CHAPTER 4

IMPACTS ANALYSIS

This chapter contains the analysis of the environmental consequences, or impacts, for each of the Proposed Actions and alternatives described in Sections 2.6 through 2.9 of Chapter 2. FAA's recommended guidance for EISs is available in the *Airport Environmental Handbook* (FAA Order 5050.4B, 2006) and *Policies and Procedures for Considering Environmental Impacts* (FAA Order 1050.1E, 2004a). The analysis of environmental impacts in this chapter is based on FAA's guidance pursuant to requirements established in §1502.16 of the CEQ regulations implementing NEPA.

The first two sections of this chapter describe general requirements for impacts analysis and the specific methods used in assessing the impacts upon each resource. In accordance with FAA guidance and the CEQ regulations, the critical elements of the human environment to be addressed in this analysis are in Sections 4.3 through 4.11:

Section	Title
4.1	Introduction to Impacts Methodology
4.2	Methods of Analysis
4.3	Runway Safety Area
4.4	Navigational Improvements
4.5	Snow Removal Equipment and Maintenance Facility
4.6	Fuel Farm Access
4.7	Aviation Facilities Development
4.8	Wildlife Hazard Management Plan
4.9	Unavoidable Adverse Impacts
4.10	Irreversible or Irretrievable Resource Commitments
4.11	Short-term Use vs. Long-term Productivity

In its guidance, FAA identifies specific impact "categories" that require analysis in an EIS. Not all of these impact categories are relevant to JNU, and other categories are more suitably addressed in the context of another resource. Table 4-1 provides a guide to the impact categories described in FAA's guidance and the resources analyses in Chapter 4 that will address those categories.

Table 4-1. Guide to Environmental Impact Categories in Chapter 4

FAA Impact Category[1]	EIS Resource Category
Noise	Noise
Compatible Land Use Social Impacts	Human Environment and Compatible Land Use
Induced Socioeconomic Impacts	Socioeconomic Impacts
Air Quality	Air Quality
Hazardous Materials, Pollution Prevention and Solid Waste	Hazardous Materials and Solid Waste
Water Quality and Floodplains	Water Resources and Floodplains
Biotic Communities; Fish, Wildlife and Plants; and Endangered and Threatened Species of Flora and Fauna, Wetlands	Vegetation Wetlands Fisheries Wildlife
Historic, Architectural, Archaeological, and Cultural Resources	Cultural Resources
Light Emissions and Visual Impacts	Visual Resources
DOT Act Section 4(f)	Department of Transportation Section 4(f)
Coastal Zone Management Program	Coastal Zone Management Program
Construction Impacts Secondary (Induced) Impacts	All Resources[2]
Farmlands Coastal Barriers and Coastal Resources Wild and Scenic Rivers Environmental Justice Children's Environmental Health and Safety Risks Natural Resources and Energy Supply	Resources and Elements of the Human Environment Not Affected

[1] Impact categories from FAA 2004a and 2006.
[2] Construction and secondary impacts are described in each resource analysis; also see Sections 2.6 through 2.9 of Chapter Two for construction impacts.

4.1 INTRODUCTION TO IMPACTS METHODOLOGY

Resource specialists have analyzed the impacts to those environmental and human resources that may result from implementation of the various Proposed Actions and alternatives. The basis for each impacts analysis is the baseline data for each resource (i.e., the existing condition of each resource), described in Chapter 3. In some instances, such as noise generated by aircraft, it is also important to consider future changes to conditions resulting from the No Action Alternative.

4.1.1 Characteristics of Impacts

Although not universally applicable to every resource, impacts are generally defined in this EIS in terms of causal relationship, magnitude, incidence, and duration.

- Direct or indirect impacts. Direct impacts are caused by the action being implemented and occur at the same time and place as that action. Indirect impacts are also caused by the action, but they occur later in time or farther removed in distance from the action even though they are still reasonably foreseeable. For example, if new aviation facilities were constructed in the Northeast Development Area on Airport property, a direct impact would be the loss of surface water infiltration capacity and flood storage. The indirect impacts of this action, which can be foreseen when one considers the hydrological system throughout and surrounding the Northeast Development Area, may be changes to tidal channel hydrology in nearby areas as a result of the upgradient hydrologic effects.
- Magnitude of impacts. These are quantified to the extent practicable. For example, impacts to vegetation can be typically quantified as number and/or percentage of acres lost per species or community type. Where quantification is not possible, an impact associated with a particular action is qualitatively described, typically in relation to impacts resulting from other alternatives, including the No Action Alternative, or the baseline condition.
- Incidence, or relative frequency, of impacts. Some impacts, such as the hydrologic changes that occur once new RSA is constructed, are continuous. Other impacts, such as noise from construction equipment, may occur only on a periodic or sporadic basis.
- Duration of impacts. Duration is generally presented in relative terms: short-term, long-term, and permanent, although sometimes duration is also quantifiable. The actual meaning of each of these terms of relative duration varies depending on the resource.

Where impacts are uncertain, resources specialists have attempted to present a range of possible impacts. Unless specifically identified as positive or beneficial, all impacts are considered negative or adverse and detrimental to the applicable resource.

4.1.2 Significance of Impacts: Context and Intensity

The impact characteristics are all means of comparing projected impacts to one another and to baseline conditions of a given resource. They also help determine how the impacts compare to the thresholds FAA has established for determining impact significance (FAA 2004a, 2006). All impacts analyses should consider the *context* of the impact—that is, the particular time, place, and circumstances in which the impact occurs, often related to the local and regional conditions of the resource. The *intensity* of the impact should also be considered, to determine how adverse or beneficial the impact is on the resource. The FAA's significance criteria for a particular resource are based on regulatory standards or guidance, where possible, and in either quantitative or qualitative terms. For example, an action that causes a regulatory standard for air emissions to be exceeded could be deemed to have a *significant* impact on air quality. In other words, the air quality standard serves as the significance threshold.

For resources such as air, water, noise, cultural resources and others, the criteria established by regulation or guidance serve well as significance thresholds. These regulatory criteria are referenced in FAA's environmental guidance for NEPA documentation (FAA 2004a; FAA 2006). For some resources such as vegetation, wildlife, visual resources and socioeconomics, regulatory criteria have not been established that could serve as clear significance thresholds. FAA has also provided guidance for determining significance thresholds for some of these resources, but in those instances the *context of the impact* can become an even more important factor (FAA 2004a; FAA 2006).

4.2 METHODS OF ANALYSIS

The following sections describe the methods used to assess the impacts of the Proposed Action and alternatives upon each resource.

4.2.1 NOISE

The methods used to forecast the future noise environment were based on the Integrated Noise Model (INM), FAA's state-of-the-art aircraft noise computer model. The INM is a computer program that FAA requires for assessing possible noise impacts caused by aviation activity. Using an extensive database of civilian aircraft performance and engine noise characteristics, the INM generates and plots noise contours for a particular airport based on the analyst's input of the operating characteristics of that airport. INM Version 6.1 was used to model the existing and future aircraft noise exposure contours at JNU.

One of the most important factors in generating accurate noise contours is the collection of accurate data regarding operational characteristics of an airport. Physical and operational characteristics of an Airport required for accurate modeling by the INM include:

- number of aircraft operations by aircraft type and time of day;
- flight tracks (paths along the ground that aircraft fly);
- flight track use by aircraft type;
- flight (approach and departure) profiles, including possible new profiles such as rotary aircraft landing areas in the proposed Northeast Development Area; and
- average meteorological conditions.

In addition, because of the unique topographical conditions of the JNU area, a data file of geographic topographic conditions was also input into the model.

This EIS uses Airport operational characteristics from the year 2000 as the baseline condition for a noise analysis. This allows for timely comparison to the Airport's aircraft noise analysis and Part 150 update, completed in 1999. Also, total aircraft operations in the year 2000 were relatively high compared to most years, and higher than the two subsequent years. Therefore, it was desirable to be more conservative to use higher operational numbers from 2000 than more recent data from 2001 or 2002 that would have fewer operations to consider in the analysis, and possibly caused underestimation of impacts.

The FAA's guidelines for the environmental analysis of airports include the generation of noise exposure contours showing 65 DNL, 70 DNL, and 75 DNL noise levels (FAA 2006). FAA Order 5050.4B, Table 7-1 states that a significant noise impact occurs when an alternative "would cause noise sensitive areas located at or above DNL 65 dB to experience a noise increase of at least DNL 1.5 dB." Additionally, "FAA Order 5050.4B, Table 7-1 identifies an increase from 63.5 dB to 65 dB as a significant impact. Therefore, FAA's environmental documents must identify areas where the project would generate an increase of at least 1.5 DNL, relative to the No Action Alternatives, over areas with noise-sensitive uses.

In 1992, the Federal Agency Review of Selected Airport Noise Analysis Issues report noted that:

> If screening analysis shows that noise-sensitive areas will be at or above DNL 65 dBA and will have an increase of DNL 1.5 or more, further analysis should be conducted of noise-sensitive areas between DNL 60-65 dBA having an increase of DNL 3 or more due to the proposed Airport noise exposure. (FICON 1992)

FAA Order 1050.1E, Appendix A, para 14.4c requires that the screening analysis and further examination of noise sensitive areas, referenced above, be conducted if noise sensitive areas at or above DNL 65 dB will have an increase of DNL 1.5 dB or more (FAA 2004a). This analysis of the DNL 60-65 dBA contour was conducted at JNU for information purposes since this contour was already generated for the Airport's Part 150 update. An INM grid analysis was prepared using a regularly spaced grid covering the 60 DNL contour. To determine if a specific action could have a significant noise impact, the noise levels were compared to the baseline conditions represented in the No Action Alternative through the development of "delta" contours, which have been plotted on figures for significant impacts. No area within the 60-65 DNL contour for any alternative would experience a 3.0 DNL increase.

Noise exposure contours were developed for year 2000 and 2015. Future noise exposure was evaluated using the forecast of aviation demand presented in Table 1-4 in Chapter 1. Appendix C provides the detailed INM data for each alternative evaluated. Existing flight track locations were altered in accordance with the location of the landing and departing threshold associated with each of the alternatives considered and formed the basis for evaluating future flight tracks.

In addition, a supplemental noise metric analysis was prepared, to show the sound exposure level (SEL) and the time above (TA) a threshold of A-weighted sound (65, 75, and 85 dBA). This supplemental analysis is provided for information purposes in Appendix C.

Noise analysis conducted for the Draft EIS indicated that no significant noise impacts would result from any of the RSA alternatives contained in that document. The runway threshold changes for Alternatives RSA-5D and RSA-5E, which are modifications of alternatives analyzed in the Draft EIS, were within the range of analysis conducted for that document. As such, FAA determined that no new noise modeling was needed for these two alternatives. The runway threshold shift for alternative RSA-6D is outside the range of parameters analyzed in the Draft EIS. Therefore, FAA determined that additional noise modeling was necessary for this alternative as part of the Final EIS.

4.2.2 HUMAN ENVIRONMENT AND COMPATIBLE LAND USE

Land use in the area surrounding the Airport is governed by various management plans and management entities, as described in Sections 3.2.2 and 3.2.3 of Chapter 3. Therefore, the primary management indicator for land use was compliance of the Proposed Actions and alternatives with these established management plans.

Since most of the action alternatives considered in this EIS would take place within the boundaries of the Airport property, which has been designated for industrial and aviation activity, there are few opportunities for land use conflicts. Some actions, however—such as RSA development, the MALSR installation, and a few wildlife habitat modifications—would directly affect Refuge lands. These actions are evaluated for compliance with the Refuge management plan. Recreational impacts are also considered in the regional context of the City of Juneau, since the Dike Trail in particular has such an important role in the community. The project is also evaluated for consistency with the Juneau Coastal Management Plan (see Section 4.2.14).

The assessments for land use compatibility also address FAA noise regulations with respect to noise-sensitive areas, in which an increase in aviation activity resulting from the project may result in an increase in noise to incompatible levels. FAA's threshold of significance has been determined to be a 1.5 DNL increase in noise for any noise-sensitive area intersecting with the 65-dBA contour. The evaluation also considered whether any noise-sensitive areas increased from one noise exposure contour into a contour of higher intensity. Either of these changes is deemed by FAA to represent a significant impact.

Population changes within each noise contour were also considered in the land use analysis. Census data for 2000 indicate that average household size in Juneau is 2.6 persons. This household population factor was used in the INM to determine the number of people occupying housing within the noise contours. Results of this analysis were examined to see if any alternatives caused noise-level incompatibilities with residential land uses.

For most alternatives, the impacts to recreational resources are difficult to quantify. The less substantial impacts to recreational resources are qualitatively described and evaluated in terms of the type of impact and the change in the resource relative to existing conditions or other alternatives. For major changes such as moving recreational facilities, criteria for evaluation can include the possibility for substitution of activities or facilities, duration and permanence of the disruption, changes in distances traveled to use the facility, and aesthetics associated with the change. Where possible, these changes are evaluated in context of other relevant studies, such as the 1995 Juneau Trails Study (Roberds 1997).

Aesthetic changes on the Airport indirectly affect some recreational activities, such as bird and wildlife watching, but because they do not eliminate the specific recreational activity or make the activity impossible, they were considered qualitatively less important than direct effects upon the recreational activity, such as those caused by moving the Dike Trail. Nevertheless, these impacts can still be substantial.

Recreational resources, although enjoyed on the Airport and lands surrounding the Airport for decades, are not always consistent with designated land uses or airfield objectives of safety and security. For example, the Airport emergency vehicle access road (EVAR) is co-located with the Dike Trail, a major, recreationally designated, hiking and wildlife viewing trail with access to the Refuge. The excellent bird watching opportunities offered by the Dike Trail indirectly conflict with Airport operations, since bird activity around the Airport has been documented to represent a risk to aviation. Therefore, adverse impacts to recreation on or near the Airport may also have beneficial consequences to airfield operations and safety.

4.2.3 Socioeconomic Impacts

Economic impacts were evaluated in terms of the FAA's established significance thresholds. If an action alternative was found to cause:

1. a relocation of households or businesses, or
2. disruption of traffic patterns that would substantially reduce level of service to the community, or
3. a substantial loss in community tax base (FAA 2006),

the impacts were considered significant. The analysis also considered socioeconomic impacts that were considered locally or regionally important to Juneau and Southeast communities, such as increased or decreased airfield services, improved or expanded aviation facilities, and safer ground and air operations.

4.2.3.1 Short-term (Construction) Economic Impacts

Construction costs were estimated by the EIS consulting team using the Airport Master Plan (USKH 1999) and assistance from CBJ engineering staff, FAA staff, NOAA/NWS staff, and data from Estimations, an Anchorage-based cost estimating firm. These costs were then entered into an econometric input/output model (IMPLAN 2000) with Juneau-specific employment and expenditure data. This model is frequently used to analyze local and regional economies in Alaska and is considered industry-standard. Costs for each alternative were input into their respective industry sectors. The industry sectors used included New Industrial and Commercial Buildings (SREF), New Utility Structures (MALSR and Fuel Farm Pipeline), and New Highways and Streets (all filling, leveling, grading, paving, and bridging and culverting activities).

Output from the model included direct impacts (resulting from direct project spending), indirect impacts (resulting from additional business spending as a result of direct project spending), and induced impacts (household spending as a result of direct and indirect business spending).[1] Under each alternative, impacts have been reported in terms of employment created, payroll, and business spending. All dollar amounts are in 2005 dollars, rounded to the nearest thousand dollars. Table 4-2 presents impacts for each alternative in terms of direct, indirect and induced business spending (output), jobs and payroll, as determined using the IMPLAN model. This table is referred to in each of the Chapter 4 sections addressing the socioeconomic impacts.

CBJ sales tax revenues generated as a result of this construction activity were also estimated. Because these projects are contracted by government entities CBJ and FAA), local sales tax revenues have been limited to indirect and induced spending. Since the CBJ owns the Airport property the sales tax impacts would be limited to development of non-CBJ buildings on the Airport (such as private hangars). Those tax impacts are not included in the analysis. Finally, it was assumed that the transfer of Refuge land to CBJ property for Airport would also have no effect on property taxes. Table 4-3 presents the sales tax revenues from construction.

4.2.3.2 Economic Impacts to Air Carrier Operations

Economic analysis of runway changes considered whether air carriers would have to change operations, in the form of aircraft used, payload per flight, and so forth. Table 2-4 in Chapter 2 documents potential operational impacts resulting from the RSA alternatives. Insufficient information is available to quantitatively determine how much economic benefit or loss would result for each alternative, although no operational change is anticipated for most of the alternatives. The likely positive impacts on air carrier revenues due to increases in safety margins resulting from many of the alternatives are also disclosed but not quantitatively estimated.

4.2.3.3 Revenue Impacts

The additional revenues to CBJ generated via Airport administration of aircraft tiedown fees and apron area leases were considered in the analysis (see Section 4.7.3). For the two apron-development alternatives, anticipated aircraft tiedown space was calculated and multiplied by current tiedown fees. Anticipated hangar space for each alternative was calculated and multiplied by current average annual lease payments to determine the increase in annual revenues. Lease of apron space by additional fixed base operators was also calculated and included in the analysis. These revenue estimates assume that all available space would be leased year-round, but they do not include other possible revenues, which could include income from transient aircraft tiedown fees, apron area leases adjacent to hangars, and commercial lease of some of these hangars. Apron and tiedown space was assumed to be available for lease beginning 2005; annual revenues through 2015 were calculated but not adjusted for inflation. Positive revenue impacts to CBJ of apron and hangar development through additional lease revenues are disclosed in Section 4.7.3.

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1. Long-term sales tax revenues from lease and rental payments and taxes from development of non-CBJ buildings on Airport property, also considered induced impacts, were not estimated here.

Table 4-2. Economic Impacts of Construction used in Chapter 4 Analysis (2005 Dollars)

Alternative	Business Income (Project Cost)	Indirect & Induced Business Income	Total Business Income	Direct FTE Jobs	Indirect & Induced FTE Jobs	Total FTE Jobs	Direct Payroll	Indirect & Induced Payroll	Total Payroll
Runway Safety Areas									
RSA-1	$17,100,000	$6,088,000	$23,117,000	92	56	148	$5,108,000	$1,804,000	$6,913,000
RSA-5C	$14,896,000	$5,291,000	$20,187,000	80	49	129	$4,440,000	$1,568,000	$6,008,000
RSA-5D	$15,256,000	$5,420,000	$20,676,000	82	50	132	$4,547,000	$1,606,000	$6,153,000
RSA-5E	$13,414,000	$4,765,000	$18,178,000	72	45	117	$3,997,000	$1,412,000	$5,409,000
RSA-6A	$29,862,000	$10,608,000	$40,970,000	163	100	263	$8,900,000	$3,144,000	$12,044,000
RSA-6B	$32,195,000	$11,437,000	$43,631,000	173	106	279	$9,596,000	$3,390,000	$12,985,000
RSA-6C	$23,598,000	$8,383,000	$31,981,000	127	77	204	$7,034,000	$2,484,000	$9,518,000
RSA-6D	$12,100,000	$4,298,000	$16,398,000	65	40	105	$3,606,000	$1,274,000	$4,880,000
NAV-2B: MALSR	$1,500,000	$557,000	$2,057,000	8	6	14	$488,000	$184,000	$672,000
Snow Removal Equipment Facility	$15,589,000	$5,793,000	$21,382,000	100	69	169	$5,997,000	$2,179,000	$8,176,000
Apron Development									
FW/RW-1: Apron Dev.	$18,052,000	$6,413,000	$24,465,000	118	72	190	$5,380,000	$1,901,000	$7,281,000
FW/RW-2: Apron Dev.and Relocate Creek	$18,598,000	$6,607,000	$25,205,000	122	75	197	$5,543,000	$1,958,000	$7,501,000

Table 4-2. Economic Impacts of Construction used in Chapter 4 Analysis (2005 Dollars), continued

Alternative	Business Income (Project Cost)	Indirect & Induced Business Income	Total Business Income	Direct FTE Jobs	Indirect & Induced FTE Jobs	Total FTE Jobs	Direct Payroll	Indirect & Induced Payroll	Total Payroll
Fuel Farm Access									
FF-1: Fuel Farm Road	$303,000	$108,000	$411,000	2	2	4	$90,000	$32,000	$122,000
FF-2: Fuel Farm Pipeline	$721,000	$268,000	$989,000	5	3	8	$235,000	$89,000	$323,000
Wildlife Hazard Management Plan									
WH-1: Most Habitat Modification	$20,198,000	$16,401,000	$36,598,000	83	152	235	$5,089,000	$1,798,000	$6,887,000
WH-2: Moderate Habitat Modification	$27,384,000	$22,236,000	$49,620,000	116	214	330	$7,939,000	$2,804,000	$10,743,000
WH-3: Some Habitat Modification & Adaptive Management	$1,201,000	$975,000	$2,176,000	5	9	14	$395,000	$425,000	$820,000

Sources: *Juneau International Airport Master Plan Update*, USKH, Inc., 1999; USKH, Inc. 2004; City and Borough of Juneau Engineering Dept., FAA; EIS Consulting Team; Estimations 2004. Also, IMPLAN Pro 2000 input/output model, Minnesota IMPLAN Group.

1. Project Cost is gross income to businesses.
2. Indirect impacts result when the contractors purchase goods and services from other producers in the local economy.
3. Induced impacts result when households receiving income from these projects increase local spending.
4. FTE is Full Time Equivalent, and represents one full time job for one year. Assumes each project takes one year to complete.
5. All costs and payrolls are in 2004 dollars. Some were adjusted from earlier dollar amounts using the Anchorage Consumer Price Index (CPI-U).
6. Apron Development costs also include private costs to develop T-Hangars and Executive Hangars.
7. Construction costs for Alternatives RSA-6A, 6B, and 6C include the present value of replacing EMAS after 10 years.

Table 4-3. Sales Taxes Generated from Construction (2005 Dollars)

Alternative	Indirect & Induced Business Income	Local Sales Tax Revenues
Runway Safety Areas		
RSA-1	$6,088,000	$304,400
RSA-5C	$5,291,000	$264,600
RSA-5D	$5,420,000	$271,000
RSA-5E	$4,765,000	$228,800
RSA-6A	$10,608,000	$530,400
RSA-6B	$11,437,000	$571,900
RSA-6C	$8,383,000	$419,200
RSA-6D	$4,298,000	$214,900
Navigational Aid (MALSR)	$557,000	$27,900
Snow Removal Equipment Facility	$5,793,000	$289,700
Aviation Facilities		
FW/RW-1	$6,413,000	$320,600
FW/RW-2	$6,607,000	$330,300
Fuel Farm Access		
FF-1: Fuel Farm Road	$108,000	$5,400
FF-2: Fuel Farm Pipeline	$268,000	$13,400
Wildlife Hazard Mgmt. Plan		
WH-1: Most Modification	$16,401,000	$820,000
WH-2: Moderate Modification	$22,236,000	$1,111,800
WH-3: Some Modification	$975,000	$48,700

Source: IMPLAN Pro 2000 input/output model, Minnesota IMPLAN Group.
Note: Since direct business income is from a government entity, it is not subject to the local sales tax of 5%. This analysis assumes that secondary expenditures in Juneau by business and households are taxed.

4.2.3.4 Social Impacts

Social and community impacts were primarily covered by analyses of recreational, noise, and aesthetic changes. Social benefits of improved navigational aids, added aviation facilities, and other Airport changes may be disclosed but have not been quantitatively estimated.

4.2.4 AIR QUALITY

Three evaluations of air pollutants were performed for each of the Proposed Actions and alternatives:

1. ***Operating emissions:*** Emissions that would occur after completion of the project due to changes in Airport operational characteristics.
2. ***Construction emissions:*** Emissions that would occur during the construction of the project due to exhaust associated with the construction equipment.
3. ***Fugitive dust emissions:*** Wind-blown dust (from heavy construction) that may have an effect on local air quality. Dust emissions often vary from day-to-day, depending on a number of factors, including level of construction, type of construction, and meteorology.

An aircraft emissions inventory was also prepared to quantify the future emissions associated with aircraft and ground support vehicle activity at JNU for each alternative identified in Chapter 2. The aircraft emissions inventory was performed using the EPA-approved Emissions and Dispersion Modeling System (EDMS) computer model, Version 4.12. Aircraft activity information for the year 2015 was input into the EDMS based on the forecast fleet assumptions discussed in Appendix C. This analysis is based on the average day in a specific year. Time-in-mode data (time-in-mode being the time that an average aircraft operates during each of four modes: takeoff, climbout, approach, and taxi/idle) for the action alternatives were calculated, where measurable, based on the operations associated with each alternative, such as change in taxi distance. Default time-in-mode information available in EDMS was used for the No Action Alternative. EDMS default information was also used concerning ground support equipment (GSE).

At the time the DEIS was prepared, $PM_{2.5}$ was not included as a criteria pollutant, as ambient air quality standards did not include $PM_{2.5}$ until 2005. Therefore, no analysis of $PM_{2.5}$ was included in the impacts analysis. Consideration has been given to $PM_{2.5}$ as a criteria pollutant in the FEIS. At the present time, there is no accurate way to measure $PM_{2.5}$ emissions from aircraft; however, the EPA has indicated that studies show $PM_{2.5}$ emissions in general appear to be approximately equal to, but slightly lower than, PM_{10} emissions. Therefore, a conservative method for estimating $PM_{2.5}$ emissions is to consider them equal to (100 percent of) estimated PM_{10} emissions. The FAA Office of Environment and Energy (AEE) approved of this method for use in the FEIS in the absence of detailed air quality modeling for PM2.5 emissions (Ralph Iovinelli, AEE, personal communication 2007). Therefore, this method was used to estimate $PM_{2.5}$ emissions associated with proposed projects at the Airport.

In addition to examining the operational impacts relative to the five criteria pollutants (CO, VOC, NOx, SOx, and PM_{10}) described in Section 3.5, and $PM_{2.5}$ as described above, consideration was also given to the emissions that could be generated during construction. Exhaust-related emissions from construction-equipment were computed using the methodology and emission rates described in the Non-Road Engine and Vehicle Emission Study (EPA 1991). The number of construction vehicles and their uses were estimated based on the construction anticipated under each alternative in conjunction with vehicle operating capabilities as documented in the 1998 National Construction Estimator (Kiley 1998).

Fugitive dust was also calculated using the EPA's AP-42 Compilation of Air Pollutant Emission Factors for heavy construction operations. The quantity of dust emissions has been shown by EPA studies to be proportional to the area of land being worked and to the level of construction activity. This methodology uses a mass of 1.2 tons per acre-month of activity as the emission factor for total suspended particulates.

4.2.5 HAZARDOUS MATERIALS AND SOLID WASTE

FAA guidance stipulates that NEPA documents such as this EIS should include an appropriate level of review regarding the hazardous nature of any materials or wastes to be used, generated, or disturbed by the Proposed Action [or alternatives] and any waste control measures to be employed (FAA 2004a). To meet FAA guidelines and federal requirements at JNU, initial consideration was given to the following components:

- the generation of solid waste as a result of new facility development and the disposal, recycling, or reuse of that waste;
- the potential for generation of hazardous materials or hazardous wastes as a result of new facility development and Airport operations; and
- the potential for Airport development to encounter preexisting hazardous wastes during construction.

The analyses were conducted based on a review of available regulatory databases for records concerning underground storage tanks, Superfund sites, waste generators, and a variety of other environmental regulation mechanisms. Historic aerial photographs were reviewed and field surveys were conducted to identify areas where waste disposal may have occurred historically. Interviews were also conducted with Airport staff concerning current waste generation and disposal practices.

All of the action alternatives would generate some solid waste, defined for the purpose of this analysis as inert, non-toxic refuse derived primarily from facility construction. For example, construction of new hangars in the Northwest and Northeast Development Areas would create some typical construction debris, such as waste sheet metal, concrete, rebar, siding, and wood. Some materials, such as wood debris and culverts being replaced, may have recycle potential. The Juneau Landfill has sufficient capacity to dispose the quantities of waste that could be generated for one or all of the actions being considered (Snow 2004a).

There is little potential to encounter asbestos-containing materials since most of the actions proposed do not include demolition of older facilities. Any buildings to be demolished would be checked for the presence of asbestos-containing material prior to removal. Other potentially hazardous wastes, such as those considered toxic or otherwise harmful to human health and the environment, are unlikely to be encountered but the analysis does include discussion of which areas to be disturbed would have higher or lesser potential to encounter hazardous waste.

Executive Order 12088 directs federal agencies to comply with applicable pollution control standards in the prevention, control, and abatement of environmental pollution and to consult with EPA and other local, state, and federal agencies concerning the best methods available for pollution prevention, control, and abatement. Changes in the use of hazardous material resulting from the alternatives that could lead to increased pollutant loads are disclosed. However, the specific environmental effects of increased pollutant loads are described in the resource analysis sections for air and water. Possible opportunities to reduce pollutant discharges are discussed in these sections as well.

4.2.6 WATER RESOURCES AND FLOODPLAINS

Water resources were evaluated in categorical terms of:

- hydrology (e.g., flow volumes and flow rates);
- hydraulics (e.g., velocities, depths, widths of channels and associated surfaces such as floodplains and marshplains);
- geomorphology (e.g., form of channels in plan, profile, and cross-section); and
- water quality (e.g., measures of basic parameters and pollutant loadings).

The analysis of potential impacts to water resources provides descriptive (qualitative) and measured (quantitative) comparisons of changes relative to existing conditions, within both local and regional contexts. The potential impacts were examined by:

- identifying new impervious and less pervious surfaces resulting from implementation of an action alternative;
- determining fill volumes;
- calculating increases in runoff volumes;
- calculating floodplain and tidal prism volume changes;
- identifying riparian and stream channel impacts;
- identifying changes to stormwater discharge; and
- identifying potential water quality impacts.

LiDAR imagery collected in 2001 was the foundation for assessing potential changes from existing conditions. These data were supplemented by partial topographic mapping from previous studies on the Airport and in the area and some fieldwork verifying hydrologic hydraulic, and geomorphic conditions.

Peak flow calculations used the Rational Method, a formula commonly used by water resources engineers to design storm drains and other structures conveying stormwater:

$$\text{flow} = \text{runoff coefficient} \times \text{rainfall rate} \times \text{area}$$

The basis for this formula is that rainfall applied at a constant rate over an impervious surface will reach equilibrium equal to that rate of precipitation. Although the formula is most accurate when applied to relatively small impervious surfaces and generally overestimates flows in larger areas or areas with more pervious surfaces, it is commonly used in preliminary analyses for peak flow calculation.

Flood insurance rate maps issued by the Federal Emergency Management Agency (FEMA 1981) define the 100-year floodplain in the vicinity of JNU. This information was used to determine peak flood elevations associated with the 100-year return interval event: 15 feet msl within the JNU dike and 14 feet msl outside the dike. The flood elevation outside the dike includes storm-induced wave action. FEMA mapping references elevations to the Mean Lower Low Water (MLLW) datum. Elevations have been lowered 8.6 feet from the MLLW datum to the msl datum, which is being used as the basis of analysis for the DEIS. Figure 4-1 illustrates the FEMA-designated floodplain surfaces in the vicinity of the Airport (MLLW datum).

Tidal data for the JNU area is collected by the National Oceanic and Atmospheric Administration (NOAA). The tide gauge data from NOAA references the MLLW datum, converting the tide elevations noted above to mean sea level and establishing a Juneau-vicinity tidal range of approximately 24 feet (-13 feet msl to +11 feet msl). *Marshplain* is defined as the estuarine surface inundated by tides. The water volume exchanged daily between the MLLW stage and the Mean Higher High Water (MHHW) stage is defined as the diurnal tidal prism (tidal prism).

Floodplain and marshplain displacement volumes were both calculated using an elevation of 15 feet msl. This approach was taken because it is difficult to clearly distinguish floodplain (15 feet msl) from marshplain (14 feet msl) in areas where both flood and tidal processes act upon the same surfaces. For this reason floodplain and tidal prism volume impacts were considered as one unit.

CBJ has adopted Specified Area Provisions (Chapter 49.70.900) that protect Coastal Zone Management Areas with physical conditions including surface and subsurface drainage, water tables, floodplains and shore forms. These conditions at the Airport are addressed in this section through impervious surface changes and floodplain and tidal prism volume changes.

The EPA's STORET (STOrage and RETrieval) water quality database and data from ADEC and Alaska Water Watch were reviewed for this analysis, but a lack of site-specific water quality data for ground water and some surface water limits the analysis of pollutant impacts to qualitative terms. Therefore, impervious or low-permeability (less pervious) surfaces and stormwater discharge were used as an indicator of potential water quality impacts. Water quality impacts were assessed in terms of typical parameters and loadings by a number of pollutants, including:

- temperature,
- total suspended solids (TSS),
- biochemical oxygen demand (BOD),
- oil and grease, and

- de-icing and anti-icing chemicals

4.2.7 VEGETATION

Direct impacts to vegetation (i.e., plant communities and cover types) were evaluated quantitatively using GIS data to calculate acreages. Each of the action alternatives was overlaid on existing, baseline vegetation polygons, and the acreages affected were tabulated for each cover type. Indirect impacts to vegetation were evaluated on a qualitative basis, based on the best professional judgment of ecologists and independent reviewers working on the EIS.

As defined in Appendix A, Section 8.3 of FAA Order 1050.1E (FAA 2004a), significant impacts to plants occur when the FWS or NMFS determines that the proposed action would be likely to jeopardize the continued existence of a federally listed threatened or endangered species. There are no federally listed plant species within the vicinity of the Airport (NMFS 2002) and, thus, no potential for the proposed actions or alternatives to have significant impacts on threatened and endangered plants. Order 1050.1E also states that lesser impacts, including impacts on non-listed species, could also constitute a significant impact. In consultation with agencies and organizations having jurisdiction or special expertise concerning the protection and/or management of the affected species, FAA NEPA practitioners are also directed to consider factors affecting population dynamics and sustainability for the affected species.

Coordination with ADF&G, NMFS, and FWS has identified the low and high estuarine marsh communities as vegetation types of conservation concern due to their rarity in Southeast Alaska.[2] As noted in Section 4.2.8, these wetlands are a regionally limited resource and sustain the majority of impacts caused by human development in coastal communities. Estuarine wetlands are essential to coastal ecosystems and provide functions such as fish and wildlife habitat and nutrient transformation and export that indirectly benefit the human environment. Thus, for the purposes of this EIS, impacts to vegetation emphasize effects to estuarine communities within their local and regional context. However, as is shown for the analyses of specific alternatives, none of the actions considered in this EIS are predicted to substantially impair plant populations or communities or threaten species sustainability in the landscape area.

Impacts to general vegetation have been evaluated at the project and landscape levels (as defined in Section 3.1.7 of Chapter 3). Some of the project alternatives, particularly the RSA alternatives, added or revised following issuance of the Draft EIS extend beyond the areas for which vegetation was identified and mapped at the project level in the Draft EIS. In these circumstances, any additional impacts to vegetation from alternatives that extended beyond the mapped project level areas from the Draft EIS were extrapolated from landscape level data. Also, for the purposes of this analysis, impacts to the developed, disturbed, and seeded grassland cover types are considered insignificant (being generally non-native) regardless of the acreage or the percentage of these

2. Estuarine communities include unvegetated tidelands, Pacific alkali grass-goosetongue, Pacific alkali grass-Lyngbye sedge, Lyngbye sedge, beach rye, and coastal grass meadow at the project area level; and unvegetated, low marsh, and high marsh at the landscape level.

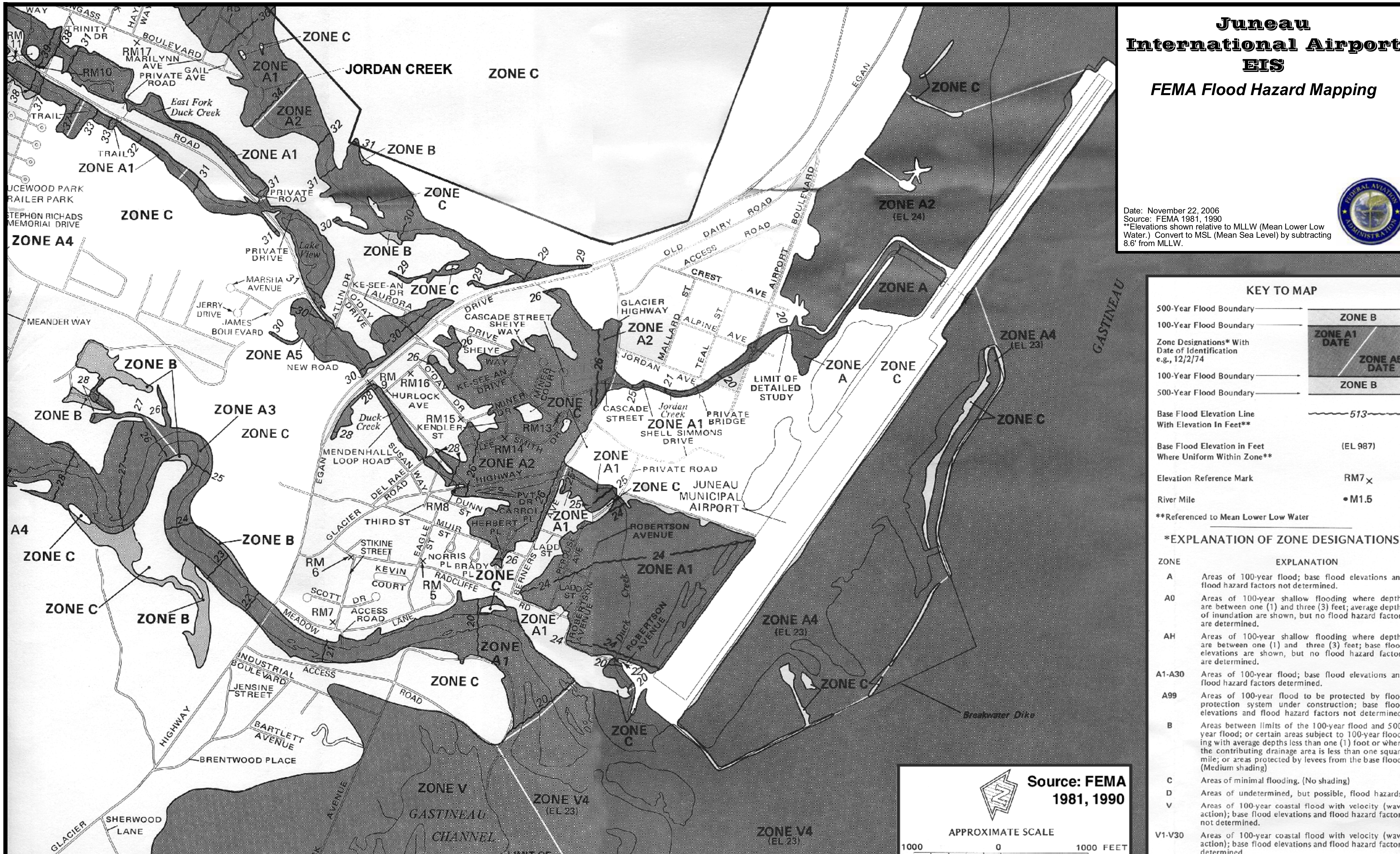

Figure 4-1. FEMA flood hazard mapping.

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cover types affected. Changes to these cover types are noted but are not emphasized in the discussion of impacts. All vegetation impacts are considered adverse and, unless otherwise indicated, permanent losses of cover.

Because there are no federally listed plant species known to be present in the project area (NMFS 2002) and, therefore, no potential for federally listed plant species to be affected by the alternatives, regulatory controls on impacts to vegetation consist of the same regulations governing impacts to other, related resources such as wetlands and wildlife. For instance, vegetation communities composing low and high marsh cover types are regulated as wetlands under Section 404 of the Clean Water Act (refer to Section 4.2.8 for more information). Similarly, trees containing eagle nests are, by default, protected under the Bald and Golden Eagle Protection Act (refer to Section 4.2.10 for more information).

As was recognized in Section 3.7.4 of Chapter 3, there is potential for some Alaska Natural Heritage Program-listed, rare plant species or Tongass National Forest-listed sensitive plant species to occur on or near the Airport. This potential is based on the documented occurrence of these species elsewhere in the Juneau area, and their requiring habitats similar to habitats on or near the Airport. However, since there are no records of occurrence of these species within the project or landscape area and none were identified during field studies, it is unlikely that they exist in areas that would be disturbed by Airport actions.

4.2.8 WETLANDS

The Proposed Actions and alternatives considered in this EIS are anticipated to affect wetland areas and wetland functions. Wetland acreage impacts were evaluated by determining the area of disturbance (also called the disturbance footprint) resulting from each action alternative.

Changes in wetland function in each of the development areas (e.g., Jordan Creek, the end of Runway 26, etc.) were also assessed. For each wetland type in each of the development areas, resource specialists qualitatively rated twelve wetland functions and quantified these ratings by calculating an "environmental score" based on the methodology developed in the Juneau Wetlands Management Plan (CBJ 1997). The wetland functions used in this analysis were based on work done by Adamus (1987) in the Juneau area. Section 3.8.1 describes wetland functions in detail, and Figures 3-22 through 3-27 in Chapter 3 illustrate the mapped wetlands.

The quantitative environmental score, as presented in the Juneau Wetlands Management Plan, does not account for wetland area. Therefore, the product of the environmental score and wetland acreage was calculated to determine the number of functional units, which provide the basis for quantification and comparison of wetland impacts. The functional unit calculation uses eleven of twelve wetland functions, which are divided among three "support categories," as listed in Table 4-4. (The twelfth function, the recreation function, was omitted from the environmental score and functional unit calculations; impacts to the recreational wetlands resources are covered in the human environment and land use analysis for each action.) More information concerning the methods used to calculate the environmental score and functional units are described in Appendix E of this EIS.

Table 4-4. Support Categories and Associated Wetland Functions[1]

Aquatic Support Category	Human Use Support Category	Terrestrial Support Category
Groundwater Discharge and Lateral Flow Sediment/Toxicant Retention Nutrient Export Riparian Support Fish Habitat Erosion Sensitivity	Groundwater Recharge Surface Hydrologic Control Downslope Beneficiary Sites	Wildlife Regional Ecological Diversity

[1] The Ecological Replacement Cost function was not used to calculate the environmental score in the JWMP.

Significance criteria for impacts to wetlands were taken from the FAA's Order 1050.1E (FAA 2004a). The significant impact threshold would be exceeded if any of the following occurred:

- The action would adversely affect the function of a wetland to protect the quality or quantity of municipal water supplies, including sole source, potable water aquifers.
- The action would substantially alter the hydrology needed to sustain the functions and values of the affected wetland or any wetlands to which it is connected.
- The action would substantially reduce the affected wetland's ability to retain floodwaters or storm-associated runoff, thereby threatening public health, safety and/or welfare (this includes cultural, recreation, and scientific resources important to the public, or property).
- The action would adversely affect the maintenance of natural systems that support wildlife and fish habitat and/or economically important timber, food, or fiber resources in the affected or surrounding wetlands.
- The action would promote development of secondary activities or services that would affect the resources mentioned above.
- The action would be inconsistent with applicable State wetland strategies.

Of these criteria, the first, third and fifth bullets are largely irrelevant to the JNU EIS. The proposed actions and their alternatives would take place downstream/downgradient of municipal water supplies and would therefore have no effect on these resources. Similarly, because these actions would take place in or near the mouths of affected streams and/or in a tidal estuary, they would have little or no overall effect on stormwater retention and thus would not create a flood-related threat to public health, safety, and welfare. It is not anticipated that the proposed actions and alternatives would promote secondary development affecting wetlands within the landscape area, as the Refuge is protected by law from other development and the Airport is primarily dedicated to aviation-related enterprise.

Significance criteria stated in bullets two, four, and six, above, are the most applicable to the JNU EIS. Several of the proposed actions and their alternatives would affect the hydrology needed to sustain wetland functions and would impact fish and wildlife habitats within the landscape area.

To determine the application of the significance criteria stated in bullets two and four it is necessary to consider the context of the analysis, specifically the importance of estuarine wetlands to southeast Alaska. These wetlands are a regionally limited resource and sustain the majority of impacts caused by human development in coastal communities. Estuarine wetlands are essential to coastal ecosystems and provide functions such as fish and wildlife habitat and nutrient transformation and export that indirectly benefit the human environment. Airport development actions that would have a substantial adverse effect on estuarine wetlands or the wetlands connected to them over the long term would be significant.

The hydrologic connectivity *between* wetlands is also important to the evaluation. For examples, the wetlands on the Refuge west of the runway are not hydrologically connected to the wetlands in the rest of the Refuge. The Mendenhall River separates these wetlands from most of the western Refuge, and tidal water recharge drains directly into the River from the wetlands without connection to the Refuge south of the Dike Trail. A somewhat similar situation exists in the Northeast Development area. Fill in this area for aviation facilities would directly affect wetlands, but the indirect impacts on wetlands south of Miller-Honsinger Pond would be relatively minor because there would be no disruption of tidal recharge and discharge. On the other hand, a hydrologic disconnect between wetlands (such as is the case with some RSA alternatives) can have significant indirect effects because of the loss of hydrologic connection between the two areas.

Concerning the criterion stated in bullet six, the state wetland strategy pertaining to wetlands around the Airport is that associated with establishment of the Refuge and the Refuge Management Plan. As noted on ADF&G's internet site for wildlife viewing information, "The refuge is a critical wetlands area preserved in the midst of an urban setting. Right in the state's capital, freshwater streams tumble down from the peaks to meet the saltwater wetlands that cradle north Gastineau Channel. The result is a rich and fertile environment that supports 140 species of birds, eight species of anadromous fish, and a dozen or so species of mammals, such as long-tailed voles and masked shrews. Mendenhall is one of the most popular wetlands areas in the nation on a per-capita basis; residents and visitors alike use the area for birding, hunting, hiking, cross-country skiing, fishing, horseback riding, boating, or simply stealing a moment of peace in the midst of a bustling community" (at www.wildlife.alaska.gov/index.cfm?adfg=viewing.mendenhall).

State designation of the Mendenhall wetlands as a game refuge came after many years of study and numerous hours of testimony establishing the unique setting (in an urban area) and nature of the wetlands habitat (with highly productive estuarine wetlands that are relatively rare in Southeast Alaska). The value of this area as a game refuge is intrinsically connected to the wetlands that attract thousands of resident and migratory birds. Statutory designation of the Refuge establishes the State of Alaska's strategy to preserve and protect the wetland resources upon which wildlife depend.

Despite designation of the Refuge, however, the enabling statute and Refuge Management also allow for necessary expansion of the Airport (see Section 3.2.2.5 of this EIS). Airport expansion into the Refuge is authorized if, among other criteria, the use of Refuge lands are *avoided or minimized to the maximum extent feasible* (emphasis added). Therefore, to the extent that a significance criterion includes consistency with State wetland strategies, adverse impacts to the Refuge wetlands would be significant if there are alternatives available that could avoid or minimize the effects. Specifically, actions that would substantially interrupt or impair wetlands hydrology to the Refuge and connected wetlands would be significant, if other alternatives could avoid or minimize that hydrologic impact.

The quantitative method for impacts analysis for wetlands is based on the total acreage, environmental score, and resultant functional units for wetlands within each wetland analysis area. These methods were developed through consultation with and comment by the cooperating agencies. The resultant scores have been summarized in Table 4-5 to serve as a basis for the analysis of each alternative. The area of wetlands lost for each alternative is placed in context by comparison to the total area of wetlands present in the project area and landscape area. The total acreage of each wetland type is summarized in Table 4-6.

Table 4-5. Total Wetland Acreage, Environmental Scores, and Functional Units by Wetland Analysis Area

Wetland Analysis Area	NWI Classification					
Jordan Creek	**R3UB2**	**PEM1**	**PSS1**	**E2EM1 (H)**	**E2EM1 (L)**	**E2USN**	**Total**
Environmental Score	139.8	67.3	124.6	135.1	136.7	138.3	N/A
Total Acreage	0.4	0.8	1.8	0.3	1.8	0.8	5.9
Total Functional Units	55.9	67.3	224.4	40.5	246.0	110.7	744.8
Northeast Airport Area	**PEM1**	**E2EM1 (H)**	**E2EM1 (L)**	**E2USN**	**Total**		
Environmental Score	119.1	128.3	130.0	138.3	N/A		
Total Acreage	5.3	31.6	1.1	1.2	39.2		
Total Functional Units	631.4	4055.8	143.0	166.0	4996.2		
Eastern RSA	**E2EM1 (H)**	**E2EM1 (L)**	**E2USN**	**Total**			
Environmental Score	142.4	144.0	145.6	N/A			
Total Acreage	40.2	19.6	25.9	85.7			
Total Functional Units	5724.5	2822.4	3772.1	12319.0			
Float Plane Pond Woodland	**PEM1**	**PSS1**	**PUB4**	**PAB3**	**L1UBH**	**Total**	
Environmental Score	103.7	95.1	103.7	134.4	123.0	N/A	
Total Acreage	11.1	2.8	0.5	23.3	59.7	97.4	
Total Functional Units	1150.6	266.3	51.8	3130.8	7343.6	11943.1	

Table 4-5. Total Wetland Acreage, Environmental Scores, and Functional Units by Wetland Analysis Area, continued

Wetland Analysis Area	NWI Classification						
Otter Pond	**E2EM1 (H)**	**E2EM1 (L)**	**E2USN**	**E1UB3**	**Total**		
Environmental Score	142.4	144.0	145.6	144.6	N/A		
Total Acreage	34.1	0.8	4.7	1.7	41.3		
Total Functional Units	4855.1	115.2	684.5	245.8	5900.6		
Western RSA	**E2EM1 (H)**	**E2EM1 (L)**	**E2USN**	**E1UB3**	**Total**		
Environmental Score	137.1	138.8	138.3	140.4	N/A		
Total Acreage	3.8	3.9	1.0	3.6	12.3		
Total Functional Units	521.1	541.2	138.3	505.4	1706.0		
Northwest Airport Area	**R3UB2**	**PEM1**	**PSS1**	**E2EM1 (H)**	**E2EM1 (L)**	**E2USN**	**Total**
Environmental Score	111.3	98.8	101.8	115.2	116.8	116.4	N/A
Total Acreage	0.3	0.5	0.9	3.2	0.7	0.5	6.1
Total Functional Units	33.4	49.4	91.6	368.6	81.8	58.2	683.0

Table 4-6. Total Wetland Acreage at the Project Area and Landscape Levels

NWI Classification (Class-level)	Project Area Acreage	Landscape Acreage
E1UB	6.2	1120.0
E2AB	0.0	115.5
E2EM-High	113.2	963.3
E2EM-Low	33.1	669.6
E2US	35.4	662.3
L1UB	59.7	88.2
M1UB	0.0	463.2
PAB3	23.3	23.4
PEM1	17.7	28.2
PSS1	5.5	6.8
PUB4	0.5	0.5
R3UB	0.7	0.7
Total	295.3	4141.7

4.2.9 FISHERIES

Impacts to fisheries are described relative to existing resources within the project and landscape area spatial contexts, the same as those used for vegetation and wetlands resources. Impacts to fish populations considered the number of fish using project and landscape area habitats at various seasons and under varying tidal and flow conditions.

As defined in Appendix A, Section 8.3 of FAA Order 1050.1E (FAA 2004a), significant impacts to fish occur when the FWS or NMFS determines that the proposed action would be likely to jeopardize the continued existence of a federally listed threatened or endangered species. There are no federally listed fish species within the vicinity of the Airport (NMFS 2002) and, thus, no potential for the proposed action and its alternatives to have significant impacts on threatened and endangered fish. Order 1050.1E also states that lesser impacts, including impacts on non-listed species, could also constitute a significant impact. In consultation with agencies and organizations having jurisdiction or special expertise concerning the protection and/or management of the affected species, FAA NEPA practitioners are directed to consider factors affecting population dynamics and sustainability for the affected species. NMFS has identified essential fish habitat (EFH) around the Airport (NMFS 2002). Thus, for the purposes of this EIS, impacts to fish emphasize effects to EFH.

Impacts to EFH for salmonids, sculpins, and forage fish, were measured using aerial imagery and are quantified in terms of the acreages affected (see relevant wetlands sections). EFH means "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (*Federal Register* 62 (244): p. 66551). In the project and landscape areas, EFH includes all streams, rivers, and estuarine habitats up to the highest high tide level (i.e., wetlands representing open water, low marsh, and high marsh habitats). Although high marsh habitats are considered EFH, they are inherently less valuable to fish than open water, tidal sloughs, and low marsh simply because they are only infrequently accessible, for brief periods during the highest tides. While high marsh habitats are inundated less frequently than other marsh habitats, they still constitute important edge habitat and are generally characterized as areas with high rates of primary production. These habitats also contribute substantial plant material, nutrients, and detritus to the remainder of the estuary when they are inundated by the tides. Therefore, these high marsh areas are also considered valuable habitats contributing to the fishery resource.

The effects of habitat changes on fish populations were evaluated qualitatively based on existing data, literature review, and professional judgment. No attempt was made to numerically gauge population impacts because of the large, naturally variable populations and the complex ecological dynamics. Impacts were considered for all anadromous, resident, and saltwater fish, with particular emphasis on coho salmon, as they are a key species that has been studied in the area and in habitats affected by the proposed Airport projects.

Direct impacts are described for the short-term construction period and the long-term, post-construction period. Indirect impacts, generally long-term and qualitative in nature, were described as well. Unless otherwise noted, all of the impacts described are adverse in nature.

Construction within aquatic habitats, if poorly timed or implemented, can be harmful to fish. It was assumed for this analysis that the majority of dredging, fill, and construction in aquatic habitats would occur "in the dry," to the extent possible. For example, active stream and tidal flows would be routed around construction via cofferdams, sheetpiling, and pumps. However, it was also recognized that the natural landscape conditions where much of the work would take place precludes complete separation of the construction zone disturbance from the surrounding environment; some short-term impact on aquatic habitat would undoubtedly occur. It was also assumed that, through the permitting process, construction impacts would be reduced via use of timing stipulations to avoid periods of greatest fish exposure (e.g., construction involving stream habitat would not occur during spring out-migration or fall spawning runs of salmon).

Other, qualitative impacts have been described using baseline fish function and value criteria. Impacts to fish access at road and runway crossings are described relative to ADF&G fish passage guidelines. The No Action Alternatives were generally assumed to have no direct effect on fish resources. However, with respect to future conditions, it is recognized that natural processes including isostatic rebound are gradually uplifting the area around the Airport and slowly reducing the area of EFH.

An EFH assessment was prepared in response to initial consultation with NMFS (2002), as well as scoping comments submitted by NMFS and other agencies regarding the potential for the Airport projects to affect EFH. Federal agencies such as FAA may incorporate an EFH assessment into documents prepared for other purposes, such as NEPA documents (see final rule regarding EFH, 50 CFR 600.920 and *Federal Register* Vol. 67, No. 12, January 17, 2002), but regardless of whether the EFH assessment is incorporated into a NEPA document, its mandatory contents include:

- a description of the action,
- an analysis of the potential adverse effects of the action on EFH and the managed species,
- the federal agency's conclusions regarding the effects of the action on EFH, and
- proposed mitigation, if applicable.

The level of detail in the EFH assessment should be commensurate with the complexity and magnitude of the potential adverse effects. The portions of this chapter discussing fisheries, in conjunction with the habitat descriptions in Section 3.9 and the cumulative effects analysis in Section 5.5.9, serve as the basis for an EFH assessment. In addition, a complete, stand-alone EFH assessment has been prepared in conjunction with a Biological Assessment (BA) and submitted to NMFS for review and determination. The EFH/BA is included as Appendix I to this EIS.

4.2.10 WILDLIFE

Because most wildlife species are highly mobile and therefore are unlikely to be affected on an individual basis by the actions evaluated in this EIS, impacts to wildlife are assessed according to changes in distribution and abundance of wildlife habitat. These assessments of habitat changes were conducted using GIS. Proposed Actions and alternatives were overlaid on existing wildlife habitat polygons, and the acreages affected were tabulated for each habitat type. Indirect impacts to wildlife have been evaluated on a qualitative basis and in comparative form between alternatives based on the best professional judgment of ecologists and independent reviewers working on the EIS.

As with vegetation and fisheries, this analysis addresses impact criteria established in Appendix A, Section 8.3 of FAA Order 1050.1E (FAA 2004a), whereby significant impacts to wildlife occur when the FWS or NMFS determines that the proposed action would be likely to jeopardize the continued existence of a federally listed threatened or endangered species. Through the consultation process initiated with these agencies, two federally listed species, the Steller sea lion and humpback whale, have been identified as likely to occur near the project area (NMFS 2002). Only one of the Proposed Actions, the expansion of the RSA, has potential to affect federally listed wildlife species. Thus, potential impacts to the Steller sea lion and humpback whale are discussed in Section 4.3.10 only.

FAA Order 1050.1E also states that lesser impacts, including impacts on non-listed species, could also constitute a significant impact. In consultation with agencies and organizations having jurisdiction or special expertise concerning the protection and/or management of the affected species, FAA NEPA practitioners are directed to consider factors affecting population dynamics and sustainability for the affected species. Coordination with ADF&G, NMFS, and FWS has identified the estuarine low and high marsh communities as habitat types of conservation concern due to their rarity in Southeast Alaska and their high value to a wide variety of wildlife, particularly migratory birds. For the purposes of this EIS, the disclosure of impacts to wildlife habitat emphasizes the effects to estuarine communities within their local and regional context.

Effects to general, high-interest, and sensitive wildlife species' habitats have been evaluated at the project and landscape levels (as defined in Section 3.1.7). However, as is shown for the analyses of specific alternatives, none of the actions considered in this EIS are predicted to substantially impair wildlife populations or threaten species sustainability in the landscape area. As with the vegetation analysis, regardless of the acreage or percent affected, impacts to the seeded grassland habitat type were considered insignificant for the purposes of this analysis. All impacts to wildlife habitat are adverse and, unless otherwise indicated, permanent.

On behalf of the FAA, in October of 2001, a letter was sent to NMFS requesting initiation of the Endangered Species Act Section 7 consultation process. In so doing, the letter also requested information concerning the presence of threatened or endangered species and designated critical habitats in the vicinity of the Airport. In July of 2002, NMFS responded with comments specific to the Section 7 process as well as to the Marine Mammal Protection Act, and the Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat (NMFS 2002). In keeping with the Section 7 process, the FAA has prepared a Biological Assessment (BA) to analyze potential project-related impacts to the Steller sea lion and humpback whale, the only two federally listed species likely to occur near the project area. The Draft BA and EFH were submitted to NMFS prior to release of the public Draft EIS and are included as Appendix I to this EIS.

4.2.11 CULTURAL RESOURCES

Under Section 106 of the National Historic Preservation Act (NHPA) of 1966, cultural resources subject to consideration for impacts analysis are those that are either listed on or eligible for listing on the National Register of Historic Places (NRHP). These resources are referred to as "historic properties." A cultural resource site or building may be considered eligible to the NRHP if it meets one or more of the four criteria established in 36 CFR §60.4:

A. - is associated with events that have made a significant contribution to the broad patterns of our history; or

B. - is associated with the lives of persons significant in our past; or

C. - embodies the distinctive characteristics of a type, period, or method of construction, or represents the work of a master, or possesses high artistic values, or represents a significant and distinguishable entity whose components may lack individual distinction; or

D. - yields, or may be likely to yield, information important in prehistory or history.

Cultural resources that are not listed on or are not eligible for listing on the NRHP need not be taken into consideration when evaluating alternatives. Therefore, significant impacts to cultural resources can only occur when NRHP-listed or –eligible sites are affected.

As described in Section 3.11, cultural resource sites had been previously documented in the Northwest Development Area, on either side of the existing runway. All of those sites have been determined ineligible for listing on the NRHP by the FAA in consultation with the Alaska State Historic Preservation Office (DNR 2003). Because no historic properties are known to be in areas that may be disturbed by Airport actions, the evaluation of potential impacts is focused on the possible presence of as-yet undiscovered resources. FAA has entered into a Memorandum of Agreement with the Alaska State Historic Preservation Officer for phased identification of potential subsurface cultural resources and cultural resources that may be obscured by dense vegetation with the areas of proposed actions. This phased identification effort will be implemented should build alternatives in the areas with the potential to contain such resources be selected in the Record of Decision for this EIS.

Previously undocumented cultural resource sites may be present within the areas of potential effects on Airport property; dense vegetation and sediment deposition can obscure sites and prevent them from being identified during visual inspection of an area. Because of this potential to encounter these as-yet unknown resources, appropriate language providing for the protection and treatment of such resources would be included in any construction contracts issued for projects addressed in this EIS.

4.2.12 VISUAL RESOURCES

FAA does not have an established protocol to assess impacts to visual resources. The methodology used in this EIS is based on visual resource management systems used by the USFS and Bureau of Land Management (BLM) to determine the magnitude of impacts from project disturbances. These visual resource management systems are also used as an aid in identifying mitigation measures for impacts to visual resources.

Generally, the degree to which an activity affects the visual quality of the landscape depends on the contrast between the activity and the baseline visual environment (USFS 1974; BLM 1986). Visual contrasts are analyzed according to the proposed changes to the form, line, color, and texture of the landscape, which constitute the visual elements of the landscape. As described in Section 3.12, analysis of visual contrast is conducted from specific points of view deemed "visually sensitive," based on factors that include the visibility of the proposed activity, the perspective of viewers and their sensitivity to changes, and the length of time that viewers might see the proposed activity. The sensitive viewpoints, shown on Figure 3-32, include the golf course clubhouse, the Dike Trail parking lot/trailhead, the covered picnic table area south of the Float Plane Pond, and Sunny Point Road.

For purposes of this NEPA analysis, a relative ranking of the degree of disturbance to visual resources (a ranking that approximates the methods used by the USFS and the BLM) is used. A perceived degree of change is determined, and a visual contrast rating of "minor," "moderate," or "major" is applied to each of the alternatives. A major visual contrast rating would constitute a significant adverse effect. The study area of analysis for the direct, indirect, and cumulative visual resource effects of the Proposed Action and alternatives consists of JNU property and surrounding areas, as seen from the scenic viewpoints.

4.2.13 DEPARTMENT OF TRANSPORTATION SECTION 4(F) LANDS

Section 3.13 describes the two DOT Section 4(f) lands located in the vicinity of the Airport: the Refuge and the Dike Trail. The following describes the methods used to assess direct and constructive-use impacts to the Refuge and Dike Trail for each of the action alternatives under consideration.

The FAA shall not approve any action that requires use of DOT Section 4(f) land, "unless there is no prudent and feasible alternative to the use of such land and such program or project includes all possible planning to minimize harm resulting from the use" (FAA Order 1050.1E). "Use" as it is meant in Section 4(f) usually occurs when the action requires a physical taking or direct control of the land, thereby changing the use of the land from its original, intended purpose. Use may include not only actual, physical taking of such lands, but also adverse, indirect impacts, such as noise, air, or water pollution, that diminish the resource value of the property. A "constructive use" relating to transportation projects occurs when the proximity of the project to the DOT Section 4(f) land substantially impairs the established or designated uses of the DOT Section 4(f) land. An example of constructive use may be a significant increase in noise, air pollution, or water pollution caused by a transportation project that substantially impairs the DOT Section 4(f) land's use as a parkland, although the parkland may not be directly affected through acquisition or land disturbance.

A direct impact to a DOT Section 4(f) land would be, in essence, an acquisition or "take" of land; some action alternatives for JNU would indeed directly impact 4(f) lands, as they have made acquisition of Refuge lands integral to implementation of the alternative. Disturbance would, predictably, directly impact the resources of the property being acquired (e.g., plant types and communities, wetland resources, and wildlife and fish habitat of the Refuge).

If all of the prudent and feasible project alternatives use some Section 4(f) property, then the FAA may approve the most prudent alternative that minimizes overall harm by considering the following factors:

1. The relative severity of the harm to the protected activities, attributes, or features that qualify each Section 4(f) property for protection;
2. The relative significance of each Section 4(f) property;
3. The views of the official(s) with jurisdiction over each Section 4(f) property;
4. The ability to mitigate adverse impacts to each Section 4(f) property (including any measures that result in benefits to the property);
5. The degree to which each alternative meets the purpose and need for the project;
6. The magnitude of any adverse impacts to resources not protected by Section 4(f);
7. Extraordinary differences in costs among the alternatives; and
8. Any history of concurrent planning or development of the proposed transportation project and the Section 4(f) property.

The 4(f) analysis describes the direct impacts to 4(f) lands that would occur under each alternative (this direct impact being a "take"), and correlative sections of the EIS describe direct impacts to these other resources within the acquired lands. For example, Section 4.3.6 examines the water quality impacts associated with the RSA alternatives while Section 4.3.4 examines the potential air quality impacts. The Section 4(f) analysis includes evaluation of the potential for substantial impairment where indirect effects have been identified.

Impacts to Section 4(f) resources from RSA alternatives must also be considered in light of the December 2006 NTSB legislation, which states (Public Law 109-433, Section 10):

a. Safety Area Alternatives.--With regard to an environmental review of a project to improve runway safety areas on Runway 8/26 at Juneau International Airport, the Secretary of Transportation may only select as the preferred alternative the least expensive runway safety area alternative that meets the standards of the Federal Aviation Administration and that maintains the length of the runway as of the date of enactment of this Act.

b. Costs to Be Considered.--In determining what is the least expensive runway safety area for purposes of subsection (a), the Secretary shall consider, at a minimum, the initial development costs and life cycle costs of the project.

c. Satisfaction of Requirement.--With respect to the project described in subsection (a), the requirements of section 303(c)(1) of title 49, United States Code, shall be considered to be satisfied by the selection of the least expensive safety area alternative.

While measures to minimize impacts to Section 4(f) resources have been incorporated into all alternatives, this legislation may require the selection of an RSA alternative that does not represent the overall least impact on 4(f) properties such as the Refuge.

4.2.14 COASTAL ZONE MANAGEMENT

CBJ has adopted Specified Area Provisions (Chapter 49.70.900), which protect Coastal Zone Management Areas with physical conditions, including surface and subsurface drainage, water tables, floodplains and shore forms. A number of policies incorporated into the coastal development plans are relevant or applicable to actions at the Airport. These include:

> Dredging and filling shall be prevented in highly productive tideflats and wetlands, subtidal areas important to shellfish, and water important for migration, spawning, and rearing of salmon and other sportfish species, unless there is a significant public need for the project and there is no prudent and feasible alternative to meet the public need. [§49.70.905(4)]
>
> Highway and Airport design, construction, and maintenance shall take all prudent and feasible steps to prevent alteration of water courses, wetlands and intertidal marshes, and aesthetic degradation. [§49.70.925(a)]

The Airport, as a designated transportation facility, is exempt from some aspects of the Juneau Coastal Management Plan (JCMP), but it is clear that a need must be demonstrated, and all prudent and feasible alternatives to the exemption must be considered. The descriptions of Purpose and Need in Chapter 1 (see Section 1.4) establish the "significant public need for the projects." Chapter 2 describes the alternatives FAA has considered to fulfill each of the needs. FAA has determined that, considering the aviation-specific technologies and developments available for meeting Purpose and Need, the alternatives presented in this EIS constitute a reasonable range and there are no other prudent and feasible alternatives that would meet the Purpose and Need while causing fewer environmental impacts.

Other policies in the JCMP address the appropriate design of facilities to prevent and/or minimize impacts upon coastal resources, recreation, fish, and habitat. Design features incorporated into the alternatives would reduce environmental impacts to some extent; other features that would reduce environmental impacts even further have been identified and described in Section 2.11 of Chapter 2. The projects would also have to comply with established policies (such as habitat rehabilitation requirements and stream setbacks) to prevent unnecessary degradation. However, it is expected that the overall consistency review and coordination process for the Alaska Coastal Management

Program will identify other design, construction, and maintenance measures appropriate to reduce impacts. This review will be conducted by ADNR in coordination with other state and federal agencies before permits are issued allowing the Airport to proceed with selected alternatives.

Therefore, a separate section for analysis of coastal zone management is not included. It is anticipated that ADNR and the other agencies will use the analyses in Sections 4.3 through 4.8 to disclose environmental impacts on coastal resources, including fish, habitat, wetlands, surface waters, recreation, aesthetics and other elements of the human environment.

4.2.15 Resources and Elements of the Human Environment Not Affected

NEPA and its implementing regulations require a comprehensive evaluation of the impacts to the human environment for major federal actions. FAA has identified the particular environmental and social resources that must be evaluated in an EIS for which it serves as the lead agency (FAA 2004a, 2006). Most of these elements of the human environment are specifically addressed in the analyses provided in Sections 4.3 through 4.8. The following resources and issues have not been separately distinguished in the analyses, for the reasons provided.

4.2.15.1 Farmlands

There are no farmlands on or near the Airport that could be converted to non-agricultural use. Therefore, the Farmland Protection Policy Act does not apply to the actions or alternatives proposed for JNU.

4.2.15.2 Coastal Barriers

The Coastal Barrier Resources Act (CBRA) protects undeveloped coastal barriers and related areas by prohibiting direct or indirect federal funding of various development projects in these areas. The purpose of the CBRA is to promote more appropriate use and conservation of coastal barriers along the Atlantic, Gulf, and Great Lakes coastlines. Since Juneau is not located along one of these coastlines, the CBRA does not apply to the actions or alternatives under consideration at JNU.

4.2.15.3 Wild and Scenic Rivers

The President's 1979 Environmental Message Directive on Wild and Scenic Rivers (August 2, 1979) directs federal agencies to avoid or mitigate adverse effects on rivers designated as wild or scenic or rivers having potential for such designation. A review of the Nationwide Rivers Inventory indicated that no designated or eligible rivers are present in the area of potential effect for this project. Therefore, the Directive on Wild and Scenic Rivers does not apply to the actions or alternatives under consideration at JNU.

4.2.15.4 Environmental Justice

Executive Order 12898 and Department of Transportation Order 5610.2 require FAA to provide for meaningful public involvement by minority and low-income populations and to analyze the action alternatives for potential impacts on these populations that may be disproportionately high and/or adverse.

Analysis in this EIS suggests that the action and alternatives considered would have few quantifiable impacts on human populations and no effects on human subsistence patterns. Section 3.3 provides information concerning incomes and housing in CBJ. Census data for 2000 indicates that average household size in Juneau is 2.6 persons, and this factor was applied to the population within various noise contours to quantify numbers of housing units within those contours.

The census data review enabled analysts to determine whether any race, age, income bracket, or other social division or group would be disproportionately impacted. Areas near the Airport for which noise levels would be projected to change as a result of the actions considered were examined for demographic distribution using the CBJ's property assessor's parcel database and GIS techniques. This analysis indicated that the action and alternatives considered in this EIS would result in no disproportionately high or adverse human health or environmental impacts on minority communities and/or low-income communities.

4.2.15.5 Children's Environmental Health and Safety Risks

Pursuant to Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks, federal agencies are directed (as appropriate and consistent with the agency's mission) to make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children and to ensure that their policies, programs, activities, and standards address any such disproportionate risks. FAA is encouraged to identify and assess environmental health risks and safety risks that the agency has reason to believe could disproportionately affect children. Environmental health risks and safety risks include risks to health or to safety that are attributable to products or substances that a child in particular is likely to come in contact with or ingest, such as toxic air emissions, food of uncertain quality, contaminated drinking water or recreational waters, contaminated soil, or unsafe play products.

The Airport property is a controlled facility with limited access and no identifiable soil, air, or water contamination that could present a disproportionate risk to children. As a result, there is minimal potential for children to be exposed to substances of concern at the Airport. No actions or alternatives being considered in this EIS would disproportionately increase environmental health or safety risks to children.

4.2.15.6 Natural Resources and Energy Supply

Executive Order 13123 encourages each federal agency to expand the use of renewable energy within its facilities and in its activities. The Order also requires each federal agency to reduce petroleum use, total energy use and associated air emissions, and water consumption in its facilities.

FAA has evaluated the Proposed Actions and alternatives and determined that they would have no significant effect on local supplies of energy or natural resources. Contact with Alaska Electric Light and Power indicated there is plenty of existing electrical generation capacity to accommodate the actions proposed for the Airport through the year 2015 planning horizon considered in this EIS (Snow 2004b). FAA will encourage the incorporation of principles of sustainability at any new facilities constructed at the Airport, including design standards that minimize energy use and maximize energy conservation.

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4.3 RUNWAY SAFETY AREA (RSA)

Section 2.6 of Chapter 2 describes the alternatives considered to bring RSA into compliance with FAA standards. The following sections describe the predicted environmental consequences of implementing each of these alternatives:[3]

- RSA-1: Construct Traditional Graded Areas Surrounding the Runway. The runway thresholds would remain in the current positions. Fill would be added to each runway end to complete a standard dimensional RSA 1000 feet long by 500 feet wide. Duck Creek, the Float Plane Pond access road, the Dike Trail, and a large portion of the Mendenhall River channel would need to be relocated to accommodate this alternative.
- RSA-5C: Displace Runway 08 Threshold and Construct Additional Runway 26 and RSA. This alternative represents the Airport Sponsor's former proposed action from the Draft EIS. Departures from Runway 08 would begin at the existing threshold location but the landing threshold would be displaced approximately 446 feet to the east. The Runway 26 threshold would be relocated approximately 446 feet to the east. Standard RSA would be installed at each runway end. Duck Creek, the Float Plane Pond access road, and the Dike Trail would need to be relocated to accommodate this alternative.
- RSA-5D: Relocate Runway 26 Threshold, construct 26 Runway extension and RSAs. The Runway 08 threshold would remain in the current position. The Runway 26 departure and arrival thresholds would be relocated 400 feet to the east. The taxiway would also be extended 400 feet to the east. In order to accommodate this alternative, Duck Creek, the Dike Trail, and the Float Plane Pond access road would need to be relocated, and a portion of the Mendenhall River channel would need to be modified.
- RSA-5E: Displace Runway 08 Threshold 120 Feet and Construct Additional 26 Runway and Safety Area. This is the Airport Sponsor's proposed action and the FAA's preferred RSA alternative. The Runway 08 landing threshold would be displaced 120 feet to the east, but departures would begin at the existing threshold location. The Runway 26 departure and landing thresholds would be relocated 520 feet to the east. The taxiway on the Runway 26 end would also be extended an additional 520 feet from its current location. In order to accommodate this alternative, Duck Creek, the Dike Trail, and the Float Plane Pond access road would need to be relocated.
- RSA-6A: EMAS with Declared Distances and Runway 26 Extension. The Runway 08 landing threshold would be displaced 188 feet to the east, but departures would begin at the existing threshold location. The Runway 26 departure threshold would be relocated 188 feet to the east and the displaced landing threshold would be at the existing Runway 26 threshold. Engineered Materials Arresting System would be installed on either end of the runway. Duck Creek, the Float Plane Pond access road, and the Dike Trail would need to be relocated to accommodate this alternative.

3. All of the alternatives except the no-action include installation of lateral RSA to meet standards.

- RSA-6B: EMAS with Declared Distances and Runway 08 Extension. The Runway 26 landing threshold would be displaced 188 feet to the west, but departures would begin at the existing threshold location. The Runway 08 departure threshold would be relocated 188 feet to the west and the displaced landing threshold would be at the existing Runway 08 threshold. Engineered Materials Arresting System would be installed on either end of the runway. In order to accommodate this alternative, Duck Creek, the Dike Trail, and the Float Plane Pond access road would need to be relocated, and a portion of the Mendenhall River channel would need to be modified.
- RSA-6C: Combined EMAS and Standard RSA. The runway thresholds would remain at their present locations. Approximately 337 feet of EMAS would be installed on the west Runway 08 end. In order to accommodate this alternative, Duck Creek, the Dike Trail, and the Float Plane Pond access road would need to be relocated, and a portion of the Mendenhall River channel would need to be modified.
- RSA-6D: Constructed RSAs with Option for EMAS. The Runway 08 departure threshold would be displaced 400 feet to the west, and the Runway 26 departure threshold would be displaced 600 feet to the east. Arrival thresholds would remain in their current location for both runways. Construction of traditional graded RSA surrounding the Runway with 600 feet of full-strength pavement at the Runway 26 end and 400 feet of full-strength pavement and 200 feet of graded RSA embankment at the Runway 08 end. In order to accommodate this alternative, Duck Creek, the Dike Trail, and the Float Plane Pond access road would need to be relocated, and a portion of the Mendenhall River channel would need to be modified. The alternative would be designed to accommodate the future installation of EMAS at one or both runway ends with no additional disturbance. In order to use this RSA configuration and still achieve the standard 1000-foot overrun protection required for traditional fill RSA, the landing distance available on both Runway 08 and Runway 26 would be reduced by 400 feet to a total available landing length of 8,056 feet for each runway. With EMAS installed on the proposed RSA-6D footprint, the landing distance for each runway would increase to approximately 8,644 feet. Duck Creek would need to be relocated and a portion of the Mendenhall River channel would need to be modified to accommodate this alternative.
- RSA-8: No Action. Retain existing airfield thresholds and non-standard RSA.

4.3.1 NOISE

The level of Airport activity is expected to rise over time and would be somehow accommodated at JNU regardless of which RSA alternative would be implemented. Total annual aircraft operations are expected to increase from 161,711 operations (arrivals plus departures) in 2000 to 175,624 operations in 2015. Similarly, annual passengers are expected to increase from 828,368 in 2000 to 1,241,226 passengers in 2015. Although activity is expected to increase regardless of the alternative chosen, the differences in the noise impacts associated with each alternative are the 1) impact that the RSA correction has on the operation of the Airport, or 2) construction associated with completing the alternative.

Table 4-7 summarizes the area predicted to be exposed to varying levels of noise for each alternative. As the table indicates, in 2015, there is a slight difference in area within the 65 DNL and greater noise contour among the alternatives (shown in the last column in Table 4-7). The largest 65 DNL and greater noise exposure area would be associated with RSA-5C, RSA-5D, and RSA-5E (at the Runway 26 end), and RSA-6D, with each of these being equal. By itself, this information does not reflect intensity of impact. As Section 4.2.1 described, the significance of noise levels and increases in noise level are based in part on the sensitivity of the land uses within the noise level contour. Section 4.3.2 discusses the noise effects on land uses in the vicinity of the Airport and the compatibility of those lands uses with noise intensity levels. Figures 4-2 through 4-6 illustrate the 65 DNL and greater noise exposure contours for each alternative.

Table 4-7. Summary of Aircraft Noise Changes due to RSA Alternatives (2015)[1]

Alternative	60-65 DNL	65-70 DNL	70-75 DNL	75+ DNL	65 DNL & Greater[2]
Alternative RSA-1/5D (Rwy 08)[3]	2.14	0.68	0.24	0.16	1.08
Alternative RSA-5C/5D/5E (Rwy 26)[3]	2.14	0.68	0.25	0.16	1.09
Alternative RSA-6A/5E (Rwy 08)[4]	2.13	0.68	0.24	0.16	1.08
Alternative RSA-6B	2.13	0.67	0.24	0.16	1.07
Alternative RSA-6C	2.14	0.68	0.24	0.16	1.08
Alternative RSA-6D	2.10	0.66	0.27	0.16	1.09
Alternative RSA-8	2.15	0.66	0.25	0.17	1.08
Baseline Conditions (year 2000)	2.29	0.82	0.30	0.24	1.36

[1] Area in Square Miles
[2] Total may not equal sum of 65-70, 70-75, and 75+ DNL contour intervals as a result of rounding.
Source: BridgeNet International, September 2004; Note: 65 DNL & Greater refers to the sum of area included in the 65-70 DNL, 70-75 DNL, and 75 DNL+ contours
[3] RSA-5D operational configuration is identical to RSA-1 at the Rwy 08 end and nearly identical to RSA-5C at the Rwy 26 end. The departure threshold for RSA-5E would be relocated 520 east of its current position at the Rwy 26 end. This is less of a shift than was analyzed for RSA-5C in the DEIS, which is what is depicted in this table. Noise impacts from RSA-5E would, therefore, be similar to RSA-5C for the Rwy 26 end.
[4] RSA-5E operational configuration is nearly identical to RSA-6A at the Rwy 08 end; the landing threshold for RSA-5E is displaced 120 feet east, while the landing threshold for RSA-6A is displaced 188 feet.
Note: The eastward shift of landing thresholds for Alternative RSA-5C was reduced by 172 feet following issuance of the DEIS. The numbers presented here are from the DEIS analysis and are considered conservative for this alternative. The reduced shift of RSA-5C is within 46 feet of the eastward Rwy 26 landing threshold shift for Alternative RSA-5D.

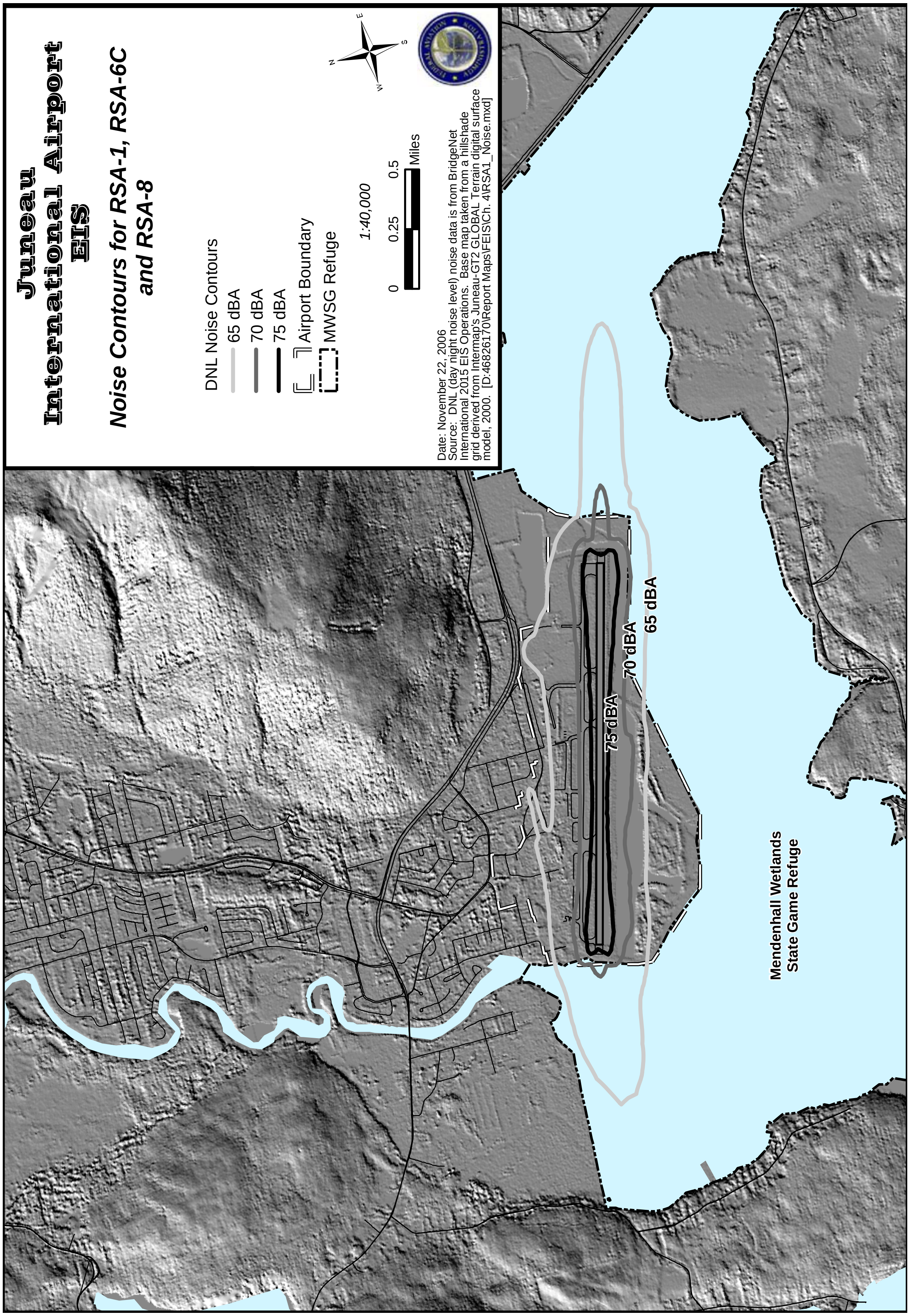


Figure 4-2. Noise exposure contours-future (2015) Alternatives RSA-1, RSA-6C and RSA-8.

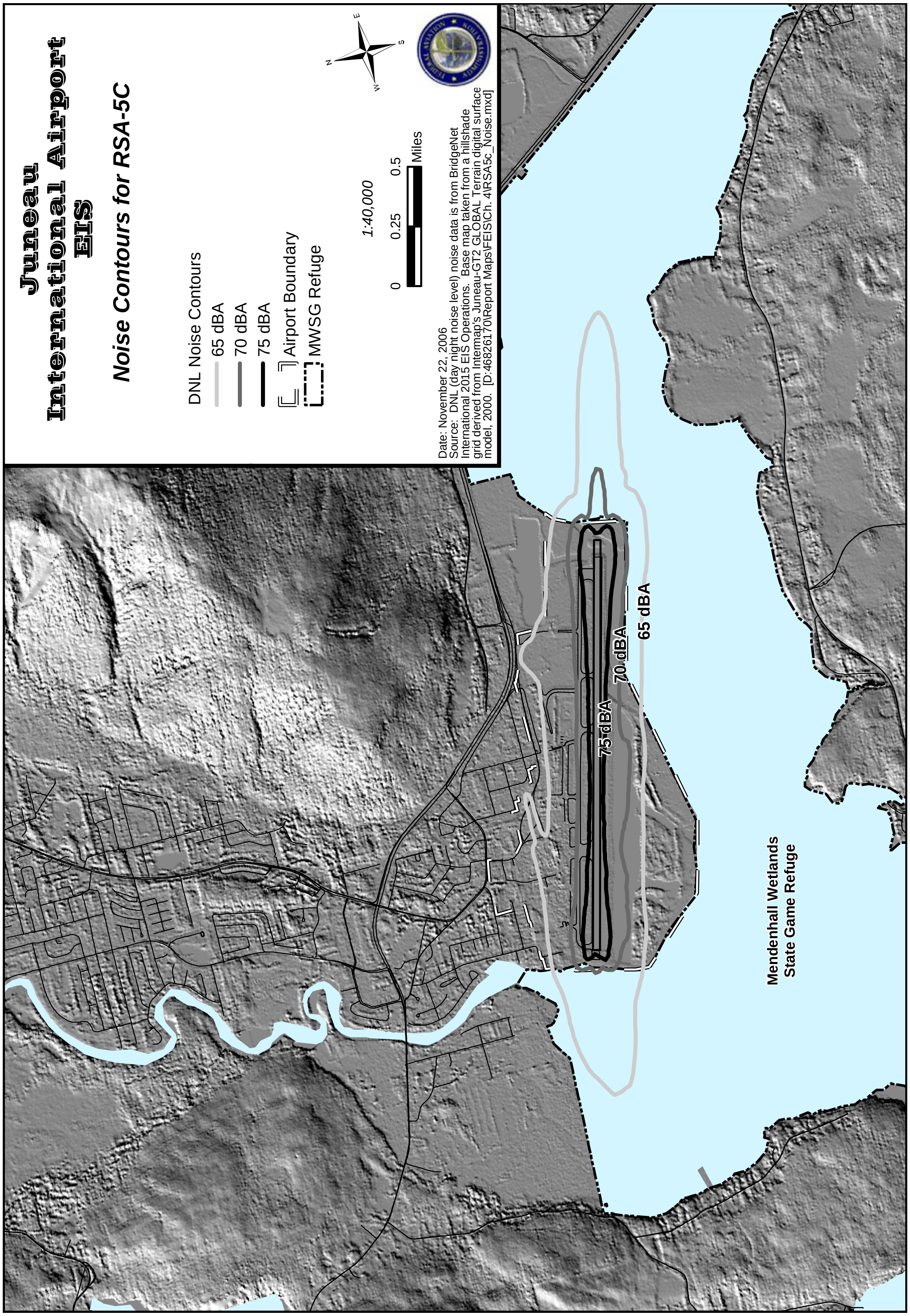


Figure 4-3. Noise exposure contours-future (2015) Alternative RSA-5C.

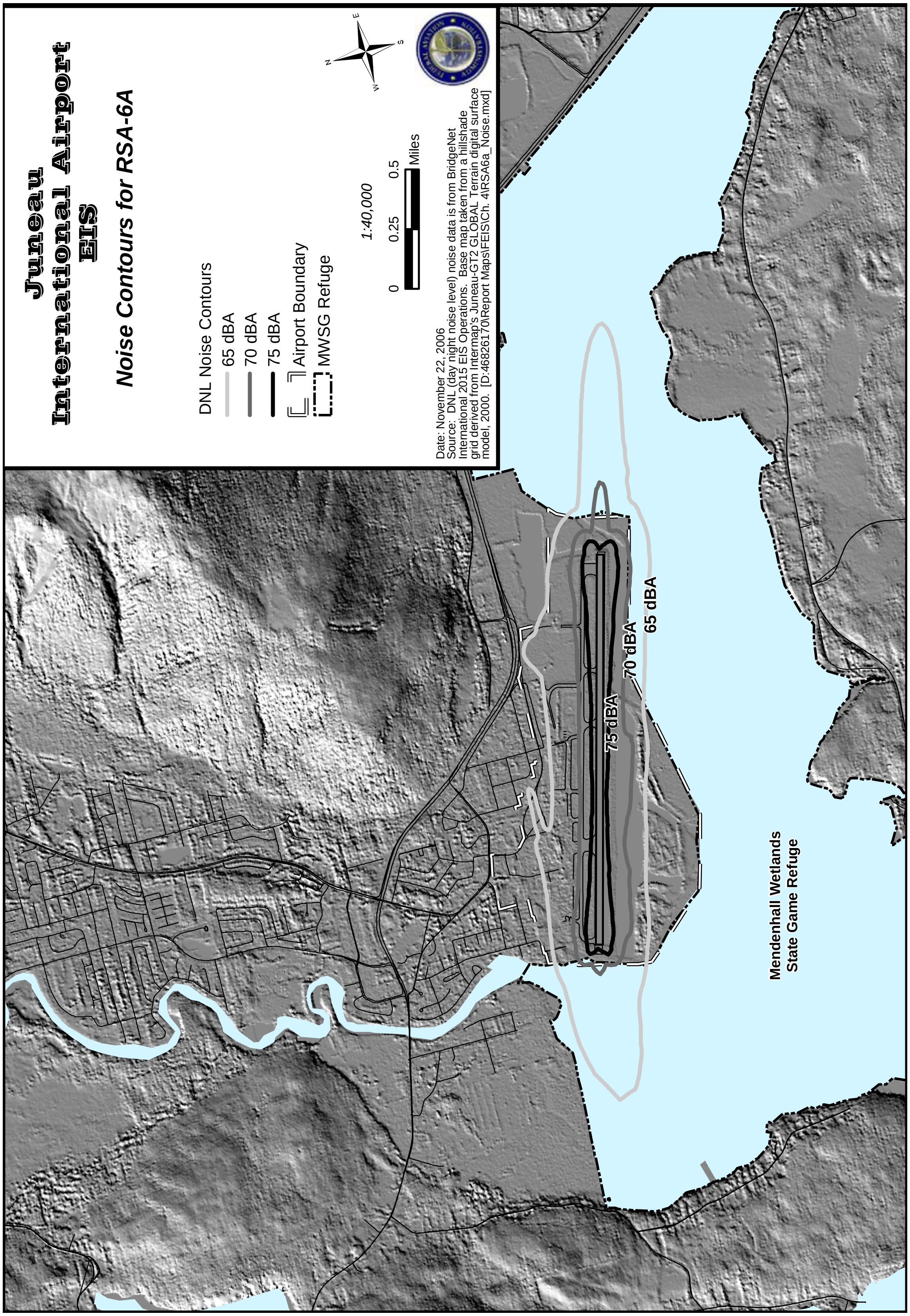


Figure 4-4. Noise exposure contours-future (2015) Alternatives RSA-6A.

