane Characteristics for Airport Planning*, Boeing Commercial Airplane Company.

Figure B-9: Takeoff Runway Length (Hot Day) Performance Chart, Boeing 767-300 Freighter to the Far East

NOTES:
- CF6-80C2B6, PW4060, RB211-524H ENGINES
- ZERO RUNWAY GRADIENT
- ZERO WIND
- AIR CONDITIONING OFF
- CONSULT USING AIRLINE FOR SPECIFIC OPERATING PROCEDURE PRIOR TO FACILITY DESIGN



3.3.16 F.A.R. TAKEOFF RUNWAY LENGTH REQUIREMENTS

STANDARD DAY + 27°F (STD + 15°C)

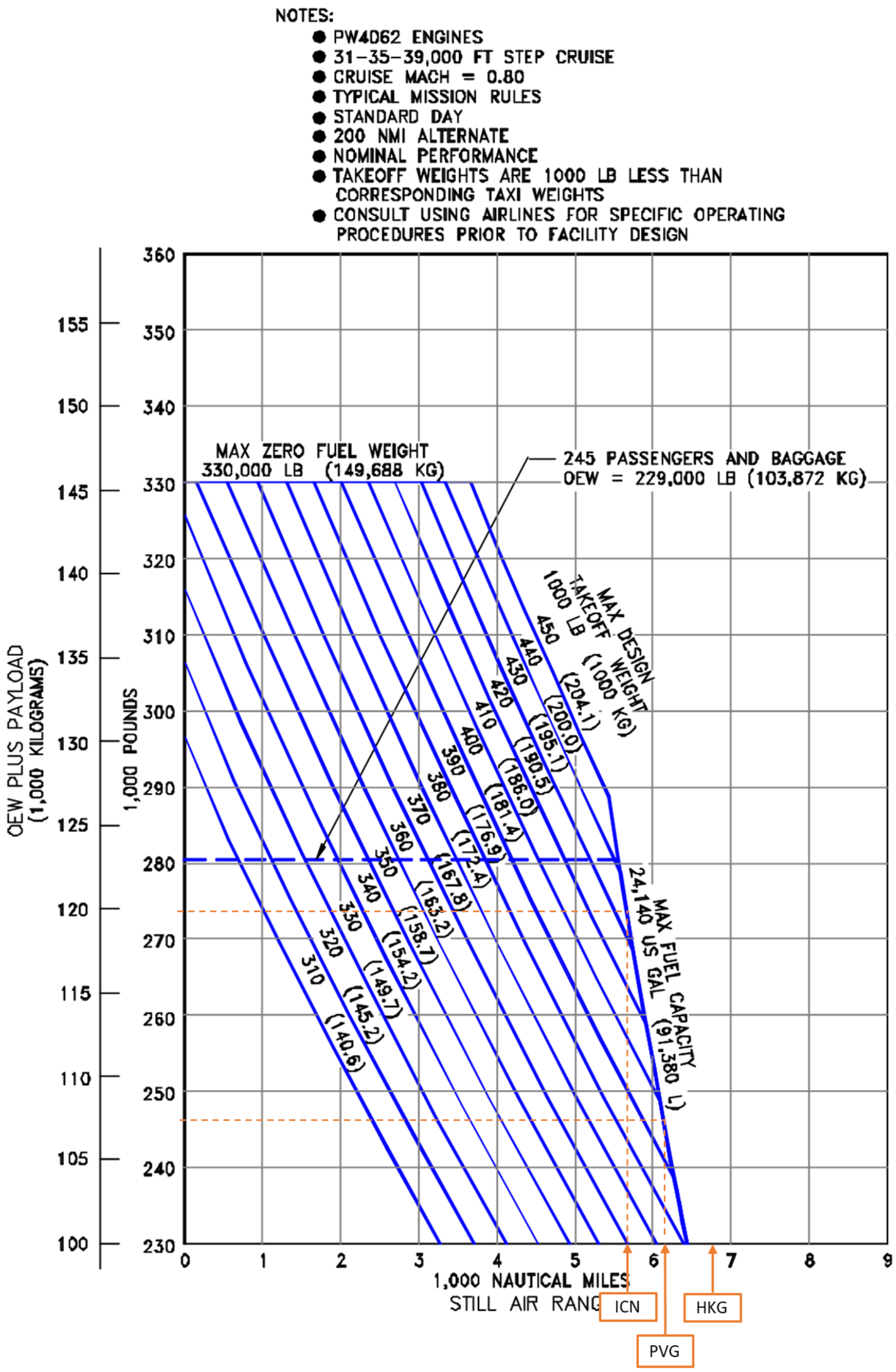
MODEL 767-300ER, -300 FREIGHTER (CF6-80C2B6, PW4060, RB211-524H ENGINES)

D6-58328

72 SEPTEMBER 2005

Source: *767 Airplane Characteristics for Airport Planning*, Boeing Commercial Airplane Company.

Figure B-10: Payload/Range Performance Chart, Boeing 767-400ER to the Far East



3.2.10 PAYLOAD/RANGE FOR LONG-RANGE CRUISE

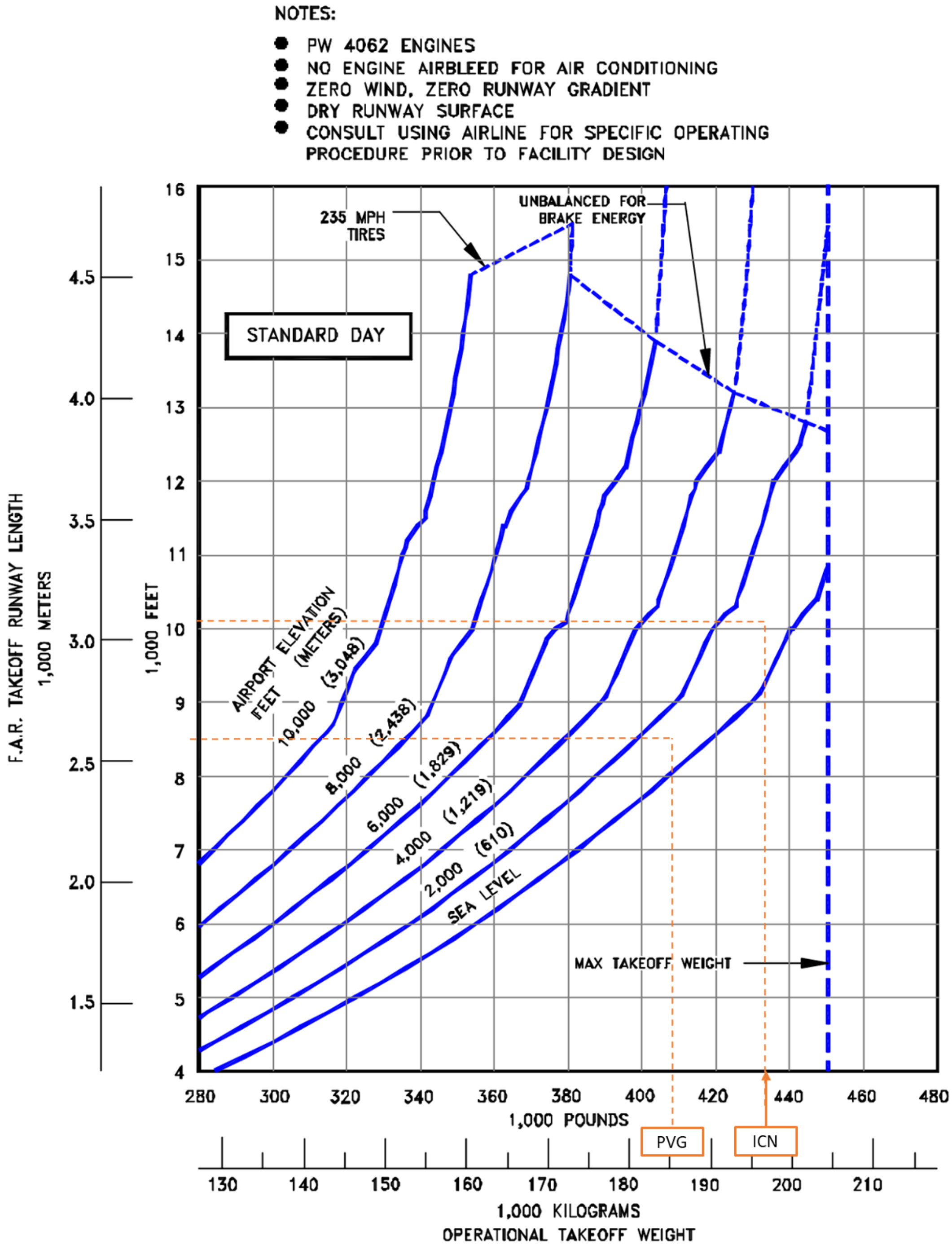
MODEL 767-400ER (PW4062 ENGINES)

D6-58328

56 SEPTEMBER 2005

Source: *767 Airplane Characteristics for Airport Planning*, Boeing Commercial Airplane Company.

Figure B-11: Takeoff Runway Length (Standard Day) Performance Chart, Boeing 767-400ER to the Far East



3.3.33 F.A.R. TAKEOFF RUNWAY LENGTH REQUIREMENTS - STANDARD DAY, DRY RUNWAY SURFACE

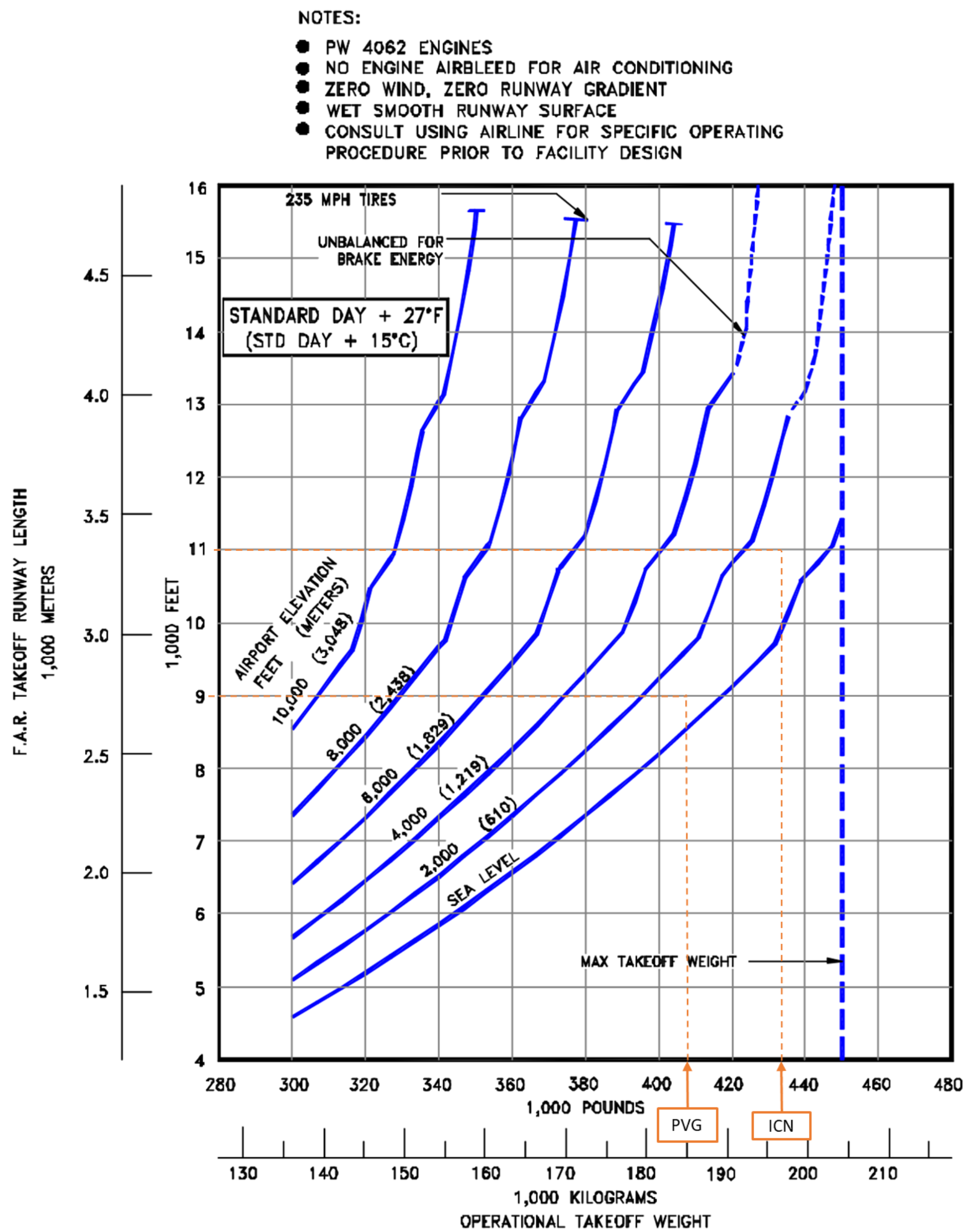
MODEL 767-400ER (PW4062 ENGINES)

D6-58328

SEPTEMBER 2005 89

Source: *767 Airplane Characteristics for Airport Planning*, Boeing Commercial Airplane Company.

Figure B-12: Takeoff Runway Length (Hot Day) Performance Chart, Boeing 767-400ER to the Far East



3.3.36 F.A.R. TAKEOFF RUNWAY LENGTH REQUIREMENTS

STANDARD DAY + 27°F (STD + 15°C), WET SMOOTH RUNWAY SURFACE

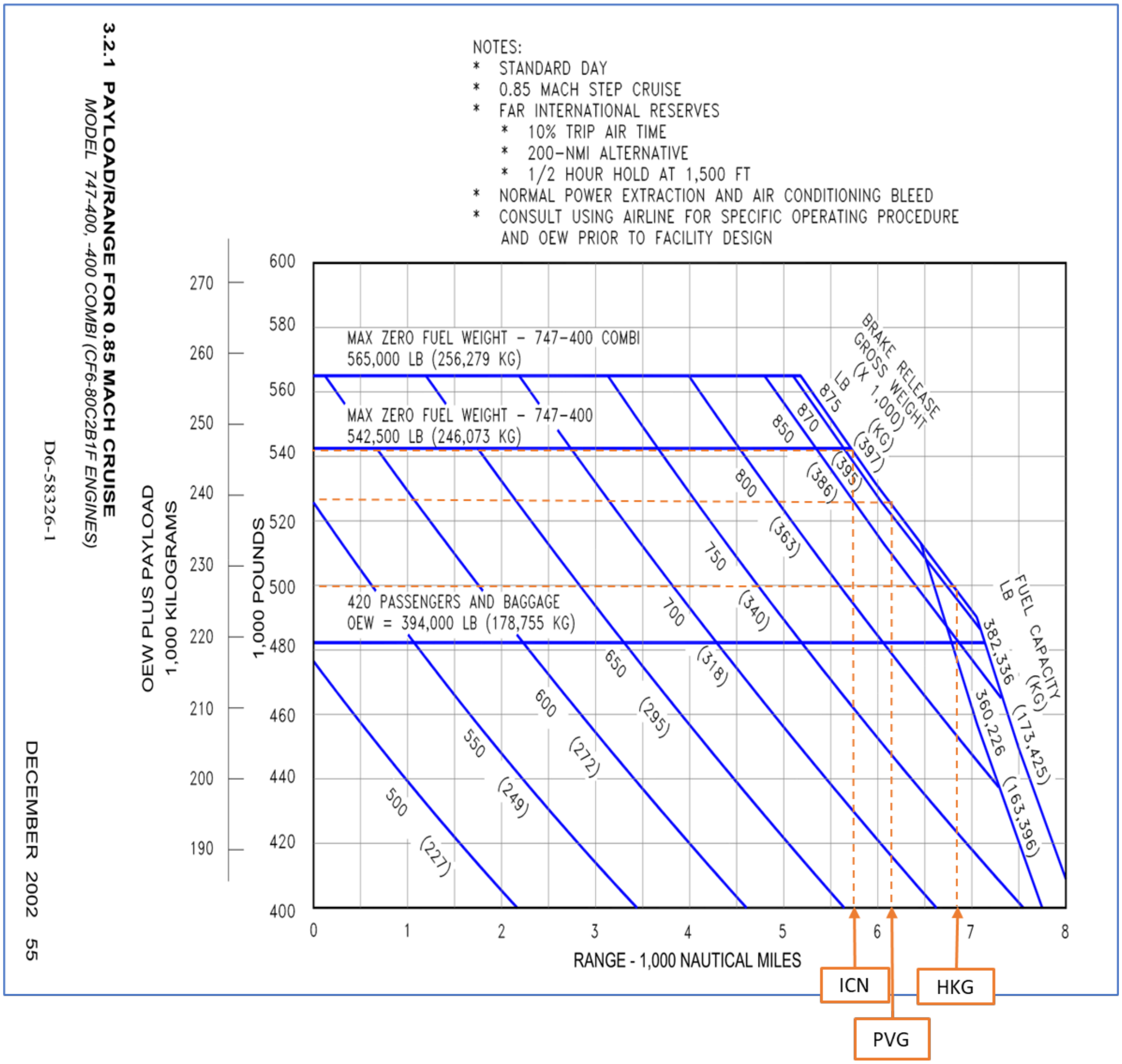
MODEL 767-400ER (PW4062 ENGINES)

D6-58328

92 SEPTEMBER 2005

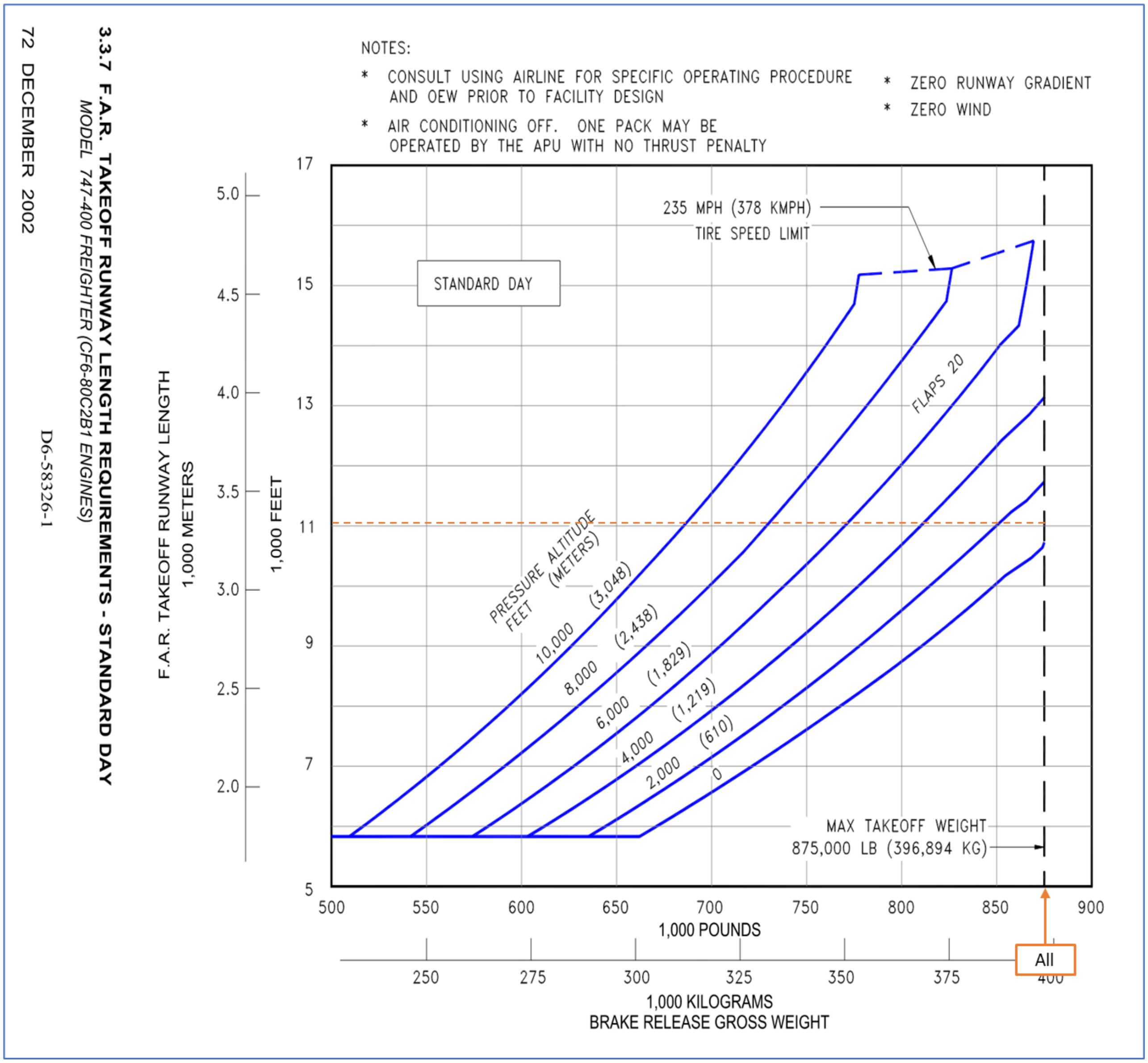
Source: *767 Airplane Characteristics for Airport Planning*, Boeing Commercial Airplane Company.

Figure B-13: Payload/Range Performance Chart, Boeing 747-400F to the Far East



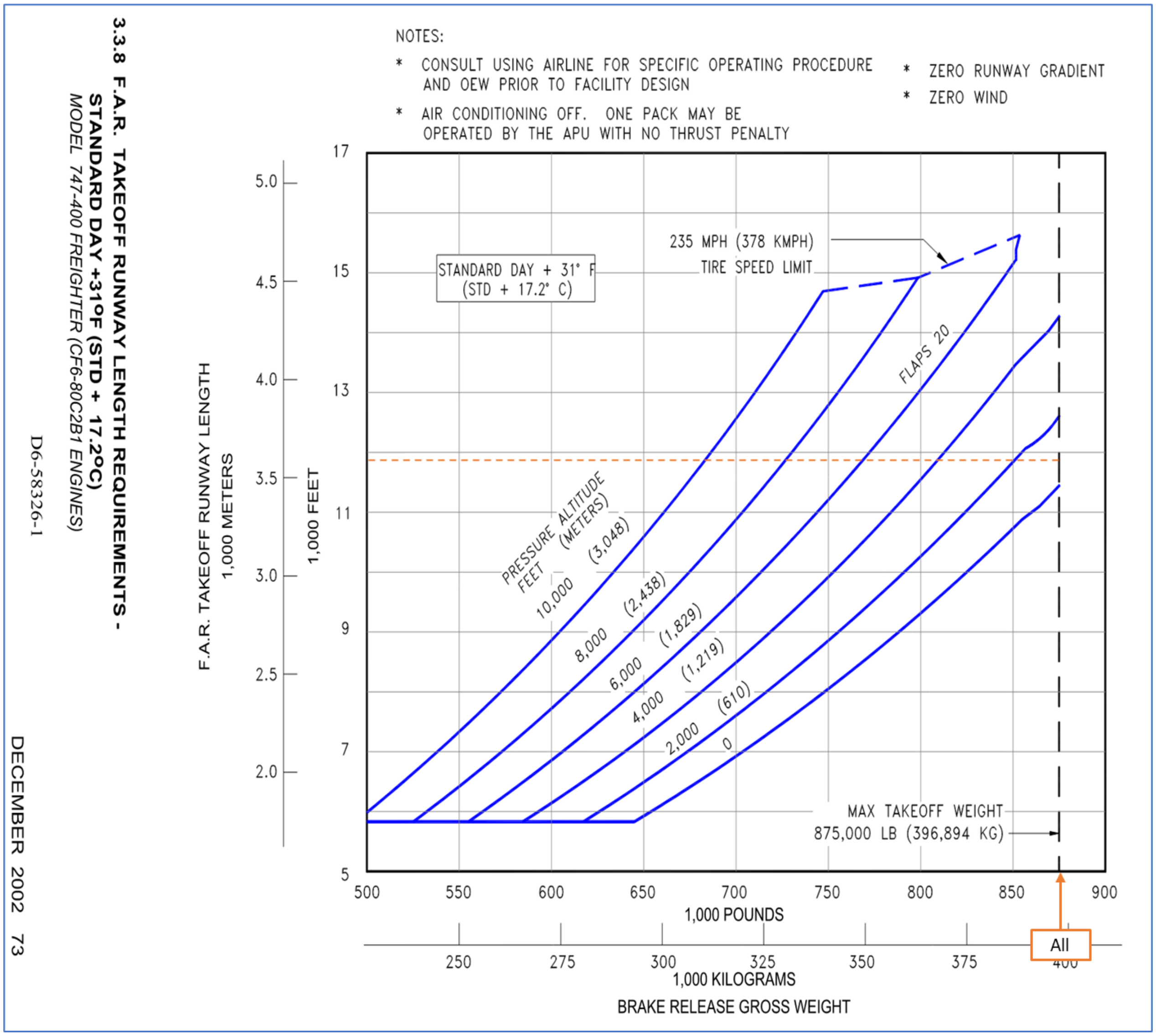
Source: *747 Airplane Characteristics for Airport Planning*, Boeing Commercial Airplane Company.

Figure B-14: Takeoff Runway Length (Standard Day) Performance Chart, Boeing 747-400F to the Far East



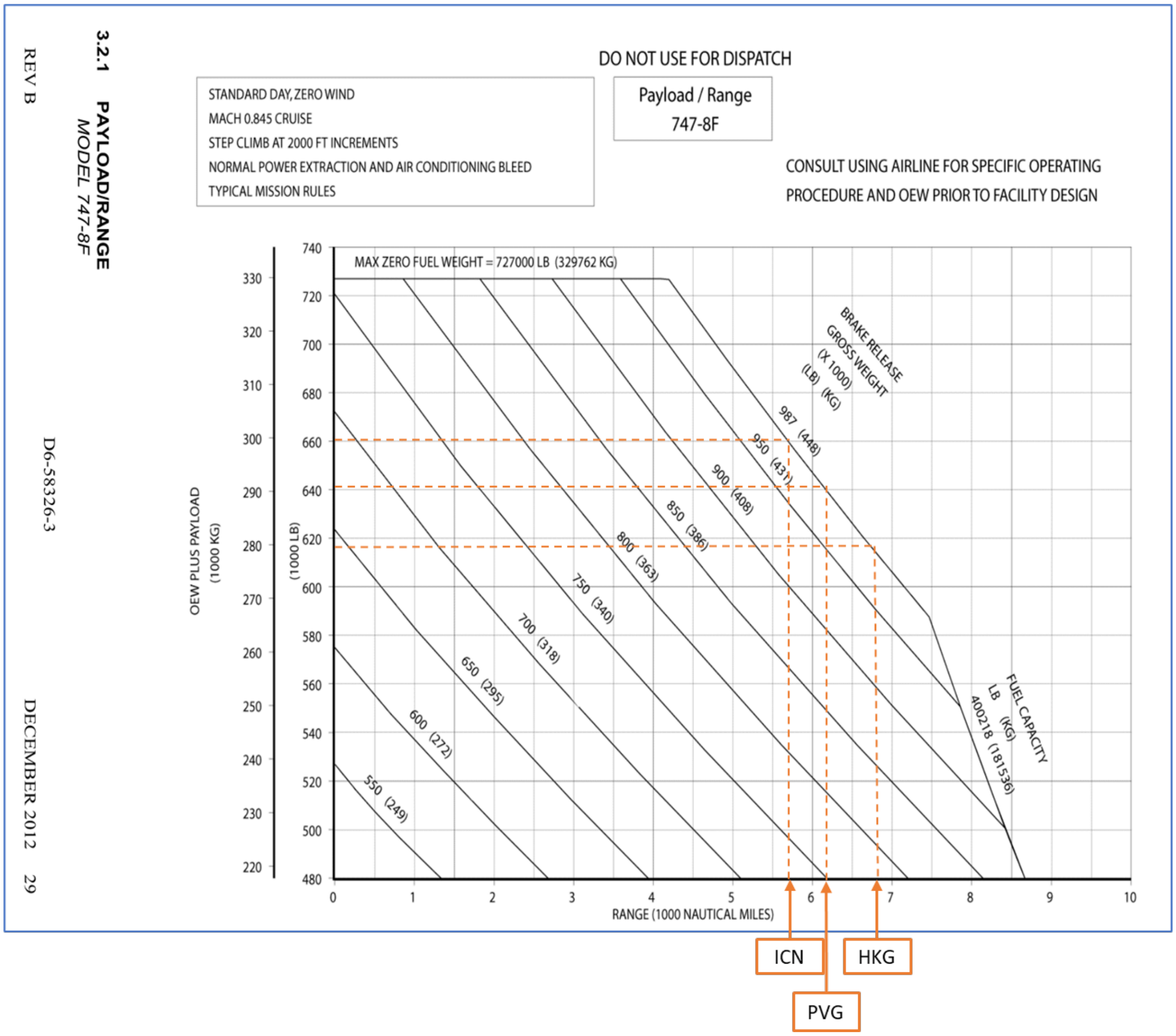
Source: *747 Airplane Characteristics for Airport Planning*, Boeing Commercial Airplane Company.

