Abatement Alternatives Evaluation (Part Two)

Introduction

The previous Working Paper presented an evaluation of feasible operational alternatives to determine the contribution each would make to noise abatement. Those "Part One" alternatives were the first set to be evaluated in the FAR Part 150 Noise Compatibility Study and were presented to the Study Advisory Committee (Committee) for discussion. During the meeting, several additional or modified alternatives were suggested for evaluation.

The Part One alternatives consisted mainly of operational alternatives with an introduction to on-airport ground noise alternatives. Additional alternatives, identified as Part Two alternatives, consist of modifications to the Part One operational alternatives and expansion of the ground-based noise abatement alternatives—primarily facility development options. Following the completion of additional facility alternatives, land use and administrative alternatives will be evaluated.

The Part Two Aircraft Operation Alternatives that have been suggested by the Committee for analysis are listed on the next page. The alternatives are not listed in terms of priority and are to be considered only as initial alternatives that will be further refined and combined to create final recommendations. The term "Flight Management System" (FMS) will be used generically to include a wide variety of satellite-based navigation systems. The alternative numbering system is consecutive with the Part One alternatives.

Aircraft Operational Alternatives: Flight Track Changes

Alternative 11 — Increase altitude to 2,500 feet above mean sea level (MSL) for all jet aircraft prior to turning.

Alternative 12 — Utilize the I-94 corridor for southern departures off Runway 25L. This is a modification of Alternative 4.

Aircraft Operational Alternatives: On-Airport Changes

Alternative 13 — Evaluate feasibility of noise wall/berm on property owned by the airport north of Layton Avenue, east of Howell Avenue. This is an expansion of Alternative 9.

Alternative 14 — Evaluate on-airfield noise barriers at locations along the northwestern area of the airport. This is a more detailed analysis associated with Alternative 9.

Alternative 15 — Evaluate location and feasibility of a low-tech turboprop run-up facility for the northeast hangar area. This is an expansion of Alternative 9.

Noise Analysis Methodology

As with the previous noise abatement alternatives, multiple noise metrics are presented for each of these alternatives. These metrics include the FAA-mandated DNL, as well as supplemental noise metrics to better understand the character of the noise and how that noise may change with the implementation of a specific alternative. The DNL metric information is presented in graphic and tabular format, the supplemental metrics in tabular format. As with the previous alternatives, all of the analysis is based upon year 2009 conditions (five years in the future from existing base year conditions). The noise metrics analyzed within this study include the following:

<u>DNL Noise Contour Analysis.</u> DNL noise contours have been developed for selected alternatives to graphically depict areas exposed to specific DNL noise levels. The comparison of noise contours for various alternatives illustrates how the contours may change in size and area relative to each other. The DNL noise contours are presented in terms of the 65, 70, and 75 DNL noise value. These contours are the average annual DNL noise level.

<u>Representative Receptor Analysis.</u> This allows for a direct comparison of how noise levels may change in different neighborhoods. The Representative Receptor locations comprise a grid of points on the ground surrounding each quadrant around the Airport where noise levels may experience a change. The effectiveness of the alternatives is not always measurable by DNL standards. Therefore, Time Above, Number of Events

Above, and Single Event analyses are included for noise receptor locations around the Airport.

The representative receptor grid locations were presented in Figure G17 at the end of Working Paper 4. The grid results tables also appear at the end of this working paper in Tables G6 through G7. Grids were drawn on the four quadrants of the Airport covering areas over which aircraft fly. Each alternative has an associated table that shows how the noise changes at each of the chosen grid points. Existing and future noise levels for any location can be approximated by plotting a location within the grid.

The following noise metrics will be determined at each grid point for each alternative under consideration:

DNL Analysis. Tables and graphics present the DNL—the annual average noise level—at the representative locations.

Time Above Analysis. Tables presenting the Time Above noise level depict the number of minutes per day that the noise is greater than 65 dBA at each of the representative locations.

Number of Events Above Analysis. Tables present the Number of Events Above noise level—the number of events per day that create noise greater than 65 dBA at each of the representative locations.

Alternatives Analysis

The following sections of this working paper provide a detailed analysis for each Part Two alternative. The analysis describes the noise goal of the alternative, a description of the alternative, how it varies from existing procedures, and what potential change in noise may result from implementation of the alternative.

Alternative 11
Increase Altitude to 2,500 feet MSL for Jet Aircraft Prior to Turning

Goal

The goal of this alternative is to increase the altitude over residential neighborhoods of jet aircraft departing from the Airport prior to turning on course. Increasing the altitude could result in reduced single-event sound exposure noise levels from these aircraft operations. The Study Advisory Committee suggested raising the minimum altitude for jets from 2,000 feet to 2,500 feet mean sea level (MSL) prior to turning.

Description

This procedure defines the minimum altitude at which a turbojet aircraft may turn toward its destination after flying runway heading. This procedure would use existing departure flight tracks, but raise the minimum altitude before turning to reduce early turns by aircraft before reaching 2,500 feet MSL and to concentrate the flight tracks along the runway centerlines.

Existing Procedure

For turbojet departures on runways to the north, east and west (Runways 1L, 7R and 25L), aircraft depart and fly runway heading until reaching a defined altitude. For turbojet aircraft, the minimum altitude is 2,000 feet MSL (approximately 1,300 feet above field elevation). Not all aircraft initiate the turn at the minimum altitude. Based upon a review of the radar data, the majority of turbojet aircraft start the initial turn between 2,000 and 3,000 feet MSL. The aircraft typically will then turn on course to its destination. The new generation aircraft climb at a faster rate than the older technology aircraft that were dominant at the time that the existing procedures were developed. Thus, these new generation aircraft reach the minimum altitude sooner than was typical of the older aircraft.