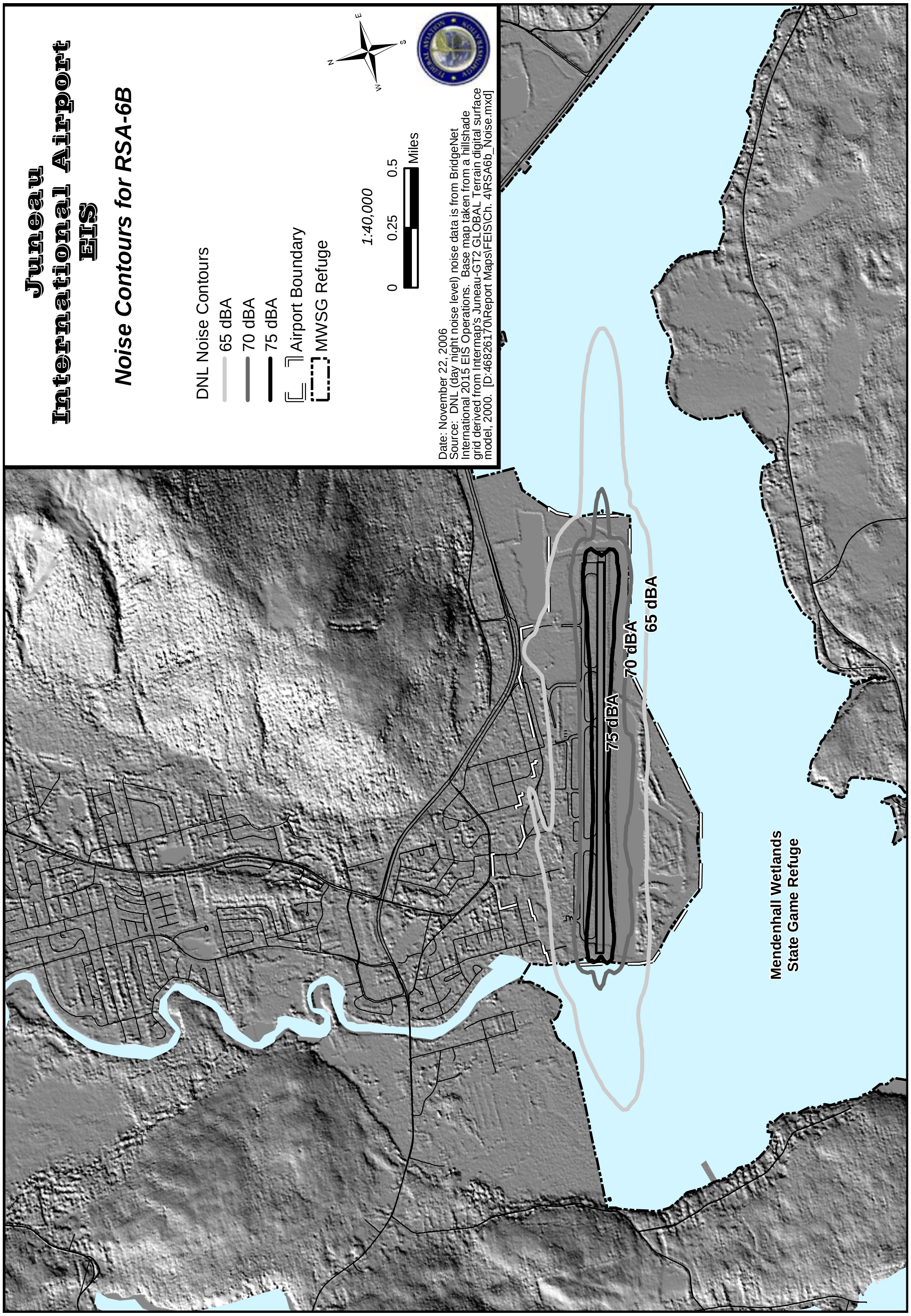


Figure 4-5. Noise exposure contours-future (2015) Alternatives RSA-6B.

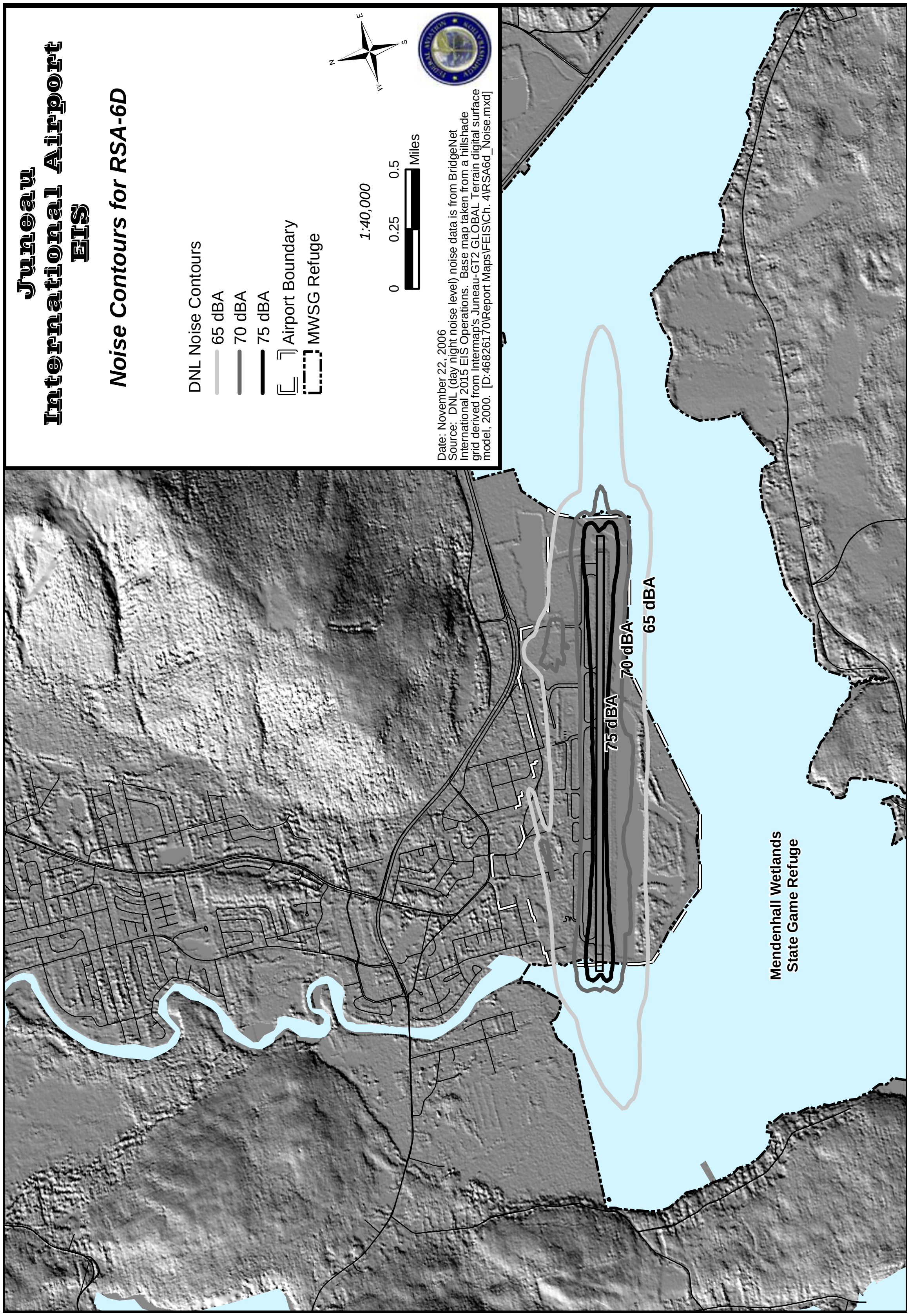


Figure 4-6. Noise exposure contours-future (2015) Alternatives RSA-6D.

Readers should note that the noise analysis conducted for the Draft EIS indicated that no significant noise impacts would result from any of the RSA alternatives contained in that document. The runway threshold changes for Alternatives RSA-5D and RSA-5E, which are modifications of alternatives analyzed in the Draft EIS, were within the range of analysis conducted for that document. As such, FAA determined that no new noise modeling was needed for these two alternatives. The runway threshold shift for alternative RSA-6D is outside the range of parameters analyzed in the Draft EIS. Therefore, FAA determined that additional noise modeling was necessary for this alternative as part of the Final EIS.

Table 4-8 lists DNL data for 295 of the 1,048 grid sites on the edge of or within the 60 DNL noise contour for each alternative based on 0.1 nautical mile (approximately 600 feet) grid spacing.[4] This table shows the 1.5 DNL or greater increases for alternatives RSA-5C/5D/5E (Rwy 26 end), RSA-6A, RSA-6C, and RSA-6D. Alternatives RSA-5C and RSA-5D would result in as many as seven sites receiving 1.5 DNL or greater increases in noise, while Alternatives RSA-6A and RSA-6B, and RSA-5E (Rwy 08 end) would each increase noise by 1.5 DNL at one site within the 65 DNL or greater contour. RSA-6D would result in eight sites receiving 1.5 DNL or greater increases in noise. A few sites for each of these alternatives would experience a 1.5 DNL or greater decrease. Alternatives RSA-5C, RSA-5D, RSA-5E, RSA-6A, RSA-6B, and RSA-6D were each found to result in a 1.5 DNL or greater noise level increase within the 65 DNL or greater contour over the No Action Alternative. Only Alternatives RSA-5C, RSA-5D, RSA-5E (Rwy 26 end), and RSA-6D would produce a 1.5 DNL increase in noise off Airport property as well. Figure 4-7 shows the 1.5 DNL contour comparing RSA-5C/5D/5E and RSA-6A with RSA-8. Figure 4-8 shows the 1.5 DNL contour comparing RSA-6D with RSA-8. Figure 4-9 displays the locations of the noise grid used in this analysis.

Table 4-8. DNL Grid Analysis Table – All RSA Alternatives (600 ft. Grid)

Site	I	J	2000 Baseline	2015 RSA-8	Change in DNL over the No Action (RSA-8)				
					2015 RSA-1/ 5D[1]/6C	2015 RSA-5C/ 5D/5E[1]	2015 RSA-6A/5E[2]	2015 RSA-6B	2015 RSA-6D
79	5	7	60.2	59.1	0.0	-0.3	-0.1	0.0	0.0
97	6	7	60.4	59.2	0.0	-0.2	0.0	0.1	0.1
98	6	8	60.2	59.2	0.0	-0.2	-0.1	0.1	0.0
115	7	7	60.4	59.4	0.0	-0.3	-0.1	0.0	-0.1
116	7	8	60.9	59.8	0.0	-0.3	-0.1	0.1	0.1
133	8	7	60.8	59.8	0.0	-0.3	-0.1	0.0	-0.1
134	8	8	62.1	60.9	0.0	-0.4	-0.1	0.1	0.1
135	8	9	60.9	60.0	0.0	-0.3	-0.1	0.0	-0.1

4. The remaining 753 grid sites receive or are predicted to receive aircraft noise exposure that is less than 65 DNL. The entire grid is shown in Appendix C.

Table 4-8. DNL Grid Analysis Table – All RSA Alternatives (600 ft. Grid), continued

Site	I	J	2000 Baseline	2015 RSA-8	Change in DNL over the No Action (RSA-8)				
					2015 RSA-1/ 5D[1]/6C	2015 RSA-5C/ 5D/5E[1]	2015 RSA-6A/5E[2]	2015 RSA-6B	2015 RSA-6D
151	9	7	60.9	60.0	0.0	-0.2	-0.1	-0.1	-0.2
152	9	8	63.2	61.9	0.0	-0.4	-0.1	0.1	0.1
153	9	9	62.5	61.3	0.0	-0.3	-0.1	0.1	0.0
169	10	7	60.6	59.9	0.0	-0.3	-0.1	-0.2	-0.4
170	10	8	63.5	62.2	0.0	-0.4	-0.1	0.2	0.2
171	10	9	63.4	62.2	0.0	-0.4	-0.1	0.2	0.2
172	10	10	60.8	60.4	0.0	-0.3	-0.1	-0.4	-0.6
188	11	8	62.7	61.6	0.0	-0.4	-0.1	0.1	-0.1
189	11	9	63.3	62.1	0.0	-0.4	-0.1	0.2	0.1
190	11	10	61.6	61.0	0.0	-0.4	-0.1	-0.1	-0.3
206	12	8	62.0	61.1	0.0	-0.4	-0.1	0.0	-0.2
207	12	9	63.3	62.2	0.0	-0.5	-0.1	0.1	0.0
208	12	10	62.1	61.4	0.0	-0.4	-0.1	0.0	-0.2
224	13	8	61.6	60.9	0.0	-0.2	0.0	0.0	-0.2
225	13	9	63.6	62.5	0.0	-0.4	-0.1	0.1	0.1
226	13	10	63.0	62.1	0.0	-0.3	-0.1	0.0	-0.1
227	13	11	60.5	60.3	0.0	-0.2	-0.1	-0.2	-0.3
242	14	8	61.5	61.0	0.0	-0.3	-0.1	-0.1	-0.4
243	14	9	63.8	62.8	0.0	-0.4	-0.1	0.1	0.0
244	14	10	63.9	62.9	0.0	-0.3	-0.1	0.1	0.1
245	14	11	61.6	61.2	0.0	-0.2	0.0	-0.1	-0.3
259	15	7	60.5	60.2	0.0	-0.2	-0.1	0.0	-0.2
260	15	8	62.0	61.5	0.0	-0.3	-0.1	-0.1	-0.3
261	15	9	64.2	63.2	0.0	-0.3	-0.1	0.0	-0.2
262	15	10	64.8	63.8	0.0	-0.4	-0.1	0.2	0.1
263	15	11	62.7	62.3	0.0	-0.3	-0.1	-0.1	-0.3
275	16	5	60.1	59.3	0.0	-0.2	0.0	0.0	0.0
276	16	6	61.1	60.4	0.0	-0.3	-0.1	0.0	-0.1

Table 4-8. DNL Grid Analysis Table – All RSA Alternatives (600 ft. Grid), continued

Site	I	J	2000 Baseline	2015 RSA-8	Change in DNL over the No Action (RSA-8) 2015 RSA-1/ 5D[1]/6C	2015 RSA-5C/ 5D/5E[1]	2015 RSA-6A/5E[2]	2015 RSA-6B	2015 RSA-6D
277	16	7	62.0	61.3	0.0	-0.3	-0.1	0.0	-0.1
278	16	8	62.9	62.3	0.0	-0.3	-0.1	-0.1	-0.3
279	16	9	64.6	63.7	0.0	-0.3	-0.1	-0.1	-0.2
280	16	10	65.9	64.8	0.0	-0.4	-0.1	0.2	0.1
281	16	11	64.1	63.5	0.0	-0.3	-0.1	-0.1	-0.3
282	16	12	60.7	60.9	0.0	-0.2	0.0	-0.1	-0.3
292	17	4	60.0	59.1	0.0	-0.2	-0.1	0.0	0.0
293	17	5	60.7	59.9	0.0	-0.2	-0.1	0.0	-0.1
294	17	6	61.4	60.7	0.0	-0.2	0.0	0.0	0.0
295	17	7	62.3	61.7	0.0	-0.3	-0.1	0.0	-0.1
296	17	8	63.4	62.8	0.0	-0.3	-0.1	-0.1	-0.2
297	17	9	65.1	64.2	0.0	-0.3	-0.1	-0.1	-0.3
298	17	10	66.6	65.5	0.0	-0.4	-0.2	0.2	0.1
299	17	11	65.8	65.0	0.0	-0.4	-0.2	-0.1	-0.2
300	17	12	62.0	62.1	0.0	-0.2	0.0	-0.2	-0.4
311	18	5	60.0	59.5	0.0	-0.1	0.0	0.0	0.0
312	18	6	60.2	60.1	0.0	-0.1	0.0	0.0	-0.1
313	18	7	61.0	61.0	0.0	-0.1	0.0	0.1	-0.1
314	18	8	62.8	62.5	0.0	-0.2	0.0	0.0	-0.1
315	18	9	64.8	64.2	0.0	-0.3	-0.1	-0.1	-0.2
316	18	10	67.3	66.2	0.0	-0.5	-0.2	0.0	-0.1
317	18	11	67.0	66.1	0.0	-0.4	-0.1	0.3	0.2
318	18	12	63.6	63.5	0.0	-0.2	-0.1	-0.4	-0.6
319	18	13	59.8	60.4	0.0	-0.1	0.0	0.0	0.0
331	19	7	59.3	60.3	0.0	-0.1	-0.1	0.0	-0.1
332	19	8	61.4	61.8	0.0	-0.1	0.0	0.0	0.0
333	19	9	64.1	63.9	0.0	-0.2	-0.1	-0.1	-0.2
334	19	10	67.1	66.2	0.0	-0.3	-0.1	0.0	0.0

Table 4-8. DNL Grid Analysis Table – All RSA Alternatives (600 ft. Grid), continued

Site	I	J	2000 Baseline	2015 RSA-8	Change in DNL over the No Action (RSA-8) 2015 RSA-1/ 5D[1]/6C	2015 RSA-5C/ 5D/5E[1]	2015 RSA-6A/5E[2]	2015 RSA-6B	2015 RSA-6D
335	19	11	68.4	67.3	0.0	-0.4	-0.1	0.5	0.5
336	19	12	65.0	64.7	0.0	-0.3	-0.1	-0.6	-0.7
337	19	13	60.9	61.2	0.0	-0.2	-0.1	0.0	0.2
349	20	7	58.9	60.0	0.0	0.0	0.0	0.1	0.0
350	20	8	61.1	61.6	0.0	-0.1	0.0	0.1	0.0
351	20	9	64.0	63.8	0.0	-0.2	-0.1	0.0	0.2
352	20	10	67.3	66.4	0.0	-0.3	-0.1	-0.4	0.6
353	20	11	69.7	68.5	0.0	-0.6	-0.2	0.8	0.9
354	20	12	66.2	65.7	0.0	-0.4	-0.1	-0.5	0.6
355	20	13	62.5	62.1	0.0	-0.2	-0.1	0.1	0.4
368	21	8	61.3	61.5	0.0	-0.1	-0.1	0.0	-0.1
369	21	9	64.9	64.0	0.0	-0.2	-0.1	0.1	0.1
370	21	10	69.8	67.5	0.0	-0.2	-0.1	0.6	1.4
371	21	11	71.9	70.4	0.0	-0.8	-0.3	0.9	3.2
372	21	12	69.4	67.2	0.0	-0.2	-0.1	0.7	1.4
373	21	13	64.3	63.1	0.0	-0.1	0.0	0.1	0.2
374	21	14	60.2	59.6	0.0	0.0	0.0	0.1	0.1
386	22	8	61.3	61.1	0.0	0.0	0.0	0.0	0.0
387	22	9	65.5	64.1	0.0	0.0	0.0	0.1	-0.1
388	22	10	72.9	69.5	0.0	-0.1	0.0	0.3	0.2
389	22	11	80.7	76.8	0.0	-1.0	-0.4	20.5	19.6
390	22	12	72.3	69.1	0.0	-0.1	0.0	0.3	0.1
391	22	13	65.2	63.7	0.0	-0.1	0.0	0.0	-0.1
392	22	14	60.5	59.8	0.0	0.0	0.0	0.0	0.0
404	23	8	60.9	60.6	0.0	0.1	0.0	0.0	0.0
405	23	9	65.6	64.1	0.0	0.0	0.0	-0.1	-0.3
406	23	10	77.2	74.2	0.0	0.0	0.0	0.0	-0.3
407	23	11	103.9	98.4	0.0	-0.1	-0.1	-1.1	-0.9

Table 4-8. DNL Grid Analysis Table – All RSA Alternatives (600 ft. Grid), continued

Site	I	J	2000 Baseline	2015 RSA-8	Change in DNL over the No Action (RSA-8) 2015 RSA-1/ 5D[1]/6C	2015 RSA-5C/ 5D/5E[1]	2015 RSA-6A/5E[2]	2015 RSA-6B	2015 RSA-6D
408	23	12	73.0	69.6	0.0	-0.1	0.0	-0.2	-0.9
409	23	13	65.4	63.9	0.0	0.0	0.0	-0.1	-0.2
410	23	14	60.4	59.7	0.0	0.1	0.0	-0.1	0.0
422	24	8	60.4	60.1	0.0	0.1	0.0	0.0	0.0
423	24	9	65.0	63.7	0.0	0.0	0.0	0.0	-0.1
424	24	10	76.1	73.2	0.0	0.0	0.0	0.0	-0.1
425	24	11	98.6	92.6	0.0	0.1	0.2	-0.8	-2.3
426	24	12	72.0	68.5	0.0	-0.2	0.0	-0.1	-0.4
427	24	13	65.4	64.3	0.0	0.0	0.0	-0.1	-0.1
428	24	14	60.1	59.5	0.0	0.2	0.1	0.0	0.1
440	25	8	60.0	59.9	0.0	0.0	0.0	0.0	0.0
441	25	9	64.5	63.5	0.0	0.0	0.0	0.0	0.0
442	25	10	73.3	70.7	0.0	0.0	0.0	-0.1	0.1
443	25	11	95.7	89.1	0.0	0.2	0.0	-0.5	-1.5
444	25	12	71.3	68.1	0.0	0.0	0.0	-0.1	-0.2
445	25	13	67.6	67.6	0.0	0.0	0.0	0.0	0.0
446	25	14	60.0	59.8	0.0	0.1	0.0	0.0	0.1
459	26	9	64.2	63.5	0.0	0.0	0.0	0.0	0.0
460	26	10	71.6	69.7	0.0	-0.1	0.0	0.0	-0.2
461	26	11	93.5	87.3	0.0	-0.5	-0.1	-0.2	-1.5
462	26	12	70.9	68.1	0.0	-0.1	0.0	0.0	-0.2
463	26	13	65.9	65.8	0.0	0.0	0.0	0.0	0.0
464	26	14	60.3	60.6	0.0	0.0	0.0	0.0	0.0
477	27	9	63.9	63.3	0.0	0.1	0.0	0.0	0.2
478	27	10	71.4	71.3	0.0	0.0	0.0	0.0	0.0
479	27	11	92.8	87.5	0.0	-1.1	-0.1	-0.2	-1.8
480	27	12	70.5	68.2	0.0	-0.1	0.0	0.0	-0.2
481	27	13	64.4	64.2	0.0	0.1	0.0	0.0	0.1

Table 4-8. DNL Grid Analysis Table – All RSA Alternatives (600 ft. Grid), continued

Site	I	J	2000 Baseline	2015 RSA-8	Change in DNL over the No Action (RSA-8) 2015 RSA-1/ 5D[1]/6C	2015 RSA-5C/ 5D/5E[1]	2015 RSA-6A/5E[2]	2015 RSA-6B	2015 RSA-6D
482	27	14	60.3	60.6	0.0	0.3	0.1	0.0	0.3
495	28	9	63.8	63.3	0.0	0.1	0.0	0.0	0.2
496	28	10	72.4	74.8	0.0	-0.1	0.0	0.0	-0.1
497	28	11	93.9	90.8	0.0	-0.5	0.0	-0.1	-1.2
498	28	12	70.0	68.4	0.0	-0.2	-0.1	-0.1	-0.2
499	28	13	63.9	63.8	0.0	0.1	0.0	0.0	0.2
512	29	8	60.2	59.5	0.0	0.3	0.1	0.1	0.4
513	29	9	64.0	63.4	0.0	0.3	0.1	0.1	0.4
514	29	10	72.8	75.5	0.0	0.0	0.0	0.0	0.0
515	29	11	92.8	93.7	0.0	-2.0	-0.1	0.0	-1.5
516	29	12	70.1	68.5	0.0	-0.1	0.0	0.0	-0.1
517	29	13	64.2	63.9	0.0	0.2	0.1	0.0	0.4
530	30	8	60.9	59.8	0.0	0.1	0.0	0.0	0.3
531	30	9	64.4	63.2	0.0	0.2	0.0	0.0	0.3
532	30	10	70.6	69.6	0.0	-0.1	-0.1	0.0	-0.1
533	30	11	91.2	92.7	0.0	-0.5	-0.3	-1.0	-0.7
534	30	12	70.6	68.6	0.0	-0.1	-0.1	0.0	-0.1
535	30	13	65.1	64.4	0.0	0.1	0.0	0.0	0.2
548	31	8	61.7	60.2	0.0	0.0	0.0	0.0	0.1
549	31	9	64.9	63.0	0.0	0.1	0.0	0.0	0.1
550	31	10	70.9	69.3	0.0	-0.2	-0.1	0.0	-0.3
551	31	11	90.8	91.3	0.0	-0.4	-0.4	0.0	-1.2
552	31	12	71.1	68.7	0.0	-0.2	0.0	0.0	-0.2
553	31	13	66.1	65.2	0.0	0.1	0.0	0.0	0.1
554	31	14	60.0	58.5	0.0	0.1	0.0	0.0	0.3
565	32	7	60.3	59.7	0.0	0.0	-0.1	0.0	0.0
566	32	8	62.3	60.6	0.0	0.0	0.0	0.0	0.0
567	32	9	65.4	63.2	0.0	0.0	0.0	0.0	0.0

Table 4-8. DNL Grid Analysis Table – All RSA Alternatives (600 ft. Grid), continued

Site	I	J	2000 Baseline	2015 RSA-8	Change in DNL over the No Action (RSA-8) 2015 RSA-1/ 5D[1]/6C	2015 RSA-5C/ 5D/5E[1]	2015 RSA-6A/5E[2]	2015 RSA-6B	2015 RSA-6D
568	32	10	71.0	69.2	0.0	-0.2	0.0	0.0	-0.3
569	32	11	91.7	92.3	0.0	-1.3	-0.5	0.1	-1.6
570	32	12	71.2	68.9	0.0	-0.2	0.0	0.0	-0.3
571	32	13	68.7	68.4	0.0	0.0	0.0	0.0	0.0
572	32	14	60.8	59.1	0.0	0.1	0.0	0.1	0.1
583	33	7	60.5	60.1	0.0	-0.1	-0.2	0.0	0.0
584	33	8	62.5	60.9	0.0	0.0	0.0	0.0	0.0
585	33	9	65.7	63.3	0.0	0.0	0.0	0.0	0.0
586	33	10	70.9	69.3	0.0	-0.3	-0.2	0.0	-0.3
587	33	11	92.9	93.7	0.0	-1.5	-0.6	0.1	-1.5
588	33	12	71.1	69.2	0.0	-0.3	-0.2	0.0	-0.3
589	33	13	69.6	69.4	0.0	-0.1	-0.1	0.0	0.0
590	33	14	63.0	62.2	0.0	0.0	0.0	0.0	0.0
601	34	7	60.5	60.1	0.0	-0.1	-0.1	0.0	0.0
602	34	8	62.6	61.1	0.0	-0.2	-0.1	-0.1	-0.2
603	34	9	65.9	63.5	0.0	-0.3	-0.1	0.0	-0.3
604	34	10	70.8	69.6	0.0	-0.6	-0.2	-0.1	-0.5
605	34	11	94.8	96.4	0.0	-2.9	-1.0	-0.1	-2.3
606	34	12	71.0	69.6	0.0	-0.6	-0.2	-0.1	-0.5
607	34	13	67.4	66.2	0.0	-0.1	0.0	0.0	-0.1
608	34	14	62.8	61.5	0.0	-0.1	0.0	0.0	0.0
619	35	7	60.5	60.2	0.0	-0.2	-0.2	-0.1	-0.1
620	35	8	62.8	61.3	0.0	-0.2	-0.1	0.0	-0.1
621	35	9	66.0	63.9	0.0	-0.5	-0.1	0.0	-0.4
622	35	10	71.0	70.8	0.0	-1.4	-0.4	0.0	-1.4
623	35	11	96.6	98.7	0.0	-2.5	-1.6	-0.1	-3.1
624	35	12	71.0	70.6	0.0	-1.3	-0.3	0.0	-1.4
625	35	13	66.3	64.5	0.0	-0.4	-0.1	0.0	-0.4

Table 4-8. DNL Grid Analysis Table – All RSA Alternatives (600 ft. Grid), continued

Site	I	J	2000 Baseline	2015 RSA-8	Change in DNL over the No Action (RSA-8) 2015 RSA-1/ 5D[1]/6C	2015 RSA-5C/ 5D/5E[1]	2015 RSA-6A/5E[2]	2015 RSA-6B	2015 RSA-6D
626	35	14	62.6	60.8	0.0	-0.2	-0.1	0.0	-0.1
637	36	7	60.5	60.1	0.0	-0.2	-0.3	0.0	0.0
638	36	8	63.0	61.6	0.0	-0.2	-0.2	0.0	0.0
639	36	9	65.8	64.1	0.0	-0.2	0.0	0.0	-0.1
640	36	10	70.4	70.3	0.0	0.3	0.5	0.0	0.4
641	36	11	76.9	79.2	0.0	17.9	19.5	-0.3	17.9
642	36	12	70.5	70.2	0.0	0.4	0.5	0.0	0.4
643	36	13	66.0	64.1	0.0	0.0	0.1	0.0	0.0
644	36	14	62.6	60.4	0.0	-0.1	0.0	0.0	-0.1
655	37	7	60.3	59.6	0.0	0.0	-0.2	0.0	0.1
656	37	8	62.9	61.5	0.0	0.0	-0.1	-0.1	0.1
657	37	9	65.5	63.7	0.0	0.4	0.1	0.0	0.5
658	37	10	68.7	67.8	0.0	2.4	1.1	0.0	2.5
659	37	11	70.8	72.7	0.0	14.1	0.2	-0.4	4.5
660	37	12	68.6	67.3	0.0	2.8	1.4	-0.1	2.8
661	37	13	65.5	63.1	0.0	0.7	0.3	0.0	0.6
662	37	14	62.5	59.9	0.0	0.3	0.1	0.1	0.3
673	38	7	60.2	59.1	0.0	0.0	-0.1	-0.1	0.1
674	38	8	62.8	61.6	0.0	0.1	-0.3	-0.1	0.3
675	38	9	65.0	63.2	0.0	0.8	0.1	0.0	0.9
676	38	10	67.1	65.2	0.0	2.6	0.3	0.0	2.6
677	38	11	69.6	71.0	0.0	1.5	0.2	-0.2	0.0
678	38	12	66.9	63.8	0.0	3.5	0.7	0.0	3.3
679	38	13	64.8	61.7	0.0	1.3	0.4	0.0	1.2
680	38	14	62.2	59.3	0.0	0.4	0.1	0.0	0.4
692	39	8	62.3	60.3	0.0	0.7	0.4	0.0	0.4
693	39	9	64.5	62.3	0.0	0.8	0.3	-0.1	0.5
694	39	10	66.6	64.6	0.0	0.4	0.3	0.0	0.1

Table 4-8. DNL Grid Analysis Table – All RSA Alternatives (600 ft. Grid), continued

Site	I	J	2000 Baseline	2015 RSA-8	Change in DNL over the No Action (RSA-8)				
					2015 RSA-1/ 5D[1]/6C	2015 RSA-5C/ 5D/5E[1]	2015 RSA-6A/5E[2]	2015 RSA-6B	2015 RSA-6D
695	39	11	68.7	69.7	0.0	1.1	0.2	-0.2	0.0
696	39	12	66.4	63.3	0.0	0.4	0.3	0.0	0.1
697	39	13	64.3	60.7	0.0	0.8	0.2	0.0	0.7
698	39	14	62.0	58.6	0.0	0.5	0.2	0.0	0.5
710	40	8	61.9	58.7	0.0	1.2	0.9	0.0	0.2
711	40	9	64.0	60.8	0.0	1.2	0.9	0.0	0.2
712	40	10	66.1	64.0	0.0	0.4	0.5	0.0	-0.1
713	40	11	67.9	68.6	0.0	0.9	0.1	-0.2	-0.1
714	40	12	66.0	63.3	0.0	-0.1	0.1	0.0	-0.2
715	40	13	64.0	60.1	0.0	0.4	0.1	0.0	0.3
716	40	14	61.8	58.1	0.0	0.3	0.1	0.0	0.3
728	41	8	61.6	57.7	0.0	0.6	0.6	0.0	0.1
729	41	9	63.6	60.0	0.0	0.5	0.5	0.0	-0.1
730	41	10	65.6	63.7	0.0	0.1	0.2	0.0	-0.1
731	41	11	67.2	67.6	0.0	0.7	0.1	-0.2	0.0
732	41	12	65.6	63.4	0.0	-0.1	0.0	-0.1	-0.2
733	41	13	63.7	59.9	0.0	-0.1	0.0	-0.1	-0.2
734	41	14	61.5	57.7	0.0	0.1	0.0	-0.1	0.0
746	42	8	61.3	57.4	0.0	0.1	0.1	-0.1	-0.1
747	42	9	63.3	59.8	0.0	0.0	0.1	0.0	-0.1
748	42	10	65.2	63.7	0.0	-0.1	0.0	-0.1	-0.1
749	42	11	66.5	66.8	0.0	0.6	0.0	-0.2	-0.1
750	42	12	65.2	63.4	0.0	0.0	0.0	-0.1	-0.1
751	42	13	63.3	59.6	0.0	0.0	0.1	0.0	-0.1
752	42	14	61.2	57.3	0.0	0.0	0.0	0.0	0.0
764	43	8	61.1	57.2	0.0	0.0	0.0	0.0	-0.1
765	43	9	63.0	59.7	0.0	-0.1	0.0	0.0	-0.1
766	43	10	64.9	63.6	0.0	0.0	-0.1	-0.1	-0.1

Table 4-8. DNL Grid Analysis Table – All RSA Alternatives (600 ft. Grid), continued

Site	I	J	2000 Baseline	2015 RSA-8	Change in DNL over the No Action (RSA-8) 2015 RSA-1/ 5D[1]/6C	2015 RSA-5C/ 5D/5E[1]	2015 RSA-6A/5E[2]	2015 RSA-6B	2015 RSA-6D
767	43	11	66.0	66.1	0.0	0.5	0.0	-0.2	-0.1
768	43	12	64.8	63.3	0.0	0.1	0.1	0.0	-0.1
769	43	13	63.0	59.5	0.0	-0.1	0.0	0.0	-0.2
770	43	14	60.9	57.0	0.0	0.0	0.0	0.0	-0.1
782	44	8	60.9	57.1	0.0	0.0	0.0	0.0	-0.1
783	44	9	62.7	59.7	0.0	-0.1	0.0	0.0	-0.1
784	44	10	64.5	63.4	0.0	0.1	0.0	-0.1	-0.1
785	44	11	65.4	65.4	0.0	0.4	0.0	-0.1	0.0
786	44	12	64.4	63.2	0.0	0.2	0.0	0.0	-0.1
787	44	13	62.6	59.4	0.0	-0.1	0.0	0.0	-0.1
788	44	14	60.5	56.8	0.0	0.0	0.0	0.0	-0.1
800	45	8	60.7	57.2	0.0	-0.1	0.0	-0.1	-0.2
801	45	9	62.5	59.7	0.0	-0.1	0.0	0.0	-0.1
802	45	10	64.1	63.2	0.0	0.2	0.0	0.0	0.0
803	45	11	64.8	64.8	0.0	0.4	0.0	-0.1	0.0
804	45	12	63.9	63.1	0.0	0.1	0.0	-0.1	-0.1
805	45	13	62.1	59.4	0.0	-0.1	0.0	-0.1	-0.2
806	45	14	60.1	56.6	0.0	0.0	0.0	0.0	-0.1
818	46	8	60.5	57.3	0.0	-0.1	0.0	-0.1	-0.2
819	46	9	62.2	59.8	0.0	0.0	0.0	0.0	-0.1
820	46	10	63.7	63.0	0.0	0.2	0.0	-0.1	-0.1
821	46	11	64.2	64.3	0.0	0.3	0.0	-0.1	-0.1
822	46	12	63.4	62.8	0.0	0.2	0.0	-0.1	-0.1
823	46	13	61.6	59.3	0.0	0.0	0.0	0.0	-0.1
836	47	8	60.2	57.4	0.0	-0.1	0.0	0.0	-0.1
837	47	9	61.8	59.9	0.0	0.0	0.0	0.0	-0.1
838	47	10	63.1	62.8	0.0	0.1	0.0	-0.1	-0.1
839	47	11	63.5	63.7	0.0	0.3	0.0	-0.1	0.0

Table 4-8. DNL Grid Analysis Table – All RSA Alternatives (600 ft. Grid), continued

Site	I	J	2000 Baseline	2015 RSA-8	Change in DNL over the No Action (RSA-8)				
					2015 RSA-1/ 5D[1]/6C	2015 RSA-5C/ 5D/5E[1]	2015 RSA-6A/5E[2]	2015 RSA-6B	2015 RSA-6D
840	47	12	62.7	62.4	0.0	0.2	0.0	-0.1	-0.1
841	47	13	60.9	59.1	0.0	0.0	0.0	0.0	-0.1
854	48	8	60.1	57.7	0.0	0.0	0.0	0.0	-0.1
855	48	9	61.5	60.3	0.0	0.0	0.0	-0.1	-0.1
856	48	10	62.5	62.5	0.0	0.2	0.0	-0.1	-0.1
857	48	11	62.7	63.2	0.0	0.2	0.0	-0.1	-0.1
858	48	12	61.8	61.9	0.0	0.1	0.0	-0.1	-0.1
859	48	13	60.0	58.8	0.0	0.0	0.0	-0.1	-0.1
872	49	8	60.0	58.4	0.0	-0.1	0.0	-0.1	-0.1
873	49	9	61.3	60.7	0.0	0.1	0.0	0.0	-0.1
874	49	10	62.0	62.3	0.0	0.2	0.0	-0.1	0.0
875	49	11	62.0	62.6	0.0	0.2	0.0	-0.1	-0.1
876	49	12	61.0	61.2	0.0	0.2	0.0	0.0	0.0
890	50	8	60.0	59.1	0.0	0.0	0.0	0.0	0.0
891	50	9	61.1	61.1	0.0	0.1	0.0	0.0	0.0
892	50	10	61.6	62.1	0.0	0.2	0.0	-0.1	-0.1
893	50	11	61.3	61.9	0.0	0.2	0.0	0.0	0.0
894	50	12	60.2	60.5	0.0	0.1	0.0	-0.1	0.0
908	51	8	60.1	59.9	0.0	0.1	0.0	-0.1	-0.1
909	51	9	60.8	61.3	0.0	0.1	0.0	-0.1	-0.1
910	51	10	61.0	61.8	0.0	0.2	0.0	0.0	0.0
911	51	11	60.5	61.3	0.0	0.1	0.0	-0.1	-0.1
926	52	8	60.1	60.4	0.0	0.1	0.0	-0.1	0.0
927	52	9	60.5	61.3	0.0	0.1	0.0	-0.1	-0.1
928	52	10	60.4	61.3	0.0	0.2	0.0	0.0	0.0
929	52	11	59.7	60.4	0.0	0.2	0.0	0.0	0.0
944	53	8	60.1	60.7	0.0	0.1	0.0	-0.1	-0.1
945	53	9	60.2	61.1	0.0	0.2	0.0	0.0	0.0

Table 4-8. DNL Grid Analysis Table – All RSA Alternatives (600 ft. Grid), continued

Site	I	J	2000 Baseline	2015 RSA-8	Change in DNL over the No Action (RSA-8) 2015 RSA-1/ 5D[1]/6C	2015 RSA-5C/ 5D/5E[1]	2015 RSA-6A/5E[2]	2015 RSA-6B	2015 RSA-6D
946	53	10	59.7	60.7	0.0	0.1	0.0	-0.1	0.0
961	54	7	59.5	60.0	0.0	0.1	0.0	-0.1	-0.1
962	54	8	59.9	60.7	0.0	0.2	0.0	0.0	0.0
963	54	9	59.7	60.7	0.0	0.1	0.0	-0.1	0.0
979	55	7	59.5	60.2	0.0	0.2	0.0	0.0	0.0
980	55	8	59.6	60.6	0.0	0.1	0.0	-0.1	0.0
981	55	9	59.1	60.1	0.0	0.1	0.0	0.0	0.0

Source: BridgeNet International, September 2004.
Note: Shaded cells represent sites where a 1.5 DNL or greater noise level increase would occur.
[1] RSA-5D operational configuration is identical to RSA-1 at the Rwy 08 end and nearly identical to RSA-5C at the Rwy 26 end. The departure threshold for RSA-5E would be relocated 520 east of its current position at the Rwy 26 end. This is less of a shift than was analyzed for RSA-5C in the DEIS, which is what is depicted in this table. Noise impacts from RSA-5E would, therefore, be similar to RSA-5C for the Rwy 26 end. Note: The eastward shift of landing thresholds for Alternative RSA-5C was reduced by 172 feet following issuance of the DEIS. The numbers presented here are from the DEIS analysis and are considered conservative for this alternative. The reduced shift of RSA-5C is within 46 feet of the eastward Rwy 26 landing threshold shift for Alternative RSA-5D.
[2] RSA-5E operational configuration is nearly identical to RSA-6A at the Rwy 08 end; the landing threshold for RSA-5E is displaced 120 feet east, while the landing threshold for RSA-6A is displaced 188 feet.

The following sections describe the predicted noise exposure contours developed for each of the alternatives, with the focus of analysis determining whether the noted increases would be deemed significant according to the criteria established in Section 4.2.1. For these evaluations, the existing flight tracks and percentage of runway use were factors, as were the forecast aircraft operations for year 2015 and fleet mix as described in Chapter 1. The data input to the INM assumed all arrival flight tracks to be straight-in for a distance of 5 miles. Future levels of activity for each alternative would be expected to use the runway system and flight tracks in the same proportion as occurs today. Based on these assumptions, aircraft noise exposure contours were developed for each alternative. The projected noise levels were then compared to the No Action Alternative, RSA-8.

4.3.1.1 Alternative RSA-1

Figure 4-2 shows the RSA-1 noise exposure contour for year 2015. In 2015, the total area (including Airport property) that would be exposed to 65 DNL and greater noise levels would be 1.08 square miles, extending from approximately 2,970 feet west of Runway 08 to approximately 3,465 feet east of Runway 26. The severe noise exposure contour of 75 DNL and greater would affect 0.16 square mile of land, all on Airport property. Under the RSA-1 alternative, the area affected by 65 DNL and greater noise levels in the future would be reduced from present conditions by approximately 20%. Although Alaska Airlines operates aircraft meeting Stage 3 noise

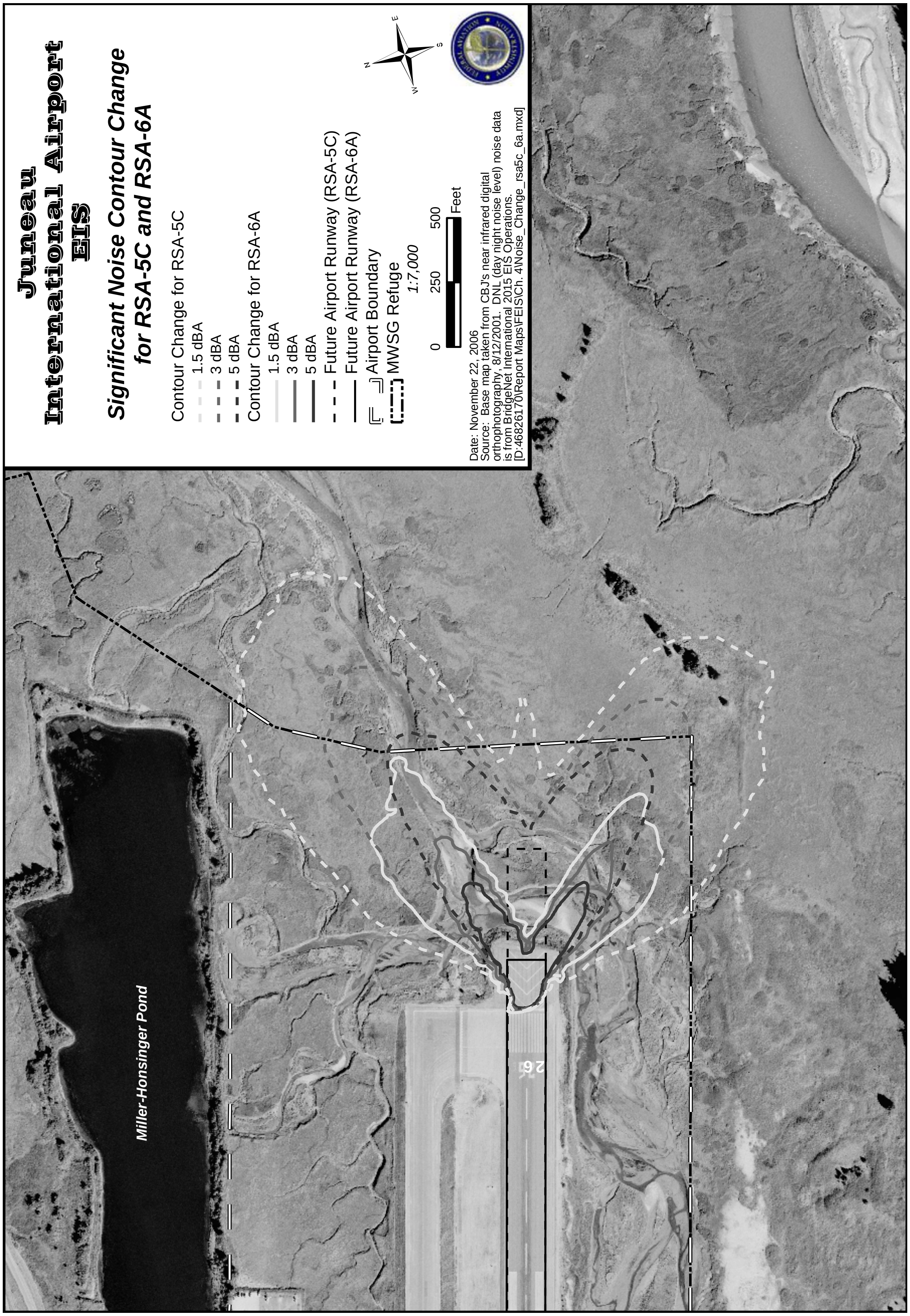


Figure 4-7. Noise exposure change contour-RSA-5C and RSA-6A.

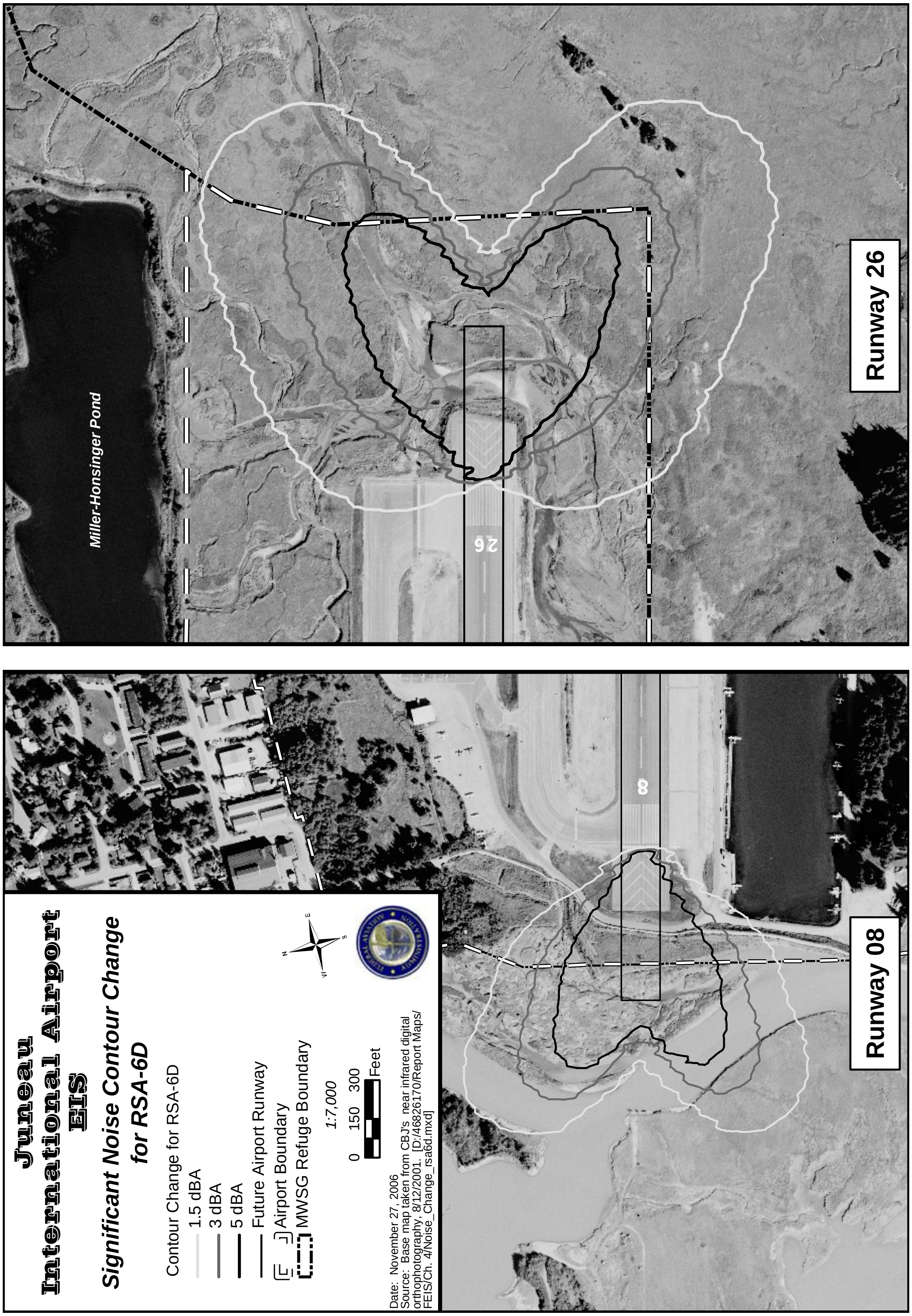


Figure 4-8. Noise exposure change contour-RSA-6D.

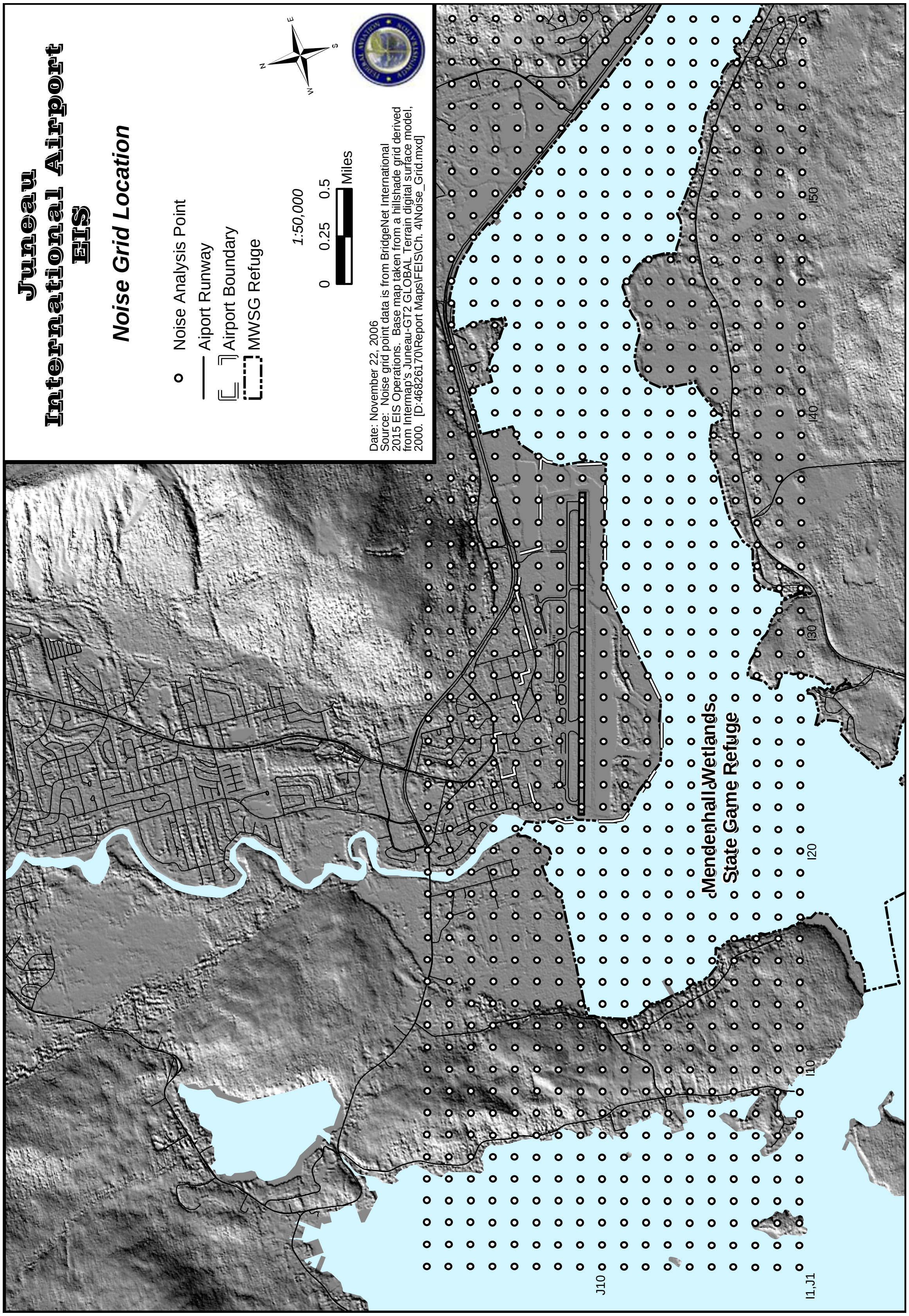


Figure 4-9. Noise grid location map.

levels, continued reductions are expected as new manufactured aircraft, meeting lower noise levels, are placed in operation and older, Stage 2 aircraft are retired. This decrease would occur despite the increased level of aircraft operations projected for the year 2015.

Relative to the No Action Alternative, RSA-8, no area within the 65 DNL and greater noise exposure contour for RSA-1 would experience a 1.5 DNL increase. Therefore, the changes in aircraft noise exposure with RSA-1 would not be significant, as defined by FAA Orders 5050.4B and 1050.1E. No area within the 60-65 DNL contour would experience a 3.0 DNL increase.

4.3.1.2 Alternative RSA-5C

With Alternative RSA-5C, the Runway 08 landing threshold would be displaced to the east, while the Runway 26 threshold would be relocated to the east. As a result, relative to existing conditions, aircraft would typically be at a higher altitude on approach to the runway from the west but slightly lower when approaching the runway from the east. Therefore, the location of the landing flight tracks was altered to reflect the displaced or relocated thresholds that would be instituted for each runway end.

The noise exposure contours for RSA-5C are shown in Figure 4-3. In 2015, the total area (including Airport property) that would be exposed to 65 DNL and greater noise levels would be 1.09 square miles, extending from approximately 2,640 feet west of Runway 08 to approximately 3,218 feet east of Runway 26. Approximately 0.16 square miles of land on Airport property would be encompassed within the severe noise exposure contour of 75 DNL and greater.

Relative to RSA-8, the No Action Alternative, seven grid points (Points 641, 658, 659, 660, 676, 677, and 678) would experience a 1.5 DNL or greater noise increase with Alternative RSA-5C. Each of these points is located east of the runway along centerline. The increase would range from a minimum of 1.5 DNL at Point 677 to a maximum of 17.9 DNL at Point 641. Only one point would generate noise levels that could be non-compatible with a specified land-use type, based on the intensity of the increase and the DNL contour (Point 641 would result in 94.8 DNL, a 17.9 DNL increase over the No Action). However, this site is located on-Airport so it is a compatible land use and the impact is not significant. All other sites experiencing a 1.5 DNL increase would result in Alternative RSA-5C noise levels being less than 75 DNL. No area within the 60-65 DNL contour would experience a 3.0 DNL increase.

Because 1.5 DNL or greater increases were identified, a refined analysis was conducted to identify a contour associated with changes of 1.5 DNL or greater. As Figure 4-7 shows, only the areas east of the Airport would experience increases of 1.5 DNL or greater in noise relative to the No Action. The increases east of the Airport would result from moving the Runway 26 arrival and departure thresholds farther east. Portions of this increase would occur within Airport property, but approximately 16.8 acres of Refuge land near the end of the runway that are within the 65 DNL or greater contour would also experience an increase of 1.5 DNL or greater. According to FAA Part 150 Land Use Compatibility guidelines, parks and recreation areas such as the Refuge are compatible with aircraft noise up to 75 DNL. Therefore, although noise increases greater than 1.5 DNL would affect approximately 16.8 acres of the Refuge, because the noise levels would still be less than 75 DNL the impact is not significant.

4.3.1.3 Alternative RSA-5D

With RSA-5D, noise impacts relative to Runway 08 would be nearly identical to those described for Alternative RSA-1. Noise impacts relative to Runway 26 would be similar, though slightly reduced from, those described for Alternative RSA-5C.

4.3.1.4 Alternative RSA-5E

With Alternative RSA-5E, noise impacts relative to Runway 08 would be nearly identical to though slightly less than those described for RSA-6A. Noise impacts relative to Runway 26 would be nearly identical to though slightly less than those described for RSA-5C. This is the Airport Sponsor's proposed action and the FAA's preferred alternative.

4.3.1.5 Alternative RSA-6A

With Alternative RSA-6A, the Runway 08 landing threshold would be displaced to the east, while the Runway 26 landing threshold would be in its current location. As a result, relative to existing conditions, aircraft would be at a slightly higher altitude on approach to the runway from the west, and at their present location when approaching the runway from the east. Therefore, the location of the landing flight tracks was altered to reflect the displaced or relocated thresholds that would be instituted for each runway end.

The noise exposure contours for RSA-6A are shown in Figure 4-4. In 2015, the total area (including Airport property) that would be exposed to 65 DNL and greater noise levels would be 1.08 square miles, extending from approximately 2,640 feet west of Runway 08 to approximately 3,218 feet east of Runway 26, virtually the same as Alternative RSA-5C. Approximately 0.16 square miles of land on Airport property would be encompassed within the severe noise exposure contour of 75 DNL and greater.

All of the area affected by 1.5 DNL or greater noise levels increases would be within Airport property. The areas subject to such increases would generally correspond with the departure track of aircraft departing from a threshold closer to the Refuge with this alternative. This increase would occur within the 65 DNL and greater contour, but the increases would not raise levels above 75 DNL. These changes would be compatible with land use and therefore insignificant.

Relative to the No Action Alternative, only Grid Point 641 would experience an apparently significant noise increase in the 65 DNL or greater contour with RSA-6A, estimated at 19.5 DNL. This point is at the end of Runway 26 on Airport property, and the increase in DNL would not be a significant impact as it would still be compatible with the land use.

4.3.1.6 Alternative RSA-6B

This alternative would not change the departure location for Runway 26, but the arrival threshold would be displaced 188 feet to the west. The arrival threshold for Runway 08 would remain in its current location, but departures would begin approximately 188 feet to the west of the existing threshold. As a result, relative to existing conditions, aircraft would be at a slightly higher altitude on approach to the runway from the east, but at the same altitude when approaching from the west. Therefore, the location of the landing flight tracks was altered to reflect the displaced/relocated thresholds that would be instituted for each runway end.

The noise exposure contours for RSA-6B are shown in Figure 4-5. In 2015, the total area (including Airport property) that would be exposed to 65 DNL and greater noise levels would be 1.07 square miles, extending from approximately 2,640 feet west of Runway 08 to approximately 3,218 feet east of Runway 26, virtually the same as Alternative RSA-5C and RSA-6A. Approximately 0.16 square miles of land would be encompassed within the severe noise exposure contour of 75 DNL and greater.

Relative to RSA-8, the No Action Alternative, only Grid Point 389 would experience an apparently significant noise increase with this alternative, estimated at 20.5 DNL. This point is on the Dike Trail at the end of Runway 08 on Airport property. The intensity of the noise increase and recreational nature of the Dike Trail location suggest a significant impact would occur to an incompatible use. However as noted in Table 4-8, the trail directly at the end of the runway currently receives an estimated noise level of 80.7 DNL; in other words, the current noise exposure levels normally experienced by trail users are in excess of the compatibility guideline. In addition, the noise increase is based on the present location of the Dike Trail. Implementation of Alternative RSA-6B would result in relocation of the Trail to the west, where the noise levels would be compatible with recreational activity.

4.3.1.7 Alternative RSA-6C

With Alternative RSA-6C, the runway thresholds would remain in their present locations. As a result, aircraft would operate at the same altitude as they currently operate when approaching the runway from either the east or west. Aircraft would also begin their departure rolls from the locations currently used. Therefore, the location of the landing flight tracks would be the same as the No Action Alternative or baseline (2000) conditions.

The noise exposure contours for RSA-6C are shown in Figure 4-2. In 2015, the total area (including Airport property) that would be exposed to 65 DNL and greater noise levels would be 1.08 square miles (688 acres), extending from approximately 3,300 feet west of Runway 08 to approximately 5,050 feet east of Runway 26. Approximately 0.16 square miles (100 acres) of land on Airport property would be encompassed within the severe noise exposure contour of 75 DNL and greater.

Relative to the No Action Alternative, RSA-8, no area within the 65 DNL and greater noise exposure contour would experience a 1.5 DNL increase. Therefore, the changes in aircraft noise exposure with RSA-6C would not be significant, as defined by FAA Orders 5050.4B and 1050.1E.

4.3.1.8 Alternative RSA-6D

With Alternative RSA-6D, the Runway 08 and Runway 26 landing thresholds would remain the same as under existing conditions. The departure threshold for Runway 08 would be displaced 400 feet to the west, and the Runway 26 departure threshold would be displaced 600 feet to the east. As a result, relative to existing conditions, aircraft would typically be at a slightly higher altitude on take-off from the runway to either the east or the west. Therefore, the location of the departure flight tracks was altered to reflect the displaced thresholds that would be instituted for each runway end.

The noise exposure contours for RSA-6D are shown in Figure 4-6. In 2015, the total area (including Airport property) that would be exposed to 65 DNL and greater noise levels would be 1.09 square miles, extending from approximately 2,640 feet west of Runway 08 to approximately 3,218 feet east of Runway 26. Approximately 0.16 square miles of land on Airport property would be encompassed within the severe noise exposure contour of 75 DNL and greater. Approximately 0.006 square miles (4 acres) of land on Refuge property would be encompassed within the severe noise contour of 75 DNL and greater.

Relative to RSA-8, the No Action Alternative, eight grid points (Points 371, 389, 641, 658, 659, 660, 676, and 678) would experience a 1.5 DNL or greater noise increase with Alternative RSA-6D. Points 371 and 389 are located west of the runway along the centerline, and the remaining points are located east of the runway along the centerline. The increase would range from a minimum of 2.5 DNL at Point 658 to a maximum of 19.6 DNL at Point 389. Four points would generate noise levels that could be non-compatible with a specified land-use type, based on the intensity of the increase and the DNL contour: Point 371 would result in 73.6 DNL, a 3.2 DNL increase over the No Action; Point 389 would result in 96.4 DNL, a 19.6 DNL increase over the No Action; Point 641 would result in 97.1 DNL, a 17.9 DNL increase over the No Action; and Point 659 would result in 77.2 DNL, a 4.5 DNL increase over the No Action. However, Points 641 and 659 are located on-Airport so the noise exposure at these points are considered compatible with the existing land use, and the impact is not significant. Point 371 is located on Refuge property west of the Airport. The resultant 73.6 DNL at this point from Alternative RSA-6D is below the 75 DNL guideline for compatible land use for refuges as set forth by FAA Part 150 Land Use Compatibility guidelines. Therefore, this impact is not considered significant. Point 389 is on the Dike Trail at the end of Runway 08 on Airport property. The intensity of the noise increase and recreational nature of the Dike Trail location suggest a significant impact would occur and result in an incompatible use. However as noted in Table 4-8, the trail directly at the end of the runway currently receives an estimated noise level of 80.7 DNL; in other words, the current noise exposure levels normally experienced by trail users are in excess of the compatibility guideline. In addition, the noise increase is based on the present location of the Dike Trail, and implementation of Alternative RSA-6D would result in relocation of the Trail to the west, where the noise levels would be compatible with recreational activity (e.g., the noise levels would be below the 75 DNL guideline threshold). All other sites experiencing a 1.5 DNL increase would result in Alternative RSA-6D noise levels being less than 75 DNL. No area within the 60-65 DNL contour would experience a 3.0 DNL increase.

Because 1.5 DNL or greater increases were identified, a refined analysis was conducted to identify a contour associated with changes of 1.5 DNL or greater. As Figure 4-8 shows, areas both east and west of the Airport would experience increases of 1.5 DNL or greater increase in noise relative to the No Action. The increase east of the Airport would result from moving the Runway 26 departure threshold farther east, while the increase west of the Airport would result from moving the Runway 08 departure threshold farther west. Portions of this increase would occur within Airport property, but approximately 36.46 acres of Refuge land near the ends of the runway that are within the 65 DNL or greater contour would also experience an increase of 1.5 DNL or greater. More of this Refuge land (20.23 acres) is located off of Runway 26, where the departure threshold would be displaced 600 feet closer to the Refuge boundary than under existing conditions. The remaining 16.23 acres are located off of the Runway 08 end, where the departure threshold would be displaced 400 feet closer to the Refuge than under existing conditions. According to FAA Part 150 Land Use Compatibility guidelines, parks and recreation areas such as the Refuge are compatible with aircraft noise up to 75 DNL. None of the areas of the Refuge located east of Runway 26 or west of Runway 08 would experience noise increases of 1.5 DNL or greater that would result in noise levels equal to or greater than 75 DNL.

4.3.1.9 Alternative RSA-8

RSA-8 is the No Action Alternative. It would leave the airfield as it exists today, with the landing and takeoff thresholds at their present locations and a runway length of 8,456 feet. Non-standard RSAs would be retained at both runway ends, but the lack of RSA would not affect the noise contours. From a noise perspective, this alternative is exactly the same as RSA-1. In 2015, area affected by 65 DNL and greater noise levels will have reduced from present conditions by approximately 20%, due to the effects of quieter Stage 3 aircraft operations and retirement of Stage 2 aircraft, even with the increased level of aircraft operations projected for the year 2015. The area exposed to severe aircraft noise would decrease from 0.24 square miles, in the year 2000, to 0.17 square miles, in the year 2015—a 34% reduction over existing conditions, even with the increased level of aircraft operations projected for the year 2015. Figure 4-2 shows the RSA-8 noise exposure contour for year 2015.

4.3.2 Human Environment and Compatible Land Use

The following sections describe potential impacts to the human environment, including compatible land uses and recreation activities, resulting from the different RSA alternatives.

Table 4-9 shows future noise levels at five non-residential, noise-sensitive facilities for each of the alternatives, relative to existing conditions in the year 2000. In most cases, the noise levels decrease, however, the noise level is expected to increase beyond the 1.5 DNL threshold within the 65 DNL or greater contour in four cases. As described in Sections 4.3.1.6 and 4.3.1.8, the apparently significant DNL increase at the Dike Trail for Alternatives RSA-6B and RSA-6D is a result of the westward shift in thresholds, but the relocation of the Dike Trail with these alternatives would render the increase insignificant. The increase on the Refuge for Alternative RSA-5C and RSA-5D (Runway 08 end) is a result of the eastward shift in thresholds, but is still compatible with the existing land use and therefore insignificant. The increase to 73.6 DNL on the Refuge (at Refuge Point 3) for Alternative RSA-6D is a result of the westward shift of the Runway 08 departure threshold. The resultant DNL is below the 75 DNL threshold guidelines for compatible use on refuges established by the FAA in its Part 150 Land Use Compatibility guidelines, and is, therefore, considered compatible with existing land use and is not significant.

Table 4-9. DNL Levels at Non-Residential Noise Sensitive Facilities

	Year 2015						
Resource	**Existing**	**RSA-1/ 6C/5D[1]**	**RSA-5C/ 5D/5E[1]**	**RSA-6A/ 5E[2]**	**RSA-6B**	**RSA-6D**	**RSA-8**
Mendenhall Golf Course Pt 1 (20,13)	62.5	62.1	61.9	62.0	62.2	62.5	62.1
Mendenhall Golf Course Pt 2 (14,11)	61.6	61.2	61.0	61.2	61.1	60.9	61.2
Juneau Christian Center School (35,15)	58.3	56.2	56.0	56.2	56.2	56.2	56.2
Juneau Christian Center Church (34,15)	57.7	55.8	57.5	57.6	55.8	55.8	55.8
Dike Trail (22,11)	80.7	76.8	75.8	76.4	**97.2**	**96.4**	76.8
Refuge Point 1 (38,11)	69.6	71.0	**72.5**	71.2	70.8	71.0	71.0
Refuge Point 2 (43,11)	66.0	66.1	66.6	66.1	65.9	66.0	66.1
Refuge Point 3 (21,11)	71.9	70.4	69.8	70.1	71.3	**73.6**	70.4
Refuge Point 4 (15,10)	64.8	63.8	63.4	63.7	64.0	63.9	63.8

Sources: BridgeNet International, 2004. Shaded data represents a 1.5 DNL or greater aircraft noise level increase caused by the RSA alternative.

Notes: (I,J) refers to the grid point used (see Table 4-8). Golf course Point 1 is at the southeastern edge of the property, while Point 2 is at the southwestern edge. Refuge points 1 and 2 represent the eastern side of Airport, Refuge point 3 and 4 represent west of the Airport.

[1] RSA-5D operational configuration is identical to RSA-1 at the Rwy 08 end and nearly identical to RSA-5C at the Rwy 26 end. The departure threshold for RSA-5E would be relocated 520 east of its current position at the Rwy 26 end. This is less of a shift than was analyzed for RSA-5C in the DEIS, which is what is depicted in this table. Noise impacts from RSA-5E would, therefore, be similar to RSA-5C for the Rwy 26 end. Note: The eastward shift of landing thresholds for Alternative RSA-5C was reduced by 172 feet following issuance of the DEIS. The numbers presented here are from the DEIS analysis and are considered conservative for this alternative. The reduced shift of RSA-5C is within 46 feet of the eastward Rwy 26 landing threshold shift for Alternative RSA-5D.

[2] RSA-5E operational configuration is nearly identical to RSA-6A at the Rwy 08 end; the landing threshold for RSA-5E is displaced 120 feet east, while the landing threshold for RSA-6A is displaced 188 feet.

The relatively small differences shown on Table 4-9 between noise levels for the alternatives for most locations are primarily a function of different departure and arrival thresholds. However, the majority of noise reduction benefit relative to the existing conditions is likely caused by the effects of quieter Stage 3 aircraft operations and retirement of Stage 2 aircraft, even with the increased level of aircraft operations projected for the year 2015.

Table 4-10 presents the number of persons and housing units residing within the various noise contours near the Airport for each alternative in the year 2015. RSA-5C, RSA-5D (Runway 08 end) and RSA-5E (Runway 26 end) include more housing units and a greater population within the 60–65 DNL noise contour compared to the No Action Alternative. However, the numbers for RSA-5C, RSA-5D, and RSA-5E are still lower than the existing population and housing unit values, and the forecast population and housing units within noise contours above 65 DNL remain at zero.

Table 4-10. Population and Housing Affected by Aircraft Noise in 2015

Population	Existing	RSA-1/6C/ 8/5D[1]	RSA-5C/ 5D/5E[1]	RSA-6A/ 5E[2]	RSA-6B	RSA-6D
60-65 DNL	416	260	338	260	260	338
65-70 DNL	0	0	0	0	0	0
70-75 DNL	0	0	0	0	0	0
75+ DNL	0	0	0	0	0	0
Housing Units	**Existing**	**RSA-1/6C/ 8/5D[1]**	**RSA-5C/ 5D/5E[1]**	**RSA-6A/ 5E[2]**	**RSA-6B**	**RSA-6D**
60-65 DNL	160	100	130	100	100	130
65-70 DNL	0	0	0	0	0	0
70-75 DNL	0	0	0	0	0	0
75+ DNL	0	0	0	0	0	0

Source: CBJ Sales Tax Assessors parcel Database (2000 data) for housing units.
Population is derived from 2000 Census persons per household data.

[1] RSA-5D operational configuration is identical to RSA-1 at the Rwy 08 end and nearly identical to RSA-5C at the Rwy 26 end. The departure threshold for RSA-5E would be relocated 520 east of its current position at the Rwy 26 end. This is less of a shift than was analyzed for RSA-5C in the DEIS, which is what is depicted in this table. Noise impacts from RSA-5E would, therefore, be similar to RSA-5C for the Rwy 26 end. Note: The eastward shift of landing thresholds for Alternative RSA-5C was reduced by 172 feet following issuance of the DEIS. The numbers presented here are from the DEIS analysis and are considered conservative for this alternative. The reduced shift of RSA-5C is within 46 feet of the eastward Rwy 26 landing threshold shift for Alternative RSA-5D.

[2] RSA-5E operational configuration is nearly identical to RSA-6A at the Rwy 08 end; the landing threshold for RSA-5E is displaced 120 feet east, while the landing threshold for RSA-6A is displaced 188 feet.

This estimate does not take into account future population growth and housing development in the Borough; however, the CBJ has adopted noise contours into their comprehensive planning document. It is considered unlikely that CBJ would allow additional housing development within these high noise contours in the future. Thus, there should be no land use conflicts due to changes in noise contours resulting from any of these alternatives.

For all RSA action alternatives, use of the Dike Trail would be temporarily disrupted for several days on two occasions as the dike is breached to allow the dredge equipment, (used to obtain fill for Airport projects) into and out of the Float Plane Pond. This action would constitute a direct but minor adverse impact on recreation activities.

Also for each action alternative, there could be some indirect, beneficial impacts associated with the relocation of the Dike Trail to the Refuge. Because the Airport emergency access and service road would remain on Airport property, recreational functions would then be separated from Airport functions. Potential for conflicts between service road use and trail use would be reduced. There would be more assurance of long-term access to the Refuge via the Dike Trail if it were shifted off-Airport, as would occur with all of the action alternatives.

4.3.2.1 ALTERNATIVE RSA-1

The noise levels estimated for the year 2015 at noise-sensitive locations would be the same as for the No Action Alternative (RSA-8). Expected populations within the 60-65 DNL noise contour would be the same as RSA-8, and decrease compared to existing conditions. No populations would reside within the 65 DNL or greater contours. No non-compatible land uses based on aircraft noise levels would result from this alternative.

This alternative would also have a direct, long-term, but minor impact on the Dike Trail. Because of the large amount of RSA added to the west end of the runway, additional development pushing the Mendenhall River to the west would be necessary to allow room for the trail on Refuge property at the end of the RSA. The trail would still follow around the end of the runway, but it would be longer than it is currently. It is likely that the trail would be closed during construction of the RSA, creating a short-term, adverse impact. In the long term, the quality of the recreational experience should remain unchanged by the new location of the trail, and the quality may even be improved by the additional trail length and different views.

Another direct impact of this alternative would be the permanent taking of more than 9.8 acres of the Refuge for Airport purposes. Land use policies in the Refuge Management Plan allow for CBJ acquisition of Refuge land for Airport expansion, provided that CBJ can show: significant public need, that use of Refuge lands are minimized as much as possible, that all impacts will be fully mitigated, and that the expansion will not create a hazardous attraction for waterfowl. Section 4.3.13 discusses the impact of this alternative with respect to the Department of Transportation Section 4(f) provisions, as a direct impact would occur on the Refuge. The acreage needed for this alternative represents 0.26% of the nearly 4,000-acre Refuge. An additional 4.5 acres of the Refuge east of the Airport would be used to reconstruct the tidal slough channel and re-establish the hydrologic connection north and south of the runway.

4.3.2.2 ALTERNATIVE RSA-5C

Approximately 16.8 acres of Refuge land located off the immediate end of Runway 26 would be expected to experience a 1.5 DNL or greater increase in aircraft noise exposure over that projected for RSA-8, the No Action Alternative, in the year 2015. It is important to note that FAA's land use compatibility guidelines (40 CFR Part 150, Table A) indicate that park and refuge lands are compatible with aircraft noise exposure up to 75 DNL. The aircraft noise exposure projected for RSA-5C would be less than 75 DNL, and the resultant noise exposure would still be a compatible use. Populations residing in the greater than 65 DNL contours would remain at zero. No non-compatible land uses related to aircraft noise would result from this alternative.

This alternative would also have a direct, long-term but minor impact on the Dike Trail, due to the small amount of RSA added to the west Runway 08 end. It is expected that the Dike Trail could be re-directed onto Refuge property around the RSA. However, it would be unnecessary to restrict trail use (i.e., the old trail alignment could continue to be used while the new alignment is under construction), and the quality of the recreational experience should remain unchanged by the new location.

Another direct adverse impact of this alternative would be the permanent and irretrievable taking of 9.0 acres of the Refuge mostly east of Runway 26 for Airport purposes. Section 4.3.13 has more information on this subject with respect to DOT Section 4(f) lands. The acreage needed for this alternative represents 0.24% of the nearly 4,000-acre Refuge. An additional 2.1 acres of the Refuge east of the Airport would be used to re-route the hydrologic connectivity of the area north of the Runway 26 end to Sunny Slough.

4.3.2.3 Alternative RSA-5D

Noise impacts under Alternative RSA-5D would be nearly identical to those described for Runway 08 under RSA-1 and Runway 26 under RSA-5C.

This alternative would also have a direct, long-term but minor impact on the Dike Trail, due to the amount of RSA added to the west Runway 08 end. It is expected that the Dike Trail could be relocated onto Refuge property off the end of the RSA embankment. However, it would be unnecessary to restrict trail use during construction (i.e., the old trail alignment could continue to be used while the new alignment is under construction), and the quality of the recreational experience should remain unchanged by the new location.

Another direct adverse impact of this alternative would be the permanent and irretrievable taking of 8.11 acres of the Refuge west of Runway 08 for Airport purposes. This action would be needed to construct the RSA, move the Float Plane Pond access road, relocate the EVAR/Dike Trail, relocate the Duck Creek channel, and modify the Mendenhall River channel. Section 4.3.13 has more information on this subject with respect to DOT Section 4(f) lands. The acreage needed for this alternative represents 0.21% of the nearly 4,000-acre Refuge. An additional 4.5 acres of the Refuge east of the Airport would be used to reconstruct the tidal slough channel and re-establish the hydrologic connection north and south of the Runway 26 end.

4.3.2.4 Alternative RSA-5E

This is the Airport Sponsor's proposed action and the FAA's preferred alternative. Noise impacts on the human environment and compatible land use under RSA-5E would be nearly identical to those described for the Runway 26 end under RSA-5C and the Runway 08 end under RSA-6A.

This alternative would require the permanent and irretrievable taking of 2.7 acres of Refuge land west of Runway 08 for Airport purposes. This action would be needed to construct the RSA, relocate and the EVAR/Dike Trail, and to relocate the Duck Creek channel. An additional 1.4 acres of Refuge land east of Runway 26 would be permanently and irretrievably taken for Airport purposes. This action would be needed to construct the RSA. The total acreage of Refuge land taken for Airport purposes would be 4.1 acres, or 0.11% of all Refuge lands. An additional 5.0 acres of the Refuge east of the Airport would be used to reconstruct the tidal slough channel and re-establish the hydrologic connection north and south of the Runway 26 end.

4.3.2.5 Alternative RSA-6A

RSA-6A changes in departure and arrival thresholds do not significantly increase noise levels estimated for the year 2015 at noise sensitive locations compared to the No Action Alternative. Populations residing in the greater than 65 DNL contours would remain at zero. No non-compatible land uses related to aircraft noise would result from this alternative.

This alternative would have a direct, long-term, but minor impact on the Dike Trail by relocating it around the extended west end of the RSA and onto Refuge property. However, it would be unnecessary to restrict trail use (i.e., the old trail alignment could continue to be used while the new alignment is under construction), and the quality of the recreational experience should remain unchanged by the new location.

Another direct adverse impact of this alternative would be the placement of fill supporting the RSA surface, new Float Plane Pond access road, and EVAR/Dike Trail, and disturbance associated with the relocation of the Duck Creek channel on approximately 2.9 acres of the Refuge. Section 4.3.13 has more information with respect to DOT Section 4(f) lands. The acreage needed for this alternative represents approximately 0.05% of the nearly 4,000-acre Refuge. An additional 0.2 acres of the Refuge east of the Airport would be used to reconstruct the tidal slough channel and re-establish the hydrologic connection north and south of the Runway 26 end.

4.3.2.6 Alternative RSA-6B

As is shown on Table 4-9, there is a 20.4 DNL difference between the No Action Alternative (76.8 DNL) and RSA-6B (97.2 DNL) at a point directly west of the runway centerline on the present Dike Trail location. However, the relocation of the Runway 08 departure threshold and installation of the EMAS would also cause relocation of the Dike Trail away from the grid point where this noise level would be projected. The Dike Trail west of the runway currently is exposed to aircraft noise levels (80.7 DNL) well in excess of the land use compatibility guidelines, and such exposure has not seemed to hamper use of the trail, probably because the noise is infrequent and of short duration.

Populations residing in the greater than 65 DNL contours would remain at zero. No non-compatible land uses relating to aircraft noise would result from this alternative.

This alternative would have a direct, long-term, but minor impact on the Dike Trail by relocating it around the extended west end of the RSA, onto Refuge property. However, it would be unnecessary to restrict trail use (i.e., the old trail alignment could continue to be used while the new alignment is under construction), and the quality of the recreational experience should remain unchanged by the new location.

Another direct impact of this alternative would be the permanent and irretrievable taking of 8.1 acres of the Refuge for Airport purposes. This action would be needed to construct the EMAS, move the Float Plane Pond access road, relocate the EVAR/Dike Trail, relocate the Duck Creek channel, and modify the Mendenhall River channel. Section 4.3.13 has more information with respect to DOT Section 4(f) lands. The acreage needed for this alternative represents approximately 0.21% of the nearly 4,000-acre Refuge. An additional 0.2 acres of the Refuge east of the Airport would be used to reconstruct the tidal slough channel and re-establish the hydrologic connection north and south of the Runway 26 end.

4.3.2.7 ALTERNATIVE RSA-6C

RSA-6C changes in departure and arrival thresholds do not significantly increase noise levels estimated for the year 2015 at noise sensitive locations. Populations residing in the greater than 65 DNL contours would remain at zero. No non-compatible land uses related to aircraft noise would result from this alternative.

This alternative would have a direct, long-term, but minor impact on the Dike Trail by relocating it around the extended west end of the RSA, onto Refuge property. However, it would be unnecessary to restrict trail use (i.e., the old trail alignment could continue to be used while the new alignment is under construction), and the quality of the recreational experience should remain unchanged by the new location.

Another direct impact of this alternative would be the permanent and irretrievable taking of 8.11 acres of the Refuge for Airport purposes. This action would be needed to construct the EMAS, move the Float Plane Pond access road, relocate the EVAR/Dike Trail, relocated Duck Creek, and modify a portion of the Mendenhall River channel. Section 4.3.13 has more information with respect to DOT Section 4(f) lands. The acreage needed for this alternative represents approximately 0.21% of the nearly 4,000-acre Refuge. An additional 4.5 acres of the Refuge east of the Airport would be used to reconstruct the tidal slough channel and re-establish the hydrologic connection north and south of the Runway 26 end.

4.3.2.8 ALTERNATIVE RSA-6D

RSA-6D changes in departure thresholds do not significantly increase noise levels estimated for the year 2015 at most noise sensitive locations compared to the No Action Alternative. However, projected noise levels at one noise sensitive location (Refuge Point 3 of Table 4-9) within the Refuge would sustain a 1.5 DNL or greater increase. The increase in noise would raise the projected noise level to 73.6 DNL as compared to the No Action Alternative. This noise level is considered compatible with existing land use on the Refuge as it is below the 75 DNL threshold guidelines established by the FAA (40 CFR Part 150, Table A) for refuges. As such, this impact is not considered significant. Populations residing in the greater than 65 DNL contours would remain at zero.

Approximately 16.23 acres of Refuge land located off the immediate ends of Runway 08 would be expected to experience a 1.5 DNL or greater increase in aircraft noise exposure over that projected for RSA-8, the No Action Alternative, in the year 2015. Approximately 20.23 acres of

Refuge land located off the immediate end of Runway 26 would be expected to experience a 1.5 DNL or greater increase in aircraft noise exposure over that projected for RSA-8, the No Action Alternative, in the year 2015. Noise impacts to Refuge lands would not exceed 75 DNL, and would, therefore, be considered compatible with existing land use.

This alternative would also have a direct, long-term but minor impact on the Dike Trail, due to the addition of RSA to the west Runway 08 end. It is expected that the Dike Trail could be relocated onto Refuge property around the RSA. However, it would be unnecessary to restrict trail use (i.e., the old trail alignment could continue to be used while the new alignment is under construction), and the quality of the recreational experience should remain unchanged by the new location.

Another direct adverse impact of this alternative would be the permanent and irretrievable taking of 8.1 acres of the Refuge west of Runway 08 for Airport purposes. This action would be needed to construct the EMAS, move the Float Plane Pond access road, relocate the EVAR/Dike Trail, relocated Duck Creek, and modify a portion of the Mendenhall River channel. Section 4.3.13 has more information on this subject with respect to DOT Section 4(f) lands. The acreage needed for this alternative represents 0.21% of the nearly 4,000-acre Refuge. An additional 0.2 acres of the Refuge east of the Airport would be used to reconstruct the tidal slough channel and re-establish the hydrologic connection north and south of the Runway 26 end.

4.3.2.9 Alternative RSA-8

No impacts to the human environment and land use are anticipated with this alternative. Population and housing within the noise contours are expected to decline by the year 2015, relative to existing conditions, as a result of the increased use of quieter Stage 3 aircraft operations and retirement of Stage 2 aircraft, even with the increased level of aircraft operations projected for the year 2015.

4.3.3 Socioeconomic Impacts

The following table summarizes short-term economic impacts to the CBJ for the RSA alternatives in terms of direct, indirect and induced business income, jobs, and payroll from construction. Table 4-11 summarizes the short-term economic business gains resulting from construction of each of the RSA alternatives.

None of the alternatives would have adverse economic effects on air carriers or Airport operations, as operations could continue while construction is under way.

The RSA alternatives incorporating EMAS on one or both runway ends (RSA-6A, RSA-6B, and RSA-6C) must have factored into their life-cycle cost replacement of the EMAS after 10 years. The present value of that additional element is added to the economic impacts of construction for these alternatives. The construction and life-cycle costs estimates for the RSA alternatives are found in Appendix A.

Table 4-11. Economic Impact of RSA Construction (2005 Dollars)

Alternative	Total Business Income	Total FTE Jobs	Total Payroll
RSA-1	$17,100,000	148	$6,913,000
RSA-5C	$14,896,000	129	$6,008,000
RSA-5D	$15,256,000	132	$6,153,000
RSA-5E	$13,414,000	117	$5,410,000
RSA-6A	$29,862,000	263	$12,044,000
RSA-6B	$32,195,000	279	$12,985,000
RSA-6C	$23,598,000	204	$9,518,000
RSA-6D	$12,100,000	105	$4,880,000
RSA-8 (No Action)	$0	0	$0

Source: Juneau International Airport Master Plan Update, USKH, 1999, Estimations 2004, CBJ Airport Staff, FAA and SWCA project team. Also, IMPLAN Pro 2000 input/output model, Minnesota IMPLAN Group.

4.3.3.1 ALTERNATIVE RSA-1

Alternative RSA-1 creates an estimated $23.1 million in business income and 148 full-time-equivalent jobs, with a total payroll of nearly $7.0 million. This alternative would generate approximately $304,400 in sales tax for CBJ in the short term. There would be no long-term operational impacts associated with this alternative.

Mitigation for this alternative amounts to $2,619,000. Economic impacts from that mitigation would depend upon what the funds are used for. Construction projects would create short-term direct and indirect positive economic impacts in the Borough. If private land is purchased with mitigation funds and held by a governmental agency, that land would be removed from the CBJ property tax base, causing a long-term negative economic impact.

4.3.3.2 ALTERNATIVE RSA-5C

RSA-5C creates nearly $20.2 million in business income and 129 full-time-equivalent jobs, with a total payroll of over $6.0 million. This alternative would generate approximately $264,600 in sales tax for the CBJ in the short term.

There would be minor, long-term operational impacts associated with this alternative, but they would not result in additional weight restrictions. In fact, this alternative would slightly increase the length of the runway, resulting in a minor but positive economic impact to the air carrier.

Mitigation for this alternative amounts to $2,518,000. Economic impacts from that mitigation would depend upon what the funds are used for. Construction projects would create short-term direct and indirect positive economic impacts in the Borough. If private land is purchased with mitigation funds and held by a governmental agency, that land would be removed from the CBJ property tax base, causing a long-term negative economic impact.

4.3.3.3 Alternative RSA-5D

Short-term economic impacts from construction of Alternative RSA-5D include a total business income of nearly $20.7 million and the creation of 132 full- time-equivalent jobs with a total payroll of nearly $6.2 million. In addition, the project will generate local sales taxes of approximately $271,000 in the short term.

This alternative would have no long-term impact on air carrier operations, as the operational characteristics are the same as presently used at JNU.

Implementation of Alternative RSA-5D could impact the economic condition of the commercial operation using the "harbor" area along the Mendenhall River to the northwest of the runway by reducing the ability to maneuver existing equipment in and out of the area via the river. The specific configuration of river channel modifications during final project design associated with this alternative would need to consider measures to avoid or minimize potential adverse impacts to this operation.

Mitigation for this alternative amounts to $2,657,000. Economic impacts from that mitigation would depend upon what the funds are used for. Construction projects would create short-term direct and indirect positive economic impacts in the Borough. If private land is purchased with mitigation funds and held by a governmental agency, that land would be removed from the CBJ property tax base, causing a long-term negative economic impact.

4.3.3.4 Alternative RSA-5E

This is the Airport Sponsor's proposed action and the FAA's preferred alternative. Short-term economic impacts from construction of Alternative RSA-5E include a total business income of nearly $18.2 million and the creation of 117 full- time-equivalent jobs with a total payroll of over $5.4 million. In addition, the project will generate local sales taxes of approximately $238,800 in the short term.

This alternative would have no long-term impact on air carrier operations, as the operational characteristics are the same as presently used at JNU.

Mitigation for this alternative amounts to $2,225,000. Economic impacts from that mitigation would depend upon what the funds are used for. Construction projects would create short-term direct and indirect positive economic impacts in the Borough. If private land is purchased with mitigation funds and held by a governmental agency, that land would be removed from the CBJ property tax base, causing a long-term negative economic impact.

4.3.3.5 ALTERNATIVE RSA-6A

The construction of RSA-6A creates the second highest short-term economic impact of all RSA alternatives, with total business income of nearly $41.0 million and 263 full-time-equivalent jobs, with a total payroll of over $12.0 million. In addition, this alternative will generate approximately $530,400 in sales tax revenue for local government during construction. (Again, note this incorporates two separate construction events for the EMAS, once every 10 years for a total of twice in the 20-year EIS analysis period.)

There would be minor, long-term operational impacts associated with this alternative, but they would not result in additional weight restrictions. In fact, this alternative would slightly increase the runway departure lengths, potentially resulting in a minor but positive economic impact to the carrier.

Mitigation for this alternative amounts to $1,587,000. Economic impacts from that mitigation would depend upon what the funds are used for. Construction projects would create short-term direct and indirect positive economic impacts in the Borough. If private land is purchased with mitigation funds and held by a governmental agency, that land would be removed from the CBJ property tax base, causing a long-term negative economic impact.

4.3.3.6 ALTERNATIVE RSA-6B

This RSA alternative creates the largest short-term economic impact from construction. Total business income from this project would be over $43.6 million, and it would create 279 full-time-equivalent jobs with a total payroll of nearly $13.0 million. During construction, sales tax revenues of approximately $571,900 would be generated. (Again, note this incorporates two separate construction events for the EMAS, once every 10 years for a total of twice in the 20-year EIS analysis period.)

There would be minor, long-term operational impacts associated with this alternative, but they would not result in additional weight restrictions. In fact, this alternative would slightly increase the length of the runway, resulting in a minor but positive economic impact to the carrier.

Implementation of Alternative RSA-6B could impact the economic condition of the commercial operation using the "harbor" area along the Mendenhall River to the northwest of the runway by reducing the ability to maneuver existing equipment in and out of the area via the river. The specific configuration of river channel modifications during final project design associated with this alternative would need to consider measures to avoid or minimize potential adverse impacts to this operation.