Figure B-15: Takeoff Runway Length (Hot Day) Performance Chart, Boeing 747-400F to the Far East



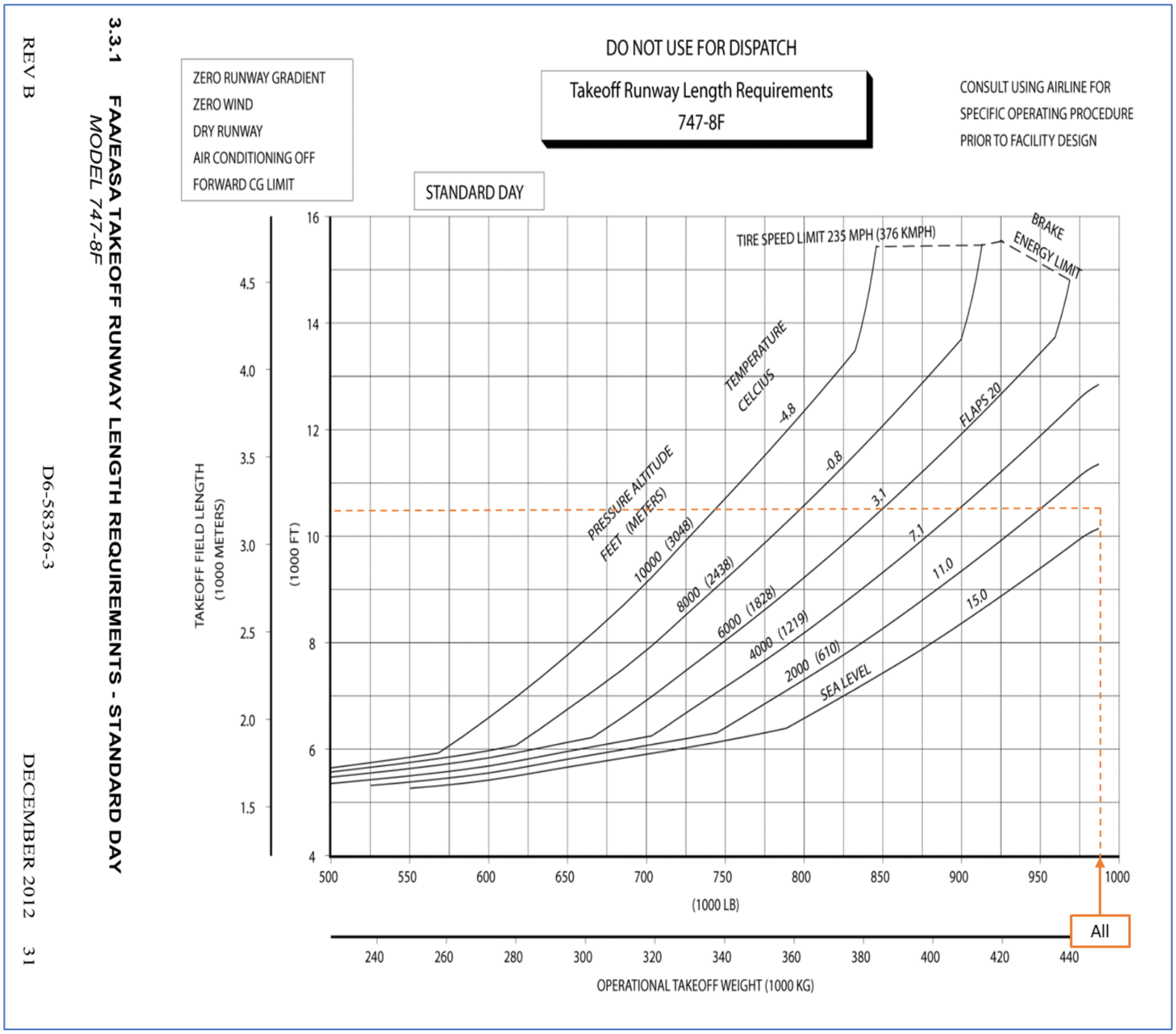
Source: *747 Airplane Characteristics for Airport Planning*, Boeing Commercial Airplane Company.

Figure B-16: Payload/Range Performance Chart, Boeing 747-8F to the Far East



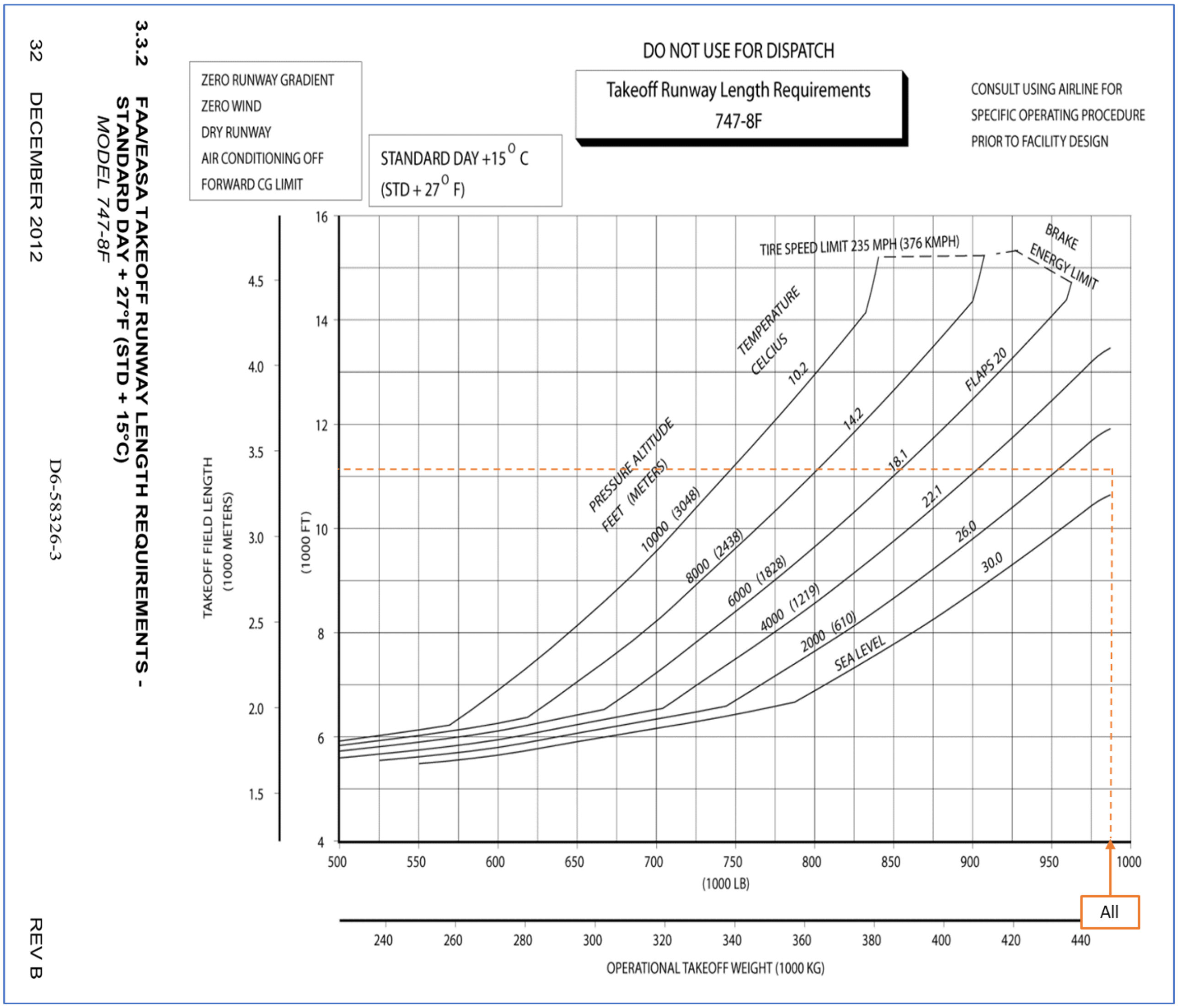
Source: *747 Airplane Characteristics for Airport Planning*, Boeing Commercial Airplane Company.

Figure B-17: Takeoff Runway Length (Standard Day) Performance Chart, Boeing 747-8F to the Far East



Source: *747 Airplane Characteristics for Airport Planning*, Boeing Commercial Airplane Company.

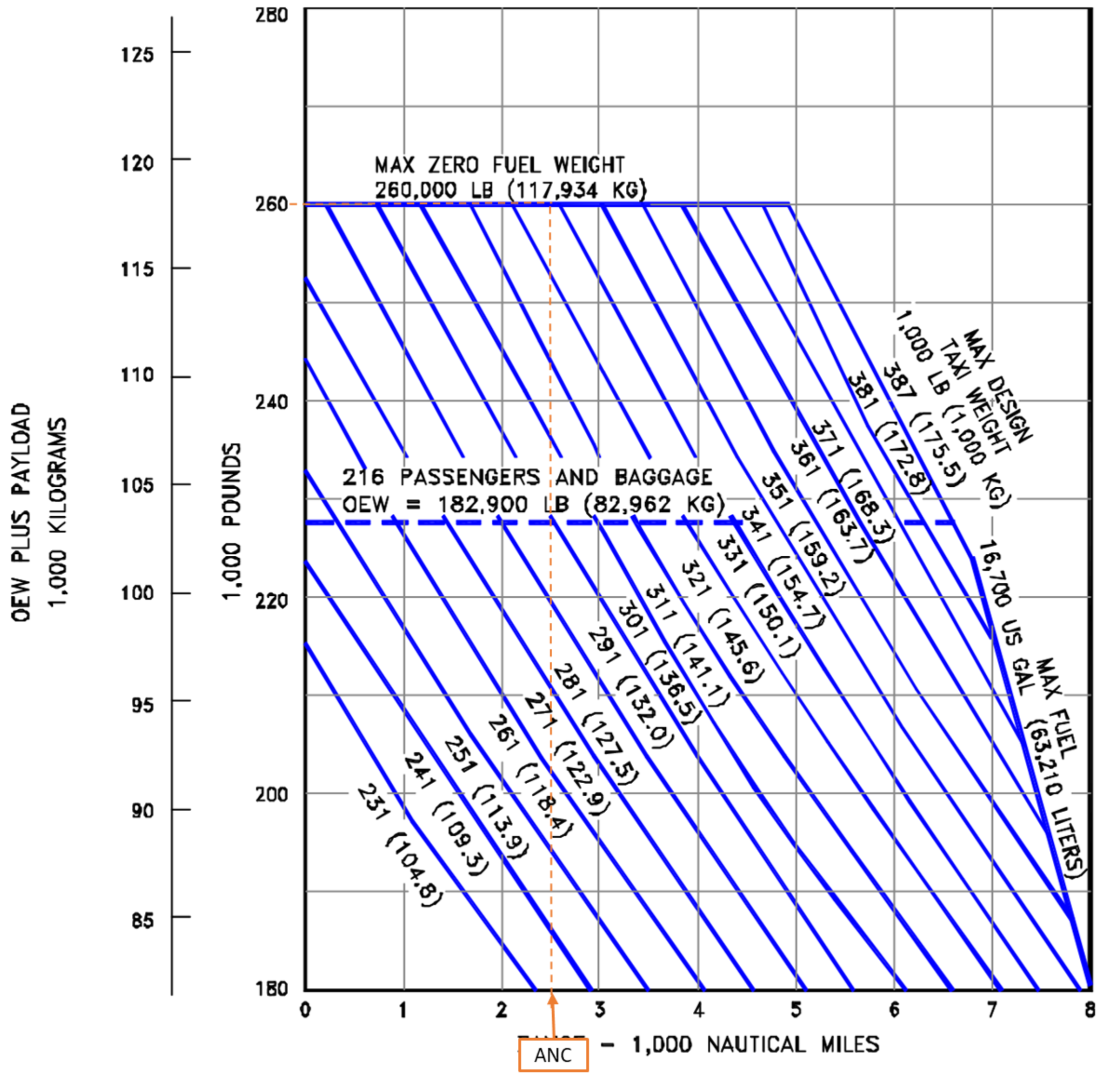
Figure B-18: Takeoff Runway Length (Hot Day) Performance Chart, Boeing 747-8F to the Far East



Source: *747 Airplane Characteristics for Airport Planning*, Boeing Commercial Airplane Company.

Figure B-19: Payload/Range Performance Chart, Boeing 767-200ER to ANC

NOTES:
- 0.80 MACH AT 35,000 AND 39,000 FT (10,668 AND 11,887 METERS)
- ATA DOMESTIC RESERVES
- STANDARD DAY
- TAKEOFF WEIGHTS ARE 1,000 LB (454 KG) LESS THAN TAXI WEIGHTS
- CONSULT USING AIRLINE FOR SPECIFIC OPERATING PROCEDURE PRIOR TO FACILITY DESIGN



3.2.2 PAYLOAD/RANGE FOR LONG-RANGE CRUISE

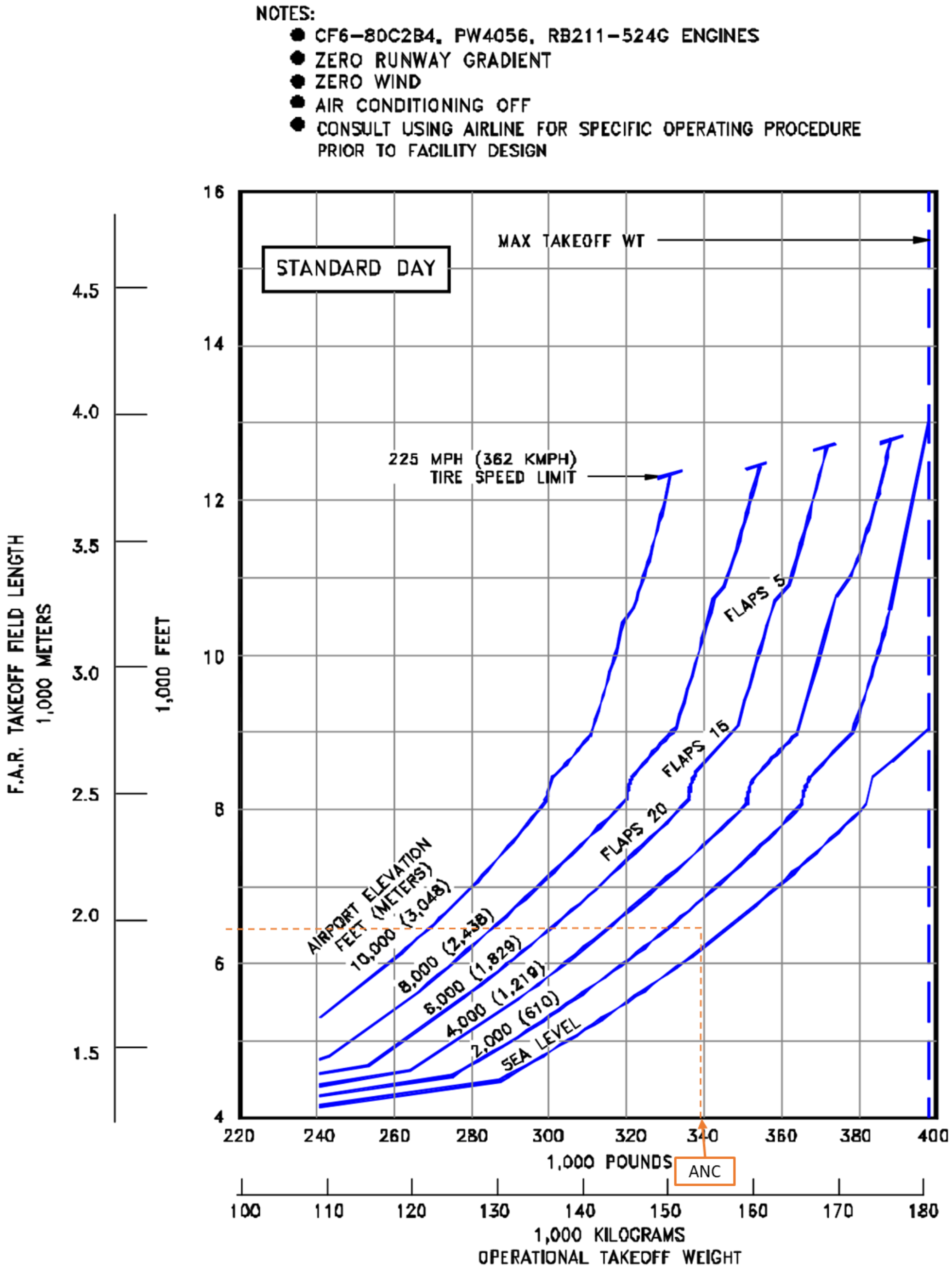
MODEL 767-200ER

D6-58328

48 SEPTEMBER 2005

Source: *767 Airplane Characteristics for Airport Planning*, Boeing Commercial Airplane Company.

Figure B-20: Takeoff Runway Length (Standard Day) Performance Chart, Boeing 767-200ER to ANC



3.3.5 F.A.R. TAKEOFF RUNWAY LENGTH REQUIREMENTS - STANDARD DAY

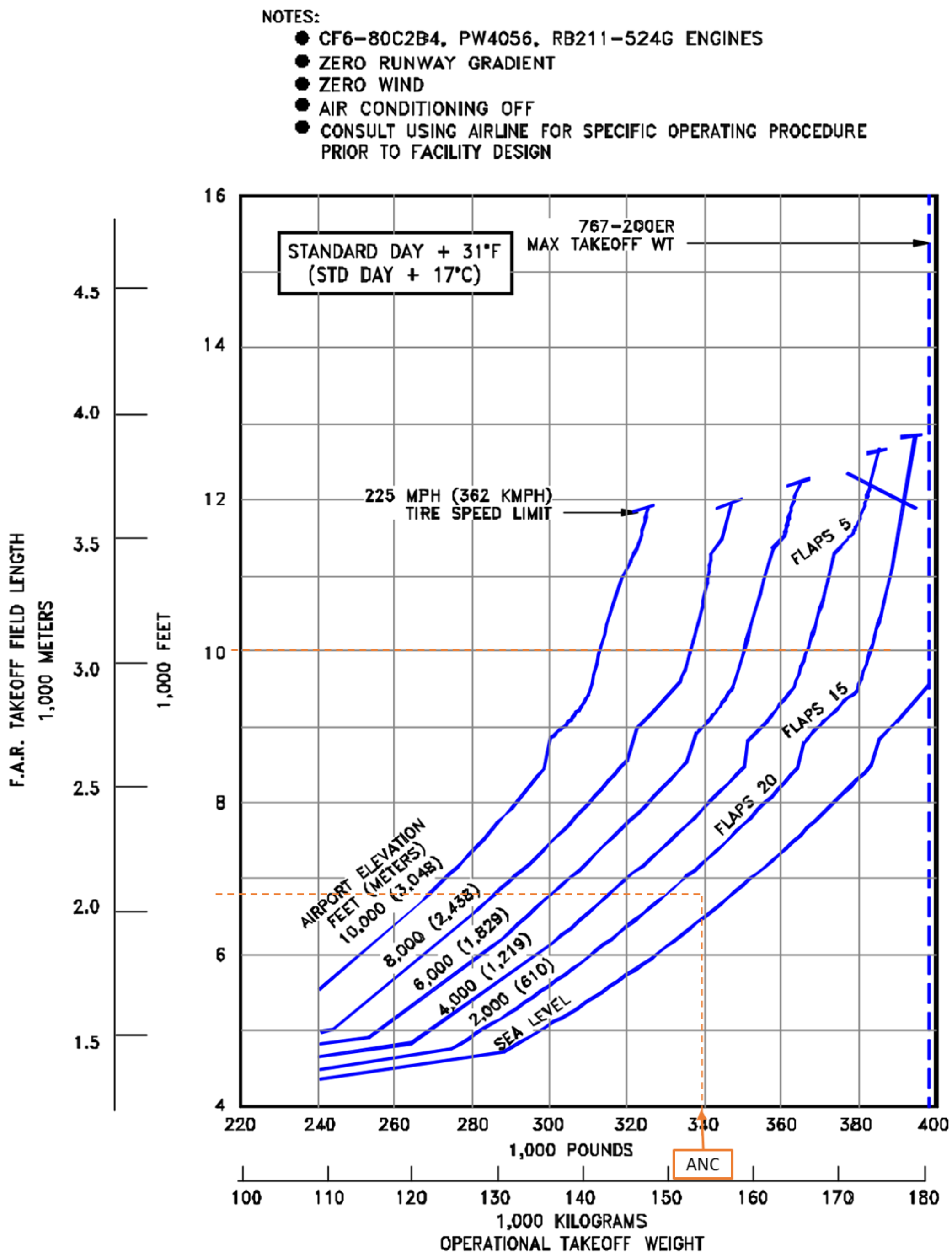
MODEL 767-200ER (CF6-80C2B4, PW4056, RB211-524G ENGINES)

D6-58328

SEPTEMBER 2005 61

Source: *767 Airplane Characteristics for Airport Planning*, Boeing Commercial Airplane Company.

Figure B-21: Takeoff Runway Length (Hot Day) Performance Chart, Boeing 767-200ER to ANC



3.3.6 F.A.R. TAKEOFF RUNWAY LENGTH REQUIREMENTS

STANDARD DAY + 31°F (STD + 17°C)

MODEL 767-200ER (CF6-80C2B4, PW4056, RB211-524G ENGINES)

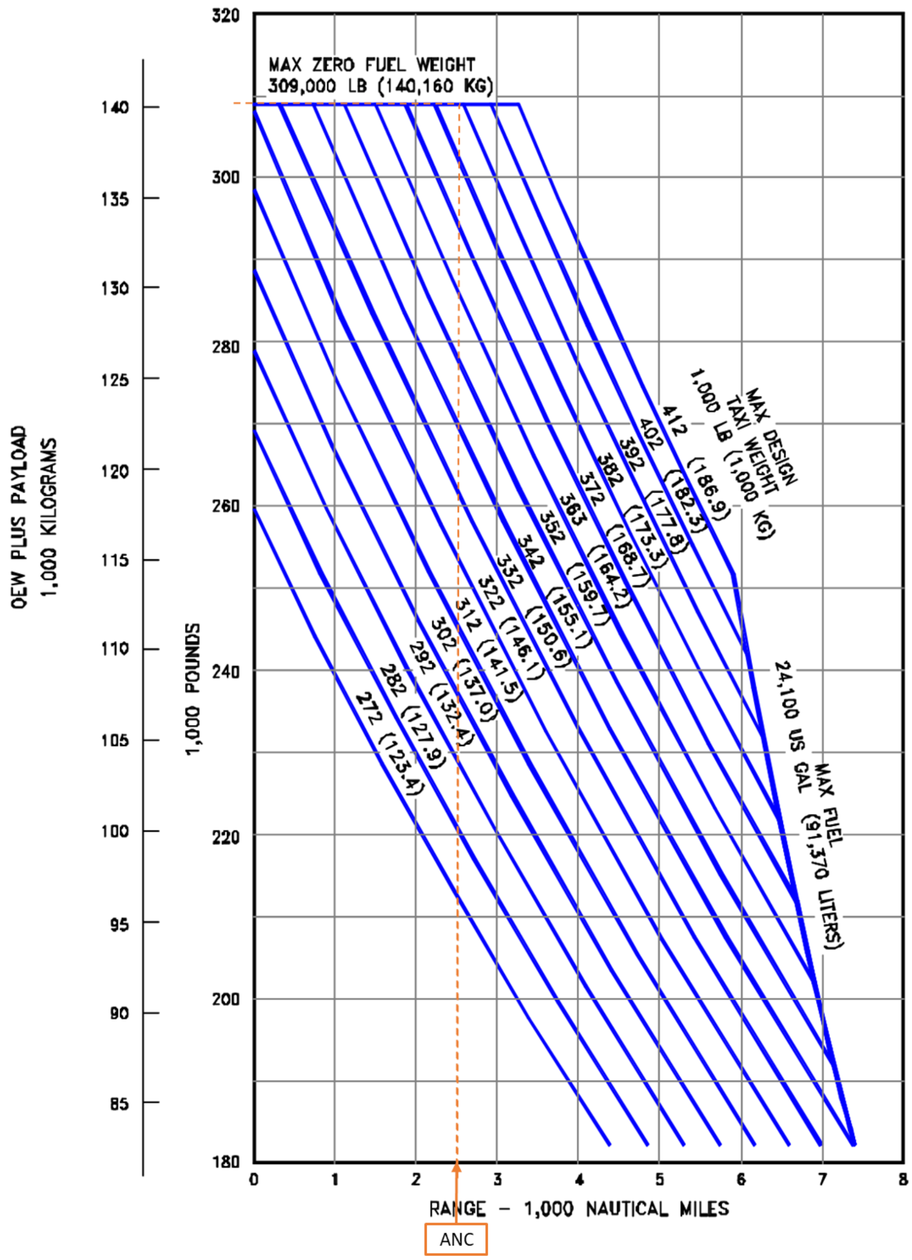
D6-58328

62 SEPTEMBER 2005

Source: *767 Airplane Characteristics for Airport Planning*, Boeing Commercial Airplane Company.

Figure B-22: Payload/Range Performance Chart, Boeing 767-300 Freighter to ANC

NOTES:
- 0.80 MACH AT 35,000 AND 39,000 FT (10,668 AND 11,887 METERS)
- ATA DOMESTIC RESERVES
- STANDARD DAY
- TAKEOFF WEIGHTS ARE 1,000 LB (454 KG) LESS THAN TAXI WEIGHTS
- CONSULT USING AIRLINE FOR SPECIFIC OPERATING PROCEDURE PRIOR TO FACILITY DESIGN



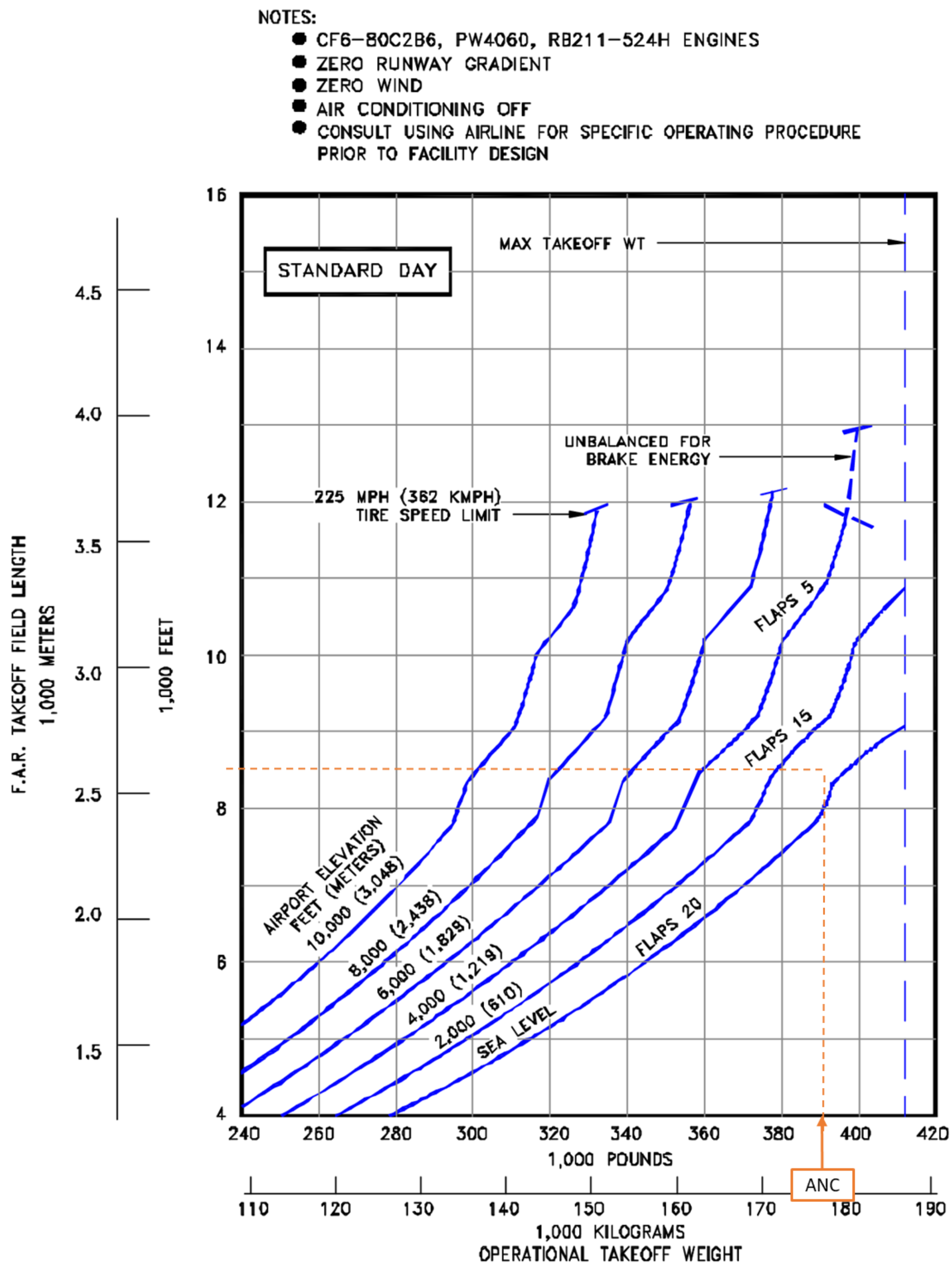
3.2.8 PAYLOAD/RANGE FOR LONG-RANGE CRUISE
MODEL 767-300 FREIGHTER (PW4062 ENGINES)

D6-58328

54 SEPTEMBER 2005

Source: *767 Airplane Characteristics for Airport Planning*, Boeing Commercial Airplane Company.