New Procedure

Aircraft would fly runway heading until reaching at least 2,500 feet MSL (approximately 1,800 feet above field elevation). The 500 feet of additional altitude is roughly the difference in climb rate between the new generation aircraft and the older generation aircraft. At that point, the aircraft would turn toward its destination as they do today. If this procedure causes delays due to additional separation needed as aircraft follow each other for a longer period of time, it could be used during periods of lower activity levels. Because the majority of these operations are performed by aircraft that regularly fly in and out of General Mitchell International Airport, a pilot awareness brochure could be developed as part of a fly-quiet program to educate the chief pilots on this new procedure.

New Procedure Noise Analysis

This alternative causes little change to the 65 DNL, with the majority of changes occurring beyond the 65 DNL noise contour. Alternative 11 could potentially reduce DNL levels up to 1.6 DNL in areas alongside the noise contours. The alternative is designed to increase the altitude of all aircraft prior to turning, but especially of the lowest aircraft. Typically, these aircraft generate the highest single-event noise levels associated with departures. Alternative 11 is dependent on Air Traffic Control workload and volume of departures. If an aircraft needs to expedite its departure, it might need to be turned early in order to keep it in the proper sequence.

The numbers of total housing units, noncompatible housing units, and people in the 65 DNL noise contour would be slightly increased. The Time Above metric ranges from an increase of 2 minutes per day above 65 dBA to a decrease of 0.4 minutes per day. The Number of Events metric ranges from an increase of 7.8 events per day to a decrease of 4.7 events per day. Increases in Time and Number of Events above occur in areas near the departure end of the flight track, and the reductions occur alongside the flight tracks.

Difference Compared to Base Case Contour

The Alternative 11 noise contours are slightly longer and slightly narrower than the 2009 Base Case noise contours. This is because of the concentration of the flight paths along the runway centerline. The DNL noise contours for Alternative 11 and the 2009 Base Case noise contour are as shown in Figure G18.

Fig. G18. Alternative 11

Alternative 12
Utilize the I-94 Corridor for Southern Departures off Runway 25L
(West Departures, Southern Destinations)

Goal

The goal of Alternative 12 is to concentrate turbojet aircraft over or east of the I-94 corridor for southern destination departures from Runway 25L. Use of the I-94 corridor would concentrate departures over areas of compatible land uses. Departures that head west or turn north would not be modified, because no large compatible land use corridors are present.

Description

This procedure would create a more defined and narrower flight path using FMS technology to concentrate aircraft flight tracks along the extended runway centerline and to the south along the I-94 corridor (and east of the freeway). Aircraft would use the existing west departure and then turn southbound while using FMS technology to reduce dispersion over noncompatible land use areas. Military aircraft, older hush-kit aircraft, turboprops, and general aviation aircraft are not equipped with the necessary instruments to fly FMS procedures; as such, these aircraft would fly a similar path, but it would not be as precise. West departures not turning south would continue to use existing departure procedures.

Existing Procedures

Aircraft depart Runway 25L and fly runway heading until reaching 2,000 feet MSL. At this point, aircraft continue on course or turn left or right to the heading assigned by Air Traffic Control based upon destination. A new procedure would be developed for those aircraft turning to the south.

New Procedure

Aircraft would depart Runway 25L and fly runway heading using FMS way points. Aircraft flying to southern destinations would turn southward using FMS way points just before reaching I-94. This would result in aircraft turning earlier than they do today, and not all aircraft may be capable of making such early turns. Aircraft turning south would fly a narrower path, following I-94 to the extent possible. Aircraft with a western or northern destination would continue to fly the existing departure procedure. Figure G19—Alternative 12, Runway 25L, Jet Departure Flight Tracks, South Turn—shows the new FMS flight path overlaid on the existing flight tracks.

New Procedure Analysis

The majority of the benefits from this alternative occur beyond the 65 DNL noise contour. This alternative could potentially increase DNL levels up to 2.3 DNL in the commercial areas along the I-94 corridor south of the airport and decrease it up to 1.7 DNL in the residential areas to the southwest of the Airport. Figure G20—Comparison of Alternative 12, FMS West DNL Contour and 2009 Base Case DNL Contours—shows the 65, 70, and 75 DNL noise contours associated with this alternative compared with the 2009 Base Case DNL noise contours. The Base Case contours are shown with a solid line; changes to the Base Case 2009 contour due to the alternative are shown as a dashed line. The land use and population changes associated with this alternative, compared to the future Base Case contour, are shown in Table G4A, at the end of this chapter.

Alternative 12 could be used by 80 percent of the existing commercial jet aircraft fleet operating at General Mitchell International Airport; exceptions are the older hush-kit jet aircraft that do not have the necessary navigation instruments and those aircraft that are not capable of making the early turn. This alternative would concentrate the turbojet departures over compatible land uses to a greater extent than the current procedure. The number of total housing units and people in the 65 DNL noise contour would be slightly reduced; however, the number of noncompatible housing units would remain the same because most of the homes have been previously sound insulated. The Time Above metric ranges from an increase of 3.5 minutes per day above 65 dBA to a decrease of 3.1 minutes per day. The Number of Events metric ranges from an increase of 12.8 events per day to a decrease of 12 events per day. Increases in Time and Number of Events above occur in areas near the departure end of the flight track, and the reductions occur to the sideline of the flight tracks.

Difference Compared to Base Case Contour

Alternative 12 is essentially identical to the 2009 Base Case noise contour. The majority of the changes occur beyond the 65 DNL noise contour. There are no perceivable differences in the 65 DNL associated with either Alternative 12 or the 2009 Base Case noise contour.