Mitigation for this alternative amounts to $1,899,000. Economic impacts from that mitigation would depend upon what the funds are used for. Construction projects would create short-term direct and indirect positive economic impacts in the Borough. If private land is purchased with mitigation funds and held by a governmental agency, that land would be removed from the CBJ property tax base, causing a long-term negative economic impact.

4.3.3.7 Alternative RSA-6C

Alternative RSA-6C would involve installation of EMAS at the west Runway 08 end and standard RSA at the east Runway 26 end. Short-term economic impacts from construction of Alternative RSA-6C include a total business income of nearly $32.0 million and the creation of 204 full-time-equivalent jobs with a total payroll of over $9.5 million. In addition, the project will generate local sales taxes of approximately $419,200 in the short term. (Again, note this incorporates two separate construction events for the EMAS, once every 10 years for a total of twice in the 20-year EIS analysis period.)

This alternative would have no long-term impact on air carrier operations, as the operational characteristics are the same as presently used at JNU.

Implementation of Alternative RSA-6C could impact the economic condition of the commercial operation using the "harbor" area along the Mendenhall River to the northwest of the runway by reducing the ability to maneuver existing equipment in and out of the area via the river. The specific configuration of river channel modifications during final project design associated with this alternative would need consider measures to avoid or minimize potential adverse impacts to this operation.

Mitigation for this alternative amounts to $2,350,000. Economic impacts from that mitigation would depend upon what the funds are used for. Construction projects would create short-term direct and indirect positive economic impacts in the Borough. If private land is purchased with mitigation funds and held by a governmental agency, that land would be removed from the CBJ property tax base, causing a long-term negative economic impact.

4.3.3.8 Alternative RSA-6D

Short-term economic impacts from construction of Alternative RSA-6D include a total business income of nearly $16.4 million and the creation of 105 full-time-equivalent jobs with a total payroll of nearly $4.9 million. In addition, the project will generate local sales taxes of approximately $214,900 in the short term.

This alternative would have no long-term impact on air carrier operations, as the operational characteristics are comparable to those presently used at JNU, and any changes would not affect the ability of air carriers to maintain current operations.

Implementation of Alternative RSA-6D could impact the economic condition of the commercial operation using the "harbor" area along the Mendenhall River to the northwest of the runway by reducing the ability to maneuver existing equipment in and out of the area via the river. The specific configuration of river channel modifications during final project design associated with this alternative would need consider measures to avoid or minimize potential adverse impacts to this operation.

Mitigation for this alternative amounts to $1,994,000. Economic impacts from that mitigation would depend upon what the funds are used for. Construction projects would create short-term direct and indirect positive economic impacts in the Borough. If private land is purchased with mitigation funds and held by a governmental agency, that land would be removed from the CBJ property tax base, causing a long-term negative economic impact.

4.3.3.9 ALTERNATIVE RSA-8

No construction would take place under Alternative RSA-8; therefore, no short-term economic benefits from RSA development would accrue to the Airport or community from RSA development. This alternative would not result in changes in air carrier operations, thus there would be no economic impacts to air carriers. Certainly, there would be no initial cost to federal or local government for RSA construction.[5]

4.3.4 AIR QUALITY

The level of Airport activity is expected to rise over time and would be accommodated at JNU regardless of which RSA alternative was implemented. Total annual aircraft operations and passenger numbers are expected to increase. The air quality emissions and changes from existing conditions associated with each alternative are: 1) long-term, that is, the impact that the RSA correction has on aircraft operations, and/or 2) short-term, that is, the construction associated with completing the alternative. The air quality analysis evaluated impacts associated with operating emissions, construction emissions, and fugitive dust for each of the RSA alternatives.

Increases or decreases in long-term emissions are primarily a result of the threshold changes incorporated into the alternatives, since aircraft touch down and take off locations can influence emissions distributions. An emissions inventory was prepared for aircraft and ground support equipment (GSE) to evaluate impacts on air quality. RSA-1, RSA-6C, and RSA-8 would have no threshold changes, and aircraft would continue to depart from and land on their existing, year 2000 positions. The remaining alternatives would result in aircraft taxiing additional distances because of the changed departure thresholds. Alternative RSA-5E is the Airport Sponsor's proposed action and the FAA's preferred alternative.

4.3.4.1 LONG-TERM, OPERATIONAL EMISSIONS

Table 4-12 summarizes the Airport operational emissions with each RSA alternative. For all of the alternatives, relative to the year 2000, emissions are anticipated to increase commensurate with the level of aviation activity predicted through the year 2015. Relative to emissions in 2000, emissions in 2015 for CO, NOx, VOC and SOx would increase by 15–17%; PM_{10} and $PM_{2.5}$ emissions would more than double (increasing by 0.8 ton per year). The increase in emissions between 2000 and 2015 would occur due to the anticipated 9% increase in annual aircraft operations over

5. Projects such as construction of the runway safety areas or a new SREF would be mostly federally funded. Approximately 95% of 0the initial cost would be federal, while the local Sponsor (CBJ) would have to pay 5% of the construction cost.

that time period and associated aircraft fleet changes. This increase in activity is forecast regardless of whether or not the RSA correction is undertaken. Alternatives RSA-1 and RSA-6C would have the same operational emissions as Alternative RSA-8, the No Action, because the runway thresholds would remain unchanged. Alternatives RSA-5D, RSA-6A, and RSA-6B would have slight increases in CO and VOCs relative to the No Action Alternative because each would have a different departure threshold on one end. Alternatives RSA-5E and RSA-6D would also result in slight increases in CO and VOCs relative to the No Action Alternative because these alternatives would include differences in departure thresholds at both ends.

Table 4-12. Summary of Airport Operational Air Emissions – RSA Alternatives[1]

Scenario	CO	NOx	VOC	SOx	PM_{10}	$PM_{2.5}$[2]
Baseline (2000)	984.0	60.0	54.6	6.2	0.7	0.7
Future (2015)						
RSA-1	1,154.7	70.6	63.1	7.2	1.5	1.5
RSA-5C/5D/5E /6D[3]	1,156.6	70.7	63.5	7.2	1.5	1.5
RSA-6A/5E[4]	1,155.4	70.6	63.2	7.2	1.5	1.5
RSA-6B	1,155.1	70.6	63.2	7.2	1.5	1.5
RSA-6C	1,154.7	70.6	63.1	7.2	1.5	1.5
RSA-8 (No Action)	1,154.7	70.6	63.1	7.2	1.5	1.5

[1] Tons per year
Source: BridgeNet International, September 2004.
Note: Data reflect emissions associated with aircraft and GSE
[2] Considering $PM_{2.5}$ emissions to be equal to PM_{10} emissions is acceptable to the FAA as a conservative approach in the absence of detailed modeling (Ralph Iovinelli, AEE, personal communication 2007).
[3] Note: The eastward shift of departure threshold for Alternative RSA-5C for Runway 26 was reduced by 172 feet following issuance of the DEIS. The numbers presented here are from the DEIS analysis and are considered conservative for this alternative. The reduced shift of RSA-5C is within 46 feet of the eastward Rwy 26 landing threshold shift for Alternative RSA-5D, and as such, the analysis for RSA-5C is considered to be within the range of the likely results of analysis for RSA-5D. RSA-6D would implement a departure threshold shift on Rwy 26 that is nearly identical to that analyzed in the DEIS for RSA-5C, the results of which are presented in this table. The departure threshold shift for Rwy 08 under RSA-6D is greater than any shift proposed for any other alternative. As such, it is expected that RSA-6D would result in the greatest increase in air emissions of all alternatives. For RSA-5E, the Rwy 26 departure threshold would be relocated 520 east of its current location. This is an approximately 100-foot smaller shift than that analyzed for RSA-5C in the DEIS and presented in this table. However, the operational configurations of the two alternatives are comparable, and the air quality impacts are expected to be similar.
[4] The RSA-5E departure threshold at the Rwy 08 end would be displaced to the east by 120 feet. This is comparable to, though slightly less than, the displacement for RSA-6A.

Alternatives RSA-5C, RSA-5D, and RSA-5E would have slightly elevated emissions of most pollutants relative to most other alternatives as a result of the relocated Runway 26 threshold and longer parallel taxiway, increasing the taxi time for aircraft to reach the threshold. Relative to the No Action Alternative, RSA-8, Airport operating CO emissions would increase by 1.9 ton per year (0.2%), NOx emissions would increase by 0.1 ton (0.1%), VOC emissions would increase by 0.4 ton per year (0.6%), and SOx, $PM_{10,}$ and $PM_{2.5}$ emissions would increase by less than 0.1 ton per year. Alternative RSA-6D would be expected to have slightly higher emissions of most pollutants relative to RSA-5C, RSA-5D, and RSA-5E because of the greater displacement of departure thresholds and the need for longer back-taxi time to reach these thresholds.

4.3.4.2 SHORT-TERM, CONSTRUCTION-RELATED EMISSIONS

Short-term increases of criteria pollutant emissions would occur during construction from construction vehicle exhaust. Fugitive dust would be released as new areas are disturbed. No RSA construction would occur for Alternative RSA-8.

Table 4-13 summarizes the construction vehicle-exhaust emissions associated with each RSA alternative. With the exception of RSA-5C and RSA-5E, most RSA alternatives would have similar short-term increases of criteria air pollutants. However, the criteria pollutant emissions from RSA-5C and RSA-5E would be substantially higher than any of the other build alternatives, due to the larger disturbance footprint for new RSA and extended parallel taxiway, and due to the greater amount of fill used to construct these facilities. Alternatives RSA-5D, RSA-6B, RSA-6C, and RSA-6D would be expected to have slightly higher short-term construction elated emissions than those noted in Table 4-13 owing to the required relocation of Duck Creek and modification to portions of the Mendenhall River channel. These additional emissions are projected to be comparable to but less than the total emissions related to RSA-1, as the nature of construction related to these additional waterway modifications is less than that for the substantial relocation of the Mendenhall River under Alternative RSA-1.

Table 4-13. Construction-Related Emissions (peak year): RSA

Project	Tons per year Vehicle Exhaust						Fugitive Dust (tons)
	CO	NOx	VOC	SOx	PM_{10}	$PM_{2.5}$	
RSA-1	8.3	13.9	1.7	0.8	0.7	0.7	44.6
RSA-5C/5E [1]	12.5	20.3	2.8	1.1	1.0	1.0	45.2
RSA-6A/6D[1]	8.6	13.1	1.8	0.8	0.8	0.8	30.4
RSA-6B	9.0	13.6	1.9	0.8	0.8	0.8	31.8
RSA-6C/5D[1]	8.6	12.9	1.9	0.6	0.5	0.5	39.7
RSA-8 (No Action)	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Source: Synergy Consultants, September 2004 and BridgeNet, October 2004.
[1] Alternatives RSA-5D, RSA-5E, and RSA-6D were brought under consideration following issuance of the Draft EIS. FAA determined that since the parameters of these alternatives fall within the range of alternatives analyzed in detail in the Draft EIS, no detailed air quality analysis of these alternatives is necessary for the Final EIS. Alternative RSA-5D is nearly identical to Alternative RSA-6C in terms of factors contributing to construction related air quality impacts. Alternative RSA-5E is most similar to RSA-5C with regards to factors contributing to construction related impacts, and Alternative RSA-6D is most similar to Alternative RSA-6A in terms of factors contributing to construction related impacts; it would have lesser air quality impacts than Alternative RSA-6C.

Table 4-13 also shows the fugitive dust emissions released during construction. Fugitive dust levels were calculated to reach over 45 tons during construction of RSA-5C and RSA-5E, assuming a dry construction season; watering the construction site during dry periods could lower fugitive dust levels from those reported in the table. Of the build alternatives, Alternatives RSA-5C and RSA-5E would result in the greatest fugitive dust emissions, again attributable to the larger disturbance for RSA and new taxiway. Alternative RSA-1 would have similar, but slightly lower, fugitive dust levels than RSA-5C and RSA-5E given the lack of an extended taxiway for this alternative. Short-term fugitive dust emissions for Alternatives RSA-5D, RSA-6B, RSA-6C, and RSA-6D would be expected to be slightly higher than identified in Table 4-13 for the same reasons described previously in relation to modifications to the Mendenhall River channel associated with these alternatives.

Part of the construction related to the Runway 08 RSA for Alternatives RSA-1, RSA-5D, RSA-6B, RSA-6C, and RSA-6D would occur within the non-attainment area west of the Airport. The analysis above indicates that the construction-related emissions associated with this work would not exceed de minimis levels. Therefore, the work for each of these alternatives would conform to the State Implementation Plan for air quality and would, therefore, be in compliance with the requirements of the Clean Air Act.

4.3.5 Hazardous Materials and Solid Waste

A search of environmental databases, field reconnaissance, and a review of historic aerial photographs suggest that areas where additional RSA is needed have a low probability of containing buried solid or hazardous waste. No information was available suggesting that historic, waste-disposal practices used the areas to be disturbed by any of the RSA alternatives. Furthermore, no building demolition would be required, so there would be little concern of encountering asbestos-containing materials.

Construction of the RSA would not generate hazardous wastes. Some additional construction debris would be generated and likely include concrete, sheet metal, wood, flagging, and plastic as well as other inert materials. The amount of solid waste generated by RSA construction is insignificant as the CBJ landfill has sufficient capacity well beyond the year 2015.

An increase in RSA does not change the level of aviation activity and its resultant pollutants (e.g., oil, grease, metals from braking actions, etc.). However, a longer or shorter runway could directly increase or decrease, respectively, the surface area treated with urea during freezing and potentially freezing conditions at JNU. In this respect, Alternative RSA-6D would result in greater loading of urea to stormwater than any other action alternative, as there would be an approximate 12% increase in runway length. The amount of urea used would be expected to increase by 12% as well, and the load of this pollutant to stormwater would likely increase proportionately. Alternative RSA-5C would result in a 5.3% increase in runway surface length, with a corresponding proportional increase in the amount of urea used and the load of this pollutant to stormwater. Additional urea use and its associated stormwater loading would occur under Alternative RSA-5C as a result of the extension of the taxiway at the Runway 26 end. Alternatives RSA-6A and RSA-6B would result in an approximate 2% increase in runway surface length, and an estimated proportional increase in the amount of urea used and its pollutant loading to stormwater. Alternative

RSA-5D would result in a 4.7% increase in runway and length and would be expected to have a comparable increase in urea use and loading in stormwater. Alternative RSA-5E would result in a 6.1% increase in runway length and would have a comparable increase in urea use and loading. The extension of the taxiway under Alternatives RSA-5D and RSA-5E would also contribute additional urea loading in stormwater and would create additional impervious surface that would contribute to overall stormwater runoff. Alternatives RSA-1 and RSA-6C would not result in any increased urea use, as neither alternative would result in an increase to the runway length. Alternative RSA-5E is the Airport Sponsor's proposed action and the FAA's preferred alternative.

4.3.6 WATER RESOURCES AND FLOODPLAINS

The following sections describe possible effects to water resources from implementation of the RSA alternatives. The following assumptions have been made in the analysis of each alternative:

1. In using the Rational Method, the 50-year storm event is equal to 5.0 inches of rainfall in 24 hours, the 100-year storm event is equal to 5.7 inches of rainfall in 24 hours, and the runoff coefficients are 0.9 and 0.6 for impervious surfaces and 0.3 for pervious surfaces.
2. Unless otherwise noted, the extended culverts in Jordan Creek would increase the overall culvert length to 770 feet.
3. The new RSA would be constructed of compacted fill material that would reduce surface water infiltration and increase runoff relative to existing conditions (a "lesser pervious" surface).
4. The East Runway Slough would be actively relocated as a result of new RSA or EMAS construction on the Runway 26 end. In other words, the tidal slough would be filled after constructing a new channel with alignment, channel slope, and channel dimensions/shape designed to convey flows in a similar manner as existing conditions. Active relocation provides more predictability on how the channel will perform and should decrease the chances for channel alterations that lead to future ponding or other wildlife hazard generating situations when compared to passive relocation.
5. The RSA end fills would be protected using riprap at a 4:1 (horizontal to vertical) slope at both ends for RSA-1, RSA-5C, and RSA-6A and would be graded to a 2:1 (horizontal to vertical) slope at the west end for RSA-5D, RSA-5E, RSA-6B, RSA-6C, and RSA-6D. The RSA lateral fills would be graded to a 1:1 (horizontal to vertical) slope for RSA-1, RSA-5C, RSA-5E, and RSA-6A and would be graded to a 1.5:1 (horizontal to vertical) slope for the west end lateral fill for RSA-5D, RSA-6B, RSA-6C, and RSA-6D. Gabion walls would be placed to protect both the RSA end and lateral slopes, and riprap would be used for additional protection around the RSA and lateral slope in the vicinity of the East Runway Slough and Jordan Creek.

Some environmental impacts are common to all of the RSA action alternatives. These include:

- The extended culvert system carrying Jordan Creek under the runway and taxiway would also remove an intermediate pool between culvert sections. There would be a slight decrease or no change in flow velocities as a result of this action. Construction of the culvert extensions would have short-term water quality impacts in terms of increased total suspended sediment (TSS) loads.
- There would be short-term increases of turbidity in the Float Plane Pond during dredging activity to acquire construction fill. Turbidity may also increase in the East Runway Slough and Mendenhall River during placement of fill for the RSA and/or RSA. However, the ponds do not have a surface water connection with the Slough, and the only connection with the Mendenhall River is through the inlet valve. As a result, the potential for turbid flows created during dredging to affect these drainages is very low.
- Stormwater treatment at JNU is conducted primarily through subsurface infiltration and soil and vegetative adsorption. The decrease in available pervious surface resulting from construction of RSAs would, therefore, indirectly affect pollutant loads by reducing the amount of pollutant capture. JNU does not have stormwater treatment within the infield beyond that provided by the natural filters. The increased stormwater load may also increase erosion of soils and vegetation at the discharge location. JNU has committed to install oil/water separators on the storm-water discharges leading to Duck Creek and the Miller-Honsinger Slough as part of their Stormwater Pollution Prevention Plan.
- A number of indirect effects could result from development of standard RSAs on the runway ends and south edge of the runway, and EMAS installation on runway ends. A reduction in the tidal prism volume, caused by fill, would likely result in a reduction in sediment transport capacity on the ebb tide. This could lead to geomorphic adjustment within the tidal channel system, resulting in smaller cross sectional channel areas and a simplification of tidal channel plan form. The magnitude of these permanent, indirect effects would correlate to size of disturbance for RSA development or EMAS installation.
- The changes to stream and tidal flows, nutrient exchange, stormwater runoff, surface water infiltration, channel morphology and upstream and downstream landforms, and other direct and indirect effects noted would be permanent, unless otherwise noted. They would begin to occur in the short-term, during construction. All of these direct effects would be adverse.

Table 4-14 summarizes the water resources and floodplains impacts that are discussed in subsequent sections.

4.3.6.1 Alternative RSA-1

This alternative would displace the Mendenhall River approximately 1,000 feet to the west, changing its alignment while shortening the channel by 30% from existing conditions. The Mendenhall River would be actively relocated by design and construction to protect the new facilities, including the new RSA and access roads, and the relocated Dike Trail. It was also assumed for this analysis that the material excavated for the new Mendenhall River channel would offset the amount of fill required to fill in the existing Mendenhall River channel. Duck Creek would be relocated as shown in Figures 2-38, 2-39 and 2-40 and as described in Section 2.8.2.3. The reloca-

Table 4-14. Summary of Water Resources and Floodplain Impacts

RSA	Mendenhall River Proposed Effected Area Channel Length (ft)	East Runway Slough Proposed Effected Area Channel Length (ft)	Cut** (cu yds)	Fill (cu yds)	Floodway/Tidal Prism Volume Removed (acre-ft)		
					Jordan Creek	East End	West End
1	*	6,390	68,400	32,990	91	161	96
5C	2,970	2,960	24,710	46,030	91	252	11
5D	2,920	6,390	68,400	20,640	91	169	71
5E	2970	6,380	72,630	29,880	91	169	71
6A	2,970	4,800	35,310	31,250	91	130	27
6B	2,920	4,800	35,310	31,250	91	116	71
6C	2,920	6,390	68,400	32,990	91	161	71
6D	2,920	4,800	35,310	31,250	91	130	71

Existing Effected Area Mendenhall River Channel length = 2,970 ft
Existing Effected Area East Runway Slough channel length = 4,630 ft
*RSA 1 option not developed for Mendenhall River relocation
**Cut volumes do not include modifications to the river channel along the Mendenhall River

tion of Duck Creek is necessary because of the RSA and the Float Plane Pond access road and Dike Trail relocations; the full relocation of the creek will also help to avoid perpetuating or enhancing existing wildlife hazards.

A portion of the East Runway Slough would be filled and replaced with a less-pervious surface to accommodate the east RSA expansion. Development of additional RSA would create approximately 37 acres of less pervious surface, increasing stormwater volumes by approximately eight percent and contributing approximately ten acre-feet of new runoff to the 100-year storm event. Table 4-15 is a summary of RSA-1 stormwater impacts.

The East Runway Slough channel would be actively relocated east around the end of the new RSA (see Figure 2-48). The affected portion of the East Runway Slough is currently 4,630 feet long; the channel relocation around the new end of the RSA would yield a new East Runway Slough length of 6,390 feet. It is estimated that 68,400 cubic yards of cut would be required and 32,990 cubic yards of fill would be required in order to implement this change, assuming that the fill would be placed up to seven feet msl. Additional fill could be used by filling to a higher elevation. A gabion wall and riprap would be used to protect the RSA from the modified East Runway slough. Currently, a portion of the water drained by Miller-Honsinger Slough flows to Sunny Slough with the majority flowing to East Runway Slough. A new connection between Miller-Honsinger Slough and the East Runway Slough would be created, as would a connection between the East Runway Slough and Sunny Slough (see Figure 2-48).

Table 4-15. Summary of RSA-1 Stormwater Impacts

	Mendenhall River		Gastineau Channel		JNU Total
	Float Plane Pond	Duck Creek	Jordan Creek	M-H/East Runway Sloughs	
New Less Pervious Surface (acres)	8.3	7.1	1.5	20.3	37.2
Percent Increase	25.9%	13.7%	2.0%	49.6%	18.5%
New runoff – 50-yr (acre-ft)	1.9	1.6	0.4	4.9	8.8
Percent Increase	9.2%	6.6%	1.1%	16.5%	8.1%
New runoff – 100-yr (acre-ft)	2.2	1.8	0.4	5.6	10.1
Percent Increase	9.2%	6.6%	1.1%	16.5%	8.1%
New Urea Application Area (acres)	0.0	0.0	0.0	0.0	0.0
Percent Increase	0.0%	0.0%	0.0%	0.0%	0.0%

Source: Vigil-Agrimis 2004

Extension of the Runway 08 RSA and relocation of the Mendenhall River would reduce floodplain/tidal prism storage by approximately 96 acre-feet (determined as the area of disturbance times the height of fill divided by 43,560 square feet per acre). Extension of the lateral RSA would reduce floodplain/tidal prism volume in the vicinity of the Jordan Creek mouth by approximately 91 acre-feet. Extension of the Runway 26 RSA would reduce floodplain/tidal prism volume in the East Runway Slough area by approximately 161 acre-feet, and decrease water, nutrient and sediment exchange during daily high tides. There would be less energy in the system, and some sedimentation of the upper marsh could occur.

Constructing the Runway 08 RSA would require relocating the confluence of Duck Creek and the Mendenhall River to north of its current location, causing permanent changes to geomorphologic features. Existing channels would be filled and new channels would be excavated. This action would shorten Duck Creek by approximately 200 feet and the Mendenhall River by approximately 2,200 feet. The proposed Duck Creek alignment is discussed in Section 2.8.2.3. Shortening the Mendenhall River would increase the channel slope and decrease the friction available to the river, giving the river more energy for potential bed and bank erosion. Shortening Duck Creek would increase its stream power, which could improve conditions related to low dissolved oxygen and dewatering.

Construction of the Runway 26 RSA would permanently displace the existing East Runway Slough channel. The channel would be lengthened by approximately 1,800 feet, resulting in a more gently sloping channel. The existing East Runway Slough slope in the affected area averages about 0.13%; the proposed East Runway Slough slope in the affected area would have an approximately 0.09% slope.

The reduction in channel length in the Mendenhall River and Duck Creek due to fill of the existing channels for the Runway 08 RSA extension would result in steeper gradient channels and would cause geomorphic adjustments of these systems. The duration of the adjustment period is difficult to predict but it could take years for the affected systems to reach equilibrium. The shortening of the Mendenhall River channel by 2,200 feet would result in a lowering of the channel by one or two feet. Adjustment to this elevation change could affect upstream properties through bank erosion. The change to stream morphology, and the overall readjustment of the surface water systems to the new channels, would begin immediately upon construction and may require many years to equilibrate.

The impacts due to erosion, channel downcutting, and channel migration are challenging to predict. All four channels (Mendenhall River, Duck Creek, Jordan Creek, and the East Runway Slough) would continue to adjust over time as the natural forms of the stream and tidal systems adapt.

4.3.6.2 Alternative RSA-5C

Alternative RSA-5C would displace the East Runway Slough east and would create new less pervious surfaces for the lateral and Runway 26 RSA extensions. This alternative differs from the others in that it extends the Runway 26 RSA into the Refuge. Extending the Runway 26 RSA would displace the existing East Runway Slough channel, which would be actively relocated to connect with Sunny Slough to the east (see Figure 2-49). Development of the additional RSA would create approximately 39 acres of new impervious and less pervious surface, increasing stormwater runoff volumes by approximately nine percent over existing conditions, and contributing approximately 10.8 acre-feet of new runoff to a 100-year storm event. Table 4-16 is a summary of RSA-5C stormwater impacts.

The existing southern portion of East Runway Slough would be permanently cut-off from Miller-Honsinger Slough and Dredge Slough, which would permanently alter the wetlands and aquatic habitat of the area. The affected portion of the East Runway Slough is currently approximately 4,600 feet; the proposed RSA-5C changes would shorten this section of the East Runway Slough to approximately 3,000 feet. This change would steepen the slope of this portion of the East Runway Slough. It is estimated that 24,710 cubic yards of cut and 46,030 cubic yards of fill will be needed in order to modify the East Runway Slough channel to connect to Sunny Slough under proposed alternative RSA-5C, assuming that the fill is placed up to seven feet msl. A gabion wall and riprap would be installed to protect the RSA from the modified slough connection to Sunny Slough.

Approximately 91 acre-feet of floodplain/tidal prism storage volume near Jordan Creek would be lost with the lateral RSA extension. Including these effects near the mouth of Jordan Creek, the Runway 26 RSA and lateral RSA extensions would reduce floodplain/tidal prism volume in the East Runway Slough by approximately 252 acre-feet. The addition of fill within the East Runway Slough would decrease the tidal prism volume with the result of less exchange of water, nutrients, and sediment during daily high tides. There would be less energy in the system, and some sedimentation of the upper marsh is possible.

Table 4-16. Summary of RSA-5C Stormwater Impacts

	Mendenhall River		Gastineau Channel		JNU Total
	Float Plane Pond	Duck Creek	Jordan Creek	M-H/East Runway Sloughs	
New Less Pervious Surface (acres)	5.6	3.5	1.5	28.7	39.3
Percent Increase	17.5%	6.8%	2.0%	70.2%	19.5%
New runoff – 50-yr (acre-ft)	1.4	0.8	0.4	6.9	9.5
Percent Increase	6.5%	3.0%	1.1%	23.2%	8.7%
New runoff – 100-yr (acre-ft)	1.6	1.0	0.4	7.9	10.8
Percent Increase	6.9%	3.3%	1.1%	23.1%	8.6%
New Urea Application Area (acres)	0.3	0.4	0.0	4.3	4.3
Percent Increase	1.3%	2.8%	0.0%	25.8%	5.1%

Source: Vigil-Agrimis 2004

Extension of the Runway 08 RSA would reduce floodplain/tidal prism storage by approximately 11.0 acre-feet. Duck Creek would be relocated as shown in Figures 2-38, 2-39, and 2-40 and as described in Section 2.8.2.3. The relocation of Duck Creek is necessary because of the RSA and Float Plane Pond access road and Dike Trail relocation; the full relocation of the creek will also help to avoid perpetuating or enhancing existing wildlife hazards. As part of the relocation, Duck Creek would be shortened by approximately 200 feet. This change would result in an increase in stream power, which could improve conditions related to low dissolved oxygen and dewatering.

The impacts due to erosion, channel downcutting, and channel migration are unpredictable. Jordan Creek and the East Runway Slough would continue to adjust over time as the natural forms of the stream and tidal systems adapt. As noted previously, the East Runway Slough could end up interconnected with an entirely different area of the Refuge, resulting in the loss of hydrologic and nutrient exchange to the Miller-Honsinger wetlands.

4.3.6.3 Alternative RSA-5D

Seven scenarios leading up to alternative RSA-5D for the west end of Runway 08 were developed and modeled with Hydrologic Engineering Center – River Analysis System (HEC-RAS, version 3.1.3) hydraulic modeling program designed by the Army Corps of Engineers (USACE, 2005). These scenarios investigate modifications solely on the east bank of the Mendenhall River, and include modifications on the west bank as well (Vigil-Agrimis Inc. 2006a and b). Ultimately, the seventh scenario was chosen due to it both meeting operational needs and it having relatively minimal effects on the channel hydraulics.

The first six scenarios are described only briefly herein. Proposed Scenario 1 is a modified RSA-5C with a 24-foot-wide Float Plane Pond Road. Scenario 1 was rejected because it does not provide for adequate wing tip clearance for aircraft being towed to the float plane pond around the west end of Runway 08.

Scenario 2 is an updated version of RSA-6B, with an approximately 78-foot-wide Float Plane Pond access road and Dike Trail in order to provide float plane transport. This configuration maintains adequate aircraft clearances with a 12:1 (H:V) slope between the outer edge of the Float Plane Pond access road and Dike Trail and the elevation 1.4 feet msl (~river sand bar) opposite the centerline of the runway. This scenario was rejected because the modeling indicates it would lead to a substantially higher water surface at the west end of Runway 08 and erosive velocities along the dike in the vicinity of the Float Plane Pond.

Scenario 3 has the same fill pattern and geometry as Scenario 2 on the airport (east) side of the Mendenhall River, but it also models alterations (cut) on the west bank of the Mendenhall River in order to accommodate the fill on the east side. This scenario was rejected in favor of using a steeper slope descending from the Float Plane Pond access road and Dike Trail that would have a lesser fill impact on the river.

Scenario 4 uses a steeper slope descending from the outer edge of the Float Plane Pond access road and Dike Trail, 1.5:1 (H:V) down to elevation 5.6 feet msl, in order to try to reduce impacts to the channel without west bank alterations. This scenario would result in undesirable changes in channel hydraulic performance due to a marked increased water surface elevations upstream and considerably increased channel velocities downstream, as well as high downstream shear stresses.

Scenario 5 has a Float Plane Pond access road that is reduced to 60 feet wide from 78 feet wide. The design intent is to try and keep the grading only on the east bank. This scenario is not desirable, due largely to the very high modeled channel velocity for the 100-year event.

Scenario 6 has a 78-foot-wide Float Plane Pond access road and Dike Trail and includes alterations only on the east side of the Mendenhall River. It has a 1.5:1 (H:V) slope from the outer edge of the Float Plane Pond Road and Dike Trail down to elevation 5.6 feet msl. It then slopes 33:1 (H:V) down to the 1.4 feet msl elevation (approximately the river sand bar). This scenario results in a channel constriction which causes a water surface elevation rise upstream and an increase in velocity downstream; this scenario was rejected due to these undesirable hydraulic changes.

Scenario 7 was chosen for Alternative RSA-5D, -6B, -6C and -6D, which have a common west end fill footprint. Figures 2-25, 2-28, 2-29, 2-30 depict this scenario. It has a 78-foot-wide Float Plane Pond access road and Dike Trail, with a 1.5:1 (H:V) slope from the outer edge of the Float Plane Pond Road and Dike Trail down to elevation 5.6 feet msl. It then slopes 33:1 (H:V) down to the elevation 1.4 feet msl (approximately the river sand bar). In addition, it also includes changes to the west bank of the Mendenhall River. These proposed modifications were developed to provide sufficient channel area to disperse channel energy without substantially increasing velocities or shear stresses and for maintaining water surface elevations at various tide conditions. Figure 4-10 shows the location of the river stations used in the modeling effort. Cross-sectional

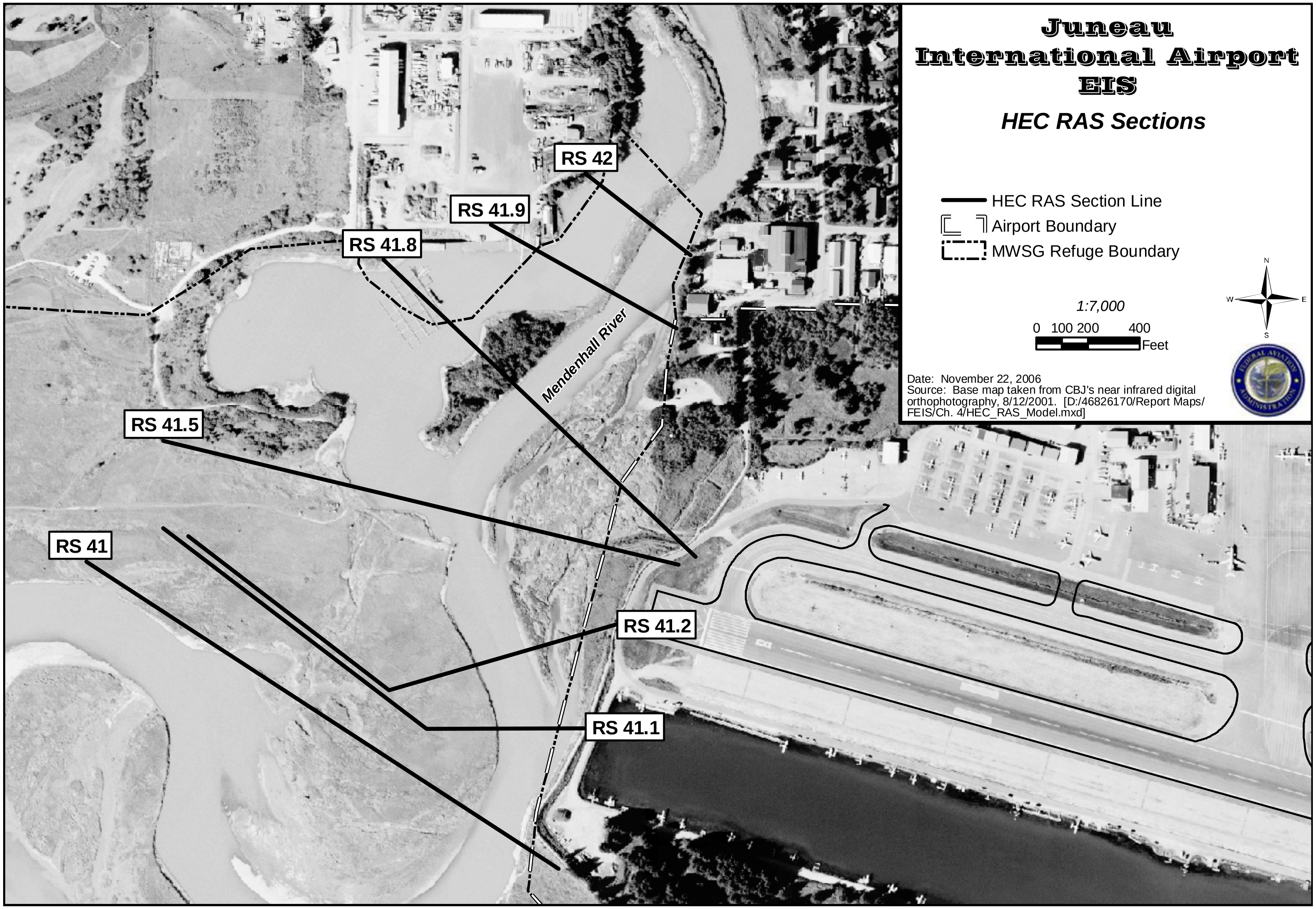


Figure 4-10. mendenhall River stations for the HEC-RAS model.

profiles of low-tide conditions are located in Figure 4-11, and a longitudinal profile of low-tide conditions is shown in Figure 4-12. Under high-tide conditions, Gastineau Channel causes a back-water effect, thus leading to the existing conditions and RSA-5D (and -6B, -6C and -6D) proposed conditions water surface profiles being nearly identical and the longitudinal profile being nearly flat.

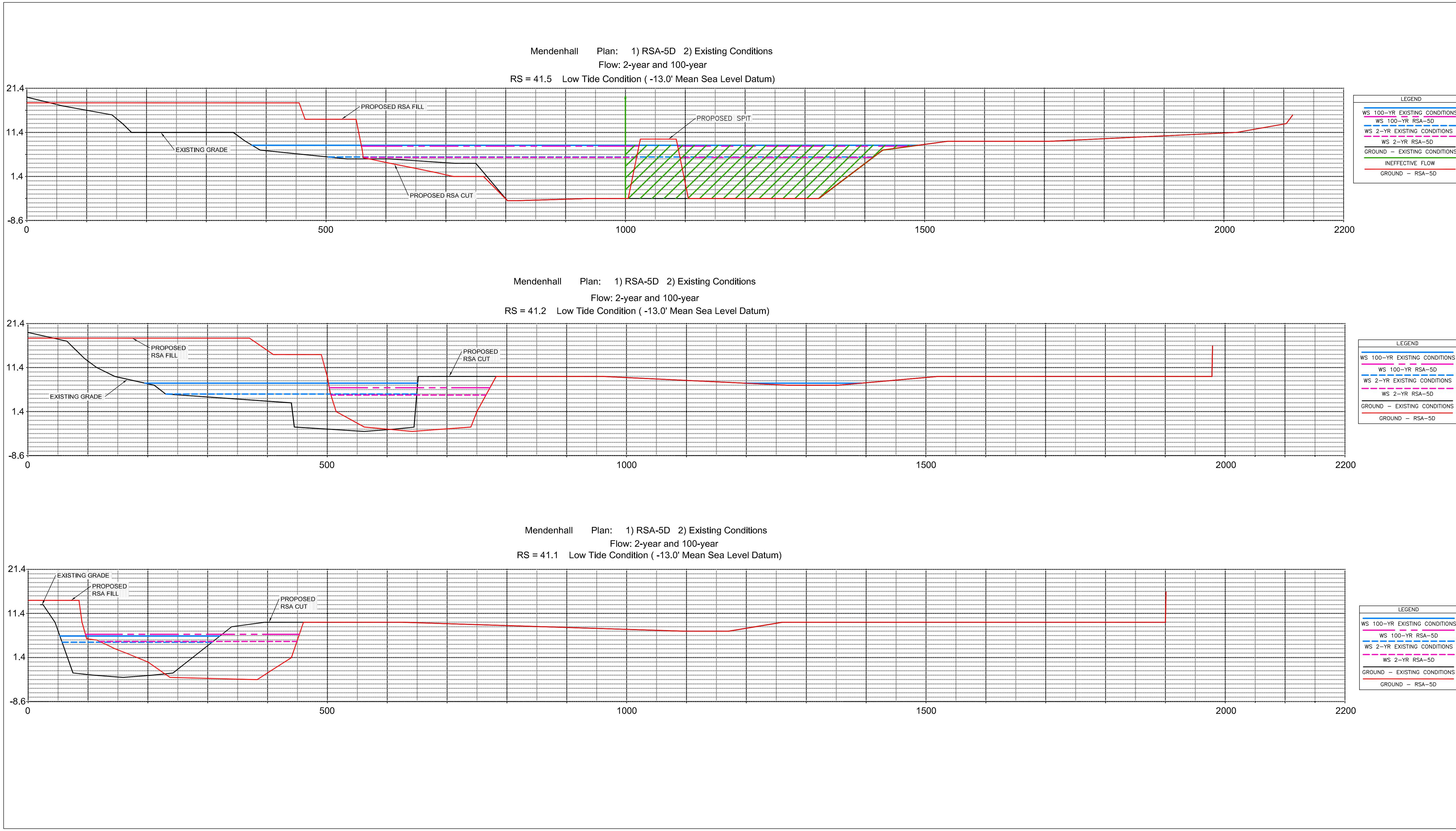
Modeled hydraulic conditions for this scenario are displayed in Tables 4-17 and 4-18. The HEC-RAS model for this scenario indicates that for the 2-year event, the fill on the east bank and offsetting excavation on the west bank of the Mendenhall River in this scenario results in channel conditions very similar to the existing conditions (Tables 4-19 and 4-20). Most cross-sections in the Runway 08 vicinity have slight increases in channel cross sectional areas and resulting small channel velocity decreases. This scenario is considered acceptable as a planning-level model in terms of water surface elevations and channel velocities.

Duck Creek would be relocated as shown in Figures 2-38, 2-39 and 2-40 and as described in Section 2.8.2.3. The relocation of Duck Creek is necessary because of the RSA and Float Plane Pond access road and Dike Trail relocation; the full relocation of the creek will also help to avoid perpetuating or enhancing existing wildlife hazards.

Development of additional RSA would create approximately 36 acres of new impervious and less pervious surface, increasing stormwater runoff volumes by approximately eight percent over existing conditions, and contributing approximately ten acre-feet of new runoff to a 100-year storm event. Table 4-21 is a summary of RSA-5D stormwater impacts.

Table 4-17. Alternative RSA-5D, 6B, 6C and 6D modeled hydraulic conditions at the Runway 08 end, low tide conditions

Cross-Section	Flow	Discharge (cfs)	Water Surface Elevation (ft-msl)	Average Channel Velocity (ft/s)	Average Channel Shear (lb/sq ft)	Flow Area (sq ft)
41.9	2-year	9580	6.1	4.1	0.2	2320
41.9	100-year	20480	8.7	6.7	0.4	3050
41.8	2-year	9580	5.9	3.8	0.1	2560
41.8	100-year	20480	8.6	5.3	0.3	3900
41.5	2-year	9580	5.7	3.6	0.1	2700
41.5	100-year	20480	8.3	5.4	0.3	3830
41.2	2-year	9580	5.2	5.5	0.3	1740
41.2	100-year	20480	6.8	9.4	0.8	2180
41.1	2-year	9580	5.1	4.7	0.2	2020
41.1	100-year	20480	6.7	7.9	0.6	2600



SCALE: 1"=20' Vertical 1"=150' Horizontal

Figure 4-11. Cross section of Mendenhall River under low tide conditions with proposed river channel modifications for RSA-5D (and RSA-6B, RSA-6C, and RSA-6D).

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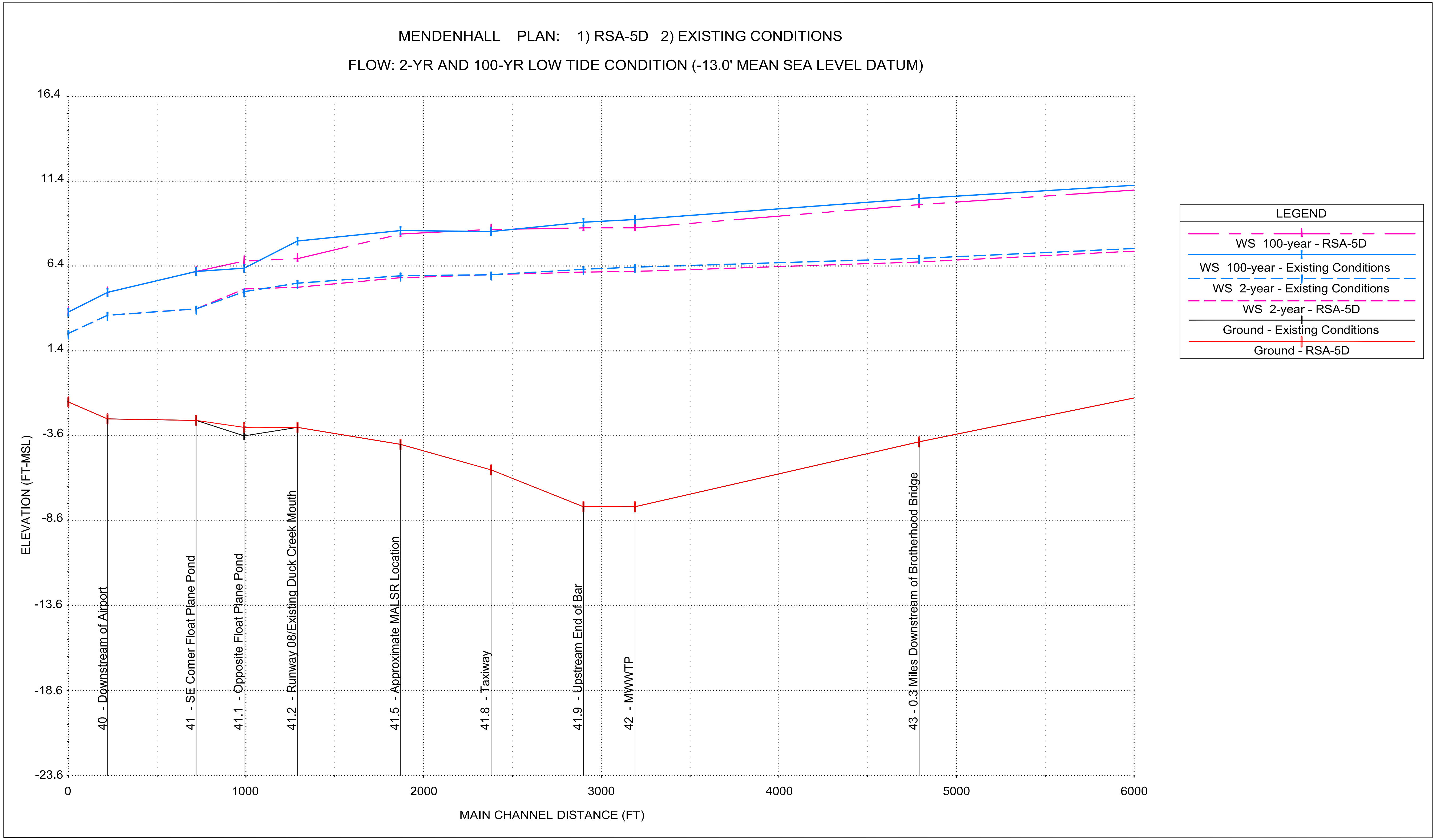

SCALE: 1"=5' Vertical 1"=500' Horizontal

Figure 4-12. Longitudinal profile of Mendenhall River under low tide conditions with proposed river channel modifications for RSA-5D (and RSA-6B, RSA-6C, and RSA-6D).

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Table 4-18. Alternative RSA-5D, 6B, 6C and 6D modeled hydraulic conditions at the Runway 08 end, high tide conditions

Cross-Section	Flow	Discharge (cfs)	Water Surface Elevation (ft-msl)	Average Channel Velocity (ft/s)	Average Channel Shear (lb/sq ft)	Flow Area (sq ft)
41.9	2-year	9580	11.1	2.6	0.1	3740
41.9	100-year	20480	11.2	5.4	0.2	3790
41.8	2-year	9580	11.1	1.9	0.0	5180
41.8	100-year	20480	11.3	3.9	0.1	5290
41.5	2-year	9580	11.0	1.9	0.0	5040
41.5	100-year	20480	11.1	4.0	0.1	5090
41.2	2-year	9580	11.0	2.3	0.0	5880
41.2	100-year	20480	10.9	5.0	0.2	5820
41.1	2-year	9580	11.0	1.9	0.0	7170
41.1	100-year	20480	11.0	4.0	0.1	7110

Table 4-19. Comparison of Proposed Alternative RSA-5D, -6B, -6C, and –6D modeled hydraulic conditions and existing hydraulic conditions at the Runway 08 end, low tide conditions[1]

Cross-Section	Flow	Discharge (cfs)	Change in Water Surface Elevation (ft-msl)	Change in Average Channel Velocity (ft/s)	Change in Average Channel Shear (lb/sq ft)	Change in Flow Area (sq ft)
41.9	2-year	9580	-0.1	-0.7	0	330
41.9	100-year	20480	-0.3	-1	-0.1	370
41.8	2-year	9580	0	-1.6	-0.2	780
41.8	100-year	20480	0.2	-3.2	-0.3	980
41.5	2-year	9580	-0.1	-0.7	-0.1	310
41.5	100-year	20480	-0.2	-0.8	0	-100
41.2	2-year	9580	-0.2	0.3	0	-110
41.2	100-year	20480	-1.1	2.4	0.3	-810
41.1	2-year	9580	0.2	-1.5	-0.2	470
41.1	100-year	20480	0.4	-2.8	-0.5	690

[1]Positive numbers indicate an increase over existing conditions; negative numbers indicate a decrease compared with existing conditions. Neutral or slight decreases in water surface elevation, channel velocity, and channel shear stress are desirable as is slight increase in channel flow area.

Table 4-20. Comparison of Proposed Alternative RSA-5D, -6B, -6C, and –6D modeled hydraulic conditions and existing hydraulic conditions at the Runway 08 end, high tide conditions[1]

Cross-Section	Flow	Discharge (cfs)	Change in Water Surface Elevation (ft-msl)	Change in Average Channel Velocity (ft/s)	Change in Average Channel Shear (lb/sq ft)	Change in Flow Area (sq ft)
41.9	2-year	9580	0.1	-0.4	0	490
41.9	100-year	20480	0	-0.9	-0.1	510
41.8	2-year	9580	0.1	-0.7	-0.1	400
41.8	100-year	20480	0.1	-1.6	-0.1	420
41.5	2-year	9580	0	-0.2	0	-510
41.5	100-year	20480	0	-0.5	-0.1	-530
41.2	2-year	9580	0	0.5	0	-1410
41.2	100-year	20480	-0.2	1.2	0.1	-1590
41.1	2-year	9580	0	-0.2	0	690
41.1	100-year	20480	0.1	-0.6	-0.1	750

[1]Positive numbers indicate an increase over existing conditions; negative numbers indicate a decrease compared with existing conditions. Neutral or slight decreases in water surface elevation, channel velocity, and channel shear stress are desirable as is slight increase in channel flow area.

Table 4-21. Summary of RSA-5D Stormwater Impacts

	Mendenhall River		Gastineau Channel		JNU Total
	Float Plane Pond	Duck Creek	Jordan Creek	M-H/East Runway Sloughs	
New Less Pervious Surface (acres)	7.1	5.2	1.5	21.8	35.6
Percent Increase	22.2%	10.0%	2.0%	53.5%	17.7%
New runoff – 50-yr (acre-ft)	1.8	1.3	0.4	5.2	8.6
Percent Increase	8.4%	5.2%	1.1%	17.5%	7.9%
New runoff – 100-yr (acre-ft)	2.0	1.5	0.4	6.0	9.9
Percent Increase	8.6%	5.0%	1.1%	17.6%	7.9%
New Urea Application Area (acres)	0.0	0.0	0.0	3.5	3.5
Percent Increase	1.3%	2.1%	0%	21.0%	4.1%

On the east side, extending the Runway 26 RSA would displace the existing East Runway Slough channel, which would be actively relocated around the east and south ends of the new RSA (see Figure 2-48). This east side configuration is identical to that of RSA-1 and RSA-6D, except that RSA-5D also includes a taxiway extension. However, this taxiway extension does not affect the relocation of the East Runway Slough. The current East Runway Slough channel in this area is approximately 4,600 feet long and the RSA-5D proposed relocated East Runway Slough channel is approximately 6,400 feet long, resulting in about 1,800 feet of channel lengthening. This lengthening would reduce the slope of the channel. The proposed channel change would preserve hydraulic connections between Sunny, East Runway, Miller-Honsinger, and Dredge Sloughs. Riprap and a gabion wall would be installed to protect the RSA from the modified East Runway slough. As proposed, this channel relocation would require approximately 68,400 cubic yards of cut and 20,640 cubic yards of fill, assuming fill to an elevation of seven feet msl.

Extension of the Runway 08 RSA would reduce floodplain/tidal prism storage by approximately 71 acre-feet on the west end. Approximately 91 acre-feet of floodplain/tidal prism storage would be lost in the vicinity of Jordan Creek. Including these effects near the mouth of Jordan Creek, the Runway 26 RSA and lateral RSA extensions would reduce floodplain/tidal prism volume in the East Runway Slough by approximately 169 acre-feet. The addition of fill within the East Runway Slough would decrease the tidal prism volume with the result of less exchange of water, nutrients, and sediment during daily high tides. There would be less energy in the system, and some sedimentation of the upper marsh is possible.

4.3.6.4 Alternative RSA-5E

Alternative RSA-5E, the FAA's preferred RSA alternative, would displace the East Runway Slough east and would create new less pervious surfaces for the lateral and Runway 26 RSA extensions. This alternative is similar to RSA-5C in that it extends the Runway 26 RSA into the Refuge. Extending the Runway 26 RSA would displace the existing East Runway Slough channel, which would be actively relocated around the end of the RSA to maintain the current hydrologic connection (see Figure 2-51). Development of the additional RSA would create approximately 35 acres of new impervious and less pervious surface, increasing stormwater runoff volumes by approximately eight percent over existing conditions, and contributing approximately 9.7 acre-feet of new runoff to a 100-year storm event. Table 4-22 is a summary of RSA-5E stormwater impacts.

The Runway 26 configuration for RSA-5E is similar to, but slightly longer than, that of RSA-1, RSA-5D, and RSA-6C, and slightly shorter than that of RSA-5C. The East Runway Slough channel would be actively relocated east around the end of the new RSA (see Figure 2-51). Currently, this portion of the East Runway Slough is about 4,600 feet long; the channel relocation around the new end of the RSA would yield a new East Runway Slough length of approximately 6400 feet. The current slope of this portion of the East Runway Slough is approximately 0.001. Under RSA-5E, the proposed slope of the relocated reach would be approximately 0.0005. It is estimated that 72,630 cubic yards of cut would be required and 29,880 cubic yards of fill would be required in order to implement this change, assuming that the fill would be placed up to seven feet msl. Additional fill could be used by filling to a higher elevation. A gabion wall could be installed to protect the RSA from the modified East Runway Slough. Approximately 91 acre-feet

Table 4-22. Summary of RSA-5E Stormwater Impacts

	Mendenhall River		Gastineau Channel		JNU Total
	Float Plane Pond	Duck Creek	Jordan Creek	M-H/East Runway Sloughs	
New Less Pervious Surface (acres)	5.2	3.6	1.5	24.8	35.1
Percent Increase	16.3%	6.9%	2.0%	60.6%	17.4%
New runoff – 50-yr (acre-ft)	1.3	0.9	0.4	6.0	8.5
Percent Increase	6.1%	3.6%	1.1%	19.9%	7.7%
New runoff – 100-yr (acre-ft)	1.5	1.0	0.4	6.8	9.7
Percent Increase	6.1%	3.6%	1.1%	19.9%	7.7%
New Urea Application Area (acres)	0.0	0.0	0.0	3.9	3.5
Percent Increase	0.0%	0.0%	0.0%	16.5%	4.1%

Source: Vigil-Agrimis 2007

of floodplain/tidal prism storage volume would be lost with the lateral RSA extension near the mouth of Jordan Creek. Including the effects near the mouth of Jordan Creek, the east and lateral RSA extensions would reduce floodplain/tidal prism volume in the East Runway Slough by approximately 169 acre-feet.

Currently, a portion of the water drained by Miller-Honsinger Slough flows to Sunny Slough with the majority flowing to East Runway Slough. A new connection between Miller-Honsinger Slough and the East Runway Slough would be created, as would a connection between the East Runway Slough and Sunny Slough.

Duck Creek would be relocated as shown in Figures 2-38, 2-39 and 2-40 and as described in Section 2.8.2.3. The relocation of Duck Creek is necessary because of the RSA and Dike Road/ Dike Trail relocation; the full relocation of the creek will also help to avoid perpetuating or enhancing existing wildlife hazards.

4.3.6.5 Alternative RSA-6A

Installation of EMAS on both runway ends would create approximately 25 acres of new impervious and less pervious surface, increasing stormwater runoff volumes by approximately 6% and contributing approximately seven acre-feet of new runoff to a 100-year storm event. Table 4-23 is a summary of RSA-6A stormwater impacts.

Table 4-23. Summary of RSA-6A Stormwater Impacts

	Mendenhall River		Gastineau Channel		JNU Total
	Float Plane Pond	**Duck Creek**	**Jordan Creek**	**M-H/East Runway Sloughs**	
New Less Pervious Surface (acres)	5.2	3.2	1.5	15.1	25.0
Percent Increase	16.3%	6.2%	2.0%	36.9%	12.4%
New runoff – 50-yr (acre-ft)	1.3	0.8	0.4	3.7	6.1
Percent Increase	6.0%	3.0%	1.1%	12.3%	5.5%
New runoff – 100-yr (acre-ft)	1.4	0.9	0.4	4.2	6.9
Percent Increase	6.0%	3.0%	1.1%	12.3%	5.5%
New Urea Application Area (acres)	0.0	0.0	0.0	0.8	0.8
Percent Increase	0.0%	0.0%	0.0%	4.8%	0.9%

Source: Vigil-Agrimis 2004

Installation of EMAS on the Runway 08 end would reduce floodplain/tidal prism storage by approximately 27 acre-feet. Duck Creek would be relocated as shown in Figure 2-38, 2-39, and 2-40 and as described in Section 2.8.2.3. The relocation of Duck Creek would be necessary because of the RSA and Float Plane Pond access road/Dike Trail relocation; the full relocation of the creek would also help to avoid perpetuating or enhancing existing wildlife hazards.

Installation of the Runway 26 end EMAS would displace the existing East Runway Slough channel east of the Runway 26 RSA and south of the lateral RSA, although less than any other action alternatives (except for RSA-6A and RSA-6B, which have almost identical proposed East Runway Slough configurations) (Figure 2-48). Connections between Sunny Slough and East Runway Slough would be maintained. A gabion wall and/or riprap would be installed to protect the RSA from the modified East Runway slough. Approximately 91 acre-feet of floodplain/tidal prism storage volume would be lost with the lateral RSA extension near the mouth of Jordan Creek. Including the effects near the mouth of Jordan Creek, the east and lateral RSA extensions would reduce floodplain/tidal prism volume in the East Runway Slough by approximately 130 acre-feet.

Active channel relocation would result in the channel being lengthened slightly from about 4,600 feet to 4,800 feet and would result in the channel slope being slightly reduced. As proposed, this channel relocation would require approximately 35,310 cubic yards of cut and 31,250 cubic yards of fill, assuming fill to an elevation of seven feet msl. Additional fill could be used to fill to a greater elevation. Adding fills along East Runway Slough would decrease the tidal prism volume and result in less exchange of water, nutrients, and sediment during daily high tides. There would be less energy in the system, and some sedimentation of the upper marsh is possible.

4.3.6.6 Alternative RSA-6B

Installation of EMAS on both runway ends would create approximately 27 acres of new impervious and less pervious surface, increasing stormwater runoff volumes by approximately 6% and contributing approximately seven acre-feet of new runoff to a 100-year storm event. Table 4-24 is a summary of RSA-6B stormwater impacts.

Table 4-24. Summary of RSA-6B Stormwater Impacts

	Mendenhall River		Gastineau Channel		JNU Total
	Float Plane Pond	Duck Creek	Jordan Creek	M-H/East Runway Sloughs	
New Less Pervious Surface (acres)	7.1	5.2	1.5	13.4	27.2
Percent Increase	22.2%	10.0%	2.0%	32.8%	13.5%
New runoff – 50-yr (acre-ft)	1.8	1.3	0.4	2.8	6.2
Percent Increase	8.4%	5.2%	1.1%	9.2%	5.6%
New runoff – 100-yr (acre-ft)	2.0	1.5	0.4	3.2	7.0
Percent Increase	8.6%	5.0%	1.1%	9.4%	5.6%
New Urea Application Area (acres)	0.3	0.5	0.0	0.0	0.8
Percent Increase	1.3%	3.5%	0.0%	0.0%	0.9%

Source: Vigil-Agrimis 2004

Duck Creek would be relocated as shown in Figures 2-38, 2-39 and 2-40 and as described in Section 2.8.2.3. The relocation of Duck Creek is necessary because of the RSA and Float Plane Pond access road/Dike Trail relocation; the full relocation of the creek will also help to avoid perpetuating or enhancing existing wildlife hazards.

Installation of the Runway 08 end EMAS would reduce floodplain/tidal prism storage by approximately 71 acre-feet. Approximately 91 acre-feet of floodplain/tidal prism storage volume would be lost with the lateral RSA extension near the mouth of Jordan Creek. Including these effects near the mouth of Jordan Creek, the east and lateral RSA extensions would reduce floodplain/tidal prism volume in the East Runway Slough by approximately 116 acre-feet.

Installation of the Runway 26 end EMAS would displace the existing East Runway Slough channel east of the Runway 26 RSA and south of the lateral RSA, although less than any of the other action alternatives (except for RSA-6A and RSA-6B, which have almost identical proposed East Runway Slough configurations) (Figure 2-50). Connections between Sunny Slough and East Runway Slough would be maintained. A gabion wall and/or riprap would be installed to protect the RSA from the modified East Runway slough. Active channel relocation would result in the channel being lengthened slightly from about 4,600 feet to 4,800 feet and would result in the channel slope being slightly reduced. As proposed, this channel relocation would require approximately 35,310 cubic yards of cut and 31,250 cubic yards of fill, assuming fill to an elevation of seven feet msl. Additional fill could be used to fill to a greater elevation. Adding fills along East Runway Slough would decrease the tidal prism volume with the result of less exchange of water, nutrients, and sediment during daily high tides. There would be less energy in the system, and some sedimentation of the upper marsh is possible.

4.3.6.7 Alternative RSA-6C

Development of additional Runway 26 end RSA and installation of EMAS on the Runway 08 end would create approximately 34 acres of new impervious and less pervious surface, increasing stormwater runoff volumes by approximately 8% and contributing approximately nine acre-feet of new runoff to a 100-year storm event. Table 4-25 is a summary of RSA-6C stormwater impacts.

Table 4-25. Summary of RSA-6C Stormwater Impacts

	Mendenhall River		Gastineau Channel		JNU Total
	Float Plane Pond	Duck Creek	Jordan Creek	M-H/East Runway Sloughs	
New Less Pervious Surface (acres)	7.1	5.2	1.5	19.9	33.7
Percent Increase	22.2%	10.0%	2.0%	48.7%	16.7%
New runoff – 50-yr (acre-ft)	1.8	1.3	0.4	4.8	8.2
Percent Increase	8.4%	5.2%	1.1%	16.0%	7.5%
New runoff – 100-yr (acre-ft)	2.0	1.5	0.4	5.4	9.3
Percent Increase	8.6%	5.0%	1.1%	15.8%	7.4%
New Urea Application Area (acres)	0.0	0.0	0.0	0.0	0.0
Percent Increase	0.0%	0.0%	0.0%	0.0%	0.0%

Source: Vigil-Agrimis 2004

Duck Creek would be relocated as shown in Figures 2-38, 2-39 and 2-40 and as described in Section 2.8.2.3. The relocation of Duck Creek is necessary because of the RSA and Dike Road/ Dike Trail relocation; the full relocation of the creek will also help to avoid perpetuating or enhancing existing wildlife hazards.

This east side configuration is identical to that of RSA-1. The East Runway Slough channel would be actively relocated east around the end of the new RSA (see Figure 2-48). Currently, this portion of the East Runway Slough is about 4,600 feet long; the channel relocation around the new end of the RSA would yield a new East Runway Slough length of 6,400 feet. It is estimated that 68,400 cubic yards of cut would be required and 32,990 cubic yards of fill would be required in order to implement this change, assuming that the fill would be placed up to seven feet msl. Additional fill could be used by filling to a higher elevation. A gabion wall would be installed to protect the RSA from the modified East Runway slough. Currently, a portion of the water drained by Miller-Honsinger Slough flows to Sunny Slough with the majority flowing to East Runway Slough. A new connection between Miller-Honsinger Slough and the East Runway Slough would be created, as would a connection between the East Runway Slough and Sunny Slough.

Installation of EMAS on the Runway 08 end would reduce floodplain/tidal prism storage by approximately 71 acre-feet. Approximately 91 acre-feet of floodplain/tidal prism storage volume would be lost with the lateral RSA extension near the mouth of Jordan Creek. Including these effects near the mouth of Jordan Creek, the east and lateral RSA extensions would reduce floodplain/tidal prism volume in the East Runway Slough by approximately 161 acre-feet. Adding fills along East Runway Slough would decrease the tidal prism volume, with the result of less exchange of water, nutrients, and sediment during daily high tides. There would be less energy in the system, and some sedimentation of the upper marsh is possible.

4.3.6.8 Alternative RSA-6D

Alternative RSA-6D uses the same west end footprint as RSA-5D, RSA-6B, and RSA-6C and the same east end RSA footprint as RSA 6A. It incorporates the use of EMAS on both Runway 08 and Runway 26. The east end slough relocation footprint is the same as that for RSA-6A.

Development of alternative RSA-6D would create approximately 29 acres of new impervious and less pervious surface, increasing stormwater runoff volumes by approximately 6% and contributing approximately eight acre-feet of new runoff to a 100-year storm event. Table 4-26 is a summary of RSA-6D stormwater impacts.

Table 4-26. Summary of RSA-6D Stormwater Impacts

	Mendenhall River		Gastineau Channel		JNU Total
	Float Plane Pond	Duck Creek	Jordan Creek	M-H/East Runway Sloughs	
New Less Pervious Surface (acres)	7.1	5.2	1.5	15.4	29.2
Percent Increase	22.2%	10.0%	2.0%	37.7%	14.5%
New runoff – 50-yr (acre-ft)	1.8	1.3	0.4	3.5	6.9
Percent Increase	8.4%	5.2%	1.1%	11.7%	6.3%
New runoff – 100-yr (acre-ft)	2.0	1.5	0.4	4.0	7.9
Percent Increase	8.6%	5.0%	1.1%	11.7%	6.3%
New Urea Application Area (acres)	1.2	1.7	0.0	3.1	2.9
Percent Increase	5.1%	11.9%	0.0%	18.6%	3.4%

Installation of the Runway 26 east end EMAS would displace the existing East Runway Slough channel east of the Runway 26 RSA and south of the lateral RSA, although less than any of the other action alternatives (except for RSA-6A and RSA-6B, which have almost identical proposed East Runway Slough configurations) (Figure 2-50). Connections between Sunny Slough and East Runway Slough would be maintained. A gabion wall and/or riprap would be installed to protect the RSA from the modified East Runway Slough Active channel relocation would result in the channel being lengthened slightly from about 4,600 feet to 4,800 feet and would result in the channel slope being slightly reduced. It is estimated that 35,310 cubic yards of cut would be required and 31,250 cubic yards of fill would be required in order to implement this change, assuming that the fill would be placed up to seven feet msl. Additional fill could be used by filling to a higher elevation.

Installation of EMAS on the Runway 08 west end would reduce floodplain/tidal prism storage by approximately 71 acre-feet. Approximately 91 acre-feet of floodplain/tidal prism storage volume would be lost with the lateral RSA extension near the mouth of Jordan Creek. Including the effects near the mouth of Jordan Creek, the east and lateral RSA extensions would reduce floodplain/tidal prism volume in the East Runway Slough by approximately 130 acre-feet. Adding fills along East Runway Slough would decrease the tidal prism volume and result in less exchange of water, nutrients, and sediment during daily high tides. There would be less energy in the system, and some sedimentation of the upper marsh is possible.

4.3.6.9 Alternative RSA-8

Alternative RSA-8 represents the No Action Alternative. There would be no loss of floodplain/ tidal prism storage and no changes to stormwater discharge in terms of flow, location, or water quality.

4.3.7 Vegetation

Tables 4-27 and 4-28 provide a detailed account of the direct impacts to vegetation types within the project and landscape areas that would result from implementation of the RSA action alternatives. Of these alternatives, RSA-5D would have the greatest direct adverse effects on native vegetation, while RSA-6A would have the least. Alternative RSA-5D would convert approximately 11.3% of the vegetation in the project area to impervious or low permeability surfaces, which would result in slightly more than 1% of the landscape area vegetation being converted to impervious or low permeability surface. Alternative RSA-6A would convert approximately 7.3% of vegetation in the project area to impervious or low permeability surfaces, which would result in less than 1% of the landscape area vegetation being converted.

The following sections describe the direct impacts to native plant communities and provide qualitative assessments of potential, indirect impacts to vegetation under each of the RSA alternatives. As was mentioned in Section 4.2.7, emphasis is placed on impacts to estuarine communities due to their ecological importance and relative rarity in southeastern Alaska. Figure 4-13 illustrates the vegetation communities that would be affected by each of the RSA alternatives.

4.3.7.1 Alternative RSA-1

Implementation of RSA-1 would affect a total of 50.5 acres of vegetation. Of this total, 35.7 acres would be impacted by construction of the RSA, relocation of associated facilities (e.g., the EVAR/ Dike Trail and Float Plane Pond access road), and the relocation of Duck Creek and the Mendenhall River channel. An additional 14.8 acres would be impacted for reconstruction of the tidal slough at the east end of the runway to maintain the hydrologic connection between the existing sloughs north and south of the runway, thereby minimizing impacts to plant communities. Impacts on individual plant communities resulting from construction of the RSA and the eastern tidal slough channel reconstruction include 12.0 acres (36.9%) of unvegetated tidelands, 1.8 acres (43.9%) of Pacific alkali grass-Lyngbye sedge, 1.9 acres (19.2%) of Pacific alkali grass-goose-tongue, 7.6 acres (38.2%) of Lyngbye sedge, 6.9 acres (25.45%) of beach rye, and 9.2 acres (12.6%) of coastal grass meadow within the project area (see Table 4-27). RSA-1 would also result in the loss of 0.4 acre (or 66.6%) of the algae tidal community, 0.4 acres (0.9%) of the coastal forb meadow community, and 6.0 acres (14.3%) of the seeded grass community within the project area. Given the ephemeral, shifting nature of algal patches, the impact to this community is not considered substantive. Approximately 0.6 acres (1.7%) of disturbed areas and 3.7 acres (4.3%) of open water within the project area would also be impacted.

Across the larger landscape area, impacts associated with RSA-1 would account for 1.6%, 1.7%, and 1.7% reductions in the coverages of unvegetated tidelands, low marsh, and high marsh plant communities, respectively (see Table 4-28). These losses would occur during construction of the RSA and would be permanent, as the vegetation would be replaced by less-pervious surfaces to support Airport operations. Combined impacts to estuarine high and low marsh communities would comprise a total of 27.4 acres or 1.7% of the total estuarine marsh vegetation present within the landscape area. Impacts associated with RSA-1 would also account for a 13.5% reduction in seeded grassland, a 0.2% reduction in supratidal vegetation, a 1.6% reduction in disturbed areas, and a 0.2% reduction in open water across the landscape area.

Indirect impacts to vegetation could occur as a result of two separate factors: 1) the introduction of weed species during construction, and 2) the alteration of tidal dynamics, which could influence species composition in affected areas. While few, if any, weed species would be likely to survive in areas subject to regular tidal inundation, RSA fill slopes could be colonized by noxious weeds such as perennial sowthistle (*Sonchus arvensis*), yellow toadflax (*Linaria vulgaris*), and/or other invasive species such as dandelion (*Taraxacum officinale*).

It should be noted that Executive Order (EO) 13112 requires federal agencies to undertake specific duties with respect to invasive species. Among other actions, EO 13112 mandates that federal agencies prevent the introduction of invasive species, detect and control populations of invasive species, and provide for the restoration of native species and habitat conditions in ecosystems that have been invaded. To the extent that these measures are undertaken in conjunction with the actions at JNU, indirect impacts associated with weed colonization and spread ought to be minimized.

Table 4-27. Summary of RSA Impacts to Plant Communities within the Project Area

Plant Community		RSA-1[1]			RSA-5C			RSA-5D			RSA-5E			RSA-6A			RSA-6B			RSA-6C			RSA-6D		
	Acres Existing	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change
Algae Tidal	0.6	0.4	0.2	66.6	0.4	0.2	66.6	0.5	0.1	83.3	0.3	0.3	50.0	0.4	0.2	66.6	0.4	0.2	66.6	0.4	0.2	66.6	0.4	0.2	66.6
Beach Rye	27.2	6.9	20.3	25.4	6.8	20.4	25.0	7.3	19.9	26.8	7.5	19.7	27.6	5.6	21.6	20.6	4.8	22.4	17.6	7.0	20.2	25.7	5.6	21.6	20.6
Beach Rye-Beach Pea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Coastal Forb Meadow	44.8	0.4	44.4	0.9	0.6	44.2	1.3	0.7	44.1	1.6	0.7	44.1	1.6	0.5	44.3	1.1	0.7	44.1	1.6	0.7	44.1	1.6	0.7	44.1	1.6
Coastal Grass Meadow	73.0	9.2	63.8	12.6	10.6	62.4	14.5	10.7	62.3	14.7	11.3	61.7	15.5	1.6	71.4	2.2	3.6	69.4	4.9	10.6	62.4	14.5	3.6	69.4	4.9
Deciduous Scrub-Shrub	22.6	0.0	22.6	0.0	0.0	22.6	0.0	0.0	22.6	0.0	0.0	22.6	0.0	0.0	22.6	0.0	0.0	22.6	0.0	0.0	22.6	0.0	0.0	22.6	0.0
Deciduous Forest	3.2	0.0	3.2	0.0	0.0	3.2	0.0	0.0	3.2	0.0	0.0	3.2	0.0	0.0	3.2	0.0	0.0	3.2	0.0	0.0	3.2	0.0	0.0	3.2	0.0
Disturbed	35.9	0.6	35.3	1.7	0.8	35.1	2.2	0.8	35.1	2.2	0.8	35.1	2.2	0.6	35.3	1.7	0.6	35.3	1.7	0.6	35.3	1.7	0.6	35.3	1.7
Ditch Grass	4.8	0.0	4.8	0.0	0.0	4.8	0.0	0.0	4.8	0.0	0.0	4.8	0.0	0.0	4.8	0.0	0.0	4.8	0.0	0.0	4.8	0.0	0.0	4.8	0.0
Fresh Grass Marsh	7.5	0.0	7.5	0.0	0.0	7.5	0.0	0.0	7.5	0.0	0.0	7.5	0.0	0.0	7.5	0.0	0.0	7.5	0.0	0.0	7.5	0.0	0.0	7.5	0.0
Fresh Sedge Marsh	1.4	0.0	1.4	0.0	0.0	1.4	0.0	0.0	1.4	0.0	0.0	1.4	0.0	0.0	1.4	0.0	0.0	1.4	0.0	0.0	1.4	0.0	0.0	1.4	0.0
Lichen-Moss	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0
Lyngbye Sedge	19.9	7.6	12.3	38.2	6.1	13.8	30.7	7.5	12.4	37.7	5.3	14.6	26.6	4.3	15.6	21.6	5.8	14.1	29.1	7.0	12.9	35.2	6.6	13.3	33.2
Marestail	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0
Mixed Woodland	26.0	0.0	26.0	0.0	0.0	26.0	0.0	0.0	26.0	0.0	0.0	26.0	0.0	0.0	26.0	0.0	0.0	26.0	0.0	0.0	26.0	0.0	0.0	26.0	0.0
Open Water	86.5	3.7	82.8	4.3	0.6	85.9	0.7	2.2	84.3	2.5	0.6	85.9	0.7	0.2	86.3	0.2	2.2	84.3	2.5	2.2	84.3	2.5	2.2	84.3	2.5
Pacific Alkali Grass-Goosetongue	9.9	1.9	8.0	19.2	2.6	7.3	26.3	1.9	8.0	19.2	1.9	8.0	19.2	1.9	8.0	19.2	1.9	8.0	19.2	1.9	8.0	19.2	1.9	8.0	19.2
Pacific Alkali Grass-Lyngbye Sedge	4.1	1.8	2.3	43.9	1.5	2.6	36.6	1.8	2.3	43.9	1.8	2.3	43.9	1.8	2.3	43.9	1.8	2.3	43.9	1.8	2.3	43.9	1.8	2.3	43.9
Reed Canary Grass	3.5	0.0	3.5	0.0	0.0	3.5	0.0	0.0	3.5	0.0	0.0	3.5	0.0	0.0	3.5	0.0	0.0	3.5	0.0	0.0	3.5	0.0	0.0	3.5	0.0
Sand	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0
Seeded Grassland	42.0	6.0	36.0	14.3	6.0	36.0	14.3	6.0	36.0	14.3	6.0	36.0	14.3	6.0	36.0	14.3	6.0	36.0	14.3	6.0	36.0	14.3	6.0	36.0	14.3
Sphagnum Bog	0.6	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.6	0.0
Spruce Forest	13.5	0.0	13.5	0.0	0.0	13.5	0.0	0.0	13.5	0.0	0.0	13.5	0.0	0.0	13.5	0.0	0.0	13.5	0.0	0.0	13.5	0.0	0.0	13.5	0.0
Unvegetated Tidal	32.5	12.0	20.5	36.9	13.3	19.2	40.9	10.5	22.0	32.3	11.4	21.1	35.1	10.5	22.0	32.3	11.4	21.1	35.1	12.0	20.5	36.9	11.3	21.2	34.8
TOTAL	**459.8**	**50.5**	**409.3**	**11.0**	**49.3**	**410.5**	**10.7**	**52.0**	**407.8**	**11.3**	**47.6**	**412.2**	**10.4**	**33.4**	**426.4**	**7.3**	**39.2**	**420.6**	**8.5**	**50.2**	**409.6**	**10.9**	**40.7**	**419.1**	**8.9**

[1] RSA-1 would have greater impacts than summarized herein. The substantial modification to the Mendenhall River channel would cause overall impacts for RSA-1 to exceed those of any other alternative.

* Includes acreages disturbed for the reconstruction of the eastern runway slough, which would ultimately benefit vegetation communities in the area. Note: the slough reconstruction for RSA-5C would maintain only the hydrologic function of existing sloughs north of the runway and would not maintain the hydrologic connection north and south of the runways as would occur under all other alternatives.

Table 4-28. Summary of RSA Impacts to Plant Communities within the Landscape Area

Plant Community		RSA-1[1]			RSA-5C			RSA-5D			RSA-5E			RSA-6A			RSA-6B/6D[2]			RSA-6C		
	Acre Existing	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change
Open Water	1691.9	3.7	1688.3	0.2	0.6	1691.4	0.0	2.2	1689.8	0.1	0.6	1691.4	0.0	0.2	1691.8	0.0	2.2	1689.8	0.1	2.2	1689.8	0.1
Unvegetated	776.4	12.4	764.1	1.6	13.7	762.8	1.8	13.1	763.4	1.7	11.7	764.7	1.5	10.9	765.6	1.4	11.8	764.7	1.5	12.4	764.1	1.6
Low Marsh	665.4	11.3	645.1	1.7	10.2	655.2	1.5	11.2	654.2	1.7	9.0	656.4	1.4	8.0	657.4	1.2	9.5	655.9	1.4	10.7	654.7	1.6
High Marsh	962.6	16.1	946.5	1.7	17.4	945.2	1.8	18.0	944.6	1.9	18.8	943.8	2.0	7.2	955.4	0.7	8.4	954.2	0.9	17.8	944.8	1.8
Supratidal	160.5	0.4	160.1	0.2	0.6	159.9	0.4	0.7	159.8	0.4	0.7	159.8	0.4	0.5	160.0	0.3	0.7	159.8	0.4	0.5	160.0	0.3
Ditch Grass	4.8	0.0	4.8	0.0	0.0	4.8	0.0	0.0	4.8	0.0	0.0	4.8	0.0	0.0	4.8	0.0	0.0	4.8	0.0	0.0	4.8	0.0
Freshwater Marsh	13.2	0.0	13.2	0.0	0.0	13.2	0.0	0.0	13.2	0.0	0.0	13.2	0.0	0.0	13.2	0.0	0.0	13.2	0.0	0.0	13.2	0.0
Marestail	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0
Sphagnum Bog	0.6	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.6	0.0
Shrub-Scrub	34.3	0.0	34.3	0.0	0.0	34.3	0.0	0.0	34.3	0.0	0.0	34.3	0.0	0.0	34.3	0.0	0.0	34.3	0.0	0.0	34.3	0.0
Forest	90.6	0.0	90.6	0.0	0.0	90.6	0.0	0.0	90.6	0.0	0.0	90.6	0.0	0.0	90.6	0.0	0.0	90.6	0.0	0.0	90.6	0.0
Seeded Grassland	44.4	6.0	38.4	13.5	6.0	38.4	13.5	6.0	38.4	13.5	6.0	38.4	13.5	6.0	38.4	13.5	6.0	38.4	13.5	6.0	38.4	13.5
Disturbed	37.0	0.6	36.4	1.6	0.8	36.2	2.2	0.8	36.2	2.2	0.8	36.2	2.2	0.6	36.4	1.6	0.6	36.4	1.6	0.6	36.4	1.6
TOTAL	**4481.8**	**50.5**	**4431.3**	**1.1**	**49.3**	**4432.5**	**1.1**	**52.0**	**4429.6**	**1.2**	**47.6**	**4434.2**	**1.1**	**33.4**	**4448.4**	**0.7**	**39.2**	**4442.6**	**0.9**	**50.2**	**4431.6**	**1.1**

[1] RSA-1 would have greater impacts than summarized herein. The substantial modification to the Mendenhall River channel would cause overall impacts for RSA-1 to exceed those of any other alternative. [2] Alternative RSA-6D has nearly identical landscape level vegetation impacts to Alternative RSA-6B. The total acreage of change for RSA-6D is 40.7. The only differences are the following acreages for RSA-6D: Unvegetated (11.7 ac), Low Marsh (10.3 ac), and High Marsh (9.2 ac).

* Includes acreages disturbed for the reconstruction of the eastern runway slough, which would ultimately benefit vegetation communities in the area. Note: the slough reconstruction for RSA-5C would maintain only the hydrologic function of existing sloughs north of the runway and would not maintain the hydrologic connection north and south of the runways as would occur under all other alternatives.

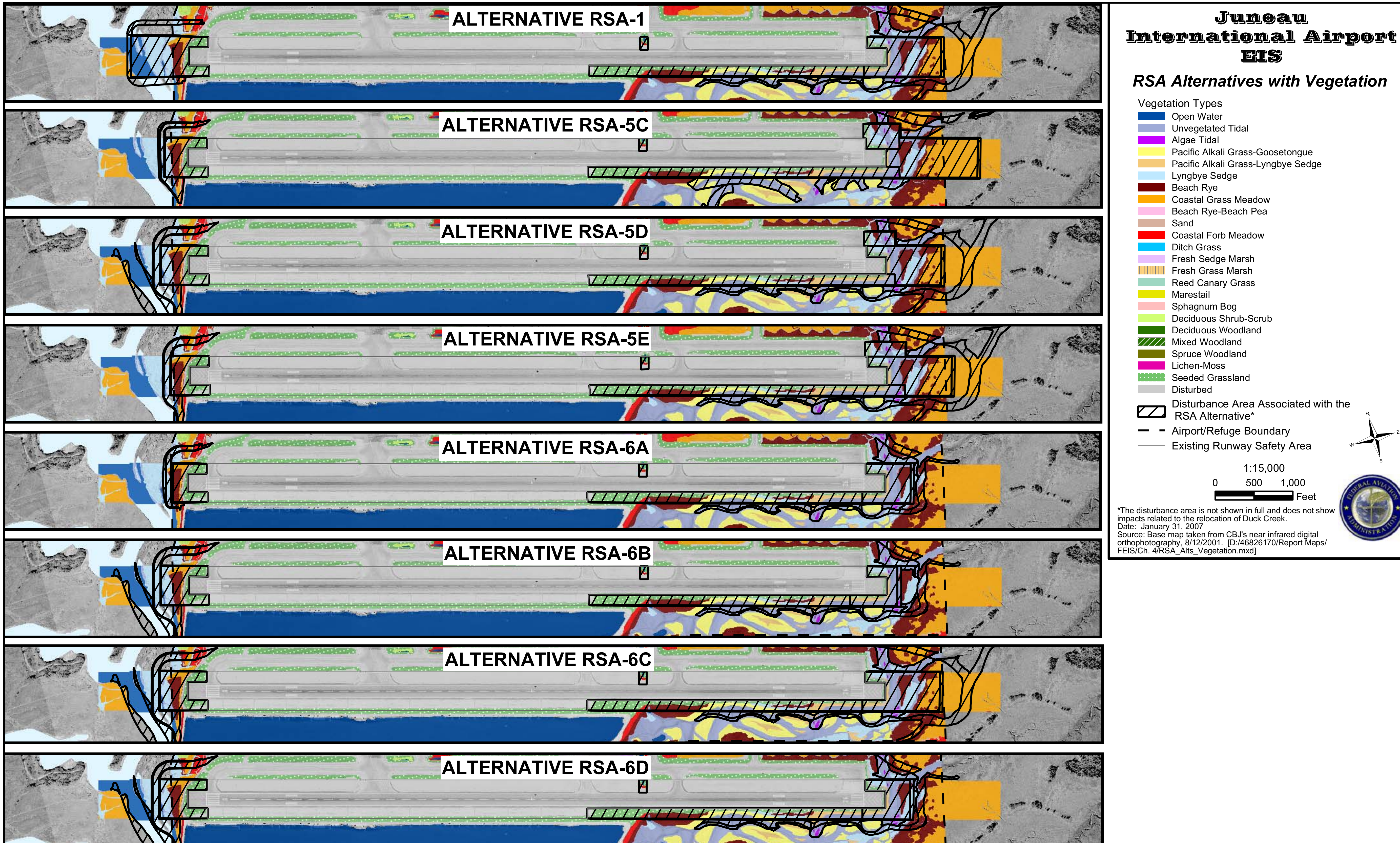

Figure 4-13. Vegetation impacted by the RSA alternatives.

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Potential changes in tidal flows associated with construction of the Runway 26 end RSA could reduce the amount of tidewater reaching the Northeast Development Area and high marsh communities east of TEMSCO. Without regular inundation and tidal scour, supratidal and upland species are likely to start invading these areas, causing short-term changes in plant species composition and long-term changes in community type. These changes would take place gradually but ultimately would be permanent. Active reconstruction of the East Runway Slough channel around the end of Runway 26 RSA would help reestablish the tidal connection; however, because the length of the new channel would be longer than the existing channel, the gradient would be shallower and the tidal scour would likely not be as strong. Short- and long-term changes in community type because of this reduction in scour effect are expected to be small. The same type of impact would occur under Alternatives RSA-5D and RSA-6D, as both of these alternatives would use the same configuration for the constructed channel. Impacts of this nature under Alternatives RSA-6A, -6B, and -6D would be expected to be less pronounced, as the reconstructed channel would be shorter, and greater under RSA-5E, as the reconstructed channel would be longer.

On the west Runway 08 end, construction of the RSA into the Mendenhall River would require the river channel to be moved westward, creating backwater in the existing meander loop which would be cut off by placement of the required fill. Without the scouring action of the river, this area could become colonized by marsh species such as Pacific alkali grass-goosetongue, and/or Lyngbye sedge, depending on substrate, elevation, and tidal dynamics. In addition, the westward relocation of the river, either actively (i.e., a new channel being created for the river) or passively (i.e., the river cutting its own channel) would also affect marsh vegetation. In either instance, low and high marsh communities, located directly west of the current river alignment, would be converted to unvegetated river bottom.

4.3.7.2 ALTERNATIVE RSA-5C

While RSA-5C would have less effect on vegetation on the west Runway 08 end than all alternatives except RSA-6A, it would have a greater impact than any of the other RSA alternatives to vegetation on the east Runway 26 end. RSA-5C would affect a total of 49.3 acres of vegetation. Of this total, 37.0 acres would be impacted by construction of the RSA, relocation of associated facilities (e.g., the EVAR/Dike Trail and Float Plane Pond access road), extension of the taxiway, and the relocation of Duck Creek. An additional 12.3 acres would be impacted for construction of a tidal slough connection between the area north of the Runway 26 end and Sunny Slough to help maintain the hydrologic function of the existing sloughs north of the runway, thereby helping to minimize hydrologic impacts to plant communities in that area. The tidal slough connection under this alternative would not maintain hydrologic connections for existing sloughs south of the runway.

For native plant communities, the greatest adverse impacts (in terms of total acreage) would be to the coastal grass meadow, unvegetated tidal, and beach rye communities. The greatest relative impacts would occur in the algae tidal, unvegetated tidal, Pacific alkali grass-Lyngbye sedge, Lyngbye sedge, Pacific alkali grass-Goosetongue, beach rye, coastal grass meadow, and seeded grassland communities, which would be reduced by 50.0%, 40.9%, 36.6%, 30.7%, 26.3%, 25%, 14.5%, and 14.3%, respectively, within the project area (see Table 4-27).

At the landscape level, the seeded grassland, high marsh, unvegetated tidal, and low marsh communities would be reduced by 6.0 acres (13.5%), 17.4 acres (1.8%), 13.6 acres (1.8%), and 10.2 acres (1.5%), respectively, as shown in Table 4-28. Combined impacts to estuarine high and low marsh communities would comprise a total of 27.6 acres or 1.7% of the total estuarine marsh vegetation present within the landscape area.

Encroachment of the Runway 26 end RSA into the Refuge would predominately affect high marsh cover types, with the southeastern edge of the RSA toe slope reaching supratidal and upland communities on the dredge spoil islands located in this area. A new tide channel would be constructed to connect the area north of the RSA to Sunny Slough as part of this alternative. It is unlikely that Sunny Slough provides the volume of water necessary to maintain low marsh communities or generates enough scour to maintain tide channels in these areas. Additionally, this channel configuration would cut off the area east and south of the RSA from receiving flows typically provided by East Runway Slough. Consequently, the indirect impacts associated with this alternative are likely to include some degree of transition from wetter to drier plant communities around the northeastern and southeastern ends of the RSA, affecting both Airport and Refuge property. This process would take place gradually after completion of the RSA and constitute a significant, permanent (though not static) impact to vegetation in this area.

4.3.7.3 Alternative RSA-5D

Alternative RSA-5D would have the greatest effect on vegetation of any alternative. It would have the same impact on the west Runway 08 end as Alternatives RSA-6B, RSA-6C, and RSA-6D and slightly less impact than RSA-5C and RSA-5E on the east Runway 26 end. For native plant communities, the greatest adverse impacts (in terms of total acreage) would be to the coastal grass meadow, unvegetated tidal, Lyngbye sedge, and beach rye communities. RSA-5D would affect a total of 52.0 acres of vegetation. Of this total, 37.2 acres would be impacted by construction of the RSA, relocation of associated facilities (e.g., the EVAR/Dike Trail and Float Plane Pond access road), extension of the taxiway, the relocation of Duck Creek, and modification of the Mendenhall River channel. An additional 14.8 acres would be impacted for reconstruction of the tidal slough at the east end of the runway to maintain the hydrologic connection between the existing sloughs north and south of the runway, thereby minimizing impacts to plant communities. The greatest relative impacts would occur in the algae tidal, Pacific alkali grass-Lyngbye sedge, Lyngbye sedge, unvegetated tidal, and beach rye communities, which would be reduced by 66.6%, 43.9%, 37.7%, 32.3%, and 26.8%, respectively, within the project area (see Table 4-27).

At the landscape level, the seeded grassland, high marsh, unvegetated tidal, and low marsh communities would be reduced by 6.0 acres (13.5%), 18.0 acres (1.9%), 13.0 acres (1.7%), and 11.2 acres (1.7%), respectively, as shown in Table 4-28. Combined impacts to estuarine high and low marsh communities would comprise a total of 29.2 acres or 1.8% of the total estuarine marsh vegetation present within the landscape area.

Indirect effects caused by Alternative RSA-5D, such as noxious weed invasions and the alteration of tidal dynamics, are expected to be minor. The East Runway Slough would be actively relocated to the east of RSA supporting slope to maintain the existing hydrologic connection in that area. Impacts from the reconstruction of the slough around the Runway 26 end would be identical to those described for RSA-1.

