A1J52: Task Force on Environmental Impacts of Aviation
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Environmental Impacts of Aviation

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Commercial aviation is experiencing dramatic growth in regions throughout the world, including North America and the United States. However, airport development has not kept pace with increases in aviation activity and the problem is now acute in the United States. In 1996 the Federal Aviation Administration (FAA) Administrator identified lack of airport capacity as the "single most important constraint" to realizing forecast rates of growth throughout the aviation industry. Funding is one problem. The annual shortfall between funds needed for airport development and total funds available is difficult to determine but has been estimated at more than $4 billion annually in recent years. A second problem is the rapid pace of change in aviation technologies. Changes in the design and construction of airfield and landside facilities will be necessary to accommodate the larger aircraft that will enter service and the new navigation and air traffic control systems that will be deployed in the near future.

Innovative planning approaches are essential to timely development of new airport facilities, and environmental documentation is a key component of the planning process. Federal actions (e.g., funding, approvals) in connection with proposed airport development often require environmental review pursuant to the National Environmental Policy Act (NEPA) and the implementing guidelines of the Council on Environmental Quality and the FAA, which is in the process of updating its *Airport Environmental Handbook* (Order 5050.4A). In addition to NEPA, a number of states have enacted statutes that mandate evaluation of the potentially significant environmental impacts of development, including airport projects. Beyond compliance with NEPA and state environmental review statutes, airport development proposals may trigger additional analytic requirements that must be carried out in parallel or sequential processes, for example, air quality assessments pursuant to the Environmental Protection Agency (EPA) General Conformity Rule and historic resource documentation pursuant to Section 106 of the National Historic Preservation Act of 1966. Environmental analyses for airport development projects are increasingly subject to technical, political, and ultimately legal scrutiny. More and more often, challenges are raised as to the adequacy of NEPA and state environmental documents as well as studies supporting related determinations by lead agencies or agencies with jurisdiction or special expertise.

It is in this context that environmental analysis for airport projects enters the new millennium. Within a year, the FAA plans to release the long-awaited update of the Handbook, Order 5050.4B, which likely will serve as the FAA's NEPA guidance for the next 20 years. This paper anticipates and explores the years beyond 2025, the period in which the FAA may issue an as yet unknown 5050.4C, presumably the state-of-the-art

NEPA guidelines for the new millennium. Major environmental assessment issues can be simplified by division into two categories:

- Operational impacts—those issues related to patterns of aviation operational activity and thus driven by changes in aircraft design, airport capacity, and air traffic management; and
- Geographical impacts—those issues related to the size, dimension, and placement of airport facilities that may result in effects on natural resources including wetlands, floodplains, flora, and fauna.

This paper covers the operational issues most likely to affect environmental assessments in the new millennium.

For projects requiring federal action in 2025, one would expect that the primary process for evaluating the environmental impacts of proposed airport development will continue to be that specified in the current version of FAA Order 5050, the regulations of the Council on Environmental Quality (CEQ), and other currently applicable NEPA guidance. Environmental documentation for airport development projects will continue to be prepared in the current forms, depending on the type of action proposed and its likely environmental effects: Environmental Assessments (EAs), Findings of No Significant Impact (FONSI), Environmental Impact Statements (EIS), and categorical exclusions. However, the analytic methodologies and the criteria for determining the significance of potential impacts will change as compared with today's state of the art. In other words, although the process may stay substantially the same, one would expect the criteria, tools, and threshold levels to change significantly.

PROCESS

In the majority of cases, environmental review pursuant to NEPA for airport projects will continue to begin with the preparation of an EA, which either will support a FONSI or, in the event that the EA concludes that the action as proposed would result in significant impacts, will require preparation of an EIS and issuance of a Record of Decision (ROD). Three major areas of the EA process that are expected to change are public participation, simplified review, and access to data. These changes will likely reduce the time and cost required to complete the assessment.

Public participation in the next millennium will benefit from improved means of reaching the general public through media. Use of the Internet, just beginning to reach the general public, will expand and become the primary medium to convey project status, information, and working documents. Its widespread use will streamline coordination and review periods between agencies and sponsors, as well as review by the general public. The Internet, with video and audio capabilities, will allow evaluators improved opportunities to understand alternatives that are not currently afforded by paper documentation.

Another improvement anticipated in the EA process will be the use of checklists or forms to streamline the agency review process. Through the use of predetermined EA categories or levels of review, the FAA, as lead agency for NEPA review, can focus efforts on significant environmental impacts only, thereby reducing the time and cost required to maneuver through the environmental review process. This process could also be integrated with the review processes of cooperating agencies and agencies with special expertise or

jurisdiction. On the basis of these improvements to the process, proponents, decision makers, and the public could expect consistent evaluations throughout the United States.