Fig. G19. Alternative 12, Runway 25L, Jet Departure Flight Tracks, South Turn

Fig. G20. Comparison of Alternative 12, FMS West DNL Contour, and 2009 Base Case DNL contours

Alternative 13
Evaluate Feasibility of Noise Wall/Berm on Property Owned by the Airport North of Layton Avenue, East of Howell Avenue

Goal

The goal of this alternative is to reduce noise in the area north/northwest of the airport from aircraft operations on the ground at General Mitchell International Airport. This alternative was developed to evaluate the feasibility of building a noise barrier at the property line behind houses on East Armour Avenue across Layton Avenue.

Description

This alternative evaluates the effectiveness of a wall to reduce ground noise intrusion to the homes along East Armour Avenue. To be most effective, a noise barrier should be as close as possible to either the noise generator or the noise receiver. Due to the distance and elevation differences from the aircraft operating surfaces, a noise barrier would be most effective close to the noise source. However, a barrier at the property edge can still be effective. The height of the wall will depend upon the FAR Part 77 surface criteria and the noise signature. To be effective, the wall would have to be solid and of sufficient height to block or reflect noise, which would also block the view of the Airport from the back of the homes.

Existing Procedures

There is one noise barrier on the Airport: the Ground Run-Up Enclosure (GRE), located on the southwest side of the airfield. The GRE is used for aircraft run-up operations and can be used by all aircraft that frequently use the Airport. The GRE is used when aircraft need to perform an above-idle run-up after maintenance has been performed or during other engine tests. Presently, there are no noise barriers on the north end of the Airport or near the terminal facilities.

New Procedure

A noise barrier was modeled along the Airport property line north of Layton Avenue and east of Howell Avenue. The barrier is shown in Figure G21—Alternative 13, Noise Wall Locations, Airport North End. The topography in this area is not level, so the barrier would need to be higher in certain locations to account for the varying topography. This would necessitate that the wall be between 8 and 20 feet high to mitigate noise and break the line of sight between the neighborhood and Airport activities. At its highest point, on the east side of the Airport property, the wall would be 5 feet below the FAR Part 77 surface. The noise barrier would be 2,208 feet long, originating on the north side of the runway protection zone and ending at the east side of the Airport property line north of Layton Avenue.

New Procedure Noise Analysis

In order to determine the best location for the noise barrier and where to park aircraft in the areas on the north of the Airport to reduce aircraft idle, taxi and auxiliary power use (APU) noise, noise contours were run using an in-house computer model that was based upon actual noise measurement data at MKE and model data in the FAA Integrated Noise Model (INM) program.

The scenario was modeled assuming that the noise sources such as engine start, idle and taxiing are occurring on the Skyway Ramp area.

Difference Compared to Base Case Contour

No DNL contours were developed for this alternative. Single-event Leq noise contours show that with the noise barrier, dBA levels would be reduced approximately 5–10 dBA in the communities north of the Airport along Layton Avenue and further north.

Fig. G21 Alternative 13, Noise Wall Locations, Airport North End

Alternative 14
Evaluate On-Airfield Noise Barriers at Specified Locations

Goal

The goal of Alternative 14 is to reduce noise in surrounding communities resulting from aircraft operations on the ground at General Mitchell International Airport, specifically the Signature Ramp, Skyway Ramp, West Ramp, and Terminal areas. This alternative was developed to explore available options that would minimize ground noise intrusion, especially in areas north of the Airport.

Description

This alternative is an expansion of Alternative 9. The description includes information from Alternative 9 and the associated areas on the airfield that were evaluated for a noise barrier.

Alternative 14 addresses aircraft noise from ground operations, which is defined as all aircraft movement while an aircraft is on the ground, including operations on the taxiways, runways, apron areas, terminal area, and ground run-up enclosure. The term "remote facilities" is an umbrella term that encompasses all facilities away from the passenger terminal, including maintenance hangars, general aviation areas, military areas, and fixed-based operators (FBOs). Types of ground noise include the following:

- Run-up procedures by all aircraft categories at the remote facilities
- Taxiing
    - to and from remote facilities
    - to and from terminal gates
- Idling
    - at terminal gates
    - at remote facilities
- Takeoff roll prior to liftoff
- Engine start and auxiliary power unit (APU) use at remote facilities
- APU use at terminal gates

The following are the types of general mitigation measures available for ground noise:

- Sound barriers such as sound walls, earthen berms, and any solid material that acts to shield the noise, including existing or proposed structures such as buildings and hangars
- Parking plans to determine aircraft placement on aprons and at terminal gates that minimize the impact of noise in the adjacent communities

- Use of ground power for aircraft to minimize use of aircraft engines and auxiliary power units
- Voluntary Airport Regulations for reducing aircraft ground noise such as time limits on APU usage and aircraft engine idle time

Ground Mitigation Measures

Sound Barriers

Ground noise irritation comes from the run-ups and taxiing of aircraft, especially at night. Sometimes, barriers can be effective in reducing ground noise exposure in adjoining neighborhoods. A noise barrier is an obstruction to the path of the sound transmission from ground-based aircraft operations. Once an aircraft becomes airborne, barriers have no further effect. Barriers include walls (those used along highways), earth mounds (berms), wall and berm combinations, or placement of buildings and landscaping. In the case of barriers, neighbors would be shielded from the noise source as long as the barrier is solid and sufficiently breaks the line-of-sight from the noise source to the listener. The closer a barrier is to the noise source, the more effective it is (i.e., the reason the Ground Run-Up Enclosure works so well is the close proximity of the noise source and the barrier).

The placement of barriers or berms is dictated by airport design guidelines and regulations, one of which is Federal Aviation Regulation (FAR) Part 77, which defines certain height restrictions at specified distances from runways. To ensure the safe operation of aircraft at the Airport, these restrictions would be followed, thereby making berms unfeasible in specific locations.