While RSA-5D may restrict tidal flows into the northwestern portion of the project area and cause indirect impacts to vegetation similar to those described for RSA-1 because of the modification of the Mendenhall River channel under RSA-5D, these effects are expected to be of a shorter duration and smaller magnitude than RSA-1 and identical to those for RSA-6B, RSA-6C, and RSA-6D.

4.3.7.4 Alternative RSA-5E

Alternative RSA-5E, the FAA's preferred RSA alternative, would have a moderate effect on vegetation relative to the other build alternatives. It would have slightly greater impact on the west Runway 08 end than Alternatives RSA-5C and RSA-6A, but less than RSA-6B, RSA-6C, and RSA-6D. It would have slightly less impact than RSA-5C and slightly more impact than RSA-1, RSA-5D, and RSA-6C on the east Runway 26 end. RSA-5E would affect a total of 47.6 acres of vegetation. Of this total, 33.3 acres would be impacted by construction of the RSA, relocation of associated facilities (e.g., the EVAR/Dike Trail and Float Plane Pond access road), extension of the taxiway, and the relocation of Duck Creek. An additional 14.3 acres would be impacted for reconstruction of the tidal slough at the east end of the runway to maintain the hydrologic connection between the existing sloughs north and south of the runway, thereby minimizing impacts to plant communities.

For native plant communities, the greatest adverse impacts (in terms of total acreage) would be to the coastal grass meadow, unvegetated tidal, beach rye, Lyngbye sedge, and seeded grassland communities. The greatest relative impacts would occur in the algae tidal, Pacific alkali grass-Lyngbye sedge, unvegetated tidal, beach rye, and Lyngbye sedge communities, which would be reduced by 50.0%, 43.9%, 35.1%, 27.6%, and 26.6%, respectively, within the project area (see Table 4-27).

At the landscape level, the seeded grassland, high marsh, unvegetated tidal, and low marsh communities would be reduced by 6.0 acres (13.5%), 18.8 acres (2.0%), 11.7 acres (1.5%), and 9.0 acres (1.4%), respectively, as shown in Table 4-28. Combined impacts to estuarine high and low marsh communities would comprise a total of 27.8 acres or 1.7% of the total estuarine marsh vegetation present within the landscape area.

Indirect effects caused by Alternative RSA-5E, such as noxious weed invasions and the alteration of tidal dynamics would be similar to, but slightly greater than those described for RSA-1, RSA-5D, and RSA-6C. The East Runway Slough would be actively relocated to the east of RSA supporting slope to maintain the existing hydrologic connection in that area. Impacts from the reconstruction of the slough around the Runway 26 end would be identical to those described for RSA-1 (and RSA-5D and RSA-6C), but less than those described for RSA-5C.

4.3.7.5 Alternative RSA-6A

Because Alternative RSA-6A incorporates the use of EMAS on both runway ends and shifts the thresholds slightly east, it would have the least overall impact to vegetation of any of the build alternatives. RSA-6A would affect a total of 33.4 acres of vegetation. Of this total, 23.5 acres would be impacted by construction of the RSA with EMAS, relocation of associated facilities (e.g., the EVAR/Dike Trail and Float Plane Pond access road), and the relocation of Duck Creek. An additional 9.9 acres would be impacted for reconstruction of the tidal slough at the east end of the runway to maintain the hydrologic connection between the existing sloughs north and south of the runway, thereby minimizing impacts to plant communities.

Within the project area, the effect of RSA-6A would be most pronounced on the unvegetated tidal, beach rye, Lyngbye sedge, Pacific alkali grass-Lyngbye sedge, and algae tidal communities, which would be reduced by 10.5 acres (32.37%), 5.6 acres (20.6%), 4.3 acres (21.6%), 1.8 acre (43.9%), and 0.4 acre (66.6%), respectively, in the project area. The greatest relative impact would occur to the algae tidal community, which would be reduced by 0.4 acre (66.6%) within the project area.

At the landscape level, low marsh and high marsh communities would be reduced by 8.0 acres (1.2%) and 7.2 acres (0.7%), respectively, under RSA-6A. Consequently, this alternative would entail the least amount of impact to estuarine marsh vegetation relative to the other build alternatives. Combined impacts to estuarine high and low marsh communities would comprise a total of 15.2 acres or 0.9% of the total estuarine marsh vegetation present within the landscape area. Unvegetated tidal communities would be reduced by 10.8 acres (1.4%) within the landscape area.

Indirect effects caused by Alternative RSA-6A, such as noxious weed invasions and the alteration of tidal dynamics, are expected to be minor. The East Runway Slough would be actively reestablished around the east end of the EMAS supporting slope. The tidal flow connection with Sunny and Miller-Honsinger Sloughs would thereby be maintained. Impacts from the reconstruction of the slough around the Runway 26 end would be less than those described for RSA-1, as the reconstructed channel would be shorter.

While RSA-6A may restrict tidal flows into the northwestern portion of the project area and cause indirect impacts to vegetation similar to those described for RSA-1, these effects are expected to be of a shorter duration and smaller magnitude relative to the other build alternatives.

4.3.7.6 Alternative RSA-6B

Alternative RSA-6B is similar to RSA-6A, but the runway thresholds would be moved westward to minimize impacts to estuarine marshlands east of the Airport. This alternative would have more direct impact on vegetative communities than RSA-6A, primarily on the west Runway 08 end. RSA-6B would affect a total of 39.2 acres of vegetation. Of this total, 28.8 acres would be impacted by construction of the RSA with EMAS, relocation of associated facilities (e.g., the EVAR/Dike Trail and Float Plane Pond access road), the relocation of Duck Creek, and the modification of the Mendenhall River channel. An additional 10.4 acres would be impacted for reconstruction of the tidal slough at the east end of the runway to maintain the hydrologic connection between the existing sloughs north and south of the runway, thereby minimizing impacts to plant communities.

The most pronounced effects to native vegetation would occur in the Lyngbye sedge, unvegetated tidal, seeded grassland, and beach rye communities, which would be reduced by 5.8 acres (29.1%), 11.4 acres (35.14%), 6.0 acres (14.3%), and 4.8 acres (17.6%), respectively, within the project area. Pacific alkali grass-Lyngbye sedge and algae tidal communities would experience dramatic relative impacts of 1.8 acres (43.9%) and 0.4 acre (66.6%), respectively. Impacts to vegetation in the project area caused by Alternative RSA-6B are listed on Table 4-27.

At the landscape level, Alternative RSA-6B would have the second lowest impact to the low marsh community, which would be reduced by 9.5 acres (or 1.4%); high marsh would be reduced by 8.4 acres (or 0.9%). Table 4-28 lists impacts to vegetative communities from Alternative RSA-6B in the landscape area. Combined impacts to estuarine high and low marsh communities would comprise a total of 17.9 acres or 1.1% of the total estuarine marsh vegetation present within the landscape area.

Tidal flows would continue to flow around the east Runway 26 end of the through a constructed channel. This would maintain the connection of East Runway Slough with Sunny and Miller-Honsinger Sloughs. Impacts from the reconstruction of the slough around the Runway 26 end would be less than those described for RSA-1. Of the various build alternatives, RSA-6B would be expected to have the fewest indirect impacts to estuarine marsh communities on the east Runway 26 end because the reconstructed channel around the RSA would be the shortest of all alternatives.

Estuarine vegetation communities in the northwestern portion of the Airport would continue to receive tide waters, but the frequency and duration of inundation would be somewhat reduced. On the west Runway 08 end, indirect impacts would be identical to those associated with RSA-5D.

4.3.7.7 Alternative RSA-6C

This alternative relies on a combination of EMAS on the west Runway 08 end and standard RSA on the east Runway 26 end, and the impacts to vegetation on either end are similar to those disclosed in analyses of other alternatives with similar or identical construction features at the runway ends. The direct and indirect effects on vegetative communities in the east portion of the Airport and into the Refuge would be as described for Alternative RSA-1. The direct and indirect effects in the west portion of the Airport and into the Refuge would be as described for Alternatives RSA-5D and RSA-6B. Alternative RSA-6C would have fewer overall impacts on vegetation than Alternative RSA-5D but greater impacts than RSA-5C, RSA-5E, RSA-6A, RSA-6B, or RSA-6D. It would have less overall impact to vegetation than RSA-1.

RSA-6C would affect a total of 50.2 acres of vegetation. Of this total, 23.5 acres would be impacted by construction of the RSA and EMAS bed, relocation of associated facilities (e.g., the EVAR/Dike Trail and Float Plane Pond access road), the relocation of Duck Creek, and the modification of the Mendenhall River channel. An additional 14.8 acres would be impacted for reconstruction of the tidal slough at the east end of the runway to maintain the hydrologic connection between the existing sloughs north and south of the runway, thereby minimizing impacts to plant communities.

Within the project area, Alternative RSA-6C would affect the unvegetated tidal areas the most in terms of pure acreage, with 12.0 acres (36.9%) of this community in the project area permanently lost and replaced by less pervious surfaces to support Airport operations. Coastal grass meadow, beach rye, Lyngbye sedge, and seeded grassland communities would also experience reductions greater than other communities at 10.6 acres (14.5%), 7.0 acres (25.7%), 7.0 acres (35.2%), and 6 acres (14.3%), respectively. Impacts to vegetation in the project area caused by Alternative RSA-6C are listed on Table 4-27.

Within the landscape area, RSA-6C would result in the permanent loss of 10.7 acres (1.6%) of low marsh vegetation, 17.8 acres (1.8%) of high marsh, and 12.3 acres (1.6%) of unvegetated tidelands. Seeded grasslands would experience a reduction of 6.0 acres (13.5%). Table 4-28 lists impacts to vegetative communities from Alternative RSA-6C in the landscape area. Combined impacts to estuarine high and low marsh communities would comprise a total of 28.5 or 1.8% of the total estuarine marsh vegetation present within the landscape area.

4.3.7.8 Alternative RSA-6D

Direct impacts to vegetation within the project area under Alternative RSA-6D would be nearly identical to those described for RSA-6B. The only difference are slight increase in acreage of impacts (0.8 acre) in impacts to beach rye and Lyngbye sedge communities, and a slight decrease in acreage of impacts (0.1 acre) to unvegetated tidal communities under Alternative RSA-6D.

RSA-6D would affect a total of 40.7 acres of vegetation. Of this total, 30.8 acres would be impacted by construction of the RSA, relocation of associated facilities (e.g., the EVAR/Dike Trail and Float Plane Pond access road), the relocation of Duck Creek, and the modification of the Mendenhall River channel. An additional 9.9 acres would be impacted for reconstruction of the tidal slough at the east end of the runway to maintain the hydrologic connection between the existing sloughs north and south of the runway, thereby minimizing impacts to plant communities.

Within the landscape area, RSA-6D would also be nearly identical to RSA-6B. The only notable differences are that RSA-6D would result in 0.8 acre increases in impacts to both the low and high marsh communities and a 0.1 acre decrease in impacts to the unvegetated tidal community.

Indirect impacts under Alternative RSA-6D would be identical to those described for RSA-5D, RSA-6B, and RSA-6C at the west Runway 08 end and for RSA-6A at the east Runway 26 end.

4.3.7.9 Alternative RSA-8

Alternative RSA-8 would have no affect on vegetation on the Airport, in the Refuge, or in the landscape area.

4.3.8 WETLANDS

Tables 4-29 and 4-30 summarize direct impacts to wetland acreages within the landscape and project areas, respectively, that would occur as a result of each of the RSA alternatives. Of the build alternatives, RSA-5D would directly affect the greatest area of wetlands. Alternative RSA-5D would convert approximately15% of the wetlands in the project area (1.1% of wetlands in the landscape area) to impervious or low permeability surfaces. As tables in subsequent sections illustrate, Alternative RSA-5D would also cause the greatest adverse impacts in terms of lost wetland functional units. However, RSA-1 would have the greatest adverse affect on hydrology and wetland function, since construction of the west Runway 08 end RSA would shift the Mendenhall River to the west. Alternative RSA-6A would have the least impact to wetlands and wetland functions of the alternatives considered in this analysis, affecting 9% and 0.6% of project area and landscape area wetland acreage, respectively. Alternative RSA-5E would affect a moderate amount of wetlands in the range of alternatives, with approximately 39.8 acres, or 13.5% of project area and 1% of landscape area wetlands being impacted.

The following sections summarize direct impacts of RSA alternatives upon estuarine communities and wetland area and function. Qualitative assessments of potential indirect impacts to wetlands are also provided. Unless otherwise noted, all of these impacts to wetlands are permanent and adverse.

Tables 4-4 through 4-6, presented in Section 4.2.8, provide the methodological basis for wetland evaluations in this analysis. For a more detailed explanation of wetland functional assessment accounting procedures, refer to Appendix E. Figure 4-14 illustrates the wetlands affected by each RSA alternative. Figures 3-22 through 3-27 in Chapter 3 illustrate the mapped wetlands within each of the specified project areas and the landscape area.

4.3.8.1 ALTERNATIVE RSA-1

Alternative RSA-1 would permanently affect 43.5 acres of estuarine wetlands, as shown on Figure 4-14. The impact acreage and loss of wetland function are broken down by wetland analysis area in Table 4-31. The Refuge both east and west of the runway would be affected by this alternative, and there would be a partial loss of hydrologic connectivity caused by filling tidal sloughs on the east side of the runway. The active construction of a slough channel around the east end of the RSA would minimize these impacts; however, tidal scour would be less dramatic than at present given that the length of the constructed slough would be longer than the existing slough and the gradient would, therefore, be shallower. These hydrologic alterations would affect functions and values of the wetlands including the natural systems that support EFH and that provide mechanisms for nutrient transformation and export. The impacts caused by Alternative RSA-1 are significant because of the relative rarity of estuarine wetlands in Southeast Alaska and their local and regional importance, particularly to continued maintenance of fish and wildlife populations, and the changes to and impairment of hydrologic functions sustaining the Refuge.

RSA-1 would affect a total of 43.5 acres of estuarine wetlands. Of this total, 28.7 acres would be impacted by construction of the RSA, relocation of associated facilities (e.g., the EVAR/Dike Trail and Float Plane Pond access road), and the relocation of Duck Creek and the Mendenhall River channel. An additional 14.8 acres would be impacted for reconstruction of the tidal slough at the east end of the runway to maintain the hydrologic connection between the existing sloughs north and south of the runway, thereby minimizing impacts to wetlands functions and values, including fisheries and wildlife habitat, hydrologic recharge, and sediment and nutrient transport, and maintaining existing wetland plant community composition to the extent possible.

Alternative RSA-1 ranks second in greatest amount of acreage disturbed, but the changes caused by RSA-1 would arguably be the most significant. RSA-1 development would require major rerouting the Mendenhall River channel, greatly affecting fish habitat and other wetland functions in both the project and landscape areas. Additionally, the East Runway Slough would be filled and actively relocated, converting high marsh habitat into low marsh habitat. Indirect effects to key wetland functions under this alternative (and associated wetland types) would include:

- Lost groundwater discharge and lateral flow (all wetland types);
- Increased sediment/toxicant retention (all wetland types);
- Nutrient transformation and export (E1UB3, subtidal sloughs and E2USN, intertidal sloughs);
- Lost riparian support (all wetland types);
- Lost fish and wildlife habitat (all wetland types); and
- Changes to and degradation of regional ecological diversity (all wetland types).

Wetland functions in the Northeast Development Area could indirectly be reduced or lost as well, by altering the current hydrologic regime. The East Runway Slough would be lengthened under this alternative resulting in a decreased channel grade, which would reduce the transport of water to the margins of high marsh habitat, potentially leading to a change from high marsh habitat to upland habitat. This would further affect the wetland functions listed above (except for nutrient transformation and export) and locally reduce functional units. Over time, rerouting the Mendenhall River channel would indirectly affect wetlands surrounding the river by altering the present vegetation composition and hydrologic regime. The use of mitigating design elements in Jordan Creek and the East Runway Slough, such as those identified in Section 2.11 of Chapter 2, would help to lessen adverse impacts to the wildlife support and fish habitat functions.

4.3.8.2 Alternative RSA-5C

Alternative RSA-5C would permanently affect 41.8 acres of estuarine wetlands, as shown on Figure 4-14. The impact acreage and loss of wetland function are broken down by wetland analysis area in Table 4-32. This alternative would cause a moderate amount of wetland impact compared to the other action alternatives. Impacts to wetland resources would be considered significant due to the affect on the Refuge, wildlife habitat, and loss of hydrologic connectivity to surrounding wetlands associated with filling East Runway Slough. This alternative would alter the hydrology needed to sustain the functions and values of the affected wetlands, and it would

Table 4-29. Summary of RSA Impacts to Wetland Resources at the Landscape Level*

Wetland Resources NWI Classification	No Action (RSA-8) Acres**	RSA-1[1]			RSA-5C			RSA-5D			RSA-5E			RSA-6A			RSA-6B/6D[1]			RSA-6C		
		Acres Lost***	Acres Left	% Change	Acres Lost***	Acres Left	% Change	Acres Lost***	Acres Left	% Change	Acres Lost***	Acres Left	% Change	Acres Lost***	Acres Left	% Change	Acres Lost***	Acres Left	% Change	Acres Lost***	Acres Left	% Change
E2EM1(H)	963.3	16.0	947.3	1.7	17.2	946.1	1.8	17.7	945.6	1.8	18.5	927.1	2.0	7.2	956.1	0.7	7.9	955.4	0.8	17.1	946.2	1.8
E2EM1(L)	669.6	11.2	658.4	1.7	10.1	659.6	1.5	11.0	658.6	1.6	8.9	660.7	1.3	7.9	661.7	1.2	9.4	660.2	1.4	10.6	659.0	1.6
E2USN	662.3	12.6	649.7	1.9	13.9	648.4	2.1	13.3	649.0	2.0	11.9	650.4	1.8	11.1	651.2	1.7	12.1	650.2	1.8	12.7	649.6	1.9
E1UB3	1120.0	3.7	1116.3	0.3	0.6	1119.4	0.0	2.2	1117.8	0.2	0.5	1119.5	0.0	0.3	1119.7	0.0	2.2	1117.8	0.2	2.2	1117.8	0.2
Total (Project Area)	**4141.7**	**43.5**	**4098.2**	**1.1**	**41.8**	**4099.9**	**1.0**	**44.2**	**4097.5**	**1.1**	**39.8**	**4101.9**	**1.0**	**26.5**	**4115.2**	**0.6**	**31.6**	**4110.1**	**0.8**	**42.6**	**4099.1**	**1.0**

[1] RSA-1 would have greater impacts than summarized herein. The substantial modification to the Mendenhall River channel would cause overall impacts for RSA-1 to exceed those of any other alternative.
[2]Alternative RSA-6D is nearly identical to Alternative RSA-6B. Total landscape area acreage impacted by RSA-6D is 33.1. The only differences in acreage impacted for RSA-6D are as follows: E2EM1(H) (8.7 acres), E2EM1(L) (10.2 acres), E2USN (12.0 acres).
*Landscape Area includes the Airport property, the Miller-Honsinger property, and the Refuge.
**The No Action Alternative, RSA-8, does not include effects associated with ongoing natural processes, such as isostatic rebound.
*** Includes acreages disturbed for the reconstruction of the eastern runway slough, which would ultimately benefit wetland resources in the area. Note: the slough reconstruction for RSA-5C would maintain only the hydrologic function of existing sloughs north of the runway and would not maintain the hydrologic connection north and south of the runways as would occur under all other alternatives.

Table 4-30. Summary of RSA Impacts to Wetland Resources Within the Project Area*

Wetland Resources NWI Classification	No Action (RSA-8) Acres**	RSA-1[1]			RSA-5C			RSA-5D			RSA-5E			RSA-6A			RSA-6B/6D[2]			RSA-6C		
		Acres Lost***	Acres Left	% Change	Acres Lost***	Acres Left	% Change	Acres Lost***	Acres Left	% Change	Acres Lost***	Acres Left	% Change	Acres Lost***	Acres Left	% Change	Acres Lost***	Acres Left	% Change	Acres Lost***	Acres Left	% Change
E2EM1(H)	113.2	16.0	97.2	14.1	17.2	96.0	15.2	17.7	95.5	15.6	18.5	94.7	16.3	7.2	106.0	6.4	7.9	105.3	7.0	17.1	96.1	15.1
E2EM1(L)	33.1	11.2	21.9	33.8	10.1	23.0	30.5	11.0	22.1	33.2	8.9	24.2	26.9	7.9	25.2	23.9	9.4	23.7	28.4	10.6	22.5	32.0
E2USN	35.4	12.6	22.8	35.6	13.9	21.5	39.3	13.3	22.1	37.6	11.9	23.5	33.6	11.1	24.3	31.3	12.1	23.3	34.2	12.7	22.7	35.9
E1UB3	6.2	3.7	2.5	59.7	0.6	5.6	9.7	2.2	4.0	35.5	0.5	5.7	8.1	0.3	5.9	4.8	2.2	4.0	35.5	2.2	4.0	35.5
Total (Project Area)	**295.3**	**43.5**	**251.8**	**14.7**	**41.8**	**253.5**	**14.2**	**44.2**	**251.1**	**15.0**	**39.8**	**255.5**	**13.5**	**26.5**	**268.8**	**9.0**	**31.6**	**263.7**	**10.7**	**42.6**	**252.7**	**14.4**

[1] RSA-1 would have greater impacts than summarized herein. The substantial modification to the Mendenhall River channel would cause overall impacts for RSA-1 to exceed those of any other alternative.
[2]Alternative RSA-6D is nearly identical to Alternative RSA-6B. Total project area acreage impacted by RSA-6D is 33.1. The only differences in acreage impacted for RSA-6D are as follows: E2EM1(H) (8.7 acres), E2EM1(L) (10.2 acres), E2USN (12.0 acres).
*Project Area includes the Airport property and immediately adjacent areas that have the potential to be directly affected by one of the alternatives.
**The No Action Alternative, RSA-8, does not include effects associated with ongoing natural processes, such as isostatic rebound.
*** Includes acreages disturbed for the reconstruction of the eastern runway slough, which would ultimately benefit wetland resources in the area. Note: the slough reconstruction for RSA-5C would maintain only the hydrologic function of existing sloughs north of the runway and would not maintain the hydrologic connection north and south of the runways as would occur under all other alternatives.

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Figure 4-14. Wetlands impacted by the RSA alternatives.

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Table 4-31. Alternative RSA-1 Impacts to Wetland Resources[1]

Wetland Analysis Area	NWI Classification				
	E1UB3	E2EM1 (H)	E2EM1 (L)	E2USN	Total
Western RSA					
Acreage Lost	3.6	1.9	4.1	1.5	11.1
Functional Units Lost	459.2	234.5	514.5	187.4	1395.7
Percent Change*	100.0[2]	50.0	100.0[2]	100.0[2]	90.5
Eastern RSA					
Acreage Lost	--	13.9	6.9	11.0	31.8
Functional Units Lost	--	1747.3	881.6	1428.2	4057.0
Percent Change*	--	36.0	32.5	42.5	37.1
Northwest Airport Area					
Acreage Lost	--	0.03	0.15	0.03	0.21
Functional Units Lost	--	3.3	16.6	3.3	23.2
Percent Change*	--	0.9	21.4	6.0	3.6
Jordan Creek					
Acreage Lost	--	0.18	--	0.03	0.21
Functional Units Lost	--	21.7	--	3.7	25.5
Percent Change*	--	60.0	--	3.8	3.7
Totals					
Acreage Lost					43.3
Functional Units Lost					5501.4
Total Percent Change (project area/landscape area)**					15.0/1.0

[1] RSA-1 would have greater impacts than summarized herein. The substantial modification to the Mendenhall River channel would cause overall impacts for RSA-1 to exceed those of any other alternative.

[2] Calculation based on wetlands in project area as defined in the Draft EIS; includes impacts that occur outside of the defined project area (in the landscape area) as a result of changes to alternatives for the FEIS.

* Percent change of wetland function within the wetland analysis area.

** Percent change of wetland acreage.

Table 4-32. Alternative RSA-5C Impacts to Wetland Resources

Wetland Analysis Area	NWI Classification				
	E1UB3	E2EM1 (H)	E2EM1 (L)	E2USN	Total
Western RSA					
Acreage Lost	0.5	1.4	2.1	0.9	4.8
Functional Units Lost	63.8	175.3	258.5	107.4	605.0
Percent Change*	13.9	37.4	52.8	86.0	39.2
Eastern RSA					
Acreage Lost	--	15.6	7.8	12.9	36.3
Functional Units Lost	--	1957.2	991.5	1678.8	4627.4
Percent Change*	--	40.3	36.6	49.9	42.4
Northwest Airport Area					
Acreage Lost	--	0.03	0.20	0.04	0.27
Functional Units Lost	--	3.3	21.1	4.4	28.7
Percent Change*	--	0.9	27.1	8.0	4.4
Jordan Creek					
Acreage Lost	--	0.20	--	0.03	0.23
Functional Units Lost	--	24.2	--	3.7	27.9
Percent Change*	--	66.7	--	3.8	4.1
Totals					
Acreage Lost					41.6
Functional Units Lost					5289.1
Total Percent Change (project area/landscape area)**					14.4 / 1.0

* Percent change of wetland function within the wetland analysis area.
** Percent change of wetland acreage.

adversely affect the maintenance of natural systems that support wildlife and fish habitat. The impacts caused by Alternative RSA-5C are significant because of the relative rarity of estuarine wetlands in Southeast Alaska and their local and regional importance, particularly to continued maintenance of fish and wildlife populations, and the changes to and impairment of hydrologic functions sustaining the Refuge.

RSA-5C would affect a total of 41.8 acres of estuarine wetlands. Of this total, 29.5 acres would be impacted by construction of the RSA, relocation of associated facilities (e.g., the EVAR/Dike Trail and Float Plane Pond access road), extension of the taxiway, and the relocation of Duck Creek. An additional 12.3 acres would be impacted for construction of a tidal slough channel from the area north of Runway 26 to Sunny Slough to help maintain the hydrologic function of the existing sloughs north of the runway, thereby helping to minimize hydrologic impacts to wetlands functions and values as described for all other alternatives. The tidal slough connection under this alternative would not maintain hydrologic connections for existing sloughs south of the runway.

Key wetland functions that would be lost under this alternative are similar to those listed in Alternative RSA-1, but the degree of loss would be slightly less in terms of both acres and functional units. The use of mitigating design elements in Jordan Creek and the East Runway Slough, such as those identified in Section 2.11 of Chapter 2, would help to lessen adverse impacts to the wildlife support and fish habitat functions.

Indirect impacts caused by Alternative RSA-5C would be similar to those mentioned under Alternative RSA-1. However, the change from estuarine habitat to more upland-type wetlands would be more pronounced in the Northeast Development Area wetland analysis area since estuarine marsh habitat may be cut off from tidal influence. Similar, but more adverse indirect impacts would be expected south of Miller-Honsinger Slough. Unlike Alternative RSA-1, Alternative RSA-5C would have little or no impact on the Mendenhall River and wetlands upstream of its mouth.

4.3.8.3 ALTERNATIVE RSA-5D

Alternative RSA-5D would permanently affect 44.2 acres of estuarine wetlands, as shown on Figure 4-14. The impact acreage and loss of wetland function are broken down by wetland analysis area in Table 4-33. This alternative would cause the greatest amount of wetland impact compared to the other action alternatives because of the combination of the extension of the taxiway to Runway 26 and the modifications to the Mendenhall River channel, a combination not associated with any other RSA alternative; this alternative would be identical to Alternatives RSA-6B, -6C, and -6D for the Runway 08 end with regards to the modifications to the Mendenhall River channel. Impacts to wetland resources would be considered significant due to the affect on the Refuge, wildlife habitat, and change of hydrologic connectivity to surrounding wetlands associated with filling and actively relocating East Runway Slough and the modifications to the Mendenhall River channel. This alternative would alter the hydrology needed to sustain the functions and values of the affected wetlands, and it would adversely affect the maintenance of natural systems that support wildlife and fish habitat. The impacts caused by Alternative RSA-5D are significant because of the relative rarity of estuarine wetlands in Southeast Alaska and their local and regional importance, particularly to continued maintenance of fish and wildlife populations, and the changes to and impairment of hydrologic functions sustaining the Refuge.

RSA-5D would affect a total of 44.2 acres of estuarine wetlands. Of this total, 29.4 acres would be impacted by construction of the RSA, relocation of associated facilities (e.g., the EVAR/Dike Trail and Float Plane Pond access road), extension of the taxiway, the relocation of Duck Creek, and modification of the Mendenhall River channel. An additional 14.8 acres would be impacted for reconstruction of the tidal slough at the east end of the runway to maintain the hydrologic connection between the existing sloughs north and south of the runway, thereby minimizing impacts

Table 4-33. Alternative RSA-5D Impacts to Wetland Resources

Wetland Analysis Area	NWI Classification				
	E1UB3	E2EM1 (H)	E2EM1 (L)	E2USN	Total
Western RSA					
Acreage Lost	2.1	2.9	3.5	1.5	10.0
Functional Units Lost	270.4	361.6	436.7	187.9	1253.7
Percent Change*	58.9	77.1	89.2	100.0[1]	81.3
Eastern RSA					
Acreage Lost	--	14.5	7.3	11.6	33.4
Functional Units Lost	--	1816.4	935.3	1506.1	4257.7
Percent Change*	--	37.4	34.5	44.8	39.0
Northwest Airport Area					
Acreage Lost	--	0.10	0.20	0.10	0.4
Functional Units Lost	--	7.6	25.5	9.9	43.0
Percent Change*	--	2.2	32.9	18.0	6.7
Jordan Creek					
Acreage Lost	--	0.20	--	0.03	0.23
Functional Units Lost	--	24.2	--	3.7	27.9
Percent Change*	--	66.7	--	3.8	4.1
Totals					
Acreage Lost					44.0
Functional Units Lost					5582.4
Total Percent Change (project area/landscape area)**					15.3/ 1.1

[1]Calculation based on wetlands in project area as defined in the Draft EIS; includes impacts that occur outside of the defined project area (in the landscape area) as a result of changes to alternatives for the FEIS.
* Percent change of wetland function within the wetland analysis area.
** Percent change of wetland acreage.

to wetlands functions and values, including fisheries and wildlife habitat, hydrologic recharge, and sediment and nutrient transport, and maintaining existing wetland plant community composition to the extent possible.

Key wetland functions that would be lost under this alternative are similar to those listed in Alternative RSA-1, but the degree of loss west of the Airport would be slightly less in terms of both acres and functional units, as the changes to the Mendenhall River channel are less substantial under Alternative RSA-5D. The degree of loss east of the Airport would be slightly higher for RSA-5D because of the taxiway extension. The use of mitigating design elements in Jordan Creek and the East Runway Slough, such as those identified in Section 2.11 of Chapter 2, would help to lessen adverse impacts to the wildlife support and fish habitat functions.

Indirect impacts caused by Alternative RSA-5D would also be similar to those mentioned under Alternative RSA-1.

4.3.8.4 Alternative RSA-5E

Alternative RSA-5E, the FAA's preferred RSA alternative, would permanently affect 39.8 acres of estuarine wetlands, as shown on Figure 4-14. The impact acreage and loss of wetland function are broken down by wetland analysis area in Table 4-34. This alternative would cause the fourth least (fourth most) amount of wetland impact compared to the other action alternatives. Impacts to wetland resources would be considered significant due to the affect on the Refuge, wildlife habitat, and change of hydrologic connectivity to surrounding wetlands associated with filling and actively relocating East Runway Slough. This alternative would alter the hydrology needed to sustain the functions and values of the affected wetlands, and it would adversely affect the maintenance of natural systems that support wildlife and fish habitat. The impacts caused by Alternative RSA-5E are significant because of the relative rarity of estuarine wetlands in Southeast Alaska and their local and regional importance, particularly to continued maintenance of fish and wildlife populations, and the changes to and impairment of hydrologic functions sustaining the Refuge.

RSA-5E would affect a total of 39.8 acres of estuarine wetlands. Of this total, 25.5 acres would be impacted by construction of the RSA, relocation of associated facilities (e.g., the EVAR/Dike Trail and Float Plane Pond access road), extension of the taxiway, and the relocation of Duck Creek. An additional 14.3 acres would be impacted for reconstruction of the tidal slough at the east end of the runway to maintain the hydrologic connection between the existing sloughs north and south of the runway, thereby minimizing impacts to wetlands functions and values, including fisheries and wildlife habitat, hydrologic recharge, and sediment and nutrient transport, and maintaining existing wetland plant community composition to the extent possible.

Key wetland functions that would be lost under this alternative are similar to those listed for Alternative RSA-5C west of the Airport, but the degree of loss in this area would be slightly less in terms of both acres and functional units, as RSA-5E does not extend as far west as RSA-5C. The degree of loss east of the Airport from RSA-5E would be similar to but slightly higher than that described for RSA-5D because fill for the RSA-5E safety area and taxiway would extend further to the east that they would under RSA-5D. The use of mitigating design elements in Jordan Creek and the East Runway Slough, such as those identified in Section 2.11 of Chapter 2, would help to lessen adverse impacts to the wildlife support and fish habitat functions.

Indirect impacts caused by Alternative RSA-5E would also be similar to those described for Alternative RSA-1.

Table 4-34. Alternative RSA-5E Impacts to Wetland Resources

Wetland Analysis Area	E1UB3	E2EM1 (H)	E2EM1 (L)	E2USN	PEM1	PSS1	Total
Western RSA							
Acreage Lost	0.40	--	0.04	0.30	--	--	0.74
Functional Units Lost	51.02	--	5.02	31.23	--	--	87.3
Percent Change*	0.11	--	1.1	7.6	--	--	6.0
Eastern RSA							
Acreage Lost	--	16.8	7.0	10.9	--	--	34.7
Functional Units Lost	--	2114.3	895.7	1417.8	--	--	4427.8
Percent Change*	--	43.3	11.7	42.1	--	--	40.5
Northwest Airport Area							
Acreage Lost	--	0.44	--	0.01	0.30	0.60	1.4
Functional Units Lost	--	47.84	--	1.10	27.71	57.47	134.1
Percent Change*	--	13.8	--	1.6	60.0	66.6	23.5
Jordan Creek							
Acreage Lost	--	0.20		0.03	--	--	0.23
Functional Units Lost	--	20.54		3.75	--	--	24.3
Percent Change*	--	66.6		3.8	--	--	3.9
Totals							
Acreage Lost							37.0
Functional Units Lost							4673.4
Total Percent Change (project area/landscape area)**							12.7/0.8

4.3.8.5 Alternative RSA-6A

Alternative RSA-6A would affect 26.5 acres of estuarine wetlands, as shown on Figure 4-14. The impact acreage and loss of wetland function are broken down by wetland analysis area in Table 4-35. This alternative would be the least damaging to wetland resources. There would be minimal impact to wetlands within the Refuge on the west side of the runway and the tidal channels around the east end of the runway would be actively reestablished under Alternative RSA-6A. The hydrologic changes imposed by this alternative would have little direct effect on the Refuge and would not affect sustainability of the wetland functions and values, including wildlife and fish habitat. Alternative RSA-6A would not have significant impacts on wetlands.

Table 4-35. Alternative RSA-6A Impacts to Wetland Resources

Wetland Analysis Area	NWI Classification				
	E1UB3	E2EM1 (H)	E2EM1 (L)	E2USN	Total
Western RSA					
Acreage Lost	0.2	1.4	1.2	0.6	3.2
Functional Units Lost	21.7	167.9	144.3	70.0	403.8
Percent Change*	4.7	35.8	29.5	56.0	26.2
Eastern RSA					
Acreage Lost	--	5.5	6.5	10.3	22.34
Functional Units Lost	--	695.1	826.7	1342.5	2864.3
Percent Change*	--	14.3	30.5	39.9	26.2
Northwest Airport Area					
Acreage Lost	--	0.10	0.20	0.05	0.34
Functional Units Lost	--	5.4	26.6	5.5	37.5
Percent Change*	--	1.6	34.3	10.0	5.8
Jordan Creek					
Acreage Lost	--	0.20	--	0.03	0.23
Functional Units Lost	--	24.2	--	3.7	27.9
Percent Change*	--	66.7	--	3.8	4.1
Totals					
Acreage Lost					26.2
Functional Units Lost					3333.6
Total Percent Change (project area/landscape area)**					9.1 / 0.6

* Percent change of wetland function within the wetland analysis area.
** Percent change of wetland acreage.

RSA-6A would affect a total of 26.5 acres of estuarine wetlands. Of this total, 16.6 acres would be impacted by construction of the RSA with EMAS, relocation of associated facilities (e.g., the EVAR/Dike Trail and Float Plane Pond access road), and the relocation of Duck Creek. An additional 9.9 acres would be impacted for reconstruction of the tidal slough at the east end of the runway to maintain the hydrologic connection between the existing sloughs north and south of the runway, thereby minimizing impacts to wetlands functions and values, including fisheries and wildlife habitat, hydrologic recharge, and sediment and nutrient transport, and maintaining existing wetland plant community composition to the extent possible.

Although the eastern channel of East Runway Slough would be actively reestablished around the east end of the RSA fill under this alternative, there would still be permanent impacts to estuarine wetlands caused by Alternative RSA-6A. However, these impacts would be much less severe than under RSA-1, RSA-5C, or RSA-5D, and hydrologic connectivity to the Miller-Honsinger Slough and wetlands south of Miller-Honsinger Pond would be affected only temporarily. There would be some impairment to wildlife support and fish habitat functions, but these impacts could be reduced with the incorporation of mitigating design elements in Jordan Creek and the East Runway Slough, such as those identified in Section 2.11 of Chapter 2. This alternative would have the least impact of any build alternative on wetlands in the west Airport area.

Indirect impacts caused by Alternative RSA-6A would be similar to those mentioned under Alternative RSA-5C, but much less pronounced in all respects, due to the smaller disturbance areas involved and maintenance of hydrologic connectivity to all areas.

4.3.8.6 Alternative RSA-6B

Alternative RSA-6B would affect 31.6 acres of estuarine wetlands, as shown on Figure 4-14. The impact acreage and loss of wetland function are broken down by wetland analysis area in Table 4-36. This alternative is the second least damaging alternative. The impact on wetlands adjacent to and within the Refuge west of the Airport would be the same as Alternative RSA-5D west of the Airport. The fills at the east runway end would have the least impact on wetlands of the RSA alternatives, in terms of area as well as hydrology, habitat, and other functions and values. The East Runway Slough and tidal channels would be actively reestablished around the east end of the RSA, and there would no loss in sustainability of wetland functions and values and only minor effects on wildlife habitat and EFH.

RSA-6B would affect a total of 31.6 acres of estuarine wetlands. Of this total, 21.2 acres would be impacted by construction of the RSA with EMAS, relocation of associated facilities (e.g., the EVAR/Dike Trail and Float Plane Pond access road), the relocation of Duck Creek, and modification of the Mendenhall River channel. An additional 10.4 acres would be impacted for reconstruction of the tidal slough at the east end of the runway to maintain the hydrologic connection between the existing sloughs north and south of the runway, thereby minimizing impacts to wetlands functions and values, including fisheries and wildlife habitat, hydrologic recharge, and sediment and nutrient transport, and maintaining existing wetland plant community composition to the extent possible.

Table 4-36. Alternative RSA-6B Impacts to Wetland Resources

Wetland Analysis Area	NWI Classification				
	E1UB3	E2EM1 (H)	E2EM1 (L)	E2USN	Total
Western RSA					
Acreage Lost	2.1	2.9	3.5	1.5	10.0
Functional Units Lost	270.4	391.6	436.7	184.9	1253.7
Percent Change*	58.9	77.1	89.2	148.0	81.3
Eastern RSA					
Acreage Lost	--	4.7	5.7	10.4	20.8
Functional Units Lost	--	592.1	725.7	1347.7	2665.5
Percent Change*	--	12.2	26.8	40.1	24.4
Northwest Airport Area					
Acreage Lost	--	0.10	0.23	0.09	0.40
Functional Units Lost	--	7.6	25.5	9.9	43.0
Percent Change*	--	2.2	32.9	18.0	6.7
Jordan Creek					
Acreage Lost	--	0.20	--	0.03	0.23
Functional Units Lost	--	24.2	--	3.7	27.9
Percent Change*	--	66.7	--	3.8	4.1
Totals					
Acreage Lost					31.4
Functional Units Lost					3390.1
Total Percent Change (project area/landscape area)**					10.9/ 0.8

* Percent change of wetland function within the wetland analysis area.
** Percent change of wetland acreage.

On the west runway end, Alternative RSA-6B would directly affect a greater acreage of wetland both inside and outside of the Refuge than Alternative RSA-6A but much less than Alternative RSA-1. Low marsh wetlands along the Mendenhall River would be adversely affected by modification of the river channel.

On the east runway end, the East Runway Slough would be filled but there would be no direct effect to other, smaller channels. The slough would be actively reestablished around the end of the RSA, and hydrologic connectivity to wetlands north, east, and south of the runway would be maintained with only minor impacts on key wetland functions. Indirect impacts to the wetlands at the Runway 26 end would be similar to but less pronounced than those described for RSA-1 and RSA-5D because the reconstructed slough channel around the RSA would be shorter and would, therefore, have a steeper gradient more closely approximating existing conditions.

There would be some adverse impact to wildlife support and fish habitat functions, but these impacts could be further reduced with the incorporation of mitigating design elements in Jordan Creek, such as those identified in Section 2.11 of Chapter 2. This alternative would have the least impact of any build alternative on wetlands in the east and northeast Airport areas. Alternative RSA-6B would also have the least indirect impact on wetlands of any RSA alternative, with only minor impacts to riparian support, fish habitat, and other functions listed in Section 4.3.8.1.

4.3.8.7 Alternative RSA-6C

Alternative RSA-6C would affect 42.6 acres of estuarine wetlands, as shown on Figure 4-14. The impact acreage and loss of wetland function are broken down by wetland analysis area in Table 4-37. Impacts on wetlands and hydrologic connectivity east of the runway would be the same as that described for RSA-1 and RSA-5D. The East Runway Slough channel would be actively reestablished under this alternative. Impacts on wetlands and hydrologic connectivity west of the runway would be the same as that described for RSA-5D and RSA-6B, as all of these alternatives share the same project footprint west of the Airport.

Table 4-37. Alternative RSA-6C Impacts to Wetland Resources

Wetland Analysis Area	NWI Classification				
	E1UB3	E2EM1 (H)	E2EM1 (L)	E2USN	Total
Western RSA					
Acreage Lost	2.1	2.9	3.5	1.6	10.0
Functional Units Lost	270.4	361.6	436.7	184.9	1253.7
Percent Change*	58.9	77.1	89.2	100.0[1]	81.3
Eastern RSA					
Acreage Lost	--	13.9	6.9	11.0	31.7
Functional Units Lost	--	1742.2	877.8	1426.9	4046.9
Percent Change*	--	35.9	32.4	42.4	37.0
Northwest Airport Area					
Acreage Lost	--	0.05	0.13	0.8	0.26
Functional Units Lost	--	5.4	14.4	8.8	28.7
Percent Change*	--	1.6	18.6	16.0	4.4
Jordan Creek					
Acreage Lost	--	0.20	--	0.03	0.23
Functional Units Lost	--	21.7	--	3.7	25.5

Table 4-37. Alternative RSA-6C Impacts to Wetland Resources, continued

Wetland Analysis Area	NWI Classification				
	E1UB3	E2EM1 (H)	E2EM1 (L)	E2USN	Total
Percent Change*	--	60.0	--	3.8	3.7
Totals					
Acreage Lost					38.9
Functional Units Lost					4936.7
Total Percent Change (project area/landscape area)**					13.5 / 0.9

[1]Calculation based on wetlands in project area as defined in the Draft EIS; includes impacts that occur outside of the defined project area (in the landscape area) as a result of changes to alternatives for the FEIS.
* Percent change of wetland function within the wetland analysis area.
** Percent change of wetland acreage.

RSA-6C would affect a total of 42.6 acres of estuarine wetlands. Of this total, 27.8 acres would be impacted by construction of the RSA and EMAS bed, relocation of associated facilities (e.g., the EVAR/Dike Trail and Float Plane Pond access road), the relocation of Duck Creek, and modification of the Mendenhall River channel. An additional 14.8 acres would be impacted for reconstruction of the tidal slough at the east end of the runway to maintain the hydrologic connection between the existing sloughs north and south of the runway, thereby minimizing impacts to wetlands functions and values, including fisheries and wildlife habitat, hydrologic recharge, and sediment and nutrient transport, and maintaining existing wetland plant community composition to the extent possible.

4.3.8.8 Alternative RSA-6D

Alternative RSA-6D would affect 33.1 acres of estuarine wetlands, as shown on Figure 4-14. The impact acreage and loss of wetland function are broken down by wetland analysis area in Table 4-38. Impacts on wetlands and hydrologic connectivity east of the runway would be nearly the same as that described for RSA-6B. The East Runway Slough channel would be actively reestablished under this alternative, though it would be slightly longer and less steep than that constructed with RSA-6B. Impacts on wetlands and hydrologic connectivity west of the runway would be the same as that described for RSA-5D, RSA-6B, and RSA-6C, as all of these alternatives share the same project footprint west of the Airport.

RSA-6D would affect a total of 33.1 acres of estuarine wetlands. Of this total, 23.2 acres would be impacted by construction of the RSA, relocation of associated facilities (e.g., the EVAR/Dike Trail and Float Plane Pond access road), extension of the taxiway, relocation of Duck Creek, and modification of the Mendenhall River channel. An additional 9.9 acres would be impacted for reconstruction of the tidal slough at the east end of the runway to maintain the hydrologic connection between the existing sloughs north and south of the runway, thereby minimizing impacts to wetlands functions and values, including fisheries and wildlife habitat, hydrologic recharge, and sediment and nutrient transport, and maintaining existing wetland plant community composition to the extent possible.

Table 4-38. Alternative RSA-6D Impacts to Wetland Resources

Wetland Analysis Area	NWI Classification				
	E1UB3	E2EM1 (H)	E2EM1 (L)	E2USN	Total
Western RSA					
Acreage Lost	2.1	2.9	3.5	1.5	10.0
Functional Units Lost	370.4	361.6	436.7	184.9	1253.7
Percent Change*	58.9	77.1	89.2	100.0[1]	81.3
Eastern RSA					
Acreage Lost	--	5.5	6.5	10.3	22.3
Functional Units Lost	--	695.1	826.7	1342.5	2864.3
Percent Change*	--	14.3	30.5	39.9	26.2
Northwest Airport Area					
Acreage Lost	--	0.10	0.20	0.10	0.4
Functional Units Lost	--	7.6	25.5	9.9	43.0
Percent Change*	--	2.2	32.9	18.0	6.7
Jordan Creek					
Acreage Lost	--	0.20	--	0.03	0.23
Functional Units Lost	--	24.2	--	3.7	27.9
Percent Change*	--	66.7	--	3.8	4.1
Totals					
Acreage Lost					32.9
Functional Units Lost					4188.9
Total Percent Change (project area/landscape area)**					11.5 / 0.8

[1]Calculation based on wetlands in project area as defined in the Draft EIS; includes impacts that occur outside of the defined project area (in the landscape area) as a result of changes to alternatives for the FEIS.
* Percent change of wetland function within the wetland analysis area.
** Percent change of wetland acreage.

4.3.8.9 ALTERNATIVE RSA-8

Alternative RSA-8 is the No Action Alternative. No direct loss of wetlands would occur. Indirect affects to wetlands caused by storm-water runoff, by human activities, or by natural processes, such as isostatic rebound, would continue at the current rate.

4.3.9 FISHERIES

Impacts to fish *habitat*, by acreage and percentage, are detailed in Sections 4.3.7, Vegetation and 4.3.8, Wetlands. Those analyses are used in this section to determine impacts to Essential Fish Habitat (EFH) for salmonids, sculpins, and forage fish. Because fish within the project area tend to use virtually all aquatic habitats during various seasons and tides, the impacts described in the following sections are presumed to affect all fish species present (resident and anadromous salmonids, sculpins, sticklebacks, starry flounders, and marine forage fish) unless otherwise specified. Because most alternatives would not substantially affect aquatic habitats beyond the project scale, they are not likely to measurably deplete fish abundance at the landscape scale.

Forage fish (e.g., Pacific herring) populations could be slightly affected by implementation of RSA alternatives. However, these reductions are not anticipated to exceed the natural range of variability in annual production for forage fish. All impacts are direct, adverse, and permanent unless specifically noted otherwise. The No Action Alternative would result in no adverse, direct or indirect effects to fish.

One key fish impact related to RSA alternatives concerns loss of EFH. All of the RSA Action alternatives would reduce EFH as a result of filling existing wetlands to accommodate the expanded RSA, as shown in Table 4-39.

Table 4-39. Direct Loss of EFH: RSA Alternatives[1]

EFH Type	RSA-1[2]	RSA-5C	RSA-5D	RSA-5E	RSA-6A	RSA-6B	RSA-6C	RSA-6D
High Marsh	16.0	17.2	17.7	18.5	7.2	7.9	17.1	8.7
Low Marsh	11.2	10.1	11.0	8.9	7.9	9.4	10.6	10.2
Slough	12.6	13.9	13.3	11.9	11.1	12.1	12.7	12.0
Open Water	3.7	0.6	2.2	0.5	0.3	2.2	2.2	2.2
EFH Total*	43.5	41.8	44.2	39.8	26.5	31.6	42.6	33.1

[1] All losses in acres.
[2] RSA-1 would have greater impacts than summarized herein. The substantial modification to the Mendenhall River channel would cause overall impacts for RSA-1 to exceed those of any other alternative.
* Includes acreages disturbed for the reconstruction of the eastern runway slough, which would ultimately benefit EFH resources in the area. Note: the slough reconstruction for RSA-5C would maintain only the hydrologic function of existing sloughs north of the runway and would not maintain the hydrologic connection north and south of the runways as would occur under all other alternatives.

All the RSA action alternatives would also adversely affect fish passage into and through Jordan Creek. The widening of the lateral RSA would require an extension of the Jordan Creek runway culvert, essentially forcing it to join the taxiway culvert. Culverting between the runway and taxiway and south of the runway would incorporate two currently open, approximately 130-foot-long reaches of Jordan Creek on each side of the runway. The result of this action would be a single culvert passage approximately 770 feet long. Both reaches have been disturbed by past development and are relatively wide, shallow riffles with cobble substrate. They lack sufficient depth, vegetation, and cover to be valuable for salmonid holding, rearing, or spawning; however, they are critically important for fish movement between the more valuable upstream and estuarine habitats. While fish passage has been studied extensively in shorter culverts (less than 300 feet long) related to road crossings, there are no analogs to this situation in the local area (especially considering the tidal fluctuations affecting it).

Relative to existing conditions, fish passage into Jordan Creek would be inhibited by joining the existing culverts. However, fish passage could be improved from existing conditions by replacing the existing culverts with a wider, bottomless concrete arch culvert. Incorporating steel grates that allow daylight and visual access into the arch culvert could also prove beneficial, though it would not directly improve fish passage. Section 2.11 of Chapter 2 describes the relative benefits or drawbacks of various culvert types that could be used in Jordan Creek.

4.3.9.1 Alternative RSA-1

The primary impacts to fish caused by Alternative RSA-1 stem from relocation of the Mendenhall River and the lowest portion of Duck Creek, fill of EFH, and extension and connection of the existing Jordan Creek runway and taxiway culverts. RSA-1 would affect a total of 43.5 acres of EFH. Of this total, 28.7 acres would be impacted by construction of the RSA, relocation of associated facilities (e.g., the EVAR/Dike Trail and Float Plane Pond access road), and relocation of Duck Creek and the Mendenhall River channel. An additional 14.8 acres would be impacted for reconstruction of the tidal slough at the east end of the runway to maintain the hydrologic connection between existing sloughs north and south of the runway, thereby minimizing impacts to the vegetation and wetland communities that comprise EFH.

Construction required to relocate the Mendenhall River channel and Duck Creek and to extend the Jordan Creek culvert would disrupt fish movement upstream and downstream in these waters. On Jordan Creek, this would be a short-term, adverse impact since the existing culverts would not be replaced until such time as they reached then end of their useful life or substantive reconstruction or repair work on the runway provided opportunity to replace the existing culverts with bottomless arch culverts. Over the long-term, the upstream movement of salmonids and resident fish into Jordan Creek may be hampered physically at low tides and behaviorally at low and high tides by the long culvert and the physical, behavioral, and maintenance problems it creates. Installation of light grates along the culvert would reduce adverse impacts on fish movement from darkness within the culvert. Adverse consequences of these actions at both Jordan Creek and Duck Creek could be reduced by segregating active flow from construction sites (ensuring that fish access within the streams is never precluded) and by timing construction to avoid periods of heavy fish use. Widening of the riparian buffer around the new Duck Creek alignment may provide long-term benefits to EFH.

EFH would be permanently reduced by 43.5 acres, which comprises mostly high marsh habitat but including 3.7 acres of open water in the Mendenhall River. This represents a 1.3% reduction of EFH available within the landscape area.

Loss of tidal sloughs and low marsh habitat at the mouth of Duck Creek could be somewhat offset if new sloughs form upstream at the relocated mouth of Duck Creek and/or in the backwater created downstream of the extended RSA fill. The relocated portion of the Mendenhall River would retain the fish access and habitat characteristics of the existing channel but would necessitate the loss of adjacent estuarine habitat. Relocation of the lowermost reach of Duck Creek at the west Runway 08 end would result in a loss of approximately 200 feet of estuarine stream channel, but fish access would be preserved within the relocated channel. Although a few chum and pink salmon (probably stray hatchery fish) attempt spawning in this portion of Duck Creek, eggs are unlikely to survive due to heavy sedimentation of the substrate (see discussion of this effect in Section 3.9.1.3). The primary goal for this and other reaches of Duck Creek on Airport property is to facilitate movement of salmonids between upstream rearing and spawning areas and the Mendenhall River. From a wildlife hazard perspective, spawning is not desirable in this reach.

Upstream movement of salmonids and resident fish into Jordan Creek may be hampered physically at low tides and behaviorally at low and high tides by the long, unlighted runway/taxiway culvert and the physical, behavioral, and maintenance problems it creates. Notably, the offset angle between the two culverts means that when they are joined, daylight would not be visible from one end of the extended culvert to the other. This may impede fish passage and hinder maintenance of the culverts.

These changes may indirectly affect EFH and fish access to it. The active development of a new tidal channel to replace the East Runway Slough would create low marsh habitat, partially offsetting the 6.8 acres of this habitat that would be lost for the new eastern RSA. New low marsh habitat would form at the expense of high marsh habitats east and southeast of the Runway 26 end, where 17.0 acres of estuarine marsh and slough habitats (including 6.8 acres of high marsh) would be directly impacted. Reduced tidal flow to estuarine wetlands near the Miller-Honsinger Slough would reduce fish access to the highest parts of this habitat on every tidal cycle. Active reconstruction of East Runway Slough around the Runway 26 RSA would help minimize these impacts. However, reductions in tidal influence with construction of the new slough would cause the loss of additional EFH along the tidal perimeter of the Miller-Honsinger Slough area. Similarly, reduction in access and eventual EFH losses would occur along the estuarine portion of Duck Creek as a result of the west runway RSA extension. Table 4-39 identifies the affects on EFH from this alternative.

4.3.9.2 ALTERNATIVE RSA-5C

Alternative RSA-5C would permanently and adversely reduce EFH by approximately 41.8 acres, a moderate to high amount in the range of alternatives but substantially more than Alternative RSA-6A. Most of the direct loss would be high marsh habitat. The short-term loss of tidal slough and low marsh habitats may be somewhat offset as tidal sloughs passively reform over time. A hydrologic connection of the areas northeast of the runway currently receiving tidal flows via East Runway Slough would be established to Sunny Slough, which would likely carry less water to the area than East Runway Slough currently does.

RSA-5C would directly affect a total of 41.8 acres of EFH. Of this total, 29.5 acres would be impacted by construction of the RSA, relocation of associated facilities (e.g., the EVAR/Dike Trail and Float Plane Pond access road), extension of the taxiway, and relocation of Duck Creek. An additional 12.3 acres would be impacted for construction of a tidal slough to connect the area north of Runway 26 to Sunny Slough to help maintain the hydrologic function of the existing sloughs north of the runway, thereby helping to minimize hydrologic impacts to vegetation communities and wetlands functions and values that comprise EFH. The tidal slough connection under this alternative would not maintain hydrologic connections for existing sloughs south of the runway.

The fish impacts of this alternative are most similar to those of RSA-1, except that there is no relocation of the Mendenhall River and virtually all of the direct habitat losses would occur south and east of the runway, where 21.8 acres of estuarine marsh and slough habitats (including 12.56 acres of high marsh) would be filled for RSA construction.

Similar to RSA-1, construction activities required to extend the Jordan Creek culverts could disrupt fish movement. This would be a short-term, adverse impact since the existing culverts would not be replaced until such time as they reached then end of their useful life or substantive reconstruction or repair work on the runway provided opportunity to replace the existing culverts with bottomless arch culverts. Over the long-term, the upstream movement of salmonids and resident fish into Jordan Creek may be hampered physically at low tides and behaviorally at low and high tides by the long culvert and the physical, behavioral, and maintenance problems it creates. Installation of light grates along the culvert would reduce adverse impacts on fish movement from darkness within the culvert.

EFH and fish access to EFH may also be affected indirectly, as the area hydrology adapts to the new fill placed for the RSA south and east of the runway. The tidal flow patterns resulting from this alternative are likely to differ substantially from existing conditions, with the long eastward runway-end RSA extension blocking flows in East Runway Slough and thereby inhibiting fish access between the north and south sides of the RSA fill. A reduction in tidal flows on the south side of the runway that would result from blocking East Runway Slough, and constructing the lateral RSA may lead to an eventual reduction in channel size of the sloughs into which Jordan Creek flows. The construction of a hydrologic connection from the area northeast of the runway to Sunny Slough would help reduce impacts in this area, but this area and the area immediately east and southeast of the runway would not experience the same level of scouring of sediments and tidal flow as currently experienced. This would likely result in a loss of EFH.

Access to Jordan Creek may change downstream from the runway. On the north side of the runway, reduced tidal flow to estuarine habitats near the Miller-Honsinger Slough would reduce fish access on each tidal cycle to the highest parts of this habitat. Eventually, reduced tidal influence would cause the loss of additional EFH along the tidal perimeter of the Miller-Honsinger Slough area. As is described in Section 4.3.6.2, it is possible that the hydrologic connection between East Runway Slough and the wetlands south of Miller-Honsinger Pond could be lost. This would have permanent, adverse impacts on fish habitat. Table 4-39 identifies the affects on EFH from this alternative.

4.3.9.3 ALTERNATIVE RSA-5D

Alternative RSA-5D would permanently and adversely reduce EFH by approximately 44.2 acres, the most of action alternatives and substantially more than RSA-6A. Most of the direct loss would be high marsh habitat.

RSA-5D would directly affect a total of 44.2 acres of EFH. Of this total, 29.4 acres would be impacted by construction of the RSA, relocation of associated facilities (e.g., the EVAR/Dike Trail and Float Plane Pond access road), extension of the taxiway, relocation of Duck Creek, and modification of the Mendenhall River channel. An additional 14.8 acres would be impacted for reconstruction of the tidal slough at the east end of the runway to maintain the hydrologic connection between existing sloughs north and south of the runway, thereby minimizing impacts to the vegetation and wetland communities that comprise EFH.

The fish impacts of this alternative are most similar to those of RSA-1, except that there is only a partial modification of the Mendenhall River. Construction required to modify the Mendenhall River channel and lowermost Duck Creek and to extend the Jordan Creek culvert would disrupt fish movement upstream and downstream in these waters. This would be a short-term, adverse impact. Adverse consequences of these actions could be reduced by segregating active flow from construction sites (ensuring that fish access within the streams is never precluded) and by timing construction to avoid periods of heavy fish use. Widening of the riparian buffer around the new Duck Creek alignment may provide long-term benefits to EFH.

Similar to RSA-1, construction activities required to extend the Jordan Creek culverts could disrupt fish movement. This would be a short-term, adverse impact since the existing culverts would not be replaced. Over the long-term, the upstream movement of salmonids and resident fish into Jordan Creek may be hampered physically at low tides and behaviorally at low and high tides by the long, unlighted runway/taxiway culvert and the physical, behavioral, and maintenance problems it creates.

EFH and fish access to EFH may also be affected indirectly, as the area hydrology adapts to the new fill placed for the RSA south and east of the runway. These impacts would be nearly identical to those described for RSA-1, except that additional fill would be placed northeast of the runway as part of the taxiway extension. The East Runway Slough channel would be actively relocated in the same manner described for RSA-1. Table 4-39 identifies the affects on EFH from this alternative.

4.3.9.4 ALTERNATIVE RSA-5E

Alternative RSA-5E, the FAA's preferred RSA alternative, would permanently and adversely reduce EFH by approximately 39.8 acres, more than RSA-6A, RSA-6B, and RSA-6D, but less than RSA-1, RSA-5C, RSA-5D, and RSA-6C. Most of the direct loss would be high marsh habitat.

RSA-5D would directly affect a total of 39.8 acres of EFH. Of this total, 25.5 acres would be impacted by construction of the RSA, relocation of associated facilities (e.g., the EVAR/Dike Trail and Float Plane Pond access road), extension of the taxiway, and relocation of Duck Creek. An additional 14.3 acres would be impacted for reconstruction of the tidal slough at the east end of the runway to minimize maintain the hydrologic connection between existing sloughs north and south of the runway, thereby minimizing impacts to the vegetation and wetland communities that comprise EFH.

The fish impacts of this alternative are most similar to those of RSA-5C for the Runway 08 end and for RSA-1, RSA-5D, and RSA-6C for the Runway 26 end. Similar to these other alternatives, construction activities required to extend the Jordan Creek culverts could disrupt fish movement. This would be a short-term, adverse impact since the existing culverts would not be replaced until such time as they reached the end of their useful life or substantive reconstruction or repair work on the runway provided opportunity to replace the existing culverts with bottomless arch culverts. Over the long-term, the upstream movement of salmonids and resident fish into Jordan Creek may be hampered physically at low tides and behaviorally at low and high tides by the long culvert and the physical, behavioral, and maintenance problems it creates. Installation of light grates along the culvert would reduce adverse impacts on fish movement from darkness within the culvert. Widening of the riparian buffer around the new Duck Creek alignment may provide long-term benefits to EFH.

EFH and fish access to EFH may also be affected indirectly, as the area hydrology adapts to the new fill placed for the RSA south and east of the runway. These impacts would be nearly identical to those described for RSA-1, RSA-5D, and RSA-6C, except that additional fill would be placed northeast of the runway as part of the taxiway extension. The East Runway Slough channel would be actively relocated in a similar manner as that described for RSA-1, RSA-5D, and RSA-6C. Table 4-39 summarizes the affects on EFH from this alternative.

4.3.9.5 Alternative RSA-6A

Relative to the other action alternatives, Alternative RSA-6A would have the least impact on EFH with a total of 26.5 acres of fish habitat replaced by upland fills. This impact would be spread between high marsh, low marsh, and slough habitats with the majority (11.1 acres) occurring in slough habitats; 7.9 acres of impacts would occur in low marsh habitats.

RSA-6A would directly affect a total of 26.5 acres of EFH. Of this total, 16.6 acres would be impacted by construction of the RSA with EMAS, relocation of associated facilities (e.g., the EVAR/Dike Trail and Float Plane Pond access road), and relocation of Duck Creek. An additional 9.9 acres would be impacted for reconstruction of the tidal slough at the east end of the runway to maintain the hydrologic connection between existing sloughs north and south of the runway, thereby minimizing impacts to the vegetation and wetland communities that comprise EFH.

Effects to EFH on the west side of the runway would be similar to but slightly more extensive than those under RSA-5C. Short- and long-term impacts to fisheries resulting from relocation of Duck Creek and culvert extension on Jordan Creek would be the same as those described under RSA-1 and RSA-5C.

The affect on EFH east of the runway would be less extensive than under RSA-1, RSA-5C, and RSA-5D. East Runway Slough would be actively reconstructed around the end of the RSA, and as the channel would be shorter for RSA-6A than under RSA-1, RSA-5C, or RSA-5D, the changes in area hydrology would be less substantial. Table 4-39 summarizes the affects on EFH from this alternative.

4.3.9.6 Alternative RSA-6B

Alternative RSA-6B is nearly identical to RSA–6A on the east runway end except it is shifted slightly to the west. The configuration of RSA-6B on the west runway end is identical to that of RSA-5D, RSA-6C, and RSA-6D. RSA-6B would affect 31.6 acres of EFH, 5.1 acres more than RSA-6A because of the modification to the Mendenhall River channel and greater impacts west of the runway associated with RSA-6B. RSA-6B would directly affect a total of 31.6 acres of EFH. Of this total, 21.2 acres would be impacted by construction of the RSA with EMAS, relocation of associated facilities (e.g., the EVAR/Dike Trail and Float Plane Pond access road), relocation of Duck Creek, and modification of the Mendenhall River channel. An additional 10.4 acres would be impacted for reconstruction of the tidal slough at the east end of the runway to maintain the hydrologic connection between existing sloughs north and south of the runway, thereby minimizing impacts to the vegetation and wetland communities that comprise EFH.

Direct, permanent impacts to EFH on the west side of the runway would total 3.1 acres of low marsh, high marsh, slough, and open water habitats relative to 1.4 acres of impact to this area under RSA-6A. On the east Runway 26 end, this alternative would adversely affect 10.6 acres of EFH, 2.1 acres less than RSA-6A.

The narrow tidal channel just east of East Runway Slough would not be blocked under this alternative. Consequently, tidal flows would still connect channels on the south side of the runway with East Runway, Sunny, Miller-Honsinger, and Zig Zag Sloughs. Additionally, East Runway Slough would be actively reconstructed around the end of the RSA as part of this alternative. As a result, this alternative would have fewer long-term, indirect impacts to EFH in the northeast portion of the project area than any of the other action alternatives. To the extent that the reestablished East Runway Slough channel can convey existing volumes of tide water into the northeast portion of the project area, long-term indirect impacts to EFH in this area may be minor under RSA-6B.

Effects to EFH and fish movement associated with the relocation of Duck Creek and extension of the Jordan Creek culverts would be identical to those associated with the other action alternatives. Table 4-39 identifies the affects on EFH from this alternative.

4.3.9.7 Alternative RSA-6C

Overall, this alternative would have permanent, adverse effects on 42.6 acres of EFH resulting from the replacement of estuarine marsh and slough habitats with RSA fill. Impacts to EFH on the west Runway 08 end would be identical to those described for RSA-5D, RSA-6B, and RSA-6D, as all of these alternatives share the same west runway end configuration. The east end would have a standard RSA identical to RSA-1, with the same degree of direct and indirect impacts to EFH.

RSA-6C would directly affect a total of 42.6 acres of EFH. Of this total, 27.8 acres would be impacted by construction of the RSA, relocation of associated facilities (e.g., the EVAR/Dike Trail and Float Plane Pond access road), relocation of Duck Creek, and modification of the Mendenhall River channel. An additional 14.8 acres would be impacted for reconstruction of the tidal slough at the east end of the runway to maintain the hydrologic connection between existing sloughs north and south of the runway, thereby minimizing impacts to the vegetation and wetland communities that comprise EFH.

Effects to EFH and fish movement associated with the relocation of Duck Creek and extension of the Jordan Creek culverts would be identical to those associated with the other action alternatives. Table 4-39 identifies the impacts to EFH caused by Alternative RSA-6C.

4.3.9.8 Alternative RSA-6D

Alternative RSA-6D would have permanent, adverse effects on 33.18 acres of EFH resulting from the replacement of estuarine marsh and slough habitats with RSA fill. Impacts to EFH on the west Runway 08 end would be identical to those described for RSA-5D, RSA-6B, and RSA-6C, as all of these alternatives share the same west runway end configuration. The east end would have a standard RSA identical in length to RSA-6B, with the same degree of direct and indirect impacts to EFH.

RSA-6D would directly affect a total of 33.1 acres of EFH. Of this total, 23.2 acres would be impacted by construction of the RSA, relocation of associated facilities (e.g., the EVAR/Dike Trail and Float Plane Pond access road), extension of the taxiway, relocation of Duck Creek, and modification of the Mendenhall River channel. An additional 9.9 acres would be impacted for reconstruction of the tidal slough at the east end of the runway to maintain the hydrologic connection between existing sloughs north and south of the runway, thereby minimizing impacts to the vegetation and wetland communities that comprise EFH.

Effects to EFH and fish movement associated with the relocation of Duck Creek and extension of the Jordan Creek culverts would be identical to those associated with the other action alternatives. Table 4-39 identifies the impacts to EFH caused by Alternative RSA-D6C.

4.3.9.9 Alternative RSA-8

Alternative RSA-8 would have no effect on fisheries in the project area, in the Refuge, or in the landscape area.

4.3.10 WILDLIFE

Tables 4-40 through 4-43 summarize the direct impacts to general wildlife habitats and the habitats of high-interest and sensitive wildlife species that would occur in the project and landscape areas under each of the RSA alternatives.[6] The following sections discuss the ramifications of these habitat impacts on wildlife species and qualitatively discuss indirect impacts. It has been assumed for this analysis that any vegetation clearing associated with any of the alternatives would not occur during avian breeding season and would result neither in the destruction of nests or eggs nor in other kinds of bird casualties.

The threatened Steller sea lion and endangered humpback whale may be indirectly affected by potential reductions in forage fish (e.g., Pacific herring) populations associated with implementation of RSA alternatives. However, these reductions are not anticipated to exceed the natural range of variability in annual production for forage fish. Thus, while populations of forage fish may be incrementally reduced as a result of these actions, their losses are not expected to have any substantive adverse effects on Steller sea lions or humpback whales.

The Queen Charlotte goshawk and peregrine falcon would experience incremental losses in potential foraging habitat under the various RSA alternatives, with RSA-5D having the greatest adverse impact. However, given the relatively broad habitat requirements, and the mobility and broad range of these species, these impacts are anticipated to be negligible. None of the alternatives considered would be expected to jeopardize the continued existence of sensitive or high interest species within the landscape area. The olive-sided flycatcher and Townsend's warbler are associated with woodlands; thus, none of the RSA alternatives would affect their habitat.

Figure 4-15 illustrates the wildlife habitat affected by each RSA alternative.

4.3.10.1 ALTERNATIVE RSA-1

Of the eight RSA build alternatives assessed in this EIS, RSA-1 would have the greatest impact on estuarine low marsh habitat, which, including Lyngbye sedge (a subset of low marsh), is considered to be the most sensitive habitat in the project and landscape areas due to its high value to wildlife and relative rarity in southeastern Alaska. Under RSA-1, the greatest adverse impacts to general wildlife habitats within the project area would occur in the estuarine low marsh (and Lyngbye sedge), high marsh, unvegetated, and seeded grassland habitats.

RSA-1 would directly affect a total of 50.5 acres of wildlife habitat Of this total, 35.7 acres would be impacted by construction of the RSA, relocation of associated facilities (e.g., the EVAR/Dike Trail and Float Plane Pond access road), and relocation of Duck Creek and the Mendenhall River channel. An additional 14.8 acres would be impacted for reconstruction of the tidal slough at the

6. See Sections 3.10.4 and 3.10.5 in Chapter 3, and Technical Working Paper #4 (SWCA 2002) for an explanation of high-interest, threatened, endangered, and sensitive species.

east end of the runway to maintain the hydrologic connection between existing sloughs north and south of the runway, thereby minimizing impacts to the vegetation and wetland communities that comprise wildlife habitat.

As shown in Table 4-40, 38.1% of the Lyngbye sedge coverage within the project area would be lost under this alternative, with most of the loss occurring west of the runway. Given that Lyngbye sedge (along with low marsh habitat in general) is one of the most important wildlife habitats in the region, the conversion of 7.6 acres of Lyngbye sedge to developed ground constitutes a substantive impact, particularly when considered at the project area scale.

At the landscape level, 1.7% each estuarine low and high marsh habitats would be lost, with a 1.6% reduction in Lyngbye sedge cover. These losses would occur during construction of the RSA and result in the permanent conversion of wildlife habitat to developed ground. Combined impacts to estuarine high and low marsh communities would comprise a total of 27.4 acres or 1.7% of the total estuarine marsh habitat present within the landscape area.

RSA-1 would have adverse effects on the habitats of all fifteen high-interest species. Those species or species groups having the broadest habitat requirements (e.g., bald eagle, other raptors, and corvids) would have the highest number of habitat acres lost (50.5) but an intermediate level of relative impact (11.9% reduction). The highest relative impact would occur to shorebirds, which have the narrowest habitat requirements. A total of 23.7 acres (35.3%) of shorebird habitat would be permanently lost from the project area under RSA-1. This translates to a 1.6% reduction in shorebird habitat at the landscape level.

The Queen Charlotte goshawk would undergo a 16.5-acre habitat reduction, while peregrine falcon habitat would be reduced by 50.5 acres under RSA-1. These impacts would reduce these sensitive species' habitats by 1.3% and 1.2%, respectively, within the landscape area.

Alternative RSA-1 would also have a variety of positive and negative, indirect effects on wildlife habitats and high-interest species. On the west Runway 08 end, rerouting the Mendenhall River would, as discussed in the vegetation Section 4.3.7, result in the creation of a backwater area in what is currently a meander loop of the Mendenhall. While the depth of the channel and tidal action would likely cause much of the area to remain open water, high and low estuarine marsh habitats would probably begin to form where sediments are deposited in backwaters. As vegetation begins to colonize the sediment deposits, marsh communities would become established and cause an increase in habitat value for the wide variety of wildlife species that use these habitats.

On the east Runway 26 end, peak tides would continue to reach the areas of the Northeast Development Area and the area between Miller-Honsinger Pond by flowing around the RSA via the constructed East Runway Slough channel that would be built as part of this alternative.

Table 4-40. Summary of RSA Impacts to Wildlife Habitats Within the Project Area

Wildlife Habitat		RSA-1[1]			RSA-5C			RSA-5D			RSA-5E			RSA-6A			RSA-6B/6D[2]			RSA-6C		
	Acres Existing	Acres Lost*	Ares Left	% Change	Acres Lost*	Ares Left	% Change	Acres Lost*	Ares Left	% Change	Acres Lost*	Ares Left	% Change	Acres Lost*	Ares Left	% Change	Acres Lost*	Ares Left	% Change	Acres Lost*	Ares Left	% Change
Open Water	86.5	3.7	82.8	4.3	0.6	85.9	0.7	2.2	84.3	2.5	0.6	85.9	0.7	0.2	86.3	0.2	2.2	84.3	2.5	2.2	84.3	2.5
Unvegetated	33.2	12.4	20.8	37.3	13.7	19.5	41.3	13.1	20.1	39.5	11.7	21.5	35.0	10.9	22.3	32.8	11.8	21.4	35.5	12.4	20.8	37.3
Freshwater Marsh	9.6	0.0	9.6	0.0	0.0	9.6	0.0	0.0	9.6	0.0	0.0	9.6	0.0	0.0	9.6	0.0	0.0	9.6	0.0	0.0	9.6	0.0
Ditch Grass	4.8	0.0	4.8	0.0	0.0	4.8	0.0	0.0	4.8	0.0	0.0	4.8	0.0	0.0	4.8	0.0	0.0	4.8	0.0	0.0	4.8	0.0
Estuarine Low Marsh	33.9	11.3	22.6	33.3	10.2	23.7	30.0	11.2	22.7	33.0	9.0	24.9	26.5	8.0	25.9	23.6	9.5	24.4	28.0	10.7	23.2	31.6
Lyngbye Sedge	19.9	7.6	12.3	38.1	6.1	13.8	30.7	7.5	12.4	37.7	5.3	14.6	26.6	4.3	15.6	21.6	5.8	14.1	29.1	7.0	12.9	35.2
Estuarine High Marsh	100.2	16.1	84.1	16.1	17.4	82.8	17.4	18.0	82.2	18.0	18.8	81.4	18.8	7.2	93.0	7.2	8.4	91.8	8.4	17.8	82.4	17.8
Supratidal	48.4	0.4	48.0	0.8	0.6	47.8	1.2	0.7	47.7	1.4	0.7	47.7	1.4	0.5	47.9	1.0	0.7	47.7	1.4	0.5	47.9	1.0
Seeded Grassland	42.0	6.0	36.0	14.3	6.0	36.0	14.3	6.0	36.0	14.3	6.0	36.0	14.3	6.0	36.0	14.3	6.0	36.0	14.3	6.0	36.0	14.3
Shrub-Scrub	22.6	0.0	22.6	0.0	0.0	22.6	0.0	0.0	22.6	0.0	0.0	22.6	0.0	0.0	22.6	0.0	0.0	22.6	0.0	0.0	22.6	0.0
Forest	42.7	0.0	42.7	0.0	0.0	42.7	0.0	0.0	42.7	0.0	0.0	42.7	0.0	0.0	42.7	0.0	0.0	42.7	0.0	0.0	42.7	0.0
TOTAL**	**423.8**	**50.5**	**373.3**	**11.9**	**49.3**	**374.5**	**11.6**	**52.0**	**371.8**	**12.3**	**47.6**	**376.2**	**11.2**	**33.4**	**390.4**	**7.9**	**39.2**	**384.6**	**9.2**	**50.2**	**373.6**	**11.8**

[1] RSA-1 would have greater impacts than summarized herein. The substantial modification to the Mendenhall River channel would cause overall impacts for RSA-1 to exceed those of any other alternative.
[2] Alternative RSA-6D has nearly identical landscape level vegetation impacts to Alternative RSA-6B. The total acreage of change for RSA-6D is 40.1 The only differences are the following acreages for RSA-6D: Unvegetated (11.7 ac), Low Marsh (10.3 ac), and High Marsh (9.2 ac).
*Includes acreages disturbed for the reconstruction of the eastern runway slough, which would ultimately minimize impacts to wildlife habitat in the area. Note: the slough reconstruction for RSA-5C would maintain only the hydrologic function of existing sloughs north of the runway and would not maintain the hydrologic connection north and south of the runways as would occur under all other alternatives.
**Total does not include acreages identified for Lyngbye Sedge because it is a sub-habitat of Estuarine Low Marsh.

Table 4-41. Summary of RSA Impacts to Wildlife Habitats Within the Landscape Area

Wildlife Habitat		RSA-1[1]			RSA-5C			RSA-5D			RSA-5E			RSA-6A			RSA-6B/6D[2]			RSA-6C		
	Acres Existing	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change
Open Water	1691.9	3.7	1688.2	0.2	065	1691.3	0.0	2.2	1689.7	0.1	0.6	1691.3	0.0	0.2	1691.7	0.0	2.2	1689.7	0.1	2.2	1689.7	0.1
Unvegetated	776.4	12.4	764.0	1.6	13.7	762.7	1.8	13.1	763.3	1.7	11.7	764.7	1.5	10.9	765.5	1.4	11.8	764.6	1.5	12.4	764.0	1.6
Freshwater Marsh	13.2	0.0	13.2	0.0	0.0	13.2	0.0	0.0	13.2	0.0	0.0	13.2	0.0	0.0	13.2	0.0	0.0	13.2	0.0	0.0	13.2	0.0
Ditch Grass	4.8	0.0	4.8	0.0	0.0	4.8	0.0	0.0	4.8	0.0	0.0	4.8	0.0	0.0	4.8	0.0	0.0	4.8	0.0	0.0	4.8	0.0
Estuarine Low Marsh	665.4	11.3	654.1	1.7	10.2	655.2	1.5	11.2	654.2	1.7	9.0	656.4	1.4	8.0	657.4	1.2	9.5	655.9	1.4	10.7	654.7	1.6
Lyngbye Sedge	480.6	7.6	473.0	1.6	6.1	473.9	1.3	7.5	473.1	0.2	5.3	475.3	1.1	4.3	476.3	0.9	5.8	474.8	1.2	7.0	473.6	1.5
Estuarine High Marsh	962.6	16.1	946.5	1.7	17.4	945.2	1.8	18.0	944.6	1.9	18.8	943.8	2.0	7.2	955.48	0.7	8.4	954.2	0.9	17.8	944.80	1.8
Supratidal	160.5	0.4	160.1	0.2	0.6	160.1	0.2	0.7	159.8	0.4	0.7	160.0	0.3	0.5	160.0	0.3	0.7	160.0	0.3	0.5	160.0	0.3
Seeded Grassland	44.4	6.0	38.4	13.5	6.0	38.4	13.5	6.0	38.4	13.5	6.0	38.4	13.5	6.0	38.4	13.5	6.0	38.4	13.5	6.0	38.4	13.5
Shrub-Scrub	34.3	0.0	34.3	0.0	0.0	34.3	0.0	0.0	34.3	0.0	0.0	34.3	0.0	0.0	34.3	0.0	0.0	34.3	0.0	0.0	34.3	0.0
Forest	90.6	0.0	90.6	0.0	0.0	90.6	0.0	0.0	90.6	0.0	0.0	90.6	0.0	0.0	90.6	0.0	0.0	90.6	0.0	0.0	90.6	0.0
TOTAL**	**4444.1**	**50.5**	**4393.6**	**1.1**	**49.3**	**4394.8**	**1.1**	**52.0**	**4392.1**	**1.2**	**47.6**	**4396.5**	**1.1**	**33.4**	**4410.5**	**0.7**	**39.2**	**4404.9**	**0.9**	**50.2**	**4393.9**	**1.1**

[1] RSA-1 would have greater impacts than summarized herein. The substantial modification to the Mendenhall River channel would cause overall impacts for RSA-1 to exceed those of any other alternative.
[2] Alternative RSA-6D has nearly identical landscape level vegetation impacts to Alternative RSA-6B. The total acreage of change for RSA-6D is 40.1 The only differences are the following acreages for RSA-6D: Unvegetated (11.7 ac), Low Marsh (10.3 ac), and High Marsh (9.2 ac).
*Includes acreages disturbed for the reconstruction of the eastern runway slough, which would ultimately minimize impacts to wildlife habitat in the area. Note: the slough reconstruction for RSA-5C would maintain only the hydrologic function of existing sloughs north of the runway and would not maintain the hydrologic connection north and south of the runways as would occur under all other alternatives.
**Total does not include acreages identified for Lyngbye Sedge because it is a sub-habitat of Estuarine Low Marsh.

Table 4-42. Summary of RSA Impacts to High-interest and Sensitive Species' Habitats Within the Project Area

Wildlife Habitat	Acres Exist.	RSA-1[1]			RSA-5C			RSA-5D			RSA-5E			RSA-6A			RSA-6B[2]			RSA-6C			RSA-6D		
		Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change
High Interest Species																									
Migratory Waterfowl	91.3	3.7	87.6	4.1	0.6	90.7	0.7	2.2	89.1	2.4	0.6	90.7	0.7	0.2	91.1	0.2	2.2	89.1	2.4	2.2	89.1	2.4	2.2	89.1	2.4
Swans	91.3	3.7	87.6	4.1	0.6	90.7	0.7	2.2	89.1	2.4	0.6	90.7	0.7	0.2	91.1	0.2	2.2	89.1	2.4	2.2	89.1	2.4	2.2	89.1	2.4
Vancouver Canada Goose	167.2	21.0	146.2	12.6	16.8	150.4	10.0	19.4	147.8	11.6	15.5	151.7	9.3	14.2	153.0	8.5	17.7	149.5	10.6	18.9	148.3	11.3	18.5	148.7	11.1
Bonaparte's Gull	253.8	43.5	210.2	17.1	41.9	211.9	16.5	44.5	209.3	17.5	40.1	213.7	15.8	26.3	227.5	10.4	31.9	221.9	12.6	43.1	210.7	17.0	33.4	220.4	13.2
Great Blue Heron	125.2	15.0	110.2	12.0	10.8	114.4	8.6	13.4	111.8	10.7	9.6	115.6	7.7	8.2	117.0	6.5	11.7	113.5	9.3	12.9	112.3	10.3	12.5	112.7	10.0
Shorebirds	67.1	23.7	43.4	35.3	23.9	43.2	35.6	24.3	42.8	36.2	20.7	46.4	30.8	18.9	48.2	28.2	21.3	45.8	31.7	23.1	44.0	34.4	22.0	45.1	32.8
Bald Eagle	423.8	50.5	373.3	11.9	49.3	374.5	11.6	52.0	371.8	12.3	47.6	376.2	11.2	33.4	390.4	7.9	39.2	384.6	9.2	50.2	373.6	11.8	40.7	383.1	9.6
Other Raptors	423.8	50.5	373.3	11.9	49.3	374.5	11.6	52.0	371.8	12.3	47.6	376.2	11.2	33.4	390.4	7.9	39.2	384.6	9.2	50.2	373.6	11.8	40.7	383.1	9.6
Rufous Hummingbird	48.4	0.4	48.0	0.8	0.6	47.8	1.2	0.7	47.7	1.4	0.7	47.7	1.4	0.5	47.9	1.0	0.7	47.7	1.4	0.5	47.9	1.0	0.7	47.7	1.4
Swallows	235.0	31.1	203.9	13.2	28.2	206.8	12.0	31.4	203.6	13.4	28.4	206.6	12.1	15.4	219.6	6.6	20.1	214.9	8.6	30.7	204.3	13.1	21.7	213.3	9.2
Corvids	423.8	50.5	373.3	11.9	49.3	374.5	11.6	52.0	371.8	12.3	47.6	376.2	11.2	33.4	390.4	7.9	39.2	384.6	9.2	50.2	373.6	11.8	40.7	383.1	9.6
Songbirds	213.9	16.5	197.4	7.7	18.0	195.9	8.4	18.7	195.2	8.7	19.5	194.4	9.1	7.7	206.2	3.6	9.1	204.8	4.3	18.3	195.6	0.9	9.9	204.0	4.6
Black Bear	299.3	33.8	265.5	11.3	34.2	265.1	11.4	35.9	263.4	12.0	34.5	264.8	11.5	21.7	277.6	7.3	24.6	274.1	8.4	35.0	264.3	11.7	26.2	273.1	8.8
River Otter	300.3	31.1	269.2	10.3	28.2	272.1	9.4	31.4	268.9	10.4	28.4	271.9	9.5	15.4	284.9	5.1	20.1	280.2	6.7	30.7	269.6	10.2	21.7	278.6	7.2
Sitka Black-tailed Deer	299.3	33.8	265.5	11.3	34.2	265.1	11.4	35.9	263.4	12.0	34.5	264.8	11.5	21.7	277.6	7.3	24.6	274.1	8.4	35.0	264.3	11.7	26.0	273.3	8.7
Sensitive Species																									
Queen Charlotte Goshawk	223.4	16.5	206.9	7.4	18.0	205.4	8.1	18.7	204.7	8.4	19.5	203.9	8.7	7.7	215.7	3.4	9.1	214.3	4.1	18.3	205.1	8.2	9.9	213.5	4.4
Peregrine Falcon	358.5	50.5	308.0	14.1	49.3	309.2	13.8	52.0	306.5	14.5	47.6	310.9	13.3	33.4	325.1	9.4	39.2	319.3	11.0	50.2	308.3	14.0	40.7	317.8	11.4
Olive-sided Flycatcher	42.7	0.0	42.7	0.0	0.0	42.7	0.0	0.0	42.7	0.0	0.0	42.7	0.0	0.0	42.7	0.0	0.0	42.7	0.0	0.0	42.7	0.0	0.0	42.7	0.0
Townsend's Warbler	42.7	0.0	42.7	0.0	0.0	42.7	0.0	0.0	42.7	0.0	0.0	42.7	0.0	0.0	42.7	0.0	0.0	42.7	0.0	0.0	42.7	0.0	0.0	42.7	0.0

[1] RSA-1 would have greater impacts than summarized herein. The substantial modification to the Mendenhall River channel would cause overall impacts for RSA-1 to exceed those of any other alternative.
*Includes acreages disturbed for the reconstruction of the eastern runway slough, which would ultimately minimize impacts to wildlife habitat in the area. Note: the slough reconstruction for RSA-5C would maintain only the hydrologic function of existing sloughs north of the runway and would not maintain the hydrologic connection north and south of the runways as would occur under all other alternatives.

Table 4-43. Summary of RSA Impacts to High-interest and Sensitive Species' Habitats within the Landscape Area

Wildlife Habitat	Acres Exist.	RSA-1[1]			RSA-5C			RSA-5D			RSA-5E			RSA-6A			RSA-6B			RSA-6C			RSA-6D		
		Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change	Acres Lost*	Acres Left	% Change
High Interest Species																									
Migratory Waterfowl	1696.7	3.7	1693.1	0.2	0.6	1696.2	0.0	2.2	1694.6	0.1	0.6	1696.1	0.0	0.2	1696.6	0.0	2.2	1694.6	0.1	2.2	1694.6	0.1	2.2	1694.6	0.1
Swans	1696.7	3.7	1639.1	0.2	0.6	1696.2	0.0	2.2	1694.6	0.1	0.6	1696.1	0.0	0.2	1696.6	0.0	2.2	1694.6	0.1	2.2	1694.6	0.1	2.2	1694.6	0.1
Vancouver Canada Goose	2406.5	21.0	2385.6	0.9	16.8	2389.8	0.7	19.4	2387.2	0.8	15.5	2391.0	0.6	14.2	2392.4	0.6	17.7	2388.9	0.7	18.9	2387.7	0.8	18.5	2388.0	0.8
Bonaparte's Gull	4096.3	43.5	4053.0	1.1	41.9	4054.6	1.0	44.5	4052.0	1.1	40.1	4056.2	1.0	26.3	4070.2	0.6	31.9	4064.6	0.8	43.1	4053.4	1.0	33.4	4062.9	0.8
Great Blue Heron	2362.1	15.0	2347.2	0.6	10.8	2351.4	0.5	13.4	2348.8	0.6	9.6	2352.5	0.4	8.2	2354.0	0.3	11.7	2350.5	0.5	12.9	2349.3	0.5	12.5	2349.6	0.5
Shorebirds	1441.8	23.7	1418.2	1.6	23.9	1418.0	1.7	24.3	1417.6	1.7	20.7	1421.1	1.4	18.9	1423.0	1.3	21.3	1420.6	1.5	23.1	1418.8	1.6	22.0	1419.8	1.5
Bald Eagle	4444.1	50.5	4393.8	1.1	49.3	4395.0	1.1	52.0	4392.3	1.2	47.6	4396.5	1.1	33.4	4410.9	0.7	39.2	4405.1	0.9	50.2	4394.1	1.1	40.7	4403.4	0.9
Other Raptors	4444.1	50.5	4393.8	1.1	49.3	4395.0	1.1	52.0	4392.3	1.2	47.6	4396.5	1.1	33.4	4410.9	0.7	39.2	4405.1	0.9	50.2	4394.1	1.1	40.7	4403.4	0.9
Rufous Hummingbird	160.4	0.4	160.0	0.2	0.6	159.8	0.4	0.7	159.7	0.4	0.7	159.7	0.4	0.5	159.9	0.3	0.7	159.7	0.4	0.5	159.9	0.3	0.7	159.7	0.4
Swallows	3338.6	31.1	3307.6	0.9	28.2	3310.5	0.8	31.4	3307.3	0.9	28.4	3310.2	0.9	15.4	3323.3	0.5	20.1	3318.6	0.6	30.7	3308.0	0.9	21.7	3316.9	0.6
Corvids	4444.1	50.5	4393.8	1.1	49.3	4395.0	1.1	52.0	4392.3	1.2	47.6	4396.5	1.1	33.4	4410.9	0.7	39.2	4405.1	0.9	50.2	4394.1	1.1	40.7	4403.4	0.9
Songbirds	1247.9	16.5	1231.4	1.3	18.0	1229.9	1.4	18.7	1229.2	1.5	19.5	1228.4	1.6	7.7	1240.2	0.6	9.1	1238.8	0.7	18.3	1229.6	1.5	9.9	1238.0	0.8
Black Bear	1971.6	33.8	1937.2	1.7	34.2	1939.6	1.8	35.9	1934.9	1.9	34.5	1937.1	1.7	21.7	1949.3	1.1	24.6	1946.4	1.3	35.0	1936.0	1.8	26.2	1945.4	1.3
River Otter	3463.5	31.1	3432.5	0.9	28.2	3435.4	0.8	31.4	3432.2	0.9	28.4	3435.1	0.8	15.4	3448.2	0.4	20.1	3443.5	0.6	30.7	3432.9	0.9	21.7	3441.8	0.6
Sitka Black-tailed Deer	1971.6	33.8	1937.2	1.7	34.2	1936.6	1.8	35.9	1934.9	1.9	34.5	1937.1	1.7	21.7	1949.3	1.1	24.6	1946.4	1.3	35.0	1936.0	1.8	26.0	1945.6	1.3
Sensitive Species																									
Queen Charlotte Goshawk	1261.8	16.5	1245.3	1.3	18.0	1243.8	1.4	18.7	1243.1	1.5	19.5	1242.3	1.5	7.7	1254.1	0.6	9.1	1252.7	0.7	18.3	1243.5	1.5	9.9	1251.9	0.8
Peregrine Falcon	4319.8	50.5	4269.3	1.2	49.3	4270.5	1.1	52.0	4267.8	1.2	47.6	4272.2	1.1	33.4	4286.4	0.8	39.2	4280.6	0.9	50.2	4269.6	1.2	40.7	4279.1	0.9
Olive-sided Flycatcher	90.6	0.0	90.6	0.0	0.0	90.6	0.0	0.0	90.6	0.0	0.0	90.6	0.0	0.0	90.6	0.0	0.0	90.6	0.0	0.0	90.6	0.0	0.0	90.6	0.0
Townsend's Warbler	90.6	0.0	90.6	0.0	0.0	90.6	0.0	0.0	90.6	0.0	0.0	90.6	0.0	0.0	90.6	0.0	0.0	90.6	0.0	0.0	90.6	0.0	0.0	90.6	0.0

[1] RSA-1 would have greater impacts than summarized herein. The substantial modification to the Mendenhall River channel would cause overall impacts for RSA-1 to exceed those of any other alternative.

