CHAPTER 3
Noise Abatement and Noise Mitigation
Alternatives

3.1 Introduction

During the preparation of a 14 Code of Federal Regulations (CFR) Part 150 noise compatibility program, it is important to conduct a balanced evaluation of noise abatement and noise mitigation alternative measures available to an airport sponsor. Noise abatement measures involve reducing noise at the source by instituting operational measures such as changes in aircraft flight tracks, changes in approach profiles, or changes in departure profiles. In contrast, noise mitigation measures involve reducing noise from the perspective of the receiver (person or land use) and can include land acquisition, acoustical treatment, and the purchase of avigation easements. Currently, the Federal Aviation Administration (FAA) differentiates between remedial and preventive noise mitigation programs. Remedial noise mitigation measures are intended to reduce or improve the compatibility of existing land uses (for instance sound insulation). Preventive mitigation measures are intended to discourage the development of new incompatible land uses (e.g., zoning regulations, preparing/amending comprehensive plan documents, etc.).

In accordance with Paragraph (b) of 14 CFR Part 150 Sec. B150.7, at a minimum the following types of alternatives must be considered during the preparation of the NCP: (1) acquisition of land and interests therein; (2) construction of barriers and acoustical shielding including the soundproofing of public and private buildings; (3) implementation of a preferential runway use program; (4) implementation of restrictions on the use of the airport by any type or class of aircraft based on the noise characteristics of those aircraft; (5) the use of flight procedures (including the modifications of flight tracks) to control the operation of aircraft to reduce exposure of individuals (or specific noise sensitive areas) to noise in the area around the airport; (6) other actions or combinations of actions that would have a beneficial noise control or abatement impact on the public; and (7) other actions recommended for analysis by the FAA for the specific airport. These minimum alternative measures were considered for implementation at San Francisco International Airport (SFO or the Airport).

Each alternative was evaluated on the basis of eight criteria specified by the FAA in 14 CFR Part 150 Section 150.35(b) and Appendix B, Section B150.5, as follows:

1) Does the measure reduce existing incompatible land uses exposed to significant aircraft noise?
2) Does it prevent or discourage development of incompatible land uses potentially exposed to significant aircraft noise?

3) Does it impose an undue burden on interstate or foreign commerce?

4) Is it unjustly discriminatory?

5) Can it be revised if conditions change?

6) Does it derogate aviation safety or adversely affect the safe and efficient use of navigable airspace?

7) Does it meet both the goals and needs of the local community and those of the national air transportation system, to the extent practicable?

8) Can it be implemented in a manner consistent with all the powers and duties of the FAA Administrator?

Related criteria that were used to evaluate the minimum alternative measures included:

- Does it reduce existing incompatible land uses exposed to significant aircraft noise?
- Does it prevent or discourage development of incompatible land uses potentially exposed to significant aircraft noise?
- Is it consistent with the policies of the San Francisco Airport Commission?
- Is it consistent with the policies of the affected local jurisdictions?
- Would it have a positive effect on existing and planned land use patterns in the Airport environs?
- Can it be implemented under existing laws?
- Is it economically, financially, and politically feasible?
- Is it feasible for early implementation?

The results of the noise abatement and noise mitigation alternative measures evaluation is summarized in the following sections. To comply with Section B150.7 of 14 CFR Part 150, the agency or agencies with implementation authority for the noise abatement/noise mitigation alternatives are listed below.

### 3.2 Evaluation of Noise Abatement Alternatives

Noise abatement alternative measures are designed to reduce current and projected aircraft noise exposure on existing and planned noise-sensitive land uses and populations. Historically, noise abatement has typically been achieved through changes in airfield (runway) layout, runway and flight track definition and use, aircraft operational procedures, or the types of aircraft using an airport. Since the passage of the *Airport Noise and Capacity Act of 1990* [III-1], airport operators have very little authority with respect to implementation of most types of abatement options, with the exception of ground noise measures (e.g., designating
specific locations on the Airport for engine run-up activity). The FAA directs, through 14 CFR Part 150, that airport operators consider noise abatement, including specific abatement measures, in developing a noise compatibility program.

This section describes various alternative measures for noise abatement that were considered for SFO and provides a discussion of their applicability. The types of noise abatement measures considered for SFO included:

- **Airfield changes**—changes in the design, layout, or other physical characteristic of the airfield for noise abatement purposes.

- **Flight track changes**—changes in flight tracks or their use to minimize overflights of noise-sensitive areas.

- **Runway use changes**—changes in the use of the runways, such as rotating runway use or identifying preferential use of some runways, to reduce overflights of noise-sensitive areas.

- **Operational measures**—changes in aircraft operating procedures or restrictions on the numbers, types, or categories of operations at an airport.

- **Ground operations or development measures**—changes in the ground operations (such as engine run-ups) or development or relocation of airport facilities (other than the airfield).

- **Management measures**—airport management procedures or controls to help achieve noise abatement. Although some of these options would not reduce noise exposure in and of themselves, they can help to monitor or achieve the goals of the measures in the previous categories.

The categories of specific options considered for the Airport and the findings of the noise abatement alternative measures evaluation are presented below and summarized in Table 3-1. As shown in Table 3-1, no new noise abatement alternative measures are recommended for implementation at SFO.

### 3.2.1 Airfield Changes

#### 3.2.1.1 Extend Runways

Runway extensions can increase the altitude of aircraft along approach and departure paths, thereby increasing the altitude of aircraft over noise-sensitive land uses in the airport vicinity. As a general rule, the altitude of departing aircraft with respect to the far end of the runway from where an aircraft begins its takeoff roll increases 140 feet for every 1,000 feet of added runway length, assuming a climb angle of 8 degrees.

SFO is bordered by U.S. Highway 101 (U.S. 101) to the west and the San Francisco Bay to the north, east and south. Runway extensions at SFO would not be feasible without either relocating U.S. 101 or placing fill in the San Francisco Bay.
Placing permanent fill to the tidal communities of San Francisco Bay (e.g., open water, mudflat, and tidal wetland habitats), are considered a major environmental impact. Impacts to wetlands would trigger a rigorous and lengthy regulatory permitting review, and if authorized, substantial compensatory mitigation.