Noise Barrier Design Overview

Noise barriers are structures designed to block the propagation of noise at the source. An overview of the acoustic principles behind noise barrier design is summarized below. An understanding of these acoustical principles is essential in the design of effective noise barriers. When there are no obstacles between the source and adjoining areas, sound travels by a direct path from "source" to "receiver." This straight line is referred to as the line-of-sight.

Introducing a barrier between the source and the receiver, which interrupts the line-of-sight, redistributes the sound energy into several paths: a diffracted path over the top of the barrier; a transmitted path through the barrier; and a reflected path directed away from the receiver. The noise reflected off the sound barrier is usually directed away from the receiver, and it can be unnoticed unless large buildings or other reflecting surfaces are present that reflect the noise back to the receiver. Absorptive barriers are often used to reduce the potential of reflective noise. The noise path of primary concern is the diffracted path.

All receivers located in the shadow zone (the area between the barrier and the diffracted noise path) will experience some sound attenuation, directly related to the degree that the sound must bend, or diffract. The barrier attenuation is a function of the geometrical relationship between the source, receiver, and barrier, i.e., the closer the receiver is to the barrier, the more attenuation it will receive.

The location of a barrier is dependent on its distance from the noise source, the orientation of the noise source, FAR Part 77 surface requirements, and the time of day. Noise propagation is louder in certain directions and during times of low ambient noise levels (generally nighttime hours). It is usually advantageous to locate a noise barrier as close to the noise source as possible; if this is not possible, aircraft should then be located as far away from noncompatible land uses as possible while still taking advantage of the noise barrier. In addition to locating an aircraft as far away as possible, the aircraft should be oriented so that noise will dissipate away from sensitive land use. For example, an idling jet should be parked with its tail pointed toward the community, because noise from an idling jet is louder at the front of the aircraft due to noise from the engine fans.

Existing Procedure

There is one noise barrier on the Airport: the Ground Run-Up Enclosure (GRE), located on the southwest side of the airfield. The GRE is used for aircraft run-up operations and can be used by any aircraft at the Airport. The GRE is used when aircraft need to perform an above-idle (above 50%) run-up after maintenance has been performed or during other engine tests. Presently, there are no noise barriers on the north end of the Airport or near the terminal facilities.

The four areas of the airfield examined in this alternative that are used for aircraft parking and taxiing are the Signature Flight Support Ramp, Skyway Ramp, West Ramp, and Terminal Facilities. Table G5—Alternative 14, Issues by Airfield Location—provides a listing of the areas being studied as well as recommended noise abatement measures for each. Figure G22—Alternative 14, Airfield Locations— graphically shows each location. The Northeast Ramp is addressed in Alternative 15.

Signature Flight Support Ramp

An aircraft parking plan is used to take advantage of the existing buildings for shielding and to maximize ramp space when needed. Presently, there is no noise barrier in this location.

Skyway Ramp

Aircraft idle and taxi to and from the terminal area on this ramp. Presently, there is no noise barrier in this location.

West Ramp

Aircraft idle and taxi to and from the terminal area on this ramp. Presently, there is no noise barrier in this location.

Terminal Facilities

Aircraft use the terminal facilities based on airline gate assignment. The gates are currently undergoing electrification. Presently, there is no noise barrier in this location.

Table G5. Alternative 14, Issues by Airfield Location
General Mitchell International Airport FAR Part 150 Noise Compatibility Study

Area	Issue	Applicable Measure
Signature Ramp	Business jet and large corporate aircraft start-up, taxi, and idle noise	Noise barrier, parking plan, electrification
Skyway Ramp	Turboprop aircraft start-up; aircraft remaining overnight	Noise barrier, parking plan
West Ramp	Large-aircraft APU use and parking orientation	Noise barrier, parking plan, electrification
Terminal Facilities	Turbojet aircraft APU use and parking orientation	Parking plan, electrification

Fig. G22. Alternative 14, Airfield Locations

Proposed Procedures

Signature Flight Support Ramp

Signature Flight Support (Signature) is a Fixed-Base Operator located on the north end of the Airport, north of Taxiway F. Signature provides aviation services such as fuel, maintenance, crew support, and hangar facilities for business jets, narrow- and wide-body charter aircraft, and turboprop aircraft. Among the services offered is a large-aircraft parking apron where corporate jets and narrow-body charter aircraft are parked. Because of Signature's location, it can expose nearby communities north of the Airport to aircraft noise from start-up, APU use, and taxiing.

The most beneficial mitigation measure for aircraft activities on the Signature Flight Support Ramp is a noise barrier, following the Signature property line.

In addition to a noise barrier, a parking and electrification plan is also an appropriate measure to mitigate noise. A parking plan was created for the Signature FBO ramp based on the following parameters:

- Size and type of aircraft
- Source of power to aircraft while on the ground (APU, GPU, in-ground electric, idle engine power)
- Location of existing buildings to use for noise shielding
- Future location of power pits on the ramp
- Future location of a noise barrier on Airport property

There are three primary types of aircraft that use the Signature ramp: business jet aircraft with on-board APUs, business jet aircraft without on-board APUs, and narrow-body commercial aircraft (such as a Boeing 737 or 757) used by charter operations. Business jet aircraft with APUs (such as the Gulfstream V) are generally larger aircraft. Aircraft without APUs (such as the Citation) are generally smaller aircraft. Each aircraft type has distinct needs when using ground facilities. In order to accommodate each aircraft type, a parking plan is presented in Figure G23, page G.81.