Figure B-23: Takeoff Runway Length (Standard Day) Performance Chart, Boeing 767-300 Freighter to ANC



3.3.15 F.A.R. TAKEOFF RUNWAY LENGTH REQUIREMENTS - STANDARD DAY

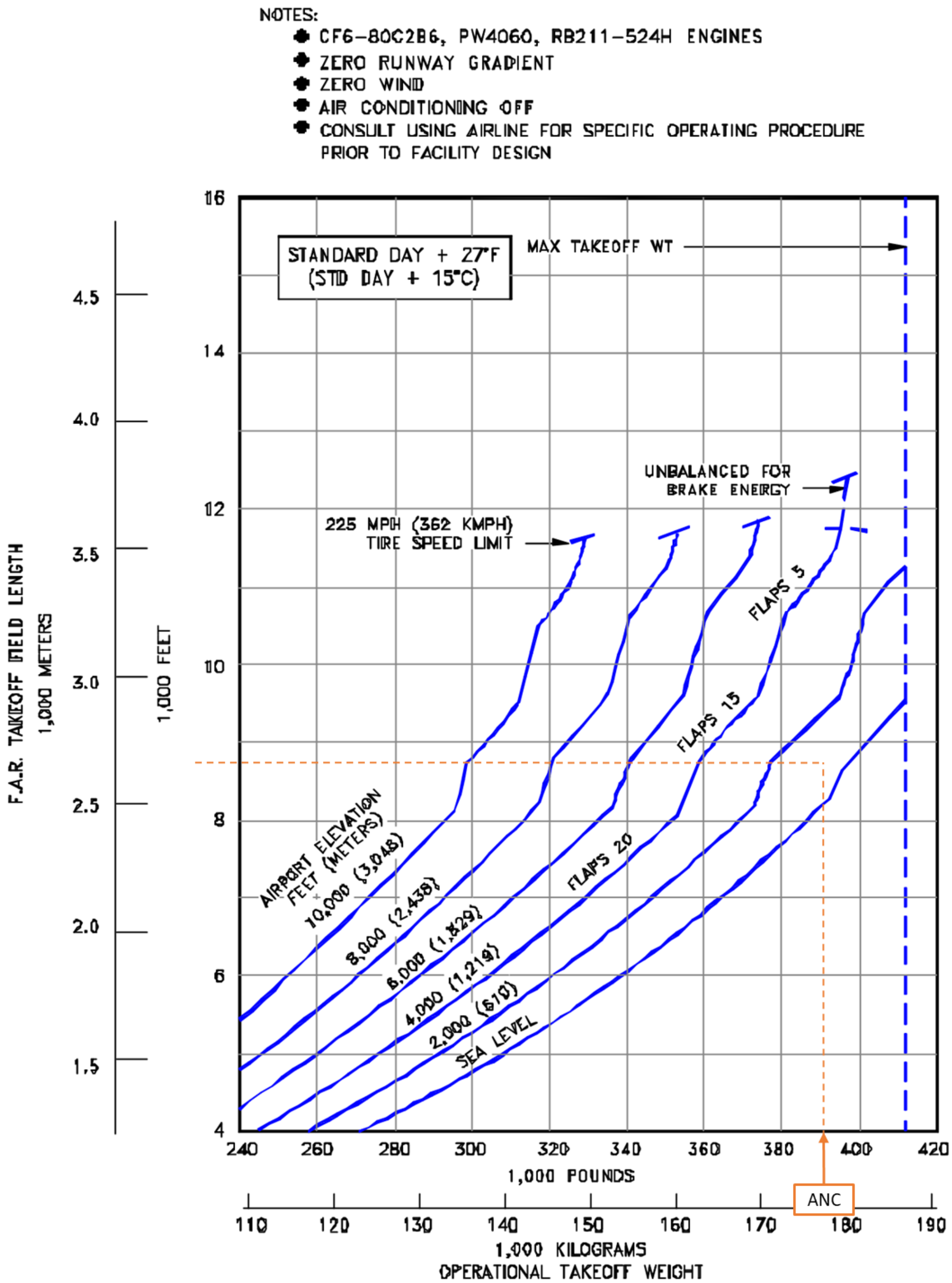
MODEL 767-300ER, -300 FREIGHTER (CF6-80C2B64, PW4060, RB211-524H ENGINES)

D6-58328

SEPTEMBER 2005 71

Source: *767 Airplane Characteristics for Airport Planning*, Boeing Commercial Airplane Company.

Figure B-24: Takeoff Runway Length (Hot Day) Performance Chart, Boeing 767-300 Freighter to ANC



3.3.16 F.A.R. TAKEOFF RUNWAY LENGTH REQUIREMENTS

STANDARD DAY + 27°F (STD + 15°C)

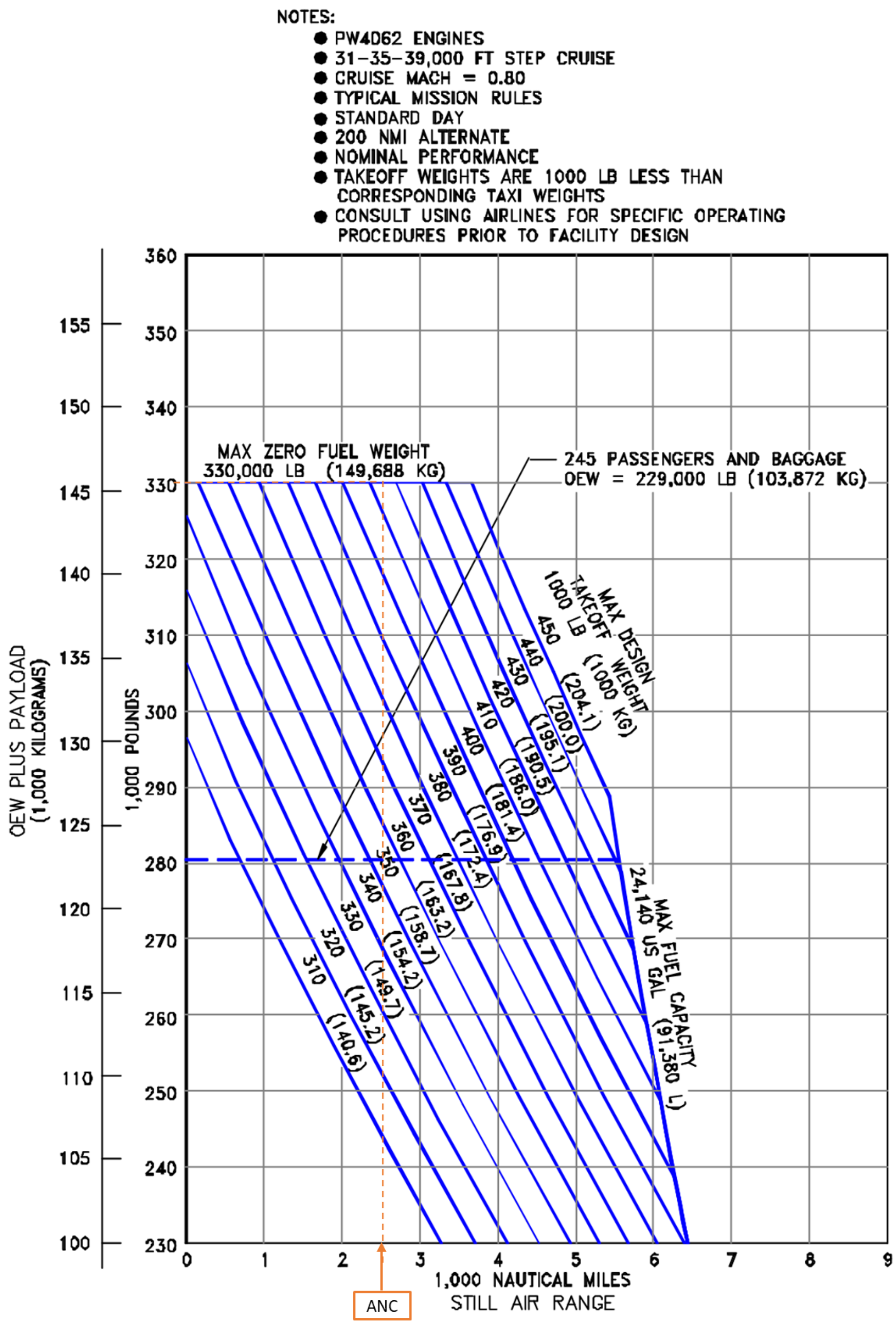
MODEL 767-300ER, -300 FREIGHTER (CF6-80C2B6, PW4060, RB211-524H ENGINES)

D6-58328

72 SEPTEMBER 2005

Source: *767 Airplane Characteristics for Airport Planning*, Boeing Commercial Airplane Company.

Figure B-25: Payload/Range Performance Chart, Boeing 767-400ER to ANC



3.2.10 PAYLOAD/RANGE FOR LONG-RANGE CRUISE

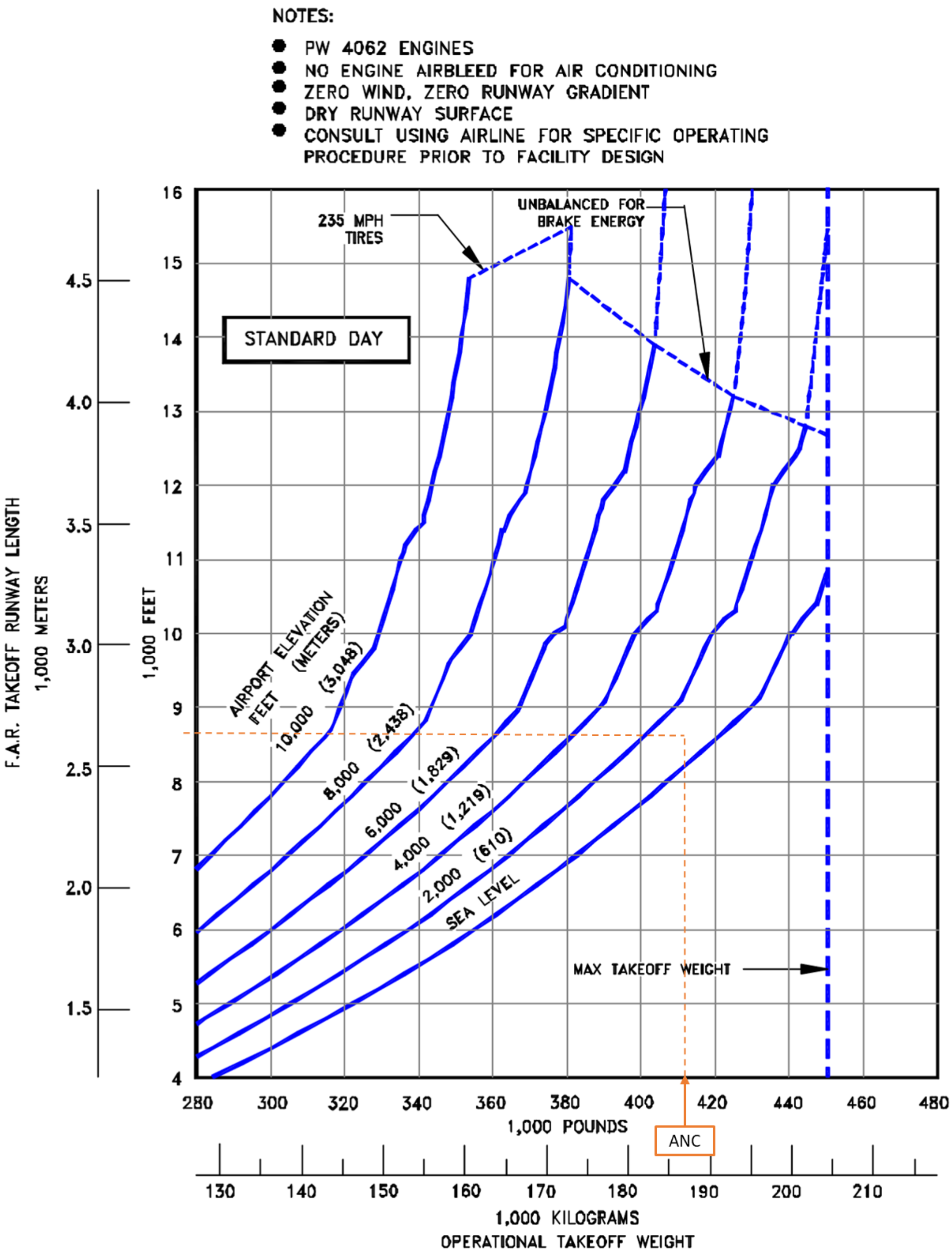
MODEL 767-400ER (PW4062 ENGINES)

D6-58328

56 SEPTEMBER 2005

Source: *767 Airplane Characteristics for Airport Planning*, Boeing Commercial Airplane Company.

Figure B-26: Takeoff Runway Length (Standard Day) Performance Chart, Boeing 767-400ER to ANC



3.3.33 F.A.R. TAKEOFF RUNWAY LENGTH REQUIREMENTS - STANDARD DAY, DRY RUNWAY SURFACE

MODEL 767-400ER (PW4062 ENGINES)

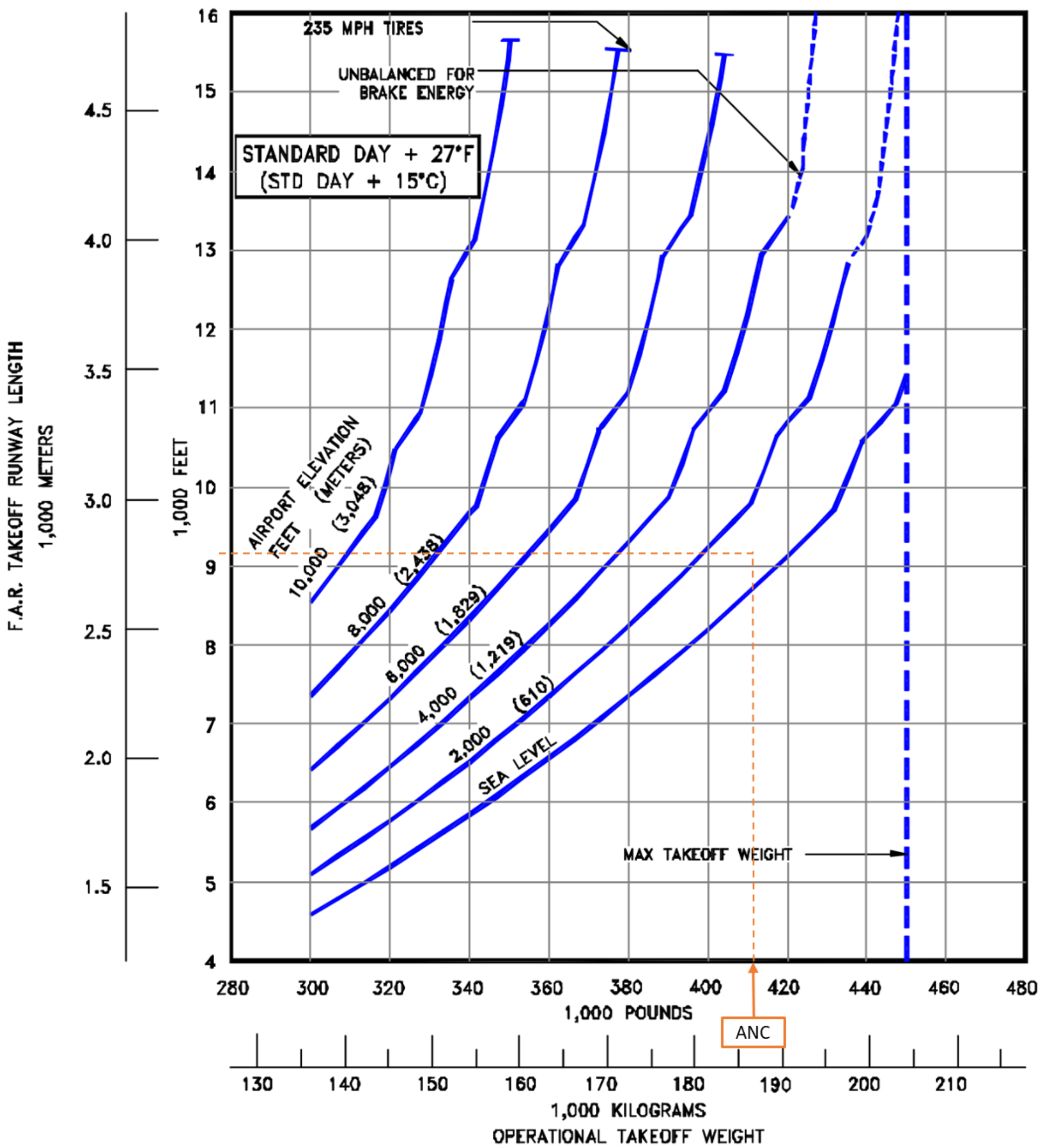
D6-58328

SEPTEMBER 2005 89

Source: *767 Airplane Characteristics for Airport Planning*, Boeing Commercial Airplane Company.

Figure B-27: Takeoff Runway Length (Hot Day) Performance Chart, Boeing 767-400ER to ANC

NOTES:
- PW 4062 ENGINES
- NO ENGINE AIRBLEED FOR AIR CONDITIONING
- ZERO WIND, ZERO RUNWAY GRADIENT
- WET SMOOTH RUNWAY SURFACE
- CONSULT USING AIRLINE FOR SPECIFIC OPERATING PROCEDURE PRIOR TO FACILITY DESIGN



3.3.36 F.A.R. TAKEOFF RUNWAY LENGTH REQUIREMENTS

STANDARD DAY + 27°F (STD + 15°C), WET SMOOTH RUNWAY SURFACE

MODEL 767-400ER (PW4062 ENGINES)

D6-58328

92 SEPTEMBER 2005

Source: *767 Airplane Characteristics for Airport Planning*, Boeing Commercial Airplane Company.

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Appendix C

General Aviation Performance Chart for Estimating Runway Length Requirements

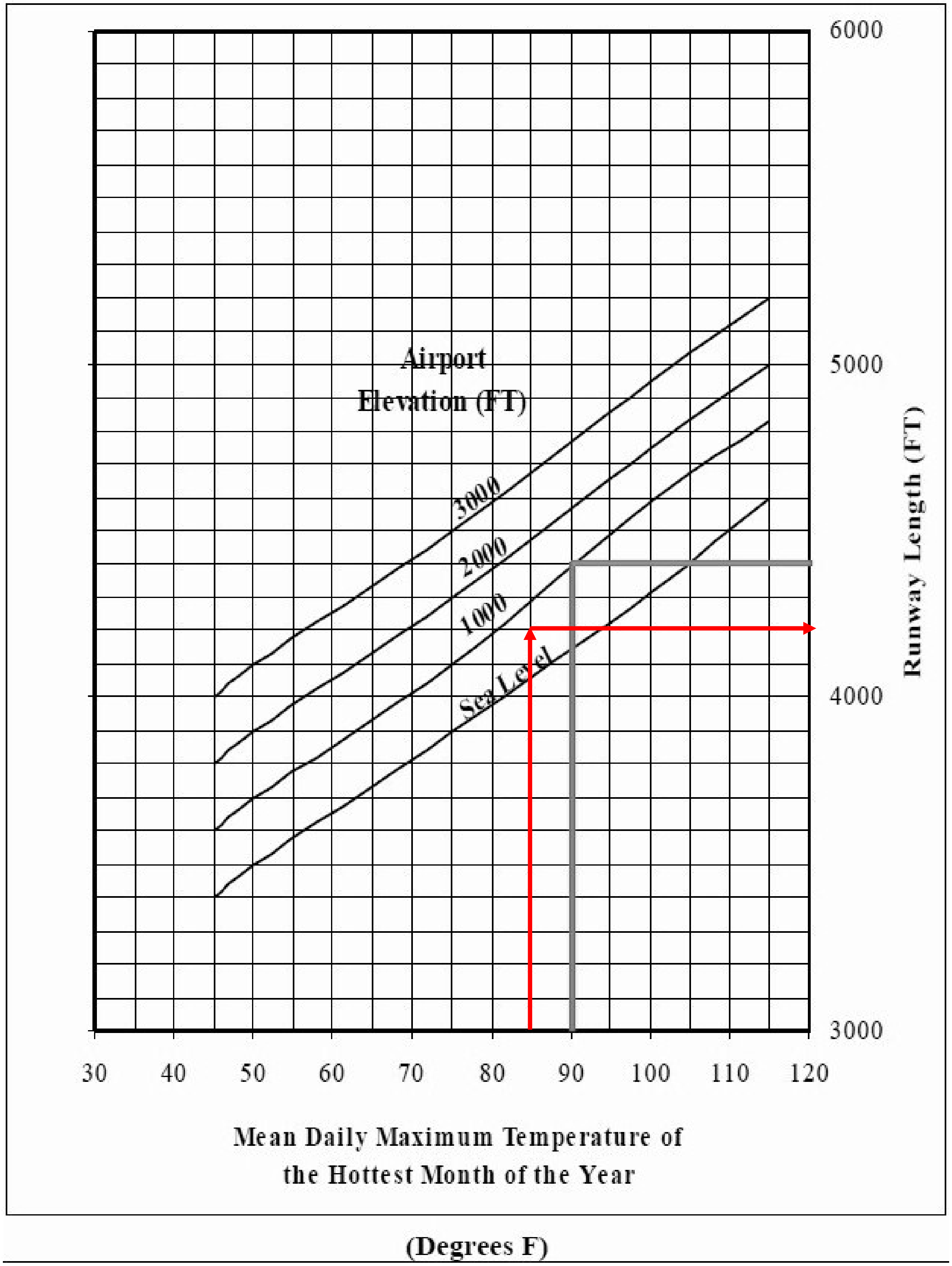
Runway 9L/27R at SBN supports general aviation activity from smaller aircraft types. Guidance for the appropriate runway length is found in FAA Advisory Circular (AC) 150/5325-4B, *Runway Length Requirements for Airport Design*. There are various methods for estimating required runway length recommended in this AC that take into account different groupings of aircraft families. All of these methods start with the critical aircraft expected to make regular use of the runway and generalize that aircraft to a broad family of aircraft with similar characteristics.

A runway's critical aircraft may fluctuate over time, with the critical aircraft for Runway 9L/27R serving as a prime example. The initial draft of the SBN forecast identified the King Air 200 or similar aircraft as the critical aircraft, and an estimated required runway length was determined for this family of aircraft. Subsequent information resulted in a revision of the forecast critical aircraft to a Diamond Star DA40, so an additional required runway length calculation was performed using this aircraft family. The methods of both estimates are detailed below and the results of both families of critical aircraft are presented since future forecasts may alter the critical aircraft for Runway 9L/27R again.

The King Air 200 is a twin-engine turboprop capable of carrying up to 11 passengers. AC 150/5325-4B recommends estimating the required runway length for aircraft in the King Air 200 family using the Runway Length Chart for Small Airplanes Having 10 or More Passenger Seats, as shown in **Figure C-1**. This chart uses the airport's elevation and mean daily maximum temperature of the hottest month of the year to calculate required runway length.

The mean daily maximum temperature of the hottest month of the year for SBN is approximately 85°F. This is the input used on the horizontal axis of the chart, as depicted with red lines on the chart. Following this temperature vertically on the graph to SBN's elevation of 798 feet, then across horizontally to the right, results in a recommended runway length of approximately 4,200 feet.

Figure C-1: Runway Length Chart for Small Airplanes Having 10 or More Passenger Seats



Source: FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*

When the Diamond Star DA40, a four-seat, single-engine piston aircraft, was identified as the critical aircraft, the required runway length changed. The Diamond Star DA40 is less demanding than the King Air 200 in terms of runway length needed, so AC 150/5325-4B recommends using the Runway Length Chart for Small Airplanes with 10 or Fewer Passenger Seats to estimate the required runway length. This chart is shown in **Figure C-2** and has an additional evaluation condition related to the percentage of the aircraft fleet evaluated.

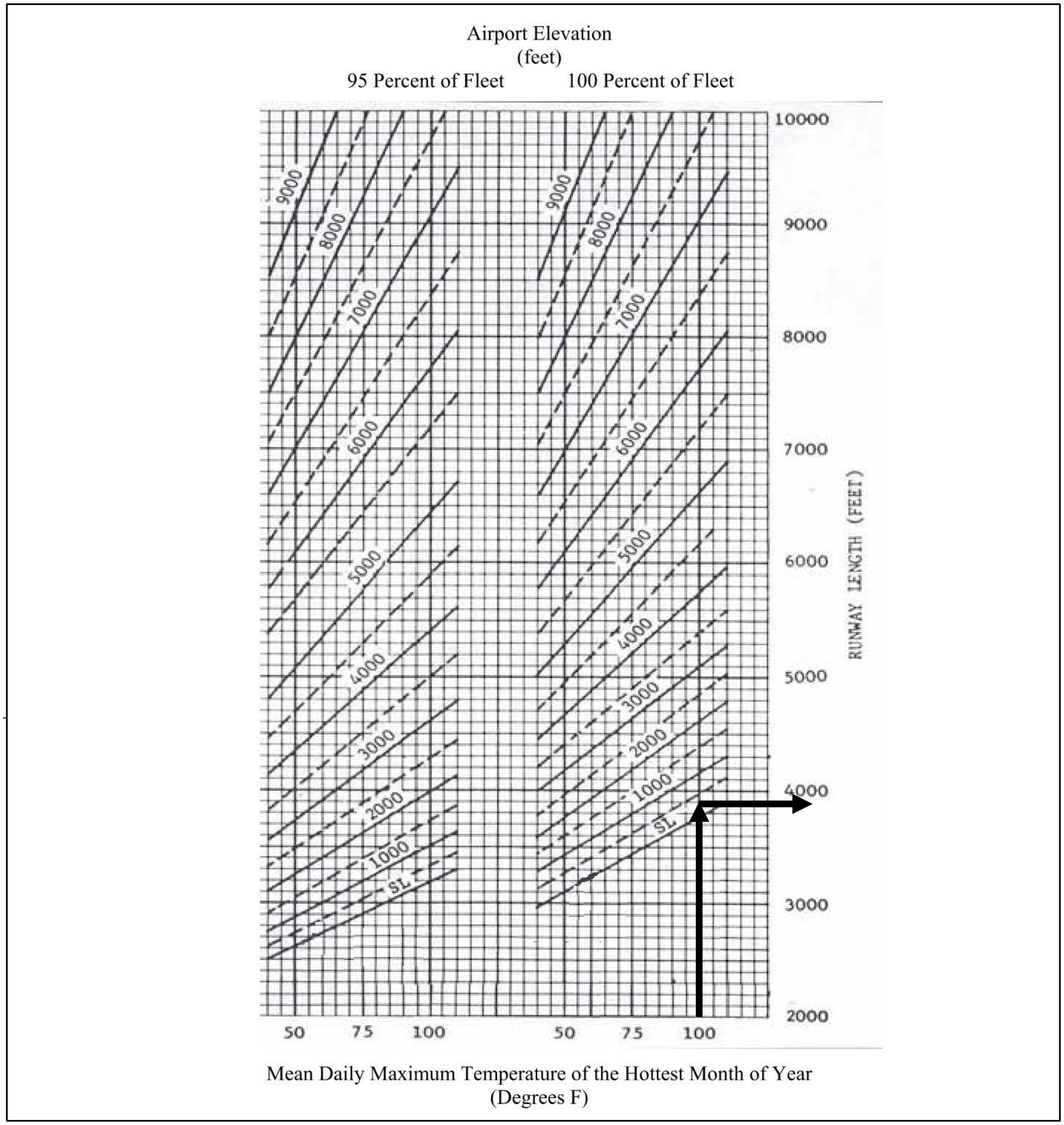
The chart provides estimated runway lengths for two conditions – 95 percent of the fleet (on the left of the chart) and 100 percent of the fleet (on the right of the chart). The 95 percent of the fleet chart is intended for airports that primarily serve medium size population communities with a diversity of usage and a greater potential for increased aviation activities. Also included in this category are those airports that are primarily intended to serve low-activity locations, small population communities, and remote recreational areas. The 100 percent of the fleet chart applies to communities located on the fringe of a metropolitan area or a relatively large population remote from a metropolitan area. Of these two conditions, the 100 percent of the fleet is more applicable to SBN given the urban nature of South Bend and the proximity of Chicago.

As was done with the previous required runway length estimation, this analysis starts with mean daily maximum temperature of the hottest month of the year for SBN of 85°F. This input on the horizontal axis of the chart – depicted with a red line – is traced upward to SBN's elevation of 798 feet. At this point, the red line is followed horizontally to the right, where a recommended runway length of approximately 3,850 feet is read off the vertical axis.

In summary, the recommended runway length for Runway 9L/27R is 4,200 feet for the King Air 200 family of critical aircraft, and 3,850 feet for the Diamond Star DA40 family of critical aircraft. As stated previously, the critical aircraft for a runway can change over time, as has been demonstrated during the planning for SBN. It is recommended that SBN maintain Runway 9L/27R at a length that can accommodate reasonable fluctuations in the critical aircraft and plan for a recommended runway length of 4,200 feet.

At a recommended length of 4,200 feet, no changes to the 4,300-foot length of Runway 9L/27R are needed to accommodate existing and projected demand.

Figure C-2: Runway Length Chart for Small Airplanes with 10 or Fewer Passenger Seats
(excludes Pilot and Co-pilot)



Source: FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*

Appendix D

Terminal Planning Study

A *Terminal Planning Study* was conducted for the commercial airline terminal building at South Bend International Airport (SBN or Airport) as part of this master plan. The *Terminal Planning Study* included the following components:

- Commercial Terminal Inventory
- Demand / Capacity Analysis
- Terminal Facility Requirements
- Summary of Findings and Recommendations for Growth
- Alternative Terminal Concepts

These components are discussed in the ensuing sections of this appendix.