Before even considering compensatory mitigation, the FAA, U.S. Army Corps of Engineers (USACE), U.S. Environmental Protection Agency, and Regional Water Quality Control Board (RWQCB) through implementation of their programs and responsibilities under the federal Clean Water Act, will require a stringent 404(b)(1) Alternatives Analysis to determine if the proposed fill meets the requirements of being the Least Environmentally Damaging Practicable Alternative (LEDPA). Per the Clean Water Act Section 404(b)(1) Guidelines, no impact would be permitted if there is a practicable alternative to the proposed discharge that would result in less adverse impact to the aquatic ecosystem. Furthermore, no impact shall be permitted if it would cause or contribute to violations of any applicable State water quality standard or jeopardize the continued existence of species listed as endangered or threatened under the Endangered Species Act of 1973.

If available, mitigation credits to offset impacts to tidal marsh and open water impacts are typically priced at about $1 million per acre in the San Francisco Bay area. Agency required mitigation ratios have typically ranged from 3:1 to 6:1 depending on project-specific details such as the size, location, and timing of the impact, value of the resource being impacted and other factors. The specific ratios would be determined based on the USACE’s Mitigation Ratios Checklist and RWQCB requirements. Extending the north-south Runways 1L-19R and 1R-19L by about 2,000 feet to the north would require about 100 acres of bay fill. Compensatory mitigation could cost between $300 million and $600 million.

Due to the high capital costs and environmental effects associated with constructing a runway extension at SFO this measure was eliminated from further consideration.

**Implementation Authority:** Implementation authority rests with the San Francisco Airport Commission as the owner and operator of SFO. FAA approval of an updated Airport Layout Plan would be required. Consultation with other federal, State, and local agencies would be required to comply with various special purpose laws and federal grant-in-aid assurances.

**Recommendation:** Not considered an effective approach to reduce aircraft noise levels in the SFO environs. FAA approval of this measure is not requested.

### 3.2.1.2 Construct New Runways

Constructing a new runway at SFO is not considered feasible due to the lack of available land to the west and the high capital costs and the environmental effects associated with constructing a new runway in SF Bay on fill to the south/east.

Construction of a new runway parallel to the primary east-west runways (10R-28L and 10L-28R) with a length equal to Runway 10R-28L (shorter of the two primary runways) would need to meet
FAA standards specified in *Airport Design* Advisory Circular 150/5300-13a. The required runway to runway centerline separation of 4,300 feet would require about 1,160 acres of tidal wetlands/open water fill. Based on the compensatory mitigation ratios and mitigation costs identified above in Section 3.2.1.1, compensatory mitigation could cost about $3.5 billion to $7 billion dollars.

Due to the high capital costs and environmental effects associated with constructing a runway extension at SFO this measure was eliminated from further consideration.

**Implementation Authority:** Implementation authority rests with the San Francisco Airport Commission as the owner and operator of SFO. FAA approval of an updated Airport Layout Plan would be required. Consultation with other federal, State, and local agencies would be required to comply with various special purpose laws and federal grant-in-aid assurances.

**Recommendation:** Not considered an effective approach to reduce aircraft noise levels in the SFO environs. FAA approval of this measure is not requested.

### 3.2.1.3 Decommission Existing Runways

Poor weather/low visibility conditions can lead to shutdowns of two of the four runways at SFO, resulting in delays and increased aircraft operations during nighttime hours. Decommissioning existing runways and reducing the capacity at SFO is not a viable option to achieve noise reduction. Such an option does not meet the goals and needs of the national air transportation system, would reduce airfield capacity and increase aircraft delays and nighttime operations, would potentially affect Airport users, and could negatively affect the operation of other airports in the region.

**Implementation Authority:** Implementation authority rests with the San Francisco Airport Commission as the owner and operator of SFO. Compliance with federal grant-in-aid assurances and applicable special purpose laws would be required. Approval from the FAA and consultation with airport users would be required.

**Recommendation:** Would be detrimental to the National Airspace System. Not considered an effective approach to reduce aircraft noise levels in the SFO environs. FAA approval of this measure is not requested.

### 3.2.1.4 Relocate Runway Thresholds

Several runway thresholds at SFO were relocated between 2012 and 2014 in connection with the Runway Safety Area program. Due to land constraints at SFO, nonstandard Engineered Material Arresting System (EMAS) was installed on the ends of Runways 1L-19R and 1R-19L. Runway 1L-19R was effectively reduced in length and shifted north away from the City of Millbrae. This shift has reduced aircraft departure back blast noise in portions of the City of Millbrae located just west of U.S. 101.
The thresholds of Runway 28L and 28R are currently displaced by 300 feet. Further displacement of the Runway 28L and 28R departure thresholds would potentially result in increased noise levels in communities north and west of the Airport including San Bruno. Relocation of the Runway 10L and/or 10R departure thresholds would not materially impact aircraft noise levels in the environs of SFO. It is also noted that relocation of the Runway 10L and 10R departure thresholds to the southeast is not practical or feasible since Runways 10L-28R and 10R-28L are both used by heavy aircraft and for long-haul flight operations.

**Implementation Authority:** Implementation authority rests with the San Francisco Airport Commission as the owner and operator of SFO. Approval from the FAA would be required to shorten the runways. Consultation with airport users would be required.

**Recommendation:** Not considered an effective approach to reduce aircraft noise levels in the SFO environs. FAA approval of this measure is not requested.

### 3.2.2 Flight Track Changes

#### 3.2.2.1 Fanning Departure Tracks

The FAA is responsible for adopting and implementing changes in flight tracks. Fanning departure tracks (i.e., distributing ground tracks over a wide geographic area) is a technique that has been applied at several airports across the country to minimize aircraft noise levels in areas developed with noise sensitive land uses. With fanned flight tracks, aircraft departing from a runway one after the other are assigned to different headings after takeoff so they fly over different areas and are not concentrated over one area. Operationally, fanning departures can lead to increased runway throughput if the aircraft makes a turn immediately after takeoff (which is not possible for some larger aircraft types).

SFO ATCT personnel currently “fan” departures from Runway 1L and 1R to some extent; however, due to the topography in the vicinity of SFO, fanning of departure tracks is limited. Fanning departure tracks from other runways at SFO would not be safe or practical due to high terrain in the region including San Bruno Mountain to the north/northwest of SFO and the mountain ridge west of Interstate 280.