Business jet aircraft with on-board APUs can be situated on the east side of the ramp, near the large hangar complex, with the nose of the aircraft pointed to the west and the engine exhaust facing to the east. This area can also be used for narrow-body aircraft parking, with the nose of the aircraft also pointed to the west. A west-facing aircraft orientation utilizes the existing large hangars as noise shields and points the exhaust and APU away from surrounding homes. In addition to using the eastern end of the Signature ramp, the secondary location for large business jet aircraft is to park in the middle row in front of the Signature building. This location will still allow for the aircraft to use the buildings for noise shielding. These aircraft can park either west facing (preferred) or east facing.

Smaller business jet aircraft that do not have APUs and use engine idle for their preflight can be parked in the middle row in front of the Signature building. These aircraft will also face to the west or east. Aircraft that use idle engine power on the ground predominately generate more noise in front of the aircraft and not as much behind it or to the side as is the case with APU-generated noise. Because of this, situating the aircraft toward the west side of the building complex still allows the aircraft to use the smaller buildings for noise shielding.

In the event that the Signature ramp will have a noise barrier built on the west side of the property in the future, the smaller business jet aircraft then can be located further to the west since there would be shielding provided from the noise barrier. In this case, aircraft will be moved closer to the airport property line, because the closer aircraft are to the noise barrier, the more the barrier reduces noise. Figure G23—Alternative 14, Signature Ramp Parking Plan—graphically shows the preferred parking locations for aircraft. This proposed parking plan is to be used as a guide that can be adjusted based upon the number of aircraft on the ramp, and when the aircraft are expected to depart.

Skyway Ramp

The Skyway Airlines Ramp is on the northwest side of the airfield. Activities on the Skyway Ramp include turboprop and regional jet maintenance, APU use, and taxiing. The apron area in front of the Skyway Ramp is used for parking of commercial aircraft that remain overnight—typically, four to twelve aircraft. Aircraft are taxied to the apron area from the terminal at night and taxied back to the terminal just before the aircraft is scheduled to depart the next day. The Skyway hanger serves as a partial barrier for local communities from much of the ground-based aircraft activity noise.

The most appropriate mitigation measure to implement for aircraft ground activities on the Skyway Ramp is a close-in noise barrier (adjacent to the hanger), which gives the neighborhoods to the north the greatest noise reduction, including breaking the line of sight to the neighborhoods. The noise barrier would be 10 feet high, extending 195 feet on the west side of the hangar and 285 feet on the east side. The east portion of the barrier would follow the fence line.

West Ramp

Commercial aircraft are often parked on the West Ramp (east of the Air Wisconsin hangar) overnight and then taxied to the terminal gates early in the morning. While on the West Ramp, these aircraft use their APUs for startup before taxiing to the terminal gates or during cleaning and minor maintenance during the night.

The most appropriate mitigation measure to implement for aircraft ground activities is to outline a parking plan for the area. Aircraft for which APU or engine idle activities may occur should be oriented with the nose of the aircraft facing to the west.

Fig. G23. Signature Ramp Parking Plan

Terminal Facilities

Terminal Facilities are used for commercial aircraft operations and are comprised of the three concourses attached to the main terminal building and the International Arrivals Building (IAB). Activities at the terminal include aircraft parking, taxiing, and APU use. The Airport is currently in the process of providing electrification at each of the terminal building aircraft gates to reduce APU use and noise.

New Procedure Noise Analysis

The mitigation measures presented in Alternative 14 will not affect the 65 DNL, but they will affect single-event noise levels.

Signature Flight Support Ramp

Noise Barrier and Parking Plan Analysis

The noise contours were run using two aircraft types: a Gulfstream IV (G-IV) aircraft and a Boeing 757. The G-IV, a Stage 3 aircraft, was chosen because it is one of the more difficult aircraft to mitigate due to the high position of the engines and because it is a common business jet at MKE. The APU is located on the right side of the aircraft, on the lower side of the jet engine.

The second aircraft used to model aircraft APU noise was the Boeing 757. This narrow-body commercial aircraft is a good representation of the charter-type aircraft that operate on the Signature Ramp. The APU is located on the right side of the aircraft, on the lower side of the jet engine.

The G-IV aircraft were modeled facing east, and the B-757 aircraft were modeled facing west. This typical aircraft parking configuration uses the suggested parking plan shown in Figure G23.

The noise barrier would break the line of sight between the neighborhood located on the north side of Layton Avenue and the Airport, and would result in approximately a greater than 6 dBA noise reduction. The noise barrier is shown in Figure G21, page G.73. While greater noise reduction could be achieved with a higher barrier, the barrier height would exceed 20 feet in the higher elevations, which would likely be too tall. Therefore, for illustrative purposes, a 10-foot-high noise barrier was modeled to provide the area north of the Airport noise reductions while maintaining a reasonable barrier height. Figure G24—Alternative 14, Signature Flight Ramp, Unmitigated and Mitigated Leq Noise Contours—shows the noise contours with and without the noise barrier.

Fig. G24. Alternative 14, Signature Flight Ramp, Mitigated and Unmitigated Noise Contours

Skyway Ramp

The skyway ramp is used by both regional jets (J328) and commuter turbo prop aircraft (B1900). The activities of concern that generate noise are engine start, engine idle, taxi and APU usage. The preferred orientation of an aircraft varies depending upon the type of aircraft and the activity that the aircraft is conducting. In addition to the aircraft parked on the ramp, in the early morning aircraft are towed out from the Skyway hanger to an open location on the ramp. These aircraft are then started and can idle for some period of time before taxiing to the gate.

With this alternative, a noise barrier is being evaluated as the best means of reducing aircraft noise on the ramp, regardless of the type of aircraft, the activity and the aircraft orientation. A 12-foot noise barrier connecting to the hanger was evaluated. With the noise barrier, there is a greater than 6 dBA noise reduction over the unmitigated conditions.