*Includes acreages disturbed for the reconstruction of the eastern runway slough, which would ultimately minimize impacts to wildlife habitat in the area. Note: the slough reconstruction for RSA-5C would maintain only the hydrologic function of existing sloughs north of the runway and would not maintain the hydrologic connection north and south of the runways as would occur under all other alternatives.

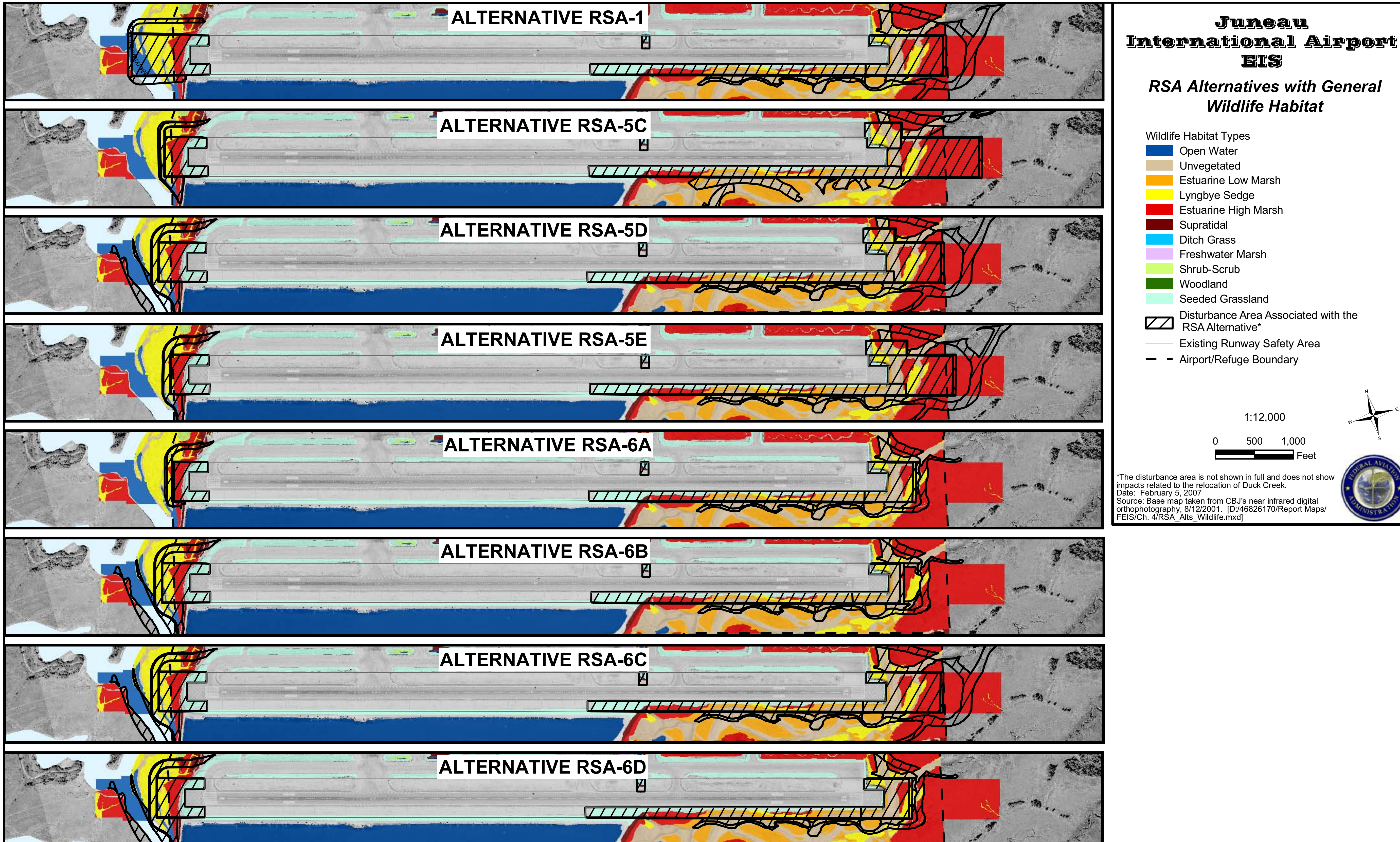

Figure 4-15. General wildlife habitat impacted by the RSA alternatives.

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4.3.10.2 Alternative RSA-5C

Implementation of Alternative RSA-5C would have the fourth greatest overall impact to wildlife habitat behind Alternatives RSA-5D, RSA-1, and RSA-6C. It would have greater impact than Alternatives RSA-5E, RSA-6A, RSA-6B, and RSA-6D. Alternative RSA-5C would have less impact on estuarine low marsh (including Lyngbye sedge) habitat than RSA-1, RSA-5D, and RSA-6C.

RSA-5C would directly affect a total of 49.3 acres of wildlife habitat. Of this total, 37.0 acres would be impacted by construction of the RSA, relocation of associated facilities (e.g., the EVAR/ Dike Trail and Float Plane Pond access road), extension of the taxiway, and relocation of Duck Creek. An additional 12.3 acres would be impacted for construction of a tidal slough to connect the area north of Runway 26 to Sunny Slough to help maintain the hydrologic function of the existing sloughs north of the runway, thereby helping to minimize hydrologic impacts to vegetation communities and wetlands functions and values that comprise wildlife habitat in this area. The tidal slough connection under this alternative would not maintain hydrologic connections for existing sloughs south of the runway.

The majority of impacts in the project area would be to estuarine high marsh habitat, which would be reduced by 17.4 acres (or 17.4%) within the project area. The highest relative impact would occur in the unvegetated and Lyngbye sedge habitats, which would undergo a 41.3% and 30.7% reduction, respectively, within the project area.

At the landscape level, these impacts would account for a 1.8% loss in estuarine high marsh habitat, a 1.5% loss of low marsh habitat (including a 1.3% loss in the coverage of Lyngbye sedge), and a 1.8% loss in area of unvegetated tidelands. Combined impacts to estuarine high and low marsh habitat would comprise a total of 27.6 acres or 1.7% of the total estuarine marsh habitat present within the landscape area. Alternative RSA-5C would cause the second highest overall impacts to estuarine marsh when compared to the other RSA alternatives because of the change in the hydrologic connection of tidal sloughs at the east runway end that would accompany this alternative. It would have greater direct but slightly lesser indirect and overall impact to estuarine high marsh habitat than Alternative RSA-1, which would require substantial modification of the Mendenhall River channel. RSA-5C would have slightly less greater direct but substantially greater indirect and overall impact than RSA-5D and RSA-6C, more substantially greater direct, indirect, and overall impact than Alternatives RSA-5E, RSA-6A, RSA-6B, and RSA-6D.

Similar to the other RSA alternatives, high-interest species with the broadest habitat requirements would undergo the greatest total habitat loss, at 49.3 acres (or 11.6%) of available habitat within the project area. Within the project area, shorebirds would experience the greatest relative loss of habitat, with a 23.9-acre (or 35.6%) reduction. At the landscape level, the greatest relative impact to high-interest species other than black bear and Sitka black-tailed deer would be to shorebirds and songbirds, with a loss of 23.9 (or 1.7%) and 18.0 acres (or 1.4%), respectively, of their existing habitat. This loss would be primarily attributable to the reduction in high marsh habitat under this alternative.

RSA-5C would also have the fourth greatest direct impact on sensitive wildlife species, with more impact than RSA-5E, RSA-6A, RSA-6B, and RSA-6D but less impact than RSA-1, RSA-5D, and RSA-6C. However, RSA-5C would have the second greatest indirect and overall impact because of the loss of hydrologic connectivity between tidal sloughs north and south of the Runway 26 end that would occur as a result of this alternative. Habitat for the Queen Charlotte goshawk and peregrine falcon would be reduced by 18.0 acres and 49.3 acres, respectively. These habitat impacts would equate to a 1.4% reduction in goshawk habitat and a 1.1% reduction in falcon habitat across the landscape area.

Indirect impacts to wildlife habitats under RSA-5C would be more severe than those described for the Runway 26 end in RSA-1. The extension of Taxiway A and the additional 446 linear feet of RSA beyond that required for RSA-1 could prevent even the highest tides from reaching the northeastern portion of JNU property and adjacent Refuge lands. Under RSA-5C, the East Runway Slough channel would be eliminated around the end of the runway, and a new channel would connect this slough to Sunny Slough. Areas formerly tidally flushed by East Runway Slough could begin to transition to supratidal and upland habitats and could experience an associated shift in wildlife species, as Sunny Slough is not likely to be able to supply the same volume of water to these areas as did East Runway Slough and the normal tidal flow.

4.3.10.3 Alternative RSA-5D

Impacts to wildlife habitats associated with RSA-5D would similar to, but slightly greater than, those associated with RSA-1. Overall, implementation of this alternative would replace 52.0 acres (see Table 4-40) of wildlife habitat with unvegetated and largely impermeable upland fill. There would be slightly lesser impact to Lyngbye sedge/low marsh habitat and slightly higher impact to high marsh habitat when compared to RSA-1.

As noted, RSA-5D would directly affect a total of 52.0 acres of wildlife habitat. Of this total, 37.2 acres would be impacted by construction of the RSA, relocation of associated facilities (e.g., the EVAR/Dike Trail and Float Plane Pond access road), extension of the taxiway, relocation of Duck Creek, and modification of the Mendenhall River channel. An additional 14.8 acres would be impacted for reconstruction of the tidal slough at the east end of the runway to maintain the hydrologic connection between existing sloughs north and south of the runway, thereby minimizing impacts to the vegetation and wetland communities that comprise wildlife habitat.

Under RSA-5D, 11.2 acres (33.0%) of estuarine low marsh habitat (including 7.5 acres of Lyngbye sedge) and 18.0 acres (18.0%) of high marsh habitat would be permanently lost from the project area. These impacts would cause reductions of 1.7% and 1.9% of these two habitats, respectively, within the landscape area. Combined impacts to estuarine high and low marsh habitat would comprise a total of 29.2 acres or 1.8% of the total estuarine marsh habitat present within the landscape area.

RSA-5D would also have slightly higher direct impacts on High Interest and Sensitive Species than RSA-1 and RSA-5C in terms of absolute acres impacted. Just as with the other RSA action alternatives, the highest absolute impacts would be to the bald eagle, other raptors, and corvids, which would experience a habitat reduction of 52.0 acres (12.3%) within the project area. Shorebird habitat would undergo the highest relative impact with a reduction of 24.3 acres (or 36.2%) within the project area. At the landscape scale, these impacts translate to 1.2% reduction each for the bald eagle, raptors and corvids, and 1.7% reductions in habitat for shorebirds. Habitats for the Queen Charlotte goshawk and Peregrine falcon would be reduced by 18.7 acres (8.4%) and 52.0 acres (14.5%), respectively, within the project area. At the landscape scale, these impacts would equate to 1.5% and 1.2% reductions in habitat, respectively.

Under RSA-5D, the East Runway Slough channel would be actively reconstructed east of the Runway 26 end to maintain the hydrologic connection between the areas north and south of the RSA. Indirect impacts under this scenario would be similar to those described for RSA-1.

4.3.10.4 ALTERNATIVE RSA-5E

Implementation of Alternative RSA-E, the FAA's preferred RSA alternative, would have the fifth most overall impact to wildlife habitat behind Alternatives RSA-5C, RSA-5D, RSA-1, and RSA-6C. It would have greater overall impact than Alternatives RSA-6A, RSA-6B, and RSA-6D. Alternative RSA-5E would have less impact on estuarine low marsh (including Lyngbye sedge) habitat than all alternatives except RSA-6A.

RSA-5E would directly affect a total of 47.6 acres of wildlife habitat. Of this total, 33.3 acres would be impacted by construction of the RSA, relocation of associated facilities (e.g., the EVAR/ Dike Trail and Float Plane Pond access road), extension of the taxiway, and relocation of Duck Creek. An additional 14.3 acres would be impacted for reconstruction of the tidal slough at the east end of the runway to maintain the hydrologic connection between existing sloughs north and south of the runway, thereby minimizing impacts to the vegetation and wetland communities that comprise wildlife habitat.

The majority of the impacts in the project area would be to estuarine high marsh habitat, which would be reduced by 18.8 acres (or 18.8%) within the project area. The highest relative impact would occur in the unvegetated and Lyngbye sedge habitats, which would undergo a 35.0% and 26.6% reduction, respectively, within the project area.

At the landscape level, these impacts would account for a 2.0% loss in estuarine high marsh habitat, a 1.4% loss of low marsh habitat (including a 1.1% loss in the coverage of Lyngbye sedge), and a 1.5% loss in area of unvegetated tidelands. Combined impacts to estuarine high and low marsh habitat would comprise a total of 27.8 acres or 1.7% of the total estuarine marsh habitat present within the landscape area. Alternative RSA-5E would cause the fifth highest absolute and relative impacts to estuarine marsh when compared to the other RSA alternatives. It would have less absolute and relative impact than Alternatives RSA-1, RSA-5C, RSA-5D and RSA-6C but slightly more than RSA-6B and RSA-6D and quite a bit more than RSA-.

Similar to the other RSA alternatives, high-interest species with the broadest habitat requirements would undergo the greatest total habitat loss, at 47.6 acres (or 11.2%) of available habitat within the project area. Within the project area, shorebirds would experience the greatest relative loss of habitat, with a 20.7-acre (or 30.8%) reduction. At the landscape level, the greatest relative impact to high-interest species other than black bear and Sitka black-tailed deer would be to shorebirds and songbirds, with a loss of 20.7 (or 1.4%) and 19.5 acres (or 1.6%), respectively, of their existing habitat. This loss would be primarily attributable to the reduction in high marsh habitat under this alternative.

RSA-5E would have the fifth greatest direct impact on sensitive wildlife species, with more impact than RSA-6A, RSA-6B, and RSA-6D but less impact than RSA-1, RSA-5C, RSA-5D, and RSA-6C. Habitat for the Queen Charlotte goshawk and peregrine falcon would be reduced by 19.5 acres and 47.6 acres, respectively. These habitat impacts would equate to a 1.5% reduction in goshawk habitat and a 1.1% reduction in falcon habitat across the landscape area. This is comparable to RSA-5D and RSA-6C for goshawk habitat but more than RSA-1, RSA-5C, RSA-6A, RSA-6B, and RSA-6D.

Under RSA-5D, the East Runway Slough channel would be actively reconstructed east of the Runway 26 end to maintain the hydrologic connection between the areas north and south of the RSA. Indirect impacts under this scenario would be similar to, but slightly greater than, those described for RSA-1.

4.3.10.5 Alternative RSA-6A

Implementation of RSA-6A would have the least adverse impact to wildlife habitats of any of the action alternatives. RSA-6A would directly affect a total of 33.4 acres (7.9%) of wildlife habitat in the project area. Of this total, 23.5 acres would be impacted by construction of the RSA with EMAS, relocation of associated facilities (e.g., the EVAR/Dike Trail and Float Plane Pond access road), and relocation of Duck Creek. An additional 9.9 acres would be impacted for reconstruction of the tidal slough at the east end of the runway to maintain the hydrologic connection between existing sloughs north and south of the runway, thereby minimizing impacts to the vegetation and wetland communities that comprise wildlife habitat.

Impacts to wildlife habitat in the project area would result from the replacement of biotic communities with less pervious fill materials. The majority of these impacts would occur to estuarine low marsh habitat, which would be reduced by 8.0 acres (23.6%) (including 4.3 acres of Lyngbye sedge habitat) within the project area. The impact to low marsh under RSA-6A would be lower than under any other action alternative. Alternative RSA-6A would have a smaller impact on unvegetated tidelands and estuarine high marsh than any other alternative.

When viewed at the landscape level, RSA-6A would result in permanent, direct adverse impacts to 1.2% of estuarine low marsh habitat, 145% of unvegetated tidelands, and 0.7% of high marsh habitat. Combined impacts to estuarine high and low marsh habitat would comprise a total of 15.2 acres or 0.9% of the total estuarine marsh habitat present within the landscape area.

Again, the highest absolute impact to high interest species would be to habitat generalists such as the bald eagle, other raptors, and corvids. Habitat for these species would be reduced by 33.4 acres under RSA-6A. This impact would comprise a 7.9% reduction in habitat within the project area and a 0.7% reduction within the landscape area. Within the project area, shorebirds would experience the greatest relative loss of habitat with an 18.9-acre or 28.2% reduction (1.3% at the landscape level). Habitats for the Queen Charlotte goshawk and peregrine falcon would be reduced by 7.7 acres (3.4%) and 33.4 acres (9.4%), respectively, within the project area. At the landscape scale, these impacts would equate to 0.6% and 0.8% reductions in habitat, respectively.

Under Alternative RSA-6A, the hydrologic connection between the areas north and south of the RSA at the Runway 26 end would be maintained by active reconstruction of the East Runway Slough channel around the end of the RSA. Indirect impacts to habitat east of RSA-6A should be negligible by implementing the proposed channel design.

4.3.10.6 Alternative RSA-6B

Impacts to wildlife habitats associated with RSA-6B would very similar to, but slightly greater than, those associated with RSA-6A. RSA-6B would directly affect a total of 39.2 acres of wildlife habitat through the replacement of this habitat with unvegetated and largely impermeable upland fill. Of this total, 28.4 acres would be impacted by construction of the RSA with EMAS, relocation of associated facilities (e.g., the EVAR/Dike Trail and Float Plane Pond access road), relocation of Duck Creek, and modification of the Mendenhall River channel. An additional 10.4 acres would be impacted for reconstruction of the tidal slough at the east end of the runway to maintain the hydrologic connection between existing sloughs north and south of the runway, thereby minimizing impacts to the vegetation and wetland communities that comprise wildlife habitat.

Because the RSA would be shifted westward under RSA-6B, there would be slightly greater impact to Lyngbye sedge/low marsh habitat and slightly greater impact to high marsh habitat when compared to RSA-6A. Under RSA-6B, 9.5 acres (28.0%) of estuarine low marsh habitat (including 5.8 acres of Lyngbye sedge) and 8.4 acres (8.4%) of high marsh habitat would be permanently lost from the project area. These impacts would cause reductions of 1.4% and 0.9% of these two habitats, respectively, within the landscape area. Combined impacts to estuarine high and low marsh habitat would comprise a total of 17.9 acres or 1.1% of the total estuarine marsh habitat present within the landscape area.

RSA-6B would also have slightly higher impacts on High Interest and Sensitive Species than RSA-6A. Just as with the other RSA action alternatives, the highest absolute impacts would be to the bald eagle, other raptors, and corvids, which would experience a habitat reduction of 39.2 acres (9.2%) within the project area. Shorebird habitat would undergo the highest relative impact with a reduction of 21.3 acres (or 31.7%) within the project area. At the landscape scale, these impacts translate to 0.9% reduction each for the bald eagle, raptors and corvids, and 1.5% reductions in habitat for shorebirds. Habitats for the Queen Charlotte goshawk and Peregrine falcon would be reduced by 9.1 acres (4.1%) and 39.2 acres (11.0%), respectively, within the project area. At the landscape scale, these impacts would equate to 0.7% and 0.9% reductions in habitat, respectively.

Under RSA-6B, the East Runway Slough channel would be actively reconstructed east of the Runway 26 end to maintain the hydrologic connection between the areas north and south of the RSA. Indirect impacts under this scenario would be similar to those described for RSA-6A.

4.3.10.7 ALTERNATIVE RSA-6C

Implementation of Alternative RSA-6C would entail greater impacts to wildlife habitat than RSA-5C, RSA-5E, RSA-6A, RSA-6B, and RSA-6D but it would have lesser impacts than RSA-1 and RSA-5D. RSA-6C would directly affect a total of 42.6 acres of wildlife habitat. Of this total, 35.4 acres would be impacted by construction of the RSA, relocation of associated facilities (e.g., the EVAR/Dike Trail and Float Plane Pond access road), relocation of Duck Creek, and modification of the Mendenhall River channel. An additional 14.8 acres would be impacted for reconstruction of the tidal slough at the east end of the runway to maintain the hydrologic connection between existing sloughs north and south of the runway, thereby minimizing impacts to the vegetation and wetland communities that comprise wildlife habitat.

Estuarine low and high marsh habitats would experience the greatest reductions under this alternative with 10.7 acres (or 31.6%) of low marsh (including 7.0 acres of Lyngbye sedge) and 17.8 acres (or 17.8%) of high marsh habitat lost to development. Within the landscape area, these impacts would translate to 1.6% and 1.8% reductions in estuarine low and high marsh habitats, respectively. Combined impacts to estuarine high and low marsh habitat would comprise a total of 28.5 or 1.8% of the total estuarine marsh habitat present within the landscape area.

The degree of direct impacts to high interest and sensitive species habitats associated with RSA-6C reflects its design incorporating both EMAS and RSA. Direct and indirect effects on habitat from installation of the EMAS on the west Runway 08 end and surrounding areas would be as those for Alternatives RSA-5D, RSA-6B, and RSA-6D. They would be greater than those described for RSA-6A. The direct and indirect impacts to wildlife habitat caused by installation of standard RSA on east Runway 26 end and surrounding areas would be as described for Alternatives RSA-1 and RSA-5D.

4.3.10.8 ALTERNATIVE RSA-6D

The impacts to wildlife habitat under Alternative RSA-6D would be nearly identical to those described for RSA-6B. The only difference would be a very slight decrease in impacts to the unvegetated tidal, and a very slight increase in impacts to the esturaine low marsh, and estuarine high marsh habitats under RSA-6D. Indirect impacts at the Runway 08 end would be the same as those for RSA-5D, RSA-6B, and RSA-6C. Indirect impacts at the Runway 26 end would be the same as those for RSA-6A.

RSA-6D would directly affect a total of 33.1 acres of wildlife habitat. Of this total, 23.2 acres would be impacted by construction of the RSA, relocation of associated facilities (e.g., the EVAR/Dike Trail and Float Plane Pond access road), extension of the taxiway, relocation of Duck Creek, and modification of the Mendenhall River channel. An additional 9.9 acres would be impacted for reconstruction of the tidal slough at the east end of the runway to maintain the hydrologic connection between existing sloughs north and south of the runway, thereby minimizing impacts to the vegetation and wetland communities that comprise wildlife habitat.

4.3.10.9 ALTERNATIVE RSA-8

There would be no impact to wildlife or wildlife habitats associated with expansion of the RSA under this alternative. Impacts associated with other Proposed Actions at the Airport are evaluated in separate sections of this EIS.

4.3.11 CULTURAL RESOURCES

Based on the results of a cultural resources survey and search of cultural resources records, no known historic properties would be affected by any of the RSA alternatives.

However, each action alternative would result in ground disturbance in areas with equal potential to contain historic properties, including intertidal areas (all alternatives) and along the edge of the Mendenhall River (RSA-1, RSA-5D, RSA-6B, RSA-6C, and RSA-6D). Such disturbance may uncover as-yet unknown subsurface cultural resources. RSA-8 is the only alternative with no potential to uncover as-yet unknown historic properties.

4.3.12 VISUAL RESOURCES

All of the RSA alternatives were analyzed from two viewpoints. The west Runway 08 end RSA extension was analyzed from the point of view of the Mendenhall Golf Course Clubhouse, and the east Runway 26 end RSA extension was analyzed from the end of Sunny Drive, east of Miller-Honsinger Pond. There would be long-term, negative visual impacts to the existing color, form, and texture of the landscape resulting from all alternatives except the No Action, RSA-8. Impacts from the RSA Action alternatives would range from minor to major.

4.3.12.1 ALTERNATIVE RSA-1

Alternative RSA-1 would alter the physical setting and visual quality of the landscape and introduce new visual elements into the existing landscape. This alternative would create a major change in the visual character of the landscape in the vicinity of the Mendenhall River. Visual impacts from the expanded RSA would be somewhat moderated because of the screening effect of 1) trees on the west side of the river and east of the golf course, and 2) a grove of trees that arc along the shoreline of a small bay that lies directly across the Mendenhall River from the Airport. Visual impacts would also be moderated because of the relatively low profile of the runway extension.

The proposed grading and filling of the Mendenhall River would produce major, short-term, construction-related changes in the middleground. These changes would consist of color and texture contrasts inherent in fresh fill, the creation of construction access roads, the removal of vegetation during construction, changes in the river's course, and the presence of equipment such as graders, bulldozers, and other heavy equipment that would detract from the visual quality of the landscape. The long-term affects of this alternative would be to create a major, permanent change in the local landscape consisting of new, man-made visual elements in the vicinity of the Mendenhall River. The most visible components of the change would be the redirection of the Mendenhall River around the runway extension and the raised fill of the RSA. The RSA would create an extension of the unnaturally linear, uniformly textured and colored surface within the Refuge's natural estuarine and riverine setting.

RSA expansion on the east Runway 26 end would create a moderate change in the visual character of the existing, natural landscape. These changes would consist of line, color, texture, and form contrasts inherent in the filled expansion of the RSA. Filling and grading of the estuarine wetlands adjacent to the Refuge would not create major visual changes to the landscape because of the screening effect of the raised margins of Miller-Honsinger Pond, the trees and vegetation around the pond, and the low profile of the runway extension.

The proposed grading and filling of the estuarine wetlands would produce short-term, construction-related changes in the viewscape. These changes would consist of color and texture contrasts inherent in construction materials, activity, and equipment that would detract from the visual quality of the landscape. The long-term affects of this alternative would be a permanent change in the landscape, consisting of new, man-made visual elements in the vicinity of estuarine wetlands south of Miller-Honsinger Pond. The RSA would create an unnaturally linear, uniformly textured and colored surface within a natural estuarine setting.

4.3.12.2 Alternative RSA-5C

Alternative RSA-5C would alter the physical setting and visual quality of the landscape at the west Runway 08 end and introduce new long-term visual elements and contrasts into the middle-ground landscape. These changes would be slightly less severe than those described for Alternative RSA-6B, because of the smaller westward expansion of the RSA under Alternative RSA-5C. Short-term disturbances to visual quality would be caused by RSA expansion and from construction equipment and construction-related activities during the relocation of the Float Plane Pond access road, Dike Trail, and Duck Creek channel.

The expansion of Runway 26 to the east, and consequent expansion of the RSA into the Refuge, would produce similar changes in visual quality as described under RSA-1, but of greater magnitude and consequence. This is because the linear extent of the new form would be increased approximately 446 feet further eastward than for Alternative RSA-1. The changes in texture, color, and form would extend into the Refuge and contrast with the natural setting of the Refuge. In addition, there would be greater visibility of the RSA from both Sunny Drive and Egan Drive.

4.3.12.3 Alternative RSA-5D

This alternative would produce changes in visual quality for the east Runway 26 end that are identical to those described for Alternative RSA-1. Construction of a traditional fill RSA on the west Runway 08 end would have similar visual quality impacts as described for Alternative RSA-6A, but to a greater degree as more habitat and areas adjacent to the Mendenhall River, as well as the Mendenhall River itself, would be disturbed. This disturbance would produce long-term moderate, unnatural changes in line, texture, and color in the area between the existing end of Runway 08 and the area just west of the Mendenhall River, caused by construction of the RSA, relocation of the Float Plane Pond access road and EVAR/Dike Trail, and realignment of portions of the west bank of the Mendenhall River west of the runway. Short-term disturbances would be similar to, but of lesser magnitude, those described for Alternative RSA-5C.

4.3.12.4 Alternative RSA-5E

Alternative RSA-5E, the FAA's preferred RSA alternative, would have visual impacts for the Runway 26 end that are intermediate between those described for RSA-5C and RSA-5D given that the length of the new RSA would be slightly longer than RSA-5D and slightly shorter than RSA-5C. Visual impacts for the Runway 08 end would be similar to those described for RSA-5C but less than those described for RSA-5D, RSA-6B, RSA-6C, and RSA-6D, all of which would require modification of the Mendenhall River channel.

4.3.12.5 Alternative RSA-6A

Alternative RSA-6A would alter the physical setting and visual quality of the landscape and introduce new visual elements into the existing landscape, but these changes would be minor. The placement of EMAS on the east and west runway ends would create a long-term change in the visual character of the existing, natural landscape. These changes would consist of line, color, texture, and form contrasts inherent in the expansion of the RSA. Filling and grading of the estuarine wetlands adjacent to the Refuge would not create major visual changes to the landscape because of the screening effect of the raised margins of Miller-Honsinger Pond, the trees and vegetation around the pond, and the low profile of the runway extension. The proposed grading and filling of the estuarine wetlands for the placement of EMAS would produce short-term, construction-related changes in the viewscape similar to those described for Alternative RSA-1. The long-term affects of this alternative on the Refuge would be similar to those described for Alternative RSA-1, but to a lesser and minor degree. There would be no affect on the visual character of the Mendenhall River. The changes to habitat adjacent to the west Runway 08 end would cause only minor visual impacts when viewed from the Clubhouse. The short-term impacts would be similar to those described for Alternative RSA-5C. The relocation of the Float Plane Pond road and trail would produce short-term construction-related impacts on visual quality, but the long-term impacts would be negligible because of the low level of disturbance caused by this activity.

4.3.12.6 Alternative RSA-6B

This alternative would produce changes in visual quality for the east Runway 26 end similar to those described for Alternative RSA-6A, but to a lesser degree, as the smaller disturbance footprint for EMAS would be less visible when viewed from Sunny Drive than those created under Alternative RSA-6A. Installation of EMAS on the west Runway 08 end would have similar visual quality impacts as described for Alternative RSA-5D, with the only difference being the use of EMAS under Alternative RSA-6B and the use of traditional fill under Alternative RSA-5D. This disturbance would produce long-term moderate, unnatural changes in line, texture, and color in the area between the existing end of Runway 08 and the area just west of the Mendenhall River, caused by construction of the RSA with EMAS, relocation of the Float Plane Pond access road and EVAR/Dike Trail, and realignment of portions of the Mendenhall River west of the runway. Short-term disturbances would be similar to, but of lesser magnitude, those described for Alternative RSA-5C.

4.3.12.7 Alternative RSA-6C

This alternative would produce changes in visual quality for the west Runway 08 end exactly as those described for Alternative RSA-6B. Changes to the visual landscape on the east Runway 26 end would be the same as described for Alternative RSA-1.

4.3.12.8 Alternative RSA-6D

This alternative would produce changes in the visual quality for the west Runway 08 end exactly as those described for Alternative RSA-5D. Changes to the visual landscape on the east Runway 26 end would be similar to those described for Alternative RSA-6A, with the exception being the use of EMAS under Alternative RSA-6A and the use of full-strength pavement under Alternative RSA-6D. Should the option be exercised to install EMAS on this RSA footprint in the future, this alternative would have identical visual impacts to Alternative RSA-6B for the west Runway 08 end and nearly identical visual impacts to Alternative RSA-6A for the east Runway 26 end.

4.3.12.9 Alternative RSA-8

The No Action Alternative RSA-8 would produce no change in visual character or quality.

4.3.13 Department of Transportation Section 4(f) Lands

Impacts to DOT Section 4(f) lands can arise from direct (acquisition or use of such land) or adverse indirect (termed "constructive use" in this regulatory context when impacts have been determined to result in substantial impairment to the 4(f) property) impacts. Based on the analysis of environmental impacts described in other sections, both the Refuge and the Dike Trail could be affected by one or more of the RSA alternatives. Direct impact to these DOT Section 4(f) lands would include:

- RSA-1: Acquisition or use of more than 9.8 acres of Refuge land west of the Airport and 0.01 acres east of the Airport for construction of the RSA and relocation of Duck Creek, use of 4.5 acres of Refuge land east of the Airport for the restoration of hydrologic functions associated with East Runway Slough that would be disrupted by construction of the RSA, large-scale relocation of the Mendenhall River on Refuge property; and relocation of the Dike Trail to Refuge property.
- RSA-5C: Acquisition or use of 5.8 acres of Refuge land east of the Airport and 3.2 acres west of the Airport for construction of the RSA and relocation of Duck Creek, use of 2.1 acres of Refuge land east of the Airport for active construction of a channel connecting the area northeast of the runway with Sunny Slough to minimize hydrologic impacts from construction of the RSA, and relocation of the Dike Trail to Refuge property.

- RSA-5D: Acquisition of 8.1 acres of Refuge land west of the Airport and 0.01 acres east of the Airport for construction of the RSA and relocation of Duck Creek, use of 4.5 acres of Refuge land east of the Airport for the restoration of hydrologic functions associated with East Runway Slough that would be disrupted by construction of the RSA, and relocation of the Dike Trail to Refuge property.
- RSA-5E (FAA's preferred RSA alternative): Acquisition of 2.7 acres of Refuge land west of the Airport and 1.4 acres east of the Airport for construction of the RSA and relocation of Duck Creek, use of 5.0 acres of Refuge land east of the Airport for the restoration of hydrologic functions associated with East Runway Slough that would be disrupted by construction of the RSA, and relocation of the Dike Trail to Refuge property.
- RSA-6A: Acquisition or use of 1.9 acres of Refuge land west of the Airport for construction of the RSA and relocation of Duck Creek, use of 0.2 acres of Refuge land east of the Airport for the restoration of hydrologic functions associated with East Runway Slough that would be disrupted by construction of the RSA, and relocation of the Dike Trail to Refuge property.
- RSA-6B: Acquisition or use of 8.1 acres of Refuge land west of the Airport for construction of the RSA and relocation of Duck Creek, use of 0.2 acres of Refuge land east of the Airport for the restoration of hydrologic functions associated with East Runway Slough that would be disrupted by construction of the RSA, and relocation of the Dike Trail to Refuge property.
- RSA-6C: Acquisition or use of 8.1 acres of Refuge land west of the Airport and 0.01 acres east of the Airport for construction of the RSA and relocation of Duck Creek, use of 4.5 acres of Refuge land east of the Airport for the restoration of hydrologic functions associated with East Runway Slough that would be disrupted by construction of the RSA, and relocation of the Dike Trail to Refuge property.
- RSA-6D: Acquisition of 8.1 acres of Refuge land west of the Airport for construction of the RSA and relocation of Duck Creek, use of 0.2 acres of Refuge land east of the Airport for the restoration of hydrologic functions associated with East Runway Slough that would be disrupted by construction of the RSA, and relocation of the Dike Trail to Refuge property.

Indirect impacts could include an increase of aircraft noise to the Refuge and Dike Trail. As explained in Sections 4.3.1 and 4.3.2, there would be no significant noise impacts caused by RSA alternatives that would be incompatible with the land uses on the Refuge as defined by the FAA 40 CFR Part 150, Table A), nor would there be adverse changes in air quality resulting from any of the RSA alternatives that would indirectly affect the Refuge or Dike Trail.

Another type of indirect impact may include changes to hydrologic systems. Indirect impacts that were identified include hydrologic modifications to Duck Creek, Jordan Creek, and tidal sloughs, with resultant effects on the designated or established uses of the Refuge, including EFH (see Section 4.3.9). To determine if these indirect effects would constitute a constructive use, FHWA guidance[7] was consulted which defines a constructive use as that which "can occur when the capability to perform any of the site's vital functions is substantially impaired by the proximity impacts

7. *FHWA Section 4(f) Policy Paper*, FHWA, Revised June 1989. See answer to Question 1A.

from a transportation project. Such substantial impairment would occur when the proximity impacts to Section 4(f) lands are sufficiently serious that the value of the site in terms of its prior significance and enjoyment are substantially reduced or lost."

The vital functions of the Refuge include those designated uses that are consistent with the management goals of the Refuge Management Plan including to manage the Refuge to maintain and enhance 1) fish and wildlife populations and their habitat, and 2) public use of fish, wildlife, and Refuge lands. In considering whether these indirect effects constitute a constructive use for a specific alternative, therefore, it was necessary to ascertain if the impairment would be sufficiently serious that one or more of these designated uses would be substantially reduced or lost.

As noted previously, impacts to Section 4(f) resources from RSA alternatives, and the selection of an alternative relative to those impacts, must also be considered in light of the December 2006 NTSB legislation, which states (Public Law 109-433, Section 10):

a. Safety Area Alternatives.--With regard to an environmental review of a project to improve runway safety areas on Runway 8/26 at Juneau International Airport, the Secretary of Transportation may only select as the preferred alternative the least expensive runway safety area alternative that meets the standards of the Federal Aviation Administration and that maintains the length of the runway as of the date of enactment of this Act.

b. Costs to Be Considered.--In determining what is the least expensive runway safety area for purposes of subsection (a), the Secretary shall consider, at a minimum, the initial development costs and life cycle costs of the project.

c. Satisfaction of Requirement.--With respect to the project described in subsection (a), the requirements of section 303(c)(1) of title 49, United States Code, shall be considered to be satisfied by the selection of the least expensive safety area alternative.

4.3.13.1 ALTERNATIVE RSA-1

To complete the west Runway 08 and Runway 26 end RSAs more than 9.8 acres of Refuge land, or greater than 0.26% of the Refuge, would be acquired or used, and the Mendenhall River would be relocated on Refuge property. This alternative would relocate the Mendenhall River approximately 1,000 feet west around the end of the RSA and shorten the channel by approximately 2,200 feet. Channel shortening would increase channel slope and cause other hydrologic changes such as reduced friction, and increase the potential for more bed and bank erosion. It would also require relocation of Duck Creek (already being considered for other development purposes and wildlife hazard management) and the Dike Trail. An additional 4.5 acres (0.12%) of Refuge property east of the Airport would be used for the active reconstruction of the slough channel to re-establish the East Runway Slough connection north and south of the runway at the Runway 26 end following construction of the RSA. The reconstruction of this channel would minimize impacts of the alternative on the Refuge property such that the key functions and values of the Refuge would be negligibly impacted.

Relocation of Duck Creek would be considered a beneficial impact of this action, as the new stream channel should improve water quality, and provide better habitat and other functions such as fish passage. Relocation of the Dike Trail is not considered an adverse impact, but also a direct, beneficial impact due to its positioning within the Refuge and separation from possible conflicts with Airport activity. However, acquisition or use of Refuge land west of the Airport, and relocation of the Mendenhall River, would constitute a DOT Section 4(f) direct impact.

Changes to hydrology on and near the Refuge would affect its established uses. These hydrologic changes, described in Section 4.3.6, would indirectly affect EFH and other habitat, hydrologic function, floodplain storage and other values and established uses of the Refuge. For example:

- Filling East Runway Slough would physically separate the tidal areas north of the runway from their major source of recharge. Given the marshplain topography, it is likely that this area would still be inundated by tides via Sunny Slough from the Gastineau Channel or through the new channel that would be constructed in the low elevation area at the east end of the RSA. Flows through Sunny Slough and any new constructed channel would be largely unchanged in the short term as the constructed channel would be designed to accommodate the same flow as is experienced in this area today. It is likely that the resulting channel system would be less complex – have less tidal channel – than the existing system. This means there would be less widespread distribution of tidal recharge and flushing in some areas.
- Extension of the lateral RSA and Runway 26 RSA would reduce floodplain storage/tidal prism volumes in the vicinity of Jordan Creek and East Runway Slough. With decreased tidal flow, nutrient and sediment exchange during daily high tides would also decrease. This change would also cause other channels to decrease in size, thereby affecting EFH.
- Relocation of the Mendenhall River (a direct impact or taking of the DOT Section 4(f) land) would also indirectly affect other areas of the Refuge, due to the major shift in river channel, conversion of habitat types, loss of flood storage, and increased bed and bank erosion.
- The relocation of the Duck Creek channel would directly alter the hydrologic function of Refuge areas immediately west of the runway and east of the Mendenhall River channel, and, thus, would indirectly affect the established uses of the Refuge. Discharge of Duck Creek into the area west of the runway would be eliminated and would contribute to changes in habitat type in this area. Only a small area of the Refuge would actually be directly impacted for the construction of the new channel outlet at the Mendenhall River.

The hydrologic changes to the Refuge east, south, and even north of the Airport, caused by placement of the fills for lateral and Runway 26 end RSAs, would indirectly affect the Refuge established uses. These impacts would be greatest immediately after construction while the tidal sloughs adjust, and severity of the impact would lessen through time as the hydrology equilibrates. However, it is likely that the new system would have a decreased function as EFH or habitat for other wildlife species.

The relocation of the Mendenhall River channel would indirectly affect other areas of the Refuge, to the west of the current channel. These changes would extend upstream and downstream. The length of channel habitat available would be decreased, thereby decreasing function as EFH or habitat for other wildlife species.

These changes to specific areas of the Refuge immediately adjacent to and near the Airport would have adverse, indirect effects on habitat, hydrology, EFH, and wetlands, including Refuge resources. However, the test for constructive use impairment is high, as described in Section 4.3.13, and this alternative would not substantially reduce or eliminate the ability to maintain and enhance fish and wildlife populations on the Refuge, or to maintain and enhance public use of the Refuge. As a result, there would be no constructive use impacts from this alternative to a DOT Section 4(f) land.

4.3.13.2 Alternative RSA-5C

Alternative RSA-5C would encroach approximately 178 feet into the Refuge west of the Airport, off the end of Runway 08, and approximately 490 feet into the Refuge east of the Airport, off the end of Runway 26. To construct this alternative would necessitate acquisition or use of approximately 9.0 acres of the Refuge, resulting in a direct impact on DOT Section 4(f) land, but representing approximately 0.24% of the Refuge. The relocation of the Dike Trail as part of this alternative would be a beneficial impact to recreation, as noted for Alternative RSA-1 in Section 4.3.13.1. An additional 2.1 acres of Refuge property east of the Airport would be used for the active reconstruction of the slough channel to connect the area northeast of the runway with Sunny Slough as a means of minimizing impacts on tidal influence in this area following construction of the RSA.

As is discussed in Section 4.3.1.2, approximately 16.8 acres of Refuge land located off the immediate end of Runway 26 would be expected to experience a 1.5 DNL or greater increase in aircraft noise exposure in 2015. This noise impact would occur within Refuge lands already exposed to 60 DNL and greater aircraft noise levels. FAA's land use compatibility guidelines (40 CFR Part 150, Table A) for compatible uses of parks and refuges indicate that such lands are compatible with aircraft noise exposure up to 75 DNL. Based on FAA guidance, the noise increase would not be significant, as the project-related increase would not result in noise exposure above 75 dB DNL and therefore noise levels would still be compatible with use of the Refuge land. Therefore, noise from Alternative RSA-5C would not constitute a constructive use impact.

Changes to tidal and creek channel flows south, east, and west of the runway would indirectly affect the Refuge and its established uses. These hydrologic changes, described in Section 4.3.6, would indirectly affect EFH and other values and established uses of the Refuge, summarized as follows:

- Filling East Runway Slough and connecting the existing slough channel north of the runway to Sunny Slough would physically separate the tidal areas north of the runway from their major source of recharge. Given the marshplain topography, it is possible that this area would still be inundated by tides accessing the area via Sunny Slough from the Gastineau Channel. Flows through Sunny Slough and any new channel that naturally developed over time would be limited in the short term until channel dimensions adjusted to accommodate a larger flow. It is likely that the resulting channel system would be less complex – have less tidal channel – than the existing system.

- Extension of the lateral RSA and Runway 26 RSA would reduce floodplain storage/tidal prism volumes in the vicinity of Jordan Creek and East Runway Slough. With decreased tidal flow, nutrient and sediment exchange during daily high tides would also decrease, causing similar reductions in other, smaller tidal channels on both the Airport and the Refuge, and affecting EFH. Because of the modification of East Runway Slough to connect to Sunny Slough , it is doubtful that a permanent hydrologic connection between Jordan Creek and these tidal channels would be maintained.
- The relocation of the Duck Creek channel would indirectly alter the hydrologic function of Refuge areas immediately west of the runway and east of the Mendenhall River channel, and, thus, would indirectly affect the established uses of the Refuge. Discharge of Duck Creek into the area west of the runway would be eliminated and would contribute to changes in habitat type in this area. Only a small area of the Refuge would actually be directly impacted for the construction of the new channel outlet at the Mendenhall River.

As with Alternative RSA-1, these changes to specific areas of the Refuge immediately adjacent to and near the Airport would have adverse, indirect effects on habitat, hydrology, EFH, and wetlands, including Refuge resources. However, Alternative RSA-5C would not substantially reduce or eliminate the ability to maintain and enhance fish and wildlife populations on the Refuge, or to maintain and enhance public use of the Refuge. As a result, there would be no constructive use impacts from this alternative to a DOT Section 4(f) land.

DOT Section 4(f) land impacts would result from RSA-5C due to the direct impacts by taking of Refuge land.

4.3.13.3 Alternative RSA-5D

Alternative RSA-5D would encroach approximately 258 feet into the Refuge west of the Airport, resulting in a direct impact on approximately 8.1 acres of DOT Section 4(f) land, representing approximately 0.21% of the Refuge. East of the Airport, Alternative RSA-5D would encroach approximately 10 feet into the Refuge for the RSA, resulting in a total of 0.01 acres of direct impacts. This represents 0.0003% of the Refuge. As with other alternatives, the Dike Trail would be relocated, but this should be a beneficial impact to the DOT Section 4(f) land and recreation. An additional 4.5 acres of Refuge property east of the Airport would be used for the active reconstruction of the slough channel to re-establish the East Runway Slough connection north and south of the runway at the Runway 26 end following construction of the RSA. The reconstruction of this channel would minimize impacts of the alternative on the Refuge property such that the key functions and values of the Refuge would be negligibly impacted.

As is noted in Table 4-9, a 1.5 DNL increase (from 71.0 DNL with the No Action to 72.5 DNL with this alternative) would occur at one point within the Refuge east of the Airport. The resultant noise level is compatible with Refuge functions as defined by the FAA guidelines for noise thresholds for such properties.

Recreational use of the Dike Trail would only be affected during construction, and the overall impact to this DOT Section 4(f) recreational land would be beneficial, for the reasons noted in Section 4.3.13.1.

Changes to tidal, creek, and river channel flows south, east, and west of the runway would indirectly affect the Refuge and its established uses. These hydrologic changes, described in Section 4.3.6, would indirectly affect EFH and other values and established uses of the Refuge, summarized as follows:

- Filling East Runway Slough and reconstructing a slough channel around the east end of the runway would maintain the tidal connection of areas north of the runway with their major source of recharge. Flows through Sunny Slough and the newly constructed slough channel would be largely unchanged in the short term, as the constructed channel dimensions would be designed to accommodate the same flow as is currently present. It is likely that the resulting channel system would be less complex – have less tidal channel – than the existing system.
- Extension of the lateral RSA and Runway 26 RSA would reduce floodplain storage/tidal prism volumes in the vicinity of Jordan Creek and East Runway Slough. With decreased tidal flow, nutrient and sediment exchange during daily high tides would also decrease, causing similar reductions in other, smaller tidal channels on both the Airport and the Refuge, and affecting EFH. Because of the reconstruction of a slough channel around the east end of the runway, a permanent hydrologic connection between Jordan Creek and these tidal channels would be maintained.
- The relocation of the Duck Creek channel would indirectly alter the hydrologic function of Refuge areas immediately west of the runway and east of the Mendenhall River channel, and, thus, would indirectly affect the established uses of the Refuge. Discharge of Duck Creek into the area west of the runway would be eliminated and would contribute to changes in habitat type in this area. Only a small area of the Refuge would actually be directly impacted for the construction of the new channel outlet at the Mendenhall River.
- Modifications to the Mendenhall River channel on the Refuge would indirectly affect other areas of the Refuge, due to the minor shift in small sections of the river channel, conversion of habitat types, minor loss of flood storage, and short-term increased bed and bank erosion. The resultant channel would be designed to maintain existing water flow rates and elevations in both low and high tide conditions.

There would be moderate, indirect effects on Refuge hydrology, habitat, and EFH from this alternative for the reasons described above. RSA-5D would cause the same hydrologic and wetland habitat impacts east of the Airport on Refuge property as Alternatives RSA-1 and RSA-6C and as Alternatives RSA-6B, RSA-6C, and RSA-6D on Refuge property west of the Airport.

This alternative would not result in substantial impairment to Refuge hydrology and other functions and values or the use and function of the Dike Trail. As a result, there would be no constructive use impacts from this alternative to a DOT Section 4(f) land.

Implementation of RSA-5D would result in the second most (tied with RSA-6C) direct impact to the Refuge of the RSA alternatives.

4.3.13.4 ALTERNATIVE RSA-5E

Alternative RSA-5E, the FAA's preferred RSA alternative, would encroach approximately 138 feet into the Refuge west of the Airport, off the end of Runway 08, and approximately 130 feet into the Refuge east of the Airport, off the end of Runway 26. To construct this alternative would necessitate acquisition or use of approximately 4.1 acres of the Refuge, resulting in a direct impact on DOT Section 4(f) land, but representing approximately 0.11% of the Refuge. The relocation of the Dike Trail as part of this alternative would be a beneficial impact to recreation, as noted for Alternative RSA-1 in Section 4.3.13.1. An additional 5.0 acres of Refuge property east of the Airport would be used for the active reconstruction of the slough channel to maintain the hydrologic the connection between the sloughs north and south of the runway and the Gastineau Channel thereby minimizing impacts to wetlands functions, fisheries and wildlife habitat, and nutrient and sediment transport in this area following construction of the RSA. .

As is discussed in Section 4.3.1.4, noise impacts on the Refuge from RSA-5E would be similar to those of RSA-6A for the Runway 08 end and RSA-5C for the Runway 26 end. Approximately 16.8 acres of Refuge land located off the immediate end of Runway 26 would be expected to experience a 1.5 DNL or greater increase in aircraft noise exposure in 2015. This noise impact would occur within Refuge lands already exposed to 60 DNL and greater aircraft noise levels. FAA's land use compatibility guidelines (40 CFR Part 150, Table A) for compatible uses of parks and refuges indicate that such lands are compatible with aircraft noise exposure up to 75 DNL. Based on FAA guidance, the noise increase would not be significant, as the project-related increase would not result in noise exposure above 75 dB DNL and therefore noise levels would still be compatible with use of the Refuge land. Therefore, noise from Alternative RSA-5E would not constitute a constructive use impact.

Changes to tidal and creek channel flows south, east, and west of the runway would indirectly affect the Refuge and its established uses. These hydrologic changes, described in Section 4.3.6, would indirectly affect EFH and other values and established uses of the Refuge, summarized as follows:

- Filling East Runway Slough and reconstructing a slough channel around the east end of the runway would maintain the tidal connection of areas north of the runway with their major source of recharge. Flows through Sunny Slough and the newly constructed slough channel would be largely unchanged in the short term, as the constructed channel dimensions would be designed to accommodate the same flows as is currently present. It is likely that the resulting channel system would be less complex – have less tidal channel – than the existing system.
- Extension of the lateral RSA and Runway 26 RSA would reduce floodplain storage/tidal prism volumes in the vicinity of Jordan Creek and East Runway Slough. With decreased tidal flow, nutrient and sediment exchange during daily high tides would also decrease, causing similar reductions in other, smaller tidal channels on both the Airport and the Refuge, and

affecting EFH. Because of the reconstruction of a slough channel around the east end of the runway, a permanent hydrologic connection between Jordan Creek and these tidal channels would be maintained.

- The relocation of the Duck Creek channel would indirectly alter the hydrologic function of Refuge areas immediately west of the runway and east of the Mendenhall River channel, and, thus, would indirectly affect the established uses of the Refuge. Discharge of Duck Creek into the area west of the runway would be eliminated and would contribute to changes in habitat type in this area. Only a small area of the Refuge would actually be directly impacted for the construction of the new Duck Creek channel outlet at the Mendenhall River.

As with Alternative RSA-1, these changes to specific areas of the Refuge immediately adjacent to and near the Airport would have adverse, indirect effects on habitat, hydrology, EFH, and wetlands, including Refuge resources. However, Alternative RSA-5E would not substantially reduce or eliminate the ability to maintain and enhance fish and wildlife populations on the Refuge, or to maintain and enhance public use of the Refuge. As a result, there would be no constructive use impacts from this alternative to a DOT Section 4(f) land.

DOT Section 4(f) land impacts would result from RSA-5E due to the direct impacts associated with conveyance and use of Refuge land for RSA development. Implementation of RSA-5E would result a moderate amount of direct impact to the Refuge within the range of RSA alternatives.

4.3.13.5 Alternative RSA-6A

Alternative RSA-6A would avoid filling the highly valued estuarine wetland adjacent to the Mendenhall River, but it would still require an encroachment of approximately 130 feet into the Refuge west of the Airport, resulting in a direct impact on approximately 1.9 acres of DOT Section 4(f) land, representing approximately 0.05% of the Refuge. As with other alternatives, the Dike Trail would be relocated, but this should be a beneficial impact to the DOT Section 4(f) land and recreation. An additional 0.2 acres (0.01%) of Refuge property east of the Airport would be used for the active reconstruction of the slough channel to re-establish the East Runway Slough connection north and south of the runway at the Runway 26 end following construction of the RSA. The reconstruction of this channel would minimize impacts of the alternative on the Refuge property such that the key functions and values of the Refuge would be negligibly impacted.

There would be minor, indirect effects on Refuge hydrology, habitat and EFH, relative to other alternatives. As with other RSA alternatives, installation of the lateral RSA would affect floodplain storage/tidal prism volume near Jordan Creek and the sloughs south of the runway. Installation of the EMAS on both runway ends would also affect flood storage, and on the east runway end a result would be a reduction of energy in the hydrologic system and a minor decrease in tidal channel size. The East Runway Slough would be reconstructed along a more easterly alignment around the end of the runway, and the channel would be designed to maintain the current hydrology. It is expected, however, that the Refuge would be affected very little by these changes, with no substantial impairment to function and value. As a result, there would be no constructive use impacts from this alternative to a DOT Section 4(f) land.

4.3.13.6 Alternative RSA-6B

Alternative RSA-6B would encroach approximately 258 feet into the Refuge west of the Airport, resulting in a direct impact on approximately 8.1 acres of DOT Section 4(f) land, representing approximately 0.21% of the Refuge. An additional 0.2 acres of Refuge property east of the Airport would be used for the active reconstruction of the slough channel to re-establish the East Runway Slough connection north and south of the runway at the Runway 26 end following construction of the RSA. The reconstruction of this channel would minimize impacts of the alternative on the Refuge property such that the key functions and values of the Refuge would be negligibly impacted. As with other alternatives, the Dike Trail would be relocated but this should be a beneficial impact to the DOT Section 4(f) land and recreation.

Impacts to Section 4(f) properties for Alternative RSA-6B would be similar to those described for RSA-6A for the area east of the Airport, including the reconstruction of the East Runway Slough channel, and to RSA-5D for the area west of the Airport, including the relocation of Duck Creek and modification to the Mendenhall River channel.

As is noted in Table 4-9, a 20.4 DNL increase (from 76.8 DNL with the No Action to 97.2 DNL with this alternative) would occur at the existing trail point along the runway centerline. It is important to note that this alternative would relocate the trail approximately 410 feet to the west, so impacts would be less at the relocated trail location. Also, existing aircraft noise levels at the Dike Trail have been modeled at 80.7 DNL, well in excess of the land use compatibility guidelines, but exposure has not seemed to hamper use of the trail. Recreational use of the Dike Trail would only be affected during construction, and the overall impact to this DOT Section 4(f) recreational land would be beneficial, for the reasons noted in Section 4.3.13.1.

This alternative would have no substantial impairment to Refuge hydrology and other functions and values. As a result, there would be no constructive use impacts from this alternative to a DOT Section 4(f) land.

4.3.13.7 Alternative RSA-6C

Alternative RSA-6C would have the same impacts to Section 4(f) properties as those described for Alternative RSA-5D. There would be no constructive use impacts from this alternative to a DOT Section 4(f) property.

4.3.13.8 Alternative RSA-6D

Impacts to Section 4(f) resources under Alternative RSA-6D would be identical to those described for RSA-6B, except that there would be a noise increase of 1.5 DNL or greater at one point on the Refuge and one point on the existing Dike Trail alignment as a result of this alternative. The noise increase at the point on the Dike Trail would be 19.6 DNL, resulting in a project level of 96.4 DNL (as compared to 76.8 DNL under the No Action Alternative). The relocation of the Dike Trail further west under Alternative RSA-6D would have the same effect on reducing the impact of this noise increase as is described for Alternative RSA-6B. The point on the Refuge that would experience an increase of 3.2 DNL compared to the No Action Alternative. This would result in a total of 73.6 DNL for this point in contrast to the projected 70.4 DNL under the No Action Alternative. Despite the increase, the projected noise level on the Refuge under Alternative RSA-6D would be less than the 75 DNL threshold for compatibility with the functions and values of refuge properties established by FAA guidance. As such, there would be no constructive use impacts from this alternative to a DOT Section 4(f) land.

4.3.13.9 ALTERNATIVE RSA-8

RSA-8 is the No Action Alternative. It would leave the airfield as it exists today, such that non-standard RSA would be provided. This alternative would not produce direct or constructive use impacts to any DOT Section 4(f) lands.

4.3.13.10 DOT SECTION 4(F) LAND: EVALUATION OF RSA ALTERNATIVES

As is described in the previous sections, several alternatives are expected to result in a DOT Section 4(f) land impact, listed in the following Table 4-44:

Table 4-44. Summary of DOT Section 4(f) Impacts: RSA Alternatives

Alternative	Refuge		Dike Trail	
	Land Acquisition[1]	Constructive Use	Land Acquisition[1]	Constructive Use
RSA-1	Yes	No	Yes	No
RSA-5C	Yes	No	Yes	No
RSA-5D	Yes	No	Yes	No
RSA-5E	Yes	No	Yes	No
RSA-6A	Yes	No	Yes	No
RSA-6B	Yes	No	Yes	No
RSA-6C	Yes	No	Yes	No
RSA-6D	Yes	No	Yes	No
RSA-8 (No Action)	No	No	No	No

[1] Land Acquisition = Land purchase or easement use, direct disturbance of the 4(f) property.
[2] Constructive Use = Occurs when the proximity of the project to the DOT Section 4(f) land substantially impairs the established or designated uses of the DOT Section 4(f) land (refers only to transportation projects).

49 U.S.C. 303 (c) states:

> The Secretary may approve a transportation program or project requiring the use … of publicly owned land of a public park, recreation area, or wildlife and waterfowl refuge of national, State, or local significance, or land of an historic site of national, State, or local significance (as determined by the Federal, State, or local

> officials having jurisdiction over the park, area, refuge, or site) only if (1) there is no prudent and feasible alternative to using that land; and (2) the program or project includes all possible planning to minimize harm to the park, recreation area, wildlife and waterfowl refuge, or historic site resulting from the use.

As Table 4-44 demonstrates, none of the action alternatives avoid direct impacts to the Refuge, although the degree of Refuge land taken varies by alternative. All RSA action alternatives would require relocation of the Dike Trail onto Refuge property, also considered a direct impact on a DOT Section 4(f) land. However, relocation of the trail would be a beneficial impact, because of the separation of recreationists from potential conflicts with Airport activities and improvements to the trail parking facilities.

There are other statutory factors that may be relevant to decisions concerning direct or indirect impacts to DOT Section 4(f) lands near the Airport, particularly concerning the Refuge. The ADF&G's Management Plan for the Refuge states the following with regard to Airport expansion policies:

> Current projected Airport expansion will not involve refuge lands; however, the City and Borough of Juneau may acquire refuge lands for Airport expansion only after the City and Borough of Juneau demonstrates that the following: 1) that there is a significant public need for the expansion which cannot reasonably be met off-refuge or through use of alternative transportation modes and technologies; 2) that the use of refuge lands are avoided or minimized to the maximum extent feasible; 3) that all impacts to the refuge and the refuge resources are fully mitigated through restoration and/or replacement; and 4) that the Airport expansion project will not create a hazardous attraction for waterfowl. (Page 10)

The following sections examine the issues of 1) public need for the proposed project; 2) the compatibility of the action with the use of the DOT Section 4(f) land; 3) other feasible and alternatives relative to the proposed action; and 4) availability of steps for avoiding or minimizing harm to the DOT Section 4(f) land.

1. ***Demonstration of Significant Public Need.*** FAA Order 5200.8 states "The RSA is intended to provide a measure of safety in the event of an aircraft's excursion from the runway by significantly reducing the extent of personal injury and aircraft damage during overruns, undershoots and veer-offs". In evaluating runway safety area alternatives, FAA guidance (FAA Order 5200.8) requires FAA to consider alternatives for meeting the runway safety area standards that are practicable and for documenting reasons where conditions prevent the compliance from being practicable. One of the purposes of this EIS is to examine if FAA compliance with the RSA standards is practicable. Based on the information available to-date, compliance with the RSA standards appears practicable, although each of the alternatives would have some adverse impact on environmental resources.
2. ***Compatibility of Action with the 4(f) Land.*** The Refuge Management Plan notes two primary goals: 1) "Manage the refuge to maintain and enhance fish and wildlife populations and their habitat. Minimize the degradation and loss of habitat values due to habitat fragmentation.

> Recognize cumulative impacts when considering effects of small incremental developments and actions affecting refuge resources," and 2) "Manage the refuge to maintain and enhance public use of fish, wildlife, and refuge lands." Based on these goals, the compatibility of the actions with the Refuge Management Plan and the uses occurring in the Refuge were considered.

For all of the RSA alternatives, the Dike Trail would be relocated from Airport property onto the Refuge. Access to the Refuge via the Dike trail would be maintained. Although the action would entail some relatively minor loss of fish and wildlife habitat, the goal of maintaining public use of Refuge lands would be maintained.

As a result of the December 2006 enactment of Public Law 109-443 (Section 10), as described in Section 4.2.13 of the EIS, only one RSA alternative, the least expensive alternative that meets FAA standards and does not shorten the usable runway length, is available to the FAA for selection as the preferred alternative, and this is Alternative RSA-5E. As such, there are no other RSA alternatives available to the FAA that might reduce impacts to the Refuge any further than those minimization elements incorporated into RSA-5E already do.

RSA-1. This alternative would reduce the size of the Refuge by more than 0.26%. The relocation of the Mendenhall River around the RSA would adversely affect fish and wildlife habitat. Changes to Jordan Creek, Duck Creek, East Runway Slough, and other tidal channels would have indirect, adverse impacts on fish and wildlife habitat in the Refuge.

RSA-5C. This alternative would reduce the size of the Refuge by approximately 0.24%. The relocation of the Float Plane Pond access road and the Dike Trail would adversely affect fish and wildlife habitat, at least temporarily, and substantial changes to tidal hydrology caused by changes to Jordan Creek, East Runway Slough, and other tidal channels would adversely affect fish and wildlife habitat in the Refuge east and north of the Airport.

RSA-5D. This alternative would reduce the size of the Refuge by approximately 0.21%. The modifications to the banks of the Mendenhall River to accommodate construction of the RSA and the relocation of the Float Plane Pond access road and the Dike Trail would adversely affect fish and wildlife habitat, at least temporarily. Changes to Jordan Creek and Duck Creek would have indirect, adverse impacts on fish and wildlife habitat in the Refuge. The reconstruction of East Runway Slough around the end of the runway would have minor, temporary adverse impacts on fish and wildlife habitat.

RSA-5E. This alternative would reduce the size of the Refuge by approximately 0.11%. The relocation of the Float Plane Pond access road and the Dike Trail would adversely affect fish and wildlife habitat, at least temporarily. Changes to Jordan Creek and Duck Creek would have indirect, adverse impacts on fish and wildlife habitat in the Refuge. The reconstruction of East Runway Slough around the end of the runway would have minor, temporary adverse impacts on fish and wildlife habitat. Alternative RSA-5E is considered consistent with the Refuge Management Plan and compatible with the Refuge land uses.

RSA-6A. This alternative would reduce the size of the Refuge by approximately 0.05%, the least amount of direct impact to DOT Section 4(f) land of any of the RSA alternatives. Changes to Duck Creek, Jordan Creek, and tidal channels would have relatively minor adverse impacts on fish and wildlife habitat in the Refuge. Overall, this alternative would have the least amount of impact on Section 4(f) properties.

RSA-6B. This alternative would reduce the size of the Refuge by approximately 0.21%. Impacts to the Refuge west of the Airport would be identical to those described for Alternative RSA-5D, RSA-6C, and RSA-6D.Changes to Jordan Creek, East Runway Slough, and tidal channels would have relatively minor adverse impacts on fish and wildlife habitat in the Refuge, less than Alternatives RSA-1, RSA-5D, and RSA-6C but slightly greater than Alternatives RSA-5E, RSA-6A and RSA-6D.

RSA-6C. This alternative would reduce the size of the Refuge by approximately 0.21%. Impacts to the Refuge west of the Airport would be identical to those described for Alternative RSA-5D, RSA-6B, and RSA-6D. Changes to Jordan Creek, East Runway Slough, and tidal channels would have adverse impacts on fish and wildlife habitat in the Refuge east of the Airport. These impacts would be nearly identical to those described for Alternatives RSA-1 and RSA-5D.

RSA-6D. This alternative would reduce the size of the Refuge by approximately 0.21%. Impacts to the Refuge west of the Airport would be identical to those described for Alternatives RSA-5D, RSA-6B, and RSA-6C. Impacts east of the Airport would be identical to those described for Alternative RSA-6A.

3. ***Prudent and Feasible Alternatives Evaluation.*** Chapter 2 of this document provides an extensive review of the alternatives available. As that chapter states, when evaluating Airport development actions that are based on air travel demand, it is customary to also consider use of other modes of transportation (bus, rail, shipping) and use of other area airports as alternatives to the development at a particular airport. Section 2.1 describes why other modes of transportation or an alternative Airport location are not prudent and feasible alternatives to the need for standard or equivalent RSA. As is also documented in Chapter 2, six of the eight alternatives to achieve compliance with RSA standards were found to be prudent and feasible (Alternatives RSA-1, RSA-5C, RSA-5D, RSA-5E, RSA-6C, and RSA-6D). These alternatives would meet the project purpose and need, and represent a range of social, policy, economic, and environmental tradeoffs for consideration. Alternatives RSA-6A and RSA-6B were found to be feasible, however, FAA has determined that these alternatives, which incorporate EMAS on both runway ends, are not prudent based on cost since these alternatives are approximately 2.5 times the cost of traditional fill RSA alternatives and exceed FAA's $30 million financial feasibility threshold for runway safety area at JNU.

4. ***Measures are available to minimize impacts to the DOT Section 4(f) lands.*** Steps are not available to completely avoid the direct impacts to the Refuge from the RSA alternatives (with the exception of RSA-8, which would not affect the Refuge but also would not meet the purpose and need for additional RSA). Alternatives have been identified that use technology (EMAS) to reduce the environmental and DOT Section 4(f) impacts, but they cannot be completely avoided and still meet the public need and two of those alternatives, RSA-6A and

RSA-6B have been found not to be prudent. Alternative RSA-1 would have the greatest impact on the Refuge in terms of the land required for the RSA; Alternatives RSA-5C, RSA-6B, RSA-6C, and RSA-6D would cause the second greatest adverse, indirect impacts to Refuge resources.

Each of the prudent and feasible alternatives would have a short-term effect on recreational use of the Dike Trail. These impacts could be minimized by constructing the new trail prior to closure of the old trail, so that there would be no interruption of trail use or Refuge access. The overall impact to the Dike Trail from relocation, however, would be beneficial.

There are measures that can be taken to further reduce indirect effects on the Refuge. These measures are more fully described in Section 2.11 of this EIS, but may include:

- Seasonal construction restrictions to reduce impacts on fish during spawning.
- Maintenance of "dry" construction sites to the extent possible, to minimize sediment releases from disturbed sites.
- The use of steep, 0.6:1 supporting slopes on the lateral RSA to reduce the footprint in estuarine wetlands and minimize changes to the tidal channels to the extent possible.
- Complete replacement of the Jordan Creek culvert system with bottomless arch spans and "daylight" windows, to facilitate fish passage up and down stream.
- Relocation of East Runway Slough to maintain hydrologic connectivity between sloughs north and south of the Runway 26 end and minimize potential conversion of vegetation/wetland communities and subsequent impacts to EFH.

4.4 NAVIGATIONAL IMPROVEMENTS

Section 2.7 in Chapter 2 describes the two navigational aid alternatives retained for detailed environmental evaluation. Of these, only one alternative, NAV-2B, would meet the defined Need to improve pilot alignment with the runway. The following sections describe the environmental impacts associated with NAV-2B: installation and operation of a medium-intensity approach light system with runway alignment indicator lights (MALSR) on Runway 26. Where appropriate, reference is made to effects of the No Action Alternative, NAV-3.

Because placement of the MALSR light supports is dependent on the final location of runway arrival thresholds, there are variances in the location of the MALSR for various RSA alternatives that result in runway threshold relocation or displacement. To determine the impact of the MALSR installation it is necessary to consider 5 different scenarios linked to construction of RSA:

- NAV-2B with RSA-1, RSA-6C, RSA-6D, or RSA-8: Installation of the MALSR extending approximately 1,400 feet into the Refuge; associated service road also extended into Refuge.
- NAV-2B with RSA-5C and RSA-5D: Installation of the MALSR extending approximately 1,800 feet into the Refuge; associated service road also extended into Refuge.
- NAV-2B with RSA-6A: Installation of the MALSR extending approximately 1,400 feet into the Refuge; associated service road also extended into Refuge.
- NAV-2B with RSA-6B: Installation of the MALSR extending approximately 1,200 feet into the Refuge; associated service road also extended into Refuge.
- NAV-2B with RSA-5E: Installation of the MALSR extending approximately 1,900 feet into the Refuge; associated service road also extended into the Refuge. This is the FAA's preferred navigational improvements alternative.

4.4.1 NOISE

Table 4-45 summarizes the area predicted to be exposed to 65 DNL and greater noise levels for each navigational aid alternative. As the table indicates, in 2015, there is no difference between the two navigational aid alternatives in area affected by a noise level of 65 DNL and greater. Figures 4-2 through 4-6 show the NAV-2B noise exposure contour with existing thresholds.

Installation of the MALSR would improve visual alignment for approaches to Runway 26, but it would not alter the location or use of the arrival or departure flight tracks. The noise contours and area of noise exposure would be controlled by the Runway 26 threshold location. Therefore, both Table 4-45 and the figures are based on an assumption that the runway threshold would remain unchanged (i.e., for RSA alternatives RSA-1, RSA-6C, or RSA-8). Should a different RSA alternative be implemented, the noise exposure relating to the MALSR would match that specific change in threshold, as was shown earlier in Table 4-7.

Table 4-45. Summary of Aircraft Noise Changes Due to Navigational Aid Alternatives (Year 2015)

Alternative	60-65 DNL	65-70 DNL	70-75 DNL	75+ DNL	65 DNL & Greater[2]
Alternative NAV-2B	2.15	0.66	0.17	0.25	1.08
Alternative NAV-3 (No Action Alternative)	2.15	0.66	0.17	0.25	1.08
Existing (2000) Conditions	2.29	0.82	0.16	0.38	1.35

[1] Area in Square Miles. Exposures are dependent on Runway 26 arrival and departure thresholds, and would apply to RSA alternatives RSA-1, RSA-6C, and RSA-8.
[2] Total may not equal sum of 65-70, 70-75, and 75+ DNL contour intervals as a result of rounding.
Source: BridgeNet International, September 2004.

As noted in the preceding sections, in the year 2015, the total area that would be exposed to 65 DNL and greater noise levels would be 1.08 square miles, extending from approximately 2,970 feet off the west Runway 08 end and approximately 3,465 feet from the east Runway 26 end. The severe noise exposure contour of 75 DNL and greater would affect 0.17 square miles. Therefore, in the future, area affected by 65 DNL and greater noise levels would be reduced from present conditions by approximately 16%, due to the effects of quieter Stage 3 aircraft operations and retirement of Stage 2 aircraft, even with the increased level of aircraft operations projected for the year 2015. The area exposed to severe aircraft noise would decrease from 0.38 square miles, in the year 2000, to 0.17 square miles, in the year 2015–-a 46% reduction over existing conditions.

There would be short-term, intermittent increases of noise during construction of the MALSR access road and support pads, caused by construction equipment. The noise should not be noticeably different from other, normal vehicle and equipment noises on the Airport.

NAV-3 would retain the existing navigational aids at the Airport, such that the MALSR would not be installed. From a noise perspective, this alternative is the same as NAV-2B. Therefore, no differences in noise exposure would occur among the navigational aid alternatives except for the minor, short-term noise associated with construction of the MALSR.

4.4.2 Human Environment and Compatible Land Use

Alternative NAV-2B, the FAA's preferred navigational improvements alternative, would involve permanent and irretrievable taking of Refuge land for installation of the MALSR and a service access road east of the Airport. The magnitude of this change in land use would vary depending on which, if any, RSA alternative was implemented. The MALSR and service road under Alternative RSA-5C would have the least impact, requiring about 0.8 acres of Refuge land east of the Airport. The reason for the lesser impact attributable to the MALSR and road system under this alternative is that more of the lights would be installed on the RSA fill in the Refuge. As such, a shorter access road in the Refuge would be needed. Installation of the MALSR system in conjunction with Alternative RSA-5D would require approximately 1.4 acres of Refuge land east of the Airport. This is greater than all other build alternatives. Alternatives RSA-1 and RSA-6C would require the second least amount of land in the Refuge, using approximately 1.1 acres of land. Alternatives RSA-5E and RSA-6B would both require the use of approximately 1.2 acres of Refuge land, while Alternatives RSA-6A and RSA-6D would require the use of approximately 1.3 acres of Refuge land.

It is important to note, though, that because of the differing RSA configurations, the length of the access road within the Refuge would vary under each alternative. In general, however, Alternative RSA-5C would have the shortest access road in the Refuge, and RSA-5E would have the second shortest. Alternatives RSA-1, RSA-5D, and RSA-6C would have the third shortest access road in the Refuge, and Alternatives RSA-6A, RSA-6B, and RSA-6D would have the longest access roads in the Refuge.

Installation of the MALSR is consistent with the Refuge Management Plan, including those policies authorizing Airport expansion and installation of new permanent structures that are essential navigational aids. The MALSR would also comply with other federal regulations concerning the use of properties such as the Refuge; Section 4.4.13 has more information on this subject. The greatest acreage needed for installation of the MALSR would constitute less than 0.04% of the land currently within Refuge jurisdiction. There would be no changes in populations within noise contours as a result of MALSR installation and use.

The Refuge immediately east of the runway is not heavily used for recreation. However, there would be some indirect adverse impact on the visual aesthetics of the recreational experience as a result of the MALSR installation. Section 4.4.12 has more information on visual impacts.

There would be no impact on the human environment or land use changes associated with the No Action Alternative, NAV-3.

4.4.3 Socioeconomic Impacts

There would be short-term, direct, beneficial impacts from construction of the MALSR. Based on information supplied by FAA and using the IMPLAN model, it is estimated that MALSR construction under all alternatives would generate over $2.0 million in total business income and create 14 temporary, full-time-equivalent jobs with a payroll of over nearly $700,000.

In addition to short-term construction impacts, the economy of Juneau and the surrounding region would indirectly benefit from the improved landing capability at night and in poor visibility conditions. The indirect economic impact of this improvement to aviation operations is difficult to quantify, but as it would result in fewer missed approaches to the runway, it would nonetheless be positive.

Positive social impacts would result from MALSR installation, as the approach lighting system would benefit all night-arrival operations on Runway 26, and assist many operations during low visibility conditions. Improved aviation safety from installation of the MALSR would benefit the community.

There would be no construction impacts with the No Action Alternative. No other economic or social consequences are anticipated from this alternative, as it would maintain existing aviation operations with respect to navigational alignment.

4.4.4 AIR QUALITY

There are no long-term or permanent changes in air quality anticipated due to installation of the MALSR (Alternative NAV-2B), since operational emissions are based on aviation forecasts and are not related to navigational systems. Operational emissions shown on Table 4-46 reflect the same values predicted for most of the RSA alternatives.

Table 4-46. Summary of Airport Operational Air Emissions: Navigational Aid Alternatives

Scenario	CO	NOx	VOC	SOx	$PM_{10}/PM_{2.5}$[3]
Existing (2000)	984.0	60.0	54.6	6.2	0.7
Future (2015)					
NAV-2B (MALSR)	1,154.7	70.6	63.1	7.2	1.5
NAV-3 (No Action)	1,154.7	70.6	63.1	7.2	1.5

[1] Tons per year
[2] Emissions data applicable for RSA alternatives that do not involve changes in thresholds, including RSA-1, RSA-6C, and RSA-8. See Table 4-12.
Source: BridgeNet International, September 2004.
Note: Data reflect emissions associated with aircraft and ground support equipment
[3] $PM_{2.5}$ emissions are estimated based upon guidance issued by the FAA Office of Environment and Energy (AEE) (Ralph Iovinelli, AEE, personal communication 2007).

Construction of the MALSR would cause short-term increases of vehicle emissions, as shown on Table 4-47. In addition to construction-equipment exhaust emissions, a fugitive dust evaluation was prepared assuming a scenario in which the construction site is periodically watered to reduce dust. The evaluation showed that fugitive dust associated with the navigational aid alternatives could range from a low of 0.0 tons per year under the No Action (NAV-3) to a high of 0.9 tons per year under NAV-2B. It was assumed that MALSR construction would be completed in one year.

Table 4-47. Construction-related Emissions (Peak Year): Navigational Aid Alternatives

Project	Tons Per Year Vehicle Exhaust					Fugitive Dust (tons)
	CO	NOx	VOC	SOx	$PM_{10}/PM_{2.5}$[1]	
NAV-2B (MALSR)	2.5	2.7	0.4	0.2	0.4	0.9
NAV-3 (No Action)	NA	NA	NA	NA	NA	NA

Source: Synergy Consultants, October 2004
[1] $PM_{2.5}$ emissions are estimated based upon guidance issued by the FAA Office of Environment and Energy (AEE) (Ralph Iovinelli, AEE, personal communication 2007).

4.4.4.1 ALTERNATIVE NAV-2B

Alternative NAV-2B, the FAA's preferred navigational improvements alternative, would result in the construction of a MALSR off the east, Runway 26 end. The MALSR would improve pilot alignment with the runway end on approach during poor weather and at night, but it would not affect taxi patterns or the time-in-mode of aircraft operations.

Table 4-46 shows the operating emissions predicted for 2015. All criteria pollutant emissions would be expected to increase from the baseline, year 2000 conditions to 2015 due to the anticipated 9% increase in annual aircraft operations over that timeframe and associated aircraft fleet changes. These increases would occur with or without installation of the MALSR.

As shown on Table 4-47, short-term increases of criteria pollutant emissions would be expected during MALSR construction, caused by construction equipment used to build the access road and install light towers and pads. There would also be short-term releases of fugitive dust. It was assumed that construction would take place in dry working conditions, but damp ground would reduce dust emissions.

4.4.4.2 ALTERNATIVE NAV-3

Alternative NAV-3, the No Action Alternative, would retain the existing Airport navigation systems. No construction-related emissions or changes to fugitive dust emissions would be anticipated. As is true for NAV-2B, there would be no change to aircraft taxi patterns or the time-in-mode of aircraft operations. The emissions increases up through the year 2015, shown on Table 4-46, are attributable to the predicted 9% increase in annual aircraft operations over that time frame and associated aircraft fleet changes.

4.4.5 HAZARDOUS MATERIALS AND SOLID WASTE

A search of environmental databases, field reconnaissance, and review of historic aerial photographs suggest a low potential for buried solid or hazardous waste east of Runway 26, where a MALSR and service road would be installed. The dredge piles east and southeast of the runway are man-made, but they reportedly consist only of sediments and silt dredged from the Gastineau Channel. No information was available suggesting that historic, waste-disposal practices used the area to be disturbed for MALSR installation.

Construction of the MALSR pads, service road, and light towers would generate a relatively small and insignificant amount of solid waste that would be disposed of at the local landfill. There would be no change in the types or amounts of hazardous wastes generated at the Airport or hazardous materials consumed by Airport uses. The only opportunities for pollution prevention beyond those design components incorporated into NAV-2B, the FAA's preferred navigational improvements alternative, are best management practices to control stormwater and minimize discharges.

4.4.6 WATER RESOURCES AND FLOODPLAINS

Only one alternative, NAV-2B, would have the potential to affect water resources. This alternative is FAA's preferred navigational improvements alternative. The magnitude of impact to water resources would vary depending on the RSA alternative selected, which would dictate the amount, location, and direction of ground disturbance for the MALSR. The greatest impact beyond the RSA end[8] would occur with Alternative RSA-8, since there would be little runway safety area on which to mount approach lights and most of the MALSR configuration would be in marshplain. Of the action alternatives, the greatest impact would be associated with alternatives RSA-6A and RSA-6B. This is because the undershoot distance with EMAS is less than for a standard construction RSA (600 feet vs. 1000 feet); therefore, a greater number of light pads would be installed in the marshplain. The greatest linear disturbance to the Refuge would occur in conjunction with Alternative RSA-5E. This alternative would extend the MALSR approximately 100 feet further east than Alternative RSA-5C and approximately 550 feet further than any other alternative. However, the greatest overall disturbance to the Refuge for the MALSR system and access road would occur under Alternative RSA-5D. To assess the potential consequences from these alternatives, the following assumptions were made consistent with the design components described for Alternatives NAV-2B in Section 2.7:

- Negligible fill would be placed in the marshplain for the MALSR footings.
- The construction technique proposed for the service road, an at-grade road system, is feasible in terms of construction cost and long-term maintenance requirements.

Installed in coordination with RSA-1or RSA-6C the MALSR and access road would affect approximately 0.7 acre of marshplain. Installation of the MALSR and access road with RSA-5E would disturb the second least amount of marshplain at 0.9 acre. Approximately 1.0 acre of marshplain would be disturbed under RSA-5D, and approximately 1.1 acres would disturbed under RSA-6D. The MALSR and access road would disturb approximately 1.2 acres when installed with RSA-6A, RSA-6B, or RSA-6D. Installation of the MALSR with RSA-5C would affect the least area of marshplain, 0.5 acre. Installation of the MALSR with RSA-8, the No Action Alternative, would impact approximately 1.3 acres of marshplain.

Installation of the bottomless concrete arch culverts, MALSR service road, and lighting equipment would have short-term, adverse impacts on water quality, primarily by increasing sediments and turbidity until soils are stabilized. These effects would be most pronounced during the daily high tides.

The long-term effect of constructing the service road in conjunction with all RSA alternatives except RSA-5C and RSA-5E would be the construction and extension of the road along the dredge islands to parallel the MALSR east of East Runway Slough across the marshplain. The service road would extend out from the dredge islands and run between the MALSR light towers. The service road would be mostly above tidal influence. Only the lower portions nearest East

8. EMAS is included as RSA for the sake of these discussions.

Runway Slough would occasionally be inundated by higher tides. Under RSA-5C and RSA-5E, the MALSR access road would extend directly east from the end of the RSA fill to parallel the MALSR light stations.

Active channel relocation will be used to move the slough for all alternatives. This will promote service road stability.

The construction of a bottomless concrete arch culvert crossing would likely armor the channel banks with non-erodible material. Special attention would need to be paid when sizing this crossing to ensure adequate capacity for the relocated tidal channel.

The footings for the MALSR light towers would displace a negligible volume within the flood-plain/tidal prism, and the control equipment building and pad would also have little consequence to water resources.

4.4.7 VEGETATION

NAV-2B, the FAA's preferred navigational improvements alternative and the only action alternative for navigational aid, would entail road and facility construction, causing both short-term construction impacts and some long-term impacts to vegetation on the Airport property and in the Refuge.

Direct impacts to vegetation under NAV-2B would vary somewhat, depending on the RSA alternative selected. If the MALSR were installed in coordination with RSA-1 or RSA-6C, approximately 1.3 acres of vegetation would be affected. Installation of the MALSR with alternatives RSA-6A or RSA-6D would affect approximately 1.8 acres of vegetation. Installation of the MALSR with alternative RSA-5C would affect approximately 0.8 acres of vegetation, and installation with RSA-6B would affect approximately 1.9 acres of vegetation. When installed with the proposed action, RSA-5E, the MALSR and access road would impact 1.2 acres of vegetation. Installation of the MALSR and access road with RSA-5D would disturb 1.6 acres of vegetation. Installation of the MALSR under RSA-8, the No Action Alternative, would impact approximately 2.1 acres of vegetation. This maximum disturbance with the No Action RSA Alternative is due to the longer access road that would be required to reach the lights.

The majority of these impacts would be to high marsh vegetation, with 1.0 acre of impact to this community under RSA-8 and RSA-6B and 1.1 acres of impact under RSA-6A and RSA-6D. There would be 0.6 acre of impact to high marsh under RSA-1 and RSA-6C, and 0.5 acre under RSA-5C. The MALSR system under RSA-6B and RSA-8 would impact 1.0 acre of high marsh, and under RSA-5D and RSA-5E, it would impact 0.9 acre of high marsh. Within the landscape area, this action would result in no more than a 0.1% reduction in this community type for all alternatives. RSA-6B would impact 0.2 acre of low marsh, less than 0.1% of this vegetation type within the landscape area. No impact to low marsh would occur with installation of the MALSR with any other alternative except RSA-8, which would impact 0.3 acre. The remaining impacts to vegetation with the installation of the MALSR with the various RSA alternatives would primarily be to the supratidal vegetation community, with 0.2 acre of this vegetation type (0.1% within the landscape area) impacted under RSA-5E, 0.3 acre impacted under RSA-5C, and 0.5 acre impacted under RSA-1, RSA-5D, RSA-6A, RSA-6B, RSA-6C, RSA-6D, and RSA-8.

Disturbance to this upland community carries the potential for introducing weed species, such as perennial sowthistle, yellow toadflax, and dandelion, to the interior of the Refuge via construction equipment. If weeds become established in affected areas and are allowed to spread to other uplands within the Refuge, there could be a significant adverse impact on plant communities within the landscape area. In the absence of a control or eradication program, this impact would be permanent. Procedures to prevent noxious weed infestation could include washing of all vehicles prior to entry on undisturbed Airport property or the Refuge, and verification that seed mixes and other organic construction materials are certified weed free.

The areas disturbed by light support pads would experience a permanent, adverse loss of native vegetative community. However, vegetation communities disturbed by the access road would experience only relatively short-term impacts, if exotic weed infestation can be prevented, as the access road design would allow native vegetation to recolonize through the road mesh.

The No Action Alternative, NAV-3, would have no affect on vegetation on Airport property, in the Refuge, or in the landscape area.

4.4.8 Wetlands

Only the action alternative, NAV-2B, would directly and indirectly affect wetlands. This alternative is also the FAA's preferred navigational improvements alternative. The basis for this evaluation is the environmental score, total acreage, and functional units for wetland types in the Eastern RSA in the vicinity of the MALSR alternative, summarized in Table 4-5.

The exact placement of MALSR towers would depend on the RSA alternatives. Installation of the MALSR with alternative RSA-1 or RSA-6C would affect 0.7 acres of estuarine wetlands, 0.5 acre with Alternative RSA-5C, 0.9 acre with RSA-5E, 1.0 acre with Alternative RSA-5D, 1.1 acres with Alternatives RSA-6A and RSA-6D, 1.2 acres with Alternative RSA-6B, and 1.3 acres with the No Action Alternative, RSA-8.

The overall effect of any of the MALSR installation scenarios is minor, particularly when compared to the changes caused by installation of an RSA or EMAS. Therefore, the impacts to wetlands for MALSR installation and use are described at the landscape level. Table 4-48 summarizes landscape-level wetland impacts[9] caused by Alternative NAV-2B.

Short-term impacts would include the temporary loss of key estuarine functions (for all estuarine wetland types) such as:

- Fish habitat;

9. The landscape-level acreages shown in the table incorporate project area wetland impacts.

Table 4-48. Summary of Landscape-level Wetland Impacts by Alternative NAV-2B

Wetland Type	RSA-1			RSA-5C			RSA-5D			RSA-5E			RSA-6A			RSA-6B			RSA-6C			RSA-6D			RSA-8		
	Acres Lost	Acres Left	% Change	Acres Lost	Acres Left	% Change	Acres Lost	Acres Left	% Change	Acres Lost	Acres Left	% Change	Acres Lost	Acres Left	% Change	Acres Lost	Acres Left	% Change	Acres Lost	Acres Left	% Change	Acres Lost	Acres Left	% Change	Acres Lost	Acres Left	% Change
E2EM (H)	0.7	962.6	0.0	0.5	962.8	0.0	1.0	962.3	0.0	0.9	962.4	0.0	1.1	962.2	0.0	1.0	962.3	0.0	0.7	962.6	0.0	1.1	962.2	0.0	1.1	962.3	0.0
E2EM (L)	0.0	669.6	0.0	0.0	669.6	0.0	0.0	669.6	0.0	0.0	662.3	0.0	0.0	669.6	0.0	0.2	669.4	0.0	0.0	669.6	0.0	0.0	669.6	0.0	0.1	669.5	0.0
E2US	0.0	662.3	0.0	0.0	662.3	0.0	0.0	662.3	0.0	0.0	662.3	0.0	0.0	662.3	0.0	0.0	662.3	0.0	0.0	662.3	0.0	0.0	662.3	0.0	0.1	662.2	0.0
Totals*	**0.7**	**4141.0**	**0.0**	**0.5**	**4141.2**	**0.0**	**1.0**	**4140.7**	**0.0**	**0.9**	**4140.8**	**0.0**	**1.1**	**4140.6**	**0.0**	**1.2**	**4140.5**	**0.0**	**0.7**	**4141.0**	**0.0**	**1.1**	**4140.6**	**0.0**	**1.3**	**4140.4**	**0.0**

* Totals and percent change based on the landscape area total wetland acreage.

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- Regional ecological diversity;
- Groundwater discharge;
- Wildlife habitat;
- Sediment and toxicant retention; and
- Riparian support.

However, constructing the MALSR system during seasons when there are not salmon and other fish runs would reduce short-term impacts to fish.

Long-term impacts would include a relatively minor loss of less than 0.05% of the landscape area. Additionally, MALSR installation would be executed with the goal of leaving adjacent wetland functions intact over the long term. MALSR installation and access road construction, in concert with the RSA alternatives, would affect a maximum of 1.3 acres of intertidal and emergent estuarine wetlands. The 14-foot wide access road would be installed at grade to maintain tidal exchange and overland flow, and the small disturbance area would have negligible effects on surface and subsurface hydrology. Thus, only minor indirect effects to wetlands are predicted as a result of Alternative NAV-2B. There would be no substantial impact on hydrology needed to maintain wetland functions and values, and therefore no affect on sustainability of the natural systems that maintain habitat. The MALSR would not be inconsistent with the state wetland strategy because there is no prudent and feasible that would satisfy the need for navigational alignment.

The No Action Alternative, NAV-3, would have no direct or indirect impact on wetland resources.