**Implementation Authority:** Implementation of flight procedures for noise abatement is exclusively within the responsibility of the FAA. Implementation depends on wind and weather, with the understanding that the final decision on flight procedures rests with the pilot-in-command of the aircraft, who is ultimately responsible for decisions regarding aircraft safety.

**Recommendation:** Limited application due to topography surrounding SFO. FAA approval of this measure is not requested.

#### 3.2.2.2 Design Flight Tracks to Follow Less Noise-Sensitive Corridors

The Airport Commission and FAA ATCT personnel at SFO have implemented arrival and departure procedures designed to reduce overflights of densely populated areas and associated
overflight noise including the FMS Bridge Approach, the TRUKN TWO (RNAV) departure procedure (previously referred to as the Shoreline departure procedure), and the NIITE THREE (RNAV) departure procedure (previously referred to as the Quiet departure procedure). As discussed in Chapter 2, voluntary implementation of the FMS Bridge approach helps to minimize aircraft noise levels in Foster City. Voluntary implementation of the TRUKN TWO (RNAV) and the NIITE THREE (RNAV) procedures keep aircraft and associated noise away from the residential communities located northwest of SFO near San Bruno Mountain.

Implementation Authority: Implementation of flight procedures for noise abatement is exclusively within the responsibility of the FAA. Implementation depends on wind and weather, with the understanding that the final decision on flight procedures rests with the pilot-in-command of the aircraft, who is ultimately responsible for decisions regarding aircraft safety. The Airport Commission and airlines would also be key stakeholders.

Recommendation: Continue use of the FMS Bridge Approach procedure and the TRUKN TWO (RNAV) and NIITE THREE (RNAV) departure procedures. These flight procedures were modeled as baseline conditions during the development of the 2014 and 2019 NEMs. FAA approval of existing noise abatement arrival and departure procedures is not requested.

3.2.3 Runway Use Changes

3.2.3.1 Rotational Runway Use

Runway use changes can be used to shift aircraft overflights from noise-sensitive areas to areas that are developed with land uses that are compatible with aircraft noise. Such changes are most effective when wind conditions allow multiple runway directions to be used and large areas of compatible land use are available, particularly as a result of geographic features (large bodies of water, land areas that are not suitable for building, etc.). In some cases rotational runway use has been used as a means to equally distribute noise to different areas around an airport.

A voluntary nighttime preferential runway use program (as part of the overall Fly Quiet Program) has been implemented at SFO. The nighttime preferential runway use program was formulated with input from the Roundtable, the FAA, and airlines. As of March 3, 1988, departures between 11:00 p.m. and 7:00 a.m. are directed to Runways 10L and 10R, or are directed to Runways 28L and 28R and assigned the NIITE THREE (RNAV) departure procedure, or directed to depart on Runways 1L and 1R over San Francisco Bay waters, in this order of priority. Changes to the existing preferential runway use program are not necessary. The existing preferential runway use program has been developed with input from local stakeholders, been in use for nearly 25 years, and is effective at reducing aircraft noise levels in communities located in the SFO environs.

Implementation Authority: The San Francisco Airport Commission is the responsible agency for establishing, or recommending changes to, the rotational runway use program at SFO. The FAA and airport users would be consulted to ensure safety and efficiency of the measures included in the voluntary program. The pilot-in-command makes the final determination regarding the safe operation of the aircraft in their control.
**Recommendation:** Continue the voluntary nighttime preferential runway use program at SFO. The voluntary nighttime preferential runway use program was modeled as baseline conditions during the development of the 2014 and 2019 NEMs. FAA approval of this measure is not requested.

### 3.2.3.2 Preferential Runway Use Program

A nighttime preferential runway use program has been implemented at SFO. The nighttime preferential runway use program was formulated with input from the Roundtable, the FAA, and airlines. As of March 3, 1988, departures between 11:00 p.m. and 7:00 a.m. are directed to Runways 10L and 10R; or are directed to Runways 28L and 28R and assigned the NIITE THREE (RNAV) departure procedure; or directed to depart on Runways 1L and 1R over San Francisco Bay waters, in this order of priority. Changes to the existing preferential runway use program are not necessary. The existing preferential runway use program has been developed with input from local stakeholders, been in use for nearly 25 years, and is effective at reducing aircraft noise levels in communities located in the SFO environs.

**Implementation Authority:** Implementation of preferential runway use for noise abatement is exclusively within the responsibility of the FAA. Implementation depends on wind and weather, with the understanding that the final decision on which runway to use rests with the pilot-in-command of the aircraft, who is ultimately responsible for decisions regarding aircraft safety. The San Francisco Airport Commission is the responsible agency for recommending changes to, the voluntary nighttime preferential runway use program at SFO.

**Recommendation:** Continue the voluntary nighttime preferential runway use program at SFO. The voluntary nighttime preferential runway use program was modeled as baseline conditions during the development of the 2014 and 2019 NEMs. FAA approval of this measure is not requested.

### 3.2.4 Operational Measures

#### 3.2.4.1 Change departure profiles or develop departure profiles specific to runway ends

At the request of the Airport Commission, FAA ATCT staff at SFO voluntarily began using the FAA recommended engine thrust and flap retraction procedures as defined in FAA Advisory Circular (AC) 91-53, *Noise Abatement Departure Profile* at SFO in 1979. Aircraft departing from Runways 28L and 28R use the appropriate International Civil Aviation Organization (ICAO) Noise Abatement Take-off Climb – Procedure A or FAA Advisory Circular 91-53A noise abatement climb procedure to minimize noise levels in communities close to SFO. SFO ANAO staff members track airline use of this noise abatement measure through the Fly Quiet Program.

**Implementation Authority:** Implementation of AC 91-53 departure profiles for noise abatement is exclusively within the responsibility of the FAA. Implementation depends on wind and weather, with the understanding that the final decision on use of noise abatement departure
profiles rests with the pilot-in-command of the aircraft, who is ultimately responsible for decisions regarding aircraft safety.