Two scenarios were modeled for this alternative. The first is with the current aircraft types, locations and orientations as typically occur today. The second scenario was assuming all regional jet aircraft. With the transition away from turbo props to more regional jets, the second scenario focused on the regional jets to reflect the long-term potential noise environment.

Figure G25—Alternative 14, Skyway Ramp, Mitigated and Unmitigated Leq Noise Contours, Existing Aircraft and Orientation—shows the noise contours with and without the noise barrier. The analysis assumes two regional jets oriented to the east and two turbo props oriented to the southwest. These are the current and preferred orientation for these aircraft types.

Figure G26—Alternative 14, Skyway Ramp, Unmitigated and Mitigated Leq Noise Contours, Future Aircraft and Orientation —shows how the noise contour would change if only regional jet aircraft were located on the ramp and a different orientation were used. The analysis assumes two regional jets oriented to the east and two regional jets oriented to the northeast.

While aircraft can be positioned with the nose of the aircraft facing many different directions, the preferred orientations for jet APU noise is for the nose to be facing to the east or secondarily to the north. For jet APU noise, the least preferred orientation is with the nose of the aircraft facing to the south. For jet aircraft under engine start or idle conditions, the preferred orientation is to the east.

With the different types of aircraft and associated activities on the ramp, and the possible orientations, a noise barrier provides the best option for reducing aircraft noise on the Skyway ramp.

West Ramp

Noise levels in adjacent communities could be reduced by parking aircraft in a specific direction to keep noise on Airport property and by implementing a plan to monitor APU use from aircraft parked on the West Ramp. Aircraft that park overnight on the West Ramp should park with the nose oriented to the east (or secondarily to the west), with the engine exhaust facing away from the communities to the north. In addition to aircraft parking, the airport could institute a voluntary measure for aircraft to use the APU for 30 minutes or less and curtail APU usage during early-morning and late-night hours. A long term goal is to add electrification to this ramp to eliminate APU use.

Terminal Facilities

Because of the central location of the terminal facility relative to the airfield, ground noise from the terminal complex contributes a relatively small amount to community noise exposure. Nonetheless, the terminal facilities, including the International Arrivals Building (IAB), has been evaluated to assess possible aircraft noise reductions through electrification.

Electrification of the terminal gates is currently underway at MKE as a result of the current Master Plan. In support of the electrified gates, it would be beneficial for the airport to notify all users that electrified ground power is the preferred method of power for aircraft at the terminal gates. Electrification of the IAB is also recommended for future mitigation in subsequent phases. Noise barriers would have little effectiveness in the terminal area because they could not be placed close to the aircraft.

Fig. G25. Alternative 14, Skyway Ramp, Mitigated and Unmitigated Leq Noise Contours, Existing Aircraft and Orientation

Fig. G26. Alternative 14, Skyway Ramp, Unmitigated and Mitigated Leq Noise Contours, Future Aircraft and Orientation

Alternative 15
Evaluate Location and Feasibility of Low-Tech Turboprop Run-up Facility for the Northeast Hangar Area

Goal

The goal of Alternative 15 is to reduce the noise from aircraft engine maintenance and testing operations in the northeast hangar area through low-tech means. This includes the feasibility and effectiveness of constructing a run-up facility from a natural, easily obtainable material or traditional noise barrier material.

Description

This alternative would minimize the noise intrusion experienced by residents in close proximity to the airport resulting from run-up operations in the northeast hangar area. Ground run-up enclosures for turboprop aircraft have successfully been constructed of hay bales, low cost barrier material or other natural materials that act as a noise barrier.

Existing Procedure:

Aircraft on the Northeast Ramp currently run up on the ramp area. While there is a GRE on the airfield, its location on the southwest side of the field makes it difficult for these smaller turboprop aircraft to taxi across multiple active runways and taxiways.

New Procedure

In order to determine the best location of the noise barrier and where to park aircraft on the ramp to reduce aircraft run-up noise, noise contours were run using an in-house computer model that was based upon actual noise measurement data at MKE and model data in the INM program.

The option chosen to model for the Northeast Ramp was to use a 10-foot-high, three-sided noise barrier constructed of hay at two locations: (1) on the north end of the Northeast Ramp, at the edge of pavement, with the opening to the barrier facing south, and (2) just west of the northern fire pit. The fire pit noise barrier location is approximately 1,570 feet south of the ramp. The model used a Beech 1900 turboprop aircraft at full run-up power to illustrate the noise levels of the turboprop aircraft that operate on the Northeast Ramp. While the model has an extensive aircraft database, it does not have the Beech 99 or King Air 90 in the model; the Beech 1900 aircraft characteristics are virtually identical (slightly louder) to those of the aircraft that use the Northeast ramp area, thus it was the aircraft chosen to model these activities.

New Noise Procedure Noise Analysis

This procedure does not have a DNL noise contour to model, as the ground noise does not have an appreciable effect on the DNL contour. Leq contours, which calculate the average noise level, were used to evaluate the noise levels of this alternative. On the north end of the ramp, a run-up enclosure provides approximately a 6 dBA noise reduction; in the fire pit location, the noise reduction is similar, except that noise from the open end of the facility is shifted to the south. Figure G27—Alternative 15, Northeast Ramp, Mitigated and Unmitigated Leq Noise Contours, North End—shows the noise contours with and without a noise barrier in place on the ramp area. Figure G28—Alternative 15, Northeast Ramp, Mitigated Leq Noise Contours, Fire Pit—shows the noise contours near the fire pit that would be associated with a run-up enclosure at this location.