Advances in computer technology will have the greatest impact on improving the EA process and quality of the documentation. Computers and the Internet have allowed agencies to collect, store, and retrieve more environmental data than ever before. This trend into the next millennium will provide decision makers and the public, as well as project proponents, with considerable historical data and also continuously updated projections (for example, air passenger and air cargo demand forecasts). Computer technology will improve the process largely through the manipulation and presentation of these data. Time-intensive efforts to collect and inventory environmental data will be improved through satellite and aerial imagery, Global Positioning System (GPS) tracking and survey, and wireless communication.

PURPOSE AND NEED

Demand, capacity, and safety have been the primary reasons defining the purpose and need for airport development for EAs. Air travel demand has grown in the last 20 years—from 326.3 million domestic enplanements in 1979 to 620.7 million domestic enplanements, 7,200 air carrier and commuter aircraft and 194,300 general aviation (GA) aircraft, and 116 million U.S. operations in 1998—and is projected to more than double by 2025 to 1,481.6 million domestic enplanements. During the same period, the U.S. fleet is expected to grow to 17,200 air carrier and commuter aircraft and 248,800 GA aircraft. Total air carrier, commuter, and GA operations are collectively projected to reach 146.8 million U.S. operations by 2025. There is continued evidence to support the robust increases in the demand forecasts for all types of aviation. As noted in the introduction to this paper, existing infrastructure will continue to fall short of these levels of demand, thereby necessitating capacity enhancements and development to meet demands.

ALTERNATIVES

NEPA characterizes the analysis of alternatives capable of satisfying the purpose and need for a proposed action as the “heart of the environmental impact statement.” Alternatives analysis, including analysis of the proposed action, will continue to be the preferred method for decision makers and the public to compare and evaluate competing issues and potential effects on the quality of the human environment. One would expect improved computer processing, graphical presentations and media, prediction models, and access to historical data to enhance the evaluation of alternatives, consistent with the NEPA mandate to “rigorously explore and objectively evaluate all reasonable alternatives.” Under the premise that air transport has provided significant public benefits over the last 50 years by providing jobs, economic prosperity, and increased trade and tourism, aviation development will continue to compare alternatives involving economics, time (translated into costs), and safety benefits with respect to minimized and mitigated environmental impacts.

AFFECTED ENVIRONMENT

Some of the most significant changes anticipated for environmental assessment will certainly be the analysis, both quantitative and qualitative, of effects on the environment. Although EAs will continue to focus on the airport and its adjacent communities, developmental impacts will also be evaluated on regional, national, and international levels. Air transport

has become an international industry and business. One could argue that it has become one of the infrastructure systems necessary to the maintenance of a global economy. As this trend continues, the potential to adversely affect the environment on a global scale will also increase.

Noise

Noise analysis and impact criteria will certainly undergo a profound change in the next millennium. Significant improvements in technology, in conjunction with regulatory mandates, have reduced noise impacts steadily over the last 20 years. This downward trend, which is based on today's evaluation metrics, is expected to continue through 2025. However, as the volume of operations continues to increase, so too will the overall noise impact and footprint. One would expect noise standards and models to change also. For example, in response to public sensitivity, the U.S. National Park Service has already begun review and consideration of new noise standards in wilderness areas.

Currently there are concerns in the environmental community that the modern high-bypass turbofan engine design, although quieter by Integrated Noise Model evaluations, may propagate other mechanical noise such as turbine whine. Could this mechanical noise trigger new thresholds or metrics? Is it not possible that technology advances in the new millennium may reach such limits that EAs will evaluate not engine noise output, but rather noise resulting from the airframe traveling through the air? In many ways, airport development is victim to the current generation of public perception. Acceptable noise levels 20 years ago would be unacceptable today. So will the case be 20 years into the future.

Noise metrics will continue to play a key role in quantifying potential noise impacts. Government agencies, including FAA, the National Aeronautics and Space Administration (NASA), and the International Civil Aviation Organization (ICAO) will certainly require and set new standards for noise metrics, modeling, and acceptable levels. Other sources of airport-related noise, including ground support equipment and vehicular traffic, will also be scrutinized.

Larger aircraft with larger engines, regional jets, and hyper- and supersonic aircraft will all redefine acceptable noise levels as well as modeling methodologies. Growing international travel and trade will necessitate global standards for the industry, with strict regulatory mandates nationally. For example, the FAA mandates for Stage 2 and 3 aircraft significantly affected engine and aircraft design as well as airline business operations and air navigation procedures. With these changes, airlines became more efficient and, arguably, more profitable. This experience demonstrated that regulatory mandates benefited the environment and the humans living in it while improving the economics of the industry.

Noise mitigation, through technology, soundproofing, curfews, and operational procedures, will reach new levels. Building soundproofing in the new millennium may include antinoise devices mounted in the home or office that cancel out aircraft engine noise. Or perhaps devices or engine design will allow these techniques to be incorporated into the aircraft or engine itself. Aircraft engine and aircraft technology may progress to allow steeper ascents and descents with reduced thrust. Satellite and navigational aid improvements may allow more precise and safer flight paths that follow rivers and other less populated areas. Analysis tools, such as computers, noise models, and geographic

information systems (GIS), will allow more data to be analyzed and more scenarios or alternatives to be evaluated, presumably with more accurate results.