**Recommendation:** Continue to use noise abatement departure profiles at SFO. FAA approval of this measure is not requested.

### 3.2.4.2 Modify Arrival Profiles/Procedures

Arrival procedures can also be modified to reduce noise levels associated with individual aircraft operations. Such procedures that have been tested for noise abatement purposes include the minimal use of flaps to reduce power settings and airframe noise, two stage descent profiles, and the use of increased approach angles. Most of these procedures are no longer regarded favorably by the industry, and some were found to increase noise because of the additional power applications required to arrest high sink rates.

The typical approach slope used by ATCT personnel and pilots includes a 3-degree glide slope to the touchdown point on the runway. In some cases, a steeper approach slope can be used to place aircraft at higher altitudes over noise-sensitive land uses on their approach to an airport. Such changes in approach slopes typically are not enough to cause a significant change in noise levels, especially in areas closer to the airport. Such changes can also affect the margin of safety of aircraft approaches because they require landing the aircraft at more than optimal approach speed.

Prior to the FAA’s approval of the 1983 NCP, studies were conducted to determine the feasibility of modifying arrival routes and altitude profiles above the San Francisco Peninsula and residential areas in Foster City southeast of the Airport. These studies determined that minor adjustments to existing flight procedures would lead to reductions in overflight noise. Rather than increase the crossing altitudes over Foster City and the Peninsula, the FAA opted to maintain the glideslope and instead offset the arrival course laterally from Foster City and the shoreline.

A continuous descent approach (CDA) is an experimental procedure that pilots can use on approach to an airport. CDAs are designed to allow a slow, gradual descent at reduced engine power settings starting at higher altitudes and greater distance from the airport than standard approach procedures. The purpose of a CDA is to reduce maneuvering and the changes in air speed at lower altitudes that are typical of the standard approach path and that can generate high noise levels on the ground. Under standard arrival procedures, aircraft are assigned altitudes by ATCT personnel in stages as they arrive at an airport. CDAs eliminate the series of altitude stages, providing for the sequencing of aircraft at higher altitudes and further away from the airport with virtually no flight phase that requires increased engine power settings.

**Implementation Authority:** Implementation of preferential runway use for noise abatement is exclusively within the responsibility of the FAA. Implementation depends on wind and weather, with the understanding that the final decision on use of noise abatement arrival profiles/procedures rests with the pilot-in-command of the aircraft, who is ultimately responsible for decisions regarding aircraft safety.
Recommendation: The Airport Commission is not seeking FAA approval of modified arrival procedures as part of the NCP update. FAA approval of this measure is not requested.

3.2.4.3 Restrict the number or time of day of aircraft operations

At some airports, operational restrictions have been imposed on certain types of aircraft. The restrictions typically are based on aircraft noise levels to prevent the loudest aircraft in the fleet from operating at the airport, and preventing the high single-event noise levels of these aircraft from affecting airport neighbors. Another common form of restriction is to regulate aircraft operations by time-of-day so as to reduce noise at times when people are typically at home and asleep (e.g., evening and night). However, a critical component of the Airport Noise and Capacity Act of 1990 (ANCA) was the inclusion of a procedure that airport sponsors must follow to restrict aircraft operations after October 5, 1990. In addition to requiring the phase out of the louder 14 CFR Part 36 Stage 2 aircraft from the airline fleets, ANCA made the process of restricting the operation of aircraft that meet federal aircraft noise standards at a particular airport much more difficult than it had been prior to passage of the act. 14 CFR Part 161, Notice and Approval of Airport Noise and Access Restrictions [III-2], implements the portion of ANCA that restricts airport sponsors from placing new restrictions on aircraft operations. The scope of ANCA and Part 161 is quite broad; virtually all types of restrictions that affect the operations of Stage 2 and Stage 3 aircraft are subject to rigorous procedural requirements and, in the cases of Stage 3 restrictions, FAA approval.

The process of meeting the requirements of 14 CFR Part 161 to restrict the number of operations or time of day of operations at SFO would be costly and extremely difficult based on historical evidence. Pursuing these types of restrictions is not recommended.

Implementation Authority: The San Francisco Airport Commission would be the responsible agency for any operational restrictions at SFO. FAA would be the lead federal agency with regulatory authority. Successful completion of a 14 CFR Part 161 study would need to be achieved prior to FAA approval to implement noise or access restriction at SFO.

Recommendation: Not considered an effective approach to reduce aircraft noise levels in the SFO environs. FAA approval of this measure is not requested.

3.2.4.4 Restrict the types of aircraft allowed to operate at the Airport

As described above, implementation of operational restrictions at airports is very costly and complicated due to the requirements of 14 CFR Part 161. Restricting the types of aircraft allowed to use SFO is not recommended.

Implementation Authority: The San Francisco Airport Commission would be the responsible agency for any operational restrictions at SFO. FAA would be the lead federal agency with regulatory authority. Successful completion of a 14 CFR Part 161 study would need to be achieved prior to FAA approval to implement noise or access restriction at SFO.
**Recommendation:** Not considered an effective approach to reduce aircraft noise levels in the SFO environs. FAA approval of this measure is not requested.

### 3.2.5 Ground Operations or Development Measures

#### 3.2.5.1 Construct a facility for Engine Run-ups

The Airport Commission conducted a study in 2009 to identify a potential location for a ground run-up enclosure (GRE) but determined that constructing a GRE at SFO was not feasible due to severe land constraints. Furthermore, noise evaluations conducted by the ANAO and its consultants suggest that noise barriers could inadvertently push noise downwind towards Foster City and San Mateo residents.

**Implementation Authority:** Implementation authority rests with the San Francisco Airport Commission as the owner and operator of SFO. FAA approval of an updated Airport Layout Plan would be required.

**Recommendation:** Not considered an effective approach to reduce aircraft noise levels in the SFO environs. FAA approval of this measure is not requested.

#### 3.2.5.2 Construct Noise Barriers

U.S. 101 physically separates the Airport from the nearest residential areas to the west. Residential areas located immediately west of U.S. 101 are exposed to highway noise and aircraft noise associated with operations at SFO. Land to the north and south of the Airport is zoned for and developed with commercial and industrial land uses. San Francisco Bay waters border the Airport to the east.