4.4.9 Fisheries

Installation and operation of the MALSR with Alternative NAV-2B, the FAA's preferred navigational improvements alternative, would likely have insignificant long-term impacts on fish and would be limited to small areas of estuarine habitats. Construction of the MALSR would have no substantial short-term impact; installation of the access road and light towers and pads would occur during low tide, when there is little fish use of the affected area, and construction could take place during seasons when salmon and other species are not spawning.

The amount of EFH permanently lost due to MALSR installation would range from 0.5 acre for RSA-5C and 0.7 acre for RSA-1 and RSA-6C to 1.3 acres for RSA-8 (the disturbance acres described do not include disturbance from RSA installation). Direct EFH reductions would occur mostly in high marsh habitat and generally would not affect open water. Effects to sloughs would be 0.1 acre for RSA-8. No other alternatives would result in impacts to sloughs. Table 4-49 quantifies the habitat types lost due to MALSR installation for each of the RSA alternatives. The long-term losses in EFH would result primarily from the construction and use of the access road and the MALSR light towers and pads. These impacts constitute a less than 0.1% reduction in EFH within the landscape area and, as such, would not be expected to have a substantive impact on fish populations within this area. Exclusionary devices would discourage fish-eating birds from perching on the MALSR towers and minimize any indirect potential for increased predation on fish.

Alternative NAV-3 would have no direct or indirect effects on fish.

Table 4-49. Direct Loss of Essential Fish Habitat (EFH): MALSR/RSA Alternatives

EFH Type	RSA-1	RSA-5C	RSA-5D	RSA-5E	RSA-6A	RSA-6B	RSA-6C	RSA-6D	RSA-8
Open Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Slough	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Low Marsh	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.1
High Marsh	0.7	0.5	1.0	0.9	1.1	1.0	0.7	1.1	1.1
EFH Total	0.7	0.5	1.0	0.9	1.1	1.2	0.7	1.1	1.3

[1] All losses in acres.
Source: RTG Associates and SWCA, Inc. 2006.

4.4.10 WILDLIFE

The installation of the MALSR with Alternative NAV-2B, the FAA's preferred navigational improvements alternative, would have minor effects on wildlife and habitat. Direct impacts to wildlife habitats would range from 0.8 acre to 2.1 acres, depending on the RSA alternative selected (the disturbance acres described do not include disturbance from RSA installation). Installation of the MALSR in conjunction with RSA-1 or RSA-6C would affect 1.3 acres of wildlife habitat (0.6 acre of estuarine high marsh habitat, 0.5 acre of supratidal habitat, and 0.2 acre of woodland habitat). Installation of the MALSR with either RSA-6A or RSA-6D would affect 1.8 acres of wildlife habitat, consisting of 1.1 acre of high marsh, 0.5 acre of supratidal habitat, and 0.2 acre of woodland habitat. The greatest impacts would be caused by installation of the MALSR in conjunction with RSA-8, the No Action Alternative, because of the need to place light standards in wetlands (as opposed to putting the stands in the RSA fill) and the longer access road necessary under this alternative. Installation of the MALSR under RSA-8, the No Action Alternative would affect 2.1 acres of wildlife habitat, comprising 1.0 acre of estuarine high marsh, 0.5 acre of supratidal, 0.3 acre of estuarine low marsh, 0.2 acre of woodland, and 0.1 acre of unvegetated tidelands. The second greatest impacts would occur with installation with RSA-6B, which would result in 1.9 acres of impact to vegetation. The largest impact (1.0 acre) would be to the high marsh habitat, with lesser impacts to low marsh (0.2 acre), supratidal (0.5 acre), and woodland (0.2 acre) habitats. Installation of the MALSR system under RSA-5E would impact 1.2 acres of wildlife habitat, consisting of 0.9 acre of high marsh, 0.2 acre of supratidal, and 0.1 acre of woodland. Installation of the MALSR with RSA-5C would disturb 0.8 acre comprising 0.5 acre of high marsh habitat and 0.3 acre of supratidal habitat.

Within the landscape area, this action would result in less than 0.1% reduction in wildlife habitat. The majority of this impact would be associated with the access road and would be short-term, occurring during construction. Consequently, the total acreage of habitat affected would diminish over time. None of these effects to habitat are anticipated to have substantive impacts on high-interest species or sensitive species in the project and landscape areas.

Another direct impact to wildlife would be associated with the disturbance created by an increased level of human activity during construction and maintenance of the MALSR facilities. Both activities would drive wildlife out of the immediate vicinity, causing them to relocate to other, similar habitats within the project or landscape areas. These impacts would be temporary and inconsequential, although possibly beneficial to the Airport's wildlife hazard management program.

As described in Section 4.4.8, disturbance to supratidal habitat carries the potential for introducing weed species to the interior of the Refuge via construction equipment. If weeds become established in affected areas and are allowed to spread to other uplands within the Refuge, there could be an adverse impact on wildlife habitat quality within the landscape area. In the absence of a control or eradication program, this impact would be permanent. Procedures to prevent noxious weed infestation could include washing of all vehicles prior to entry on undisturbed Airport property or the Refuge, and verification that seed mixes and any straw used in construction are certified weed free.

The No Action Alternative, NAV-3, would leave existing conditions unchanged.

4.4.11 CULTURAL RESOURCES

No known historic properties would be affected by construction of the MALSR and access road, as described for Alternative NAV-2B, the FAA's preferred navigational improvements alternative. However, there is the potential for ground disturbance in the estuarine wetlands south and east of the runway to uncover as-yet unknown subsurface cultural resources. As the magnitude of the disturbance increases with increasing lengths of the access road under the various combinations of NAV-2B and the RSA alternatives, the potential for encountering such resources also increases. NAV-3 would have no impact on historic properties because there would be no ground disturbance with the No Action Alternative.

4.4.12 VISUAL RESOURCES

Of the two navigational aid alternatives to consider, the No Action Alternative (NAV-3) would result in no changes to the existing visual landscape. Impacts of the MALSR installation and operation with Alternative NAV-2B, the FAA's preferred navigational improvements alternative, were analyzed from the Sunny Drive viewpoint.

The addition of the MALSR and its partial extension into the Refuge would add new visual elements to the existing estuarine landscape east of Runway 26. Construction of the MALSR towers would create minor, short-term impacts within the middleground from construction equipment, access road construction, and ground disturbance. Moderate, long-term impacts would be produced as color, line, texture, and form that contrast with the natural landscape of the Refuge. The at-grade MALSR service road would result in only minor impacts relative to the contrasts created by the MALSR towers. The long-term, indirect, visual-quality effects of the MALSR's medium-intensity light emissions upon area residents would be minor. This conclusion is based on the lack of any documented reports of lighting complaints caused by the MALSR on the west end runway approach (FAA 2002).

The extent of visual change caused by the MALSR would depend on which RSA alternative was to be implemented. All of the RSA alternatives would require that a MALSR be extended into the Refuge, but the maximum encroachment into the Refuge by the MALSR system and access road, and therefore greatest visual impacts, would be caused by Alternative RSA-5E, which would require the placement of the most light stations within the Refuge because of the greater eastward shift of the Runway 26 landing threshold. This alternative would, however, have the second shortest length of access road within the Refuge. Alternative RSA-5C would have a similar impact. Alternative RSA-5D would have a similar impact relative to the light stations but would have a greater impact relative to the access road. The remaining alternatives would have roughly the same impact relative to the placement of light stations; however, Alternatives RSA-1 and RSA-6C would have lesser impact relative to the placement of the access road than would Alternatives RSA-6A, RSA-6B, and RSA-6D. Alternatives RSA-1, RSA-6A, RSA-6B, RSA-6C, and RSA-6D would all have relatively intermediate visual impacts caused by encroachment into the Refuge for placement of the MALSR and access road.

4.4.13 Department of Transportation Section 4(f) Land

Only NAV-2B, installation of a MALSR, would result in direct and indirect effects to a Section DOT Section 4(f) land. This alternative is the FAA's preferred navigational improvements alternative. Light stations and an access road would be placed on Refuge land acquired by the Airport or through an access and use easement. A direct impact to DOT Section 4(f) land would result from installation of the MALSR, regardless of any changes to runway or RSA. However, the extent of the direct impact to DOT Section 4(f) land would depend on the RSA alternative implemented, with the most land (1.4 acres) needed for Alternatives RSA-5D and RSA-8. Most of the remaining RSA alternatives would require the same amount of Refuge land for the MALSR access road and light support pads, since the Runway 26 landing thresholds would be in the same location as present or in a roughly comparable location. The exception is Alternative RSA-5C, for which the Runway 26 landing threshold would be 446 feet east of its existing location, and Alternative RSA-5E, for which the Runway 26 land threshold would be 520 feet east of existing location. Alternative RSA-6B would require slightly less Refuge land (equivalent to one support pad and 200 feet of service road) since the Runway 26 landing threshold would be approximately 188 feet to the west. The MALSR would have no affect on the Dike Trail.

NAV-3, the No Action Alternative, would retain existing navigational aids at the Airport, and no direct or indirect DOT Section 4(f) land impacts would occur.

The following sections examine the issues of 1) public need for the proposed MALSR; 2) the compatibility of the action with the use of the DOT Section 4(f) land; 3) other alternatives prudent and feasible relative to NAV-2B, the Proposed Action; and 4) steps available to avoid or minimize harm to the DOT Section 4(f) land. These discussions are based on the impacts unique to the installation of the MALSR lighting system. See Section 4.3.13 for the impacts on DOT Section 4(f) lands from the RSA alternatives.

4.4.13.1 Demonstration of Significant Public Need

Chapter 1 provides a complete discussion of the public need for the improved navigation lighting. The purpose of installing additional navigational systems is to improve pilot alignment with the runway at JNU at night and during poor weather conditions. Chapter 1 notes the rather unique operating circumstances at JNU due to its mountainous location, which requires special flight operations to safely clear the terrain obstructions, and due to frequent, severe weather conditions, including low cloud cover, fog, rains, snow and combinations of these events. On an annual basis, as many as 149 to 262 hours of accessibility to the Airport are affected. During these periods, flights are delayed, which in turn affects flight schedule reliability particularly for commercial traffic and results in clear economic and social impacts. The MALSR would satisfy the need to provide better pilot alignment with the runway at night and during poor weather.

4.4.13.2 Compatibility of Action With the DOT Section 4(f) Land

The two primary goals of the Refuge Management Plan are described in Section 4.3.13. As is noted in the enabling legislation that created the Refuge, future needs of the Airport to use Refuge lands were recognized, as long as the need could be demonstrated. As the Need for improved navigational instrumentation has been demonstrated, the compatibility of the MALSR installation with the affected Refuge lands is examined, below.

The installation of the MALSR with any of the RSA alternatives (RSA-1 through RSA-8) would require a disturbance of the Refuge during construction and for system operation. The wetland and habitat impacts associated with this action would be relatively minor, in terms of acreage or functions and values affected. It is not expected that the MALSR installation and use would harm fish and wildlife populations, nor would the MALSR affect public use of the Refuge. The Refuge Management Plan (upon which compatibility is being compared and impairment is determined) does not address visual quality. Based on this analysis, the MALSR would have no substantial impairment to beneficial uses of the Refuge, and therefore no constructive use impact.

4.4.13.3 Prudent and Feasible Alternatives Evaluation

As was described in Chapter 2 and also in the DOT Section 4(f) analysis for RSA alternatives, it is not prudent or feasible to consider other modes of transportation, or the use of other airports, or the construction of a new Airport, as alternatives to the navigational improvements. The objective of improving pilot alignment with the runway during poor weather and at night is based on existing uses, regardless of whether another regional Airport was developed.

Section 2.2 of Chapter 2 described a range of possible alternatives for navigational alignment. Only one other alternative was considered prudent and feasible (NAV-2A, installation of an ALSF), but it would have cost more than the MALSR, would have had no greater operational benefit, and would have had as much or more environmental impact on the Refuge as the MALSR. Therefore, this other alternative did not obviate the Purpose of and Need for the Proposed Action.

4.4.13.4 AVAILABILITY OF MEASURES TO MINIMIZE IMPACTS TO THE DOT SECTION 4(F) LANDS

The FAA has incorporated into the MALSR design (see Section 2.7) the use of an at-grade access road, composed of a mesh that would allow native vegetation to become re-established and would ensure hydrologic functions are not impaired. Under all RSA alternatives except RSA-5C and RSA-5E, this access road takes advantage of the dredge spoil pile islands to avoid some of the high value estuarine wetlands and habitat immediately east of the RSA or EMAS. This route would have lesser environmental benefit for the EMAS alternatives because of the greater distance between the EMAS end and the dredge islands. An alternative access road route extending due east from the end of the RSA would be implemented for Alternatives RSA-5C and RSA-5E. Construction could occur during low tide cycles, and in seasons when salmon and other fish are not spawning, to further reduce impacts to fish and habitat.

4.5 Snow Removal Equipment and Maintenance Facility

Section 2.8.1 of Chapter 2 describes the alternatives for development of a new snow removal equipment and maintenance facility (SREF). Three alternatives were selected for detailed consideration; two alternatives would meet the need for a new SREF, while the No Action Alternative would offer no improvement from the existing facility. Environmental consequences of the following alternatives are described in Sections 4.5.1 through 4.5.13:

- SREF-1B: Develop a new SREF on the west end of the Airport, east of a relocated Duck Creek.
- SREF-3B1: Develop a SREF south of Yandukin Drive. This is the FAA's preferred SREF alternative.
- SREF-5: No Action: retain use of the existing snow removal and maintenance equipment building and sand storage shed.

4.5.1 Noise

Operation of a new SREF at the Airport would not have a regular or predictable impact on aircraft operations or airfield usage. Therefore, the development of a new SREF would not alter the future aircraft noise conditions at JNU. Both of the action alternatives would, in effect, result in the same long-term noise exposure as the No Action Alternative, SREF-5.

There would be short-term increases of noise associated with construction equipment used to build a new SREF under alternatives SREF-1B and SREF-3B1, the FAA's preferred SREF alternative. These increases would be similar to other road or building construction noise levels in the area. In addition, the movement of the SREF from the existing location west of the terminal to a different location would alter the location of snow removal equipment storage and the noise associated with mobilizing this equipment. Off-Airport noise impacts associated with this noise source are minimal and would be expected to remain so with any of the alternatives.

4.5.2 Human Environment and Compatible Land Use

None of the alternatives for a SREF would conflict with existing, designated land uses or land management plans, as the development would occur within the Airport boundary and is compatible with the Airport Master Plan. No recreational activities would be directly affected by the SREF alternatives. However, use of the Dike Trail would be temporarily disrupted for several days on two occasions as the dike is breached to allow the dredge equipment (used to obtain fill for Airport projects) into and out of the Float Plane Pond. This action would constitute a minor, indirect, adverse impact on recreation activities.

There would be no changes in populations within noise contours as a result of SREF construction and use.

4.5.3 SOCIOECONOMIC IMPACTS

There would be short-term, direct, beneficial impacts from construction of a new SREF. Based on information incorporated into the Master Plan (USKH 1999) and updated by Estimations (2004), an Anchorage based consulting firm, and using the IMPLAN model and adjusting for 2005 dollars, it is estimated that SREF construction would generate nearly $21.4 million in total business income and create 169 temporary, full-time-equivalent jobs with a payroll of nearly $8.2 million. The two build alternatives, SREF-1B and SREF-3B1, would generate the same revenue: approximately $289,700 in sales tax for CBJ in the short term.

Long-term economic impacts from a new SREF are difficult to quantify but likely to be positive. The building would protect snow removal equipment from deterioration by the area's inclement weather, increasing the useful life of such equipment. Equipment maintenance requirements would be reduced and more easily undertaken, since the new facility would have adequate space for all work to be conducted inside.

Additional social and economic benefits from a new SREF could include faster and more efficient snow removal operations, thereby reducing operational delays associated with contaminated runways.

4.5.4 AIR QUALITY

A new SREF, regardless of its location in the Northeast or Northwest Development Areas, would improve snow removal operational efficiency but the predicted future operating emissions for the new SREF alternatives are approximately the same as for the No Action Alternative, SREF-5. Because air emissions from Airport operations are largely dependant on aircraft movement, the emissions values for the SREF reflect those predicted for most of the RSA alternatives (see Table 4-12). These increases are a function of the anticipated 9% increase in annual aircraft operations over that time frame and associated aircraft fleet changes.

Operating emissions remain constant regardless of SREF alternative for several reasons. Aircraft taxi patterns or the time-in-mode of aircraft operations would be unaffected with or without a new SREF; minor reductions in aircraft idling time could result from improved snow removal efficiency but this benefit to air quality cannot be reliably estimated. A new SREF would also not affect average day Ground Support Equipment (GSE) emissions.

The two action alternatives would involve construction of a new SREF and would cause short-term, construction-related increases of criteria pollutants associated with vehicle exhaust. Table 4-50 summarizes the airport operating emissions in the year 2015 and construction emissions associated with each SREF alternative. In addition to construction exhaust emissions, fugitive dust would be generated, and a fugitive dust evaluation was prepared assuming that the construction site is periodically watered to reduce dust. That evaluation showed that dust associated with constructing the SREF alternatives could range from a low of 0.0 tons per year under the No Action Alternative to a high of 2.7 tons per year for either of the Action alternatives.

Table 4-50. SREF-1B and SREF-3B1 Emissions Summary

Activity	Tons per year Emissions					Fugitive Dust (tons)
	CO	NOx	VOC	SOx	PM_{10}/ $PM_{2.5}$	
Operating (2015)	1,154.7	70.6	63.1	7.2	1.5	N/A
Construction (peak year)	6.8	6.9	1.3	0.6	0.8	2.7

Source: BridgeNet International and Synergy Consultants, October 2004.
Note: $PM_{2.5}$ emissions are estimated to be equal to PM_{10} emissions for the purpose of this analysis.

Other benefits from a new SREF may accrue. Indoor storage of snow removal equipment would reduce cold engine starts and lower CO and possibly other emissions. Furthermore, snow removal operations do not reflect average day conditions, which are evaluated by the operational emissions. It can be expected that SREF-1B would result in snow-removal-related operational emissions that are lower than the No Action Alternative but potentially slightly greater than SREF-3B1, the FAA's preferred SREF alternative, since the location of SREF-1B would require a slightly longer travel distance to much of the airfield. SREF-3B1 would likely result in the lowest emissions of all SREF alternatives because the northeast Airport location would provide unimpeded access to the priority snow removal locations (runway, taxiways), thereby increasing efficiency of snow removal operations.

The No Action Alternative, SREF-5, would retain the existing snow removal equipment and maintenance building and sand storage shed. No additional construction-related emissions or fugitive dust would be anticipated. As with the other SREF alternatives, it is not possible to isolate the emissions solely attributable to snow removal operations. It is surmised that the existing SREF location offers less efficient snow removal service than either of the new SREF locations would offer, particularly because of the frequent cold engine starts and the lack of a clear thruway to the rest of the airfield. Therefore, emissions from snow removal operations for the No Action Alternative would be slightly greater than those generated from either of the action alternatives.

4.5.5 HAZARDOUS MATERIALS AND SOLID WASTE

A search of environmental databases and a review of historic aerial photographs suggest that the two areas considered for construction of a SREF have a relatively low probability for containing buried solid or hazardous waste. No information was available suggesting that historic, waste-disposal practices used the areas to be disturbed by either of the SREF action alternatives.

The Northwest Development Area is heavily vegetated in some areas, and it was not possible to thoroughly inspect the entire 6.7 acres potentially dedicated to SREF buildings and pavement. Even so, no evidence of waste disposal was found in the areas that were inspected. Although the fuel farm and adjacent areas have been the site of fuel spills and leaks, leading to subsurface contamination in some areas, the fuel farm is approximately 1,200 feet upgradient from the proposed location for Alternative SREF-1B. No investigation has been conducted to determine whether groundwater is contaminated in the area that would be disturbed for Alternative SREF-1B.

The Northeast Development Area is very open, so a field reconnaissance for this EIS was able to inspect the entire area. Personnel identified no visible areas of waste disposal. In March 1999, work was undertaken to remove contaminated soil and old petroleum delivery piping from an area immediately adjacent to the TEMSCO hangar. However, this known area of contamination is significantly downgradient and distant from the proposed location for SREF-3B1, the FAA's preferred SREF alternative, and would not be disturbed by a new SREF.

Construction of the SREF and access road would generate a relatively small and insignificant amount of solid waste, estimated at 50 cubic yards, which would be disposed at the local landfill. There would be no increase in the types or amounts of hazardous wastes generated at the Airport or hazardous materials consumed by Airport uses; in fact, a new SREF would provide safer, more secure storage, use, and disposal of waste products. The SREF design incorporates opportunities for pollution prevention through new maintenance stalls, dedicated storage areas for chemicals such as urea and potentially hazardous materials, and utilities connecting drains to the Mendenhall wastewater treatment plant.

Under the No Action Alternative, SREF-5, current arrangements for snow-removal-equipment storage and maintenance would continue. Snow removal equipment is stored at numerous locations on the Airport, and the maintenance building is both undersized and poorly designed. The existing building stores potentially hazardous substances, including solvents and hydraulic fluid, dry urea, paint, gasoline, and kerosene. Because of the overcrowded conditions, poor design, and inefficient operations, the No Action Alternative (relative to the action alternatives) has a greater probability of unintended release of these compounds into water resources via spills, leaks, or inadequate drainage treatment systems.

4.5.6 WATER RESOURCES AND FLOODPLAINS

To evaluate the impacts of alternative SREF-1B and SREF-3B1, the FAA's preferred SREF alternative, upon water resources it was assumed that a new access road would not be necessary. SREF-1B assumes the SREF parking and maneuvering area would connect directly to existing apron, while SREF-3B1 assumes that relocation of the TEMSCO access road would occur with airfield development (i.e., alternatives FW/RW-1 and FW/RW-2). Both alternatives would include a main building, an adjacent sand shed, and parking and maneuvering area totaling 6.7 acres of impact.

The fill used to construct the SREF, in either location, would be obtained by dredging the Float Plane Pond. This activity would create turbidity in the pond and may result in increased turbidity in the East Runway Slough and the Mendenhall River, depending on erosion control measures and weather.

Stormwater runoff from a SREF is typically of lower water quality due to the sands and chemicals used in conjunction with snow removal activities. However, concentration of snow removal equipment and maintenance facilities in one location designed to handle drainage, chemical storage and discharge, and other operational issues may have beneficial effects relative to the existing, undersized and poorly designed SREF.

4.5.6.1 Alternative SREF-1B

This alternative would place the SREF just north of developed apron in the Northwest Development Area. It was assumed that Duck Creek would be relocated to the north and west of the SREF in conjunction with wildlife hazard management options, so that new creek crossings would not be needed for large snow removal equipment to access the airfield. Approximately 6.7 acres of the Duck Creek floodplain would be affected by the SREF, and approximately 4.0 acres of that would be impervious. As a result, 1.6 acre-feet of new stormwater runoff would be generated for the 100-year flood event. Table 4-51 is a summary of SREF-1B stormwater impacts.

Table 4-51. Summary of SREF-1B Stormwater Impacts

	Mendenhall River		Gastineau Channel		
	Float Plane Pond	**Duck Creek**	**Jordan Creek**	**M-H/East Runway Sloughs**	**JNU Total**
New Impervious Surface (acres)	0.0	3.9	0.0	0.0	3.9
Percent Increase	0.0%	0.8%	0.0%	0.0%	2.0%
New runoff – 50-yr (acre-ft)	0.0	1.4	0.0	0.0	1.4
Percent Increase	0.0%	11.0%	0.0%	0.0%	3.0%
New runoff – 100-yr (acre-ft)	0.0	1.6	0.0	0.0	1.6
Percent Increase	0.0%	11.0%	0.0%	0.0%	3.0%
New Urea Application Area (acres)	0.0	0.0	0.0	0.0	0.0
Percent Increase	0.0%	0.0%	0.0%	0.0%	0.0%

Source: Vigil-Agrimis 2004

Approximately 2,900 of the 45,000 cubic yards of fill used in developing the SREF would be placed in the Duck Creek floodplain, resulting in a relatively small but permanent loss of flood storage and a small but permanent increase in stormwater runoff. The adverse loss of flood storage, in conjunction with increased urbanization in the Duck Creek watershed, could contribute to upstream flooding problems. The increased stormwater runoff volume into Duck Creek, caused by the new impervious surface, could contribute to stream bank erosion. Stormwater runoff from a SREF is associated with lower water quality due to sands and chemicals used in conjunction with snow removal activities.

The Float Plane Pond would be the source of fill used to prepare the surface for construction of the SREF. Dredging in the Pond would create turbidity, and erosion control measures would need to be in place to prevent increased sediment loads from entering the Mendenhall River.

4.5.6.2 Alternative SREF-3B1

Alternative SREF-3B1, the FAA's preferred SREF alternative, would place the SREF just south of Yandukin Drive and adjacent to a straightened TEMSCO access road, in the Northeast Development Area. This area is currently undeveloped and drains through Zig Zag Slough to the Miller-Honsinger Slough.

Approximately 6.7 acres would be impacted by the SREF, and approximately 4.0 acres of this would be impervious, increasing the volume of stormwater runoff generated during the 100-year flood event by approximately 1.6 acre-feet. Table 4-52 is a summary of SREF-3B1 stormwater impacts.

Table 4-52. Summary of SREF-3B1 Stormwater Impacts

	Mendenhall River		Gastineau Channel		
	Float Plane Pond	Duck Creek	Jordan Creek	M-H/East Runway Sloughs	JNU Total
New Impervious Surface (acres)	0.0	0.0	0.0	3.9	3.9
Percent Increase	0%	0%	0%	10%	2%
New runoff – 50-yr (acre-ft)	0.0	0.0	0.0	1.4	1.4
Percent Increase	0%	0%	0%	22%	3%
New runoff – 100-yr (acre-ft)	0.0	0.0	0.0	1.6	1.6
Percent Increase	0%	0%	0%	22%	3%
New Urea Application Area (acres)	0.0	0.0	0.0	0.0	0.0
Percent Increase	0%	0%	0%	0%	0%

Source: Vigil-Agrimis 2004

Approximately 19,000 of the 40,000 cubic yards of fill used to construct the SREF in the Northeast Development Area would be placed in areas subject to tidal inundation and inundation from 100-year flood events, resulting in a relatively small but permanent loss of 12 acre-feet of floodplain/marshplain storage. Fill in the tidally inundated marshplain would result in a reduction in tidal prism volume. This area is connected to the Refuge via Zig Zag Slough, Miller-Honsinger Slough and East Runway Slough, all of which would experience some channel adjustment as a result of the tidal prism volume reduction. The East Runway Slough channel cross-sectional area would be reduced over time. Tidal channel adjustments would continue until a state of equilibrium is reached in the local drainage basin. However, the small reduction in tidal prism volume and adjustments to tidal channel morphology would have little impact on the Refuge hydrologic system.

4.5.6.3 Alternative SREF-5

Snow removal equipment is presently stored at numerous locations on the Airport, and the maintenance building is both undersized and poorly designed. Because of the overcrowded conditions, poor design, and inefficient operations, implementation of the No Action Alternative likely would increase the probability of uncontrolled releases of sand, urea, maintenance chemicals and oil/grease, and other pollutants into water resources.

4.5.7 Vegetation

The action alternatives considered for the new SREF would result not only in short-term, construction-related impacts to vegetation, but also in long-term impacts to vegetation due to the conversion of approximately 4.0 to 6.0 acres of vegetative habitat to impervious surface.

4.5.7.1 Alternative SREF-1B

Alternative SREF-1B would adversely affect 1.7 acres (3.8%) of coastal forb meadow and 1.1 acres each of deciduous shrub-scrub (4.9%) and deciduous woodland (34.4%) for a total, permanent impact to 3.9 acres of existing vegetation within the project area. These losses would occur on the Airport property and would account for reductions of 0.1% of high marsh, 0.2% of the supratidal, 3.2% of shrub-scrub, and 1.2% of woodland cover within the landscape area. Implementation of this alternative would entail minimal adverse effects to estuarine marsh communities.

Just as for other proposed actions or alternatives affecting vegetation in and around the project area, the only indirect effect would be the potential to introduce and/or spread noxious weeds and other invasive plants during construction. Because SREF-1B would be located immediately adjacent to the Duck Creek riparian zone, earth-moving equipment would have the potential to introduce riparian weeds such as garlic mustard (*Alliaria petiolata*). Perennial sowthistle, yellow toadflax, dandelion, and sheep sorrel (*Rumex acetosella*) could be introduced to meadow areas in the same manner. While it is unlikely that these plants, if established, would spread to native plant communities outside of the Northwest Development Area, they could have substantive adverse effects on the vegetation of this area.

4.5.7.2 Alternative SREF-3B1

The construction of SREF-3B1, the FAA's preferred SREF alternative, and attendant relocation of the TEMSCO access road would impact approximately 6.0 acres of vegetation in the northeastern corner of the Airport. The vegetation community affected most by this alternative would be coastal forb meadow, which would be reduced by 4.9 acres or 10.9% in the project area. This alternative would also impact 0.7 acre (1.0%) of the coastal grass meadow community and 0.4 acre (11.4%) of the reed canary grass community within the project area. Overall, these impacts would result in a 1.3% reduction in vegetation within the project area. At the landscape level, vegetation impacts associated with SREF-3B1 would comprise a 0.7-acre (0.1%) loss of high marsh and a 5.3-acre (3.3%) reduction in supratidal vegetation for a total change of 0.1% in the landscape area. Snow removal equipment access to taxiways and runways would use new taxiways, which would entail additional disturbance as discussed relative to the Aviation Facilities Development alternatives. Implementation of this alternative would have minimal adverse effects to estuarine marsh communities.

The indirect effects associated with Alternative SREF-3B1 would be negligible. Weeds including dandelion and sheep sorrel are already common throughout the Northeast Development Area, and it is unlikely that weed propagules inadvertently brought in during construction of SREF-3B1 would contribute substantively to this infestation.

4.5.7.3 Alternative SREF-5

Implementation of Alternative SREF-5 would have no effect on vegetation in the project or landscape areas.

4.5.8 Wetlands

Table 4-53 summarizes the environmental score, total acreage, and functional units for wetland types in the Northwest and Northeast Development Areas, the two potential locations for a new SREF. The environmental score, total acreage, and functional units for wetland types in the Northwest and Northeast Development Areas, including locations for the SREF alternatives, are summarized in Table 4-5 of Section 4.2.

Table 4-53. Total Wetland Acreage, Environmental Scores, and Functional Units by Wetland Analysis Area in Northeast and Northwest Development Areas

Wetland Analysis Area	NWI Classification						
Northeast Airport Area			**PEM1**	**E2EM1 (H)**	**E2EM1 (L)**	**E2USN**	**Total**
Environmental Score			119.1	128.3	130.0	138.3	N/A
Total Acreage			5.3	31.6	1.1	1.2	39.2
Total Functional Units			631.4	4055.8	143.0	166.0	4996.2
Northwest Airport Area	**R3UB2**	**PSS1**	**PEM1**	**E2EM1 (H)**	**E2EM1 (L)**	**E2USN**	**Total**
Environmental Score	117.8	101.8	98.8	115.2	116.8	116.4	N/A
Total Acreage	0.3	0.9	0.5	3.2	0.7	0.5	6.1
Total Functional Units	35.4	91.6	49.4	368.6	81.8	58.2	685.0

4.5.8.1 ALTERNATIVE SREF-1B

Alternative SREF-1B would permanently disturb 1.5 acres of wetlands in the Northwest Development Area. The impact acreage and loss of wetland function are broken down by wetland type in Table 4-54 (refer to Section 3.8.2 for a description of wetland types). Key wetland functions lost under this alternative would include (by wetland type):

Table 4-54. Alternative SREF-1B Impacts to Wetland Resources for the Northwest Airport Wetland Analysis Area

	NWI Classification				
	PEM1	**E2EM1 (H)**	**E2EM1 (L)**	**E2USN**	**Total**
Acreage Lost	0.1	1.3	0.0	0.1	1.5
Functional Units Lost	9.8	149.8	0.0	11.6	171.2
Percent Change*	0.6%	1.1%	0.0%	0.3%	0.5%

*Percent change of wetland acreage over the project area (by wetland type).

- Regional ecological diversity (PEM1, E2EM1(H), and E2USN);
- Groundwater discharge (PEM1, E2EM1(H), and E2USN);
- Nutrient transformation and export (E2EM1(H) and E2USN);
- Sediment and toxicant retention (PEM1, E2EM1(H), and E2USN); and
- Riparian support (PEM1, E2EM1(H), and E2USN).

The direct, adverse impacts to estuarine and palustrine emergent wetlands at the project area and landscape area levels from SREF-1B would be minor. There would be no substantial impact on hydrology needed to maintain wetland functions and values, and therefore no affect on sustainability of the natural systems that maintain habitat. There would be no direct or indirect impact on Refuge wetlands.

4.5.8.2 ALTERNATIVE SREF-3B1

Alternative SREF-3B1, the FAA's preferred SREF alternative, would permanently disturb 2.5 acres of wetlands in the Northeast Development Area. The impact acreage and loss of wetland function are broken down by wetland type in Table 4-55. Key wetland functions lost under this alternative would include (by wetland type):

- Surface hydrologic control (PEM1);
- Groundwater recharge and lateral flow (E2EM1);
- Sediment and toxicant retention (all wetland types);
- Wildlife (all wetland types);

Table 4-55. Alternative SREF-3B1 Impacts to Wetland Resources for the Northeast Airport Wetland Analysis Area

	NWI Classification		
	PEM1	**E2EM1 (H)**	**Total**
Acreage Lost	0.9	1.6	2.5
Functional Units Lost	107.2	216.2	323.4
Percent Change*	5.1%	1.4%	0.9%

* Percent change of wetland acreage over the project area (by wetland type).

- Fish habitat (E2EM1);
- Riparian support (E2EM1); and
- Regional ecological diversity (All).

The direct, adverse impacts to estuarine and palustrine emergent wetlands at the project area and landscape area levels from SREF-3B1 would be greater than those for SREF-1B, but still minor. There would be no substantial impact on hydrology needed to maintain wetland functions and values, and therefore no affect on sustainability of the natural systems that maintain habitat. There would also be no direct or indirect impact on Refuge wetlands.

4.5.8.3 Alternative SREF-5

The No Action Alternative would have no direct or indirect effects on wetlands.

4.5.9 Fisheries

The SREF action alternatives would not directly affect aquatic habitat and would have no direct impact on fish resources. Generally, development of either SREF site would cause a reduction of infiltration, an increase in peak flows, and concentration of contaminants near either Duck Creek or the Miller-Honsinger Slough during precipitation events, thereby indirectly increasing the potential to harm fish or otherwise degrading fish habitat.

4.5.9.1 Alternative SREF-1B

The footprint of this location includes 1.7 acres of coastal forb meadow, which is normally not an intertidal habitat. However, in the Duck Creek vicinity, this vegetation type is consistently inundated by the highest tides (more than 19 feet msl) and consequently qualifies as EFH. Thus, SREF-1 would cause a reduction of EFH by 1.7 acres. Indirectly, the reduction in infiltration and the increase in equipment activity would speed runoff and contribute contaminants to Duck Creek, increasing the potential for fish injury and occasional fish kills.

4.5.9.2 ALTERNATIVE SREF-3B1

This is the FAA's preferred SREF alternative. The habitats directly affected by this location are rarely inundated by peak tides. However, just as in the Northwest Development Area, peak tides can inundate coastal forb vegetation, causing what is typically a supratidal plant community to function as high marsh. Consequently, with respect to fisheries, Alternative SREF-3B1 would effectively impact 1.6 acres (0.2%) of high marsh habitat with a corresponding reduction in EFH. Indirectly, the reduction in infiltration and the increase in equipment activity would speed runoff and contribute contaminants to the estuarine habitats near Miller-Honsinger Slough, increasing the potential for fish injury and occasional fish kills.

4.5.9.3 ALTERNATIVE SREF-5

The No Action Alternative would have no direct or indirect effects on fisheries, with the possible exception of concerns relating to surface water contamination caused by the inadequate storage and use areas of the existing SREF (see Section 4.5.6).

4.5.10 WILDLIFE

The two Action alternatives for a SREF would have similar disturbance footprints but would affect different types of habitat because of their different locations (see figures in Section 3.10 of Chapter 3). The No Action Alternative would have no direct or indirect effects on wildlife.

4.5.10.1 ALTERNATIVE SREF-1B

Implementation of SREF-1B would adversely affect 1.7 acres of supratidal, and 1.1 acres each of shrub-scrub and woodland habitats, for a total, permanent loss of 3.9 acres of existing wildlife habitat. These acreages account for 3.5% of the supratidal, 4.9% of shrub-scrub, and 2.6% of forest habitats within the landscape area. Implementation of this alternative would entail minimal adverse effects to estuarine marsh habitats.

High-interest species with potential to be affected by this alternative include raptors, songbirds, and the rufous hummingbird. Habitat for sensitive species, including the Queen Charlotte goshawk, peregrine falcon, olive-sided flycatcher, and Townsend's warbler, would be affected as well. However, given the small proportion of affected habitats to total available habitat across the landscape area, habitat-related impacts to these species are expected to be minor.

Indirectly, increased levels of human activity and disturbance may affect wildlife more than the relatively small loss of habitat. Construction and use of the new SREF in the Northwest Development Area would be expected to result in a shift in wildlife species composition around the new facility. Disturbance-tolerant, open-habitat species would likely maintain or increase their use of the area, while more secretive species typical of densely vegetated habitats would be displaced to other suitable habitats elsewhere in the vicinity.

Just as for other Proposed Actions affecting wildlife habitats in and around the project area, construction of the SREF would have the potential to indirectly degrade wildlife habitat via the introduction and/or spread of noxious weeds and other invasive plants during construction. Refer to Section 4.5.7.1 for a discussion of weeds relevant to this alternative.

4.5.10.2 Alternative SREF-3B1

The construction of SREF-3B1, the FAA's preferred SREF alternative, and the attendant relocation of the TEMSCO access road would result in a loss of 6.0 acres of supratidal and high marsh habitats in the northeastern corner of JNU property. As a result, these habitats would be reduced by 11.0% and 0.7% in the project area and approximately 3.3% and 0.1% in the landscape area, respectively. Implementation of this alternative would have minimal adverse effects to estuarine marsh habitats.

Construction of SREF-3B1 would therefore cause a reduction in habitat available for high-interest species, including raptors, songbirds, and the rufous hummingbird, as well as sensitive species, including the Queen Charlotte goshawk and peregrine falcon. With the possible exception of the rufous hummingbird, which would undergo 11.0% and 3.3% reductions in habitat within the project and landscape areas, respectively, habitat-related impacts associated with SREF-3B1 are expected to be minor. The disturbance associated with increased human activity during construction and use of the facility would be expected to displace resident wildlife to other suitable habitats in the vicinity.

Weeds, including dandelion and sheep sorrel, are already common throughout the Northeast Development Area, and it is unlikely that weeds inadvertently brought in during construction of SREF-3B1 would contribute substantively to this infestation or cause further displacement of wildlife. The indirect effects to wildlife and wildlife habitats associated with Alternative SREF-3B1 would be negligible.

4.5.10.3 Alternative SREF-5

The No Action Alternative would have no direct or indirect effects on wildlife or habitat.

4.5.11 Cultural Resources

No known historic properties would be affected by any of the SREF alternatives. However, both SREF-1B and SREF-3B1, the FAA's preferred SREF alternative, would disturb areas that have not been disturbed in recent times, and each area could contain subsurface cultural resources. SREF-5 would have no impact on historic properties because there would be no ground disturbance associated with the No Action Alternative.

4.5.11.1 Alternative SREF-1B

Dense, ground-level vegetation obscures much of the surface in the Northwest Development Area. Archival research and oral interviews indicate the area was used both by indigenous peoples and by the U.S. military during WWII. Clearing for fill placement and construction could reveal previously undetected surface sites, and ground disturbance associated with construction of the SREF could inadvertently affect previously undocumented subsurface sites. The possibility of impacts to potential subsurface sites is somewhat higher for this alternative than for SREF-3B1 because of the documented historic, indigenous and military uses in the area.

4.5.11.2 Alternative SREF-3B1

The Northeast Development Area has little vegetative cover that could obscure cultural resources on the surface. Ground disturbance associated with extension of the Livingston Way roadway and with construction of the SREF could inadvertently affect previously undocumented subsurface cultural resource sites.

4.5.11.3 Alternative SREF-5

The No Action Alternative would have no direct or indirect effects on cultural resources.

4.5.12 Visual Resources

Although the SREF form and color would be the same whether constructed in the Northeast Development Area (SREF-3B1) or the Northwest Development Area (SREF-1B), the visual impacts would vary because of the different landscapes in each area. There would be no changes to visual resources resulting from the No Action Alternative, SREF-5. Visual effects of SREF installation in the Northwest Development Area were analyzed from the Dike Trail trailhead viewpoint. Visual effects of SREF installation in the Northeast Development Area were analyzed from the Sunny Drive and end-of-Dike Trail viewpoints.

4.5.12.1 Alternative SREF-1B

SREF-1B would produce minor changes in visual quality when viewed from the existing Dike Trail parking lot. Construction of the SREF would result in the removal of trees and mature vegetation within the existing Duck Creek floodplain. There would be minor, short-term impacts in the foreground from construction equipment, loss of vegetation, and loss of or reduction in visual screening from tree removal. Long-term changes in visual quality and changes in visual contrasts would be minor, as the area currently shows obvious signs of development: asphalt roads, chain link fences, vehicles, and buildings in the middleground and background are clearly visible. New construction near Duck Creek, in the presence of these existing structures, would not result in high levels of visual contrast.

4.5.12.2 Alternative SREF-3B1

SREF-3B1, the FAA's preferred SREF alternative, would have minor, short-term and long-term effects on landscape visual quality. The proposed location for the SREF is in an area that has undergone little development in the foreground, but aviation facilities, roads, and Airport apron are visible in the middleground and background. Visual contrast between new construction and the existing landscape would not be evident to the casual viewer from Sunny Drive. The foreground viewshed, especially as seen by travelers on Egan Drive and Yandukin Drive, would manifest more moderate, long-term impacts, resulting from the new building and the straightening of the TEMSCO access road.

4.5.12.3 ALTERNATIVE SREF-5

The No Action Alternative would have no direct or indirect effects on the visual landscape.

4.5.13 DEPARTMENT OF TRANSPORTATION SECTION 4(F) LANDS

No significant adverse impacts would occur to DOT Section 4(f) lands with any of the SREF alternatives. Neither of the possible SREF sites would involve direct impacts to the Refuge or the Dike Trail. No changes in aircraft exposure noise or air quality impacts are expected. Under Alternative SREF-3B1, the FAA's preferred SREF alternative, there could be minor, indirect impacts to hydrology associated with conversion of 6.7 acres in the Northeast Development Area to impervious surface. This area drains through Zig Zag Slough to the tidal channels that ultimately flow through the Refuge. However, as discussed in Section 4.5.6, the small reduction in tidal prism volume and adjustments to tidal channel morphology would have little impact on the Refuge hydrologic system. There would be no constructive use impact to DOT Section 4(f) lands from construction and operation of a SREF.

4.6 Fuel Farm Access

Section 2.8.3 of Chapter 2 describes two alternatives that would provide more efficient access to aviation gas and jet fuel stored at the Airport fuel farm. A third alternative is also considered, the No Action, which would not meet Purpose and Need. Environmental consequences of the following alternatives are described in Sections 4.6.1 through 4.6.13:

- FF-1: Develop new Airport roadway to access the fuel farm. This is the FAA's preferred fuel farm access alternative.
- FF-2: Install pipelines from fuel farm to a central fuel distribution port on the Apron.
- FF-3: No Action – Maintain current route for trucks to access the fuel farm.

4.6.1 Noise

Alternative methods to access the fuel needed for aviation operations would not have a measurable impact on aircraft operations or airfield usage. The development of a new fuel farm access mechanism would not alter the aircraft noise exposure associated with existing or future conditions at JNU and operation of such a mechanism would not add enough noise to cause measurable changes to current contours. Each of the action alternatives would have virtually the same long-term noise exposure as the No Action Alternative, FF-3.

Alternative FF-1, the FAA's preferred fuel farm access alternative, would shift refueling truck traffic from a publicly used road to a new route just west of the existing Duck Creek channel. Given the small number of trucks making this trip and the short distance between the old route and the new road, the shift in noise-generating sources (the trucks) would have insignificant impacts. Similarly, installation of a fuel pipeline would eliminate the need for airfield refueling trucks to access the fuel farm. Because the trucks currently making this trip every day are few, and the surrounding environment already has substantial vehicle traffic, the reduction in truck-related noise would be insignificant.

There would be short-term increases in noise associated with construction of a new access road, as considered in Alternative FF-1, or installation of a new fuel pipeline and fuel distribution port, as considered in Alternative FF-2. These increases would be temporary and similar to other construction noise levels in the area.

4.6.2 Human Environment and Compatible Land Use

None of the alternatives for access to the petroleum resources at the fuel farm would conflict with existing, designated land uses or land management plans. The actions considered would occur on Airport property and comply with the Airport Master Plan. No recreational activities would be directly or indirectly affected. There would be no changes in populations within noise contours as a result of either fuel access alternative or the No Action Alternative.

4.6.3 Socioeconomic Impacts

Table 4-56 summarizes short-term economic benefits to the CBJ for the fuel farm access alternatives in terms of direct, indirect and induced business income, jobs and payroll. All of these benefits would be generated by construction work to build the access road or install the fuel pipeline and service station.

Table 4-56. Construction Impact of Fuel Farm Access Alternatives (2004 Dollars)

Alternative	Total Business Income	Total FTE Jobs	Total Payroll
FF-1: Fuel Farm Road	$303,000	4	$122,000
FF-2: Fuel Farm Pipeline	$721,000	9	$323,000

Source: CBJ Airport Staff and SWCA Project Team. Also, IMPLAN Pro 2000 input/output model, Minnesota IMPLAN Group.

The cost of construction of the fuel farm pipeline would be more than twice the cost of construction of the fuel farm road and would have proportionately greater impacts in terms of both temporary jobs and payroll. The pipeline would generate approximately $13,400 in sales tax for CBJ in the short term, while the fuel farm road would generate approximately $5,404 in sales tax.

It is expected that the alternatives would have some long-term economic benefits, compared to the No Action Alternative, as a result of increased Airport efficiency. Refueling operations would take less time, require less travel distance, and involve fewer security checks.

Positive social benefits, in the form of increased safety, would accrue by removing the fuel trucks from public streets. The No Action Alternative, FF-3, would continue the use of public streets for private refueling trucks to gain access to the fuel farm.

4.6.4 Air Quality

The predicted future operating emissions for the new fuel farm access alternatives are the same as for the No Action Alternative, FF-3, and reflect the same values as predicted for the year 2015, for several reasons. Neither action alternative would affect aircraft taxi patterns or the time-in-mode of aircraft operations. Also, neither action alternative would measurably affect average day ground support equipment (GSE) emissions. Table 4-57 shows the estimated Airport operational emissions in the year 2015 and construction-related emissions of criteria pollutants and fugitive dust for each fuel farm access alternative.

Alternative FF-1, the FAA's preferred fuel farm access alternative, would result in the construction of a new, non-public, fuel farm access road on the northwest side of the Airport. The new location would save approximately 450 feet of total travel distance from the current route and would not require access to public streets. Alternative FF-2 would involve installation of pipelines from the fuel farm to a new refueling station located on existing Airport apron, near private aviation facilities. The corridor for the pipelines would be the same as for a new fuel farm road.

Table 4-57. Operations and Construction-related Emissions (Peak Year): Fuel Farm Access Alternatives

Project	Tons per Year Vehicle Exhaust					Fugitive Dust (tons)
	CO	NOx	VOC	SOx	PM_{10}/ $PM_{2.5}$	
Operating (2015)[1]	1,154.7	70.6	63.1	7.2	1.5	NA
Construction						
FF-1, Fuel Farm Road	2.7	3.3	0.5	0.3	0.4	2.7
FF-2, Fuel Pipeline	6.7	8.5	1.3	0.7	1.1	1.5
FF-3, No Action	NA	NA	NA	NA	NA	NA

[1] All three fuel farm access alternatives would have same operating emissions, as the alternatives do not affect aviation or airfield activity.
Note: $PM_{2.5}$ emissions are estimated as equal to PM_{10} emissions for the purpose of this analysis.
Source: Synergy Consultants, October 2004

However, the travel distance for fuel trucks would be further reduced since the refueling station would be located on the Airfield apron, incrementally reducing truck operational time and emission volumes. It was assumed that a trench-and-fill operation would be used for pipeline installation, extending approximately 600 linear feet from the fuel farm to a new refueling station, and that the refueling station would be constructed on existing pavement.

Construction activity associated alternatives FF-1 and FF-2 would cause short-term increases of criteria pollutants from vehicle exhaust. Fugitive dust would also be generated by the construction activity. Construction of a new fuel farm road (FF-1) would generate more fugitive dust than the fuel pipeline corridor, reflecting the wider disturbance corridor associated the road. However, more equipment and different types of heavy equipment would be needed for the fuel pipeline and refueling station construction, so the emissions of criteria pollutants would be greater than those for construction of the access road. Fugitive dust levels generated for either alternative may be controlled and reduced by watering disturbed areas periodically during dry seasons.

For the No Action Alternative FF-3, Cessna Drive would continue to be used by airfield refueling trucks to load aviation gas or jet fuel at the fuel farm. This alternative would not affect taxi patterns or the time in mode of aircraft operations, and no construction-related emissions would occur. The operational emissions associated with this alternative would be the same as for both of the Action alternatives, shown on Table 4-57, and attributable to the predicted 9% increase in annual aircraft operations over that time frame and associated aircraft fleet changes.

4.6.5 Hazardous Materials and Solid Waste

A search of environmental databases and a review of historic aerial photographs suggest that the areas considered for construction of a fuel farm access road or fuel pipelines may contain buried waste and/or evidence of upgradient contamination. The basis for this conclusion is the proximity of the proposed route (for either FF-1 or FF-2) to areas with historic petroleum contamination.

The fuel farm has a history of being used to store and transfer petroleum products. Prior to and during WWII, the U.S. Army used the fuel farm area for airplane bunkers, fuel storage tanks, and an underground fuel transfer system. Since the war, the area has continually been used for fuel storage and truck refueling, and some fuel storage tanks were buried at the fuel farm. These buried tanks and fuel transfer pipes have been removed from the area, but there may still be at least one underground tank present on or near the property (R. Watt, CBJ City Engineer, personal communication with L. Bennett, SWCA Geologist 2002). Leaking tanks and transfer pipes and at least one fuel spill of approximately 300 gallons have contaminated the subsurface in the immediate area. It is unknown whether all of the contaminated soils were cleaned up, or whether (and to what extent) groundwater may have been affected by these releases.

A fuel farm road would have little chance of disturbing buried wastes, including contaminated soils or groundwater, since most of the installation would occur on the surface to raise the road above high-tide flood levels. The trench-and-fill method of fuel pipeline installation would have a greater potential to intrude on contaminated materials or disturb buried wastes, since the pipelines would be buried approximately 3 to 5 feet below surface.

A new access road to the fuel farm may indirectly result in a beneficial effect, relative to the No Action Alternative. A new access road would decrease the travel distance for refueling trucks and limit travel of these trucks to a non-public thoroughfare. It is likely that the risk of an accident would be reduced; therefore, the potential for accident-related release of petroleum product into the creek would also be reduced. A truck accident involving the release of AvGas or jet fuel into Duck Creek could have significant adverse consequences, both short-term and long-term, to water quality, fisheries, and aquatic habitat in Duck Creek and possibly the Mendenhall River.

Fuel pipelines would further reduce the potential for accidental releases to the environment via truck or other aboveground transport. On the other hand, the long-term consequences to water quality of a leak from fuel pipelines could be even more dramatic than from a fuel truck spill. While fuel products (and possibly other chemicals such as de-icing) would be encased in a double-pipeline system, leak detection systems and product metering may not be sufficiently sensitive to detect small, relatively slow leaks. Release of petroleum product to the subsurface could result not only in groundwater contamination, but also contamination of Duck Creek and the Mendenhall River, due to the strong inter-connection between shallow groundwater and surface water in this area.

Construction of the fuel farm access road or fuel pipeline system would generate a relatively small and insignificant amount of solid waste, which would be disposed at the local landfill. There would be no change in the types or amounts of hazardous wastes generated at the Airport or hazardous materials consumed by Airport uses. There is a low probability that asbestos-containing materials would be uncovered, but if found they could be disposed at the local landfill.

4.6.6 WATER RESOURCES AND FLOODPLAINS

The two action alternatives offer more efficient, safe, and secure access to aviation gas and jet fuel at the fuel farm. Each of these could result in short-term impacts to water resources, primarily due to construction techniques and potential releases of sediment. Each of the action alternatives also has the potential to cause long-term environmental impacts.

4.6.6.1 ALTERNATIVE FF-1

Alternative FF-1, the FAA's preferred fuel farm access alternative, would involve the construction and use of a new fuel farm access road in the floodplain of Duck Creek. The increased impervious surface from the road would cause a 0.29 acre-foot increase in stormwater runoff. An arch culvert or bottomless concrete arch culvert would be used to cross the creek, over which the fuel farm access road would be routed.

Construction of a 565-foot-long road to the fuel farm would result in approximately 13,600 square feet (or 0.3 acres) of new impervious surface in the Duck Creek floodplain, an increase of less than 1%. This increase would have an adverse but relatively minor effect on runoff volume.

The 2,000 cubic yards of fill associated with the road and stream crossing would adversely reduce the floodplain storage volume by 0.2 acre-feet. The new crossing would constrict conveyance of Duck Creek to 550 cfs, down from the estimated 890 cfs the current culvert can pass. Flooding in the vicinity of the proposed crossing is influenced by tidal inundation, backwater from the Mendenhall River, and the drainage from Duck Creek. The 100-year storm event on Duck Creek would probably produce a flow that is on the order of 100 cfs, less than the 550-cfs capacity of the crossing. However, the 100 cfs flow rate does not account for either tidal or backwater influences. The effect of backwater flooding from the Mendenhall River and tidal flows is not quantifiable for this EIS, but they are largely responsible for the base flood elevations identified by FEMA for the Duck Creek floodplain. It is therefore reasonable to assume that flooding immediately upstream of the crossing would increase as a result of a loss in channel and floodplain capacity. Because of the tidal influence, these events would be short-term in duration.

Fill material for the road would come from the Float Plane Pond. Dredging in the pond would create turbidity and may result in increased turbidity in Duck Creek and the Mendenhall River, depending on erosion control measures and weather. However, the ponds do not have a surface water connection with the Slough, and the only connection with the Mendenhall River is through the inlet valve. As a result, the potential for turbid flows created during dredging to affect these drainages is very low.

The installation of a new culvert in Duck Creek could have long-term, adverse impacts to both downstream and upstream channel shape, bank, and pattern and potentially cause increased erosion. Changes in the geomorphology of the stream channel would continue until equilibrium in the channel geometry was established.

4.6.6.2 Alternative FF-2

Alternative FF-2 involves construction and operation of a fuel pipeline system extending from the fuel farm to a new, central refueling station on the existing Airport apron. For the purpose of this analysis, it has been assumed that all of the individual pipes carrying different products would be enclosed in a single, larger pipeline providing secondary containment. The pipeline would follow the same corridor as the alternative for a new fuel farm road, extending approximately 600 feet to the existing apron.

The pipeline would be installed using a trench-and-fill technique. A 50-foot-wide disturbance corridor would be necessary for installation, and best management practices would be employed to control construction-related disturbances and prevent sediment releases to the creek.

Construction of a 600-foot pipeline would result in approximately 30,000 square feet (or less than three-fourths of an acre) of disturbance in the floodplain. There would be no new impervious surface associated with this alternative.

The pipeline would be buried well below Duck Creek, to prevent any potential for dewatering. Dewatering would not be likely at any rate, due to the relatively high water table and, if a new Duck Creek corridor is established, the lined and impervious bottom in the new creek bed. Installation of the pipeline would have to be conducted during low tide and dry seasons, to reduce opportunities for work in the channel to release sediments into surface water. Ideally, the pipeline would be installed during relocation of the Duck Creek, so that no work would have to be done within the active channel.

A fuel pipeline would reduce the potential for accidental release of petroleum compounds into Duck Creek, since refueling trucks would no longer need to travel along or cross the creek: in some respects, a long-term, beneficial effect relative to both the No Action Alternative and the fuel farm access road alternative. On the other hand, if a leak in the pipeline system develops, it might have more dramatic, long-term consequences to water quality. While petroleum products would be encased in a double pipeline system, leak detection systems and product metering may not be sufficiently sensitive to detect small, relatively slow leaks. Release of petroleum product to the subsurface could result in groundwater contamination as well as contamination of Duck Creek and the Mendenhall River, due to the strong connection between shallow groundwater and surface water in this area.

4.6.6.3 Alternative FF-3

Under the No Action Alternative, existing refueling operations would remain as they currently are. There would be no adverse consequences due to construction in the Duck Creek floodplain. The risk of accident, and potential release of petroleum compounds into surface water, is considered greatest for this alternative relative to either FF-1 or FF-2.

4.6.7 VEGETATION

Both FF-1 and FF-2 would have short-term, construction-related impacts to vegetation in the Northwest Development Area. A new access road would also result in permanent changes to vegetative cover, whereas the long-term effects of a buried pipeline system would be minimized by the use of proper reclamation techniques.

4.6.7.1 ALTERNATIVE FF-1

This is the FAA's preferred fuel farm access alternative. Construction of the fuel farm access road would adversely and permanently affect just over 0.2 acres of native vegetation communities, including 0.2 acre of deciduous shrub-scrub, 0.01 acre of lichen-moss, and 0.02 acre of mixed woodland. Implementation of this alternative would account for a 0.9%, 20%, and 0.1% reduction in these community types within the project area, respectively. At the landscape level, impacts to the shrub-scrub and mixed woodland communities would be negligible. Proportional impacts to the lichen-moss community appear substantial due to the small size of the single patch of this vegetation type within the project area.

Construction and use of the fuel farm access road would have the potential to introduce and spread noxious weeds and other invasive species within the Northwest Development Area. This adverse indirect impact could be managed to some extent by requiring weed-free revegetation seed mixes, and washing of construction vehicles prior to site entry. Another potential indirect impact would be caused by fuel spills along the proposed access road. To the extent that fuel trucks leak or are likely to get in an accident along the new access road, there is potential for spilled fuel to adversely affect native plant communities along and downgradient of the route.

4.6.7.2 ALTERNATIVE FF-2

Construction of FF-2 would have relatively minor adverse effects on the mixed woodland, deciduous shrub-scrub, and lichen-moss communities. An approximate 50-foot construction corridor would be created to install the fuel pipelines, but the construction impacts would be short-term. Following installation of the pipeline, the alignment would be reclaimed and revegetated with an appropriate mix of native plant species, preferably species that do not attract wildlife hazardous to aircraft.

Alternative FF-2 could have two indirect impacts on vegetation. The first would be related to the introduction and spread of noxious weeds and other invasive species and, as such, would be similar to those indirect impacts described for Alternative FF-1.

Another type of indirect impact would occur if the fuel pipeline were to rupture. Depending on the location and severity of the break, there could be adverse impacts to plant species in the mixed woodland, deciduous shrub-scrub, and lichen-moss communities as well as to those in downgradient communities, such as coastal forb meadow, Lyngbye sedge, and other aquatic and estuarine environments. The potential for a large release to occur is probably lower under this alternative than it would be under FF-1 or FF-3, but the consequences of such an event on vegetation could be much greater.

4.6.7.3 Alternative FF-3

Alternative FF-3 would result in no change to existing refueling operations and would therefore have no direct impacts on vegetation in the project or landscape areas. Trucks would continue to cross Duck Creek and transport fuel on a non-secure, public roadway. The risk of accident, and the potential release of petroleum compounds into vegetation, is considered greatest for this alternative.

4.6.8 Wetlands

Direct impacts to wetland resources under either of these action alternatives would not be significant. Each alternative would affect approximately 0.04 acre of wetland, while Alternative FF-2 would have the least impact on wetland function of the two action alternatives. Neither alternative would have a substantial impact on hydrology needed to maintain wetland functions and values, and therefore no affect on sustainability of the natural systems that maintain habitat. There would be no direct or indirect impact on Refuge wetlands.

The environmental score, total acreage, and functional units for wetland types in the Northwest Development Area that could be affected by fuel farm access alternatives are summarized in the Methods descriptions of Section 4.2.8, Table 4-5.

4.6.8.1 Alternative FF-1

This is the FAA's preferred fuel farm access alternative. Construction of the fuel farm access road would permanently impact 0.04 acres and 4.1 functional units of palustrine shrub-scrub (PSS1) wetlands in the Northwest Development Area. This would result in a 0.6% change to overall wetland function in the Northwest Development Area. As is described in other sections, including Section 4.6.5, an accident involving a loaded fuel truck could have serious consequences for water resources, fish, vegetation, and also wetlands. However, the potential for an accident on a new fuel farm access road would decrease relative to the No Action Alternative (FF-3), since the new road would not allow public vehicles and the route would be entirely within the secure Airport confines.

4.6.8.2 Alternative FF-2

Alternative FF-2 would temporarily impact 0.04 acres and 4.1 functional units of palustrine shrub-scrub (PSS1) wetlands in the Northwest Development Area. The 50-foot-wide right-of-way would be cleared to construct the pipeline. Shrub-scrub vegetation would require mechanical removal along the pipeline corridor to prevent deep roots from interfering with pipeline integrity, but other palustrine emergent vegetation would be allowed to re-establish. Construction of the fuel pipelines would result in the loss of 0.1 functional units (due to conversion from palustrine shrub-scrub to palustrine emergent wetland). This represents a change of less than 0.1% in the Northwest Development Area.

The fuel pipelines exhibit even less potential for accidental spills or releases of petroleum compounds than refueling trucks. However, as discussed in other sections, including 4.6.5, the adverse consequences of a release from the fuel pipeline could be more severe on wetland and other natural resources than a release from fuel trucks.

4.6.8.3 ALTERNATIVE FF-3

Alternative FF-3 would result in no change to existing refueling operations and would therefore have no direct impacts on wetlands in the project or landscape areas. Trucks would continue to cross Duck Creek and transport fuel on a non-secure, public roadway; the risk of accident, and the potential affect of petroleum compounds upon Duck Creek wetlands, is considered greatest for this alternative.

4.6.9 FISHERIES

The primary direct impact of these actions relates to construction of a new crossing of Duck Creek in the Northwest Development Area. EFH in this reach is limited to the active stream channel, which would only be reduced by a small amount to accommodate the road crossing needed for a new access road. The primary, indirect impact relates to potential differences in the risk of a fuel spill due to vehicular accident or pipeline leak. Both adverse and beneficial impacts are possible. No direct effects on fish would result from FF-3, the No Action Alternative.

4.6.9.1 ALTERNATIVE FF-1

This is the FAA's preferred fuel farm access alternative. Construction of the bottomless concrete arch culvert for the new road crossing could disrupt fish movement in Duck Creek. These effects would be short-term in duration.

Approximately 60 linear feet of riparian habitat would be lost along both banks of stream corridor and replaced with the concrete arch culvert. This loss would be considered a minor, adverse impact since the primary goal for this reach is to facilitate fish migration, not encourage rearing or spawning. The new culvert would simulate stream conditions and ensure fish passage at all flows.

There may be a beneficial, indirect impact (relative to the No Action) consisting of a slight reduction in the risk of catastrophic fish kills due to accident-related fuel spills in or near Duck Creek, since the fuel delivery route would be shorter and more secure than the existing route along Cessna Drive.

4.6.9.2 ALTERNATIVE FF-2

Channel excavation and pipeline burial could temporarily disrupt fish movement in Duck Creek. These adverse effects would be short-term in nature. Construction techniques would be employed to minimize the potential for creek dewatering by the pipeline channel. There would be no direct, long-term impacts to fish, as the stream channel and riparian corridor would be restored to existing conditions following pipeline placement.

Indirectly, there may be a beneficial reduction in the risk of catastrophic fish kills due to vehicular accident-related fuel spills in or near Duck Creek, since fuel delivery would require no trucking across Duck Creek. Conversely, there would be increased potential for fuel leakage directly into groundwater and/or Duck Creek, both acute (e.g., a large break) and chronic (e.g., a small leak that may persist undetected or uncorrected for a long time). Both would require re-excavation to locate and repair the pipeline. The environmental harm caused by such an event could be greater than for a vehicle accident, since subsurface contamination is generally much more difficult to detect, confine, and clean up than surface contamination.

4.6.9.3 Alternative FF-3

No direct impacts to fish would be caused by the No Action Alternative. Indirectly, the risk of catastrophic fish kill due to vehicular accident-related fuel spill may increase gradually with greater use of the Airport and increased truck deliveries of fuel along the existing non-secure, public route.

4.6.10 Wildlife

Alternatives FF-1 and FF-2 would each result in short-term, construction-related impacts to wildlife and wildlife habitat in the Northwest Development Area. A new access road would also result in permanent changes to habitat, whereas the long-term effects of a buried pipeline system would be minimized by use of proper reclamation techniques. Alternative FF-3, the No Action Alternative, would have no direct impacts on wildlife or habitat.

4.6.10.1 Alternative FF-1

This is the FAA's preferred fuel farm access alternative. Construction of the fuel farm access road would adversely and permanently affect slightly more than 0.2 acres of wildlife habitat, including 0.2 acre of shrub-scrub and 0.02 acre of forest. Within the project area, implementation of this alternative would account for a 0.9% and 0.1% reduction in each of these community types, respectively. At the landscape level, these impacts would be negligible. Alternative FF-1 would have no effect on estuarine marsh communities.

General, high-interest, and sensitive wildlife species with potential to be affected by FF-1 are identical to those discussed under SREF-1B. They include raptors, songbirds, and the rufous hummingbird. Habitat for sensitive species including the Queen Charlotte goshawk, peregrine falcon, olive-sided flycatcher, and Townsend's warbler would also be affected. However, given the proportion of affected habitat relative to total available habitat across the landscape area for each of these species, habitat-related impacts to these species are expected to be negligible.

Construction and use of the fuel farm access road would have the potential to degrade wildlife habitat via the introduction and spread of noxious weeds and other invasive species within the Northwest Development Area. This adverse indirect impact could be managed by requiring weed-free revegetation seed mixes, and washing construction vehicles prior to site entry. A fuel spill along the proposed access road could cause harm to wildlife (see discussion on fish impacts, Section 4.6.9), particularly those species that are relatively immobile and could not easily relocate away from contamination. Vertebrate species would avoid contaminated areas and, overall, the long-term impacts to terrestrial and avian wildlife would be minor. The risk of a spill that would harm wildlife is believed to be greater for the No Action Alternative than with a new fuel farm access road.

4.6.10.2 ALTERNATIVE FF-2

Construction of FF-2 would have relatively minor adverse effects on the woodland and shrub-scrub wildlife habitats. An approximate 50-foot-wide construction corridor would be created to install the fuel pipelines, but the construction impacts would be short-term. Following installation of the pipeline, the alignment would be reclaimed and revegetated with an appropriate mix of native plant species that do not attract wildlife hazardous to aircraft. Over the long term, direct impacts to wildlife resulting from this alternative would be negligible. Because FF-2 would have no effect on estuarine marsh communities.

Alternative FF-2 could have two indirect impacts on wildlife habitat. The first would be related to the introduction and spread of noxious weeds and other invasive species and, as such, would be similar to those indirect impacts described for other alternatives resulting in new facilities in the Northwest Development Area.

Another type of indirect impact would occur if the fuel pipeline were to rupture. Depending on the location and severity of the break, there could be adverse impacts to woodland and shrub-scrub habitats as well as to habitat downgradient of the fuel lines, such as high marsh, Lyngbye sedge, and other aquatic and estuarine habitats. The potential for this type of event to occur is probably lower under this alternative than it would be under FF-1 or FF-3, but the consequences of such an event on wildlife could be much greater.

4.6.10.3 ALTERNATIVE FF-3

Alternative FF-3 would result in no change to existing refueling operations and would therefore have no direct impacts on wildlife habitat in the project or landscape areas. Trucks would continue to cross Duck Creek and transport fuel on a non-secure, public roadway, and the risk of accident, and the potential of petroleum compounds to affect habitats in and a long Duck Creek, is considered greatest for this alternative.

4.6.11 CULTURAL RESOURCES

No known historic properties would be affected by any of the fuel farm access alternatives. Alternative FF-1, the fuel farm road and the FAA's preferred fuel farm access alternative, and Alternative FF-2, the fuel pipeline, would follow approximately the same route to the existing Airport apron, across or through areas that have not previously been disturbed, at least in recent time. Both alternatives would require ground disturbance that could uncover subsurface cultural resource sites—sites potentially related to the known WWII-era historical use of the Airport or related to ethnographic use of the area by indigenous peoples.

Alternative FF-2 would result in slightly more ground disturbance than FF1, and would, therefore, have a slightly higher potential for encountering such subsurface sites. Alternative FF-3, the No Action Alternative, would not affect historic properties because it would cause no ground disturbance.

4.6.12 VISUAL RESOURCES

Both the fuel farm road (FF-1), the FAA's preferred fuel farm access alternative, and the fuel pipeline (FF-2) would follow the same route to existing Airport apron, across or through areas that have not previously been disturbed, in recent time. The sensitive viewpoint from which the fuel farm alternatives were assessed for visual impacts is the Dike Trail trailhead.

Each of the Action alternatives would result in minor, short-term visual impacts during construction as vegetation is cleared and heavy equipment is used to create a linear corridor through the Northwest Development Area between the fuel farm and the apron. The road would result in a long-term, linear contrast with existing conditions, but this effect would be minor, as the road would be screened from view by trees and other aviation facilities. A fuel pipeline corridor would have almost no long-term visual impact, since the area disturbed by burial of the pipeline would be reclaimed. A new refueling station, part of Alternative FF-2, would result in no change to the visual setting since it would be installed in an area already disturbed, partially paved, and with hangars and other buildings in the immediate vicinity. Alternative FF-3, No Action, would cause no changes to the existing visual environment.

4.6.13 DEPARTMENT OF TRANSPORTATION SECTION 4(F) LANDS

No significant, adverse impacts would occur to DOT Section 4(f) lands with any of the fuel farm access alternatives. Neither of the two action alternatives, construction and use of a fuel farm access road (FF-1) , the FAA's preferred fuel farm access alternative, or installation of fuel pipelines (FF-2), would involve direct impacts to the Refuge or Dike Trail. No changes in aircraft exposure noise or air quality impacts are expected. All of the fuel farm access alternatives, including the No Action, carry some risk of a release of petroleum products into the environment. As described in earlier sections, the current risk of release to Duck Creek and water resources would actually be lessened by use of a fuel farm road or fuel pipelines, in comparison to the No Action. The potential for impact to the Refuge downstream would therefore be lessened by either of the action alternatives.

Under Alternative FF-1, installation of an additional culvert in Duck Creek could cause indirect impacts upstream or downstream in the form of minor changes in channel shape or increased erosion. However, these changes would be insignificant to DOT Section 4(f) lands and would not measurably affect beneficial uses of the Refuge. There would be no constructive use impact to DOT Section 4(f) lands from construction and operation of a fuel farm access road or fuel pipelines.

4.7 Aviation Facilities Development

Section 2.8.2 of Chapter 2 describes two alternatives that would meet the existing and future demands for additional aviation facilities at JNU. The two action alternatives are similar, in that each would develop approximately 25 acres in the northeast portion of the Airport (the Northeast Development Area) and approximately 17 acres in the northwest portion of the Airport (the Northwest Development Area). Where the two alternatives differ is in their plans for Duck Creek. One action alternative (FW/RW-2) would relocate almost the entire reach of Duck Creek that is on Airport property. The other action alternative, FW/RW-1, would relocate only a portion of the creek, starting at the EVAR/Dike Trail crossing. A third alternative considered, the No Action, would not meet the Purpose and Need for new aviation facilities. Environmental consequences of the following alternatives are described in Sections 4.7.1 through 4.7.13:

- FW/RW-1: Full development of Northeast and Northwest Development Areas with partial Duck Creek relocation.
- FW/RW-2: Full development of Northeast and Northwest Development Areas with Duck Creek relocation. This is the FAA's preferred aviation facilities alternative.
- FW/RW-3: No Action.

As described in Section 2.10 of Chapter 2, development of aviation facilities in the Northeast Development Area in FW/RW-1 and FW/RW-2 would necessitate relocation of the RCO and ASOS. The RCO would be moved to the FAA's facility at Engineer's Cut, west of the Airport. This area has already been disturbed and designated for aviation uses. Environmental impacts at the Engineer's Cut to develop a new RCO would be short-term and would occur only during construction. The ASOS would be moved to either to a presently undisturbed site east of TEMSCO and just south of Miller-Honsinger Pond or to a presently undisturbed site southeast of TEMSCO, just north of Zig Zag Slough and the main parallel taxiway. Although relatively few environmental consequences are anticipated with development of a new ASOS and access road, the consequences of this development would be long-term to permanent. Environmental impacts from these two connected actions are described under FW/RW-1 (and should be assumed to be identical under FW/RW-2) in each of the resource analyses.

The conceptual aviation facilities layouts for these alternatives are shown on Figures 2-34 through 2-36, in Chapter 2. More detailed illustrations of changes to Duck Creek are shown in Figures 2-38 through 2-43.

4.7.1 Noise

Based on the methodology discussed in Section 4.2.1, the consequences of the aviation facilities development alternatives have been considered relative to aircraft operational noise exposure. Table 4-58 shows the predicted noise exposure contour areas for each alternative as determined using the INM. In short, the new rotary wing aircraft facilities associated with FW/RW-1 and FW/

RW-2 would result in a slight decrease to the noise contours, relative to the No Action. The total area within the 65 DNL and greater noise contour would decrease a total of 0.07 square miles from the No Action, from 1.08 to 1.01 square miles.

Table 4-58. Summary of Aircraft Noise Changes due to Aviation Facilities Alternatives (Year 2015)[1]

Alternative	60-65 NL	65-70 DNL	70-75 DNL	75 DNL+	65 DNL & Greater[2]
FW/RW-1	1.92	0.60	0.24	0.16	1.01
FW/RW-2	1.92	0.60	0.24	0.16	1.01
FW/RW-3 (No Action)	2.15	0.66	0.17	0.25	1.08

[1] Area in Square Miles
[2] Total may not equal sum of 65-70, 70-75, and 75+ DNL contour intervals as a result of rounding.
Source: BridgeNet International, October 2004

4.7.1.1 Alternatives FW/RW-1 and FW/RW-2

Both action alternatives would include expansion of the existing commercial hangars and apron area within the Northeast Development Area, as well as expansion of the helicopter tour operations. Similar to existing facilities, the new apron in the Northeast Development Area would include a final approach and takeoff area for rotary wing aircraft. The path to and from this area would parallel Taxiway A, the runway's parallel taxiway. In other words, rotary wing aircraft would approach and take off from the Airport following paths that are used today by helicopter traffic. However, one of the objectives for aviation facility development is to consolidate operations by aircraft type. Therefore, the assumption built into the INM for these alternatives is that rotary aircraft would arrive and depart from pads only in the Northeast Development Area, as opposed to the current use of pad locations in different Airport areas reflected in the No Action Alternative, FW/RW-3.

The proposed development of additional apron and hangar space in the Northeast and Northwest Development Areas is independent of the level of aviation activity accommodated at the Airport in the future. However, the additional rotary wing aircraft using JNU by year 2015 would follow the flight pattern described above, resulting in a slight change in noise exposure. Within the 65 DNL and greater noise contour, the two action alternatives would reduce the area exposed to significant noise by 0.07 square miles, or approximately 7%. Within the severe noise exposure contour (75 DNL and greater) the area would decrease, from 0.25 square miles under the No Action Alternative to 0.16 square miles (a 36% decrease) under both action alternatives, although noise would actually increase within the 70-75 DNL contour by approximately 40%. Based on the grid analysis, the proposed expansion of the commercial hangars and apron areas would not produce a significant change in aircraft noise levels (as defined by a 1.5 DNL increase over the No Action with respect to the 65 DNL and greater contour over noise sensitive areas) with either of the action alternatives.

Aside from the slight changes to noise contours described above, the new aviation facilities would result in no additional long-term impacts on aviation noise levels. Noise from construction of the aviation facilities would increase in the short term, but the levels would be comparable to other area developments (e.g., road work, new housing construction, etc.) and would not be significant. Relocation of the RCO and ASOS would also cause only short-term, construction-related noise increases and would cause no long-term changes to noise patterns.

4.7.1.2 Alternative FW/RW-3

Alternative FW/RW-3 would retain Airport facilities as they exist today, but with increasing levels of aircraft operation over time, as discussed in Chapter 1. Therefore, aircraft noise exposure conditions would be as shown on Table 4-6 and earlier presentations of noise for No Action Alternatives (e.g., RSA-8, in Section 4.3.1.6).

4.7.2 Human Environment and Compatible Land Use

With one exception, the aviation facilities would have no conflict with existing, designated land uses or land management plans. The actions considered would occur on Airport or FAA property and generally would comply with the Airport Master Plan.

The exception, which would occur under both action alternatives, would be the relocation of the entrance to the Dike Trail and the development of new parking and trail access facilities. There would be no changes in populations within noise contours as a result of either aviation facility alternative.

Development of aviation facilities in the Northeast Development Area would eliminate an area currently used by ultralight aircraft for recreational flying. The Airport has not identified a replacement facility or suitable location for the ultralights if their "runway" is eliminated. This action, incorporated into both facilities alternatives, would represent an adverse impact to a small group of recreational aviators.

For both aviation facility development alternatives, use of the Dike Trail would be temporarily disrupted for several days on two occasions, as the dike is breached to allow the dredge equipment (used to obtain fill for Airport projects) into and out of the Float Plane Pond. This action would constitute a minor, indirect, adverse impact on recreation activities. There could be other temporary disruptions to recreation on the Dike Trail related to full or partial relocation of the Duck Creek, but these should be short-term and minor.

4.7.2.1 Alternative FW/RW-1

Alternative FW/RW-1 would cause the permanent relocation of the entrance and initial portion of the Dike Trail, necessary for the construction and use of aviation facilities in the Northwest Development Area. A new parking structure and trail head would be established at about 9501 Radcliffe Road. A new footbridge would also be constructed to allow trail users to cross Duck Creek to access the trail. These direct changes would be permanent and beneficial. The designated parking area would provide easier parking for vehicles. The quality of the recreational experience on the Dike Trail would be only slightly changed and would not be degraded by this alternative, and since the trail would be separated from the emergency vehicle access road (EVAR), there would be fewer conflicts between users of the Dike Trail and the Airport.

Relocation of the RCO to the Engineer's Cut would be consistent with designated land uses for aviation purposes for that location. The ASOS would be moved either to a designated lease lot on Airport property, which could otherwise be used for private and/or commercial aviation facilities, or on Airport property within the Building Restriction Line, which would not otherwise be available for use by private and/or commercial aviation facilities. This action would be consistent with the Master Plan. Neither of these actions would affect any other recreational features or opportunities.

4.7.2.2 ALTERNATIVE FW/RW-2

This is the FAA's preferred aviation facilities alternative. Although this alternative incorporates a full relocation of Duck Creek on Airport and Refuge property, it would result in the same direct and indirect effects to the Dike Trail as described for Alternative FW/RW-1. Development of a new trail head, parking lot, and creek crossing would have no adverse impacts to the Dike Trail and, in fact, would probably benefit the recreational experience, in that it would reduce opportunities for conflict with Airport operations. The relocation of Duck Creek would require the use of approximately 0.2 acres of land on the Refuge and would be considered a minor, long term, adverse impact on the Refuge property. Use of this portion of the Refuge property for the relocation of Duck Creek would not alter the values or functions of the Refuge as a whole and would be compatible with existing land use.

4.7.2.3 ALTERNATIVE FW/RW-3

There would neither be direct impacts on the human environment nor land use changes associated with the No Action Alternative, FW/RW-3.

4.7.3 SOCIOECONOMIC IMPACTS

The following sections describe potential socioeconomic impacts resulting from the two aviation facility development alternatives. Table 4-59 presents a breakdown of project costs by each major facility for each alternative. Table 4-60 presents short-term economic benefits from construction of the aviation facility alternatives.

Table 4-61 presents potential lease revenue generated by the aviation facilities for the two alternatives. This revenue estimate assumes that all available private hangar and permanent tiedown space is leased year around. It does not include possible other revenues, such as those potentially derived from transient aircraft tiedown fees, leases of apron area adjacent to hangars, or commercial lease of some of these hangars (i.e., if a hangar is leased for commercial use, the lessee pays a higher rate than if it were leased for private use).

Table 4-59. Project Costs for Apron Development (2005 Dollars)

Alternative and Project Components	Project Cost
FW/RW-1	
Fixed and Rotary Wing Apron	$6,661,000
Hangars and Tiedowns	$10,228,000
RCO & ASOS Relocation[1]	$1,163,000
Total FW/RW-1	$18,052,000
FW/RW-2	
Fixed and Rotary Wing Apron	$6,661,000
Hangars and Tiedowns	$10,051,000
RCO & ASOS Relocation	$1,163,000
Duck Creek Relocation	$723,000
Total FW/RW-2	$18,597,000

Sources: Juneau International Airport Master Plan Update, USKH, 1999, and SWCA Project Team. Also, IMPLAN Pro 2000I input/output model.
[1] Estimate applies to both ASOS alternatives, though costs for the BRL ASOS site would be slightly lower because of the shorter access road.
Note: Hangar development includes costs for private developers building hangars on apron space constructed for the project.

Table 4-60. Construction Impact of Aviation Facilities Alternatives (2005 Dollars)

Alternative	Total Business Income	Total FTE Jobs	Total Payroll
FW/RW-1	$18,052,000	190	$7,281,000
FW/RW-2	$18,598,000	197	$7,501,000

Source: Juneau International Airport Master Plan Update, USKH, 1999, and SWCA Project Team. Also, IMPLAN Pro 2000 input/output model, Minnesota IMPLAN Group.

Table 4-61. Potential Lease Revenues from Apron Development

Facility	Average Annual Rate	Facilities in FW/RW-1	Revenues for FW/RW-1	Facilities in FW/RW-2	Revenues for FW/RW-2
Executive/T-Hangars[1]	$503	37	$18,611	38	$19,114
Tiedown Spaces	$540	29	$15,660	23	$12,420
FBO Space[2]	$2,720	9	$24,480	9	$24,480
Total Revenue			$58,751		$56,014

Table 4-61. Potential Lease Revenues from Apron Development, continued

Facility	Average Annual Rate	Facilities in FW/RW-1	Revenues for FW/RW-1	Facilities in FW/RW-2	Revenues for FW/RW-2
Revenue 2006-2015			$587,510		$560,140

Sources: JNU Management, Airport lease records; CBJ Administrative Code, Title 07, Ch.10, Rates and Fees.
[1] This is a blended lease rate – 75% t-hangars @ $372/yr and 25% executive hangars @ $899/yr.
[2] Assumes 8,000 square feet at the commercial ramp access rate of $0.34/square feet per year.
Note: This analysis includes only revenue to the Airport.

4.7.3.1 Alternatives FW/RW-1 and FW/RW-2

The aviation facility alternatives have relatively similar economic and social impacts. Because it involves slightly more development (i.e., the relocation of a portion of Duck Creek), Alternative FW/RW-2, the FAA's preferred aviation facilities alternative, would cost slightly more to construct than FW/RW-1; it would also create more new jobs and generate a slightly larger construction payroll.

Alternative FW/RW-1 would generate approximately $320,600 in sales tax for CBJ in the short term, whereas Alternative FW/RW-2 would generate approximately $330,300 in sales tax. The alternatives are similarly sized, with Alternative FW/RW-1 having more tiedown spaces but one less hangar. The estimated annual lease for Alternative FW/RW-1 is $58,751 while the lease for FW/RW-2 would be $56,014. These two facility development alternatives would provide other economic and social benefits, including the increased opportunities for private aviation, protection of investments in aircraft, and increased commercial business opportunity, which may indirectly cause creation of new jobs, income and business revenue.

Development of new aviation facilities would have few social impacts, and most of these are described in other sections. The parking area and entrance to the Dike Trail would be relocated under each alternative (see Sections 4.7.2.1 and 4.7.2.2). There would also be an increased level of activity, particularly during daylight hours, in the Northwest and Northeast Development Areas. In this respect, FW/RW-2 would have less effect on human populations near the Airport because the new Duck Creek channel would provide a visual and noise buffer.

There would be obvious social benefits to users of the Airport, particularly persons with business or aircraft on the Airport. The increased apron size would mean less airfield congestion and safer operations, particularly in terms of parking, aircraft movement, and snow removal operations.

4.7.3.2 Alternative FW/RW-3

The No Action Alternative, FW/RW-3, would have no short-term economic benefit to JNU or CBJ, as there would be no construction, added jobs, or increase in local payroll or sales tax. Furthermore, Alternative FW/RW-3 could have negative, long-term economic consequences in the form of increasingly constricted apron space, limited tiedowns and aircraft parking, a shortage of hangars for storing private and business aircraft, and a lack of development space and facilities for new commercial operations. These factors would impede economic growth at the Airport and in CBJ.

4.7.4 AIR QUALITY

Neither of the two action alternatives would affect aircraft taxi patterns or the time–in-mode of aircraft operations, although some changes in taxi/idle/delay time could be experienced as a result of the new facility locations. Air quality impacts from changes in taxi/idle/delay time would be very minor and insignificant, although they cannot be reliably quantified. In sum, the predicted future operating emissions for the two action alternatives are the same as for the No Action Alternative, FW/RW-3, and reflect the same values as the baseline values predicted for the year 2015.

General increased operating emissions for the entire Airport are attributable to the predicted 9% increase in annual aircraft operations over that timeframe and associated aircraft fleet changes and are unaffected by the new aviation facilities (see Chapter 1, Table 1-4). Table 4-62 shows the estimated Airport operational emissions in the year 2015 as well as the short-term, construction-related emissions of criteria pollutants and fugitive dust for each aviation facility alternative.

Table 4-62. Operations and Construction-related Emissions (Peak Year): Aviation Facilities Alternatives

Project	Tons Per Year Vehicle Exhaust					Fugitive Dust (tons)
	CO	NOx	VOC	SOx	PM_{10}/ $PM_{2.5}$	
Operating (2015)[1]	1,154.7	70.6	63.1	7.2	1.5	NA
Construction						
FW/RW-1	9.6	12.3	1.9	1.1	1.5	18.0
FW/RW-2	17.8	30.2	4.2	2.7	3.1	24.0
FW/RW-3 No Action	NA	NA	NA	NA	NA	NA

[1] All three aviation facility alternatives would have same operating emissions, as the alternatives do not affect aviation or airfield activity.
Note: $PM_{2.5}$ emissions are estimated to be equal to PM_{10} emissions for the purpose of this analysis.
Source: BridgeNet International and Synergy Consultants, October 2004

The following sections discuss the operating, construction, and fugitive dust emissions associated with each alternative.

4.7.4.1 ALTERNATIVES FW/RW-1 AND FW/RW-2

Both of these alternatives would result in greater aircraft- and support-equipment operating efficiencies than would occur under the No Action Alternative. However, it is not possible to quantify the effects these efficiencies would have on reducing either taxi/idle/delay time (and emissions) of fixed or rotary wing aircraft or the equipment (and emissions) that service these aircraft, but the benefits to air quality from increased efficiency likely would be minor. Therefore, using conservative assumptions (that likely have overestimated the emissions), the Airport operating conditions and resulting emissions associated with these alternatives were assumed to be the same as the No Action.

As shown on Table 4-62, during construction of the fixed and rotary wing aircraft parking facilities and the new RCO and ASOS facilities, there would be short-term emissions of criteria pollutants from the construction equipment. Site disturbance would also release fugitive dust. The construction-related emissions represent short-term, adverse impacts necessary to build the new aviation facilities and relocate the RCO and ASOS. Fugitive dust levels may be controlled and reduced by watering disturbed areas periodically during dry seasons.

During the year of construction, a substantial portion of the construction emissions associated with Alternative FW/RW-2, the FAA's preferred aviation facilities alternative, would occur in relocating the entire Airport reach of Duck Creek. Fugitive dust levels could reach 24 tons during construction, assuming a dry construction season (see Table 4-62). Emissions of criteria pollutants would also be greater.

4.7.4.2 Alternative FW/RW-3

Alternative FW/RW-3 would retain the fixed and rotary wing aircraft facilities as they are today. Over the planning period (through year 2015), airfield facilities and operations would become increasingly inefficient as the 9% growth forecasted in general aviation operation was accommodated. Aircraft parking would become very congested, and additional employees would be required to move aircraft and ensure that passenger loading and unloading was conducted quickly and safely. It is not possible to quantify the effect inefficient operations would have on emissions, but the No Action Alternative would almost certainly increase taxi/idle/delay time and thereby increase aircraft operating emissions of criteria pollutants. There would be no short-term, construction-related exhaust or fugitive dust emissions generated by this alternative.

4.7.5 Hazardous Materials and Solid Waste

A search of environmental databases and a review of historic aerial photographs suggest that the areas considered for construction of new aviation facilities, the RCO, and the ASOS have a relatively low probability of containing buried solid or hazardous waste, with one exception: near the TEMSCO facility.

The Northeast Development Area is very open, and a field reconnaissance for this EIS identified no visible areas of waste disposal. However, in March 1999, work was undertaken to remove contaminated soil and old petroleum-delivery piping from an area immediately adjacent to the TEMSCO hangar. Approximately 75 cubic yards of petroleum-contaminated soil, containing diesel, gasoline, and other compounds, were excavated and removed. Contaminated soil was also found adjacent to the hangar at a depth of 5 feet below ground surface, but the building foundation and the presence of an above-ground storage tank prevented further soil remediation. Therefore, development of aviation facilities in the area near the TEMSCO hangar would have the potential to unearth contaminated soils and/or groundwater.

The Northwest Development Area is heavily vegetated in some areas, and it was not possible to thoroughly inspect the entire area that would be disturbed for aviation facilities. Areas that were inspected exhibited no evidence of waste disposal. Although the fuel farm and adjacent areas have been the site of fuel spills and leaks, leading to subsurface contamination in some areas, the fuel farm is sufficiently upgradient and distant from the area planned for development in FW/RW-1 and FW/RW-2, the FAA's preferred aviation facilities alternative. Nevertheless, there is some possibility of fuel farm-related contamination during excavation and ground preparation in the Northwest Development Area. There is a low probability that asbestos-containing materials would be uncovered during construction or remediation. The existing ASOS and RTR facilities could have asbestos-containing materials, such as transite pipe, but a survey has not been conducted to make a final determination.

Construction of the aviation facilities and new RCO and ASOS would generate solid waste, but this waste would be disposed at the local landfill. Construction and operation of the new facilities would not change the types or amounts of hazardous wastes generated at the Airport or hazardous materials consumed by Airport uses.

The additional loads of anti-icing and de-icing compounds that would be generated in the Northeast and Northwest Development Areas remain a concern. JNU does not have stormwater treatment within the infield beyond that provided by the natural filtration of soil and vegetation. The Airport has committed to install oil/water separators or similar systems on the stormwater discharges leading to Duck Creek and Miller-Honsinger Slough, which would provide some treatment to discharge coming from the Northeast and Northwest Development Areas. These systems would reduce quantities of oil and grease and possibly sediments in stormwater discharge, but they would have little or no effect on urea and other pollutants.

4.7.6 Water Resources and Floodplains

Each of the aviation facilities action alternatives could have short-term and long-term, adverse environmental impacts to water resources, as these alternatives are sited in areas of the Airport that include floodplain and wetlands. Some beneficial impact may accrue due to the better design of facilities and routing of stormwater runoff. This section first describes common attributes and consequences of the two action alternatives, followed by specific explanation of the differences in impacts between the two alternatives.

4.7.6.1 Impacts Common to Both Action Alternatives

Full development of the Northeast Development Area, common to both alternatives, requires filling over 21 acres to a base elevation of 17 feet msl and covering the area with an impervious surface. This increase in impervious surface would result in a 9-acre-foot increase in stormwater runoff volume for the 100-year storm event. Approximately 105,700 cubic yards of fill would be placed in the floodplain/marshplain, resulting in loss of 64 acre-feet for floodplain/marshplain storage in the East Runway Slough.