D.1 Commercial Terminal Inventory

The commercial airline terminal building is at the south end of the Airport along Terminal Drive with access from the intersection of Lincoln Way West and Airport Boulevard. Lincoln Way West provides access via a roundabout north to Terminal Drive. Terminal Drive becomes a one-way counterclockwise roadway heading east, then north, cutting a path around the terminal and train station parking lots, with terminal curbside access located along the north side of the roadway.

The L-shaped terminal building follows the curb, turning south parallel to Terminal Drive, with the longer axis running east to west. This section discusses the various components of SBN's commercial terminal.

D.1.1 Terminal Building

There have been several additions to the terminal since the original building was constructed in 1981. The middle portion of the concourse was built in 2010, and the east end was completed in 2012. The U.S. Customs Facility was constructed in 2016. Today, the net area of the terminal building is 204,763 square feet, and its gross area is 217,221 square feet.

The terminal has a linear east-west layout with the westernmost portion turning 90 degrees south. The security checkpoint is in the connector between the terminal and concourse. A partially elevated nine-gate concourse pier runs parallel to the terminal. Basement areas house building systems and storage and a small second-floor area houses several offices and a public viewing area as part of the Airport's aviation museum.

The domestic travel section of the terminal is concentrated in the 90-degree bend of the building. The main corridor runs the length of the terminal, connecting all major components together on the north and west side of the corridor. The departures hall houses passenger circulation and queuing areas, baggage screening, check-in kiosks, and airline ticket counters and offices (ATOs). Four airlines use the terminal building: Allegiant, American, Delta, and United. A small bank of restrooms, a vending area, meditation room, and fitness center are located on the opposite side of the main corridor. A gift shop is located adjacent to the checkpoint entrance.

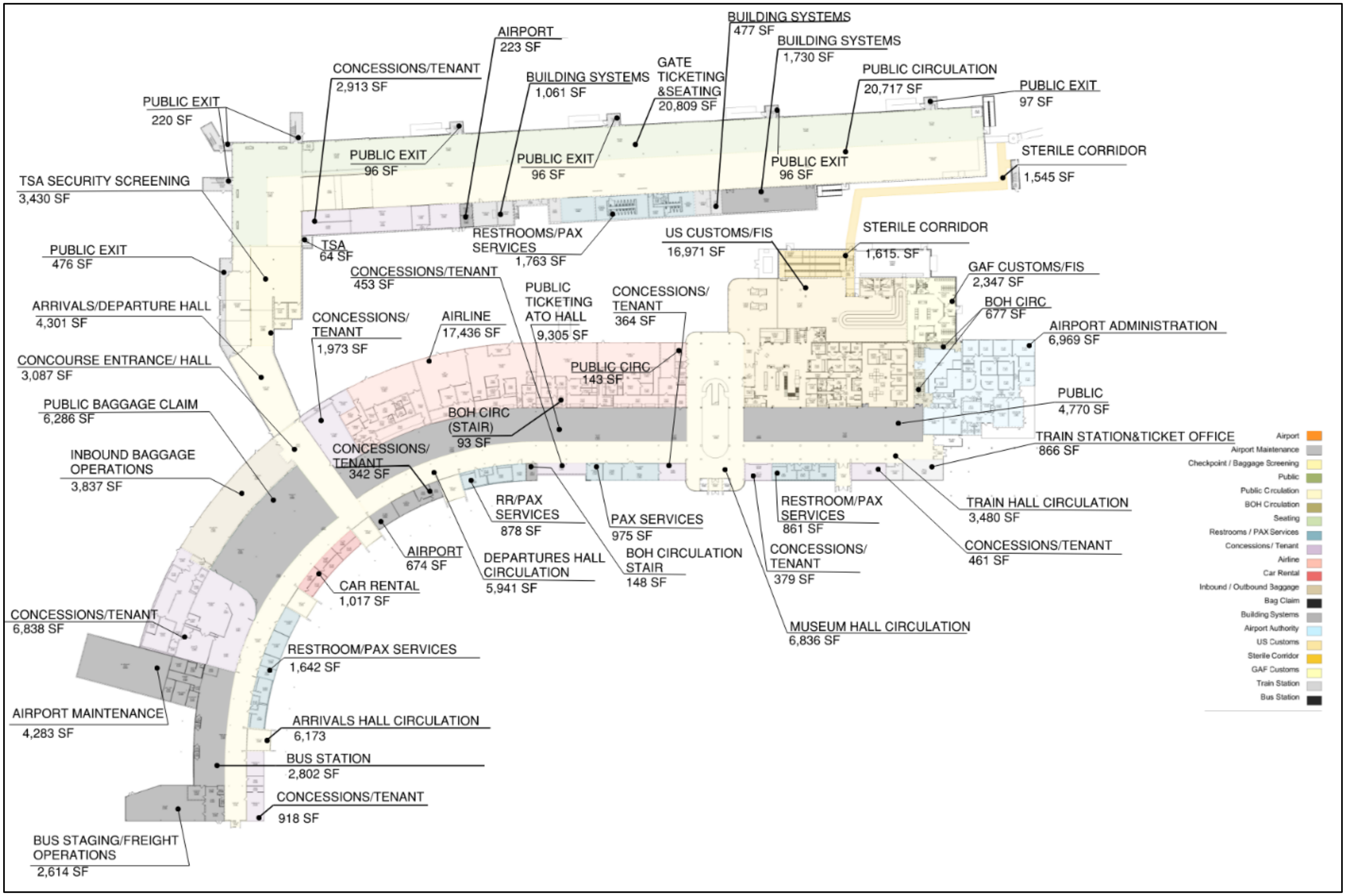
The arrivals hall is in the western portion of the 90-degree bend in the building and contains a baggage claim area, rental car counters, and bus station waiting areas. The inbound baggage room, two baggage claim carousels, and a bar/restaurant are located on one side of the main circulation corridor, with the rental car counters located on the other side. Public restrooms are found west of the restaurant, across the corridor from the bus station and a short walk from the baggage claim area.

Terminal concessions at SBN
Source: SBN official Twitter account

Tenants, such as concessionaires, local law enforcement, Transportation Security Administration (TSA), and car rental agencies, lease space in the terminal that typically includes office or operational support space for commercial terminal operations. Airlines and/or third-party airline service providers are the largest tenants in terms of space.

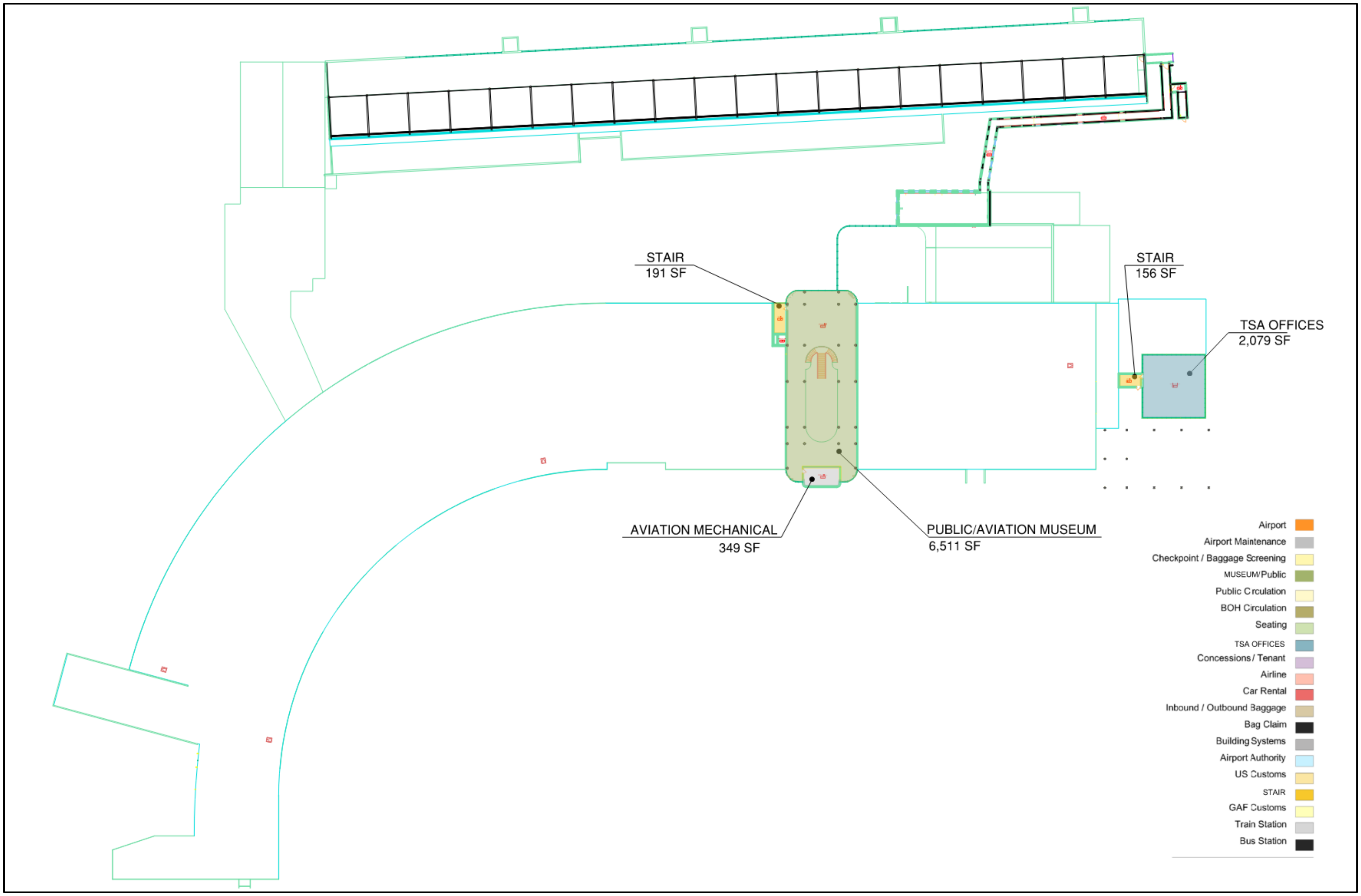
Spaces and functions within the terminal building are discussed in the sections below. These are security screening, concourse, U.S. Customs Federal Inspection Services and General Aviation Facility, a station for the South Shore Train, bus stations, and building support. A complete layout plan of the terminal is shown in **Figures D-1**, **D-2**, and **D-3.** The existing terminal and concourse areas and sizes are listed in **Table D-1**.

Figure D-1: Existing Terminal and Concourse Area First Floor Plan



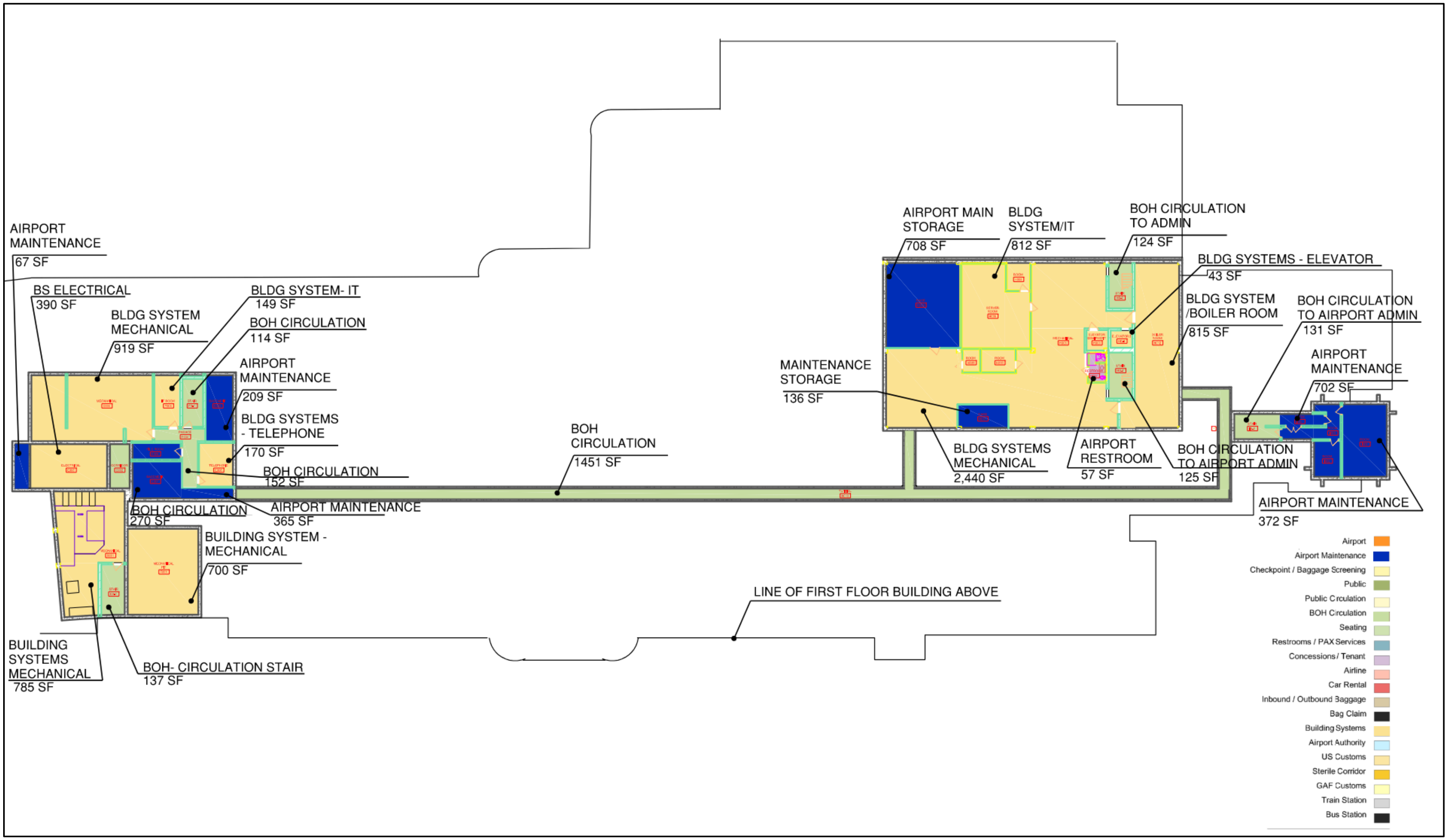
Source: Mead & Hunt, Inc. (2021)

Figure D-2: Existing Terminal and Concourse Area Second Floor Plan



Source: Mead & Hunt, Inc. (2021)

Figure D-3: Existing Terminal and Concourse Area Basement Floor Plan



Source: Mead & Hunt, Inc. (2021)

Table D-1: Existing Commercial Terminal Building Plan Area

Terminal Space	Net Area Square Footage	Terminal Space	Net Area Square Footage
First Floor		**First Floor (continued)**	
Airport	1,535	Concourse Entrance Hall	3,087
Airport Maintenance	4,283	Bus Staging/Freight Operations	2,614
Public	5,246	**First Floor Total**	**183,134**
Public Circulation	20,717	**Second Floor**	
Gate Ticketing & Seating	20,809	Public Aviation Museum	6,511
Restrooms/Passenger Services	5,241	Aviation Mechanical	349
Concessions/Tenant	14,299	Stair	347
Airline	17,436	TSA Offices	2,079
Car Rental	1,017	**Second Floor Total**	**9,286**
Inbound/Outbound Baggage	3,837	**Basement**	
Public Baggage Claim	6,286	Airport Maintenance	1,715
Building Systems	3,268	BS Electrical	390
Airport Authority	878	Building System Mechanical	4,844
U.S. Customs/FIS	16,971	Building System IT	961
Sterile Corridor	3,160	BOH Circulation	1,987
GAF Customs/FIS	2,347	Airport Maintenance Storage	844
Train Station	4,346	BOH Circulation to Admin	380
Bus Station	2,802	Airport Restroom	57
Arrivals Hall Circulation	6,173	Building System Boiler Room	815
Departures Hall Circulation	5,941	Building System Telephone	170
Museum Hall Circulation	6,836	Building System Elevator	43
Airport Administration	6,969	BOH Circulation Stair	137
Public Ticketing ATO Hall	9,305	**Basement Total**	**12,343**
Passenger Security Screening	3,430		
Arrivals/Departure Hall	4,301	**Building Total**	**204,763**

Source: Mead & Hunt, Inc. (2021)

Security Screening

Security screening for checked baggage is in the airline operations areas behind their ticket counters. The semi-automated part of the process consists of conveyors that bring baggage to the screening areas located within the airline operations areas, but the screening process itself is not automated. American's baggage is screened within United's screening area. A takeaway belt delivers the baggage to this area from American's ticket counters.

A single passenger security checkpoint is in the connector corridor between the public, non-secure area of the terminal and the secure concourse. The checkpoint floor is elevated above the terminal floor and below the main concourse floor. The checkpoint space is approximately 45 feet wide and 56 feet long. There are three standard passenger security screening lanes in the security checkpoint, as well as several TSA offices. Approximately 600 square feet of queuing area is available for the checkpoint with ample space for queue overflow into the non-secure corridor.

Concourse

The concourse is directly beyond the checkpoint, providing departure lounges, restrooms, a café, business center, and a gift shop, linked together by a main concourse corridor that runs the length of the building. From the checkpoint, passengers walk to one of three gates at a slightly higher elevation than the checkpoint and proceed up a ramp on the main portion of the concourse to the remaining departures lounges. All the gates use boarding bridges to load passengers onto aircraft.

The concourse was originally designed to serve smaller aircraft than those currently in the commercial fleet. As a result, the boarding bridge located at Gate 4 has been removed to reconfigure the aircraft parking positions. Gate 4 now serves as an entry to a service animal relief area located just outside the gatehouse. The remaining gates are approximately 140 feet apart except for Gate 9, which is located on the end of the concourse, enabling it to serve larger aircraft. There are currently seven boarding bridges and a total of nine parking positions on the commercial apron.

U.S. Customs Federal Inspection Service and General Aviation Facility

U.S. Customs operates a General Aviation Facility (GAF), designed to clear up to 20 international general aviation passengers, crew, and their baggage, as well as a Federal Inspection Services (FIS) facility for clearing commercial flights. The 26,000-square-foot combined facility is on the east side of the terminal between the airline ticket counters and the train station. General aviation aircraft park in the “red box” apron location east and south of Gate 9. Passengers and crew walk from the aircraft to the GAF portion of the U.S. Customs facility where they are screened with their baggage before entering the terminal. Commercial passengers arrive at Gate 9 and are directed to the FIS portion of the facility where they are screened with their baggage before they enter the terminal. The FIS is primarily used for large charter flights, as there are not yet scheduled international commercial flights at SBN.

Train and Bus Stations

The South Shore train station is located at the far east end of the terminal building. The South Shore rail line connects SBN with several cities throughout northwestern Indiana, ending at Millennial Park in downtown Chicago. The bus station is located on the far west side of the terminal, which is used by Transpo, offering intracity bus service to destinations throughout South Bend.

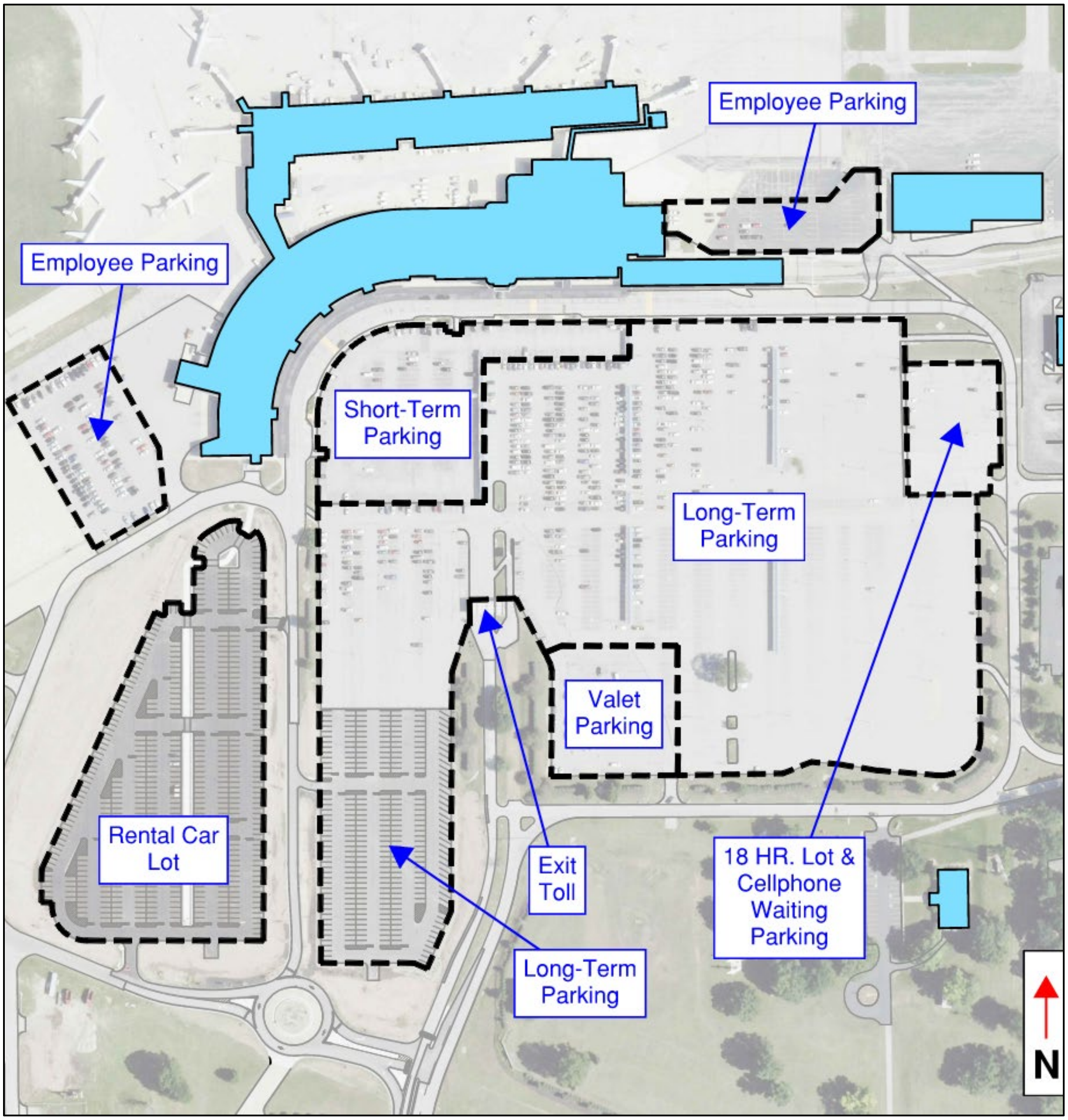
Building Support

Building support spaces are the portions of the building that house essential services, including the mechanical, plumbing, electrical, and information systems. Operational support, administrative offices, janitorial spaces, maintenance areas, storage rooms, delivery areas, and waste collection facilities are other supports spaces within the terminal building.

Vehicle Parking

Several vehicle parking options are available to users at SBN (shown on **Figure D-4**): short-term, long-term, valet, 18-hour, and cell phone waiting. The 18-hour lot serves passengers using the South Shore Line and is located at the northeast corner of infield parking. The cell phone waiting lot is located within the 18-hour lot.

Figure D-4: Vehicle Parking Lot Layout



Source: Mead & Hunt, Inc. (2021)

SJCAA employee parking is in two lots. One lot is east of the terminal building and north of the train station, with the other lot west of the terminal building. The rental car lot is south of the far western end of the terminal building. **Table D-2** summarizes the number of parking stalls available to each parking category.

Table D-2: Vehicle Parking Spaces

Parking Type	Parking spaces
Short-Term Hourly	261
Long-Term (Including Valet)	2,363
Daily 18-Hour & Cell Phone Waiting	120
Rental Car	486
Employee	169
Total Parking Spaces	**3,399**

Source: Mead & Hunt, Inc. (2021)

D.1.2 Landside

The landside facilities supporting SBN's commercial airline terminal building are described below. These facilities are the access roadway and curbside.

Access Roadway

Terminal Drive is a two-lane roadway leading to the terminal at which point it becomes a three-lane curbside access (**Figure D-5**). The roadway follows a traditional loop around infield terminal parking. Passengers and visitors can enter short- and long-term parking at various points along Terminal Drive, dropping passengers off and parking before joining their parties to see them off or to travel together.

Passengers entering the terminal access roadway from the south follow the roadway east, then north. Entrances to the long-term and train station parking lots are the first access to parking along the east side of the roadway. The roadway turns west along the train station where a taxi queue is positioned to serve both the train station and air travelers at curbside further to the west. Drivers who drop passengers off at the curb have access to short-term parking across from the curb. Meeters and greeters will also use this lot to meet their party in the terminal. Valet parking is available at the curb for passengers when air travel supports this service. A secondary entrance to long-term parking is just around the turn to the south, away from the terminal, for departing passengers whose drivers will drop-off at the curb and join their party in the terminal.

Recent development expanded the rental car ready/return and long-term parking lots and added a new roundabout to re-route rental car return traffic from the terminal access roadway. Travelers returning rental cars use Progressive Drive from Airport Boulevard to the rental car entrance at the south end of the lot. The new route directs all traffic exiting the commercial terminal and rental car lots through the new roundabout to Airport Boulevard and on to Lincoln Way West.

Figure D-5: Terminal Roadway Lanes and Signage

Source: Mead & Hunt, Inc. (2021)

Lincoln Way West, which connects to Airport Boulevard and Terminal Drive, is the primary landside access for SBN's terminal building. Lincoln Way West runs east through the city center of South Bend and west to U.S. 31. North Bendix Drive gives access to the east side of SBN and runs in a north-south direction between Lincoln Way West and Interstate 90. From North Bendix Drive, Voorde Drive provides an alternate access route to the terminal building and parking facilities.

Curbside

Vehicle curbside access is provided via three lanes of the access roadway, which expands from two to three lanes as it turns west toward the terminal. The lane closest to the curb allows for passenger pickup and drop-off. The second lane provides for vehicle stacking and/or maneuvering into or pulling out of the curbside lane. The third, outside lane serves as a bypass lane for vehicles that will drive beyond cars stacked at the departures curb to pull up to the curb, for those drivers who have pulled out from the curbside to bypass all other traffic, and for other vehicles heading to the arrivals curb.

Vehicles for hire such as taxis, limousines, and shared ride network company vehicles such as Lyft and Uber also use the outside lane to bypass departures or arrivals activity to engage passengers at designated curbside areas.

The terminal building is parallel to the roadway. The terminal frontage at curbside provides multiple entrances to the building corresponding to activity within the terminal. The ticketing and baggage claim components at SBN are located closely together at the west end of the building. Most Airport users arrive and depart through the main entrance to the building. This entrance is between ticketing and baggage claim. The secure concourse has one entrance and exit, also between ticketing and baggage claim, which draws departing passengers to the main entrance. The departures hall is west of the international arrivals curb. The arrivals hall is also at the west end of the terminal, driving most of the domestic arriving passenger activity toward this area. This accumulation of functions is experienced most acutely at the curb.

In addition to personal vehicles, several other transportation options offer access to SBN. As previously noted, Transpo offers bus service to destinations throughout the South Bend area as well as taxis and ridesharing services that are available for use by passengers at designated curbside areas outside the terminal.

D.2 Demand / Capacity Analysis

As previously explained, SBN has one commercial airline terminal building. It is an L-shaped terminal building that has a linear east-west layout with the westernmost portion turning 90 degrees to the south. Today, the net area of the terminal building is 204,763 square feet, and its gross area is 217,221 square feet. The existing terminal building currently accommodates the operations of four airlines: Allegiant, American, Delta, and United.

Understanding the ground operations that support air travel increases the likelihood for safe and efficient operations within the terminal areas. Early planning decisions have long lasting impacts to building functions, including future expansion and services. Planning a terminal building to allow growth and be adaptive to industry changes is necessary for all airports.

Analysis of terminal building operations begins with a current airline schedule to determine peak hour operations to learn how periods of the greatest demand affect the internal and external processes of the terminal area. Planning adheres to basic precepts and safety standards and must factor in the building and site limits, compromising, if necessary, without limiting operational efficiency. Factors such as performance requirements, air carrier standards, and airport standards to maximize safety, security, and revenue influence improvement plans and should render designs that deliver a seamless passenger experience and enhance airport and air carrier operations. Ideally, the terminal design uniquely reflects the geography, climate, cities, and populations for every airport.

D.2.1 Airline Flight Schedule Peak Hour Review

The projections of passenger demand were developed for five-year increments (2025, 2030, 2035, and 2040). For future terminal facility planning purposes, the forecasts are presented as Planning Activity Levels (PALs) 1 through 4. Assigning PALs, rather than projected years, recognizes the uncertainties associated with forecasting and ties project milestones to activity levels rather than years. This allows the forecast to remain flexible, realizing activity levels may occur sooner or later than the forecast predicts. The PALs identify when the air carrier and subsequent passenger activity levels at SBN will trigger the need for additional capacity or other development.

The forecast of peak hour enplanements contains the Base Case Recovery forecast scenario. This scenario guided planning facility requirements for the terminal building. A peak hour passenger enplanement level was derived from current airline flight schedules and was used to determine facility requirements for the terminal building. The Base Case Recovery Forecast is presented below in **Table D-3**.