The Airport Commission has planted trees along the western side of U.S. 101 to reduce highway and aircraft noise for residents west of the Airport’s West of Bayshore Property.\(^1\) Such natural barriers are only marginally effective at mitigating aircraft departure back blast noise.

**Implementation Authority:** Implementation authority rests with the San Francisco Airport Commission. The Airport’s West of Bayshore Property contains wetlands that are habitat for a federally and state listed species. Planting trees would require approvals from the U.S. Fish and Wildlife Service and the California Department of Fish and Wildlife.

**Recommendation:** Construction of additional noise barriers would not be an effective approach to reduce aircraft noise levels in the SFO environs. FAA approval of this measure is not requested.

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\(^1\) The West of Bayshore Property is a 180-acre undeveloped property separated from the Airport by U.S. 101. The West of Bayshore property has several utility right of ways for major utilities (i.e., electricity, water, and regional transit) and provides habitat for two federal and California State listed endangered species.
3.2.6 Management Measures

3.2.6.1 Implement noise abatement office for monitoring, reporting, and responding to aircraft noise

The SFO ANAO is responsible for implementing the recommended mitigation measures found in the 1980 Joint Land Use Study Final Technical Report. The SFO ANAO has led the industry in addressing community concerns of aircraft noise since the mid-1970s when it developed and installed the first airport noise monitoring system.

**Implementation Authority:** Implementation authority rests with the San Francisco Airport Commission.

**Recommendation:** No changes to SFO ANAO roles/functions are recommended. FAA approval of this measure is not requested.

3.2.6.2 Record or Track Noise Complaints

The SFO ANAO has maintained a database of all noise nuisance complaints received from nearby communities since 1970. The Noise Complaint Tracking System is used to track and respond to noise complaints, investigate noise events, and report findings to the Roundtable.

**Implementation Authority:** Implementation authority rests with the San Francisco Airport Commission.

**Recommendation:** Continue to track noise complaints. FAA approval of this measure is not requested.

3.2.6.3 Install permanent or portable aircraft noise and operations monitoring equipment

SFO’s noise monitoring system was developed and installed in 1981 with local funds, prior to the submission of SFO’s 14 CFR Part 150 NCP to the FAA. The system currently has 29 off-airport remote monitoring stations located around the San Francisco Bay Area and four on-airport units that are used to measure noise from aircraft run-up activity. The SFO ANAO also has four portable units, which are used for short-term noise monitoring at off-airport locations on an as-needed basis.

**Implementation Authority:** Implementation authority rests with the San Francisco Airport Commission.

**Recommendation:** This measure was approved by the FAA and has been implemented. FAA approval of this measure is not requested.
### TABLE 3-1
SUMMARY OF NOISE ABATEMENT MEASURES CONSIDERED FOR SAN FRANCISCO INTERNATIONAL AIRPORT

<table>
<thead>
<tr>
<th>Category</th>
<th>Noise Abatement Measure</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airfield Changes</td>
<td>Extend runways</td>
<td>Cost prohibitive and with environmental effects. Not considered an effective approach to reduce aircraft noise levels in the airport environs.</td>
</tr>
<tr>
<td></td>
<td>Construct new runways</td>
<td>Cost prohibitive and with environmental effects. Not considered an effective approach to reduce aircraft noise levels in the airport environs.</td>
</tr>
<tr>
<td></td>
<td>Decommission existing runways</td>
<td>Would be detrimental to the National Airspace System. Not considered an effective approach to reduce aircraft noise levels in the airport environs.</td>
</tr>
<tr>
<td></td>
<td>Relocate runway thresholds</td>
<td>Runway thresholds were displaced in connection with the runway safety area program. Not considered an effective approach to reduce aircraft noise levels in the airport environs.</td>
</tr>
<tr>
<td>Flight track changes</td>
<td>Fanning departure tracks</td>
<td>Limited application due to topography near SFO. FAA ATCT personnel already fan Runway 1L and 1R departures to some extent.</td>
</tr>
<tr>
<td></td>
<td>Design flight tracks to follow less noise-sensitive corridors</td>
<td>Continue use of the FMS Bridge Approach procedure and the TRUKN TWO (RNAV) and NIITE THREE (RNAV) departure procedures.</td>
</tr>
<tr>
<td>Runway Use Changes</td>
<td>Rotational Runway Use</td>
<td>Continue the Nighttime Preferential Runway Use Program.</td>
</tr>
<tr>
<td></td>
<td>Preferential Runway Use Program</td>
<td>Continue the Nighttime Preferential Runway Use Program.</td>
</tr>
<tr>
<td>Operational measures</td>
<td>Change departure profiles or develop departure profiles specific to runway ends</td>
<td>Continue to use noise abatement departure profiles at SFO.</td>
</tr>
<tr>
<td></td>
<td>Modify arrival profiles/procedures</td>
<td>Continue to use existing arrival procedures.</td>
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<tr>
<td></td>
<td>Restrict the number or time of day of aircraft operations</td>
<td>Would be subject to 14 CFR Part 161. Not considered an effective approach to reduce aircraft noise levels in the SFO environs.</td>
</tr>
<tr>
<td></td>
<td>Restrict the types of aircraft allowed to operate at the Airport</td>
<td>Would be subject to 14 CFR Part 161. Not considered an effective approach to reduce aircraft noise levels in the SFO environs.</td>
</tr>
<tr>
<td>Ground operations or development measures</td>
<td>Change location for and/or construct a facility for ground run-ups</td>
<td>Continue to perform run-ups away from residential areas. Not considered an effective approach to reduce aircraft noise levels in the SFO environs.</td>
</tr>
<tr>
<td></td>
<td>Construct noise barriers</td>
<td>Continue use of existing noise barriers.</td>
</tr>
<tr>
<td>Management measures</td>
<td>Implement noise abatement office for monitoring, reporting, and responding to aircraft noise</td>
<td>No changes to SFO ANAO roles/functions are recommended.</td>
</tr>
<tr>
<td></td>
<td>Record or track noise complaints</td>
<td>Continue to track noise complaints.</td>
</tr>
<tr>
<td></td>
<td>Install permanent or portable aircraft noise and operations monitoring equipment</td>
<td>Continue deployment of permanent and portable noise monitors.</td>
</tr>
</tbody>
</table>

**NOTES:**
The San Francisco Airport Commission is not requesting FAA approval for any of the abatement measures listed in this table.