Fig. G27. Alternative 15, Northeast Ramp, Mitigated and Unmitigated Noise Contours, North End

Fig. G28. Alternative 15, Northeast Ramp, Mitigated Noise Contours, Fire Pit

Contour Evaluation

Land Use Comparison

For each alternative that a DNL contour was modeled, population, housing units, schools, and churches are evaluated and compared to the Future Base Case noise contours in Table G4A. The table compares the number of residents, housing units, and other noise-sensitive uses within the 65 DNL and greater noise contour, which is the federally recognized contour for identifying land use compatibility.

This information was presented in the last Working Paper for Alternatives 1 through 8, with Alternatives 11 and 12 added for this Working Paper. As seen, Alternatives 1A, 1B, 4, 8, and 12 result in the same or slightly less total population within the 65 DNL noise contour as the 2009 Future Base Case contour. The other alternatives increase, although not dramatically in some cases, the number of noncompatible housing units and people within the 65 DNL noise contour compared to the 2009 Future Base Case.

Table G4A. 2009 DNL Contour Comparison for Each Modeled Alternative

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	2009 Future Base Case		**Alt 1A**		**Alt 1B**		**Alt 2**		**Alt 3**		**Alt 4**		**Alt 8**		**Alt 11**		**Alt 12**	
	Total	Non-compatible[1]	Total	Non-compatible[1]	Total	Non-compatible[1]	Total	Non-compatible[1]	Total	Non-compatible[1]	Total	Non-compatible[1]	Total	Non-compatible[1]	Total	Non-compatible[1]	Total	Non-compatible[1]
DNL 65																		
Housing Units	463	77	460	76	463	84	529	147	502	77	462	77	414	76	516	89	457	77
Population	1,090	180	1,080	180	1,090	195	1,240	345	1,180	180	1,085	180	970	180	1,212	210	1,074	180
Schools	1	0	1	0	1	0	1	0	2	0	1	0	1	0	2	0	1	0
Churches	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
DNL 70																		
Housing Units	8	7	7	6	7	6	6	8	7	5	9	8	5	4	8	7	8	7
Population	20	15	15	15	15	15	15	20	15	10	20	20	10	10	20	15	20	15
Schools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Churches	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DNL 75																		
Housing Units	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Population	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Schools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Churches	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

A1A FMS Departure Procedure, Runway 19R, East Destinations
A1B FMS Departure Procedure, Runway 19R, West Destinations
A2 FMS Procedures for East Departures, No Turns until Reaching Lake Michigan, Runway 7R
A3 FMS Procedures, North-Bound Departures, Runway 1L
A4 FMS Procedures, South-Bound Departures, Runway 25L
A8 Intersection Departures for South-Bound Departures at Night.
A11 Increase Altitude to 2,500 feet MSL for Jet Aircraft Prior to Turning
A12 Utilize the I-94 Corridor for Southern Departures off of Runway 25L

1 Housing units that have not been sound attenuated because they are either outside of the 1997 68.5 DNL contour or are units eligible for sound insulation that refused assistance

Note: Population numbers are derived from the average number of persons per household per census tract times the number of housing units, rounded to the nearest 5.

Note: Numbers are cumulative between contours; the 65 DNL contains the 70 and 75 DNL numbers.

Grid Analysis

Tables G6 and G7 present the results of the representative grid analysis completed for each of the alternatives for which DNL noise contours were generated. These grids can be used to identify the potential change in noise that may occur in a neighborhood as a result of each of the alternatives. Only the grids in the quadrant for which a change may potentially occur as a result of that alternative are presented. The location of each of the grids was presented in Figure G17. The noise metrics that are calculated are the DNL, the Time Above 65 dBA (TA65) Per Day, and the Number of Events Above 65 dBA (NA65) Per Day that were described at the beginning of this working paper.

Table G6. Change in Noise Grids Per Day (Alternative 11, Increase altitude to 2,500 feet above mean sea level (MSL) for all jet aircraft prior to turning, Base Case 2009 Noise Levels and Alternative 11 Change.

General Mitchell International Airport FAR Part 150 Noise Compatibility Study

Grid ID	2009 Base Case DNL	DNL Change	2009 Base Case Time Above 65 DNL (Minutes/Day)	Time Above 65 DNL Change (Minutes/Day)	2009 Base Case Number of Events Above 65 DNL	Number of Events Above 65 DNL Change
S11	56.2	0.0	6.7	0.1	33.2	0.0
S12	59.3	0.1	10.9	0.3	46.7	0.5
S13	61.9	0.0	17.6	0.4	62.1	1.7
S14	60.9	-0.3	19.6	-0.4	65.4	0.1
S15	58.0	0.0	17.4	-0.1	68.5	-1.4
S21	59.9	0.0	21.0	0.1	91.2	-0.1
S22	62.9	0.1	28.4	0.9	120.2	7.8
S23	65.2	0.4	39.7	1.7	164.7	2.7
S24	67.9	0.3	52.6	2.0	203.0	5.2
S25	68.6	-0.2	82.5	1.0	223.7	-0.1
S31	59.0	0.0	13.9	0.1	61.5	0.1
S32	61.8	0.0	20.5	0.2	82.9	1.0
S33	64.0	-0.2	26.8	0.2	106.1	2.1
S34	65.4	-0.7	37.8	0.6	143.5	2.0
S35	66.0	-0.1	69.8	-0.5	203.7	0.1
S41	58.3	0.0	13.1	-0.1	57.0	0.0
S42	58.7	-0.2	12.0	-0.4	53.6	-0.1
S43	56.8	-0.4	10.8	-0.9	50.5	-4.7
S44	55.4	-0.2	8.9	-0.4	37.3	-1.8
S45	54.6	-0.1	6.9	-0.2	33.2	-2.1
E11	55.7	0.0	13.0	0.0	66.1	0.0
E12	73.6	0.0	55.4	0.0	236.2	0.0
E13	64.3	0.0	71.2	0.0	228.5	0.0
E21	54.4	0.0	9.2	-0.2	41.9	-0.3
E22	68.4	0.0	50.6	0.0	195.9	0.0
E23	57.2	0.0	16.6	0.2	81.7	0.3
E31	53.8	-0.2	8.2	-0.3	35.1	-2.4
E32	65.9	0.0	47.6	0.1	186.5	0.0
E33	55.5	0.1	10.9	0.2	49.7	0.1
E41	55.0	-0.1	8.0	-0.1	33.0	0.1
E42	63.4	0.0	45.6	0.2	175.4	0.4
E43	55.5	0.1	8.7	0.2	41.3	0.4