Table D-3: Base Case Recovery Forecast, from Table 2-13 of Master Plan: Forecast of Peak Hour Activity

		FORECAST			
	Actual	**2025**	**2030**	**2035**	**2040**
	2019	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Base Case					
Peak Month Enplanements	40,371	42,750	47,880	53,610	60,040
Average Day Peak Month (ADPM)	1,302	1,379	1,545	1,729	1,937
Peak Day Enplanements	1,762	1,866	2,090	2,340	2,620
Peak Hour	267	280	313	351	393

Source: Marr Arnold Planning, 2021

As shown in Table D-3, the peak hour enplanements total 280 for PAL 1 and 313 for PAL 2. SBN's summer 2021 early morning peak hour flight schedule (**Table D-4**) lists one CRJ-200, one CRJ-700, and three CRJ-900 aircraft departures by the legacy carriers. This provides for a total of 348 seats, or 289 enplanements using the 2019 average load factor of 83 percent.[1] This is equal to PAL 1 figures today. An additional departing flight with a 50-seat capacity and 42 enplaned passengers would yield a total of 398 seats, or 330 enplanements, exceeding the PAL 2 threshold.

United Airlines has use of two gates during the early morning peak hour (SBN operates a common-use gate system). Departing early in the 06:00 a.m. departures bank would allow passengers to connect with United's eight westbound flights from Denver that currently depart between 07:50 a.m. and 08:05 a.m.[2] United could also choose to serve Newark again to provide a feeder route from SBN for the New York-New Jersey region; or provide onward travel to points north (New England) and south (Mid-Atlantic).

United Airlines ramp operations at SBN
Source: SBN official Twitter account

Tables D-5 and **D-6** show the both the departure and arrival flight schedules for July 26, 2021.

[1] From Chapter 2: Projections of Aviation Demand, p. 19

[2] United westbound departures during this period include Fresno, Spokane, Los Angeles, Phoenix, Portland, San Diego, San Francisco, Salt Lake City and Tucson; scheduled service to Seattle is included if this window is extended from 8:05 a.m. to 8:10 a.m. Source: United Airlines website.
A flight's scheduled block time (SBT) is the time an aircraft pushes back from an origination airport gate (unblocked) to the time it docks (the point at which the wheels are blocked) at the destination airport gate (essentially the time an aircraft stops at the gate). Source: www.cirium.com
UA/ORD scheduled times are assumed to include built-in delays, allowing SBN flights to make up time for distance.

Table D-4: Daily Flight Bank Structure for Summer, 2021 - South Bend International Airport[3]

Arriving Seats	Gate	Airline	Flight No.	Aircraft	Origin	Depart	SBN Time	Arrive	Destination	Aircraft	Airline	Flight No.	Gate	Departing Seats
156	A9	G4	131	A319	LAS	22:45	5:15							
							6:00	7:01	DTW	CR7	DL	3529	A6	70
							6:07	8:05	CLT	CR9	AA	5399	A2	76
							6:09	8:00	ATL	CR9	DL	4765	A5	76
							6:15	7:05	LAS	A319	G4	228	A9	156
							6:20	6:12	ORD	CR2	UA	5768	A8	50
							6:53	7:38	MSP	CR9	DL	3572	A6	76
							7:40	9:12	DFW	CR7	AA	3289	A3	70
							9:45	9:37	ORD	CR2	UA	5720	A7	50
50	A6	DL	5172	CR2	ATL	9:00	10:51							
50	A7	UA	3848	CR2	ORD	9:00	10:56							
							11:30	11:22	ORD	CR2	UA	3843	A7	50
							11:31	12:30	DTW	CR2	DL	4764	A6	50
50	A5	DL	5243	CR2	DTW	10:49	11:46							
50	A7	UA	4645	CR2	ORD	10:40	12:24							
							12:35	14:33	ATL	CR2	DL	5006	A5	50
							13:00	12:52	ORD	CR2	UA	5496	A7	50
70	A3	AA	5189	CR9	CLT	11:20	13:14							

[3] Flight schedule for Monday, July 26th, 2021, from FlightStats.com. Some variation in scheduled activity will occur throughout the week during this period. The peak hour shown is peak activity as defined in Chapter 2: Projections of Aviation Demand.

Table D-4: Daily Flight Bank Structure for Summer, 2021 - South Bend International Airport (cont.)

Arriving Seats	Gate	Airline	Flight No.	Aircraft	Origin	Depart	SBN Time	Arrive	Destination	Aircraft	Airline	Flight No.	Gate	Departing Seats
							13:48	15:45	CLT	CR7	AA	5189	A3	70
156	A9	G4	2285	319	SFB	12:25	14:45							
							15:35	17:49	SFB	A319	G4	2315	A9	156
50	A7	UA	3907	CR2	ORD	14:10	15:59							
70	A3	AA	3084	CR7	DFW	12:35	16:05							
							16:35	18:03	DFW	CR7	AA	3084	A3	70
							16:36	16:28	ORD	CR2	UA	3785	A7	50
76	A5	DL	4656	CR9	ATL	15:15	17:11							
50	A6	DL	3836	CR2	DTW	16:59	17:55							
							17:59	19:53	ATL	CR9	DL	4656	A5	50
							18:45	19:48	DTW	CR2	DL	3836	A6	76
50	A7	UA	5556	CR2	ORD	18:10	20:04							
177	A9	G4	1655	320	PGD	17:37	20:10							
							21:00	23:29	PGD	A320	G4	1623	A9	177
76	A6	DL	3541	CR9	DTW	21:05	22:05							
76	A6	DL	3536	CR9	MSP	19:40	22:09							
70	A3	AA	3182	CR7	DFW	18:41	22:13							
186	A9	G4	613	320	AZA	16:05	22:23							
70	A2	AA	5240	CR9	CLT	20:38	22:28							
50	A7	UA	5783	CR2	ORD	21:15	22:58							
76	A5	DL	5477	CR9	ATL	21:04	22:58							
							23:13	23:44	AZA	A320	G4	647	A9	186

Source: Flight schedule for Monday, July 26th, 2021, from FlightStats.com

Table D-5: Peak Hour Departing Flights, Monday, July 26th, 2021

Seats	Gate	Airline	Flight No.	Aircraft	Origin	Depart	SBN Time	Arrive	Destination	Aircraft	Airline	Flight No.	Gate	Seats
156	A9	G4	131	A319	LAS	22:45	5:15							
							6:00	7:01	DTW	CR7	DL	3529	A6	70
							6:07	8:05	CLT	CR9	AA	5399	A2	76
							6:09	8:00	ATL	CR9	DL	4765	A5	76
							6:15	7:05	LAS	A319	G4	228	A9	156
							6:20	6:12	ORD	CR2	UA	5768	A8	50
							6:53	7:38	MSP	CR9	DL	3572	A6	76

Source: FlightStats.com

Table D-6: Peak Hour Arriving Flights, Monday, July 26th, 2021.

Seats	Gate	Airline	Flight No.	Aircraft	Origin	Depart	SBN Time	Arrive	Destination	Aircraft	Airline	Flight No.	Gate	Seats
							21:00	23:29	PGD	A320	G4	1623	A9	177
76	A6	DL	3541	CR9	DTW	21:05	22:05							
76	A6	DL	3536	CR9	MSP	19:40	22:09							
70	A3	AA	3182	CR7	DFW	18:41	22:13							
186	A9	G4	613	320	AZA	16:05	22:23							
70	A2	AA	5240	CR9	CLT	20:38	22:28							
50	A7	UA	5783	CR2	ORD	21:15	22:58							
76	A5	DL	5477	CR9	ATL	21:04	22:58							
							23:13	23:44	AZA	A320	G4	647	A9	186

Source: FlightStats.com

Peak hour departing flights occur early in the morning, from 06:00 a.m. to 07:00 a.m. Legacy carriers operate five of these flights: Delta (DL) - three flights; American (AA) - one flight; and United (UA) – one flight. With 348 departing seats at an 83 percent load factor, 289 passengers will depart SBN on legacy carrier flights during the peak hour. This figure is equal to the base and optimistic forecasts of peak hour enplaned passengers for 2025. For that reason, it was used to determine requirements for the legacy airlines' ticketing component.

The early morning departures bank also includes Allegiant's (G4) 06:15 a.m. departure. The flight is an Airbus 319 aircraft with 156 seats. This, combined with the legacy carrier early morning flights, brings the total departing seats to 504 during the early morning peak. Using the boarding load factor (83 percent) and current scheduled flights, this adds 129 departing passengers to the departures bank, for a total of 418 enplaned passengers. Allegiant requires passengers to be checked in and waiting at the gate at least one hour prior to departure.[4] Additional demand resulting from the new departures, noted above, will require capacity for these facilities in the future.

Allegiant Air jet at SBN
Source: SBN official Twitter account

Seven flights were scheduled to arrive at SBN during the 22:00 p.m. to 23:00 p.m. arrivals bank on July 26th, 2021. Four of these flights were scheduled to arrive within 20 minutes of each other. Typically, 20 minutes is the estimated time for determining requirements for claim device display frontage and space. Allegiant's flight from Phoenix-Mesa was one of the initial four arriving flights, disembarking approximately twice the number of passengers than those on the other flights during the period. There were also five scheduled arrivals within a 30-minute period during this peak hour.

D.2.2 Demand / Capacity Analysis by Function

Demand / capacity analysis studies a facility's ability to support demand. This includes the terminal building system's ability to accommodate passengers. The multiple components of a terminal building processing system allow the airlines to operate with a minimum of delay, depending on whether components are performing at a sufficient capacity. Calculations of existing and forecasted demand are applied to system

[4] Allegiant Airlines website check-in instructions state that check-in closes at 45 minutes prior to departure, but the airline requests passengers arrive at the gate earlier, noting: "Please arrive at the airport at least two hours prior to your scheduled flight departure. Plan to be completely checked in, through airport security and at the departure boarding gate **at least one hour** before your flight."

component capacity thresholds. The resultant data indicates whether additional capacity is necessary to support demand. Industry standards are used to analyze a peak passenger demand period.

Demand / capacity analysis provides a basis for determining a system's processing capacity and space requirements, which yields the facility space requirements program. Demand thresholds represent the breaking point at which the system becomes stressed and ultimately fails. This results in a lower level of service due to increased passenger and baggage processing times, waiting, and queues. Level of service assumes queueing as a normal activity in component demand. The amount of time and space required to process passenger demand determines whether a queue is functioning normally or has exceeded its target level of service.

Delays are normally evident during peak periods. In the past, a lower level of service was considered acceptable if it occurred briefly (fifteen minutes or less). A broader definition of level of service range now exists in the *Terminal Development Reference Manual* published by the International Air Transport Association (IATA).[5] The manual considers this over-capacity period as a separate, lower level of service category. The breakdown in capacity and level of service will determine the overall space requirements and priority of component improvements necessary to increase capacity.

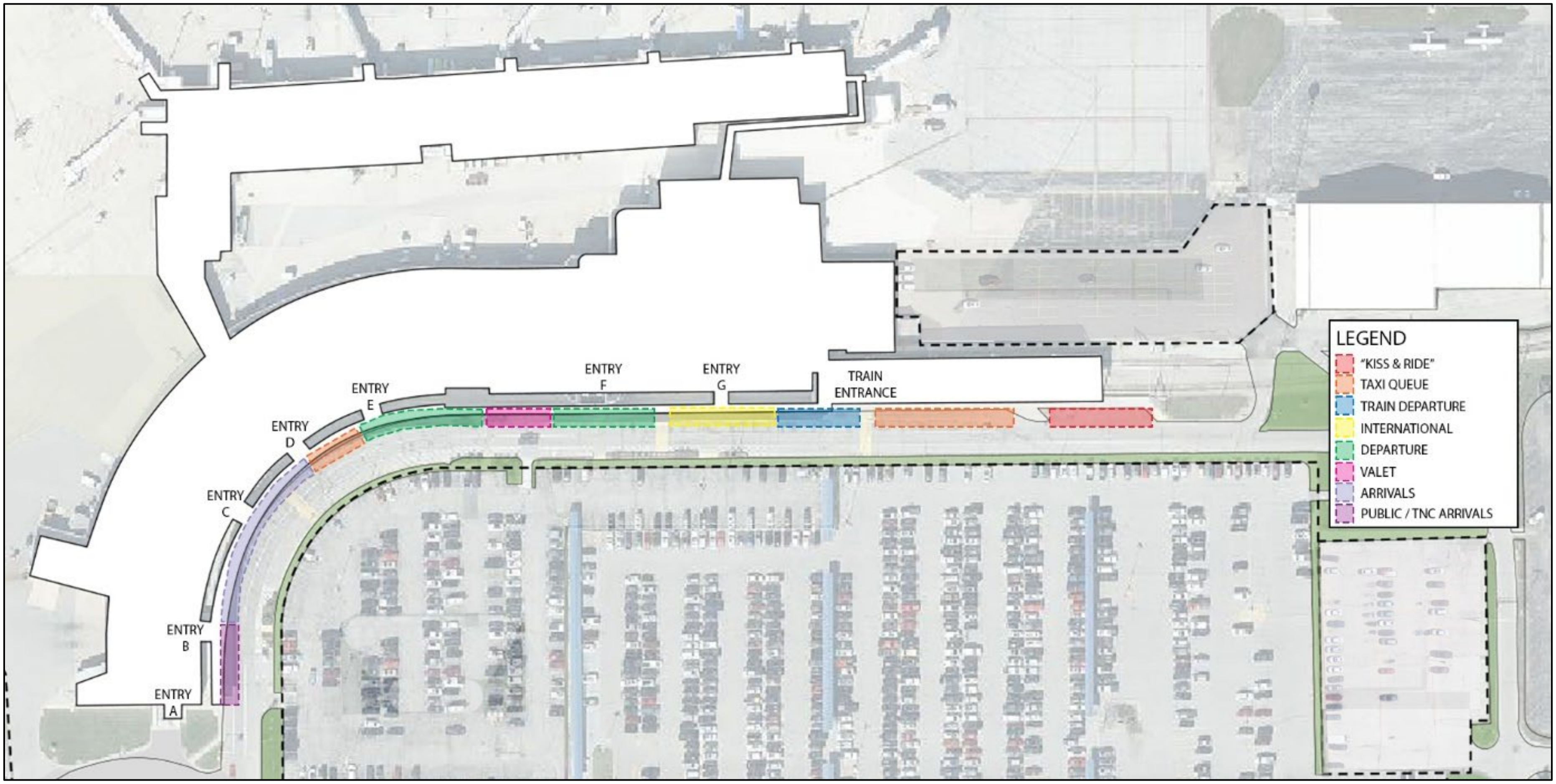
Terminal Curbside

Approximately 1,000 linear feet of terminal vehicle curb serves eight entrances along Terminal Drive. The terminal access roadway curb length is divided into two segments along the south side of the terminal: one serving train station passengers, the other serving airport passengers. The vehicle curb is divided between the departure and arrival curbs. However, there are multiple curb designations representing activity within the terminal, beginning with the train station departures and arrivals curb, then the international arrivals curb, followed by departures curb, and domestic arrivals curb.

Future terminal development will increase curbside demand. Provision of additional curb capacity will help alleviate vehicle congestion at the arrivals curb, particularly directly in front of the arrival hall entrance. Additional signage and striping of parking spaces along the curb would assist travelers in choosing the appropriate place to drop off and pick up passengers. Additional curb length in the form of another lane or a second curb would increase total curb length and vehicle capacity. This will impact short-term parking, requiring adjustment of the barriers between short- and long-term parking lots. The terminal curb is illustrated in **Figure D-6.**

[5] *Airport Development Reference Manual, 11th Edition,* March 2020; The International Air Transport Association.

Figure D-6: Terminal Curb Frontage and Building Entrance Designations



Source: Mead & Hunt, Inc. (2021)

Beginning from the east end of the South Shore Line train station, the curb consists of eight angled parking spaces that provide “Kiss & Ride” drop-off, short-term parking.[6] Next is a taxi stand/staging queue that runs the remaining length of the station platform shed to the first terminal building entrance. Metro passengers use this entrance (Entrance T) for train ticketing, a waiting area, and platform access. A short curb, approximately 50 feet long, serves arriving and departing passenger pick-up and drop-off at Entrance T. This entrance has a small shelter for passengers awaiting transport at curbside.

From Entrance T to just past Entrance G, the curb is designated as an international arrivals curb. Entrance F, the first departures curb and iconic two-story airport entrance, serves departing passengers who will use airline ticketing and baggage check-in services. The drop-off curb extends to either side of the entrance where passengers can access a ramp leading up to the terminal level. The valet parking drop-off and stand are just west of Entrance F. This is followed by the departures curb serving Entrance E.

Between Entrances D and E, a second taxi stand serves arriving passengers exiting through Entrance D. Building Entrances D and C serve arriving passengers as they exit from the arrivals hall. Entrance D is aligned directly with the concourse connector from the terminal. Passenger demand converges on four key components at this entrance: curbside, baggage claim, security screening, and concessions. Arriving passengers who bypass baggage claim will proceed directly to this exit or to the right for car rental pick up. Departing passengers who bypass terminal ticketing and baggage check-in counters will proceed directly to TSA security screening at the front of the concourse connector. This area of the curb becomes congested, particularly during peak arrival periods when vehicle dwell times increase, and queues form at the curb. As SBN’s travel demand grows, maintaining this area as the main entry and exit from the concourse will increase congestion at the curb, as well as within the building.

Entrance C and its curb are designated for arriving passengers claiming luggage and private vehicles, passengers, and/or visitors meeting their party curbside. Arrival curb frontage is allocated to both sides of the entrance. The remainder of the curb from this point to the curb end is designated for public transit and ridesharing, or Transportation Network Companies (TNCs) such as Uber and Lyft, serving Entrance B. Entrance A serves as an entrance and exit for passengers who reserve rental cars. It leads to the car rental lot to the south.

Terminal curb frontage allocation and use is detailed in **Table D-7**.

[6] Northern Indiana Commuter Transportation District (NICTD) operates the South Shore Line train with service from Millennium Station in Chicago, IL to the South Bend International Airport in South Bend, IN. Source: NICTD website.

Table D-7: Terminal Curb Frontage Allocation-Use and Building Entrance Designations

Arrivals & Departures Curb				
Entrance	**Curb Designation**	**Use**	**Curb Length, Linear Feet (LF)**	**Notes**
T	Departures	Kiss & Ride	105 LF	Train Entrance
	Arrivals	Taxi Queue	165 LF	Queue for Train & Staging for Arrivals at Entrance D
G	International Arrivals	Private Vehicles	129 LF	Currently designated as Departures Curb
F	Departures	Private Vehicles	94 LF	Main Iconic Terminal Entrance
	Valet	Private Vehicles	65 LF	Lane Blocked Off
E	Departures	Private Vehicles	102 LF	-
D	Arrivals	Taxis	60 LF	Taxi Stand
C	Arrivals	Private Vehicles	104 LF	Arrivals Hall/Claim Area
B	Public/TNC	Public Transit/TNC	94 LF	Public Transit/Transportation Network Companies
A	Car Rental	Entry/Exit		Car Rental Entrance & Exit to RAC Lot

Source: Mead & Hunt, Inc. (2021)

Observations of vehicle curb use and dwell times were recorded on April 29, 2021. **Table D-8** shows vehicles at the departures curb. The busiest period, with 29 vehicles, occurred between 16:00 p.m. and 16:29 p.m. When comparing the average dwell times in the first half-hour to the second, the latter average dwell times were nearly twice those of the first half-hour. This can be attributed to overlap between the first and second period with drivers arriving at the curb in greater numbers over a shorter period of time. It would also indicate that a majority of vehicles are using a single departures hall entrance. SBN staff noted that departing passengers use terminal Entrance E more than departures Entrances F and G.

Table D-8: Vehicles at Departures Curb - April 29, 2021

Departures Curb		Departures Curb		Departures Curb	
Period	15:30-15:59 PM	Period	16:00-16:29 PM	Period	16:30-16:59 PM
Total Vehicles	28	Total Vehicles	29	Total Vehicles	28
Average Dwell Time at Curb	5:02	Average Dwell Time at Curb	10:19	Average Dwell Time at Curb	4:36
Max Dwell Time at Curb	28:00	Max Dwell Time at Curb	36:00	Max Dwell Time at Curb	12:00

Source: Mead & Hunt, Inc. (2021)

A striped off, no parking zone is also along the departures curb. This is divided by a landscaped area across from Entrance D. The no parking zone could be converted to a through-traffic lane, creating a four-lane concept where the two lanes nearest the curb frontage function as double-stacked parking. In this concept, the inside lane is adjacent to the curb with the second lane serving as a stacking lane in which drivers are double-parked. Visitors parked in the double-stacked lane(s) would use the third lane to pull out and merge. The newly created fourth lane becomes a bypass lane that eases access and departure for vehicles using the departures curb. A fourth lane has the potential to limit or reduce delays created by departure curb activity.

Table D-9 shows arrivals curb dwell time activity. The busiest period is from 16:00 p.m. to 16:29 p.m. Its average dwell time is also the highest of the three observation periods. Passenger service ambassadors manage traffic at the curb, directing visitors to move on to allow others access to the curb. From the Planning Team's observations, more vehicles arrived at the curb at an average rate of just over one per minute. This prompted the ambassadors to move drivers along, particularly those creating congestion in the third lane.

Table D-9: Vehicles at Arrivals Curb - April 29, 2021

Arrivals Curb		Arrivals Curb		Arrivals Curb	
Period	15:30-15:59 PM	Period	16:00-16:29 PM	Period	16:30-16:59 PM
Total Vehicles	11	Total Vehicles	30	Total Vehicles	19
Average Dwell Time at Curb	10:33	Average Dwell Time at Curb	4:48	Average Dwell Time at Curb	3:27
Max Dwell Time at Curb	26:00	Max Dwell Time at Curb	18:00	Max Dwell Time at Curb	13:00

Source: Mead & Hunt, Inc. (2021)

A lane similar to the one at the departures area is adjacent to the outer drive lane. In this lane, drivers remained in their cars longer than either the typical behavior or what is allowed in the curbside lanes next to the building. Driver behaviors contribute to the longer average times shown in the tables. Under these conditions, the curb is functioning, but requires ambassadors to keep vehicles moving during peak periods.

D.3 Terminal Facility Requirements

The terminal building comprises specific functions supporting passenger, baggage, and cargo handling as well as aircraft services, such as cabin services and maintenance. The spaces within terminal facilities must meet the requirements of the airlines, as well as the traveling public.

Public space within terminal building is divided among secure, non-secure, and sterile areas. Sterile areas refer to space in which U.S. Customs and Border Protection (CBP) personnel process international passengers entering the U.S. through the FIS. The FIS, added at the east side of the terminal space in 2017, serves mainly general aviation international arriving passengers in a smaller facility. Though equipped to serve larger, commercial international flights and passengers, the Airport has yet to develop a demand for anything other than international charter flights (prior to the 2020 drop in air travel). The FIS facility program is complete and is not included in future requirements.

The identified terminal facility requirements anticipate growth in flights during the traditional peak hour. The requirements are based upon data collection from observations taken of airline and TSA passenger processing operations; departures lounge activity; anecdotal observations by the Mead & Hunt data collection team on April 29, 2021; and information provided by the Airport and Delta Air Lines. This processing data was compiled and combined with the flight schedule to calculate demand and capacity requirements for terminal facility components. These requirements serve as the basis of the program. Additional analysis for arrivals curb, ticketing and baggage check, TSA security screening, gate departures lounge, and baggage claim is described in the following sections.

D.3.1 Arrivals Curb

With the arrivals curb located on a curved roadway section, coupled with longer dwell times for the arrivals curb, additional capacity is needed. Alternatively, flattening out the roadway curve to increase space between the curb and entrance would achieve two objectives:

1. The curb becomes elongated within the entrance area, lessening congestion.
2. Reducing the roadway curve increases maneuverability for drivers accessing and departing the curbside lanes due to a better field of vision.

Future terminal development should increase curbside demand. Providing additional curb capacity will help alleviate vehicle congestion at the arrivals curb, particularly directly in front of the arrival hall entrance. Additional signage and striping of parking spaces along the curb would assist travelers in choosing the appropriate place to drop-off and pick-up passengers. Additional curb length, such as another lane or a second curb would increase total curb length and vehicle capacity. Providing additional curb length will impact close-in, short-term parking and will require an adjustment of barriers between short- and long-term parking lots.

D.3.2 Airline Ticketing & Baggage Check-In

Ticketing and baggage check-in statistics from American, Delta, and United's ticket counters were analyzed to determine the user preferences for each airline serving SBN. The analysis of these statistics shows that with one to two agents per carrier (two for Delta) processing passengers, capacity is sufficient over the planning period because the existing, fully staffed ticket counters are capable of meeting demand. Under existing conditions, airline agents consistently perform better than the service level wait time set as the precedent for the analysis, further confirming that the airline ticketing and baggage check-in facilities have sufficient capacity to process existing demand. In addition, other existing ticketing positions are available to expand capacity in the future. **Table D-10** presents averaged data for passenger profiles.

Table D-10: Observed Passenger Statistics at Airline Ticket Kiosks and Counters

Average Observed Time (Hrs:Mins)	Average Passengers	Average Passenger Parties	Average Party Size	Average Bags	Average Bags Checked	Average Checked Bags Per Passenger	Average Passenger Carry-On Bags	Average Carry-On Bags Per Passenger
1:54	58	37	1.68	95	36	0.68	59	1.03

Source: Mead & Hunt, Inc. (2021)

The passenger profile figures provide insight into passenger ticketing and baggage check-in behavior, particularly the number of passengers and how early passengers check-in prior to their flight. This population represents a percentage of all passengers boarding the aircraft. Since a separate segment of travelers print their boarding passes prior to arriving at the Airport, the data is further segmented by travelers who proceed directly to security screening with pre-printed boarding passes versus those who have a bag to check at airline ticket counters. Another passenger segment refers to the number of people who are traveling together. Identifying passenger groups provides additional information pertinent to airline passenger handling performance. Air carriers can process more passengers within a given period when passengers travel in groups.

The average number of bags calculation includes both checked and carry-on baggage. This data is significant because the industry uses average bags per passenger checking bags as a reference to determine size of outbound baggage security screening, airline baggage makeup, and claim device areas. **Table D-11** shows the average passenger processing time observed at the ticket counters.

Table D-11: Observed Passenger Time Statistics at Airline Ticket Kiosks & Counters

Number of Passengers in Queue Over Period	Number of Passengers at Ticket Counters	Average Passenger Time in Queue[1]	Maximum Passenger Time in Queue[1]	Average Passenger Time at Counters[1]	Average No. of Passengers at Kiosks	Passengers to Ticket Queue After Kiosks
15	58	2:03	5:30	2:04	7	4

[1] Time in minutes and seconds
Source: Mead & Hunt, Inc. (2021)

The design hour departing passengers include Allegiant’s 06:15 a.m. departure passengers, bringing the total to 418 enplaned passengers (as compared to the legacy carriers’ 348 enplaned passengers for the period). The same processing standards and observed times were applied to all carriers. It is presumed that fewer Allegiant passengers use ticketing and/or bag check-in services due to charges for these services. Kiosks were available to passengers at the legacy carrier ticketing counters, but the number of passengers using the machines was low during the observation period. **Table D-12** presents passenger ticketing performance metrics observed during the morning peak hour.

Table D-12: Passenger Ticketing & Baggage Check-In Peak Hour

Passenger Ticketing & Baggage Check-in Peak Hour 83% PLF & 5-Minute Service Level Existing Capacity	
Demand Profile	
Design Hour Departing Passengers	418
Percent of Passengers in Peak 30-Minute Period	47%
Percent of Passengers Using Ticketing	42%
Peak 30-Minute Originating Passengers	196
Peak 30-Minute Originating Passengers at Ticket Counter	83
Service Level	
Processing Time Per Passenger (Rounded Average)	2
Service Level Maximum Wait Time	5
Required Number of Staffed Positions	6
Queue Results	
Number of Staffed Service Positions	6
Average Queue Wait Time	1.8
Maximum Queue Wait Time	3.9
Maximum Number of Passengers in Queue	12
Ticket Counter Requirements	
Actual Number of Ticket Counter Positions	12
Average Width of Ticket counter Position (LF)	5
Depth of Check-In Queue (LF)	30
Length of Check-In counter (LF)	60
Existing Queue Area (SF)	1,200
Passenger Level of Service	
Passenger Space Required Level of Service LOS (SF)	15
Required Queue Area per LOS (SF)	265
Passenger Space (Average SF/Passenger)	103
Average Demand	
Design Hour Passengers per position	25

Source: Mead & Hunt, Inc. (2021); ACRP[7]

[7] *Airport Cooperative Research Program (ACRP) Report 25, Volumes 1 & 2, Airport Passenger Terminal Planning & Design*; Transportation Research Board (TRB), 2010.

D.3.3 TSA Checkpoint

The TSA checkpoint currently processes passengers during the morning peak hour without delay. A total of 418 departing passengers were identified in the current summer flight schedule's morning peak hour. During this peak period, three checkpoint lanes were operational. The maximum number of passengers in the queue was 36, and the average wait time was 4.2 minutes. This processing time is far less than the standard 10-minute wait time necessary to achieve an appropriate level of service at a checkpoint. The TSA passenger and carry-on luggage security screening are sufficient to manage today's passenger demand. Improvements to passenger and carry-on screening processes, along with increased enrollment in the TSA's *Pre-Check Known-Traveler* program will likely provide increases in security checkpoint capacity over time. **Table D-13** presents the security screening performance and requirements with a 10-minute queue.