ANAO = Aircraft Noise Abatement Office
ATCT = Airport Traffic Control Tower
CFR = Code of Federal Regulations
FAA = Federal Aviation Administration
RNAV = Area Navigation
3.3 Evaluation of Noise Mitigation Alternatives

Noise mitigation measures are designed to mitigate aircraft noise exposure (i.e., reduce or minimize the number of people and the existing or planned noise-sensitive land uses exposed to significant aircraft noise). This section describes several measures for noise mitigation and provides an evaluation of their applicability to SFO and its environs. The mitigation measures are classified as:

- **Remedial Measures** – Intended to reduce or improve the compatibility of existing incompatible land uses.
- **Preventative Measures** – Intended to discourage the development of new incompatible land uses.

The categories of specific measures considered for the Airport and the findings of the noise mitigation alternatives evaluation are presented below and summarized in Table 3-2. As shown in Table 3-2, one updated mitigation measure is recommended for implementation at SFO – continuation of the ongoing Residential Sound Insulation Program (RSIP).

3.3.1 Remedial Measures

3.3.1.1 Land Acquisition

Acquisition of property in fee simple ownership, which involves the full purchase of land and the improvements thereon, is the most direct means of achieving land use compatibility in an airport environs and eliminating incompatible land uses. The acquired property can be (1) used for airport purposes, (2) resold with avigation easements and deed restrictions that would permit only compatible uses, or (3) maintained by the airport sponsor and maintained as permanent open space or buffer. Land acquisition programs are typically focused on areas exposed to aircraft noise of CNEL 70 dB and higher and are most effective in areas transitioning from residential land uses to commercial or industrial land uses.

The primary advantages of fee simple acquisition are that it:

- Eliminates land uses that are not compatible with aircraft noise
- Enables the occupants of residences exposed to high levels of aircraft noise to relocate to areas not affected or less severely affected by aircraft noise
- Allows the airport sponsor to better control development in areas exposed to the highest levels of aircraft noise.

The primary disadvantages of a fee simple property acquisition program are that such a program:

- Can be expensive and can require lengthy and costly relocation efforts
- Often reduces the available supply of affordable housing in the airport environs
3. Noise Abatement and Noise Mitigation Alternatives

- Can change the character of a neighborhood over time and disrupt local land use and traffic patterns
- Can lead to reduced property tax revenues by transferring land from private to public ownership.

Residential neighborhoods located north, west, and south of SFO are well established. The density of residential development in the SFO environs suggests that a land acquisition program would be difficult to administer. The median cost of residential property within SFO’s CNEL 65 dB contour has not been evaluated in detail. Since the median home price in San Mateo County is greater than $1.3 million, a land acquisition program is cost prohibitive, disruptive to established neighborhoods, and not recommended.

**Implementation Authority:** Implementation authority rests with the San Francisco Airport Commission. FAA approval of the Noise Compatibility Program Update would be required to be eligible for federal funding support for such a program with AIP grants.

**Recommendation:** Not considered an effective approach to mitigate the effects of aircraft noise exposure in the SFO environs. Since 1983, SFO’s RSIP has successfully mitigated the effects of aircraft noise in the environs of SFO and increased overall airport/community land use compatibility. FAA approval of this measure is not requested.

### 3.3.1.2 Transaction Assistance Programs

Residential transaction assistance programs assure owners of eligible properties that their homes will be sold at fair market value if they decide to relocate because of noise. Residential transaction assistance programs are most effective in areas that are expected to remain in residential use.

The advantages of a residential transaction assistance program are that it:

- Allows residents who are unhappy with the aircraft noise levels in their homes to relocate to a quieter neighborhood.
- Assures area residents that their homes would be sold at fair market value.
- Retains existing neighborhoods and protects the property tax base.

The disadvantages of such a program include:

- Significant administrative time and cost.
- Overall complexity to implement. If federal funds are used to fund the program it is likely that relocation assistance would need to be provided to property owners.

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2 California Association of Realtors, April 2016.
There are no known residential transaction assistance programs in place in San Mateo County. Due to the significant administrative time and costs associated with managing a transaction assistance program this measure is not recommended.

**Implementation Authority:** Implementation authority rests with the San Francisco Airport Commission. FAA approval of the Noise Compatibility Program Update would be required to be eligible for federal funding support for such program with AIP grants.

**Recommendation:** Not considered an effective approach to mitigate the effects of aircraft noise exposure in the SFO environs. Since 1983, SFO’s RSIP has successfully mitigated the effects of aircraft noise in the environs of SFO and increased overall airport/community land use compatibility. FAA approval of this measure is not requested.

### 3.3.1.3 Acoustical Treatment Programs

In combination with other measures included in the FAA-approved NCP for SFO, the RSIP has mitigated the effects of aircraft noise in the environs of SFO and increased overall airport/community land use compatibility. As described in Chapter 2 of this NCP Update, SFO became the first major commercial service airport in California to achieve Title 21 compliance in 2002.

Moving forward the Airport Commission recommends acoustical treatment of homes that were not insulated in prior phases of the RSIP because the owners at the time declined to participate in the program or failed to respond to invitations to participate in the program and that have subsequently been sold to new owners who want insulation. All property owners participating in the voluntary program would be required to grant an avigation easement to the City and County of San Francisco (CCSF) by and through the San Francisco Airport Commission. The Airport Commission also intends to renew avigation easements that were erroneously recorded with an expiration date. This project to renew and re-record the avigation easements would be funded entirely with local funds and FAA grant eligibility will not be sought.

**Implementation Authority:** Implementation authority rests with the San Francisco Airport Commission. FAA approval of the Noise Compatibility Program Update would be required to continue being eligible for AIP grant funding support for program implementation.

**Recommendation:** The Airport Commission is seeking FAA approval of this updated measure. Details regarding this updated measure are provided in Chapter 4 of this NCP Update.