Table G6 (Continued)

Grid ID	2009 Base Case DNL	DNL Change	2009 Base Case Time Above 65 DNL (Minutes/Day)	Time Above 65 DNL Change (Minutes/Day)	2009 Base Case Number of Events Above 65 DNL	Number of Events Above 65 DNL Change
N11	56.9	0.0	11.0	0.0	43.8	0.0
N12	53.5	-0.2	3.8	-0.2	14.1	-0.1
N13	52.5	-0.4	3.1	-0.2	11.8	-1.3
N14	53.3	-1.2	4.0	-0.7	15.8	-2.0
N15	54.9	-0.7	5.0	-0.3	19.7	-1.1
N21	68.8	0.0	114.0	-0.1	251.0	0.0
N22	61.2	-0.5	15.3	-0.5	58.1	0.0
N23	60.0	-1.6	10.4	-0.4	40.8	-0.1
N24	59.6	-1.1	8.0	0.3	31.0	1.3
N25	56.8	0.1	6.3	0.5	26.9	1.6
N31	63.3	0.0	50.2	0.2	191.3	0.0
N32	61.4	0.5	16.1	0.3	62.0	0.1
N33	61.9	0.9	17.6	0.6	75.7	0.2
N34	60.3	1.2	17.2	1.6	73.4	3.2
N35	58.5	0.6	14.3	1.1	60.7	6.3
N41	57.4	0.0	13.9	0.1	70.5	0.2
N42	53.8	0.0	6.7	0.0	28.0	0.9
N43	54.4	-0.7	5.8	-0.2	24.4	0.2
N44	55.4	-0.1	5.7	0.2	25.3	0.6
N45	53.1	0.4	4.3	0.5	21.4	2.8
W11	54.4	-0.1	7.8	-0.1	33.5	0.2
W12	55.2	-0.1	8.5	0.1	39.6	1.0
W13	59.3	0.1	24.8	0.2	102.7	1.4
W14	53.4	-0.3	5.8	0.1	31.7	1.3
W15	49.5	0.0	2.2	0.0	13.6	-0.1
W21	55.8	-0.2	8.9	-0.1	37.9	0.0
W22	56.0	-0.1	9.9	-0.1	41.9	0.2
W23	58.8	0.1	24.5	0.2	110.2	0.2
W24	55.9	0.0	12.5	0.3	67.2	1.1
W25	50.8	0.0	3.6	0.0	21.5	-0.2
W31	57.6	-0.2	10.3	-0.1	41.6	0.1
W32	56.9	-0.2	10.0	-0.2	40.3	-0.7
W33	56.9	-0.2	13.7	-0.4	58.1	0.1
W34	60.9	0.2	26.5	0.0	111.2	0.0
W35	52.9	0.0	5.1	0.0	29.8	0.7
W41	60.3	-0.2	14.6	-0.1	52.4	0.7
W42	59.0	-0.2	13.8	-0.3	50.4	0.1
W43	56.6	0.0	14.4	-0.3	60.8	-0.5
W44	71.8	0.0	24.2	-0.1	129.8	0.0
W45	54.4	0.0	10.8	0.0	42.6	0.2

Table G7. Change in Noise Grids Per Day (Alternative 12, Satellite-Based Departure Procedure for Runway 25L at I-94 Corridor), Base Case 2009 Noise Levels and Alternative 12 Change.
General Mitchell International Airport FAR Part 150 Noise Compatibility Study

Grid ID	**2009 Base Case DNL**	**DNL Change**	**2009 Base Case Time Above 65 DNL** (Minutes)	**Time Above 65 DNL Change** (Minutes)	**2009 Base Case Number of Events Above 65 DNL**	**Number of Events Above 65 DNL Change**
W11	54.4	-0.7	7.8	-1.7	33.5	-7.7
W12	55.2	-1.7	8.5	-3.1	39.6	-12.0
W13	59.3	-0.7	24.8	-3.0	102.7	-11.9
W14	53.4	-0.4	5.8	-0.9	31.7	-4.9
W15	49.5	-0.1	2.2	-0.1	13.6	-1.0
W21	55.8	0.3	8.9	1.0	37.9	4.3
W22	56.0	0.1	9.9	-0.1	41.9	0.2
W23	58.8	-1.6	24.5	-3.1	110.2	-4.5
W24	55.9	-1.1	12.5	-2.6	67.2	-8.5
W25	50.8	-0.2	3.6	-0.3	21.5	-0.7
W31	57.6	0.6	10.3	2.8	41.6	11.8
W32	56.9	1.4	10.0	3.5	40.3	12.8
W33	56.9	2.3	13.7	2.0	58.1	0.0
W34	60.9	-0.6	26.5	-1.1	111.2	0.0
W35	52.9	-0.1	5.1	-0.3	29.8	-1.0
W41	60.3	0.1	14.6	1.5	52.4	6.3
W42	59.0	0.2	13.8	1.5	50.4	5.2
W43	56.6	0.3	14.4	1.6	60.8	1.9
W44	71.8	0.0	24.2	0.2	129.8	0.0
W45	54.4	-0.1	10.8	-0.2	42.6	-0.6