TSA checkpoint at SBN
Source: flysbn.com

Table D-13: Passenger Security Screening Performance & Requirements

Passenger Security Screening Peak Period 10-Minute Service Level Requirement	
Demand Profile	
Design Period Departing Passengers (83% PLF)	418
Peak 30-Minute Period Total Traffic Percentage	47%
Peak 30-Minute Period Total Passenger Traffic	196
Throughput Rate Passengers per Hour per Lane	170
Passengers Processed per Minute per Lane	2.8
Maximum Target Wait Time	10
Minimum Required Number of Screening Lanes	3
Queue Results	
Number of Screening Lanes	3
Maximum Queue Wait Time (Minutes)	4.2
Maximum Number of Passengers in Queue	36

Source: Mead & Hunt, Inc. (2021)

Computed Tomography (CT) scanners are expected to be installed in screening lanes for carry-on luggage screening in the future. While automated screening lanes have provided gains in processing, these can be reduced by inadequate intake and reclaim belt length. Overall, increasing the number of lanes in a checkpoint is still the most efficient means of gaining screening capacity.

SBN's security checkpoint processing capacity should be able to manage passenger demand forecasted through the PAL 2 period. The facility requirements analysis shows that the existing three passenger screening lanes are adequate for passenger screening up to the PAL 4 scenario. Future expansion of the security checkpoint area will allow space for the installation of a fourth lane should the flight schedule grow beyond what is programmed as part of this master plan.

D.3.4 Gate Departure Lounges / Concourse

The gate departure lounges for the terminal concourse were built in 2011 to accommodate small regional aircraft operating from SBN. As of today, only Allegiant operates a narrow-body aircraft from the concourse. Larger charter flights for sports events also occur during the fall. The schedule for summer 2021 travel has resulted in a high level of departing passengers that have pushed the limits of the concourse capacity for gate departure lounge areas, the number of functional operating gates, and restrooms. **Table D-14** identifies the departure lounge area requirements based upon the current flight schedule.

Table D-14: Passenger Departures Lounge Area Requirements

Passenger Departures Lounge Area Requirements Current Flight Schedule	
Demand Profile	
Design Peak Hour Aircraft Seats	504
Design Peak Hour Planning Load Factor	85%
Design Peak Hour Departing Passengers	428
Percent of Passengers Seated	90%
Number of Seated Passengers	386
Percent Passengers Standing	10%
Number of Standing Passengers	43
Total Seats	386
Passengers Seated Percent of Total Aircraft Seats	77%
Area Requirements	
Area per Seated Passenger (SF)	21
Seated Passengers Space Requirements (SF)	8,097
Area per Standing Passenger (SF)	15
Standing Passengers Space Requirements (SF)	643
Passengers Space Requirement (SF)	8,739
Podium Position Width (LF)	6
Depth of Podium to Back Wall (LF)	8
Area per Podium Position (SF0	48
Podium Queue Depth (LF)	19
Area per Podium Position & Queue (SF)	162
Podium Positions	6
Total Podium & Queue Area (SF)	972
Boarding Corridor Width (LF)	5
Boarding Corridor Depth (LF)	26
Boarding Corridor Area (SF)	26
Total Board Corridor Area (F)	780
Total Lounge Requirements (SF)	**10,491**

Source: Mead & Hunt, Inc. (2021)

The gate departure lounge area measures approximately 20,800[8] square feet. This space includes lower and upper lounges, gate ticket lifts, queueing and boarding space, a seating area, and circulation at the lower level.

The concourse corridor is 34 feet wide, and the departures lounge is 26 feet wide. During multiple arrivals, the concourse visually appears crowded, but this is likely because people use the entire width of the corridor as they proceed to the exit. Expanding the concourse width to 35 feet would provide some relief for lounge areas, with the additional 5,400 square feet along the length of the concourse. The additional area will create seating area for departing passengers. It will also provide space for peak seasonal travelers and their carry-ons when the flights are full.

The figures in Table D-14 represent the minimum requirement for the airlines' current flight schedule. Future flight schedules will require more departure lounge area at the gates to meet passenger demand. Lounge area allocation has to rectify the Gates 2 and 3 level of service issue of insufficient space. Concourse layouts that allow passengers to use adjacent gate lounges, known as overflow, support greater efficiency over time.

In addition, it was observed that the layout and space within the concourse present challenges, particularly due to the original design that uses ramps and lifts to serve travelers. The existing ramps should also be eliminated or elongated so that passengers will not experience a sense of slipping on the surface when descending on the ramps. The Airport, airlines, and passengers have made the best of working within the concourse's limitations, but fundamental flaws remain.

The building was not designed to fully support airline operations during winter weather conditions. The concourse building impedes ground services operations, requiring long drives from gates to baggage claim with the clearance between the apron and concourse level too low to use the area beneath it. The benefits gained by maintaining a low-profile building are exceeded by an ability to use sheltered space under a concourse for airline and other tenant operations and to provide an apron clear of ground service equipment (GSE) equipment during snow removal.

D.3.5 Arrivals Curb

The percentage of passengers checking baggage at their origination airport and the number of bags per passenger determine the demand for baggage claim space and the required claim device frontage. The observed number of passengers checking bags at SBN was lower than anticipated. This is likely because passenger observations took place during the early morning departures bank. Typically, passengers during the early morning flights at SBN carry bags onto their flights rather than utilize baggage check-in services. The data collected from the morning observations confirmed the majority of passengers checked fewer bags than they carried onto the aircraft.

[8] Total lounge area take-off includes gate ticket lift, queue, and boarding corridor as well as seating areas.

Travel trends typically lean towards a higher percentage of passengers checking bags during seasonal leisure travel, rather than business travel that dominates early morning flights. Consequently, a more traditional figure of 60 percent of passengers checking bags was used to estimate necessary baggage claim frontage. Seven flights arrive during a peak hour from 10:00 p.m. to 11:00 p.m. Four flights arrive during a 20-minute window within this peak hour, and five flights arrive during a 30-minute window. The remaining two flights are scheduled to arrive at the end of the peak hour.

The length of the existing baggage claim devices meets demand for the current 20-minute peak arrivals period. As the Airport grows, baggage claim requirements will also grow. A third baggage claim device will be required to meet PAL 1 arriving passengers baggage claim demand. The arrival hall includes concessions and retail stores that will have to move to accommodate expanding the baggage claim area.

Table D-15 identifies passenger demand and capacity of the baggage claim device.

Table D-15: Passenger Demand & Capacity Requirements

Passenger Baggage Claim Demand & Capacity Requirement	
Passenger Demand	
Peak Hour Arriving Seats	604
Peak 20-Minute Period Arriving Seats	478
Peak 20-Minute Period Percent Arriving Seats	67%
Peak 20-Minute Period Terminating Passengers (85% LF)	405
Percentage of Passengers Checking Bags	60%
Passengers Checking Bags	243
Average Traveling Party Size	1.4
Number of Parties (Groups)	173
Percent Additional Passengers at Claim	10%
Peak 20-Minute Period Passengers at Claim Devices	180
Claim Frontage per Person (LF)	1.5
Total Claim Frontage Required (LF)	270
Total Drop-Off Belt Required (LF)	80
Total Claim Device Frontage Required (LF)	350
Number of Claim Devices (LF)	2
Baggage Claim Device Frontage per Device	**175**

Source: Mead & Hunt, Inc. (2021)

Baggage claim space requirements to meet current arriving flight demand are shown in **Table D-16**. The baggage claim device area includes the circulating belt width and area within the center of the device. Airline personnel manage baggage storage from the airline ticket offices. The space requirements include baggage carts to accommodate passengers who require this amenity and seating for 18 passengers or visitors.[9]

[9] A total of 18 passenger seats is calculated based on the area requirements identified in Table D-16. The calculation is as follows: *324 sf. (baggage hall seating space available) divided by 18 sf. (area per passenger) yields 18 passenger seats.*

Table D-16: Passenger Arrivals Hall Space Requirements

Passenger Arrivals Hall Space Requirements	
Passenger Demand	
Peak 20-Minute Period Passengers at Claim Devices	180
Area per Passenger	18
Passenger Area (SF)	3,240
Claim Device Area (SF)	1,350
Baggage Hall Seating (10% of Total Passengers) (SF)	324
Baggage Cart Staging/Storage (SF)	100
Baggage Services Storage (SF)	240
Total Claim Hall Area Required (SF)	**5,254**

Source: Mead & Hunt, Inc. (2021)

D.3.6 U.S. Customs Federal Inspection Services Facility and General Aviation Facility

None of the PAL facility programs include area for the U.S. Customs FIS and GAF. Together, these facilities total 22,500 square feet, including sterile corridors. They are not identified for expansion within the planning period.

D.4 Summary of Findings and Recommendations for Growth

Analysis of the terminal's operations centered around airline ticketing and baggage check, security screening, concourse gate departure lounges, and baggage claim. The analysis addressed whether these facilities need to be expanded and renovated to provide sufficient space for operations and passenger processing.

Deficiencies in terminal space identified during the facility requirements review process that should be remedied to accommodate SBN's PALs are outlined below.

Areas requiring expansion or inclusion are as follows:

- **Allegiant Airlines' Ticket Queue** – The queue requires more space to accommodate the rush of passengers checking in during the early morning departures bank. The high demand in this short period is due to Allegiants' larger aircraft, historically higher load factors, and the carrier's 45 – 60-minute cut-off time prior to departure.

- **Additional Airline Ticketing Office (ATO)** - At approximately 2,000 square feet per airline, the ATO areas will require expansion. Expansion of these facilities can be achieved by building out storage for airline GSE beyond the present ATOs and TSA's future checked-baggage inspection system.

- **TSA Checked Baggage Inspection System (CBIS)** - Consolidation of the CBIS housed beyond the airline's ATOs will reduce the number of explosive detection machines in use today and provide space for airlines to load carts in a consolidated outbound baggage make-up and GSE storage room.

- **Gate Departure Lounges** - The gate departures lounge area is too small to accommodate demand during the early morning departures peak hour when all gates have scheduled service within the period.

- **Terminal Gate** - Allegiant's operation requires a minimum of one gate to be built at the end of the concourse to accommodate the carrier's flights and not obstruct passenger handling operations at Gate 8.

- **Mother's Room** - A mother's room should be provided separately, away from restrooms.

- **Restrooms** - Single-use restrooms should be provided at multiple points in the concourse to limit walk time for passengers with reduced mobility.

- **Concessions** - Secure concourse concessions should be expanded to provide more seating and retail space.

Analysis of the terminal building plans, airline and tenant operations, and demand / capacity analysis of terminal components has provided insight on recommendations for growth. Projects below represent issues identified in the planning process that require updates. The list also represents priorities for interim improvements to be incorporated into SBN's capital improvement plan. Priority projects for improvement consideration include:

- Renovate and expand gatehouses 2 and 3 to provide American Airlines' passengers a higher level of service (LOS) and to help American meet their performance requirements.

- Upgrade the upper concourse to include new and expanded restrooms, single-user restrooms, mother's room, Gate 9 expansion and concourse renovation to include expanding departures lounges out onto the concourse, and food and beverage concessions expansion (existing or new tenants).

- Add a new claim device to the arrivals hall and move concessions south or to the secure concourse.

- Renovate and expand the connector building, including the security checkpoint, passenger exit, and employee screening hall. Development of this project will depend upon which terminal plan alternative is chosen by SBN for future development.

- Renovate and expand the Gates 2 and 3 departures lounges and concourse corridor to include raising the concourse level in this area to match that of the upper concourse.

- Expand and renovate the ATOs, consolidate TSA CBIS (just beyond ATO space), and build a new consolidated airline outbound baggage make-up room beyond the CBIS.

- Expand the terminal curbside to provide more curb length by expanding into the existing short-term parking or adding drive-through drop-off lanes; redevelop the terminal's main entrance D.

D.5 Alternative Terminal Concepts

The review of facilities requirements measured the ability of SBN's commercial airline terminal building to meet current and projected demand over the 20-year planning period. Terminal concepts developed as part of this *Terminal Planning Study* to accommodate projected demand are presented in the following sections.

The terminal concepts developed for this *Terminal Planning Study* are a result of the Planning Team's observations and documentation of passenger behavior during the facility requirements analysis as well as discussions of operational issues with the St. Joseph County Airport Authority (Authority). Recommendations for facility expansion concepts increase the amount of space required to meet program requirements above the baseline terminal configuration. A more comprehensive analysis of functional area requirements should be undertaken in an advanced planning phase to confirm the calculations presented in this terminal area plan.

D.5.1 Terminal Improvement Planning Considerations

Several considerations guided development of the terminal concept plans. These are discussed below.

Train Station

Although multiple potential locations have been identified, the future location of the train terminal has not yet been determined. The Authority has reported that the station is likely to remain at its current location at the east end of the terminal building for the foreseeable future.

Bus Station

Bus service ended at SBN in 2020 due to lack of demand. Consequently, the Authority has indicated that terminal concepts do not need to show a location for a bus station as a part of the terminal building.

Curbside

Vehicle access to the curb is limited during peak travel due to congestion. The curved drive lanes at the east complicate this congestion by compressing activity. Increasing the amount of vehicle curbside length by adding lanes to this area is one potential consideration, as is incorporating a second drop-off and/or pickup curb. Eliminating or "softening" the curve to improve vehicle circulation is considered a potential option to decreasing congestion.

Curb Access – Passengers with Restricted Mobility

Linear access from curb to entrances is limited, and multiple entrance stairs do not meet Americans with Disabilities Act (ADA) requirements. The curbside will meet requirements for passenger safety and operational efficiency in all planning options. This involves increasing sidewalk width and building alternate ramps to provide sufficient space for vertical transitions to meet ADA requirements.

Baggage claim at SBN
Source: Mead & Hunt, Inc.

Arrivals Hall / Baggage Claim

Baggage claim areas are supplemented with additional devices and space to address growth. Claim devices are planned to recirculate bags within public claim areas, eliminating traditional recirculation into secure baggage drop-off areas of the terminal.

U.S. Customs and Border Protection Facility

The FIS remains in place in all future concepts. The present location of the General Aircraft Facility, adjacent to the FIS, is the preferred location as both facilities are a recent addition.

Passenger Security Screening

The security checkpoint and queuing areas currently have sufficient area for processing passengers and meet future checkpoint requirements.

TSA Checked Baggage Security Screening

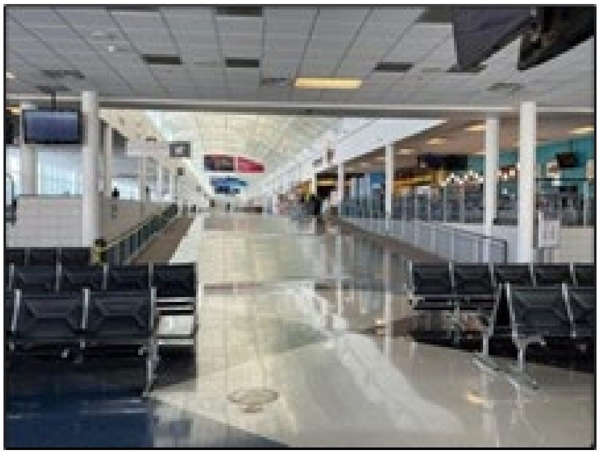
A location for a future consolidated baggage screening and shared airline outbound baggage make-up room is included for each concept.

Passenger Queueing

Existing terminal areas were designed to serve smaller regional jets. A lack of adequate queueing for larger flights has caused congestion in the departures and arrivals halls, at the security checkpoint, and at gate departure lounges. As seating capacity of aircraft in the commercial fleet increases, the frequency of crowded conditions at queuing areas will increase. Adequate space for queueing is a primary consideration for future concept planning.

Concourse Gate Departure Lounges

Some additional seating can be placed in the concourse corridor to meet near-term seating needs. Ultimately, new concourse space should be built to directly support the forecasted commercial fleet and passengers. The existing concourse can continue to serve smaller regional jets, or it can be widened in areas that serve larger aircraft.



Concourse gate departure lounge at SBN
Source: Mead & Hunt, Inc.

Concourse Height and Gate Utilization

The Planning Team created aircraft parking layout plans as part of a separate project for phased apron reconstruction. The final plan has been incorporated into this master plan. Replacement of boarding bridges will address issues with current gate equipment.

Future concourse concepts may include lifting the existing concourse to a full second level height. This would improve ADA access inside the building and passenger boarding bridges. It would also allow GSE to be parked under and pass below the concourse level, shortening GSE travel routes, and reducing baggage delivery times to the claim devices.

ADA Access at Gates 2, 3, and 9

ADA access to the aircraft boarding level at Gates 2 and 3 involves passengers using a single-occupancy elevator from the departure lounge to the passenger boarding bridge level. This is inefficient and disruptive to boarding flights. A building pedestrian ramp at Gate 9 provides an accessible route to the passenger boarding bridge.

Responding to vertical movement needs at Gates 2, 3 and 9 has been necessary to meet requirements set by varying floor heights. Using central vertical circulation nodes, such as escalators and elevators, is recommended. Stairs and ramps may be provided to supplement these devices.

New Concourse Option

A new concourse and vertical circulation core, built to today's standards, should be built to meet the Airport's mid- to long-term requirements. This achieves key development objectives: building at a greenfield site while providing for uninterrupted operations at the existing concourse during construction. Accommodating American Airlines' operations at the east side of the concourse during construction would open space to the west for development.

Building a new concourse will allow the Airport to meet requirements of a higher capacity fleet over time, adding gates with sufficient apron area and separation between aircraft parking positions to accommodate larger aircraft. New gate boarding bridges provide alternatives to existing limited-range bridges.

D.5.2 Terminal Concepts

Three terminal concepts were proposed based on the considerations above. For each concept, instead of attempting to categorize advantages and disadvantages of the proposed development, the key elements of the concept are identified.

Terminal Concept 1

Terminal Concept 1 is presented in **Figure D-7**. Elements of this concept are as follows:

- A prominent central 2-story entrance, passenger security checkpoint, and vertical circulation node are added.
- The existing FIS/GAF and South Shore train station remain in their current locations.
- The former bus station would be available for another use, potentially for rental car VIP parking.
- The first-floor security checkpoint and arriving passenger exit lane from the concourse are relocated to the new central structure east of the existing checkpoint.
- The east addition provides space for a consolidated baggage screening and airline outbound baggage make-up area used by all airlines.
- The airline offices are reworked and expanded to the other side of the central core into the existing baggage make-up areas.
- The second floor provides space for new gates and gate departures lounges on the west side and offices on the east side for airport tenants.
- Expansion to the west is adjacent to the existing hangar apron, south of the proposed concourse.
- Long-term expansion of the concourse is planned to the east of the existing terminal and north of the existing train station.
- The new east concourse can be built with a separate security screening checkpoint and vertical circulation.

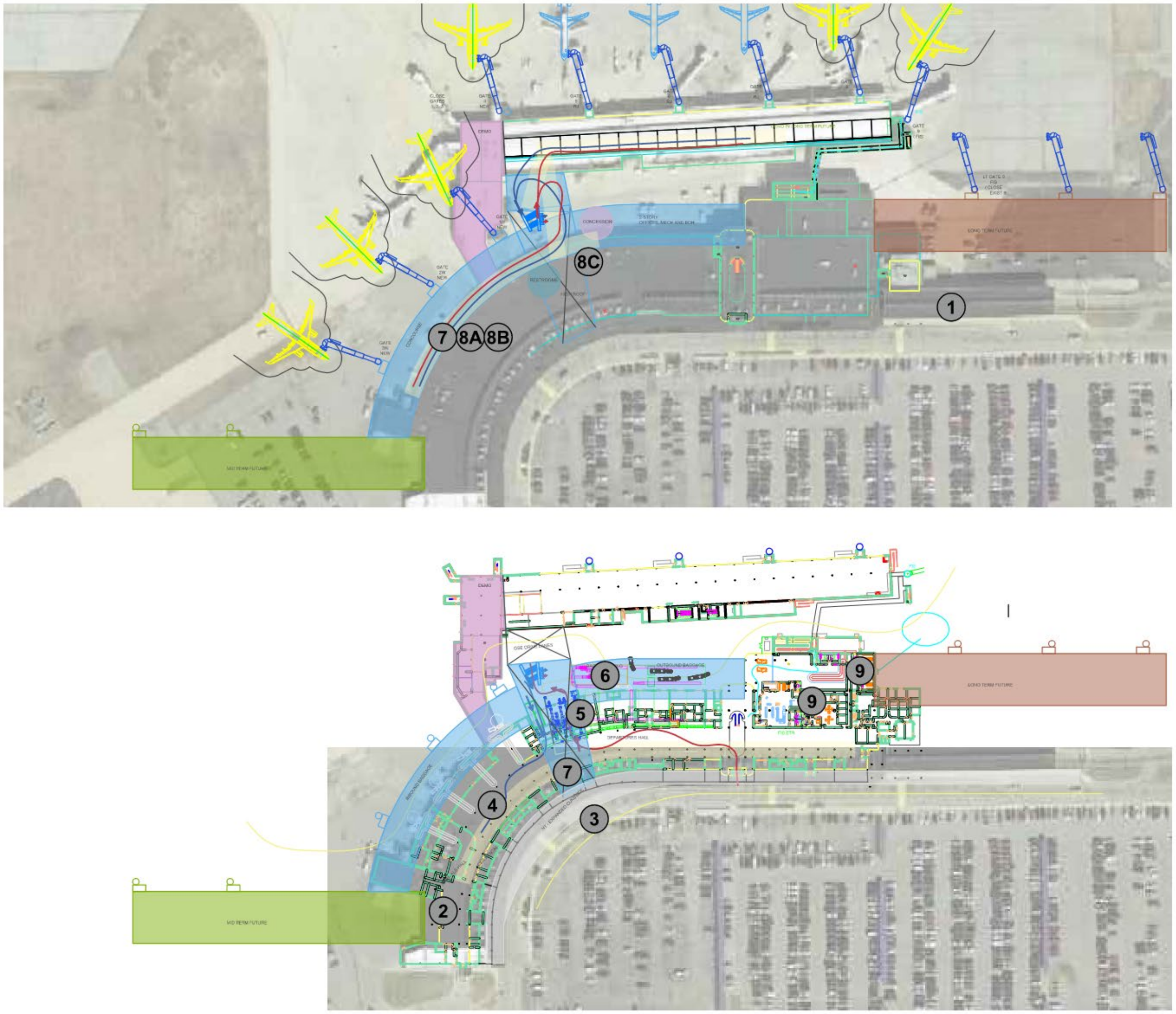
Gate expansion associated with Terminal Concept 1 is shown in **Table D-17**.

Table D-17: Terminal Concept 1 Gate Development

Phase	Number of Gates
I – Near-Term	9
II – Mid-Term	12
III – Long-Term	15

Source: Mead & Hunt, Inc. (2021)

Figure D-7: Terminal Concept 1



Considerations

1. Train Station: Remains in place.
2. Former Bus Station is repurposed.
3. Curbside: Entry drive curve is softened. Curbside is widened, providing space for vertical transitions and improving access.
4. Arrivals Hall: New carousels in baggage claim.
5. Passenger Screening: The checkpoint is relocated and expanded.
6. Baggage Screening: A location is chosen for consolidated baggage screening and an outbound baggage make-up room shared by the airlines.
7. Passenger Queuing: Additional space is provided for passenger queuing in all affected areas.
8. Concourse:
   - A. All new gates serve ADG Group III.
   - B. The new concourse is located on a full second floor, allowing GSE to pass below and improving passenger access at each new gate. A central vertical circulation node with stairs, elevators and escalators provides efficient passenger access between floors.
   - C. Space in the new concourse is provided for departure lounges, concessions, restrooms and other passengers services.
9. US Customs: Both the FIS and GAF remain in place.

GATES: 9

Source: Mead & Hunt, Inc. (2021)

Terminal Concept 2

Figure D-8 shows Terminal Concept 2. This concept addresses the concentration of arriving and departing passenger activity at the west end of the existing terminal building. Specific elements of the concept are the following:

- Departing passenger activity, including ticketing, baggage check-in, TSA CBIS, passenger security checkpoint, and vertical circulation, is relocated east of the FIS in this plan.
- Terminal Concept 2 relies on St. Joseph County to move the existing train station to a new location further to the east along the existing railway right-of-way.
- Building just beyond the CBP facility separates departure and arrival functions.
- Baggage claim is moved to the former ATO areas, decreasing congestion while increasing passenger LOS.
- Separating arrivals and departures activity increases the building's total functional capacity above what can be achieved in other concepts.
- Developing new departure processing and concourse areas constitutes building new infrastructure, a departure hall, and a 3-4 gate, two-story concourse.
- This concept allows use of the existing terminal until additional curb capacity requires extending it to the west.
- The concourse would serve until it reaches the end of its useful life.

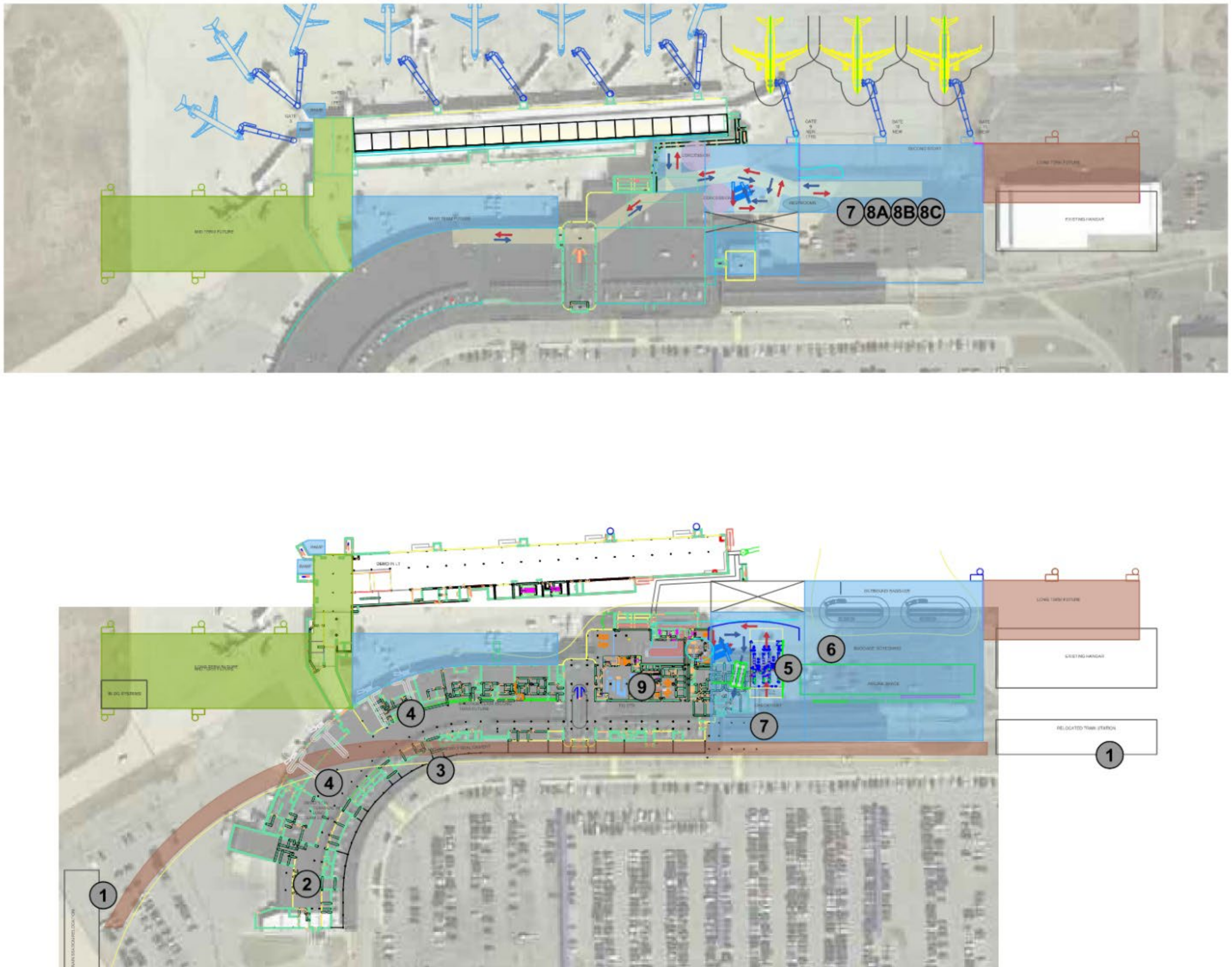
Gate expansion associated with Terminal Concept 2 is presented in **Table D-18**.

Table D-18: Terminal Concept 2 Gate Development

Phase	Number of Gates
I – Near-Term	10
II – Mid-Term	12
III – Long-Term	16

Source: Mead & Hunt, Inc. (2021)

Figure D-8: Terminal Concept 2



Considerations

1. Train Station: Moves east or southwest.
2. Former Bus Station is demolished.
3. Curbside: Entry drive curve is realigned. Curbside is widened, providing space for vertical transitions and improving access.
4. Arrivals Hall: Baggage claim moves east.
5. Passenger Screening: The checkpoint is relocated and expanded.
6. Baggage Screening: A location is chosen for consolidated baggage screening and an outbound baggage make-up room shared by the airlines.
7. Passenger Queuing: Additional space is provided for passenger queuing in all affected areas.
8. Concourse:

A. All new gates serve ADG Group III.

B. The new concourse is located on a full second floor, allowing GSE to pass below and improving passenger access at each new gate. A central vertical circulation node with stairs, elevators and escalators provides efficient passenger access between floors.