Dredging in the Float Plane Pond to obtain construction fill would create turbidity in the pond and may result in increased turbidity in Duck Creek, Zig Zag Slough, TEMSCO Slough, Miller-Honsinger Slough, East Runway Slough, and the Mendenhall River, depending on erosion control measures and weather.

The increased stormwater runoff represents a long-term, direct effect that would occur periodically during rain events; the indirect effects on habitat and aquatic life from the increased runoff would also be long-term. The loss of floodplain storage would be evident on a daily basis during high tides. The effect may be particularly noticeable in the Northeast Development Area where high tides provide recharge through a culvert into the Zig Zag Slough, a drainage channel installed as required mitigation for other Airport projects. Development in the northeast portion of the Airport would eliminate the western portion of Zig Zag Slough and all recharge/floodplain storage potential in this area. These losses would be permanent.

Increased stormwater runoff and loss of floodplain storage can cause geomorphologic changes to surface water channels. Bank erosion and other channel changes in Duck Creek may also be caused by the installation of new structures in the channel. These adverse impacts may occur both upstream and downstream. Similarly, changes to the form of tidal channels feeding East Runway Slough may result from fill in the Northeast Development Area.

New development in the Northeast and Northwest Development Areas would bring new aviation facilities and Airport operations into previously undisturbed locations; vehicles, aircraft, and snow removal and other equipment would regularly traverse these areas. These new or increased disturbances would not increase the amount of discharge pollutants (e.g., oil, grease, or de-icing compounds), since the level of aviation activity is expected to increase regardless of the alternative implemented. The development would, however, complicate the control of these contaminants due to the increased impervious surface and increased volumes of stormwater runoff. Without more sophisticated stormwater capture and treatment systems to accompany the implementation of the action alternatives, adverse impacts to water quality would be expected.

4.7.6.2 Alternative FW/RW-1

Alternative FW-RW-1 would result in the development of new impervious surface in the Northeast and Northwest Development Areas. A short reach of Duck Creek, extending from about where Radcliffe Road crosses it to its discharge into the Mendenhall River, would be relocated to the north. Two 35-foot-wide bridges would be installed over the existing Duck Creek corridor to connect the new aviation facilities to existing apron and taxiway. The bridges would be designed to pass 550 cfs, which is greater than the 100-year flood flow on Duck Creek but is still a constriction on the floodway width. Table 4-63 is a summary of stormwater impacts, by drainage basin, for Alternative FW/RW-1.

Full development of the Northwest Development Area would require filling over 17 acres to a base elevation of 19 feet msl and covering the area with an impervious surface. There would be an approximate 7.3 acre-feet increase in runoff for the 100-year storm event. Approximately 3,350 cubic yards of fill would be placed in the floodplain, resulting in a loss of 2 acre-feet of flood storage along Duck Creek.

Table 4-63. Summary of FW/RW-1 Stormwater Impacts

	Mendenhall River		Gastineau Channel		JNU Total
	Mendenhall River	Duck Creek	Jordan Creek	M-H/East Runway Sloughs	
New Impervious Surface (acres)	0.0	17.0	0.0	21.0	38.0
Percent Increase	0%	33%	0%	52%	19%
New runoff – 50-yr (acre-ft)	0.0	6.4	0.0	8.0	14.4
Percent Increase	0%	47%	0%	121%	7%
New runoff – 100-yr (acre-ft)	0.0	7.3	0.0	9.1	16.4
Percent Increase	0%	47%	0%	121%	8%

Source: Vigil-Agrimis 2004

Flooding in the vicinity of the proposed crossings is influenced by tidal inundation, backwater flooding from the Mendenhall River, and the drainage from Duck Creek. The 100-year storm event of Duck Creek would probably produce a flow that is on the order of 100 cfs, less than the 550 cfs capacity of the crossings. However, the 100 cfs flow rate does not account for either tidal or backwater influences. These flows are largely responsible for the base flood elevations identified by FEMA for the Duck Creek floodplain (see Figure 4-1). It is therefore reasonable to assume that flooding immediately upstream of the crossing would increase as a result of a loss in channel and floodplain capacity. The confluence of the relocated Duck Creek channel and the Mendenhall River would remain outside of the regulatory mixing zone for the Mendenhall treatment plant.

The new impervious surface in the Northwest Development Area would result in an estimated 47% increase to stormwater runoff volume. New impervious surface in the Northeast Development Area would result in a 52% increase in impervious surface draining from the Airport directly to the East Runway Slough, causing an estimated 121% increase in stormwater runoff volume.

4.7.6.3 ALTERNATIVE FW/RW-2

This alternative, which is the FAA's preferred aviation facilities alternative, has a similar development scenario, in that new aviation facilities would be created in the Northeast and Northwest Development Areas. The development in the northeast would be as described for FW/RW-1. The difference would occur in the Northwest Development Area: Duck Creek would be relocated toward the northern Airport boundary. Table 4-64 is a summary of stormwater impacts, by drainage basin, for Alternative FW/RW-2.

Full development of the Northwest Development Area would require filling over 17 acres to a base elevation of 19 feet msl and covering the area with an impervious surface. There would be an approximate 7.3 acre-feet increase in runoff for the 100-year storm event in this area, with all runoff discharging to lower Duck Creek or the Mendenhall River. Approximately 2,500 cubic

Table 4-64. Summary of FW/RW-2 Stormwater Impacts

	Mendenhall River		Gastineau Channel		JNU Total
	Menden-hall River	Duck Creek	Jordan Creek	M-H/East Runway Sloughs	
New Impervious Surface (acres)	9.7	7.3	0.0	21.0	38.0
Percent Increase	19%	14%	0%	52%	19%
New runoff – 50-yr (acre-ft)	3.6	2.7	0.0	8.0	14.4
Percent Increase	27%	13%	0%	121%	7%
New runoff – 100-yr (acre-ft)	4.1	3.1	0.0	9.1	16.3
Percent Increase	27%	20%	0%	121%	8.1%

Source: Vigil-Agrimis 2004

yards of fill would be placed in the floodplain, resulting in a loss of 1.6 acre-feet of flood storage along Duck Creek. However, relocation of Duck Creek would entail the excavation of approximately 115,100 cubic yards of material to create a new channel and setbacks. Approximately 71 acre-feet of new floodplain storage would be created, resulting in a net gain in floodplain storage in this area of approximately 69.4 acre-feet. Under this alternative, the confluence of the relocated creek and the Mendenhall River would remain outside of the regulatory mixing zone for the Mendenhall treatment plant.

In addition, the realignment would increase the gradient of the Duck Creek channel, which would cause an increase in flow velocities and provide better conveyance capacity for the creek. Installing an impervious liner underneath the relocated stream channel would minimize the loss of water from the channel, providing more consistent stream flows and indirectly benefiting water quality and aquatic habitat.

The realignment of Duck Creek would also change some of the existing drainage patterns on Airport property. Fifty-seven percent (57%) of the runoff that currently drains into Duck Creek would be rerouted to drain directly into the Mendenhall River. Included in this 57% is runoff from 14.3 acres that habitually receives application of urea used for runway and taxiway de-icing, as well as runoff from 0.5 acres that receives application of glycol, used for plane de-icing. Rerouting the stormwater does not change the contaminant load, but it may indirectly result in an overall water quality improvement to Duck Creek, since the larger Mendenhall River can more easily dilute the contaminant load.

The new impervious surface in the Northwest Development Area would result in an additional estimated 7.3 acre-feet of stormwater runoff, which is an increase of 14% above existing conditions. As with FW/RW-1, new impervious surface in the Northeast Development Area would result in a 52% increase in impervious surface draining from the Airport directly to the East Runway Slough, causing an estimated 121% increase in stormwater runoff volume for the 100-year flood event.

The realignment of Duck Creek in FW/RW-2 would reduce the length of Duck Creek from 3,000 feet to approximately 2,500 feet: a net loss of approximately 500 feet. Shortening the channel would result in steeper channel gradient, which would speed flows and increase conveyance, which in turn would provide indirect benefits to aquatic habitat, particularly fish migration.

In summary, for alternative FW/RW-2, the realignment of Duck Creek is expected to result in the following additional benefits to water resources, relative to existing conditions:

- Duck Creek would have a better channel conveyance.
- Increased grade and velocities would improve the water quality of Duck Creek, including an enhanced ability to flush out iron floc that contributes to low dissolved oxygen levels in the Creek.
- Lining the new Duck Creek channel with an impervious liner would minimize infiltration loss.
- Duck Creek would have greater floodplain storage capacity.
- Less stormwater drainage to Duck Creek would reduce the amount of urea and glycol de-icing chemicals draining into the Creek from the Airport.

4.7.6.4 ALTERNATIVE FW/RW-3

No new aviation facilities would be developed on the Airport under this alternative. As a result, there would be no changes to floodplain storage or to the amount or quality of stormwater runoff.

4.7.7 VEGETATION

Table 4-65 provides a summary of the direct impacts to plant communities that would be associated with the construction of aviation facilities in the Northwest and Northeast Development Areas. It is important to note that, for any given plant community in the table, the sum of "acres lost" and "acres left" under one of the three headings ("Northwest Airport Area," "Northeast Airport Area," or "Total Impact") equals a constant number: the total acreage of that given plant community within the total project area. The "percent change" reflects the change/loss in terms of total project area:

$$\frac{\text{acres lost}}{(\text{acres lost} + \text{acres left})}$$

This was done to show how development of either the Northwest or Northeast Development Area would affect the total project area vegetation. Of course, both alternatives would result in the development of both sites. Thus, the third heading, titled "Total Impacts," summarizes the vegetation impacts within the Northwest and Northeast Development Areas and the percent of each community type affected in the project area as a whole.

Table 4-65. Summary of Vegetation Impacts Associated with Aviation Facilities Alternatives FW/RW-1 and FW/RW-2 [1]

Plant Community	Northwest Airport Area			Northeast Airport Area			Total Impact		
	Ac. Lost	Ac. Left	Percent Change	Ac. Lost	Ac. Left	Percent Change	Ac. Lost	Ac. Left	Percent Change
Algae Tidal	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.6	0.0
Beach Rye	0.2	27.0	0.7	0.0	27.2	0.0	0.2	27.0	0.7
Beach Rye-Beach Pea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Coastal Forb Meadow	5.5	39.3	12.3	22.0	22.8	49.1	27.5	17.3	61.4
Coastal Grass Meadow	0.5	72.5	0.7	4.8	68.2	6.6	5.3	67.7	7.3
Deciduous Scrub-Shrub	7.4	15.2	32.7	0.0	22.6	0.0	7.4	15.3	32.7
Deciduous Forest	3.1	0.1	96.9	0.0	3.2	0.0	3.1	0.1	96.9
Disturbed	0.0	35.9	0.0	0.6	35.3	1.7	0.6	35.3	1.7
Ditch Grass	0.0	4.8	0.0	0.0	4.8	0.0	0.0	4.8	0.0
Fresh Grass Marsh	0.2	7.3	2.7	0.0	7.5	0.0	0.2	7.3	2.7
Fresh Sedge Marsh	0.0	1.4	0.0	0.0	1.4	0.0	0.0	1.4	0.0
Lichen-Moss	0.1	0.0	100.0	0.0	0.1	0.0	0.1	0.1	100.0
Lyngbye Sedge	0.9	19.0	4.5	0.0	19.9	0.0	0.9	19.0	4.5
Marestail	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0
Mixed Woodland	2.6	23.4	10.0	0.0	26.0	0.0	2.6	23.4	10.0
Open Water	0.2	86.3	0.2	0.0	86.5	0.0	0.0	86.3	0.2
Pacific Alkali Grass-Goosetongue	0.0	9.9	0.0	0.0	9.9	0.0	0.0	9.9	0.0
Pacific Alkali Grass-Lyngbye Sedge	0.0	4.1	0.0	0.0	4.1	0.0	0.0	4.1	0.0
Reed Canary Grass	0.0	3.5	0.0	0.6	2.9	17.1	0.6	2.9	17.1
Sand	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0
Seeded Grassland	0.2	41.8	0.5	2.2	39.8	5.2	2.4	39.6	5.7
Sphagnum Bog	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.6	0.0
Spruce Forest	0.1	13.4	0.7	0.0	13.5	0.0	0.1	13.4	0.7
Unvegetated Tidal	0.3	32.2	0.9	0.0	32.5	0.0	0.0	32.5	0.0
Totals	**21.3**	**439.6**	**4.6**	**30.2**	**429.5**	**6.6**	**51.5**	**408.3**	**11.2**

[1] Numbers do not reflect impacts caused by relocation of the ASOS to south of Miller-Honsinger Pond.

Although the location and extent of the relocation of Duck Creek would vary by alternative, approximately the same level of impact to vegetation would occur in the Northwest Development Area under each alternative. Development of the Northeast Area would be the same under each of the alternatives. The ASOS, currently located in the Northeast Development Area, would be moved under each of these alternatives. Impacts to vegetation resulting from relocation of the ASOS are discussed under Alternative FW/RW-1. There would be no adverse affect on vegetation resources at the RCO relocation site, Engineer's Cut, as the area has already been cleared and disturbed.

4.7.7.1 Alternative FW/RW-1

Under FW/RW-1, the Northwest Development Area north of the Duck Creek buffer zone would be filled and paved to provide hangars and tiedowns for general aviation. As a result, there would be a loss of 20.1 acres of vegetation, composed primarily of deciduous shrub-scrub, coastal forb meadow, deciduous woodland, and mixed woodland. If considered as an independent action, development of this area would have the greatest relative impact on the lichen-moss community, a 0.1-acre patch of which would be lost. Alternative FW/RW-1 would also affect 96.9% of the deciduous forest and 32.3% of deciduous shrub-scrub within the project area.

The construction of aviation facilities in the Northeast Development Area would primarily impact the coastal forb meadow and coastal grass meadow communities. Within the project area, this action would reduce the coverage of these communities by 22.0 acres (49.1%) and 4.8 acres (6.6%), respectively. In conjunction with these impacts, relocation of the ASOS facility to the East of TEMSCO site just south of Miller Honsinger Pond would adversely affect 0.4 acre of coastal grass meadow, or 0.6% of its coverage within the project area.[10] The same type of vegetation would be impacted in the BRL ASOS site, though at lesser acreage because of the shorter access road associated with this second location.

Cumulatively, the actions under FW/RW-1 would directly affect 10.9% of vegetative cover within the project area and would result in the loss of 27.5 acres (61.4%) of coastal forb meadow, 5.3 acres (7.3%) of coastal grass meadow, and 7.3 acres (32.3%) of deciduous shrub-scrub. Notably, the 3.1-acre loss of deciduous forest directly resulting from implementation of FW/RW-1 would result in a 96.9% decrease in the coverage of this plant community within the project area.

When viewed in terms of their corresponding landscape-area vegetation types, these losses comprise a 0.6% reduction in high marsh vegetation, a 17.6% reduction in supratidal, and a 21.3% reduction in shrub-scrub. In addition, 6.2% of forest cover within the landscape area would be impacted by implementation of this alternative. All of these impacts would be permanent.

Potential indirect impacts to vegetation associated with Alternative FW/RW-1 would be similar to those described for most of the other proposed actions, i.e., the introduction and spread of noxious weeds and other invasive species. The majority of the Northwest and Northeast Development Areas would be paved following implementation of this alternative, but areas in which weeds

10. ASOS impacts are not reflected in Table 4-54, but are shown in the alternative summary, Table 2-20.

would likely be a concern are the modified Duck Creek corridor and the coastal grass meadow/ high marsh community around the relocated ASOS facility, particularly in conjunction with RSA alternatives that could limit tidal inundation in this area.

4.7.7.2 Alternative FW/RW-2

Under FW/RW-2, the FAA's preferred aviation facilities alternative, Duck Creek would be moved toward the northern boundary of the Northwest Development Area, where it would be flanked by a buffer zone averaging more than 50 feet wide. The newly constructed floodplain would be revegetated with appropriate native species, and the vegetation in the Creek's old location, south of the buffer zone, would be removed and replaced by fill material and pavement. Direct and indirect impacts to vegetation under Alternative FW/RW-2 would therefore be similar to those described for FW/RW-1, with the following exceptions.

Excavation of the new Duck Creek channel and floodplain and fill of the existing channel would impact approximately 8.2 acres of vegetation. The majority of these impacts (4.4 acres) would be to the deciduous shrub-scrub community. In addition, 1.1 acres of deciduous woodland, 1.0 acre of mixed woodland, 0.4 acre of coastal forb meadow, and 0.3 acre of Lyngbye sedge, along with 0.2 acre of seeded grassland and minor amounts of lichen-moss, spruce, open water, and unvegetated tidal, would be removed and paved over. Approximately 0.5 acres of the existing creek channel (open water) would be infilled. Portions of an existing parking lot would also be removed under this alternative.

After the new channel and floodplain are constructed, the above vegetation types and parking lot would be replaced with approximately 3.0 acres of deciduous shrub-scrub, 1.5 acres of coastal forb meadow, 1.4 acres of mixed woodland, 1.2 acres of Lyngbye sedge, 0.9 acre of open water, and 0.2 acre of seeded grassland. Thus, over time, relocation of Duck Creek would result in no net loss or gain of native cover types.

4.7.7.3 Alternative FW/RW-3

Under this alternative, there would be no impact to plant communities within the Northwest and Northeast Development Areas related to the development of aviation facilities. While there may be vegetation impacts in the Northwest Development Area relating to the relocation of Duck Creek for wildlife hazard management purposes, these are described in Section 4.8.7.

4.7.8 Wetlands

Table 4-5 in Section 4.2.8 summarizes the environmental score, total acreage, and functional units for wetland types in the Northwest and Northeast Development Areas. Subsequent tables in following sections describe the impact acreage and loss of functional units associated with the two action alternatives.

Development of the aviation facilities would require relocation of the RCO to the Engineer's Cut, west of the Airport, and construction of a new ASOS facility and access road east of TEMSCO, just south of Miller-Honsinger Pond. There are no wetlands at the proposed site for the relocated

RCO on Engineer's Cut. Construction of the ASOS and access road, east of TEMSCO, would result in the permanent loss of 0.4 acre of estuarine high marsh wetland (E2EM1). The same type of high marsh wetland would be impacted by relocation of the ASOS to the BRL site, though lesser acreage would be impacted because of the shorter access road associated with this second location.

Following the significance criteria listed in Section 4.2.8 from the FAA's Order 1050.1E (FAA 2004a), both aviation facilities development alternatives would have substantial short-term and long-term impacts to wetland resources in the Northwest and Northeast Development Areas of the Airport.

4.7.8.1 ALTERNATIVE FW/RW-1

Full development of aviation facilities without Duck Creek relocation would result in the loss of approximately 5.0 acres of wetlands in the Northwest Development Area and 19.9 acres in the Northeast Development Area, with direct wetland impacts totaling 24.9 acres. The filling and grading of the development areas would reduce wetland functions and values, but the short reach of Duck Creek, from Radcliffe Road down to the Mendenhall River mouth, would be replaced with a new channel that should improve surrounding wetlands and riparian habitat. Direct effects of FW/RW-1 are summarized by wetland type in Table 4-66.

Of the two aviation facilities action alternatives, Alternative FW/RW-1 would have the greater net adverse effect on wetland resources. Flood control by estuarine and palustrine wetland types would be eliminated in lower Duck Creek, since the total wetland area in the northwest portion of the Airport would be reduced by approximately 81%. The installation of mostly impervious surface in the Northwest Development Area would cause a loss of flood storage due to the direct loss of wetlands.

Most of Zig Zag Slough would be eliminated in the Northeast Development Area, and there would be a loss of hydrologic connectivity to the wetlands south of Miller-Honsinger Slough. These hydrologic alterations would have an adverse effect on functions and values of the wetlands, including the estuarine slough channel dynamics and other natural systems that support EFH and nutrient transformation and export. However, the available fish habitat is currently limited to the 0.1 acres of slough channels in the Northeast Development Area. Where impacts would occur, high marsh (E2EM1) wetlands are at an elevation that is seldom flooded and that provides little fish habitat. Additionally, this alternative would not have a direct, adverse effect on Refuge wetlands.

4.7.8.2 ALTERNATIVE FW/RW-2

This is the FAA's preferred aviation facilities alternative. Duck Creek's existing riverine and estuarine channels would be filled, and the Creek would be relocated along the northwest Airport boundary and flanked by a buffer zone at least 50 feet wide on either side. Most of the remainder of the Northwest Development Area would be fully built out for aviation facilities. The Duck

Table 4-66. Alternatives FW/RW-1 Impacts to Wetland Resources

Wetland Analysis Area	NWI Classification					
	PEM1	PSS1	E2EM1 (H)	E2USN**	R3UB2	Total
Northwest Airport Area						
Acreage Lost	0.5	0.9	3.1	0.3	0.2	5.0
Functional Units Lost	46.2	86.2	337.0	33.1	22.4	524.9
Percent Change***	100.0	100.0	96.9	60.0	66.7	81.2
Northeast Airport Area						
Acreage Lost	5.0	--	14.8****	0.1	--	19.9
Functional Units Lost	525.0	--	1721.3	12.5	--	2258.8
Percent Change***	94.3	--	46.8	8.3	--	50.2
Totals						
Acreage Lost						24.9
Functional Units Lost						2783.8
Total Percent Change†						8.6

* Impacts to wetland resources would be the same for either alternative.
** Partial riverine wetland function would be retained with culverts or bridges in the Northwest Development Area.
*** Percent change in functional units within the development area.
****Includes acreage for the east of TEMSCO location. Impacts with the BRL location would be slightly lower.
† Percent change of wetland acreage over the project area (by wetland type).

Creek buffer zone would be revegetated with native species comprising high and low estuarine marsh plant communities (see Section 4.7.7.2). Many wetland functions of the original Duck Creek would be restored or improved in the new channel.

Approximately 2,450 feet of Duck Creek channel would be rerouted. It was assumed that the tidal influence would occur approximately 1,800 linear feet up the relocated channel and would create estuarine wetlands up to this point. The average channel width in this design is approximately 15 feet, creating 0.6 acres of estuarine sloughs (E2USN) and 0.2 acres of riverine channel (R3UB2). To determine net impacts, it was assumed that wetlands would develop within the floodplain of the rerouted channel. The average floodplain width in this design is 151 feet, for a total corridor area of approximately 8.2 acres. Based on the design presented in Figure 2-35, it is estimated that approximately 1.5 acres of high estuarine marsh (E2EM1-High), 1.2 acres of low estuarine marsh (E2EM1-Low), 0.6 acres of intertidal estuarine wetlands (E2USN), 0.2 acres of lower riparian areas (R3UB2), and 0.1 acres of palustrine shrub-scrub wetlands (PSS1) would form within the floodplain area.

Alternative FW/RW-2 would have less of an impact on wetland resources than FW/RW-1. Full development with Duck Creek relocation would result in the net loss of 19.8 wetland acres in the Northeast Development Area and a net loss of 1.4 acre of wetlands in the Northwest Development

Area, for a total wetland loss of 21.2 acres. In the short term, fish habitat would be reduced by construction impacts. In the long term, the stream would be restored to enhance fish movement upstream and downstream. Net impacts (post-Duck Creek relocation) are summarized by wetland type in Table 4-67; positive and negative numbers are presented in this table to show the net gain or loss of wetland acreage and function.

Table 4-67. Alternative FW/RW-2 Net Impacts to Wetland Resources

Wetland Analysis Area	NWI Classification							
	PEM1	PSS1	R3UB2	E1UB3	E2EM1 (H)	E2EM1 (L)	E2USN	Total
Northwest Airport Area								
Acreage Lost(-)/ Gained(+)	-0.2	-0.8	--	-0.3	-1.6	+1.2	+0.3	-1.4
Functional Units Lost/Gained	-18.5	-76.6-	--	-38.3	-174.0	+132.9	+37.5	-137.0
Percent Change*	-40.0	-88.9	--	-8.4	-42.2	+71.4	+30.0	-11.3
Northeast Airport Area								
Acreage Lost/Gained	-5.0	--	--	--	-14.8	--	-0.1	-19.8
Functional Units Lost/Gained	-595.5	--	--	--	-1721.3	--	-12.5	-2246.4
Percent Change*	-94.3	--	--	--	-46.8	--	-8.3	-49.8
Totals								
Acreage Lost								21.2
Functional Units Lost								2383.4
Total Percent Change**								-7.5

* Percent change in functional units by development area.
** Percent change of wetland acreage over the project area.

Of the two aviation facility action alternatives, Alternative FW/RW-2 would have less direct and indirect adverse effect on wetland resources, with the difference being associated with relocation of Duck Creek and restoration of the riparian channel. However, the substantial hydrologic alterations, particularly in the Northeast Development Area, would affect functions and values of the surrounding wetlands, including the estuarine slough channel dynamics and other natural systems that support EFH and nutrient transformation and export. Where impacts would occur, high marsh (E2EM1) wetlands are at an elevation that is seldom flooded and that provides little fish habitat. Additionally, this alternative would not have a direct, adverse effect on Refuge wetlands.

Other indirect effects, some adverse, some beneficial, would occur if FW/RW-2 was implemented. Flood control or alleviation in the Duck Creek floodplain would be temporarily reduced until wetlands vegetation was established along the banks of relocated Duck Creek. Wildlife hazards would be reduced at the west, Runway 08 end, since fish would have to move further up the Mendenhall River before entering Duck Creek. This would reduce foraging by corvids and bald eagles in the aircraft approach and departure path at the end of Runway 08.

4.7.8.3 ALTERNATIVE FW/RW-3

The No Action Alternative, FW/RW-3, would have no direct or indirect effects on wetlands.

4.7.9 FISHERIES

There is potential for substantial adverse and beneficial direct impacts to fish in the Northwest Development Area, especially relating to Duck Creek and associated estuarine habitat. Although the portion of Duck Creek on and near the Airport has some spawning pink and chum salmon, this spawning is considered largely unsuccessful due to high sedimentation of the streambed. The goal for this reach of the Creek is to facilitate upstream and downstream fish movement and not to encourage fish to spawn within the reach.

Under both action alternatives, direct impacts to fish in the Northeast Development Area are limited to a small amount of slough and low marsh habitat in and near Zig Zag Slough and a larger amount of high marsh habitat. There is no fish habitat on Engineer's Cut, site of the RCO relocation, but the ASOS relocation sites and access roads would affect high marsh habitat. Siting the ASOS equipment at the BRL location would have slightly lesser impacts to this high marsh habitat because of the shorter access road needed to reach this location from the taxiway.

Development of the large areas of impervious surface in the Northeast and Northwest Development Areas would cause a reduction of infiltration, an increase in peak flows, and concentration of contaminants near Duck Creek and the Miller-Honsinger Slough areas during precipitation events. These changes could indirectly increase the potential for harm to fish or degrade fish habitat.

Table 4-68 identifies the acres of all types of EFH potentially affected by these alternatives. The following sections primarily discuss the effects of the action alternatives' different plans for Duck Creek.

4.7.9.1 ALTERNATIVE FW/RW-1

Construction of the new stream crossings would temporarily disrupt fish movement in Duck Creek. Relocation of the reach of Duck Creek from Radcliffe Road to the Mendenhall River may also have short-term, direct construction impacts on fish movement.

Approximately 18.5 acres of EFH, most of it high marsh habitat and rarely inundated during the highest tides, would be lost under this alternative, as shown on Table 4-68. This represents approximately 0.5% of EFH available within the landscape area. In addition to these impacts, estuarine and riparian habitat along approximately 160 feet on both banks of Duck Creek would

Table 4-68. Direct Loss of Essential Fish Habitat (EFH): Aviation Facilities Alternatives

EFH Type	FW-RW-1	FW/RW-2[2]	FW/RW-3
Open Water	0.2	0.0	0.0
Slough	0.4	+0.2	0.0
Low Marsh	0.0	+0.7	0.0
High Marsh	17.9	-13.3	0.0
EFH Total	18.5	-12.4	0.0

[1] All losses and gains in acres.
[2] "+" indicates net gain in EFH resulting from Duck Creek Relocation

be compromised by the two bridges used to allow aircraft and vehicles to cross Duck Creek from northwest aviation facilities to the rest of the Airport. The bridges would be designed to retain existing hydrologic and fish passage conditions in Duck Creek.

Indirect introductions of sediment, debris, and contaminants into Duck Creek may increase as a result of increased human, aircraft, and vehicle traffic (including maintenance and snow removal activity) along and across the stream. The likelihood of increased stormwater discharge into Duck Creek would have an indirect effect on fish, since the stormwater quality would be expected to decrease relative to existing conditions (see Section 4.7.6). These problems could compromise the already marginal habitat in the upper portions of this reach and would increase the potential for contaminant-related fish kills. Fish movement would continue to be hampered when the reach dewaters during dry periods. Retention of the existing Radcliffe Road culvert would cause the aggraded Duck Creek channel to persist in its existing condition.

4.7.9.2 Alternative FW/RW-2

Alternative FW/RW-2, the FAA's preferred aviation facilities alternative, would result in the construction of a new, lined channel for Duck Creek, designed to prevent dewatering and improve fish passage upstream and downstream. Also, the existing Radcliffe Road culvert would be abandoned, and Radcliffe Road would cross Duck Creek over a new, 12-foot-wide, bottomless concrete arch culvert designed to ensure fish passage. The new Duck Creek channel would provide somewhat more EFH than would the modified channel under Alternative FW/RW-1. Therefore, as shown in Table 4-68, there would be less overall impact (12.4 acres) to EFH under this alternative (compared to baseline conditions) due to the design of the relocated Duck Creek channel. Like FW/RW-1, impacts to EFH would occur primarily as a result of reductions of high marsh in the Northwest and Northeast Development Areas.

Relocation of the Duck Creek channel would entail substantial excavation and grading, and in the short term, the new channel would have poor-quality habitat until new estuarine and riparian vegetation established (see Section 4.7.7). Fish movement may be disrupted during construction and in the new channel until a stable connection with the Mendenhall River forms. The construction impacts would be adverse but short-term.

Although the total length of Duck Creek would be reduced, the habitat and access quality of the new channel would partially offset this loss. Fish passage conditions would be improved in Duck Creek via the new, lined channel (which would prevent dewatering) and the wider, stream-simulation, concrete arch culvert at Radcliffe Road. Improvements to migration are potentially important during low-flow periods and in concert with future flow and habitat improvements in upstream reaches, such as those being considered by the Duck Creek Advisory Group and local, state, and federal agencies.

4.7.9.3 ALTERNATIVE FW/RW-3

According to the assessment of EFH, no direct impacts to fish would occur under the No Action Alternative. Indirect mortality of migrating juvenile salmon would continue during dry periods and low tidal cycles, when this portion of the Duck Creek stream channel dries up. This could be potentially important when it occurs, but it is also noteworthy that the same problems occur upstream of Airport property as well.

4.7.10 WILDLIFE

Table 4-69 provides a summary of the direct impacts to wildlife habitats that would be associated with the construction of aviation facilities in the Northwest and Northeast Development Areas. For any given habitat in the table, the sum of "acres lost" and "acres left" under one of the three headings ("Northwest Airport Area," "Northeast Airport Area," or "Total Impact") equals a constant number: the total acreage of that given habitat within the project area. The "Percent Change" reflects the change/loss in terms of total project area:

$$\frac{\text{acres lost}}{(\text{acres lost+ acres left})}$$

This was done to show how development of either the Northwest or Northeast Development Area would affect the total project area habitat. Of course, both alternatives would result in the development of both sites. Thus, the third heading, titled "Total Impacts," summarizes the habitat impacts within the Northwest and Northeast Development Areas and the percent of each habitat type affected in the project area as a whole.

The location of Duck Creek would vary by alternative, and relative impacts to wildlife habitat based on these differences are described. Approximately the same level of impact to habitat would occur in the Northwest Development Area under each alternative. The ASOS, currently located in the Northeast Development Area, would be moved under each of these alternatives; impacts to wildlife resulting from relocation of the ASOS are discussed under Alternative FW/RW-1. Due to the already developed nature of the FAA communications site adjacent to Engineer's Cutoff Road, habitat impacts associated with relocating the RCO facility to this location would be considered negligible.

Table 4-69. Summary of Wildlife Habitat Impacts Associated with Aviation Facilities Alternatives FW/RW-1 and FW/RW-2 in Project Area

Wildlife Habitat	Northwest Airport Area			Northeast Airport Area			Total Impact		
	Ac. Lost	Ac. Left	Percent Change	Ac. Lost	Ac. Left	Percent Change	Ac. Lost	Ac. Left	Percent Change
General Wildlife Habitat									
Open Water	0.2	86.3	0.2	0.0	86.5	0.0	0.2	86.5	0.2
Unvegetated	0.3	32.9	0.9	0.0	33.2	0.0	0.3	32.9	0.3
Freshwater Marsh	0.2	9.4	2.1	0.0	9.6	0.0	0.2	9.4	2.1
Ditch Grass	0.0	4.8	0.0	0.0	4.8	0.0	0.0	4.8	0.0
Estuarine Low Marsh	0.9	33.0	2.7	0.0	33.9	0.0	0.9	33.0	2.7
Lyngbye Sedge	0.9	19.0	4.5	0.0	19.9	0.0	0.9	19.0	4.5
Estuarine High Marsh	3.2	97.0	3.2	4.8	95.4	4.8	8.0	92.2	7.9
Supratidal	3.3	42.8	6.8	22.6	25.8	46.7	25.9	20.2	54.1
Seeded Grassland	0.2	41.8	0.5	2.2	39.8	5.2	2.4	39.6	5.7
Shrub-Scrub	7.4	15.2	32.7	0.0	22.6	0.0	7.4	15.2	32.7
Forest	5.6	37.1	13.1	0.0	42.7	0.0	5.6	37.1	13.1
Totals*	21.3	402.5	5.0	29.6	394.2	7.0	50.9	372.8	12.0
High-interest Species Wildlife Habitat									
Migratory Waterfowl	0.2	91.1	0.2	0.0	91.3	0.0	0.2	91.1	0.2
Swans	0.2	91.1	0.2	0.0	91.3	0.0	0.2	91.1	0.2
Vancouver Canada Goose	1.3	165.9	0.8	2.2	165.0	1.3	3.5	163.7	2.1
Bonaparte's Gull	4.6	249.2	1.8	4.8	249.0	1.9	9.4	244.4	3.7
Great Blue Heron	1.1	124.1	0.9	0.0	125.2	0.0	1.1	124.1	0.9
Shorebirds	1.2	65.9	1.8	0.0	67.1	0.0	1.2	65.9	1.8
Bald Eagle	21.3	402.5	5.0	29.6	394.2	7.0	50.9	372.9	12.0
Other Raptors	21.3	402.5	5.0	29.6	394.2	7.0	50.9	372.9	12.0
Rufous Hummingbird	3.3	45.1	6.8	22.6	25.8	46.7	25.9	22.5	53.5
Swallows	4.5	230.5	1.9	4.8	230.2	2.0	9.3	225.7	4.0
Corvids	21.3	402.5	5.0	29.6	394.2	7.0	50.9	372.9	12.0
Songbirds	19.5	194.4	9.1	27.4	186.5	12.8	46.9	167.0	21.9
Black Bear	20.4	278.9	6.8	29.6	269.7	9.9	50.0	249.3	16.7

Table 4-69. Summary of Wildlife Habitat Impacts Associated with Aviation Facilities Alternatives FW/RW-1 and FW/RW-2 in Project Area, continued

Wildlife Habitat	Northwest Airport Area			Northeast Airport Area			Total Impact		
	Ac. Lost	Ac. Left	Percent Change	Ac. Lost	Ac. Left	Percent Change	Ac. Lost	Ac. Left	Percent Change
River Otter	17.5	282.8	5.8	4.8	295.5	1.6	22.3	278.0	7.4
Sitka Black-tailed Deer	20.8	278.5	6.9	29.6	269.7	9.9	50.4	248.9	16.8
Sensitive Species Habitat									
Queen Charlotte Goshawk	19.7	203.7	8.8	27.4	196.0	12.3	47.1	176.3	21.0
Peregrine Falcon	8.3	350.2	2.3	29.6	328.9	8.3	37.9	320.6	10.6
Olive-sided Flycatcher	5.6	37.1	13.1	0.0	42.7	0.0	5.6	37.1	13.1
Townsend's Warbler	5.6	37.1	13.1	0.0	42.7	0.0	5.6	37.1	13.1

*Note: Totals do not include Lyngbye Sedge because it is a sub-habitat of Estuarine Low Marsh.
ASOS not included in totals.

4.7.10.1 Alternative FW/RW-1

Under FW/RW-1, the Northwest Development Area north of the Duck Creek buffer zone would be filled and paved to provide hangars and tiedowns for general aviation. As a result, there would be a loss of 20.1 acres of general wildlife habitat, composed primarily of shrub-scrub, woodland, and estuarine high marsh. If development of the Northwest Development Area were an independent action, the development would affect 13.6% of the forest, 32.3% of the shrub-scrub, 11.6% of the supratidal, and 0.7% of the estuarine high marsh wildlife habitats within the project area.

The construction of aviation facilities in the Northeast Development Area would primarily affect estuarine high marsh and supratidal habitats. Within the project area, this action would reduce the coverage of these habitats by 4.8 acres (4.8%) and 22.6 acres (46.7%), respectively. In conjunction with these impacts, relocation of the ASOS facility would adversely affect 0.4 acre of high marsh habitat, or 0.5% of its coverage within the project area.[11]

Full development of all facilities under FW/RW-1 would affect 11.7% of the general wildlife habitat available within the project area and result in the loss of 5.5 acres (5.5%) of high marsh, 28.2 acres (58.3%) of supratidal, and 7.3 acres (32.3%) of shrub-scrub habitat.

With regard to high-interest species, Alternative FW/RW-1 would have the greatest relative impacts on songbird and rufous hummingbird habitats, which would be reduced by 46.8 acres (21.9%) and 28.2 acres (58.3%), respectively. Species with broader habitat requirements (e.g., bald eagle and other raptors, corvids) would lose 49.7 acres or 11.7% of their potential habitat

11. ASOS impacts on wildlife habitat are not shown in Table 4-58 but can be seen on Table 2-20.

within the project area.[12] Across the landscape area, these impacts indicate a habitat reduction of 3.8% and 17.6% for songbirds and rufous hummingbirds, respectively, while bald eagles, other raptors, and corvids, would undergo a 1.1% reduction in suitable habitat.

For sensitive species within the project area, habitat for the Queen Charlotte goshawk would be reduced by 47.0 acres, or 21%, and peregrine falcon habitat would decrease by 36.6 acres, or 10.2%, under Alternative FW/RW-1. This would translate to 3.7% and 0.8% reductions in these species' habitats across the landscape area, respectively. Suitable habitat for the olive-sided flycatcher and Townsend's warbler would be reduced by 5.8 acres, or 13.6%, in the project area and 6.4% in the landscape area.

Potential indirect impacts to habitat associated with Alternative FW/RW-1 would be similar to those described for most of the other proposed actions, i.e., the introduction and spread of noxious weeds and other invasive species. The majority of the Northwest and Northeast Development Areas would be paved, but areas in which weeds would likely be a concern are the modified Duck Creek corridor and the coastal grass meadow/high marsh community around the relocated ASOS facility, particularly in conjunction with RSA alternatives that could limit tidal inundation in this area.

4.7.10.2 ALTERNATIVE FW/RW-2

Alternative FW/RW-2, the FAA's preferred aviation facilities alternative, would have the same development scenario as FW/RW-1 in the Northeast Development Area, but Duck Creek, in the Northwest Development Area of the Airport, would be relocated to a new channel near the northern boundary of the Airport, where it would be flanked by a buffer at least 50 feet wide. The newly constructed floodplain would be revegetated with appropriate native species, but all vegetation south of the buffer zone would be removed and replaced by fill material and pavement. Direct and indirect impacts to general wildlife and high-interest and sensitive species habitats under Alternative FW/RW-2 would, therefore, be similar to those described for FW/RW-1, with the following exceptions.

Excavation of the new Duck Creek channel and floodplain would impact approximately 8.2 acres of wildlife habitat. The majority of these impacts (4.4 acres) would be to shrub-scrub habitat. In addition, 2.1 acres of forest, 0.5 acre of supratidal, 0.5 acres of open water, 0.3 acre of low marsh (primarily Lyngbye sedge), and 0.2 acres each of seeded grassland and unvegetated habitat would be removed. Portions of an existing parking lot would also be removed under this alternative.

After the new channel and floodplain are constructed, the above habitats and parking lot would be replaced with approximately 3.0 acres of shrub-scrub habitat, 1.5 acres of supratidal/estuarine high marsh, 1.4 acres of forest, 1.2 acres of estuarine low marsh (primarily Lyngbye sedge), 0.9 acre of open water, and 0.2 acre of seeded grassland. Thus, over time, relocation of Duck Creek would result in no net loss or gain of wildlife.

12. Total acres of impact to wildlife habitat are greater than construction acres as a result of the dual effects of moving portions of Duck Creek.

4.7.10.3 Alternative FW/RW-3

Alternative FW/RW-3 would have no effect on wildlife or wildlife habitat. Existing conditions in the Northeast and Northwest Development Areas would remain unchanged.

4.7.11 Cultural Resources

No known historic properties would be affected by the aviation facilities development alternatives or the connected actions to relocate the RCO and ASOS. The two action alternatives would result in disturbance of approximately the same surface area in the Northeast and Northwest Development Area. Each of these alternatives may uncover subsurface cultural resource sites related to the known, WWII-era historical use of the Northwest Development Area or to ethnographic use of the area by indigenous peoples.

FW/RW-3 would have no impact on historic properties because no ground disturbance would occur under the No Action Alternative.

There is low potential for subsurface cultural resource sites to be uncovered at either Engineer's Cut, site of the RCO relocation, or east or southeast of TEMSCO, alternative sites for the ASOS and access road. In consultation with the SHPO and as authorized by 36 CFR 800.4(b)(2), the FAA has instituted a phased approach for the identification of cultural resources, whereby a subsurface archaeological testing program will be conducted prior to ground disturbance in areas of higher occurrence probability and where ground surface visibility during the field inventories for the EIS was poor due to dense vegetation cover.

4.7.12 Visual Resources

The two action alternatives would result in disturbance of approximately 42 acres in the Northeast and Northwest Development Areas. There would be no substantial difference between the visual impacts of aviation facility development with the relocation of Duck Creek and the visual impacts of aviation facility development without relocation of Duck Creek. However, the visual impacts of the action alternatives are noteworthy when compared to FW/RW-3, which would have no impact on visual resources.

4.7.12.1 Alternative FW/RW-1

Alternative FW/RW-1 would result in moderate, long-term impacts on visual quality when viewed from the existing Dike Trail parking lot. Construction in the area would necessitate the removal of trees and mature vegetation and the leveling of the surface. There would be moderate, short-term impacts in the foreground from construction equipment, loss of vegetation, and the loss of or reduction in visual screening from trees growing near Duck Creek. Long-term changes in visual quality and changes in visual contrast would be minor, as the area presently shows obvious signs of development; asphalt roads, chain link fences, vehicles, and buildings in the middleground and background are clearly visible. New construction near Duck Creek, in the presence of these existing structures, would not result in major levels of visual contrast compared to baseline conditions.

The impacts of development within the Northeast Development Area would have moderate, short-term and long-term effects on visual quality. Short-term effects would be produced by construction-related soil disturbance, paving, and building construction that would alter the visual character of the area. Long-term effects would be produced by the new Airport structures in the Northeast Development Area and at either of the potential ASOS relocation sites, which would partially block views of the landscape middleground and background. However, because JNU service roads and facilities such as TEMSCO exist within or adjacent to the areas proposed for development, newly constructed buildings would not result in high levels of contrast, in the context of existing buildings. There would be minor, long-term visual impacts as a result of RCO facilities at Engineer's Cut, since the area has already been disturbed and includes other aviation navigation equipment that would continue to dominate the local landscape.

The screening of visual change from Sunny Drive and Egan Drive viewpoints would be accommodated somewhat by the dike and vegetation surrounding Miller-Honsinger Pond. Travelers on Egan Drive and Yandukin Drive would have unobstructed views of the visual changes in the Northeast Development Area, but the viewing time would be limited.

4.7.12.2 Alternative FW/RW-2

The visual impacts of Alternative FW/RW-2, the FAA's preferred aviation facilities alternative, would be very similar to those for FW/RW-1, with similar development and visual alterations in the Northeast Development Area. Duck Creek would be relocated under this alternative, and visual changes would be evident from the Dike Trail parking lot. However, the visual impact of Duck Creek relocation, while negative in the short term during construction, would probably represent a positive, long-term impact due to the improved conditions of the creek and revegetation of the "setback" zone.

4.7.12.3 Alternative FW/RW-3

There would be no change in the visual landscape if the No Action Alternative was implemented.

4.7.13 Department of Transportation Section 4(f) Land

As the following sections discuss, no significant adverse impacts would occur to DOT Section 4(f) lands with implementation of the Airport facility alternatives. Neither of the action alternatives would require the acquisition or long-term use of Refuge property, and there would be no direct impact to DOT Section 4(f) lands. Neither action alternative would result in significant changes to aircraft noise exposure or air quality. The connected action to relocate the RCO would have no impact on DOT Section 4(f) lands. The following sections, therefore, discuss those indirect impacts that may occur as a result of aviation facility development and ASOS relocation.

4.7.13.1 ALTERNATIVE FW/RW-1

The Northeast Development Area would be completely developed; approximately 24 acres of pervious surface would be converted to impervious surface and would include a small disturbance associated with ASOS relocation. There are numerous hydrologic and stormwater impacts from these changes, all of which are discussed in more detail in Section 4.7.6.1. It is difficult to anticipate whether these changes would measurably affect the Refuge; the tidal channels south of Miller-Honsinger Pond remain on Airport property until approximately the area where Jordan Creek daylights from underneath the runway. It is believed than any changes in hydrology and stormwater discharge from aviation facility development in the Northeast Development Area would not affect the activities in or the beneficial uses of the Refuge.

Full development of the Northwest Development Area would also result in a loss of flood storage along Duck Creek, and increased storm-water runoff and loss of floodplain storage can cause geomorphologic changes to surface water channels. Bank erosion and other channel changes in Duck Creek may also be caused by the installation of new structures in the channel. These adverse impacts may occur upstream or downstream, including in the Refuge.

This action would relocate a small reach of Duck Creek within the Refuge. Long-term effects of this relocation would not be adverse, since there would be minor improvements to floodplain storage, flow velocities and stream conveyance within the short reach on the Refuge and immediately upgradient, to Radcliffe Road. These impacts would be beneficial to the Refuge in the long term.

The relocation of the trail head and the construction of a parking lot and pedestrian bridge for the Dike Trail would be permanent and beneficial direct effects of this alternative. These changes would occur on Airport property. A new parking structure and trail head would be established at approximately 9501 Radcliffe Road. A new footbridge would also be constructed to allow trail users to cross Duck Creek to access the trail. The designated parking area would provide easier parking for vehicles. The quality of the recreational experience on the Dike Trail would be enhanced by this alternative, and since the trail would be separated from the emergency vehicle access road (EVAR), there would be fewer conflicts with Airport needs.

Despite the potential for some adverse, indirect effects to Refuge resources, Alternative FW/RW-1 would not substantially reduce or eliminate the ability to maintain and enhance fish and wildlife populations on the Refuge, or to maintain and enhance public use of the Refuge. As a result, there would be no constructive use impacts from this alternative to a DOT Section 4(f) land.

4.7.13.2 ALTERNATIVE FW/RW-2

This is the FAA's preferred aviation facilities alternative. Comparable, indirect impacts to Refuge resources, as described for Alternative FW/RW-1, would occur in the Northeast Development Area under this alternative. Aviation facilities would also be constructed in the Northwest Development Area of the Airport, but a notable difference from FW/RW-1 is that the entire reach of Duck Creek on Airport property, and a portion of the reach within the Refuge, would be relocated. The relocation of Duck Creek would also require approximately 0.2 acres of grading and disturbance at the confluence of the creek and the Mendenhall River, on Refuge property, in order to stabilize the new outlet channel for the creek. Overall, this action should provide long-term benefits by increasing floodplain storage, increasing flow velocities and stream conveyance, and enhancing fish migration capability. The net, indirect effects to the Refuge would be beneficial.

As with Alternative FW/RW-1, the trail head and parking lot for the Dike Trail would be relocated immediately west of its current location, and a pedestrian bridge would be installed to cross the relocated Duck Creek. These changes would occur on Airport property and would likely benefit the overall recreational experience for persons using the Dike Trail.

Despite the potential for some adverse, indirect effects to Refuge resources, Alternative FW/RW-2 would not substantially reduce or eliminate the ability of the Refuge to maintain and enhance its fish and wildlife populations or to serve as a public recreational experience. As a result, there would be no constructive use impacts from this alternative to a DOT Section 4(f) land.

4.7.13.3 Alternative FW/RW-3

Alternative FW/RW-3 would retain Airport facilities as they exist today, but with increasing levels of aircraft operation, as discussed in Chapter 1. This action would not require the acquisition of any DOT Section 4(f) lands, and no indirect impacts to 4(f) lands would occur. Therefore, no DOT Section 4(f) land impacts would result from Alternative FW-RW-3.

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4.8 WILDLIFE HAZARD MANAGEMENT PLAN (WHMP)

Section 2.9 of Chapter 2 describes four alternatives associated with wildlife hazard management at JNU. Two of these alternatives, WH-1 and WH-2, include a number of actions that would permanently modify wildlife habitat or areas on the Airport that attract wildlife—birds in particular—whose presence and movement can be hazardous to aviation. A third alternative, WH-3, relies more on ongoing wildlife management than habitat modification and consists of relatively few actions that would affect the human environment. The fourth alternative, the No Action Alternative, would result in no habitat modification to the Airport or adjacent Refuge and no change to current wildlife management practices. Environmental consequences of the following alternatives are described in Sections 4.8.1 through 4.8.13:

- WH-1: Wildlife Hazard Management Plan, Proposed Action: Most Habitat Modification. This is the FAA's preferred WHMP alternative.
- WH-2: Moderate Habitat Modification Alternative
- WH-3: Minor Habitat Modification and Adaptive Hazard Management
- WH-4: No Action

4.8.1 NOISE

The options contained within the four alternatives to reduce wildlife hazards at JNU would not have a regular or predictable impact on frequency or intensity of aircraft operations or airfield usage. None of the WHMP alternatives would alter the existing or future aircraft noise exposures, according to the INM.

There would be short-term, construction equipment-related noise increases during the filling of wetlands on the west end of the Airport and on the Refuge, during the filling and grading of infield areas, during the modification of surface drainage systems, during the creation of the new channel for Duck Creek, and during the dredging or filling of the Float Plane Pond. Noise increases related to construction would be temporary and, in many areas, would be comparable to or indistinguishable from other traffic-, construction-, or aviation-related noise. Dike Trail users would notice noise from construction activity west of the runway or Airport boundary and noise caused by dredging, filling, or other activities in or around the Float Plane Pond.

WH-1, the set of options described in the Airport's WHMP (with some modifications developed during 2004), would cause the greatest amount of short-term construction noise, reflecting the greatest amounts of disturbance in most areas of wildlife concern. This alternative comprises the FAA's preferred WHMP alternative. Alternative WH-2 also involves substantial habitat modification, but as there would be less overall construction activity than WH-1, less short-term, construction-related noise would be generated. Alternative WH-3 would involve almost no construction activity and would generate almost no short-term noise. The No Action Alternative, WH-4, would result in no changes to short-term or long-term noise levels.

Virtually all of the noise generated by these alternatives would be adverse and of relatively temporary duration. However, the No Action and WH-3 alternatives would also have long-term, periodic increases to noise generated by hazard control devices, such as propane cannons, cracker shells, vehicle horns, and so forth. Because these noises would be made on an as-needed basis, it is not possible to estimate the extent to which this noise would increase above existing levels.

4.8.2 HUMAN ENVIRONMENT AND COMPATIBLE LAND USE

Since the objective of wildlife hazard management is to reduce potential for aircraft strikes with wildlife by reducing wildlife presence, each of the action alternatives would inherently affect opportunities for bird and wildlife viewing, particularly from the Dike Trail. Some of the habitat modifications incorporated in these alternatives would directly affect land use and recreational uses as well. Indirect effects on the quality of recreational experience are also predicted for some of the actions. The actions would be compatible with the Airport Master Plan, but not always compatible with objectives of the Refuge Management Plan. There would be no changes in populations within noise contours caused by the wildlife hazard management alternatives.

Each of the alternatives would incorporate wildlife hazing actions (e.g., cannons, whistles, vehicles, etc.) as part of the hazard management program; the amount and intensity of hazing would generally have an indirect relationship to the degree of habitat modification. This is important to consider for the analysis of recreational and land use impacts. The No Action Alternative would involve no habitat modification and would have no direct negative impact to recreationists using the Dike Trail and Refuge. However, the increased hazing efforts that would be necessary if the No Action or WH-3 alternatives were implemented would result in more frequent noise and human disruption in areas such as the Float Plane Pond, the wetlands west of the runway and adjacent to the Dike Trail, and other locations.

Most of the habitat modification in the WHMP alternatives would take place on the Airport and therefore would have little or no direct affect on land uses or the human environment. The following sections focus on activities that would take place on or adjacent to the Refuge or Dike Trail and on activities that would affect recreational experience from the Dike Trail.

4.8.2.1 ALTERNATIVE WH-1

Implementation of Alternative WH-1, the FAA's preferred WHMP alternative, would permanently alter approximately 10.2 acres of the Refuge. This land would not necessarily need to be transferred from Refuge to Airport ownership. However, the habitat would be substantially altered and thereby would affect other resources. It is unclear whether these actions, undertaken to control wildlife on and around the Airport, would actually conflict with designated land uses. The Refuge Management Plan contains objectives for land use and management, including to "manage the Refuge to maintain and enhance public use of fish, wildlife, and Refuge lands [ADF&G 1990: p.6]." On the other hand, the statute designating the Refuge clearly forecasts a potential need for the Airport to acquire or use Refuge lands. The statute also states that if requested by the CBJ, the ADF&G and ADNR will assist in filling water bodies adjacent to the existing Airport runway to eliminate the water bodies as sites attractive to waterfowl. The WHMP and this EIS have demonstrated a need to reduce wildlife hazards in the vicinity of the Airport, including Refuge lands, approximately 0.25% of which would be directly affected by this action. Section 4.8.13 contains more discussion on compliance with the Refuge Management Plan.

This alternative also calls for selective thinning of trees and understory removal in the Float Plane Pond woodland complex, as well as installation of a fence to keep large mammals out. These actions would affect the visual character of the area, particularly along the Dike Trail. The recreational experience for some users of the Dike Trail, particularly bird watchers, may be adversely affected as selective nesting and perching habitat would be removed. The fence may create a visual "barrier" to such activities. On the other hand, changes to the woods may create new bird-watching opportunities if new species move in to use the thinner woodland habitat.

Other actions, like dredging the Float Plane Pond, filling wetlands on Airport property, filling and paving infield areas, and modifying or relocating channels and drainages, would have short-term, indirect effects (consisting of construction noise and visual modifications) on recreational uses of the Dike Trail and Refuge. Use of the Dike Trail would be temporarily disrupted for several days on two occasions as the dike upon which it sits is breached to allow the dredge equipment into and out of the Float Plane Pond.

4.8.2.2 ALTERNATIVE WH-2

This alternative would result in direct impacts that are similar to WH-1 in kind, but generally smaller in scale and typically less than WH-1 in intensity. Selective fill of wetlands and recontouring of the landscape west of the Airport adjacent to the Mendenhall River would permanently and irretrievably alter approximately 3.3 acres of the Refuge. As with alternative WH-1, it is unknown whether this land would need to be transferred from the Refuge to the Airport, but at a minimum, it would alter the habitat type and have other indirect effects on land uses. The acreage needed for this alternative represents less than 0.1% of the Refuge property.

Bird-watching opportunities would also change as a result of filling the Float Plane Pond fingers. This action would have a dramatic affect on the species normally present in those areas, as waterfowl would be displaced, and populations of other species, such as raptors, may increase. The type of bird-watching experience, but not necessarily the quality, would change. As with Alternative WH-1, the new wildlife fence may create a visual "barrier" to bird watching. In addition, use of the Dike Trail would be temporarily disrupted for several days on two occasions as the dike upon which it sits is breached to allow the dredge equipment, used to obtain fill for Airport projects, into and out of the Float Plane Pond.

4.8.2.3 ALTERNATIVE WH-3

Under this alternative, the on-Airport duck hunting program would be eliminated. According to a 1999 Hunter Survey performed by JNU, hunters involved in this program spent approximately 25 hunter-days with an average of approximately 4.9 hours per day hunting on Airport property during that hunter season, and took 15 birds. This action would bar those hunters from Airport property but would not affect hunting programs in other parts of the Refuge.

This alternative involves increased hazing efforts, which would indirectly have an adverse impact on recreational uses of the Refuge, due to more frequent, short-term noise and human disruption in areas such as the Float Plane Pond, the wetlands west of the runway and adjacent to the Dike Trail, and other locations.

4.8.2.4 Alternative WH-4

The No Action Alternative would have no direct impact on the human environment, land use, or recreational opportunities or experience. Hazing efforts to disburse wildlife would need to intensify and would indirectly adversely affect recreationists.

4.8.3 Socioeconomic Impacts

Table 4-70 presents the construction or implementation costs for each option within the three wildlife hazard alternatives for which estimates can be prepared. (There would be no immediate or short-term economic impact from WH-4 since no construction or habitat modification would take place.) Specific changes in operations and maintenance costs indirectly resulting from these options, such as annual clearing of understory in the woodlands for option WH-1i, are not included in these estimates. However, long-term economic costs associated with increased labor directed at wildlife hazard control have been estimated for each alternative. Table 4-71 presents short-term construction costs for the three WHMP action alternatives in terms of direct, indirect, and induced business income, full-time-equivalent jobs, and payroll.

Table 4-70. Construction Costs for Wildlife Hazard Alternatives (2005 dollars)

Alternative	Project Cost
Alternative WH-1, WHMP Actions	$20,198,000
WH-1a: Pave Infield Areas	$11,986,000
WH-1b: Fill Airport Wetlands West	$804,000
WH-1c: Fill Refuge Wetlands West	$2,504,000
WH-1d: Relocate Duck Creek	$1,274,000
WH-1e: Convert Drainage Ditches	$1,854,000
WH-1f: Remove Swales	$838,000
WH-1g: Remove Pond Vegetation	$288,000
WH-1h: Remove Jordan Creek Dam	$12,000
WH-1i: Remove Understory, Thin and Fence Woodlands	$637,000
Alternative WH-2	$27,384,000
WH-2a: Install Avturf at Infield	$21,783,000
WH-2b: Fill Airport Wetlands West	$329,000
WH-2c: Selectively Fill Refuge Wetlands West	$555,000

Table 4-70. Construction Costs for Wildlife Hazard Alternatives (2005 dollars), continued

Alternative	Project Cost
WH-2d: Relocate Duck Creek - West	$231,000
WH-2e: Reline Drainage Ditches	$918,000
WH-2f: Remove Swales	$838,000
WH-2g: Fill Float Pond Fingers	$2,393,000
WH-2h: Remove Jordan Creek Dam	$12,000
WH-2i: Denest and Fence Woodlands	$241,000
Alternative WH-3	$1,201,000
WH-3e: Regrade Ditches	$350,000
WH-3f: Remove Swales	$838,000
WH-3h: Remove Jordan Creek Dam	$12,000
Long-Term Economic Costs for Hazard Control[1]	
Alternative WH-1	$1,816,000
Alternative WH-2	$2,132,000
Alternative WH-3	$2,956,000
Alternative WH-4	$655,000

Sources: CBJ Engineering Department, CBJ Airport Staff and SWCA Project Team.
Note: Alternative WH-4, No Action, would have no construction or habitat modification costs.
[1] Long term costs of performance is the direct and indirect economic impact of the net present value of 20 years worth of annual labor, supplies, equipment and materials used to perform hazard control for each alternative. The figure also includes net present value of local sales taxes paid.

Table 4-71. Construction Impact of Wildlife Hazard Alternatives (2005 dollars)

Alternative	Total Business Income	Total FTE Jobs	Sales Tax Generated	Total Payroll
Alternative WH-1	$20,198,000	235	$820,000	$13,793,000
Alternative WH-2	$27,384,000	330	$1,111,804	$18,700,000
Alternative WH-3	$1,201,000	14	$48,700	$820,000

Source: CBJ Engineering Department, CBJ Airport Staff, and SWCA Project Team. Also, IMPLAN Pro 2000 input/output model, Minnesota IMPLAN Group.
Note: WH-4, No Action Alternative, would have no construction costs.

The tables suggest that Alternative WH-2 would have the greatest short-term economic impact in terms of business income, jobs created, payroll, and sales taxes generated for CBJ. An examination of Table 4-70 indicates that over 75% of the construction cost for WH-2 would result from the use of a synthetic surface cover on the infield areas. Products suitable for such application are relatively new on the market. The purchase and preparation costs may be lower in the future as there is more application and competition in the marketplace.

With one important exception, Alternative WH-3 would be expected to require the greatest investment in annual manpower, since the focus of this alternative is on active hazard management as opposed to habitat modification under Alternatives WH-1, the FAA's preferred WHMP alternative, and WH-2. However, it is also necessary to consider the cost of tree thinning and understory removal in the Float Plane Pond woodlands, under Alternative WH-1. For this action to be effective in the long term, it is predicted that new understory would have to be removed on an annual or biennial basis. This activity could raise operating and maintenance costs substantially.

4.8.4 AIR QUALITY

None of the four alternatives would affect aircraft taxi patterns or the time-in-mode of aircraft operations. As a result, the predicted future operating emissions for the action alternatives are the same as for the No Action Alternative. General increased operating emissions for the entire Airport are attributable to the predicted 9% increase in annual aircraft operations through 2015 and associated aircraft fleet changes, increases that would be unaffected by the WHMP. The predicted future operating emissions for these alternatives reflect the same values predicted for the airfield when runway thresholds remain unchanged.

Two of the wildlife hazard action alternatives, WH-1 and WH-2, would result in substantial construction-related activity, primarily dredging for fill materials, placement of fill in various locations, grading, and so forth. Alternative WH-1 is the FAA's preferred WHMP alternative. The third action alternative, WH-3, would have relatively little construction-related activity. Construction work would cause short-term increases of criteria pollutants associated with vehicle exhaust and elevated levels of fugitive dust. Table 4-72 summarizes the operational emissions for the year 2015, as well as the construction-related emissions associated with each of the wildlife hazard alternatives.

Criteria pollutant emissions for Alternatives WH-1 and WH-2 have been deemed identical. Differences in surface disturbance would likely result in a slightly lower construction emissions level for WH-2, but at this scale of analysis, it is not possible to distinguish the minor differences; furthermore, although Alternative WH-2 would involve less surface disturbance in some areas, the types of equipment used for WH-2 construction would be identical to those used for WH-1. Fill of the Float Plane Pond in Alternative WH-2 would also cause substantial emissions not generated for Alternative WH-1.

The construction emissions are shown in Table 4-72 as annual releases. However, it is certain that the actions involved in each alternative would not all be conducted in the same year; they would be dispersed over multiple construction seasons. Fugitive dust levels may be controlled and reduced somewhat by watering disturbed areas periodically during dry seasons.

Table 4-72. Operating and Construction (Peak Year) Emissions Summary for Wildlife Hazard Management Alternatives

Activity	Tons per year Vehicle Exhaust					Fugitive Dust (tons)
	CO	NOx	VOC	SOx	PM_{10} / $PM_{2.5}$	
Operating (2015)	1,154.7	70.6	63.1	7.2	1.5	N/A
Construction						
Alternative WH-1	10.1	24.9	3.0	2.2	2.1	103.3
Alternative WH-2	10.1	24.9	3.0	2.2	2.1	96.7
Alternative WH-3	7.3	17.1	2.1	1.6	1.6	14.9

Note: $PM_{2.5}$ emissions are estimated to be equal to PM_{10} emissions for the purpose of this analysis.
Source: BridgeNet International and Synergy Consultants, October 2004

Alternative WH-4, the No Action Alternative, would retain the Airport wildlife habitat as it exists today. There would be no construction-related exhaust or fugitive dust emissions generated by this alternative. Because wildlife habitat would not be modified, an increased level of wildlife management would be needed. This could result in a minor increase of vehicle-exhaust emissions associated with intensified hazing efforts. However, it is not possible to estimate how much of an increase would occur.

4.8.5 Hazardous Materials and Solid Waste

A search of environmental databases, field reconnaissance, and review of historic aerial photographs suggest that most areas potentially modified by wildlife hazard alternatives have a low probability of containing buried solid or hazardous waste.

One exception is the Float Plane Pond area. In the early 1970s, approximately 50 cars were abandoned and buried at a site just south of the dredge channel running along the Dike Trail boundary. However, since there would be no subsurface excavation associated with the wildlife hazard management activities, the risk of encountering buried debris is low. There is no information available suggesting waste has been deposited in the Float Plane Pond or its fingers that could be encountered during dredging activities.

The habitat modification actions would generate only minor amounts of solid waste, all of which would be disposed at the local landfill. There would be no change in the types or amounts of hazardous wastes generated at the Airport or hazardous materials consumed by the Airport. There is a low probability that asbestos-containing materials would be uncovered. Wildlife hazard control activities anticipated under WH-3 would have no affect on hazardous waste generation or disposal.

Section 4.8.6 documents impacts to water resources for each of the wildlife hazard management alternatives. The creation of extensive, new impervious surface, associated with Alternative WH-1, would result in substantial increases to storm-water discharge volumes, affecting all of the surface water systems in the Airport area. With the WH-1 proposed changes to the stormwater drainage system (from surface infiltration and ditches to buried pipe conveyance), it is expected that loads of de-icing and anti-icing compounds could substantially increase in the creeks. Other pollutants, such as oil, grease, and metals from aircraft braking actions, could also be carried in stormwater in greater quantities. Oil/water separators would be effective at removing oil and petroleum compounds but ineffective at capturing other pollutants, particularly urea and de-icing and anti-icing chemicals.

Alternative WH-2 would have much less effect on stormwater discharge or contaminant loading to surface waters, since the material proposed as ground cover near runways and in drainage ditches would be semi-permeable. Alternative WH-3 would have virtually no impact on contaminant loads to stormwater.

4.8.6 WATER RESOURCES AND FLOODPLAINS

Descriptions of relative, quantitative and qualitative impacts to water resources resulting from the implementation of wildlife hazard management alternatives are included in the following sections. Two assumptions are relevant to each of the analyses. First, the Rational Method is an acceptable method for calculating the volume of stormwater runoff during a 100-year storm event, with such an event equal to 5.7 inches of rainfall in 24-hours and the coefficients for impervious surfaces at 0.9, 0.7 and 0.3 for pervious surfaces. Second, for any action involving fill of wetlands, a standard fill elevation of 15 feet msl would be used.

4.8.6.1 ALTERNATIVE WH-1

Alternative WH-1, the FAA's preferred WHMP alternative, would include a number of options that could affect water resources by reducing pervious surface, filling floodplains/marshplains, converting drainage systems, and modifying other habitat. Table 4-73 is a summary of stormwater impacts by drainage basin projected to occur with Alternative WH-1.

In the Mendenhall River drainage, approximately 12 acres of grass-covered infield would be filled and covered with impervious surface. This would cause a 19% (or 3 acre-foot) increase in the 100-year storm event runoff volume. To reduce the likelihood of bird strikes, 13 acres of floodplain/marshplain to the west of the runway would be filled to an elevation of 19 feet msl, requiring approximately 104,000 cubic yards of fill material. Almost the entire reach of Duck Creek on Airport property would be relocated to the northern Airport perimeter, with a discharge location into a backwater slough. As described for FW/RW-2, approximately 115,100 cubic yards of material would be excavated to create a new channel and stream setbacks. Approximately 3.2 acre-feet of new floodplain storage would be created overall by this alternative. Other impacts, as stated below, would also occur.

Table 4-73. Summary of Alternative WH-1 Stormwater Impacts

	Mendenhall River		Gastineau Channel		JNU Total
	Menden-hall River	Duck Creek	Jordan Creek	M-H/East Runway Sloughs	
New Impervious Surface (acres)	12.0	16.0	30.0	19.0	77.0
Percent Increase	23%	31%	39%	46%	38%
New runoff – 50-yr (acre-ft)	2.6	4.4	7.9	4.4	19.3
Percent Increase	19%	32%	36%	67%	42%
New runoff – 100-yr (acre-ft)	3.0	5.0	9.0	5.0	22.0
Percent Increase	19%	32%	36%	67%	42%

Source: Vigil-Agrimis 2004

- Cutting trees adjacent to the Float Plane Pond may cause an increase in pond temperature, which would decrease the quality of any water draining from the pond into the Mendenhall River.
- In the Duck Creek drainage, 16 acres of grass-covered infield would be filled and covered with impervious surface. This would cause a 32% (or 5 acre-foot) increase in the 100-year storm event runoff volume. The Duck Creek channel on Airport property would be reduced in length by approximately 500 feet. The shorter channel would result in a steeper channel gradient, greater flow velocities, and an increased capacity to move bed material.
- In the Jordan Creek drainage, 30 acres of grass-covered infield would be filled and covered with impervious surface. This would cause a 36% (or 9 acre-foot) increase in the 100-year storm event runoff volume.
- In the East Runway Slough drainage, 19 acres of grass-covered infield would be filled and covered with impervious surface. This would cause a 67% (or 5 acre-foot) increase in the 100-year storm event runoff volume.
- New stormwater conveyance pipes would be installed underground, and would have to be sized to handle increased stormwater flows caused by the new impervious surface over infield areas. The loss of soil and vegetation filtration of stormwater may have some adverse affect on the quality of stormwater entering Duck Creek, the Mendenhall River, Jordan Creek and East Runway Slough.
- Alternative WH-1 would pave over approximately 77 acres of pervious surface, an increase of 38% in impervious area. This would cause a 42% (or 22 acre-foot) increase in the 100-year storm event runoff volume.
- The fill for some actions, such as wetlands fill west of the runway, would come from the Float Plane Pond. Dredging of the pond would create short-term turbidity increases that could also affect Duck Creek, Jordan Creek, East Runway Slough, and the Mendenhall River, depending on erosion control measures and weather.

Section 3.6.7.10 of this EIS discussed the concerns associated with anti-icing and de-icing compounds; approximately 80% of these chemicals, when used in aircraft operations, are estimated to stay on the surface. It is unknown how much treatment benefit is provided by grass and other vegetation in stormwater ditches, but there is likely to be chemical adsorption and biodegradation at levels that reduce, to some extent, the amount of pollutants carried in stormwater. Replacement of the vegetated drainage ditches with a pipe system would have a potentially adverse effect by increasing the amount of de-icing chemicals discharged into Duck Creek and Jordan Creek. JNU has proposed to install oil/water separators or similar technology in the Duck Creek and Jordan Creek stormwater systems concurrent with modifications to the stormwater drain system. Oil/water separators would provide water quality benefits by removing oil and grease prior to discharge into the creeks, but they would have no affect on de-icing and anti-icing compounds. As a result, changes to the stormwater conveyance system are predicted to result in decreased loads of oil and grease entering Duck Creek and Jordan Creek, but increased loads of de-icing and anti-icing compounds.

Many of the wildlife habitat modifications undertaken for this alternative would have permanent, adverse impacts to water resources, including:

- Loss of floodplain/marshplain storage.
- Changes to tidal channel geomorphology.
- Increased incidence of upstream flooding in Jordan Creek drainage.
- Increased stormwater runoff volumes.
- Loss of vegetative and subsurface filtration of stormwater, and resultant degraded stormwater discharge for some pollutants, particularly de-icing and anti-icing compounds.
- Minor increase of water temperature in the Float Plane Pond due to removal of the trees that provide a shade effect.
- Indirect effects on wetlands and aquatic life.

There would also be a number of beneficial impacts to water resources, particularly as a result of relocation of Duck Creek.

- Increased grade and velocities would improve the water quality of Duck Creek, including an enhanced ability to flush out iron floc that contributes to low dissolved oxygen levels in the Creek.
- Lining Duck Creek channel with an impervious liner would minimize infiltration loss.
- Duck Creek would have greater floodplain storage capacity.
- Less stormwater would drain into to Duck Creek (off-setting or partially off-setting the negative water quality impacts associated with increased de-icing and anti-icing compounds in stormwater).
- The amount of oil and grease entering Duck Creek and Jordan Creek would be reduced with the use of oil-water separators in the stormwater drainage.

4.8.6.2 ALTERNATIVE WH-2

Alternative WH-2 would replace the infield grass areas with synthetic, permeable groundcover and would regrade and add synthetic, permeable groundcover to swales and ditches. In contrast to Alternative WH-1, this action would reduce vegetated wildlife habitat in the infield areas and ditches but retain water infiltration function. Under this alternative, only the downstream reach of Duck Creek, from approximately Radcliffe Road to the Mendenhall River, would be relocated, similar to the action discussed in FW/RW-1. Smaller amounts of fill would be used in the wetlands in the Refuge west of the Airport; an average of 3 feet of fill would be placed over approximately 3 acres of selected wetland drainage and depressions in this area. In addition, an average of 5 feet of fill would be placed in the Float Plane Pond fingers. Table 4-74 is a summary of stormwater impacts by drainage basin.

Table 4-74. Summary of Alternative WH-2 Stormwater Impacts

	Mendenhall River		Gastineau Channel		JNU Total
	Menden-hall River	Duck Creek	Jordan Creek	M-H/East Runway Sloughs	
New Synthetic Ground Cover (acres)	12.0	16.0	30.0	19.0	77.0
Percent Increase	23%	31%	39%	46%	38%
New runoff – 50-yr (acre-ft)	4.4	1.8	3.5	2.6	12.3
Percent Increase	32%	13%	16%	40%	27%
New runoff – 100-yr (acre-ft)	5.0*	2.0	4.0	3.0	14.0
Percent Increase	32%*	13%	16%	40%	27%

Source: Vigil-Agrimis 2004
* Calculation includes filling 17 acres of open water in the float plane pond fingers and converting it to pervious surface.

In the Mendenhall River drainage, 12 acres of grass-covered runway buffer, or swale, would be filled and covered with synthetic, permeable groundcover. This would cause a 32% (or 5 acre-foot) increase in the 100-year storm event runoff volume. To reduce the likelihood of bird strikes, 3 acres of floodplain/marshplain to the west of the runway would be filled to an elevation of 15 feel msl. In addition, a 3-acre area would be selectively filled. Approximately 58,000 cubic yards of fill material would be placed in these areas. Approximately 23,000 cubic yards of material would be excavated for the relocation of Duck Creek. This would result in a net loss of 22 acre-feet of floodplain/marshplain storage and may constrict the conveyance of floodwater during flood events. A small amount of fill would be placed in the old Duck Creek channel, providing a small, partial compensation for the loss of flood storage. Other impacts, as stated below, would also occur.

- In the Duck Creek drainage, 16 acres of grass-covered infield would be filled and covered with synthetic permeable groundcover. This would cause a 13% (or 2 acre-foot) increase in the 100-year storm event runoff volume. The Duck Creek channel on Airport property would be reduced in length. The shorter channel would result in a steeper channel gradient, greater flow velocities, and an increased capacity to move bed material, although with less overall benefit than would be provided by complete relocation of the channel, as described for FW/RW-2 and WH-1.
- In the Jordan Creek drainage, 30 acres of grass-covered runway buffer, or swale, would be filled and covered with synthetic, semi-permeable groundcover. This would cause a 16% (or 4 acre-foot) increase in the 100-year storm event runoff volume.
- In the East Runway Slough drainage, 19 acres of grass-covered runway buffer, or swale, would be filled and covered with synthetic, semi-permeable groundcover. This would cause a 40% (or 3 acre-foot) increase in the 100-year storm event runoff volume.
- The fill for some actions, such as wetlands fill west of the runway, would come from the Float Plane Pond. Dredging of the pond would create short-term turbidity increases that could also affect Duck Creek, Jordan Creek, East Runway Slough, and the Mendenhall River, depending on erosion control measures and weather.
- New stormwater conveyance pipes would be installed underground and would have to be sized to handle increased stormwater flows caused by the reductions of surface water infiltration caused by the use of synthetic, permeable groundcover. The loss of soil and vegetation filtration of stormwater may have some adverse affect on the quality of stormwater entering Duck Creek, the Mendenhall River, Jordan Creek, and East Runway Slough. These effects would not be as great as for WH-1, since there would be a small reduction in the surface infiltration capability of synthetic permeable groundcover relative to asphalt or other impervious surface.
- The proposed alternative would cover over approximately 77 acres of surface with synthetic permeable groundcover or other semi-pervious material that would still detract wildlife. This would cause a 27% or 14 acre-feet increase in the 100-year storm event runoff volume.
- Approximately 35,000 cubic yards of material would be placed in the floodplain/marshplain at the confluence of the Mendenhall River and Duck Creek. This will result in a loss of 22 acre-feet of floodplain/marshplain storage.

In general, WH-2 would result in similar direct and indirect effects causing adverse changes to water resources as were described for WH-1, including loss of floodplain/marshplain storage, changes to tidal channel geomorphology, increased incidence of upstream flooding, and increased stormwater runoff volumes. However, the magnitude of these impacts would be lessened, primarily as a result of the use of smaller fill volumes and replacement of grassed infields with synthetic permeable groundcover, as opposed to an impervious material such as asphalt.

Fill of Float Plane Pond fingers would not be expected to have an overall negative impact on water resources, except for short-term elevations of total suspended sediment as fill material is dredged from the main pond and placed in the pond fingers. (It is also possible that inert construction debris from Airport projects or other activities in Juneau could be used to partially fill the fingers.) Conversely, the benefits of Duck Creek relocation would be reduced relative to WH-1, since a much shorter reach would be relocated and improved.

A synthetic, permeable groundcover would likely cause larger amounts of deicing compounds to reach groundwater and surface water, relative to existing conditions, since there would be no natural biological treatment function provided. However, synthetic permeable groundcover would retain some infiltration capacity, so the amount of these chemicals reaching Duck Creek and Jordan Creek would be less than expected under WH-1, but still greater than existing conditions.

Another possible concern with the synthetic groundcover is that sand, used extensively in snow removal and ice control, can clog the membrane pores. This effect would reduce water infiltration capacity and result in more runoff and less groundwater recharge and biochemical treatment.

4.8.6.3 Alternative WH-3

This alternative would result in little impact to water resources, as it includes few actions that would modify habitat through the use of fill or other changes to floodplain storage, stormwater runoff, and so forth. The changes in vegetation management may have a slight increase in stormwater volume, estimated for the 100-year storm event at 1 acre-foot (or 2% increase) in the Mendenhall River drainage, 1 acre-foot (or 3% increase) in the Duck Creek drainage, 2 acre-feet (or 4% increase) in the Jordan Creek drainage, and 1 acre-foot (or 3% increase) in the East Runway Slough drainage. Table 4-75 is a summary of stormwater impacts by drainage basin.

Table 4-75. Summary of Alternative WH-3 Stormwater Impacts

	Mendenhall River		Gastineau Channel		JNU Total
	Mendenhall River	Duck Creek	Jordan Creek	M-H/East Runway Sloughs	
New Impervious or Altered Surface (acres)	0.0	0.0	0.0	0.0	0.0
Percent Increase	0.0	0.0	0.0	0.0	0.0
New runoff – 100-yr (acre-ft)	0.9	0.9	1.8	0.9	4.4
Percent Increase	7%	7%	8%	13%	10%
New runoff – 100-yr (acre-ft)	1.0	1.0	2.0	1.0	5.0
Percent Increase	7%	7%	8%	13%	10%

Source: Vigil-Agrimis 2004

The fill to regrade surface water ditches would come from the Float Plane Pond. Dredging the pond would create short-term turbidity increases that could also affect Duck Creek, Jordan Creek, East Runway Slough, and the Mendenhall River, depending on erosion control measures and weather. However, only 13,000 cubic yards would be needed for this action, and the adverse affect on surface water resources would be minimal.

4.8.6.4 ALTERNATIVE WH-4

The No Action Alternative would have no affect on current conditions at the Airport with respect to water resources.

4.8.7 VEGETATION

Wildlife hazard management alternatives WH-1 and WH-2 would effect vegetation within the project and landscape areas to varying degrees. Alternative WH-3 would take an adaptive management approach to habitat modification. Using this approach, vegetation types that provide habitat for hazardous wildlife would be incrementally altered or eliminated and then monitored to determine whether this action had the desired effect. If not, additional vegetation/habitat modifications would be undertaken until the identified hazard was reduced to an acceptable level. Alternative WH-4, the No Action Alternative, would entail the continuation of the Airport's existing wildlife hazardous management activities. While some hazard-reducing habitat modifications (such as the relocation of Duck Creek) could occur, these modifications would be associated with other actions on the Airport and not undertaken with the sole purpose of reducing wildlife hazards.

Table 4-76 summarizes the direct impacts that each of the four alternatives would have on the total acreage of plant communities within the project area. The following sections evaluate how the individual action elements of each alternative affect plant communities within the project and landscape areas.

4.8.7.1 ALTERNATIVE WH-1

This is the FAA's preferred WHMP alternative. As shown in Table 4-76, implementation of the Wildlife Hazards Management Plan would directly impact 84.9 acres, or 18.5% of the existing vegetation within the project area. In terms of acreage, the majority these impacts would occur in disturbed and seeded grassland cover types within the Airport infields. These impacts would be neither adverse nor beneficial to vegetation, in that the affected cover types are non-native and contribute nothing to the vegetative diversity of the project area.

An estimated 1.4 acres of beach rye, 0.8 acre of Lyngbye sedge, and 0.2 acre of unvegetated tidelands would be lost as a result of filling wetlands on Airport property west of the runway. Wetlands within the Refuge and west of the runway would also be filled, adversely affecting an additional 7.2 acres of low marsh, 1.8 acres of unvegetated tidelands, 0.6 acre of open water, and 0.2 acre of high marsh. Collectively, these actions would cause an 8.0-acre, or 1.2%, decrease in the low marsh community within the landscape area (7.2 acres of low marsh and 0.8 acre of Lyngbye sedge).

Table 4-76. Summary of Wildlife Hazard Management Alternative Direct Impacts to Plant Communities within the Project and Landscape Area

Plant Community	Alternative WH-1			Alternative WH-2			Alternative WH-3 & 4		
	Acre Lost	Acre Left	% Loss	Acre Lost	Acre Left	% Loss	Acre Lost	Acre Left	% Loss
Project Area									
Algae Tidal	0.0	0.6	0	0.0	0.6	0.0	0.0	0.6	0.0
Beach Rye	1.4	25.8	5.1	1.4	25.8	5.1	0.0	27.2	0.0
Beach Rye-Beach Pea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Coastal Forb Meadow	1.2	43.6	2.7	1.3	43.5	2.9	0.0	44.8	0.0
Coastal Grass Meadow	0.5	72.5	0.7	0.5	72.5	0.7	0.0	73.0	0.0
Deciduous Scrub-Shrub	10.4	12.2	46.0	0.4	22.2	1.9	0.0	22.6	0.0
Deciduous Forest	0.1	3.1	3.1	0.0	3.2	0.0	0.0	3.2	0.0
Disturbed	27.8	8.1	77.4	27.8	8.1	77.4	0.0	35.9	0.0
Ditch Grass	4.8	0.0	100.0	4.8	0.0	100.0	0.0	4.8	0.0
Fresh Grass Marsh	0.0	7.5	0.0	0.4	7.1	5.3	0.0	7.5	0.0
Fresh Sedge Marsh	0.4	1.0	28.6	0.4	1.0	28.6	0.0	1.4	0.0
Lichen-Moss	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0
Lyngbye Sedge	0.8	19.1	4.2	0.8	19.1	4.0	0.0	19.9	0.0
Marestail	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0
Mixed Woodland	0.0	26.0	0.0	0.0	26.0	0.0	0.0	26.0	0.0
Open Water	0.8	85.7	0.9	11.9	74.6	13.8	0.0	86.5	0.0
Pacific Alkali Grass-Goosetongue	0.0	9.9	0.0	0.0	9.9	0.0	0.0	9.9	0.0
Pacific Alkali Grass-Lyngbye Sedge	0.0	4.1	0.0	0.0	4.1	0.0	0.0	4.1	0.0
Reed Canary Grass	0.0	3.5	0.0	0.0	3.5	0.0	0.0	3.5	0.0
Sand	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0
Seeded Grassland	36.5	5.6	86.8	36.4	5.6	86.7	0.0	42.0	0.0
Sphagnum Bog	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.6	0.0
Spruce Forest	0.0	13.5	0.0	0.0	13.5	0.0	0.0	13.5	0.0
Unvegetated Tidal	0.2	32.3	0.6	0.2	32.3	0.6	0.0	32.5	0.0
Total Project Area	**84.9**	**375.0**	**18.5**	**86.3**	**373.5**	**18.8**	**0.0**	**459.8**	**0.0**

Table 4-76. Summary of Wildlife Hazard Management Alternative Direct Impacts to Plant Communities within the Project and Landscape Area, continued

Plant Community	Alternative WH-1			Alternative WH-2			Alternative WH-3 & 4		
	Acre Lost	Acre Left	% Loss	Acre Lost	Acre Left	% Loss	Acre Lost	Acre Left	% Loss
Landscape Area									
Open Water	1.4	1690.5	0.1	12.5	1679.4	0.7	0.0	1691.9	0.0
Unvegetated	2.0	774.4	0.3	1.9	774.5	0.2	0.0	776.4	0.0
Low Marsh	8.0	657.4	1.2	1.8	663.6	0.3	0.0	665.4	0.0
High Marsh	2.1	960.5	0.2	1.9	960.7	0.2	0.0	962.6	0.0
Supratidal	1.1	159.4	0.7	1.3	159.2	0.8	0.0	160.5	0.0
Ditch Grass	4.8	0.0	100.0	4.8	0.0	100.0	0.0	4.8	0.0
Freshwater Marsh	0.4	12.8	3.0	0.8	12.4	6.1	0.0	13.2	0.0
Marestail	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.10	0.0
Sphagnum Bog	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.6	0.0
Shrub-Scrub	10.4	23.9	2.6	0.4	33.9	1.3	0.0	34.3	0.0
Forest	0.0	90.6	28.9	0.0	90.6	0.0	0.0	90.6	0.0
Seeded Grassland	36.5	7.9	82.2	36.4	8.0	82.0	0.0	44.4	0.0
Disturbed	27.8	9.2	75.1	27.8	9.2	75.1	0.0	37.0	0.0
Total Landscape Area	**94.5**	**4387.3**	**2.1**	**89.6**	**4392.2**	**2.0**	**0.0**	**4481.8**	**0.0**

The goal of relocating Duck Creek toward the northern Airport boundary is to move birds preying on fish at the creek mouth away from the aircraft approach and departure path. This action would reduce open water, Lyngbye sedge, and coastal forb meadow communities along the existing channel and recreate similar habitat along the new stream channel. There would be no net adverse impact resulting from this particular action, though benefits to vegetation, wildlife habitat, and fisheries would result from the improved riparian corridor.

Replacement of drainage ditches with underground drains would eliminate 7.3 acres of seeded grassland, 0.4 acre of coastal forb meadow, and a combined 0.5 acres of deciduous shrub-scrub, fresh sedge marsh, and open water.

Removal of vegetation from the Float Plane Pond would eliminate 100% of the ditch grass community from the Airport. At the time vegetation was originally mapped for this EIS, ditch grass covered approximately 4.8 acres within the Float Plane Pond. This community currently occupies a much larger portion of the pond. With the exception of a stand of ditch grass in Miller-Honsinger pond, the Float Plane Pond supports the only known occurrence of ditch grass in the landscape area. The permanence of this impact would depend on how completely dredging operations can remove ditch grass from all areas of the ponds.

Under Alternative WH-1, all vegetation in the Float Plane Pond woodland would be removed to a height of 10 feet and approximately one-third of the trees in the area (primarily the largest spruce) would be removed through thinning. These actions would alter the structure of forest and woodland communities within the Float Plane Pond woodland but probably would not have a substantial effect on the distribution and abundance of tree-dominated communities within this area.

The deciduous shrub-scrub community would likely be eliminated from the Float Plane Pond woodland under this alternative. Shrubs and small trees such as willows and alders would undergo a substantial adverse impact resulting from understory clearing. Assuming that the clearing of understory vegetation would continue in perpetuity, areas currently occupied by shrub-scrub vegetation would eventually be replaced with either forested or herbaceous vegetation. Thinning of the largest trees would allow additional light to reach the forest floor, thereby promoting the growth of groundcover such as grasses and forbs.

Installation of a deer fence around the Float Plane Pond woodland would require clearing a 6 foot-wide swath of vegetation for the construction and long-term maintenance of the fence. This would constitute a 0.9-acre loss of vegetation comprised primarily of reductions in the coastal forb meadow (0.4 acre) and deciduous shrub-scrub (0.2 acre) communities. Approximately 0.1 acre, combined, of fresh grass marsh and spruce forest would be impacted by fence construction and maintenance and the remainder of the area affected would consist of already disturbed ground. It is assumed that, under this alternative, woody vegetation would be prevented from growing back to maintain the clear zone, and the impacts associated with this action would thus be permanent.

The potential for indirect effects to vegetation is fairly limited for this alternative, since much of the goal is to directly eliminate vegetation or at least change the community compositions. Thinning trees within the Float Plane Pond woodland could reduce the rate of evapotranspiration in this area, which would in turn lead to an increase in soil moisture. Increased soil moisture would confer a competitive advantage to hydrophytic shrubs, grasses, and forbs and likely result in an increase in the areal extent of the fresh grass marsh, fresh sedge marsh, and marestail communities within this area. As indicated above, it is assumed that understory shrubs and trees would continue to be removed over time, and that the conversion from a forest community to a combination of open woodland and herbaceous communities would be permanent.

4.8.7.2 Alternative WH-2

Implementation of WH-2 would directly impact 86.3 acres or 18.8% of the existing vegetative cover types within the project area. Just as under WH-1, the majority of these impacts would occur to disturbed and seeded grassland cover types as a result of the comprehensive effort to eliminate areas currently covered in grass, and attractive to birds, within the infield. This alternative would use a synthetic cover to remove grass and reduce attraction to birds. Although the method is different, essentially the same amounts and types of vegetation would be lost as described for the Alternative WH-1.

This alternative also includes the fill of approximately 2.9 acres, combined, of beach rye, coastal grass meadow, Lyngbye sedge, and unvegetated tidelands on the Airport property west of the runway. Impacts to vegetation would be as described for Alternative WH-1. However, a more limited amount of fill and disturbance would occur in estuarine communities on the Refuge west of the runway. Only wetlands that retain open water (i.e., ponds, channels, and swales) at low tide would be filled and regraded. Consequently, while its impacts on open water west of the runway and adjacent, unvegetated tidelands would be the same as under the Alternative WH-1, implementation of this action would result in less than 1.0 acre (0.1%) of impact to low marsh habitat, compared to the 7.2 acres (1.1%) of low marsh that would be affected in this area under WH-1.

This alternative would relocate only a limited reach of Duck Creek, from the Radcliffe Road crossing to the creek mouth at the Mendenhall River. This action would reduce open water, Lyngbye sedge, and coastal forb meadow communities along the existing channel, but these communities would be recreated along the new portion of the stream channel, and the net impact to vegetation communities would be negligible. There may be some indirect benefits to vegetation by the improved riparian corridor along the new channel.

Drainage ditches would be lined with concrete or a synthetic cover material, resulting in similar types and quantities of vegetation losses as described for Alternative WH-1.

Although the method would differ from that of Alternative WH-1, this alternative would also eliminate virtually all of the ditch grass community from the Airport property, in this case by filling the sloughs on the south side of the Float Plane Pond. Just as under WH-1, this action may result in a substantial reduction in the coverage of ditch grass across the landscape area as a whole.