### 3.3.2 Preventative Measures

#### 3.3.2.1 Purchase of Avigation Easements

The Airport Commission has purchased avigation easements in the past but does not intend to purchase avigation easements in the future. Avigation easement dedication is a requirement for property owners that choose to participate in SFO’s RSIP. The 2012 Airport Land Use Compatibility Plan (ALUCP) for SFO also includes policies related to mandatory dedication of
avigation easements. Local land use actions within SFO’s airport influence area that would either permit or result in the development of a land use considered to be conditionally compatible with aircraft noise of CNEL 65 dB or greater can only be approved if the property owner grants an avigation easement to SFO.

Since 1983, SFO’s RSIP has successfully mitigated the effects of aircraft noise in the environs of SFO and increased overall airport/community land use compatibility. All property owners participating in the RSIP are required to grant an avigation easement to the CCSF by and through the San Francisco Airport Commission.

**Implementation Authority:** Implementation authority rests with the San Francisco Airport Commission. FAA approval of the Noise Compatibility Program Update would be required to be eligible for federal funding support for such a program with AIP grants.

**Recommendation:** Purchasing avigation easements is not considered an effective approach to mitigate the effects of aircraft noise exposure in the SFO environs. FAA approval of this measure is not requested.

### 3.3.2.2 Noise Disclosure Ordinance

In 1992, the Airport Commission entered into a Memorandum of Understanding (MOU) with neighboring communities to provide $120 million for home noise insulation. Local government signatories to the MOU are to promote real estate disclosure for all residential properties within the Airport’s CNEL 65 dB aircraft noise contour and in proximity to the airport, as well as prohibit new residential construction within the CNEL 70 dB aircraft noise contour.

State law requires people offering subdivided property for sale or lease to disclose the presence of all existing and planned airports within two miles of the property as a condition of the sale. For residential properties within an Airport Influence Area (AIA) designated by an airport land use commission state law requires the following statement be included in the notice of intention to offer the property for sale:

**Notice of Airport In Vicinity**

This property is presently located in the vicinity of an airport, within what is known as an airport influence area. For that reason, the property may be subject to some of the annoyances or inconveniences associated with proximity to airport operations (for example: noise, vibration, or odors). Individual sensitivities to those annoyances can vary from person to person. You may wish to consider what airport annoyances, if any, are associated with the property before you complete your purchase and determine if they are acceptable to you.

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3 Parties to the Agreement include the City and County of San Francisco, San Mateo County, and the cities of Daly City, Millbrae, Pacifica, San Bruno, and South San Francisco.

4 California Business and Professions Code, §11010; California Civil Code, §§1102.6, 1103.4, 1353.
In November 2012, the City/County Association of Governments of San Mateo County (C/CAG), the designated airport land use commission for San Mateo County, adopted an updated ALUCP for SFO which defines the AIA for SFO. Within AIA Review Area A the real estate disclosure requirements of state law apply. AIA Review Area A encompasses all of San Mateo County including the CNEL 65 dB and higher noise contours as shown on the 2019 Noise Exposure Map for SFO.

**Implementation Authority:** The San Francisco Airport Commission, C/CAG and the cities of Burlingame, Daly City, Millbrae, San Bruno, and South San Francisco are the responsible agencies for new measures related to noise disclosure.

**Recommendation:** Adoption of stand-alone noise disclosure ordinances by cities in San Mateo County is not required. Real estate disclosure is already required by state law as a condition of the sale of residential properties within the AIA for SFO. FAA approval of this measure is not requested.

### 3.3.2.3 Comprehensive Planning

The noise elements and/or General Plans adopted by the cities of Burlingame, Daly City, Millbrae, San Bruno, and South San Francisco restrict the development of new housing and various noise sensitive facilities within areas exposed to aircraft noise of CNEL 70-75 dB. SFO staff have encouraged surrounding jurisdictions to update their general plan noise elements to prohibit the development of residences and other noise sensitive land uses in areas exposed to CNEL 65 dB and greater. Through the SFO Airport/Community Roundtable, Airport staff members meet regularly with local elected officials to discuss aircraft noise and airport/community land use compatibility.

In November 2012, the C/CAG adopted an updated ALUCP for SFO. SFO staff were directly involved with the development of the 2012 ALUCP for SFO. The ALUCP defines airport land use compatibility policies related to noise, safety, and airspace protection that apply within the designated AIA for SFO. The noise compatibility policies included in the ALUCP are based on criteria found in Appendix A, Table 1 of 14 CFR Part 150.

In accordance with State law (Govt. Code, Section 65302.3), local agencies within the AIA with land use authority have 180 calendar days to amend their general plans, specific plans, and zoning ordinances to be consistent with an amended ALUCP or to override the ALUCP. Local agencies that decide to override an amended ALUCP are required by law to refer all proposed development and land use policy actions that affect property within AIA Review Area B/the project referral area to the Airport Land Use Commission for a determination of consistency before issuing a permit for the proposed development (Public Utilities Code, Section 21676.5(a)).
Local agencies within SFO’s AIA Review Area B/project referral area\(^5\) have updated their zoning ordinances and general plans to be specific with land use compatibility policies contained within the ALUCP or are required by law to refer all proposed development and land use policy actions that affect property within the project referral area to C/CAG.

SFO staff regularly attend meetings of the San Mateo County Airport Land Use Committee (ALUC) and monitor development proposals that would affect properties within SFO’s AIA.

**Implementation Authority:** The San Francisco Airport Commission, C/CAG, and the cities of Burlingame, Daly City, Millbrae, San Bruno, and South San Francisco are the responsible agencies for new or modified measures related to comprehensive planning.

**Recommendation:** No new or modified measures related to comprehensive planning are required. FAA approval of this measure is not requested.

### 3.3.2.4 Overlay Zoning

A zoning overlay is a form of zoning that applies certain restrictions, such as the type of structure constructed, and other limitations, on a specific area without rezoning each parcel within the overlay zone. The allowed uses on land within an overlay zone would be those that conform to the underlying zoning as well as the overlay zoning requirements. Noise overlay zones can be used to limit the types of land uses allowed in areas exposed to aircraft noise and to specify certain building requirements (such as acoustical treatment) without changing the underlying zoning. The airport sponsor and the local jurisdictions that would be responsible for implementation and enforcement of the overlay zone requirements typically determine the limits of the zoning overlay.