C. Space in the new concourse is provided for departure lounges, concessions, restrooms and other passengers services.

9. US Customs: The FIS remains in place and the GAF is relocated.

GATES: 10

Source: Mead & Hunt, Inc. (2021)

Terminal Concept 3

Terminal Concept 3 is depicted in **Figure D-9**. This concept is comprised of the following near-, mid- and long-term development aspects:

- This concept adds a prominent, central, two-story structure on the west side of the existing checkpoint that extends from the curb to beyond the existing concourse.
- The FIS, GAF, and train station remain in their current locations.
- The former bus station and restaurant can be converted to expand baggage claim.
- The relocated and expanded security screening checkpoint and arriving passenger exit lane are on the first floor of the new central structure.
- A central vertical circulation node is located on the secure side of the checkpoint.
- The arrival hall remains near its current location with new baggage carousels added to the southwest side.
- A one-story addition on the east side of the central structure provides space for a consolidated baggage screening and an outbound baggage area for the airlines.
- Airline offices are reworked and expanded to the north, into the existing baggage make-up areas.
- This concept provides gate departure lounges and aircraft stands that accommodate larger aircraft and increase the total gate count to 15.
- The existing concourse would remain in place to continue to serve regional jets while the east and west ends are built to serve mainline aircraft.
- The existing international arrivals at Gate 9 continue to be used for passengers who will clear the FIS.
- Gate 4 is overhauled.
- The service animal relief area would be relocated.
- Expansion of the double-loaded pier concourse to the west provides four additional aircraft gates for a total of 19 gates.
- The long-term expansion shown in this concept is not feasible, as it would impact Taxiway N.

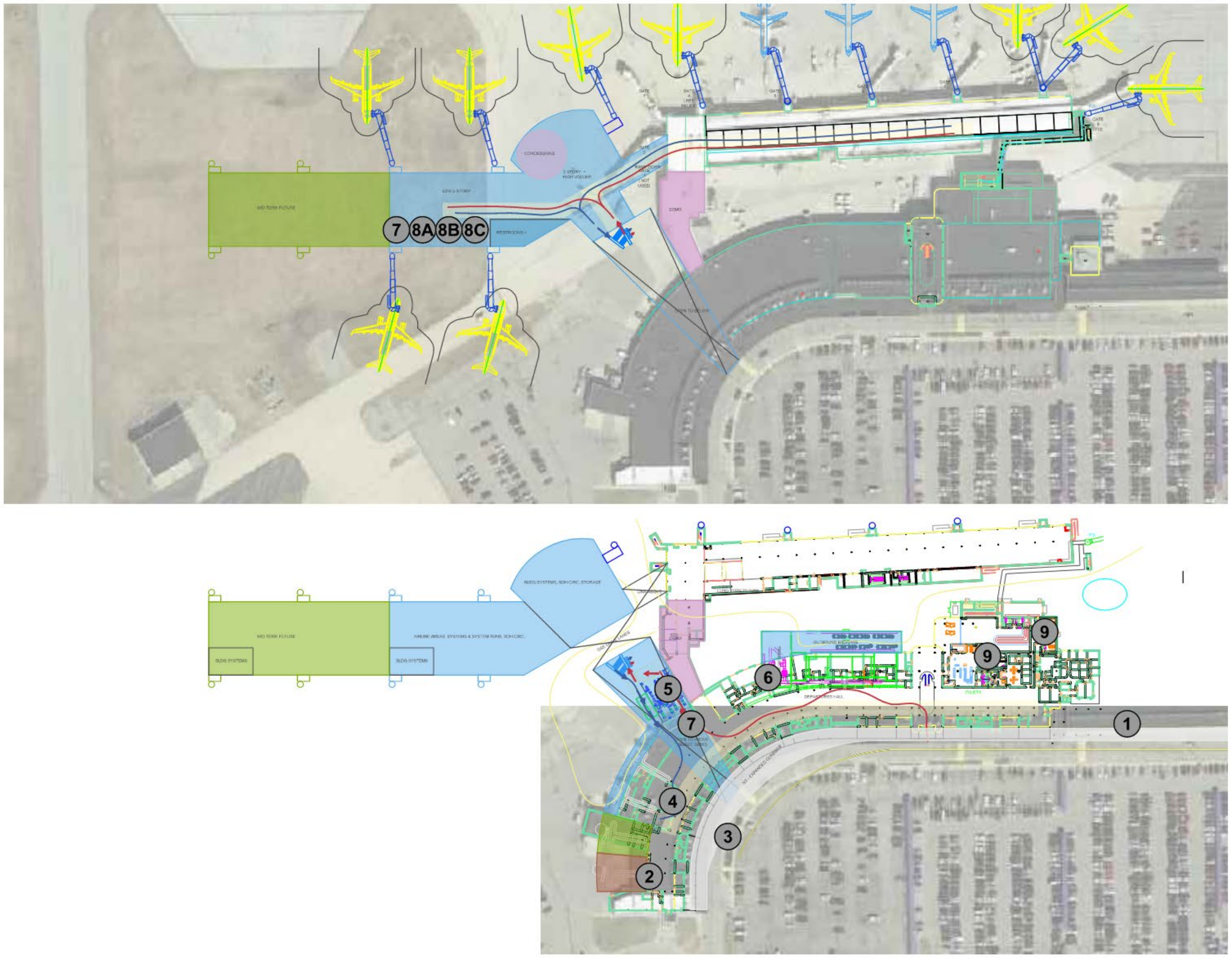
Gate expansion associated with Terminal Concept 3 is shown in **Table D-19**.

Table D-19: Terminal Concept 3 Gate Development

Phase	Number of Gates
I – Near-Term	11
II – Mid-Term	15
III – Long-Term	19

Source: Mead & Hunt, Inc. (2021)

Figure D-9: Terminal Concept 3



Considerations
1. Train Station: Remains in place.
2. Former Bus Station is repurposed.
3. Curbside: Entry drive curve is softened. Curbside is widened, providing space for vertical transitions and improving access.
4. Arrivals Hall: New carousels in baggage claim.
5. Passenger Screening: The checkpoint is relocated and expanded.
6. Baggage Screening: A location is chosen for consolidated baggage screening and an outbound baggage make-up room shared by the airlines.
7. Passenger Queuing: Additional space is provided for passenger queuing in all affected areas.
8. Concourse:
A. All new gates serve ADG Group III.
B. The new concourse is located on a full second floor, allowing GSE to pass below and improving passenger access at each new gate.
A central vertical circulation node with stairs, elevators and escalators provides efficient passenger access between floors.
C. Space in the new concourse is provided for departure lounges, concessions, restrooms and other passengers services.
9. US Customs: Both the FIS and GAF remain in place.

GATES: 11

Source: Mead & Hunt, Inc. (2021)

D.5.3 Preferred Terminal Concept

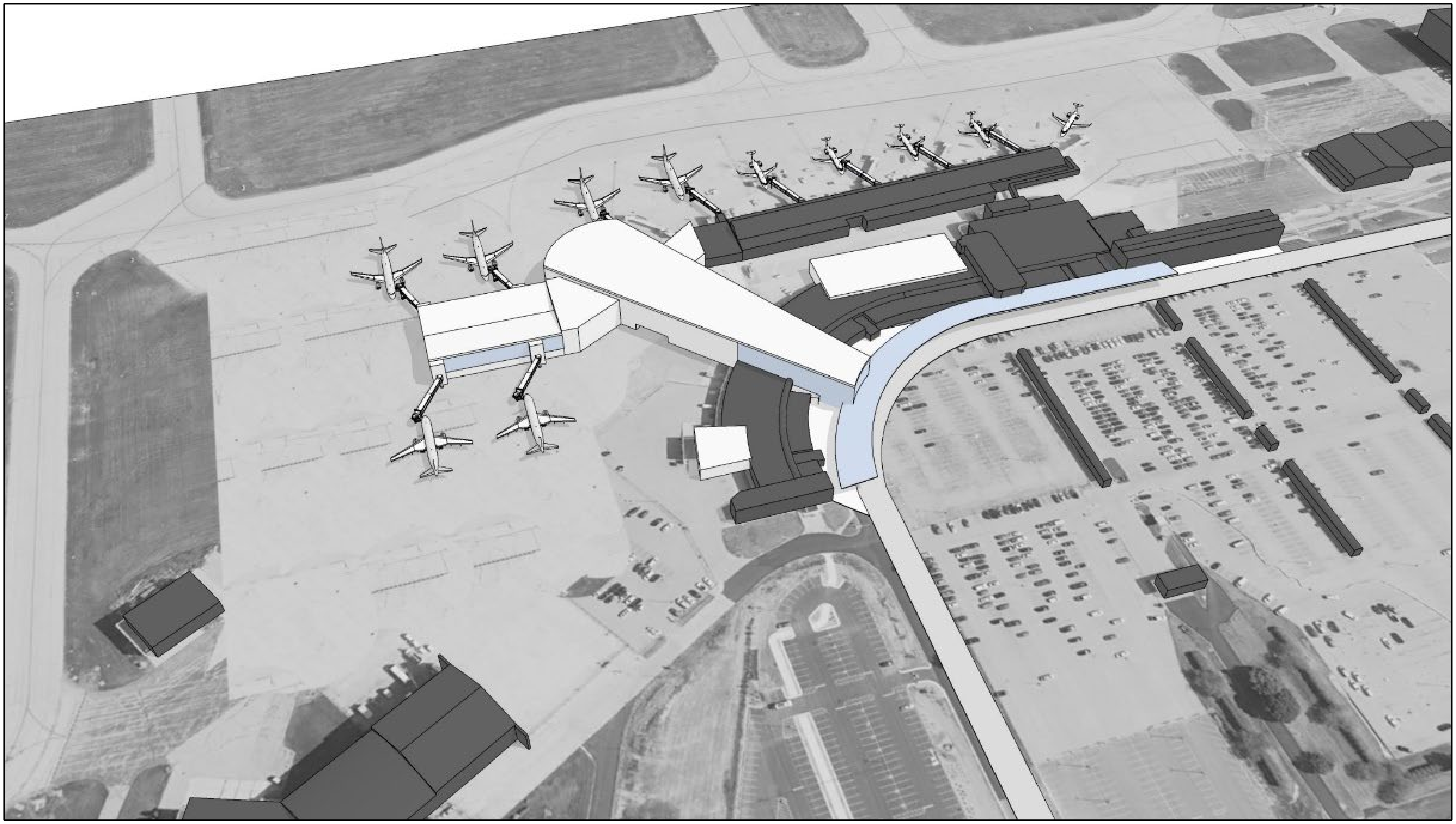
Three initial plan concepts were proposed. Terminal Concept 3 was chosen as the preferred development concept since it provides the most flexibility for future growth. **Figure D-10** and **Figure D-11** show Phase I and Phase II development, respectively, for the preferred Terminal Concept. The proposed Phase III work will not be performed due to constraints on the airfield, specifically, as long as Taxiway N is still in use. Instead, Phase III work will involve replacement of the existing concourse and expansion to connect to the terminal in direct response to future aircraft gate and concourse demand.

D.5.4 Estimated Construction Cost

The estimated cost for the preferred Terminal Concept is $80.7 million, which includes the following:

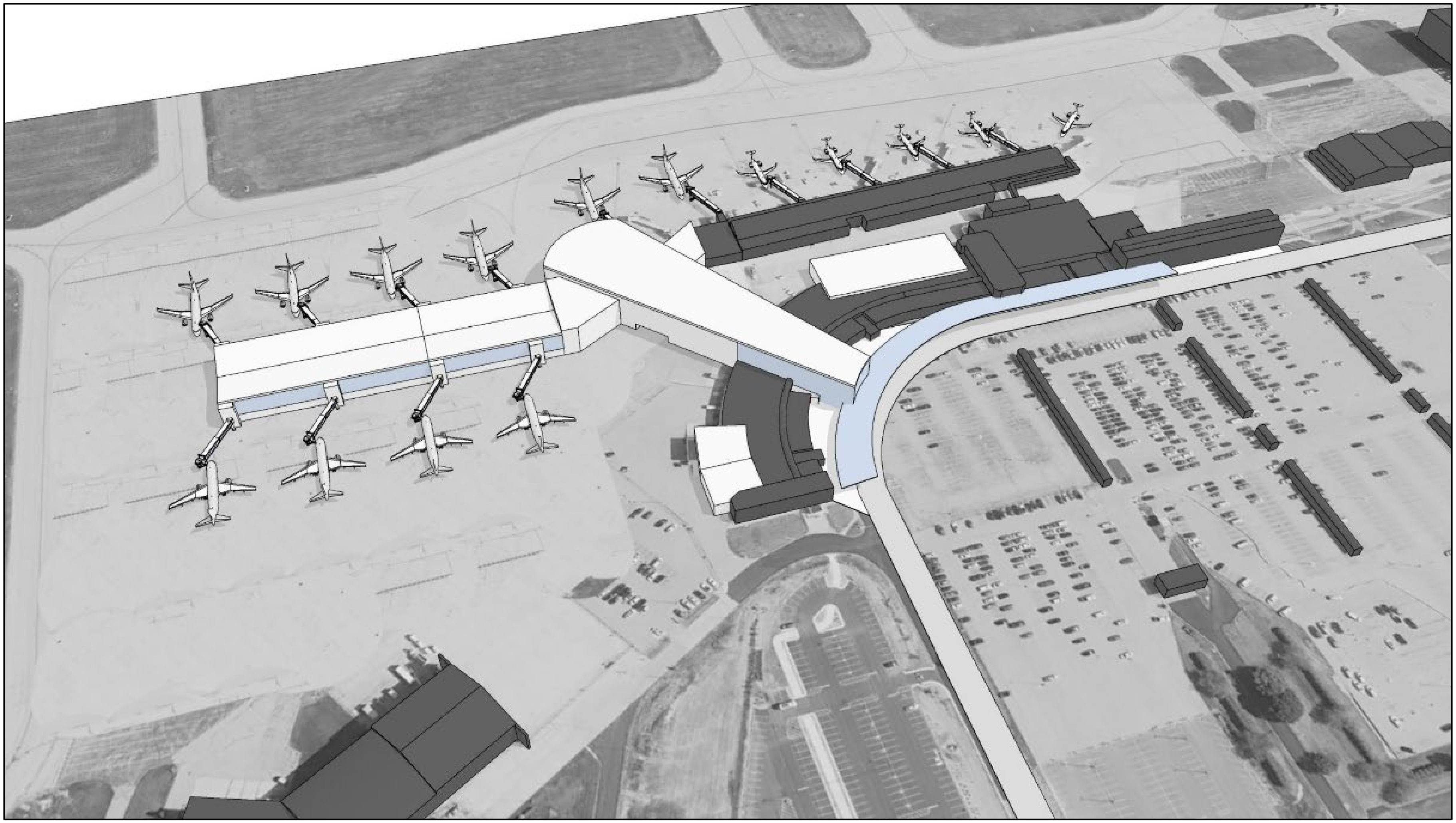
- Construction
- Professional services
  - Design
  - Permitting
  - Construction administration
  - Construction inspection
  - Quality assurance testing
- Contingency – 15 percent

Figure D-10: Preferred Terminal Concept Phase I, PAL 1



Source: Mead & Hunt, Inc. (2021)

Figure D-11: Preferred Terminal Concept Phase II, PAL 2



Source: Mead & Hunt, Inc. (2021)

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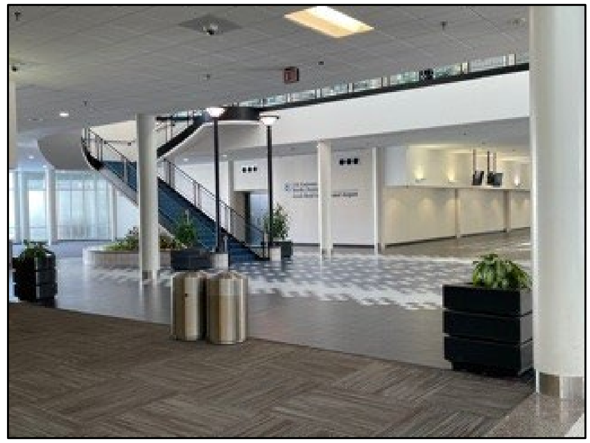
Appendix E

Master Plan Drainage Analysis



Appendix F

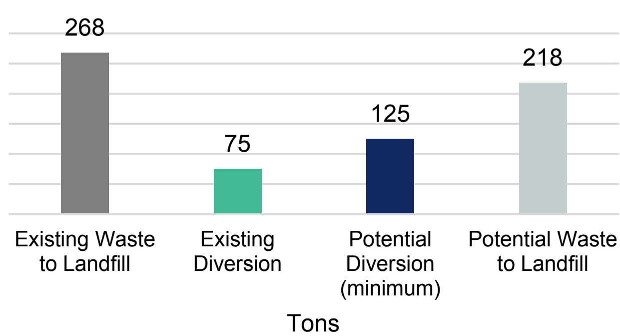
Airport Waste Reduction, Reuse, and Recycling Plan

South Bend International Airport (SBN) can reduce waste generation and increase landfill diversion by:

- Integrating waste diversion practices into airport operations
- Improving purchasing practices, reducing disposable items, and reusing supplies
- Enhancing the existing recycling program
- Tracking and voluntarily reporting waste metrics and diversion progress
- Collaborating with tenants and stakeholders to achieve diversion goals

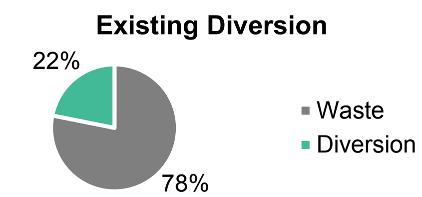
The existing program at SBN generates approximately 268 tons of landfill-bound waste annually, as well as an additional 75 tons of recycling (see **Figures F-1** and **F-2**). These recommended strategies have the potential to divert at least 50 more tons of general materials from the landfill a year.

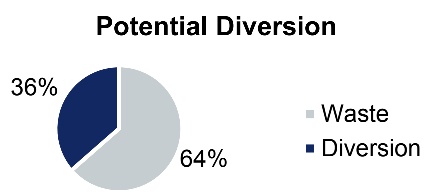
Figure F-1: Waste at SBN



Source: Mead & Hunt, Inc. (2021); EPA Conversion Factors

Figure F-2: Landfill Diversion at SBN





Source: Mead & Hunt, Inc. (2021); EPA Conversion Factors

Reducing waste generation and increasing landfill diversion align with SBN's efforts to operate in a responsible, sustainable manner.

Planning for solid waste and recycling under the on-going Master Plan fulfills SBN's federal obligation under the **Federal Aviation Administration (FAA), FAA Modernization and Reauthorization Act of 2012 (FMRA), FAA Reauthorization Act of 2018**, and associated guidance.

F.1 Recommendations (Plan to Minimize Waste Generation)

The following recommendations to improve waste diversion at SBN include waste reduction, reuse, and recycling strategies. Evaluation for each recommendation considered estimated relative cost and diversion potential, the suggested implementation time frame, and noted alignment with best practices or standard programs. **Table F-1** shows the key for quick comparison of the impact of each recommendation on diversion.

F.1.1 Recommendation 1: Integrate Waste Diversion in Airport Operations

Description

Waste diversion is the concept of avoiding and/or managing waste to avoid landfill disposal. Waste diversion strategies include practices such as reduction, reuse, donation, sustainable procurement, recycling, and composting. These strategies offer various levels of fiscal, environmental, and social benefits.

Action

It is recommended that SBN continue to integrate waste diversion concepts and practices into existing policies and operations, for example, in maintenance operations, purchasing practices, and tenant involvement.

Table F-1: Recommendation Key

Item	Icons	Significance
Relative Cost	$ (1 of 3)	Relatively Low Cost
	$ $ (2 of 3)	Relatively Medium Cost
	$ $ $ (3 of 3)	Relatively High Cost
Estimated Potential Diversion	🗑 (1 of 3)	Low Diversion Potential
	🗑 🗑 (2 of 3)	Medium Diversion Potential
	🗑 🗑 🗑 (3 of 3)	High Diversion Potential
Suggested Implementation Time Frame	🕒 (1 of 3)	Short Range (<1 Year)
	🕒 🕒 (2 of 3)	Medium Range (1-3 Years)
	🕒 🕒 🕒 (3 of 3)	Long Range (3+ Years)
Alignment	BMP	**Best Management Practice (BMP)**
	TRUE	BMP and **Total Resource Use and Efficiency (TRUE)** Certification Program Element

Source: Mead & Hunt, Inc. (2021)

Justification

Most of the municipal solid waste generated at SBN is disposed of at a local landfill and recycling center. Waste diversion would reduce the volume of waste sent to the landfill as well as reduce the financial and social impacts of waste.

Information Needed

- Communication tools to reach SBN staff and tenants
- Waste diversion information

Action Plan

- Emphasize the importance of waste diversion (including, but not limited to, recycling) to SBN staff and tenants
- Adopt waste diversion mindset and policy statement
- Identify sources of waste and promote strategies to avoid, reduce, or divert these materials
- Encourage waste diversion in the design and construction of future SBN development projects

Relative Cost

Estimated Diversion

Time Frame

Alignment

BMP

F.1.2 Recommendation 2: Improve Purchasing Practices, Reduce, & Reuse

Description

To reduce the facility's volume of waste sent to the landfill, SBN should reduce waste generation and reuse materials where possible. SBN staff's existing purchasing practices may generate waste in the form of single-use and/or disposable items and supplies. Tracking these items could reveal opportunities for reduction and reuse.

Action

It is recommended SBN adopt a purchasing policy prioritizing durable (versus disposable) items and supplies that are reusable, recyclable, compostable, and/or made from recycled content. It is also recommended that SBN identify supplies and materials which can be avoided, reused on site, or donated to a third party. Additional strategies to eliminate waste at the source include switching to coreless toilet paper rolls, donating unfinished rolls of toilet paper, mandating double-sided printing, and gifting employees reusable tumblers and mugs.

Justification

Waste reduction is the most environmentally preferred waste diversion strategy as determined by the **Environmental Protection Agency (EPA)**. Reduction and reuse simultaneously lower waste program costs by producing a smaller material stream.

Information Needed

- Purchasing records
- Waste stream information

Action Plan

- Adjust practices which generate waste (printing, housekeeping, etc.).
- Substitute durable alternatives for single use or disposable items in the administration office and staff areas.
- Reuse items and materials where possible and encourage reuse by passengers, tenants, and contractors.
- Purchase items in bulk to eliminate waste from shipping and packaging.

Relative Cost

Estimated Diversion

Time Frame

Alignment

BMP

F.1.3 Recommendation 3: Enhance Existing Recycling Program

Description

To reduce the facility's volume of waste sent to the landfill, SBN should continue to recycle materials that cannot be reused or avoided.

Action

It is recommended SBN maintain its existing recycling program and supplement current practices with additional receptacles, signage, and an education campaign.

Justification

Convenient receptacles, effective signage, and educational campaigns have been shown to increase participation and improve compliance with a recycling program. Recycling bins should be readily visible and instructional recycling signage would greatly increase the effectivity of designated recycling bins. An awareness campaign for employees, tenants, or visitors further compounds the program's effectiveness.

Information Needed

- Inventory of related signage and areas of significant waste generation.
- Protocol for communicating program to employees, tenants, and visitors.
- Input from janitorial staff and contractors regarding current practices and program effectivity.

Action Plan

- Convert surplus garbage cans into recycling bins with labeling.
- Collocate all recycling bins and garbage cans into pairs throughout the facility.
- Right-size and standardize bins and bin liners to match capacity needs.
- Install color-coded, graphic instructional signage in public areas.
- Train employees on the recycling program to explain its purpose, requirements, and importance.
- Develop a promotional campaign to communicate information about the recycling program to tenants and passengers.
- Monitor and adjust recycling program using feedback from the hauler.

Relative Cost

Estimated Diversion

Time Frame

Alignment

TRUE

F.1.4 Recommendation 4: Tracking & Reporting

Description

Monitoring waste metrics provides feedback on the efficiency of diversion efforts. Sharing this information with stakeholders has been shown to increase participation in diversion practices.

Action

It is recommended that SBN begin to regularly estimate and track the volume of waste sent to the landfill and diverted through reduction, reuse, donation, recycling, or other strategies as well as the costs associated with these services. It is also recommended SBN discuss these trends with the waste hauler and share this information with program stakeholders (SBN staff and tenants).

SBN could benefit from adopting both a vision and a waste diversion goal/target to set a reasonable standard of progress. A diversion goal of 40 percent, for example, would represent a realistic goal for SBN.

Justification

SBN does not currently track metrics associated with its waste. Trends related to SBN's waste generation, landfill, diversion, and associated costs could indicate opportunities for improvement.

Information Needed

- Waste generation, disposal, and cost estimates.
- Estimates of volume of waste diverted by various strategies and avoided costs.
- Mechanism for communicating progress to stakeholders.

Action Plan

- Collaborate with waste hauler to measure or estimate waste and recycling volumes.
- Set specific, measurable, achievable, realistic, and time-bound (SMART) goals for SBN's waste program.
- Create a tracking tool (such as a spreadsheet) to assess the total volume and cost of SBN's waste management program.
- As strategies are implemented, update tracking tool to reflect waste avoided, diverted, and costs.
- Evaluate data for additional opportunities to set and pursue waste diversion goals, such as waste generated from Airport project sites.
- Share and celebrate progress with stakeholders.

Relative Cost

Estimated Diversion

Time Frame

Alignment

TRUE

F.1.5 Recommendation 5: Collaborate with Tenants and Stakeholders to Achieve Waste Diversion Goals

Description

Rules and Regulations, Minimum Standards, leases, contracts, and partnerships are all vehicles through which SBN can influence tenant behavior, including recycling.

Action

It is recommended SBN design a recognition or incentive program to reward stakeholders for their contributions to the diversion plan. SBN should also ensure language pertaining to the waste diversion program, including recycling, is incorporated in the facility's Rules and Regulations, Minimum Standards, and future Requests for Bids/Proposals (RFB/RFPs).

Justification

SBN's contracts and other agreements establish expectations related to waste diversion and form the basis of actions. At the time of this Master Plan, SBN is in the process of updating its Rules and Regulations and its Commercial Minimum Standards documents. Updating these documents to encourage tenant participation in the waste diversion program advances the program in areas beyond its existing control. Private hangar tenants, who are responsible for obtaining their own waste collection services, could be encouraged to consider their own waste diversion practices. Other tenants, like airline leased areas, could be included as well.

Information Needed

- Existing Rules and Regulations and/or Minimum Standards.
- Current contracting template and protocol for revising.

Action Plan

- Thank and publicly recognize tenants and stakeholders that contribute to SBN's waste diversion program.
- Update the newest Rules and Regulations and/or Minimum Standards to encourage or require waste diversion, including recycling.
- Encourage private hangar tenants to divert waste and encourage or require these tenants to obtain both waste and recycling collection services.
- Review governance documents and contracts on a regular basis to ensure they reflect SBN's goals.
- Draft waste diversion specifications and incorporate in upcoming requests for bids or proposals.

Relative Cost

Estimated Diversion

Time Frame

Alignment

TRUE

F.1.6 Alignment with Draft Airport Sustainability Plan

The St. Joseph County Airport Authority (SJCAA) is committed to environmental responsibility and a draft Airport Sustainability Plan was developed to assist SBN in evaluating various options for greening operations. The draft Airport Sustainability Plan incorporated many aspects of SBN's operations and identified waste reduction as one strategy to become more sustainable. At the time of this Master Plan, the Airport Sustainability Plan was still a draft document. Preliminary waste goals considered in the current draft of the Plan include:

- A 50 percent reduction in waste generated by airport offices and terminals by 2025.
- The introduction of a formalized recycling program, headed by a recycling coordinator, to reduce waste and track recycling.
- The provision of accessible recycling receptables with clear signage and a training program for effective use by employees and janitorial staff.

- A unified effort to assist waste diversion through reducing, reusing, and recycling materials throughout the facility.

The recommendations outlined in this Airport Waste Reduction, Reuse, and Recycling Plan are aligned with and/or offer alternative strategies to these draft objectives based on industry best practice and the project team's expertise.

F.2 Attachments

F.2.1 Additional Strategies for Future Consideration

In addition to the recommendations described above, the consultant team identified several other strategies that could be implemented at SBN in the future. These additional recommendations for future consideration are found in **Table F-2**.

Table F-2: Additional Strategies for Future Consideration

Future Waste Diversion Strategies
Continuously monitor the waste program for areas of improvement
Donation of surplus food items from restaurant tenants to food banks or other non-profits
Composting of appropriate waste items wherever feasible *Green waste (tree/yard trimmings), excess food waste (coffee grounds/filters), shredded paper, etc.*

Source: Mead & Hunt, Inc. (2021)

F.2.2 Regulatory Background

Figure F-3 outlines the introduction timeline and specifics of the FAA's waste planning requirement. The FAA provides content guidance for airport waste plans in the September 2014 memo on the topic (available on the FAA's website found here: FAA Guidance on Airport Recycling, Reuse, and Waste Reduction Plans, 30 September 2014).

Figure F-3: FAA Solid Waste Recycling Planning Requirement Timeline and Details

Febuary 2012

FAA Modernization and Reform Act (FMRA) of 2012 Section 132(b) expanded the definition of airport planning to include:

"developing a plan for recycling and minimizing the generation of airport solid waste."

Section 133 of the FMRA specifies airports must develop an "Airport Waste Reduction, Reuse, and Recycling Plan" during master planning projects.

September 2014

"Guidance on Airport Recycling, Reuse, and Waste Reduction Plans" memorandum details the FAA's expectations of and suggestions for an airport's solid waste plan, including the five elements listed in the FMRA and two additional elements.

October 2018

The FAA Reauthorization Act of 2018 Section 148(a)(1-2) amends 49 U.S.C. 47106(a) to update requirements for solid waste plans.

July 2019

Reauthorization Program Guidance Letter (R-PGL) 19-02 provides details about the changes found in the October 2018 regulation:

"Any airport that applies for a funding grant for a project described in the facility's master plan must 1) have a waste plan in place or 2) develop one concurrently with the project grant."