Removing corvid nests within the Float Plane Pond woodlands would affect individual trees (primarily spruce) but would have little direct impact on the plant communities in this area. Installation of a deer fence around the Float Plane Pond woodland would require clearing a narrow swath of vegetation for the construction and long-term maintenance of the fence.

Indirect impacts to vegetation communities would primarily take the form of long-term shifts in the relative cover of different vegetation types within the Float Plane Pond woodland. For instance, fill placed in the Float Plane Pond sloughs would eventually be colonized by plants. Depending on the relative height of the fill above the water table, these areas could become marestail, fresh sedge marsh, fresh grass marsh, coastal grass meadow, coastal forb meadow, deciduous shrub-scrub, or a mosaic of these communities.

4.8.7.3 Alternative WH-3

Alternative WH-3 primarily involves managing existing infield vegetation to minimize its attractiveness to wildlife and using an adaptive management approach to controlling wildlife hazards at JNU. In the short-term, few actions would result in the direct or indirect loss of vegetation or changes to plant communities. Over the long-term, if monitoring indicates that hazing activities are not reducing wildlife hazards to an acceptable level, habitat modifications could have to be implemented. The type and extent of these modifications are unknown at this time.

4.8.7.4 Alternative WH-4

Under Alternative WH-4, there would be no impact to plant communities and other vegetative cover types beyond those associated with existing wildlife hazard management practices at JNU.

4.8.8 Wetlands

Since some of the wildlife hazard actions would affect habitat within and outside of the project area, the environmental scores calculated for project area wetlands were used to determine loss of functional units for wetlands in the landscape area as well. Impacts to wetlands for the wildlife hazard alternatives are analyzed, accounting for acreage and percent change of acreage at the landscape level. These landscape level impacts are summarized in Table 4-77. Subsequent tables summarize loss of wetland function by the wildlife hazard actions. No direct or indirect impacts to wetlands would be caused by the No Action Alternative, WH-4, and existing conditions would persist.

4.8.8.1 Alternative WH-1

Alternative WH-1, the FAA's preferred WHMP alternative, would have the greatest effect on wetlands of any of the wildlife hazard management alternatives. This alternative would result in the loss of 13.5 acres of wetlands and short-term construction impacts on 16.1 acres of wetlands by dredging activities. Table 4-78 provides a listing of the impacts to area wetlands caused by Alternative WH-1. A breakdown of the actions causing the loss or change to wetlands includes:

- Paving of grass infields (0.8 acres)
- Filling of on-Airport wetlands to above high-tide mark (2.2 acres)
- Filling of Refuge wetlands on west end of runway (10.0 acres)
- Major relocation of Duck Creek (0.5 acres)
- Dredging of Float Plane Pond and fingers to remove vegetation (16.1 acres)

Paving grass infields would result in the loss of some high marsh wetland functions such as sediment and toxicant retention, riparian support, fish and wildlife habitat, and regional ecological diversity. Filling the on-Airport wetlands and Refuge wetlands west of the runway to above the high-tide mark would reduce all wetland functions, especially fish and wildlife habitat and regional ecological diversity. Relocation of Duck Creek would also cause a net loss of 0.5 acres of estuarine channels.

Dredging the Float Plane Pond and fingers would reduce wetland functions relating to wildlife habitat and regional ecological diversity by changing 16.1 acres of palustrine aquatic beds to open water, lacustrine habitat. Approximately 1,203 functional units would be lost through this conversion. The Float Plane Pond is hydrologically isolated from other wetlands, including those within the Refuge, and the loss of this habitat is not considered significant, particularly because the Pond's primary function is to serve aviation operations.

Table 4-77. Summary of Landscape-level Wetland Impacts by Wildlife Hazard Alternatives*

Wetland Resources NWI Classification	Alternative WH-1			Alternative WH-2			Alternative WH-3			Alternative WH-4		
	Acres Lost	Acres Left	% Change	Acres Lost	Acres Left	% Change	Acres Lost	Acres Left	% Change	Acres Lost	Acres Left	% Change
E1UB	0.6	1119.4	0.1	0.6	1119.4	0.1	0.0	1120.0	0.0	0.0	1120.0	0.0
E2EM (H)	2.3	961.0	0.2	1.3	962.0	0.1	0.0	963.3	0.0	0.0	963.3	0.0
E2EM (L)	8.1	661.5	1.2	1.7	667.9	0.3	0.0	669.6	0.0	0.0	669.6	0.0
E2US	2.4	659.9	0.4	2.1	660.2	0.3	0.0	662.3	0.0	0.0	662.3	0.0
PAB	16.1**	7.3	68.8	16.1	7.3	68.8	0.0	23.4	0.0	0.0	23.4	0.0
PEM	0.0	28.2	0.0	0.5	27.7	1.8	0.0	28.2	0.0	0.0	28.2	0.0
PSS	0.0	6.8	0.0	0.1	6.7	1.5	0.0	6.8	0.0	0.0	6.8	0.0
R3UB	0.0	0.7	0.0	0.0	0.7	0.0	0.0	0.7	0.0	0.0	0.7	0.0
Total Impacts	29.6	4112.1	0.7	22.4	4119.3	0.5	0.0	4141.7	0.0	0.0	4141.7	0.0

***** - Total impacts account for all wetland acreage in the landscape area.
** - Wetland impacts from dredging; all other impacts are from filling wetlands.

Table 4-78. Alternative WH-1: Wetland Impacts

	NWI Classification					
	E1UB3	E2EM1 (H)	E2EM1 (L)	E2USN	PAB3	Total
Landscape Area						
Total Acreage Lost*	0.6	2.3	8.1	2.5	16.1**	29.6
Functional Units Lost	84.2	315.3	1124.3	345.8	1246.4**	3116.0

* - Minor impacts (<0.05 acres) would occur to PEM1, PSS1, and R3UB2 wetlands.
** - Acres affected by dredging activities; functional units lost assume very low ratings for Wildlife and Regional Ecological Diversity due to dredging.

Removal of some trees and understory in the Float Plane Pond woodland would likely alter the hydrologic regime, resulting in the formation of more wetlands due to loss of transpiration. Palustrine emergent (PEM1) wetlands would be most likely to form under this scenario. Indirect effects of hydrologic changes are described in sections 4.8.6 and 4.8.9.

The direct loss of estuarine wetlands west of the runway both on- and off-Airport property would alter hydrology, degrade wetland functions and values, and adversely affect maintenance of natural systems that support EFH. In addition, approximately 10 acres of Refuge wetlands would be lost or changed. However, as explained in Section 4.2.8, the wetlands west of the runway western are not hydrologically connected to the rest of the Refuge. That is, the loss of the wetlands in this area would not have an adverse affect on functions of wetlands in other areas.

4.8.8.2 Alternative WH-2

This alternative would result in the loss of 22.4 acres of wetlands, as shown in Table 4-79. There would also be direct losses of estuarine habitat west of the runway, as with Alternative WH-1, but at comparatively lesser levels. As a result, there would be less impact on the hydrologic capability of the system needed to maintain wetland functions and values and habitat. Though this alternative does call for filling 16.7 acres of wetlands (the Float Plane Pond fingers), these wetlands are part of a system created as a result of building the Float Plane Pond impoundment. They are hydrologically disconnected from the Refuge wetland system and have a primary function for Airport use. Therefore, though filling of wetlands would affect wildlife habitat within this area of the Airport, the impact would not be significant given the context of the action. A breakdown of the actions causing the loss or change to wetlands includes:

- Selective dredging and filling on Airport property (2.2 acres)
- Selective filling of wetlands in Refuge at west end of runway to eliminate ponds and swales that capture and hold water (3.3 acres)
- Relocation of limited reach of Duck Creek from Radcliffe Road (0.2 acres)
- Filling of Float Plane Pond fingers to remove vegetation (16.7 acres)

Table 4-79. Alternative WH-2: Wetland Impacts

	NWI Classification						
	E1UB3	**E2EM1 (H)**	**E2EM1 (L)**	**E2USN**	**PAB3**	**PEM1/ PSS1**	**Total**
Landscape Area							
Total Acreage Lost	0.6	1.3	1.7	2.1	16.1	0.5/0.1	22.4
Functional Units Lost	84.2	178.2	236.0	290.4	2163.8	51.8/9.5	3013.9

Installation of synthetic ground cover would preserve wetland functions such as sediment and toxicant retention but reduce functions that promote wildlife hazards, such as wildlife habitat and regional ecological diversity.

Filling on-Airport wetlands and selectively filling wetlands in the Refuge off the west runway would reduce functions that cause wildlife to be hazards to aviation, including functions such as fish habitat, wildlife habitat, and regional ecological diversity.

Relocating a limited reach of Duck Creek from Radcliffe Road would result in temporary loss of fish and wildlife habitat functions by filling part of the existing Duck Creek channel, but the channel would be nearly restored in terms of these functions.

The filling of the Float Plane Pond fingers would result in the loss of all functions associated with palustrine wetlands (PAB3, PEM1, and PSS1 wetland types), including the loss of functions, such as wildlife habitat and regional ecological diversity that cause wildlife to be hazards to aviation.

Selective filling of wetlands in the Refuge would alter hydrology, degrade wetland functions and values, and adversely affect maintenance of natural systems that support EFH. However, as explained in Section 4.2.8 and for Alternative WH-1, the wetlands west of the runway western are not hydrologically connected to the rest of the Refuge. That is, the loss of the wetlands in this area would not have an adverse affect on functions of wetlands in other areas.

4.8.8.3 Alternative WH-3

Direct losses of or impacts to wetland acreage would not occur under this alternative. The limited dredging of the Float Plane Pond to obtain fill to regrade surface water ditches would have on a minor, short-term impact on aquatic vegetation and should not result in the loss of function.

4.8.8.4 Alternative WH-4

No direct impacts would result from the No Action Alternative. The present influence of Airport wildlife hazard management activities upon wetlands would continue indefinitely.

4.8.9 FISHERIES

The actions considered for wildlife hazard management have a variety of potential impacts to fish and fish habitat, mostly in the vicinity of the west Runway 08 end, lower Duck Creek, and the mouth of Jordan Creek. Most impacts result from the direct loss of estuarine EFH. Fisheries would not be adversely affected by actions in the Float Plane Pond woodland. The Float Plane Pond is designed for aviation uses and fish access is purposely inhibited, so the pond is not considered EFH. Removal of the rock dam near the mouth of Jordan Creek, an action incorporated into alternatives WH-1, -2, and -3, would be accompanied by maintenance and improvement of semi-natural cobble/boulder steps at the culvert entrance. Removal of the dam would ease fish access and allow fish to move more swiftly through the culverts. This action would also reduce wildlife hazards by limiting a food source at this location. Alternatives to the dam that would help with fish passage but do not result in a hazardous wildlife attractant would be considered at the time wildlife hazard management actions are implemented. Such alternatives might include bioengineering of the pool to make fish passage into the adjacent culvert easier. The timing of the removal of the dam would be determined in the project permit.

Table 4-80 summarizes direct loss of EFH associated with each of the wildlife hazard alternatives.

Table 4-80. Direct Loss of Essential Fish Habitat: Wildlife Hazard Alternatives[1]

EFH Type	WH-1	WH-2	WH-3, WH-4
Open Water	0.6	0.6	0.0
Slough	2.4	2.1	0.0
Low Marsh	8.1	1.7	0.0
High Marsh	2.3	1.3	0.0
EFH Total	13.4	5.7	0.0

[1] All losses in acres.

4.8.9.1 ALTERNATIVE WH-1

This is the FAA's preferred WHMP alternative. Fish movement in Duck Creek may be temporarily disrupted during channel relocation and establishment of a new confluence to the Mendenhall River. Fish movement in the Mendenhall River may be slightly disrupted during wetland fill activities. Resident fish (mostly sticklebacks and sculpins) would be disrupted, and some would be destroyed, during dredging of the Float Plane Pond fingers.

Long-term adverse impacts would include a 13.5-acre reduction in EFH along and within the Mendenhall River, most of which is low marsh habitat. This loss of habitat would comprise a 0.4% reduction in EFH within the landscape area.

The dredging and loss of vegetation in the Float Plane Pond (to obtain borrow material) would render them less useful as habitat for resident sculpins and sticklebacks. Fish access into Duck Creek would be improved within the relocated channel as described for Alternative RW/FW-2 (see Section 4.7.9.2).

The increased impervious surfaces installed on the Airport infield would reduce surface water infiltration and increase the risk of intermittent contamination of streams and estuarine habitats with harmful concentrations of pollutants. While the incidence would be infrequent, the magnitude of impacts like local fish kills could be substantial.

4.8.9.2 Alternative WH-2

Impacts to fish would be similar to those under WH-1 with the following exceptions. Duck Creek construction impacts would be similar in kind but lower in degree due to the reduced fill of estuarine habitat along the Mendenhall River and the shortened extent of relocated Duck Creek. There would be less disturbance from these actions, relative to WH-1, and shorter construction time; therefore short-term impacts to fish would be reduced. Following construction, long-term impacts would include a 6.7-acre reduction in EFH, much less than with Alternative WH-1, primarily because of the reduced fill along the Mendenhall River.

The fish function value of the Float Plane Pond would decrease to Very Low after the Float Plane Pond fingers were filled but, based on the use of the pond for aviation purposes, this is not considered an adverse impact. Fish movement may be improved slightly through the lowermost portion of Duck Creek, but these improvements would be lower in degree than under the extensive Duck Creek relocation in WH-1.

The indirect reduction of infiltration due to regrading drainages could increase risk of contaminating streams and estuarine habitats with harmful concentrations of pollutants, but the overall impact is less than with WH-1. The use of synthetic, permeable ground cover (instead of concrete) would help to retain some infiltration characteristics and flood storage and would limit increases of stormwater discharge. There would still be indirect effects to fish from these hydrologic changes, but to a lower degree than for alternative WH-1.

4.8.9.3 Alternative WH-3

This alternative would not require fill of any EFH and, in the short-term, would entail no direct impacts to fisheries. Over the long-term, if monitoring indicates that wildlife hazing activities are insufficient to reduce wildlife hazards to an acceptable level, habitat modifications would likely be implemented. The extent to which such modifications could impact EFH and fisheries in general is unknown at this time.

4.8.9.4 Alternative WH-4

No direct impacts would result from the No Action Alternative. The present effect of Airport wildlife hazard management activities upon fish and fish habitat would continue indefinitely.

4.8.10 WILDLIFE

As context for discussion of how the wildlife hazard management alternatives would affect wildlife species or habitat, it is worth noting that the fundamental purpose of the alternatives is to influence the behavior of wildlife, via habitat modifications and/or harassment, so that there is reduced risk to aviation. Actions having the greatest adverse impact on wildlife habitat are generally considered to have the greatest success at reducing wildlife aviation risks at airports. However, frequent and systematic wildlife hazing activities may serve to reduce these risks to an acceptable level with little or no habitat modification.

Alternatives WH-1 and WH-2 would affect wildlife habitats within the project and landscape areas to varying degrees. Alternative WH-3, like the No Action Alternative, WH-4, would (at least in the short term) have negligible direct impacts on native habitats and would instead involve the management of existing habitats (primarily disturbed ground and seeded grassland) that attract hazardous wildlife species.

Table 4-81 summarizes the direct impacts that each of the four alternatives would have on the total acreage of wildlife habitats within the landscape area. The following sections evaluate how the individual action elements of each alternative affect habitat and wildlife within the project and landscape areas.

Table 4-81. Summary of Wildlife Hazard Management Alternative Direct Impacts to General, High Interest, and Sensitive Species' Habitats within the Landscape Area

	WH-1			WH-2			WH-3 and 4		
Habitat Type	**Ac. Lost**	**Ac. Left**	**% Change**	**Ac. Lost**	**Ac. Left**	**% Change**	**Ac. Lost**	**Ac. Left**	**% Change**
General Wildlife Habitat									
Open Water	1.3	1690.6	0.1	12.4	1679.5	0.7	0.0	1691.9	0.0
Unvegetated	2.0	774.4	0.3	1.9	774.5	0.2	0.0	776.4	0.0
Freshwater Marsh	0.4	13.5	2.9	0.6	13.3	4.3	0.0	13.9	0.0
Ditch Grass	4.8	0.0	100.0	4.8	0.0	100.0	0.0	4.8	0.0
Estuarine Low Marsh	8.0	660.7	1.2	1.8	666.9	0.3	0.0	668.7	0.0
Lyngbye Sedge	8.0	475.3	1.7	1.8	481.5	0.4	0.0	483.3	0.0
Estuarine High Marsh	2.1	957.1	0.2	1.9	957.3	0.2	0.0	959.2	0.0
Supratidal	1.1	159.3	0.7	0.9	159.5	0.6	0.0	160.4	0.0
Seeded Grassland	36.5	8.0	82.1	29.1	15.3	65.5	0.0	44.4	0.0
Shrub-Scrub	10.4	23.9	30.3	0.3	34.0	1.0	0.0	34.3	0.0
Forest	0.0	90.6	0.0	0.0	90.6	0.0	0.0	90.6	0.0
Total*	74.6	4378.1	1.7	53.7	4390.9	1.2	0.0	4444.6	0.0

Table 4-81. Summary of Wildlife Hazard Management Alternative Direct Impacts to General, High Interest, and Sensitive Species' Habitats within the Landscape Area, continued

Habitat Type	WH-1			WH-2			WH-3 and 4		
	Ac. Lost	Ac. Left	% Change	Ac. Lost	Ac. Left	% Change	Ac. Lost	Ac. Left	% Change
High Interest Species Habitats									
Migratory Waterfowl	6.1	1690.6	0.4	17.3	1679.4	1.0	0.0	1696.7	0.0
Swans	6.1	1690.6	0.4	17.3	1679.4	1.0	0.0	1696.7	0.0
Canada Goose	50.6	2359.3	2.1	55.5	2354.3	2.3	0.0	2406.5	0.0
Bonaparte's Gull	13.4	4082.8	0.3	18.1	4078.1	0.4	0.0	4096.3	0.0
Great Blue Heron	14.1	2351.3	0.6	19.1	2346.3	0.8	0.0	2362.1	0.0
Shorebirds	10.0	1435.1	0.7	3.7	1441.4	0.3	0.0	1441.8	0.0
Bald Eagle	74.6	4370.0	1.7	62.7	4381.9	1.4	0.0	4444.6	0.0
Other Raptors	74.6	4370.0	1.7	62.7	4381.9	1.4	0.0	4444.6	0.0
Rufous Hummingbird	1.1	159.3	0.7	1.3	159.1	0.8	0.0	160.4	0.0
Swallows	11.8	3326.7	0.4	21.8	3316.7	0.7	0.0	3338.6	0.0
Corvids	74.6	4370.0	1.7	62.7	4381.9	1.4	0.0	4444.6	0.0
Songbirds	14.5	1214.2	1.2	3.7	1240.8	0.3	0.0	1247.9	0.0
Black Bear	59.4	1852.0	3.0	42.7	1884.4	2.2	0.0	1971.6	0.0
River Otter	54.1	3419.7	1.6	22.3	3441.1	0.6	0.0	3463.5	0.0
Sitka Black-tailed Deer	59.4	1896.4	3.0	42.7	1928.8	2.2	0.0	1971.6	0.0
Sensitive Species Habitats									
Q.C. Goshawk	14.9	1227.7	1.2	4.5	1253.9	0.4	0.0	1261.8	0.0
Peregrine Falcon	51.4	4268.4	1.2	61.4	4258.3	1.4	0.0	4319.8	0.0
Olive-sided Flycatcher	0.0	64.4	0.0	0.0	90.6	0.0	0.0	90.6	0.0
Townsend's Warbler	0.0	64.4	0.0	0.0	90.6	0.0	0.0	90.6	0.0

*Total does not include Lyngbye sedge as it is a sub-habitat of estuarine low marsh.

4.8.10.1 ALTERNATIVE WH-1

As shown in Table 4-81, implementation of Alternative WH-1, the FAA's preferred WHMP alternative, would directly affect 74.6 acres or 1.7% of the existing wildlife habitat within the landscape area. A large portion of these impacts would result from the elimination of approximately 36.5 acres (82.1%) of seeded grassland habitat within the Airport infield. Paving of the infield would eliminate the habitat currently used by Vancouver Canada geese for foraging, but this loss is considered to be neither adverse nor beneficial, in that seeded grassland is a non-native habitat type and does not contribute to the biological diversity of the region.

An estimated 2.1 acres of estuarine high marsh and 8.0 acres of low marsh (comprised entirely of Lyngbye sedge) would be lost as wetlands west of the runway, on Airport property and in the Refuge, are filled to reduce the attractiveness of the area to birds. These actions (WH-1b and WH-1c) would cause a 1.2% decrease in the low marsh community within the landscape area (note that Table 4-81 does not detail the impacts of individual action elements).

The goal of relocating Duck Creek toward the northern Airport boundary is to move birds preying on fish at the creek mouth away from the aircraft approach and departure path. This action would reduce open water, Lyngbye sedge, and supratidal habitats along the existing channel but recreate similar habitat along the new stream channel. There would be no net adverse impact to wildlife from this particular action but potential benefits may occur as a result of the improved riparian corridor.

Replacement of drainage ditches with underground drains would eliminate 7.3 acres of seeded grassland, 0.4 acre of supratidal, and a combined 0.5 acres of shrub-scrub, freshwater marsh, and open water habitats. These impacts to habitat on the Airport, while permanent, would not be substantial in terms of the landscape area.

Removal of vegetation from the Float Plane Pond would eliminate all ditch grass habitat from the Airport. As noted in the Vegetation section above, at the time of mapping in 2001, ditch grass occupied approximately 4.8 acres within the Float Plane Pond and adjacent sloughs. Ditch grass has since colonized most of the pond and this acreage is currently much greater than previously identified. With the exception of a stand of ditch grass in Miller-Honsinger Pond, this is the only known stand of this community type in the landscape area. The permanence of this impact would depend on how completely dredging operations can remove ditch grass from all areas of the ponds. While this action would degrade waterfowl foraging habitat, the presence of the Airport dike, surrounding shrub cover, and open water would provide adequate protection for loafing waterfowl.

Thinning of forested habitats within the Float Plane Pond woodland would alter the structure of this habitat, but it would remain forested. Thus, this action would have no effect on the overall acreage of forest habitat within the treated area. Removing the forest understory to a height of ten feet would essentially eliminate shrub-scrub habitat from the Float Plane Pond Woodland. As a result, 10.4 acres or 30.3% of this habitat type would be lost from the landscape area.

With regard to high-interest species, the greatest effect would be to species with the broadest habitat requirements. Consequently, 74.6 acres or 1.7% of potentially suitable habitat for bald eagles and other raptors would be impacted within the landscape area. While raptors and corvids may continue to forage and roost in the area, they would be unlikely to nest there in the absence of tree cover. The greatest relative impacts to high interest species would be to black bear and Sitka black-tailed deer, which would have 3.0% of their habitat affected by this action. However, because these impacts would primarily constitute a change (rather than a loss) in habitat for these two species, they are considered inconsequential. Construction of a deer fence around the Float Plane Pond Woodland would prevent these large mammals from continuing to use the area, regardless of understory vegetation cover.

It is notable that the Vancouver Canada goose and river otter would undergo the next most severe relative impacts, losing 50.6 acres (2.1%) and 54.1 (1.6%) of their respective habitats within the landscape area. For geese, the majority of these impacts (29.2 acres) would be attributed to paving seeded grassland habitat in the Airport infields where geese are known to forage and loaf and where they constitute the greatest hazard to aircraft. These habitat modifications would not be expected to have substantive effects on populations of high interest species within the landscape area.

Under WH-1, 14.9 acres (1.2%) of potential habitat for the Queen Charlotte goshawk would be affected in the landscape area, along with 51.4 acres (1.2%) for the peregrine falcon. While thinning trees within the Float Plane Pond woodland would degrade habitat for forest-interior bird species such as kinglets, wood warblers, thrushes, as well as sensitive species including the olive-sided flycatcher and Townsend's warbler, this action would not constitute a total loss of habitat for these species.

Additional indirect impacts associated with the thinning of trees from the Float Plane Pond woodland could include a reduction in the rate of transpiration in this area, which in turn would lead to an increase in soil moisture. Increased soil moisture would confer a competitive advantage to hydrophytic grasses and forbs and likely result in an increase in the areal extent of the fresh-water marsh habitats within this area. It is assumed that trees would continue to be thinned and shrubs removed over time, and that the conversion from forest to herbaceous communities would be permanent. This habitat conversion would be accompanied by a shift in wildlife species within the affected area. Habitat for forest-nesting songbirds such as the Townsend's warbler, olive-sided flycatcher, hermit thrush, and ruby-crowned kinglet would be converted to herbaceous communities. This habitat conversion would favor marsh-associated species such as the savannah sparrow, Lincoln sparrow, and common redpoll.

Other indirect impacts of tree clearing relate to how the trees function in influencing the flight patterns of birds in the project and landscape areas. There is anecdotal evidence to suggest that the existing tree cover acts as a partial barrier for birds flying northward out of the Refuge and adjacent Airport wetlands. Observers along the dike trail have witnessed birds flying northward from the Refuge veer to the east and west upon reaching the Float Plane Pond woodland. It has been suggested that, without the existing tree cover in this area, these individuals might continue flying northward across the runway, thereby exacerbating wildlife hazards to aviation. It should be noted that this phenomenon has not been scientifically verified. Observations from other persons, including USDA wildlife hazard control specialists and hunters, appear to contradict this conclusion. These persons suggest the trees have little or no effect on bird flight patterns across the runway.

4.8.10.2 Alternative WH-2

Implementation of WH-2 would directly affect 53.7 acres, or 1.2% of the existing wildlife habitat types within the project area. Just as under WH-1, most of the impact would occur to seeded grassland habitat as a result of the comprehensive effort to eliminate areas currently covered in grass, and attractive to birds, within the infield. This alternative would use a synthetic cover to remove grass and reduce attraction to birds. Although the method is different, essentially the same amounts and types of habitat would be lost as described for Alternative WH-1.

This alternative also includes the fill of approximately 2.7 acres of wetlands (comprised of estuarine high and low marsh and unvegetated tidelands) on the Airport property west of the runway. Impacts to habitat would be as described for Alternative WH-1. However, a more limited amount of fill and disturbance would occur in wetlands on the Refuge west of the runway. Only wetlands that retain open water (i.e., ponds, channels, and swales) at low tide would be filled and regraded. Consequently, while impacts to open water and unvegetated tidelands along the Mendenhall River would be the same as Alternative WH-1, this alternative would cause the loss of just 1.0 acre (0.1%) of low marsh from the landscape area, compared to the 7.2 acres (1.1%) of low marsh that would be lost under WH-1 (note that Table 4-81 does not detail the impacts associated with individual action elements of the wildlife hazard management alternatives).

Alternative WH-2 would relocate only a limited reach of Duck Creek, from the Radcliffe Road crossing to the creek mouth in the Mendenhall River. This action would impact wildlife habitats along the existing channel, but these habitats would be recreated along the new portion of the stream channel, and the net impact to wildlife resulting from this action would be negligible.

Drainage ditches would be lined with concrete or a synthetic cover material, resulting in similar types and quantities of habitat losses as described for Alternative WH-1.

Although the method would differ from Alternative WH-1 this alternative would also eliminate virtually all of the estimated 4.8 acres of ditch grass habitat from the Airport property, by filling the sloughs on the south side of the Float Plane Pond. Just as under WH-1, this action may eliminate the ditch grass habitat from the landscape area. In contrast to WH-1, this action would render affected areas totally unsuitable for use by waterfowl, a benefit in terms of wildlife hazard management.

For high-interest species, the greatest impacts of WH-2 would, like WH-1, occur to the species with the broadest habitat requirements. Consequently, bald eagles and other raptors would lose 62.7 acres, or 1.4% of potentially suitable habitat within the landscape area. While raptors and corvids may continue to forage and roost in the area, trees supporting corvid nests would be selectively removed. It is unknown whether eagles would continue to nest in the area under these conditions. The greatest relative impact to high interest species would be to the Vancouver Canada goose, which would have 55.5 acres or 2.3% of potentially suitable habitat in the landscape area impacted by this alternative. Just as under WH-1, the majority of these impacts would be attributed to loss of the seeded grassland cover type. These actions would not be anticipated to jeopardize the continued existence of high interest species in the landscape area.

Implementation of WH-2 would affect 4.5 acres or 0.4% of Queen Charlotte goshawk habitat within the landscape area. Absolute and relative impacts to peregrine falcon habitat would be more substantial at 61.4 acres or 1.4% of potentially suitable habitat within the landscape area. Neither of these effects would constitute a straight loss of habitat but, rather, a conversion of one habitat type to another. For instance, filling the fingers of the Float Plane Pond would affect approximately 17 acres of potential foraging habitat for the peregrine falcon. Over time, much of this area would be colonized by a variety of grasses and forbs. Though the prey species composition would change, it would continue to provide potentially suitable foraging habitat for peregrine falcons. These actions would not be anticipated to have substantive effects on populations of sensitive species in the landscape area.

4.8.10.3 Alternative WH-3

Alternative WH-3 primarily involves managing existing vegetation to minimize its attractiveness to wildlife. Few actions would result in the direct or indirect loss of habitat. In the short term, this alternative would not entail any other conversion of cover types and would have few or no direct impacts on habitat within the project and landscape areas. Over the long term, if monitoring indicates that wildlife hazing and other active management approaches are not reducing wildlife hazards to an acceptable level, habitat modifications may be implemented. The type and extent of these modifications and their impacts to general, high-interest, and sensitive wildlife species are unknown at this time.

It has been suggested that current hunting practices may influence daily flight patterns of Vancouver Canada geese. Some persons have reported that, during the hunting season, geese apparently fly across the west Runway 08 end approach and departure path in the early morning on their way to Auke Lake where they stay for the remainder of the day, ostensibly to avoid hunting pressure. The geese then return to estuarine marsh habitats south of the Airport in the evening. If these reports are accurate, continuation of hunting in this area may contribute to bird airstrike hazards on the western approach to the Airport. Alternatively, some hunters who have used the Airport for waterfowl hunting dispute this reported effect, and note that if anything, hunting pressure from the north side of the Float Plane Pond tends to direct birds south, toward the Refuge interior and away from aviation flight paths.

This alternative would require that hunting on the Airport be stopped, although it would have no affect on hunting in the Refuge. Based on the hunting data presented in Section 4.2, it is not likely this action would have any substantive beneficial or detrimental impacts on waterfowl populations. The benefits of this action to the wildlife hazard management program (by reducing waterfowl crossings of the runway or approach/departure paths as a response to gunshots) should be verified by monitoring during hunting season.

4.8.10.4 ALTERNATIVE WH-4

Under alternative WH-4, there would be no additional impact to wildlife habitat beyond those associated with existing wildlife hazard management practices at JNU.

4.8.11 CULTURAL RESOURCES

No known historic properties would be affected by the proposed WHMP or the alternatives. The possibility of impacts to potential subsurface sites increases with the level of ground disturbance associated with each alternative, although it is also dependent on the areas to be disturbed. Therefore, Alternative WH-1 has the greatest potential to uncover cultural resources, while WH-2 would have less potential. WH-3 would have the least potential for cultural resource site discovery. WH-4 would have no impact on historic properties because there would be no ground disturbance associated with this No Action Alternative.

4.8.11.1 ALTERNATIVE WH-1

This is the FAA's preferred WHMP alternative. The spruce grove south of the Float Plane Pond was identified by local Auke Tlingit elders and heritage groups as one of the most important sources of roots for the traditional practice of basket and hat weaving in Southeast Alaska. However, research indicates that the grove of trees is less than 50 years old and thus does not meet the minimum age requirement for listing on the NRHP. Although the NRHP does allow for exceptions to this 50-year rule, the NRHP also notes that importance assigned to a site by a cultural group only within the last 50 years cannot be considered traditional. Therefore, the site cannot be considered a Traditional Cultural Property.

Further, although the spruce grove at the airport is considered important by those who obtain roots there, it cannot necessarily be said that the grove itself is integral to maintaining the cultural identity of the Native Alaskan groups with cultural patrimony over the area. A description of the FAA's determination that the spruce grove does not presently qualify as a eligible property or even as site per se was provided to the SHPO as part of the cultural resource studies conducted as part of this EIS. The SHPO concurred with the findings of those studies.

This is not to say, however, that impacts to the spruce grove would not cause concern amongst those who obtain roots there or those who support the use of the roots in the traditional practice of weaving. Indeed, it is probable that impacts to the spruce grove would induce some level of concern and discomfort within the Auke Tlingit community. Installation of a fence around the Float Plane Pond should not preclude access to this area for spruce roots, but it would require those gathering the roots to obtain permission and security escort from the Airport for access.

Subsurface archaeological sites may be present within the areas that would be disturbed by this alternative, with higher potential for sites in the intertidal zones, along the Mendenhall River, and south of the Float Plane Pond. Dredging of the Float Plane Pond to remove vegetation (and also obtain borrow material) could uncover prehistoric or ethnographic sites that were not discovered during initial excavation of the ponds. Alternatively, there could be historic material that was disposed of in the Float Plane Pond, most likely in one of the fingers during or immediately following World War II. It is reported that at other airports in southeast Alaska that were used during World War II, following the war and the closing of the military facilities at the air fields, pieces of military support equipment and other materials were discarded into the waters surrounding Airport facilities. However, the probability of either occurrence at JNU is low, and this determination was concurred with by the SHPO as part of consultation regarding the cultural resource studies associated with this EIS.

The northwest area of the Airport has dense, ground-level vegetation that may obscure surface sites, and there is greater potential to discover previously undiscovered cultural resources here, particularly along a new corridor excavated for Duck Creek relocation. Removal of some trees and understory in the Float Plane Pond woodlands would also clear vegetation that may be covering surface sites. In consultation with the SHPO and as authorized by 36 CFR 800.4(b)(2), the FAA has determined to implement a phased approach to the identification of cultural resources. The phased approach will ensure implementation of a subsurface archaeological testing program prior to ground disturbance in areas of high occurrence probability and where ground surface visibility during the field inventories for the EIS was poor due to dense vegetation cover.

4.8.11.2 ALTERNATIVE WH-2

There is a lower potential for cultural resources and historic properties to be affected by this alternative than for Alternative WH-1, primarily because there would be less ground disturbance. The large spruce trees and woodlands would not be removed, although clearing of vegetative understory could uncover surface cultural sites. As with Alternative WH-1, persons desiring to gather spruce root for traditional purposes would have to obtain permission and security escort from the Airport for access.

Dredging of the Float Plane Pond fingers would not take place, eliminating the opportunity to uncover sites under water, though the proposed placement of fill in the fingers could result in covering and compressing such sites if they are present. Only the lowermost portion of Duck Creek would be relocated, so the dense vegetative cover in the northwest area of the Airport would remain undisturbed.

4.8.11.3 ALTERNATIVE WH-3

There is little potential for cultural resources and historic properties to be affected by this alternative. The only activity in the Float Plane Pond woodlands would be to periodically remove nests. Other than some regrading of drainage ditches, no other ground disturbing activity would take place that could uncover subsurface cultural resources.

4.8.11.4 ALTERNATIVE WH-4

There is no potential for the No Action Alternative to affect cultural resources or historic properties.

4.8.12 VISUAL RESOURCES

The visual effects of the wildlife hazard management alternatives were analyzed from the point of view of the covered picnic table area along the Dike Trail. In general, the degree of visual resource impact is directly related to the amount of habitat modification proposed. Therefore, the Alternative WH-1, consisting of the greatest amount of habitat modification, would have the greatest affect on visual resources, and WH-2 would have less potential. Alternative WH-3 would have relatively limited impact on visual resources. Alternatives WH-1, -2, and -3 would indirectly affect recreational experience on the Dike Trail as a result of visual modifications to the Float Plane Pond and/or woodlands. Alternative WH-4 would have no impacts to visual resources.

4.8.12.1 ALTERNATIVE WH-1

Alternative WH-1, the FAA's preferred WHMP alternative, would alter the physical setting and the visual integrity of the existing landscape, and introduce new visual elements into the existing landscape. With the exception of the proposed clearing of understory and tree thinning within the Float Plane Pond woodland, the actions of WH-1 would have moderate, short-term effects on visual quality. These changes would be caused by construction activity, dredge and staging of fill material from the Float Plane Pond, and equipment used to fill the wetlands adjacent to Duck Creek. With the exception of the understory removal and tree thinning in the woodlands, WH-1 would result in minor, long-term visual affects on the existing landscape, caused by filling the wetlands on and adjacent to the west side of the Airport. Positive, long-term changes could result from Duck Creek relocation and revegetation of an improved riparian habitat.

Removal of understory and thinning of trees and other vegetation, and the installation of a deer fence along the Float Plane Pond would constitute a major, long-term negative change in visual quality. Short-term changes would be produced by tree-removal activities that expose soil, remove screening vegetation, create roads, and introduce vehicles and machinery into a relatively natural setting. This action would expose the Airport's developed areas to viewers along the Dike Trail and would add strong color, form, texture, and linear contrasts to the viewshed. Long-term changes would be similar to short-term changes, except that maintenance vehicles and machinery would periodically enter the area along the Dike Trail to cut emerging vegetation.

4.8.12.2 ALTERNATIVE WH-2

Alternative WH-2 would produce both long-term negative and positive changes in visual quality. Moderate, short-term effects on visual quality would be caused by construction activity, dredge and staging of fill material from the Float Plane Pond, and equipment used to fill the wetlands adjacent to Duck Creek and to conduct other implementation activities. Overall, WH-2 would result in moderate, long-term visual affects on the existing landscape caused by filling the wetlands on and adjacent to the west side of the Airport. The magnitude of these changes would be less than for Alternative WH-1, owing to the smaller area of disturbance within the Refuge wetlands. Positive, long-term changes could result from Duck Creek modification and revegetation of an improved riparian habitat.

Filling the Float Plane Pond fingers would create a short-term negative impact, particularly when viewed from the Dike Trail. However, a long-term, indirect but positive visual impact could result, as vegetation takes hold and develops a better screen from Airport facilities (when viewed from the Dike Trail). However, some persons may perceive the change from ponds to a terrestrial environment as an overall negative impact.

4.8.12.3 Alternative WH-3

Alternative WH-3 would have negligible impacts on visual quality, as there would be few perceptible changes in the viewshed under this alternative.

4.8.12.4 Alternative WH-4

The No Action Alternative would have no direct or indirect impacts to the visual character of the study area.

4.8.13 Department of Transportation Section 4(f) Lands

Some of the actions and alternatives considered for wildlife hazard management would have direct and/or indirect impacts on DOT Section 4(f) lands, including the Refuge and the Dike Trail. None of the alternatives would result in changes to aircraft noise exposure, and no significant air quality impacts are expected to result.

4.8.13.1 Alternative WH-1

This is the FAA's preferred WHMP alternative. This wildlife hazard management plan includes nine distinct actions designed to address the wildlife hazards at JNU. Two of these actions, filling wetlands on Refuge land west of the Airport and relocating the Duck Creek channel, would have a direct effect on the Refuge.

Wetlands on the Refuge between the Airport and the Mendenhall River present an increased risk of bird collision with aircraft, particularly those arriving from the west to Runway 08. The Airport has proposed to import borrow material from the Float Plane Pond to fill these wetlands. Approximately 10 acres of Refuge would be filled or altered by this action. In addition, the Duck Creek channel would be relocated so that its discharge point would enter the Mendenhall River upstream and north of the aircraft approach path to Runway 08. This action would result in the fill of the old creek channel but also the creation of a new channel designed to increase flow velocities and improve opportunities for fish migration.

Many of the actions incorporated into Alternative WH-1 would have indirect impacts on the Refuge, and some would indirectly affect recreational uses of the Dike Trail. Hydrologic changes resulting from wetland fills and development of new impervious surfaces on the Airport property would change flood storage capacity, increase stormwater runoff, alter channel morphology, and potentially result in degraded water quality. All of these changes would have some minor, adverse affect on the Refuge by changing or reducing habitat, including EFH, west of the Airport.

Three actions in Alternative WH-1 would affect the Dike Trail. Removal of vegetation from the Float Plane Pond and pond fingers may satisfy an objective to reduce populations of feeding waterfowl. However, this would also degrade the wildlife viewing experience of some Dike Trail users who watch and track the variety of birds using the area. Similarly, removal of the vegetative understory and thinning of trees in the woodlands would eliminate a visual screen between the Dike Trail and the Airport. The new fence would introduce another man-made feature to the viewshed from the Dike Trail.

Despite the potential for some adverse, indirect effects to Refuge resources, Alternative WH-1 would not substantially reduce or eliminate the ability to maintain and enhance fish and wildlife populations on the Refuge, or to maintain and enhance public use of the Refuge. As a result, there would not be substantial impairment to the resource and no constructive use impacts from this alternative to a DOT Section 4(f) land. Alternative WH-1 would have a direct impact on DOT Section 4(f) land.

4.8.13.2 Alternative WH-2

This alternative would incorporate many of the same actions as described for WH-1, although some of those actions would involve smaller amounts of disturbance and impact. Two of these actions, partial relocation of Duck Creek and selective fill of wetlands on the Refuge, would directly affect DOT Section 4(f) lands.

The reach of Duck Creek from Radcliffe Road to its discharge point would be relocated upstream so that its mouth in the Mendenhall River would be away from the Runway 08 aircraft approach path. Although this action would involve only a short reach of Duck Creek and not the entire channel on Airport property, as in WH-1, the direct effects to the Refuge would be the same. The old channel would be filled, and a new channel would be created that should provide hydrologic and biologic benefits.

Wetlands west of the Airport on the Refuge would be filled, but only on a selective basis to reshape the existing landscape. Areas of the Refuge between the Airport and the Mendenhall River that pond rain or tidal water would be filled and graded. A total of approximately 3.3 acres of Refuge land would be filled. However, the entire 10-acre area may be disturbed, as landforms are shaped and recontoured.

As with WH-1, many of the actions incorporated into alternative WH-2 would indirectly affect the Refuge and some would indirectly affect recreational uses of the Dike Trail. Hydrologic changes resulting from wetland fills and development of new impervious surfaces on the Airport property would change flood storage capacity, increase stormwater runoff, alter channel morphology, and potentially result in degraded water quality.

Two actions in Alternative WH-2 would indirectly affect the Dike Trail. Fill of Float Plane Pond fingers would degrade the waterfowl/wildlife viewing experience of some Dike Trail users who watch and track the variety of birds using the area. Installation of the wildlife fence would also introduce a man-made feature to the viewshed from the Dike Trail.

Despite the potential for some adverse, indirect effects to Refuge resources, Alternative WH-2 would not substantially reduce or eliminate the ability to maintain and enhance fish and wildlife populations on the Refuge, or to maintain and enhance public use of the Refuge. As a result, there would not be substantial impairment to the resource and no constructive use impacts from this alternative to a DOT Section 4(f) land. Alternative WH-2 would have a direct impact on DOT Section 4(f) land.

4.8.13.3 ALTERNATIVE WH-3

Alternative WH-3 would have little effect on hydrology, wetlands, or wildlife habitat and cause no direct impacts on DOT Section 4(f) lands. Although hunting would be discontinued on the Airport, hunting opportunities on the Refuge would remain unchanged and there would be no affect on recreational opportunities to DOT Section 4(f) lands. Alternative WH-4 would not have a constructive use impact on DOT Section 4(f) land.

4.8.13.4 ALTERNATIVE WH-4

The No Action Alternative would retain the Airport as it exists today without habitat modifications to reduce wildlife hazards. No impacts to DOT Section 4(f) lands would occur with this action.

4.8.13.5 DOT SECTION 4(F) EVALUATION (49 U.S.C. 303)

As noted in the previous sections and summarized on Table 4-82, two of the alternatives are expected to result in a direct impact to DOT Section 4(f) lands. Therefore, a DOT Section 4(f) evaluation is needed to conform with 49 U.S.C. 303(c) (see Section 4.3.13.5 for the determining factors for approval of direct or constructive use).

Table 4-82. Summary of DOT Section 4(f) Impacts: WHMP Alternatives

Alternative	Refuge		Dike Trail	
	Land Acquisition[1]	Constructive Use	Land Acquisition[1]	Constructive Use
WH-1	Yes	No	Yes	No
WH-2	Yes	No	Yes	No
WH-3	No	No	No	No
WH-4 (No Action)	No	No	No	No

[1] Land Acquisition = Land purchase or easement use, direct disturbance of the 4(f) property.
[2] Constructive Use = Occurs when the proximity of the project to the DOT Section 4(f) land substantially impairs the established or designated uses of the DOT Section 4(f) land (refers only to transportation projects).

It is important to consider the ADF&G's Management Plan for the Refuge for conformance with land use and management criteria when evaluating impacts to the Refuge, particularly as the evaluations will factor in decisions affecting purpose and need. Section 4.3.13.5 also provides the relevant text from the Management Plan with respect to Airport expansion policies.

The following sections examine the issues required from the DOT Section 4(f) land policy or the Refuge Management Plan, including (1) public need for the proposed project; (2) the compatibility of the action with the use of the DOT Section 4(f) land; (3) other prudent and feasible alternatives relative to Alternative WH-1; and (4) availability of steps to avoid, or minimize harm to the DOT Section 4(f) land.

1. ***Demonstration of Significant Public Need.*** The need for changes to the Airport's wildlife hazard management plan was established in Section 1.4.4 of Chapter One. The number of bird strikes and the abundance of wildlife in the vicinity of the Airport, including a major bird strike to an air carrier aircraft in August 2004, demonstrate the need to implement an updated WHMP. In accordance with FAR Part 139, an improved WHMP is necessary to undertake habitat modifications and/or management actions that will reduce potential for aircraft collisions with wildlife.

2. ***Compatibility of Action with the 4(f) Land.*** The Refuge Management Plan notes two primary goals, summarized as (1) the maintenance and enhancement of fish and wildlife populations and habitat, including minimization of the degradation and loss of habitat values due to fragmentation, and also (2) the maintenance and enhancement of public use of fish, wildlife, and Refuge lands. The enabling legislation that created the Refuge, Alaska Statute 16.20.034 (h) states: "…if requested by the City and Borough of Juneau the Departments of Fish and Game and Natural Resources shall assist in filling the ponds, lakes or other bodies of water adjacent to the existing Airport runway to eliminate them as sites attractive to waterfowl." Based on these goals, the compatibility of the wildlife hazard management actions with the Refuge Management Plan were considered.

   The wildlife hazard assessment was intended to serve as an audit to ensure that all appropriate wildlife hazard management actions are being undertaken. As the wildlife assessment showed, additional measures could be undertaken to decrease the risk of wildlife hazards. Thus, it is the FAA's belief that the actions recommended in WH-1, the FAA's preferred WHMP alternative, through WH-3 are compatible with the objectives of the founding legislation of the Refuge, despite the fact that some of the actions included in these alternatives could degrade or destroy some habitat values. While these would seem to be conflicting policies, it is the FAA's belief that the enabling legislation establishes a precedent that deems the impact compatible as long as the public need has been demonstrated. This does not obviate, however, the requirement that impacts have to be minimized to the DOT Section 4(f) land (see item 4, below).

3. ***Prudent and Feasible Alternatives Evaluation.*** As was described in Chapter 2 and also in the DOT Section 4(f) analysis for RSA alternatives, it is not prudent or feasible to consider other modes of transportation, the use of other airports, or the construction of a new Airport as alternatives to the wildlife hazard improvements. The objective of reducing the potential for wildlife strikes to aircraft is based on existing Airport uses, regardless of whether or not

another regional Airport was developed. Therefore, these other alternatives—a new Airport, other modes of transportation, or the use of other airports—to escape the wildlife hazards posed by habitat on and around the Airport are not considered prudent and feasible. The alternatives incorporate a range of feasible actions to reduce wildlife hazards by habitat removal and/or increased use of hazard control techniques.

4. ***Measures are available to minimize impacts to the DOT Section 4(f) lands.*** Virtually any action that would eliminate bird habitat on the Refuge, which creates a hazard to aviation – that is, Refuge land underlying the critical portions of the approach and departure paths – would have an adverse impact on natural resource attributes particular to the Refuge. Alternatives were specifically developed for this EIS that would achieve purpose and need, and reduce or minimize impact to the DOT Section 4(f) lands relative to the actions incorporated in Alternative WH-1, the FAA's preferred WHMP alternative. For example, the increased use of hazing and other hazard control techniques can reduce wildlife hazards without altering habitat. However, it is FAA's determination that the habitat in some areas (such as the wetlands on the Refuge west of the Airport) will continue to present a significant hazard to aviation, no matter how much hazard control can realistically be applied. In other words, to achieve the need to reduce hazards on Refuge habitat, the habitat must be altered.

4.9 COMBINED IMPACTS OF THE PREFERRED ALTERNATIVES

The alternatives described in Chapter 2 were evaluated in Chapter 4 for their potential impact to the human environment. Because these alternatives were developed to satisfy various, distinct purposes and needs, the evaluation of each alternative was typically conducted based on construction and operation effects. Impacts of individual alternatives were compared to existing conditions, conditions in the year 2015, and the other alternatives satisfying the same need. However, the Chapter 4 analyses did not consider whether the alternatives satisfying other needs would be implemented. In reality, it is possible that alternatives serving two or more of the different needs (RSA, aviation facilities, SREF, etc.) would be implemented, and the environmental analysis needs to consider the combined effects of these actions.

To address these combined effects, it is necessary to summarize the environmental effects associated with a comprehensive set of alternatives satisfying the different needs. The preferred alternatives consist of the actions for each need that the FAA has identified as the most prudent and feasible actions to meet the needs identified by the Airport. The actions comprising the preferred alternative are RSA-5E, NAV-2B, FF-1, FW/RW-2, SREF-3B1, and elements WH-1b, WH-2c, WH-1d, WH-3e, WH-1f, WH-1g, WH-1h, and a modification of WH-1i from the Wildlife Hazard Management Plan. Table 4-83 summarizes the combined impacts of these actions.

Table 4-83. Summary of Combined Impacts of All Actions Comprising the Preferred Alternatives

Resource/Issue	Impact
Noise	No significant impact over noise sensitive areas
Human Environment and Compatible Land Use	Permanent taking of Refuge land for RSA development, MALSR installation, and wildlife habitat modifications Minor degradation of recreational opportunities (e.g., wildlife viewing and bird watching)
Socioeconomic	No measurable impact on air carrier operations. Improved flight safety at JNU, providing good environment for economic/business growth
Air Quality	No impacts in exceedence of State and Federal air quality standards; construction-related emissions increase in the short-term
Hazardous Materials and Solid Wastes	Minor amounts of construction debris would be generated by preferred alternatives No change in hazardous materials produced beyond slight increase in urea application Risk of fuel truck petroleum spills reduced

Table 4-83. Summary of Combined Impacts of All Actions Comprising the Preferred Alternatives, continued

Resource/Issue	Impact
Water Resources and Floodplains	76% increase in impervious and less pervious surfaces (154 acres) within the project area Loss of 331 acre feet of floodplain/tidal prism storage volume Increased impervious surface would increase contaminant loads to receiving waters; water quality would remain within local, State, and Federal standards Improved long-term sediment loading in Duck Creek but short-term increase in turbidity during construction
Vegetation	Reduction of estuarine marsh communities by approximately 45.3 acres. Supratidal and forest communities would be reduced by 34.4 acres and 6.0 acres, respectively Active relocation of a tidal channel around the east end of the runway would minimize alteration of existing plant community composition following construction
Wetlands	Reduction of estuarine high and low marsh by approximately 55.3 acres within the landscape area. Palustrine wetlands would be reduced by 22 acres within the landscape area (16 acres of which would be dredged). No net loss of riverine habitat would occur and lacustrine wetlands would not be affected Active relocation of a tidal channel around the east end of the runway would minimize the conversion of high marsh to low marsh and unvegetated tidelands in this area
Fisheries	Reduction of EFH by approximately 68 acres Active relocation of a tidal channel around the east end of the runway would minimize the conversion of high marsh to low marsh and unvegetated tidelands in this area and maintain hydrologic connectivity north and south of Runway 26, thereby minimizing impacts on EFH

Table 4-83. Summary of Combined Impacts of All Actions Comprising the Preferred Alternatives, continued

Resource/Issue	Impact
Fisheries, continued	Benefits to Duck Creek through relocated, lined channel, and bottomless arch culverts Lengthened culvert in Jordan Creek increases fish passage difficulty but installation of bottomless arch culverts would minimize these impacts Expansion of impervious surfaces and conversion of ditches to drains may increase potential for injury to fish through increased contaminant loads but would maintain water quality within local, State, and Federal standards
Wildlife	Reduction in estuarine habitats by approximately 45.3 acres within the landscape area Supratidal and forest habitats would be reduced by about 34.4 and 6.0 acres, respectively. No significant adverse effect on Steller sea lion or humpback whale, the two federally-listed species with the potential to occur in the area
Cultural Resources	No known historic properties affected Memorandum of Agreement between FAA, SHPO, and JNU for phased identification of subsurface resources and resolution of adverse effects is being prepared
Visual Resources	Degradation of the natural character of some areas on Airport and surrounding landscapes, but consistent with previous development and land use objectives
DOT Section 4(f)	Direct impact on 4(f) properties through use of Refuge land and relocation of Dike Trail No constructive use of 4(f) lands

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4.10 UNAVOIDABLE ADVERSE IMPACTS

Unavoidable adverse impacts are those consequences of an action that cannot be avoided and also cannot be mitigated to less than significant levels. Virtually all of the resources would incur unavoidable, short-term impacts associated with construction. Unavoidable construction impacts are only described for air quality, since there are emissions standards relevant to the impacts. The following sections describe unavoidable adverse impacts for each of the environmental resources.

4.10.1 NOISE

Regardless of which development alternative is pursued at JNU, off-Airport aircraft noise exposure greater than 65 DNL would be experienced. This represents an unavoidable adverse impact resulting from aircraft operations at JNU that is independent of the alternative selected, but the noise levels are not incompatible with land uses. However, as is described in earlier sections, future aircraft noise exposure is expected to be less than existing levels regardless of future development scenarios. These reductions will be primarily due to quieter Stage 3 aircraft operations and retirement of Stage 2 aircraft, even with the increased level of aircraft operations projected for the year 2015.

4.10.2 HUMAN ENVIRONMENT AND COMPATIBLE LAND USE

The proposed actions and alternatives typically have few or no unavoidable adverse impacts to the human environment, in terms of compatible land uses, recreation, and social consequences. However, there are often tradeoffs associated with impact avoidance, particularly with the RSA and wildlife hazard management alternatives.

4.10.2.1 RUNWAY SAFETY AREA

The analysis in Chapter 2 demonstrates that one alternative, RSA-6A, can avoid most direct impact to or taking of Refuge land. The other seven action RSA alternatives would unavoidably directly impact greater amounts of Refuge land. Each of the action RSA alternatives would also have a minor but unavoidable direct effect on the Dike Trail, by relocating it onto Refuge property to the west and/or east of its current location. Each alternative provides substantial improvements to aviation safety.

4.10.2.2 NAVIGATIONAL AIDS

The land use impacts to the Refuge are unavoidable if the purpose and need for improving alignment with Runway 26 is to be met. The MALSR would have to extend into the Refuge, and an access road would be necessary for emergency repairs and equipment maintenance. The magnitude of this impact would vary, depending on the RSA alternative selected, but some changes in land use could not be avoided.

4.10.2.3 AIRPORT FACILITIES

There would be no unavoidable adverse impacts associated with snow removal equipment and maintenance building alternatives, or with fuel farm access alternatives. These actions would be consistent with land use plans, including the Airport Master Plan.

In order to meet the projected demand for aviation facilities the Dike Trail parking lot and trail-head would need to be relocated to the west. This does constitute an unavoidable impact, but it is not necessarily adverse. The parking area would be off-street, improved recreational signs would be developed, and the potential for conflict with other Airport activities would be reduced. This action would be compatible with the Airport Master Plan, CBJ Trails Plan, and goals and objectives for management of the Refuge.

4.10.2.4 WILDLIFE HAZARD MANAGEMENT

Similar to the RSA alternatives, some impacts to the Refuge could be avoided but only by either reducing the efficacy of the wildlife hazard management program or by causing other environmental impacts. Some actions in each of the alternatives WH-1, WH-2, and WH-3 (see actions WH-1c, -2c, -1d, -2d, -1g, -2g, -3g, -1i, -2i, and -3i) would cause adverse impacts to non-consumptive recreation (bird-watching, hiking), consumptive recreation (hunting) and the Refuge that could conceivably be avoided. Alternatives to the wildlife hazard management plan were created to minimize or avoid impacts to natural resources. However, the tradeoffs of such avoidance would include 1) reduced effectiveness of the wildlife hazard management program, and 2) increased use of hazard management activities such as hazing, that would introduce other adverse environmental impacts to recreation.

4.10.3 SOCIOECONOMIC IMPACTS

There are few unavoidable adverse economic impacts associated with the alternatives. Alternative FW/RW-3 could have adverse economic consequences because of increasingly constricted apron space, limited tiedowns and aircraft parking, shortage of hangars for storing private and business aircraft, and lack of development space and facilities for new commercial operations. These factors would impede economic growth at the Airport and in CBJ, and could be avoided by implementing either alternative FW/RW-1 or FW/RW-2.

4.10.4 AIR QUALITY

Source control of aircraft-related emissions (including aircraft and ground support equipment) is regulated by the Federal government. Aircraft and GSE emissions are expected to increase through the year 2015 due to the forecast increase in air travel demand. Increased aircraft operations would occur regardless of the alternatives chosen, whether Action or No Action. The increase in air emissions would not occur in direct proportion to the increase in activity, as the emission changes would vary substantially depending on the types of aircraft that would be operating.

As steps were taken during the 1970s, 1980s, and 1990s to reduce noise levels associated with individual aircraft, improvements in the high-bypass ratio engines occurred; now, virtually all large commercial jet aircraft are operating with this type of aircraft engine. However, in achieving tremendous reductions in noise, the bypass process has resulted in large increases in NOx emissions. While steps are being pursued within the aviation industry to examine emissions reductions that could be undertaken for the aircraft, increases in aircraft-related emissions through the forecast horizon of 2015 can be expected and are unavoidable.

Only RSA-5C, RSA-5D, RSA-5E, and RSA-6D would cause an increase in the total quantity of operating-related emissions beyond those projected for the no action alternative, due to the increased taxi/idle time to reach the eastward-relocated Runway 26 threshold. The increased emissions associated with RSA-5C, RSA-5D, and RSA-6D could only be avoided through the selection of a different RSA alternative.

Unavoidable construction-related air emissions would occur as a result of any of the Action alternatives. As is documented in Chapter 5, the maximum cumulative project-related emissions (assuming that all projects were constructed in the same calendar year) associated with the precursor pollutants from construction activity would be 56.5 tons of CO, 93.5 tons of NOx, 13.0 tons of VOC, 7.5 tons of SOx, and 8.5 tons of PM_{10}.

JNU is currently located in attainment area for all precursor pollutants. However, the Airport sits just outside the boundary of the Juneau non-attainment area for PM_{10}. For purposes of examining the potential effects of the increases in emissions due to construction, the de-minimus thresholds established by the Clean Air Act Amendments General Conformity rule were used.[13] For federal actions occurring in the Juneau non-attainment area, the de-minimus threshold is 100 tons of direct and indirect, project-related PM_{10} per year. The maximum construction-related exhaust emissions from all of the proposed projects (assuming they were conducted in the same year) would not exceed the thresholds (7.8 tons of PM_{10}, in comparison to the threshold of 100 tons).

The analysis in Chapter 5 demonstrated that the maximum fugitive dust level could reach 178.5 tons per year, assuming that all construction activity is undertaken in the same year. However, this impact is clearly avoidable and likely not applicable, as construction projects would be phased over a number of years and annual dust emissions would be much lower than the de-minimus threshold of 100 tons (assuming all fugitive dust is in the form of PM_{10}.

4.10.5 Hazardous Materials and Solid Waste

It should be possible to avoid disturbance of all buried debris and potentially hazardous waste during construction of all facilities. Even though some areas of proposed disturbance have a higher probability of containing subsurface debris or contamination (e.g., fuel farm, immediately

13. The General Conformity Regulation establishes de-minimus thresholds that are applied for purposes of identifying if a Conformity Determination is required for projects located in non-attainment or maintenance areas. Because the action would be undertaken outside the non-attainment area, the FAA believes that the conformity rule does not apply to improvements at JNU. The thresholds are used solely for the purposes of providing context to the quantity of emissions.

west of TEMSCO), impacts can be avoided and/or minimized by careful construction techniques. Surface geophysical surveys could be conducted of some areas, particularly the Northeast Development Area, to screen for buried metals and objects. Monitoring instruments such as soil-vapor detectors could be used during construction to screen for soils contaminated with petroleum hydrocarbons.

Most of the alternatives would unavoidably generate solid waste associated with construction debris.

4.10.6 WATER RESOURCES AND FLOODPLAINS

There would be unavoidable water resources impacts due to increased impervious and less pervious surface area, increased runoff volumes, and loss of floodplain/tidal prism volume due to the RSA improvements, aviation facilities developments, and Wildlife Hazard Management Plan implementation.

Greater adverse impacts would result from RSA-1, RSA-5C, RSA-5D, RSA-5E, and RSA-6C than with Alternatives RSA-6A or RSA-6B. Channel impacts to the Mendenhall River would be most adverse for RSA-1, which would cause bed and bank erosion and a strong potential for a channel shift away from the River's present location. However, smaller impacts to the channel would occur under Alternatives RSA-5D, RSA-6B, RSA-6C, and RSA-6D. Channel impacts to the East Runway Slough would be most adverse from Alternative RSA-5C, which would result in the construction of a channel connection to Sunny Slough, cutting off the areas southeast of the runway from the normal tidal inundation they currently experience. The effects on water resources could be reduced, but not entirely avoided, with implementation of Alternative RSA-6A. Any of the RSA alternatives, except for RSA-5D, RSA-5E, or RSA-6D, would avoid the water quality impacts associated with RSA-5C due to the greater runway and taxiway surfaces, and proportionately increased amount of urea used.

Relatively minor but unavoidable adverse impacts would be caused by installation of the MALSR in association with any of the RSA alternatives. Aviation facilities alternatives RW/FW-1 and RW/FW-2 would have similar unavoidable adverse impacts. Wildlife hazard management alternatives WH-1 and WH-2 would have substantially greater impacts on water resources than WH-3.

4.10.7 VEGETATION

Vegetation loss is unavoidable with virtually any new development on the Airport or in the Refuge. The magnitude of this loss and relative significance would vary, depending on the location and extent of development. As was described in Section 4.10.2, alternatives that would result in the least impact to vegetation, while still meeting purpose and need, may cause increased operational limitations or other adverse environmental impacts.

4.10.7.1 Runway Safety Area

Alternatives that would meet the purpose and need for standard RSA would cause the unavoidable loss of at least 7.2 acres of high marsh, 8.0 acres of low marsh, and 10.9 acres of unvegetated tidelands. Over time, some low marsh and tidal channel habitat would reform along and around the east Runway 26 end as a result of the reconstructed tidal slough associated with all alternatives except RSA-5C. Alternative RSA-6A would have the least overall adverse impact to vegetation, while RSA-6B and RSA-6D would cause the loss of somewhat more vegetation, and alternatives RSA-1, RSA–5C, RSA-5D, RSA-5E, and RSA-6C would increase the amount of vegetative impact by at least 7 acres.

4.10.7.2 Navigational Aids

There would be an unavoidable loss of at least 0.8 acre of vegetation, including unvegetated, low marsh, high marsh, and supratidal communities, to meet the need for improved navigational alignment to Runway 26. The MALSR would have to extend into the Refuge, and an access road would be necessary for emergency repairs and equipment maintenance. The magnitude of this impact would vary, depending on the RSA alternative selected, but some adverse impact to vegetation could not be avoided.

4.10.7.3 Airport Facilities

Construction of the Airport facilities, including SREF, Fuel Farm Access, and Aviation Facilities, would unavoidably impact plant communities in the northeast and Northwest Development Areas. A minimum of 50 combined acres of various vegetation types, including coastal grass meadow, coastal forb meadow, deciduous shrub-scrub, deciduous forest, and mixed woodland would be lost to meet the need for new facilities and the estimated demands through the year 2015.

4.10.7.4 Wildlife Hazard Management

As described in Section 4.10.2, some impacts to vegetation could be avoided but only by either reducing the efficacy of the wildlife hazard management program or by causing other environmental impacts. Alternatives to the wildlife hazard management plan were created to minimize or avoid impacts to vegetation and other natural resources. However, the tradeoffs of such avoidance would include 1) reduced effectiveness of the wildlife hazard management program, and 2) increased use of hazard management activities such as hazing, that would introduce other adverse environmental impacts. Alternative WH-3 would have virtually no unavoidable adverse impacts to vegetation (other than ditch grass in the Float Plane Pond). Alternative WH-2 would cause the loss of approximately 90 acres of various cover types including open water, ditch grass, and high and low marsh. Alternative WH-1 would cause the loss of approximately 111 acres of various cover types, including spruce forest and mixed woodlands, high and low marsh, and ditch grass.

4.10.8 WETLANDS

As with the description of impacts to vegetation, above, wetland loss is unavoidable with virtually any new development on the Airport or in the Refuge. The magnitude of this loss and relative significance would vary, depending on the location and extent of development. As was described in Section 4.9.2, alternatives that would result in the least impact to wetlands, while still meeting purpose and need, may cause increased operational limitations or other adverse environmental impacts.

4.10.8.1 RUNWAY SAFETY AREA

Alternatives that would meet the purpose and need for standard RSA would cause the unavoidable loss of at least 7.2 acres of high marsh, 7.9 acres of low marsh, and 11.1 acres of intertidal sloughs. Some low marsh and tidal channel habitat would be restored along and around the east Runway 26 end. Alternative RSA-6A would have the least overall adverse impact to wetlands, while RSA-6B and RSA-6D would cause the loss of more wetland acreage and functions. Alternatives RSA-1, RSA-5C, RSA-5D, RSA-5E, and RSA-6C would cause the greatest impacts to wetland acreage and function and would potentially reduce net function of Refuge wetlands adjacent to these potential development footprints.

4.10.8.2 NAVIGATIONAL AIDS

There would be an unavoidable loss of at least 0.7 to 1.3 acres of wetland habitat, including high marsh, low marsh, and intertidal sloughs, to meet the need for improved navigational alignment to Runway 26. The MALSR would have to extend into the Refuge, and an access road would be necessary for emergency repairs and equipment maintenance. The magnitude of this impact would vary, depending on the RSA alternative selected, but some adverse impact to wetlands could not be avoided.

4.10.8.3 AIRPORT FACILITIES

Construction of the Airport facilities, including SREF, Fuel Farm Access, and Aviation Facilities, would unavoidably impact wetland communities in the northeast and Northwest Development Areas. A combination of SREF-1B, FW/RW-2, and FF-1 (or FF-2) would have the least effect on wetlands, totaling approximately 15.8 acres of net wetland loss. Considering the range of alternative combinations, between approximately 15.8 and 27.4 acres of palustrine and estuarine wetlands, and a very small amount of shrub-scrub wetlands, would be unavoidably lost to meet the need for new facilities and the estimated Airport logistical demands through the year 2015.

4.10.8.4 WILDLIFE HAZARD MANAGEMENT

As described in Section 4.9.2, some impacts to wetlands could be avoided but only by either reducing the efficacy of the wildlife hazard management program or by causing other environmental impacts. Alternatives to the wildlife hazard management plan were created to minimize or avoid impacts to wetlands and other natural resources. However, the tradeoffs of such avoidance would include 1) reduced effectiveness of the wildlife hazard management program, and 2) increased use of hazard management activities such as hazing, that would introduce other adverse environmental impacts. Alternative WH-3 would have virtually no unavoidable adverse, direct effects to wetlands. Alternative WH-2 would result in the fill of approximately 22.4 acres of various wetland types. Alternative WH-1 would cause adverse impacts to approximately 29.6 acres of various wetland types, through filling activities (13.5 acres) and dredging activities (16.1 acres). Specific components of Alternatives WH-1 and WH-2 would affect Refuge lands west of the Airport.

4.10.9 Fisheries

Most action alternatives would have unavoidable adverse impacts to fish, fish passage, and fish habitat. As with the description of impacts to vegetation or wetlands, above, EFH loss is unavoidable with virtually any new development on the Airport or in the Refuge. The magnitude of this loss and relative significance would vary, depending on the location and extent of development. As was described in Section 4.9.2, alternatives that would result in the least impact to EFH, while still meeting purpose and need, may cause increased operational limitations or other adverse environmental impacts.

4.10.9.1 Runway Safety Area

Alternatives that would meet the purpose and need for standard RSA would cause the unavoidable loss of at least 26.5 acres of EFH. Some EFH would likely reform along and around the east Runway 26 end. Alternative RSA-6A would have the least overall adverse impact to EFH, while RSA-6B and RSA-6D would cause the loss of between 5 and 7 acres more EFH, and alternatives RSA-1, -5C, -5D, -5E, and -6C would increase the impacts to EFH by at between 13.3 and 17.7 acres compared to RSA-6A.

4.10.9.2 Navigational Aids

There would be an unavoidable loss of at least 0.7 acre of EFH to meet the need for improved navigational alignment to Runway 26. The MALSR would have to extend into the Refuge, and an access road would be necessary for emergency repairs and equipment maintenance. The magnitude of this impact would vary, depending on the RSA alternative selected, but some minor, adverse impact to EFH could not be avoided.

4.10.9.3 Airport Facilities

Construction of the Airport facilities, including SREF, Fuel Farm Access, and Aviation Facilities, would unavoidably impact EFH in the Northeast and Northwest Development Areas. A combination of SREF-3B1, FW/RW-2, and FF-2 would have the least direct effect on fish and fish habitat. Approximately 17 acres of essential fish habitat would unavoidably be lost to meet the need for new facilities and the estimated demands through the year 2015. Indirect but still adverse impacts would also be caused due to changes in stormwater quantity and quality.

4.10.9.4 Wildlife Hazard Management

As described in Section 4.10.2, some impacts to EFH could be avoided but only by either reducing the efficacy of the wildlife hazard management program or by causing other environmental impacts. Alternatives to the wildlife hazard management plan were created to minimize or avoid impacts to fish and other natural resources. However, the tradeoffs of such avoidance would include 1) reduced effectiveness of the wildlife hazard management program, and 2) increased use of hazard management activities such as hazing, that would introduce other adverse environmental impacts. Alternative WH-3 would have virtually no unavoidable adverse, direct effects to EFH. Alternative WH-2 would cause the loss of approximately 6.7 acres of EFH. Alternative WH-1 would cause adverse impacts to approximately 13.5 acres of EFH, primarily through filling open water and wetland habitats on the west Runway 08 end.

4.10.10 Wildlife

As with the description of impacts to other natural resources, wildlife habitat loss is unavoidable with virtually any new development on the Airport or in the Refuge. The magnitude of this loss and relative significance would vary, depending on the location and extent of development. As was described in Section 4.10.2, alternatives that would result in the least impact to wildlife habitat, while still meeting purpose and need, may cause increased operational limitations or other adverse environmental impacts.

4.10.10.1 Runway Safety Area

Alternatives that would meet the purpose and need for standard RSA would cause the unavoidable loss of at least 33.4 acres of wildlife habitat, including unvegetated tidelands, estuarine low marsh, and estuarine high marsh. Alternative RSA-6A would have the least overall adverse impact to wildlife, while RSA-6B and RSA-6D would cause the loss of between 5.8 and 6.7 acres more habitat, and alternatives RSA-1, RSA-5C, RSA-5D, RSA-5E, and RSA-6C would increase the impact to wildlife habitat by between 14.2 and 18.6 acres compared to RSA-6A.

4.10.10.2 Navigational Aids

There would be an unavoidable loss of at least 0.8 acre of wildlife habitat, including mostly high marsh but also unvegetated tidelands and Lyngbye sedge/low marsh habitat types, to meet the need for improved navigational alignment to Runway 26. The MALSR would have to extend into the Refuge, and an access road would be necessary for emergency repairs and equipment maintenance. The magnitude of this impact would vary, depending on the RSA alternative selected, but some adverse impact to wildlife habitat could not be avoided.

4.10.10.3 Airport Facilities

Construction of the Airport facilities, including SREF, Fuel Farm Access, and Aviation Facilities, would unavoidably impact wildlife habitat in the northeast and Northwest Development Areas. A combination of SREF-3B1, FW/RW-2, and FF-1 (or FF-2) would have the least adverse effect on wildlife. Approximately 50 acres of wildlife habitat, including estuarine high marsh, supratidal, shrub-scrub, and woodland, would be lost to meet the need for new facilities and the estimated demands through the year 2015.

4.10.10.4 Wildlife Hazard Management

As described in Section 4.10.2, some impacts to wildlife habitat could be avoided but only by either reducing the efficacy of the wildlife hazard management program or by causing other environmental impacts. Alternatives to the wildlife hazard management plan were created to minimize or avoid impacts to some natural resources, but the primary intent is to reduce wildlife use of and activity around the Airport. The tradeoffs of wildlife habitat avoidance would include 1) reduced effectiveness of the wildlife hazard management program, and 2) increased use of hazard management activities such as hazing, that would introduce other adverse environmental impacts and maintain a high level of impact on wildlife. Alternative WH-3 would have virtually no unavoidable adverse, direct effects to wildlife. Alternative WH-2 would result in the loss of approximately 54 acres of various wildlife habitat types. Alternative WH-1 would cause adverse impacts to approximately 75 acres of various wildlife habitats including approximately 37 acres of seeded grassland, 10 acres of shrub-scrub, 8 acres of estuarine low marsh, 5 acres of ditch grass, and 2 acres of estuarine high marsh.

4.10.11 Cultural Resources

At present there are no known unavoidable impacts to any historic properties within the JNU study area.

4.10.12 Visual Resources

Most of the development impacts on visual resources are minor but unavoidable, as a consequence of the type of facility being constructed and its purpose. These developments include installation of new MALSR, RSA, SREF and aviation facilities.

Of these actions, two would potentially cause substantial negative impacts to visual quality. Construction of RSA-1 would result in negative changes to visual characteristics along the Mendenhall River. These negative impacts could only be avoided through the use of a different RSA alternative with more moderate visual impacts.

Also, thinning of the trees from the Float Plane Pond woodland and installation of a deer fence (see WH-1) would result in substantially adverse impacts to the viewshed from the Dike Trail that could not be mitigated within the context of that action. Other actions for the woodland, such as nest removal and/or wildlife hazing, would certainly have lesser visual impact, but they may not achieve the hazard reduction objectives for the Airport. If not, tree thinning and deer fence installation would represent unavoidable adverse visual impacts needed to achieve purpose and need. (However, it is worth noting that tree thinning would also restore that area to a visual condition more representative of the native viewshed prior to Airport construction.)

4.10.13 DEPARTMENT OF TRANSPORTATION SECTION 4(F) LANDS

Most of the alternatives and actions considered for implementation at JNU that meet purpose and need would have some direct or indirect effect on DOT Section 4(f) land. Construction of standard RSA would unavoidably impact Refuge hydrology and habitat, although the magnitude of these impacts would vary by alternative. All of the RSA alternatives would require relocation of the Dike Trail, but this direct impact is considered beneficial.

Direct impacts to the Refuge could not be avoided while meeting the purpose and need to improve navigational alignment to Runway 26. The MALSR would have to extend into the Refuge, and an access road would be necessary for emergency repairs and equipment maintenance. The magnitude of this impact would vary, depending on the RSA alternative selected, but some direct impact to DOT Section 4(f) land could not be avoided.

The SREF and new access for the fuel farm would avoid direct and indirect effects to DOT Section 4(f) lands. Installation of new aviation facilities would have indirect but unavoidable impacts on the Refuge through changes in hydrology, but they would not substantially impair beneficial use of the Refuge. Both of the aviation facility alternatives would also have an unavoidable direct impact on the Dike Trail. The trail parking lot and trailhead would need to be relocated to the west. This does constitute an unavoidable impact, but it is also considered beneficial due to the enhanced parking and signage, and reductions in potential conflict with other Airport activities.

Direct impacts to the Refuge resulting from the wildlife hazard management plan could only be avoided with WH-3, although the actions to reduce aviation hazards caused by wildlife are consistent with Refuge statute and management policy. Alternatives WH-1 and WH-2 would have indirect impacts on the recreational experience of the Dike Trail and Refuge. Again, these impacts are only avoidable through increased hazard control activities as in WH-3, but those actions may be insufficient to satisfactorily reduce wildlife hazards.

4.11 IRREVERSIBLE OR IRRETRIEVABLE RESOURCE COMMITMENTS

Resource commitments may irreversibly limit potential uses of lands and resources, or irretrievably use, consume, destroy, or degrade these resources. For example, considerable amounts of fossil fuels, labor and airfield construction material such as cement, aggregate (sand and gravel), and bituminous materials would be expended for any of the build alternatives. These materials would represent a loss of non-renewable resources, which are not retrievable. However, these resources are not in short supply, and their use would not have an adverse effect on continued availability.

Construction and operation of the proposed projects and their alternatives would consume energy resources such as electricity, natural gas, and various transportation-related fuels. This would represent a loss of non-renewable resources, which are not retrievable. However, these resources are not in short supply, and their use will not have an adverse effect on continued availability.

Construction would also require a substantial expenditure of funds that is likely to be obtained from the Aviation Trust Fund and Passenger Facility Charges and will not be retrievable. This would represent the loss of non-renewable, irretrievable economic resources. Project-specific uses could have an effect on the availability of such funds for other aviation purposes. However, because of the need for the proposed projects, no significant adverse impacts from the use of funding for the proposed projects would be expected. Further, the long-range benefits of the proposed project are expected to outweigh the commitment of the financial resources to complete the project.

4.11.1 NOISE

The initial designation many years ago of 660-acres of CBJ property for Airport use may be considered an irreversible commitment of resources, including noise, since a certain level of noise will always be generated by aircraft. No net increases of long-term noise would be generated by any of these actions or alternatives that would constitute greater resource commitments.

4.11.2 HUMAN ENVIRONMENT AND COMPATIBLE LAND USE

Irreversible resources commitments would include the changes in land use, from recreational and rural to industrial, associated with RSA and MALSR development on Refuge lands. Reductions in bird habitat at the Float Plane Pond and its woodlands would indirectly yet irreversibly affect recreational experiences by degrading the visual quality of the Dike Trail, and reducing opportunities for bird watching and hunting.

4.11.3 SOCIOECONOMIC IMPACTS

Construction of any of the Action alternatives would require substantial expenditure of funds, most of which is likely to come from the Aviation Trust Fund and Passenger Facility Charges. These expenditures would represent a loss of non-renewable, irretrievable economic resources, which would not be available for other local or state-wide aviation purposes. Long-range social and economic benefits of the proposed projects are expected to outweigh the financial commitments to complete these projects.

4.11.4 Air Quality

No irreversible or irretrievable commitments of air resources would occur as a result of the proposed actions or alternatives to those actions.

4.11.5 Hazardous Materials and Solid Waste

The use of non-renewable resources such as gasoline and diesel fuel, and construction materials such as iron, aluminum, and asphalt, would constitute an irreversible and irretrievable loss of these resource commitments. However, these resources are not in short supply, and their use will not have an adverse effect on continued availability. Their use would not have a project-specific effect on the local availability of these resources.

4.11.6 Water Resources and Floodplains

Filling of floodplains, marshplains, and channels would be irreversible and irretrievable resource commitments. There are very limited opportunities for adding floodplains, marshplains, and channels. The proposed Duck Creek relocation would be an exception because stream functions could be increased by adding a liner and steepening the channel slope by shortening. Those proposed actions would improve fish migration by maintaining flows and sediment transport capacity.

4.11.7 Vegetation

Each of the RSA alternatives involving new safety area construction would cause a net loss of estuarine vegetation communities. These losses would be assumed to constitute a permanent, irreversible, and non-renewable commitment of biological resources.

The MALSR would have a relatively small impact to vegetation; only the light standards and control building would result in an irreversible commitment of biological resources, since it has been assumed that vegetation would ultimately develop through the access road grid.

Construction of a SREF, in either the northeast or Northwest Development Areas, would irreversibly convert native vegetation to impervious surface. The fuel farm road included in alternative FF-1 would irreversibly convert approximately 2.0 acres of vegetation to impervious surface. Loss of vegetation during installation of fuel pipelines, alternative FF-2, would be reversible, as the filled trench and construction disturbance zone could be reclaimed and revegetated.

Construction and use of new aviation facilities, under alternatives FW/RW-1 and FW/RW-2, would irreversibly convert native vegetation in the Northwest Development Area to impervious surface. New facilities in the Northeast Development Area would irreversibly convert native and exotic vegetation to impervious surface.

Two of the wildlife hazard management alternatives, WH-1 and WH-2, would irreversibly convert open water, low marsh, and high marsh communities to other vegetation types or impervious surfaces.

4.11.8 WETLANDS

Each of the RSA alternatives involving new safety area construction would cause a net loss of estuarine wetlands. These losses would be assumed to constitute a permanent, irreversible, and non-renewable commitment of biological resources.

The MALSR would have a relatively small impact to wetlands; only the light standards and control building would result in an irreversible commitment of biological resources, since it is expected that wetlands would be able to maintain functions through the access road grid.

Construction of a SREF, in either the northeast or Northwest Development Areas, would irreversibly convert existing wetlands to impervious surface. The fuel farm road included in alternative FF-1 would irreversibly convert approximately 0.04 acres of wetlands to impervious surface. Loss of wetlands during installation of fuel pipelines, alternative FF-2, would be retrievable, as the filled trench and construction disturbance zone would likely be converted to palustrine emergent marsh (from palustrine shrub-scrub).

Construction and use of new aviation facilities, under alternatives FW/RW-1 and FW/RW-2, would irreversibly convert palustrine and estuarine wetlands in the Northwest and Northeast Development Areas to impervious surface.

Two of the wildlife hazard management alternatives, WH-1 and WH-2, would irreversibly convert palustrine aquatic beds, palustrine emergent marsh, low marsh, and high marsh wetlands to upland habitat.

4.11.9 FISHERIES

Each of the RSA alternatives involving new safety area construction would cause a net loss of EFH. These losses would constitute a permanent and irreversible commitment of fishery resources.

The MALSR would have a relatively small impact on fish; only the light standards and control building would result in an irreversible commitment of fishery resources, since the at-grade access road should maintain tidal exchange necessary for maintenance of the EFH.

Construction of a SREF, in either the northeast or Northwest Development Areas, would irreversibly convert some EFH to impervious surface. Construction and use of new aviation facilities, under alternatives FW/RW-1 and FW/RW-2, would irreversibly convert EFH to impervious surface.

Two of the wildlife hazard management alternatives, WH-1 and WH-2, would cause an irreversible loss of EFH. The magnitude of loss would be greatest for WH-1.

4.11.10 WILDLIFE

Provided that vegetation clearing and construction activities take place outside of the avian breeding season, implementation of the action alternatives would have few direct impacts on terrestrial vertebrate fauna. Small mammals such as mice, shrews, and voles may be unable to avoid mortality by construction vehicles. Loss of these individuals would constitute an irreversible commitment of wildlife resources. Other irreversible commitments would pertain to soil in-fauna and other terrestrial invertebrates unable to avoid destruction by development actions.

Other than the above, irreversible commitments of wildlife resources would pertain to habitat only. These commitments would mirror those described for vegetation in Section 4.11.7.

4.11.11 CULTURAL RESOURCES

There are no known irreversible or irretrievable commitments of cultural resources at this time, as no historic properties have been identified within the JNU study area. As-yet unknown subsurface resources may be present within the footprint of proposed development projects. Should such resources be encountered during construction, there would likely be an irreversible loss of the resource in its natural context unless an avoidance strategy was implemented.

4.11.12 VISUAL RESOURCES

Permanent visual resource commitments would be made by the construction of: 1) the MALSR on the Refuge; 2) the construction of the RSA; 3) development of the northwest and northeast quadrants of JNU; 4) some wildlife hazard actions to fill or remove habitat; and 5) the relocation of Duck Creek. These changes could conceivably be removed from the area viewshed in the future, but they are considered irreversible because of the long-term commitment to use the area for aviation purposes.

The relocation of Duck Creek and the development of the northwest quadrant would constitute an irretrievable visual resource commitment. Development would destroy the existing stream channel, although it should be noted it has already been heavily altered by the Airport and nearby urbanization.

4.11.13 DEPARTMENT OF TRANSPORTATION SECTION 4(F) LANDS

The previous Sections 4.11.1 through 4.11.12 describing specific irreversible or irretrievable resources commitments were used to assess similar commitments relative to DOT Section 4(f) lands. In general, direct impacts to the Refuge constitute irreversible commitments of those resources, in that the specific land use would be presumed to be permanent. For example, it is reasonable to assume that if new RSA were constructed to encroach upon Refuge land (as in alternative RSA-5C), it would not be removed in the foreseeable future, and the DOT Section 4(f) land would not be returned to a pre-disturbance condition. Changes to the Dike Trail, parking lot and trailhead (all RSA and aviation facility alternatives) would be permanent and irreversible, but not constitute an adverse resource commitment since the DOT Section 4(f) land would still be available.

Many of the indirect impacts can be mitigated to reduce their effect on DOT Section 4(f) land, but some are also considered irreversible. In particular, hydrologic responses to the construction of new facilities (such as RSA) would generate geomorphologic changes that would be irreversibly committed. These changes and other impacts caused by water-related changes (flood storage reduction, increased stormwater runoff, and so forth) may be mitigated to some extent but are still presumed to be irreversible resource commitments.

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4.12 Short-Term Use vs. Long-Term Productivity

The discussions in the following sections identify the tradeoffs between short-term use and long-term resource productivity. Generally, short-term impacts are related to immediate changes in land use and construction impacts that would be reduced or eliminated once development is complete.

4.12.1 Noise

For the short-term, present aircraft noise exposure is expected to be greater than future noise exposure because a national requirement to achieve Stage 3 aircraft noise levels for aircraft weighing greater than 75,000 pounds will be in effect. Early attempts to achieve Stage 3 compliance resulted in replacing the engines on existing airframes. However, as these aircraft age, it is expected that the older, retrofitted aircraft would be replaced with newer technology that produce noise levels less than the Stage 3 standard. In addition, aircraft still classified as Stage 2 will continue to decrease in numbers of operations. The long-term benefits of these changes include decreased noise levels to human populations and wildlife, even with increased air traffic.

4.12.2 Human Environment and Compatible Land Use

Relocation of the Dike Trail entrance and parking lot may have short-term impacts on recreation, as a result of construction activities and new trail markings and signage. In the long-term, this action would benefit the recreational experience by the designation of a trail parking area, use of a new footbridge over an improved Duck Creek riparian corridor, and less potential for conflict with Airport uses.

4.12.3 Socioeconomic Impacts

While construction projects are expensive, and could hinder air traffic in the short term, the long-term improvements to air traffic safety and Airport capacity would create positive impacts on the local and regional economies for the foreseeable future.

4.12.4 Air Quality

During the short-term, construction emissions from vehicle exhaust and fugitive dust are expected. These emissions would cease after construction completion, and would be necessary to the delivery of a completed capital improvement project. Once the project(s) is completed, no ongoing Airport operational emission increase is expected.

4.12.5 HAZARDOUS MATERIALS AND SOLID WASTE

Facility construction would cause short-term increases in the amount of solid waste generated at the Airport, but there would be no long-term adverse effect as the local landfill has sufficient capacity. There would be other long-term benefits from facility construction. A new SREF would provide safer, more efficient conditions for the use and storage of hazardous materials, and reduce the risks of uncontrolled releases of such compounds as urea, de-icing chemicals, gasoline, kerosene, paint, and solvents. Construction of a new fuel farm access road or fuel pipelines would have short-term environmental impacts, but long-term benefits by reducing the risk of accidental release of petroleum compounds.

4.12.6 WATER RESOURCES AND FLOODPLAINS

The short-term negative impacts on water quantity and quality resulting from construction of RSA, MALSR, aviation and support facilities, or habitat modifications would cause no corresponding increase of long-term productivity. Active relocation of the East Runway Slough for the runway safety area alternatives would have short-term water quality impacts during construction, and could ultimately decrease existing channel complexity. This effect would be greatest the farther east the Slough is relocated. However, because of the proposed configuration of the constructed channel, the impacts on long-term productivity, including recharge to the wetlands south of Miller-Honsinger Pond, is expected to be minimal.

The only exceptions would be the installation of oil/water separators or treatment systems for storm water discharge, which would have long-term benefits to the quality of receiving waters. Also, the Duck Creek relocation proposed in FW/RW-2 and for wildlife hazard management would shorten Duck Creek by approximately 500 feet and have short-term water quality impacts. But relocation should result in a more stable channel that retains more flow, and ultimately provides better conditions for fish migration.

4.12.7 VEGETATION

There would be few short-term uses that would provide long-term gains in vegetative productivity. Short-term losses of deciduous shrub-scrub, woodland, and lichen-moss communities would be balanced by long-term gains in productivity as vegetation becomes reestablished on a fuel pipeline corridor. Relocation of Duck Creek would cause short-term losses in plant communities along the existing Duck Creek channel and the corridor developed for the new channel. However, these losses would be balanced by long-term gains in productivity where communities are restored and potentially enhanced along the relocated channel. The short-term loss of forest cover in the Float Plane Pond woodland would be replaced by an increase in the long-term productivity of shrub-scrub and herbaceous communities in this area.

4.12.8 WETLANDS

Few short-term uses would provide long-term gains in wetland acreage or function. Relocation of Duck Creek would cause short-term losses in existing Duck Creek wetlands. However, these losses would be balanced by long-term gains in productivity where wetlands are restored and potentially enhanced within the relocated channel.

4.12.9 FISHERIES

There would be some short-term losses that would provide long-term gains in productivity of fish resources. Installation of a new, bottomless arch culvert in Jordan Creek, to replace the existing corrugated metal pipe culvert, would cause short-term disruption to fish movement. However, this action would result in long-term improvement in fish access and habitat productivity. Relocation of Duck Creek would cause short-term reduction in fish access and habitat quality but result in a long-term improvement in fish access and habitat quality.

4.12.10 WILDLIFE

There would be few, if any, short-term uses that would provide for long-term gains in terrestrial wildlife productivity. Construction of a tidal channel around the eastern RSA would result in a short-term loss of high marsh habitat and a long-term gain in the acreage of unvegetated tidelands and low marsh in this area. While this habitat conversion could cause an increase in the long-term productivity of Vancouver Canada geese, shorebirds, and other species that use these habitats, ongoing wildlife hazard management activities around the ends of the runway would likely prevent it from doing so. The conversion of spruce and mixed woodland habitat to deciduous shrub-scrub and herbaceous communities in the Float Plane Pond woodland area may increase habitat quality for some bird and small mammal species. It is unknown whether this habitat conversion will result in a net gain or loss in wildlife productivity over the long term.

4.12.11 CULTURAL RESOURCES

There are no expected short-term commitments of cultural resources that would affect long-term productivity.

4.12.12 VISUAL RESOURCES

The relocation of Duck Creek would have short-term adverse impacts on visual quality, with long-term beneficial impacts to aesthetic productivity. Construction activity and ground disturbance would have short-term visual impacts along the relocation corridor. In the long-term, the stream characteristics and aquatic functions of Duck Creek would be improved by enhancing the stream as a migration corridor for resident salmonids and anadromous fish.

4.12.13 DEPARTMENT OF TRANSPORTATION SECTION 4(F) LANDS

The proposed improvements at JNU are necessary to ensuring the long-term productivity and efficiency of the Airport to meet local and regional needs for air transportation. The facilities constructed by the proposed actions would have a lifespan well beyond the timeframe evaluated in this EIS, and therefore represent a long-term commitment of the DOT Section 4(f) lands committed to Airport uses. This commitment would be consistent with the existing identity of the Airport as an aviation facility that has been in operation more than 60 years, beginning in the late 1930s. Construction of the proposed projects would enhance the existing uses of the Airport by providing needed facilities to safely and efficiently accommodate existing and future activity. Implementation of the projects would contribute to the long-term productivity of the site as the primary, commercial air transportation facility for the Juneau region.

In contrast, some of the direct and indirect impacts on DOT Section 4(f) lands may result in decreased long-term productivity of such resources as water quality and quantity, essential fish habitat, vegetation, wetlands, and wildlife habitat.