Land Use

In general, land use compatibility impacts relate directly to the extent of noise on and around an airport. As discussed previously, the extent of noise impacts and compatible land use will continue to be an important part of EAs in the next millennium. Since many airports have become small cities, compatible land use for cargo, industry, hotels, tourism, and other passenger amenities will continue to affect and compete with adjacent communities. As noise impact areas change, so will adjacent demographics and associated land use. At major air carrier airports, larger, new-generation aircraft, including space planes, will increase demand for longer runways and additional land as well as provide more vehicular access for higher peak levels of passengers associated with larger aircraft. At commuter and general aviation airports, regional jets will increase demand for longer runways and additional land for more gates due to an increase in the overall number of flights. In many ways, the aviation development of the next millennium will parallel that of the modern city: the airport will grow denser at the center with related development and environmental impacts (noise, societal, wetlands, etc.) expanding outward. Therefore, the future EA will evaluate these impacts in relation to continued dwindling availability of space.

Air Quality

Scientific analysis and debate concerning greenhouse gases and global warming have brought air quality to the forefront in the environmental community and general public concern. The future FAA 5050 Handbook will most likely consider assessment guidelines for potential impacts resulting from emissions of air toxics from aircraft engines, ground vehicles, and other point sources at airports. Advances in computer modeling and historical data should allow evaluators to develop acceptable, predictable quantitative analysis. Significant improvements in jet engine design in recent years, including high-bypass engines, have resulted in reductions in aircraft noise and emissions of certain criteria pollutants [e.g., volatile organic compounds (VOCs), carbon monoxide (CO)]. However, it appears that the changes in design and technologies to achieve these reductions in noise and some criteria pollutants have also resulted in increased emissions of other criteria pollutants [e.g., oxides of nitrogen (NOx)]. Although jet engines built after 1982 emit about 85 percent less unburned hydrocarbons than jet engines built in the 1970s, and CO emissions have decreased by 70 percent, increased operations have significantly affected air quality. Air carrier airports have begun to face the task of evaluating their contributions to air quality, in accordance with the EPA General Conformity Rule within nonattainment areas. EAs prepared in the new millennium will also focus on source emitters on the ground (idling aircraft, auxiliary power units, ground support equipment, vehicular traffic) as well as the aircraft emissions in cruise. Subsonic and supersonic aircraft emissions affect air quality in different manners, both of which have an impact on the global atmosphere.

Environmental assessment of air quality and mitigation of impacts will include considerations of technology (improved engine and airframe design), operational measures (communications, navigation, surveillance, and air traffic management), and market-based options [environmental levies (taxes) and emissions trading]. No doubt FAA and ICAO will lead this endeavor.

CONCLUSION

Air quality and noise are likely to remain the central operational impact issues in environmental documentation into the new millennium, although the discussion of these concerns will undergo change in terms of both types of impacts considered and methods of evaluation. Similar changes are probable in the discussion of other operational impacts, including surface vehicle traffic, social and economic effects, and energy supply. The assessment of geographical impacts will also be subject to new considerations in the future.

However, the new millennium also might see recognition of the environmental benefits generated by airports. Because of their size, their location requirements (flat terrain), and their proximity to population centers that historically developed adjacent to lakes, rivers, and oceans, airports have the potential to function as preserves or conservation areas for natural resources that may be threatened by development "beyond the fence." Even now, perhaps inadvertently, managers of large air carrier airports in urban areas might find themselves effectively serving as custodians of special-status species (plant and animal), remnant landscape units, rare geological formations, wetlands of various types, aquifers, and surface water bodies. In some cases, important natural resources may present conflicts with an airport's functions, hence the problem at times encountered in environmental documentation in which mitigation requirements to restore or replace filled wetlands on an airport must be balanced with operational safety concerns associated with the location of natural features that attract birds in proximity to active runways. In other cases, airports may serve as protected oases for scarce and threatened natural resources within the densely developed urban region without compromise of their operational requirements. Environmental documentation in the future may include more detailed assessment of the ecological benefits provided by airports as well as of the ecological costs of development at airports.

Advances in technology are the primary catalysts that have transformed aviation since its infancy 96 years ago. The modern airport is pushing its capacity limits because of demand—demand driven by economics, larger and more efficient aircraft, and improvements in navigation, safety, and communications. The new millennium will inevitably bring even larger, faster, higher-flying aircraft that will carry more passengers and more cargo and require airport development—runways, taxiways, terminals, and roads—all with known and maybe some unknown environmental impacts. New advances will require continued research into the state-of-the-art environmental assessment issues discussed here and others yet to be discovered.

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