C/CAG is the designated Airport Land Use Commission for San Mateo County. As discussed above, C/CAG adopted an updated ALUCP for SFO in November 2012. The ALUCP defines airport land use compatibility policies related to noise, safety, and airspace protection that apply within the designated AIA for SFO. SFO staff were directly involved with the development of the 2012 ALUCP for SFO.

Local agencies within SFO’s AIA Review Area B/project referral area have updated their zoning ordinances and general plans to be specific with land use compatibility policies contained within the ALUCP or are required by law to refer all proposed development and land use policy actions that affect property within the project referral area to C/CAG. Development of an overlay zone ordinance covering the environs of SFO is not necessary. The adopted ALUCP for SFO contains policies that limit the introduction of noise sensitive land uses in areas exposed to aircraft noise of CNEL 65 dB and higher.

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\(^5\) The project referral area encompasses the CNEL 65 dB and higher noise contours shown on the 2019 Noise Exposure Map for SFO, SFO’s 14 CFR Part 77 conical surface, and the outer boundary of the TERPS approach and One Engine Inoperative (OEI) departure surfaces.
Implementation Authority: The San Francisco Airport Commission, C/CAG, and the cities of Burlingame, Daly City, Millbrae, San Bruno, and South San Francisco are the responsible agencies.

Recommendation: The adopted ALUCP for SFO contains policies that limit the introduction of noise sensitive land uses in areas exposed to aircraft noise of CNEL 65 dB and higher. Development of an overlay zone ordinance covering the environs of SFO is not necessary. FAA approval of this measure is not requested.

3.3.2.5 Subdivision Regulations

Subdivision regulations in most communities control the platting of land by establishing site planning standards, including standards for lot layout and the design of utilities and improvements. Some jurisdictions in the United States have used subdivision regulations to promote compatible development in airport environs by requiring the consideration of aircraft noise at the time public officials are reviewing the plat. Other jurisdictions have incorporated fair disclosure requirements into their subdivision regulations to ensure that prospective property owners entering the sales transaction have been informed as to whether or not the property they are considering for purchase is exposed to significant levels of aircraft noise. In some communities, aircraft noise levels are depicted on the final subdivision plats. In other communities, notes are recorded on the plat or deed stating the property is located in an aircraft noise zone or is subject to disruptive levels of aircraft noise.

The adopted ALUCP for SFO contains policies that limit the introduction of noise sensitive land uses in areas exposed to aircraft noise of CNEL 65 dB and higher. Local jurisdictions have already updated their building codes to be compliant with Title 24 (Part 2, Section 1207.11) of the California Code of Regulations and Title 25 of the California Administrative Code. Real estate disclosure is required by state law as a condition of the sale of most residential property if the property is located in the vicinity of an airport and is within its AIA. Adoption of subdivision regulations to promote compatible development in the environs of SFO is not required.

Implementation Authority: The San Francisco Airport Commission, C/CAG, and the cities of Burlingame, Daly City, Millbrae, San Bruno, and South San Francisco are the responsible agencies.

Recommendation: Not considered an effective approach to mitigate the effects of aircraft noise exposure in the SFO environs. FAA approval of this measure is not requested.

3.3.2.6 Building Codes

Local jurisdictions have already updated their building codes to be compliant with Title 24 (Part 2, Section 1207.11) of the California Code of Regulations and Title 25 of the California Administrative Code. No new or modified measures related to building codes are required.
**Implementation Authority:** The San Francisco Airport Commission, C/CAG, and the cities of Burlingame, Daly City, Millbrae, San Bruno, and South San Francisco are the responsible agencies.

**Recommendation:** Local building codes are compliant with Title 24 of the California Code of Regulations and Title 25 of the California Administrative Code. No modifications to building codes are necessary or recommended. FAA approval of this measure is not requested.

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**TABLE 3-2**

**SUMMARY OF NOISE MITIGATION MEASURES CONSIDERED FOR SAN FRANCISCO INTERNATIONAL AIRPORT**

<table>
<thead>
<tr>
<th>Category</th>
<th>Noise Mitigation Measure</th>
<th>Evaluation</th>
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<tbody>
<tr>
<td>Remedial measures</td>
<td>Land acquisition</td>
<td>Not considered an effective approach to mitigate the effects of aircraft</td>
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<td>noise exposure in the SFO environs.</td>
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<td></td>
<td>Transaction assistance programs</td>
<td>Not considered an effective approach to mitigate the effects of aircraft</td>
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<td>noise exposure in the SFO environs.</td>
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<td></td>
<td>Acoustical treatment programs*</td>
<td>Details regarding this updated measure are provided in Chapter 4 of the</td>
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<td></td>
<td>Noise Compatibility Program Update.</td>
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<td>The Airport Commission is seeking FAA approval of this updated measure.</td>
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<tr>
<td>Preventative</td>
<td>Purchase of avigation easements</td>
<td>Not considered an effective approach to mitigate the effects of aircraft</td>
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<tr>
<td>measures</td>
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<td>noise exposure in the SFO environs.</td>
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<td></td>
<td>Noise disclosure ordinance</td>
<td>Adoption of a noise disclosure ordinance is not required.</td>
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<td></td>
<td>Comprehensive planning</td>
<td>No new or modified measures related to comprehensive planning are required.</td>
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<td></td>
<td>Overlay zoning</td>
<td>The adopted ALUCP for SFO contains policies that limit the introduction</td>
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<td>of noise sensitive land uses in areas exposed to aircraft noise of CNEL 65</td>
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<td>dB and higher. Development of an overlay zone ordinance covering the</td>
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<td>environs of SFO is not necessary.</td>
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<td></td>
<td>Subdivision regulations</td>
<td>Not considered an effective approach to mitigate the effects of aircraft</td>
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<td>noise exposure in the SFO environs.</td>
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<tr>
<td></td>
<td>Building codes</td>
<td>No modifications to building codes are necessary or recommended.</td>
</tr>
</tbody>
</table>

**NOTES:**
*The San Francisco Airport Commission is requesting FAA approval of this measure. No other measures are recommended.

ALUCP = Airport Land Use Compatibility Program
CNEL = Community Noise Equivalent Level
SFO = San Francisco International Airport