Sources: FAA; Mead & Hunt, Inc. (2021)

Figure F-4 details the elements which are required for a solid waste recycling plan per the FMRA (marked with an asterisk, *) or suggested for inclusion in a plan in the FAA Memo (marked with two asterisks, **). **Figure F-5** lists the factors influencing the scope and nature of an airport's waste program, as described in the FAA memo.

Figure F-4: Elements of Airport Solid Waste Management

Sources: FAA; Mead & Hunt, Inc. (2021)

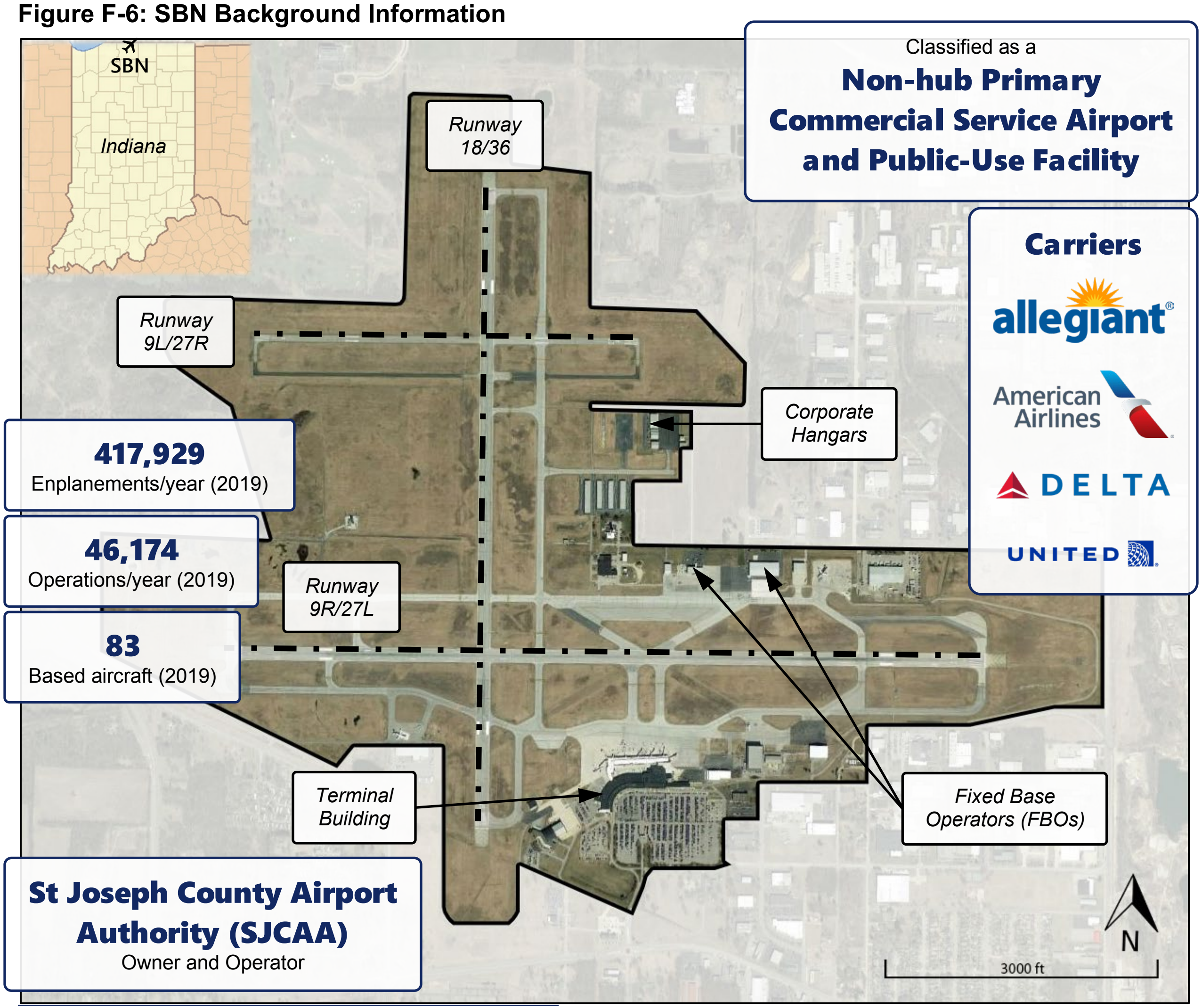
Figure F-5: Factors Influencing Airport Solid Waste Management Programs

Sources: FAA; Mead & Hunt, Inc. (2021)

F.2.3 Airport Information (Facility Description and Background)

Figure F-6 shows a summary of background information about SBN, including its location, operations, air carriers, layout, governance, and classification.

Figure F-6: SBN Background Information



Sources: South Bend International Airport; FAA OPSNET database; Indiana Department of Revenue; Mead & Hunt, Inc. (2021); Google Basemap (Earth); Indiana County Map (Ruhrfisch, 2007)

Plan Scope

Municipal Solid Waste (MSW) consists of everyday items that are used and then discarded. This plan focuses on the management of MSW and other materials that may be recycled or disposed of in a municipal solid waste landfill. There are five primary types of MSW generated at airports: **general MSW**, **food waste**, **green waste (yard waste)**, **deplaned waste**, and **construction and demolition (C&D) waste**. This plan does not address the management of other waste types regulated by federal, state, or local laws, specifically: hazardous, universal, or industrial waste; waste from international flights, or C&D waste that is subject to special requirements/handling.

Facilities at SBN include buildings and areas over which SBN has a varying degree of control or influence over waste management practices. Some areas fall under direct control of SBN and its staff, while others SBN has influence over but not direct control. According to FAA guidance, areas over which SBN has direct control or influence should be included in the Recycling, Reuse, and Waste Reduction Plan; areas outside SBN's control or influence may be excluded.

Table F-3 lists a breakdown of the areas SBN controls, influences, and neither controls nor influences.

Table F-3: Waste Management Areas at SBN

Management Level	Description
Areas under direct control	Public terminal areas • Parking and curbside • Ticketing lobby, baggage claim, restrooms, mall, prayer room, museum, gates, and hold rooms
	Aircraft Rescue and Fire Fighting (ARFF) station
	Maintenance facilities
	Airport administration areas • Conference rooms and office spaces • Airport badging office

Areas under influence
(Spaces owned by Airport, leased by tenants)
	Terminal tenants
	• TSA offices
	• Restaurants
	    ○ South Bend Chocolate Café
	    ○ Bar Fly
	    ○ Studebagels
	    ○ The Pop Stop
	• Gift shops
	• Airline spaces
	    ○ Ticketing counters and offices
	• Car rental areas
	• Dimension Global Travel
	• CBP Global Entry Enrollment Center

	Cargo tenant facilities • UPS direct lease • FedEx sublet Aeroterm • Sorting facilities
	Airline maintenance facilities • Hangars and offices
	General aviation facilities • Fixed Base Operators (FBOs) • Michiana Aircraft Service • Private hangars
	Transportation services • South Shore train station • Transpo bus station
Areas not under control or influence	FAA Airport Traffic Control Tower (ATCT)
	TSA Security Screening Area

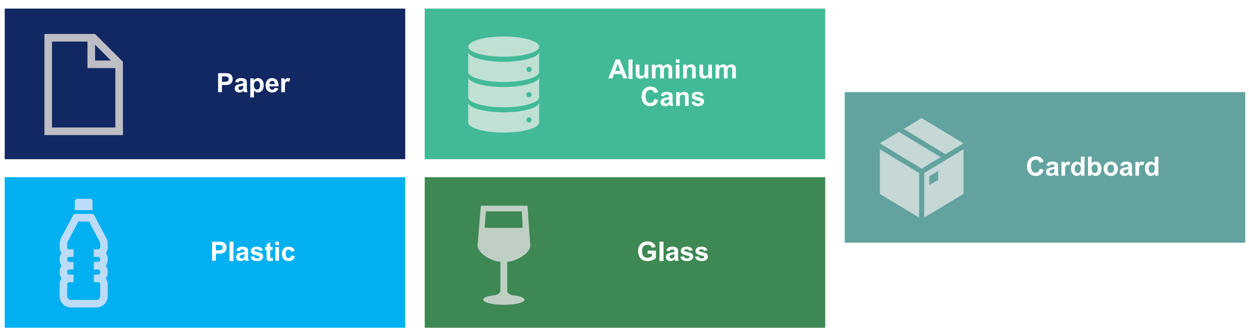
Sources: South Bend International Airport; Mead & Hunt, Inc. (2021)

F.2.4 Current Waste Management Program

The waste program at SBN is managed by SJCAA Administration and maintained by facilities staff. Republic Services is the waste and recycling hauling contractor for SBN and collects garbage and recyclable materials from SBN's dumpsters and compactor. Three waste dumpsters are provided by SJCAA for use by the airport administration and maintenance facilities; the dumpsters are also open for use by SBN tenants. There is also a 42 cubic yard compactor, from which waste is compacted and collected by Republic Services for disposal. Two 8 cubic yard containers for comingled recyclable materials are also serviced by Republic Services. Additional dumpsters are individually used and managed by the airlines (SkyWest and airlines using common-use gates) and couriers (FedEx and UPS).

Figure F-7 shows materials accepted in SBN's existing recycling program. These items are currently collected at SBN and picked up by the waste hauler for recycling.

Figure F-7: Items Currently Collected for Comingled Recycling at SBN



Source: South Bend International Airport; Mead & Hunt, Inc. (2021)

Operation and Maintenance Requirements (Roles and Responsibilities)

The waste management program at SBN is managed by the operations manager and the airport's janitorial contractor, Performance Plus, is responsible for custodial activities in specific buildings and areas, including collecting waste and recyclables from cans and bins and transferring these materials to the appropriate dumpsters.

The airport operations manager is responsible for communicating with the collection service provider, directing housekeeping activities, and communicating with SBN's janitorial contractor about collection services.

SBN's terminal tenants (rental car companies and air carriers) and the tenants in the outlying buildings (FBO and GA hangars) are responsible for custodial activities in their areas including transferring waste to the appropriate dumpsters. The terminal tenants are responsible for housekeeping in their leased areas and use SBN's dumpsters. The FBO, hangar tenants, and other aviation-related businesses at the airport are responsible for housekeeping in their facilities and contracting for their own waste dumpsters and recycling services.

Infrastructure

Figure F-8 details the existing waste infrastructure in place at SBN.

Figure F-8: Existing SBN Infrastructure

Sources: South Bend International Airport; Mead & Hunt, Inc. (2021)

F.2.5 Waste Audit

SBN staff provided information about the following categories to assist with this plan:

- Airport buildings and facilities
- Areas that generate waste
- Types of waste generated in each area.

An evaluation of SBN's information and records, as well as aviation industry waste and recycling trends, supported efforts to identify the source, composition, and quantity of waste generated at SBN, including areas under SBN's direct control or influence. This information then served as a foundation to identify opportunities to improve and monitor program effectiveness.

Quantity

The project team estimated a total of 268 tons of MSW and 75 tons of comingled recyclables is generated at SBN annually. These volumes are based upon the capacity and frequency of collection service for each of the facility's dumpsters and the EPA's volume-to-weight conversion factors for MSW and comingled recyclables (including glass). The calculations utilized a 75 percent fill factor for SBN's two recycling dumpsters and a 100% fill factor for the trash compactor, as extra waste tonnage was noted on airport invoices from Republic Services. Average additional waste overflow was added to the estimated total waste generation.

Sources and Composition

Based on the activities taking place at SBN, a varied waste stream can be expected. **Table F-4** lists each area included in the scope of this plan and the type(s) of waste likely generated there. A waste stream composition study (waste sort) could provide more detailed information about the specific composition of waste at SBN and assist in suggesting targeted improvements to the diversion program (by item substitution, by improving recycling to reduce the volume of waste, etc.). This information may include:

- Types of items included in each general category
- Contamination rate of the recycling stream (items that are not recyclable in the recycling bins)
- Recovery rate for recycling (the proportion of recyclable items that are segregated properly)

Purchases

SBN staff do not currently track the quantity and type of disposable items and supplies purchased for the facility. This information could provide insight on some of the materials coming into the airport that will go back out as waste (other materials are brought on-site by visitors, employees, and vendors). Identifying and tracking the type and quantity of all disposable items purchased for use at SBN, will allow SJCAA to identify opportunities to reduce outgoing waste, including:

- Some items that could be eliminated
- Items that have reusable or recyclable alternatives

Table F-4: SBN Waste by Area and Material

Area | Material	Office Paper	Newspapers	Magazines	Plastic	Aluminum	Cardboard	Glass	Food Waste	Paper Products	Liquids	Toiletries	Deplaned Waste	Packaging	Styrofoam	Metals	Green Waste	C & D Waste	Other Waste
Terminal Building																		
Public areas *Curbs, restrooms, seating areas*		x	x	x	x		x	x	x	x			x					x
Airline areas	x	x	x	x	x	x	x	x	x	x		x	x					x
Tenant areas *Retail, restaurants, gift shops*	x	x	x	x	x	x	x	x	x	x			x					x
Airport administration offices	x	x	x	x	x	x	x	x	x				x					x
TSA security checkpoint		x	x	x	x		x	x		x	x		x					
Airport Support Buildings																		
Maintenance building	x	x	x	x	x	x	x	x	x	x			x	x				x
Airport maintenance facilities			x	x	x	x				x			x		x	x	x	x
General aviation facilities *FBOs, Michiana Aircraft Service*	x		x	x	x	x	x							x				
Other Airport Buildings																		
GA and commercial hangars				x	x	x	x	x		x			x					
Cargo tenant facilities	x			x	x	x	x	x					x	x				
Transportation services		x	x	x	x		x	x	x	x			x					x

Sources: South Bend International Airport; Mead & Hunt, Inc. (2021)

F.2.6 Review of Recycling Feasibility

As noted in **Figures F-4** and **F-5**, there are several factors that influence the feasibility of recycling and other waste diversion strategies at an airport. The project team assessed these factors for influence at SBN, as described below.

Technical and Economic Factors

Technical and economic factors that were assessed are discussed below.

Local Markets and Infrastructure

Markets for recycled materials fluctuate widely based on many factors and interactions. Local waste haulers typically accept materials that can be recycled cost-effectively in the area or region. Manufacturers purchasing recycled material as base stock want it to be predictable and ready for use; therefore, recycling facilities are discriminatory about what materials they accept. They almost unilaterally prefer materials that are of high value, clean, and easy to separate.

Recycling in St. Joseph County, Indiana is managed by the St. Joseph County **Solid Waste Management District (SWMD)**. Materials listed in **Table F-5** may be recycled through the County's recycling program. As noted above, inclusion in such programs typically indicates that the market and/or infrastructure for these materials is strong. (St Joseph County, n.d.)

Table F-5: Curbside Recycling Materials in St. Joseph County

Accepted Materials	
Food glass bottles and jars	Aluminum, tin, steel, and bi-metal cans
Plastic bottles, jugs, and containers	Aluminum foil, food trays, and pie pans
Newspapers, magazines, mixed paper, and cardboard	
Unaccepted Materials	
Lightbulbs	Household electronics
Plastic bags	Window glass
Plastic motor oil bottles	Batteries
C&D Waste	Styrofoam

Sources: St. Joseph County

The drop-off location for MSW and recycling in St. Joseph County is a facility operated by the St. Joseph County Solid Waste Management District. This facility is located five miles southeast of SBN, and it is anticipated that the District has adequate capacity to serve SBN and the local area for the foreseeable future.

Logistical Considerations and Constraints

To maintain a recycling program at SBN, certain elements must be in place. These include:

- A proactive and engaged custodial staff
- A willing and affordable hauling contractor

- Space for bins, dumpsters, and compactors
- Hauler access to secure areas of the facility (including airside ramps and sterile areas).

At present, these elements appear unconstrained. Additional resources including custodial labor, waste hauling services, space, and airport access are anticipated to be available to support the introduction and/or expansion of the diversion program at SBN.

Partnerships

The air carriers serving SBN have established sustainability programs that include elements of waste diversion and recycling for both passengers and internal operations. The following practices and principles complement the SBN program:

- Per corporate policy, Delta is "committed to minimizing waste streams through diversion and re-use, waste recycling programs, and [waste reduction]."
- American Airlines has had an aluminum can recycling program since 1989. Internal operations at American Airlines reflect waste reduction and diversion through minimizing paper use and recycling electronic waste.
- United Airlines is "committed to operating sustainably and responsibly" and has recycled more than 28 million pounds of aluminum cans, paper, and plastic from flights and facilities. In 2014, United began to replace its hot beverage cups with fully recyclable alternatives made from recycled plastic water bottles.

Aligning the SBN program with air carrier practices provides the opportunity for a win-win scenario whereby the facility can reduce its environmental impact and, by helping the air carriers reduce their impact, generate goodwill between SBN and the local community.

Recycling, Landfill, and Energy-From-Waste Facility Requirements

Components that seem recyclable (plastic, glass, or metal parts) may make up some items generated at SBN; however, the recycling facility has specific material standards which should be followed to protect the stream. It is important that non-recyclable items are not included in future recycling efforts at the facility.

Costs

SJCAA strives to be as self-sustaining as is feasible; therefore, it is imperative that programs implemented and maintained at SBN, including recycling and other waste diversion strategies, are as cost-effective as possible. See **Financial Analysis** (pg. 24) for more information.

Guidelines and Policies

To evaluate SBN's existing diversion plan in the context of local, state, and national requirements, the project team reviewed federal, Indiana State, and local-level waste and recycling regulations, policies, and factors.

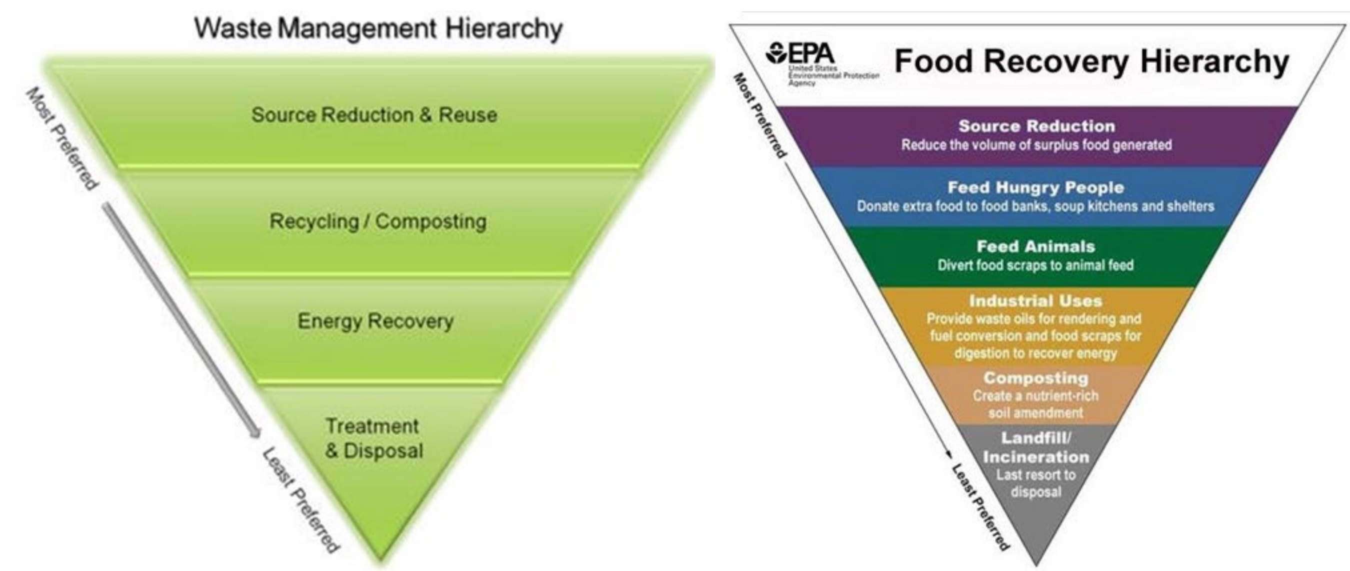
Federal

As described in **Regulatory Background**, the FAA's definition of airport planning includes planning for recycling and waste minimization.

The United States **Environmental Protection Agency (EPA)** is responsible for developing a solid waste management program under the **Resource Conservation and Recovery Act (RCRA)** and related policies and guidance. RCRA provides the framework for management of hazardous and non-hazardous waste. All generators of hazardous waste, including airports, are required to comply with RCRA and all other federal waste laws and regulations.

Figure F-9 shows a hierarchy of waste management strategies developed by the EPA. This hierarchy on the left ranks these strategies from most- to least-environmentally preferred and places emphasis on reducing, reusing, and recycling. In addition to the general waste management hierarchy, the EPA has also developed a preference ranking of management strategies for food waste, as shown in the figure at the right.

Figure F-9: Waste Management and Food Recovery Hierarchies



Source: United States Environmental Protection Agency, (Waste Management Hierarchy), (Food Recovery Hierarchy)

State

Indiana House Bill 1183, passed in 2014, establishes a set of standards requiring certain recyclers to track the amount and type of recyclables they process from Indiana's overall waste stream and report to the **Indiana Department of Environmental Management (IDEM).** This Bill also introduced a goal to reach 50 percent recycling across the state by 2019.

IDEM's 2019 Recycling Activity Summary noted the state had achieved 19 percent total statewide recycling; this falls short of House Bill 1183's goal but indicated an improvement in the state's overall progress since 2014. (2019 Recycling Activity Summary, 2020)

Statewide management of waste is established through each county's SWMD. They are governed by the **Association of Indiana Solid Waste Management Districts (AISWMD)** as the primary state-wide association; however, each county operates its own SWMD.

Local

SBN is in the St. Joseph County SWMD, which is managed by the government of St. Joseph County. All waste in the County, including within the City of South Bend, is managed by the SWMD. Residential recycling consists of street side single-stream pickup; items currently accepted by the residential and commercial programs are listed in **Table F-6**.

Table F-6: Recyclable Items Available for Single-Stream Curbside Pickup in St. Joseph County

Containers
#7 plastic resin grocery narrow neck containers only
1-to 5-gallon plastic buckets/pails – food, beverage, pet and or cleaners empty and rinsed clean
Aluminum cans, trays, and foil (trays and foil clean and free of food residue)
Aseptic packaging and gable top containers (milk and juice cartons)
Flexible plastic flower flats and small plastic bush container pots – no rigid plastic plant pots
Glass bottles and jars: green, clear, brown – no window glass, dinnerware, or ceramics
HDPE detergent and fabric softener containers (#2 colored plastic resin)
HDPE milk and juice jugs (#2 clear plastic resin)
LDPE grocery containers (#4 plastic resin) – margarine tubs, frozen desert cups, six and 12 pack rings
PET soda, water, and flavored beverage bottles (#1 clear and green plastic resin)
PP grocery containers (#5 plastic resin) such as yogurt cups, narrow neck syrup and ketchup bottles
PVC narrow neck containers only (#3 plastic resin) – health/beauty aid products, household cleaners
Steel cans and tins
Paper Fiber
Cardboard (unwaxed)
Carrier stock – soda or beer can cases
Chipboard – cereal, cake and food mix boxes, gift boxes, etc.
Junk mail and envelopes – no plastic cards, stick on labels, or unused stamps
Kraft (brown paper) bags
Magazines, catalogs, telephone books, books
Newspaper, including inserts (remove outer plastic sleeves)
Office, computer, notebook, and gift wrap paper – no metal clips, spirals, binders

Source: St. Joseph County

Based on the availability of residential and commercial recycling, this plan assumes the residents of the communities surrounding SBN, and therefore its employees and visitors, have been exposed to recycling, receive on-going messaging about its importance, and are generally supportive of recycling efforts.

F.2.7 Review of Waste Management Contracts

The FAA memorandum titled “Guidance on Airport Recycling, Reuse, and Waste Reduction Plans” explains that the purpose of reviewing waste management contracts is to “identify opportunities for improving (waste) program scope and efficiency, as well as identify constraints.”

Tenant leases were not reviewed as part of this study; however, at the time of this Master Plan, SBN was updating its Rules and Regulations and Minimum Standards documents. SBN expressed a desire to improve tenant involvement in the Airport’s waste and recycling program and requested example text to include in these standards to encourage tenant participation. The project team provided example language in response to this request. Once the Rules and Regulations and/or Minimum Standards are updated, they will provide a vehicle for encouraging (or mandating) tenant activities and waste diversion efforts.

F.2.8 Financial Analysis (Potential for Cost Savings or Revenue Generation)

According to the FAA memo “Guidance on Airport Recycling, Reuse, and Waste Reduction Plans,” an analysis of the financial aspects of waste management assists airport sponsors in determining the cost versus benefit of all existing and proposed enhancements to an airport’s practices and should include capital costs, physical infrastructure, transport, and labor.

SBN staff provided invoices from Republic Services for three months (January – March 2021.) The project team reviewed these invoices and estimated annual waste and recycling costs based on the information they contained. According to these invoices, SBN’s annual costs for recycling, waste, and waste overfill are approximately $2,937 for recycling, $3,432 for waste, and $3,404 for overfill charges (nearly equal to the contracted waste fee).

According to these invoices, recycling collected from the two 8 cubic yard recycling containers costs approximately $15.29 per cubic yard. The estimated per ton cost for collection and disposal of waste from the 42 cubic yard trash compactor equals $6.29, nearly one third of the cost of recycling. This is one reason waste reduction and reuse are important strategies for SBN and why the Airport’s diversion program should not be based solely on recycling. In addition to the cost per cubic yard of waste, Republic Services charges a $44 fee for every ton of waste that exceeds the maximum capacity of the 42 cubic yard trash compactor. This overfill charge has occurred on every invoice in the first quarter of 2021, and cost SBN an additional $322.96 for the month of March alone.

The size of dumpsters and the frequency at which they are serviced significantly contributes to the cost of waste and recycling. Increasing the size of the trash compactor and/or increasing the frequency it is serviced provide more appropriate capacity and eliminate waste overfill fees. Reduction and reuse practices would further lower the program’s cost, as materials that are eliminated from the stream do not need to be recycled or landfilled.

F.2.9 Resources

Citations

Sources

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Additional Reading

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F.2.10 Glossary

(sorted by chronology)

Federal Aviation Administration (FAA) – regulatory body of the US government that regulates all national aviation activities.

FAA Modernization and Reform Act of 2012 (FMRA) – legislation that seeks to improve aviation safety and capacity of the national airspace system and provide a stable funding system.

FAA Reauthorization Act of 2018 – reauthorization of FMRA 2012 to extend funding and administrative authority to the FAA.

Best Management Practice – industry standard or preferred management practice.

Total Resource Use and Efficiency (TRUE) – Zero waste certification program administered by the Green Business Certification Inc. (GBCI).

Environmental Protection Agency (EPA) – independent agency of the US government that establishes policies that protect the natural environment.

Reauthorization Program Guidance Letter (R-PGL) 19-02 – implements provisions to FAA Reauthorization Act of 2018 that changed project eligibility, scope, or funding under 49 U.S.C., Chapter 471.

Municipal Solid Waste (MSW) – everyday items that are used and then discarded. There are five primary types of MSW generated at airports:

> ***General MSW*** *– common inorganic waste, such as product packaging, disposable utensils, plates and cups, bottles, and newspaper. Less common items, such as furniture and clothing, are also considered general MSW.*
>
> ***Food waste*** *– either food that is not consumed or the waste generated and discarded during food preparation. Food waste and green waste make up a waste stream known as compostable waste.*
>
> ***Green waste (yard waste)*** *– tree, shrub and grass clippings, leaves, weeds, small branches, seeds, pods, and similar debris generated by landscape maintenance activities. Food waste and green waste make up a waste stream known as compostable waste.*
>
> ***Deplaned waste*** *– waste removed from passenger aircraft. These materials include bottles and cans, newspaper and mixed paper, plastic cups, service ware, food waste, food-soiled paper, and paper towels.*
>
> ***Construction and demolition (C&D) waste*** *– any non-hazardous solid waste from land clearing, excavation, and/or the construction, demolition, renovation or repair of structures, roads, and utilities. C&D waste commonly includes concrete, wood, metals, drywall, carpet, plastic, pipes, land clearing debris, cardboard, and salvaged building components.*

Solid Waste Management District (SWMD) – local county authority for waste management.

Resource Conservation and Recovery Act (RCRA) – federal law of the US governing the disposal of solid or hazardous waste.

Indiana Department of Environmental Management (IDEM) – state body dedicated to protecting the public health and environment of Indiana.

Association of Indiana Solid Waste Management Districts (AISWMD) – primary professional association that manages the Indiana SWMDs as a single entity.

Appendix G

Aviation Demand Forecast Approval Letter

U.S. Department of Transportation
Federal Aviation Administration

Federal Aviation Administration
Great Lakes Region

2300 E. Devon Avenue
Des Plaines, Illinois 60018

September 26, 2022

Mr. Michael A. Daigle, A.A.E
CEO & Executive Director
South Bend International Airport
4477 Progress Drive
South Bend, Indiana 46628

South Bend International Airport (SBN)
South Bend, Indiana
Aviation Demand Forecast Approval

Dear Mr. Daigle:

The Federal Aviation Administration (FAA) is in receipt of the South Bend International Airport Aviation Demand Forecast, dated July 27, 2022.

The FAA concurs with the base case forecasts as presented in Tables 2-28 and 2-29.

Please let me know if you have any questions, I can be reached at (847) 294-7631 or Gary.d.wilson@faa.gov.

Sincerely,

Gary D. Wilson

Gary D. Wilson, Assistant Manager
Chicago Airports District Office

cc: Mead and Hunt
INDOT Office of Aviation

Mead
&Hunt

south bend
INTERNATIONAL